1949-50-51 FORD

F-SERIES TRUCKS

SHOP MANUAL

FORD DIVISION
FORD MOTOR COMPANY

FORM 7099-A

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PREFACE

This manual combines under one cover complete service information for the 1949-50-51 Ford Trucks. All aspects of the servicing of the parts, assemblies, or systems involved will be found here. Repair men will find step by step procedures plus disassembled views of all of the assemblies used in these models. The diagnostician will find that working procedures for each kind of trouble he will encounter are covered. Maintenance and lubrication data is provided for those interested in this aspect of service. Service Managers and salesmen will find hints of everyday care that they can pass on to their customers. Collision men will find construction detail well illustrated to assist them in collision work. Electrical men will find simply written principles, not only of operation, but of testing as well for each of the electrical units or systems. Upholstery men will find how-to-do-it procedures for their work.

Step-by-step procedures for the disassembly, inspection, and repair are presented throughout this manual. In addition, each assembly has been illustrated disassembled, with each of the component parts arranged in the order of assembly or disassembly. In many cases, a glance at these illustrations will tell you all you need to know about how the parts go together. These illustrations carry basic part numbers for each of the parts. These basic numbers plus the model number of the truck will permit you to order parts from any Ford dealer even though you may not have a "Parts Book."

In recognition of the specialization that is currently practiced in many service establishments, this manual has been divided into five major divisions. These five parts are as follows:

Part ONE—POWER PLANT—has to do with the Ford engines and the various systems that are necessary to their operation. These include fuel system, ignition system, and the cooling system.

Part TWO—CHASSIS—starting with the clutch, covers the entire power train (clutch, transmission, drive line, rear axles, etc.) and the running gear (wheels, tires, brakes, springs, suspension, frames, steering gear, and linkages, etc.).

Part THREE—ELECTRICAL AND ACCESSORIES—covers all of the electrical systems and units (other than ignition which is covered in Part ONE) and accessories for Ford Truck models.

Part FOUR—BODIES—contains complete information on the maintenance and repair of all body components, including adjustment and alignment not only of the body proper, but also of doors, hoods, fenders, and shields.

Part FIVE—MAINTENANCE, TROUBLE SHOOTING, AND SPECIFICATIONS—has been arranged in the back of the book separately for the convenience of quick service men. In this part, all of the information ordinarily required for quick service men and service salesmen has been combined into three separate chapters.

The Table of Contents on the next page shows not only the part break-down as described above, but also the chapters that have been established in each of the five parts. Each chapter has been divided into sections which also are listed in the Table of Contents. Regardless of the aspect of service in which you are interested or the unit of the vehicle in which you may be specializing, a glance at the Table of Contents will quickly direct you to the portion of this manual in which you are interested. If you are interested in maintenance procedures, trouble shooting, or specifications, the information you desire will be found in Part FIVE. Otherwise, it will fall in one of the four other parts. A quick glance at the chapter and section listings under the part involved will direct you to the page desired.

Throughout this manual the top of each left-hand, even-numbered page gives the name of the chapter; and the top of each right-hand, odd-numbered page gives the name of the section involved. Thus, regardless of where you open the manual, a glance at the top of the two pages will tell you exactly what subject matter is discussed at that point.

No one expects even the most experienced mechanic to remember all details of servicing these trucks and you will find that you will have to occasionally refer to this manual. Keep your manual where it will be readily available for reference at all times.

FORD DIVISION
FORD MOTOR COMPANY
SERVICE DEPARTMENT

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Part ONE

POWER PLANT

Chapter

I

General Engine Repair

This Chapter brings together repair procedures that are common to all engines. Instructions for fitting the various engine parts are accompanied by charts that conveniently list the tolerances for all engines. This eliminates searching through the book for specifications. For added convenience, a complete list of specifications is included in the back of the book.

Engine removal and installation procedures are presented first with respect to the body style and then are subdivided according to the engine. This eliminates repetition of preliminary operation procedures and quickly guides the reader to the procedure for any combination of body style and engine.

1. ENGINE REMOVAL AND INSTALLATION

A detailed procedure for removing and installing the engine is given in this section for the various body styles. Ford trucks are classified by a series number from F-1 thru F-8 according to their wheelbase and gross weight. The possible combinations of truck series, body style, and engine that may need servicing are listed in Table 1.

Removal and installation procedures are given according to the type of truck. The operations common to the removal of any engine are covered immediately following the heading for a certain type truck. The major headings are "a. Conventional Truck" and "b. Cab-Over-Engine." Specific information for each engine is covered under headings "(1) H or M Series Engine Removal," "(2) H or M Series Engine Installation," "(3) R Series Engine Removal," "(4) R Series Engine Installation," "(5) E Series Engine Removal," and "(6) E Series Engine Installation."

Only the H series engine is used in the parcel delivery truck and it is handled separately under the heading "c. Parcel Delivery."

a. Conventional Truck.

Drain the radiator and crankcase. Remove the hood, air cleaner, and battery. Disconnect the heater hoses at the engine.

Disconnect the generator wires, temperature sending unit wire, and oil pressure sending unit wire. Disconnect the flexible fuel line, choke wire, throttle linkage, vacuum hose, and starter cable at the starter.

(1) *H OR M SERIES ENGINE REMOVAL.* Disconnect the upper radiator hose at the engine and the lower radiator hose at the radiator. Disconnect the fan shroud from the radiator and lean it against the engine. Remove the radiator, then remove the shroud. Disconnect the ignition switch to coil wire. Disconnect the muffler inlet pipe at the exhaust manifold, and the clutch release bearing spring and rod.

Install an engine lift bracket (fig. 1) and take up the load with a hoist. Remove the engine front support bolts. Remove the bolts which secure the transmission to the flywheel housing.

Pull the engine away from the transmission and lift

Table 1—Truck Models

Engine	Body Style		
	Conventional	Cab-Over-Engine	Parcel Delivery
H	F-1 to F-6	F-5 and F-6	F-3
R	F-1 to F-6	F-5 and F-6	
M	F-6	F-6	
E	F-7 and F-8		

the engine from the chassis. Do not allow the engine to strike the grille.

(2) *H OR M SERIES ENGINE INSTALLATION.* To install the engine, lower it into the engine compartment and align it with the flywheel housing. Shift the transmission into any gear. Start the transmission main shaft into the clutch disc spline. If the spline grooves do not mesh, turn the crankshaft slowly with a box wrench on the crankshaft damper retaining bolt until the main shaft slides into the clutch disc spline.

Install the transmission to flywheel housing bolts and tighten them to 40-50 foot-pounds torque. Install the engine front support bolts. Remove the lift bracket from the engine.

Connect the clutch spring and rod, the muffler inlet pipe, and ignition switch to coil wire. Lean the fan shroud over the engine and install the radiator.

Fasten the fan shroud to the radiator. Connect the radiator hoses.

To complete the engine installation, connect the starter cable, vacuum hose, throttle linkage, choke wire, temperature and pressure sending unit wires, generator wires, and heater hoses. Install the battery, air cleaner, and hood. Fill the cooling system and crankcase according to the prevailing temperature.

(3) *R SERIES ENGINE REMOVAL.* Remove the upper radiator hoses. Remove the fan belt and fan, and the generator belt and generator. Disconnect the lower radiator hoses at the radiator and remove the radiator. Disconnect the ignition switch to coil wire, muffler inlet pipe, and the clutch pedal retracting spring. Remove the road draft tube.

Place a support under the transmission to prevent it from dropping out of line when the engine is removed.

Install the engine lift hook assembly (fig. 2) and take up the slack in the cables with a hoist. Remove the engine front support bolts. Remove the transmission to flywheel housing bolts. Pull the engine away from the transmission and lift it from the engine compartment. Do not allow the engine to strike the grille.

(4) *R SERIES ENGINE INSTALLATION.* To install the engine, lower it into the engine compartment and align it with the flywheel housing. Shift the transmission into any gear. Start the transmission main shaft into the clutch disc spline. If the spline grooves do not mesh, turn the crankshaft slowly until the main shaft slides into the clutch disc spline.

Install the transmission to flywheel housing bolts and tighten to 40-50 foot-pounds torque. Install the engine front support bolts. Remove the engine lift hook assembly.

Connect the clutch pedal retracting spring, muffler inlet pipe, ground strap, and ignition switch to coil wire. Install the radiator and connect the lower radiator hoses. Install the generator and generator belt and the fan and fan belt. Adjust belt tension. Install the radiator hoses.

To complete the engine installation, connect the starter cable, vacuum hose, throttle linkage, choke wire, temperature and oil pressure sending unit wires, and heater hoses. Install the road draft tube. Install the battery, air cleaner, and hood. Fill the cooling system and crankcase according to the prevailing temperatures.

(5) *E SERIES ENGINE REMOVAL.* Remove the upper radiator hoses. Remove the fan belt and fan and the generator belt and generator. Disconnect the lower radiator hoses at the radiator and remove the radiator. Disconnect the distributor primary wire and the coil to distributor high tension wire. Disconnect the throttle linkage. Loosen the road draft tube clamp at the elbow and remove the road draft tube. Disconnect the muffler inlet cross over pipe and muffler inlet pipe from the exhaust manifolds.

Install the engine lift hook assembly (fig. 2) and take up the slack in the cables with a hoist. Remove the engine front support bolts. Support the transmission to prevent it from dropping out of line when the engine is removed. Remove the bolts that secure the flywheel housing to the engine block. Move the engine far enough forward to clear the transmission main shaft, then lift the engine from the chassis.

(6) *E SERIES ENGINE INSTALLATION.* To install the engine, lower it into the engine compartment and align it with the flywheel housing. Shift the trans-

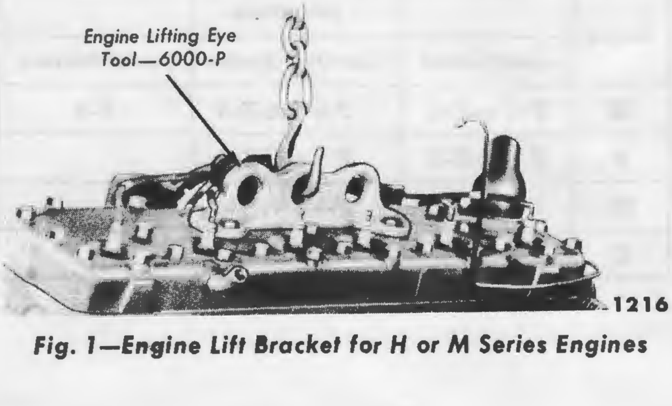

Fig. 1—Engine Lift Bracket for H or M Series Engines

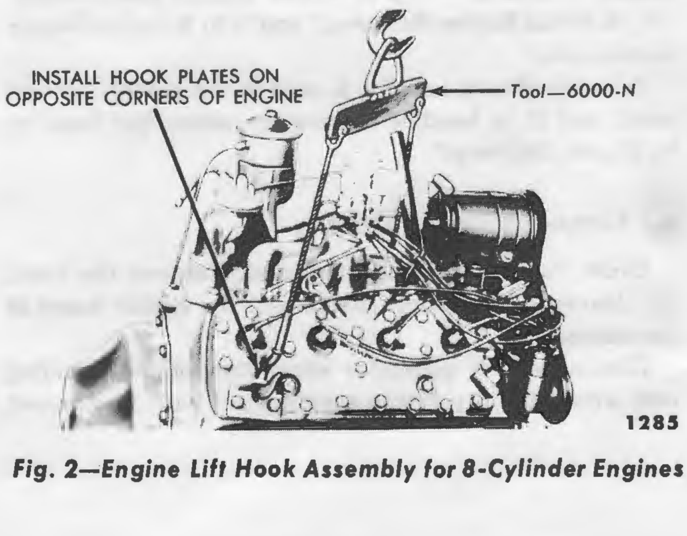

Fig. 2—Engine Lift Hook Assembly for 8-Cylinder Engines

mission into any gear. This will keep the main shaft from turning. Move the engine toward the transmission until the main shaft enters the clutch disc spline. If the spline gooves do not mesh, turn the crankshaft slowly until the main shaft slides into the clutch disc spline.

Install the flywheel housing to engine bolts and torque them to 40-50 foot-pounds. Install the engine front support bolts. Remove the engine lift hook assembly.

Connect the muffler inlet pipe and muffler inlet cross over pipe to the exhaust manifolds. Install the road draft tube. Connect the distributor primary wire and the coil to distributor high tension wire. Install the radiator and connect the lower radiator hoses. Install the generator and generator belt and the fan and fan belt. Adjust the belt tension. Install the upper radiator hoses.

To complete the engine installation, connect the starter cable, vacuum hose, throttle linkage, choke wire, temperature and pressure sending unit wires, and heater hoses. Install the battery, air cleaner, and hood. Fill the cooling system and crankcase according to the prevailing temperatures.

b. Cab-Over-Engine.

Begin the engine removal operation by draining the crankcase and cooling system. Remove the hood, air cleaner and flexible tube, floor pan over the engine, and dash panel. Remove the oil filter lines. Remove either front wheel. Remove the grille assembly (fig. 3). Disconnect the radiator hoses and remove the radiator support assembly with the radiator (fig. 4).

Disconnect the generator wires, ignition switch to coil wire, temperature sending unit wire, oil pressure sending unit wire, vacuum hose at the intake manifold, starter motor cable at the starter, throttle linkage, choke wire, and heater hoses. Disconnect the flexible fuel line, muffler inlet pipe, and clutch release bearing spring. Remove the engine front support bolts.

Fig. 3—C.O.E. Grille Assembly

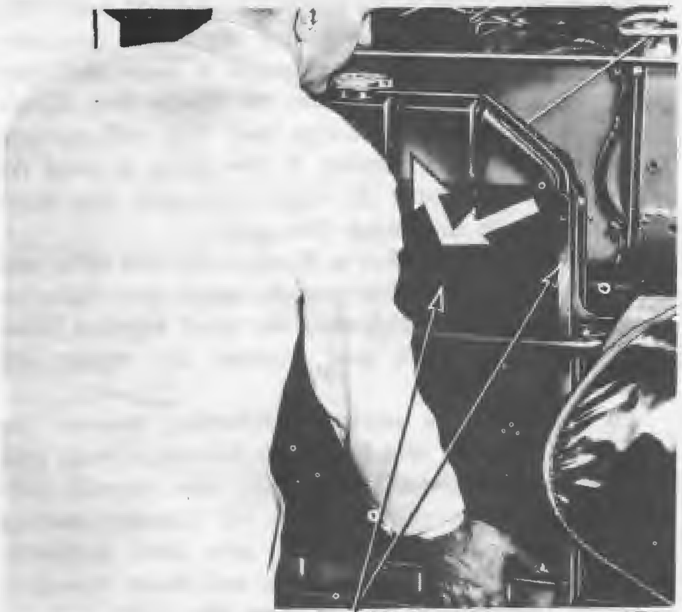

Fig. 4—Removing Radiator (H or M Series Engines)

(1) *H OR M SERIES ENGINE REMOVAL.* Install the engine lift bracket on the cylinder head. Connect a portable floor crane to the lift bracket and take up the engine load (fig. 5). Remove the bolts which secure the transmission to the flywheel housing. Move the engine away from the transmission, lift it high enough to clear the chassis, and carefully maneuver the engine out of the engine compartment.

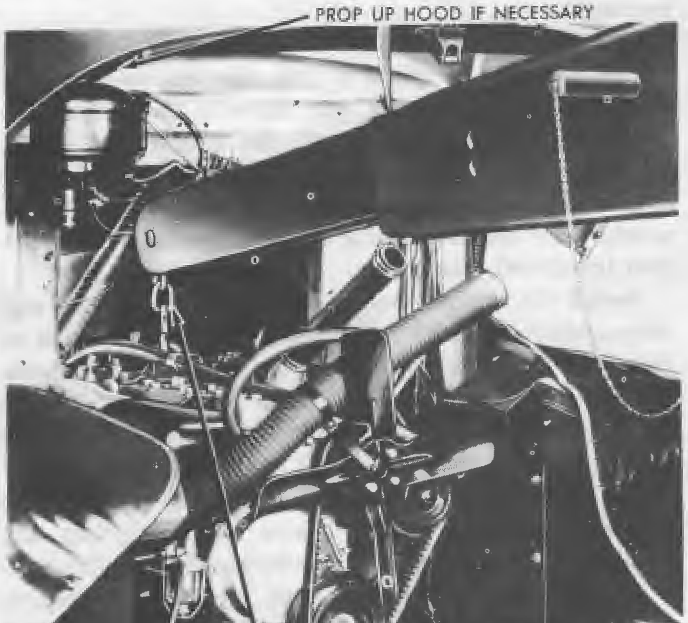

Fig. 5—Lifting the 6-Cylinder Engine

(2) *H OR M SERIES ENGINE INSTALLATION.* To install the engine, guide it into the engine compartment. Lower the engine and move it back until the transmission main shaft enters the clutch disc spline. Shift the transmission into any gear. This will prevent the main shaft from turning. If the spline grooves do not mesh, slowly turn the crankshaft until the main shaft slides into the clutch disc spline.

Install the transmission to flywheel housing bolts and torque them to 40-50 foot-pounds. Lower the engine to the front supports and install the front support bolts. Disconnect the crane and remove the engine lift bracket.

To complete the engine installation, connect the muffler inlet pipe, clutch release bearing spring, and flexible fuel line. Connect the choke wire, throttle linkage, starter cable, vacuum hose, oil pressure sending unit wire, temperature sending unit wire, generator wires, ignition switch to coil wire, and heater hoses.

Install the radiator and connect the radiator hoses. Install and secure the grille assembly. Install the front wheel. Install the dash panel, floor pan, air cleaner and flexible tube, and hood. Fill the crankcase and cooling system according to the prevailing temperatures.

(3) *R SERIES ENGINE REMOVAL.* Remove the generator, carburetor, crankcase inlet pipe and fuel pump. Install the engine lift hook assembly and take up the slack in the cables with a portable floor crane. Remove the bolts which secure the transmission to the flywheel housing. Move the engine away from the transmission. Lift it high enough to clear the chassis and carefully maneuver the engine from the engine compartment.

(4) *R SERIES ENGINE INSTALLATION.* To install the engine, guide it into the engine compartment. Lower the engine and move it back until the transmission main shaft enters the clutch disc spline. Shift the transmission into gear to prevent the main shaft from turning. If the spline grooves do not mesh, slowly turn the crankshaft until the main shaft slides into the clutch disc spline.

Install the transmission to flywheel housing bolts and torque them to 40-50 foot-pounds. Lower the engine to the front supports and install the front support bolts. Disconnect the crane and remove the engine lift hook assembly. Install the fuel pump, crankcase inlet pipe carburetor, and generator.

To complete the engine installation, connect the muffler inlet pipe, clutch release bearing spring, and flexible fuel line. Connect the choke wire, throttle linkage, starter cable, vacuum hose, oil pressure sending unit wire, temperature sending unit wire, generator wires, ignition switch to coil wire, and heater hoses.

Install the radiator and connect the radiator hoses. Install and secure the grille assembly. Install the front wheel, dash panel, floor pan, air cleaner and flexible tube, and hood. Fill the crankcase and cooling system according to the prevailing temperature.

c. Parcel Delivery.

Drain the crankcase and cooling system. Remove the hood and radiator support bar. Disconnect the upper radiator hose. Remove the fan shroud from the radiator and lean the shroud against the engine. Disconnect the lower radiator hose, remove the radiator support assembly with the radiator, and remove the fan shroud.

Remove the engine compartment rear cover. Open the engine compartment front cover and attach the hook at the left corner near the hinge to keep it open. Remove the weatherstrip retaining panel at the rear edge of the engine compartment rear cover.

Remove the air cleaner and flexible tube. Disconnect the generator wires, ignition switch to coil wire, temperature sending unit wire, oil pressure sending unit wire, vacuum hose at the intake manifold, starting motor cable at the starter, throttle linkage, choke wire, and heater hoses. Disconnect the flexible fuel line, muffler inlet pipe, clutch release bearing spring, and hand brake cable where it is clipped to the transmission.

Fasten the engine lift bracket to the cylinder head. Project the portable floor crane through the right-hand door. Connect the crane chain to the lift bracket and take up the engine weight. Remove the engine front support bolts. Remove the bolts that secure the transmission to the flywheel housing.

Move the engine far enough forward to clear the transmission main shaft. Lift the engine and carefully maneuver it through the door (fig. 6).

To install the engine, guide it through the right-hand

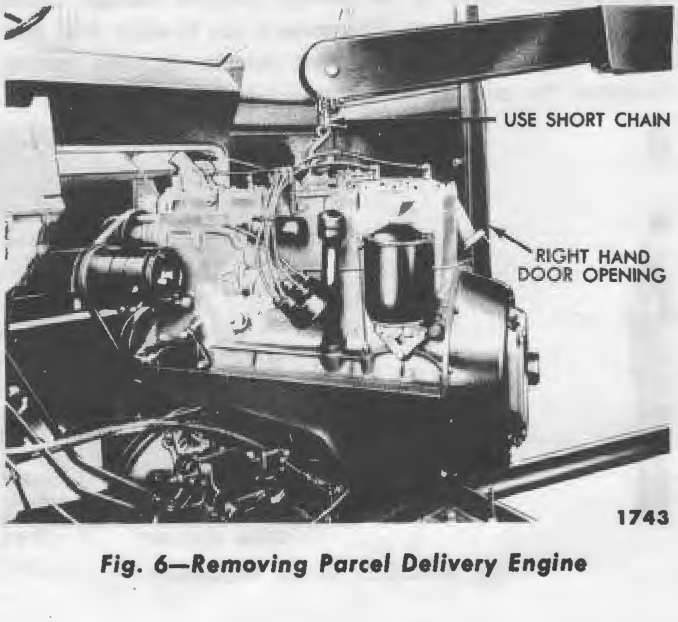

Fig. 6—Removing Parcel Delivery Engine

door and lower it into the engine compartment. Do not allow the engine to strike any part of the body or chassis. Shift the transmission into any gear. This will prevent the main shaft from turning. Align the engine with the transmission and move it back until the transmission main shaft starts into the clutch disc spline. If the spline grooves do not mesh, slowly turn the crankshaft with a box wrench on the crankshaft damper bolt until the main shaft slides into the clutch disc spline.

Install the transmission to flywheel housing bolts and torque them to 40-50 foot-pounds. Lower the engine to the front supports and install the front support bolts. Disconnect the crane and remove the engine lift bracket.

Connect the hand brake cable to the transmission. Connect the clutch release bearing spring, muffler inlet pipe, fuel line, starter cable, and heater hoses. Connect the generator wires, ignition switch to coil wire, temperature sending unit wire, oil pressure sending unit wire, vacuum hose, throttle linkage, and choke wire. Install the air cleaner and flexible tube.

Install the weatherstrip retaining panel, lower the engine front compartment cover, and install the engine rear compartment cover. Lay the fan shroud over the engine. Install the radiator support assembly with the radiator and connect the lower radiator hose. Fasten the fan shroud to the radiator. Connect the upper radiator hose. Install the radiator support bar and hood. Fill the crankcase and cooling system according to the prevailing temperature.

2. VALVES, SPRINGS, GUIDES, AND VALVE SEAT INSERTS

Removal and disassembly procedures for valves and guides in a specific engine are covered in the chapter on that particular engine. Cleaning, testing, inspection, and repair operations common to all valves, guides, and seats, are given in this section under headings which are descriptive of the parts covered.

a. Valves, Springs, and Valve Guides.

The procedure given below constitutes the essential steps for a valve grinding operation when the valves have been removed from the engine. This procedure includes cleaning, inspection, spring testing, and refacing valves and valve seats. Valve clearances are set at the time of valve installation and are discussed for each engine in the chapter on that particular engine.

Valve operation is dependent on the clearance between the valve stem and valve guide. Excessive clearance or bellmouthed valve guide ends cause noisy valve operation. Insufficient clearance may cause the valve to stick open resulting in rough engine operation and valve failure.

(1) *CLEANING.* Wash all parts of the valve assembly in solvent. Scrape carbon and lead deposits from head and stem of valve. Remove varnish from the stem with lacquer thinner. On rotating type valves clean the valve caps thoroughly.

NOTE: ***Foreign particles between the valve stem and cap may prevent the valve from rotating and cause the valve to fail.***

(2) *INSPECTION.* Check the valves for burned or warped heads. Measure the stem diameter and replace the valve if the diameter is less than 0.341 inch. Measure the valve guide inside diameter to determine valve to guide clearance. Figure 7 illustrates the method of measuring the valve guide with the telescope gauge and micrometer. Replace the guide if the clearance is greater than the tolerance shown in Table 2 for each engine. Tight guides can be relieved by burnishing (fig. 8). Replace the guide if either end is bellmouthed. Replace warped, burned, pitted, or worn valves.

(3) *SPRING TESTING.* Test the Valve Springs (fig. 9) for compression. Replace springs if they are not within the limits given in Table 3.

Table 2—Valve Stem Clearance Specifications

Engine	Valve Stem to Guide Clearance (Inches)
R	0.0015-0.0035
H or M	0.0010-0.0031
E	0.0022-0.0037

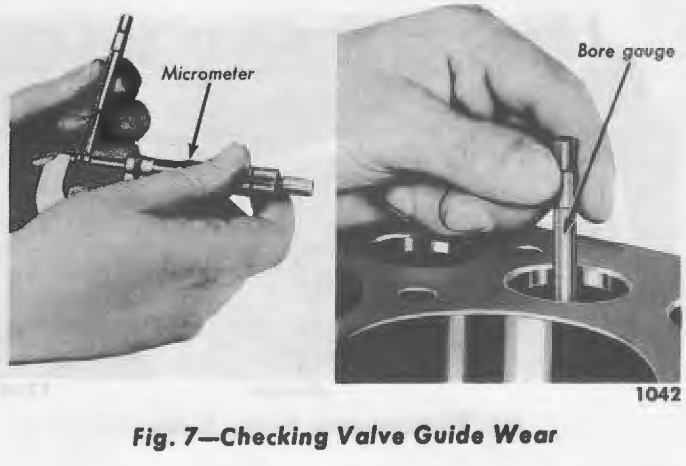

Fig. 7—Checking Valve Guide Wear

Table 3—Spring Test Specifications

Engine	Year	Test Length	Compression (Pounds)
R	1949-1950	2.13	37-40
R	1951	1.89	40-43
H and M	1949-1951	2.11	47-50
E	1949-1951	1.68	63-69

(4) *REFACING VALVES.* Remove all carbon from the valve head and stem. Grind the face of the valve at 45° angle as shown in fig. 10. If the valve head is less than $\frac{1}{32}$ inch thick at the outer edge replace the valve.

(5) *REFACING VALVE SEATS.* Clean seats thoroughly with a wire brush to prevent carbon from becoming embedded in the grinding wheel during the refacing operation. Keep grinding dust from entering the engine. Remove only enough stock to clean up pits and other depressions.

NOTE: ***Worn valve guides must be replaced before refacing valve seats.***

After regrinding the valve seats, the width of the seat must not exceed $\frac{1}{16}$ inch measured across the face of the seat as shown in fig. 11.

If the valve seat is too wide, remove just enough stock from the top or bottom of the valve seat to reduce the width to approximately $\frac{1}{16}$ inch. This can be done by using a 30 degree angle grinder to remove stock from the bottom of the valve seat, and a 60 degree angle grinder to remove stock from the top of the valve seat. The valve seat should not exceed 0.005 inch run out. Check the valve seat run out with a dial indicator (fig. 12). Lap the seat and valve together with a fine lapping compound to finish the operation.

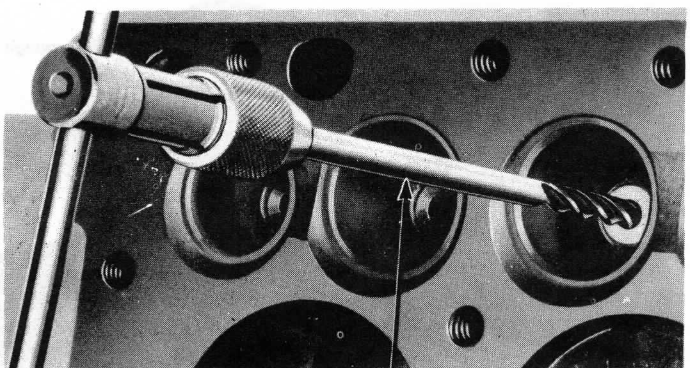

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Fig. 8—Burnishing Valve Guide

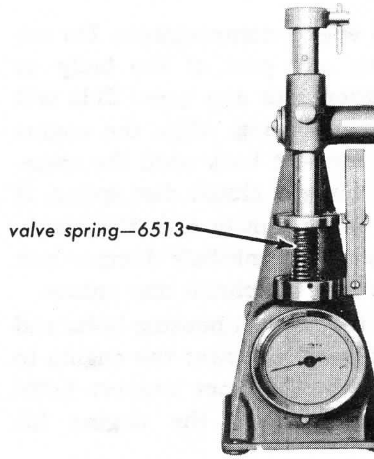

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Fig. 9—Checking Valve Spring

b. Valve Seat Inserts.

Some R series engines are equipped with valve seat inserts for both intake and exhaust valves, others use inserts in the exhaust valve ports only, and some have no inserts at all. The H, M, and E series engines have inserts in the exhaust valve port only.

Valve seat inserts are pressed into the counterbore in the cylinder block valve port (fig. 13).

(1) *REMOVAL.* Remove the insert by driving a wedge under the insert and prying it out.

(2) *INSTALLATION.* Chill the inserts with dry ice before inserting them in the cylinder block. Tap them with a soft faced hammer until they seat firmly in the recess. After installing the valve seat inserts, grind them concentric to the valve guides.

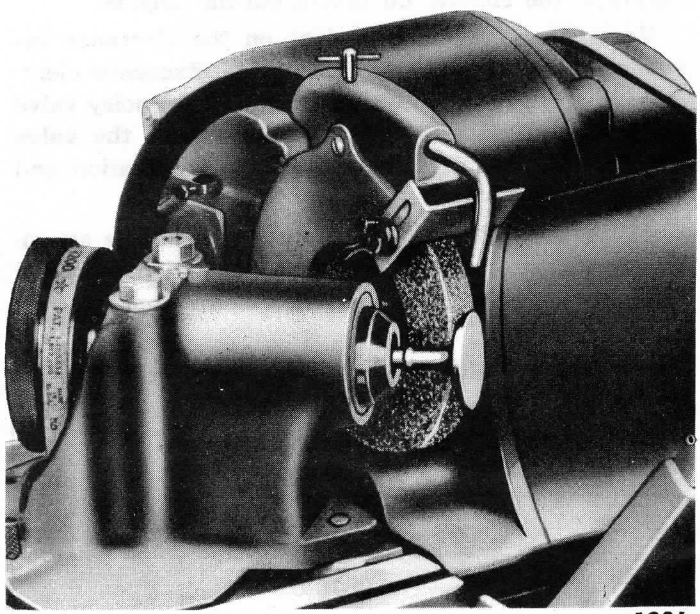

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Fig. 10—Grinding Valve Face

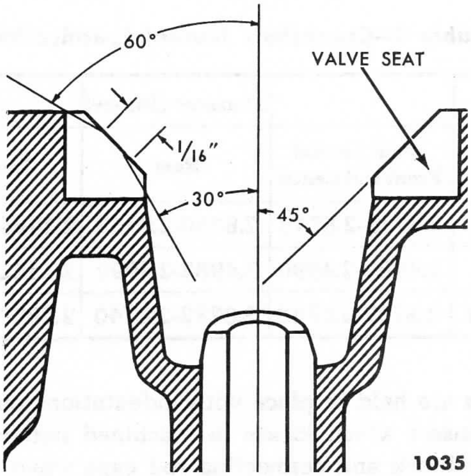

Fig. 11—Correct Valve Seat Width

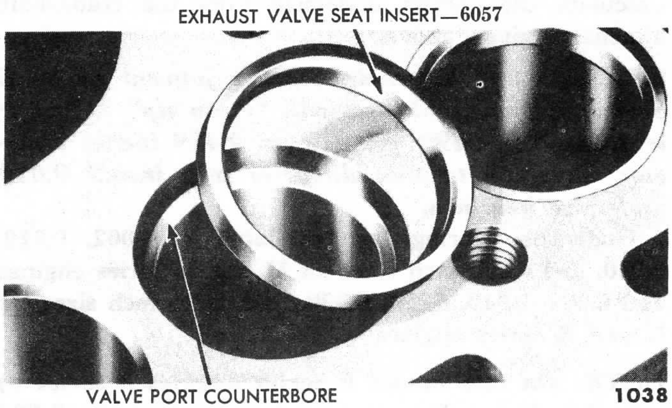

Fig. 13—Valve Seat Insert

3. CRANKSHAFT, BEARINGS, AND PISTON ASSEMBLIES

The crankshaft is supported in three main bearings in the 8-cylinder engines and four main bearings in the 6-cylinder engines. The center bearings are placed so that two crankshaft throws are located between any two main bearings. This arrangement provides a rigid support for the crankshaft and allows the bearing load to be distributed.

a. Camshaft.

The crankshaft is made of cast alloy steel with integral counterweights and is dynamically and statically balanced. Oil distribution holes are drilled through the shaft for main bearing and connecting rod lubrication. Figure 14 shows these oil passages in a cutaway view of the R series engine crankshaft.

(1) *CLEANING AND INSPECTION.* Wash the crankshaft in solvent. Blow out the oil passages with compressed air. Remove the sludge trap plugs and clean out the traps. Press in new plugs. Examine the shaft for evidence of cracks. Check the dowel pins in the flange for looseness. Remove any nicks on the ends of the pins with a file.

CAUTION: ***Do not file the body diameter of the dowel pins.***

(2) *CRANKSHAFT JOURNAL MEASUREMENT.* Measure each crankshaft journal diameter at a minimum of four places to determine the size, whether or not it is out of round, and whether or not it has taper. If any of the journals are out of round more than 0.0015 inch or if taper of more than 0.001 inch exists, they should be machined. Journals that are worn evenly and have less than 0.001 inch taper or a 0.0015 inch out of round condition will not require machining if the available bearings will provide not more than 0.002 inch clearance for the main bearing, or not more than 0.003 inch clearance for the crankpin bearings.

Manufacturer's crankshaft journal diameters for each engine are given in Table 4.

Fig. 12—Checking Valve Seat Runout

Fig. 14—Crankshaft Oil Passages (R Series Engines)

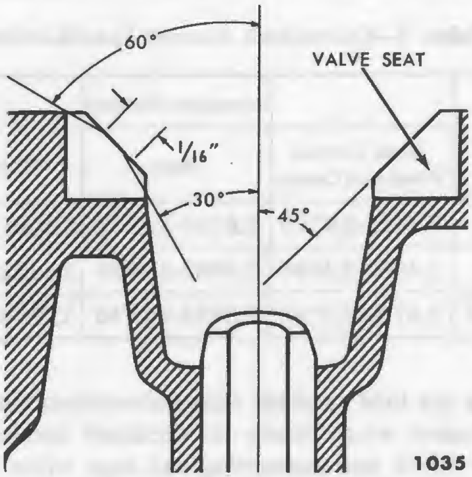

Fig. 11—Correct Valve Seat Width

Fig. 13—Valve Seat Insert

3. CRANKSHAFT, BEARINGS, AND PISTON ASSEMBLIES

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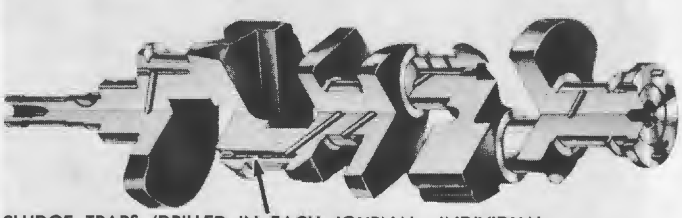

Fig. 14—Crankshaft Oil Passages (R Series Engines)

(3) *GRINDING CRANKSHAFT JOURNALS.* Calculate the correct undersize from the crankshaft dimension given above.

EXAMPLE: ***If the main bearing journal on an E Series Engine crankshaft will "clean up" before it is ground to 2.499 —0.010 = 2.489 inches diameter, finish it to that diameter and install 0.010 undersize bearings.***

Undersize bearings are available in 0.002, 0.010, 0.020, and 0.030 inch sizes for H and M series engines and 0.002, 0.010, 0.020, 0.030, and 0.040 inch sizes for R and E series engines.

NOTE: ***On late model E series engines a series of selective fit bearings are used instead of the 0.002 inch undersize bearing.***

Always reproduce the same radii that existed originally in the corners of the pin or journal. Too small a radius may result in crankshaft failure, while too large a radius will result in bearing failure.

After grinding, polish the pin or journal with No. 320 grit emery cloth and engine oil. Crocus cloth may also be used.

b. Main and Connecting Rod Bearings.

Steel backed copper-lead insert bearings are used in the main bearing supports and connecting rods. These

Table 4—Crankshaft Journal Specifications

Engine	Diameter (Inches)		
	Main Journal Front and Center	Rear	Crankpin
E	2.8735-2.8740	2.8730-2.8735	2.3995-2.4000
R	2.4982-2.4990	2.4982-2.4990	2.1382-2.1390
H or M	2.8732-2.8740	2.8732-2.8740	2.2980-2.2988

bearings are held in place with indentations on the end of the insert which locate in machined notches in the cylinder block and connecting rod caps when installed.

Care should be used in fitting bearings since the crankshaft carries the entire engine load. Lubrication must be maintained or the bearings will wear out rapidly with possible damage to the crankshaft journals. Be sure the oil holes in the bearing line up with those in the bearing bore.

Crankshaft end thrust is controlled by the rear main bearing flange.

Bearing inserts are precision manufactured and are ordered by size to re-establish the manufacturer's tolerance when the engine is overhauled.

Main bearing inserts that are scratched, show fatigue pockets, or have the overlay wiped out, should be replaced.

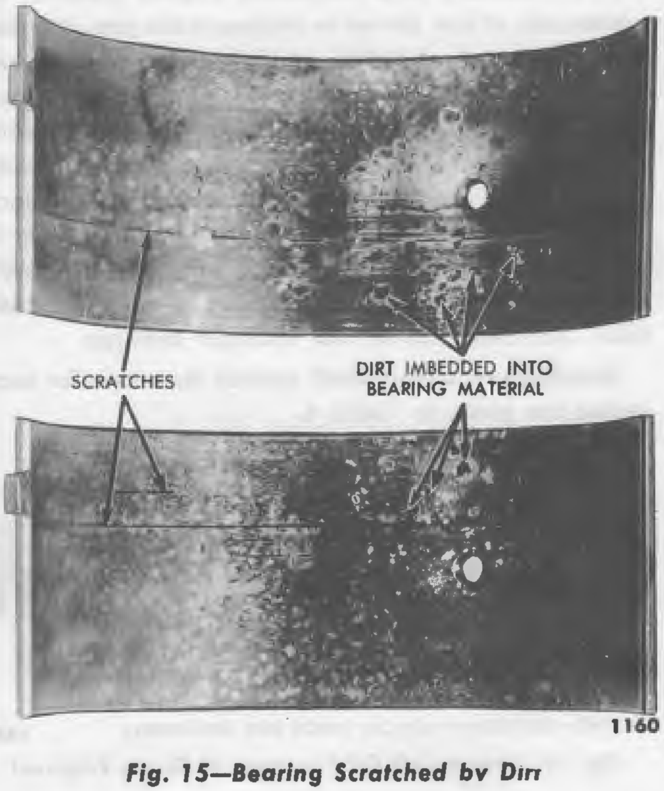

Fig. 15—Bearing Scratched by Dirt

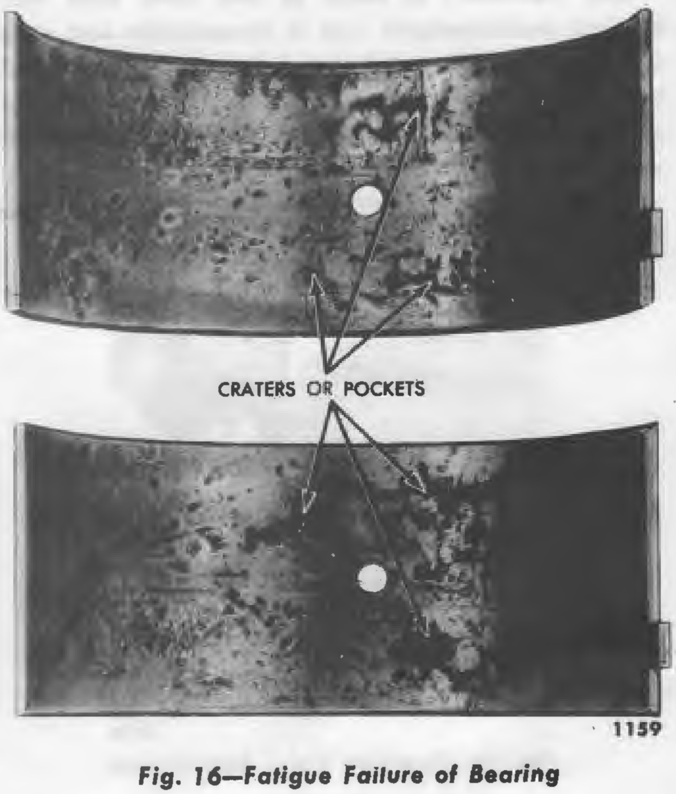

Fig. 16—Fatigue Failure of Bearing

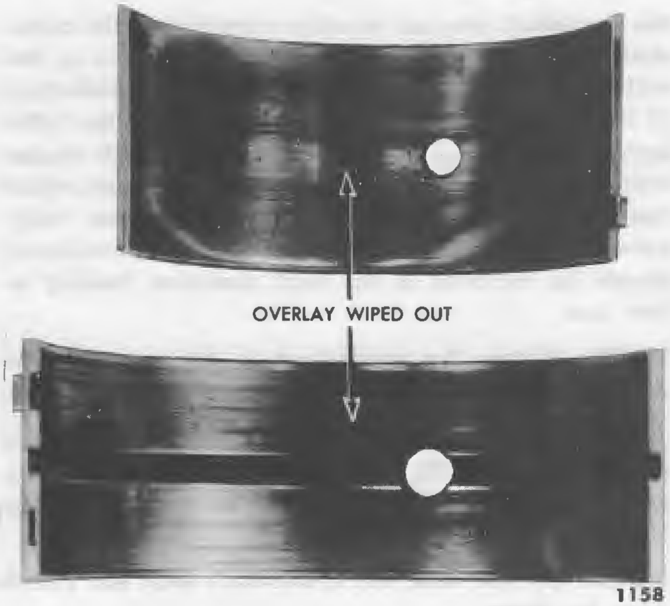

Fig. 17—Bearing Failure Due to Lack of Oil

A bearing that has only light scratches may be re-used providing the clearances are satisfactory. Scratched bearings are shown in fig. 15. Fatigue failure can be recognized by the breaking away of the bearing overlay material (fig. 16). Figure 17 shows two bearings with the overlay wiped out.

Excessive wear on one side of the bearing half (fig. 18) indicates a tapered bearing journal. The journal should be reground to the next undersize to remove the taper and undersize bearings should then be installed. Similarly excessive wear at the center or end of the bearing around the circumference (fig. 19) indicates high spots on the bearing journal which should be corrected before the engine is rebuilt.

Bright sections across the back of the bearing (fig. 20) indicate the bearings have been loose in the bore either because of an undersize outside diameter, be-

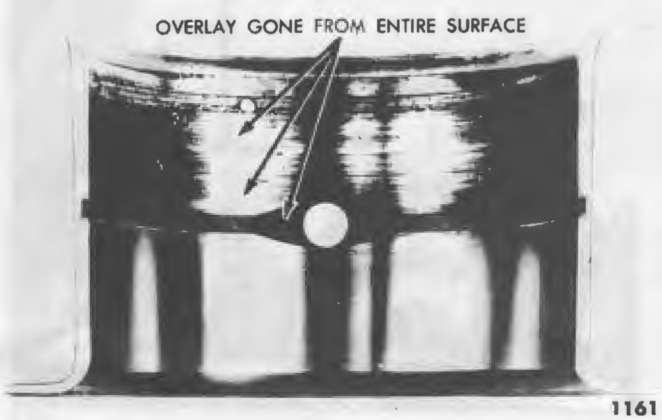

Fig. 18—Bearing Failure Due to Tapered Journal

Fig. 19—Bearing Showing Radii Ride

cause of the bearing bore being too large, or by the bearing not having sufficient "crush."

Grooved or scored main bearing or crank pin journals will cause bearing failure and should be machined if possible; otherwise the crankshaft should be replaced. Light scores or scratches can be removed with a hone, then polished with No. 320 grit polishing paper.

(1) *FITTING MAIN BEARINGS (PLASTIGAGE METHOD).* Remove the bearing cap and wipe the oil from the bearing and journal.

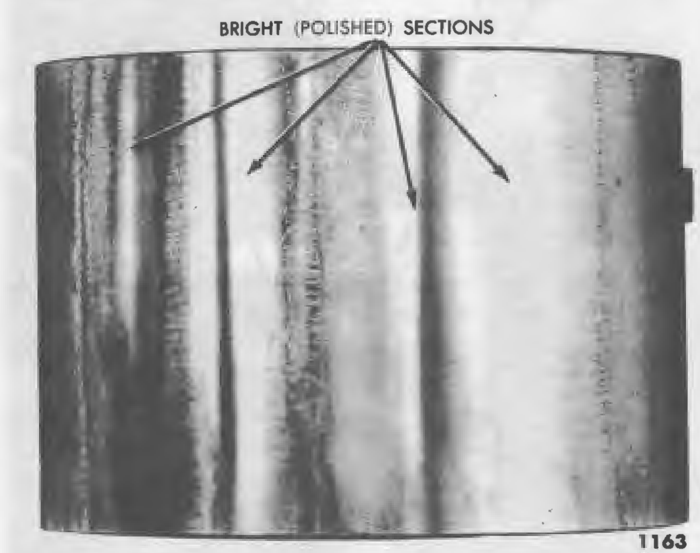

Fig. 20—Bearing Showing Bright Spots Because of Improper Seating

inch wide by 1 inch long in the bearing cap with a new standard insert and install the cap. Tighten the nuts.

Attempt to move the connecting rod endwise on the crank pin by hand and then by a light tap of a hammer.

Remove the shim and repeat the above test. If connecting rod did not move by hand, but moved by tap of hammer in the previous test and moved freely with shim removed, the standard bearing as installed should be used. If rod could be moved by hand when used with the shim, install the 0.002 inch undersize bearing and repeat the above test.

After determining that the correct bearing insert has been fitted, tighten connecting rod bearing cap nuts. Then rotate the shaft to be sure the bearing is not too tight.

(5) *CHECKING CRANKSHAFT END CLEARANCE.* Before you install new rear main bearing inserts the crankshaft end play should be checked. To check the crankshaft end play, pry the crankshaft toward the rear of the engine. Place a dial indicator against the forward side of the rear counterweight. Set the dial to zero and then pry the shaft forward (fig. 22).

Table 5—Crankshaft End Play Specifications

Engine	Crankshaft End Play (Inches)
H.M. or E	0.004-0.006
R	0.002-0.006

If the dial indicator shows excessive end play (Table 5), the rear main bearing insert should be replaced with a new insert to take up the end clearance.

4. CONNECTING RODS, PISTONS, RINGS, AND PINS

Procedures in this section cover all operations necessary to fit an engine with new piston rings. Piston cleaning and inspection, cylinder bore inspection and reboring, fitting pistons, and fitting piston rings are discussed under the heading "a. Piston and Rings." Inspection and fitting of piston pins is covered under

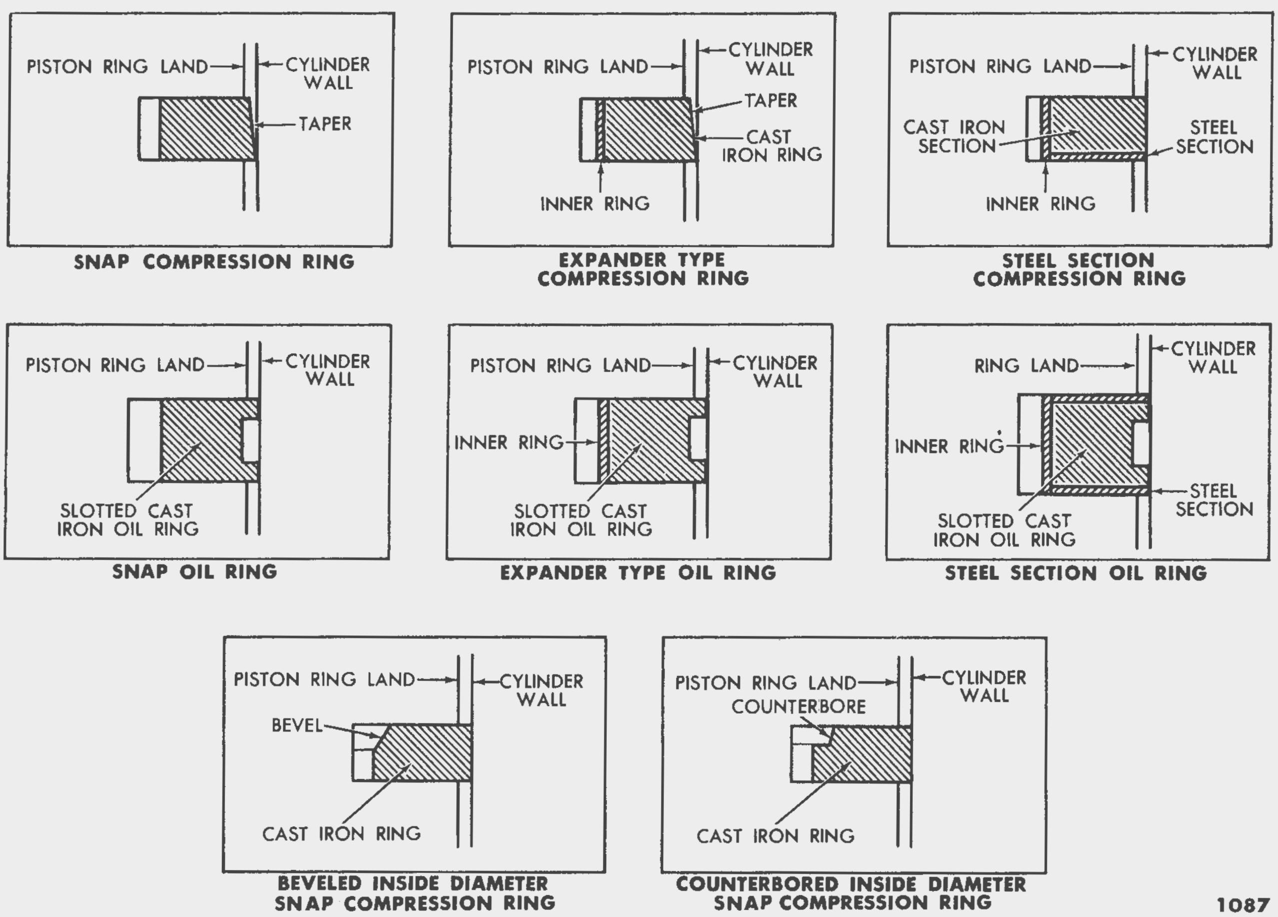

Fig. 23—Piston Ring Types

the heading "b. Piston Pins." Connecting rod inspection is covered under the heading "c. Connecting Rods."

a. Pistons and Rings.

Pistons and rings seal the combustion gases from the crankcase and control the amount of oil left on the cylinder wall for lubrication. Worn or improperly installed rings will cause engine oil contamination, excessive oil consumption, fouled spark plugs, and poor engine performance.

Three types of piston rings sets are used in servicing Ford engines. They are: a "snap" type or standard ring set; an "expander" type ring set; and a "steel section" type ring set. Figure 23 shows the various compression and oil control rings included in these ring sets.

The standard or snap type ring is designed for use in a new engine block or whenever a block is rebored and new pistons installed. Under these conditions the block would neither be out-of-round nor have a taper. A light honing with a No. 280 grit hone is recommended in either case.

Under a tapered condition the standard type oil rings are not flexible enough to provide sufficient wiping action on the cylinder wall. Oil is then allowed past the rings and oil consumption increases. To remedy this situation the expander type ring is used in cylinder bores where the taper does not exceed 0.006 inch or whenever an oil consumption condition is encountered. Ring pressure is maintained by an expander under the oil ring. Hone the cylinder bores before installing the expander type ring.

When the cylinder bore taper is greater than 0.006 inch but less than 0.015 inch, the expander type ring is not adequate to seal the combustion chamber from the crankcase. Under this condition the steel section type ring is used. The oil ring is installed with a steel ring on both top and bottom in addition to the expander under the ring. Honing is not necessary when the steel section type ring is used.

(1) *CLEANING AND INSPECTION.* Remove all carbon from the piston with a scraper or carbon brush. Clean the piston ring grooves with a ring groove cleaner (fig. 24). Clean the carbon from the oil return holes in the oil ring grooves by running a drill through the holes. Be sure the drill is the same size as the hole.

Inspect pistons for fractures at the ring lands, skirt, and pin bosses. Replace pistons showing signs of wavy ring lands, fractures, or damage from detonation. Spongy eroded areas around the top edge of the piston, usually on the side opposite the valves, are caused by detonation. In some instances holes are also burned through the top of the piston.

(2) *INSPECT CYLINDER BLOCK.* Make a thorough check for cracks. Minute cracks can be located simply and quickly with the following procedure: Coat the cylinder wall with a mixture of 25 percent kerosene and 75 percent light engine oil. Wipe the wall dry, then apply a light coat of zinc oxide powder dissolved in wood alcohol. The cracks will show as discolored lines on the zinc oxide coating.

Inspect the cylinder bore for scratches or scuffing. Check for bulging at the top of the cylinder bore. Replace any leaking expansion plugs (indicated by rust around the plug). Use a sealing compound under the new plug.

Check the cylinder bore using a telescope gauge and outside micrometers, cylinder gauge, or inside micrometers. Measure and record as "A," "B," "C," and "D" the dimensions shown in fig. 25.

Compare "A" with "B" and "C" with "D" to determine the amount of taper in the bore. If the taper is greater than 0.015 inch, the cylinder must be rebored.

Compare "A" with "C" and "B" with "D" to determine how much the cylinder is out of round. If the bore is more than 0.003 inch out of round it must be rebored.

(3) *BORING CYLINDER BLOCK.* To assure maximum performance and balance of the reciprocating parts of the engine, all cylinders must be bored to the same size even though only one cylinder requires reboring and the others are within tolerance. Manufacturers recommendations on how to use boring equipment should be followed and the work performed only by experienced personnel.

Bore the most badly worn cylinder first to determine the proper oversize. If the cylinders will not clean up at 0.060 inch oversize, the block must be replaced.

When reboring the cylinders allow 0.0015 inch stock for honing when fitting pistons. Use a number 220 to 280 grit hone for this operation.

CAUTION: ***Thoroughly clean the block to remove all particles of abrasive after the honing operation.***

Fig. 24—Cleaning Piston Ring Grooves

Table 6—Piston Fitting Specifications

	Engine				
	H		R		M and E
	Piston Type		Piston Type		
	7HA	0HA	49T	8BA	
New Piston in New Bore					
Gauge Thickness (Inches)	0.003	0.002	0.003	0.0015	0.0015
Pounds Pull	6-12	3-12	6-12	3-12	5-10
New Piston in Used Bore					
Gauge Thickness (Inches)	0.003	0.002	0.003	0.0015	0.0020
Pounds Pull	6-12	3-12	6-12	3-12	5-10
Used Piston in Used Bore					
Gauge Thickness (Inches)	0.003	0.003	0.004	0.003	0.003
Pounds Pull	6-12	3-12	6-12	3-12	5-10

(4) *FITTING PISTONS.* Proper assembly tolerances of pistons are required if satisfactory engine operation is to be obtained. Cylinder bores must be checked for taper and out-of-round condition before fitting a piston.

To install a piston with new rings in a used bore, the high polish on the cylinder bore must be removed to allow the new rings to seat without scuffing. This is done by running a hone through the cylinder bore. Clean the cylinder thoroughly to remove the hone dust.

To fit a new piston in a new bore, attach a tension scale to the end of a feeler ribbon ½ inch wide and having the correct feeler ribbon thickness as given in Table 6. Position the feeler ribbon on the thrust side of the cylinder (right-hand side of cylinder bore as viewed from the driver's seat). Invert the piston, then push the piston into the cylinder bore until the skirt is about ½ inch below the top of the block. Keep the piston pin bore parallel with the camshaft. Pull out the feeler gauge and at the same time note the reading (fig. 26).

The pull limits for new pistons and used pistons in new or used bores is given in Table 6.

(5) *FITTING PISTON RINGS.* Insert the ring in the cylinder bore. Invert a piston and use it to push the ring about half way down into the bore. This will also square the ring with the bore. Measure the ring gap. It should be 0.007 to 0.047 inch in a worn cylinder. If the gap is smaller than 0.007 inch, file the ends of the ring until the correct clearance is obtained.

If the ring gap exceeds 0.047 inch install the next oversize ring. Be sure to identify the rings so they will be installed in the same cylinder in which they were fitted.

Check the ring groove clearance on the proper piston for the cylinder as shown in fig. 27.

The rings should have the clearance shown in Table 7.

To relieve rings with less than the minimum allow-

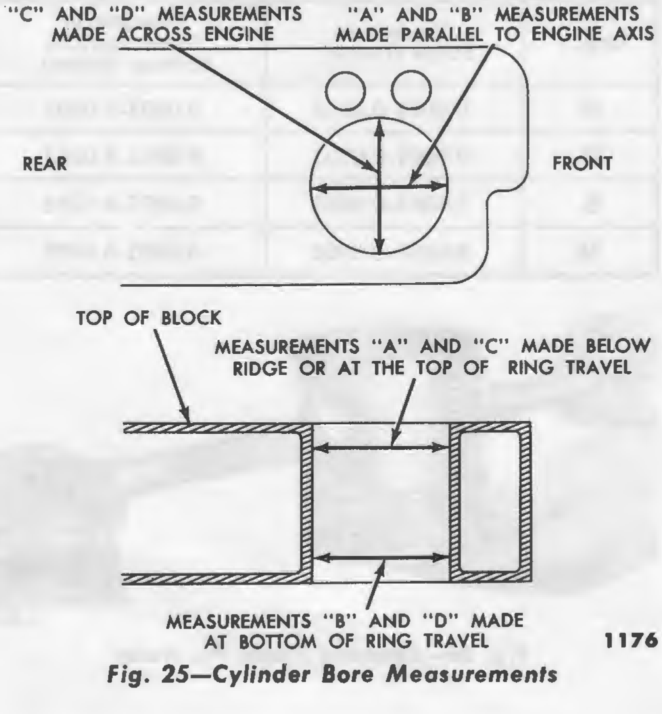

Fig. 25—Cylinder Bore Measurements

Fig. 26—Fitting Piston to Cylinder Bore

Table 7—Ring Groove Clearance Specifications

Rings	Engine				
	H	M	R	E	
				8MTH Piston	8EQ Piston
Upper Compression	0.0015-0.0030	0.0015-0.0030	0.0015-0.0030	0.0015-0.0030	0.0020-0.0040
Lower Compression	0.0010-0.0025	0.0010-0.0025	0.0010-0.0025	0.0010-0.0025	0.0015-0.0030
Oil Rings	0.0010-0.0025	0.0010-0.0030	0.0010-0.0030	0.0010-0.0025	0.0015-0.0030

able clearance, place a piece of emery cloth on a flat surface and rub the ring on the emery cloth in a circular motion. Rotate the ring while rubbing to maintain uniform ring thickness.

If several rings are found to have greater than the maximum allowable clearance, the piston should be replaced.

NOTE: ***When the steel section OHA ring sets are not available for H series engines, the steel section 7HA rings may be used on the OHA piston by installing the oil ring expander in the third groove rather than in the fourth groove as specified on the 7HA pistons.***

b. Piston Pins.

Ford engines use hollow piston pins held in the piston by wire retainers at both ends of the pin. Piston pins are available in 0.001 and 0.002 inch oversizes for use when a standard pin fits too loosely.

(1) *INSPECTION.* Replace piston pins showing signs of fractures or etching. Worn piston pins or pins that fit loosely in the piston or rod bushing should be replaced. Replace all piston pin retainers.

(2) *FITTING PISTON PINS.* Check the piston pin fit in the piston pin bore at normal room temperature (70°F.). Table 8 gives the proper piston pin fit for each engine.

If oversize piston pins are used, or if the piston pins are too tight, use an expansion type piston pin reamer. Place the reamer in a vise and revolve the piston around the reamer (fig. 28).

Set the reamer to the size of the piston pin bore, then expand the reamer slightly and trial ream the bore 1/8 inch deep in the piston. Use a pilot sleeve of the nearest size to maintain alignment of the piston pin bores.

Check the reamed hole size using a new piston pin as a gauge. If the bore is too small, finish reaming the hole, then turn the piston around and ream the other hole.

Expand the reamer slightly and make another trial cut, then repeat the procedure outlined until the desired pin fit is obtained.

Table 8—Piston Pin Fit Specifications

Engine	Clearance in Piston (Inches)	Clearance in Connecting Rod Bushing (Inches)
H	0.0001-0.0003	0.0001-0.0003
R	0.0001-0.0003	0.0001-0.0003
E	0.0001-0.0005	0.0001-0.0002
M	0.0001-0.0002	0.0001-0.0003

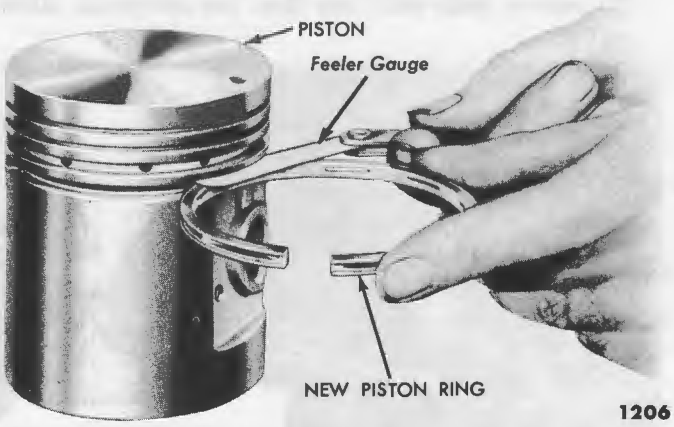

Fig. 27—Checking Ring Groove Clearance

Fig. 28—Reaming Piston Pin Holes

Check each piston pin bore which has been reamed with the pin to be used in that particular bore.

Use a new piston pin to check the piston pin bushing in the connecting rod for wear. If the new pin falls through the bore by its own weight, ream the bore for the next oversize pin (fig. 29), or replace the bushing.

c. Connecting Rods.

Connecting rods with damaged threads, nicked studs, deep nicks, signs of fractures, scored bore, or with the bore out of round more than 0.0002 inch should be replaced.

Connecting rods with twists or bends should be replaced. Check every connecting rod for alignment on a fixture after fitting the piston pins (fig. 30).

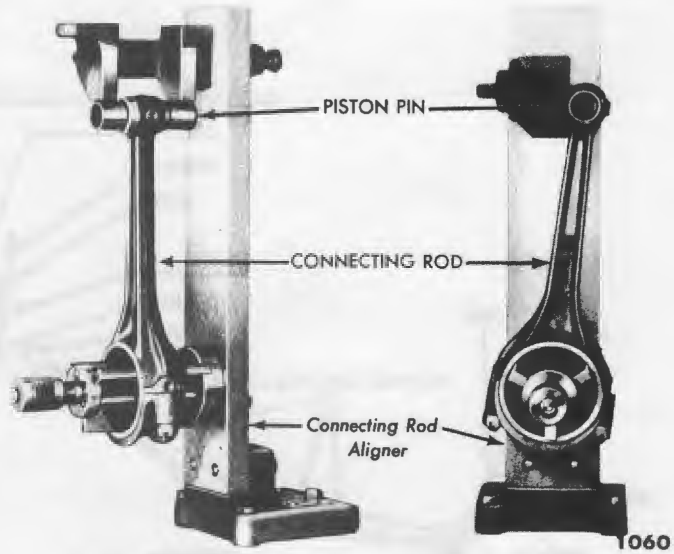

Fig. 30—Checking Connecting Rod Alignment

5. FLYWHEEL REPAIR

Flywheel repair consists of refacing the clutch friction surface or replacing the starter ring gear.

a. Inspection.

Flywheels that have a burned or scored friction face surface should be replaced or machined. Check the flywheel runout by positioning a dial indicator on the outer edge of the surface contacted by the clutch plate (fig. 31).

If the runout exceeds 0.005 inch total indicator reading, remove the flywheel and turn it 180°, then replace it and again check the runout. If the runout is still in excess of 0.005 inch, machine or replace the flywheel.

b. Refacing.

If it is necessary to remove more than 0.045 inch from the original thickness of the flywheel to obtain a smooth surface, it should be replaced.

c. Ring Gear Replacement.

To replace a ring gear, drill a $^{17}/_{32}$ inch hole nearly through the ring gear on the engine side of the gear, and cut the remaining portion with a chisel. Heat the new ring evenly to 360°F., and place it in position on the flywheel and allow it to cool. Check the ring gear runout. The runout must not exceed 0.010 inch.

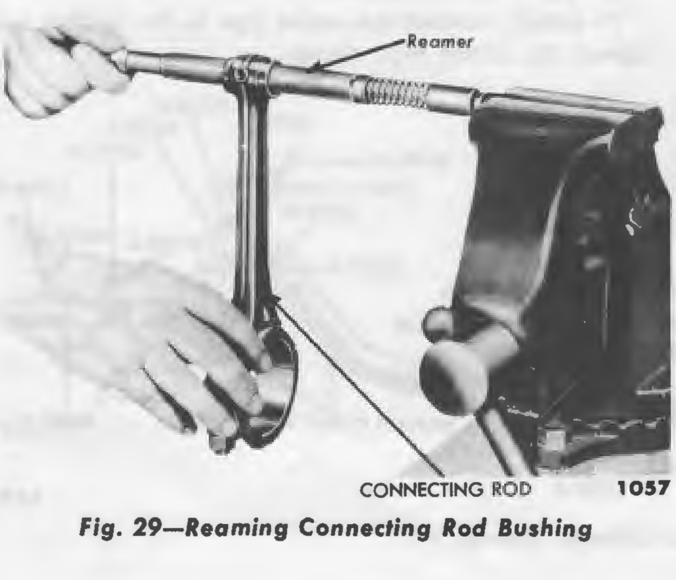

Fig. 29—Reaming Connecting Rod Bushing

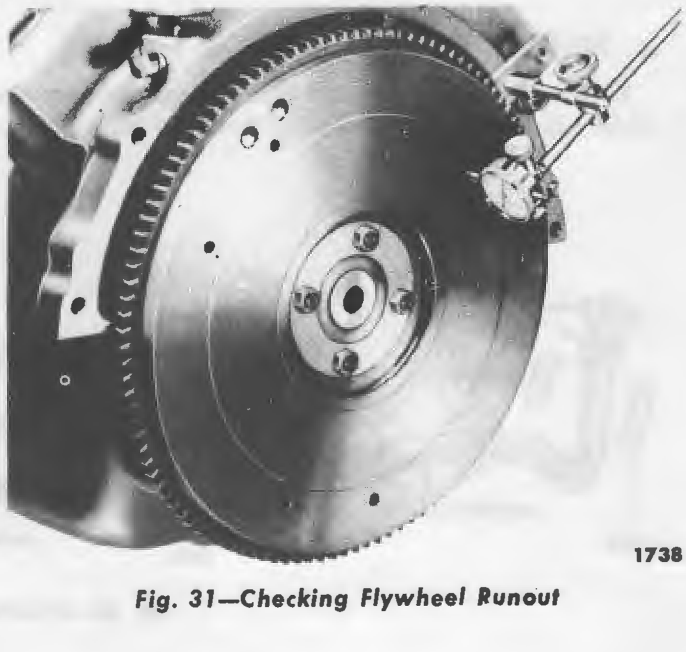

Fig. 31—Checking Flywheel Runout

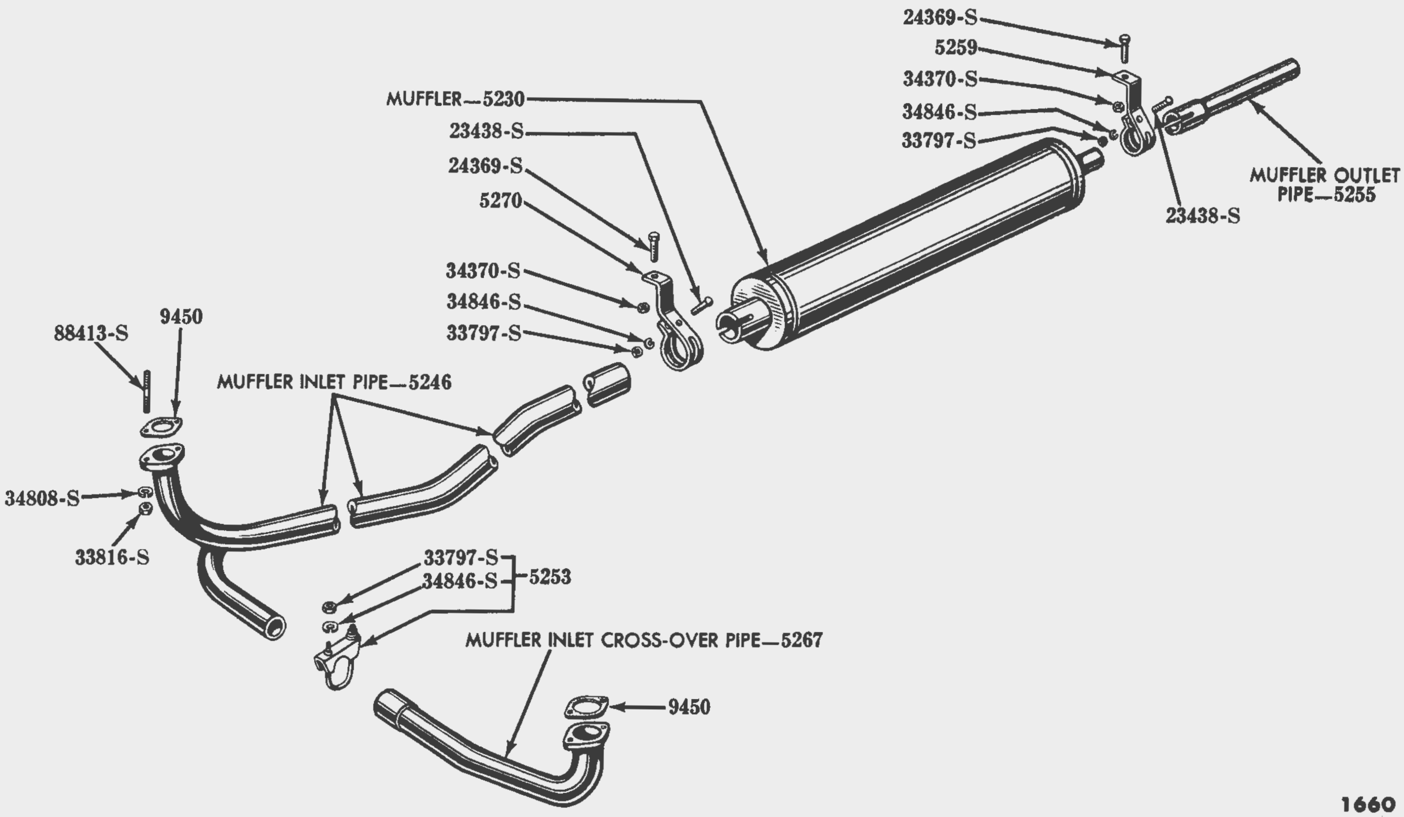

Fig. 32—8-Cylinder Exhaust System

6. MUFFLER, INLET PIPE, OUTLET PIPE, AND CROSSOVER PIPE (8-CYLINDER ONLY)

The procedures given here cover the removal and installation of each part in the exhaust system.

Figure 32 shows the 8-cylinder exhaust system. The 6-cylinder parcel delivery exhaust system shown in fig. 33 is typical of all 6-cylinder trucks.

a. Muffler Replacement.

Loosen the inlet and outlet pipe clamps. Remove the outlet pipe. Remove the muffler from the inlet pipe.

To install, connect the muffler to the inlet pipe. Connect the outlet pipe to the muffler and tighten both clamps.

b. Muffler Outlet Pipe Replacement.

Loosen the muffler outlet pipe clamp and remove the outlet pipe from the muffler.

To install, connect the outlet pipe to the muffler and tighten the outlet pipe clamp.

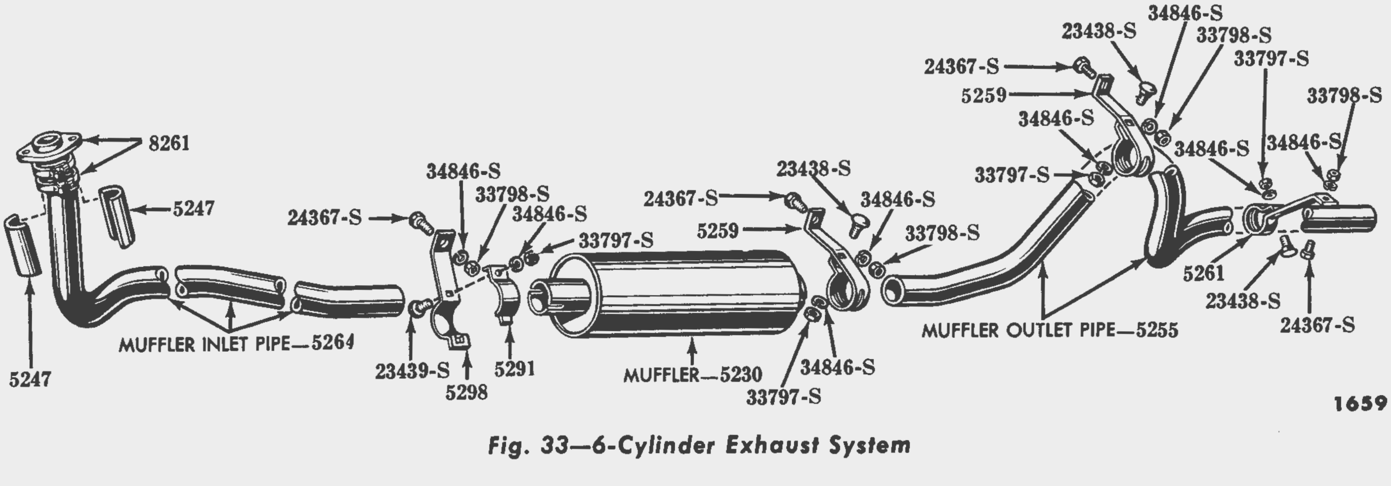

Fig. 33—6-Cylinder Exhaust System

c. Muffler Inlet Pipe Replacement.

Loosen the crossover pipe clamp and muffler inlet pipe clamp. Disconnect the inlet pipe from the right hand exhaust manifold. Remove the inlet pipe from the muffler.

To install, connect the inlet pipe to the muffler. Connect the inlet pipe to the right hand exhaust manifold. Tighten the cross-over pipe clamp and muffler inlet pipe clamp.

d. Crossover Pipe Replacement (8-Cylinder Only).

Loosen the crossover pipe clamp. Disconnect the crossover pipe from the left hand exhaust manifold. Remove the cross-over pipe from the inlet pipe.

To install, connect the cross-over pipe to the inlet pipe. Connect the cross-over pipe to the left hand exhaust manifold. Tighten the cross-over pipe clamp.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part ONE

POWER PLANT

Chapter

II

H-Series—6-Cylinder Engine

The material presented in this chapter covers the H-Series 6-cylinder engine illustrated in figs. 1 and 2. This engine is a 95-horsepower L-head engine with a 3.3 inch cylinder bore and a 4.4 inch piston stroke. The piston displacement is 226 cubic inches.

Complete removal and installation information covering all of the component parts of the engine are included in this chapter. Procedures for disassembly, cleaning, inspection, repair, and assembly of the different units of this engine are also given here. General overhaul procedures for the H-Series engine are given in the chapter on general engine repair. The procedures and operations described and illustrated in this chapter can only be used for working on this engine.

Always install new gaskets when any installation is made where gaskets have been previously removed. A complete engine overhaul gasket kit illustrated in fig. 3 is available for engine overhaul.

1. MANIFOLD REPLACEMENT

A chamber is built into the intake manifold center section where the carburetor and exhaust manifold are attached. An exhaust control valve, located in the exhaust manifold, directs exhaust gases into this chamber when the engine is cold to provide faster engine warm-up.

NOTE: ***Do not remove manifolds when hot. They may warp and make reassembly difficult.***

Replace manifolds that are warped or have developed cracks. The exhaust control valve (fig. 4) may stick and need replacement.

Manifold replacement procedures are covered under the headings "**a.** Conventional Truck," "**b.** Cab-Over Engine," and "**c.** Parcel Delivery."

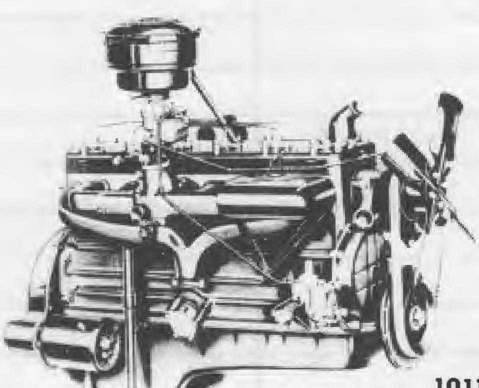

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Fig. 1—H-Series 6-Cylinder Engine (¾ Front View)

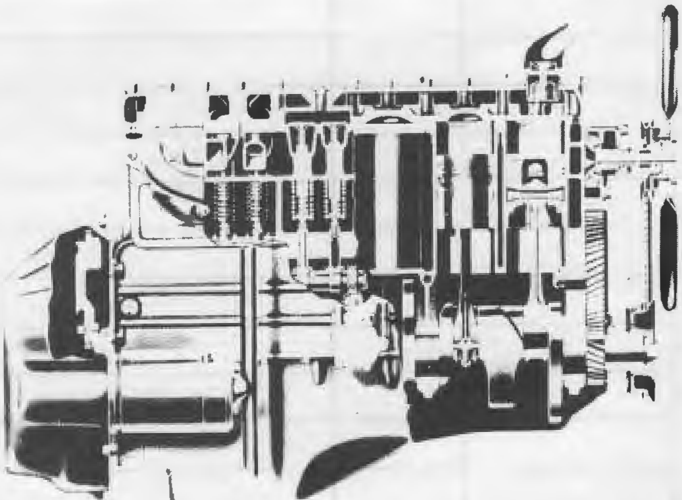

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Fig. 2—H-Series 6-Cylinder Engine (Sectional View)

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Fig. 3—Engine Overhaul Gasket Kit

a. Conventional Truck.

Remove the air cleaner. Disconnect the distributor vacuum line, choke wire, and fuel line at the carburetor. Disconnect the governor lines. Disconnect the accelerator linkage at both sides of the bell crank and at the carburetor. Remove the carburetor and governor. Disconnect the windshield wiper hose. Remove the screw holding the manifold air baffle assembly to the cylinder head. Remove the top nut from the engine right front support bracket and remove the intake manifold baffle assembly. Disconnect the muffler inlet pipe from the exhaust manifold. Remove the manifold hold down nuts and lift both the intake and exhaust manifolds and gaskets from the block. Remove the nuts holding manifolds together and separate the manifolds.

Disassembled views of the intake and exhaust manifolds used on H-Series engines are shown in figs. 5 and 6 respectively. Before reassembling and installing the manifolds, make sure all gasket surfaces are free from old gasket material and projections that may affect sealing.

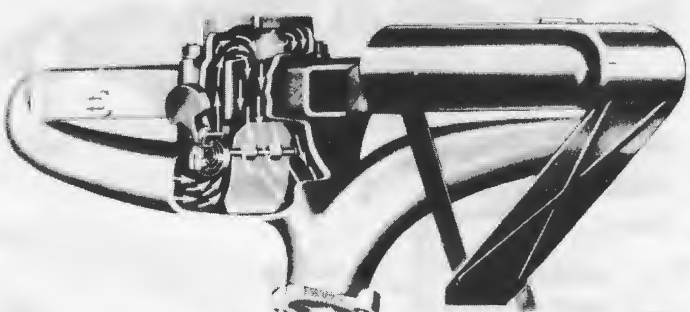

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Fig. 4—Manifolds Showing Exhaust Control Valve

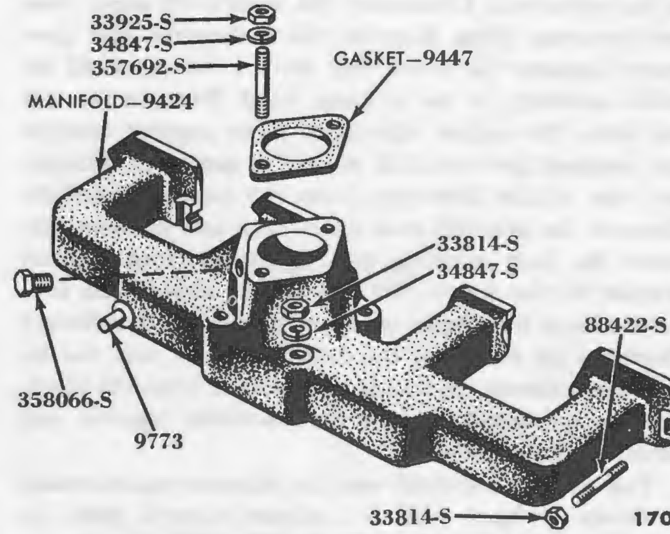

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Fig. 5—Intake Manifold (Conventional Truck)

To install the manifolds, fasten them together and tighten the nuts to 30-35 foot-pounds torque. Place the manifolds on the engine block with new manifold gaskets (fig. 7). Tighten the nuts to 25-30 foot-pounds torque. Start at the center and work toward the ends to avoid manifold distortion. Install the carburetor and governor. Connect the windshield wiper hose. Connect the accelerator. Connect the choke wire, fuel line, and distributor vacuum line to the carburetor. Connect the governor lines. Fasten the manifold air baffle assembly to the cylinder head. Install the top nut on the engine front support bracket. Connect the muffler inlet pipe to the exhaust manifold. Connect the heater hose and install the air cleaner.

b. Cab-Over-Engine.

Remove the engine cover and dash panel to gain access to the engine from inside the cab. Disconnect the air cleaner flexible tube at the carburetor. Disconnect the distributor vacuum line, choke wire, and fuel line

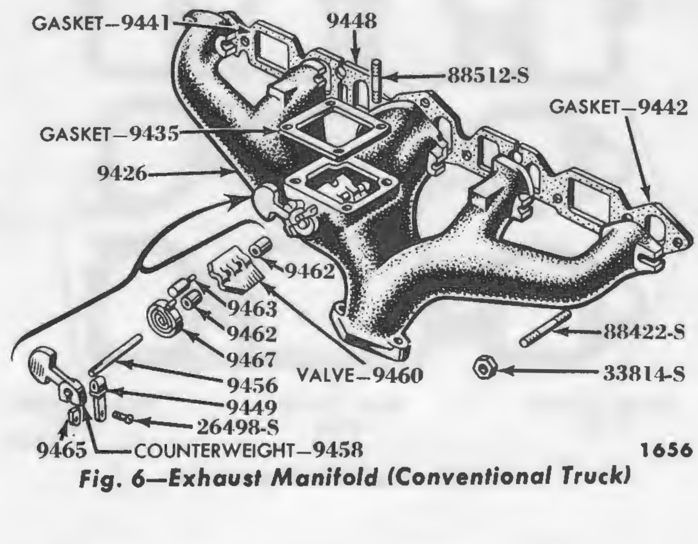

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Fig. 6—Exhaust Manifold (Conventional Truck)

at the carburetor. Disconnect the windshield wiper hose and governor lines. Remove the carburetor and governor. Remove the screw that secures the manifold air baffle assembly to the cylinder head. Remove the top nut from the engine right-hand front support bracket and remove the manifold air baffle assembly. Disconnect the muffler inlet pipe from the exhaust manifold. Remove the manfold hold down nuts and washers. Remove the bolt securing the right-hand front support bracket to the frame. Tilt the engine toward the left-hand side of tne engine compartment to allow sufficient clearance for removing the manifolds. Lift both the intake and exhaust manifolds and gaskets from the block. Remove the nuts that hold the manifolds together and separate the manifolds.

The exhaust manifold used in cab-over-engine trucks is shown in fig. 8 with the exhaust control valve removed and disassembled. Figure 9 illustrates the intake manifold.

Before reassembling and installing the manifolds, make sure all gasket surfaces are free from old gasket material and projections that may affect sealing.

To install the manifolds, fasten them together and tighten the nuts to 30-35 foot-pounds torque. With the engine tilted toward the left-hand side of the engine compartment, place new manifold gaskets (fig. 7) on the studs and install the manifolds on the block. Tighten the manifold retaining nuts to 25-30 foot-pounds torque. Start at the center and work toward the ends to avoid manifold distortion when tightening the nuts. Return the engine to its proper position and install the engine support to frame bolt.

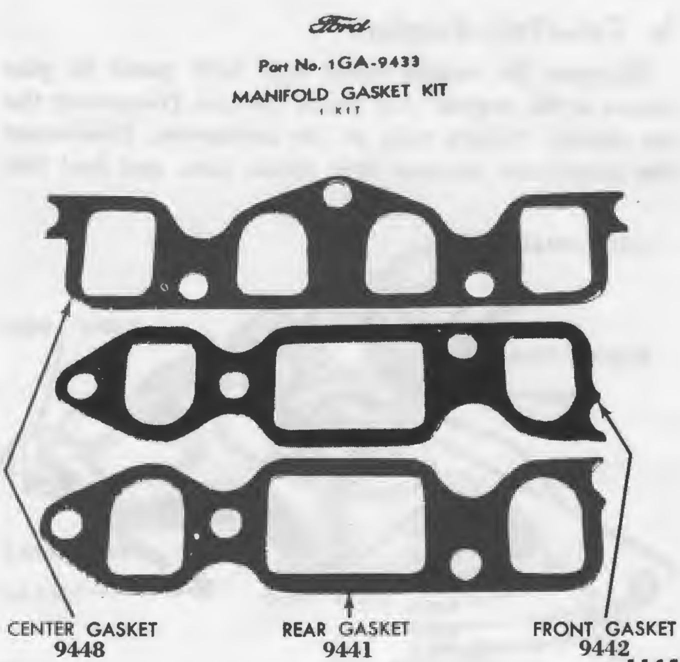

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Fig. 7—Manifold Gasket Set

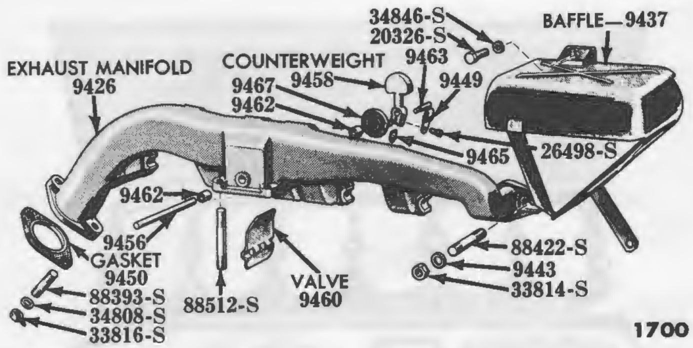

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Fig. 8—Exhaust Man[illegible] [illegible]-Engine)

Connect the muffler inlet pipe. Install the manifold air baffle assembly and secure it to the cylinder head and engine support bracket. Install the governor and carburetor. Connect the windshield wiper hose, governor lines, fuel line, choke wire, distributor vacuum line, and air cleaner flexible tube. Install the dash panel and engine cover.

c. Parcel Delivery.

Remove the engine compartment rear cover. Lift the engine compartment front cover and fasten it open with the hook provided at the left-hand corner near the hinge. Disconnect the air cleaner flexible tube, distributor vacuum line, choke wire, and fuel line at the carburetor. Disconnect the windshield wiper hose. Remove the carburetor. Remove the screw that secures the manifold air baffle assembly to the cylinder head. Remove the top nut from the engine right-hand front support bracket and remove the air baffle assembly. Disconnect the muffler inlet pipe from the exhaust manifold. Remove the manifold retaining nuts and washers and lift the manifolds from the block. Remove the nuts that hold the manifolds together and separate the manifolds.

The parcel delivery truck is equipped with the same type intake and exhaust manifolds as used on cab-over-engine trucks (figs. 8 and 9).

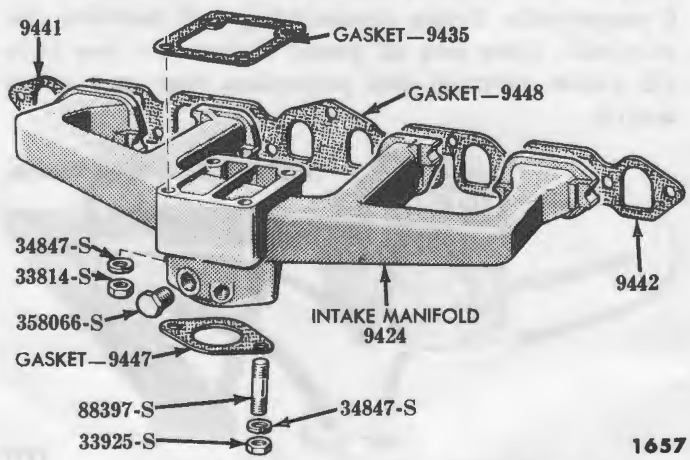

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Fig. 9—Intake Manifold (Cab-Over-Engine)

Before reassembling and installing the manifolds, make sure all gasket surfaces are free from old gasket material and projections that may affect sealing.

To install the manifolds, fasten them together and tighten the nuts to 30-35 foot-pounds torque. Place new manifold gaskets (fig. 7) on the block and install the manifolds. Tighten the manifold retaining nuts to 25-30 foot-pounds torque. Start at the center and work toward the ends to avoid manifold distortion when tightening the nuts.

Connect the muffler inlet pipe. Install the manifold air baffle assembly and secure it to the cylinder head and engine support bracket. Install the carburetor. Connect the windshield wiper hose, fuel line, choke wire, distributor vacuum line, and air cleaner flexible tube. Lower the engine compartment front cover and install the engine compartment rear cover.

2. CYLINDER HEAD REPLACEMENT

Cylinder heads are cast from the same high grade iron as is used for the cylinder block. Expansion and contraction due to temperature variations is the same for both head and block lessening the possibility of cylinder head distortion.

NOTE: ***The 1HA-6050 cylinder head is interchangeable with either the 7HA-6050 or the 0HA-6050 cylinder head.***

Cylinder heads must be replaced when cracks develop or distortion prevents adequate sealing at the gasket surface.

Replacement procedures are covered under headings "a. Conventional Truck," "b. Cab-Over-Engine." and "c. Parcel Delivery."

a. Conventional Truck.

Drain the cooling system. Remove the air cleaner. Disconnect the upper radiator hose at the cylinder head. Disconnect the cylinder head temperature unit sending wire. Remove the screw from the distributor vacuum line clamp on the forward left corner of the cylinder head. Disconnect the ignition wires from the spark plugs and remove the plugs. Remove the two screws from the coil bracket and let the bracket hang from the distributor. Disconnect the heater hose. Remove the screw from the manifold air baffle assembly on the right-hand side of the cylinder head. Remove the cylinder head bolts, then remove the cylinder head.

Before installing a cylinder head, clean the carbon deposits from the combustion chambers and check to see that all water passages are open. Gasket surfaces must be free of old gasket material and projections at bolt holes that may affect sealing.

Install a new cylinder head gasket (fig. 10) with the cut off corner at the left front corner of the block.

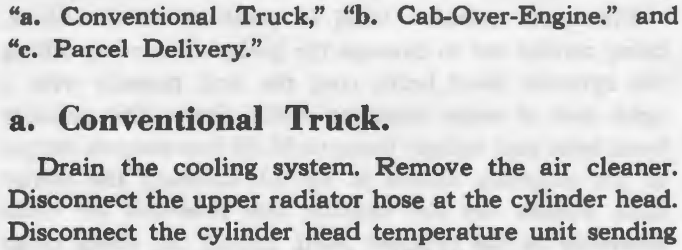
NOTE: ***If the gasket is installed improperly, water will leak externally at the left rear corner of the engine between cylinder head and block. Do not enlarge any gasket holes or overheating of the rear cylinders may result.***

Place the cylinder head in position on the block, being careful not to damage the gasket. Before installing the cylinder head bolts, coat the bolt threads with a light coat of water resistant sealer. Insert the cylinder head bolts and tighten them to 65-70 foot-pounds torque in the sequence shown in fig. 11. Fasten the manifold air baffle assembly to the cylinder head. Connect the heater hose. Fasten the distributor vacuum line clamp to the cylinder head. Connect the temperature unit sending wire. Install the spark plugs. Torque the plugs to 24-30 foot-pounds. Position the coil bracket and install the two holding screws. Connect the ignition secondary wires to the spark plugs. Connect the radiator hose. Fill the cooling system according to the prevailing temperature. Operate the engine for five minutes, stop the engine, and check the coolant level in the radiator.

b. Cab-Over-Engine.

Drain the cooling system. Disconnect the upper radiator hose at the cylinder head. Remove the engine compartment cover. Disconnect the cylinder head temperature sending unit wire. Remove the screw from

CYLINDER HEAD GASKET



CUT-OFF CORNER TOWARD FRONT 1133

Fig. 10—Cylinder Head Gasket Installation

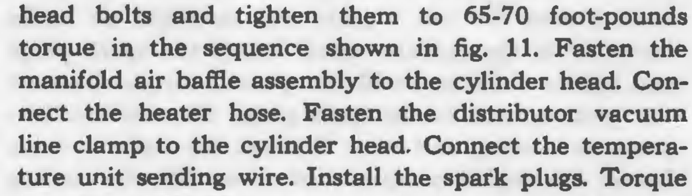


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Fig. 11—Cylinder Head Bolt Tightening Sequence

the manifold air baffle assembly on the right-hand side of the cylinder head. Disconnect the ignition wires from the spark plugs and remove the plugs. Remove the two screws from the coil bracket and let the bracket hang from the distributor. Disconnect the heater hose. Remove the cylinder head bolts, then remove the cylinder head.

Before installing a cylinder head, clean the carbon deposits from the combustion chambers and check to see that all water passages are open. Gasket surfaces must be free of old gasket material and projections at bolt holes that may affect sealing.

Install a new cylinder head gasket (fig. 10) with the cut off corner at the left front corner of the block.

NOTE: ***If the gasket is installed improperly, water will leak externally at the left rear corner of the engine between the cylinder head and block. Do not enlarge any gasket holes or overheating of the rear cylinders may result.***

Place the cylinder head in position on the block, being careful not to damage the gasket. Before installing the cylinder head bolts, coat the bolt threads with a light coat of water resistant sealer. Insert the cylinder head bolts and tighten them to 65-70 foot-pounds torque in the sequence shown in fig. 11. Connect the heater hose. Fasten the coil bracket and manifold air baffle assembly to the cylinder head. Install the spark plugs and tighten them to 24-30 foot-pounds torque. Connect the ignition wires to the spark plugs. Connect the temperature sending unit wire. Connect the radiator hose. Install the engine compartment cover. Fill the cooling system according to the prevailing temperature. Operate the engine for five minutes, stop the engine, and check the coolant level in the radiator.

c. Parcel Delivery.

Drain the cooling system. Open the engine compartment rear cover. Open the engine compartment front cover and fasten it open with the hook provided at the left-hand corner near the hinge. Disconnect the upper radiator hose at the cylinder head. Disconnect the temperature sending unit wire. Remove the screw from the manifold air baffle assembly on the right-hand side of the cylinder head. Disconnect the ignition wires from the spark plugs and remove the plugs. Remove the two screws from the coil bracket and let the bracket hang from the distributor. Disconnect the heater hose. Remove the cylinder head bolts, then remove the cylinder head.

Before installing a cylinder head, clean the carbon deposits from the combustion chambers and check to see that all water passages are open. Gasket surfaces must be free of old gasket material and projections at bolt holes that may affect sealing.

Install a new cylinder head gasket (fig. 10) with the cut-off corner at the left front corner of the block.

NOTE: ***If the gasket is installed improperly, water will leak externally at the left rear corner of the engine between the cylinder head and block. Do not enlarge any gasket holes or overheating of the rear cylinders may result.***

Place the cylinder head in position on the block, being careful not to damage the gasket. Before installing the cylinder head bolts, coat the bolt threads with a light coat of water resistant sealer. Insert the cylinder head bolts and tighten them to 65-70 foot-pounds torque in the sequence shown in fig. 11. Connect the heater hose. Fasten the coil bracket and manifold air baffle assembly to the cylinder head. Install the spark plugs and tighten them to 24-30 foot-pounds torque. Connect the ignition wires to the spark plugs. Connect the radiator hose. Close the engine compartment covers. Fill the cooling system according to the prevailing temperature. Operate the engine for five minutes, stop the engine, and check the coolant level in the radiator.

3. OIL PAN, OIL PUMP, AND PRESSURE RELIEF VALVE

Procedures in this section cover removal, cleaning, inspection, installation of the oil pan, reconditioning the oil pump, and replacement of oil seals and oil pressure relief valve.

a. Oil Pan.

An oil pan cleanout plate is provided on the bottom of the oil pan. The oil pump screen assembly can be cleaned when the cleanout plate is removed. Figure 12 illustrates the pan, cleanout plate, gaskets, oil seals, and screen assembly.

(1) *REMOVAL.* Raise the front end of the truck and set it on safety jacks. Drain the crankcase. Remove the splash pan. Disconnect the starter cable and remove the starter. Disconnect the ventilation pipe bracket. Remove the screws that hold the oil pan to the engine rear plate. Remove the screws that hold the oil pan to the engine block and the front cover plate. Remove the oil pan from the engine.

(2) *CLEANING.* Use a solvent to remove the sludge and dirt from both the inside and outside of the oil pan. Scrape the old gasket flange. Clean the oil pump inlet screen.

(3) *INSPECTION.* Inspect the oil pan for any external damage such as cracks or warped gasket surfaces. Inspect the drain plug threads for damage that may cause leakage. Check the oil pump screen and inlet tube

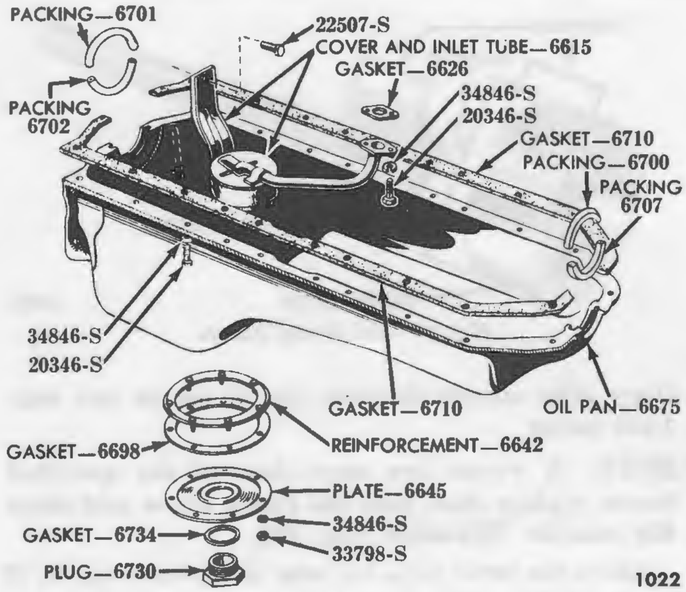

Fig. 12—Oil Pan and Related Parts

assembly for restrictions in the passages. Repair any damage or replace the pan if repairs cannot be made.

(4) *OIL SEAL REPLACEMENT.* Remove the oil packing and thoroughly clean the packing retainer grooves. Soak the packing (fig. 13) in SAE 20 oil for two hours before installation. Install the short packing in the front retainer groove and the long packing in the rear retainer groove. "Roll-in" the packing with a round bar (fig. 14) to make sure the packing meets the gasket evenly.

(5) *INSTALLATION.* Spread a thin film of grease on the oil pan gasket surface to hold the gasket in place during installation. Install a new gasket (fig. 13) on the pan. Lift the pan into place and install the screws that hold the oil pan to the block and front cover plate. Torque the screws to 15-18 foot-pounds torque.

NOTE: ***Alignment of the oil pan can be simplified by temporarily installing two studs in opposite corners of the block to guide the pan into place.***

Install the screws that hold the oil pan to the engine

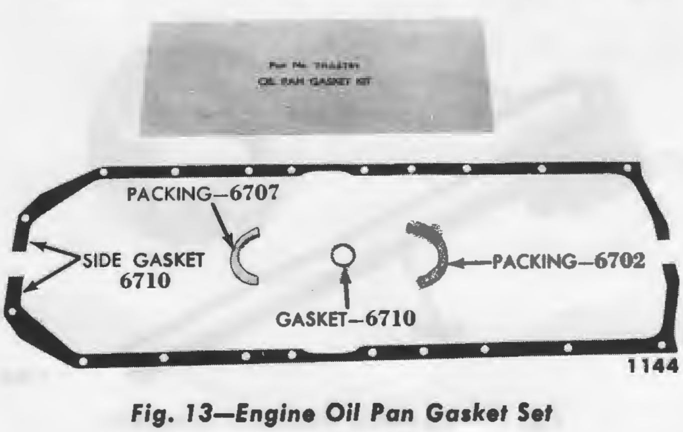

Fig. 13—Engine Oil Pan Gasket Set

Fig. 14—Installing Oil Seal Packing

rear plate. Torque screws to 10-15 foot-pounds torque. Install the drain plug. Connect the ventilation pipe bracket. Install the starter and connect the starter cable. Install the splash pan. Remove the jacks from under the front end. Fill the crankcase with proper quantity and grade of oil according to the prevailing temperature.

b. Oil Pump.

The rotor type oil pump is used on the H-Series engine and is externally mounted. In order to remove the oil pump with the engine in the chassis, it is necessary to raise the front of the engine so that the pump will clear the frame side rail when it is pulled out.

NOTE: ***The oil pump and camshaft gear back lash should be 0.0003-0.005 inch.***

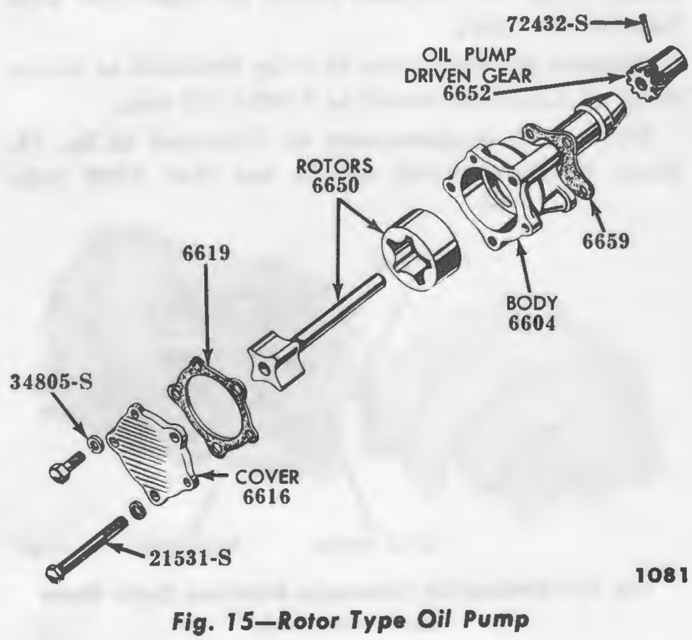

Fig. 15—Rotor Type Oil Pump

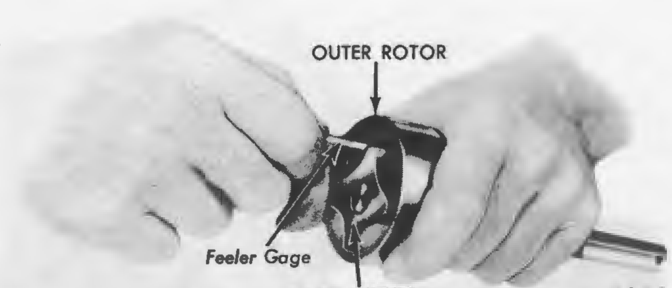

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Fig. 16—Measuring Clearance Between Oil Pump Rotors

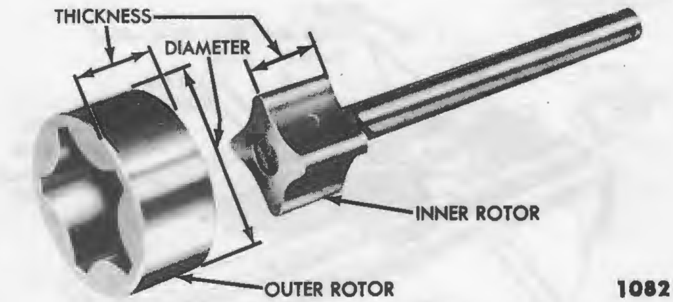

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Fig. 18—Oil Pump Rotors

Before removing the oil pump, check the back lash between the oil pump driven gear and the camshaft gear. This can be done by moving the distributor rotor and checking the distributor shaft free play. The rotor free play should be less than ¼ inch at the tip of the rotor.

(1) *REMOVAL.* Disconnect the right hand engine front support. Disconect the radiator hose. Raise the engine so the pump will clear the frame when removed.

Remove the screws that hold the pump to the block and remove the pump.

(2) *DISASSEMBLY.* A disassembled rotor type pump is illustrated in fig. 15. Remove the cover plate. Remove the outer rotor. Remove the pin from the oil pump driven gear. Remove the gear. Remove the inner rotor and shaft.

(3) *CLEANING.* Remove any dirt and sludge formation from the pump parts. Clean all parts with a suitable solvent.

(4) *INSPECTION.* Visually check all parts for breakage. Measure the clearance between the rotors as shown in fig. 16. Clearance should be 0.006-0.010 inch between the rotors.

Measure the outer rotor to body clearance as shown in fig. 17. Clearance should be 0.005-0.010 inch.

Make rotor measurements as illustrated in fig. 18. Rotor thickness should not be less than 0.998 inch. Outer rotor outside diameter should not be less than 2.246 inches.

NOTE: ***If rotors are worn beyond the specified limits, replace them with Oil Pump Rotor and Shaft Kit number 7HA-6650 (fig. 19).***

Check the cover plate for wear as shown in fig. 20. If the clearance exceeds 0.001 inch, replace the plate.

With the rotors assembled in the housing, place a straight edge over the rotors and pump body. Measure the clearance between the pump body and the straight edge. Replace the pump body if clearance is less than 0.001 to 0.003 inch.

Measure the pump shaft end play as shown in fig. 21. End play should be 0.008-0.012 inch.

(5) *ASSEMBLY.* Install the inner rotor and the shaft in the housing. Press the oil pump driven gear on the shaft until there is a shaft end play of 0.008-0.012 inch.

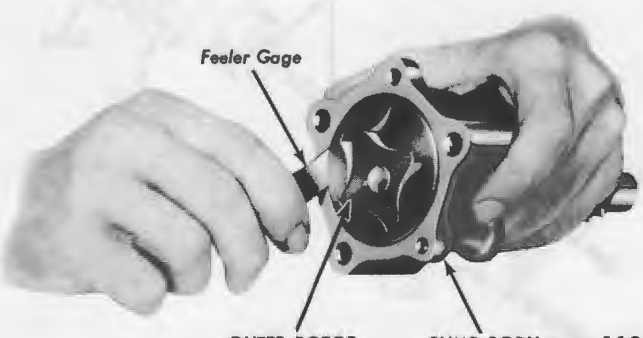

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Fig. 17—Measuring Clearance Between Outer Rotor and Pump Body

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Fig. 19—Oil Pump Rotor and Shaft Kit

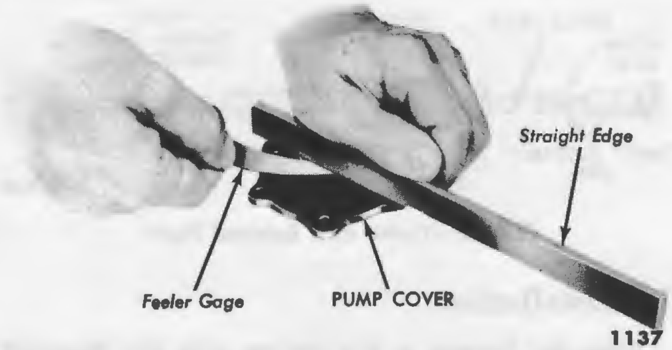

Fig. 20—Measuring Oil Pump Cover Plate Wear

NOTE: ***Oil pump shaft end play can be changed by pressing the driven gear on the shaft with the pinhole at a right angle to the old pinhole. Set the proper clearance and drill the shaft with a number 30 (0.1285) drill, and install the pin. Peen both ends of the pin after it is installed.***

Install the outer rotor and lubricate the rotors with engine oil. Install a new cover plate gasket and install the cover plate. Tighten the screws to 7-10 foot-pounds torque.

(6) *INSTALLATION.* Use a new gasket between the oil pump and block. Insert the pump into the block and install the hold down screws. Tighten the screws to 10-15 foot-pounds torque. Time the engine ignition.

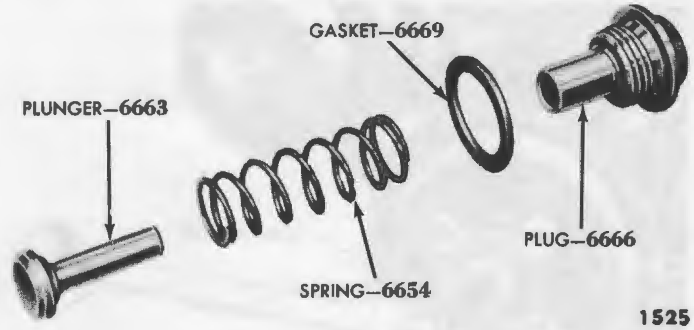

Fig. 22—Oil Pump Relief Valve

c. Oil Pressure Relief Valve.

A non-adjustable spring loaded oil pressure relief valve is located in the left rear corner of the engine block.

(1) *REMOVAL.* Remove the spring and plunger retaining plug from the block. Remove the spring and plunger (fig. 22).

(2) *INSPECTION.* Test the oil pressure relief valve spring. When it is compressed to 1.14 inches, the spring force should be 12.75 pounds plus or minus 2 ounces. Replace the spring if it is not within specifications.

(3) *INSTALLATION.* Insert the plunger and spring. Install a new valve retainer plug gasket. Install the valve retainer plug.

4. CRANKSHAFT DAMPER

The 6-cylinder engine is equipped with either a viscous type or a rubber type vibration damper. The damper outside diameters are different, requiring two timing pointers on the engine front cover. Both type dampers can be replaced with the engine in the truck. Figure 23 shows the stamped dampers used on 1949-50 engines. Malleable iron dampers are used on 1951 engines and are interchangeable with 1949-50 models.

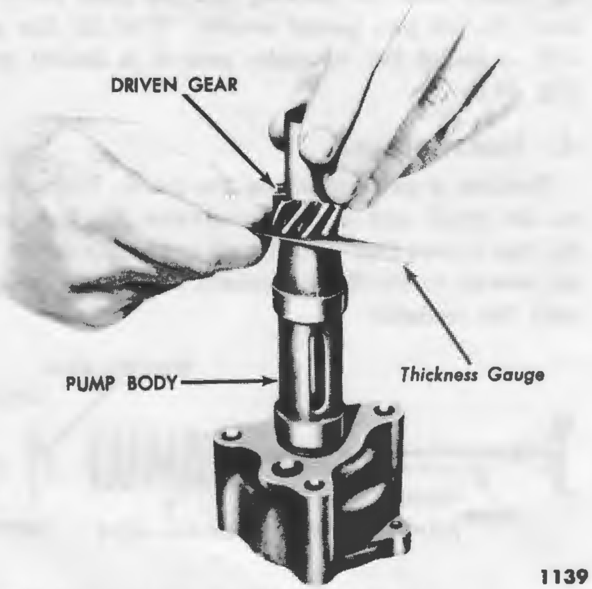

Fig. 21—Measuring Oil Pump End Play

a. Removal.

Remove the radiator. Remove the damper retainer bolt and washer from the end of the crankshaft. Install the damper removing tool on the damper assembly as

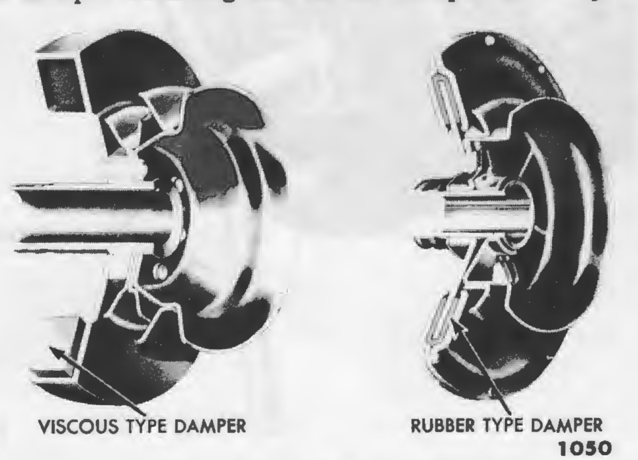

Fig. 23—1949-50 Vibration Dampers

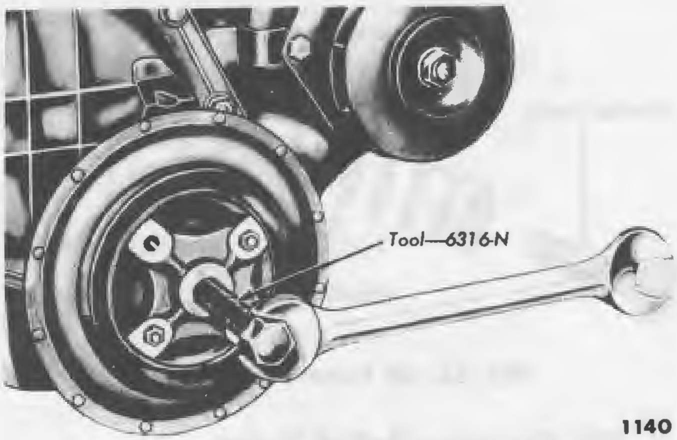

Fig. 24—Damper Remover

shown in fig. 24. Pull the damper assembly from the crankshaft.

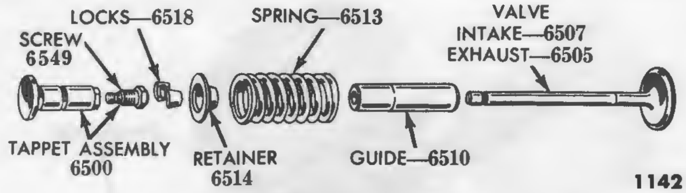

Fig. 26—Valve and Related Parts

b. Installation.

Align the keyway in the damper with the Woodruff key on the shaft and press the damper into place.

NOTE: ***If the engine is out of the truck, a damper replacing tool (fig. 25) can be used to install the damper.***

Install the damper retainer bolt and the washer in the end of the crankshaft. Install the radiator.

5. CYLINDER FRONT COVER

The cylinder front cover is either a stamping or an aluminum diecasting. The cover has two timing pointers to correspond with the different size dampers. The upper half of the crankshaft front packing is retained by the cover plate. Two dowels are used to locate the cover on the block.

The cover removal, inspection, oil seal installation, and cover installation procedures are given below.

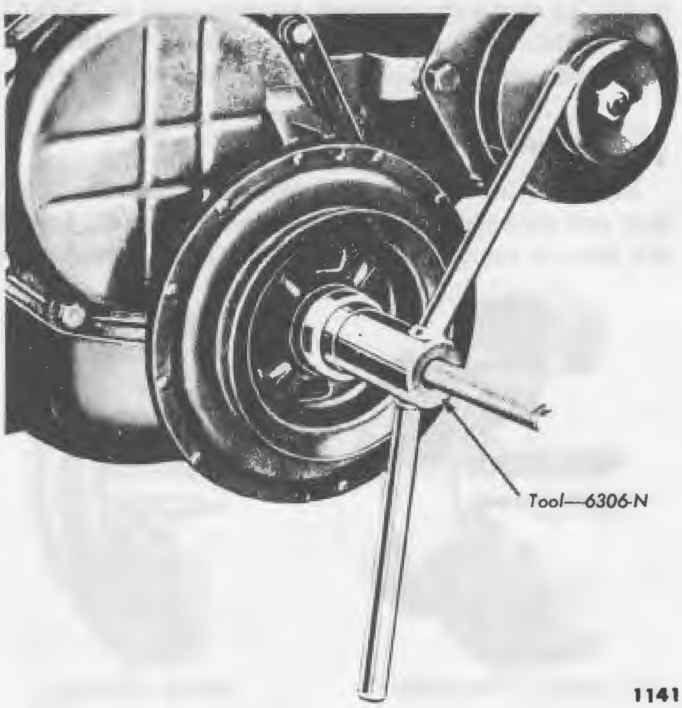

Fig. 25—Damper Replacer

a. Removal.

Remove the radiator. Remove the damper. Remove the two screws that hold the oil pan to the front cover. Remove the front cover retaining screws and remove the cover.

b. Inspection.

Inspect the cover for cracks or a damaged gasket surface. Replace the cover if it is cracked or damaged.

c. Oil Seal Replacement.

Remove the old packing and clean the packing groove. Soak the new packing (fig. 13) in SAE 20 oil for two hours before installation. Install the new oil seal packing. Make sure the packing and the front cover gasket meet the oil pan gasket evenly. "Roll in" the packing with a round bar to make sure it is seated properly (fig. 14).

d. Installation.

Position a new gasket on the cover. Place the cover on the block and install the screws. Be sure to install the two screws that hold the oil pan to the cover. Torque the screws to 15-18 foot-pounds. Install the damper. Install the radiator.

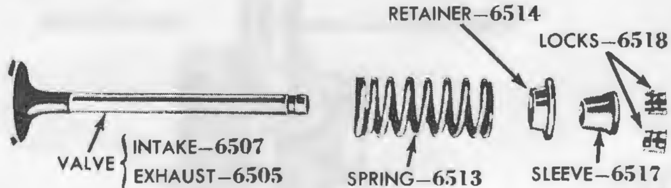

Fig. 27—Rotatable Valve and Related Parts

6. VALVES AND VALVE GUIDES

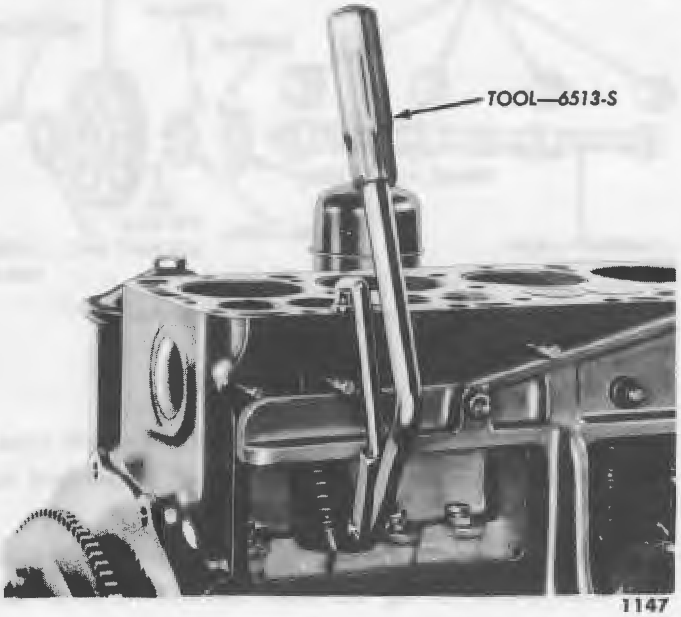

Fig. 28—Valve Spring Remover and Replacer

Procedures for removing and installing the valves and valve guides are given in this section. Valve clearance is set when the engine is cold. Figure 26 shows the valve and its related parts as used in 1949-50 H-Series engines. Figure 27 shows the rotatable valve used in 1951 engines.

a. Valves.

Rotatable intake and exhust valves are used in 1951 engines. This type of valve has a two piece spring retainer differing from the single piece spring retainers.

Rotatable valves and parts can be installed in engines not so equipped, by changing the spring retainer, intake valve, and exhust valve.

Openings in the valve chamber should be covered before valves are removed to prevent the valve locks from falling into the oil pan.

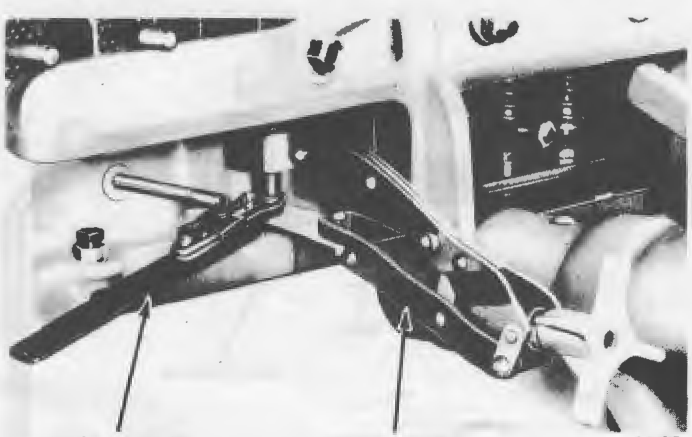

Fig. 29—Installing Valve Stem Locks

Fig. 30—Adjustable Type Tappet

As parts of the valve assemblies are removed, tag or otherwise identify them so they can be installed for reassembly in the valve port from which they were removed.

(1) *REMOVAL.* Remove the cylinder head. Remove the manifolds. Remove the valve chamber covers. Crank the engine until the tappet rests on the heel of the cam. Compress the valve spring and remove the valve spring retainer locks. Remove the valve. Remove the valve spring and valve spring retainer as shown in fig. 28. The valve spring retaining sleeve used with rotatable valves will remain on the tappet when the spring is compressed and can easily be lifted out.

(2) *INSTALLATION.* Install the retainer and the valve spring (with the tightly wound coils in the up position against the block) with the tool shown in fig. 28. Insert the valve in the guide and align it with the spring retainer. For non-rotating valves, compress the spring and install the valve spring retainer locks as shown in fig. 29. For rotating valves, compress the spring, lift the valve, align the retainer sleeve with the valve locks held in it under the valve. Then lower the valve and seat the locks with your finger. Release the spring slowly while holding the locks in place. Install the valve chamber covers. Install the manifolds and the cylinder head.

(3) *VALVE CLEARANCE ADJUSTMENT.* The adjustable type tappet (fig. 30) has a self-locking adjustment screw requiring no lock nut. The valve clearance is adjusted by the use of two open end wrenches,

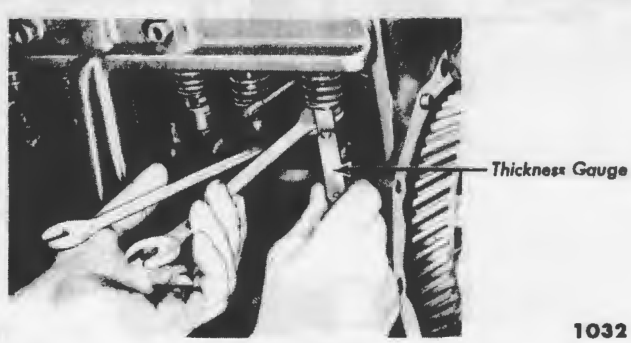

Fig. 31—Adjusting Tappets

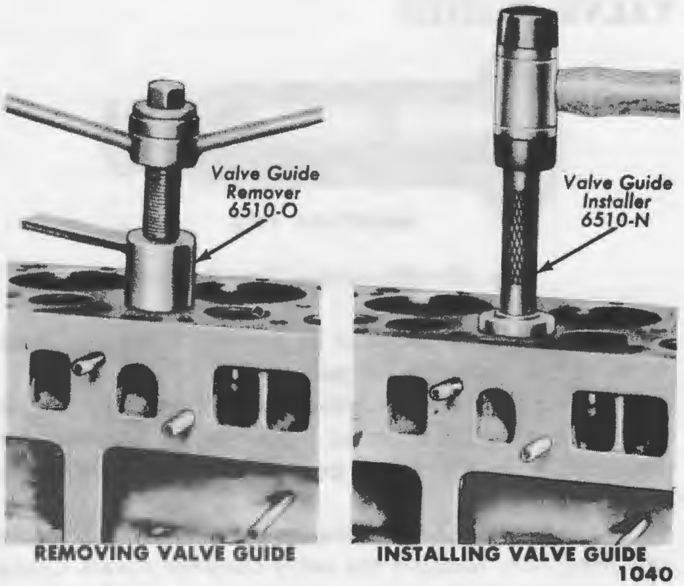

Fig. 32—Removing and Installing Valve Guides

one to hold the tappet body and the other to turn the adjusting nut. The adjustment is illustrated in fig. 31.

Valve gap settings are 0.013-0.015 inch for intake valves and 0.017-0.019 inch for exhaust valves when used with the new camshaft with the letter "O" or "B" stamped on the forward end. For old camshafts with no letter stamped on them set the intake valves at 0.009-0.011 inch and the exhaust valves at 0.013-0.015 inch.

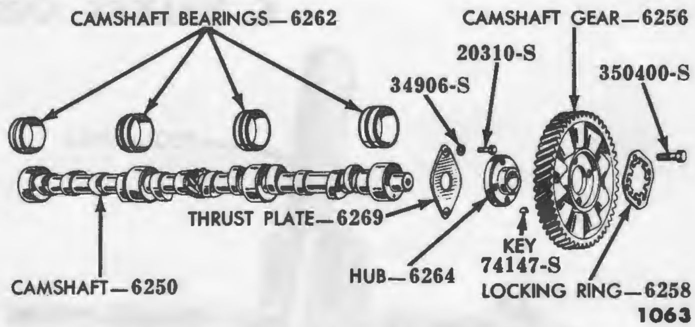

Fig. 34—Camshaft and Related Parts

b. Valve Guide Replacement.

Valve guides are of the single piece pressed-in type. The outside diameter at the lower end is reduced to act as a pilot when installing the guide.

Remove the guide by pulling it from the block with the tool shown in fig. 32. This method removes the guide with no distortion to the valve guide hole.

To install the valve guide, position the new guide in the bore. Drive the guide in the block as shown in fig. 33. Drive the exhaust valve guides to a depth of 1.08 inches and the intake valve guides to a depth of 1.18 inches measured from the top of the valve guide to the cylinder block surface as shown in fig. 33.

7. CAMSHAFT GEAR, CAMSHAFT, AND BEARINGS

The camshaft is supported by four bearings, which are pressed into the block, and it is driven by a gear in mesh with a gear on the crankshaft. A special cam on the camshaft contacts the fuel pump operating arm and operates the fuel pump. A bolt-on type aluminum timing gear is used on the early 1949 engines and a pressed-on type aluminum timing gear is used on the late 1949, 1950, and 1951 engines. The camshaft thrust is controlled by a plate which is bolted on the front of the engine block. Figure 34 illustrates the camshaft, thrust plate, and the bolt-on type timing gear.

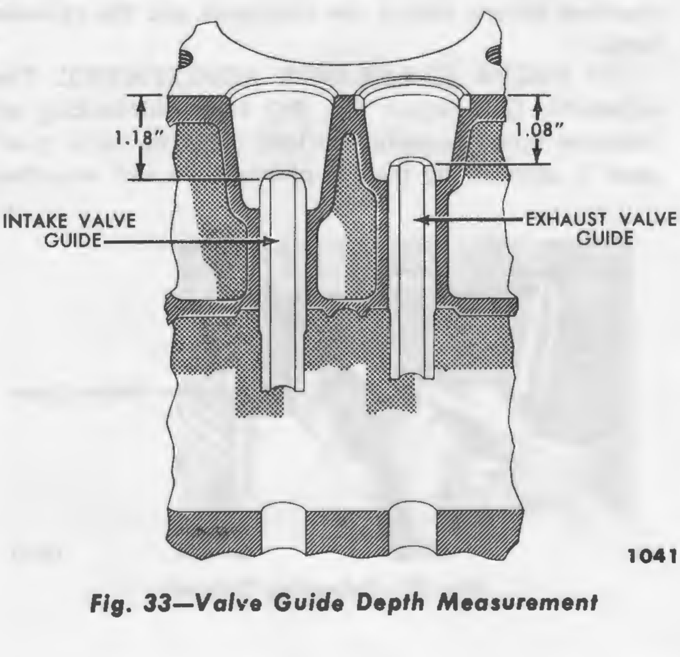

Fig. 33—Valve Guide Depth Measurement

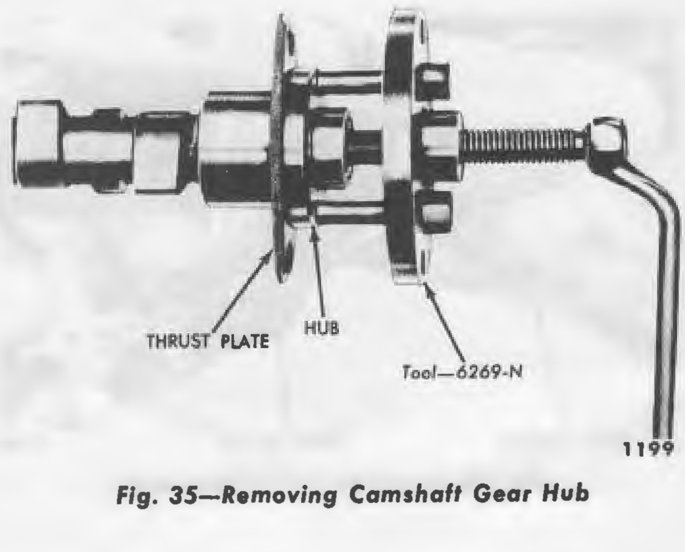

Fig. 35—Removing Camshaft Gear Hub

Fig. 36—Removing Camshaft Gear

The procedures for removal, inspection, and installation of the camshaft gear, camshaft, and camshaft bearings are given below.

a. Camshaft Gear.

The bolt-on type timing gear is secured to the camshaft gear hub by four screws which are locked with retaining tabs. The mounting holes are spaced to make it impossible to install the gear incorrectly. The camshaft gear hub is aligned by a key and pressed on the shaft.

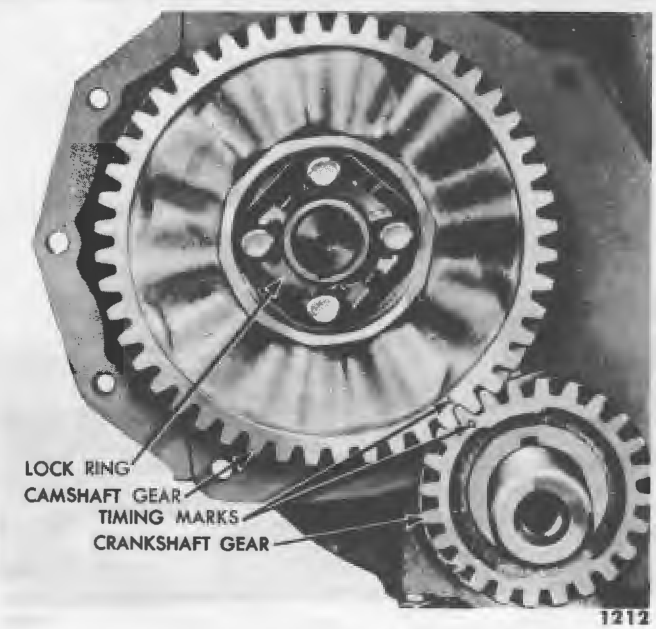

Fig. 37—Bolt-On Type Gear With Timing Marks Aligned

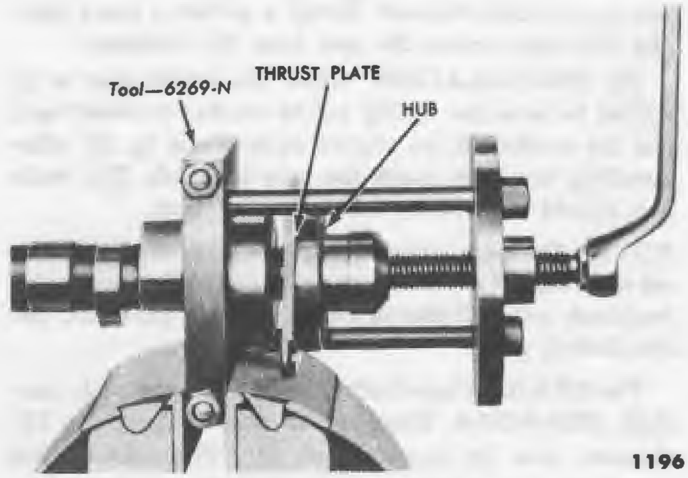

Fig. 38—Installing Camshaft Gear Hub

The pressed-on type gear is pressed on the camshaft and is located on the shaft by a key. Two types of pressed-on gears are used. One type has two tapped holes in the hub and the other does not have any holes.

All oversize camshaft gears can be identified by the pitch diameter stamped on the outer edge of the gear.

(1) *REMOVAL.* If the engine is in the vehicle, access to the camshaft gear can be obtained by removing the radiator. Then remove the vibration damper.

Remove the front cover and bend the oil slinger outward.

Follow the instructions given here that apply to the type of installation with which you are working.

(a) BOLT-ON GEAR. Bend the lock ring tabs away from the cap screws. Remove the cap screws and lock plate. Pull the gear off the camshaft. Remove the camshaft gear hub as shown in fig. 35).

(b) PRESSED-ON GEAR. This gear is an aluminum diecasting. Core holes are provided on either side of the

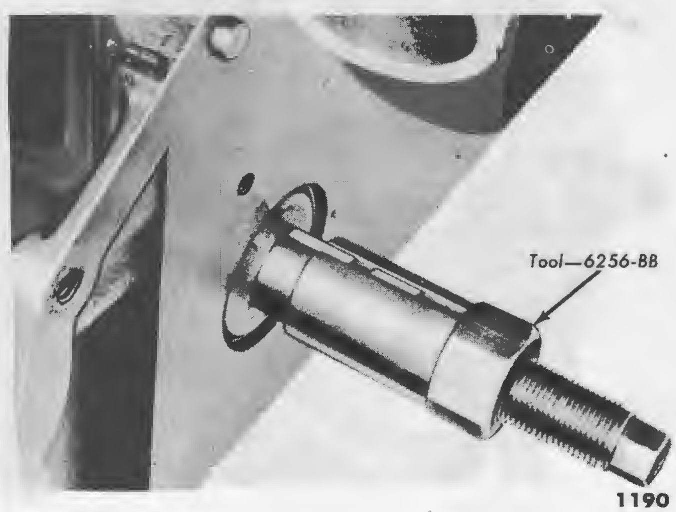

Fig. 39—Camshaft Gear Keyway Alignment Tool

hub to facilitate removal. Install a puller in these holes (fig. 36) and remove the gear from the camshaft.

(2) *INSTALLATION.* When the timing gear is installed be sure the timing marks on the camshaft gear and the crankshaft are aligned as shown in fig. 37. After installing the gear, check the gear backlash. The backlash should be between 0.002 to 0.003 inch.

NOTE: ***Oversize camshaft gears are available for service. Install the next oversize gear when excessive backlash exists between the camshaft gear and the crankshaft gear.***

The 8HA-6256 camshaft gear can be used with camshaft 0HA-6250-A. However, if this is done, the 15° chamfer must be increased to 45°. The 0HA-6256-A gear can be used with the 7HA-6250-C camshaft.

(a) BOLT-ON GEAR. Align the camshaft gear hub with the Woodruff key in the camshaft. Press the hub on the camshaft (fig. 38) leaving 0.003-0.006 inch clearance between the hub and thrust plate.

Align the mounting holes in the gear with those in the hub. Install the lock ring and screws. Tighten the screws to 15-20 foot-pounds torque and bend the lock plate tabs. Install the front cover with a new gasket. Install the vibration damper and radiator.

(b) PRESSED-ON GEAR. The tool shown in fig. 39 aligns the camshaft key with a pilot key. Place the camshaft gear on the camshaft and press it into place (fig. 40) leaving 0.003-0.006 inch clearance between the gear and thrust plate.

Bend the oil slinger to its original shape. Install the front cover, vibration damper, and radiator.

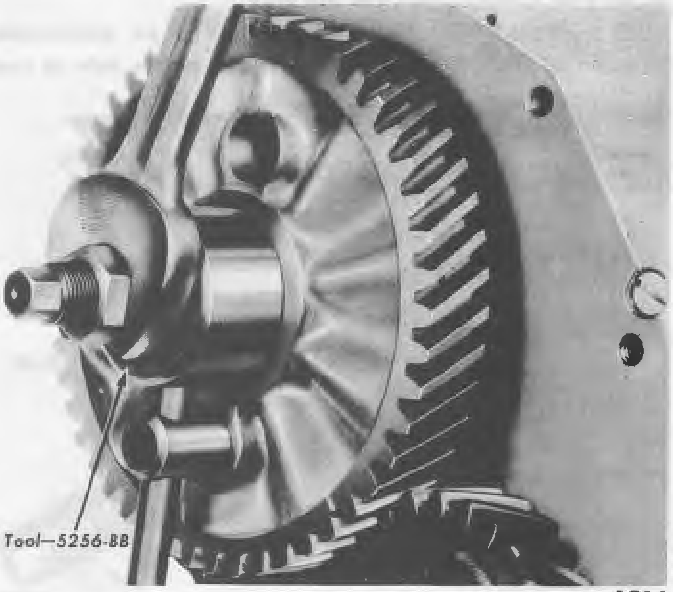

Fig. 40—Installing Camshaft Gear

b. Camshaft.

Late 1950 engines are equipped with an 0HA-6250 camshaft which replaces the 7HA-6250-C camshaft used in the 1949 and early 1950 engines. This camshaft can be identified by the letter "C" stamped on the forward end of the camshaft. The 1951 engines are equipped with an 0HA-6250-B camshaft which can be identified by the letter "B" stamped on the forward end.

The undercut at the point where the camshaft gear post joins the camshaft proper was eliminated on the 0HA-6250 camshaft and a radius was incorporated. This radius made it necessary to increase the chamfer on the inside diameter of the camshaft gear hub from 15° to 45° in order to avoid interference. The camshaft gear 0HA-6256-A with a larger chamfer incorporated on the hub is available for use with the 0HA-6250 camshaft.

Engines equipped with the 0HA-6250 camshaft are identified by the letters "OH" stamped on the righthand side of the cylinder block directly above the number 3 intake valve port.

If a 7HA-6250-C camshaft is used to replace the 0HA-6250 camshaft, it will be necessary to change the valve gap spacing to 0.009-0.011 inch for the intake valves and 0.013-0.015 inch for the exhaust valves.

If an 0HA-6250 camshaft is used to replace a 7HA-6250-C camshaft, it is necessary to change the valve gap spacing to 0.013-0.015 inch for the intake valves and 0.017-0.019 inch for the exhaust valves. Stamp the letters "OH" on the cylinder block directly above the number 3 intake valve port to identify the new type camshaft.

It will be necessary to replace the 1949 and early 1950 camshaft when the cam lobes are worn so the valve lift is less than 0.337 inch for the intake valves

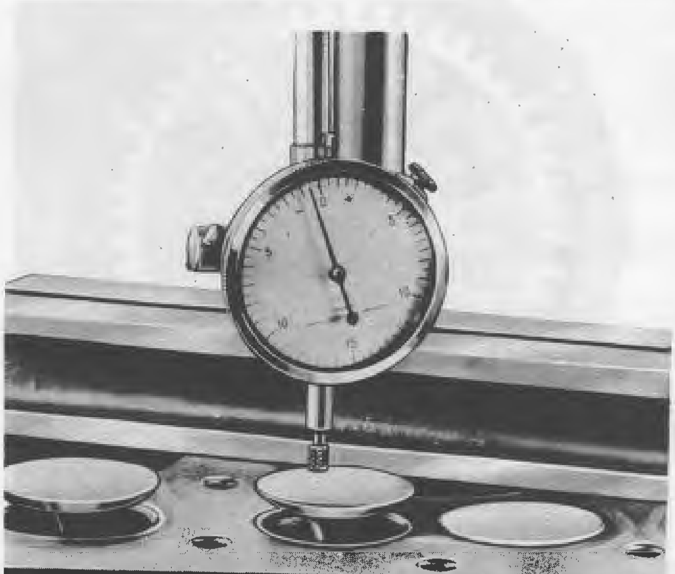

Fig. 41—Checking Valve Lift

and 0.333 inch for exhaust valves. Minimum lift on late 1950 and 1951 camshaft is 0.333 inch for intake valves and 0.329 inch for exhaust valves. Make valve lift measurements when the engine is cold and valve gaps are within specifications. Check the valve lift with a dial indicator as shown in fig. 41.

(1) *REMOVAL.* Remove the grille and radiator. Remove the cylinder heads, manifolds, and valves. Lift the valve tappet assembly and hold in the up position with spring clothespins or rubber bands.

NOTE: ***If the engine is on an engine stand and the valves have been removed, invert the block to eliminate tappet interference.***

Loosen the oil pump. Remove the front cover and the camshaft gear. Remove the thrust plate. Remove the camshaft by pulling it through the bearings.

NOTE: ***Exercise care that the camshaft bearings are not damaged by the lobes on the camshaft.***

(2) *INSPECTION.* Check the camshaft journal surface for grooves or scratches.

Measure the diameter of the journals with a micrometer for wear and out of round. Replace the camshaft if the journals measure less than 1.924 inches in diameter. Measure the inside diameter of the bearings with an inside micrometer or telescope gauge. The difference in measurements (amount of clearance) should be 0.001 to 0.002 inch for a new camshaft and bearings and not over 0.005 inch for a used camshaft and bearings.

Check the fuel pump eccentric for wear (deep groove worn by the rocker arm). Inspect the oil pump drive gear for worn, chipped, or broken teeth.

Replace the camshaft if any of the above conditions exist.

(3) *INSTALLATION.* Position the thrust plate on the camshaft with the oil groove toward the journal. Press the gear or the hub on the camshaft until the camshaft thrust plate has 0.003 to 0.006 inch clearance. Carefully slide the camshaft through the bearings. Secure the thrust plate to the block. Tighten the screws to 15-18 foot-pounds torque. Install the camshaft gear.

Check the camshaft gear runout. It should not exceed 0.002 inch. Install the front cover and gasket. Connect the oil pump. Remove the valve tappet holders if used. Install the valves. Install the cylinder head and the manifolds. Install the radiator and grille.

c. Camshaft Bearing Replacement.

Under normal use the camshaft bearings will not require replacement. However, they should be replaced if they are damaged or worn. It will be necessary to remove the engine from the vehicle to gain access to the bearings.

Bearings are finished to size and should not be line bored or reamed after installation.

(1) *REMOVAL.* Remove the camshaft. Remove the camshaft rear bearing expansion plug from the block at the rear end of the camshaft. Remove the camshaft bearings with the tool shown in fig. 42.

(2) *INSTALLATION.* Select the correct size camshaft bearings after measuring the camshaft journal outside diameter and the inside diameter of the camshaft bores in the block. Position each camshaft bearing at the bearing bore and press it into place.

NOTE: ***Be sure the oil hole in each bearing and bore are in alignment.***

The tool shown in fig. 42 is also used to install camshaft bearings. Apply sealer on the camshaft rear bearing plug and install the plug. Install the camshaft.

8. FLYWHEEL, CRANKSHAFT, AND BEARINGS

Removal and installation procedures are covered in this section for the flywheel, crankshaft, crankshaft gear, rear main bearing oil seal, and main bearings.

a. Flywheel.

The flywheel acts to carry over and smooth out the separate thrusts of each piston. The rear face of the flywheel is used as a friction surface which is engaged by the clutch plate. The flywheel ring gear which is engaged by the starter pinion when starting, is secured to the flywheel by a shrink fit.

(1) *REMOVAL.* Remove the engine from the chassis. Remove the clutch housing and clutch assembly. Remove the retaining bolts and lock ring. Install the flywheel puller (fig. 43) and remove the flywheel from the crankshaft flange.

(2) *INSTALLATION.* Assemble the flywheel to the mounting flange and install the lock ring and mounting bolts. Tighten the bolts to 75-85 foot-pounds torque. Install the clutch and clutch plate to the fly-

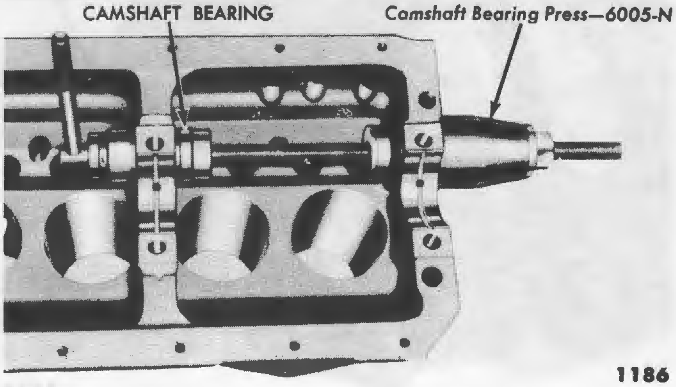

Fig. 42—Removing Camshaft Bearings

wheel making sure that the clutch is in the same position on the flywheel as it was before removal. Install the clutch assembly and housing. Install the engine.

b. Crankshaft Gear.

The crankshaft gear drives the camshaft through the camshaft gear. These gears must mesh in the proper relation to each other to synchronize valve action with piston movement. Backlash between these gears should be 0.002-0.003 inch. Excessive backlash indicates camshaft gear wear.

(1) *INSPECTION.* When it is necessary to replace the camshaft gear, it is advisable to inspect the crankshaft gear. Check the crankshaft gear for chipped, cracked, or worn teeth. Check the crankshaft gear runout. The maximum allowable runout is 0.0015 inch.

(2) *REMOVAL.* To remove the crankshaft gear it is necessary to remove the damper assembly, cylinder front cover, oil slinger, oil pan, and the front main bearing cap. Remove the gear with a crankshaft gear puller (fig. 44).

(3) *INSTALLATION.* Install the Woodruff key. Start the gear on the shaft making sure the keyway aligns with the key and the timing marks are facing out. Position the crankshaft gear installing tool on the crankshaft, making sure the puller stud is fully threaded into the crankshaft. Assemble the sleeve and wing nut and tighten the nut pulling the gear firmly into place (fig. 45).

CAUTION: ***Make sure the timing gear marks align as the teeth of the gears engage. Make sure the teeth engage freely before pulling the gear into place.***

Check the gear lash by inserting a feeler gauge between the teeth of the crankshaft and the camshaft

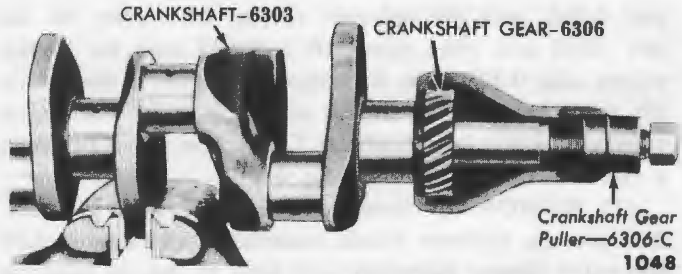

Fig. 44—Removing Crankshaft Gear

gears. The lash should be between 0.002 and 0.003 inch. Install the oil slinger with the concave side outward. Inspect the condition of the oil seal in the timing gear cover and in the oil pan. Replace the seal if necessary.

Install the engine front cover using a new gasket. Install the damper assembly and be sure the oil seal does not become damaged while installing the assembly. Install the oil pan using new gaskets.

c. Crankshaft.

The crankshaft is made of cast alloy steel with integral counterweights and is dynamically and statically balanced. Oil distribution holes are drilled through the shaft for main bearing and connecting rod bearing lubrication.

(1) *REMOVAL.* Remove the engine from the chassis. Remove the flywheel housing assembly, clutch and clutch plate, flywheel, starter and engine rear plate assembly, vibration damper, front cover assembly, oil pan, and oil pump screen cover assembly. A disassembled view of the crankshaft is shown in fig. 46.

When removing the clutch and clutch plate, make certain the clutch and flywheel are marked so the clutch may be reassembled to the flywheel in the same rela-

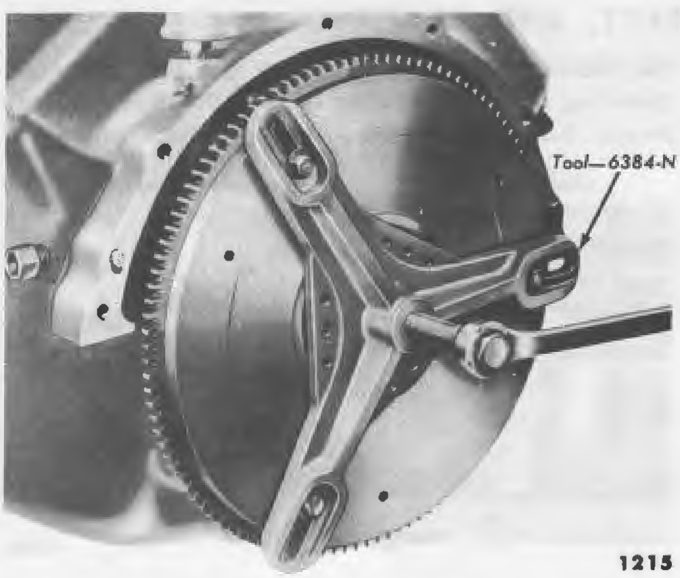

Fig. 43—Removing Flywheel

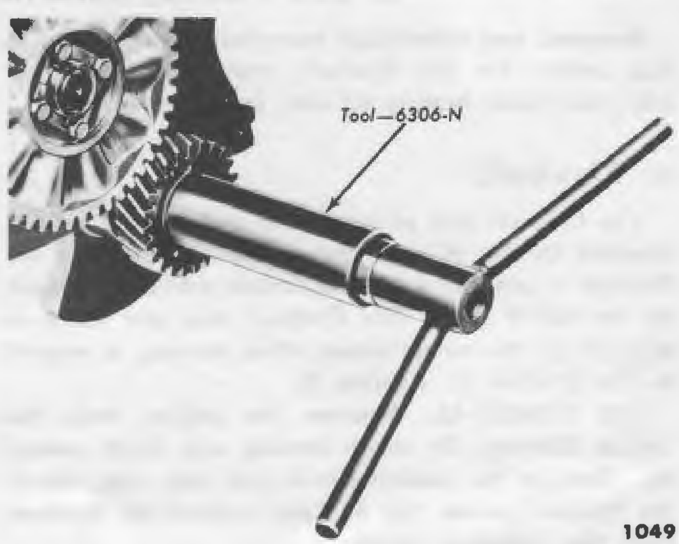

Fig. 45—Installing Crankshaft Gear

tionship as when it was removed. It is important to do this so the assembly will be properly balanced.

Before removing any of the bearings, make sure they are marked so they may be replaced exactly as they were originally installed. Remove all connecting rod bearing caps and inserts. Move the pistons up in the bores to avoid interference when maneuvering the crankshaft. Remove the four main bearings caps and inserts. Remove the crankshaft.

(2) *REAR OIL SEAL REPLACEMENT.* Remove the oil seal retainer. Pry the old seal out of the retainer and clean the groove thoroughly. Soak new oil seals at least two hours in oil before installation. Roll the seal into position in the recess with a round bar. Trim the ends of the seal flush with the block if necessary.

CAUTION: ***Oil seals extending below the mating surfaces of the block will result in oil leaks at the main bearing.***

Install the oil seal retainer with a new gasket. Oil seals should be changed when the engine is overhauled or if oil leakage is experienced at the bottom of the clutch housing.

(3) *INSTALLATION.* Coat the crankshaft journals and bearing inserts with engine oil. Install the upper main insert bearings, position the crankshaft, and install the lower main insert bearings and caps. Tighten the main bearing bolts to 95-105 foot-pounds torque. Pull the connecting rods into place, install the bearing inserts and bearing caps, and tighten the connecting rod nuts to 45-50 foot-pounds torque. Install the lock nuts and tighten them to 4-5 foot-pounds torque.

Install the flywheel, clutch disc and pressure plate, flywheel housing, and engine rear plate assembly. Install the oil pump screen cover assembly, oil pan, starter motor, front cover, and vibration damper. Install the engine in the chassis.

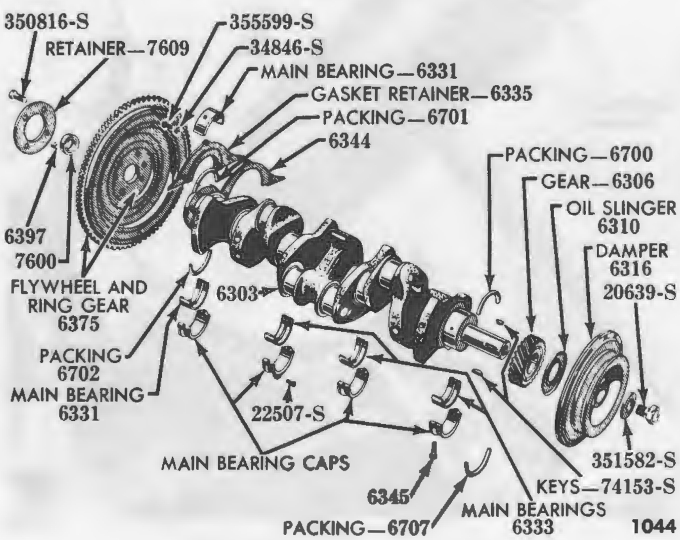

Fig. 46—Engine Crankshaft

Fig. 47—Install Bearing Remover in Oil Hole

d. Main Bearing Replacement with Crankshaft in Vehicle.

After the bearing cap has been removed, a special tool designed for removing the upper bearing insert may be inserted in the oil hole in the crankshaft as shown in fig. 47. Figure 48 shows the tool in position ready to bear against the insert. Rotate the crankshaft so the tool bears against the plain end of the insert to remove the insert.

To install the upper main bearing insert, start the plain end of the bearing between the journal and notched side of the bearing support. Using the same tool (fig. 47), rotate the crankshaft so the tool bears against the tab end of the bearing. When the bearing seats itself in the bearing support, back off the crankshaft and remove the tool.

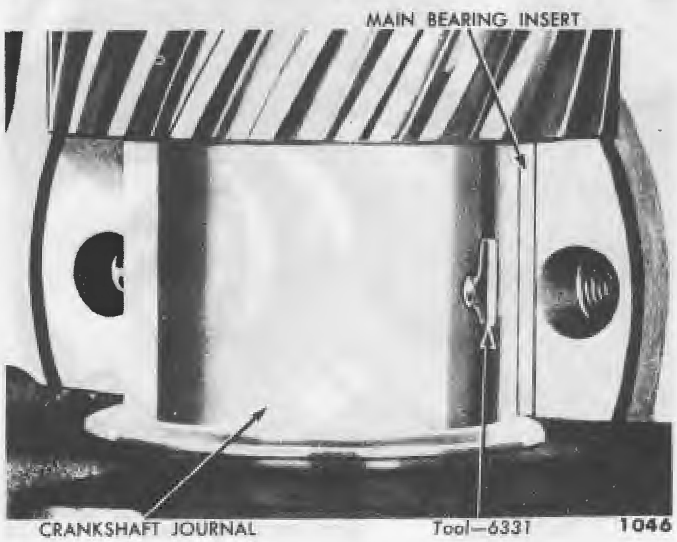

Fig. 48—Removing Main Bearing Insert

9. PISTON AND CONNECTING ROD ASSEMBLIES

This section gives removal and installation procedures for connecting rods, pistons, and pins. Fitting of bearings, pistons, pins, and rings is covered completely in the chapter on general engine repair.

a. Removal.

Remove the oil pan and cylinder head.

Before removing a piston from the engine, remove any ridge that may be present around the top of each cylinder bore.

Move the piston to the bottom of its travel area and place a cloth on the piston head to catch the cuttings. Position the ridge remover in the cylinder and adjust the ridge remover pilot to the cylinder bore size. Make sure the cutter is at the top side of the roller bar and that the cutter does not extend beyond the roller. Make sure the ridge remover shoes are tight. Hold the ridge remover tightly against the block and turn the arbor clockwise with a wrench (fig. 49).

CAUTION: ***Never cut into the ring travel area in excess of $\frac{1}{32}$ inch when removing ridges.***

Remove the ridge remover from the cylinder bore. Turn the crankshaft until the piston is at the top of its stroke and carefully remove the cloth and all cuttings.

Turn the crankshaft until the piston is at the bottom of its stroke. Remove the nuts from the connecting rod studs. Lift the bearing cap from the rod and push the rod and piston assembly out the top of the cylinder with the handle end of a hammer.

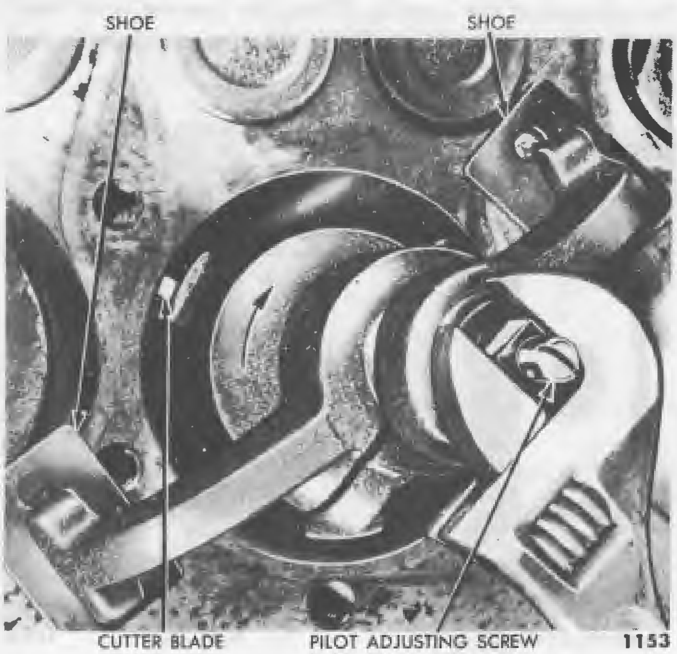

Fig. 49—Removing Cylinder Ridge

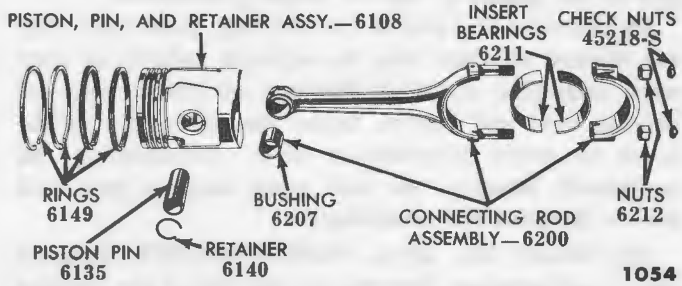

Fig. 50—Piston and Connecting Rod Assembly

NOTE: ***Each rod and bearing cap is numbered from 1 to 6 beginning at the front end of the engine. The numbers on the rod and bearing cap must be on the same side when re-installing them into their respective cylinder bores. If a connecting rod is transposed from one block to another be sure all the bearings are new and the number on the rod is restamped or prick punched to correspond with the cylinder number.***

b. Disassembly.

File the cylinder number on the inside bottom of the piston skirt prior to removing the rods from the pistons. This serves to identify the piston with the bore for reassembling purposes.

Remove the piston rings. Remove the retainers at each end of the piston pin. Push the piston pin out of the piston, or if necessary heat the assembly in hot

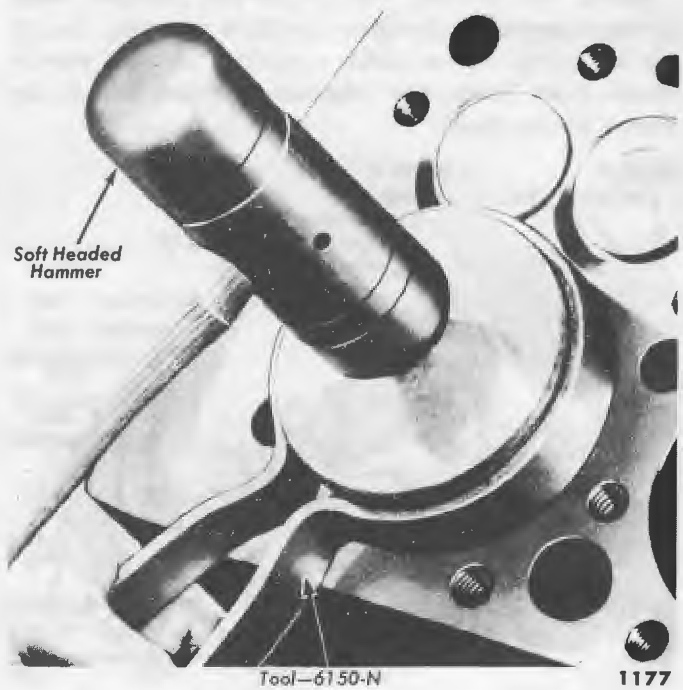

Fig. 51—Tapping In Piston

water and remove the pin by tapping with a hammer and a brass drift slightly smaller than the pin diameter. The piston and rod assembly is shown in fig. 50.

NOTE: ***The OHA type piston is serviced as a piston, pin, and retainer assembly. The retainer has a tang for aiding in its removal from the groove.***

c. Assembly.

Lubricate all parts with engine oil. Position the connecting rod in the piston and push the piston pin into place.

NOTE: ***The oil squirt hole in the connecting rod should be toward the valve side of the engine when the assembly is installed.***

Insert new piston pin retainers. Install the piston rings.

d. Installation.

Oil the cylinder wall with light engine oil. Make sure the ring gaps are spaced equi-distant around the circumference of the piston. Compress the rings with a compressing tool and tap the piston down with a soft faced hammer (fig. 51) until it is slightly below the top of the cylinder bore.

NOTE: ***Install the OHA type piston with the indentation in the top of the piston toward the front of the engine.***

Turn the crankshaft throw downward. Oil the crank pin and push the piston all the way down until the rod bearing seats on the crank pin. Install the bearing cap (line up the stamped numbers) and tighten the retaining nuts to 45-50 foot-pounds torque. Install new lock nuts and tighten to 4-5 foot-pounds.

Install the oil pan and cylinder head. Fill the crankcase with the proper grade and amount of lubricant according to the prevailing temperature. Fill the cooling system. Start the engine and run it slowly. Make sure there is sufficient oil pressure. Check the temperature to make sure the engine does not overheat. Overheating can be caused by too tight bearings.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part ONE

POWER PLANT

Chapter

III

M-Series—6-Cylinder Engine

The M-Series engine (figs. 1-3) is an L-head type engine with a bore of 3.5 inches, a stroke of 4.4 inches, and is rated at 110 horsepower. This engine is used for heavy duty operation in F-6 Series conventional and cab-over-engine trucks.

Complete removal and installation information covering all the component parts of the engine are included in this chapter. Procedures for disassembly, cleaning, inspection, repair, and assembly of the different units of this engine are also given here. General overhaul procedures for the M-Series engine are given in the chapter on general engine repair. The procedures and operations described and illustrated in this chapter can only be used for working on this engine.

Always install new gaskets when any installation is made where gaskets have been previously removed. A complete engine overhaul gasket kit (fig. 4) is available for engine overhaul.

1. MANIFOLD REPLACEMENT

A chamber is built into the intake manifold center section where the carburetor and exhaust manifold are attached. An exhaust control valve, located in the exhaust manifold, directs exhaust gases into this chamber when the engine is cold to provide faster engine warm-up.

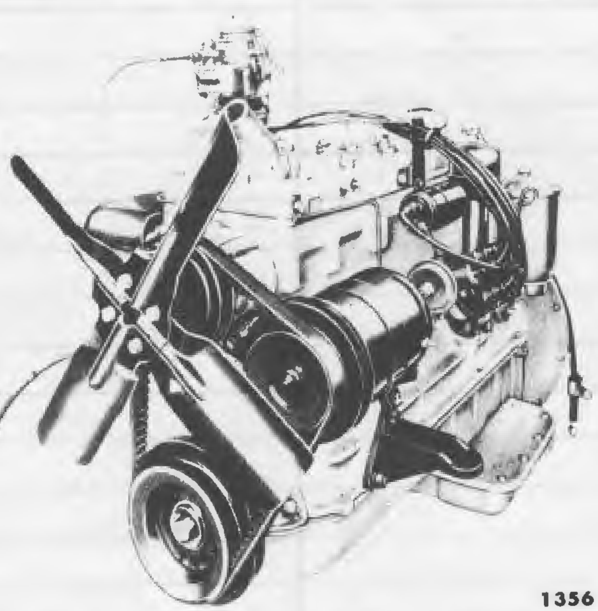

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Fig. 1—M-Series Engine (Left Front View)

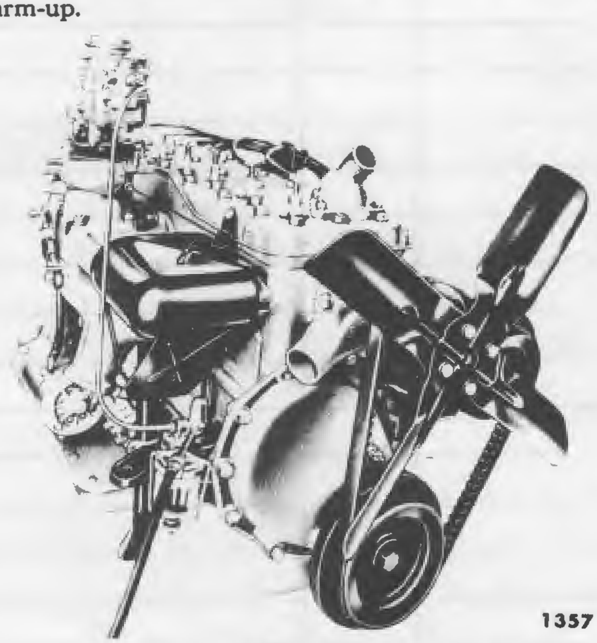

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Fig. 2—M-Series Engine (Right Front View)

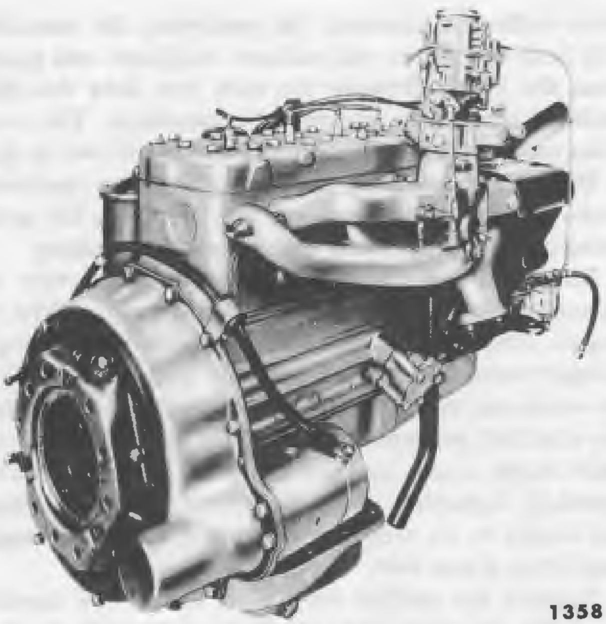

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Fig. 3—M-Series Engine (Right Rear View)

NOTE: ***Do not remove manifolds when hot. They may warp and make reassembly difficult.***

Replace manifolds that are warped or have developed cracks. The exhaust control valve (fig. 5) may stick and need replacement.

Manifold replacement procedures are covered under the headings "**a.** Conventional Truck" and "**b.** Cab-Over-Engine."

a. Conventional Truck.

Remove the air cleaner. Disconnect the distributor

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Fig. 4—Engine Overhaul Gasket Kit

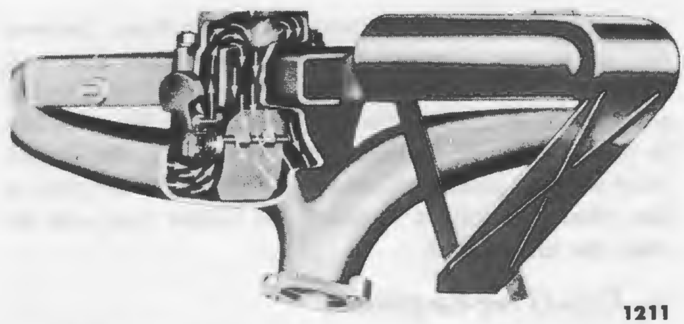

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Fig. 5—Manifolds Showing Exhaust Control Valve

vacuum line, choke wire, and fuel line at the carburetor. Disconnect the governor lines. Disconnect the accelerator linkage at both sides of the bell crank and at the carburetor. Remove the carburetor and governor. Disconnect the windshield wiper hose. Remove the screw holding the manifold air baffle assembly to the cylinder head. Remove the top nut from the engine right front support bracket and remove the intake manifold baffle assembly. Disconnect the muffler inlet pipe from the exhaust manifold. Remove the manifold hold down nuts and lift both the intake and exhaust manifolds and gasket from the block. Remove the nuts holding the manifolds together and separate the manifolds.

A disassembled view of the intake and exhaust manifolds used on conventional engines is shown in fig. 6. Before reassembling and installing the manifolds, make sure all gasket surfaces are free from old gasket material and projections that may affect sealing.

To install the manifolds, fasten them together and tighten the nuts to 30-35 foot-pounds torque. Place the manifolds on the engine block with new manifold gaskets (fig. 7). Tighten the nuts to 25-30 foot-pounds torque. Start at the center and work toward the ends to avoid manifold distortion. Install th carburetor and

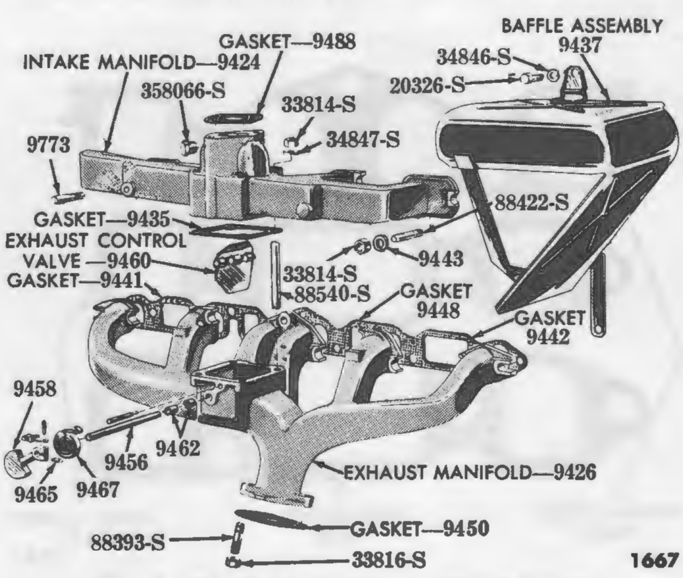

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Fig. 6—Manifolds for Conventional Trucks

governor. Connect the windshield wiper hose. Connect the accelerator. Connect the choke wire, fuel line, and distributor vacuum line to the carburetor. Connect the governor lines. Fasten the manifold air baffle assembly to the cylinder head. Install the top nut on the engine front support bracket. Connect the muffler inlet pipe to the exhaust manifold. Connect the heater hose and install the air cleaner.

b. Cab-Over-Engine.

Remove the engine compartment cover and dash panel to gain access to the engine from inside the cab. Disconnect the air cleaner flexible tube at the carburetor. Disconnect the distributor vacuum line, choke wire, and fuel line at the carburetor. Disconnect the windshield wiper hose and governor lines. Remove the governor and carburetor. Remove the screw that secures the manifold air baffle assembly to the cylinder head. Remove the top nut from the engine right-hand front support bracket and remove the manifold air baffle assembly. Disconnect the muffler inlet pipe from the exhaust manifold. Remove the manifold hold down nuts and washers. Remove the bolt securing the right-hand front support bracket to the frame. Tilt the engine toward the left-hand side of the engine compartment to allow sufficient clearance for removing the manifolds. Lift both the intake and exhaust manifolds and gaskets from the block. Remove the nuts that hold the manifolds together and separate the manifolds. The manifolds used for cab-over-engine trucks are shown in fig. 8.

Before reassembling and installing the manifolds, make sure all gasket surfaces are free from old gasket material and projections that may affect sealing.

To install the manifolds, fasten them together and tighten the nuts to 30-35 foot-pounds torque. With the engine tilted toward the left-hand side of the engine compartment, place new manifold gaskets (fig. 7) on the studs and install the manifolds on the block. Tighten the manifold retaining nuts to 25-30 foot-pounds torque. Start at the center and work toward the ends to avoid manifold distortion when tightening the nuts. Return the engine to its proper position and install the engine support to frame bolt.

Connect the muffler inlet pipe. Install the manifold air baffle assembly and secure it to the cylinder head and engine support bracket. Install the governor and carburetor. Connect the windshield wiper hose, governor lines, fuel lines, choke wire, distributor vacuum line, and air cleaner flexible tube. Install the dash panel and engine cover.

2. CYLINDER HEAD REPLACEMENT

Cylinder heads are cast from the same high grade iron as is used for the cylinder block. Expansion and contraction due to temperature variations is the same for both head and block lessening the possibility of cylinder head distortion.

Cylinder heads must be replaced when cracks develop or distortion prevents adequate sealing at the gasket surface.

Replacement procedures are covered under headings "a. Conventional Truck" and "b. Cab-Over-Engine."

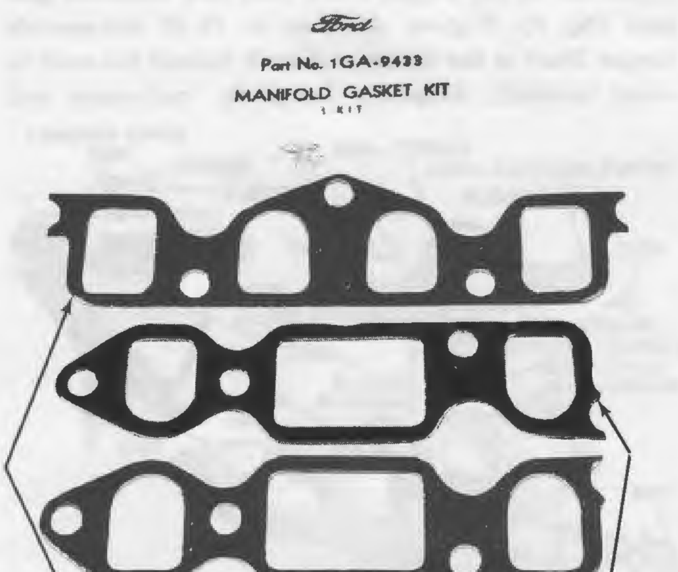


Fig. 7—Manifold Gasket Set

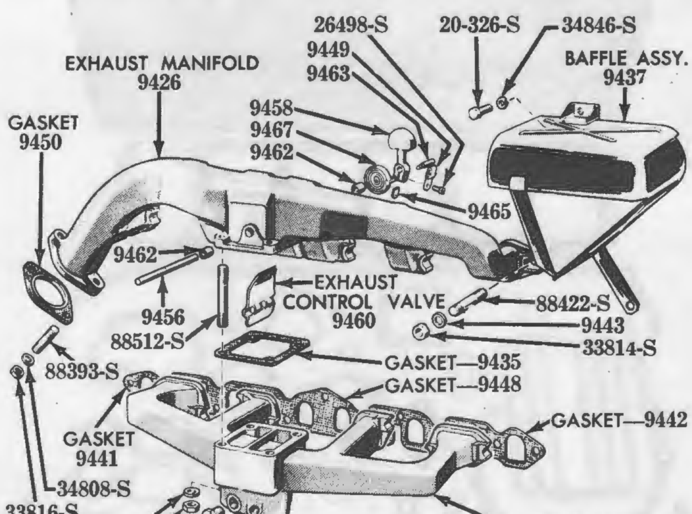


Fig. 8—Manifolds for Cab-Over-Engine Trucks

a. Conventional Truck.

Drain the cooling system. Remove the air cleaner. Disconnect the upper radiator hose at the cylinder head. Disconnect the cylinder head temperature unit sending wire. Remove the screw from the distributor vacuum line clamp on the forward left corner of the cylinder head. Disconnect the ignition wires from the spark plugs and remove the spark plugs. Remove the two screws from the coil bracket and let the bracket hang from the distributor. Disconnect the heater hose. Remove the screw from the manifold air baffle assembly on the right-hand side of the cylinder head. Remove the cylinder head bolts, then remove the cylinder head.

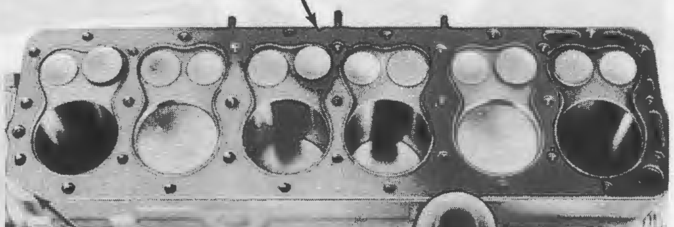
Before installing a cylinder head, clean the carbon deposits from the combustion chambers and check to see that all water passages are open. Gasket surfaces must be free of old gasket material and projections at bolt holes that may affect sealing.

Install a new cylinder head gasket (fig. 9) with the cut off corner at the left front corner of the block.

NOTE: ***If the gasket is installed improperly, water will leak externally at the left rear corner of the engine, between the cylinder head and block. Do not enlarge any gasket holes or overheating of the rear cylinders may result.***

Place the cylinder head in position on the block, being careful not to damage the gasket. Before installing the cylinder head bolts, coat the bolt threads with a light coat of water resistant sealer. Insert the cylinder head bolts and tighten them to 65-70 foot-pounds torque in the sequence shown in fig. 10. Fasten the manifold air baffle assembly to the cylinder head. Connect the heater hose. Fasten the distributor vacuum line clamp to the cylinder head. Connect the temperature unit sending wire. Install the spark plugs. Torque the plugs to 24-30 foot-pounds. Position the coil bracket and install the two holding screws. Connect the secondary ignition wires to the spark plugs. Connect the radiator hose. Fill the cooling system according to the prevailing temperature. Operate the engine for five minutes, stop the engine, and check the coolant level in the radiator.

CYLINDER HEAD GASKET



CUT-OFF CORNER TOWARD FRONT 1133

Fig. 9—Cylinder Head Gasket Installation

b. Cab-Over-Engine.

Drain the cooling system. Disconnect the upper radiator hose at the cylinder head. Remove the engine compartment cover. Disconnect the cylinder head temperature sending unit wire. Remove the screw from the manifold air baffle assembly on the right hand side of the cylinder head. Disconnect the ignition wires from the spark plugs and remove the spark plugs. Remove the two screws from the coil bracket and let the bracket hang from the distributor. Disconnect the heater hose. Remove the cylinder head bolts, then remove the cylinder head.

Before installing a cylinder head, clean the carbon deposits from the combustion chambers and check to see that all water passages are open. Gasket surfaces must be free of old gasket material and projections at bolt holes that may affect sealing.

Install a new cylinder head gasket (fig. 9) with the cut off corner at the left front corner of the block.

NOTE: ***If the gasket is installed improperly, water will leak externally at the left rear corner of the engine between the cylinder head and block. Do not enlarge any gasket holes or overheating of the rear cylinders may result.***

Place the cylinder head in position on the block, being careful not to damage the gasket. Before installing the cylinder head bolts, coat the bolt threads with a light coat of water resistant sealer. Insert the cylinder head bolts and tighten them to 65-70 foot-pounds torque in the sequence shown in fig. 10. Connect the heater hose. Fasten the coil bracket and manifold air baffle assembly to the cylinder head. Install the spark plugs and tighten them to 24-30 foot-pounds torque. Connect the ignition wires to the spark plugs. Connect the temperature sending unit wire. Connect the radiator hose. Install the engine compartment cover. Fill the cooling system according to the prevailing temperature. Operate the engine for five minutes, stop the engine, and check the coolant level in the radiator.

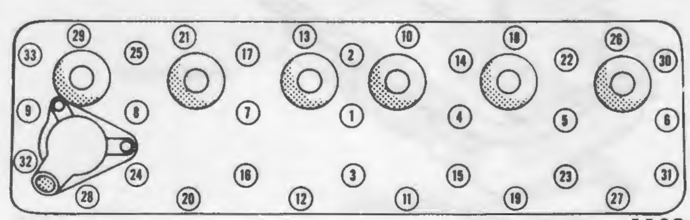


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Fig. 10—Cylinder Head Bolt Tightening Sequence

3. OIL PAN, OIL PUMP, AND OIL PRESSURE RELIEF VALVE

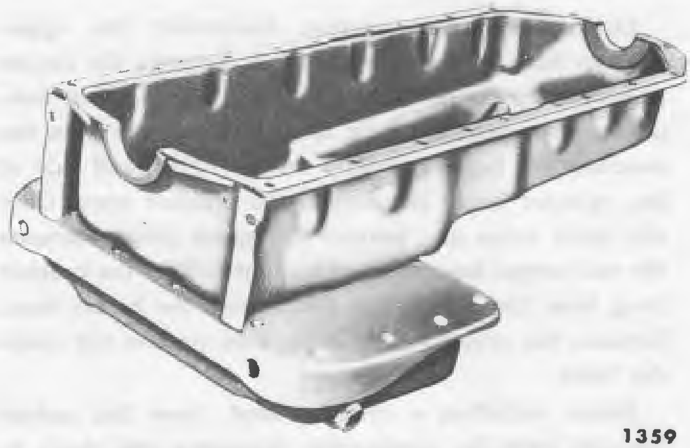

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Fig. 11—Oil Pan and Sump Assembly

Procedures in this section cover oil seal replacement and removal, cleaning, disassembly, inspection, assembly, and installation of the oil pan under heading "a. Oil Pan." Procedures for repairing the oil pump are given under heading "b. Oil Pump." Replacement of the oil pressure relief valve is given under heading "c. Oil Pressure Relief Valve."

a. Oil Pan.

The oil pan used on the M-Series engine is equipped with a removable sump (fig. 11): This permits cleaning the oil pump screen assembly without removing the oil pan.

(1) *REMOVAL.* Raise the front end of the truck and set it on safety jacks. Drain the crankcase. Remove the splash pan. Disconnect the starter cable and remove

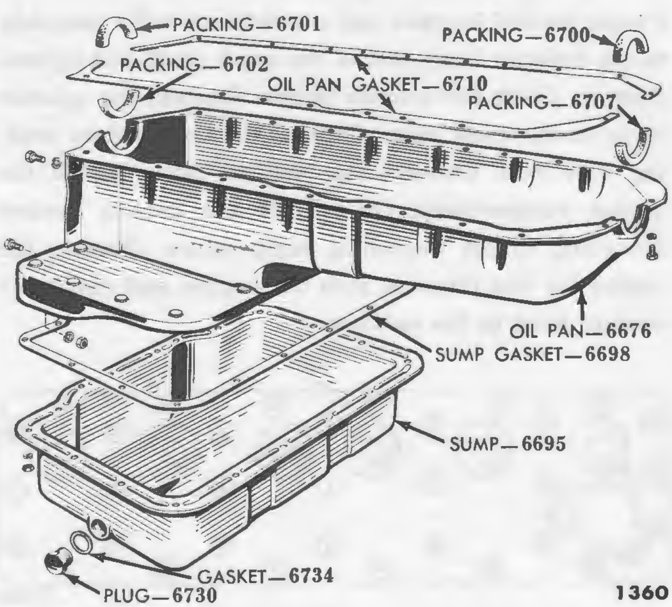

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Fig. 12—Oil Pan and Related Parts

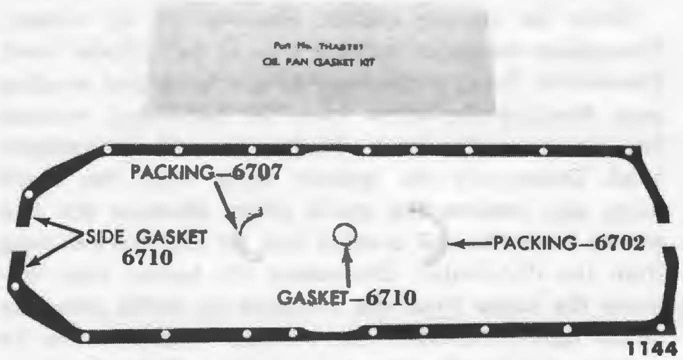

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Fig. 13—Engine Oil Pan Gasket Set

the starter. Disconnect the ventilation pipe bracket. Remove the screws that secure the oil pan to the engine rear plate. Remove the screws that secure the oil pan to the engine block and front cover plate. Remove the oil pan from the engine.

(2) *DISASSEMBLY.* Remove the sump pan retaining screws and remove the sump pan and gasket. Figure 12 illustrates the oil pan disassembled.

(3) *CLEANING.* Use a solvent to remove the sludge and dirt from both the inside and outside of the oil and sump pans. Scrape old gasket material from the gasket surfaces and file off any projections at the bolt holes. Clean the oil pump inlet screen.

(4) *INSPECTION.* Inspect the oil pan for external damage such as cracks or warped gasket surfaces. Inspect the drain plug threads and sump pan retainer stud threads for damage that may allow leakage. Check the oil pump screen and inlet tube assembly for crimped passages. Repair any damage or replace the pans.

(5) *OIL SEAL REPLACEMENT.* Remove the oil packing and thoroughly clean the packing retainer

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Fig. 14—Installing Oil Seal Packing

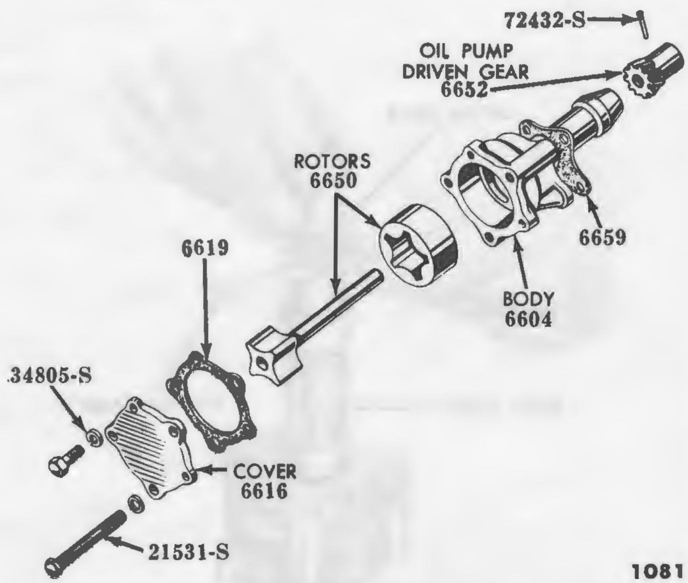

Fig. 15—Rotor Type Oil Pump

grooves. Soak packing (fig. 13) for two hours in SAE 20 oil before installation. Install the short packing in the front retainer groove and the long packing in the rear retainer groove "Roll-in" the packing with a round bar (fig. 14) to make sure the packing meets the gasket evenly.

(6) *ASSEMBLY.* Use a new gasket. Install the sump pan and tighten the screws to 10-15 foot-pounds.

(7) *INSTALLATION.* Spread a thin film of grease on the oil pan gasket surface to hold the gasket in place

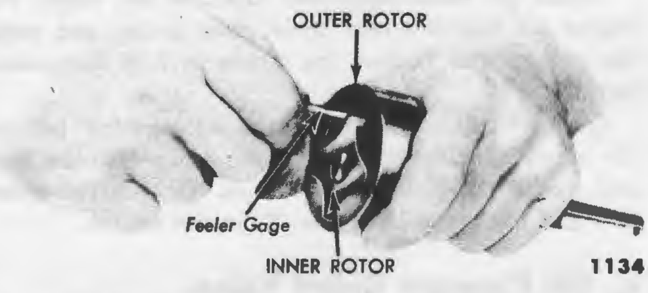

Fig. 16—Measuring Clearance Between Oil Pump Rotors

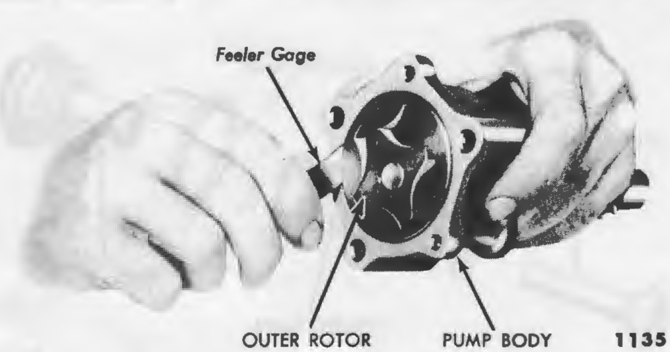

Fig. 17—Measuring Clearance Between Outer Rotor and Pump Body

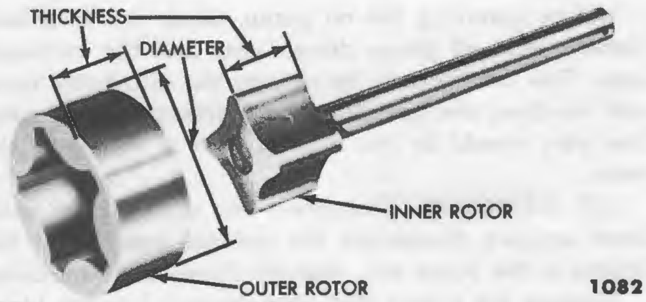

Fig. 18—Oil Pump Rotors

during installation. Install a new gasket (fig. 13) on the pan. Lift the pan into place and install the screws that secure the oil pan to the engine block and front cover. NOTE: ***Alignment of the oil pan can be simplified by temporarily installing two studs in opposite corners of the block to guide the pan into place.***

Connect the ventilation pipe bracket. Install the starter and connect the starter cable. Install the splash pan. Remove the safety jacks. Fill the crankcase with proper grade of oil according to the prevailing temperature.

b. Oil Pump.

The rotor type oil pump is used on the M-Series engine and is externally mounted. In order to remove the oil pump with the engine in the chassis, it is necessary to raise the front of the engine so the pump will clear the frame side rail when it is pulled out.

NOTE: ***The oil pump and the camshaft gear back lash should be 0.003-0.005 inch.***

Fig. 19—Oil Pump Rotor and Shaft Kit

Before removing the oil pump, check the back lash between the oil pump driven gear and the camshaft gear. This can be done by moving the distributor rotor and checking the distributor shaft free play. The rotor free play should be less than ¼ inch at the tip of the rotor.

(1) *REMOVAL.* Disconnect the engine right hand front support. Disconnect the radiator hose. Raise the engine so the pump will clear the frame when removed.

Remove the screws that hold the pump to the block and remove the pump.

(2) *DISASSEMBLY.* Remove the cover plate. Remove the outer rotor. Remove the pin from the oil pump driven gear. Remove the gear. Remove the inner rotor and shaft. A disassembled rotor type pump is illustrated in fig. 15.

(3) *CLEANING.* Remove any dirt and sludge formation from the pump parts. Clean all parts with a suitable solvent.

(4) *INSPECTION.* Visually check all parts for breakage. Measure the clearance between the rotors as shown in fig. 16. Clearance should be 0.006-0.010 inch between the rotors.

Measure the outer rotor to body clearance as shown in fig. 17. Clearance should be 0.005-0.010 inch.

Make rotor measurements as illustrated in fig. 18. Rotor thickness should not be less than 0.998 inch. Outer rotor outside diameter should not be less than 2.246 inches.

NOTE: ***If rotors are worn beyond the specified limits, replace them with Oil Pump Rotor and Shaft Kit number 7HA-6650 (fig. 19).***

Check the cover plate for wear as shown in fig. 20. If the clearance exceeds 0.001 inch replace the plate.

With the rotors assembled in the housing, place a straight edge over the rotors and pump body. Measure the clearance between the pump body and the straight edge. Replace the pump body if clearance is less than 0.001 to 0.003 inch.

Measure the pump shaft end play as shown in fig. 21. End play should be 0.008-0.012 inch.

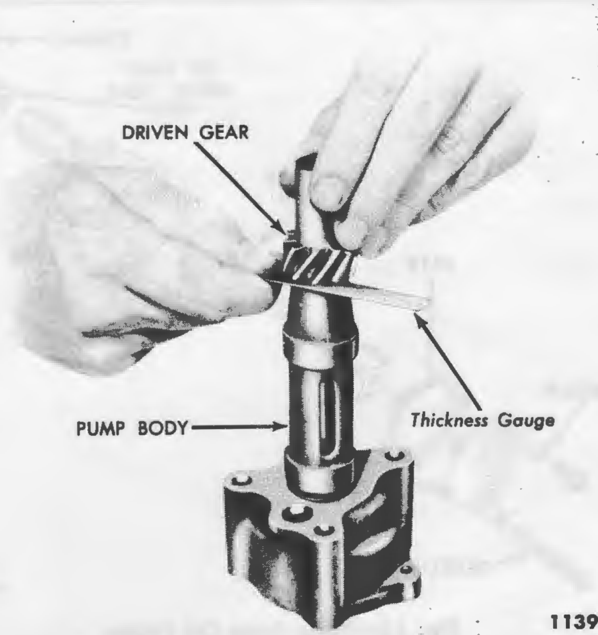

Fig. 21—Measuring Oil Pump End Play

(5) *ASSEMBLY.* Install the inner rotor and the shaft in the housing. Press the oil pump driven gear on the shaft until there is a shaft end play of 0.008-0.012 inch.

NOTE: ***Oil pump shaft end play can be changed by pressing the driven gear on the shaft with the pin hole at right angle to the old pin hole. Set the proper clearance and drill the shaft with a number 30 (0.1285) drill, and install the pin. Peen both ends of the pin after it is installed.***

Install the outer rotor and lubricate the rotors with engine oil. Install a new cover plate gasket and install the cover plate. Tighten the screws to 7-10 foot-pounds torque.

(6) *INSTALLATION.* Use a new gasket between the oil pump and block. Insert the pump into the block and install the hold down screws. Tighten the screws to 10-15 foot-pounds torque. Time the engine.

c. Oil Pressure Relief Valve.

A non-adjustable spring loaded oil pressure relief

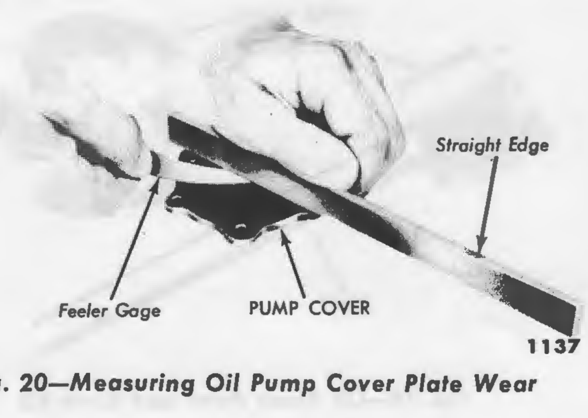

Fig. 20—Measuring Oil Pump Cover Plate Wear

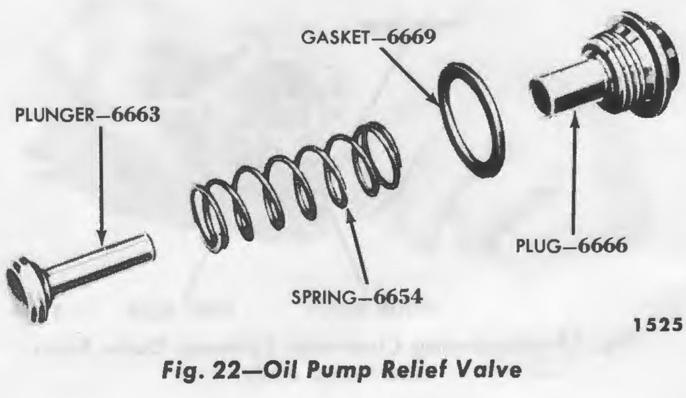

Fig. 22—Oil Pump Relief Valve

valve is located in the left rear corner of the engine block.

(1) *REMOVAL.* Remove the spring and plunger retaining plug from the block. Remove the spring and plunger (fig. 22).

(2) *INSPECTION.* Test the oil pressure relief valve spring. When it is compressed to 1.14 inches, the spring force should be 12.75 pounds plus or minus 2 ounces. Replace the spring if it is not within specifications.

(3) *INSTALLATION.* Insert the plunger and spring. Install a new valve retainer plug gasket. Install the valve retainer plug.

4. CRANKSHAFT DAMPER

The M-Series engine is equipped with either a viscous type or rubber type vibration damper. The damper outside diameters are different requiring two pointers on the front cover for timing the engine. Stamped dampers used on 1949-1950 engines are shown in fig. 23. Malleable iron dampers used on 1951 engines are interchangeable with the stamped type damper. The damper can be replaced while the engine is in the vehicle.

a. Removal.

Remove the radiator. Remove the damper retaining bolt and washer from the end of the crankshaft. Install the damper removing tool on the damper assembly as shown in fig. 24. Remove the damper from the crankshaft.

b. Installation.

Align the damper keyway with the Woodruff key on the crankshaft. Press the damper into place. Install the damper retaining bolt and washer on the end of the crankshaft. Install the radiator.

NOTE: ***If the engine is out of the vehicle, a damper replacing tool (fig. 25) can be used to install the damper.***

5. CYLINDER FRONT COVER

The cylinder front cover is either a stamping or an aluminum diecasting. The cover has two timing pointers to correspond with the different size dampers. A groove in the lower edge of the front cover is a retainer for the upper half of the front crankshaft oil seal packing. Two dowels locate the cover on the block.

a. Removal.

Remove the radiator. Remove the vibration damper. Remove the two screws that secure the oil pan to the front cover and the cover retaining screws. Remove the front cover from the dowels by tapping along the edge with a soft faced hammer.

b. Inspection.

Inspect the cover for cracks or a damaged gasket surface. Replace the cover if it is cracked or damaged.

c. Oil Seal Replacement.

Remove the old packing and clean the groove. Soak the new packing (fig. 4) in SAE 20 oil for at least two hours before installation. Install the new oil seal packing. Make sure the packing and the front cover gasket meet the oil pan gasket evenly. "Roll in" the packing with a round bar to make sure it is seated properly (fig. 26).

d. Installation.

Position a new gasket on the cover. Place the cover on the block and install the screws. Be sure to install the two screws that secure the oil pan to the front cover. Tighten the screws to 15-18 foot-pounds torque. Install the damper. Install the radiator.

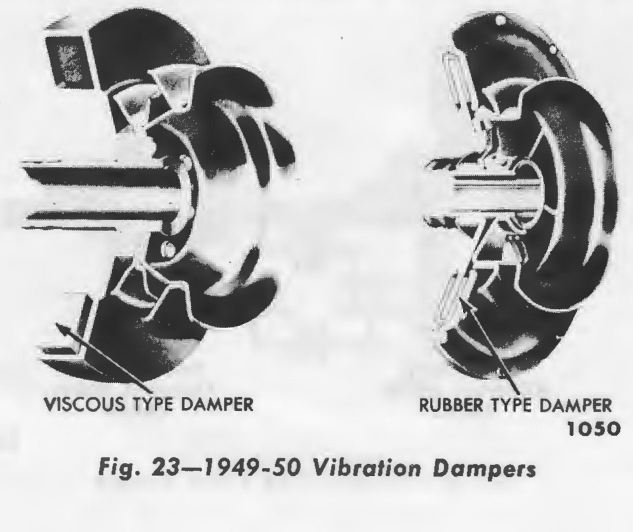

Fig. 23—1949-50 Vibration Dampers

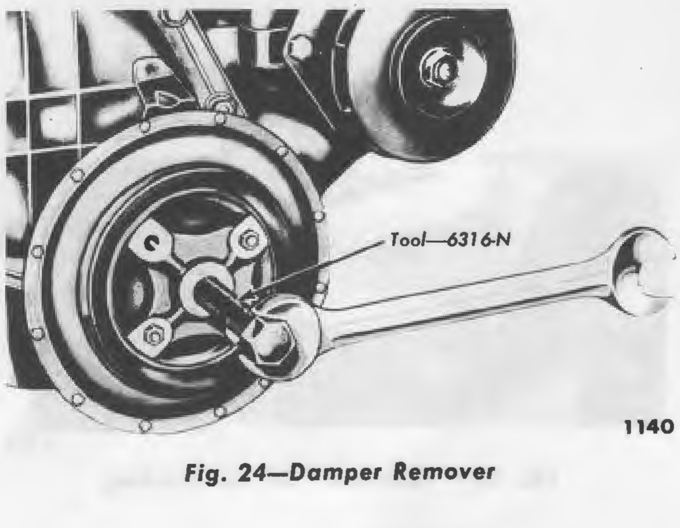

Fig. 24—Damper Remover

6. VALVES AND VALVE GUIDES

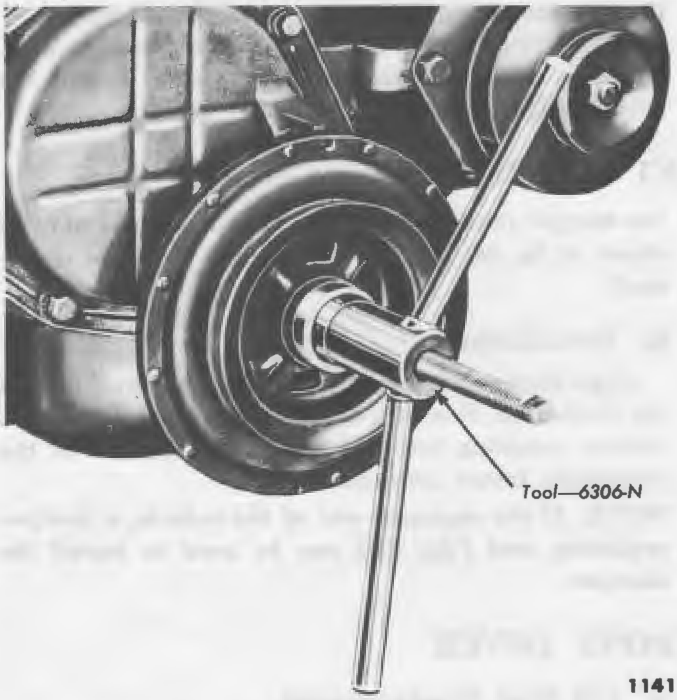

Fig. 25—Damper Replacer

Procedures for removing and installing the valves and valve guides are given in this section. Valve clearance is set when the engine is cold. Valves, guides, and related parts are shown in fig. 27.

a. Valves.

Engines built after May 1950 are equipped with a new design exhaust free valve shown in fig. 28. The valve stem cap height is increased, the undercut is farther from the valve end, and the spring retainer is a thicker 3-step design with a deeper recess for the valve stem cap.

Fig. 26—"Rolling In" Oil Seal Packing

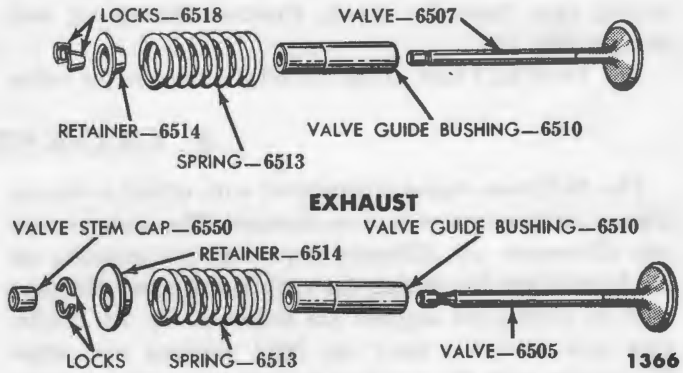

Fig. 27—Valves and Related Parts

Intake valves are the conventional poppet type in all M-Series truck engines.

(1) *INTAKE.* Removal and installation procedures are covered below with illustrations of the necessary tools.

(a) Removal. Remove the cylinder head, manifolds, and valve chamber covers. Crank the engine until the tappet rests on the heel of the cam. Compress the valve spring with the compressing tool shown in fig. 30 and remove the valve spring retainer locks. Remove the valve. Remove the valve spring and spring retainer (fig. 29).

NOTE: ***Cover oil passage holes before compressing valve spring or locks may fall into the oil pan.***

(b) Installation. Install the spring retainer. Install the valve spring with the tightly wound coils in the up position against the block. Use the tool shown in fig. 29. Insert the valve in the guide and align it in the spring retainer. Compress the spring and install the valve spring retaining locks as shown in fig. 30. Install the valve chamber covers, manifolds, and cylinder head.

(2) *EXHAUST.* Removal and installation of exhaust free valves requires a narrow tool due to the narrow

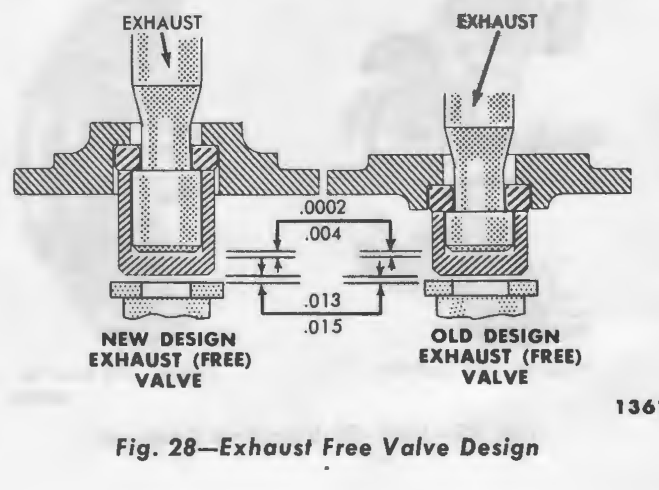

Fig. 28—Exhaust Free Valve Design

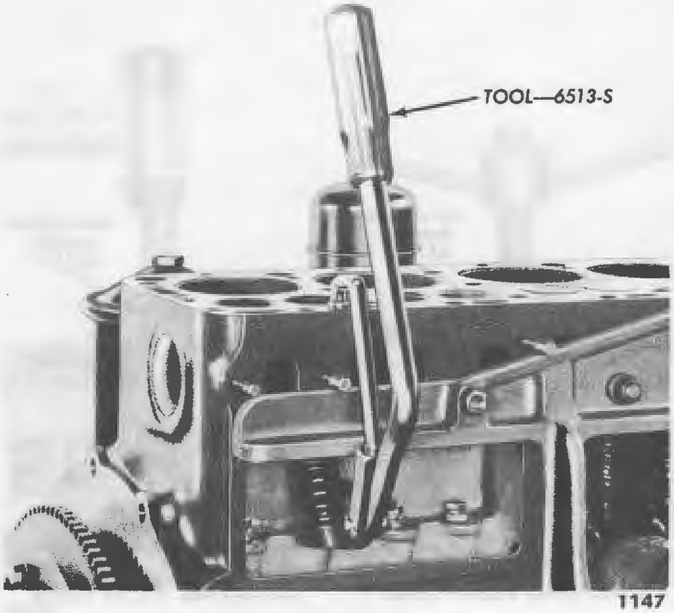

Fig. 29—Valve Spring Remover and Replacer

valve stem locks and valve stem cap. The procedures are given below.

(a) REMOVAL. Remove the cylinder head, manifolds, and valve chamber covers. Crank the engine until the tappet rests on the heel of the cam. Compress the valve spring and remove the valve spring retainer locks.

NOTE: *Cover the oil passage holes before compressing the valve spring or locks may fall into the oil pan.*

Remove the valve and valve cap. Remove the valve spring retainer and valve spring (fig. 29).

(b) INSTALLATION. Install the valve spring with the tightly wound coils up against the block. Install the valve spring retainer (fig. 29). Compress the valve spring and install the free valve cap in the retainer recess. Insert the valve in the valve guide and align it in the cap. Install the valve stem locks as shown in fig. 31.

Successful free valve operation depends on the clearance between end of valve stem and inside of cap. Figure 28 illustrates the free type valve installation and the proper clearances.

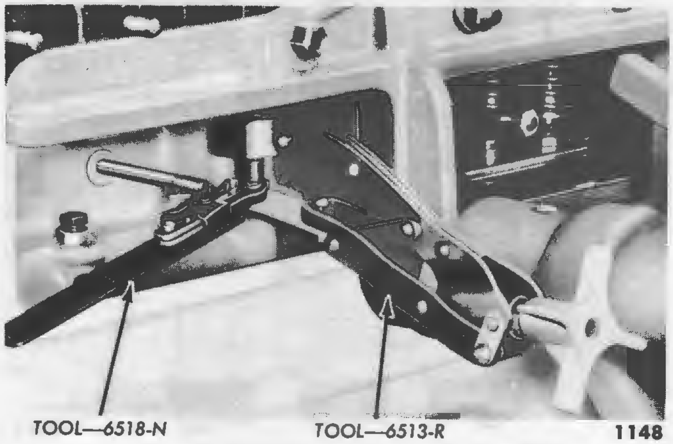

Fig. 30—Installing Intake Valve Locks

Fig. 31—Installing Exhaust Valve Locks

CAUTION: *If the cap inside depth is too shallow or the length between the face of the undercut and end of valve stem is too long, the cap will not lift the spring pressure from the valve and consequently the valve will not rotate. On the other hand, if the cap depth is too deep or the length between the face of the undercut and the valve stem end is too short, the clearance will be excessive resulting in a high wear rate between cap and keys and possible valve breakage.*

The exhaust free valve to cap clearance of 0.0002-0.004 can be measured accurately before the valve is installed in the engine by using the micrometer shown in fig. 32.

The clearance between end of valve stem and inside of cap can be checked after the parts are assembled in the engine by rotating the crankshaft until the valve is off the seat and can be rotated freely by thumb and forefinger in the lifted position. In this free position the actual clearance can be measured by locating an indicator on the valve head and noting the reading when the valve is moved vertically. This clearance can be 0.0002 inch providing the valve turns freely but not

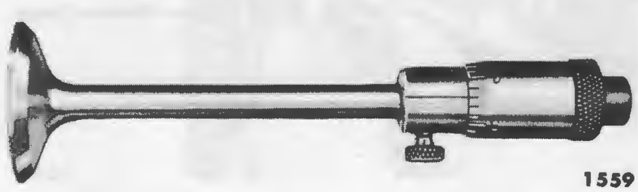

Fig. 32—Measuring Exhaust Valve to Cap Clearance

over 0.004 inch maximum vertical movement. If vertical movement exceeds 0.004 inch, polish the open end of cap on a piece of fine emery cloth to bring vertical movement of valve to within specified clearance. If vertical movement is less than 0.0002 inch, grind off the end of the valve stem to provide the proper clearance.

Install the valve chamber covers, manifolds, and cylinder head.

(3) *VALVE CLEARANCE*. The adjustable type tappet has a self-locking adjustment screw requiring no lock nut. The valve clearance is adjusted by the use of two open end wrenches, one to hold the tappet body and the other to turn the adjusting nut. The adjustment is illustrated in fig. 33.

Valve gap settings are 0.013-0.015 inch for intake valves and 0.017-0.019 inch for exhaust valves when used with the new camshaft with the letter "O" or "B" stamped on the forward end. For old camshafts with no letter stamped on them set the intake valves at 0.009-0.011 inch and the exhaust valves at 0.013-0.015 inch.

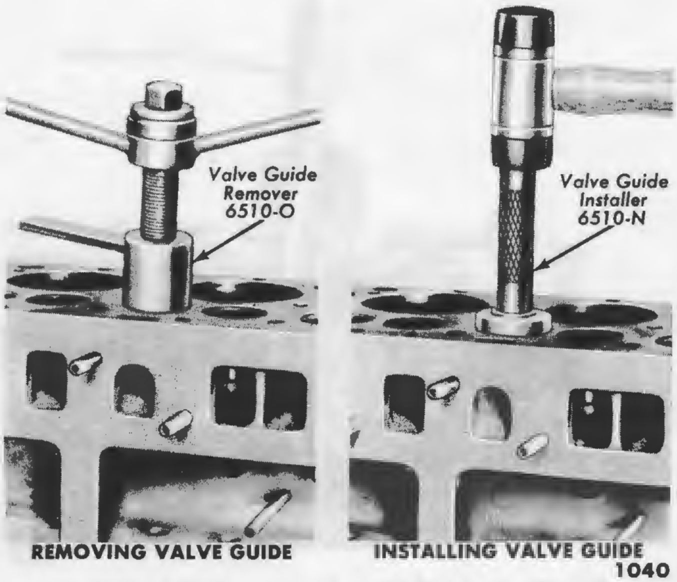

Fig. 34—Removing and Installing Valve Guides

b. Valve Guide Replacement.

Valve guides are of the single piece pressed-in type. The outside diameter at the lower end is reduced to act as a pilot when installing the guide.

Remove the guide by pulling it from the block with the tool shown in fig. 34. This method removes the guide with no distortion to the valve guide hole.

To install the valve guide, position the new guide in the bore. Drive the guide in the block as shown in fig. 34. Drive the exhaust valve guides to a depth of 1.08 inches and the intake valve guides to a depth of 1.18 inches measured from the top of the valve guide to the cylinder block surface as shown in fig. 35.

7. CAMSHAFT GEAR, CAMSHAFT, AND BEARINGS

The camshaft is supported by four bearings, which are pressed into the block, and it is driven by a gear in mesh with a gear on the crankshaft. A special cam on the camshaft contacts the fuel pump operating arm and operates the fuel pump. Either a bolt-on type or a pressed-on type aluminum timing gear is used on M-Series engines. The camshaft thrust is controlled by a plate which is bolted on the front of the engine block. Figure 36 illustrates the camshaft, thrust plate, and the bolt-on type timing gear.

The procedures for removal, inspection, and installation of the camshaft gear, camshaft, and camshaft bearings are given below.

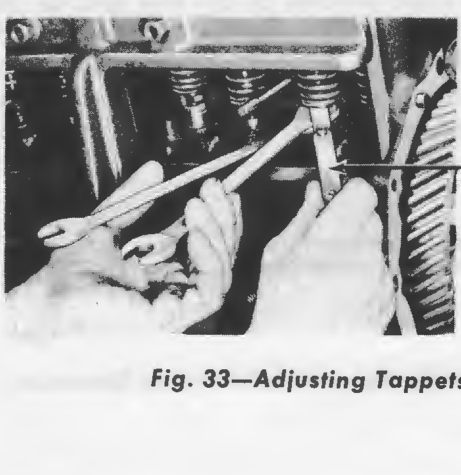

Fig. 33—Adjusting Tappets

a. Camshaft Gear.

The bolt-on type timing gear is secured to the camshaft gear hub by four screws which are locked with

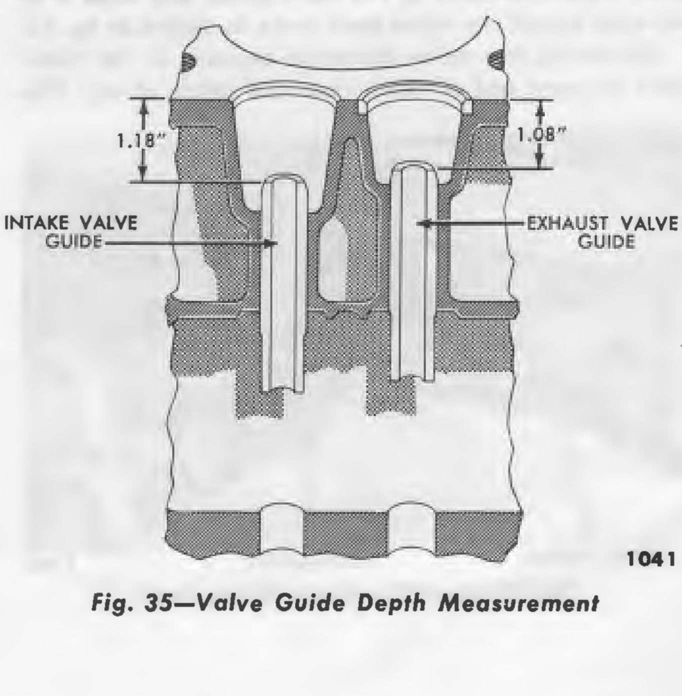

Fig. 35—Valve Guide Depth Measurement

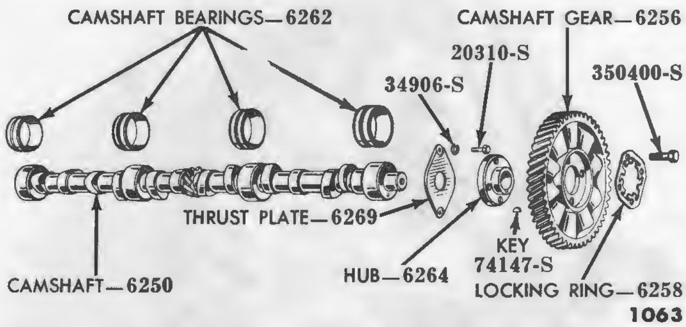

Fig. 36—Camshaft and Related Parts

retaining tabs. The mounting holes are spaced to make it impossible to install the gear incorrectly. The camshaft gear hub is aligned by a key and pressed on the shaft. The pressed-on type gear is pressed on the camshaft and is located on the shaft by a key.

All oversize camshaft gears can be identified by the pitch diameter stamped on the outer edge of the gear.

(1) *REMOVAL.* If the engine is in the vehicle, remove the radiator, vibration damper, front cover, and bend the oil slinger outward.

Follow the instructions given here that apply to the type of installation with which you are working.

(a) BOLT-ON GEAR. Bend the lock ring tabs away from the cap screws. Remove the cap screws and lock plate. Remove the gear from the camshaft. Remove the camshaft gear hub as shown in fig. 37.

(b) PRESSED-ON GEAR. This gear is an aluminum diecasting. Core holes are provided on either side of the hub to facilitate removal. Install a puller in these holes (fig. 38) and remove the gear from the camshaft.

(2) *INSTALLATION.* When the timing gear is installed be sure the timing marks on the camshaft gear and the crankshaft are aligned as shown in fig. 39. After installing the gear, check the gear backlash. The backlash should be between 0.002 to 0.003 inch.

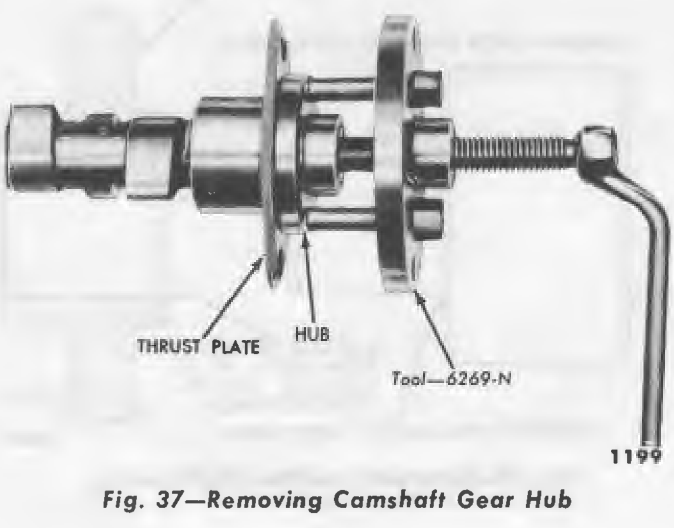

Fig. 37—Removing Camshaft Gear Hub

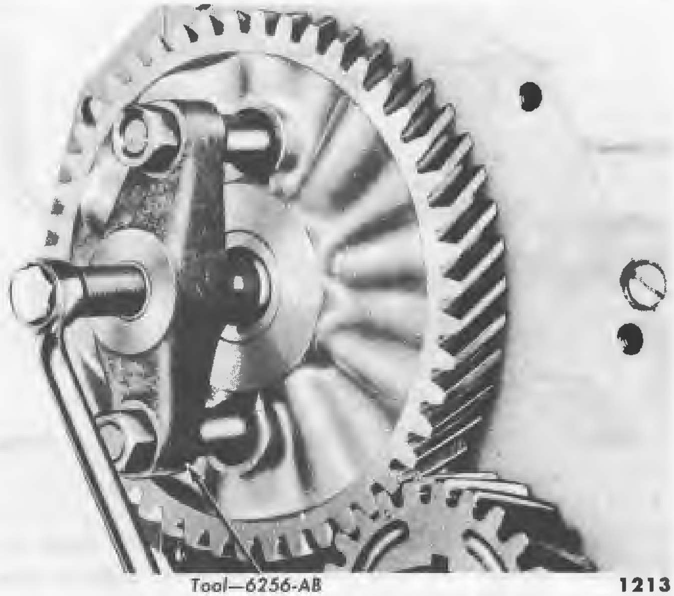

Fig. 38—Removing Camshaft Gear

NOTE: ***Oversize camshaft gears are available for service. Install the next oversize gear when excessive backlash exists between the camshaft gear and the crankshaft gear.***

The 7HA-6256 or 8HA-6256 camshaft gear can be used with camshaft 8MTH-6250. However, if this is done, the 15° chamfer must be increased to 45°. The 7HT-6256-A gear can be used with the 7HA-6250-C camshaft.

(a) BOLT-ON GEAR. Align the gear hub keyway with the Woodruff key in the camshaft. Press the hub on the camshaft (fig. 40) leaving 0.003-0.006 inch clearance between the hub and thrust plate.

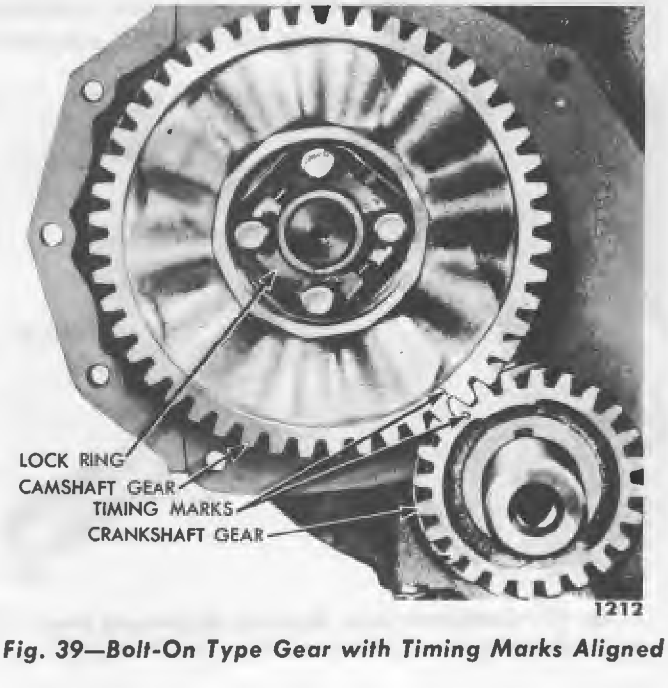

Fig. 39—Bolt-On Type Gear with Timing Marks Aligned

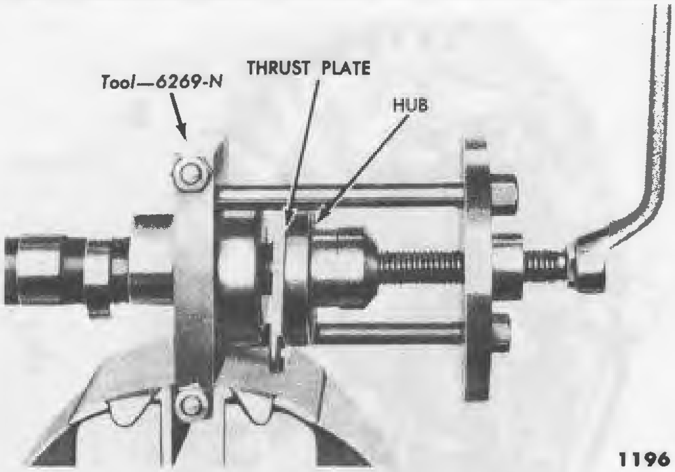

Fig. 40—Installing Camshaft Gear Hub

Align the mounting holes in the gear with those in the hub. Install the lock ring and screws. Tighten the screws to 15-20 foot-pounds torque and bend the lock plate tabs. Install the front cover with a new gasket. Install the vibration damper and radiator.

(b) PRESSED-ON GEAR. The tool shown in fig. 41 aligns the camshaft key with a pilot key. Place the camshaft gear on the camshaft and press it into place (fig. 42) leaving 0.003-0.006 inch clearance between the gear and thrust plate.

Bend the oil slinger to its original shape. Install the front cover, vibration damper, and radiator.

b. Camshaft.

Engines built prior to December, 1950 are equipped with a 7HA-6250-C camshaft. Engines built after this date have an 8MTH-6250 camshaft. The 7HA-6250-C camshaft has an undercut where the gear post joins the front main journal. The newer 8MTH-6250 camshaft

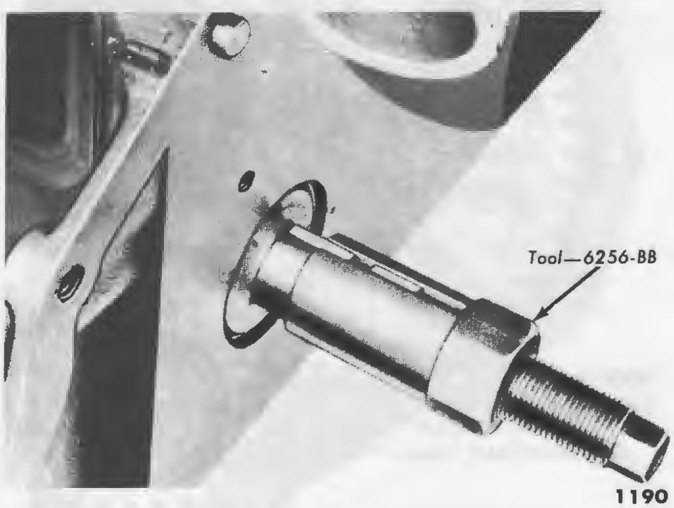

Fig. 41—Camshaft Gear Keyway Alignment Tool

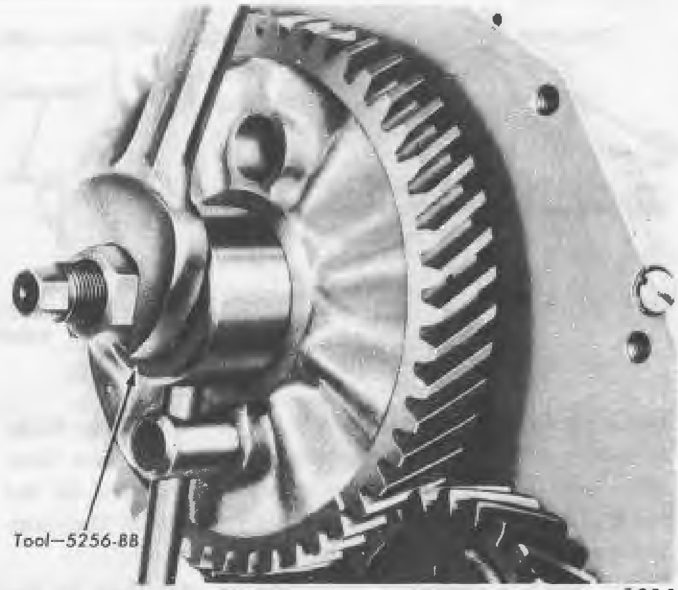

Fig. 42—Installing Camshaft Gear

has a radius in this location. This radius requires a larger chamfer on the inside diameter of the camshaft gear hub to avoid interference. Increase the chamfer angle from 15° to 45° or replace the camshaft gear with camshaft gear 7HT-6256-A. These changes are shown in fig. 43. Valve clearances are 0.009 to 0.011 inch for the intake valves and 0.013 to 0.015 inch for the exhaust valves with either camshaft.

The oil pump driving gear diameter on the 8MTH-6250 camshaft is 0.045 inch smaller than on the 7HA-6250-C camshaft and the Lubrite finish removed. It is identified by the letter "M" stamped on the forward end of the camshaft.

It will be necessary to replace the camshaft when the cam lobes are worn so the valve lift is less than 0.337 inch for the intake valves and 0.333 inch for exhaust valves. Make valve lift measurements when the

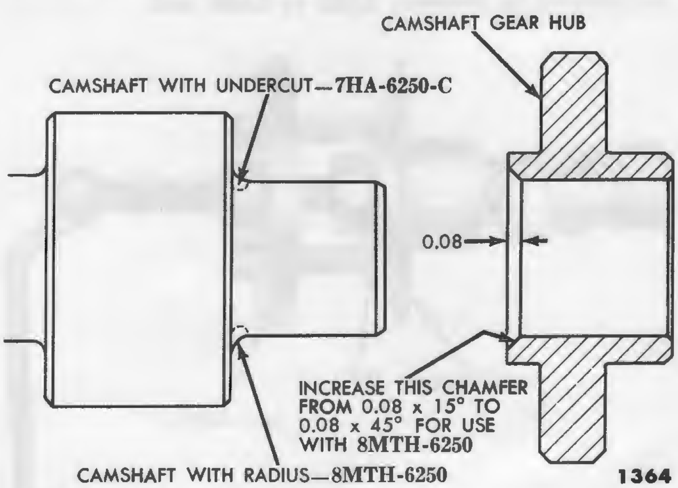

Fig. 43—Camshaft and Hub Modifications

engine is cold and valve gaps are within specifications. Check the valve lift with a dial indicator as shown in fig. 44.

(1) *REMOVAL.* Remove the grille and radiator. Remove the cylinder heads, manifolds, and valves. Lift the valve tappet assembly and hold in the up position with spring clothespins or rubber bands.

NOTE: ***If the engine is on an engine stand and the valves have been removed, invert the block to eliminate tappet interference.***

Loosen the oil pump. Remove the front cover and the camshaft gear. Remove the thrust plate. Remove the camshaft by pulling it through the bearings.

NOTE: ***Exercise care that the camshaft bearings are not damaged by the lobes on the camshaft.***

(2) *INSPECTION.* Check the camshaft journal surface for grooves or scratches. Measure the diameter of the journals with a micrometer for wear and out of round. Replace the camshaft if the journals measure less than 1.924 inches in diameter. Measure the inside diameter of the bearings with an inside micrometer or telescope gauge. The difference in measurements (amount of clearance) should be 0.001 to 0.002 inch for a new camshaft and bearings and not over 0.005 inch for a used camshaft and bearings.

Check the fuel pump eccentric for wear (deep groove worn by the rocker arm). Inspect the oil pump drive gear for worn, chipped, or broken teeth. Replace the camshaft if any of the above conditions exist.

(3) *INSTALLATION.* Position the thrust plate on the camshaft with the oil groove toward the journal. Press the gear or the hub on the camshaft until the camshaft thrust plate has 0.003 to 0.006 inch clearance. Carefully slide the camshaft through the bearings. Secure the thrust plate to the block. Tighten the screws to 15-18 foot-pounds torque. Install the camshaft gear.

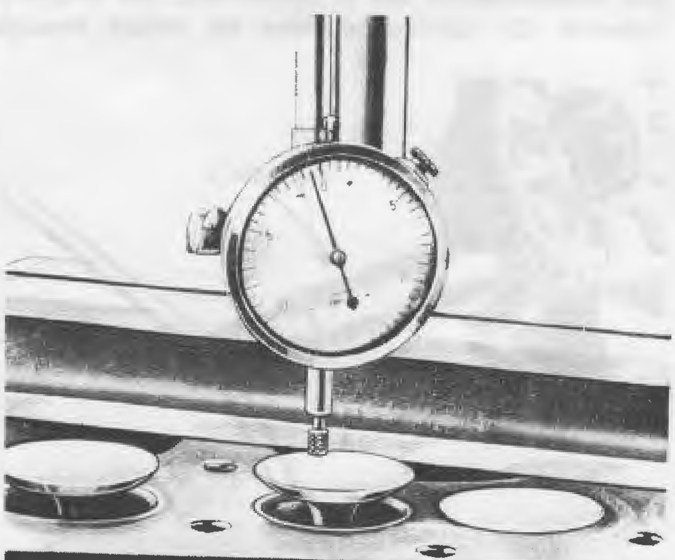

Fig. 44—Checking Valve Lift

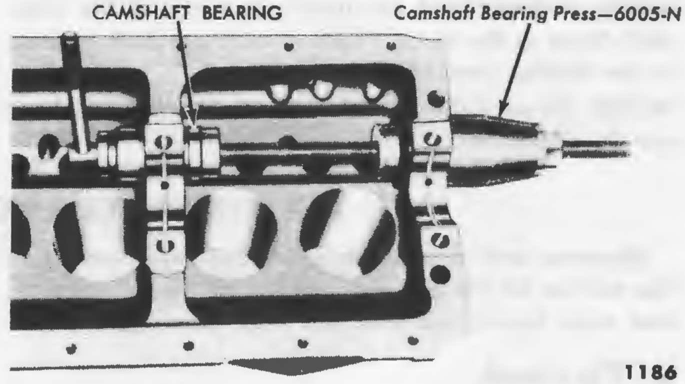

Fig. 45—Removing Camshaft Bearings

Check the camshaft gear runout. It should not exceed 0.002 inch. Install the front cover and gasket. Connect the oil pump. Remove the valve tappet holders if used. Install the valves. Install the cylinder head and manifolds. Install the grille and radiator.

c. Camshaft Bearing Replacement.

Under normal use the camshaft bearings will not require replacement. However, they should be replaced if they are damaged or worn. It is necessary to remove the engine from the vehicle to replace the bearings.

(1) *REMOVAL.* Remove the camshaft. Remove the shaft rear bearing expansion plug from the block at the rear end of the camshaft. Remove the camshaft bearings with the tool shown in fig. 45.

(2) *INSTALLATION.* Select the correct size camshaft bearings after measuring the camshaft journal

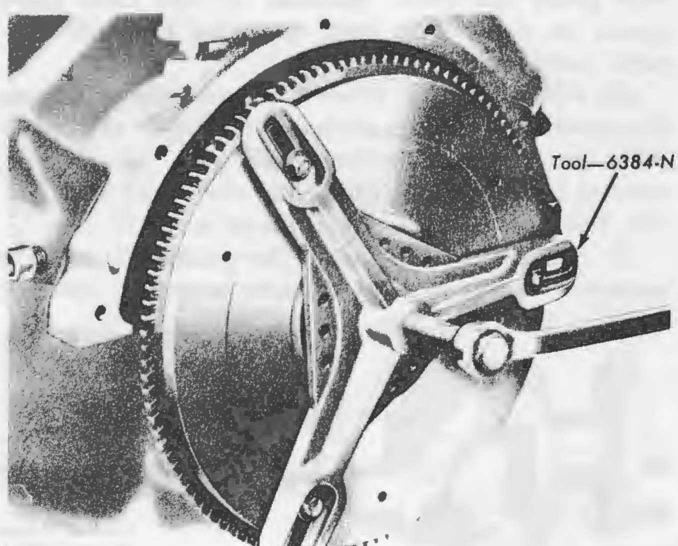

Fig. 46—Removing Flywheel

outside diameter and the inside diameter of the camshaft bores in the block. Position each camshaft bearing at the bearing bore and press it into place.

NOTE: ***Be sure the oil hole in each bearing and bore are in alignment.***

The tool shown in fig. 45 is also used to install camshaft bearings. Apply sealer on the camshaft rear bearing plug and install the plug. Install the camshaft.

NOTE: ***Bearings are finished to size and should not be line bored or reamed after installation.***

8. FLYWHEEL, CRANKSHAFT, AND BEARINGS

Removal and installation procedures are covered in this section for the flywheel, crankshaft, crankshaft gear, rear main bearing oil seal, and main bearings.

a. Flywheel.

The flywheel acts to carry over and smooth out the separate thrusts of each piston. The rear face of the flywheel is used as a friction surface which is engaged by the clutch plate. The flywheel ring gear, which is engaged by the starter pinion when starting, is secured to the flywheel by a shrink fit.

(1) *REMOVAL.* Remove the engine from the chassis. Remove the clutch housing and clutch assembly. Remove the retaining bolts and lock ring. Install the flywheel puller (fig. 46) and remove the flywheel from the crankshaft flange.

(2) *INSTALLATION.* Assemble the flywheel to the mounting flange and install the lock ring and mounting bolts. Tighten the bolts to 75-85 foot-pounds torque. Install the clutch and clutch plate to the flywheel. Make sure the clutch is in the same position on the flywheel as it was before removal. Install the clutch assembly and clutch housing. Install the engine in the chassis.

b. Crankshaft Gear.

The crankshaft gear drives the camshaft through the camshaft gear. These gears must mesh in the proper relation to each other to synchronize valve action with piston movement. Backlash between these gears should be 0.002-0.003 inch. Excessive backlash indicates camshaft gear wear.

(1) *INSPECTION.* When it is necessary to replace the camshaft gear, it is advisable to inspect the crankshaft gear. Check the crankshaft gear for chipped, cracked or worn teeth. Check the crankshaft gear runout. The maximum allowable runout is 0.0015 inch.

(2) *REMOVAL.* To remove the crankshaft gear it is necessary to remove the damper assembly, cylinder front cover, oil slinger, oil pan, and the front main bearing cap. Remove the gear with a crankshaft gear puller (fig. 47).

(3) *INSTALLATION.* Install the Woodruff key. Start the gear on the shaft making sure the keyway aligns with the key and the timing marks are away from the engine block. Position the crankshaft gear installing tool on the crankshaft. Make sure the puller stud is fully threaded into the crankshaft. Assemble the sleeve and wing nut. Tighten the nut to pull the gear firmly into place (fig. 48).

CAUTION: ***Make sure the gear teeth freely engage and the timing marks are aligned before pulling the gear into place.***

Check the gear lash by inserting a feeler gauge between the teeth of the crankshaft and the camshaft gears. The lash should be between 0.002 and 0.003 inch. Install the oil slinger with the concave side outward. Inspect the condition of the oil seal in the timing gear cover and in the oil pan. Replace the seal if necessary.

Install the cylinder front cover with a new gasket. Install the damper assembly and be sure the oil seal does not become damaged while installing the assembly. Install the oil pan with new gaskets.

c. Crankshaft.

The crankshaft is made of cast alloy steel with integral counterweights and is dynamically and statically balanced. Oil distribution holes are drilled through

Fig. 47—Removing Crankshaft Gear

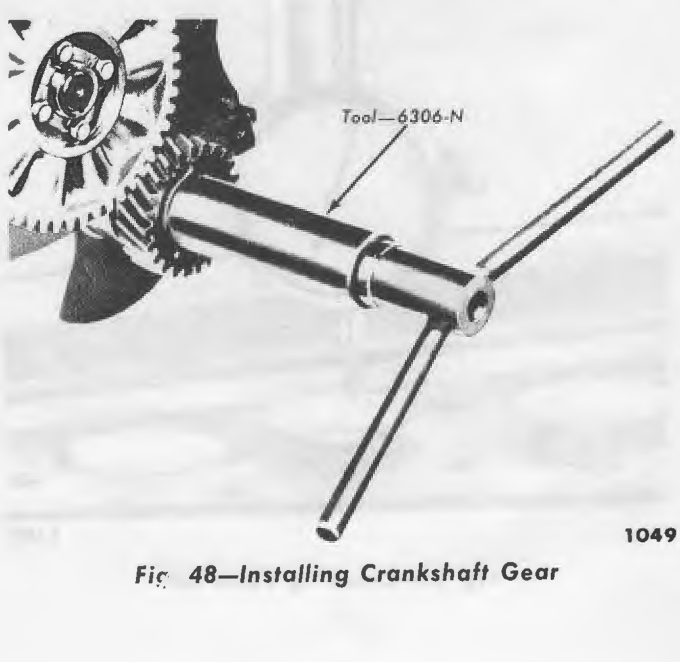

Fig. 48—Installing Crankshaft Gear

the shaft for main bearing and connecting rod bearing lubrication.

(1) *REMOVAL.* Remove the engine from the chassis. Remove the clutch housing, clutch and clutch plate, flywheel, starter, engine rear plate, vibration damper, front cover, oil pan, and oil pump screen cover assembly. A disassembled view of the crankshaft is shown in fig. 49.

Mark the clutch and flywheel so the clutch may be reassembled to the flywheel in the same relationship as when it was removed. It is important to do this so the assembly will be properly balanced.

Mark the bearings so they may be installed exactly as they were originally installed. Remove all connecting rod bearing caps and inserts. Move the pistons up in the bores to avoid interference when maneuvering the crankshaft. Remove the four main bearing caps and inserts. Remove the crankshaft.

(2) *REAR OIL SEAL REPLACEMENT.* Remove the oil seal retainer. Pry the old seal out of the retainer and clean the groove thoroughly. Soak new oil seals at least two hours in light engine oil before installation. Roll the seal into position in the recess with a round bar. Trim the ends of the seal flush with the block if necessary.

CAUTION: ***Oil seals extending below the mating surfaces of the block will result in oil leaks at the main bearing.***

Install the oil seal retainer with a new gasket. Oil seals should be changed when the engine is overhauled or if oil is found at the bottom of the clutch housing.

(3) *INSTALLATION.* Coat the crankshaft journals and bearing inserts with engine oil. Install the upper main inserts bearings, position the crankshaft, and install the lower main insert bearings and caps. Tighten the main bearing bolts to 95-105 foot-pounds torque.

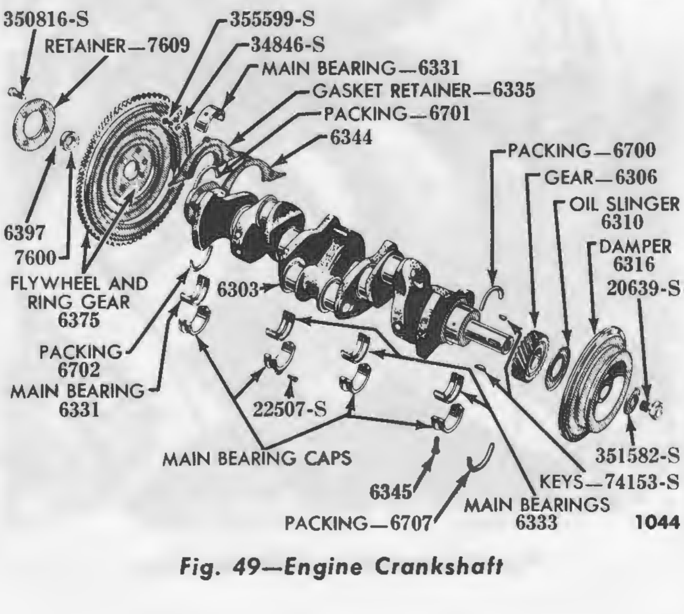

Fig. 49—Engine Crankshaft

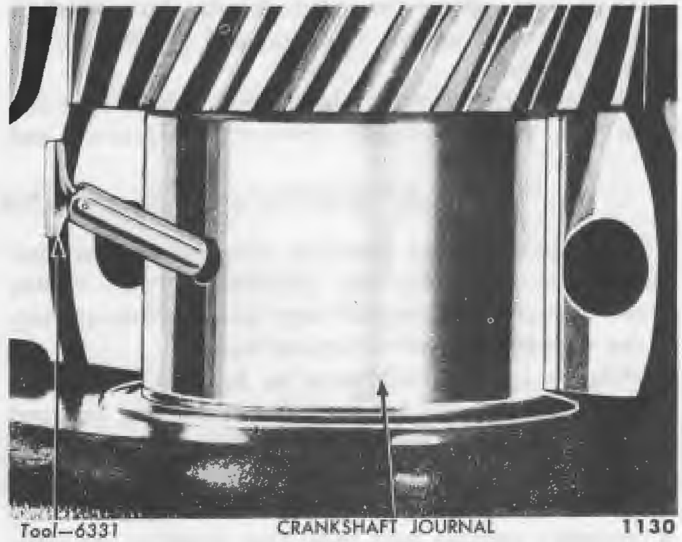

Fig. 50—Install Bearing Remover in Oil Hole

Pull the connecting rods into place, install the bearing inserts and bearing caps, and tighten the connecting rod nuts to 45-50 foot-pounds torque. Install the lock nuts and tighten them to 4-5 foot-pounds torque.

Install the flywheel, clutch disc and pressure plate, clutch housing, and engine rear plate assembly. Install the oil pump screen cover assembly, oil pan, starter motor, front cover, and vibration damper. Install the engine in the chassis.

d. Main Bearing Replacement with Crankshaft in Vehicle.

After the bearing cap has been removed, a special tool designed for removing the upper bearing insert may be inserted in the oil hole in the crankshaft as shown in fig. 50. Figure 51 shows the tool in position

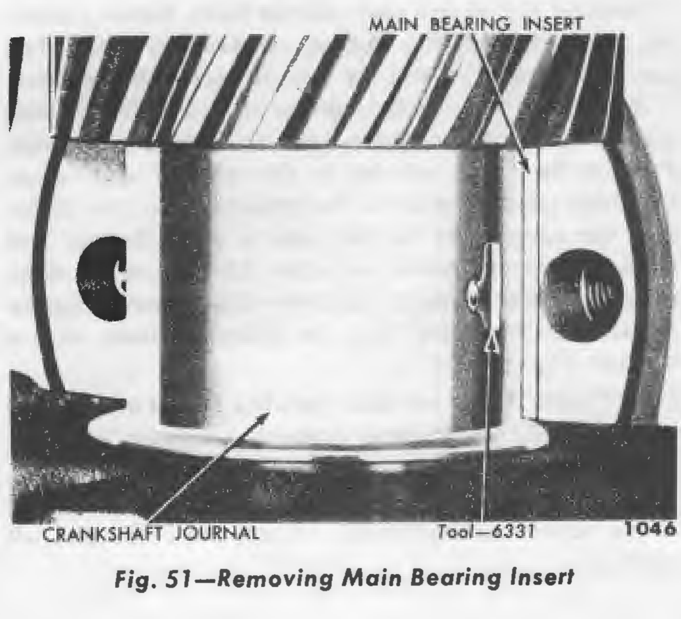

Fig. 51—Removing Main Bearing Insert

ready to bear against the insert. Rotate the crankshaft so the tool bears against the plain end of the insert to remove the insert.

To install the upper main bearing insert, start the plain end of the bearing between the journal and notched side of the bearing support. With the same tool (fig. 50), rotate the crankshaft so the tool bears against the tab end of the bearing. When the bearing seats itself in the bearing support, back off the crankshaft and remove the tool.

9. PISTON AND CONNECTING ROD ASSEMBLIES

This section gives removal and installation procedures for connecting rods, pistons, and pins. Fitting of bearings, pistons, pins, and rings is covered completely in the chapter on general engine repair.

M-Series engines built prior to January, 1950 were equipped with shims between the connecting rod and cap. Engines built after this date did not have shims. Early engines with shims must be serviced with shims and late engines must be serviced without shims. This is necessary because both rods were bored to the same diameter, the rods with shims being bored with the shims in place at the time of the boring operation.

The shimmed rods were built with one 0.0015 inch shim on each side between the parting face of the cap and the rod. These shims permit selecting desired bearing clearance of 0.0007 inch to 0.0013 inch. When assembling new rods and new crankshafts and the bearing clearance is in excess of 0.0013 inch, the removal of one shim will reduce the clearance 0.00075 inch. If both shims are removed the bearing clearance will be reduced 0.0015 inch. Determine the bearing clearance with Plastigage.

These shims were used only for initially fitting new bearings and are not intended for reducing the clearance on worn bearings. When bearings are worn to the point where clearance is excessive, the bearing should be replaced.

a. Removal.

Remove the oil pan and cylinder head. Before removing a piston from the engine, remove any ridge that may be present around the top of each cylinder bore.

Move the piston to the bottom of its travel area and place a cloth on the piston head to catch the cuttings. Position the ridge remover in the cylinder and adjust the ridge remover pilot to the cylinder bore size. Make sure the cutter is at the top side of the roller bar and does not extend beyond the roller. Make sure the ridge remover shoes are tight. Hold the ridge remover tightly against the block and turn the arbor clockwise with a wrench (fig. 52).

CAUTION: ***Never cut into the ring travel area in excess of 1/32 inch when removing ridges.***

Remove the ridge remover from the cylinder bore. Turn the crankshaft until the piston is at the top of its stroke and carefully remove the cloth and all cuttings.

Turn the crankshaft until the piston is at the bottom of its stroke. Remove the nuts from the connecting rod bolts. Lift the bearing cap from the rod and push the rod and piston assembly out the top of the cylinder with the handle end of a hammer.

NOTE: ***Each rod and bearing cap is numbered from 1 to 6 beginning at the front end of the engine. The numbers on the rod and bearing cap must be on the same side when re-installing them into their respective cylinder bores. If a connecting rod is transposed from one block to another be sure all the bearings are new and the number on the rod is restamped or prick punched to correspond with the cylinder number.***

b. Disassembly.

File the cylinder number on the inside bottom of the piston skirt prior to removing the rods from the pistons. This serves to identify the piston with the bore for reassembling purposes.

Remove the connecting rod bolts and piston rings. Remove the retainers at each end of the piston pin. Push the piston pin out of the piston, or if necessary heat the assembly in hot water and remove the pin by tapping with a hammer and a brass drift slightly

Fig. 52—Removing Cylinder Ridge

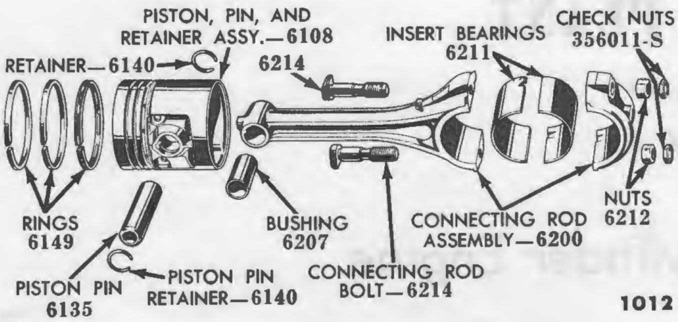

Fig. 53—Piston and Connecting Rod Assembly

smaller than the pin diameter. The piston and rod assembly is shown in fig. 53.

c. Assembly.

Lubricate all parts with engine oil. Position the connecting rod in the piston and push the piston pin into place.

NOTE: ***The oil squirt hole in the connecting rod should be toward the valve side of the engine when the assembly is installed.***

Insert new piston pin retainers. Install the piston rings and connecting rod bolts.

d. Installation.

Oil the cylinder wall with light engine oil. Make sure the ring gaps are spaced equidistant around the circumference of the piston. Compress the rings with a compressing tool and tap the piston down with a soft faced hammer (fig. 54) until it is slightly below the top of the cylinder bore.

Turn the crankshaft throw downward. Oil the crank

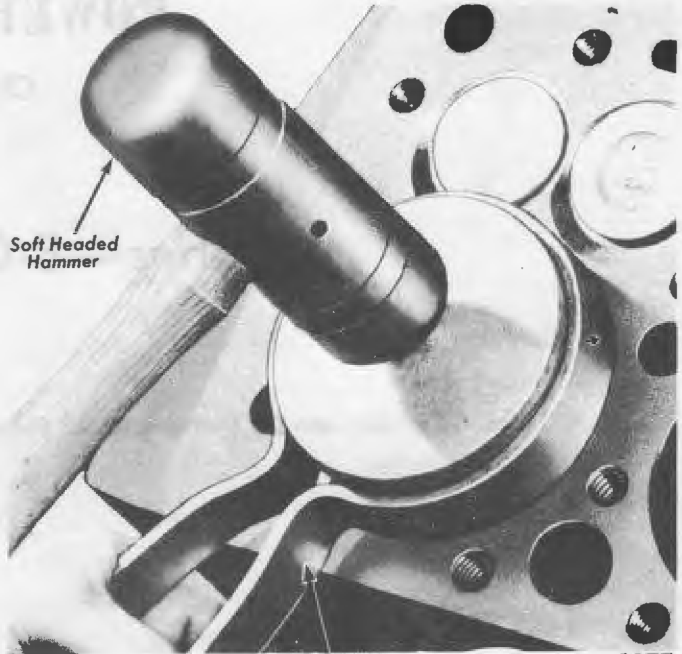

Fig. 54—Tapping In Piston

pin and push the piston all the way down until the rod bearing seats on the crank pin. Install the bearing cap (line up the stamped numbers) and tighten the retaining nuts to 45-50 foot-pounds torque. Install new lock nuts and tighten to 4-5 foot-pounds.

Install the oil pan and cylinder head. Fill the crankcase with the proper grade and amount of lubricant according to the prevailing temperature. Fill the cooling system. Start the engine and run it slowly. Make sure there is sufficient oil pressure. Check the temperature to make sure the engine does not overheat. Overheating can be caused by too tight bearings.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part ONE

POWER PLANT

Chapter

IV

R-Series—8-Cylinder Engine

Procedures for overhaul and repair of the R-Series, 8-cylinder engine are presented here under the section headings listed above.

The "R" series engines has a bore of $3\frac{3}{16}$ inches, a stroke of $3\frac{3}{4}$ inches, and is rated at 100 horsepower. Figure 1 illustrates the engine assembly and component parts. An overhaul gasket kit for use when the engine is overhauled is illustrated in fig. 2.

1. MANIFOLDS

Procedures for removal, cleaning, inspection and installation of intake and exhaust manifolds are outlined separately. An exhaust manifold gasket kit is illustrated in fig. 3.

a. Intake Manifold.

The procedure for replacing the intake manifold differs for conventional type truck and cab-over-engine type trucks. For this reason the procedure for each truck is given separately. The manifold is illustrated in fig. 4.

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Fig. 1—R-Series Engine

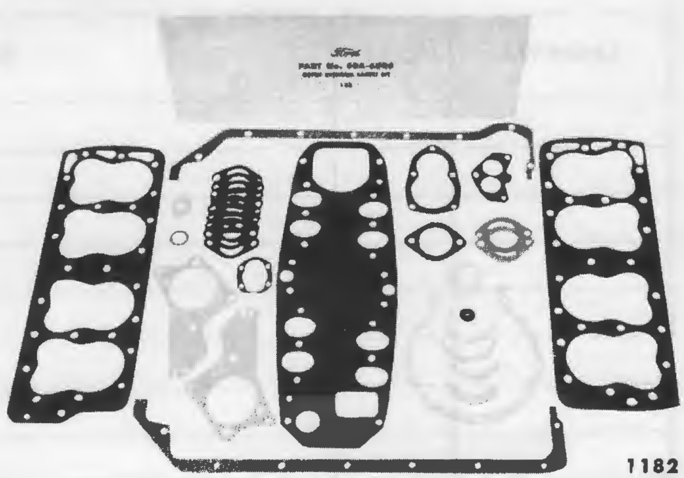

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Fig. 2—R-Series Engine Gasket Kit

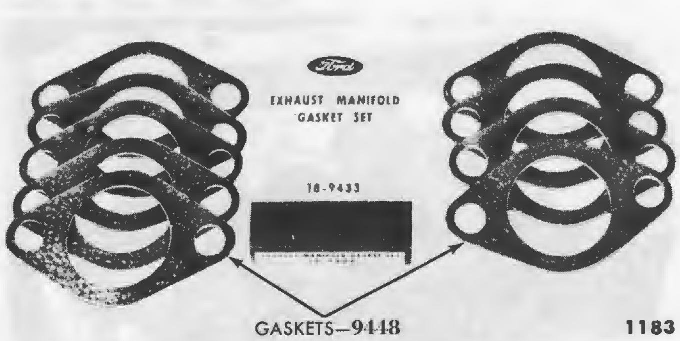

Fig. 3—Manifold Gasket Kit

(1) *CONVENTIONAL TRUCK.* The carburetor can be left on the manifold unless it must be removed for other repair procedures.

(a) REMOVAL. Remove the carburetor air cleaner. Disconnect the generator wires and the temperature sending unit wire. Remove the generator and fan assembly. Disconnect the fuel lines at the fuel pump and remove the pump. Pull out the fuel pump push rod. Disconnect the throttle linkage, choke wire, and distributor vacuum line at the carburetor. Loosen the crankcase breather pipe clamp and remove the pipe. Disconnect the spark plug wires at the left-hand bank. Remove the manifold retaining bolts, clear the spark plug wires out of the way, and remove the manifold and gasket.

NOTE: ***Leave the ignition cable brackets hanging on the spark plug wires.***

(b) CLEANING. Brush out all rust and dirt from the inside of the manifold. Wash oil and grease from the outside with solvent and dry the manifold.

(c) INSPECTION. Inspect the manifold for cracks or warped sealing surfaces. Replace the manifold if defective.

(d) INSTALLATION. Place a new gasket on the cylinder block and lay the manifold on the gasket, aligning the bolt holes. Install the manifold retaining screws. Torque the screws to 23-28 foot-pounds torque.

Fig. 4—Intake Manifold

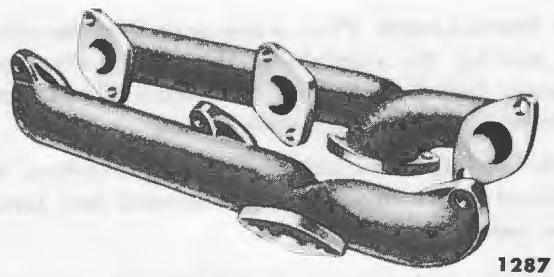

Fig. 5—Exhaust Manifold

NOTE: ***The ignition cable mounting brackets must be placed under the two screws located just forward of the carburetor pad.***

Insert the fuel pump push rod into its guide in the cylinder block and install the fuel pump. Be sure the push rod is seated in the pump rocker arm. Connect the fuel lines to the fuel pump.

Install the crankcase breather and tighten the retaining clamp. Connect the carburetor linkage, choke wire, and distributor vacuum line. Install the generator and fan assembly and adjust the belt tension. Connect the generator wires, the temperature sending unit wire, and the spark plug wires. Install the air cleaner.

(2) *CAB-OVER-ENGINE TRUCK.* On the cab-over-engine truck the engine is made accessible by removing the transmission cover plate and engine cover panel.

(a) REMOVAL. Disconnect the air cleaner pipe at the carburetor. Disconnect the accelerator linkage, choke and throttle wires, and distributor vacuum line. Disconnect the fuel line and remove the carburetor. Disconnect the generator wires and the temperature sending unit wire. Remove the generator and fan assembly.

Remove the fuel pump and pull out the fuel pump push rod. Loosen the crankcase breather clamp and remove the breather pipe. Disconnect the left-hand bank spark plug wires. Remove the manifold retaining screws, move the spark plug wires out of the way, and remove the manifold and gasket.

(b) CLEANING. Brush out all rust or dirt from the inside of the manifold. Wash oil or grease from the outside with solvent and dry the manifold.

(c) INSPECTION. Check the manifold for cracks or for warped sealing surfaces. Replace the manifold if it is defective.

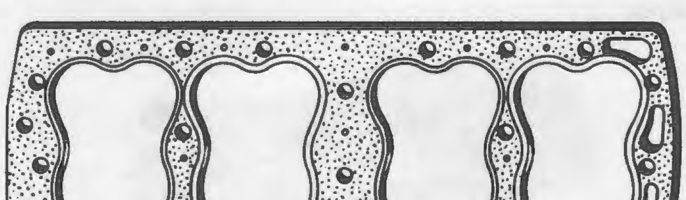

Fig. 6—Cylinder Head Gasket

(d) INSTALLATION. Place a new gasket on the cylinder block and lay the manifold on the gasket, aligning the bolt holes. Install the manifold retaining screws. Torque the screws to 23-28 foot-pounds torque.

NOTE: ***The ignition cable mounting brackets must be placed under the two screws located just forward of the carburetor pad.***

Insert the fuel pump push rod into its guide in the block and install the fuel pump. Be sure the rod is seated in the fuel pump rocker arm. Connect the fuel lines to the fuel pump.

Install the carburetor and connect the fuel line, vacuum line, accelerator rod, choke wire, and throttle wire. Install the crankcase breather tube and tighten the clamp. Install the generator and fan assembly and adjust the belt tension. Connect the generator wires, temperature sending unit wire, and spark plug wires. Connect the air cleaner pipe. Install the engine cover panel and the transmission cover plate.

b. Exhaust Manifold.

Exhaust manifolds are accessible from underneath the truck. The manifold is illustrated in fig. 5.

(1) *REMOVAL.* Remove the crossover pipe. Disconnect the muffler inlet pipe when removing the right-hand manifold. Remove the manifold retaining screws and remove the manifold and gaskets.

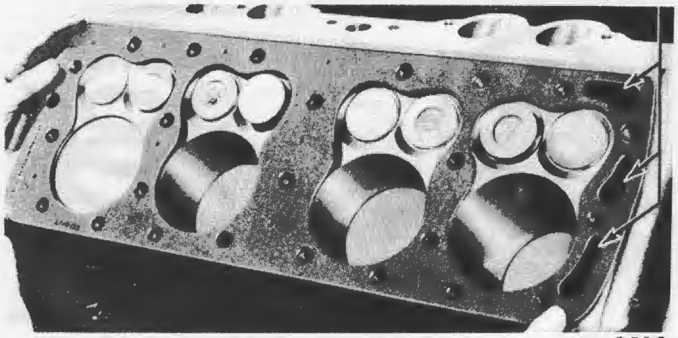

Fig. 8—Cylinder Head Gasket Installation

(2) *CLEANING.* Use a wire brush to remove carbon deposits from the inside of the manifold. Clean all surfaces.

(3) *INSPECTION.* Check the manifold for cracks or holes. Check gasket surfaces for warping. Replace cracked or warped manifolds.

(4) *INSTALLATION.* Install the manifold with new gaskets. Install the retaining screws and tighten them to 25-30 foot-pounds torque. Install the crossover pipe. Connect the muffler inlet pipe when installing the right-hand manifold.

2. CYLINDER HEADS

Procedures for the removal, cleaning, inspection, and installation of cylinder heads are given here for the conventional type truck and the cab-over-engine type. Figure 6 illustrates the cylinder head gasket. The cylinder head is shown in fig. 7.

a. Conventional Truck.

The preliminary procedures give instructions for removing parts that interfere with the removal of either cylinder head.

(1) *PRELIMINARY.* When removing the left-hand cylinder head, disconnect and remove the oil filter. Disconnect and fold back the generator wires and ignition wires.

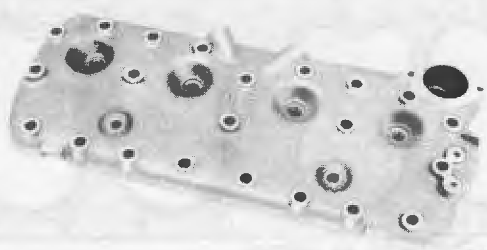

Fig. 7—Cylinder Head

When removing the right-hand head, remove the coil bracket mounting screws. Disconnect the heater hose at the cylinder head elbow.

(2) *REMOVAL.* Drain the coolant and disconnect the radiator hose at the cylinder head elbow. Disconnect the battery ground strap. Disconnect the spark plug wires and remove the plugs. Remove the cylinder head bolts and remove the head and gasket.

(3) *CLEANING.* Remove carbon deposits by brushing with a wire brush or by using a suitable scraper. Do not scratch the gasket surfaces of the head. Clean out rust and dirt from the coolant holes.

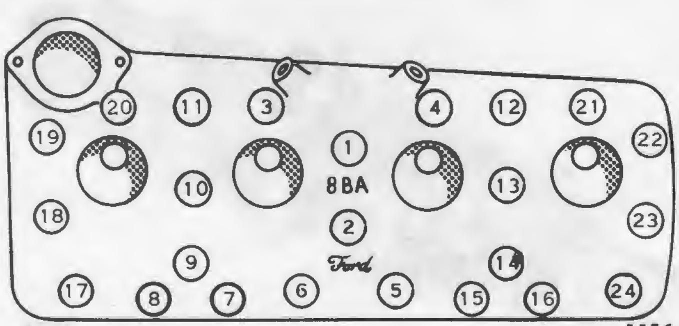

Fig. 9—Cylinder Head Bolt Tightening Sequence

(4) *INSPECTION*. Check the head for cracks or warped surfaces. Replace the head if it is cracked or warped.

(5) *INSTALLATION*. Place the head gasket in position as shown in fig. 8. Lay the head on the gasket and install one head bolt finger tight at each end of the head to align the head and gasket with the block. Use a water resistant sealer to prevent leakage at the head bolts. Install the remaining head bolts and tighten all bolts to 65-70 foot-pounds torque in the order shown in fig. 9.

Install the spark plugs and tighten them to 24-30 foot-pounds torque. Install the spark plug wires. Connect the radiator hose and fill the radiator with coolant. Install the battery ground strap.

NOTE: ***On the left-hand cylinder head, install the oil filter, generator wires, and ignition primary wire. On the right-hand head, install the coil and the heater hose.***

Run the engine and check for coolant leaks.

b. Cab-Over-Engine Truck.

To make the cylinder heads accessible, remove the transmission cover plate, right-hand seat, and floor mat. Remove the engine cover panel. The preliminary procedure gives instructions for removing parts that interfere with the removal of either head.

(1) *PRELIMINARY*. When removing the left-hand head, disconnect and remove the oil filter. Disconnect and fold back the generator wires and ignition wires.

When removing the right-hand head remove the coil mounting screws and the heater hose.

(2) *REMOVAL*. Drain the coolant and disconnect the radiator hose at the cylinder head elbow. Disconnect the battery ground strap. Disconnect the spark plug wires and remove the spark plugs. Disconnect the temperature sender unit wire and oil pressure sender unit wire. Remove the cylinder head retaining bolts and remove the head and gasket.

(3) *CLEANING*. Remove carbon deposits with a wire brush or by using a suitable scraper. Do not scratch the gasket surfaces of the head. Clean out rust and dirt from the coolant holes in the cylinder head.

(4) *INSPECTION*. Check the cylinder head for cracks or warped surfaces. Replace the head if it is cracked or warped.

(5) *INSTALLATION*. Place the head gasket on the cylinder and lay the head on the gasket. Install a head bolt finger tight at each end of the head to align the head and gasket with the block. Install the remaining head bolts and tighten all bolts in the order shown in fig. 9 to 65-70 foot-pounds torque. Install spark plugs and tighten them to 24-30 foot-pounds torque. Install the temperature sender unit and oil pressure sender unit wires. Install the spark plug wires. Install the battery ground strap. Connect the radiator hose and fill the system with coolant.

NOTE: ***On the left cylinder head, connect the generator and ignition primary wire, install the oil filter, and connect the oil lines to the filter. On the right cylinder head, connect the heater hose and install the coil.***

Run the engine and check for coolant leaks.

3. OIL PAN, OIL PUMP, AND PRESSURE RELIEF VALVE

Detailed procedures for repair and replacement of the oil pan, oil seals, oil pump, and pressure relief valve are presented in this section. Information can be located by referring to the headings which describe the particular unit or operation. The oil pan gasket kit is illustrated in fig. 10.

a. Oil Pan.

Procedures covering the oil pan and oil seal are presented here under headings indicating the nature of the procedure. Removal, cleaning, inspection, and installation of the oil pan and the steps necessary for oil seal installation are all described below. The oil pan is illustrated in fig. 11.

(1) *REMOVAL* Drain the crankcase. Remove the starter motor, clutch return spring, and the flywheel housing front cover. Remove the bolt retaining the road air breather duct and remove the duct. Remove the bolts retaining the steering gear idler arm bracket to the frame. Remove the steering gear arm and drop the idler arm connecting rod until it hangs from the spindle arms.

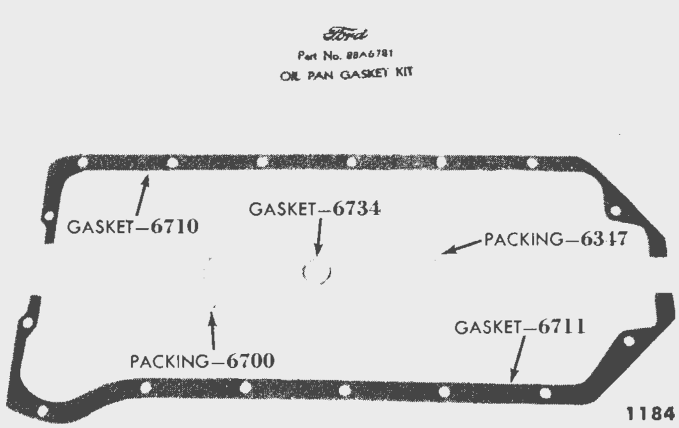

Fig. 10—Oil Pan Gasket Kit

Unscrew the oil level indicator tube. Remove the oil pan retaining screws and the oil pan. The two front retaining screws can be reached through access holes provided in the frame front cross member.

NOTE: ***On some engines it will be necessary to disconnect the front engine supports and lift the front of the engine.***

(2) *CLEANING.* Wash the pan in solvent. Brush any dirt or metal particles from the inside of the pan. Scrape off old gasket material on the gasket surface of the pan. Dry any remaining solvent.

(3) *INSPECTION.* Check the pan for stripped threads, cracks, holes, or warped gasket surfaces. Repair any cracks and holes or replace the pan if repairs cannot be made.

(4) *OIL SEAL REPLACEMENT.* Pry out the old packing in the front and rear seal retaining grooves. Install new packing in the recess at each end of the oil pan. "Roll" the packing in with a round bar as shown in fig. 12 to make sure it is seated properly in the recess.

NOTE: ***Soak oil seal packing in light engine oil for at least two hours before installation.***

(5) *INSTALLATION.* Make sure the gasket surface of the cylinder block is clean. File off any burrs around the threaded bolt holes. Tie each half of the gasket to the pan through two of the bolt holes to hold the gasket in place while installing the pan.

Hold the pan in place on the cylinder block and install two screws (not tight) in each side (not in the same holes as those used for tying the gasket). Remove the string

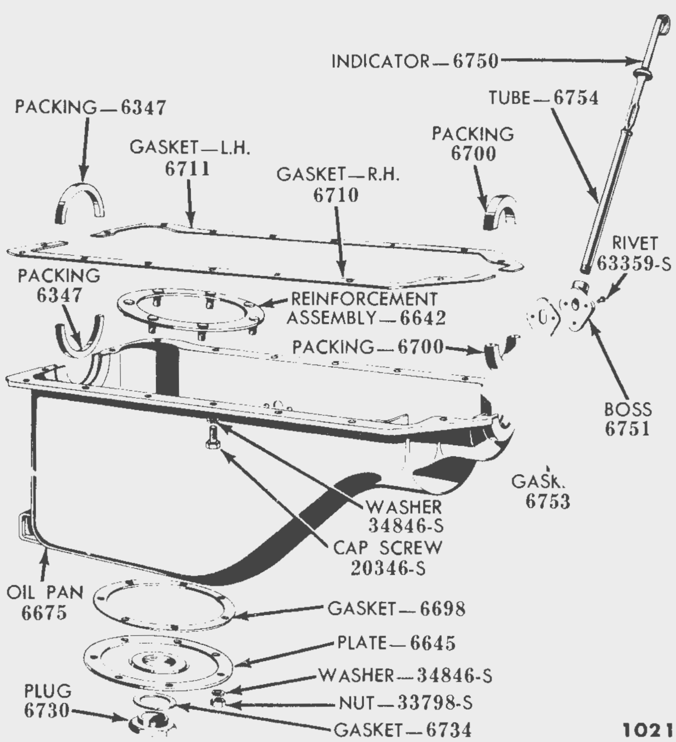

Fig. 11—Oil Pan

ties and install the remaining screws and tighten them to 15-18 foot-pounds torque. Install the oil level indicator tube, the road air breather duct, and the flywheel housing front cover.

NOTE: ***Align the flywheel housing front cover by installing the two shoulder bolts in the top holes.***

Install the starter motor and the clutch return spring. Install the steering idler arm support bracket and the steering gear arm. Fill the crankcase with the proper grade and amount of oil. Run the engine and check for oil leaks.

b. Oil Pump and Pressure Relief Valve.

The gear type oil pump is mounted on the cylinder block inside the oil pan at the rear of the engine. The pressure relief valve is mounted in the pump housing.

The oil pump used on early 1949 engines is equipped with spur gears. The increased capacity oil pump used on late 1949, 1950 and 1951 engines is equipped with helical gears. There is no visible difference between the pumps. To determine which pump you have, remove the oil pump tube and screen, and check the gears.

Oil pump removal, disassembly, cleaning, inspection, assembly, and installation procedures are presented below. The pressure relief valve is covered in the disassembly and assembly procedures for the pump since the valve is a part of the pump.

(1) *REMOVAL.* Drain the oil and remove the oil pan. Remove the oil pump retaining screw and remove the pump and strainer assembly.

(2) *DISASSEMBLY.* Remove the strainer assembly retaining screws, the strainer, and the gasket. Remove the cover plate and the pump driven gear. Remove the lock wire and the pressure relief valve (plug, gasket, spring, and valve).

Drive out the pin and remove the upper driven gear.

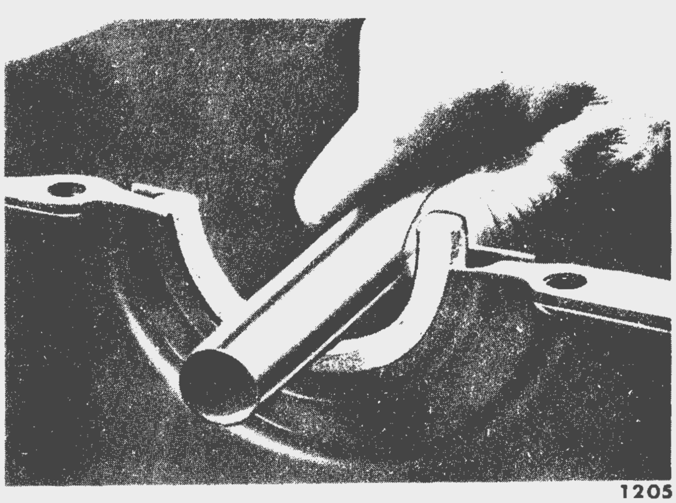

Fig. 12—"Rolling In" Oil Seal Packing

Slide the shaft and drive gear assembly out of the housing. The oil pump is shown completely disassembled in fig. 13.

(3) *CLEANING.* Wash all the parts in solvent and dry them thoroughly. Brush the inside of the pump housing to make sure no dirt or metal particles remain.

(4) *INSPECTION.* Check the pump housing for cracks or excessive wear. The pump shaft should have a free running fit without excessive play in the bushings (0.0005 to 0.0025 inch clearance). Check the pump gear teeth for scratches and wear. Measure the clearance between the pump gears and the pump body. It should be no greater than 0.005 inch. Check the compression of the relief valve spring. It should be 12 pounds plus or minus 2 ounces when the spring is compressed to 1.14 inches. Replace any worn or defective parts.

(5) *ASSEMBLY.* Apply a light coat of engine oil to all moving parts. Slide the shaft and drive gear assembly into the housing. Install the upper driven gear, insert the retaining pin, and rivet the end of the pin to hold it in place.

NOTE: ***When a new shaft and pump drive gear assembly is installed, it will be necessary to drill the retaining pin hole in the shaft. Set the end clearance to 0.016 inch and use a number 30 (0.1285) drill for the retaining pin hole.***

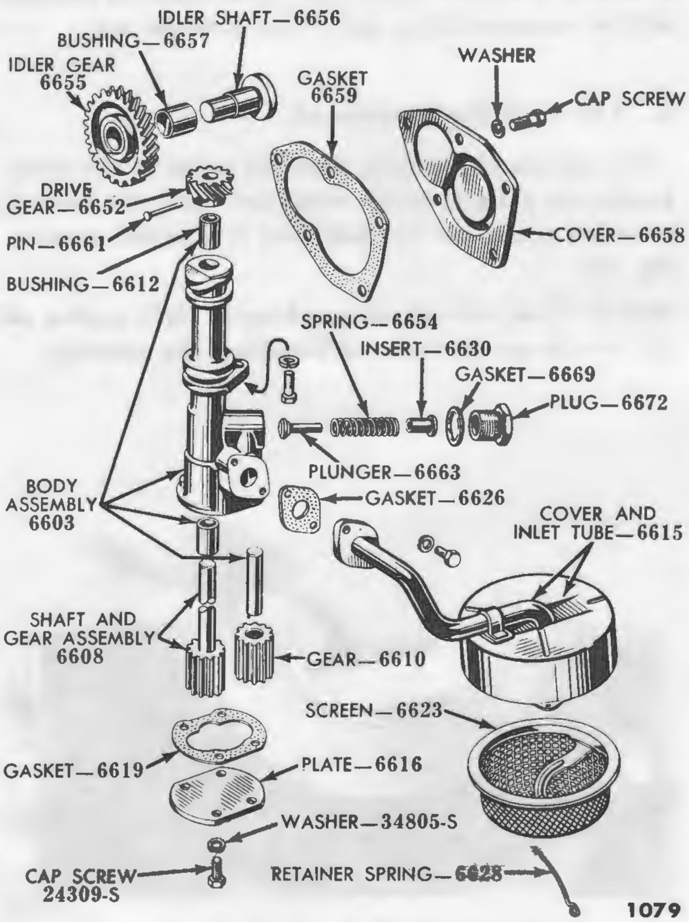

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Fig. 13—Oil Pump Disassembled

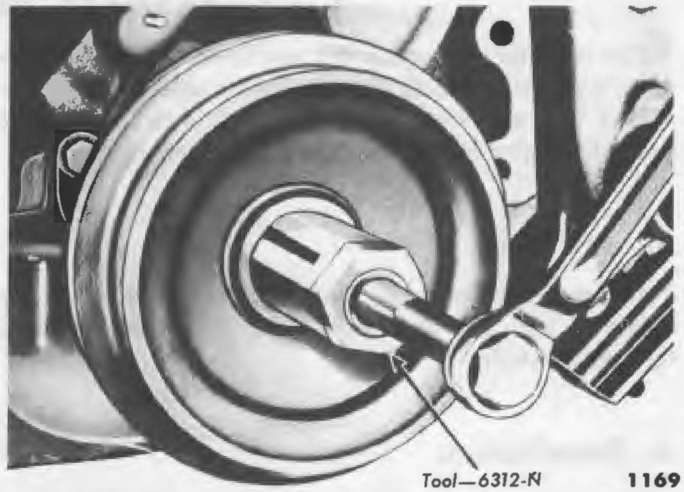

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Fig. 14—Removing Crankshaft Pulley

Install the pump driven gear, the cover plate gasket, and the cover plate. Tighten the cover plate screws to 7-10 foot-pounds torque. Install the pressure relief valve, the spring, the gasket, and the plug. Insert a piece of lock wire through the hole provided in the plug and twist the wire around the housing extension. Install the strainer gasket and strainer and tighten the screws securely.

(6) *INSTALLATION.* Slide the pump into the cylinder block (make sure the upper driven gear meshes properly) and install the pump retaining screw with a lockwasher. Tighten the screw to 12-15 foot-pounds torque. Install the oil pan and fill the crankcase with the proper grade and amount of oil.

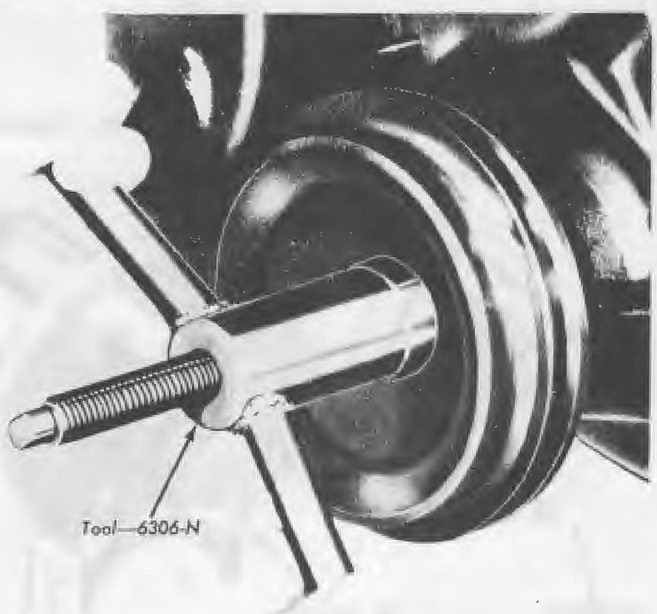

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Fig. 15—Installing Crankshaft Pulley

4. CRANKSHAFT PULLEY REPLACEMENT

The 8-cylinder engines are equipped with a double groove pulley keyed to the crankshaft and held in place with a bolt and washer. If the pulley is to be replaced with the engine in the car, remove the radiator.

a. Removal.

Remove the fan and generator belts. Remove the retaining bolt and lockwasher. Use a tool as shown in fig. 14 to remove the pulley.

b. Installation.

Start the pulley on the shaft by tapping it with a soft-faced hammer. Use a tool as shown in fig 15 to install the pulley tightly against the crankshaft shoulder. Install the retaining bolt and washer. Install and adjust the fan and generator belts.

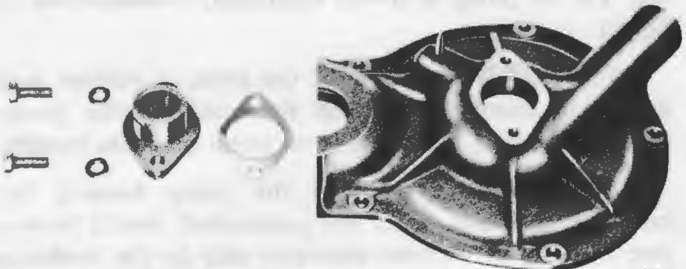

Fig. 17—Cylinder Front Cover Kit

NOTE: ***With the engine in the vehicle, it will be necessary to press the pulley on far enough to permit using the pulley retaining bolt for seating the pulley.***

5. CYLINDER FRONT COVER

The 1949 and early 1950 engines are equipped with a cast iron front cover. The distributor drive gear is supported by the distributor housing. Late 1950 engines and 1951 engines have an aluminum front cover with a support for the end of the distributor shaft. The procedure for removing and installing either cover is the same with minor differences which are noted below. Oil seal replacement is covered separately. Figure 16 shows both the cast iron and aluminum cylinder front covers.

A front cover kit (fig. 17) is available for 1949 and early 1950 engines. This kit has an adjustable camshaft thrust bearing surface for controlling camshaft end movement.

a. Removal.

Remove the fan. Remove the distributor. Remove the front cover retaining screws and remove the cover and gasket.

NOTE: ***On some models the road air breather clamp bracket is mounted under one of the cover screws and will be removed when the screw is taken out.***

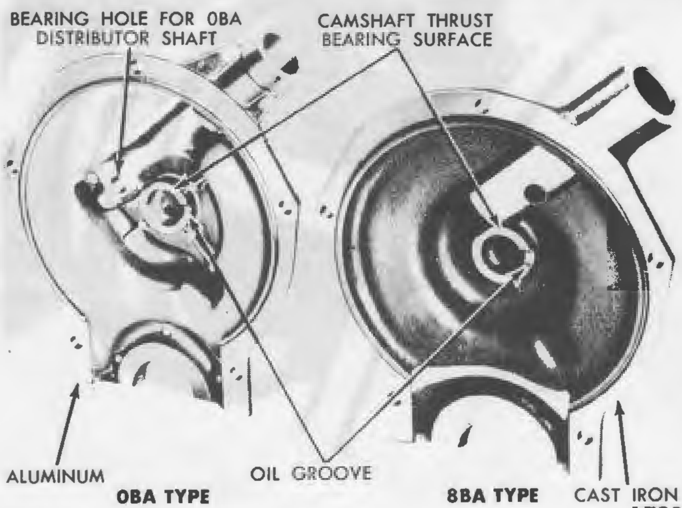

Fig 16—Cylinder Front Covers

b. Oil Seal Replacement.

Pry out the old packing from the recess in the cover. Install new packing in the recess and "roll" the packing in with a round bar to make sure it is seated properly (fig. 18).

NOTE: ***Soak the oil seal packing in light engine oil for two hours previous to installing the packing.***

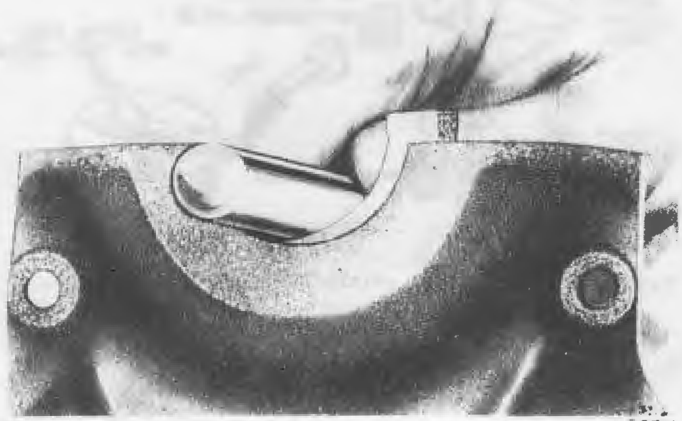

Fig 18—"Rolling In" Oil Seal Packing

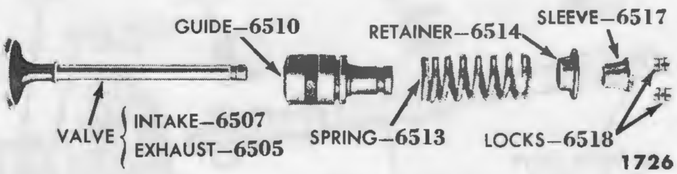

Fig. 19—Rotatable Valve and Related Parts

c. Installation.

Install the cover (with a new cover gasket) by placing the lower end over the crankshaft and tight against the cylinder block. Install the two lower retaining screws finger tight. Tap the top edge of the cover with a soft-faced hammer until the ridge inside the cover seats in the cylinder block recess. Install the remaining screws (replace the air duct clamp support if necessary) and tighten the screws to 12-15 foot-pounds torque. Install the distributor, fan, and generator. Adjust the belts and check the ignition timing.

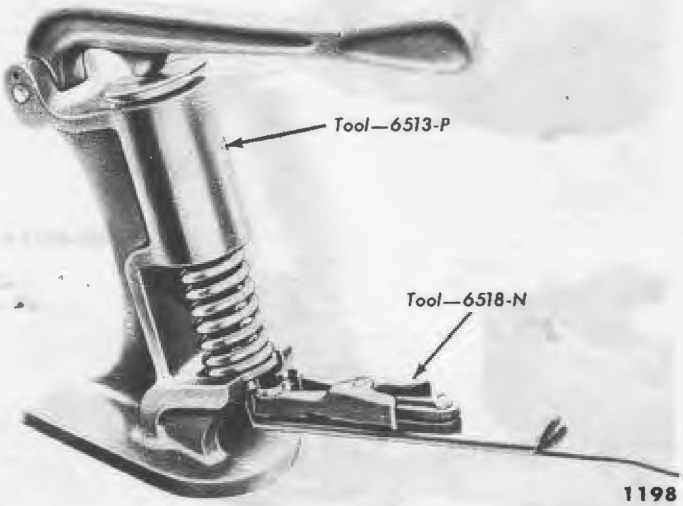

Fig. 21—Replacing Valve Spring Retainer Locks

CAUTION: *Do not install the upper edge of the cover first, or the oil pan gasket may be damaged by the sharp lower edge of the cover.*

6. VALVES, GUIDES, AND TAPPET CLEARANCE

Removal and installation of valves and guides are presented below. Tappet adjustment procedures are also given.

a. Valves and Guides.

Exhaust and intake valves serviced for Ford 8-cylinder engines are made of nickel-chrome alloy to withstand the high operating temperatures encountered. Rotatable intake and exhaust valves are used in 1951 engines. This type of valve (fig. 19) has a two piece spring retainer that differs from previous single piece spring retainer. A shorter valve spring is used but no change has been made in the valve locks.

Rotatable valves and parts can be installed in engines not so equipped by changing the spring retainer, valve spring, intake valve, and exhaust valve. When removing valve assemblies from the engine be sure to identify each assembly so it can be replaced in the same valve port from which it was removed.

(1) *REMOVAL.* Remove the cylinder heads and intake manifold. Compress the valve spring down against the valve locks and remove the valve guide retainer as shown in fig. 20. Pry up on the tappet end of the valve spring to remove the assembly.

(2) *DISASSEMBLY.* Compress the spring with a compressing tool as shown in fig. 21 and remove the valve spring retainer locks. Remove the valve spring retainer, valve spring, and the valve guide (fig. 22).

(3) *ASSEMBLY.* For 1949-50 type valves, install the valve guide on the valve. Install the spring, the spring retainer, and place the assembly in the compressing tool (fig. 21). Compress the spring and install the retainer locks with the lock replacer.

For 1951 rotable valves, place the valve, spring, guide, and spring retainer in the compressing tool. Place the valve locks in the valve spring retainer sleeve. Hold

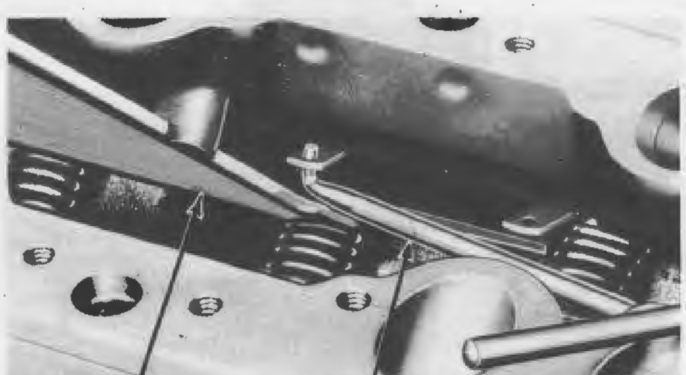

Fig. 20—Removing Valve Guide Retainer

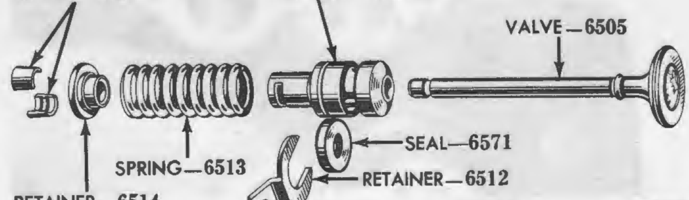

Fig. 22—Valve and Related Parts

Fig. 23—Assembling Rotatable Valve

the locks in the sleeve, start the sleeve over the end of the valve, compress the valve spring, and work the sleeve and locks into place with your finger (fig. 23).

(4) *INSTALLATION.* Slide the valve and spring assembly in the valve chamber. Compress the valve spring and insert the guide retainer in the groove provided in the valve guide. Be sure the guide retainer seats properly when you release the spring. Install the cylinder heads and intake manifold.

CAUTION: ***Be sure the rubber seal around the intake valve guide starts evenly in the valve guide opening.***

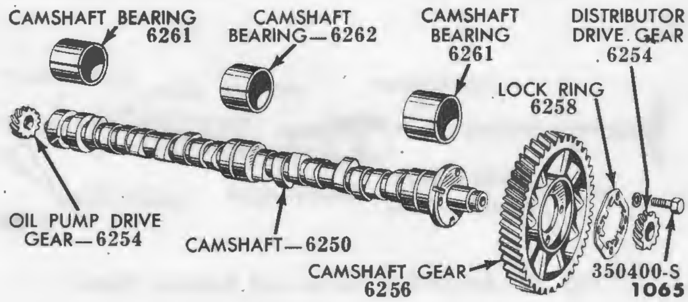

Fig. 25—Camshaft and Related Parts

Otherwise part of the seal may be sheared off by the sharp edge of the hole.

b. Valve Tappet Clearance.

The solid type tappets are not adjustable. However tappet clearance can be increased by grinding the end of the valve stem, or decreased by grinding the valve face. Check the tappet clearance as shown in fig. 24.

The clearance should be as follows:

Valve	Early 1949 Engine Clearance (inch)	Late 1949, 1950, and 1951 Engine Clearance (inch)
Intake	0.010-0.012	0.013-0.015
Exhaust	0.014-0.017	0.017-0.019

If the clearance is too small, grind the required amount of material from the end of the valve stem. If the clearance is too large, grind the face of the valve until the clearance is within the limits.

7. CAMSHAFT GEAR, CAMSHAFT, AND CAMSHAFT BEARINGS

Procedures for removal, inspection, and installation of the camshaft gear, camshaft, and camshaft bearings are presented below under the part name. Figure 25 shows the camshaft gear and camshaft bearings disassembled from the camshaft.

a. Camshaft Gear.

The camshaft gear is secured to the camshaft by four screws which are kept from coming loose by a lock ring. The mounting holes are spaced to make it impossible to install the gear incorrectly.

(1) *REMOVAL.* Remove the generator and fan.

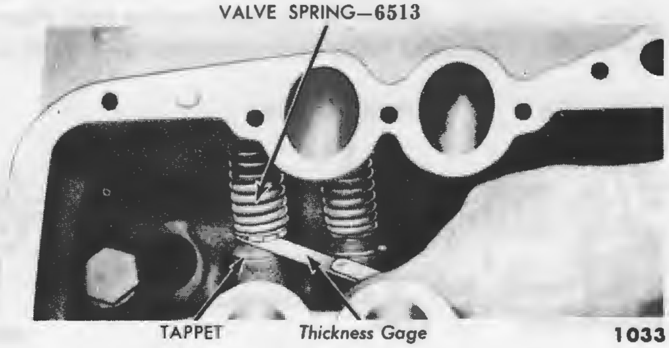

Fig. 24—Checking Valve Clearance

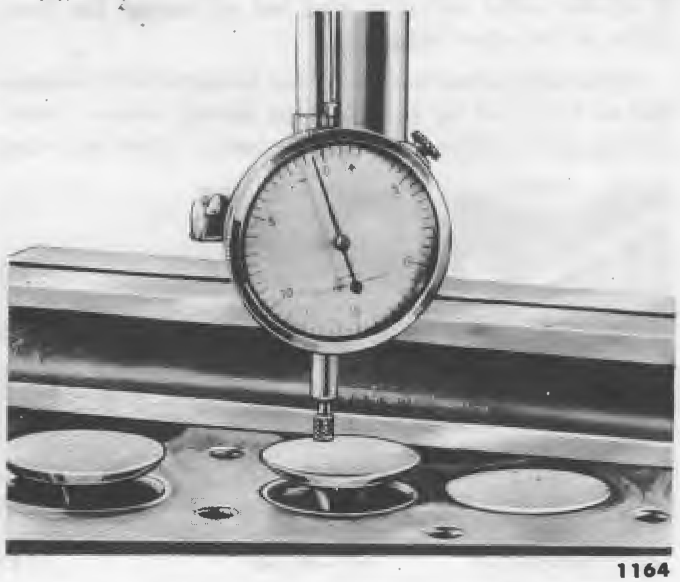

Fig. 26—Checking Valve Lift

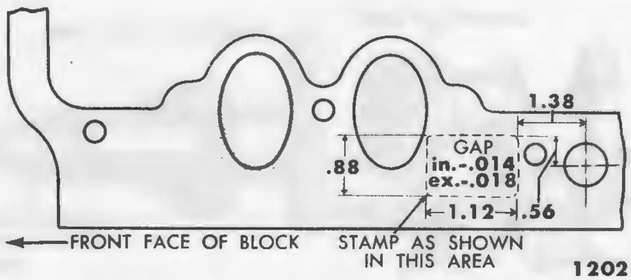

Fig. 27—Valve Gap Specification Stamp Location

Remove the front cover. Rotate the crankshaft until the timing marks line up. Bend the lock tabs away from the retaining screws and remove the screws. Remove the camshaft gear.

(2) *INSTALLATION.* When the timing gear is installed be sure the timing marks on the camshaft gear and the crankshaft gear line up.

NOTE: ***Oversize gears are available for service.***

Install the next oversize gear when excessive backlash exists between the camshaft gear and the crankshaft gear.

Install the gear on the camshaft flange and align the bolt holes. Install the lock-plate and screws. Tighten the screws to 15-20 foot-pounds torque and bend the lock plate tabs against the screws. Install the front cover, the generator, and the fan. Adjust the belt tension.

b. Camshaft Replacement.

It will be necessary to replace the camshaft when the cam lobes are worn to such an extent that the valve lift is less than 0.291 inch for the intake valves and 0.287 inch for exhaust valves. Make valve lift measurements when the engine is cold and valve gaps are within specifications. Check the valve lift with a dial indicator clamped to the cylinder block as shown in fig. 26.

Camshafts in late 1949, 1950, and 1951 engines have the letter "B" stamped on the forward end. Late 1949 engines have the valve gap specification "intake 0.014 inch, exhaust 0.018 inch" stamped on the top of the cylinder block as shown in fig. 27. Service limits on the valve gap spacings are: intake 0.013-0.015 inch, exhaust 0.017-0.019 inch. Early 1949 engines have service limits of: intake 0.010-0.012 inch, exhaust 0.014-0.016 inch.

When installing a new type camshaft in an old block, stamp the specifications on the block.

NOTE: ***If the valve gap setting for the old design camshaft is used for the new design camshaft, the valve timing will not be correct resulting in loss of power.***

(1) *REMOVAL.* Remove the cylinder heads, the intake manifold, and all the valve assemblies. Remove the tappets by lifting them into the valve chamber. Remove the cylinder cover and the camshaft gear. Remove the camshaft by pulling it through the camshaft bearings. Be careful not to scratch or gouge the bearings with the tips of the cam lobes while removing the camshaft.

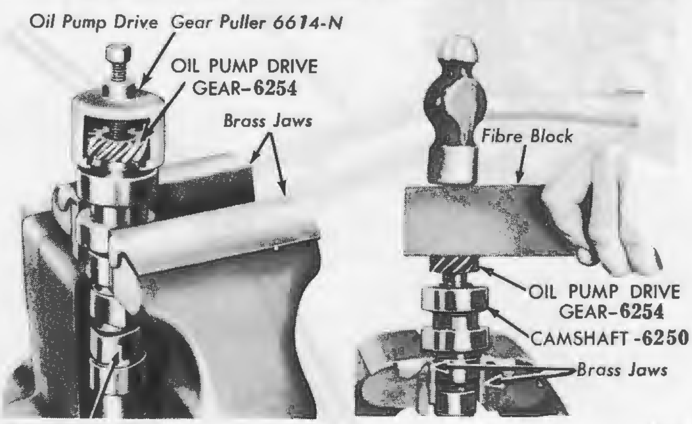

Fig. 28—Removing and Installing Oil Pump Drive Gear

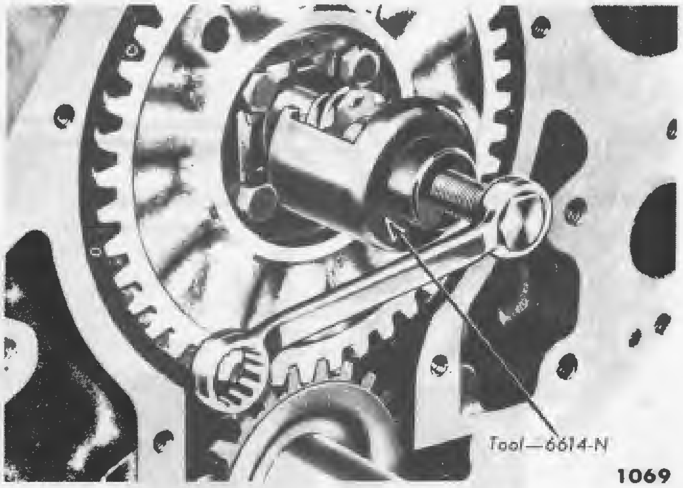

Fig. 29—Removing Distributor Drive Gear

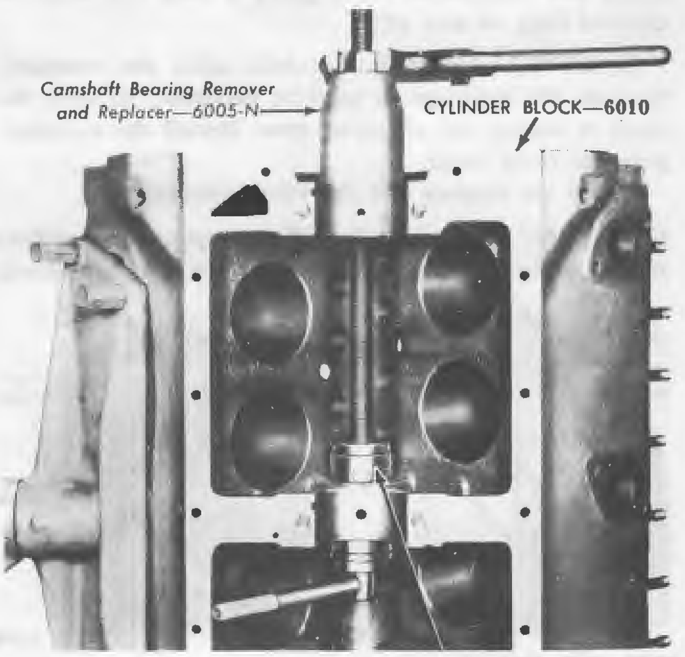

Fig. 30—Removing Camshaft Bearings

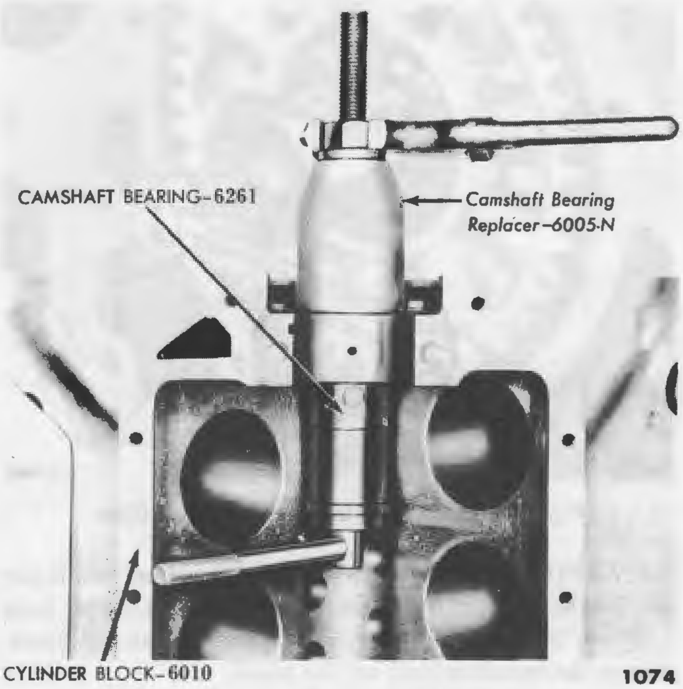

Fig. 31—Installing Camshaft Bearings

NOTE: ***If the engine is mounted in the car, remove the grille and radiator to permit pulling the camshaft.***

(2) *INSPECTION.* Check the camshaft journal surfaces for grooves or scratches. Check camshaft runout. Replace if not within 0.005 inch. Check the fuel pump eccentric for wear (deep groove worn by the push rod end). Inspect the oil pump drive gear and the distributor drive gear for worn, chipped or broken teeth. Replace the camshaft if it is worn or damaged. Replace the oil pump and distributor drive gears if they are worn or chipped (figs. 28 and 29).

(3) *INSTALLATION.* Carefully slide the camshaft through the bearings. It may be necessary to turn the shaft to engage the oil pump gear. Install the camshaft gear and front cover.

Install the tappets and the valve assemblies.

CAUTION: ***Be sure to install the tappets and valves in the same cylinder from which they were removed.***

Fig. 32—Checking Flywheel Runout

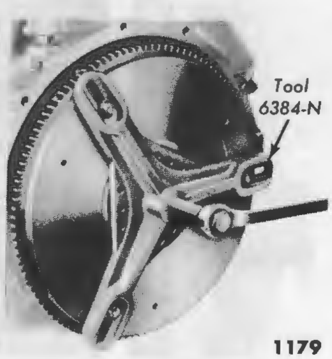

Fig. 33—Removing Flywheel

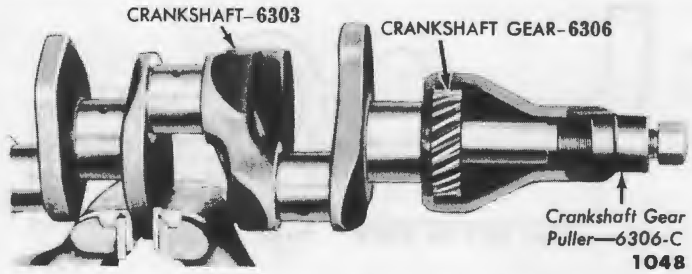

Fig. 34—Removing Crankshaft Gear

Install the cylinder heads and the intake manifold.

c. Camshaft Bearing Replacement.

Under normal usage the camshaft bearings will not need replacement. However they should be replaced in case they are damaged through insufficient lubrication or worn because of severe usage. It will be necessary to remove and disassemble the engine to make the bearings accessible.

(1) *REMOVAL.* Remove the engine from the vehicle and mount it on a work stand. Remove cylinder heads, intake manifold, valve assemblies, tappets, oil pan, and front cover. Remove the camshaft. Disconnect the connecting rods, push the pistons up in the cylinders, and remove the crankshaft. Remove the clutch housing, clutch plate assembly, and flywheel. Remove oil pump drive cover and idler gear. Remove the camshaft bearings with a bearing puller as shown in fig. 30.

(2) *INSTALLATION.* Install the camshaft bearings with a bearing installation tool as shown in fig. 31.

Install the oil pump drive idler gear and cover. Install flywheel, clutch plate assembly, and clutch housing. Install the crankshaft, connecting rods, camshaft and camshaft gear. Install the front cover and the oil pan. Install tappets, valve assemblies, intake manifold, and cylinder heads. Install the engine in the car.

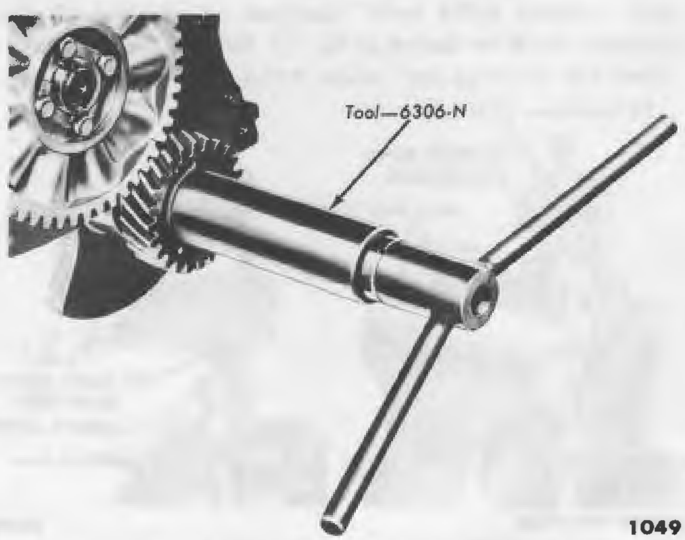

Fig. 35—Installing Crankshaft Gear

8. FLYWHEEL, CRANKSHAFT, AND BEARINGS

Procedures in this section cover the removal, inspection, repair, and installation of the crankshaft, rear oil seal, main bearings, crankshaft gear, and flywheel.

a. Flywheel.

The flywheel is mounted on the crankshaft rear flange with dowel pins and self-locking bolts. The rear face of the flywheel is a friction surface for clutch plate engagement. The starter ring gear is not an integral part of the flywheel. It is held on the flywheel by a shrink fit.

The flywheel can be checked for runout (fig. 32), removed, and installed with the engine mounted in the vehicle. Support the rear end of the engine on an engine support and remove the transmission, flywheel housing, clutch assembly, and starter motor.

(1) *REMOVAL.* Remove starter motor, clutch housing, clutch pressure plate, and disc. Remove the flywheel bolts and locking ring. Bolt flywheel puller to rear face of flywheel and remove the flywheel (fig. 33).

(2) *INSTALLATION.* Align flywheel on dowel pins, install the lock ring, and install and torque bolts to 75-85 foot-pounds. Install clutch pressure plate and disc. Torque screws to 17-20 foot-pounds. Install clutch housing and torque bolts to 37-42 foot-pounds. Install starter motor.

b. Crankshaft Gear.

The crankshaft gear is pressed on and keyed to shaft.

SLUDGE TRAPS (DRILLED IN EACH JOURNAL—INDIVIDUAL OIL PASSAGES FROM SLUDGE TRAP TO EACH ROD BEARING—PRESSED-IN HOLLOW PLUGS SEAL OPENINGS.) 1523

Fig. 36—Crankshaft Oil Passages

(1) *INSPECTION.* Remove the oil pan and front cover. Check the gear teeth for cracks, nicks, or wear. If the gear teeth are cracked, badly nicked, or show signs of excessive wear, replace the gear.

(2) *REMOVAL.* Remove the oil pan and front cover. Remove the crankshaft pulley and front main bearing cap. Remove the gear with the pulling tool as shown in fig. 34.

(3) *INSTALLATION.* Press the gear on the crankshaft with the tool as shown in fig. 35. Be sure the keyway and key are aligned.

Install the bearing cap, front cover, and oil pan. Install the pulley.

c. Crankshaft.

Crankshafts are made of cast alloy steel with integral counterweights and are both statically and dynamically

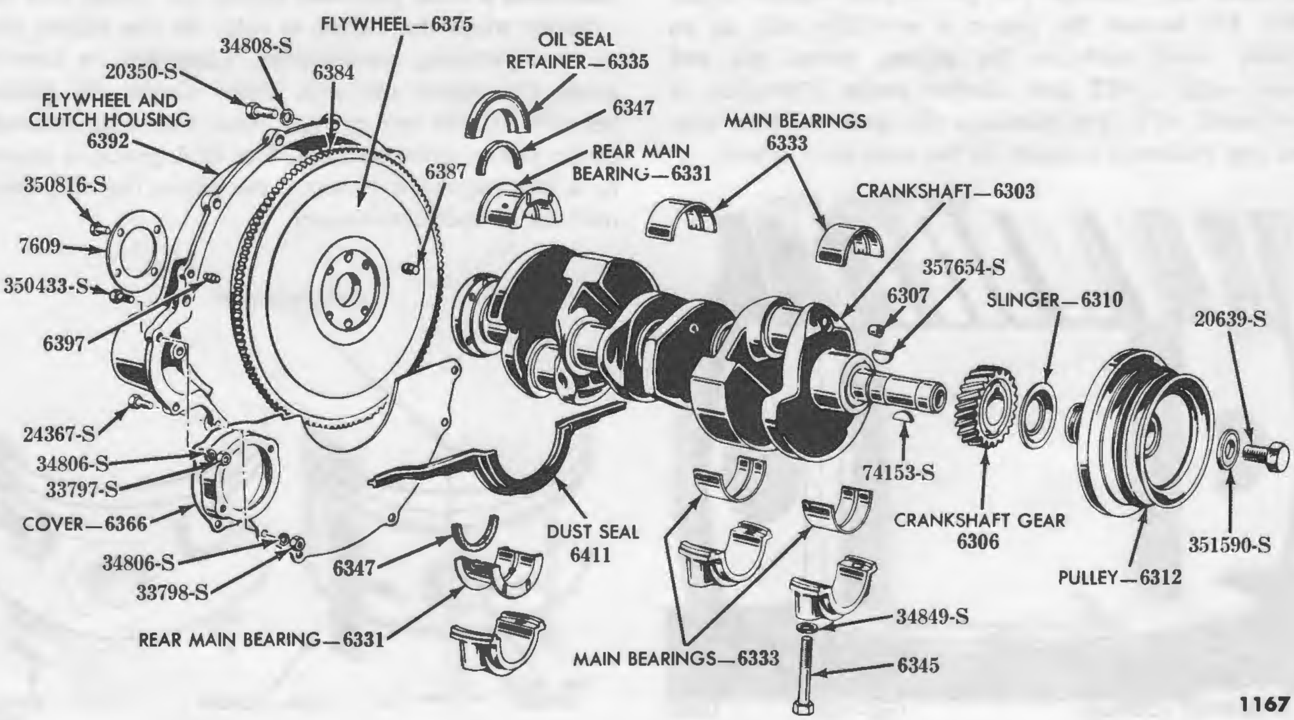

Fig. 37—Crankshaft and Related Parts

balanced. Drilled oil passages (fig. 36) provide lubrication to main and connecting rod bearings.

Remove engine from chassis and mount on work stand. Figure 37 shows the crankshaft and its related parts.

(1) *REMOVAL.* Remove the spark plugs, oil pan, clutch housing, clutch, and flywheel. Remove the connecting rod caps and push the pistons up into the cylinders. Remove the main bearing caps. Lift out the crankshaft and place it where it will not be dropped or damaged.

(2) *INSTALLATION.* Oil the bearing inserts with engine oil. Lay the crankshaft in the bearings. Install the bearing caps (with inserts) and tighten the retaining bolts to 95-105 foot-pounds torque. Push the pistons down and install the connecting rod bearing caps. Install the flywheel, clutch, and housing. Install the oil pan and spark plugs.

d. Rear Oil Seal Replacement.

Remove the oil seal retainer from the cylinder block, pry out the packing and "roll in" new packing.

NOTE: ***Soak packing in engine oil for at least two hours before installing.***

Clean the retainer slot in the cylinder block. Install the retainer making sure it seats all the way in the slot. The edges of the retainer should be flush with the cylinder block.

e. Main Bearings.

The main bearings can be replaced without removing the crankshaft by using the following procedure: Remove the oil pan. Remove one main bearing cap at a time allowing the other two caps to support the crankshaft. NOTE: ***If all bearings are to be replaced, replace the intermediate bearing first.***

Turn the crankshaft until the oil hole is near the un-notched edge of the bearing half. Insert the bearing removing tool in the oil hole and rotate the crankshaft ½ turn to remove the bearing (fig. 38).

Oil the new bearing half and lay it in the same position the old bearing was when it was taken off the journal. Rotate the crankshaft ½ turn in the opposite direction until the insert is flush with the cylinder block. Install the bearing insert in the cap and replace the cap. Torque the cap retaining bolts to 95-105 foot-pounds. Repeat the procedure for replacing the other bearings. Install the oil pan.

9. PISTON AND CONNECTING ROD ASSEMBLIES

Removal, disassembly, assembly, and installation of the connecting rod assembly are covered separately.

The 1949 and early 1950 engines are equipped with 4-ring split skirt pistons. The piston part number prefix is 09T. For service the piston is available only as an assembly which includes the piston, piston pin and retainer under a 49T part number prefix. Therefore, in this manual, 49T type piston is the nomenclature used when any reference is made to the split skirt piston.

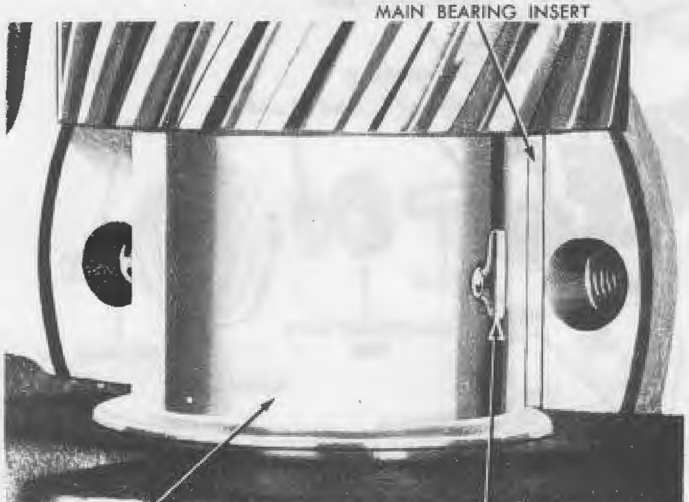

Fig. 38—Removing Main Bearing Insert

On late 1950 engines and 1951 engines, a solid skirt 4-ring piston (8BA Piston) was installed for quieter engine operation. The 8BA piston is cam ground and maintains a close tolerance across the thrust axis of the cylinder when the engine is cold. As the engine warms up to operating temperature, expansion is controlled along the piston pin axis which causes the piston to become circular and provide close tolerance around the entire piston circumference. The 8BA piston is identified by a locating mark on top of the piston (fig. 39) which is used for proper installation.

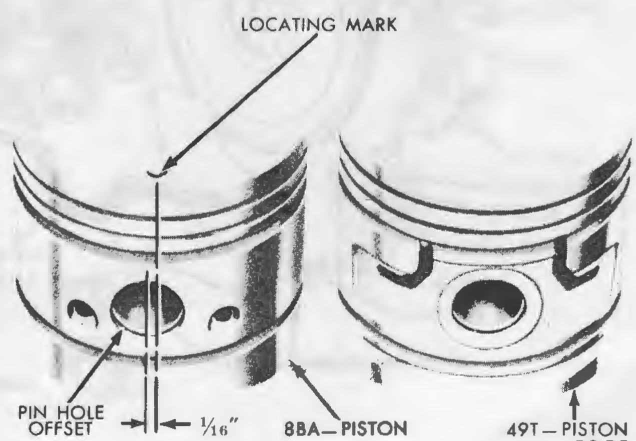

Fig. 39—8BA Piston and 49T Piston

The 8BA pistons can be used in engines formerly equipped with 49T pistons but installation of 49T pistons in engines equipped with 8BA pistons is not recommended. Replacement should be in sets of 8 but installation of one or more is permissible as required.

In addition to the oversizes of 0.0025 inch, 0.020 inch, 0.030 inch, 0.040 inch, and 0.060 inch, service pistons are available in four grades in 0.0003 inch steps for selective fitting.

a. Removal.

Remove the cylinder heads and the oil pan. Check the cylinder wall around the top of the bore to see if a ridge has been worn by the piston. If any appreciable ridge is present, it will be necessary to remove the ridge before removing the piston.

To remove the ridge, rotate the crankshaft until the piston is at the bottom of the cylinder and place a cloth on the piston to collect any cuttings made in removing the ridge. Adjust the ridge removing tool to the cylinder size and move the cutter blade to a depth just below the ridge (no more than 1/32 below). Make sure the ridge remover is held tightly against the top of the block and turn the arbor to cut away the ridge (fig. 40).

After the ridge has been removed turn the crankshaft to bring the piston to the top of the cylinder and carefully remove the cloth and cuttings from the piston head. Repeat the procedure for the other cylinders.

Turn the crankshaft until the throw is down. Remove the lock nuts and retaining nuts from the connecting rod studs. Remove the cap and each half of the bearing. Push the rod and piston assembly up through the top of the cylinder. Each rod assembly is number to correspond to the cylinder in which it operates. Keep all parts of the assembly together when it is removed.

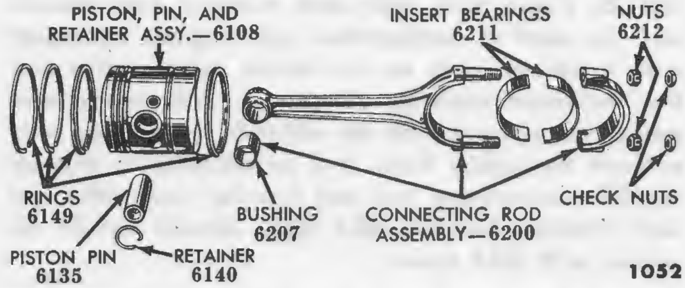

Fig. 41—Piston and Connecting Rod Assembly

b. Disassembly.

Spread and remove the piston rings with an expanding tool. Remove the piston pin retainers with a needle-nose plier or by prying them out of the groove. Push out the piston pin. Press out the connecting rod bushing. The piston and rod are shown completely disassembled in fig. 41.

c. Assembly.

Position the connecting rod in the piston so the connecting rod squirt hole will face toward the front of the engine upon installation and push the pin in place.

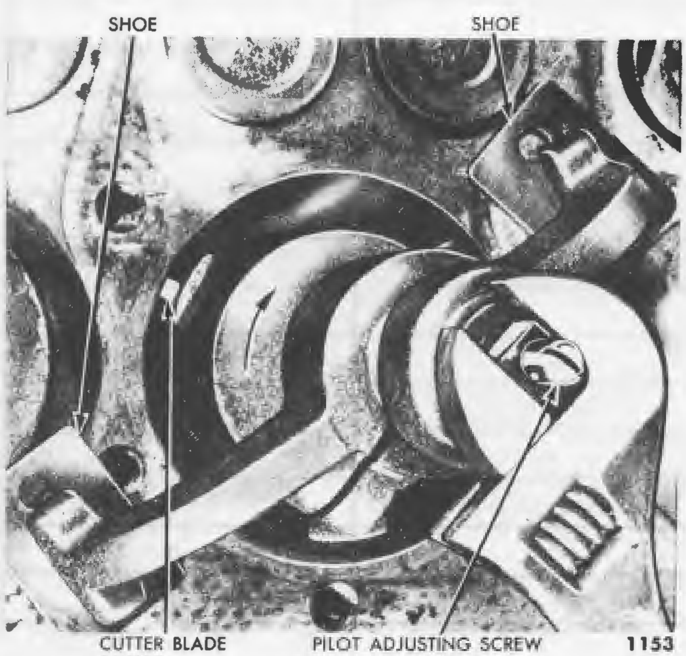

Fig. 40—Removing Ridge from Cylinder

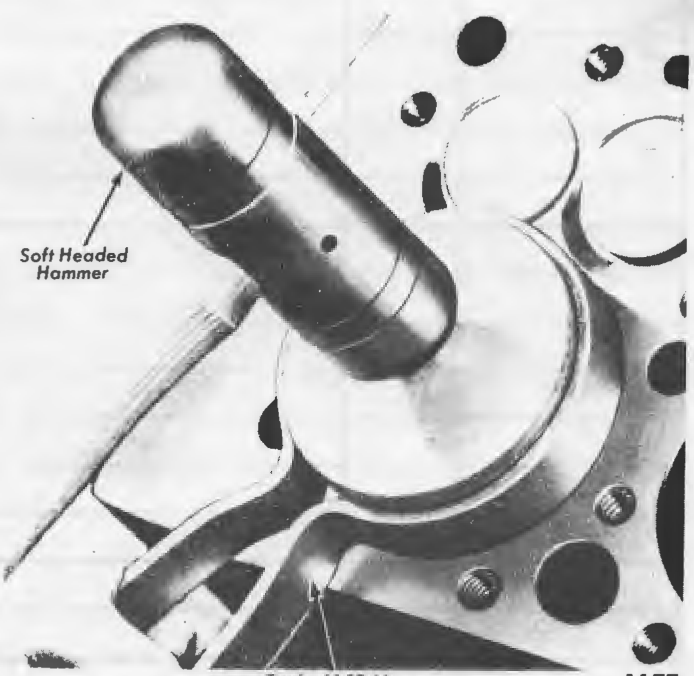

Fig. 42—Tapping in Piston

NOTE: ***Connecting rods with metered hole should only be used in conjunction with engines equipped with neoprene seals on the intake valve guides and the increased capacity oil pump. This pump and guide can be used with the old-style connecting rods without the squirt hole. It is permissible to replace the 8BA connecting rod and bearings with 0BA rod and bearings but the 0BA types should not be replaced with 8BA types.***

Insert the pin retaining clips. Install the piston rings with the side up that is counterbored, beveled, or stamped "top."

Insert the bearing halves in the rod and cap.

NOTE: ***Rings with a beveled or counterbored inside diameter must be assembled with the counterbore or bevel up in order to obtain full advantage of their sealing abilities.***

d. Installation.

Oil the cylinder wall with light engine oil. Make sure ring gaps are equally spaced around circumference of piston. Compress the lower ring with a ring compressor and start the piston in the cylinder by tapping the piston head with a soft hammer.

NOTE: ***Position 8BA pistons so the indentation in the piston head is toward the front of the engine. This is necessary as the 8BA piston pin is offset 1/16 inch.***

Shift the compressor to the three upper rings, compress them, and tap the piston in with a soft hammer (fig. 42) until it is slightly below the top of the cylinder. Turn the crankshaft so the throw is down and push the piston all the way down until the rod bearing seats on the crankpin. Install the bearing cap, lining up the stamped numbers, and tighten the retaining nuts to 45-50 foot-pounds. Install new lock nuts.

Install the oil pan and cylinder heads. Fill the crankcase with the proper grade and amount of lubricant. Fill the cooling system. Start the engine and run it slowly. Make sure there is sufficient oil pressure. Check the temperature to make sure the engine does not overheat. Overheating can be caused by too tight bearings.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part ONE

POWER PLANT

Chapter

V

E-Series—8-Cylinder Engine

The 337 cu. in 8-cylinder engine has a bore of 3½ inches, a stroke of 4⅜ inches, and is rated at 145 horsepower. This engine is used in Series F-7 and F-8 trucks. 1949 and early 1950 engines are shown in figures 1 and 2.

Several changes in the external appearance have been made in the late 1950 and 1951 engines. Of these changes, the fan design, ignition cable brackets, addition of the external water by-pass tubes, oil filter tubes, and location of the oil filter are shown in figs. 3 and 4.

Complete procedures for the overhaul and repair of the 337 cubic inch 8 cylinder truck engine are given below. The necessary operations are presented in the written text and supplemented with illustrations. Specially designed tools are fully illustrated to aid you in learning their use easily and quickly. Pay particular attention to the notes, cautions, and examples accompanying the written procedures. They contain time saving and material saving hints and suggestions.

Always install new gaskets when overhauling an engine. Figure 5 shows the gaskets needed for this engine when you are performing a major overhaul.

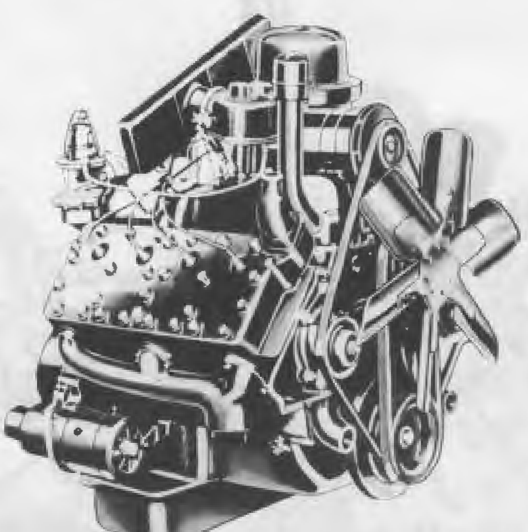

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Fig. 1—1949 and Early 1950 8EQ Engine (¾ Front View)

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Fig. 2—1949 and Early 1950 8EQ Engine (Rear View)

1. MANIFOLDS

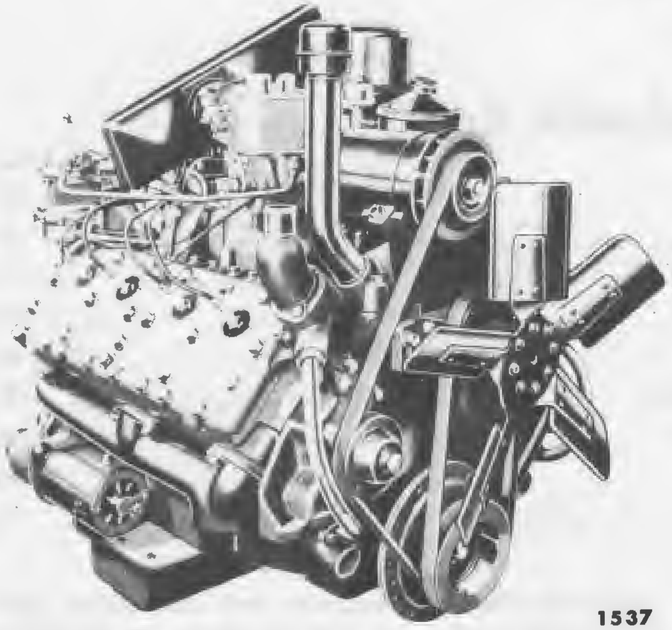

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Fig. 3—Late 1950 and 1951 8EQ Engine (¾ Front View)

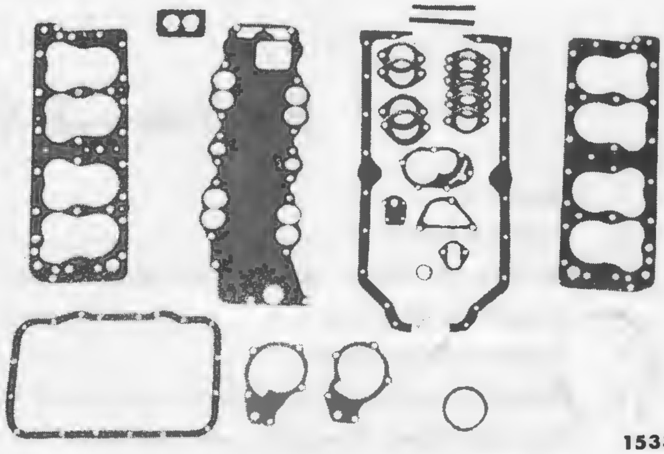

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Fig. 5—Engine Overhaul Gasket Set

Procedures for removal, cleaning, inspection, and installation of the exhaust and intake manifolds are presented below.

a. Intake Manifold.

The intake manifold can be removed from the cylinder block without removing the oil filter, carburetor or fuel pump (Fig 6). If it is necessary to repair any accessories, you may remove the accessories before you remove the manifold.

(1) *REMOVAL.* Remove the air cleaner and oil filter lines. Disconnect the generator wires, oil pressure sending unit wire, and temperature sending unit wires at both heads. Disconnect the throttle linkage, choke wire, vacuum booster hose, and the flexible fuel line. Disconnect the spark plug wires, ignition wire brackets, and remove the ignition wires, brackets, and distributor cap from the engine. Disconnect the distributor diaphragm vacuum line at the distributor. Disconnect the governor vacuum lines at the distributor and remove the distributor assembly. Remove the generator belt

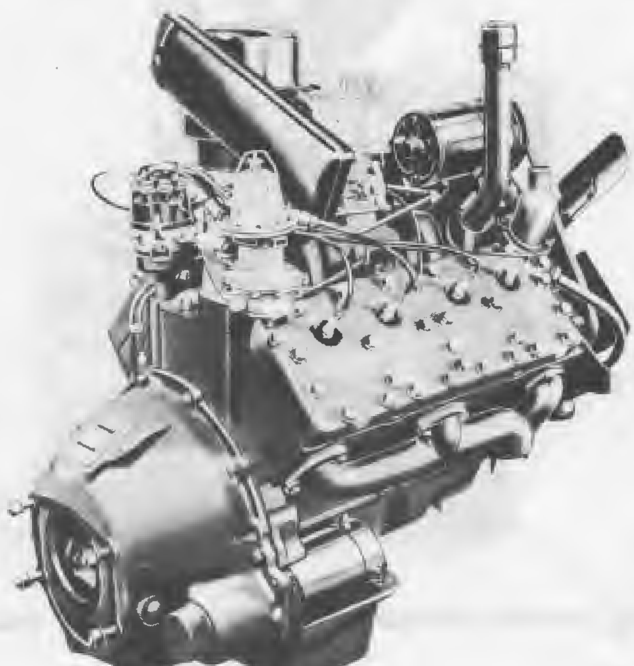

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Fig. 4—Late 1950 and 1951 8EQ Engine (¾ Rear View)

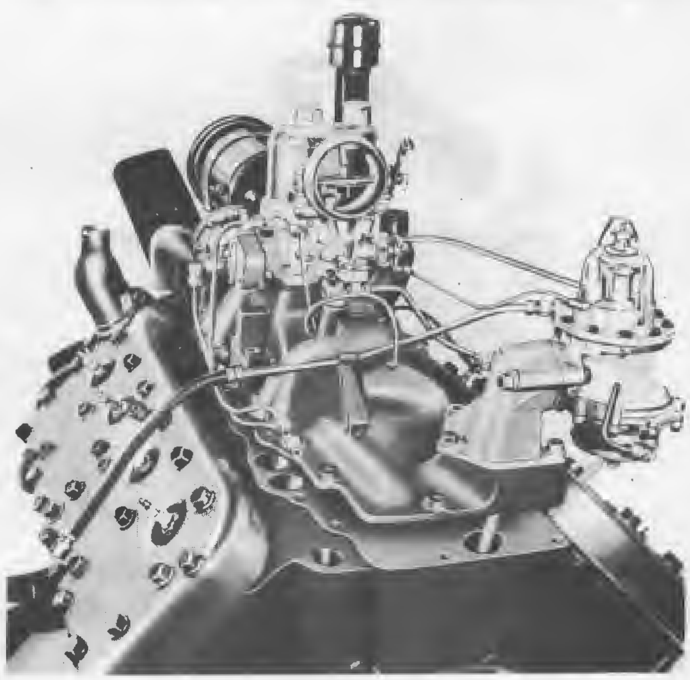

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Fig. 6—Intake Manifold Removal

and generator. Loosen the road draft tube clamp at the elbow. Remove the intake manifold retaining bolts and lift the manifold from the engine.

The remaining engine accessories are removed as follows: Remove the fuel line between the fuel pump and carburetor. Remove the vacuum line between the vacuum pump and vacuum booster fitting. Remove the fuel pump, oil filter, and carburetor. Remove the road draft ventilation elbow, oil filter tube, and windshield wiper fitting. Figure 7 shows the intake manifold stripped of all engine accessories.

(2) *CLEANING*. Brush out rust and dirt from the inside of the manifold. Clean and oil and grease accumulation from the outside.

(3) *INSPECTION*. Inspect the manifold for cracks and warped gasket surfaces. Replace the manifold if it is cracked or warped. Replace studs with stripped threads. Check the vacuum booster fitting threads in the manifold.

(4) *INSTALLATION*. Position a new gasket on the block. Align the manifold on the gasket and install one bolt at each end finger tight. If the manifold is disassembled, install the engine as follows: Install vacuum booster fitting, oil filler tube, and road draft tube elbow. Install the carburetor, oil filter, and fuel pump. Install the vacuum line between the vacuum pump and vacuum booster fitting. Install the fuel line between fuel pump and carburetor.

With the above engine accessories in place, install the ignition wire brackets (with ignition wires and distributor cap). Install the manifold retaining bolts and tighten them to 25-30 foot-pounds torque. Tighten the road draft tube clamp. Install the distributor assembly. Install the distributor cap and connect the spark plug wires. Connect the governor vacuum lines and the distributor diaphragm vacuum line. Connect the throttle linkage, choke wire, vacuum booster hose, and fuel line. Install the generator and generator belt and adjust the belt tension. Connect the generator wires, oil pressure sending unit wire, and temperature sending unit wires. Install oil filter lines and air cleaner.

b. Exhaust Manifold.

Exhaust manifolds should not be hot when removed from the engine or they may warp and make reassembly difficult.

Four ear type washers are used to lock the exhaust manifold bolts into place on late 1950 and 1951 engines. One ear of these washers is bent up against the bolt head and one is bent down against the manifold forming a positive lock. 1949 and early 1950 engines used ordinary lock washers. Individual manifolds are used on each side of the engine (fig. 8).

(1) *REMOVAL*. Disconnect the muffler inlet crossover pipe from the left hand manifold and the muffler inlet pipe from the right hand manifold. Remove the manifold retaining bolts and remove the manifolds.

(2) *CLEANING*. Use a wire brush to remove carbon deposits from the inside of the manifold. Clean the flange and gasket surfaces.

(3) *INSPECTION*. Inspect the manifolds for cracks or warped gasket surfaces. Replace cracked or warped manifolds.

4. *INSTALLATION*. Always use new gaskets and new lock washers when installing the manifolds. Hold the manifold in place and install the retaining bolts. Tighten the retaining bolts to 25-30 foot-pounds torque. Secure the bolts with the retaining washers. Connect the muffler inlet crossover pipe to the left hand manifold.

2. CYLINDER HEADS

A complete procedure for the removal, cleaning, inspection, and installation of cylinder heads is given below. The heads are so designed that the coolant enters the rear of the head and flows toward the front. This flow must not be obstructed or inadequate cooling will result.

External water by-pass tubes have been added to late 1950 and 1951 engines to assure even heat control.

An 8EQ engine cylinder head is shown in fig. 9.

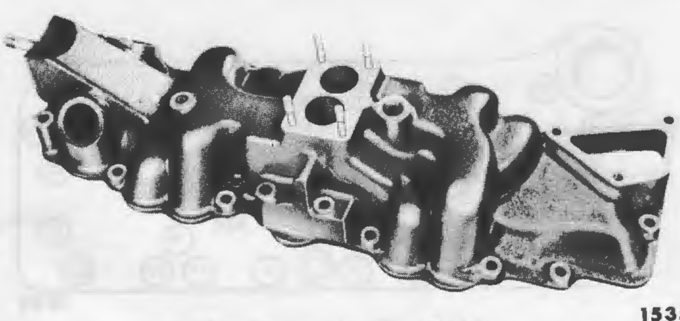

Fig. 7—Intake Manifold

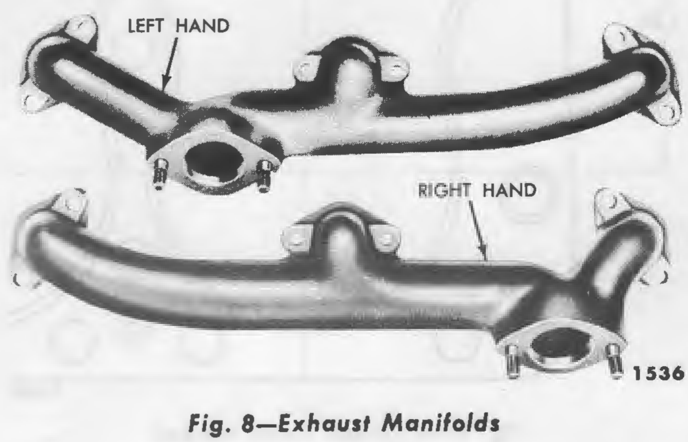

Fig. 8—Exhaust Manifolds

Fig. 9—Cylinder Head

a. Removal.

Drain the coolant and disconnect the upper radiator hoses at the cylinder heads. Disconnect the spark plug wires and temperature sending unit wires. Remove the screws at the lower ends of the external water by-pass tubes used on late 1950 and 1951 engines. Loosen the upper fittings and remove the by-pass tubes. The right-hand cylinder head can now be removed by disconnecting the battery ground strap and removing the cylinder head bolts.

NOTE: ***The fuel pump to carburetor vacuum line interferes with removal of the head bolt directly below it. Loosen this bolt and remove it with the head.***

To remove the left-hand cylinder head, first remove the air cleaner. Then disconnect the oil pressure sending unit wire and the oil filter lines (at filter). Remove

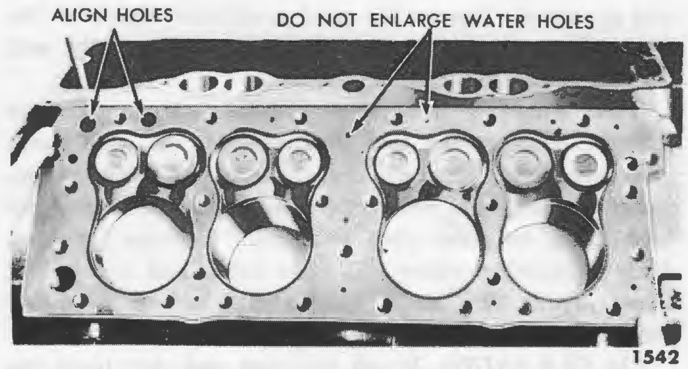

Fig. 11—Cylinder-Head Gasket Installation

the cylinder head bolts and cylinder head. The air cleaner support will come off with the left hand cylinder head.

b. Cleaning.

Remove any carbon deposits from the inside of the head by brushing and scraping. Be careful not to scratch the gasket surfaces of the cylinder head when removing old pieces of gasket. Clean all dirt or rust from the coolant holes.

c. Inspection.

Inspect the cylinder head for cracks, warped surfaces, and raised projections that may occur at bolt holes. Replace cracked or warped heads.

d. Installation.

Always use new gaskets when installing heads. Use cylinder head gaskets 0EL-6051 or 8EL-6051-D (fig. 10) on engines which are *not* equipped with the external water by-pass tube and 8EQ-6051 on engines equipped with external water by-pass tubes. The 8EQ-6051 gasket does not have the 7/16 inch internal water by-pass hole shown in fig. 10. Align the water passages with those in both the cylinder head and the cylinder block to insure free water passage.

CAUTION: ***Do not enlarge any gasket water holes or overheating of the rear cylinders may result.***

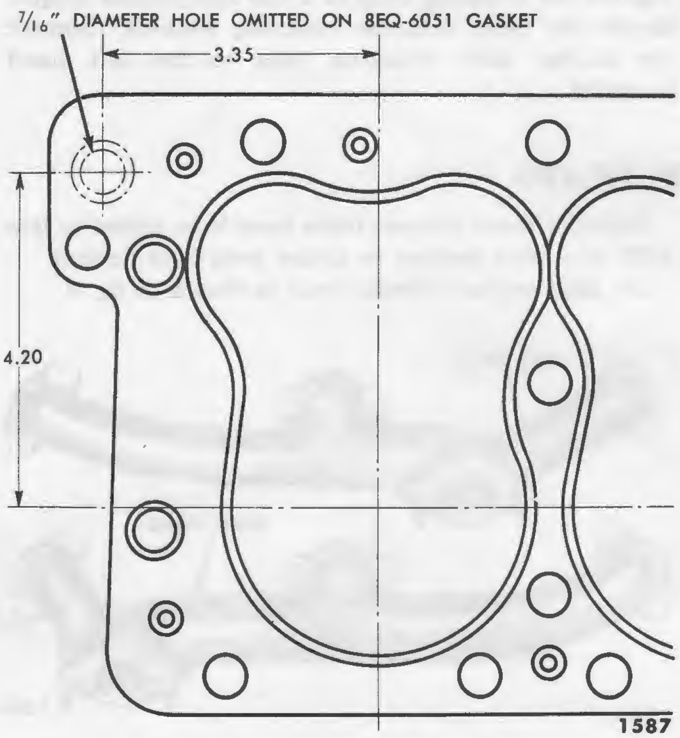

Fig. 10—Cylinder Head Gasket

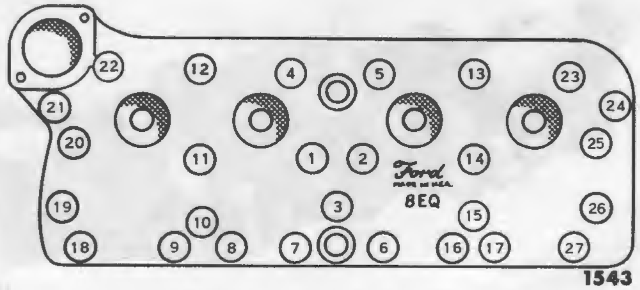

Fig. 12—Cylinder Head Bolt Tightening Sequence

Correct gasket installation is shown in fig. 11.

Place the left-hand cylinder head and gasket on the block. Install one bolt at each end of the head to align and hold it in the proper position. Install the air cleaner support and torque the head bolts to 65-70 foot-pounds in the sequence shown in fig. 12. Install oil filter. Connect the oil filter lines, oil pressure sending unit wire, and generator wires.

Place the right-hand cylinder head and gasket on the block. Install head bolts and torque them to 65-70 foot-pounds in the sequence shown in fig. 12. Connect the battery ground strap.

Position the external water by-pass tubes, install screws in the lower flanges and tighten the upper fitting. Connect the temperature sending unit wires and spark plug wires. Connect the radiator upper hoses and fill cooling system with coolant. Operate engine and check for coolant leaks.

3. OIL PAN, OIL PUMP, AND PRESSURE RELIEF VALVE

The oil pressure system used in the 8EQ engine is illustrated in fig. 13. After leaving the pump, the oil divides into two paths. In one line the oil flows through the filter and returns to the crankcase. The other line carries the oil to all tappet assemblies. The oil flows from the tappets to the camshaft bearings and then to the crankshaft main bearings through passages in the block. Drilled oil passages through the crankshaft (fig. 14) conduct the oil to the connecting rod bearings. The oil then lubricates the cylinder walls through connecting rod squirt holes and drips back to the crankcase.

A cylinder block oil relief valve located in the forward end of the valve chamber holds the pressure in the hydraulic lifters at 15 P.S.I. (fig. 15). Exhaust oil from this valve flows into the timing gears and returns to the crankcase.

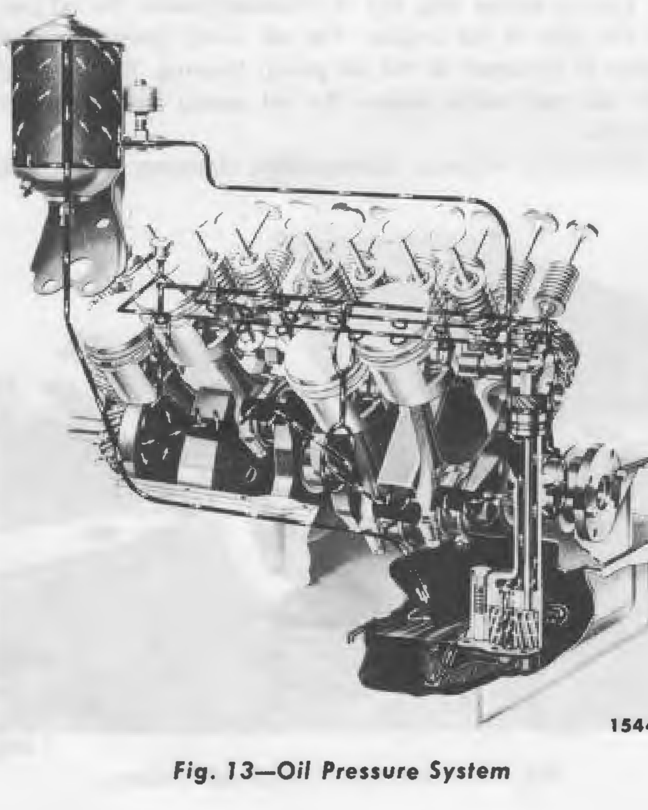

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Fig. 13—Oil Pressure System

a. Oil Pan.

The procedure for removing, cleaning, inspecting, and installing the oil pan is described below. A sump pan on the oil pan makes the oil pump accessible for service without removing the oil pan. Fig. 16 shows an exploded view of the oil pan assembly.

(1) *REMOVAL.* Drain the crankcase. Remove the engine dust pan. Disconnect the muffler inlet pipe at both exhaust manifolds and the lower inlet pipe. Disconnect the starter cable at the starter motor and remove the starter motor. Remove the sump pan and the four bottom clutch housing to engine rear plate bolts. Remove the baffle (fig. 17) between the sump pan and oil pan. Remove the oil pan dip stick and tube. Remove the oil pan screws and lower the oil pan from the engine.

(2) *CLEANING.* Wash the pan in a solvent. Remove any dirt or metal particles from the inside of the pan. Scrape old gasket material from gasket surfaces.

(3) *INSPECTION.* Check the oil pan for cracks, holes, or warped gasket surfaces. Repair the pan or replace it if repairs cannot be made. Inspect baffle for broken clips. Inspect sump pan retaining studs for stripped threads that may lead to external oil leaks.

(4) *OIL SEAL REPLACEMENT.* Remove the old packing from the front and rear seal retaining grooves. Install new packing with the use of a round bar as shown in fig. 18 to make sure it seats properly.

NOTE: ***Soak oil seal packing in light engine oil for at least two hours before installation.***

(5) *INSTALLATION.* Use new oil pan gaskets. Tie each gasket to the pan through two bolt holes. Hold

INDIVIDUAL OIL PASSAGES FROM SLUDGE TRAP TO EACH ROD BEARING. THREADED PLUGS SEAL OPENINGS. 1545

Fig. 14—Crankshaft Oil Passages

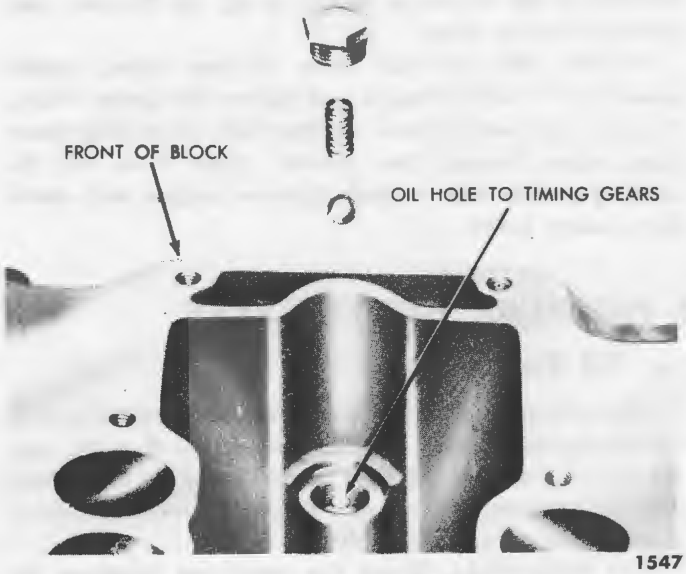

Fig. 15—Oil Pressure Relief Valve

the pan in place against the cylinder block and install two screws (finger tight) in each side of the pan. Remove the string ties, install the remaining screws, and tighten them to 15-18 foot-pounds torque. Install the oil pan dip stick tube and dip stick. Install the engine oil pan baffle. Install the sump pan with a new gasket. Install the clutch housing to engine rear plate bolts.

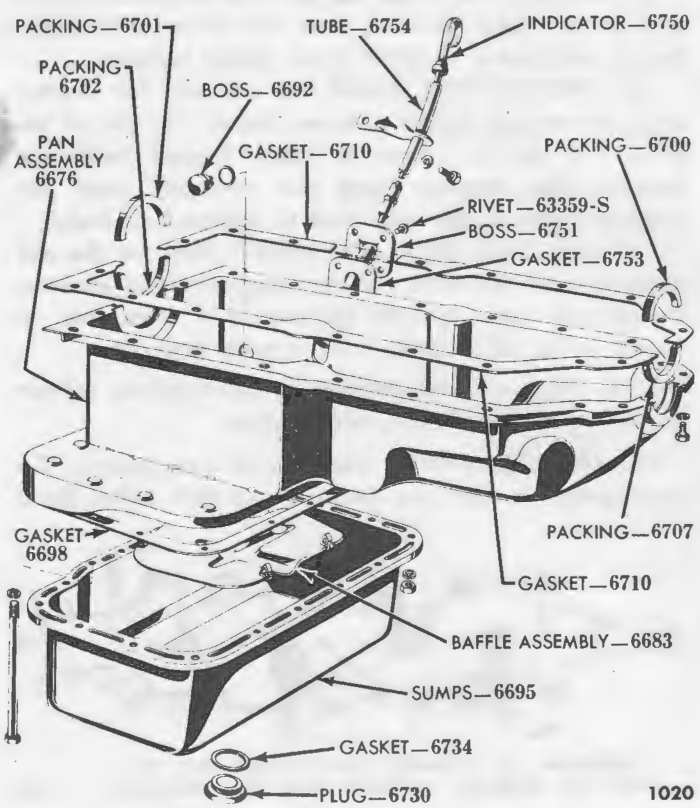

Fig. 16—Engine Oil Pan

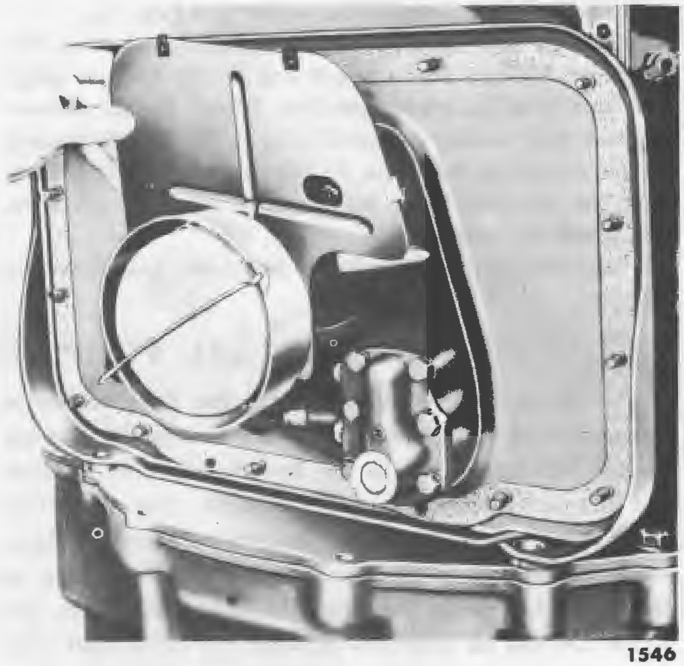

Fig. 17—Removing Engine Oil Pan Baffle

Install the starter and connect starter cable. Connect the muffler inlet pipe to the exhaust manifolds. Install the engine dust pan. Fill the crankcase with the proper amount and grade of oil.

b. Oil Pump and Oil Pressure Relief Valve.

The oil pump (fig. 19) is mounted inside the oil pan at the rear of the engine. The oil pump pressure relief valve is mounted in the oil pump housing. Removal of the oil pan sump makes the oil pump accessible for service.

Oil pump removal, disassembly, cleaning, inspection,

Fig. 18—"Rolling In" Oil Seal Packing

assembly, and installation are presented below. The oil pump pressure relief valve is included with the oil pump procedure.

(1) *REMOVAL.* Drain the crankcase. Remove the oil pan sump and baffle plate. Remove the oil pump retaining screw and carefully guide the pump past the oil pan.

(2) *DISASSEMBLY.* Remove the screen retaining spring and screen. Remove the cover and tube assembly. Remove the oil pump cover plate, oil pump driven gear, oil pump driven gear stud, oil pressure relief valve spring and plunger. Remove the oil pressure relief valve plug and gasket. Drive the pin from the oil pump shaft upper gear. Remove the upper gear, oil pump shaft and gear assembly. Fig. 20 shows the oil pump disassembled.

(3) *CLEANING.* Wash all parts in solvent. Be certain the pump and screen are free of any foreign particles.

(4) *INSPECTION.* Check the pump housing for cracks or excessive wear. Check the shaft to bushing clearance (0.0005 to 0.0025 inch). Check the pump gear teeth for wear. Pump gear to body clearance should measure no greater than 0.005 inch.

Check the oil pressure relief valve spring compression. It should be 12.42 pounds ± 2 ounces when the spring is compressed to 2.18 inches. Check the condition of the oil seals.

(5) *ASSEMBLY.* Coat all moving parts with engine oil. Slide the gear and shaft assembly into the housing. Install the oil pump shaft upper gear on the pump shaft, tap the pin into place, and peen both ends.

NOTE: ***When a new gear and shaft assembly is used, it is necessary to drill the retaining pin hole in the shaft. Set the end clearance (fig. 21) to 0.016 inch and use a number 30 (0.1285) inch drill for the retaining pin hole.***

Install the oil pressure relief valve spring and plunger, driven gear stud, driven gear and cover plate. Torque the cover plate screws to 7-10 foot-pounds. Install the oil pressure relief valve plug with a gasket.

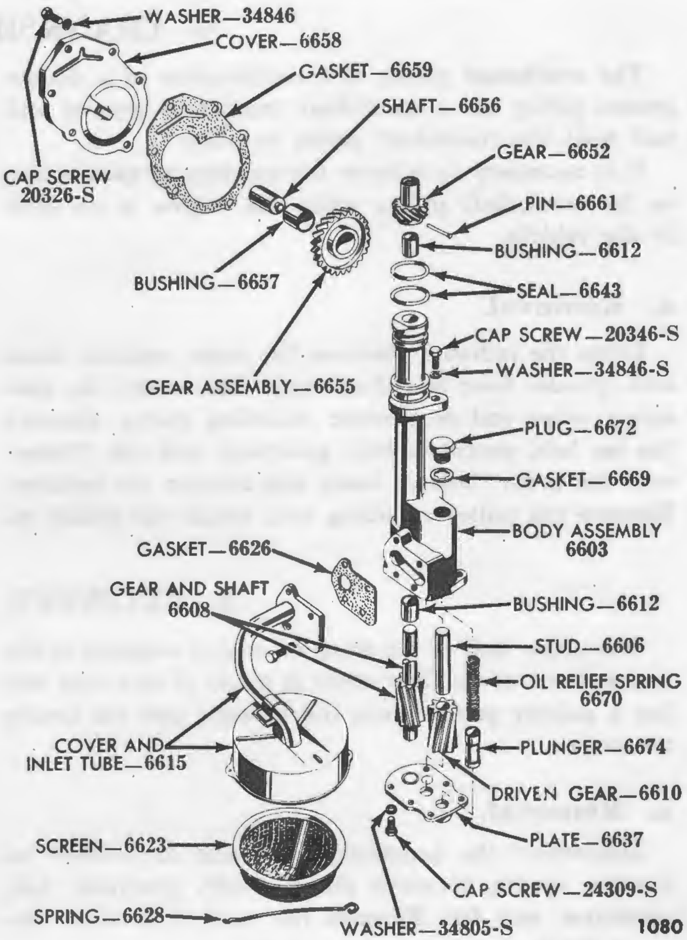

Fig. 20—Oil Pump Disassembled

Attach the cover and tube assembly. Install the screen and screen retaining spring.

(6) *INSTALLATION.* Slide the pump into the cylinder block. Avoid damaging the two oil seals at the top of the oil pump housing. Install the pump retaining screw and tighten it to 10-15 foot-pounds torque. Install the oil pan baffle and oil pan sump. Fill the crankcase with the proper amount and grade of oil.

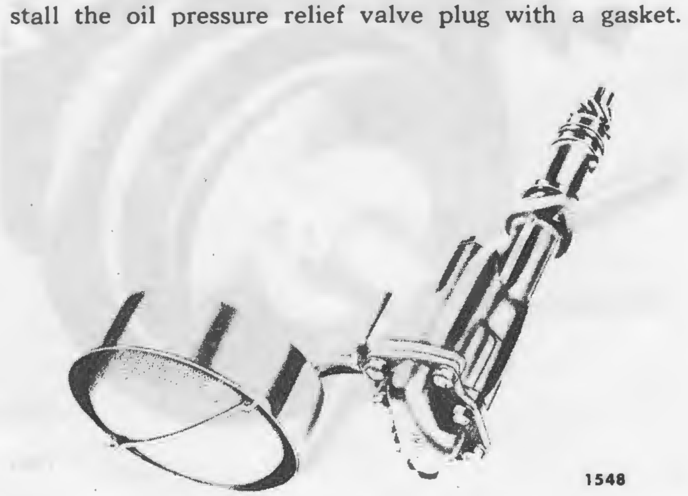

Fig. 19—Oil Pump and Screen Assembly

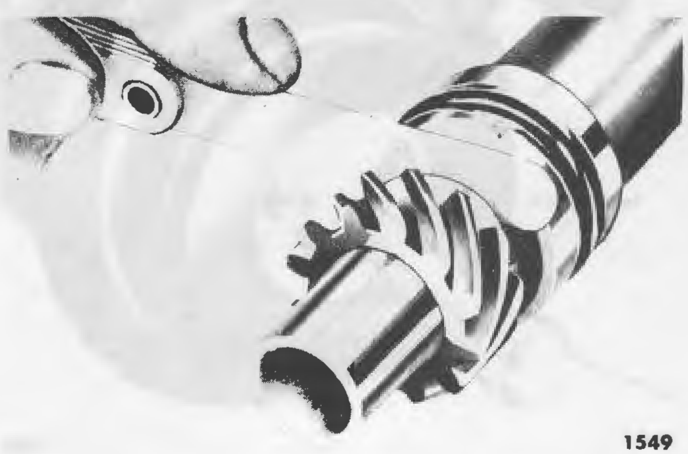

Fig. 21—Oil Pump End Clearance

4. CRANKSHAFT DAMPER

The crankshaft pulley is a combination of a double groove pulley and a crankshaft damper. A keyway and bolt hold the crankshaft pulley in place.

It is necessary to remove the radiator to gain access to the crankshaft pulley when the engine is installed in the vehicle.

a. Removal.

Drain the radiator. Remove the upper radiator hoses and cylinder head to radiator pipe. Disconnect the generator wires and accelerator retarding spring. Remove the fan belt, generator belt, generator, and fan. Disconnect the lower radiator hoses and remove the radiator. Remove the pulley retaining bolt, install the pulley removing tool (fig. 22) and remove the pulley from the crankshaft.

b. Installation.

Align the pulley with the keyway and start it on the crankshaft. Install the pulley replacing tool (fig. 23) and press the pulley on the crankshaft. Remove the tool and install the crankshaft retaining bolt and washer. Install the radiator. Connect the lower radiator hoses. Install the fan, generator, generator belt, and fan belt. Connect the generator wires and the accelerator retarding spring. Install the cylinder head to radiator pipes and upper radiator hoses. Fill the cooling system with coolant and check for leaks.

5. CYLINDER FRONT COVER

The upper half of the front oil seal is retained in the engine front cover. The cover is made of cast iron and has a pointer pressed into the forward side for timing the engine.

a. Removal.

Disconnect the generator wires and accelerator retracting spring. Remove the fan belt, generator belt, generator, and fan. Remove the road draft tube. Remove the front cover.

b. Oil Seal Replacement.

Remove the old packing from the groove in the covet. Install new packing and roll it in place with a round bar to make sure it seats properly (fig. 18).

NOTE: ***Soak new packing in light engine oil at least two hours before installation.***

c. Installation.

Position the lower edge of the cover first, tap the cover with a soft faced hammer until it seats in the block, and install the cover retaining screws. Tighten the screws to 15-18 foot-pounds torque.

CAUTION: ***The oil pan gasket may be damaged if the cover plate is not properly installed.***

Install the road draft tube. Install the fan, generator belt, and fan belt. Connect the generator wires and accelerator retracting spring.

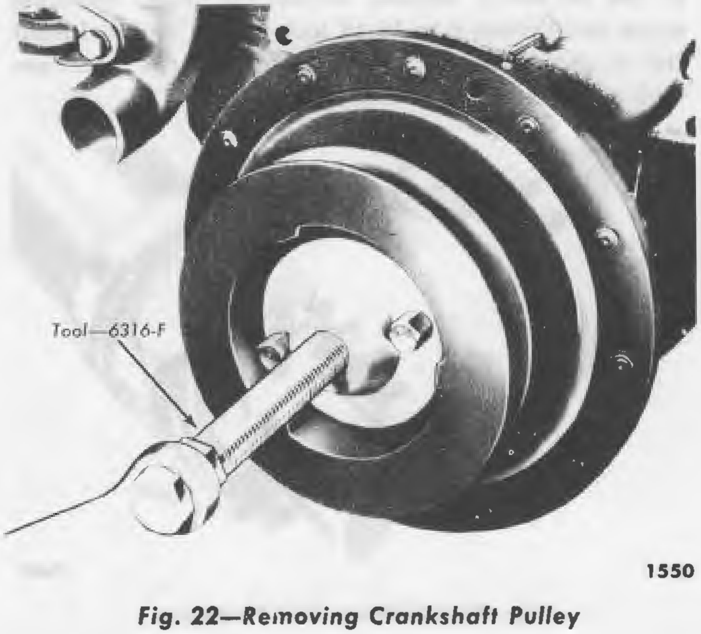

Fig. 22—Removing Crankshaft Pulley

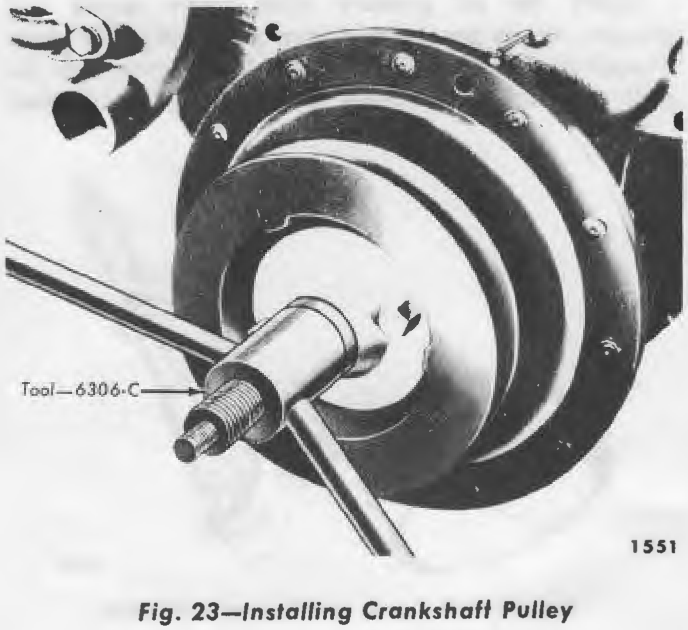

Fig. 23—Installing Crankshaft Pulley

6. VALVES. VALVE GUIDES, HYDRAULIC LIFTERS, AND TAPPETS

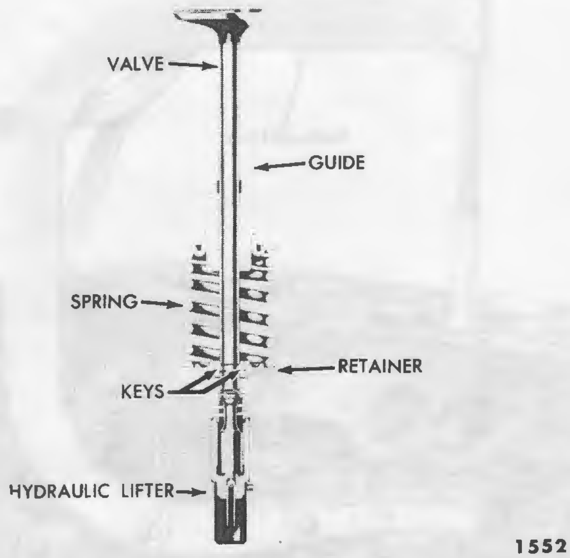

Fig. 24—Valve and Hydraulic Lifter

Early 1949 engines are equipped with hydraulic valve lifters. A cutaway view of the valve and hydraulic lifter assembly is shown in fig. 24. Adjustable type tappets (fig. 25) are used in late 1949, 1950, and 1951 engines.

a. Valves.

Intake and exhaust valves (fig. 26) are not interchangeable. Each valve should be marked or put in a rack so they can be installed in the same valve port from which they are removed.

Exhaust free valves are installed in 8-cylinder truck engines starting in February 1949. A change in the cap, valve, and retainer design was made in April, 1950. Both the old and new designs are shown in fig. 27.

(1) *REMOVAL.* Remove the intake manifold and cylinder heads. Compress the valve spring as shown in fig. 30 and remove the locks. In most cases the locks will fall free of the valve when the spring is compressed. NOTE: ***Cover oil passage holes before compressing valve spring or the locks may fall into the oil pan.***

Remove the valve spring compressor and lift the valve from the guide. To remove the cap from the free valve installation insert a short stem valve (standard length valve cut to 3 inches) in the guide, compress the

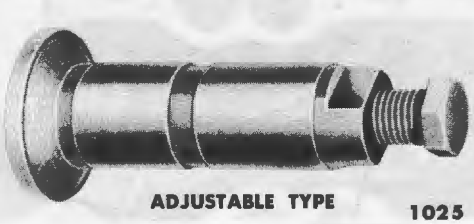

Fig. 25—Adjustable Type Tappet

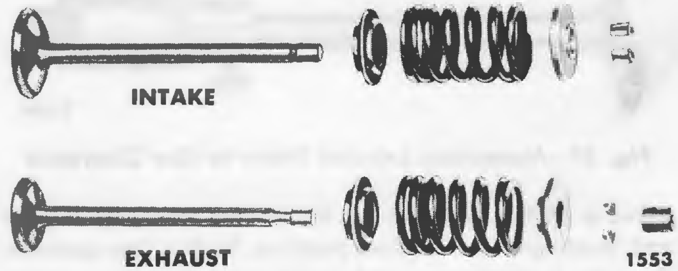

Fig. 26—Valves, Springs, and Retainers

valve spring and remove the cap. Remove the compressing tool and short valve. Remove the valve spring and retainers.

(2) *INSTALLATION.* Install the retainers and springs. Install the exhaust free valve caps using the compressing tool and short stem valve. Successful free valve operation depends on the clearance between the end of the valve stem and the inside of the cap. Fig. 27 illustrates the free type valve installation and the proper clearances.

CAUTION: ***If the cap inside depth is too shallow or the length between the face of the undercut and the end of the valve stem is too long, the cap will not lift the spring pressure from the valve and consequently the valve will not rotate. On the other hand, if the cap depth is too deep or the length between the face of the undercut and the valve stem end is too short, the clearance will be excessive, resulting in a high wear rate between cap and keys and possible valve breakage.***

The exhaust free. valve to cap clearance of 0.0002-0.004 inch can be measured accurately before the valve is installed in the engine by using the micrometer shown in fig. 28.

The clearance between the end of the valve stem and the inside of the cap can be checked after the parts are assembled in the engine. Rotate the crankshaft until the

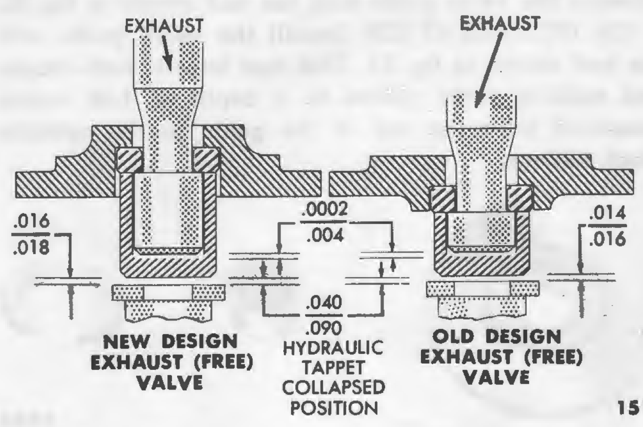

Fig. 27—Exhaust Free Type Valve Installation

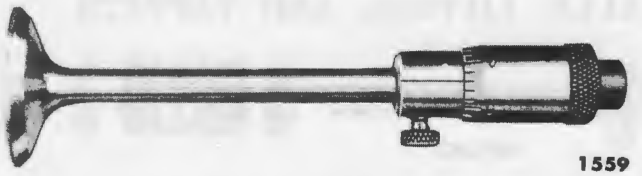

Fig. 28—Measuring Exhaust Valve to Cap Clearance

valve is off the seat and can be rotated freely by thumb and forefinger in the lifted position. In this free position the actual clearance can be measured. Locate an indicator on the valve head and note the reading while the valve is pushed in and pulled out. This clearance can be 0.0002 inch (providing the valve turns freely) but not over 0.004 inch maximum vertical movement. If the vertical movement exceeds 0.004 inch, polish the open end of the cap with a piece of fine emery cloth to bring the vertical movement of the valve to specified clearance. If the vertical movement is less than the specified amount (.0002 inch) grind off the end of the valve stem to provide the proper clearance.

An exhaust valve locking kit 8EQ 6534 (fig. 29) is available for replacing the locks, cap, and lower spring retainer.

Install the intake and exhaust valve locks as shown in figs. 30 and 31. Install the intake manifold and cylinder heads.

b. Guides.

Valve guides are the pressed-in type. Damage to the guide and block is avoided by using special tools when replacing guides.

(1) *INSPECTION*. Measure the valve guide inside diameter. The difference between the valve stem diameter and the guide inside diameter should not exceed 0.0037 inch. Replace guides that show excessive wear or are bellmouthed.

(2) *REMOVAL*. Remove the intake manifold and cylinder heads. Remove the valves, springs, and retainers. Remove the adjusting screw from the tappet. Remove the valve guide with the tool shown in fig. 32.

(3) *INSTALLATION*. Install the valve guide with the tool shown in fig. 33. This tool installs both intake and exhaust valve guides to a depth of 1.28 inches measured from the top of the guide to the cylinder block surface.

Fig. 29—Exhaust Valve Locking Kit

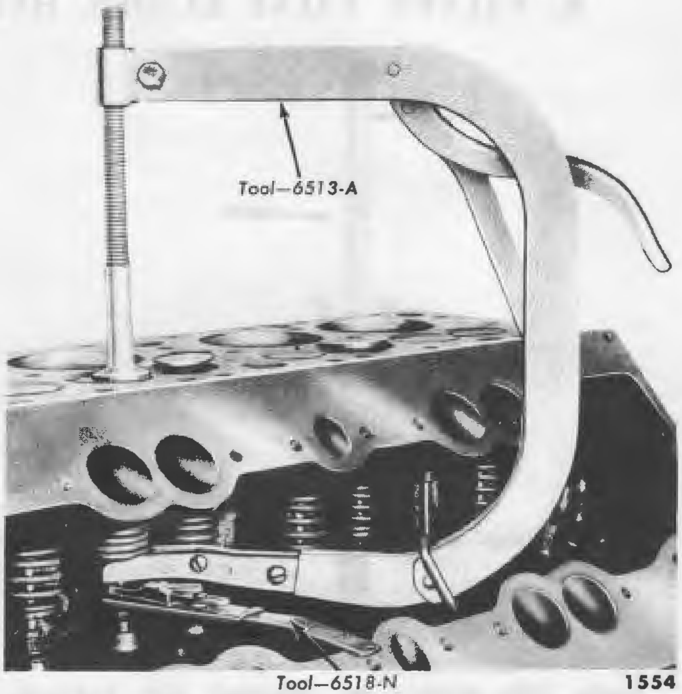

Fig. 30—Installing Intake Valve Locks

Install the valves, springs, and retainers. Install the intake manifold and cylinder heads.

c. Hydraulic Lifter.

Auxiliary oil lines are used to supply oil to the valve lifters from the engine lubricating system. The oil pressure to the lifters is reduced by passing the oil through the metering hole at the point of entry into the auxiliary oil lines. This restriction in combination with the oil pressure relief valve at the forward end of the valve chamber reduces the pressure for proper operation of

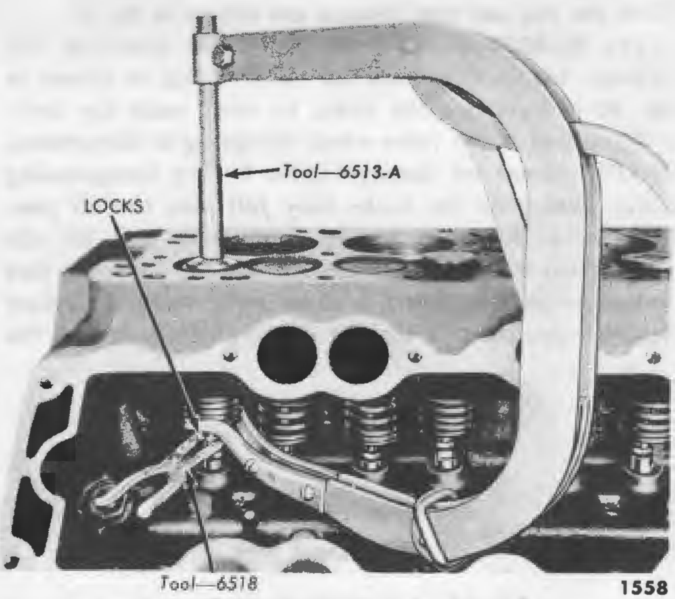

Fig. 31—Installing Exhaust Valve Locks

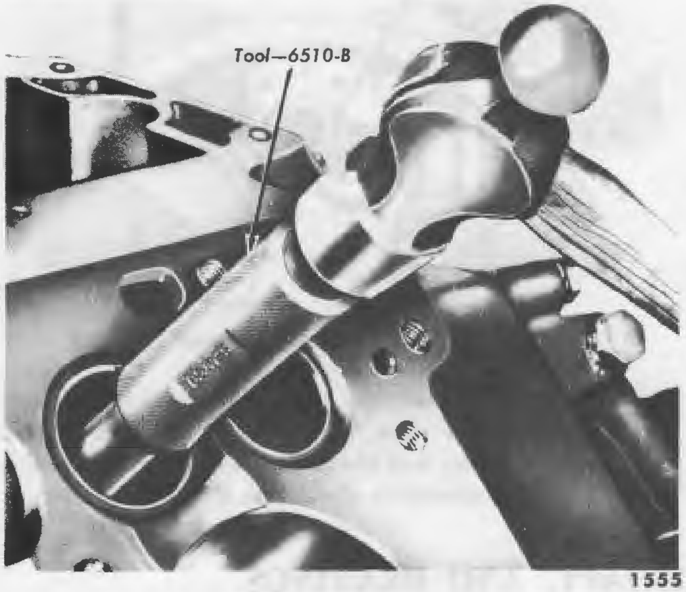

Fig. 32—Removing Valve Guide

the lifters. The meter hole is located under the oil pump drive idler gear cover.

To remove the hydraulic lifter body, it is necessary to remove the camshaft. To remove only the hydraulic cylinder assembly, it is necessary to remove only the valve. Fig. 34 shows the hydraulic lifter disassembled.

(1) *REMOVAL.* Remove the cylinder heads and intake manifold. Remove the valves, springs, and retainers. Lift the plunger and cylinder assembly from the lifter body.

NOTE: ***The plunger and cylinder assembly should slide freely from the lifter body. If an excessive***

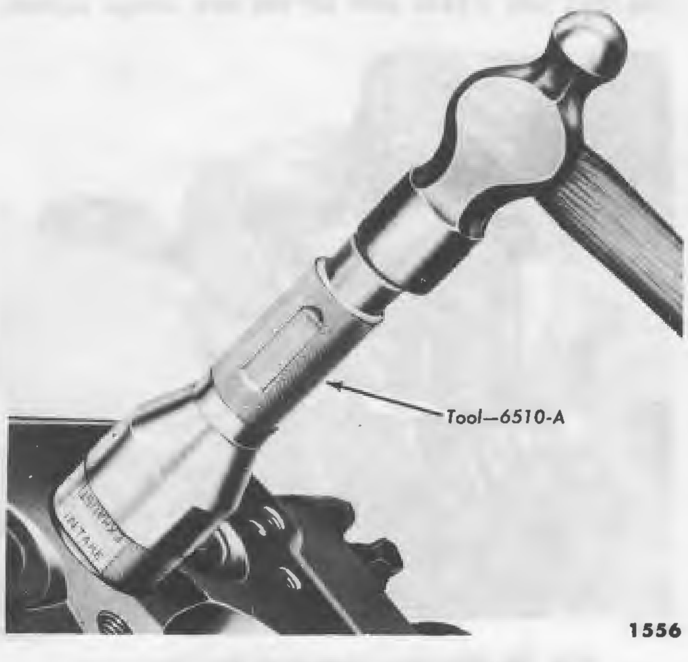

Fig. 33—Installing Valve Guide

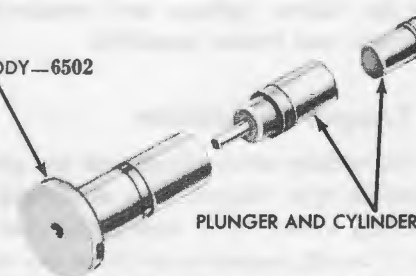

Fig. 34—Hydraulic Valve Lifter Disassembled

deposit of sludge or dirt prevents it from being so, it is necessary to remove the camshaft and remove the entire hydraulic lifter.

Immerse the lifter in solvent and wash until the cylinder and body separate. Disengage the spring by twisting the plunger and spring clockwise and pulling outward simultaneously. Bleed the hydraulic lifter by inserting a wooden stick in the oil inlet hole (fig. 35) to unseat the ball check valve and allow the oil to drain. If the plunger cannot be removed after bleeding, discard the unit.

NOTE: ***Do not interchange hydraulic lifter parts. The plunger and cylinder are matched to a selective fit at time of assembly.***

(2) *CLEANING.* Wash all parts thoroughly with solvent and dry immediately with compressed air.

(3) *INSPECTION.* Examine the plunger for scored surfaces and check for a free fit between cylinder and plunger. Inspect the body for wear, pits, and scores. Replace defective parts. Test for free movement of the ball check valve (fig. 35).

(4) *LIFTER TEST.* Push the plunger into the cylinder quickly then release the pressure. If the plunger rises, the unit is operative (fig. 35).

(5) *INSTALLATION.* Install the plunger in the cylinder and the cylinder in the body. If the lifters were removed, install the valve lifter and camshaft in the

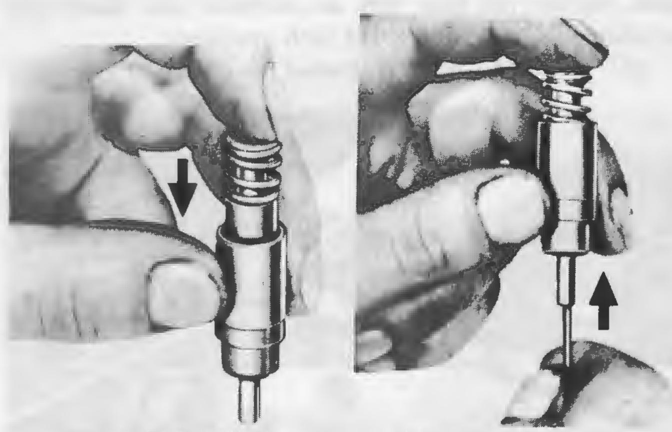

Fig. 35—Testing Hydraulic Lifter

block. Install the valves, springs, and retainers. Install the cylinder heads and intake manifold.

d. Valve Tappet Clearance.

Procedure for setting valve clearances are given here for the adjustable type tappet. The adjustable tappet has a self-locking screw. The hydraulic lifter is self-adjusting and it is only necessary to check the clearance.

(1) *ADJUSTABLE TYPE TAPPET.* Remove the intake manifold to make tappet adjustments. Valve clearance is set as shown in fig. 36 when the engine is cold. The valve clearance should be:

	1949 and Early 1950	Late 1950 and 1951
Intake	0.010-0.012 inch	0.010-0.012 inch
Exhaust	0.014-0.016 inch	0.016-0.018 inch

(2) *HYDRAULIC VALVE LIFTER.* Remove the intake manifold. Rotate the crankshaft until the lifter is on the heel of the cam. Compress the plunger to the bottom of its stroke and check the valve stem to plunger clearance. This clearance should be 0.040-0.090 inch.

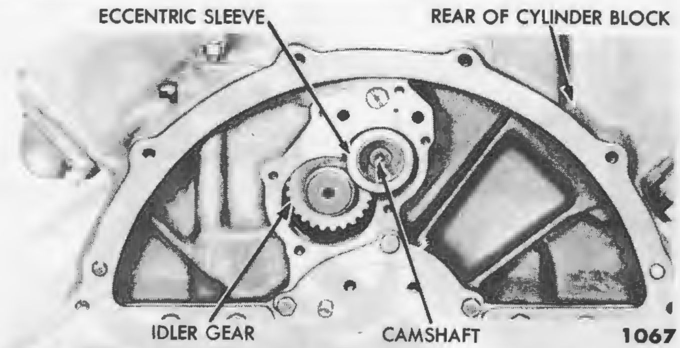

Fig. 37—Fuel Pump Eccentric Sleeve Location

7. CAMSHAFT GEAR, CAMSHAFT, AND BEARINGS

Procedures for removal and installation of the camshaft gear, camshaft, and camshaft bearings are given below. The camshaft gear can be removed with the engine in the truck. To remove the camshaft or replace the camshaft bearings it is necessary to remove the engine.

a. Camshaft Gear Replacement.

The camshaft gear is an aluminum bolt-on type. The bolt holes are spaced irregularly so the gear cannot be installed improperly. Four bolts hold the gear to the camshaft flange.

(1) *REMOVAL.* Disconnect the generator wires and accelerator retracting spring. Remove the fan belt, generator belt, generator, and fan. Remove the road draft tube and front cover. Remove camshaft gear retaining bolts, locking ring, and camshaft gear.

(2) *INSPECTION.* Check the gear for cracks and chipped teeth. Check the backlash. If backlash is excessive, replace the gear with an oversize gear. Gears are available in 0.006 and 0.012 inch oversizes.

(3) *INSTALLATION.* Install the camshaft gear with the timing marks aligned. Install the lock ring and retaining bolts. Tighten the bolts to 15-18 foot-pounds torque. Bend the lock ring tabs against the head of each bolt. Install the engine front cover. Tighten the bolts to 15-18 foot-pounds torque. Install the road draft tube. Install the fan, generator, generator belt, and fan belt. Connect the generator wires and accelerator retracting spring.

b. Camshaft Replacement.

It will be necessary to replace the camshaft when the cam lobes are worn to such an extent that the valve lift is less than 0.3375 inch for old design exhaust free valves (fig. 27), and 0.3315 inch for the new design exhaust

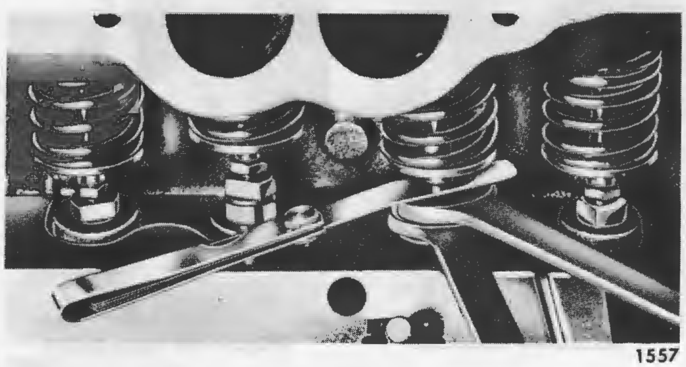

Fig. 36—Setting Valve Clearance

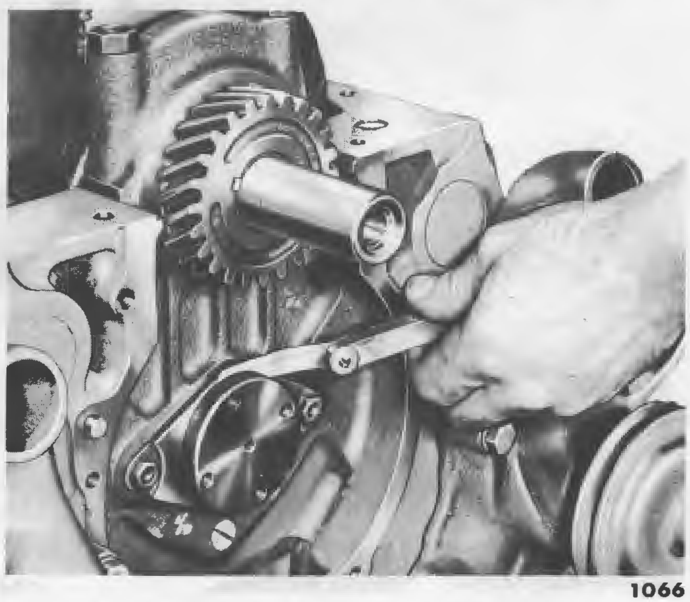

Fig. 38—Checking Camshaft End Clearance

free valves. Make lift measurements when the engine is cold and the tappet clearance is within specifications.

To remove the camshaft it is necessary to remove the engine from the chassis due to the eccentric sleeve that operates the fuel pump push rod at the rear of the camshaft. This sleeve (fig. 37) must be removed before the camshaft can be removed from the engine.

Check the camshaft end clearance between the camshaft flange and the thrust plate (fig. 38). This clearance should be 0.003 to 0.006 inch. .

(1) *REMOVAL.* Remove the engine from the chassis. Remove the cylinder heads and intake manifold. Remove the valve assemblies or block the valves in the open position. Remove the flywheel housing, clutch pressure plate assembly and disc, and flywheel. Remove the oil pump drive cover and fuel pump eccentric sleeve. Invert the engine so the tappets will fall away from the camshaft, or with the engine upright, pull the tappets away from the camshaft and hold them in place with rubber bands. Remove the engine front cover, camshaft gear and camshaft thrust plate. Turn the camshaft away from the oil pump idler gear, and remove the camshaft from the engine. Fig. 39, shows the camshaft and related parts disassembled.

CAUTION: ***Exercise care to avoid gouging the camshaft bearings with the cam lobes when removing the camshaft.***

(2) *INSPECTION.* Inspect the camshaft journal surfaces for grooves or scratches. Check the camshaft runout by setting the end journals in "V" blocks and using a dial indicator on the center journal. Runout should not exceed 0.005 inch. Inspect the oil pump drive gear and oil pump idler gear for worn, chipped, or broken teeth. Replace gears if worn or broken. Figure 40 shows removal and installation of the oil pump idler gear.

(3) *INSTALLATION.* Guide the camshaft through the bearings being careful not to gouge the bearings. Install the camshaft thrust plate, camshaft gear and engine front cover. Turn the engine upright or release the tappets if the engine remained upright during the camshaft removal procedure. Install the fuel pump

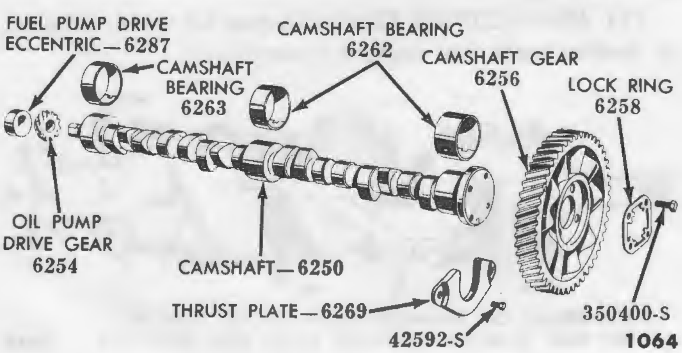

Fig. 39—Camshaft and Related Parts

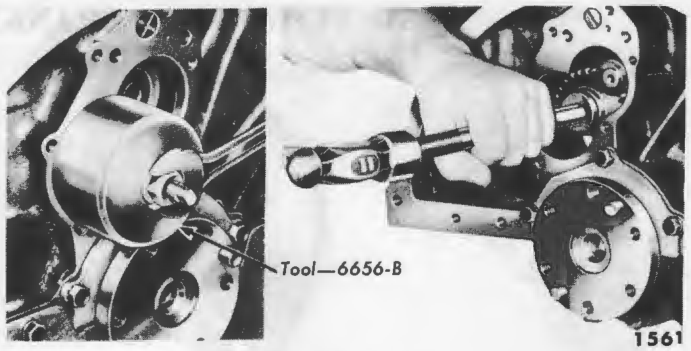

Fig. 40—Oil Pump Idler Gear

eccentric sleeve and oil pump drive cover. Install the flywheel, clutch pressure plate assembly and disc, and flywheel housing. Tighten the flywheel bolts to 75-85 foot-pounds torque. Install valve assemblies or remove blocks from under the valve heads. Install the cylinder heads and intake manifold. Tighten the cylinder head bolts to 65-70 foot-pounds torque and the intake manifold bolts to 25-30 foot-pounds torque. Install the engine in the chassis.

c. Camshaft Bearing Replacement.

Under normal usage the camshaft bearings will not need replacement. They should be replaced if they have been damaged due to lack of lubrication or worn because of severe usage. It is necessary to remove the engine from the chassis and then disassemble it to gain access to the camshaft bearings.

(1) *REMOVAL.* Remove the shaft, oil pan, and oil pump. Disconnect the connecting rods and remove the piston and rod assemblies. Remove the main bearing caps and crankshaft. Remove the tappets. Tap the bearings out as shown in fig. 41.

(2) *INSTALLATION.* Tap the new bearings into place with the tool shown in fig. 41. Install the tappets, crankshaft, and main bearing caps. Tighten the main bearing bolts to 120-130 foot-pounds torque. Install the piston and rod assemblies. Fasten the connecting rods to the crankshaft. Tighten the connecting rod nuts to 52-60 foot-pounds torque. Install the oil pump, oil pan, and camshaft.

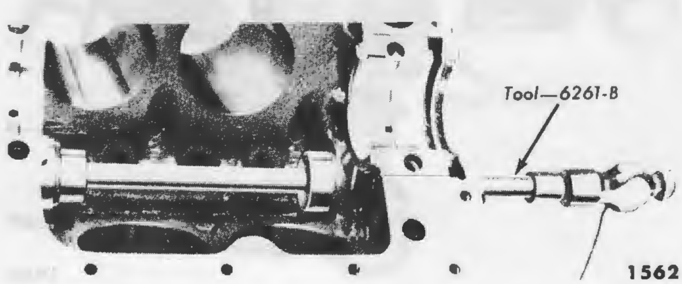

Fig. 41—Replacing Camshaft Bearings

8. FLYWHEEL, CRANKSHAFT, AND BEARINGS

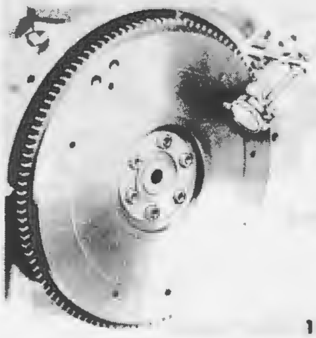

Fig. 42—Checking Flywheel Runout

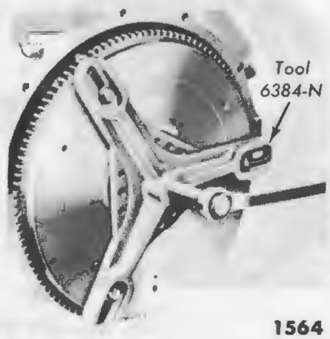

Fig. 43—Removing Flywheel

The procedures given in this section cover the removal, inspection, repair, and installation of the crankshaft, rear oil seal, main bearings, crankshaft gear, and flywheel.

a. Flywheel.

The flywheel is mounted on the crankshaft rear flange. The rear face of the flywheel has a friction surface for clutch plate engagement. The starter ring gear is shrunk to the flywheel and can be removed by relieving the fit.

(1) *INSPECTION.* Check the flywheel runout (fig. 42). The runout should not exceed 0.005 inch. If the runout is excessive, remove the flywheel and check the crankshaft flange runout. If the flange is at fault replace the crankshaft. Replace or machine the flywheel if the crankshaft flange runs true.

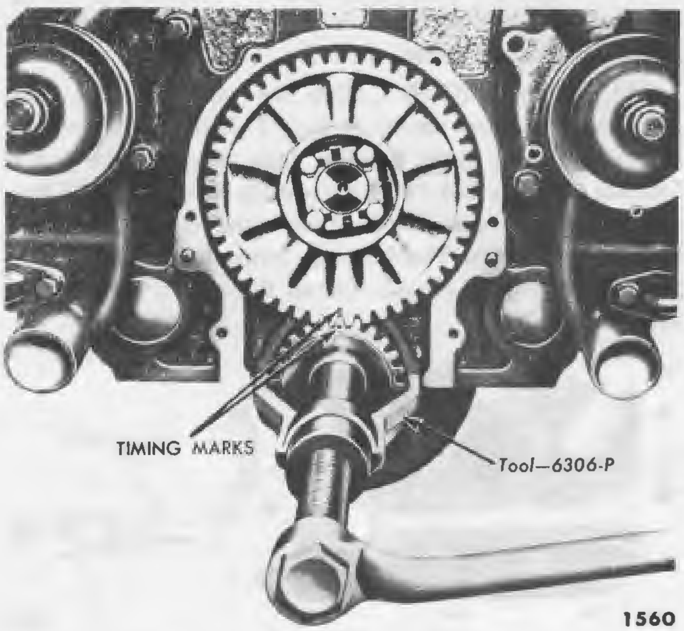

Fig. 44—Removing Crankshaft Gear

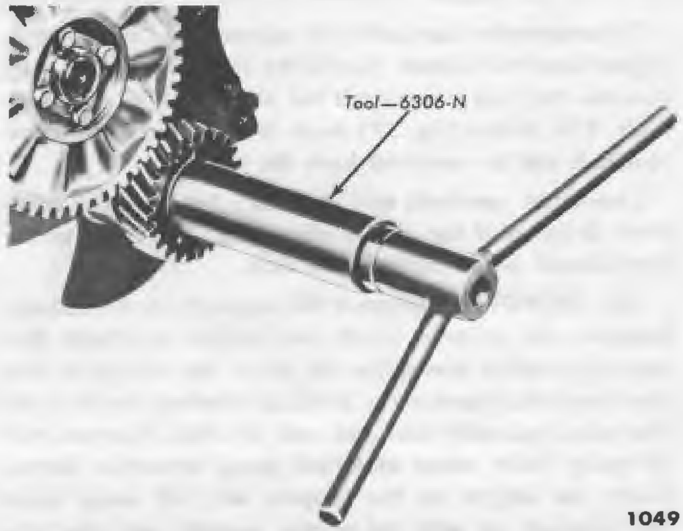

Fig. 45—Installing Crankshaft Gear

Inspect the flywheel ring gear for cracks and worn, chipped, or broken teeth. Check the ring gear runout. If the runout exceeds 0.010 inch, replace the ring gear.

(2) *REMOVAL.* Remove the engine from the chassis. Remove the starter, flywheel housing, and clutch pressure plate and disc. Remove the flywheel retaining bolts and locking ring. Pull the flywheel as shown in fig. 43.

(3) *INSTALLATION.* Align the flywheel on the dowel pins, install the locking ring, and install the bolts. Torque the bolts to 75-85 foot-pounds. Install the clutch pressure plate assembly and disc. Tighten the bolts to 15-18 foot-pounds. Install the flywheel housing and tighten the bolts to 45-50 foot-pounds torque. Install the starter and tighten the starter bolts to 15-20 foot-pounds torque.

b. Crankshaft Gear.

The crankshaft gear is pressed on the crankshaft and keyed in place. A timing mark on one tooth of this gear is used in conjunction with the camshaft gear timing mark for timing the engine. These timing marks are shown in fig. 44.

(1) *INSPECTION.* Check the gear for worn, chipped, or broken teeth and replace if necessary.

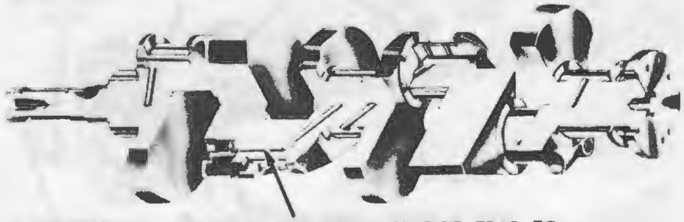

Fig. 46—Crankshaft Oil Passages

(2) *REMOVAL.* Remove the crankshaft damper, engine front cover, and oil pan. Remove the front main bearing cap. Remove the crankshaft gear (fig. 44).

(3) *INSTALLATION.* Align the crankshaft gear keyway with the key on the crankshaft and the timing mark on the camshaft gear. Press the gear on as shown in fig. 45. Install the front main bearing cap and tighten the bolts to 120-130 foot-pounds torque. Install the oil pan, engine front cover, and crankshaft damper.

c. Crankshaft.

Crankshafts are made of cast alloy forging steel with integral counter weights and are both statically and dynamically balanced. Drilled oil passages (fig. 46) provide lubrication to main and connecting rod bearings.

The flywheel is fastened to the crankshaft rear flange by six bolts. The crankshaft gear and the damper are keyed to the crankshaft. A retaining bolt prevents damper movement along the crankshaft axis.

Procedures for crankshaft removal, repair, and installation are given here. Fig. 47 shows the crankshaft and its related parts.

(1) *REMOVAL.* Remove the engine from the chassis and mount it on an engine work stand. Remove the spark plugs from the cylinder heads. Remove the oil pan, oil pump, flywheel and engine rear plate. Remove the crankshaft damper, engine front cover, and oil slinger. Invert the engine. Disconnect the connecting rods and push the rod and piston assemblies away from the crankshaft. Disconnect and remove the front main bearing cap. Remove the crankshaft gear with the gear puller shown in fig. 44. Disconnect and remove the intermediate and rear main bearing caps. Remove the crankshaft from the block.

(2) *REAR OIL SEAL REPLACEMENT.* The upper half of the rear oil seal is held in a retainer that bolts to the cylinder block rear surface. The lower half is held in the oil pan.

To remove the upper oil seal retainer with the crankshaft in place, it is necessary to remove the engine from the chassis and remove the oil pan, flywheel, engine rear plate, and oil pump drive cover. Remove the retainer by rotating it around the crankshaft as shown in fig. 48. Remove the packing and clean the retainer groove. It is not necessary to remove the oil pump drive cover if the crankshaft is removed.

NOTE: ***Soak new packing in engine oil for at least two hours before installing.***

"Roll" the new packing into the retainer groove (fig. 49) and check to see that the packing ends come flush with the retainer ends. Incorrect packing length may result in oil leaking from the flywheel housing.

Rotate the retainer around the crankshaft into place.

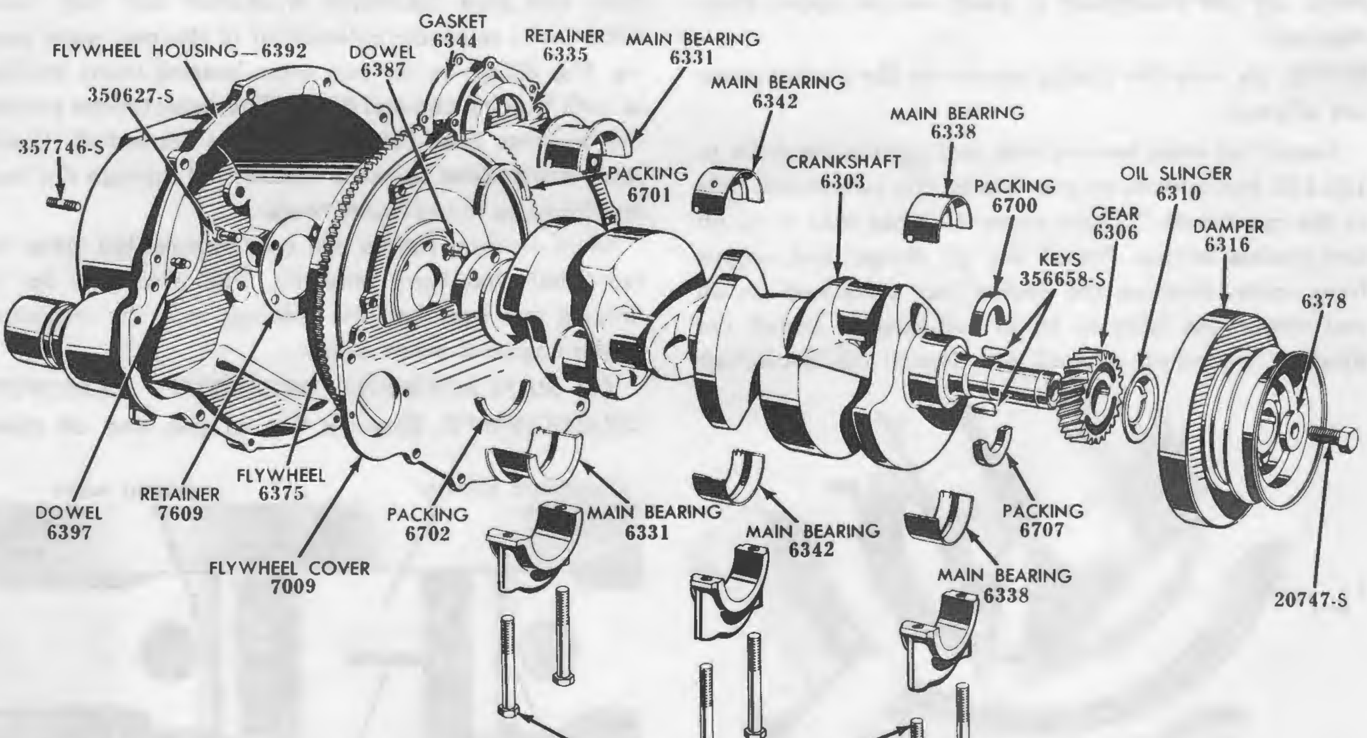

Fig. 47—Crankshaft and Related Parts

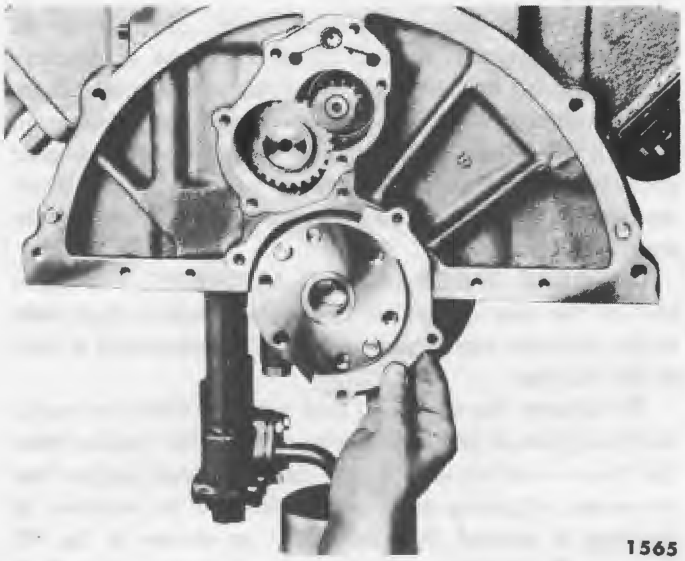

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Fig. 48—Removing Rear Oil Seal Retainer

Install the retainer bolts and tighten them to 5-8 foot-pounds torque. Install the oil pump drive cover and tighten the bolts to 7-10 foot-pounds torque. Install the engine rear plate and tighten the bolts to 50-60 foot-pounds torque. Install the flywheel and oil pan. Install the engine in the chassis.

(3) *INSTALLATION.* Install the crankshaft gear on the crankshaft. With the engine inverted on the work stand, lay the crankshaft in place on the upper main bearings.

NOTE: ***Be sure the timing marks on the timing gears are aligned.***

Install the main bearing caps and tighten the bolts to 120-130 foot-pounds torque. Fasten the connecting rods to the crankshaft. Tighten connecting rod nuts to 52-60 foot-pounds torque. Install the oil slinger and engine front cover. Position the engine rear plate and install and torque the bolts tc 50-60 foot-pounds. Install the flywheel, oil pump, and oil pan. Install the crankshaft

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Fig. 49—"Rolling" Packing Into Retainer Groove

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Fig. 50—Rear Main Bearing

damper. Install the spark plugs in the cylinder heads. Install the engine in the chassis.

d. Main Bearing Replacement.

The main bearing inserts are held in place by indentations on the end of the inserts which locate themselves in the machined notches in the cylinder block and cap.

Main bearings have a copper-lead overlay on a steel back. If this overlay becomes damaged, the insert should be replaced.

The rear main bearing has flanges that control crankshaft end play. Excessive crankshaft end play (over 0.008 inch) requires replacement of the rear main bearing. Fig. 50 shows the rear main bearing insert location in both bearing cap and block. The indentations prevent the bearings from rotating with the crankshaft. Crankshaft longitudinal thrust is transmitted through the bearing flange to the cylinder block.

Main bearing inserts are easily accessible when the crankshaft has been removed. The procedure for removing and installing the bearings with the crankshaft in the engine is given below.

(1) *REPLACEMENT WITHOUT REMOVING CRANKSHAFT.* Remove the oil pan and oil pump.

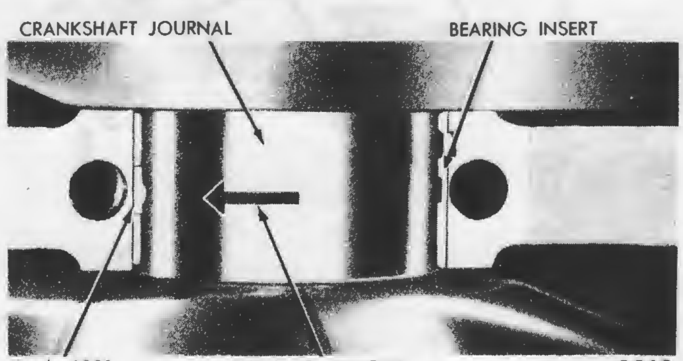

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Fig. 51 Removing Main Bearing

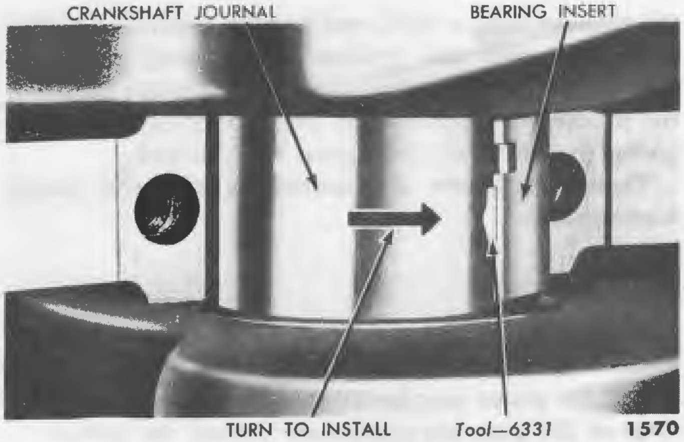

Fig. 52—Installing Main Bearing

Fig. 54—Removing Piston Rings

Remove one bearing cap; leave the other two tight. Insert the bearing removing tool in the crankshaft oil hole and rotate the crankshaft so the removing tool presses on the plain end of the bearing (fig. 51). Continue rotating the crankshaft until the bearing is displaced.

Coat the new bearing with a film of engine oil. Start the plain end of the bearing between the crankshaft journal and the block. Rotate the crankshaft so the removing tool presses against the indented end of the bearing (fig. 52). Continue rotating the crankshaft until the bearing seats.

Install the bearing cap and torque the bolts to 120-130 foot pounds. Replace the two remaining bearings in the same manner. Install the oil pump and oil pan.

9. PISTON AND CONNECTING ROD ASSEMBLIES

Engines made in 1949 and early 1950 are equipped with 4-ring split skirt aluminum pistons. Late 1950 and 1951 engines use a 3-ring solid skirt aluminum piston with controlled expansion.

Fig. 53—Removing Ridge From Cylinder

The piston pin is held in place with a clip retainer at each end. A notch is provided in the piston at the top of the retainer groove to facilitate retainer removal

The connecting rod has oil squirt holes for increased piston lubrication. Oil from the crankshaft oil hole passes through the hole in the connecting rod bearing, through the connecting rod squirt holes, and is squirted on the cylinder wall.

The connecting rod bolts are integral with the rod. Lock nuts prevent the connecting rod nuts from vibrating loose.

The following procedures cover removal, disassembly, assembly, and installation of the connecting rod and piston assemblies.

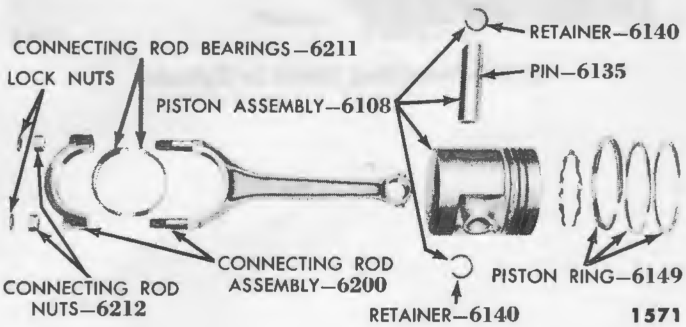

Fig. 55—Connecting Rod and Piston, Disassembled

a. Removing Piston and Connecting Rod Assemblies.

Remove the cylinder heads, oil pan, and oil pump. Check the top of the cylinder bore above the piston ring travel area for a ridge. If any appreciable ridge exists, it must be cut away before removing the piston and rod assembly.

To remove the ridge, rotate the crankshaft until the piston is at the bottom of the cylinder. Place a cloth on the piston to catch the ridge cutter chips. Install the ridge cutter, set the cutting tool just below the ridge (not more than $\frac{1}{32}$ inch) and adjust it to the cylinder bore size. Cut the ridge away by rotating the cutter (fig. 53).

Turn the crankshaft to bring the piston to the top of the cylinder and carefully remove the cloth and chips. Turn the crankshaft until the piston is at the bottom of the stroke. Remove the lock and retaining nuts, bearing cap, and bearing. Push the rod assembly away from the crankshaft and remove it from top of the cylinder bore. If the connecting rod bearings are to be used again, mark them to correspond with the cylinder from which they are removed.

b. Disassembly.

Spread the rings (fig. 54) and remove them from the piston. Rotate the piston pin retainer until the opening is toward the bottom of the piston or away from the notch. Use needle nose pliers or a screwdriver, cover the retainer with a cloth, and pry the retainer out. The cloth will catch the retainer as it springs from the groove. Use a brass drift to remove the piston pin from the piston. Where the piston pin is very tight, heat the piston in hot water, then press the pin out.

Figure 55 shows the connecting rod and piston disassembled.

c. Assembly.

Oil the piston pin and press it into the piston and connecting rod bushing. Install the retainers at each end of the piston pin. Install the piston rings. Space the rings so the gaps are equidistant around the piston.

d. Installation.

Turn the crankpin to the bottom of the stroke. Cover the cylinder wall with engine oil. Start the piston and connecting rod assembly into the cylinder with the cylinder identification number (stamped on the connecting rod) away from the camshaft. Compress the rings (fig. 56) and tap the piston into the cylinder. Guide the connecting rod onto the crankpin so the bearing surfaces do not get marred. Install the connecting rod bearing inserts and bearing cap with the cylinder identification number corresponding to the connecting rod (fig. 57). Install the connecting rod nuts and tighten them to 52-60 foot-pounds. Tighten the lock nuts to 4-5 foot-pounds torque. Install the oil pump, oil pan, and cylinder heads.

Fig. 56—Installing Piston In Cylinder

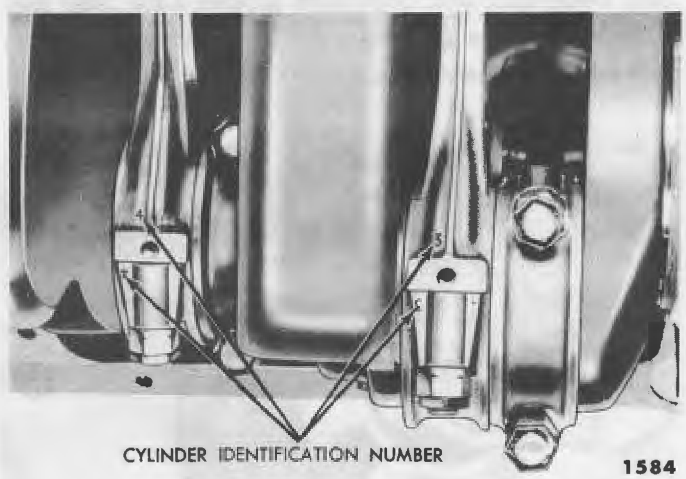

Fig. 57—Connecting Rod and Cap Installation

Part ONE

POWER PLANT

Chapter

VI

Ignition, Fuel, and Cooling System

The ignition, fuel and cooling systems are all necessary components of the engine itself. However, due to the fact that service on these systems is performed separately from engine service they have been grouped together here in one chapter. Another advantage to this grouping, lies in the fact that most quick service operations involve one or more of these systems, and you now have the service information necessary for performing quick service operations in one place, arranging in easy to find sections as listed above.

Information contained in this chapter includes adjustments, testing, replacement and repair of the parts which are included in the ignition system, fuel system, and cooling system.

1. IGNITION SYSTEM

The ignition system consists of the distributor assembly which includes the condenser, the coil, the spark plugs, and the necessary wires and terminals for connecting these units.

Information on how to perform all repairs and adjustments on the ignition system with the exception of the distributor, are given in this section.

Spark plug replacement, testing, and adjustment are covered in "a. Spark Plugs." "b. High Tension (Secondary) Wires" gives procedures for replacement of the secondary ignition wires on both the 6 and 8-Cylinder engines. Coil replacement and testing are procedures described in "c. Coil." "d. Timing" gives the engine ignition timing procedure.

a. Spark Plugs.

Spark plugs should be cleaned and inspected, adjusted, and tested at least every 5000 miles.

(1) *REMOVAL.* Pull the wire off each spark plug. Use compressed air to clean the area around each spark plug. Remove the plugs with a spark plug wrench. Be sure to remove the spark plug gasket when the plug is removed.

(2) *CLEANING.* The main object in cleaning plugs is to remove all of the carbon and lead deposits from the insulator, shell, and electrodes. This can be done on a sand blast cleaner. Do not prolong the use of the abrasive blast as it will wear the insulator and damage the plug. A thorough cleaning of spark plugs should always include removing carbon and other deposits from the threads with a stiff wire brush. These threads are the means of carrying the heat away from the plug. Any deposits will retard the heat flow from the plug to the cylinder head, causing overheating and pre-ignition.

The electrode construction (fig. 1) is such that the cleaning process sometimes does not remove the deposits from all surfaces of the electrodes. Therefore, it is important to clean the electrode surfaces with a small file of the type used on distributor contacts. Dress the electrodes to secure flat parallel surfaces on both the center and side electrode.

By restoring the flat surfaces and providing sharp edges on the electrodes, the voltage required to jump the gap is reduced and the spark plug performance is improved. A visual inspection will indicate when the plug has been properly cleaned. The insulator appearance should be white and the metal case clean.

After cleaning, examine the plug carefully for cracked or broken insulators, badly pitted electrode, or other signs of failure and replace as required.

(3) *ADJUSTMENT*. Set the spark plug gap (0.025-0.028 inch). All adjustments should be made by bending the side electrode only.

(4) *TESTING*. After setting the gap, test the plugs on an approved tester. Compare the sparking efficiency of the cleaned and re-gapped plug with a new plug. Replace the plug if it fails to meet requirements.

During this test, check the plug for pressure leakage at the insulator seal. Cover with oil the shoulder of the plug where the insulator projects through the shell and the top of the plug where the center electrode and terminal project from the insulator. Place the plug under pressure and if oil bubbles appear, the plug is leaking and must be replaced. If the plug is satisfactory, wipe it clean before installing it in the engine.

(5) *INSTALLATION*. Clean the area around the spark plug port, to ensure proper seating of the plug gasket. Use a new gasket when installing a spark plug.

After the plugs are installed, connect the spark plug wires and operate the engine until it reaches its normal operating temperature. Remove the wires, tighten each plug to the proper torque (24-30 foot-pounds), and reconnect the wires.

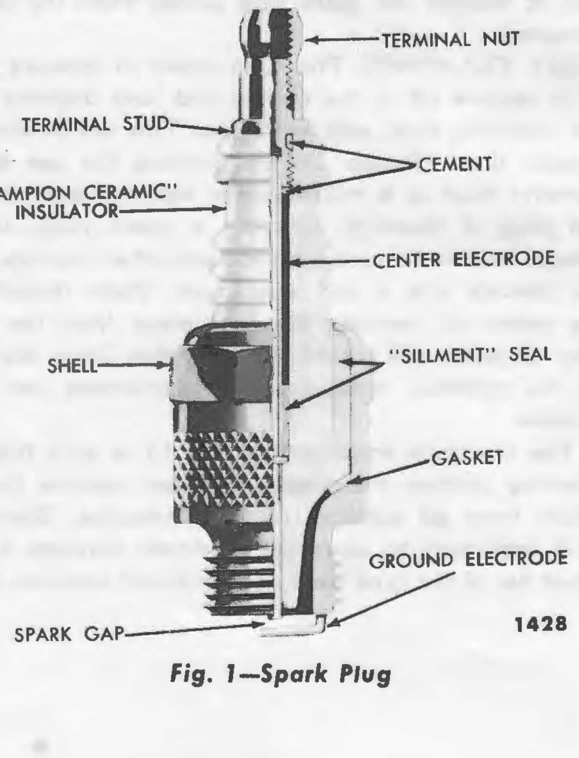

Fig. 1—Spark Plug

Fig. 2—Installing Wire Terminal

b. High Tension (Secondary) Wires.

The high tension wires include the wires connecting the distributor cap to the spark plugs, and the wire connecting the center terminal of the distributor cap to the center terminal of the ignition coil.

At regular intervals clean and inspect the wires for cracked insulation and loose terminals. If any of these conditions exist, replace the wires.

The wiring used for the ignition systems is available in sets or in 100 foot rolls. When making up an ignition set from the roll wire, use the old wires for a pattern to obtain the correct length. Clip the terminals on the end of the wire with terminal pliers as shown in fig. 2.

(1) *REPLACEMENT (6-CYLINDER)*. A spark plug wire set for 6-cylinder engines, which consists of parts shown in fig. 3, is available from Ford Dealers.

(a) REMOVAL. Disconnect the wires at the spark plugs and at the distributor cap and pull the wires out of the ignition coil mounting strap bracket. Disconnect the ignition coil to distributor high tension wire assembly from the coil and distributor cap.

(b) INSTALLATION. Remove the shielding cover on the old wire, place it over the same spark plug wire in the new set, and position wires in the bracket as shown in fig. 4. Connect the proper wires to the proper spark plugs. Install the weather seals on the distributor end of the wires and insert the end of the wire in the correct socket in the distributor cap. Be sure the wires are forced all the way down into their sockets and that they are held firmly in position. Sockets are numbered to identify the correct socket for inserting the wire which will con-

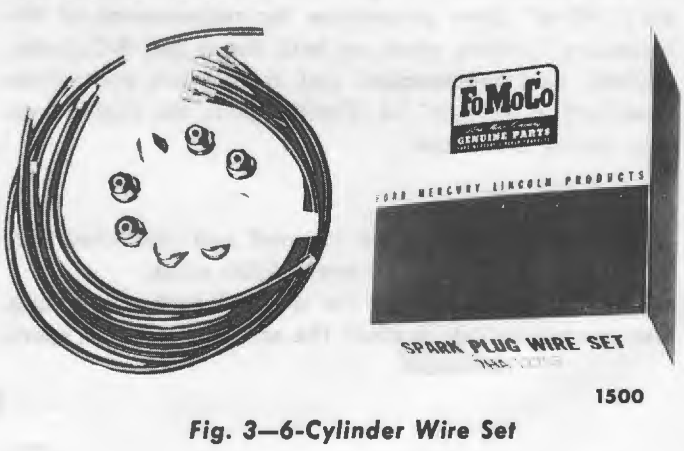

Fig. 3—6-Cylinder Wire Set

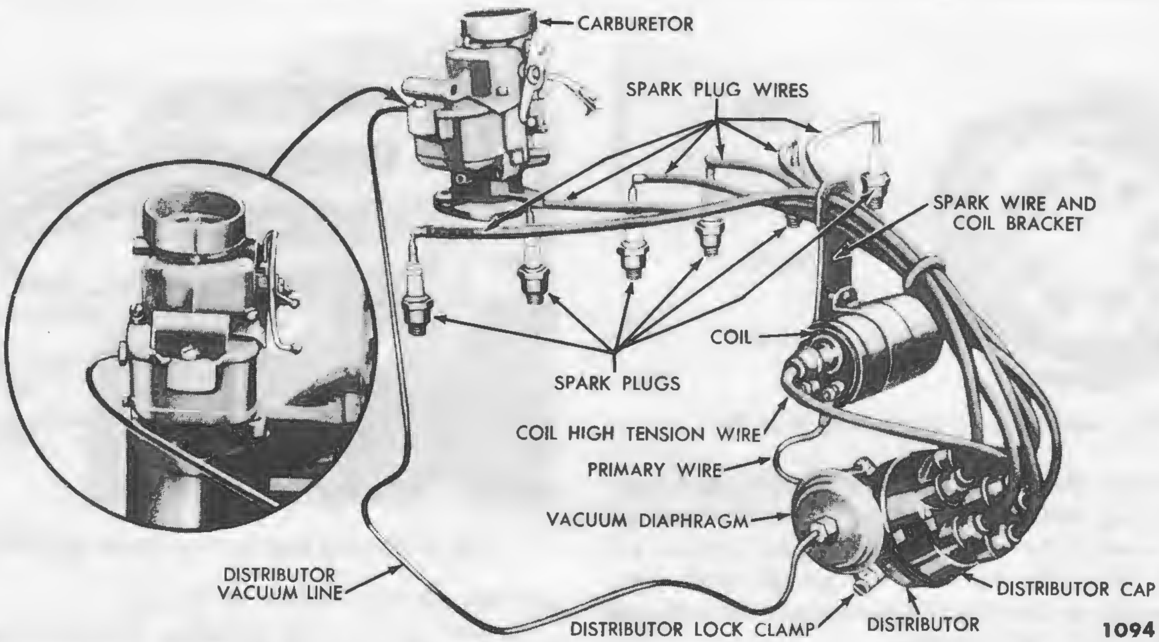

Fig. 4—6-Cylinder Ignition Wire Installation

nect the distributor and the correct spark plug. Install the coil to distributor wire and push the weather seals into position.

(2) *REPLACEMENT (R-Series).* Two types of ignition wire brackets (figs. 5 and 6) are used on the 8-cylinder engines. The procedure for replacing the wires is the same except that on the spread type bracket be sure to install the wires in the proper holes in the bracket.

A spark plug wire set containing the parts shown in figure 7 is available from Ford Dealers.

(a) REMOVAL. Disconnect the wires from the spark plugs and the distributor cap. Pull the wires out of the mounting brackets. Disconnect the coil high tension wire from distributor cap and coil.

(b) INSTALLATION. Place the shielding on the No. 8 wire and position the wires in the brackets as shown in figs. 5 and 6. Install the weather seals in the dis-

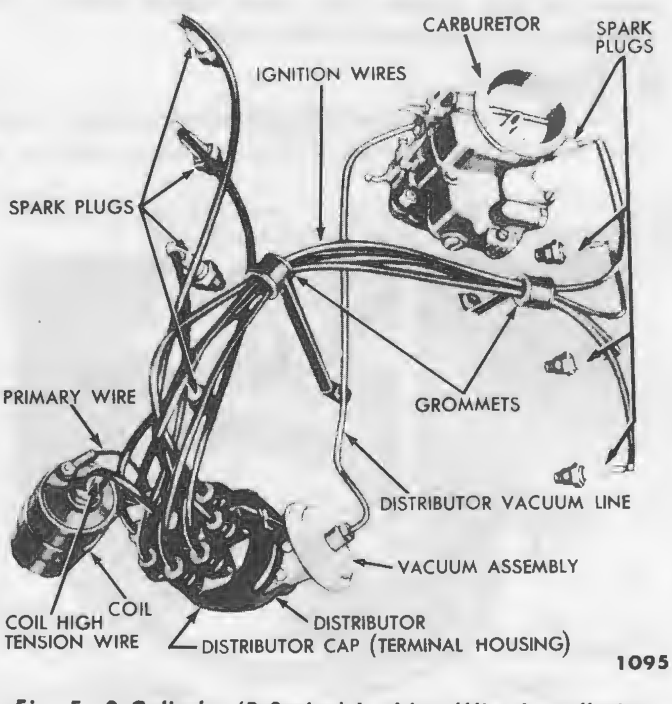

Fig. 5—8-Cylinder (R Series) Ignition Wire Installation with 7RA-12111-A Bracket

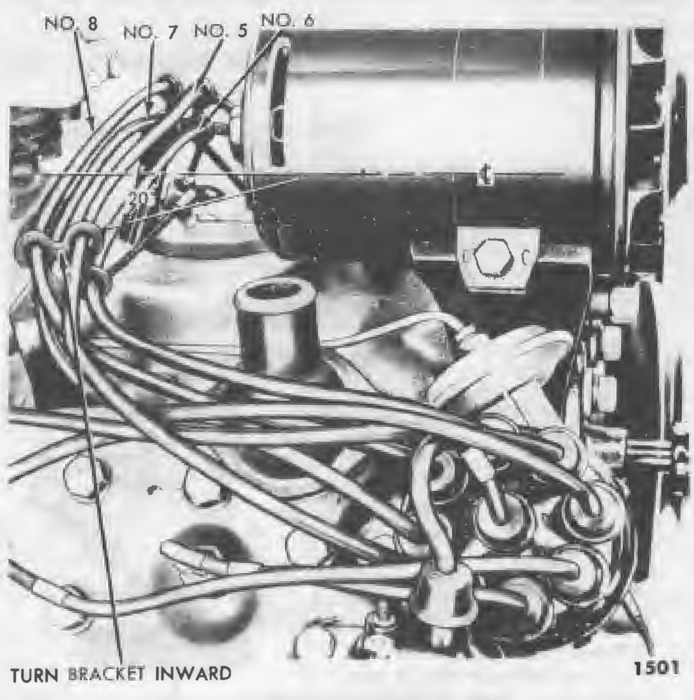

Fig. 6—8-Cylinder (R Series) Ignition Wire Installation with OBA-12111 Bracket

Fig. 7—8-Cylinder Spark Plug Wire Set

tributor end of the wires. Insert the wires in the proper distributor cap socket. Be sure the wires are forced all the way down into their sockets. These sockets are numbered to correspond with the proper spark plug. Install the coil to distributor high tension lead and push all weather seals into position.

(3) *REPLACEMENT (E Series).* The removal and installation procedures for the E Series engine are the same as the R-Series, except that no spread type bracket is used. The E Series harness is shown installed in Fig. 8.

c. Coil.

The same coil is used on all Ford trucks. This metal clad coil is mounted on the plug wire and coil bracket on the 6-cylinder engine. On the 8-cylinder "R" Series engine a bracket attached to the front end of the right-hand cylinder head holds the coil. The coil used on the E-Series engine is mounted on the engine side of the dash panel.

(1) *REMOVAL.* Disconnect the high tension lead

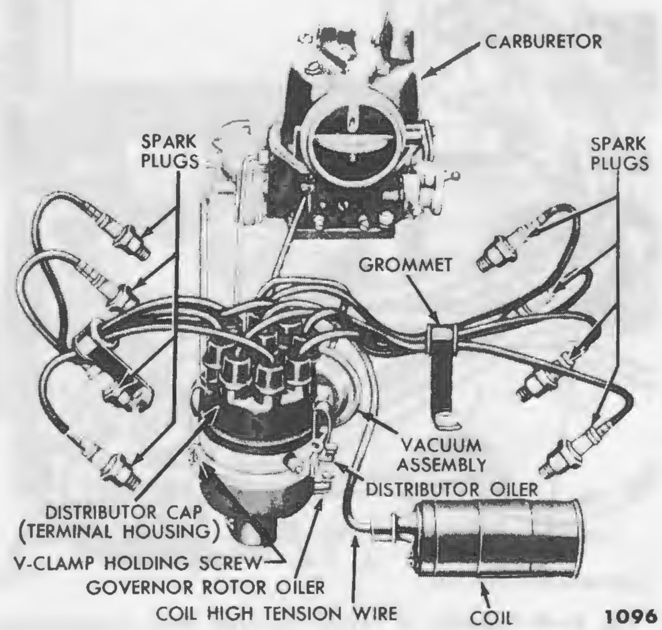

Fig. 8—E-Series Ignition Wire Installation

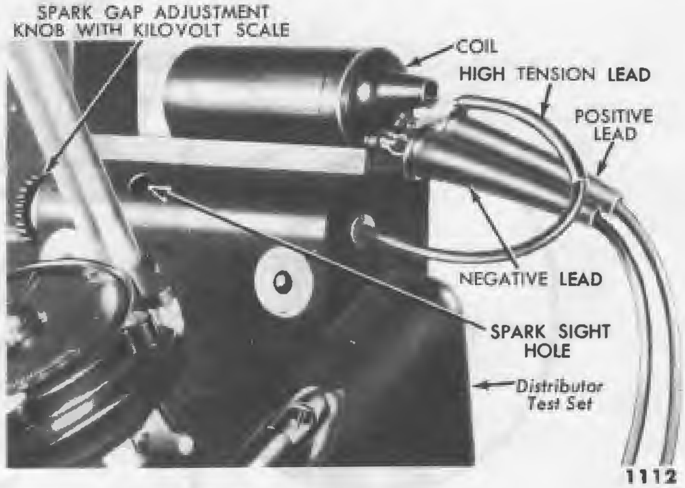

Fig. 9—Testing Coil on Distributor Stroboscope

and the primary leads from the coil.

Loosen ignition coil mounting strap and remove coil.

(2) *INSTALLATION.* Position the coil in the mounting strap, then tighten the mounting strap. Insert the high tension lead into the coil socket and connect the primary wires to the coil. Push the weather seal tightly against the coil.

(3) *TESTING ON VEHICLE.* Place the spark plug end of a spark plug wire approximately $\frac{3}{16}$ inch from the cylinder head. Run the engine at idle speed. If the spark will jump the gap regularly the coil and the condenser are satisfactory.

(4) *TEST ON DISTRIBUTOR STROBOSCOPE.* Install the coil on the test set as shown in fig. 9 and check the coil output. The spark should jump a 14 kilovolt setting regularly at 2000 R.P.M.

d. Timing.

The 6-cylinder engine is equipped with either a viscous type damper having a groove timing mark or a

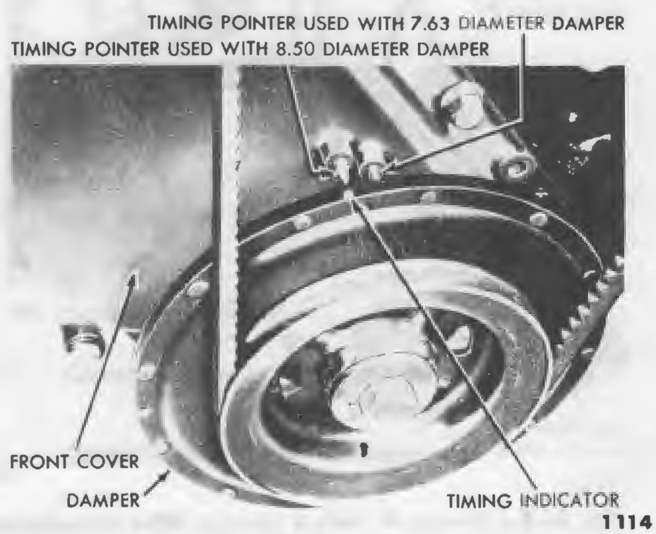

Fig. 10—6-Cylinder Engine Timing Mark

rubber type damper having a ball timing mark. Because of the difference in diameter between the two types of dampers, two timing pointers are located on the engine front cover (fig. 10). The pointer nearest to the outer circumference of the damper should be used to time the engine. A pointer on the engine front cover and a mark on the crankshaft pulley are used to time the 8-cylinder engine.

When the pointer, as shown in fig. 10, is in line with the timing mark, No. 1 or No. 6 cylinder is in firing position, depending on which piston is on the compression stroke.

In order to determine which piston is on compression stroke, use a compression gauge or block the spark plug hole with your thumb. Pressure will be high on the compression stroke.

(1) *INITIAL TIMING.* Align the rotor with the No. 1 spark plug wire terminal in the distributor cap, when the No. 1 cylinder piston is on the compression stroke and timing marks are aligned.

With the timing mark in line with the pointer, the distributor points should just start to open. It may be necessary to rotate the distributor body approximately 15 degrees clockwise, and then slowly rotate it counterclockwise until the contacts start to open. Tighten the distributor lock screw. Start the engine and check the timing with the aid of a timing light.

(2) *CHECKING TIMING WITH TIMING LIGHT.* Always disconnect the distributor vacuum line before checking the timing.

Connect the timing light to the engine with the high tension lead on No. 1 spark plug and the other two leads to the proper battery terminals.

NOTE: ***1951 models have a molded rubber seal covering the spark plug. To install the timing light clip on these models, use the tool shown in fig. 11.***

Clean the grease and dirt from the timing mark and, if necessary, cover the timing mark and pointer with white chalk. Start the engine and operate it at idle speed. Direct the light on the timing mark as shown in fig. 12. It should flash just as the timing mark lines up with the pointer, indicating correct timing. The operator should stand so that his eye is in line with center of damper and timing pointer.

If the timing mark and the pointer do not line up, rotate the distributor until the timing mark is in line with the stationary pointer.

To advance the timing, rotate the distributor body counterclockwise and to retard the timing, rotate the distributor body clockwise.

2. DISTRIBUTOR MINOR REPAIR AND ADJUSTMENTS

Ford distributors are known as the Loadomatic type, with the spark advance regulated by the vacuum differential at the carburetor. This distributor advance is operated by a vacuum unit mounted on the distributor. One side of this vacuum unit is connected to the breaker plate by direct linkage and the other side is connected by a vacuum line to the carburetor.

The spark advance characteristics are controlled by two breaker plate springs working against the distributor diaphragm (fig. 14). The amount of spark advance is determined by the amount of vacuum supplied to the distributor and by adjustment of breaker plate spring.

The carburetor has a vacuum passage with openings at both the venturi tube and a point just above the throttle plate (fig. 13), so that the vacuum in the distributor line is at all times a combination of the carburetor throat and venturi vacuums. The lower opening is above the throttle plate when the engine is idling, and at idle speed the spark is retarded.

Under normal road load or part throttle operation the vacuum ("B" fig. 13) is high, and the spark will become fully advanced at 18 to 35 miles per hour.

When the engine is accelerating the vacuum at the venturi increases as the engine speed increases; however, the manifold vacuum (vacuum at the throttle body throat) decreases considerably from the road load vac-

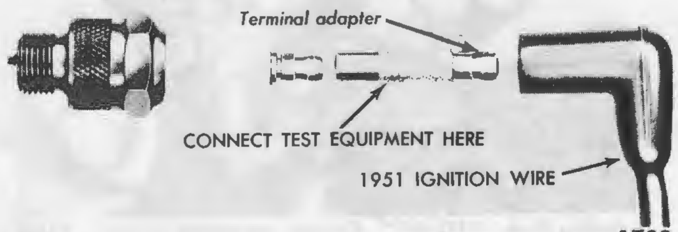

Fig. 11—Spark Plug Connector Extension

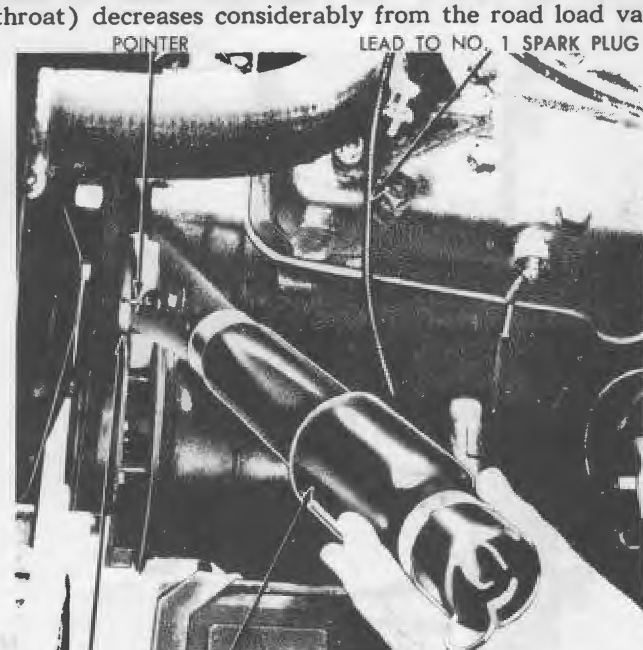

Fig. 12—Checking Timing with Timing Light

uum. The net result of these two changes is to lower the vacuum at the distributor diaphragm while the springs retard the spark advance from its road load setting. As the vehicle speed increases, the venturi vacuum and the manifold vacuum continue to increase.

The procedure for replacing, testing, or adjusting the distributor points, testing the condenser, and replacing the distributor is given below.

a. Distributor Points.

The distributor point assembly in the loadomatic distributor consists of the stationary distributor point bracket assembly, breaker arm, and primary wire terminal. This assembly is mounted on the breaker plate as a unit and can be replaced without removing the distributor from the engine (fig. 14).

Although the distributor point assembly spring tension is set by the manufacturer, the tension should be adjusted, if it is not within specifications.

(1) *REMOVAL.* Disconnect the primary and condenser leads. Remove the screws which secure the point assembly to the breaker plate. Remove the point assembly.

(2) *INSTALLATION.* Place the primary and condenser leads, lock washers, and nut on the point assembly primary terminal and tighten the nut securely. Position the point assembly on the breaker plate. Install the holding screws. Be sure the ground wire terminal is on the screw nearest to the adjustment slot and the lock washer is used under the screw at the opposite end. Adjust the distributor point spacing.

(3) *CHECKING SPRING TENSION.* Place the tension gauge as near as possible to the distributor points and push at right angle (90°) until the points just open (fig. 15). Read the spring tension and adjust if outside specifications (17-20 ozs.).

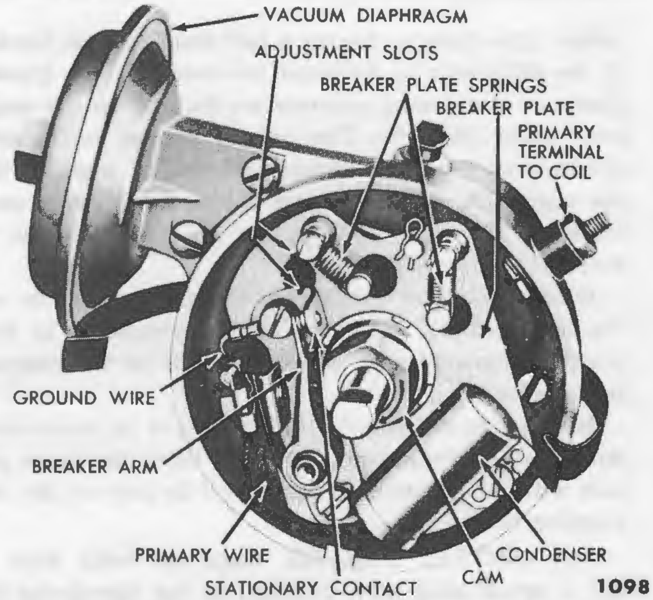

Fig. 14—Distributor Points and Condenser Installation

(4) *ADJUSTING SPRING TENSION.* Disconnect the wires at the distributor point terminal, and loosen the nut holding the spring in position. Move the spring toward the screw stud to increase the tension and in the opposite direction to decrease the tension. Tighten the nut securely and recheck the spring tension. After the proper tension is obtained, install the primary wires on the point assembly primary terminal and tighten the nut securely.

(5) *DISTRIBUTOR POINT SPACING ADJUSTMENT.* The distributor points can be adjusted with the distributor in the car or on a distributor stroboscope. Before adjusting the points, they should be examined and replaced if they are oily, severely pitted, badly oxidized, or have an excessive amount of foreign matter on the contact surfaces.

To increase point life and improve engine perform-

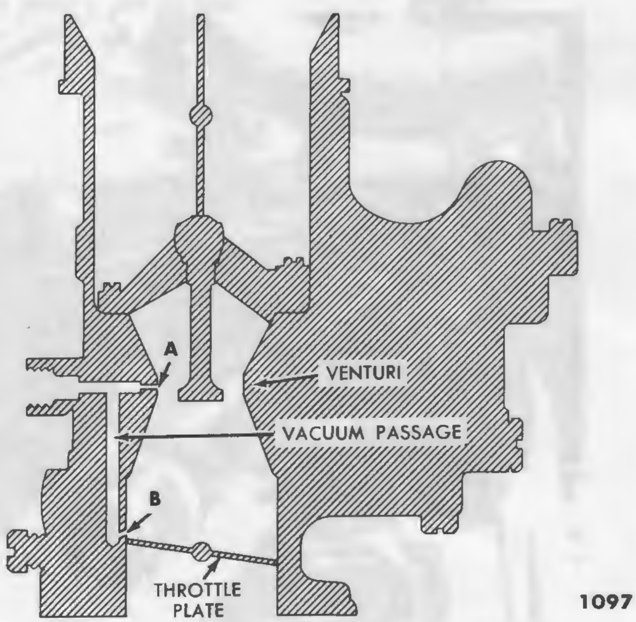

Fig. 13—Carburetor Vacuum Passage

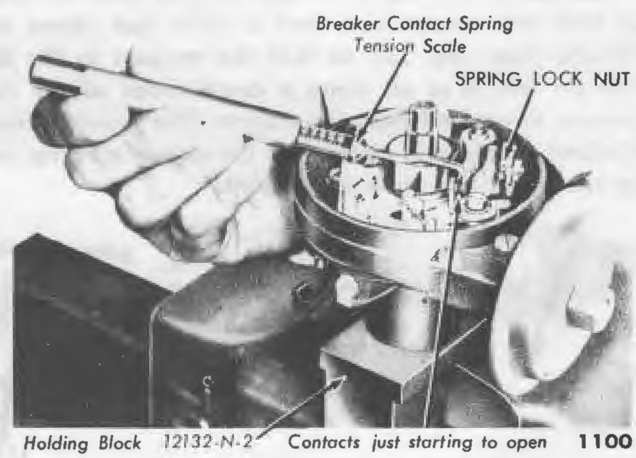

Fig. 15—Checking Breaker Arm Spring Tension

ance, it is important to adjust the point spacing accurately.

If the distributor point assembly needs adjustment, crank the engine until the rubbing block rests on the peak of a cam lobe. Loosen the lock screws, insert a screw driver blade or adjusting blade of distributor adjusting wrench (fig. 16) in the adjustment slot, and turn it to obtain the proper point spacing (0.024-0.026 inch on 6-cylinder engine and 0.014-0.016 inch on 8-cylinder engine).

Tighten the lock screws and recheck the clearance between the distributor points. Always retime the ignition after adjusting the distributor point gap.

b. Condenser.

The condenser can be removed from the distributor, either when the distributor is in the engine or when it is removed from the engine.

(1) *REMOVAL.* Disconnect the condenser lead from the distributor point primary terminal and remove the screw that holds the condenser on the breaker plate. Lift the condenser out of the distributor.

(2) *INSTALLATION.* Position the condenser on the breaker plate. Install the condenser holding screw. Connect the condenser lead to the primary terminal.

(3) *TESTING.* Before removing the condenser to make a test, it is advisable to first make the test on the vehicle.

(a) TEST ON VEHICLE. This test is made at the same time as the coil test. If the spark is not satisfactory, it will be necessary to remove the condenser and test it on a distributor stroboscope test set.

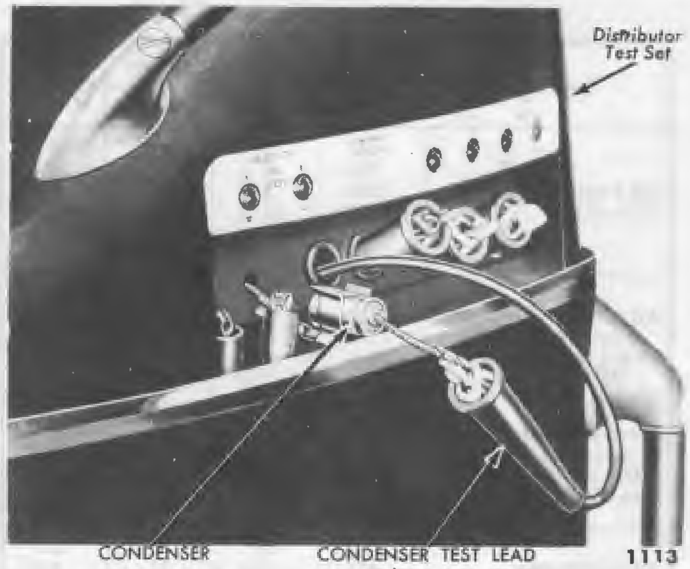

Fig. 17— Testing Condenser on Distributor Stroboscope

(b) TEST ON DISTRIBUTOR STROBOSCOPE. Install the condenser on a distributor test set as shown in fig. 17. Test the condenser for leakage, series resistance, and capacity. Condenser capacity is 0.21 to 0.25 microfarads, leakage should be greater than 5 megohms at room temperature and series resistance should be one ohm or less.

c. Distributor.

The distributor must be removed from the engine when the vacuum advance is to be checked or adjusted.

(1) *REMOVAL.* Before removing the distributor from an engine which is timed correctly, be sure to scribe a mark on the distributor housing indicating the

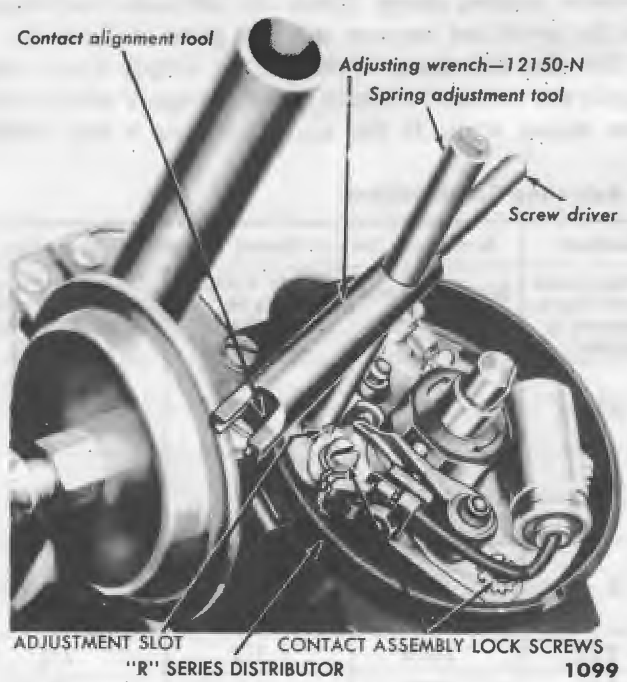

Fig. 16—Adjusting Distributor Contacts

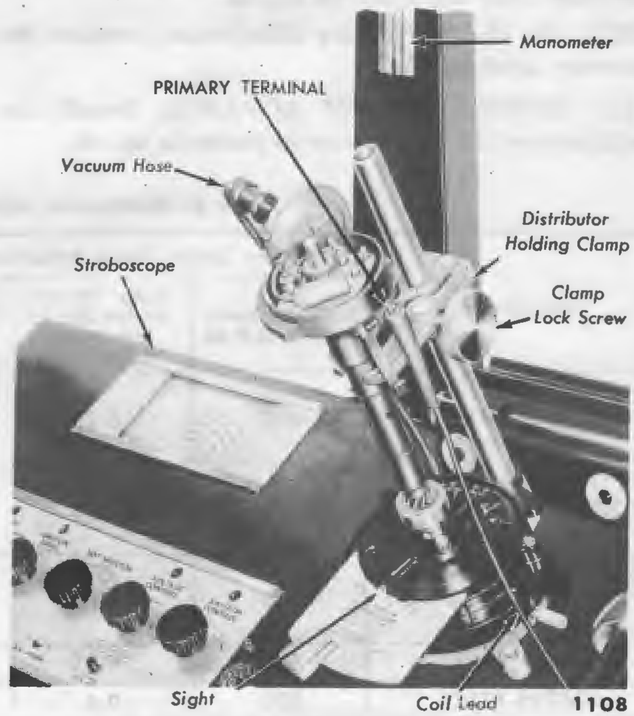

Fig. 18—Distributor Installed on Stroboscope

Table 1—Distributor Vacuum Advance

Distributor	Distributor R.P.M.	Distributor Degrees Min.	Distributor Degrees Max.	Vacuum (Inches of Mercury)
All 6-cyl. Models 7HA-12127	200	0	0	0
	500	1¾	3	0.4
	1000	5½	6¾	1.4
	1000	11½	13	5.5
	1500	8½	9¾	2.9
	2000	10½	11½	4.1
All 1949 and early 1950 8-cyl. Models 7RA-12127-C	200	0	0	0
	500	1¼	2¼	0.4
	1000	4¼	5¼	1.7
	1500	6¼	7¼	2.8
	2000	7½	8½	3.7
Late 1950 and 1951 8-cyl. Models 8BA-12127 0BA-12127	200	0	0	0
	500	0	1	0.30
	1000	5¼	6¼	1.32
	1500	8¾	10	2.85
	2000	10	11¼	3.7
All EQ Models 8EQ-12127	200	0	0	0
	400	1½	3	0.25
	1000	7¼	8¼	1.3
	1600	10¼	11¼	2.7
All M Series 8MTH-12127	200	0	0	0
	500	2	3	0.4
	1000	6¼	7¼	1.3
	1400	10½	12	3.6
	1600	9¼	10¼	2.6

position of the rotor, and another mark on the engine and housing to indicate the position of the housing. The distributor can be reinstalled when the rotor is in line with the mark without rotating the engine crankshaft to obtain the proper timing.

Remove the distributor cap. Disconnect the primary wire and vacuum line. Loosen the distributor clamp lock screw or distributor hold-down bolt and remove the distributor assembly from the engine.

NOTE: ***On the "E" Series distributor, remove the governor vacuum lines.***

(2) *CHECK VACUUM ADVANCE.* Install the distributor on the stroboscope as shown in fig. 18.

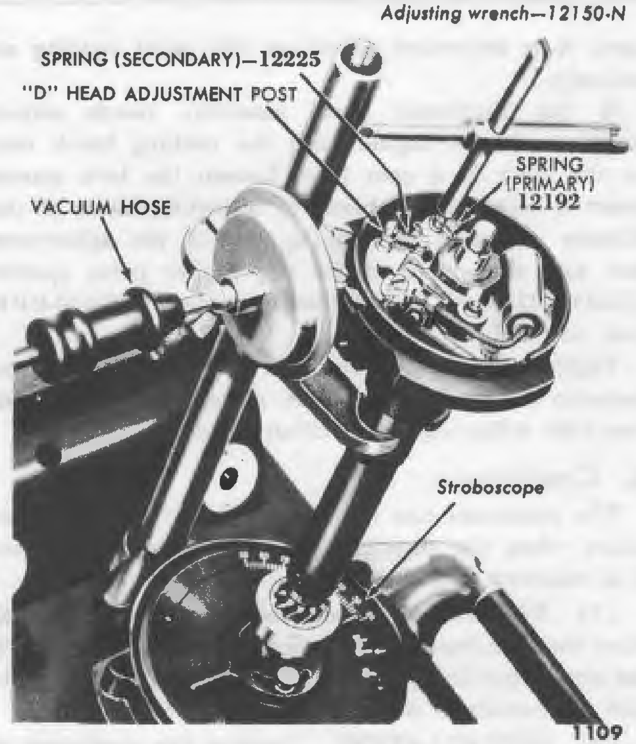

Fig. 18—Adjusting Spark Return Spring Tension

Connect the dwell lead and check the percent dwell. If the dwell is not between 58 and 63 per cent and the point spacing is not within limits, it will be necessary to adjust the points. Check the breaker arm spring tension and adjust if required (17-20 ozs.). Set the distributor speed at 200 r.p.m., hold the distributor breaker plate against the stops in full retard position, and rotate the distributor housing until the spark lines up with the zero degree position on the scale. Tighten the distributor holding clamp. Check the distributor according to the speed and vacuum setttings given in Table 1.

Set the distributor speed to the proper r.p.m. and apply the required vacuum. Read the spark advance on the degree scale. If the spark advance is not within

Table 2—Distributor Advance Adjusting Specifications

Distributor	Primary (Light) Spring Adjustment Procedure			Secondary (Heavy) Spring Adjustment Procedure		
	Set Distributor Speed to R.P.M.	Apply Vacuum (inches Hg) to distributor diaphragm	Turn Adjustment Post until Spark is advanced to (degrees)	Set Distributor Speed to R.P.M.	Apply Vacuum (inches Hg) to distributor diaphragm	Turn Adjusting Post until Spark is advanced to (degrees)
7HA-12127 (1949-1950-1951 6-cylinder)	400	0.26	1¾	1000	1.4	6¼
7RA-12127-C (1949 and early 1950 8-cylinder)	400	0.28	1	1200	2.1	6
8BA-12127 and OBA-12127 (Late 1950-1951 8-cylinder)	500	0.30	1	1000	1.32	5¾
8EQ-12127	400	0.25	2½	1000	1.3	7¾
8MTH-12127	500	0.4	2½	1000	1.3	6¾

these specifications, adjust the tension on the springs.

(3) *VACUUM ADVANCE ADJUSTMENT.* Install distributor on a distributor stroboscope. Adjust the distributor point spacing. Set the distributor speed at 200 r.p.m., hold the distributor breaker plate against the stops in full retard position, and rotate the distributor housing until the timing light in the stroboscope base lines up with the zero degree position on the scale. Tighten the distributor holding clamp. Release the tension on the two retard springs by turning both adjustment posts clockwise until the tension is relieved from each spring as shown in fig. 19.

Adjust the primary (light) spring first and the secondary (heavy spring on H & R series distributor) last.

Two springs of the same kind are used as the primary and the secondary spring on the 8EQ, 0BA, and 8BA type distributors.

The procedure for setting the required tension on each spring is given in Table 2.

Check the operation of the vacuum advance at the various speeds. The degrees advance should be within the limits given in Table 1. If the spark advance is not within the limits under low vacuum, the primary spring is at fault. If the spark advance is not within the limits under high vacuum, the secondary spring is at fault.

If it is impossible to adjust both springs to give the correct spark advance, one or both springs should be replaced, and the spark advance readjusted.

(4) *INSTALLATION.* Align the rotor with the mark previously scribed on the distributor body. Install the distributor in the engine, with the housing mark in alignment with the mark previously made on the engine. Tighten the holding clamp cap screw. Check and adjust the ignition timing, using a timing light.

NOTE: ***On the E Series distributor, install the governor vacuum lines.***

3. DISTRIBUTOR OVERHAUL

Before disassembling the distributor for overhaul it is advisable to place the distributor on a distributor stroboscope and, after adjusting the distributor point spacing, test the distributor for variation of spark and correct vacuum advance. This test will give valuable information on the distributor condition and indicate the parts which need replacement.

a. 6-Cylinder.

If the vacuum unit, ground wire and primary wire are in satisfactory condition it is not necessary to remove these parts from the distributor housing when replacing bushings. Figure 20 illustrates the 6-cylinder distributor parts and their relative positions.

(1) *SHAFT AND CAM REMOVAL.* File off the rivet head. Drive out the collar rivet with a punch.

Slide the collar off the drive shaft. Remove the shaft and cam assembly from the distributor housing.

(2) *BREAKER PLATE REMOVAL.* Place the

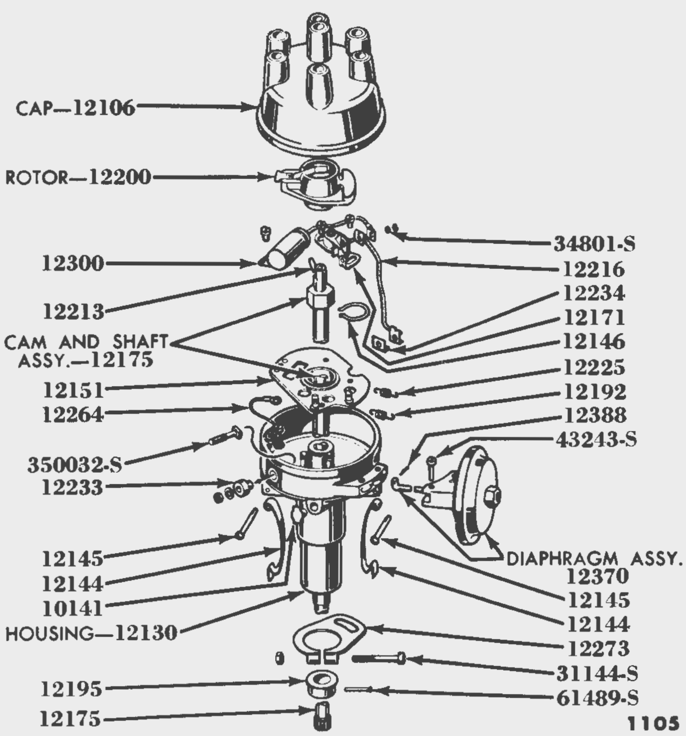

Fig. 20—6-Cylinder Distributor, Disassembled

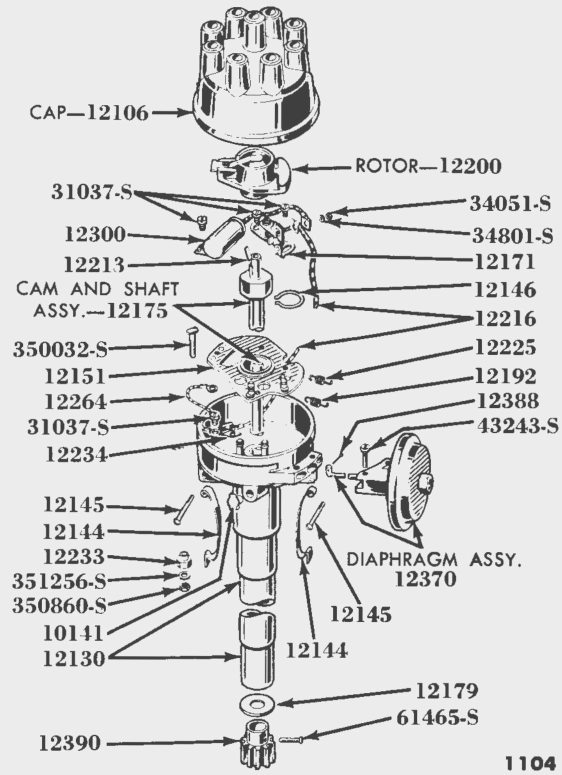

Fig. 21—8-Cylinder Distributor Disassembled 7RA and 8BA Type

distributor housing in a holding block, and clamp the tool in a vise.

Remove the two screws holding the distributor point assembly on the breaker plate. Disconnect the primary wire and the condenser lead from the distributor point assembly primary terminal. Lift the point assembly from the breaker plate.

Remove the hair-pin retainer attaching the vacuum unit rod to the breaker plate, and push the rod end out of the breaker plate.

Release the tension on the two return springs by rotating the adjustment posts to a position nearest to the stationary posts. Remove the two springs.

NOTE: ***Do not stretch or bend the springs during their removal as this might make it difficult to obtain the correct spark advance adjustment.***

Remove the lock ring attaching the breaker plate to the upper bushing. Lift the breaker plate from the distributor housing.

Disconnect the primary and ground wires from the distributor housing.

(3) *INSPECTION.* Inspect the distributor shaft and bushings for wear. The distributor shaft manufacturing minimum diameter is 0.4675 inch. The upper bushing manufacturing limit inside diameter is 0.4685-0.4695 inch. Replace all parts that are not within these limits.

(4) *BUSHING REMOVAL.* Drive the upper and lower bushings from the housing by using the split drift.

(5) *BUSHING INSTALLATION.* Bushings are made of powdered metal and must not be reamed. Place a new lower bushing in position on the bushing installation tool. Place the distributor housing and the "A" spacer on the tool. Turn the T-handle until the lower bushing is flush with the distributor housing. Remove the T-handle and the "A" spacer. Position the upper bushing on the housing with the lock ring end up. Place the "A" spacer over the bushing. Turn the T-handle until the spacer bottoms firmly against the distributor housing.

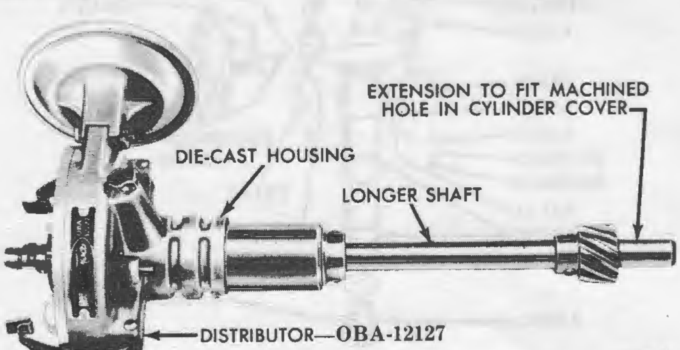

Fig. 22—8-Cylinder Distributor—OBA Type

Properly size the upper and lower bushing using the burnishing tool.

(6) *BREAKER PLATE INSTALLATION.* Install the ground wire and the primary wire in the distributor housing. Position the breaker plate in the housing. Install the lock ring to secure the breaker plate. Install the condenser on the breaker plate. Place the condenser lead, primary lead, lock washer, and nut on the distributor point primary terminal, and securely tighten the nut.

Install the distributor point assembly. Be sure the pivot pin enters the hole in the breaker plate. Install the ground wire and the screw at the adjustment slot end of the breaker assembly and the screw at the opposite end of the assembly. Install the vacuum unit on the distributor housing if it was previously removed.

Install the two return springs on the adjustment and body posts. Connect the vacuum unit rod to the breaker plate, and attach it with the hair pin retainer.

(7) *SHAFT INSTALLATION.* Slide the shaft into the housing. Place the collar in position on the shaft. Install the collar rivet. Place the distributor in position on the block tool and peen the end of the rivet. Adjust distributor point spacing. Adjust vacuum advance.

b. 8-Cylinder (R-Series).

Three different distributors are used in the 8-cylinder (R series) engines. The 1949 and some early 1950 model engines use the 7RA-12127 distributor which has a cast iron housing fig. 21. The housing extends along the shaft to the distributor gear and contains two bushings which support the distributor shaft at both ends. The distributor shaft is held in position by the distributor gear which is pressed on end of shaft and pinned in place.

Some Early 1950 models use an 8BA-12127 distributor which is the same distributor as the 7RA-12127 except the two spark advance return springs were replaced with two 8EQ-12192 springs. These springs are adjusted to 8BA-12127 distributor advance limits.

Late 1950 distributors, part no. 0BA-12127 have a longer shaft and a die-cast housing with a short extension (fig. 22).

A collar on the distributor shaft holds the shaft in position and controls the shaft end play. The gear is installed on the shaft and allows the shaft to extend below the gear (fig. 22). The additional length of the shaft fits into a pilot hole in the engine front cover. All R series distributors have the same distance between the distributor pad and the distributor gear.

(1) *SHAFT AND CAM REMOVAL.* Position the distributor housing on the repair block. File off the rivet head on the distributor drive gear. On the 0BA-12127 distributor also file off the collar rivet head. Drive out the rivet or rivets with a punch (fig. 23).

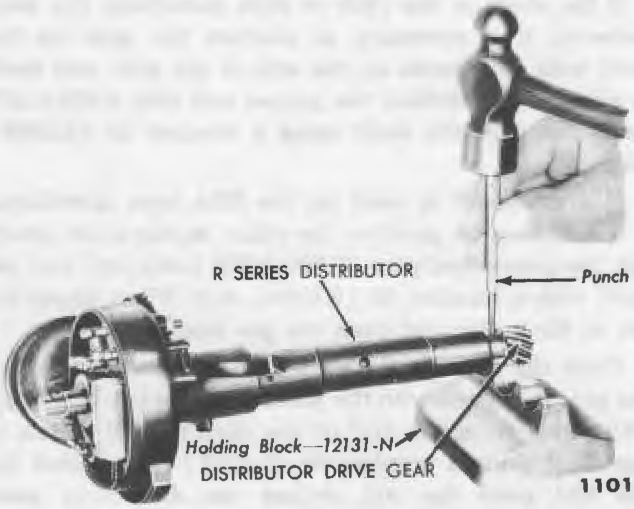

Fig. 23—Removing Pin From Distributor Gear

Pull the distributor gear (fig. 24). On the 0BA-12127 distributor slide the collar off the shaft.

Slide the shaft out of the distributor housing.

(2) *BREAKER PLATE REMOVAL.* Place the distributor housing in the holding block. Remove the distributor point assembly. Remove the condenser. Remove the hair pin retainer and disconnect the rod. Release the tension on the return springs. Disconnect the return springs.

NOTE: ***Do not stretch the springs as this may distort the springs making it difficult to obtain adjustment.***

Remove the lock ring attaching the breaker plate to the upper bushing. Lift the breaker plate from the housing. If required, disconnect and remove the primary and ground wires.

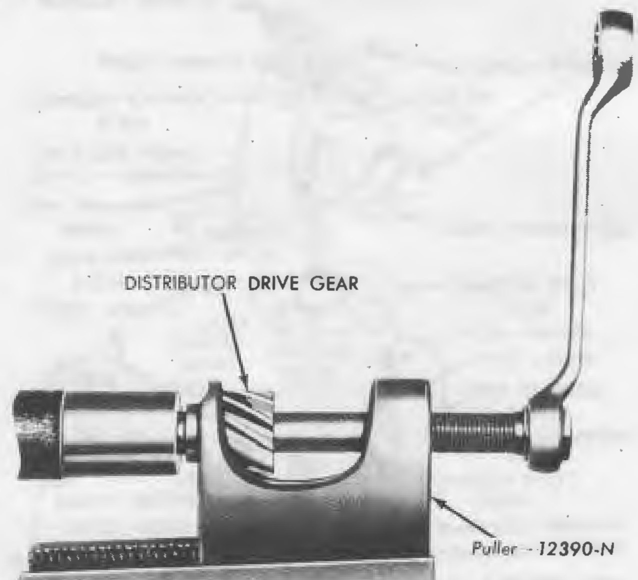

Fig. 24—Removing Distributor Gear

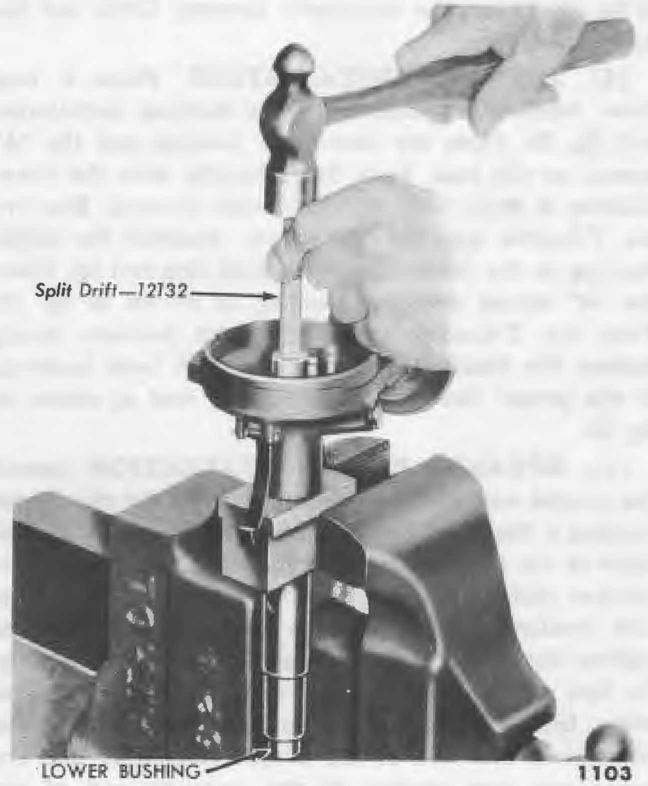

Fig. 25—Removing Bushings

(3) *INSPECTION.* Inspect the distributor shaft and bushings for wear and replace if outside the limits. The distributor shaft minimum diameter at the bushing is 0.4675 inch. The upper bushing manufacturing limit inside diameter is 0.4685-0.4695 inch.

(4) *BUSHING REMOVAL.* Drive out the lower bushing with the distributor bushing remover as shown

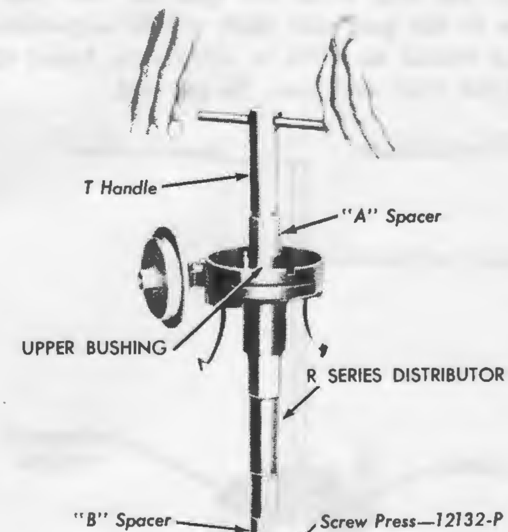

Fig. 26—Installing Bushing

in fig. 25. Invert the distributor housing. Drive out the upper bushing.

(5) *BUSHING INSTALLATION.* Place a new lower bushing in position on the bushing installation tool fig. 26. Place the distributor housing and the "A" spacer on the tool. Turn the T-handle until the lower bushing is flush with the distributor housing. Remove the T-handle and the "A" spacer. Position the upper bushing on the housing with the lock ring end up. Place the "A" spacer over the bushing as shown in fig. 26. Turn the T-handle until the spacer bottoms firmly against the distributor housing. Burnish both bushings to the proper size with a burnishing tool as shown in fig. 27.

(6) *BREAKER PLATE INSTALLATION.* Install the ground wire and the primary wire on the distributor housing if they had been removed. Position the breaker plate in the housing. Install the lock ring to secure the breaker plate. Place the condenser lead, primary lead, lock washer, and nut on the primary terminal, and tighten the nut. Install the distributor point assembly. Be sure the pivot pin enters the hole in the breaker plate. Install the ground wire and the screw at the adjustment slot end of the breaker assembly and the screw and lock washer at the opposite end of the assembly. Install the vacuum unit on the distributor housing if previously removed during disassembly. Install the two return springs on the adjustment and body posts. Connect the vacuum unit rod to the breaker plate, and attach the rod with the hair pin retainer.

(7) *SHAFT INSTALLATION.* Slide the shaft into the housing. Place the spacer on the gear end of the shaft (7RA & 8BA distributors only). On the 0BA distributor slide the collar on the shaft. Install the pin and peen the pin end. Press the gear on the shaft until the hole in the gear and shaft are in alignment. End clearance should be 0.002 to 0.005 inch. Insert the pin through the shaft and peen the pin end.

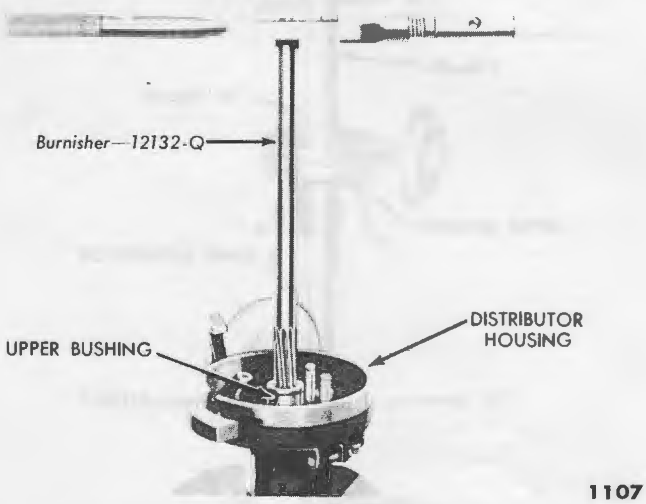

Fig. 27—Burnishing Upper Bushing

If the shaft on the 7RA or 8BA distributor has been replaced, it is necessary to position the gear on the shaft with the marks on the end of the gear and shaft in alignment. Establish the proper end play 0.002-0.005 inch then drill the shaft using a number 30 (0.1285) drill.

If a new shaft is used on the 0BA type distributor, it is necessary to position the collar on the shaft, establish the proper end play (0.002-0.005 inch) and drill the shaft with a number 30 (0.1285) drill. Then install the pin in the collar and peen the pin head.

Press the gear on the shaft until the bottom edge of the gear is aligned with the junction of the two diameters (0.94 inch from the end of the shaft). Drill a hole in the shaft using a number 30 (0.1285) drill, install the pin and peen the end. Adjust the distributor point spacing. Adjust the vacuum advance.

c. E-Series.

The distributor used on the EQ engine is mounted on the governor body and the cam is driven by a drive plate connected to the governor shaft. The distributor body is clamped to the governor body by a ring clamp. Adjustment of spark timing is made by loosening the clamp and rotating the distributor body.

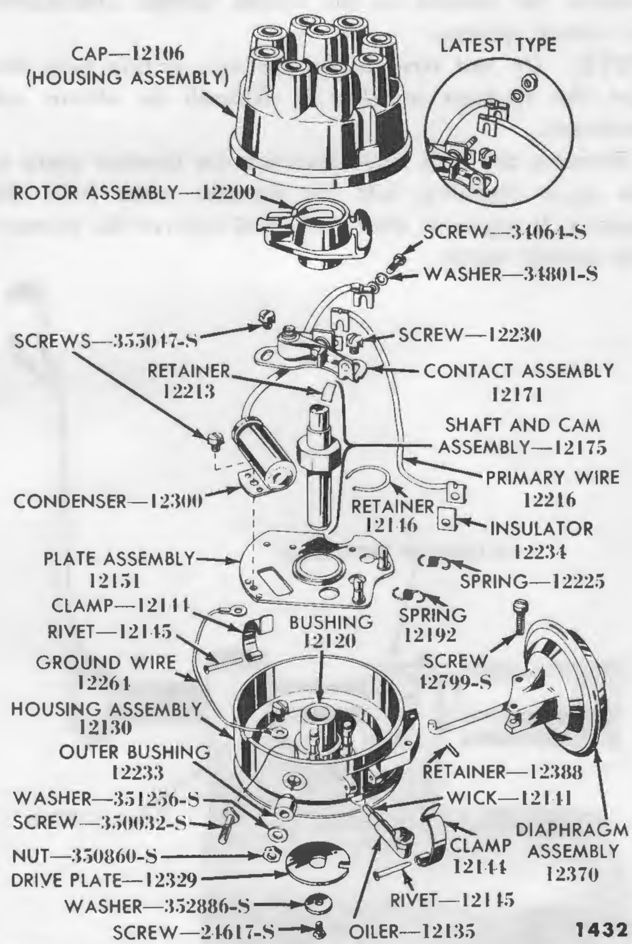

Fig. 28—EQ Distributor Disassembled

(1) *REMOVAL.* Remove the distributor cap. Disconnect the primary wire from the distributor. Remove the ring clamp and pull the distributor from the governor body.

(2) *DISASSEMBLY.* Remove the rotor, washer, felt, and dust cap. Remove the distributor points. Remove the shaft and cam assembly by unscrewing the drive plate retaining screw, removing the drive plate, and sliding the shaft out of the bushing. Remove the hairpin retainer and push the vacuum unit rod out of the breaker plate. Release the tension on the return springs and remove the springs. Remove the lock ring retaining the breaker plate on the bushing and remove the plate. Press out the bushing toward the lock ring end.

A disassembled view of the distributor is shown in fig. 28.

(3) *ASSEMBLY.* Install a new bushing with the same tool used on the R-Series distributor upper bushing. Use an extra spacer on the tool. Burnish the bushing to the proper size. Install the breaker plate and lock ring. Install the return springs and the vacuum unit rod. Secure the rod with the hairpin retainer. Install the cam and shaft assembly and secure the drive plate to the shaft with the retaining screw and lockwasher. Install and adjust the breaker points. Adjust the vacuum advance.

(4) *INSTALLATION.* Install the distributor body on the governor body. Be sure to engage the drive plate on the governor shaft. Install the clamp ring and tighten the screw. Connect the primary wire. Install the distributor cap.

4. CARBURETOR CONSTRUCTION, OPERATION, AND ADJUSTMENTS

The construction, operation and adjustment of each carburetor used on Ford truck engines is given here.

a. Construction.

Four types of carburetors are used on trucks. These four types are described under the headings, "(1) Dual Carburetor," "(2) Dual Concentric Carburetor," "(3) Single Updraft Carburetor," and "(4) Single Downdraft Carburetor."

(1) *DUAL CARBURETOR.* The dual carburetor (fig. 29), used on the R-Series, is a plain-tube-dual downdraft type. On this carburetor, all the main channels are in a removable nozzle bar which carries the idle tube and an aspirating nozzle. The discharge nozzle is positioned in the center of the air stream and in the smallest part of the venturi.

On all carburetors, the choke valve is mounted on a shaft located off center in the air passage. On dual and single drowndraft models, a tension spring tends to close the choke valve when the choke lever is moved to the choke position. Free movement in the mechanism allows the in-rushing air to force the valve open.

(2) *DUAL CONCENTRIC CARBURETOR.* The dual concentric carburetor (fig. 30) is used on the EQ-Series 8-Cylinder engine.

The dual concentric carburetor is one of the plain-tube-dual downdraft type. All the main channels are located in the main body and air horn. The dual concentric carburetor can be considered as two carburetors built into one unit. There is a separate venturi, idle tube, throttle plate, main metering system, and idle system for each side. There is one accelerating pump from which the fuel is divided at the pump discharge nozzle, one air chamber, one concentric fuel chamber, and one power valve. The governor carburetor unit is an integral part of the throttle body.

(3) *SINGLE DOWNDRAFT CARBURETOR.* The single carburetor (fig. 31) is similar to the dual carburetor. It is used on the 6-cylinder engines. In this carburetor, all the main channels are in a removable nozzle bar which carries the idle tube and an aspirating nozzle. The central portion of the nozzle bar forms the discharge nozzle. The discharge nozzle proper is located in the nozzle, helps to completely vaporize the fuel.

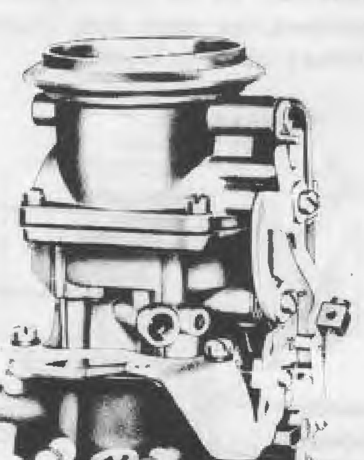

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Fig. 29—Dual Carburetor

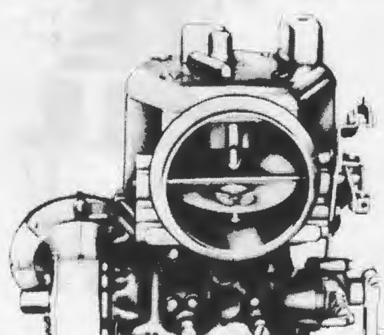

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Fig. 30—Dual Concentric Carburetor

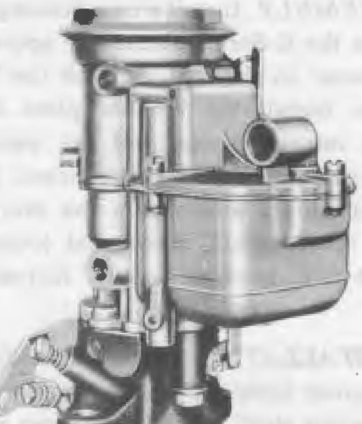

Fig. 31—Single Downdraft Carburetor

diameter as to create a high suction at the end of the nozzle. This suction, in addition to the atomizing holes in the nozzle, helps to completely vaporize the fuel.

(4) *SINGLE UPDRAFT CARBURETOR.* The updraft carburetor (fig. 32) is used on the 6-cylinder engines, in cab-over-engine trucks, and in the F-3 parcel delivery model. The single updraft carburetor is similar in construction to the Ford single downdraft carburetor. The construction differs in that the updraft carburetor is mounted under the manifold and the flow of air and fuel mixture is in the upward direction.

b. Operation.

While some variation in design exists among the various carburetors, each carburetor has four basic fuel circuits and the principles involved are the same for each. Minor variations in design are pointed out throughout the presentation.

The four systems or circuits are each designed to supply the correct quantity of fuel under a particular type of operation. The operating principles of these

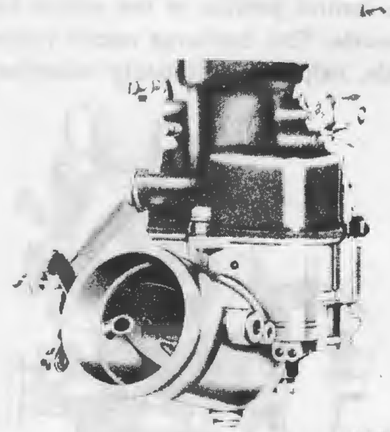

Fig. 32—Single Updraft Carburetor

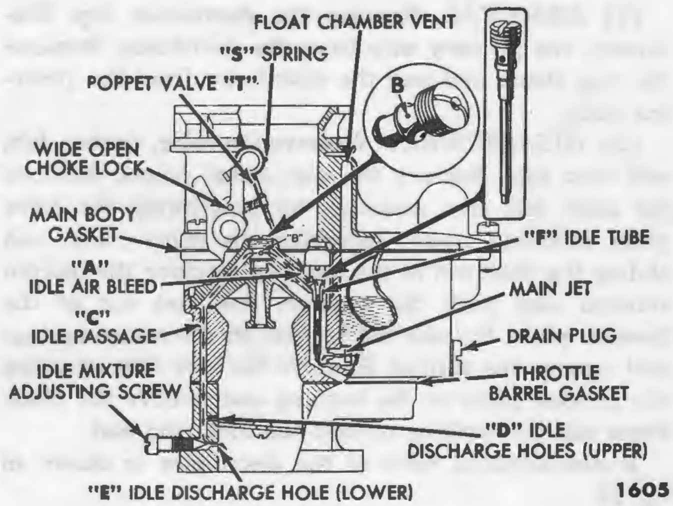

Fig. 33—Dual Carburetor

separate circuits are presented here under the following headings: "(1) Idle Fuel Supply," "(2) Main Fuel Supply," "(3) Power Fuel Supply," and "(4) Accelerating System."

(1) *IDLE FUEL SUPPLY.* Figures 33-36 illustrate the idling system of Ford carburetors.

The fuel from the carburetor bowl passes through the main metering jet and into the idle tube. Air is introduced into the fuel stream by the idle air bleed inlet, and a small additional amount of air is bled in by a small hole in the aspirating nozzle of the single and dual downdraft carburetors. In the single and dual carburetors, the idle mixture goes around the aspirating nozzle, then travels down the idle passages to the idle discharge holes. In the single updraft and dual concentric carburetor, the idle mixture travels directly from the main metering jet to the idle discharge holes.

When the engine is running at a speed of 350 r.p.m., the mixture is discharged out of the lower hole only. On the updraft carburetor, the mixture is discharged out of the upper hole only. As the throttle plate opens and the speed is increased, the upper hole (lower hole on updraft carburetor) starts to discharge.

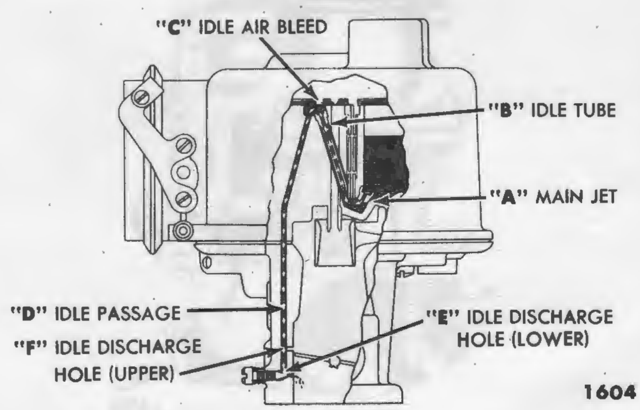

Fig. 34—Dual Concentric Carburetor

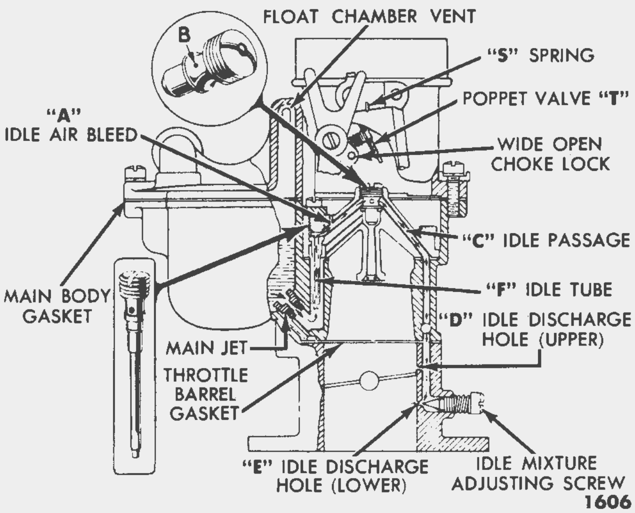

Fig. 35—Single Downdraft Carburetor

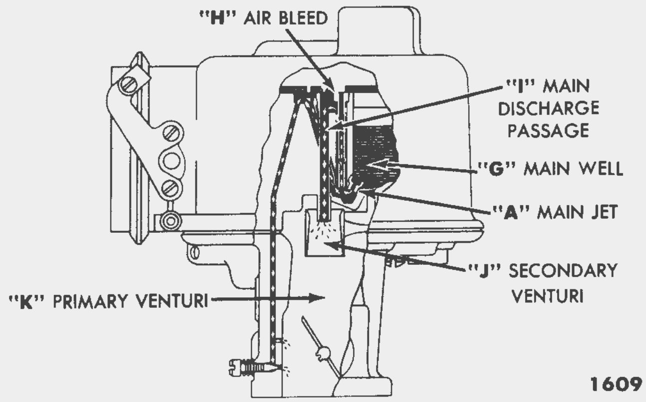

Fig. 38—Dual Concentric Carburetor

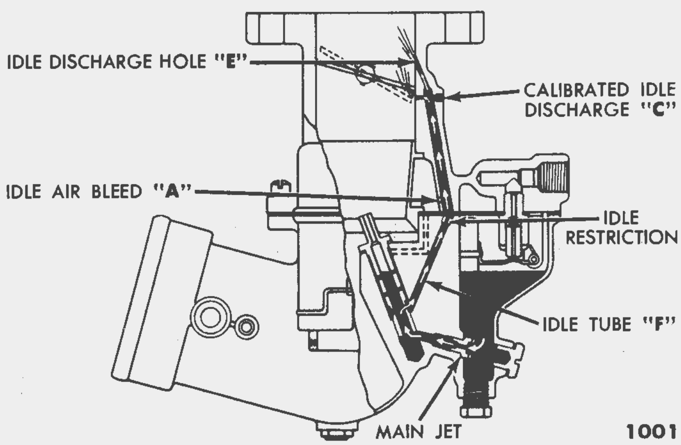

Fig. 36—Updraft Carburetor

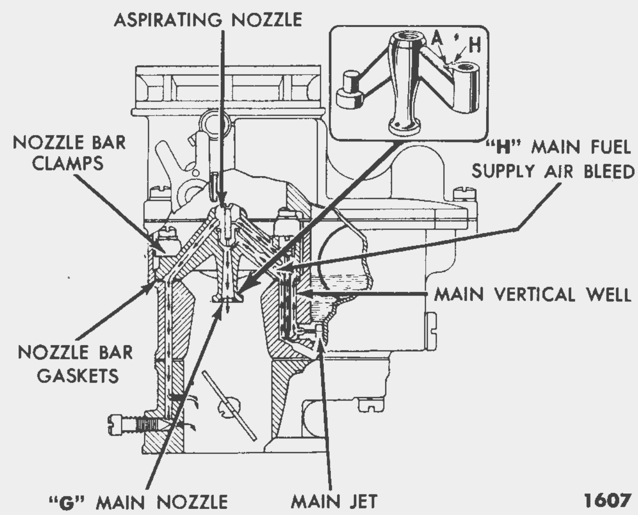

Fig. 39—Dual Carburetor

(2) *MAIN FUEL SUPPLY.* Figures 37-40 illustrate the main fuel supply on Ford carburetors.

The main fuel supply comes in as the idle system becomes less effective and the main nozzle starts to deliver fuel. This occurs at about 900 r.p.m. Between 900 r.p.m. and 1250 r.p.m. there is a definite blend of the idle system and the main metering system. In this range, all the fuel passes through the main jets up through the main vertical well, on single and dual carburetors. On updraft and dual concentric carburetors,

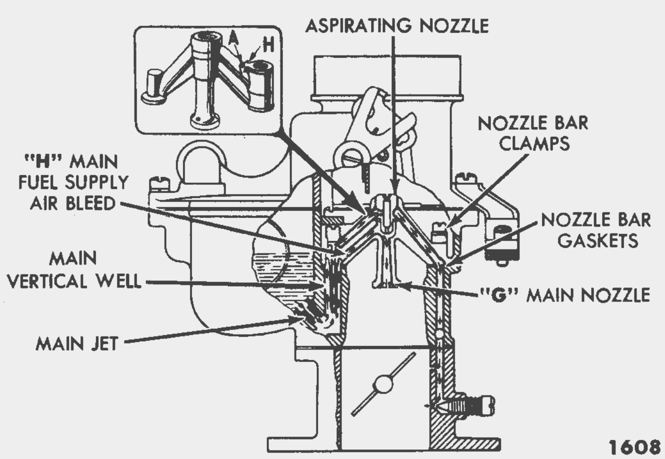

Fig. 37—Single Carburetor

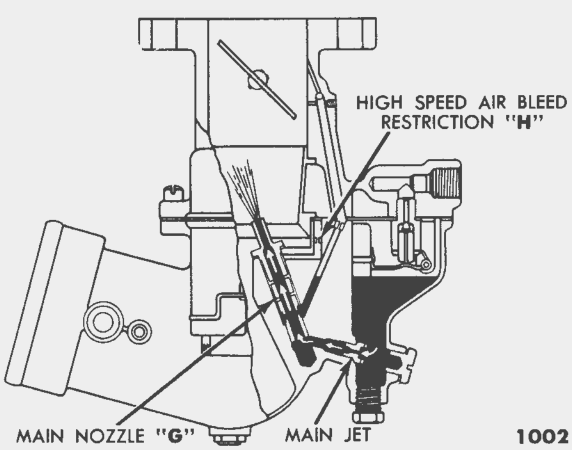

Fig. 40—Updraft Carburetor

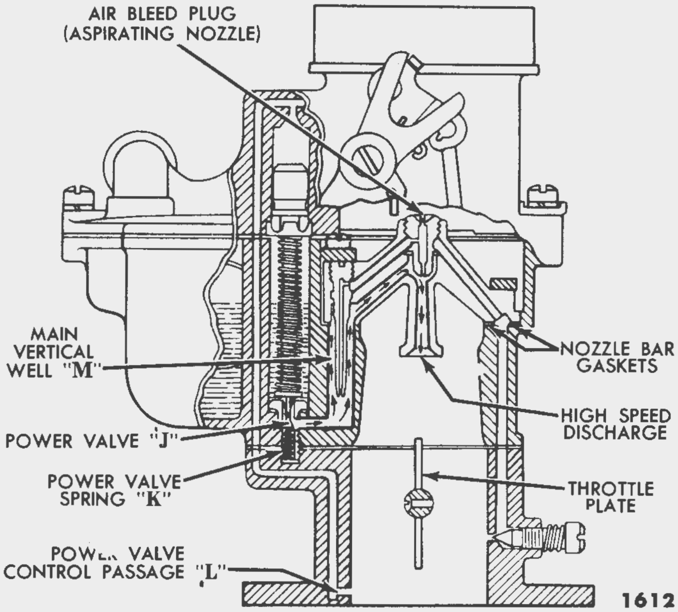

Fig. 41—Single Carburetor

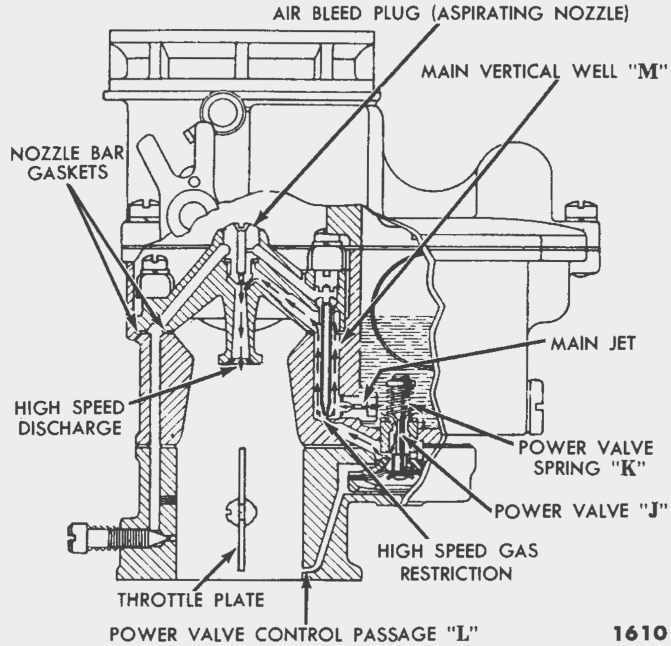

Fig. 43—Dual Carburetor

the fuel passes directly from the main jet to the main discharge nozzle.

Air entering at the main fuel supply air bleed inlet lightens the fuel and makes the mixture more responsive to the throttle changes.

(3) *POWER FUEL SUPPLY.* The power fuel supply is controlled by the power by-pass valve. At idle speed, vacuum is high but decreases as the load increases. The diaphragm (on dual carburetors only) actuated by the vacuum, holds the power valve on its seat until the vacuum drops to about 6½ to 7½ inches of mercury, which is not high enough to resist the action of the spring. (On the dual concentric, single downdraft and single updraft carburetors, a piston actuates the power valve.)

Under load, as in climbing hills, etc., the vacuum drops. When the vacuum drops to about 6½ to 7½ inches of mercury, the power valve is opened by the spring and the fuel then flows into the power valve chamber, through the high speed restrictions, and into the main discharge nozzle. Figures 41-44 show the power fuel supply system on Ford carburetors .

The accelerating pump is connected directly to the throttle linkage, and its function is to enrich the mixture temporarily for rapid acceleration. The fuel is drawn into the pump chamber, through the pump inlet passage, and the pump inlet ball check valve, on the up stroke of the pump piston. When the throttle is opened, the piston moves down, closing the pump check valve and overcoming the weight of the pump discharge valve. The accelerating fuel then goes around the pump discharge jet. Free movement against a spring load is provided in the pump stem. (Figs. 45-48 show the accelerating systems on the various Ford carburetors.)

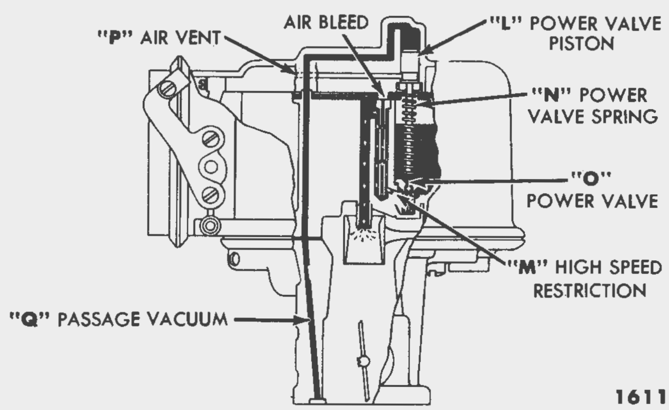

Fig. 42—Dual Concentric Carburetor

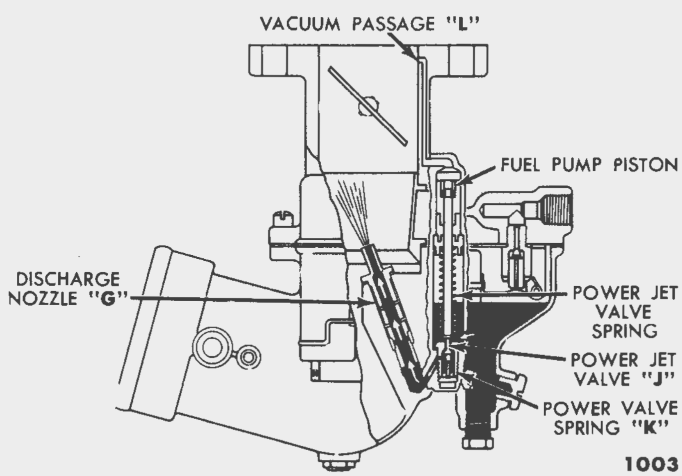

Fig. 44—Updraft Carburetor

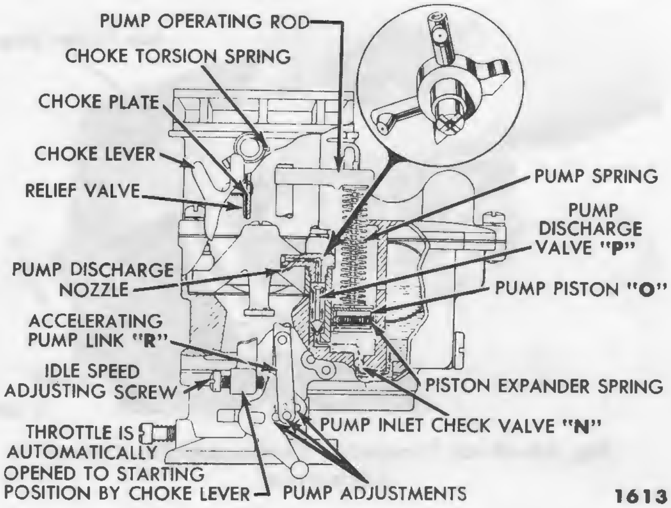

Fig. 45—Dual Carburetor

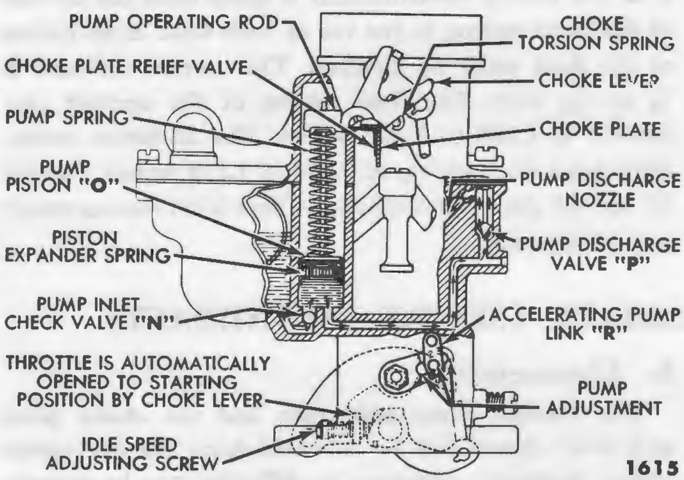

Fig. 46—Single Carburetor

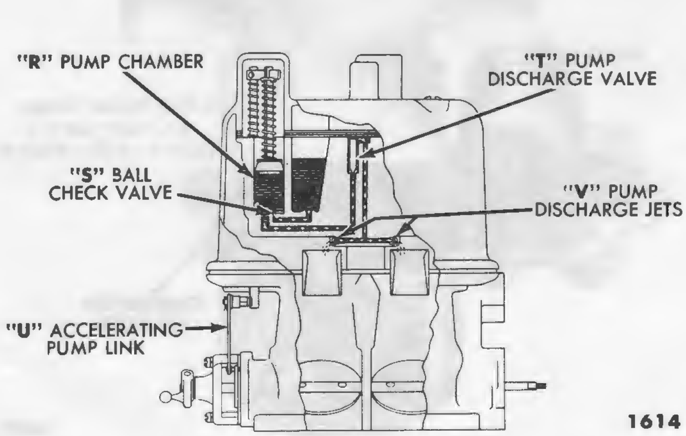

Fig. 47—Dual Concentric Carburetor

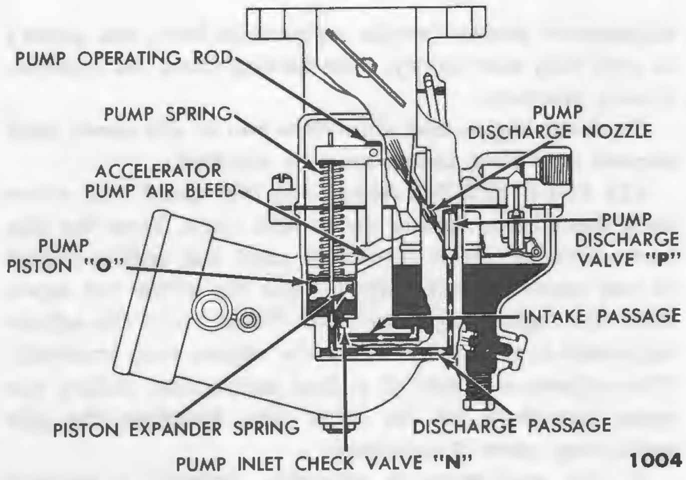

Fig. 48—Updraft Carburetor

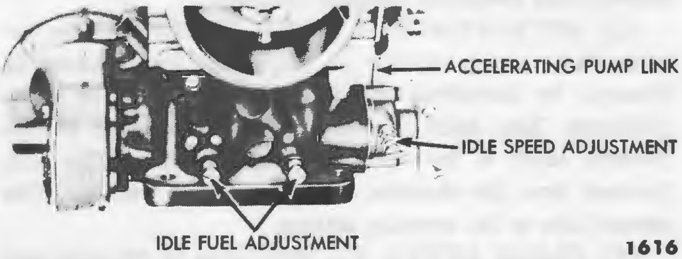

Fig. 49—Dual Concentric Carburetor Adjustments

c. Adjustment.

Ford carburetors are provided with four points of adjustments: "(1) Idle Fuel," "(2) Idle Speed," "(3) Accelerating Pump Stroke," and "(4) Float Level."

Figures 49-52 illustrate the adjustments on Ford Carburetors.

(1) *IDLE FUEL.* An initial idle fuel adjustment is made before starting the engine by turning the idle

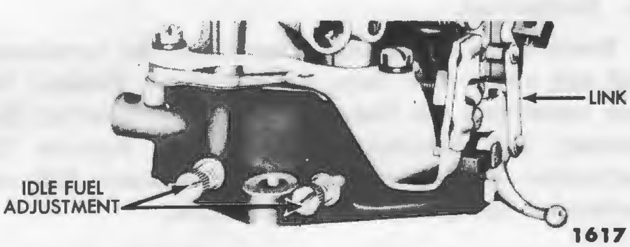

Fig. 50—Dual Carburetor Adjustments

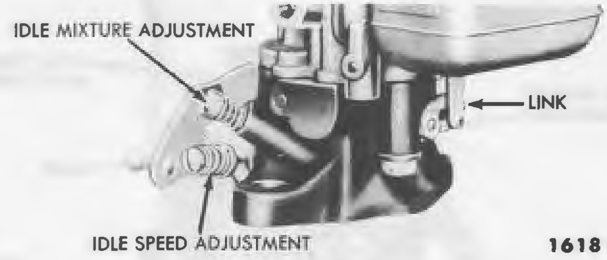

Fig. 51—Single Downdraft Carburetor Adjustment

adjustment screws (single carburetors have one screw) in until they seat lightly, then turning them out approximately one turn.

Start the engine and allow it to run at idle speed until normal operating temperature is reached.

(2) *IDLE SPEED.* Adjust the idle speed stop screw until the engine runs at about 450 r.p.m. Turn the idle fuel adjusting screw in slowly until the engine begins to run unevenly, then slowly turn the screw out again until the engine begins to "roll." Finally turn the adjusting screw in to a point where the engine runs smoothly. This adjusts one side of a dual carburetor. Follow the same procedure for the other side. Readjust the idle speed stop screw if necessary.

If test equipment is available, connect a vacuum gauge to the carburetor, and adjust the idle fuel to the highest and steadiest vacuum reading.

(3) *ACCELERATING PUMP STROKE.* The accelerating pump stroke is adjusted for seasonable changes by installing the pump link in one of three positions. The hole in the shift lever closest to the throttle shaft is for extremely hot weather. The hole farthest from the throttle shaft is for cold weather. The center hole is the average setting.

(4) *FLOAT LEVEL.* The float level of the dual and single downdraft carburetor is measured from the bottom of the float, (in closed position) to the face of the air horn casting. The correct distance should be 1.322 to

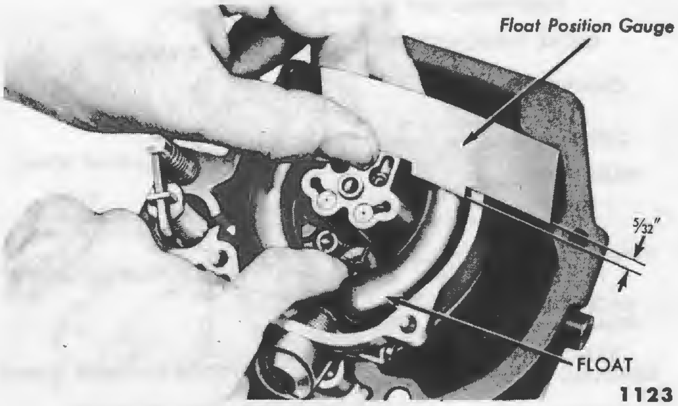

Fig. 53—Dual Concentric Carburetor-Float Level Adjustment

1.353 inches. Bend the float hinge until the correct measurement is reached.

The float in the dual concentric carburetor (fig. 53) is in two halves. Measurement is made from the surface of the bowl casting to the toe of each float. Both halves of the float must be checked. The correct distance is $\frac{1}{8}$ to $\frac{3}{16}$ inch. The float setting of the updraft carburetor is 1.180 to 1.200 inches. The M-Series carburetor has a float setting of 1.283 to 1.315 inches. Figures 53 and 54 show the methods of float level measurement and adjustment.

5. 6-CYLINDER CARBURETOR OVERHAUL (SINGLE DOWNDRAFT)

The procedure for removing, overhauling, and installing the 6-cylinder carburetor is given under the following headings: "a. Removal," "b. Disassembly," "c. Cleaning," "d. Assembly," and "e. Installation."

a. Removal.

Remove the air cleaner. Disconnect the accelerator rod and choke wire from the carburetor. Remove the line connecting the fuel pump to the carburetor. Disconnect the distributor vacuum line. Remove the carburetor holding nuts and lock washers. Lift the carburetor and gaskets off the manifold.

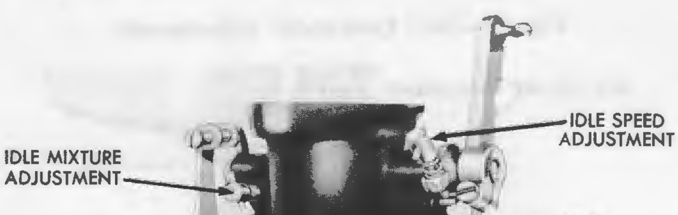

Fig. 52—Single Updraft Carburetor Adjustment

b. Disassembly.

The throttle plate and shaft, and the choke plate and shaft should not be removed from the carburetor unless absolutely necessary as difficulty may be encountered when installing these parts in their correct position.

(1) *REMOVE AIR HORN.* Remove the carburetor fast idler rod clips and fast idle rod. Remove the screws

Fig. 54—Dual Downdraft Carburetor-Float Level Adjustment

holding the air horn on the main body and lift the air horn and the gasket off the main body.

(2) *REMOVE THROTTLE BODY.* Remove the carburetor accelerator pump to throttle shaft lever retainer and lever. Remove the throttle body to main body screws and separate the throttle body and gasket from the main body.

(3) *DISASSEMBLE MAIN BODY.* Lift the accelerating pump assembly from the main body. Remove the two nozzle bar clamps and lift the nozzle bar out of the main body. Remove the power valve. Remove the main jet. Remove the pump discharge valve retainer. Remove the carburetor pump check ball retainer with a wire with a hook at one end. Place a hand over the top of the main body, and turn the body over, being careful to catch the pump check ball and the pump discharge valve. Remove the idle tube and nozzle air bleed plug from the nozzle bar.

(4) *DISASSEMBLE AIR HORN.* Remove the float hinge pin and float from the air horn. Lift the float needle valve from the valve seat. Remove the float needle valve seat.

NOTE: ***On the M-Series carburetor, remove the float spring and spring hooks.***

Pull the power valve piston assembly from air horn. Remove the choke lever, choke lever plunger, and spring.

If absolutely necessary, remove the two choke plate screws, hold the choke lever in the open position, and remove the choke plate shaft and spring.

(5) *DISASSEMBLE THROTTLE BODY.* Remove the carburetor idle adjustment needle and spring fig. 55. If necessary, remove the throttle plate screws and slide the throttle plate out of the throttle shaft. Remove the shaft nut, lock washer, and accelerator pump lever.

c. Cleaning and Inspection.

Many carburetor troubles are the result of deposits accumulating in the carburetor. A thorough cleaning must be performed to assure the satisfactory performance of the carburetor. Clean all parts in solvent.

(1) *THROTTLE BODY.* Remove all gum and varnish from the throttle bore. Clean the upper and lower idle discharge hole with a number 53 (0.0595) drill. Clean the distributor vacuum hole at the venturi (upper hole) with a number 56 (0.0465) drill and the lower hole with a number 55 (0.052) drill.

Inspect the fit of the throttle plate when held in the closed position and observe the amount of light that can be seen around the edges of the plate. A very snug fit is necessary for proper idling and low speed operation. The complete assembly should be discarded if wear or looseness is evident. Replace the idle adjusting needle if a ridge is visible on the valve surface.

(3) *MAIN BODY.* Clean all passages with compressed air. Replace the main body if it is cracked, has nicks large enough to permit leakage at any gasket surface, or if it has stripped threads.

Inspect the accelerating pump and replace the pump piston spring if it is broken. Replace the pump piston if the leather cup is worn or damaged, or if the piston expanding spring is broken.

Inspect the idle tube and replace if it is plugged, bent, damaged, or the screw driver slot is damaged. Replace the pump discharge needle if it is ridged. Replace the nozzle bar air bleed plug if it is clogged, threads are stripped, or if the screw driver slot is damaged. Replace the power valve if it is leaking, has a broken spring, or if the valve will not seat.

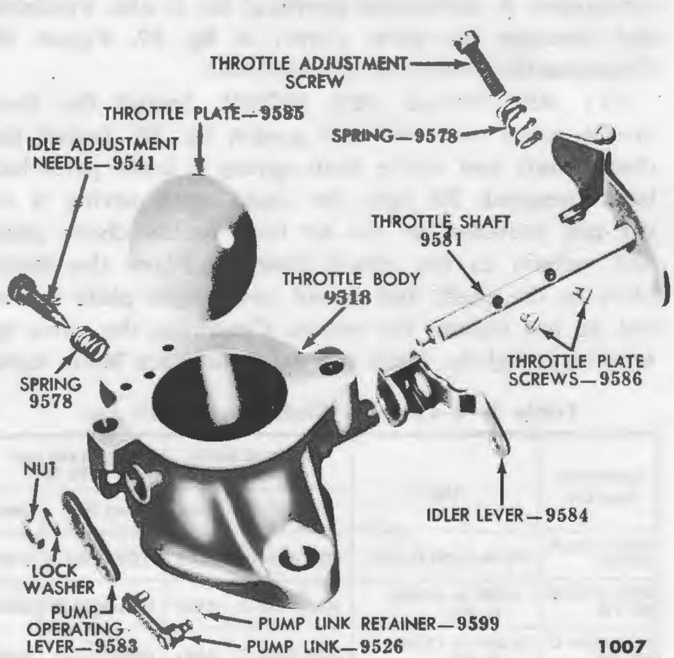

Fig. 55—6-Cylinder Carburetor Throttle Body, Disassembled

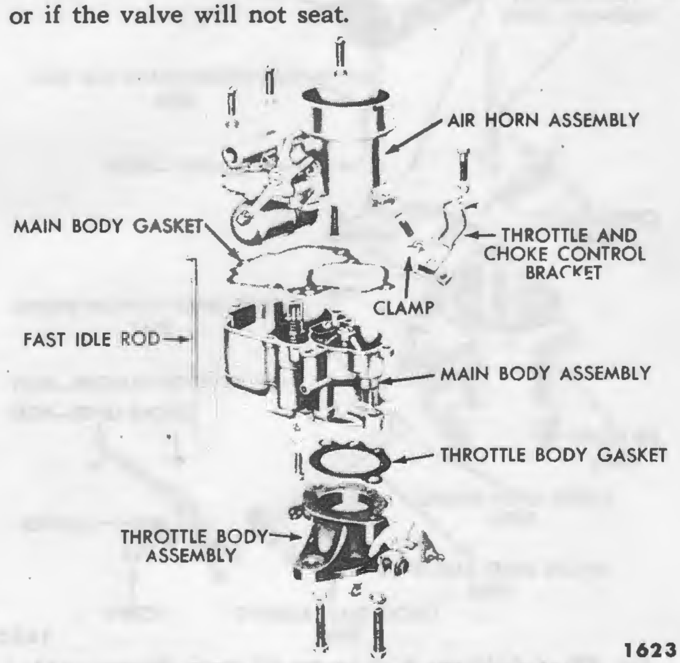

Fig. 56—6-Cylinder Carburetor, Disassembled

Fig. 57—6-Cylinder Carburetor Overhaul Kit

(4) *AIR HORN.* Replace the air horn if it is cracked or has nicks large enough to permit leakage at any gasket surface.

Close the choke plate and hold the horn in position to observe the fit of the plate in the air horn. If the choke plate does not fit tightly or if the shaft is loose, replace the air horn assembly.

Inspect the solder on the float to make certain the float does not leak. Inspect the float for leaks by holding the float under water that has been heated to just below the boiling point. Bubbles will appear if the float leaks. Another method to detect a leaking float is to

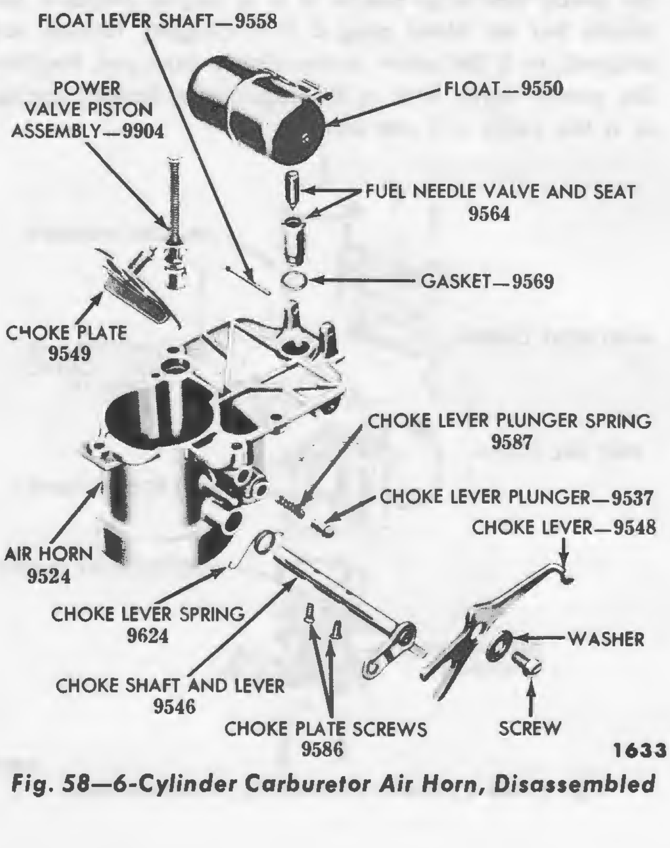

Fig. 58—6-Cylinder Carburetor Air Horn, Disassembled

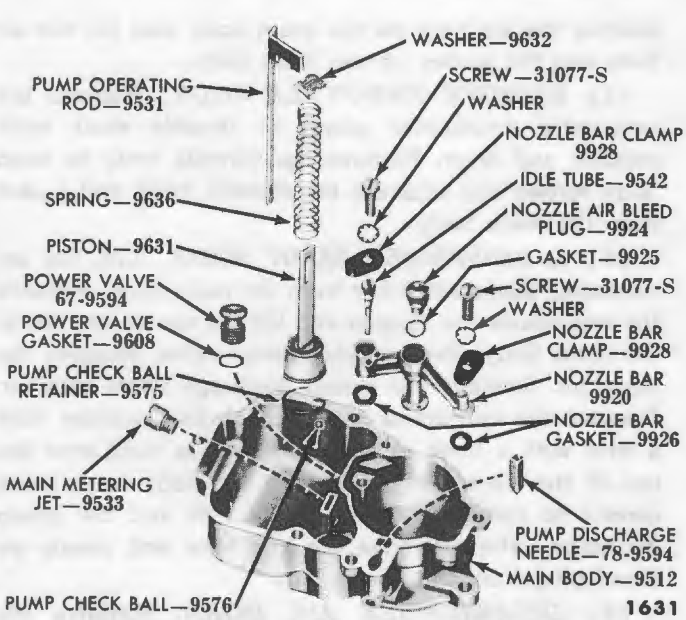

Fig. 59—6-Cylinder Carburetor Main Body, Disassembled

shake the float and see if gasoline can be detected inside the float. If the float leaks, replace it with a new one. Polish the fuel needle contact surface of the float arm.

Inspect the fuel inlet needle valve and seat, and replace both parts if there is any indication of wear on either part. The parts are supplied in matched sets.

Make a visual inspection of the choke lever for wear in the "v" opening. Replace the choke lever if excessive wear is evident.

d. Assembly.

Always install new gaskets when rebuilding the carburetor. A carburetor overhaul kit is also available and contains the parts shown in fig. 57. Figure 56 illustrates the carburetor disassembled.

(1) *ASSEMBLE AIR HORN.* Install the float needle valve seat and new gasket fig. 58. Install the choke shaft and choke shaft spring if these parts had been removed. Be sure the choke shaft spring is on the peg provided on the air horn so the choke plate will remain in the closed position. Place the choke plate in the shaft, and install new choke plate screws but do not tighten the screws. Centralize the valve by tapping it lightly. Hold the valve in place while tight-

Table 3—6-Cylinder Carburetor Main Jets

Carburetor Part No.	Use	1949 and Early 1950 Jet		Late 1950 and 1951 Jet	
		Part No.	Size	Part No.	Size
8HA-9510-A 8MTH	Up to 5,000 ft. alt.	5GA-9533-A	0.065	1GA-9533-A	0.064
8HA-9510-B 8MTH	5,000 to 10,000 ft. alt.	5GA-9533-B	0.063	1GA-9533-B	0.062
8HA-9510-C 8MTH	10,000 to 15,000 ft. alt.	5GA-9533-C	0.061	1GA-9533-C	0.060
8HA-9510-D 8MTH	15,000 ft. alt. and up	5GA-9533-D	0.059	1GA-9533-D	0.058

ening the screws. Stake the screws in place on the shaft.

Install the choke lever, plunger, and spring on the air horn. Place the choke lever on the boss. Make sure the stop on the choke shaft lever is in the "v" of the choke lever. Install the piston and stem power valve piston assembly in the air horn.

NOTE: ***On the M-Series Carburetor, install the float spring and hooks.***

Install the float needle valve and float in the air horn. Adjust the float level to 1.322-1.353 inches.

(2) *ASSEMBLE MAIN BODY.* Place a new gasket on the power valve and install the valve in the main body (fig. 59). Install the correct size main jet. Table 3 shows the available main jets. Place the pump check ball in the forward hole in the pump bore. Install the check ball retainer in the pump bore, making sure the bent end of the retainer is over the check ball. Install the pump discharge needle and retainer. Install the idle tube (fig. 44) in the nozzle bar. Place a new gasket on each nozzle seat in the main body. Position the nozzle bar and install the nozzle bar clamps, lock washers, and screws. Install the air bleed plug and gasket. Install the pump piston assembly.

(3) *ASSEMBLE THROTTLE BODY.* Install the adjusting needle and spring.

If throttle plate and shaft were removed, slide the shaft into the throttle body. Install the accelerating pump lever and secure with the lock washer and nut. Place the throttle plate in the shaft, and install new throttle plate screws but do not tighten the screws. Centralize the valve by tapping it lightly. Hold the valve in place while tightening screws. Stake the screws.

(4) *ASSEMBLE THROTTLE BODY TO MAIN BODY.* Position a new throttle body gasket on the main body and secure the throttle body to the main body. Insert the grooved pin (long pin) of the pump link in the pump operating rod and the other pin in the pump operating lever. Install the pump link retainer in the groove of the pin. The hole farthest from the pivot point is for extreme cold temperatures. The hole nearest to the pivot is for extreme hot temperatures. The center hole is for average driving conditions.

(5) *ASSEMBLE AIR HORN TO MAIN BODY.* Position a new gasket on the main body. Position the air horn on the main body and secure with the screws. Be sure to install the choke control bracket under the rear screw. Install the idle lever on the throttle body. Install a cotter pin to secure the lever in place. Connect the fast idle rod to the choke shaft lever. Connect the idle lever to the fast idle rod.

e. Installation.

Position a new gasket on the manifold. Place the carburetor on the manifold and secure with the lock washers and nuts. Tighten the nuts evenly. Connect the choke, and throttle linkage to the carburetor. Connect the fuel line and the distributor vacuum line. Place air cleaner on the carburetor and tighten clamp.

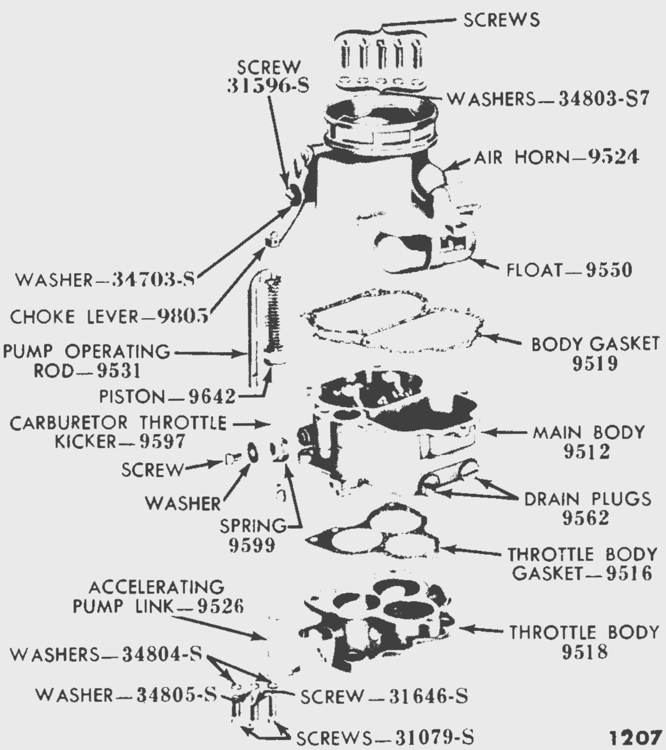

Fig. 60—8-Cylinder Carburetor, Disassembled

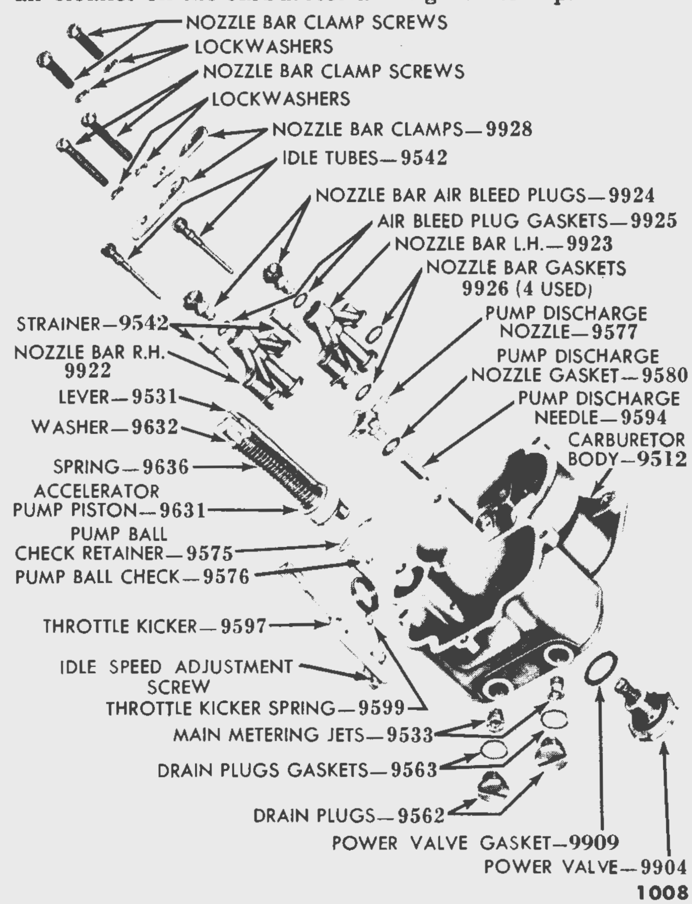

Fig. 61—8-Cylinder Carburetor Main Body, Disassembled

6. 8-CYLINDER CARBURETOR OVERHAUL (DUAL DOWNDRAFT)

The procedure for removing, overhauling, and installing the 8-cylinder dual downdraft carburetor is covered in this section under "a. Removal," "b. Disassembly," "c. Cleaning and Inspection," "d. Assembly," and "e. Installation."

a. Removal.

Remove the air cleaner. Disconnect the accelerator rod and choke wire at the carburetor.

Remove the line connecting the fuel pump to the carburetor. Disconnect the distributor vacuum line. Remove the carburetor holding nuts and lock washers then lift the carburetor and gaskets off the manifold.

b. Disassembly.

The throttle plate and shaft and the choke plate and shaft should not be removed from the carburetor, unless absolutely necessary as difficulty may be encountered in installing these parts in their correct position.

(1) *REMOVE CHOKE LEVER AND THROTTLE KICKER.* Remove the screw and flat washer that secure the choke lever to the air horn, and remove the lever, fig. 60. Lift the choke lever plunger and spring from the air horn. Remove the screw and washer holding the throttle kicker to the main body. Lift the throttle kicker and spring from the main body. Disconnect the pump link from the pump rod and throttle shaft lever.

(2) *REMOVE THROTTLE BODY AND AIR HORN FROM MAIN BODY.* Remove the screws holding the throttle body to the main body. Lift the throttle body and gasket from the main body. Remove the screws holding the air horn on the main body. Lift the air horn and gasket from the main body.

(3) *DISASSEMBLE MAIN BODY.* Lift the accelerating pump assembly from the main body (fig. 61). Remove the screw from each nozzle bar clamp and remove the clamps. Lift the pump discharge nozzle and the two nozzle bars from the main body. Remove the two drain plugs and gaskets from the main body. Remove the two main jets as shown in fig. 62. Remove the power valve and gasket. Remove the pump check ball retainer from the main body. A tool for this operation can be made by bending the end of a small wire to form a hook. Insert the hook into the bore and engage the end of the retainer. Turn the assembly upside down, be sure to catch the pump check ball and pump discharge needle.

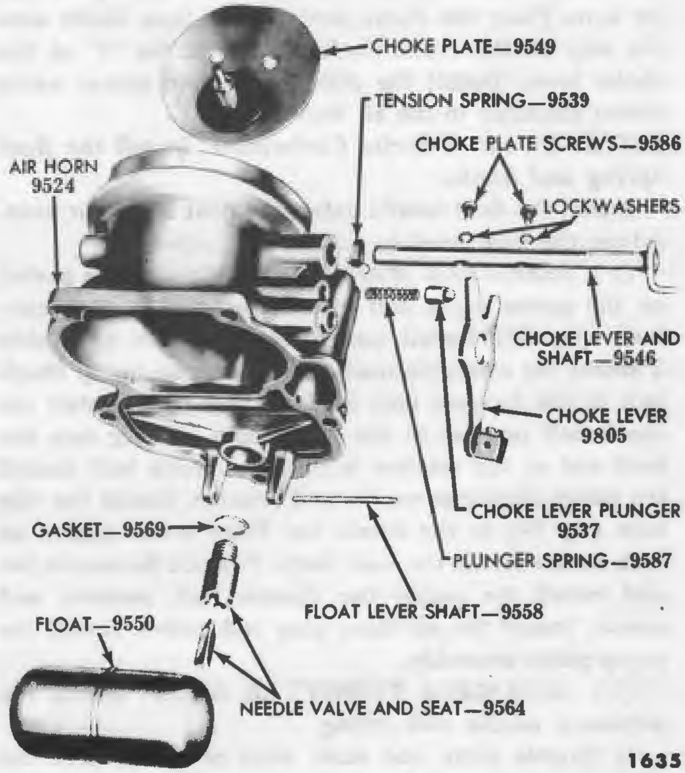

Fig. 63—8-Cylinder Carburetor Air Horn, Disassembled

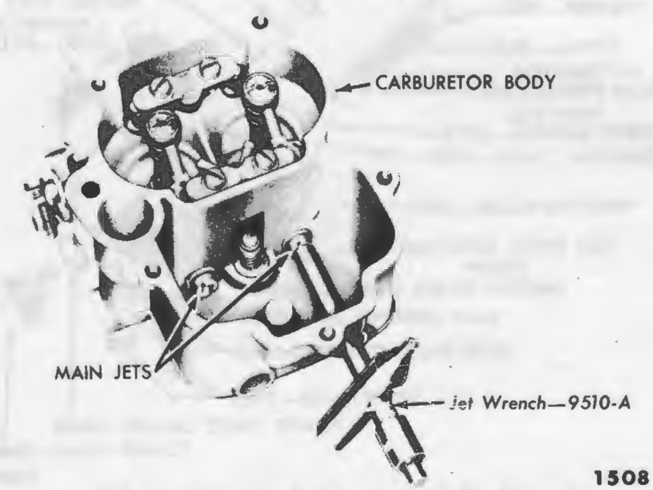

Fig. 62—Removing Main Jet from 8-Cylinder Carburetor

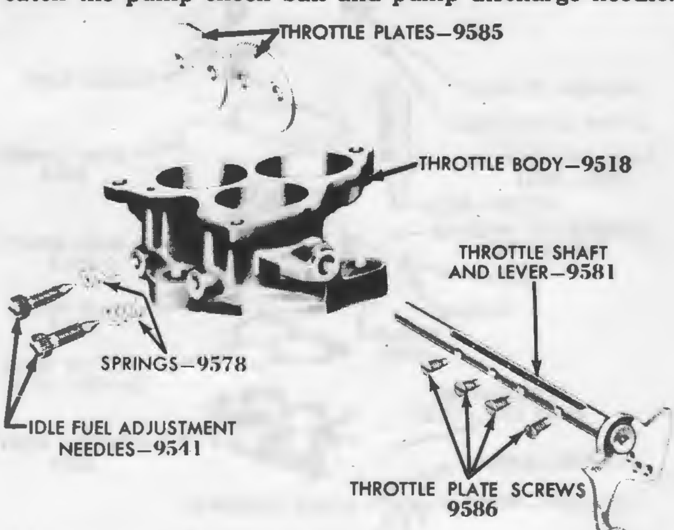

Fig. 64—8-Cylinder Throttle Body, Disassembled

(4) *DISASSEMBLE AIR HORN.* Remove the float lever shaft, float, and float needle valve from the air horn (fig. 63). Remove the float needle valve seat with a jet wrench. Remove the screws holding the choke plate to the choke shaft. Remove the choke plate from the shaft, then remove the shaft.

(5) *DISASSEMBLE THROTTLE BODY.* Remove the two idle fuel needles and springs (fig. 64). Remove the throttle plates. Remove the throttle lever stop spring and throttle lever. Slide the shaft out of the throttle body.

c. Cleaning and Inspection.

Many carburetor troubles are the result of deposits accumulating in the carburetor. A thorough cleaning must be performed to assure the satisfactory performance of the carburetor.

Clean all parts in a cleaning solvent except the carburetor power valve. Cleaning solvent may damage the power valve diaphragm.

(1) *THROTTLE BODY.* Make certain that any gum or varnish is removed from the throttle bores. Clean the upper idle feed holes in the throat above the throttle plates with drills number 60 (0.040) and number 65 (0.035), drill and the lower idle discharge holes with a number 56 (0.0465) drill. Clean the distributor vacuum hole in the carburetor throttle body with a number 56 (0.0465) drill. Clean the idle adjusting holes.

Inspect the fit of the throttle plates when held in the closed position and observe the amount of light that can be seen around the edges of the plate. A very snug fit is necessary for proper idling and low speed operation. The complete assembly should be discarded if wear or looseness is evident.

Replace the idle adjusting needle if a ridge is visible on the valve surface of the needle.

(2) *MAIN BODY.* Clean all passages with compressed air. Replace the main body if it is cracked, has nicks large enough to permit leakage at any gasket surface, or if it has stripped threads.

Inspect the accelerating pump and replace the pump piston spring if it is broken. Replace the pump piston if the leather cup is worn or damaged, or if the piston expander spring is broken.

Inspect the idle tube and replace if it is plugged, bent, damaged, or the screw driver slot is damaged. Replace the pump discharge needle if it is ridged. Replace the nozzle bar air bleed plug if it is clogged, threads are stripped, or if the screw driver slot is damaged.

Replace the pump discharge nozzle if it is plugged, broken, or damaged in any way.

Examine the power valve seat and replace the body if the seat is damaged so that the valve will not seat properly. This would cause fuel to leak into the lower body and affect the fuel mixture.

(3) *AIR HORN.* Replace the air horn if it is cracked or has nicks large enough to permit leakage at any gasket surface.

Close the choke plate and hold the air horn in position to observe the fit of the plates in the air horn. If the choke plate does not fit tightly or the shaft is loose, replace the air horn assembly.

Inspect the solder on the float to make certain the float does not leak. Inspect the float for leaks by holding the float under water that has been heated to just below the boiling point. Bubbles will appear if the float leaks. A leaking float can frequently be detected by shaking the float vigorously, and observe the noise made by any fuel inside the float. If the float leaks replace with a new float. Polish the fuel needle contact surface of the float arm.

Inspect the fuel inlet needle valve and seat, and replace both parts if there is any indication of wear on either parts as the fuel needle valve and seat are matched in sets. Make a visual inspection of the choke lever for wear in the "v" opening which operates the lever on the choke plate shaft. Replace the choke lever if the wear is excessive.

d. Assembly.

Always use new gaskets when rebuilding the carburetor. The gasket kit shown in fig. 65 is available from

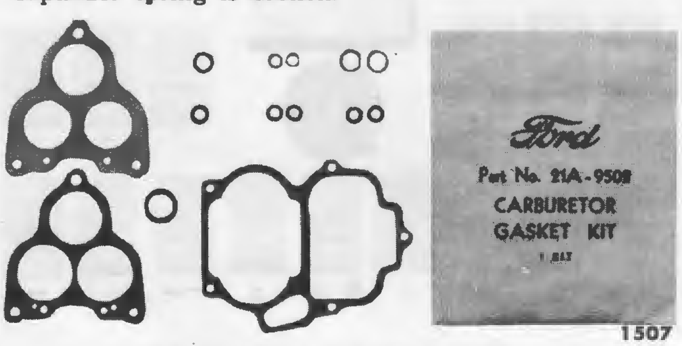

Fig. 65—8-Cylinder Carburetor Gasket Kit

Fg. 66—8-Cylinder Carburetor Repair Kit

Ford Dealers. An overhaul carburetor kit is also available and contains the parts shown in fig. 66.

(1) *ASSEMBLE AIR HORN.* Install the float needle valve seat and new gasket. Install the choke shaft and choke shaft spring in the air horn. Be sure the choke shaft spring is in the slot provided in the air horn so the choke plate will remain in the closed position. Place the choke plate in the shaft and install new choke plate screws but do not tighten the screws. Centralize the valve by tapping it lightly. Hold the valve in place while tightening the screws. Stake the screws in place on the shaft. Install the float needle valve and float in the air horn. Adjust the float level to 1.322-1.353 inches.

(2) *ASSEMBLE MAIN BODY.* Install standard size number 51 main jets for sea level operation. At altitudes of 5,000 to 10,000 feet use number 49 and higher altitudes use number 47. Install the two drain plugs with new drain plug gaskets. Install the power valve, using a new gasket. Position the pump discharge needle, pump discharge nozzle, and a new gasket in the main body. Place four new nozzle bar gaskets in the main body. Place the two nozzle bars in position with the air bleeds close to the pump discharge nozzle and secure with the two nozzle bar clamps.

NOTE: ***The two long screws are used at the pump discharge side.***

Install the pump check ball and retainer. Install the accelerator pump.

(3) *ASSEMBLE THROTTLE BODY.* Insert the throttle shaft in the throttle body. Position the throttle valve in the shaft. Install new throttle valve screws but do not tighten them. Centralize valves by tapping lightly and hold in place while tightening the throttle valve screws. Stake the screws in position. Install the throttle lever, spring, and throttle lever stop.

(4) *INSTALL THROTTLE BODY AND AIR HORN ON MAIN BODY.* Place a new throttle body gasket on the main body. Secure the throttle body to the main body with three screws and lock washers. Place a new gasket on the main body and secure the air horn to the main body with the screws and lock washers. Install the accelerator pump link and be sure to use the correct adjustment hole.

(5) *INSTALL CHOKE LEVER AND THROTTLE KICKER.* Attach the throttle kicker and spring to the main body with a screw and flat washer. Install the choke lever plunger spring and plunger in the main body. Install the choke lever.

e. Installation.

Position a new gasket on the manifold. Place the carburetor on the manifold, install the lock washer and nuts. Tighten the nuts evenly. Connect the choke and throttle linkage to the carburetor. Connect the fuel line and the distributor vacuum line. Place the air cleaner on the carburetor, and tighten the clamp.

7. 8-CYLINDER CARBURETOR OVERHAUL (DUAL CONCENTRIC)

Overhauling procedures for the dual concentric carburetor used on the E-Series engine appear under the headings "a. Removal," "b. Disassembly," "c. Cleaning and Inspection," "d. Assembly," and "e. Installation." Repair kits for the carburetor are shown in figs. 67-69.

a. Removal.

Remove the air cleaner. Disconnect the choke wire and accelerator rod. Disconnect the fuel line, distributor vacuum line, and governor vacuum lines. Remove the carburetor to manifold nuts and lock washers. Lift the carburetor and gaskets from the manifold.

b. Disassembly.

Remove the five screws holding the air horn to the main body and remove the air horn. Remove the bowl

Fig. 67—Carburetor Metering Repair Kit

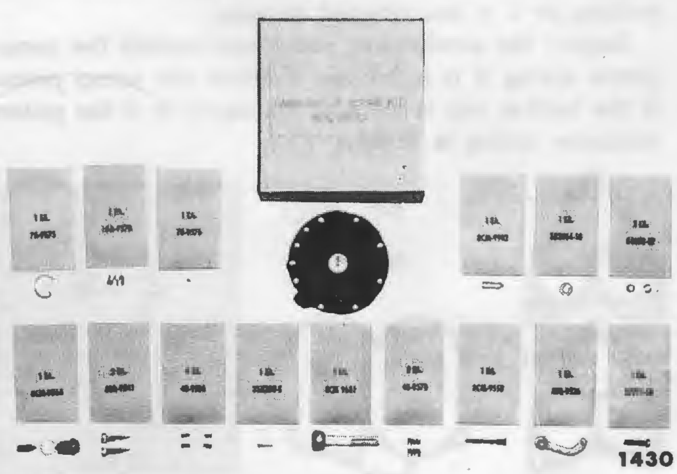

Fig. 68—Carburetor Repair Kit

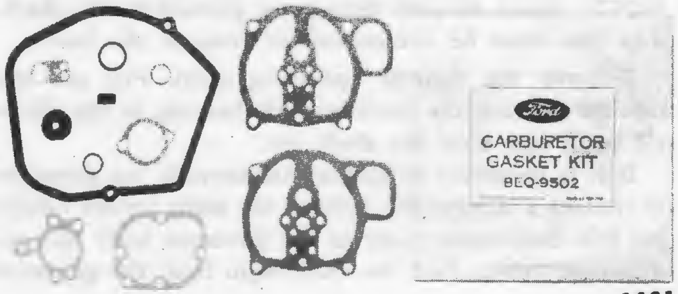

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Fig. 69—Carburetor Gasket Kit

cover plate and gaskets. Remove the two screws holding the main body to the throttle body. Remove the accelerating pump link. Unscrew the stud from the accelerating pump operating rod. Remove the throttle body.

The carburetor is shown disassembled into major subassemblies in fig. 70.

(1) *DISASSEMBLE AIR HORN.* Remove the two choke lever bracket mounting screws and the bracket. Remove the choke plate screws, slide the plate out of the slot in the shaft, and remove the shaft. Remove the bowl vent screws and the bowl vent. If it is necessary to remove the power piston assembly, cut the indentations away with a sharp edged tool and pull the assembly out. Figure 71 illustrates the air horn completely disassembled.

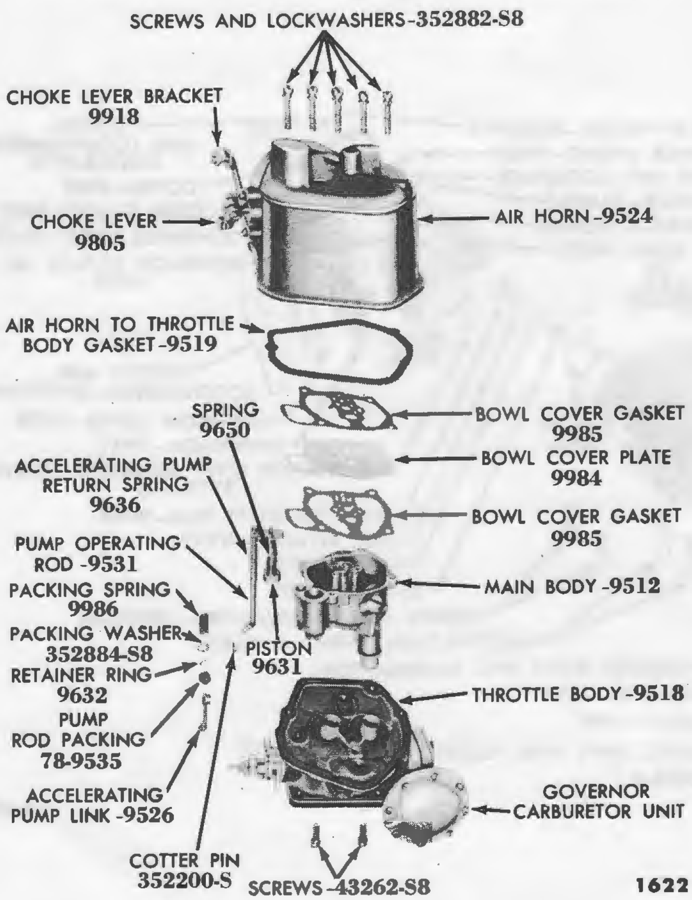

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Fig. 70—Dual Concentric Carburetor, Disassembled

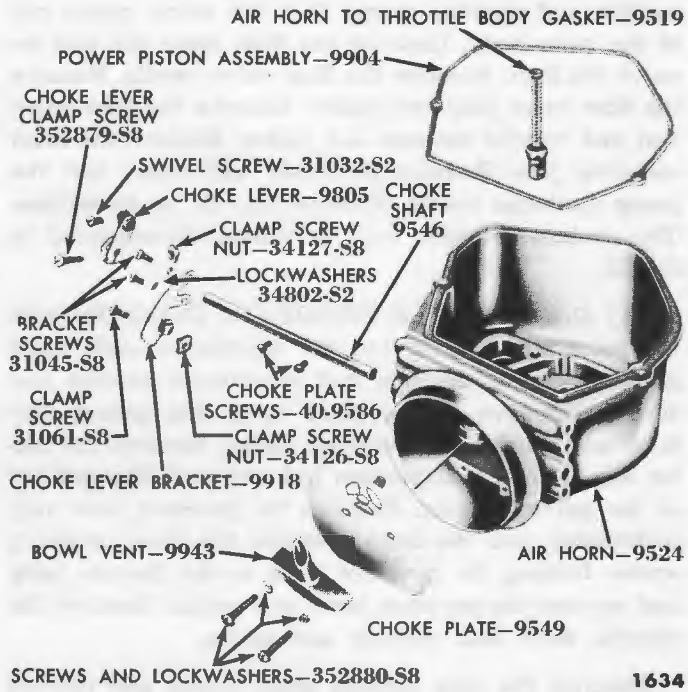

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Fig. 71—Air Horn, Disassembled

(2) *DISASSEMBLE MAIN BODY.* Remove the accelerating pump operating rod retainer ring, packing

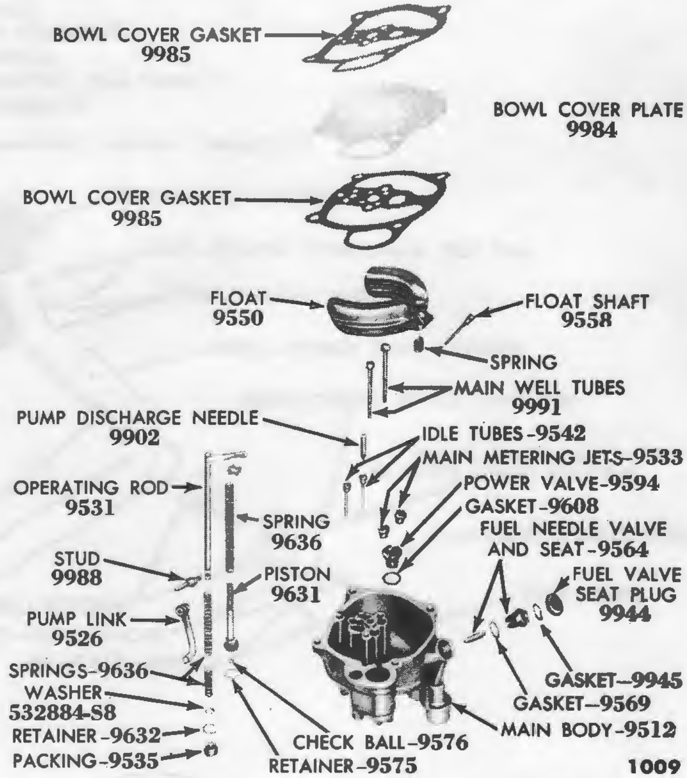

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Fig. 72—Carburetor Main Body, Disassembled

washer, and packing spring. Pull the pump piston out of the main body. Unscrew the float hinge pin and remove the float. Remove the float valve needle. Remove the float valve plug and gasket. Unscrew the float valve seat and remove the seat and gasket. Remove the main metering jets. Remove the main well tubes and the pump discharge needle. Remove the idle jet assemblies. The carburetor main body is shown disassembled in fig. 72.

(3) *DISASSEMBLE THROTTLE BODY.* Remove the secondary venturi and the throttle to main body gasket. Remove the idle fuel adjustment needles and springs. Remove the governor cover and gasket. Unhook and remove the governor spring. Remove the cotter key from the diaphragm rod and push the rod out of the governor lever. Remove the governor lever nut, lockwasher, and the lever. Remove the three retaining screws holding the governor body to the throttle body and remove the governor body and gasket. Remove the throttle shaft seal, retainer and spring.

Unscrew the four throttle plate screws and remove the throttle plates. Remove the two screws retaining the throttle shaft housing and remove the housing. Remove the screw clamp and the throttle lever.

NOTE: ***Some throttle levers are pinned to the shaft. The pin must be driven out to remove the lever.***

Remove the throttle operating shaft. Pry out the retainer holding the throttle shaft bearing in the throttle body and slide the shaft out.

If it is necessary to further disassemble the governor to replace a diaphragm, remove the eight screws retaining the diaphragm cover to the governor body and remove the cover. Peel the diaphragm from the governor body.

The throttle body is shown completely disassembled in fig. 73.

c. Cleaning and Inspection.

Wash all parts thoroughly in a cleaning solution. Several carburetor cleaning solutions are available. In the absence of a special cleaner, use alcohol or lacquer thinner. Blow out all passages with compressed air. Clean out any gum or varnish from the throttle openings. Check the throttle plates with the plates in a closed position. If an excessive amount of light shows between the plates and throttle body, replace the throttle body. Replace any parts that are cracked, badly nicked, or worn. Replace parts with stripped threads. Check the

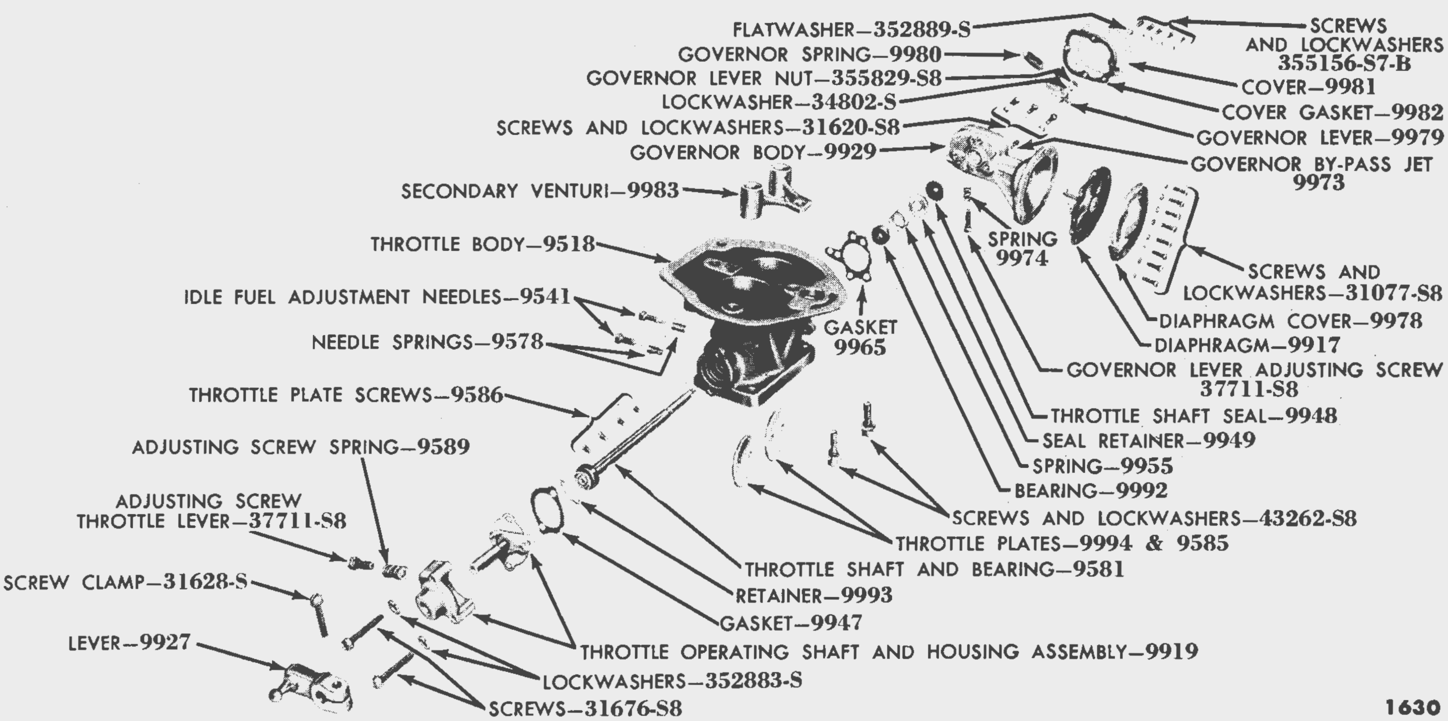

Fig. 73—Throttle Body, Disassembled

pump discharge valve needle for ridges on the valve surface.

Replace the accelerator pump piston if the leather cup is worn or damaged or if the expander spring is broken. Replace any other broken springs.

Check the float for leaks. Replace the float if it leaks, is bent, or is damaged. Check the float valve needle and seat. Replace both needle and seat if either is worn. Replace any damaged or plugged idling jets. Replace main metering jets if they are damaged or scored.

d. Assembly.

First assemble the major sub assemblies as described in "(1) Throttle Body Assembly," "(2) Main Body Assembly," and "(3) Air Horn Assembly." Finally, join the sub assemblies together as described in "(4) Carburetor Assembly."

(1) *THROTTLE BODY ASSEMBLY*. Install a new diaphragm if the governor body was disassembled. Be sure the vent hole in the diaphragm lines up with the vent in the cover and governor body. Install the cover screws and lockwasher.

Install the throttle shaft and bearing and insert the bearing retainer. Slide the throttle operating shaft into the throttle shaft housing and install the throttle lever on the shaft.

NOTE: ***If the lever was secured by a pin, install the pin and peen the ends.***

Install the throttle control shaft and housing assembly on the throttle body. Use a new gasket. Install the throttle plates in the throttle shaft. Install new screws and spread the hollow ends of the screws.

Operate the throttle lever and check the movement of the throttle plates. A correctly installed throttle control will close the throttle plates but will not open them. If the throttle lever operates incorrectly, loosen the two control shaft housing to throttle body screws far enough to permit slipping the drive coupling clockwise until the lever will control the plates correctly.

Install the spring, retainer, and throttle shaft seal on the governor end of the shaft. The shoulder on the seal fits inside the retainer. Place a new gasket in position on the throttle body and install the governor body. Install the three retaining screws. Install the governor lever, lockwasher and nut on the end of the throttle shaft. Insert the diaphragm rod through the lever and install the cotter key. Install the governor spring. Install the governor cover with a new gasket. Install the secondary venturi and a new throttle to main body gasket. Install the idle fuel adjustment needles and springs.

(2) *MAIN BODY ASSEMBLY*. Install the idle jet assembly, the pump discharge needle, and the main well tubes. Install the main metering jets. Install the float and float hinge pin. Insert the float valve needle into the inlet opening with the point away from the float arm. Install the float valve seat with a new gasket. Guide the point of the needle into the seat. Install the float valve plug with a new gasket.

Insert the accelerating pump and operating rod assembly into the main body. Be sure the return spring (longer than packing spring) is on the operating rod. Install the packing spring, packing washer, and retainer ring.

(3) *AIR HORN ASSEMBLY*. If the power piston assembly was removed, install a new assembly and stake it in four places. Install the choke shaft and plates.

NOTE: ***The choke plate is correctly installed when the air valve in the plate opens into the air horn with the plate in the closed position.***

Install the choke plate screws and spread the screw ends. Be careful not to bend the shaft.

Slide the bowl vent into the recess provided and install the vent retaining screws. Install the choke lever bracket and screws.

(4) *CARBURETOR ASSEMBLY*. Install the main body on the throttle body (aligning the gasket) and secure it with the two screws. Be sure the accelerating pump operating rod slides through the hole provided in the throttle body. Install the pump link stud, pump link, and cotter key. Install the bowl cover plate with new gaskets above and below the plate. Be sure to align the gaskets. Install the air horn with a new gasket. The tool illustrated in fig. 74 will aid in guiding the air horn into position.

Secure the cover with the five retaining screws. The short screw fits the center hole in the cover.

e. Installation.

Install a new gasket on the manifold studs. Install the carburetor and secure it with the mounting nuts. Tighten the nuts evenly. Install the governor vacuum lines, distributor vacuum line, and fuel line. Connect the accelerator rod. Connect the choke wire and adjust the wire in the clamp so the choke control operates properly. Install the air cleaner.

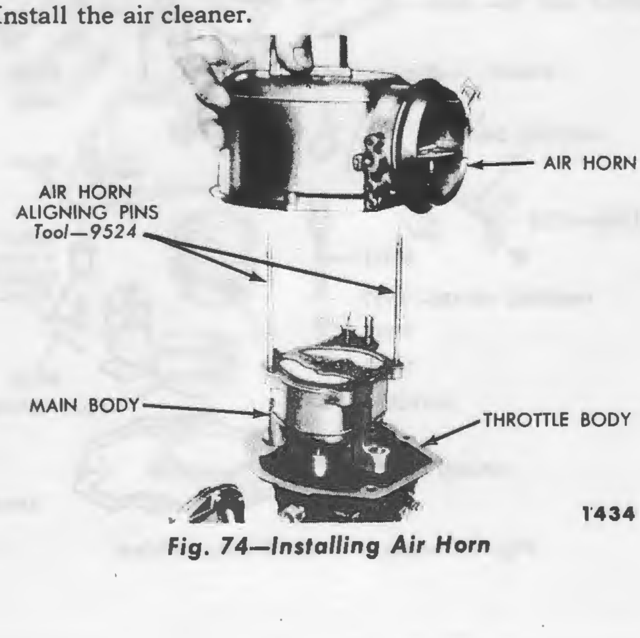

Fig. 74—Installing Air Horn

8. 6-CYLINDER CARBURETOR OVERHAUL (SINGLE UPDRAFT)

The single updraft carburetor is used on the H and M Series engine in the C.O.E. truck and on the H-Series engine in Parcel delivery trucks. Information on overhauling the carburetor has been divided under the headings "**a.** Removal," "**b.** Disassembly," "**c.** Cleaning and Inspection," "**d.** Assembly," and "**e.** Installation."

a. Removal.

Disconnect the flexible air intake tube. Disconnect the fuel line, distributor vacuum line, and the governor line (if a governor is used). Disconnect the choke wire and accelerator rod. Remove the carburetor flange mounting nuts and the carburetor.

b. Disassembly.

Remove the cotter key and pin connecting the pump link to the pump rod extension. Remove the five screws retaining the upper and lower body assemblies, separate the castings, and remove the gasket.

(1) *UPPER BODY DISASSEMBLY.* Slide the float hinge pin from the bracket and remove the float and lever assembly. Remove the float valve needle, seat, and gasket. Remove the screw and washer retaining the throttle kicker lever and remove the lever and spring. NOTE: ***Do not remove the adjuster screw in the end of the lever.***

Remove the distributor vacuum line fitting. Unscrew the vacuum passage jet, invert the upper body and shake the jet and gasket out.

Slide the venturi out of the upper body. Pull the economizer piston and stem out of its bore. Remove the idle adjusting needle and spring.

Loosen the throttle lever clamp screw and remove the lever. Remove the pump link retainer and the link. Remove the throttle stop screw and spring. Drive out the pin in the throttle stop lever with a $\frac{3}{32}$ inch drift and remove the lever. Remove the throttle plate screws and throttle plate. Slide out the throttle shaft and packing. Remove the distributor passage plug.

Fig. 75 illustrates the upper body when it is disassembled.

(2) *LOWER BODY DISASSEMBLY.* Remove the pump operating rod pin and slide the rod extension out of the lower body. Slide the pump assembly out of the body. By depressing the spring and washer and removing the pump rod, the entire assembly will come apart. Remove the main nozzle, the float chamber drain plug, and the drip plug. Remove the main jet passage plug and gasket. Remove the main jet.

Remove the choke lever retaining nut lockwasher, hub, lever and swivel assembly, and the choke lever. Remove the choke bracket. Remove the choke plate screws and slide the plate out of the shaft. Remove the choke shaft.

Remove the pump check valve retainer and the ball check. Remove the power valve and gasket. Pry out the pump discharge valve cover and remove the valve. Drive out the pump rod seal and washer with a drift from the opposite end of the bore.

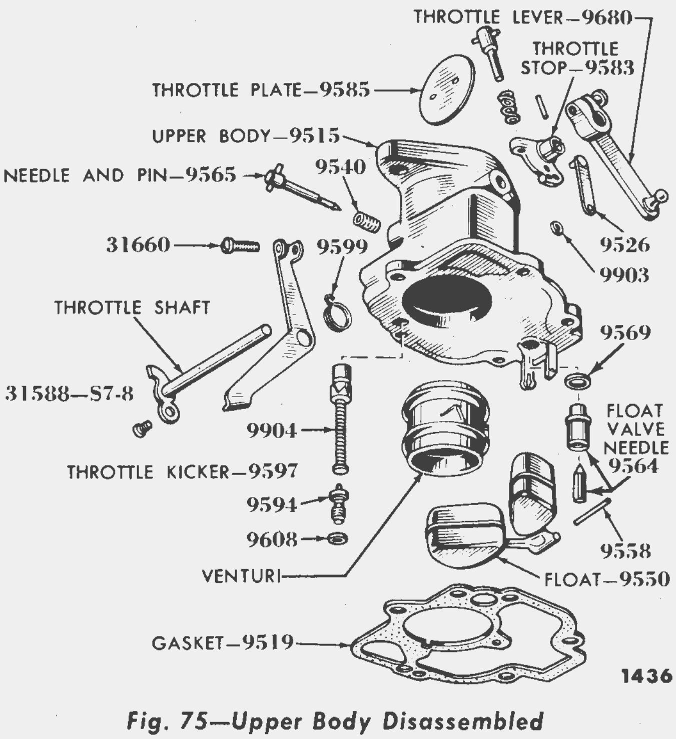

Fig. 75—Upper Body Disassembled

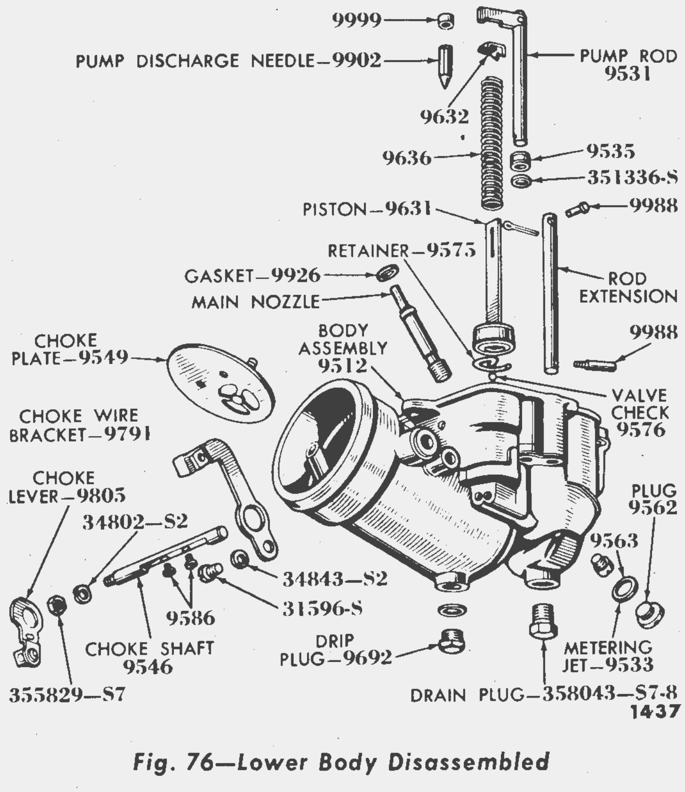

Fig. 76—Lower Body Disassembled

A disassembled view of the lower body is shown in fig. 76.

c. Cleaning and Inspection.

Wash all parts except the drip plug thoroughly in a carburetor cleaning solution. Wash the drip plug with gasoline. Lacquer thinner or denatured alcohol may be used if carburetor cleaning fluid is not available. Scrub away foreign matter with a stiff bristle brush. Blow out all passages in the body with compressed air.

Inspect all parts of the carburetor for damage or sear. Replace body castings if they are cracked, have stripped threads, or if the gasket surfaces are nicked or damaged. Replace any bent shafts or broken springs. Replace any bent shafts or broken springs. Replace the float if it leaks or is bent or damaged.

Replace the choke or throttle plate if the edges are nicked or the protective plating is worn away. Replace the choke plate if the poppet valve is inoperative.

Replace the main nozzle if the discharge hole is nicked or plugged. Replace the distributor vacuum passage jet if the top is damaged or has deposits of foreign matter.

d. Assembly.

Assemble the lower and upper body sub-assemblies as described in "(1) Lower Body Assembly" and "(2) Upper Body Assembly." The upper and lower body assemblies are then joined together as described in "(3) Carburetor Assembly."

(1) *LOWER BODY ASSEMBLY.* Install a new pump rod felt seal and washer. Drive the washer down flush or slightly below the casting surface with a 3/8 wood dowel. Stake the washer lightly in four places.

Install a new pump discharge needle, point down, in the discharge valve seat and tap the needle gently three or four times to seat the valve. Be sure to use a *small* hammer and brass drift and tap *gently.* Install the new retainer over the valve needle (bulging side up) and tap the center of the bulge until it flattens out.

Install the power valve with a new gasket and tighten the valve securely. Drop a new pump check valve ball into its seat and install the retainer.

Slide the choke shaft in the lower body. Place the choke plate in the slot so the poppet valve is at the bottom of the air inlet with the valve opening into the carburetor. Install choke plate screws finger tight. Operate the choke lever to check for binding. Adjust the choke plate position, if necessary, and tighten the screws securely. Stake the screws.

Install the choke bracket. Hold the choke plate open and install the choke lever with the pin down and pointing out. Insert the hub in the lever and swivel assembly and place the lever on the shaft with the swivel down and pointing in. Engage the pin in the slot in the choke lever. Install the nut and lockwasher.

Install the main jet. Install the jet passage plug with a new gasket. Install the float chamber drain plug and the drip plug. Install the main nozzle with a new gasket.

Place the pump spring and washer on the piston stem. Press down on the washer and insert the pump rod into the slot in the piston stem. Install the pump piston assembly in the lower body. Be sure the piston leather does not catch and turn over when you install the piston. Install the pump rod extension and pin.

(2) *UPPER BODY ASSEMBLY.* Install the distributor passage plug. Place a new seal on the throttle shaft and slide the shaft into the upper body. Turn the shaft so the first idler lever points toward the fuel inlet fitting. Insert the throttle plate and install the screws finger tight. Operate the throttle shaft to check for binding. If the shaft moves freely and the plate closes evenly in the throttle opening, tighten the screws. Stake the screws.

Install the throttle stop lever with the pump link holes toward the fuel inlet. Align the pin holes in the shaft and lever and install the pin. Install the throttle stop screw and spring. Install the pump link and link retainer. Install the throttle lever with the ball and pointing outward and the lever arm over the pump link.

Install the idle adjusting valve needle and spring and gently turn the needle in until it seats. Back it off 3/4 turn.

Slide the venturi into position aligning the holes in the venturing and upper body wall. Install the distributor vacuum jet with a new gasket. Install the distributor vacuum line fitting.

Install a new power piston and stem and stake it lightly to secure it in place.

Install the throttle kicker spring with the loop of the short end over the pin in the upper body. Hook the adjusting screw arm of the kicker lever in the spring and install the kicker lever with the adjusting screw touching the flat portion of the fast idle lever. Install the screw and washer.

Install the fuel inlet needle, seat, and gasket. Install the float and lever assembly and the float hinge pin. Check the float seating.

(3) *CARBURETOR ASSEMBLY.* Install a new gasket on the upper body. Be sure the gasket is in the correct position. Hold the throttle kicker lever against the fast idle lever and carefully guide the power piston stem, venturi and pump rod extension into the proper holes in the lower body. Install the five retaining screws finger tight. Check the gasket to see that it overlaps evenly and then tighten the screws securely. Install the pump link, pin, and cotter key.

Hold the throttle closed and turn the throttle stop screw in until it just touches the stop pin. Then turn it 1/2 turn more as a preliminary adjustment.

e. Installation.

Clean the intake manifold gasket surface. Smooth down any nicks or scratches. Install a new gasket on the manifold. Install the carburetor and tighten the mounting nuts evenly.

Connect the throttle rod and the choke wire. Check the operation of the choke knob and accelerator pedal in the cab. Connect the distributor vacuum line and the governor line (if governor is used). Connect the fuel line and the flexible air intake tube.

9. GOVERNORS

Two types of governors are used on Ford trucks. A vacuum type governor is used on F-7 and F-8 trucks. A velocity type governor is used on all other models. Service information about each governor appears under the headings "a. Vacuum Type" and "b. Velocity Type".

a. Vacuum Type.

The engine speed governor is made up of two units. The governor is vacuum controlled which eliminates the linkage required with a mechanical governor. Figure 77 shows a diagrammatic view of the governor system.

The control at the engine end of the governor consists of a governor valve assembly "A" and an adjusting screw "B" assembled in a rotor, which is mounted in a housing directly under the ignition distributor. The rotor and ignition distributor are driven by a common shaft "C".

The control at the carburetor end of the governor consists of a diaphragm: "D" which is connected to the throttle shaft by a rod and governor lever "E". A tension spring "F" also attached to the governor lever, and anchored on a stud "G" in the governor housing, tends to hold the throttle open.

The diaphragm chamber is connected to the governor valve air bleed orifice "H" by means of a conventional pipe line. The air bleed supply enters the rotor body from a second pipe line to the carburetor. Vacuum to the diaphragm is supplied by two channels "I" and "J". One channel is below the throttle plate and the other channel is above the throttle plate. The two channels

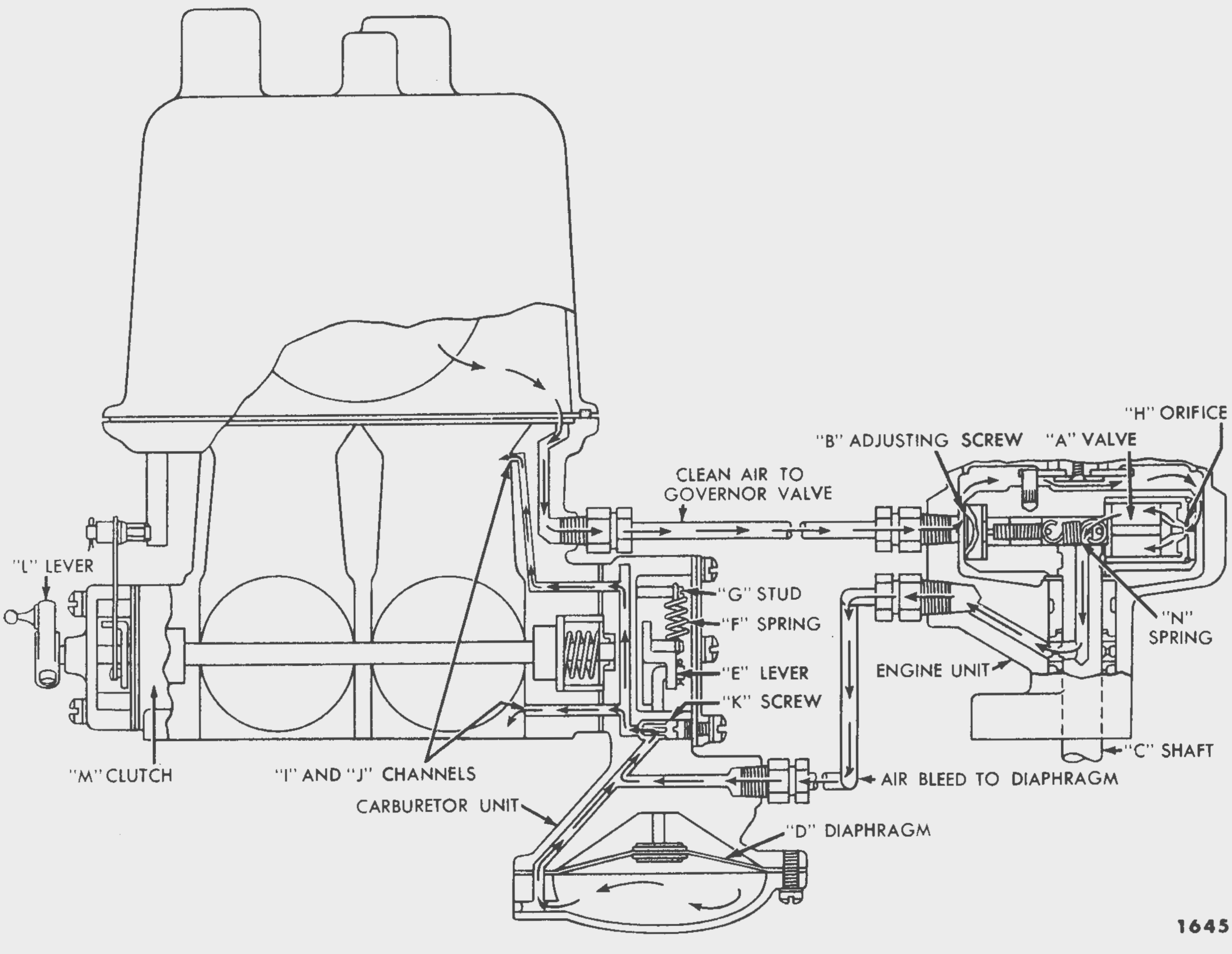

Fig. 77—Diagrammatic View of the Governor System

equalize the vacuum at the diaphragm and are connected to a channel in which is located a restriction screw "K".

When the engine is at idle speed the throttle is controlled by the external level "L" on the throttle operating shaft. The throttle operating shaft is provided with a clutch, "M" which engages the main throttle shaft. The clutch is so designed that when the accelerator is moved to the open position the governor takes over control of the throttle.

At low speed the governor valve "A" is held away from the air bleed orifice "H" by the spring "N" which is fastened to the governor adjusting screw "B". As the accelerator is moved, "F", pulls the throttle to the wide open position to remain there until the engine r.p.m. has reached the predetermined governor cut-off speed. At this point, the governor takes over control of the throttle, causing the accelerating pedal to become ineffective for further increase in engine speed. When the engine speed increases, the action of the mchanism is as follows: The governor valve "A" stretches the spring "N" and moves toward the air bleed orifice "H", thus restricting the air bleed to the diaphragm. As the air bleed to the diaphragm is reduced, it permits the suction from the orifices "I" and "J" to operate the diaphragm. As the suction increases, the diaphragm power overcomes the tension of the governor spring "F" and takes over full control of the throttle. The engine governed speed is then held constant by the valve "A", being balanced between the pull of centrifugal force actuated by the rotation of the rotor shaft and the tension of the spring "N".

Any slight change in speed will cause the governor to act immediately, either to increase or decrease the amount of air bleed through the orifice "H", which in turn, causes an instantaneous response from the diaphragm to increase or decrease the throttle opening. When the accelerator is released, the control is taken away from the governor by the external lever "L", and the accelerator spring closes the throttle to bring the engine to any desired lower speed.

(1) *ADJUSTMENT*. The governor adjustment is made at the factory and no further attention should be required. If, however, the factory setting has been changed for any reason, or if either a replacement governor or rotor assembly has been installed, it will be necessary to readjust the governor. Connect a tachometer to the engine, and adjust the governor to the no-load cut-off speed of 3250 r.p.m., as follows: turn the ignition switch off, and remove the seal wire from the rotor adjusting hole plug. Remove the plug and rotate the engine until the adjusting screw (fig. 77) in the end of the enclosed rotor is in line with the plug hole in the rotor body. Enter a screw driver through the hole and turn the adjusting screw to the RIGHT, to increase the governed speed, or to the LEFT to decrease the governed speed. One turn of the adjusting screw will affect the engine governed speed approximately 100 r.p.m. Replace the plug and start the engine. Gradually increase the throttle opening, observing the tachometer, until the no-load cut-off speed is reached. If the cut-off is not within the specified range, stop the engine and make the necessary correction at the governor adjusting screw. Repeat the test until correct cut-off speed is obtained.

NOTE: ***Before resealing the governor, make sure the air bleed pipe union nuts and the adjusting hole plug are tight. Air entering the diaphragm from any source other than the rotor orifice will cause faulty governor control.***

The second unit of the governor is located in a housing directly below the ignition distributor, and is driven by the governor rotor shaft. The rotor assembly consists of the rotor and the integral shaft, a valve, a spring, and a connector illustrated in fig. 78. The governor valve is always balanced between the existing centrifugal force provided by the revolving of the rotor and the tension of the valve spring.

(2) *DISASSEMBLY*. Remove the ignition distributor and the governor rotor assembly from the engine. Remove the distributor from the rotor housing. Drive the pin out of the rotor shaft collar, and remove the shaft, rotor, and the thrust washer.

Remove the retaining ring and the valve seat sleeve from the rotor. Turn the rotor valve adjusting screw to the left to release the valve assembly from the adjusting screw. Remove the valve assembly. Remove the gasket from the rotor body. The governor valve may be disassembled by driving the spring retainer pins out far enough to release the spring.

NOTE: ***Do not remove the valve adjusting screw or the short connector locating pin from the rotor.***

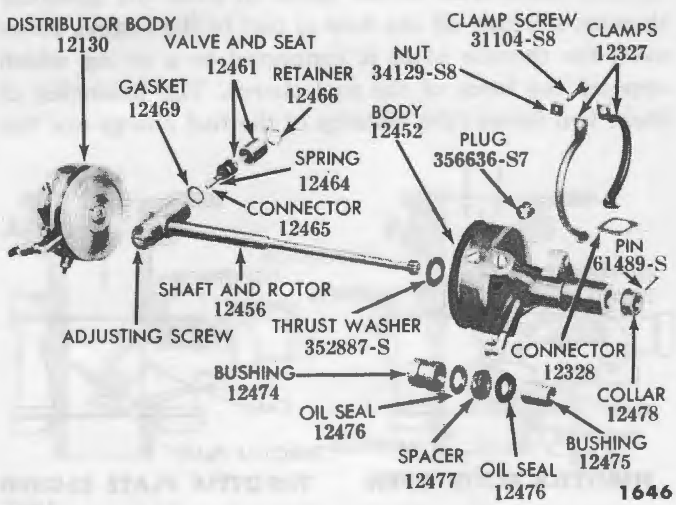

Fig. 78—Governor Rotor, Disassembled

(3) *CLEANING, INSPECTION, AND REPAIR.* Clean each part thoroughly. Replace the governor valve, and the valve seat if they are scored or show signs of leakage.

NOTE: ***The valve and seat are matched in sets. Therefore, when one is at fault, both must be replaced.***

Replace the valve spring if it is broken, distorted, or corroded.

(4) *ASSEMBLY.* Install the gasket in the rotor body. Assemble the valve, spring, and the connector, staking the spring pins to prevent them from falling out. Insert the valve assembly in the rotor body, rotating the valve until the slot in the connector indexes with the pin in the rotor body. Press the valve assembly lightly into the rotor body, and turn the adjusting screw to the **RIGHT** two full turns. Releasing the pressure on the valve, turn the rotor over, and if the connector is not properly threaded to the adjusting screw, the valve assembly will fall out of the rotor. If this occurs, repeat the above procedure, using more care in engaging the connector slot with the pin in the rotor body. Install the valve seat sleeve and the retaing ring. A preliminary governor rotor adjustment is made before the rotor is installed in the rotor housing, by turning the adjusting screw to the **RIGHT** until it stops, then turning the screw to the **LEFT** three full turns. Install the thrust washer on the rotor shaft, and install the rotor and shaft assembly in the rotor housing. Install the rotor shaft collar on the shaft. Install the collar pin, and rivet each end. Install the ignition distributor on the rotor housing.

NOTE: ***Final adjustment of the govenor is made after both units are installed on the engine.***

b. Velocity Type.

The velocity type governor is installed between the carburetor and the intake manifold. As the fuel mixture passes through the governor, it impinges on the throttle plate. This action tends to close the governor throttle, shutting off the flow of fuel to the engine. However, the throttle plate is connected to a spring which opposes the force of the fuel charge. The balancing of these two forces (the velocity of the fuel charge and the tension of the spring) results in the passage of a governed amount of fuel and air into the engine intake manifold.

The governor throttle-plate shaft is installed off center so that approximately 75 per cent of the throttle-plate area is exposed to the force of the incoming fuel air mixture. This causes a strong actuating force on the throttle plate and makes it possible to reduce surging or variation in top governed speed.

The opposing or braking force applied against the tendency of the throttle plate to close under the velocity of the fuel charge is accomplished by a coil spring operating through a cam. In fig. 79 the goveronor throttle plate is shown in its wide-open and closed positions.

As the throttle plate closes, the greater is the force applied against it by the incoming fuel charge. The effective radius of the cam results in an over-increasing tension on the spring to oppose the closing of the throttle plate. The throttle plate, of course, does not completely close but assumes a position somewhere between fully opened and fully closed. This results in an air-fuel charge of sufficient volume to run the engine at its governed speed. The governor contains an adjustment screw which varies the tension and rate of the spring. A seal is attached to the adjustment screw to prevent anyone tampering with the speed adjustment.

In the velocity type of governor, the difference in vacuum below and above the throttle plate results in forces which tend to open or close the throttle plate. The design of the cam and spring helps to overcome this additional force.

By manipulation of the carburetor throttle, however, a high vacuum can be created above the throttle plate. This would result in opening of the throttle plate, allowing the engine to exceed governed speed. A stabilizer piston (fig. 80) is used to offset this possibility.

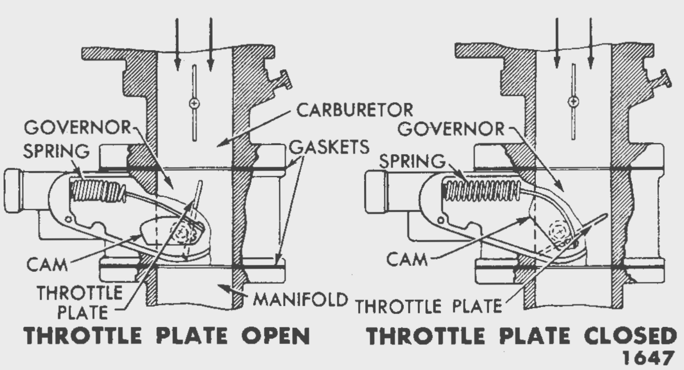

Fig. 79—Open and Closed Position of Throttle Plate

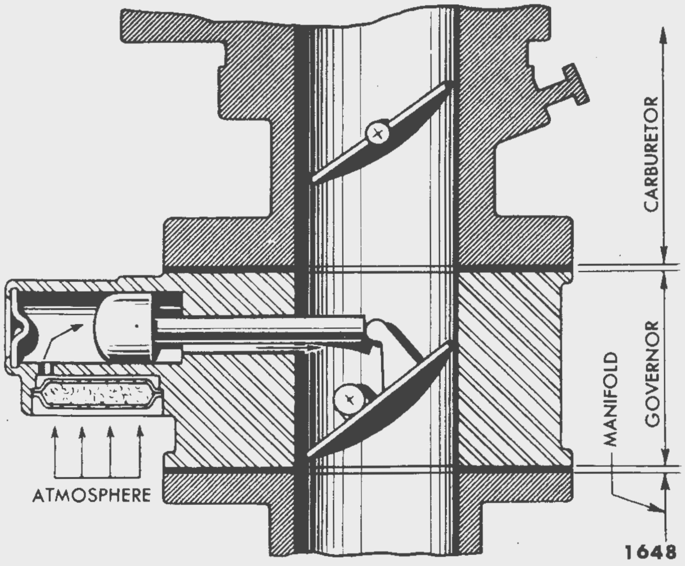

Fig. 80—Stabilizer Piston

The piston operates in a cylinder which is open to atmospheric pressure and the piston is open to the pressure which exists above the throttle plate draws the piston toward the throat of the governor. A stem attached to the piston acts against the throttle plate, causing it to close, thus offsetting the tendency of high vacuum above the plate to open it.

(1) *REPAIR*. The velocity type governor is replaced as a unit if parts become inoperative or fail in operation.

(2) *INSTALLATION*. To install the governor, disconnect the gas line, choke control wire, and carburetor control rod. Disconnect the vacuum line on the carburetor. Remove the carburetor. Remove studs in manifold flange, and replace them with two long studs. Install governor with slotted gasket placed between governor and carburetor. Connect the control rod, using extension if necessary. Connect the choke control wire.

On engines equipped with vacuum spark advance, connect the line from the carburetor to the hole at the end of the governor flange. Connect the line from the vacuum diaphragm at the distributor to the hole on the side of the governor. When carburetor is the economizer by-pass or vacuum-pump type, the regular by-pass hole should be closed with the small solid screw or hollow screw, so the by-pass outlet will operate through the governor.

(3) *ADJUSTMENT*. To adjust the governor for a higher engine governed speed, turn the adjusting cap counterclockwise or to the **LEFT**: for decreasing engine governed speed, turn adjusting cap clockwise or to the RIGHT. Seal adjustment and mounting studs with seal provided.

10. FUEL PUMPS AND VACUUM BOOSTER

The fuel pump used on the 6 and 8-cylinder engines are the same except for a difference in the method of driving the pumps. The 8-cylinder fuel pump is driven by a push rod which is activated by an eccentric on the camshaft (fig. 81).

The 6-cylinder fuel pump is driven directly off the camshaft eccentric (fig. 82).

A combination fuel pump and vacuum booster is available as standard equipment on the E-Series engine. This unit is actuated by the camshaft in the same manner as the single fuel pump assemblies. The operation, testing, replacement, and overhaul of the fuel pump is given in "**a.** Fuel Pumps." "**b.** Fuel Pump and Vacuum Booster" covers the operation, testing, replacement, and overhaul of the combination fuel pump and vacuum booster.

a. Fuel Pumps.

For servicing the fuel pump, kits are available for both the 6 and 8-cylinder engines (fig. 83 and 84).

(1) *OPERATION*. The rotation of the camshaft eccentric actuates the rocker arm "A" (through a push rod in the 8-cylinder engine fig. 85) which pulls the link "B" and diaphragm "C" downward against spring pressure "D," which creates a vacuum in the pump chamber "E."

On the suction stroke of the pump, fuel from the gas tank enters through the inlet into the sediment bowl "F" and passes through the strainer "G" and then through the inlet valve "H" into the pump chamber "E."

On the return stroke, spring pressure "D" pushes the diaphragm upward, forcing the fuel from the chamber "E" through the outlet valve "J" and through chamber "K" to the carburetor.

When the carburetor bowl is filled to the correct level, the float valve will close, thus creating a pressure in the pump chamber "E." This pressure holds the diaphragm "C" downward against spring pressure "D" where it will remain inoperative until the carburetor requires further fuel and the float opens the float valve.

(2) *TESTS*. The following fuel pump tests can be performed with the fuel pump on the engine.

(a) PRESSURE TEST. Disconnect the carburetor line at the fuel pump and attach a fuel pump pressure test gauge to fuel pump outlet (fig. 86).

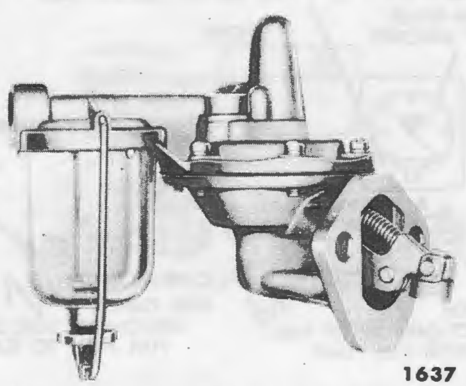

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Fig. 81—8-Cylinder (R Series) Engine Fuel Pump

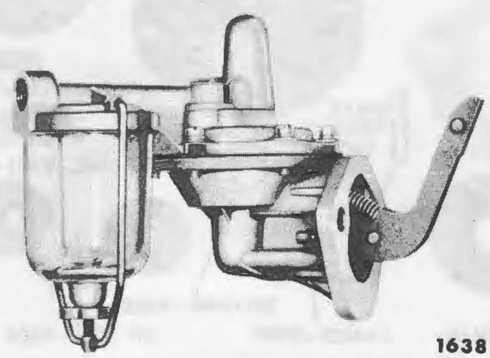

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Fig. 82—6-Cylinder Engine Fuel Pump

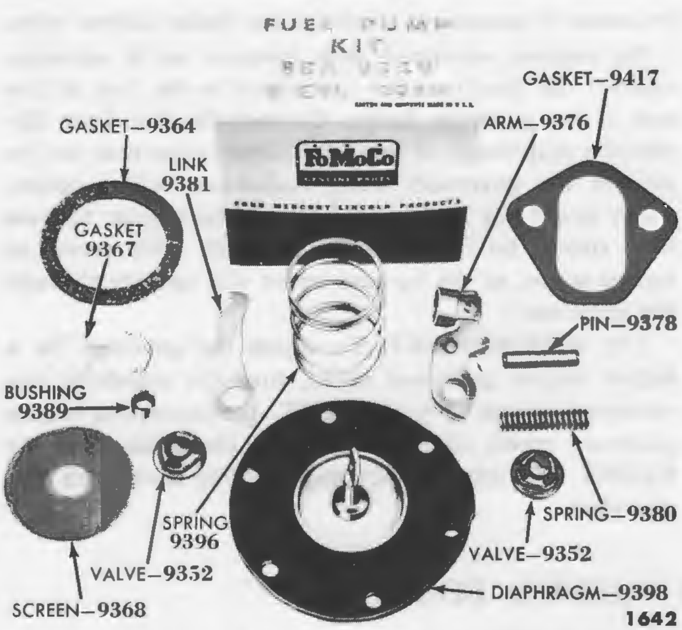


Fig. 83—8-Cylinder Fuel Pump Repair Kit

Operate the engine at idle speed on the fuel remaining in the carburetor and observe the pressure reading on the gauge. Pressure reading should be 4 to 5 pounds per square inch for 6 cylinder and 3½ to 4½ for 8-cylinder engines.

(b) Vacuum Test. Install the vacuum gauge on the inlet side of the fuel pump. Operate the engine at idle speed and observe the reading on the gauge. The pump vacuum should increase until the gauge indicates a vacuum of at least 10 inches of mercury. Stop the engine

Fig. 84—6-Cylinder Pump Repair Kit

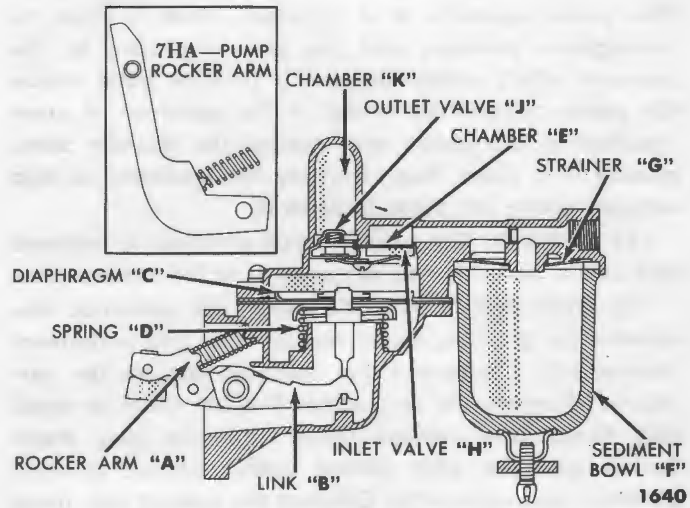


Fig. 85—Cross Section of 8-Cylinder Engine Fuel Pump

and the gauge pointer should fall slowly at a rate which will not allow it to reach zero in less than one minute. If the rate is faster the intake valve is at fault.

(c) Capacity Test. The capacity test is necessary only when the pressure is within specifications.

Install a fitting with rubber tubing on the fuel pump outlet. Position the end of the rubber tube in a pint measure at the same height as the carburetor. Operate the engine at idle speed. Observe the time required to fill the one pint measure (should be 45 seconds or less).

(3) *REMOVAL.* The procedure for removing the fuel pump from the 6- and 8-cylinder engines is given below:

(a) 6-Cylinder. Disconnect the two fuel lines at the fuel pump. Remove the two cap screws and the fuel pump from the engine block.

(b) 8-Cylinder. Disconnect the fuel line at the the dash connection, and unscrew the line from the pump. Disconnect the fuel pump to carburetor fuel line. Remove the two cap screws and the fuel pump.

(4) *DISASSEMBLY.* Remove the glass sediment bowl gasket and screen. Scratch a line on the pump

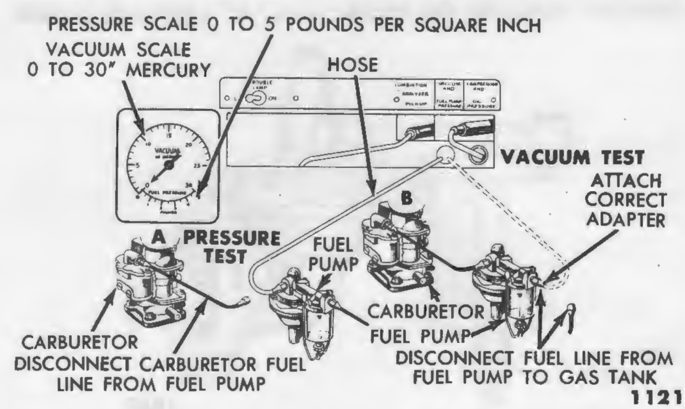


Fig. 86—Fuel Pump Vacuum and Pressure Tests

cover and body so that on reassembly the inlet and outlet holes will be in the correct position.

Remove the upset end of the rocker arm pin and drive out the rocker arm pin using a long drift.

Remove the screws holding the cover to the pump body while holding down on the fuel cover until all screws are removed.

Turn diaphragm slightly to unhook the eye in the pull rod from the rocker arm and remove the diaphragm and spring. Remove the rocker arm and spring. Remove the valve plate and lift the intake and outlet valves from the cover. Figure 87 illustrates the relative position of the 8-cylinder fuel pump parts. The 6-cylinder pump is similar except the method of drive is different.

(5) *CLEANING AND INSPECTION.* Clean the bowl, and fuel pump housing. Make certain that all corrosion is removed. Inspect the housing for cracks or other damage and replace if required. It is advisable to install the parts included in the repair kit when rebuilding the fuel pump.

NOTE: ***Always use new gaskets when rebuilding a fuel pump.***

(6) *ASSEMBLY.* Position the rocker arm and bushing in the 6-cylinder fuel pump body. For the 8-cylinder pump, place the link rocker arm bushing and rocker arm in position in the body.

Install the rocker arm pin. Place the diaphragm spring and diaphragm in the body, and hook the diaphragm pull rod on the lower link. Install the rocker arm spring in the rocker arm. Install the valve gaskets, valves, and

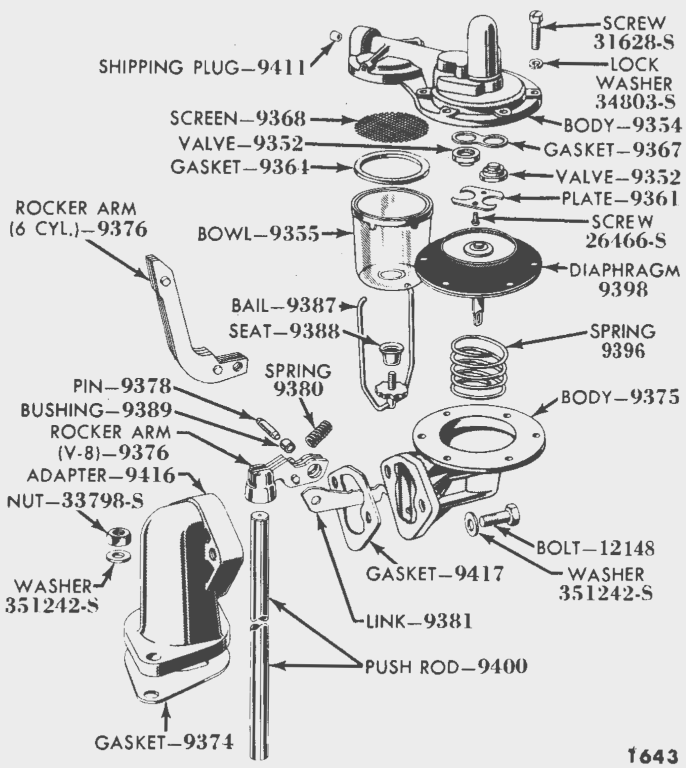


Fig. 87—8-Cylinder Fuel Pump, Disassembled

plate in the pump cover. Hold the rocker arm in the up position and position the cover on the pump body. Install the screws, release the rocker arm, and tighten the screws evenly. Install the sediment bowl gasket and bowl.

(7) *INSTALLATION.* The procedure for installing the fuel pump is given below:

(a) 6-CYLINDER. Install a new gasket and place the pump in position on the block. Make sure the rocker arm is against the eccentric on the camshaft. Secure the pump with two cap screws. Connect the two fuel lines.

(b) 8-CYLINDER. Install a new gasket and place the pump in position. Make sure the rocker arm socket is properly seated on the push rod inside. Secure the pump to the adapter with the two cap screws. Connect the two fuel lines to the pump.

b. Fuel Pump and Vacuum Booster.

An overhaul kit (fig. 88) for servicing the combination fuel pump and vacuum booster is available.

(1) *OPERATION.* The rocker arm "A" actuated by the pump push rod, as shown in fig. 89, moves the two links "L" to which the booster diaphragm "M" is hooked, downward against the diaphragm spring "N" which expels the air in the lower pump chamber "O" through the exhaust valve "P" and through the line to the intake manifold. On the return stroke, the spring moves the diaphragm upward, creating a suction in the pump chamber "O," opening the intake valve and drawing air through the inlet line "Q" from the windshield wiper.

When the windshield wiper is not being used, the manifold vacuum holds the diaphragm down against the spring pressure so that the diaphragm does not make a complete stroke for every stroke of the rocker. Figure 89 shows a cross-section of the combination fuel and vacuum booster pump.

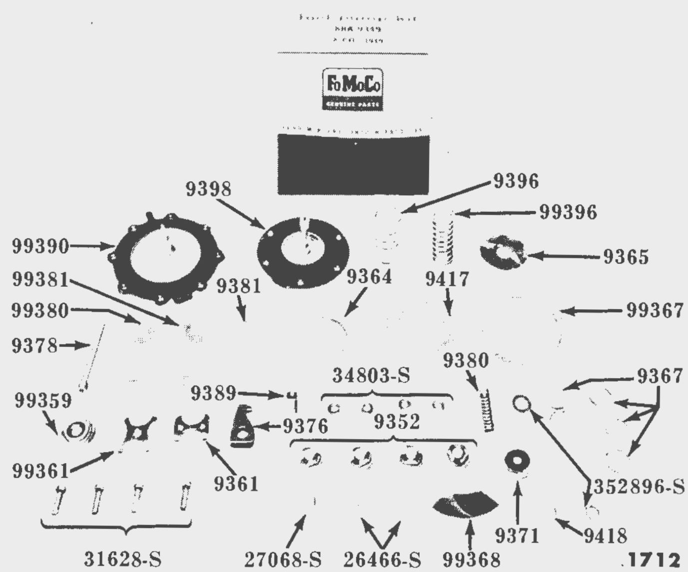


Fig. 88—Fuel Pump and Vacuum Booster Kit

(2) *TEST.* Disconnect both inlet and outlet lines at the vacuum booster. Attach a vacuum gauge to the wiper motor side of the booster.

Operate the engine at 1000 r.p.m. and observe the reading. The reading should be between 7 and 12 inches of vacuum. If reading is less than 7 inches of vacuum the vacuum pump is not operating properly.

CAUTION: ***When making this test the pump outlet should always be open as a closed outlet will damage the unit.***

(3) *REMOVAL.* Disconnect the fuel and vacuum lines at the fuel pump and booster. Remove the pump holding screws and remove the pump.

(4) *DISASSEMBLY.* Remove the sediment bowl, gasket, and screen. Scratch a mark in line on both the fuel and vacuum diaphragm flanges so these parts may be reassembled in their correct position. Remove only two cover screws from opposite sides of the vacuum section and install two 10-32x1½ inch screws. Remove remaining short screws, then back out the two long screws until the heavy spring tension is relieved. When removing the diaphragm, avoid the possibility of damaging the built-in oil seal by first removing the rocker arm pin, then wiggle the rocker arm to disconnect the links from the diaphragm pull rods. This permits the diaphragm to be drawn straight out of the body oil seal.

Place the pump in a vise with fuel pump section on top. Remove screws from the fuel cover while holding the fuel cover down until all screws are removed, then release the pressure on the cover gradually until the spring is expanded.

Remove the retainer holding the valves in the fuel cover and remove the valves and gaskets. Remove the retainer holding the valves in the vacuum cover and remove valves and gaskets.

(5) *CLEANING AND INSPECTION.* Clean the sediment bowl and fuel and vacuum booster housing. Inspect the housing for cracks or damage and replace if required. It is advisable to replace all parts in the assembly with the new parts included in the repair kit.

(6) *ASSEMBLY.* Position the spacer with the projection for the rocker arm coil spring on each side of the fuel pump link (short link) so that the holes line up and the projection on the spacer for the spring points toward the hood end of the link. Place one long link on each side of spacer so that holes line up and so that hook ends of long links come together. Be sure hooks on long links point in the same direction as hook on short link. Insert links and spacer in fork of rocker arm so hooks point up when flat (cam) face of rocker arm is up on 6-cylinder and when push rod cup is down on 8-cylinder, and insert bushing through the holes in rocker arm, spacer, and links.

Insert links, bushing and spring in pump body. Insert a long tapered drift in place of rocker arm pin. Install the new rocker arm pin, driving out the drift. Place the flat washer over the pin and peen the hollow end of the pin over the washer. Install new oil seal in fuel pump side of pump body casting with lip toward the rocker arm side.

Place new gaskets in recess of fuel cover. Install outlet valve in center recess so three legs of valve caps are down. Install inlet valve in outer recess so three legs are up. Then install retainer with forks over the valve cages and hump in retainer up. Position the spring between the fuel diaphragm and housing. Position the fuel diaphragm in the housing and hook the short center link to the diaphragm pull rod.

Assemble the fuel cover and place the cover over the diaphragm. Be sure to align the marks on the flanges and retain the cover with the screws until they just engage the lockwashers.

Push the rocker arm in all the way and do not release until all cover screws are tightened.

Hook vacuum diaphragm to both long links.

Install the inlet and outlet valves in the vacuum body. Install the heavy spring over the diaphragm. Align the housing marks and pull the cover down with the two 10-32x1½ inch screws. Install short screws. Remove the long screws and tighten all cover screws securely. Install a new bowl gasket and the sediment bowl.

(7) *INSTALLATION.* The procedure for installing the fuel pump with booster is given below:

(a) 6-CYLINDER. Position a new gasket on the block. Place the pump in position. Make sure the rocker arm

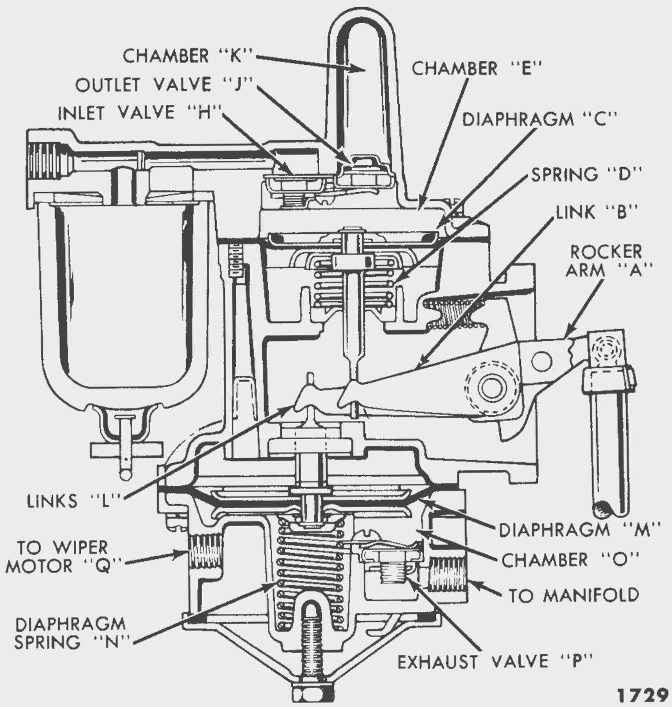


Fig. 89—Fuel Pump and Vacuum Booster

is against the eccentric on the camshaft. Tighten the nuts 15-20 foot-pounds torque. Connect the vacuum lines and the fuel lines.

(b) 8-CYLINDER. Position a new gasket on the adapter. Install the pump on the adapter, tighten screws to 6-9 foot-pounds torque. Make sure the rocker arm socket is properly seated on the push rod. Connect the vacuum and fuel lines.

11. FUEL TANKS AND LINES

Replacement procedures for fuel tanks and lines are presented below under appropriate headings.

a. Fuel Tank Replacement.

Two types of fuel tanks are used in trucks. Some models are equipped with a tank mounted in the cab directly behind the seat. Others are equipped with a tank mounted on the chassis side rail.

(1) *CAB MOUNTED TANK*. Close the fuel tank shut-off valve, then disconnect the fuel line at the valve. Open the shut-off valve, drain the tank, then remove the shut-off valve. Remove the two screws which hold the seat cushion hinge on each side, and remove the seat. Remove the fuel gauge tank unit cover attaching screws and cover, then disconnect the wire from the tank unit. Loosen the filler pipe hose clamp at the tank, then pull the filler pipe away from the tank. Remove the three bolts which scure the tool tray and the fuel tank to the mounting bracket, then remove the tank from the cab. Remove the fuel guage tank unit from the tank.

When installing the fuel tank, replace all fuel tank insulating pads that are not in good condition. Install the fuel gauge tank unit in the fuel tank. Position the two insulating pads on the cab floor, then place the fuel tank and the tool tray to the mounting bracket. Position the filler pipe hose on the neck of the fuel tank, and secure the hose with the hose clamp. Connect the fuel gauge wire to the fuel tank gauge unit terminal, then install the gauge unit cover. Place the seat in the cab, and install the four mounting bolts. Install the fuel tank shut-off valve, then connect the fuel line to the valve. Fill the tank with fuel, open the shut-off valve, then check the tank and fuel line connections for leaks.

(2) *CHASSIS MOUNTED TANK*. Remove the fuel tank drain plug and drain the tank. Loosen the hose clamps on the filler pipe and the air vent pipe. Disconnect the fuel line at the fuel tank. Remove the cotter pins, nuts, and bolts from the fuel tank support straps. Lower the fuel tank to the floor, and remove the insulating pads. Disconnect the fuel gauge wire from the fuel gauge tank unit. Remove the fuel line fitting from the fuel tank. Remove the fuel tank gauge assembly from the tank.

To install, mount the fuel tank gauge assembly in the fuel tank. Install the fuel line fitting. Position the tank on the fuel tank support straps, then install the insulating pads. Secure the tank in the straps with the bolts and nuts. Tighten the nuts securely, then install new cotter pins. Connect the fuel gauge wire to the terminal on the fuel tank gauge assembly. Connect the fuel line to the fitting on the tank. Install the filler pipe and air vent pipe hoses on the tank and secure the hoses in place with the hose clamps. Install the fuel tank drain plug, fill the tank with fuel, and check the tank and fuel connection for leaks.

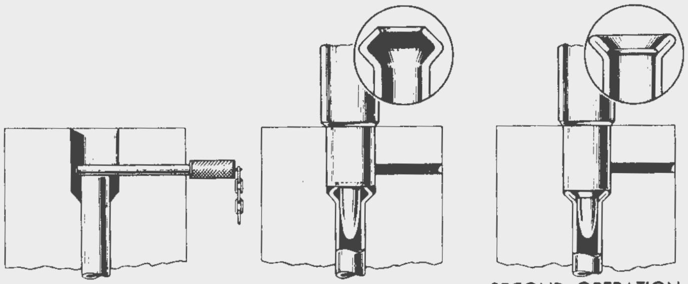
b. Fuel Line Replacement.

The fuel line connecting the fuel tank to the flexible line at the fuel pump is a 5/16 inch outside diameter line. The 5/16 inch line is available in 25 foot rolls for service. A 1/4 inch line connects the fuel pump to the carburetor. This 1/4 inch line cut to the correct length with the two connectors and ferrules installed, is available for service.

(1) *REMOVAL*. Drain the fuel from the tank. Disconnect the fuel line at the fuel tank, fuel pump flexible hose, and at the intermediate sections. Remove the lines from the holding clips and remove the lines. Slide the loom off the line.

(2) *INSTALLATION*. Cut the new line to approximately the same length as the original line allowing additional length for the flaring operation. Square off the end with a file, then ream the sharp edges with the reamer blade on the tube cutter.

Position the looms on the new lines. Place new connections on the line and flare the ends of the lines using a flaring tool (fig. 90). Bend the new line to conform to contour of the original line. Position the line in the clips on the vehicle, and tighten the connections. Check the connections for leaks.



SECTIONAL VIEW OF DIE SHOWING TUBING LOCATED AGAINST STOP PIN.

FIRST OPERATION TOOL SHOWN FORMING OUTSIDE FLARE.

SECOND OPERATION TOOL SHOWN FORMING INSIDE FLARE AND SEAT. COMPLETED DOUBLE-LAP FLARE SHOWN IN INSERT.

2074

Fig. 90—Line Flaring Tool

12. FANS AND BELTS

The fans used on Ford trucks require no lubrication. Servicing of fans is limited to replacement in case of damage. Adjusting slack belts or replacing worn or broken belts are the only operations required to maintain the fan and generator belts.

a. Fans.

All truck engines are equipped with four bladed removable fans as standard equipment. The procedure for removal and installation of the fan blades is the same for all engines.

(1) *REMOVAL.* Remove the cap screws and lockwashers retaining the fan blade to the hub. Remove the fan.

(2) *INSTALLATION.* Place the blades in position against the hub and install the cap screws (with lockwashers). Tighten the screws securely.

b. Belts.

Proper adjustment of the fan and generator belts must be maintained at all times. A loose or broken belt will cause improper operation of the water pump and generator. A belt that is too tight places a severe strain on the water pump and generator bearings.

(1) *6-CYLINDER ENGINES.* A single fan belt is adjusted by positioning the generator.

(a) ADJUSTMENT. Loosen the bolt in the slot on the generator support bracket. Move the generator either toward or away from the cylinder block until a ¼ inch deflection of the belt is obtained (with normal thumb pressure) between the generator and water pump (fig. 91). Occasionally it is necessary to loosen the generator support bolts located at the right-hand forward side of the generator before the generator can be moved. After the adjustment is made, tighten the bolts securely.

(b) REPLACEMENT. Loosen the generator support bracket bolts. Move the generator toward the cylinder block. Remove the belt from the generator, crankshaft damper, and water pump pulley.

To install, position the belt on crankshaft damper and water pump pulley. Stretch the belt over the generator pulley and adjust. Tighten generator support belts.

(2) *8-CYLINDER ENGINES.* This engine is equipped with two fan belts. The longer belt is mounted on the generator, right and left-hand water pumps, and inner crankshaft pulley groove. The shorter belt is mounted on the fan and outer crankshaft pulley groove.

(a) ADJUSTMENT. To adjust the generator and fan belts, loosen the hub and adjusting bracket assembly adjusting nut and screws (fig. 92). Raise or lower the generator until a belt deflection of ½ inch is obtained (with normal thumb pressure) between the generator and the left-hand water pump, then tighten the adjusting nut. Raise or lower the fan until a deflection of ½ inch is obtained (with normal thumb pressure) on the small belt between the fan and crankshaft pulley, then tighten the adjusting screws.

(b) REPLACEMENT. To remove the generator belt, loosen the adjusting nut, lower the generator and fan assembly, and remove the belt.

To install, position the belt on the crankshaft, right and left-hand water pumps, and generator pulleys. Raise the generator until the belt has the proper deflection. Adjust small belt and tighten adjusting screws and nut.

To remove the small fan belt, loosen the adjusting screws, lower the fan, and remove the belt.

To install, position the belt on the crankshaft and fan pulleys. Raise the fan until the belt has the proper deflection, then tighten the adjusting screws.

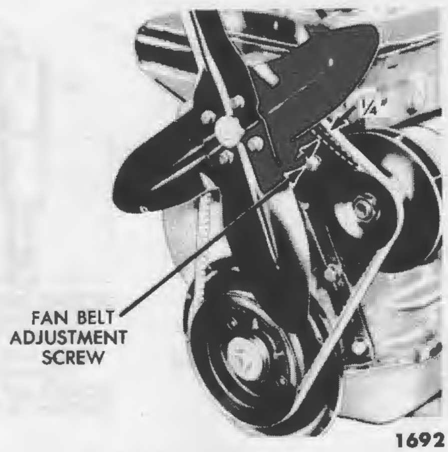


Fig. 91—Fan Belt Adjustment (6-Cylinder)

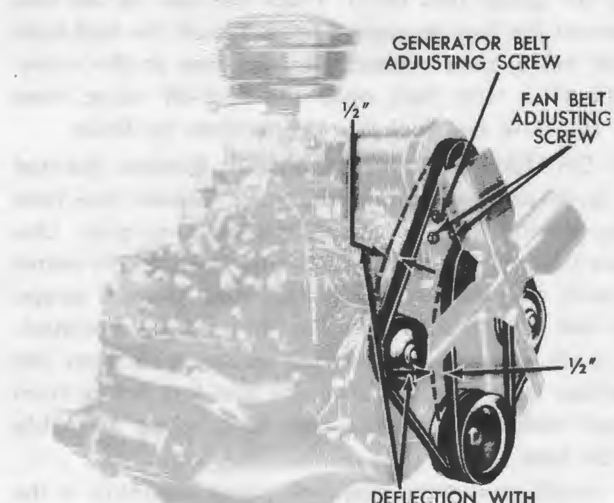


Fig. 92—8-Cylinder Belt Adjustment (R-Series shown—typical of E-Series)

13. WATER PUMPS

Four types of water pumps are used on Ford trucks. The "H" series engine is equipped with a single water pump. This water pump requires no lubrication. Two water pumps are used on 8-cylinder engines. Some water pumps used on early 1949 "R" series engine are equipped with a bearing that is serviced separately from the shaft. This bearing is lubricated through an oil cup located at the top of the water pump housing. Use S.A.E. 20 engine oil at installation and every 1000 miles. The bearing used on the late 1949, 1950, and 1951 "R" series and on all E-series engines is integral with the shaft and requires no lubrication.

When water pump difficulty is experienced, it is not necessary to replace the entire assembly as a water pump repair kit for each type water pump is available for service. Whenever a pump is disassembled, the impeller, slinger, seal, bearing, shaft, or shaft and bearing assembly should always be replaced.

Water pump repair procedures are described according to the various water pump types and appear under descriptive headings "a. H and M-Series Engine," "b. R-Series Engine," and "c. E-Series Engine." The R-Series water pump procedures take into account the differences in the two 8-cylinder pumps.

a. "H" and "M" Series Engine.

When repairing this type water pump, use the 8HA-8591 or 8HA-8591-B water pump repair kit (fig. 93).

NOTE: ***These kits will be replaced by a later kit No. APA-8591 when the present stock is exhausted.***

(1) *REMOVAL.* Drain the radiator. Remove the fan belt, fan, and pulley. Remove the lower radiator hose and heater hose. Remove the four cap screws, water pump assembly, and gasket from the engine block.

(2) *DISASSEMBLY.* Remove the bearing retainer located in the access hole on the housing (fig. 94). Press the hub off the shaft. Press the impeller and the shaft and bearing assembly out of the housing.

(3) *ASSEMBLY.* Install a new slinger on the shaft with flange end toward bearing. Press seal assembly into the housing. Press the shaft assembly (fig. 95) into the housing, pressing on the outer shell of the bearing only. Install the bearing retainer in the access hole. Press the hub on the shaft with the flat side of the hub facing the housing.

NOTE: ***Support opposite end of shaft when installing hub.***

Position the impeller on the shaft with the flat portion out, then press the impeller on the shaft to proper position. (On 7HA-8501 pump, set impeller 0.020-0.044 inch below body face and on 0HA-8501 pump, set impeller 0.024-0.034 inch below body face.)

(4) *INSTALLATION.* Position the new gasket and water pump assembly on the cylinder block and secure with the four cap screws. Tighten the cap screws to 27-32 foot-pounds torque. Install the lower radiator hose and heater hose. Install the pulley, fan, and fan belt. Fill the radiator with coolant.

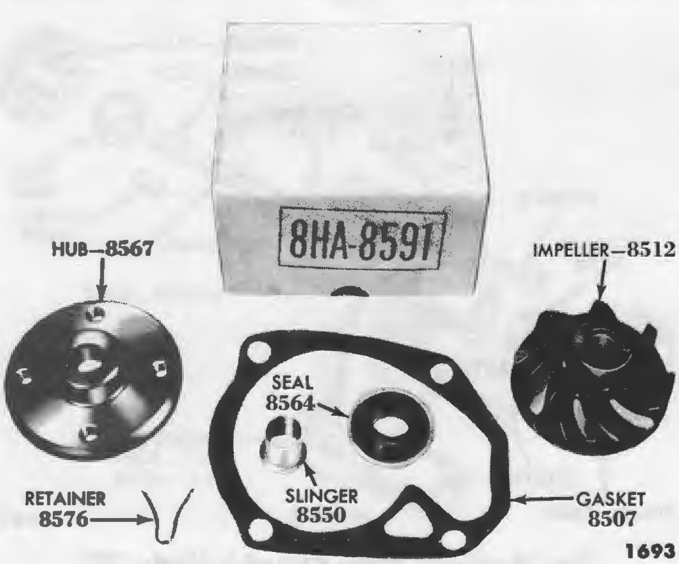


Fig. 93—6-Cylinder Water Pump Repair Kit

b. "R" Series Engine.

When repairing the early type "R" series Engine water pump, use the 8BA-8591-A or 8BA-8591-B water pump repair kit (fig. 96). The kit for late type "R" engine is shown in fig. 97.

NOTE: ***A new repair kit will replace the kit shown in fig. 96 when the present stock is exhausted. The new kit does not contain a water pump pulley.***

(1) *REMOVAL.* Drain the radiator. Remove the fan belts. Remove the water pump to radiator hose. Place a jack or other support under the engine, then remove the two cap screws securing the water pump

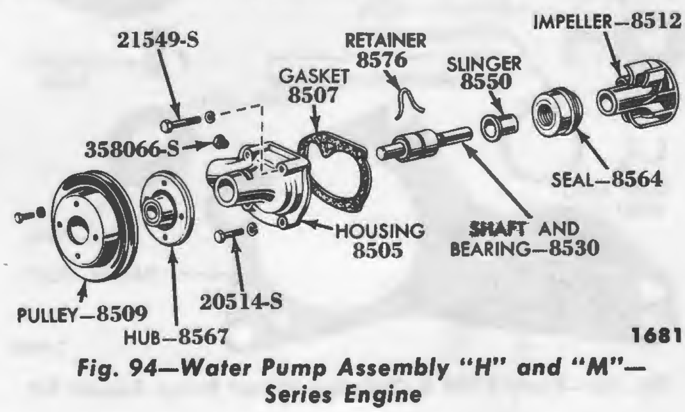


Fig. 94—Water Pump Assembly "H" and "M"—Series Engine

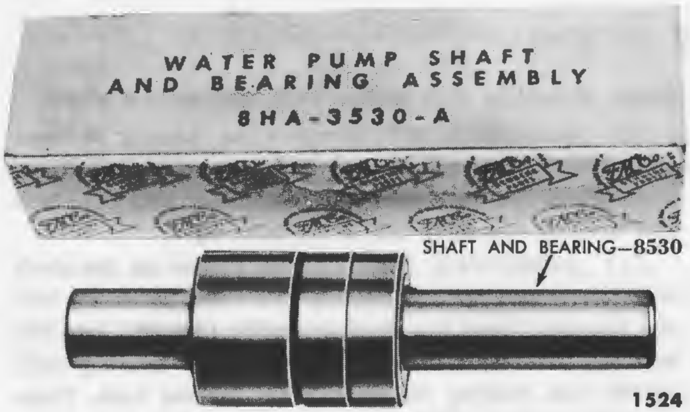


Fig. 95—Water Pump Shaft and Bearing

to the engine front support. Remove the cap screw located inside the pump hose opening. Remove the remaining three cap screws, water pump assembly, and gasket from the cylinder block.

(2) *DISASSEMBLY.* Because of the differences in design and disassembly procedures for the early "R" series and the late "R" series water pumps are described separately.

(a) EARLY "R" SERIES. Using a suitable puller, remove the pulley (fig. 98) from the shaft. Remove the bearing retainer located in the access hole in the housing. Press the impeller off the shaft by pressing the shaft and bearing out through the front end of the housing. Press the bushing, slinger, and seal out through the impeller end of the housing. Press the bearing off the shaft and, if necessary, remove the lock ring.

(b) LATE "R" SERIES. Remove the pulley (fig. 99)

Fig. 96—Early 1949 8-Cylinder Water Pump Repair Kit

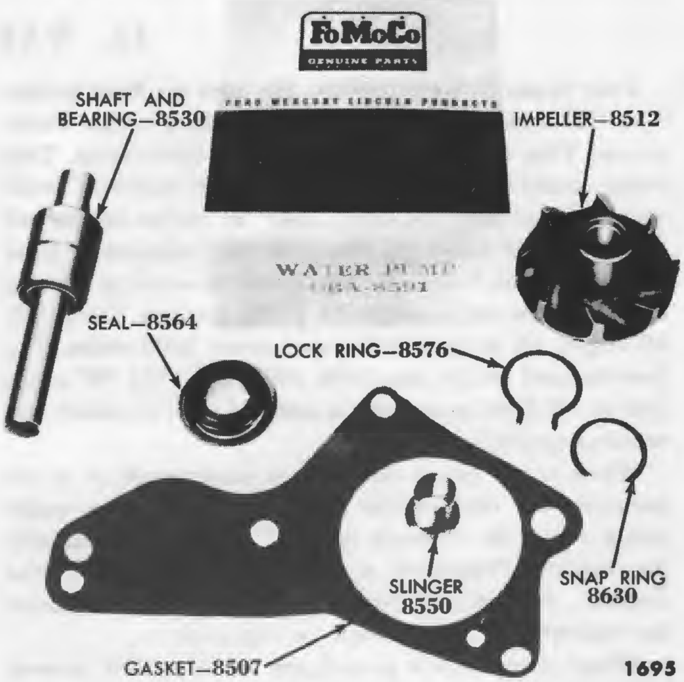


Fig. 97—Late 1949, 1950, and 1951 8-Cylinder Water Pump Repair Kit

from the shaft. Remove the bearing lock ring located at the pulley end of the housing. Press the impeller off the shaft by pressing the shaft and bearing assembly out through the front of the housing. Press the seal out of the housing and, if necessary, remove the snap ring located inside the housing.

(3) *ASSEMBLY.* Before assembling the "R" series water pumps, make sure the proper repair kit has been obtained.

(a) EARLY "R" SERIES. Using a 0.5925 inch arbor, press a new bushing into the housing. *Bushing should be soaked in oil before inserting.* If the snap ring was

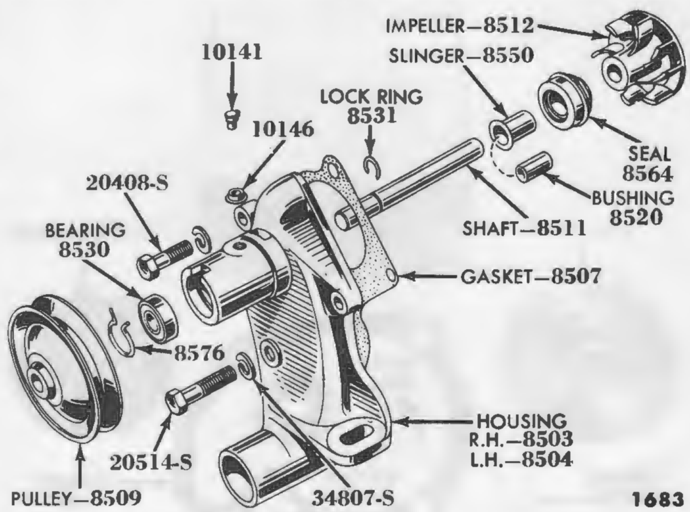


Fig. 98—Water Pump Assembly (Early "R" Series Engine)

removed from the shaft, install it on the shaft, then press the bearing on the shaft. Press on inner race only. Insert the shaft and bearing assembly into the front end of the housing, then press the bearing assembly and shaft into the housing, pressing on *outer race only*. Install the bearing retainer in the groove located in the housing. Press slinger to proper position on shaft. Insert the seal into the housing with the carbon washer of the seal toward the impeller end, then press the seal into position, using proper tool, which presses on flange only. Press the pulley on the shaft. Support *opposite end* of *shaft* when doing this. Press impeller on shaft to proper position. Make sure a 0.030 to 0.040 inch clearance is maintained between the impeller blades and the housing. Press from opposite end of shaft when pressing impeller on shaft. Thoroughly lubricate the bushing through oil cup located on the housing.

(b) LATE "R" SERIES. If the snap ring was removed from inside the housing install a new snap ring. Press a new seal into the housing with carbon washer of the seal facing the impeller. Make sure the seal replacer contacts only the outer metal portion of the seal. Position the slinger on the shaft with the flanged end of the slinger toward the bearing. Insert the shaft and bearing assembly into the housing at the front end, then press the shaft and bearing assembly into the housing. Press on outer shell of bearing only (not on shaft end). Install the bearing lock ring in the groove located in the housing, then press the pulley onto the shaft by pressing on opposite end of shaft. Press impeller on shaft to proper position. Make sure a clearance of 0.030 to 0.040 inch is maintained between the impeller blades and the housing. Press from opposite end of shaft.

(4) *INSTALLATION*. Using a new gasket, position the water pump assembly on the cylinder block and secure with the three cap screws. Install the cap screw located inside the radiator hose opening. Attach the engine front support to the water pump housing with the

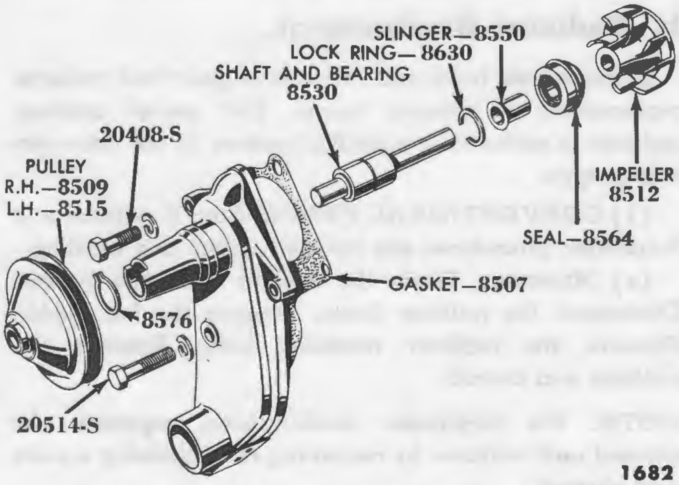


Fig. 99—Water Pump, Disassembled (Late "R" Series Engine)

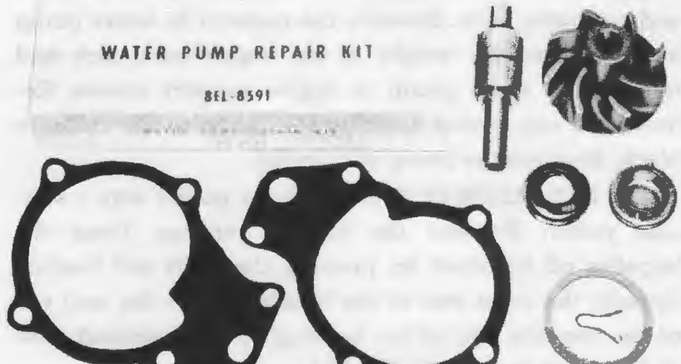


Fig. 100—E-Series Water Pump Kit

two cap screws. Remove the support from under the engine.

NOTE: ***Tighten all water pump cap screws to 25-28 foot-pounds torque.***

Install the water pump to radiator hose. Install the fan belts and fill the radiator with coolant.

c. E-Series Engine.

When overhauling the E-Series water pump use the repair kit shown in fig. 100.

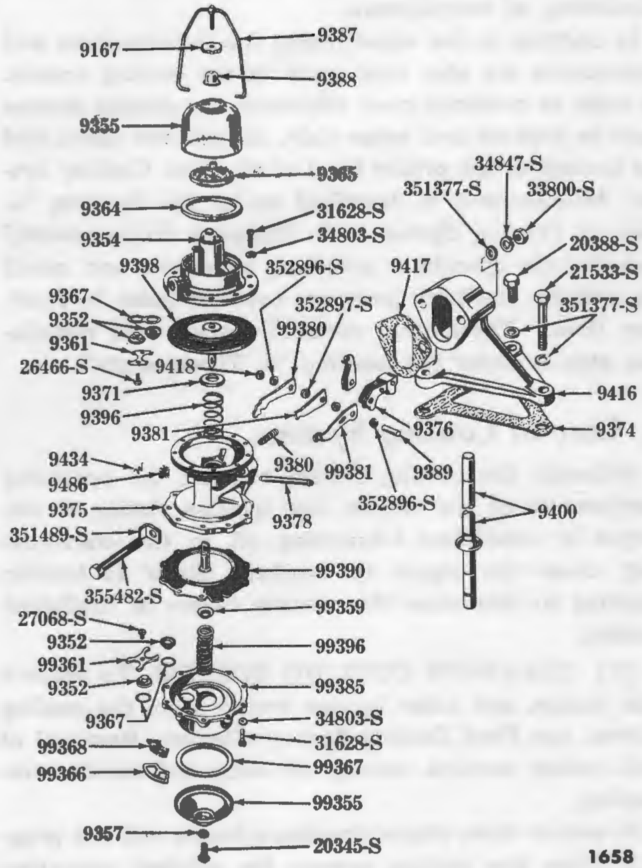


Fig. 101—E-Series Pump, Disassembled

(1) *REMOVAL.* Drain the radiator. Remove the fan and generator belts. Remove the radiator to water pump hose. Support the weight of the engine on a jack and remove the water pump to engine support screws. Remove the cap screws securing the pump to the cylinder block. Remove the pump and gasket.

(2) *DISASSEMBLY.* Remove the pulley with a suitable puller. Remove the bearing retainer. Press the impeller off the shaft by pressing the shaft and bearing through the front end of the housing. Press the seal out of the impeller end of the housing. A disassembled view of the pump is shown in fig. 101.

(3) *ASSEMBLY.* Press a new seal into the housing with the carbon washer toward the impeller. Install the slinger with the flange toward the impeller. Press the shaft and bearing in from the front end of the pump.

CAUTION: ***Apply pressure to the bearing outer race only, not the shaft.***

Install the bearing retainer. Press the pulley on the shaft. Be sure to support the opposite end of the shaft. Press the impeller on the shaft. Be sure to maintain a clearance of 0.030-0.040 inch between the impeller blade and the housing.

(4) *INSTALLATION.* Use a new gasket and install the pump and gasket on the cylinder block. Install the retaining screws and tighten them to 25-28 foot-pounds torque. Install the water pump to engine support screws. Remove the support from under the engine.

Install the radiator hose, fill the cooling system and check for leaks. Install and adjust the fan and generator belts. Run the engine until it is warmed up and check for leaks at the gasket and at the radiator hose.

14. RADIATOR, HOSE, AND THERMOSTATS

The cooling system used on trucks is the pressure type, having a regulated pressure of 3½ to 4½ pounds maintained in the system while in operation. With this pressure system, the coolant is allowed to reach a higher boiling point. This higher coolant temperature reduces the loss of energy to the coolant and also assists in decreasing internal friction by maintaining a higher lubricating oil temperature.

In addition to the water pump, the radiator, hose and thermostats are also vital parts in the cooling system. In order to maintain peak efficiency, the cooling system must be kept air and water tight, the radiator clean, and the coolant at the proper level at all times. Cooling System Maintenance is described under the heading "**a.** Care of Cooling System." "**b.** Radiator Replacement," describes the operations necessary to remove and install the radiator. Radiator hoses are covered under "**c.** Radiator Hose." Thermostat removal, testing, and installation appear under the heading "**d.** Thermostats."

a. Care of Cooling System.

Although the cooling system controls the operating temperature of the engine, late ignition timing or improper or insufficient lubricating oil in the crankcase may cause the engine to overheat. Refer to trouble shooting to determine the various causes of inefficient cooling.

(1) *CLEANING COOLING SYSTEM.* To remove rust, sludge, and other foreign matter from the cooling system, use Ford Cooling System Cleaner. Removal of such matter restores cooling efficiency and avoids overheating.

In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation it may be necessary to use the pressure flushing system.

Various types of flushing equipment are available. If the pressure flushing system is used, make sure the cylinder head bolts are properly tightened to prevent possible water leaks into the cylinders.

NOTE: ***Always remove the thermostats when using a pressure flushing system.***

A pulsating or reversed direction of water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

(2) *RUST INHIBITOR.* To prevent the accumulation of rust or scale in the cooling system, use 8A-19546-C rust inhibitor. It is a good practice to use rust inhibitor after the cooling system has been cleaned.

It is a safeguard against additional corrosion or rust which usually occurs where dissimilar metals are used. Rust inhibitor does not remove rust nor dissolve rust. It is a preventive only and not a cleaner.

b. Radiator Replacement.

Conventional truck and cab-over-engine truck radiator replacement is covered below. The parcel delivery radiator is replaced in a similar manner to the cab-over-engine type.

(1) *CONVENTIONAL TRUCK.* Both 6-cylinder and 8-cylinder procedures are covered under this heading.

(a) REMOVAL. Drain the coolant from the system. Disconnect the radiator hoses. Remove the fan blades. Remove the radiator retaining bolts. Remove the radiator and shroud.

NOTE: ***On 8-cylinder installations, separate the shroud and radiator by removing the retaining screws and shroud.***

(b) INSTALLATION. Place the shroud on the radiator.

NOTE: ***Install retaining screws on 8-cylinder radiators.***

Install the radiator and shroud in the vehicle and secure the radiator with the retaining bolts. Connect the radiator hoses. Install the fan blade.

Fill the system with coolant, start the engine, and check for leaks.

(2) *CAB-OVER-ENGINE TRUCKS.* Replacement procedures for the 6-cylinder or 8-cylinder are the same in these trucks.

(a) REMOVAL. Drain the coolant from the system. Remove the radiator grille. Disconnect the radiator hoses. Remove the radiator retaining bolts and remove the radiator and shroud.

(b) INSTALLATION. Place the radiator in position and install the retaining bolts. Connect the radiator hose and fill the cooling system. Run the engine and check for leaks. Install the radiator grille.

c. Radiator Hose.

Radiator hoses should be replaced whenever they become cracked or soggy.

(1) *REMOVAL.* Drain the radiator, then loosen the clamp bolts at each end of the hose. Slide the hose off the radiator connection and the cylinder head water outlet connection (upper hose) or the water pump connection (lower hose).

(2) *INSTALLATION.* Position the clamps on each end of the new hose. Slide the hose on the connections and firmly tighten the clamp bolts. Fill the radiator with coolant, run the engine for several minutes and observe the hose and connections for leaks.

d. Thermostats.

Two thermostats are used in the 8-cylinder engine and one thermostat is used in the 6-cylinder engine. They are mounted inside the water outlet elbow on the cylinder head.

NOTE: ***Do not attempt to repair thermostats. They should be replaced if they are not operating properly.***

(1) *REMOVAL.* Drain the coolant. Remove the cap screws, water outlet elbow, and gasket from the cylinder head. Remove the thermostat.

(2) *TESTING.* Inspect the bellows and valve. The valve should be closed at room temperature. Immerse the thermostat in a heated pan of water. Raise the temperature of the water (check with a thermometer) to the range in which the thermostat operates. If the thermostate does not open within the limits given, it should be replaced.

(3) *INSTALLATION.* Insert the thermostat in the cylinder head with the bellows portion down. Install a new elbow gasket, the water outlet elbow, and the cap screws. Torque the screws to 12-15 foot-pounds on the 8-cylinder engine and 13-19 foot-pounds on the 6-cylinder engine. Fill the radiator and check for leaks.

SERVICE LETTER REFERENCE

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Part TWO

CHASSIS

Chapter I

Clutch and Transmission

A gyro-grip, semi-centrifugal, single-plate clutch is used in all Ford trucks in conjunction with one of the six different types of transmissions. The description, replacement and repair information for the clutch is given under "1 Clutch." General information covering transmission cleaning, inspection and alignment is given under "2. Transmission Cleaning, Inspection, and Alignment." Transmission service information is grouped in sections as indicated in the chapter index and each section includes information on transmission replacement, and overhaul. Construction and adjustment information on the remote type gear shift linkage is given under "7. Gear Shift Linkage."

The model application for each type of transmission is as follows:

Transmission Type	*Model Application*
3-Speed (Center Shift)	F-1 (1949 & 1950)
3-Speed (Remote Shift)	F-1 (1951)
3-Speed Heavy Duty (Remote Shift)	F-3 (Par. Del.); F-5 Par. Del.)
3-Speed Heavy Duty (Center Shift)*	F-1 (1951); F-2, F-3; F-4 & F-5; F-5 C.O.E. & Sch. Bus (1951).
4-Speed	F-1 (*); F-2, F-3, F-4, F-5, F-6; F-5 C.O.E. & Sch. Bus; F-6 C.O.E.
4-Speed Synchro-Silent (*) (†)	F-4, F-5, F-6 & F-6 C.O.E.
5-Speed Overdrive	F-7; F-8 (*)
5-Speed Direct	F-8; F-7 (*)

* Optional Equipment

† Standard Equipment on F-6 and "M" Engine.

1. CLUTCH

Complete information on the clutches used in all Ford F-Series trucks is given in this section. The headings throughout the section are descriptive of the information given under that particular heading. The major headings are: "**a.** Clutch Adjustment," which includes clutch pedal free play adjustment and "**b.** Clutch Pressure Plate or Disc Replacement" which includes clutch removal, parts inspection and clutch installation.

The clutch disc assembly contains the hub, disc, facings, and damper springs (fig. 1).

The hub, on which the disc is mounted, is splined to the transmission main drive gear. Spring steel cushion springs are installed between the facing on the transmission side, and the disc. The facing is riveted to the cushion springs and the springs in turn are riveted to the disc. The facing on the engine side is riveted directly to the disc.

The clutch facings contact the surface of the flywheel on the engine side and the clutch pressure plate on the transmission side during clutch engagement.

The clutch pressure plate and cover assembly contains the pressure plate, clutch springs, clutch release levers and cover. The three release levers, mounted on needle roller bearings, are centrifugally out of balance due to weights at the outer end. The faster the clutch revolves the greater the pressure on the pressure plate due to the centrifugal force of the release levers.

The clutch release bearing is a pre-lubricated sealed type which eliminates the need for periodic lubrication.

The construction of the clutch operating linkage varies with the different vehicle models. F-1 through F-6 models are equipped with a clutch release shaft fork mounted on a one-piece shaft. F-7 and F-8 models are equipped with a clutch release shaft fork mounted on a two-piece shaft (fig. 2). The clutch release shaft is supported by bronze bushings which are pressed into the clutch housing.

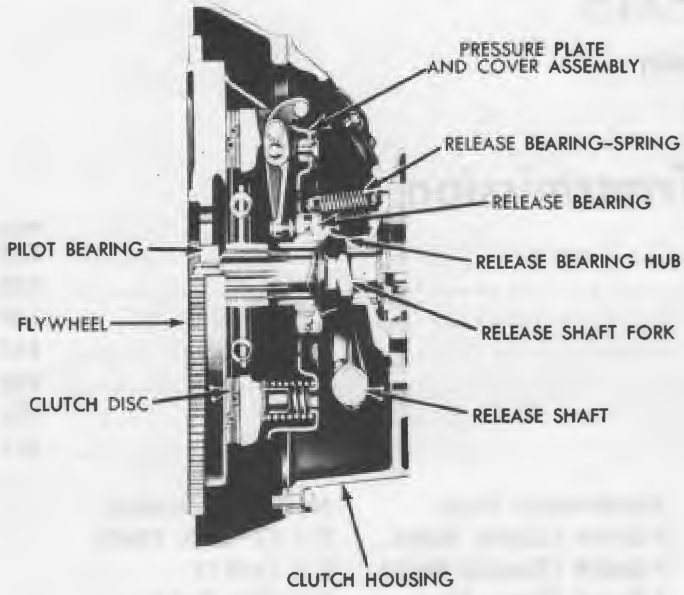

Fig. 1—Clutch Assembly, F-1 Through F-6 Trucks

Fig. 3—Clutch Pedal Free Travel Adjustment

F-1 through F-6 trucks are equipped with a bronze bushing which is used as the clutch pilot bearing. On F-7 and F-8 trucks the clutch pilot bearing is a prelubricated ball bearing type. This bearing is located in the flywheel and is used as a pilot for the transmission main drive gear.

All clutch housings are bolted to the flywheel housing except on the F-7 and F-8 trucks. These units are equipped with a one-piece flywheel and clutch housing.

The clutch pedal linkage consists of an adjustable clutch pedal to release arm rod and clevis which connects the clutch pedal to the clutch release equalizer shaft. The equalizer shaft is attached to the clutch release shaft with a clevis pin. On F-7 and F-8 models, the two-piece clutch release shaft is installed in the ends of the clutch release shaft fork and secured with lock screws. A woodruff key is used to prevent rotation of the shaft inside the fork.

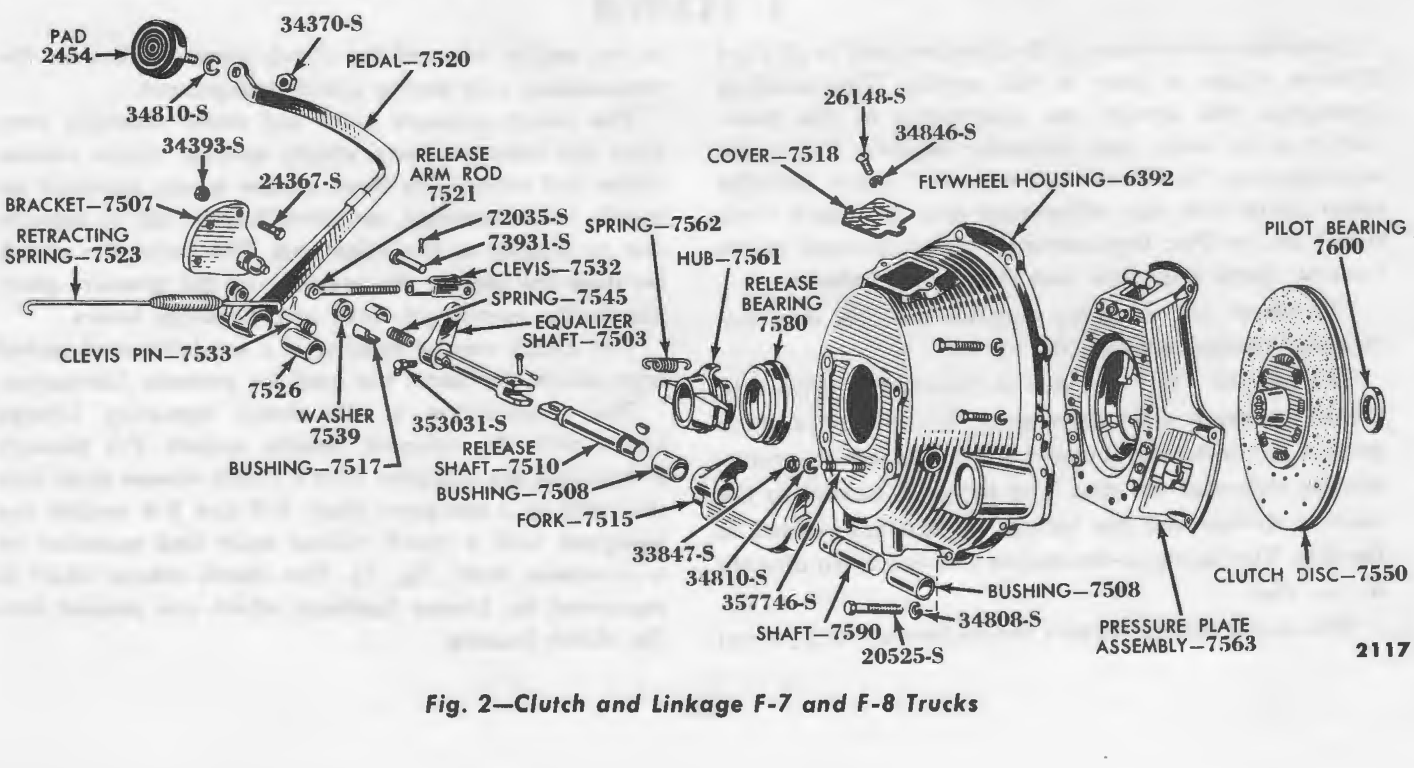

Fig. 2—Clutch and Linkage F-7 and F-8 Trucks

a. Clutch Adjustment.

The only clutch adjustment required is the clutch pedal free travel adjustment. The specified pedal free travel should be maintained for best operation. The need for a clutch pedal adjustment is indicated when the clutch slips, chatters, grabs, or when transmission gear clashing indicates the clutch will not disengage. The pedal free travel should also be checked and adjusted after new clutch parts have been installed.

To check the clutch pedal free travel, depress the clutch pedal by hand and measure the distance the pedal travels before the beginning of the clutch disengagement is felt (fig. 3).

The free travel limits are 1⅛-1⅜ inches for 10 and 11 inch clutches, and 1⅜-1⅝ inches for 12 inch clutches. If the free travel is not within these limits, adjust the travel as follows:

Remove the clutch pedal to release arm rod clevis pin, then rotate the clevis until the pedal free travel is within limits. Install the clutch pedal to release arm rod clevis pin and the cotter pin.

NOTE: ***If the clutch pedal free travel adjustment does not eliminate the clutch trouble, it will be necessary to remove the clutch for repairs.***

b. Clutch Pressure Plate or Disc Replacement.

If the clutch disc facings become worn to the extent that clutch pedal free travel cannot be adjusted to the correct limits, the clutch pressure plate assembly should be removed and the clutch disc replaced.

The removal procedure is given under the heading, "(1) Clutch Pressure Plate or Disc Removal." The installation procedure is given under the heading, "(2) Clutch Pressure Plate or Disc Installation."

(1) *CLUTCH PRESSURE PLATE OR DISC REMOVAL.* Disconnect the clutch release equalizer shaft from the clutch release shaft (fig. 2). Remove the transmission assembly including the clutch housing where a separate housing is used. Unhook the clutch release bearing spring, then remove the clutch release bearing and hub from the transmission main drive gear bearing retainer.

Remove the two-piece flywheel housing or the one-piece housing, depending on the type being serviced. Mark the clutch assembly and the flywheel so the parts may be installed in the same relative positions. Loosen the clutch pressure plate and cover assembly to flywheel bolts until the clutch springs are expanded, then remove the bolts and the pressure plate and cover assembly. Remove the clutch disc. Remove the clutch pilot bearing from the flywheel with the tool shown in fig. 4.

Inspect the clutch disc for worn, loose, or oil-soaked facings, for loose rivets at the hub, and for distortion. Replace the clutch disc if any of these defects are evident.

Inspect the surface of the pressure plate for evidence of burning, scores, or ridges. Generally, the resurfacing of the clutch pressure plate is not recommended. However, minor scores, ridges, and marks resulting from excessive heat may be removed provided the "flatness" of the pressure plate is not destroyed in the process. If the pressure plate is deeply scored or badly heat-checked, the pressure plate and cover assembly should be discarded.

Remove the clutch release bearing from the hub. Inspect the hub bearing surface for score marks or roughness. Replace the hub if defective.

Wipe all lubricant and dirt from the clutch release

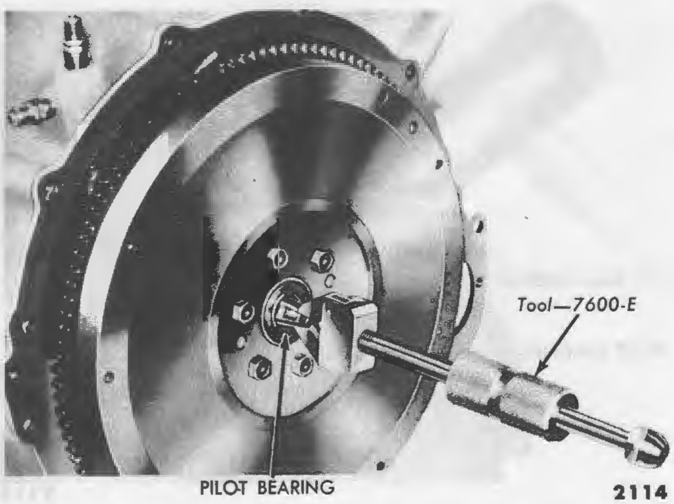

Fig. 4—Clutch Pilot Bearing Removal

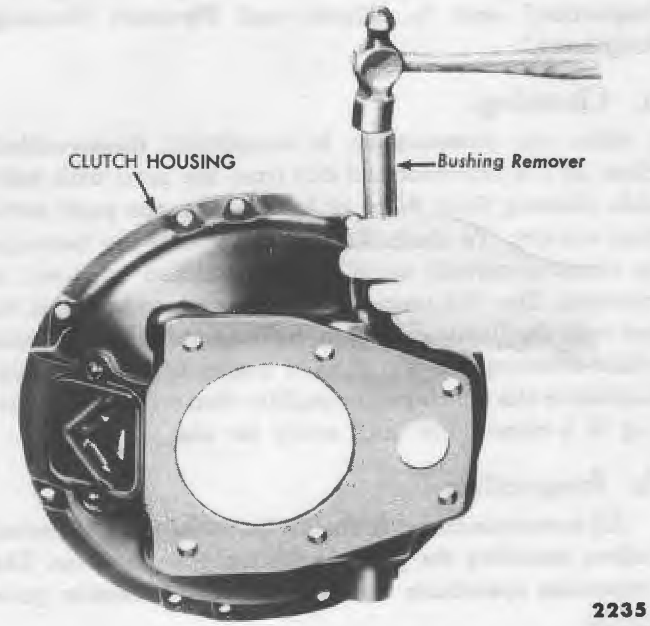

Fig. 5—Clutch Release Shaft Bushing Removal

bearing. Do not clean the clutch release bearing with solvent as the bearing is pre-lubricated. Check the release bearing for free movement, scores, or looseness on the hub and replace if required.

Check the ball bearing type clutch pilot bearing for free movement, and replace the bearing if defective. Inspect the clutch pilot bearing (ball or bushing type) for scores on the outer diameter. If scores are present, the bearing has been turning in the bore of the flywheel and should be replaced.

Check the inner diameter of the bushing type pilot bearing for wear or a bell-mouth condition. Discard the pilot bearing if any of these conditions are evident.

Check the clearance between the clutch release shaft and the shaft bushings. If this clearance exceeds the allowable limits, replace the bushings as follows:

Remove the clutch release fork and shaft, then remove the bushings with the tool shown in fig. 5.

Position the new bushings in the housing with the lubricating hole in each bushing aligned with the grease fitting holes in the housing. Press the bushing into the housing until lubricating holes in the bushing line up with the lubricating holes in the housing. Ream the bushing to the correct size with the proper reamer. Install the clutch release shaft and fork. Secure the clutch release fork to the shaft.

(2) *CLUTCH OR DISC INSTALLATION.* Place a small quantity of wheel bearing lubricant in the pilot bearing bore in the flywheel.

CAUTION: ***Avoid over lubrication of the pilot bearing to prevent lubricant being thrown onto the clutch disc.***

Install the pilot bearing with the tool shown in fig. 6.

NOTE: ***On F-7 and F-8 trucks, install the pilot bearing with the shielded side of the bearing to the rear.***

Install a clutch disc pilot tool in the clutch disc, then place the disc on the flywheel with the pilot entered in the clutch pilot bearing.

Position the pressure plate and cover assembly on the flywheel, then install the cover assembly to flywheel cap screws. Tighten the cap screws to 17-20 foot-pounds torque.

NOTE: ***If the original clutch assembly is installed, be sure to place the assembly in position according to the marks made during disassembly.***

Remove the clutch disc pilot tool. Attach the flywheel housing to the cylinder block and torque the bolts to 37-42 foot-pounds.

Place the clutch release bearing and the hub assembly on the transmission main drive gear bearing retainer, then install the clutch release bearing retracting spring. Install the transmission assembly. Connect the clutch release equalizer shaft to the clutch release shaft and adjust the clutch pedal free play.

2. TRANSMISSION CLEANING, INSPECTION, AND ALIGNMENT

Certain transmission service procedures apply to all types of transmissions. To avoid repetition throughout the chapter, these procedures are presented in this section under the following headings: "a. Cleaning," "b. Inspection," and "c. Clutch and Flywheel Housing Alignment."

a. Cleaning.

After the transmission is completely disassembled clean all old lubricant and dirt from the parts with suitable cleaning fluid. Wipe or blow air on the parts until they are dry. To clean the bearings, rotate the bearings in cleaning solvent until all old solidified lubricant is removed. Dry the bearings with compressed air but do not spin the bearings. Slowly turn the bearings by hand while directing the air at right angles to the assembly. Lubricate the bearings thoroughly, then wrap each bearing in a clean cloth until ready for use.

b. Inspection.

All transmission parts should be thoroughly inspected before installing the parts in the transmission case. The inspection operations for the various transmission parts follow.

(1) *TRANSMISSION CASE.* Replace the transmission case if the case is cracked or otherwise damaged. On the three and four-speed transmissions pull the clutch release shaft part way out of the housing on the left side, and check the release shaft bushing for scores or excessive clearance between the shaft and bushing. If necessary, replace the bushings.

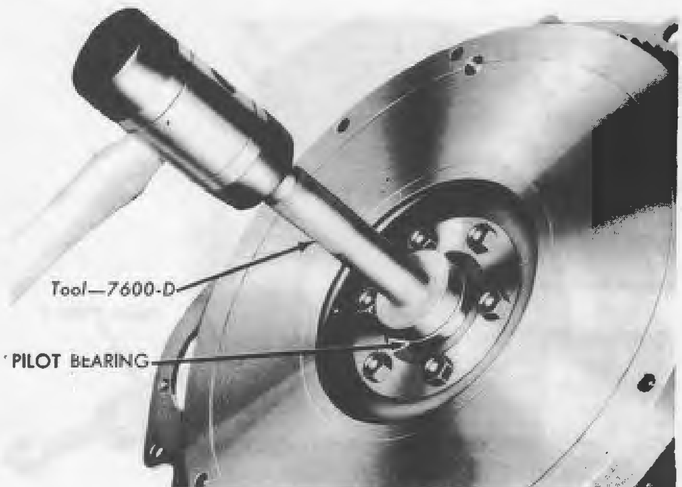

Fig. 6—Clutch Pilot Bearing Installation

(2) *CLUSTER GEAR, BEARINGS, AND SHAFT.* On three and four-speed transmission, replace the roller bearings if they are discolored from overheating, or if the rollers are worn. On five-speed transmissions, replace the bearings if they have loose races. Replace the countershaft, if the shaft is bent or grooved, or if the gear teeth are chipped or badly worn. Replace the cluster gear or countershaft gears if the gear teeth are chipped or excessively worn. On three and four-speed transmissions, check the end play between the cluster gear and the case. If the end play is beyond specifications, replace the cluster gear. Check the thickness of the cluster gear thrust washers and thrust plates. If the thickness is less than the wear limit, replace the washers or plates.

(3) *REVERSE IDLER GEAR ASSEMBLY.* Replace the reverse idler gear if the gear is excessively worn, or if the gear teeth are chipped. If the bushing in the idler gear used on 3 and 4-speed transmissions is worn, replace the gear, as the bushing is not serviced separately. Replace the reverse idler shaft if it is excessively worn.

On the four-speed transmission, replace the reverse idler shifter fork and shaft, if they are worn or bent.

On the five-speed transmission, replace the idler gear roller bearings if they are discolored from over heating, or are worn.

(4) *MAIN SHAFT ASSEMBLY.* Replace all main shaft gears that are chipped or excessively worn. Replace any sliding gears that are loose enough on the main shaft to slide by their own weight. Replace the intermediate or second-speed gears if the end play is not within specifications. Replace the main shaft if it is worn. Replace the main shaft bearing if it is discolored due to overheating, if the bearing races are loose or rough, or if the bearing binds on the main shaft. Replace the speedometer driven gear if the gear teeth are either worn or broken. Be sure the correct replacement gear is used.

On four and five-speed transmissions, replace the oil seal in the bearing retainer regardless of its condition. On five-speed transmissions, replace the mainshaft thrust washers, if they are worn beyond the specified limits.

(5) *MAIN DRIVE GEAR ASSEMBLY.* Replace the main drive gear if it is worn or has chipped or missing teeth. If the bearing is discolored due to overheating, binds on the main gear, is excessively rough, or has loose races, replace the bearing.

(6) *GEAR SHIFT HOUSING ASSEMBLY.* It is not necessary to disassemble the gear shift housing assembly to determine the condition of the housing parts. Observe the condition of the shift levers and forks. If there is evidence of binding when the lever is operated, then the housing must be disassembled and the faulty parts replaced.

c. Clutch and Flywheel Housing Alignment.

If the truck is equipped with either a 4-speed (Standard) or a 4-speed synchro-silent transmission, the clutch and flywheel housing alignment should be checked if the transmission has been removed for repair. The clutch should be checked for parallelism and also for concentricity of the bore relative to the dowel pins. The flywheel housing should be removed and checked for parallelism and the relationship of the front and rear face dowels to each other.

The clutch assembly should be removed and the flywheel surface checked for squareness relative to the center line of the crankshaft.

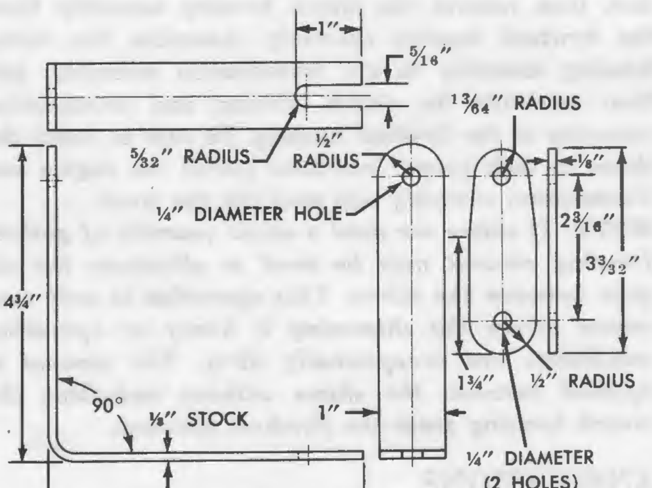

Fig. 7—Dial Indicator Linkage

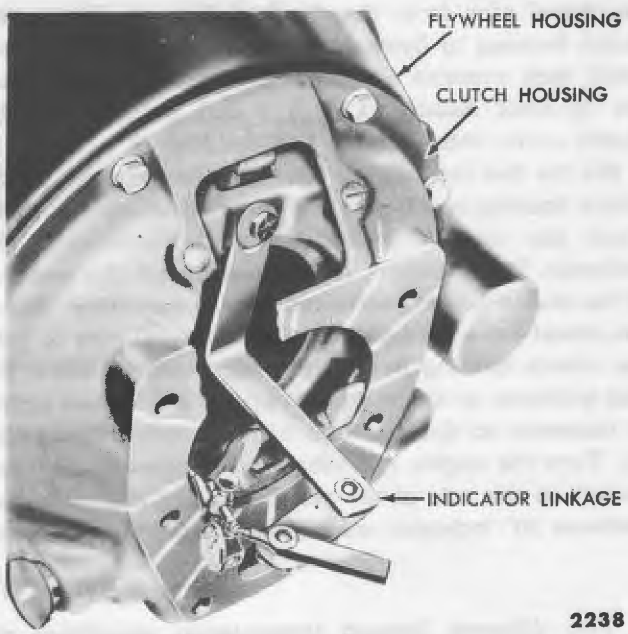

Fig. 8—Checking Concentricity of Clutch Housing

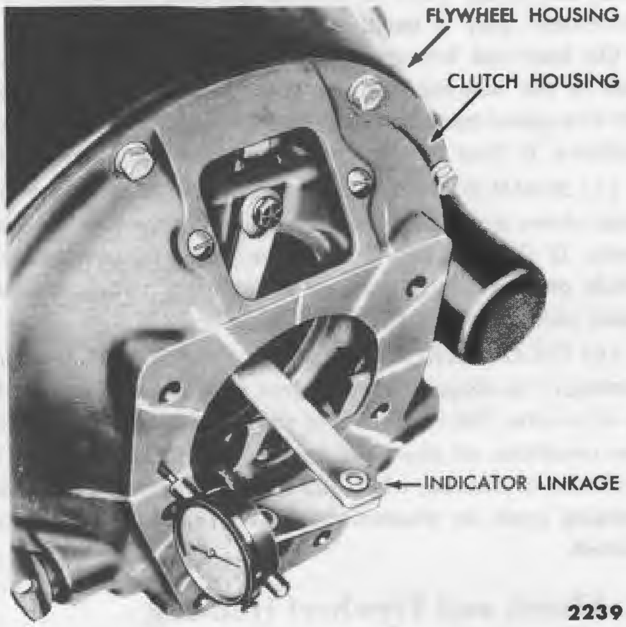

Fig. 9—Checking Face of Clutch Housing

The clutch-pilot bearing should be checked for excessive wear and replaced if necessary. The cylinder block dowels should be checked for location relative to the center line of the crankshaft. The rear face of the cylinder block should be checked for squareness.

If any of the above checks indicate misalignment proceed as follows:

Install the clutch assembly. Install the flywheel housing. File any burrs from around the tapped holes on the rear face of the flywheel housing to ensure a flat mounting surface for the clutch housing. Remove the clutch housing assembly from the transmission. Remove the dowel pins from the flywheel housing. Ream the clutch housing to flywheel housing attaching bolt holes 0.031 inch oversize. Assemble the clutch housing and the flywheel housing. Clamp a dial indicator to the clutch cover with suitable linkage (fig. 7).

Set the dial indicator to read the concentricity of the clutch housing rear bore (4.75 inches diameter) (fig. 8). Turn the engine crankshaft while observing the indicator. If the bore is not centered, shift the position of the clutch housing until the bore is concentric. Ream the dowel holes, and install oversize dowel pins to hold the clutch housing in a concentric position. Move the dial indicator to scribe a circle approximately six inches in diameter on the rear face of the clutch housing (fig. 9). Turn the engine crankshaft approximately 30°, and record on the side of the clutch housing, the difference between 30° indicator reading and the 0° indicator reading. Turn the crankshaft through 30° and repeat these steps until approximately 12 indicator readings have been obtained.

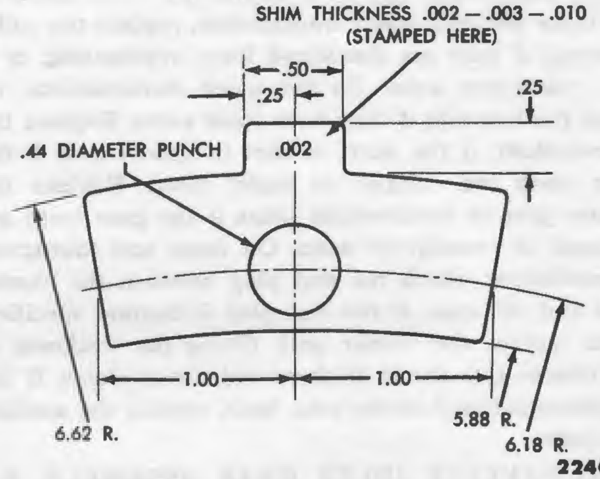

Fig. 10—Clutch Housing Shim

NOTE: ***When turning the crankshaft press towards the rear of the engine to prevent end-wise movement of the crankshaft.***

If the rear face of the clutch housing is not square, insert suitable shims, at three equally spaced bolts, between the clutch housing and flywheel housing. Repeat the foregoing procedure and adjust the shims until the rear face of the clutch housing is square with the center line of the crankshaft. Use a feeler gauge to determine the thickness of shims required under each of the remaining bolts. Recheck the rear face of the clutch housing for squareness.

NOTE: ***Shims (fig. 10) are available in the sizes indicated: Part Number 8T-7638-A, 0.002 inch; 8T-7638-B, 0.003 inch; and 8T-7638-C, 0.010 inch.***

Identify each shim between the clutch and flywheel housing to enable their reinstallation in the same location, then remove the clutch housing assembly from the flywheel housing assembly. Assemble the clutch housing assembly to the transmission assembly, and then assemble the clutch housing and transmission assembly to the flywheel housing. Be sure to insert the shims in their proper locations. Install the engine and transmission assembly and road test the truck.

NOTE: ***If shims are used a small quantity of gasket-forming cement may be used to eliminate the air gaps between the shims. This operation is only necessary where the shimming is heavy or operating conditions are exceptionally dirty. The cement is applied between the shims without unbolting the clutch housing from the flywheel housing.***

3. 3-SPEED TRANSMISSIONS

Two different 3-speed transmission assemblies are used on the F series trucks. The 1949 and early 1950 F-1 trucks are equipped with the standard 3-speed center shift transmission. The late 1950 and 1951 F-1

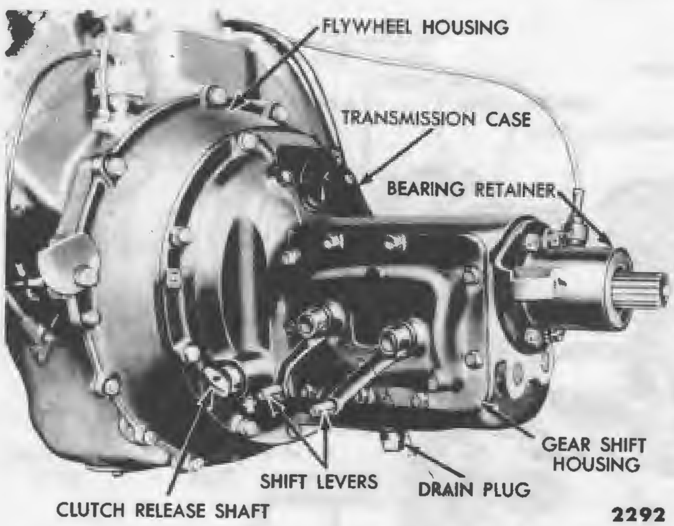

Fig. 11—3-Speed Remote Shift Transmission F-1 (1951)

trucks are equipped with the standard 3-speed remote shift transmission (fig. 11). A heavy duty, 3-speed remote shift transmission is used as standard equipment on the F-3 and F-5 Parcel Delivery models (fig. 12). The heavy duty, 3-speed, center shift transmission is also available as optional equipment for the F-1, F-2, F-3, F-4, and F-5 models.

The service information for both 3-speed transmissions is included in this section. Although these transmissions are similar in construction, there are differences in some of the parts. Where these differences affect the servicing of the transmissions, the variations in procedures are given.

A blocker type synchronizer is used in conjunction with the second and third-speed helical type gears. First and reverse gears are spur type, and are engaged by the use of a sliding gear. Refer to fig. 13 for gear identification. Figure 14 shows a sectional view of the 3-speed heavy duty transmission.

The power flow through the gear train in the various transmission speeds is as follows:

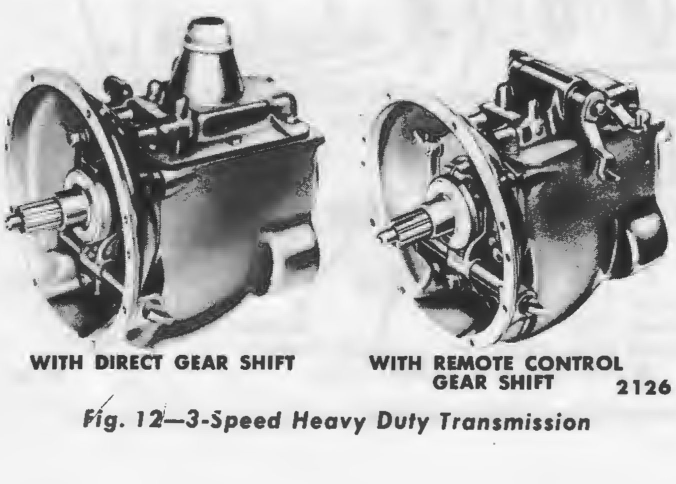

Fig. 12—3-Speed Heavy Duty Transmission

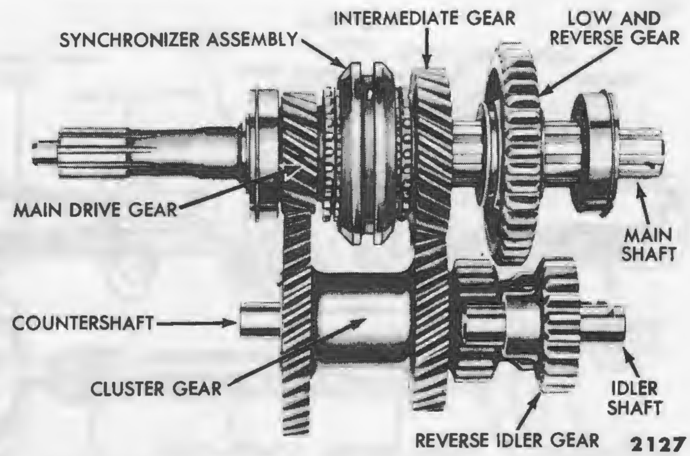

Fig. 13—Transmission Gear Train

In first or low, power is transmitted from the main drive gear to the countershaft cluster gear, to the main shaft sliding gear and then to the drive line. In second gear, power is transmitted from the main drive gear to the countershaft cluster gear, to the second speed gear and then to the drive line. In third or high, the synchronizer meshes with the main drive gear transmitting power directly to the drive line. When the gearshift is placed in reverse, power is directed from the main drive gear to the countershaft cluster gear, to the reverse idler gear, to the main shaft sliding gear, then to the drive line.

A clutch housing, containing the clutch release mechanism is bolted to the front side of the transmission case on the 3-speed heavy duty transmission. The 3-speed

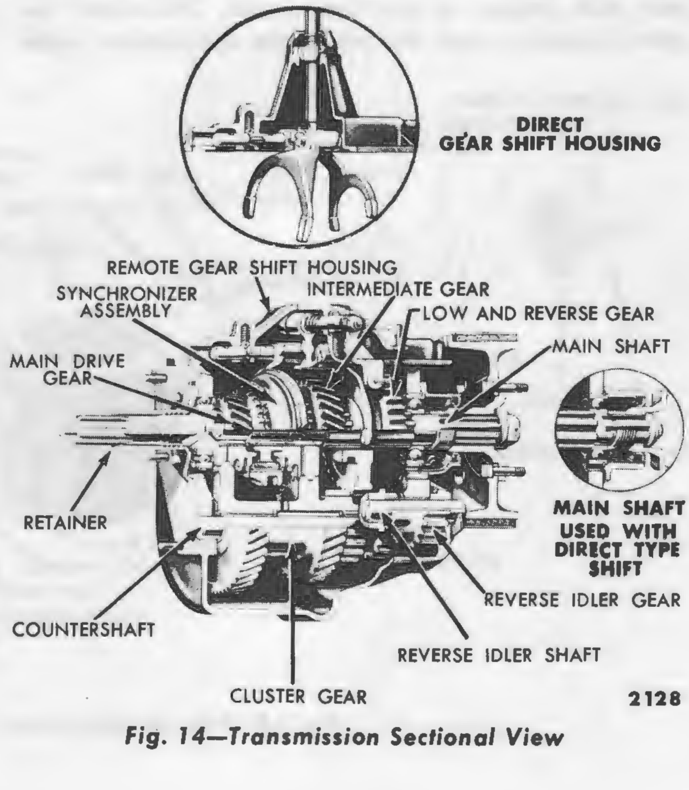

Fig. 14—Transmission Sectional View

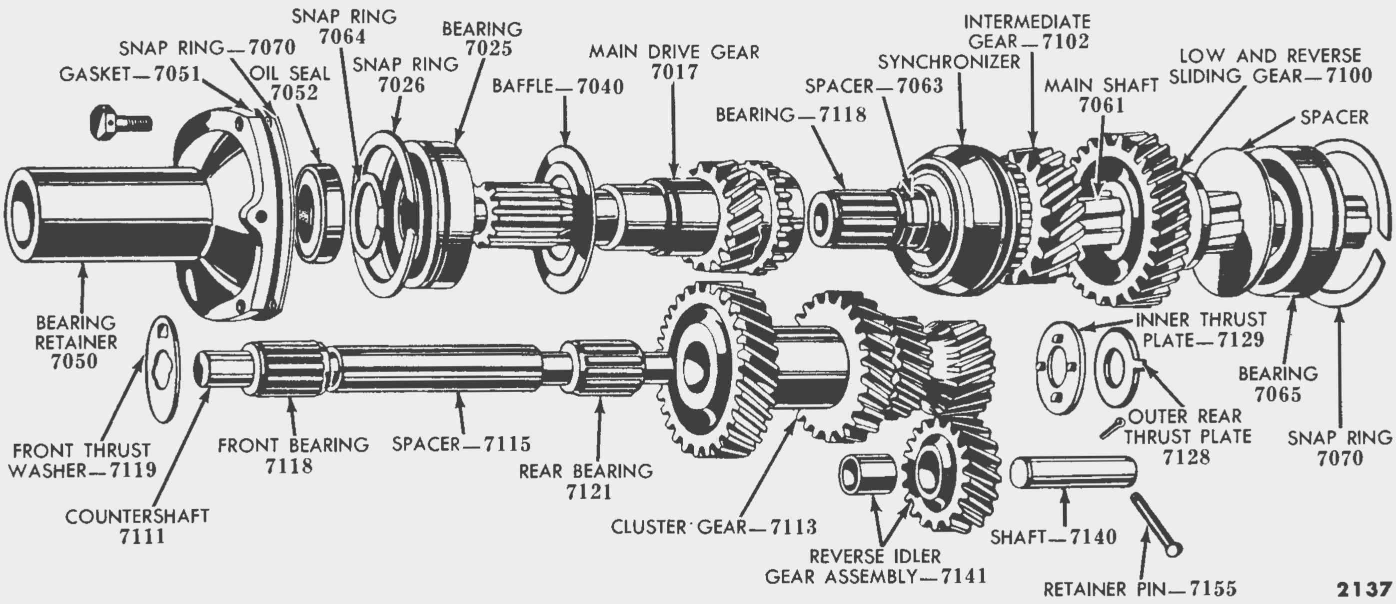

Fig. 15—3-Speed Standard Transmission, Disassembled

standard transmission has the clutch housing cast as an integral part of the transmission case.

Gears and bearings are splash lubricated by oil in the transmission case.

a. Transmission Removal.

Place the vehicle on a hoist, then drain the lubricant from the transmission. Remove the seat cushion and the floor plate. Place a support under the rear of the engine. Disconnect the drive shaft. If the vehicle is equipped with remote control shifting mechanism, disconnect the gear shift linkage at the transmission. Disconnect the clutch equalizer shaft. Disconnect the speedometer cable from the transmission. Disconnect the transmission at the engine rear support and at the flywheel housing. Pull the transmission to the rear until the transmission spline shaft is clear of the clutch. Lift the transmission through the opening in the floor pan.

b. Transmission Disassembly.

The following instructions describe the operations required for disassembling the three-speed transmissions (fig. 15 and 16). Refer to figs. 13 and 14 for the identification and location of the various transmission parts and subassemblies.

(1) *REMOVE GEAR SHIFT HOUSING.* Remove

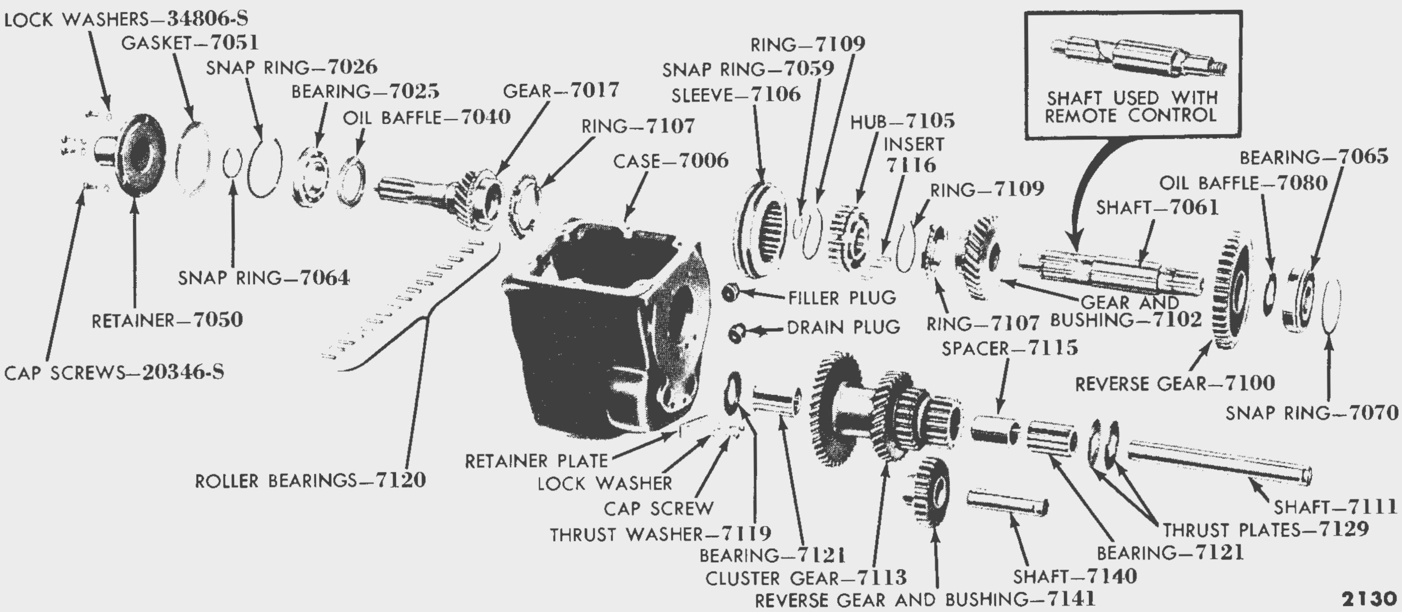

Fig. 16—3-Speed Heavy Duty Transmission, Disassembled

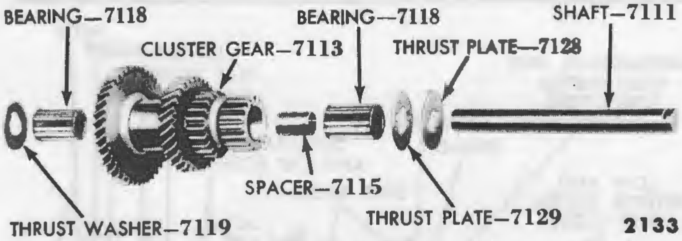

Fig. 17—Countershaft Cluster Gear, Disassembled

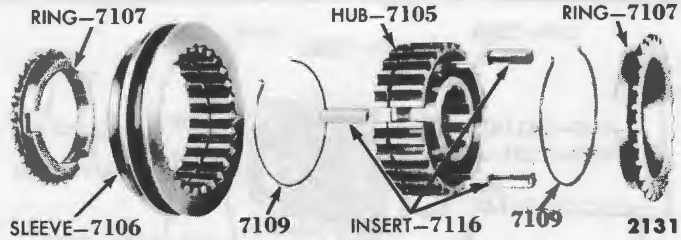

Fig. 19—Synchronizer, Disassembled

the cap screws and lock washers which attach the gearshift housing to the case. Remove the gearshift housing and gasket from the case.

(2) *REMOVE MAIN SHAFT.* Unhook the clutch release bearing hub return spring and slide the release bearing and hub off the front bearing retainer. Remove the screws which secure the front bearing retainer to the transmission case, tap the retainer lightly, then slide the retainer and gasket off the main drive gear shaft.

On the 3-speed heavy duty transmission, remove the screws and countershaft locking plate located at the lower rear end of the case. On the 3-speed standard transmission, remove the lock pin securing the countershaft and reverse idler gear shaft in the case.

Remove the main shaft rear bearing retainer, then remove the snap ring from the bearing. Using a puller, remove the bearing from the main shaft. Slide the oil baffle off the shaft. Using a drift against the front end of the countershaft, drive the countershaft out through the rear of the case. Pull the main drive gear forward as far as possible, then lift the main shaft assembly out of the case.

(3) *REMOVE MAIN DRIVE GEAR.* Remove the snap ring from the main drive gear bearing. Tap gently on the end of the shaft with a lead hammer until the bearing is free. Place one hand over the gear end of the main drive gear to prevent loss or damage of the roller bearings, then lift the main drive gear out of the transmission case.

(4) *REMOVE COUNTERSHAFT CLUSTER AND REVERSE IDLER GEARS.* Lift the cluster gear assembly out of the case, then remove the thrust washer and thrust plates located at each end of the cluster gear. Remove the two roller bearing assemblies (fig. 17) and spacer from inside the cluster gear. Drive the reverse idler shaft towards the front of the case until the shaft is free, then lift the idler gear and shaft out of the case. Slide the idler gear off the shaft.

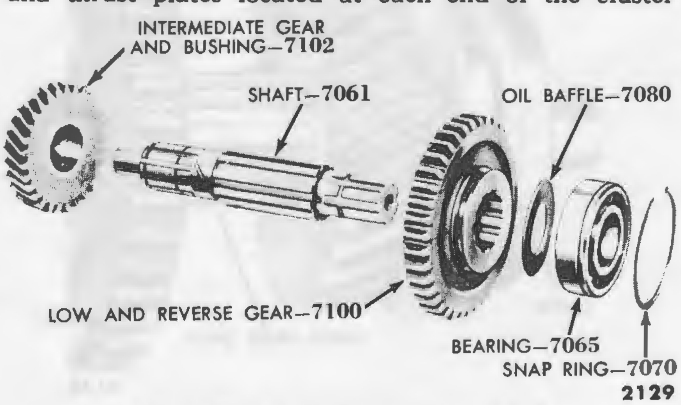

Fig. 18—Main Shaft, Disassembled

c. Dissassembly of Sub-Assemblies.

The following procedures contain instructions for disassembling the transmission sub-assemblies.

(1) *DISASSEMBLE MAIN SHAFT.* Slide the first and reverse sliding gear off the end of the main shaft (fig. 18). Remove the snap ring from the synchronizer end of the shaft, then slide the synchronizer assembly and second-speed gear off the shaft.

(2) *DISASSEMBLE SYNCHRONIZER.* Slide the synchronizer hub assembly out of the synchronizer sleeve (fig. 19). Remove the snap rings located on each side of the hub, then remove the inserts.

NOTE: ***The blocker rings used with the synchronizer are removed separately from the assembly. One ring is removed with the second-speed gear, and the other ring is removed with the main drive gear.***

(3) *DISASSEMBLE MAIN DRIVE SHAFT.* Remove the synchronizer ring, then remove the roller bearings from inside the drive gear. Remove the snap ring from the end of the shaft. Using an arbor press or puller force the bearing off the shaft, then remove the oil baffle (fig. 20).

(4) *DISASSEMBLE GEARSHIFT HOUSING.* It

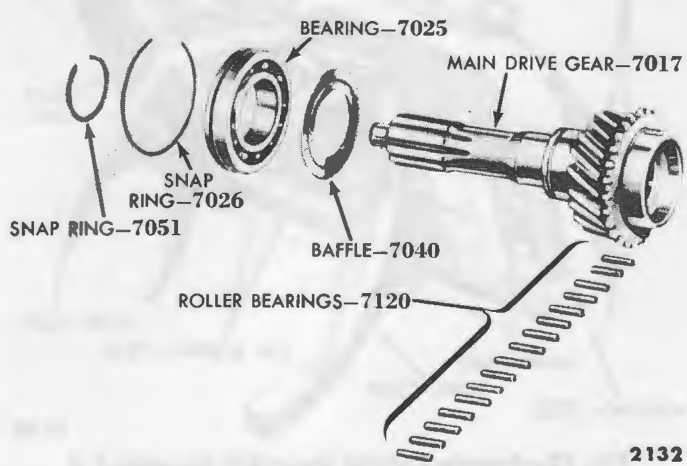

Fig. 20—Main Drive Gear, Disassembled

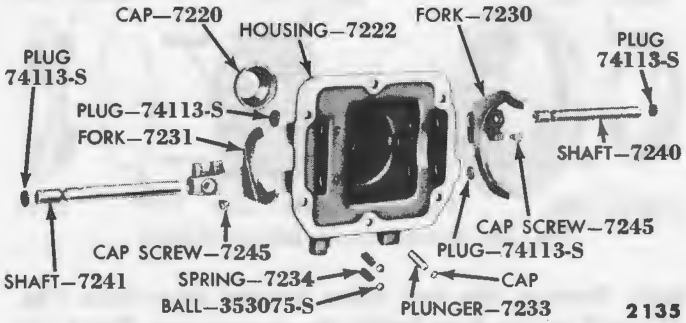

Fig. 21—Gearshift Housing, Disassembled (Direct Type)

is not necessary to disassemble the gearshift housing assembly to determine if parts are worn. If the shift levers and forks show excessive wear, or if there is evidence of binding when they are shifted into the various positions, the unit must be disassembled to make the necessary repairs.

(a) Direct Type Gearshift Housing. Remove the lockwires and lock screws attaching the shifter forks to the shifter shafts (fig. 21). Insert a drift in the lock screw hole in one of the shafts, gently tap the shaft and expansion plugs out of the housing.

CAUTION: ***While removing the shaft, place one hand over the plunger spring and ball hole to prevent these parts from flying out. Tag or mark each shaft and fork and side of housing as to its position to assure correct assembly.***

Remove the plunger spring and ball from the housing. Remove the shifter fork from the housing. Remove

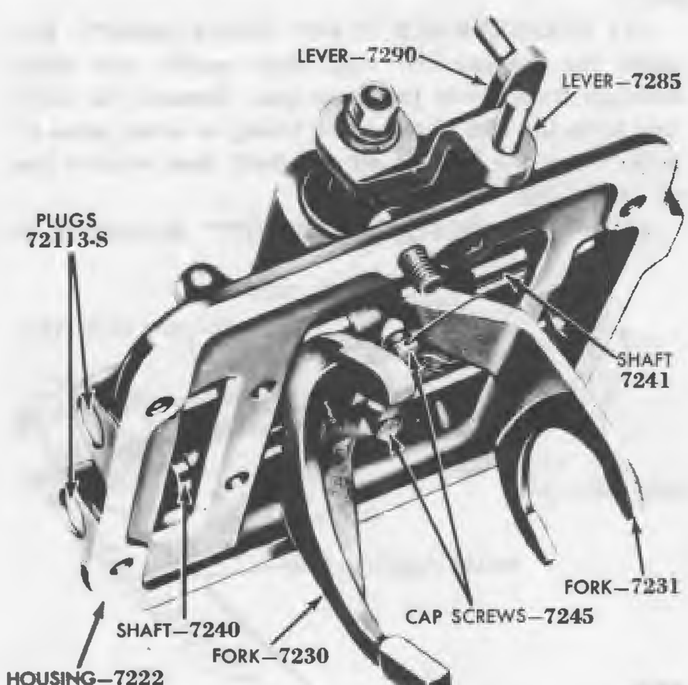

Fig. 22—Remote Control Gearshift Housing F-3 and F-5 Par. Del.

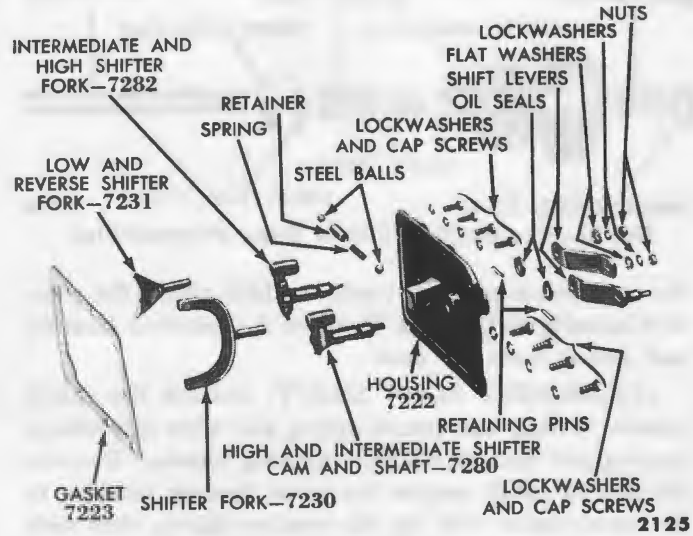

Fig. 23—Remote Control Gearshift Housing

the remaining shifter shaft and fork in the same manner. Remove the expansion plugs at the opposite end of the housing from which the shafts were removed. Remove the plunger plug and plunger from the housing.

(b) Remote Control Type Gearshift Housing, F-3 and F-5 (Par. Del.). Remove the selector lever assembly and the shifter shaft outer lever from the housing (fig. 22). Remove the lockwires and lock screws attaching the shifter forks to the shifter shafts. Insert a drift in the lock screw hole of one of the shifter shafts, gently tap the shaft and expansion plug out of the housing.

CAUTION: ***While removing the shaft, place one hand over the plunger spring and ball hole to prevent these parts from flying out. Tag or mark each***

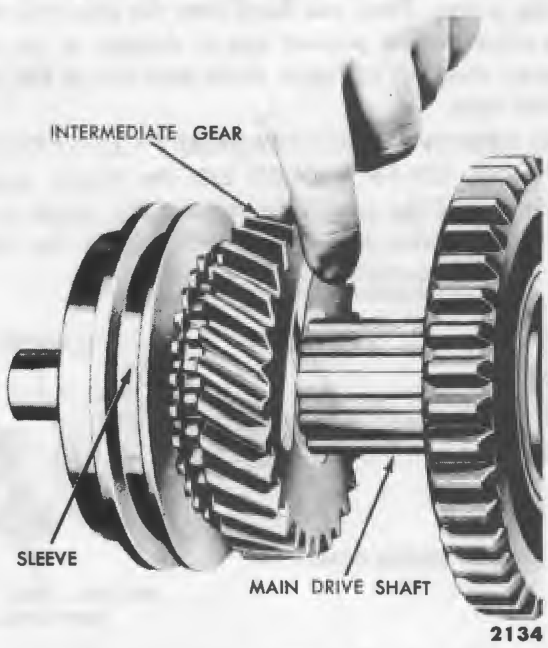

Fig. 24—Checking Intermediate Gear End Play

shaft and fork and side of housing as to its position to assure correct assembly.

Remove the plunger ball and spring from the housing. Remove the remaining shifter shaft and fork in the same manner.

Remove the snap rings located on each side of the shifter shaft inner lever. Tap on the inner lever until the key in the shifter shaft is exposed, then remove the key. Slide the shifter shaft out of the housing, then remove the spring and inner lever. Remove the plunger plug and plunger from the housing.

(c) REMOTE CONTROL TYPE—F-1 (1951). Remove the shift lever retaining pins and levers from the camshaft (fig. 23). Pull the shifter fork and cams out of the gearshift housing. With the cams removed the interlock balls, retainer, and spring will fall out of the gearshift housing. Pull the shifter forks out of the shifter cams. Remove the oil seals from the gearshift housing.

d. Sub-Assembly Build-Up.

All transmission parts should be cleaned and inspected before installation. The following procedures contain information for the build-up of the transmission sub-assemblies.

(1) *ASSEMBLE MAIN SHAFT*. Slide the second speed gear onto the front end of the shaft. Coat the synchronizer ring with grease, then install the ring on the shaft. Install the synchronizer assembly on the shaft. Make sure the cutouts on the synchronizer ring mate with the inserts on the hub, then install the snap ring on the shaft. Check the end play between the second-speed gear and the shaft spline shoulder with a feeler gauge (fig. 24). The end play should not exceed 0.020 inch. Install the first and reverse sliding gear on the rear end of the shaft.

(2) *ASSEMBLE SYNCHRONIZER*. Install the inserts in the hub, then position the two snap rings on each side of the hub. Slide the hub assembly into the sleeve.

(3) *ASSEMBLE MAIN DRIVE SHAFT*. Install the oil baffle, bearing and bearing snap ring (small) on the shaft. Coat the cavity in the rear end of the shaft with grease, then install the roller bearings.

(4) *ASSEMBLE CLUSTER GEAR*. Install the spacer and the front and rear roller bearings in the cluster gear. Place a thick coating of grease on the thrust washer and thrust plates, then position the two rear thrust plates on the rear end of the cluster gear.

(5) *ASSEMBLE GEAR SHIFT HOUSING*. The assembly procedures for the various types of gearshift housing assemblies used with the 3-speed transmissions are given under the following headings: "(a) Direct Type," "(b) Remove Control Type—F-3 and F-5 Parcel Delivery," and "(c) Remote Control Type—F-1 (1951)."

(a) DIRECT TYPE. Slide the plunger in position in the housing, then install the plunger plug. Drop a spring and ball through one of the holes in the housing, then place the proper shift fork in position in the housing. Hold the ball down with a drift, and slide the correct shaft into the housing and shift fork. Install a cap screw in the fork and shaft and secure with lockwire. Install the remaining spring, ball, shift fork, shaft, cap screw, and lockwire in the same manner. Install the expansion plugs at each end of each shaft.

(b) REMOTE CONTROL TYPE—F-3 AND F-5 PARCEL DELIVERY. Slide the plunger into position in the housing, then install the plunger plug. Install the shifter shaft spring, shifter shaft inner lever and shifter shaft in the housing. Press the spring away from the inner lever then insert the keyway in the shifter shaft. Align the key with the keyway in the inner lever, then force the lever over the key. Install one snap ring at each side of the inner lever. Drop a shifter shaft lock plunger spring and ball through one of the holes in the housing, then place the proper shift fork in position in the housing. Move the ball down with a drift, and slide the correct shifter shaft into the housing and shift fork. Install a shifter fork lock screw in the fork and shaft, and secure the screw with lockwire. Install the remaining spring and ball, shift fork, shaft, cap screw, and lockwire in the same manner. Install the expansion plugs in the housing at each end of each shaft. Place the selector lever assembly on the stud in the housing, then install the spacer, locker washer, and nut.

Position the shifter shaft outer lever on the shifter shaft, then install the flat washer, the lock washer, and the nut.

(c) REMOTE CONTROL TYPE—F-1 (1951). Place one shifting cam in position in the gearshift housing. Assemble the interlock spring and balls in the retainer and install the interlock assembly in the gearshift housing.

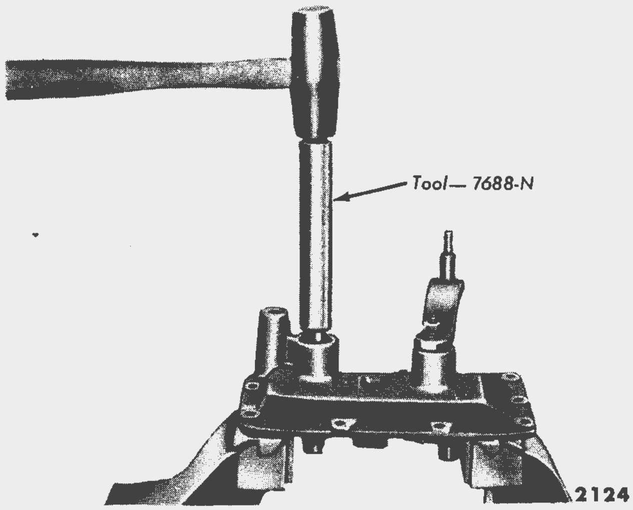

Fig. 25—Installing Shifter-Fork Cam or Shift-Shaft Lever Seal

Place the other cam assembly in position in the gearshift housing. Install the oil seals in the gearshift housing (fig. 25). Install the gearshift levers on the camshafts, then install the retaining pins. Assemble the shifter forks to the cams.

e. Transmission Assembly.

Lubricate all parts with transmission grease before installation to prevent scoring of parts when the transmission is first put into operation.

(1) *INSTALL COUNTERSHAFT, CLUSTER, AND REVERSE IDLER GEARS.* Position the reverse idler gear in the transmission case, then install the idler shaft. On the standard 3-speed transmission, drive the idler shaft into the case until the retainer pin hole in the shaft is aligned with the hole in the case. On the 3-speed heavy duty transmission, drive the idler shaft into the case until the edge of the lock plate notch in the shaft is flush with the rear face of the case. Install the countershaft gear front thrust washer with the tip on the washer hooked into the groove on the inside of the case. Position the cluster gear assembly in the case with the larger gear toward the front. Make sure the thrust washer and plates remain in position.

(2) *INSTALL MAIN DRIVE GEAR.* Coat the synchronizer blocking ring with grease. Place the ring on the front end of the main drive gear, and install the main shaft assembly in the case. Install the snap ring in the groove on the main drive gear bearing, making sure that the snap ring is flush with the side of the case. Position a new gasket on the transmission case, then install the main drive gear bearing retainer on the case. Tighten the cap screws securely. Install the clutch release bearing and return spring.

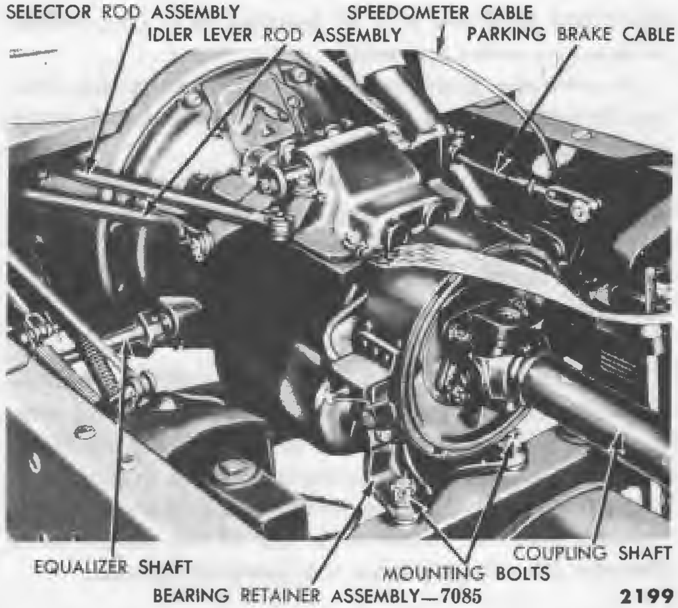

Fig. 26—F-3 Parcel Delivery Transmission Installation

(3) *INSTALL MAIN SHAFT.* Position the main shaft assembly in the transmission case. Install the oil baffle (or spacer) on the main shaft. Install the snap ring in the groove on the rear bearing, then drive the bearing on the shaft until the bearing snap ring is flush with the side of the case. Make sure the synchronizer rings are free in the synchronizer assembly.

(4) *INSTALL COUNTERSHAFT.* Raise the cluster gear assembly until the bore of the gear is aligned with the countershaft holes in the transmission case. Make sure the thrust washer and plates are also in alignment. Insert the end of the countershaft in the hole in the rear end of the case. On the 3-speed heavy duty transmission,

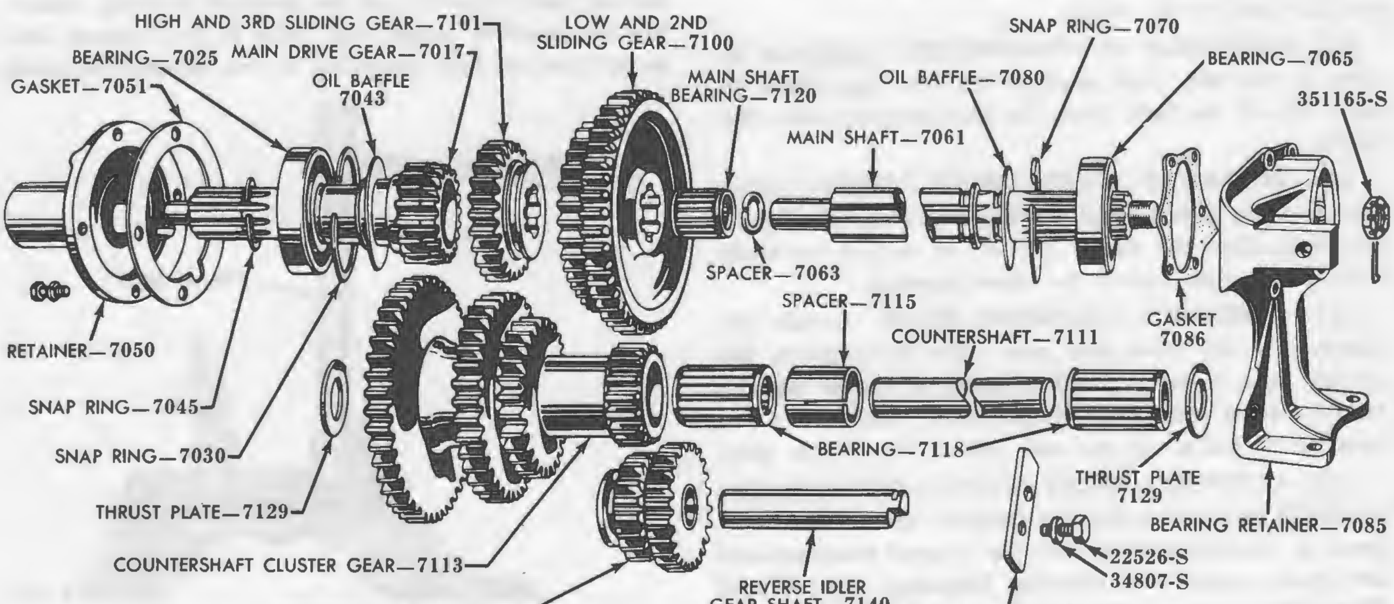

Fig. 27—4-Speed Transmission, Disassembled

push the shaft forward until the edge of the notch in the shaft is flush with the transmission case and the notch is in alignment with the notch in the idler gear shaft.

On the 3-speed standard transmission, push the shaft forward until the retainer pin hole in the shaft is aligned with the retainer pin hole in the case.

Install the locking plate (3-speed heavy duty) or the retainer pin (3-speed standard).

On the 3-speed heavy duty transmission, install the main shaft bearing retainer assembly. On the 3-speed standard transmission, install the speedometer drive gear and snap ring, then install the retainer assembly.

(5) *INSTALL GEARSHIFT HOUSING.* Position a new gasket on the case, then place the shift forks in the neutral position. Place the housing assembly on the case, making sure the shift forks are located in their proper channels on the sliding gear and the synchronizer sleeve. Install the cap screws and lock washers that secure the gearshift housing to the case. Install the drain plug. Turn the main drive gear by hand to make sure the gears do not bind and that the shift forks are in their proper positions.

f. Transmission Installation.

Place the transmission in position and align the transmission spline shaft with the clutch disk splines. Slide the transmission forward until the transmission is in position on the flywheel housing. Install the lock washers and cap screws which secure the transmission to the flywheel housing. Tighten the screws securely. Connect the speedometer cable. On models equipped with the remote control shifting mechanism, connect the steering column gear shift linkage to the transmission linkage as shown in fig. 26. Install the clutch equalizer shaft and adjust the clutch pedal free travel. Connect the transmission to the engine rear support. Connect the coupling shaft, and install the floor pan and seat cushion. Refill the transmission with the correct amount of the proper lubricant.

4. 4-SPEED STANDARD TRANSMISSION

A 4-speed, sliding spur gear type, transmission having four forward speeds and one reverse speed, is used as standard equipment on all F-2, F-3, F-4, F-5, and F-6 trucks except those equipped with the "M" series engine. This transmission is available as optional equipment on F-1 truck models.

The transmission spur gears are heat-treated alloy steel. The main drive shaft is supported at the case end in a ball bearing. The front end of the shaft is piloted in caged roller bearings installed in the main drive gear. The main drive gear is supported in the case by a large ball bearing. The countershaft is mounted in two caged roller bearings which are installed between the shaft and the cluster gear. Fig. 27 shows the disassembled view of this transmission and the relative position of all of the component parts.

a. Transmission Removal.

To remove a 4-speed transmission from an F-1 truck, use the procedure given for F-1 truck equipped with a 3-speed transmission.

To remove a 4-speed transmission from the F-2 through F-6 trucks, use the following procedure.

Drain the transmission. Remove the seat cushion. Remove the cap screws which secure the floor plate to the floor, then remove the plate.

Place a jack under the flywheel housing, then place a block of wood between the jack and the housing. Raise the jack until the engine is supported by the jack. Remove the coupling shaft. Remove the clutch equalizer shaft, then disconnect the speedometer cable from the transmission. Remove the two engine support to frame crossmember bolts, then remove the transmission to flywheel housing bolts. Move the transmission to the rear until the main drive gear splines are clear of the clutch, then remove the transmission through the floor opening.

b. Transmission Disassembly.

The transmission assembly should be positioned to allow access to the main drive gear at the front of the case, as well as to the reverse idler shaft and bearing caps at rear of the transmission case. Instructions for removing the major sub-assemblies from the transmission are given below and instructions for disassembling the various sub-assemblies are given separately.

(1) *REMOVE GEARSHIFT HOUSING.* Remove the hand brake lever assembly. Remove the cap screws and lock washers that secure the housing assembly to the transmission case. Lift the housing assembly until

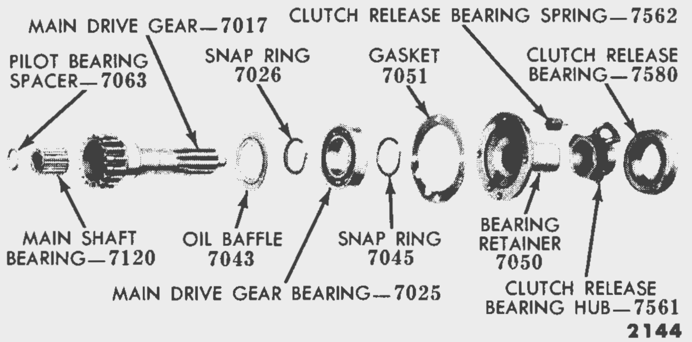

Fig. 28—4-Speed Transmission Main Drive Gear, Disassembled

the shifter forks clear the transmission gears, then remove the assembly. Remove and discard the gearshift housing gasket.

The gearshift housing may be disassembled, if necessary, in the same manner as the housing used with the 3-speed heavy duty transmission equipped with a center shift.

(2) *REMOVE MAIN DRIVE GEAR.* Remove the clutch release bearing return spring, then slide the clutch release bearing and hub off the main drive gear (fig. 28). Remove the clutch housing and then remove the main drive gear bearing retainer from the front of the transmission case. Tap the main drive gear out off the transmission case. Remove the main shaft pilot bearing from the main drive gear. Remove the snap ring, then press the bearing off the shaft.

(3) *REMOVE MAIN SHAFT.* On transmissions equipped with a parking brake drum at the rear of the transmission, remove the parking brake assembly, then remove the main shaft as follows:

Remove the transmission main shaft bearing retainer assembly and gasket (fig. 29). Slide the speedometer drive gear and spacer off the main shaft. Remove the speedometer driven gear bearing and gear from the main shaft bearing retainer. Tap the pilot end of the main shaft lightly with a brass hammer until the main shaft bearing clears the transmission case. Pull the main shaft and the bearing out through the rear of the transmission. Lift the third and high speed gear, and the first and second speed gear out of the transmission case.

(4) *REMOVE REVERSE SHIFTER FORK.* Remove the cotter pin from the reverse idler shifter shaft located on the left side of the transmission case. Tap the shifter shaft out of the housing. Remove the reverse idler shifter fork from the case (fig. 30).

(5) *REMOVE REVERSE IDLER GEAR.* Remove the lock plate from the rear of the transmission case (fig. 30). Insert a screw driver or pry bar in the slot in the reverse idler shaft, and pry the reverse idler shaft out of the case. Lift the reverse idler gear out of the case.

(6) *REMOVE CLUSTER GEAR.* Working from the forward end of the transmission case, drive the countershaft out of the case (fig. 30). Lift the cluster gear and the two thrust washers from the case.

c. Transmission Assembly.

Prior to assembling the transmission be sure to clean and inspect all transmission parts thoroughly. Then follow the procedure given in the following paragraphs to assemble the transmission.

(1) *INSTALL CLUSTER GEAR ASSEMBLY.* Insert the spacer in the cluster gear (fig. 30). Position a roller bearing assembly in each end of the cluster gear. Place the cluster gear in the transmission case with the larger gear toward the front of the case. Place one thrust washer at each end of the cluster gear. Align the cluster gear with the countershaft holes in the case. Insert the end of the countershaft that is not slotted through the rear of the case and through the cluster gear. Tap the countershaft into the case until the slot in the countershaft is flush with the rear face of the case.

(2) *INSTALL REVERSE IDLER GEAR AND SHIFTER FORK.* Position the reverse idler gear in the case with the shifter shaft channel toward the front of the case (fig. 30). Align the reverse idler gear with the reverse idler shaft hole in the case. Insert the reverse idler shaft in the case and through the reverse idler gear. Tap the reverse idler shaft into the case until the slot in the shaft is flush with the rear face of the case. Install the lock plate in the slots of the countershaft and the reverse idler shaft. Install the cap screws and lock washers that secure the lock plate to the case.

(3) *INSTALL MAIN SHAFT ASSEMBLY.* Install the bearing, oil baffle, and washer on the main shaft. Slide the main shaft assembly part way into the case. Slide the first and second speed gear and the third and

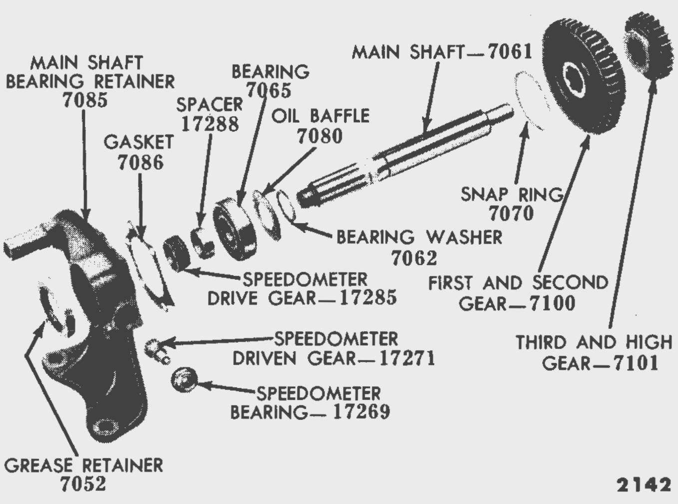

Fig. 29—4-Speed Transmission Main Shaft, Disassembled

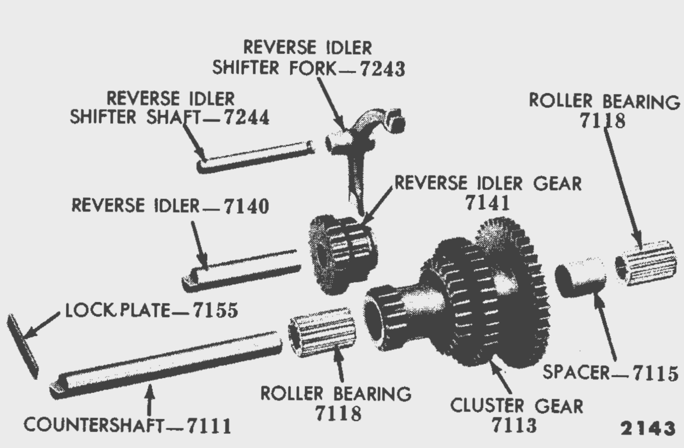

Fig. 30—4-Speed Transmission Cluster Gear and Reverse Idler Gear, Disassembled

fourth speed gear on the main shaft through the opening at the top of the case. Install the gears with the shifter fork channels in the gears facing each other. Push the main shaft with the washer, oil baffle, and bearing assembly into the case until the main bearing is seated firmly against the snap ring in the case. Install the spacer and the speedometer drive gear on the main shaft.

Position a new gasket on the case. Place the main shaft bearing retainer in position on the case, and install the retainer to case cap screws. Install the lock wire in the cap screws. Install the speedometer driven gear bearing and gear in the main shaft bearing retainer.

(4) *INSTALL MAIN DRIVE GEAR.* Install the spacer and the pilot bearing on the pilot end of the main shaft (fig. 28). Install the oil baffle and the bearing on the main drive gear then install the bearing snap ring. Insert the main drive gear through the opening at the forward end of the transmission and onto the main shaft pilot bearing. Tap the main drive gear until the bearing is seated firmly in the case and against the snap ring. Place a new front main bearing retainer gasket on the transmission case. Install the bearing retainer and the clutch housing on the transmission case. Install the clutch release bearing hub and the clutch release bearing on the bearing retainer then install the clutch release bearing return spring.

(5) *INSTALL GEARSHIFT HOUSING ASSEMBLY.* If the gear shift housing has been disassembled, the housing may be reassembled in the same manner as the housing used with a 3-speed heavy duty transmission equipped with center shift.

To install the housing, position a new gasket on the transmission case. Then with the gearshift lever in the neutral position, place the gearshift housing on the case. Install the screws and lock washers that secure the gearshift housing to the case and tighten the screws to the correct torque. Move the shift lever to the various positions, and turn the main drive gear by hand to make sure the gears do not bind and that the shifter forks are in their proper locations.

d. Transmission Assembly Installation.

To install a four-speed transmission in a F-1 truck, use the procedure given for F-1 trucks equipped with a three-speed heavy duty transmission.

To install a four-speed transmission in the F-2 through F-6 trucks, use the following procedure.

Lower the transmission into position through the floor opening, then align the transmission main drive gear splines with the clutch disc splines. Slide the transmission forward into position against the flywheel housing. Install the cap screws and lock washers that secure the transmission to the flywheel housing. Tighten each screw a little at a time until all are tightened to the specified torque. Install the engine rear support bolts, then install the coupling shaft. Connect the speedometer cable, then install the clutch equalizer shaft. Install and attach the hand brake parts. Install the floor plate and the seat cushion.

5. 4-SPEED SYNCHRO-SILENT TRANSMISSION

F-6 model trucks that are equipped with the 6-cylinder ("M" Series) engine use the 4-speed synchro-silent transmission as standard equipment. This transmission is available as optional equipment for F-4, F-5, and F-6 model trucks equipped with either the 8-cylinder ("R" Series) or 6-cylinder ("H" Series) engines.

The 4-speed synchro-silent transmission is the constant mesh type and provides synchro-silent action in second, third, and fourth speeds. First and reverse gears are of the spur gear type. Helical gears are used for the second, third, and fourth speed gears.

The main drive gear is of the helical gear type and is supported by the main drive gear bearing, which is of the ball bearing type. The bearing is pressed onto the main drive gear shaft and is held in place by a snap ring. The main drive gear bearing is also a press fit in the transmission case. A snap ring, installed in a groove in the bearing outer race, locates the bearing and drive gear in the correct assembled position.

The main shaft is supported at the front end by needle bearings installed in the main drive gear and at the rear end of the transmission case by a ball type bearing. The rear bearing is a press fit on the shaft and also in the transmission case. A snap ring which fits a groove in the rear bearing locates the bearing and main shaft in the correct assembled position.

The third and high gear synchronizer assembly is mounted on the splines at the forward end of the main shaft and is held in position by a snap ring. This synchronizer is followed by a third and high speed gear. The second speed gear containing needle bearings, a spacer, and a thrust washer, is held in position on the center of the main shaft by two snap rings, one at each side of the second speed gear. The second speed synchronizer assembly is installed behind the second speed gear and is held in position by a snap ring.

The cluster gear is supported by two sets of needle type roller bearings installed between the countershaft and the gear at each end of the shaft. The shaft is held in position in the transmission case by a lock plate which fits into a slot in the end of the shaft.

a. Transmission Removal.

Drain the lubricant from the transmission. Remove the seat cushion and the floor plate. Place a jack under the rear of the engine at the flywheel housing. Insert

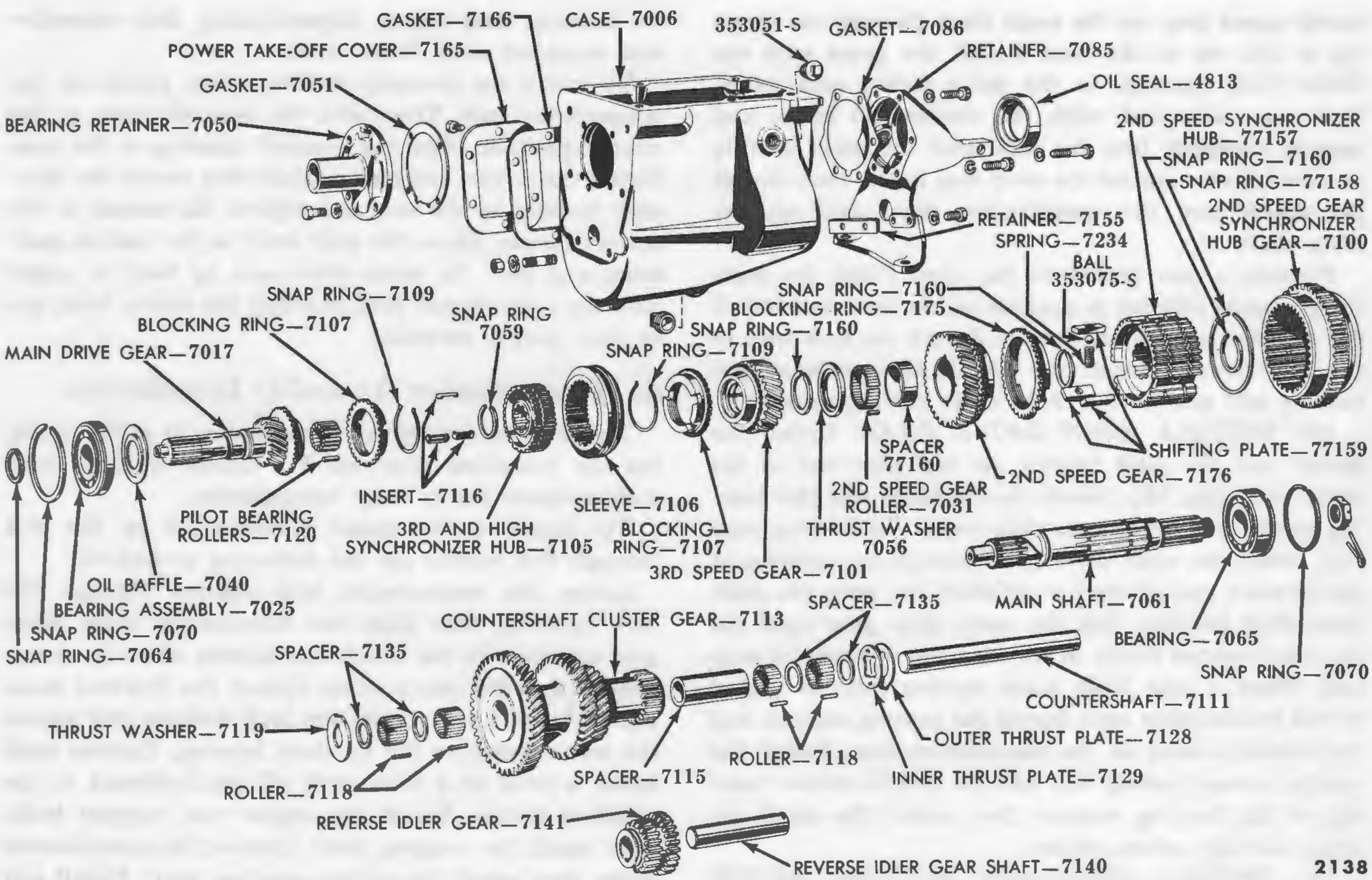

Fig. 31—4-Speed Synchro-Silent Transmission, Disassembled

a wooden block between the jack and the housing, then raise the jack until the engine is firmly supported. Disconnect the coupling shaft at the transmission companion flange. Disconnect the clutch release equalizer shaft from the clutch release shaft. Disconnect the speedometer cable at the transmission. Remove the bolts which attach the engine rear support to the frame crossmember. Disconnect the clutch housing from the flywheel housing, slide the transmission backward until the transmission main drive gear splines are clear of the clutch, then lift the transmission out through the floor pan opening.

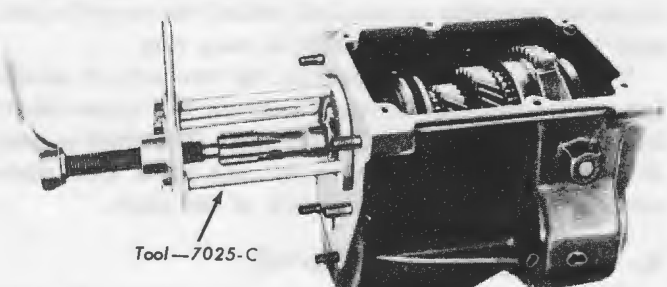

Fig. 32—Removing Main Drive Shaft Bearing, Tool No. 7025-C

b. Transmission Disassembly.

The disassembly procedures for the 4-speed synchro-silent transmission are given in the following paragraphs. The disassembled view of this transmission is shown in fig. 31.

Remove the parking brake assembly, then remove the

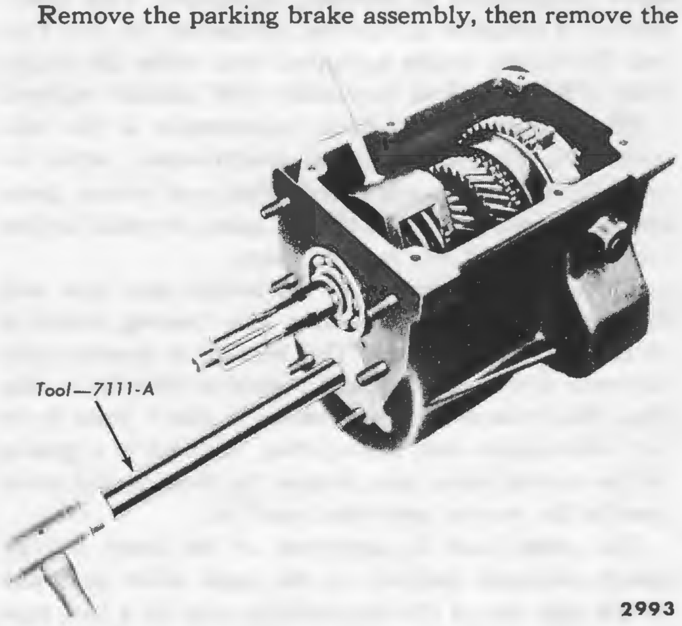

Fig. 33—Dummy Countershaft Installation

speedometer driven gear retaining nut and the driven gear. Remove the rear bearing retainer and gasket noting the location of the longest retainer to case bolt. Remove the reverse idler shaft and countershaft retainer plate from the case. Slide the speedometer drive gear and spacer off the main shaft. Remove the gearshift housing assembly and the gasket from the case. Unhook the clutch release bearing return spring, and then remove the clutch release bearing and hub assembly. Remove the cap screws which attach the front bearing retainer to the case. Remove the nuts and lock washers which attach the clutch housing to the case, then remove the clutch housing and the front bearing retainer from the case. Remove the snap ring from the main drive gear bearing, remove the snap ring from the main drive gear, then remove the bearing using the tool shown in fig. 32. Remove the oil baffle.

Remove the snap ring from the rear main shaft bearing, then pull the bearing with the tool shown in fig. 32.

Drive the countershaft out of the case, working from the front end of the case, and using the dummy shaft shown in fig. 33.

CAUTION: ***Keep the dummy shaft in contact with the countershaft to avoid dropping any needle bearings.***

Allow the cluster gear to remain on the bottom of the case.

Remove the main drive gear through the front end of the case, then remove the synchronizer blocking ring and needle bearings from the gear. Pull the reverse gear idler shaft out of the case, using a tool as shown in fig. 43.

Slide the reverse shifter fork off the shifter fork shaft and lift the fork from the case.

Tilt the main shaft assembly, then lift the main shaft assembly through the top of the case. Lift the idler gear out of the case.

Position the case with the power take-off side next to the bench. Roll the cluster gear assembly toward the top of the case until the small end of the cluster gear can be pushed through the main shaft bearing bore of the case. Using extreme care so as not to disturb the needle bearings, lift the cluster gear assembly out of the case.

c. Disassembly of Sub-Assemblies.

The procedures for disassemblying the transmission sub-assemblies are given below under self explanatory headings.

(1) *DISASSEMBLE MAIN SHAFT.* Remove the third and high synchronizer snap ring from the main shaft, then slide the third and high speed synchronizer assembly and third speed gear off the shaft. Remove the transmission main shaft second speed synchronizer snap ring. Slide the second speed synchronizer hub gear off the synchronizer, using extreme care not to lose any of the balls, springs and plates. Pull the synchronizer hub off the shaft. Remove the snap ring at the rear of the second speed gear. Remove the second speed gear, spacer, rollers and thrust washer from the shaft. Remove the snap ring.

(2) *DISASSEMBLE CLUSTER GEAR.* Remove the dummy shaft, 88 pilot bearing rollers, the bearing spacer washers, and the bearing spacer from the cluster gear.

(3) *DISASSEMBLE GEARSHIFT HOUSING.* Remove the gearshift lever cap, then lift the lever out of the cover (fig. 34). Remove the lock wires and lock screws from the shifter forks and shifter shaft gates. Remove the expansion plugs from the front end of the housing. Tap the shifter shafts out of the housing while holding one hand over the holes in the housing to prevent losing the springs and steel balls. Lift the two lock plungers out of the case.

d. Sub-Assembly Build-Up.

The following paragraphs apply to the assembly of the transmission sub-assemblies.

(1) *ASSEMBLE CLUSTER GEAR ASSEMBLY.* Slide the long spacer into the cluster gear, then insert the dummy shaft in the spacer. Hold the cluster gear in

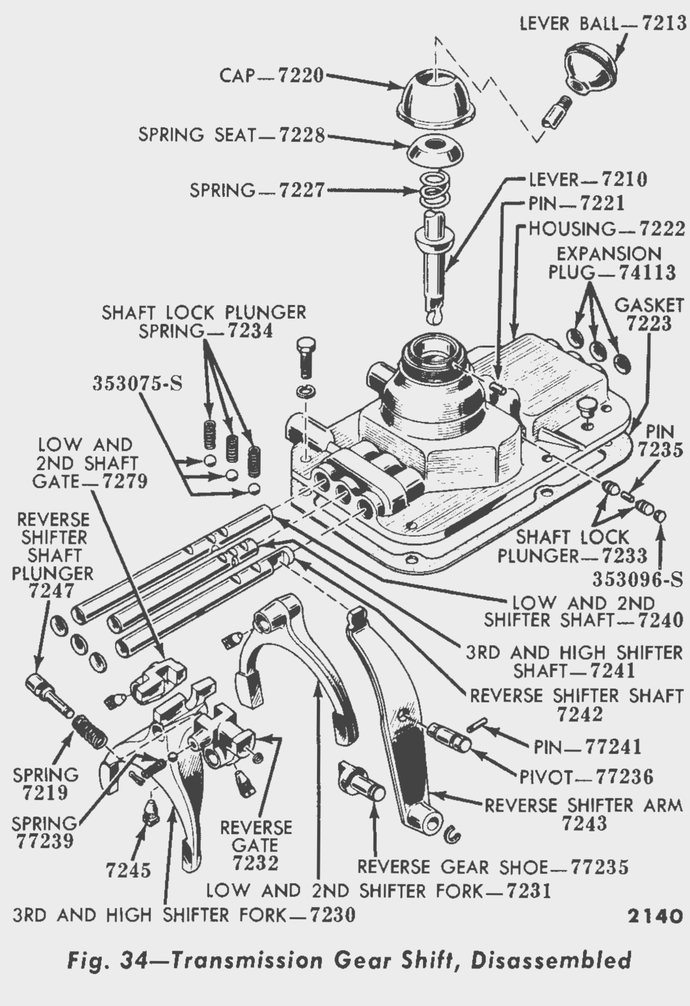

Fig. 34—Transmission Gear Shift, Disassembled

a vertical position and install twenty-two (22) transmission countershaft gear pilot bearing rollers inside the cluster gear. Install a spacer washer on top of the rollers, then install twenty-two (22) rollers and a spacer washer on top of the rollers. Hold a large thrust washer against the end of the cluster gear to keep the rollers from dropping out, and invert the gear assembly. Install the rollers in the opposite end of the gear as previously described.

(2) *ASSEMBLE MAIN SHAFT ASSEMBLY.* Install the second speed gear thrust washer on the main shaft. Hold the shaft in a vertical position and slide the second speed gear on the main shaft. Insert the second speed gear bearing rollers in the second speed gear, then slide the spacer into the gear hub. Install the second speed gear spacer snap ring in the groove in the mainshaft.

NOTE: ***Do not invert the shaft as the rollers will slide out of the hub.***

Press the second speed synchronizer hub on the shaft and install the snap ring. Place the main shaft in a verticle position in a vise. Position the synchronizer springs and plates in the synchronizer hub and place the second speed synchronizer ring on the synchronizer hub. Hold the ring above the hub spring and ball holes and position one ball at a time in the hub. Push down to depress the ball into the hole and slide the ring down to retain the ball in the hub. Push up on the plate and insert a small block to hold the plate in the up position to aid in retaining the ball in the hub, then repeat the foregoing procedure and install the remaining two balls. Extreme care must be used to keep the ball from jumping out of the hub. Remove the main shaft from the vise, then install the third speed gear, and synchronizer blocking ring on the shaft.

Install a synchronizer snap ring at each end of the hub with the spring openings staggered. Place the synchronizer inserts on the synchronizer sleeve. Slide the synchronizer assembly onto the main shaft, making sure the slots in the blocker ring are in line with the synchronizer inserts. Install the front snap ring.

(3) *GEARSHIFT HOUSING ASSEMBLY.* Place the spring on the reverse gate plunger, then install the plunger and spring in the reverse gate. Press the plunger through the gate and secure it with the clip. Place the reverse gate plunger ball and spring in the reverse gate poppet hole. Compress the spring and install the cotter pin.

Place the shifter shaft lock plunger spring and a steel ball into the reverse shifter shaft hole in the gearshift housing. Press down on the ball with a long, narrow drift, then position the reverse shifter shaft so that the reverse arm notch does not slide over the ball, and insert the shaft part way into the housing.

Slide the reverse shaft gate onto the shaft, and drive the shaft into the housing until the ball snaps into the groove of the shaft. Install the lock screw and lock wire to secure the gate to the shaft.

Insert the two interlock plungers in the pockets between the shifter shaft holes. Place the spring and a steel ball into the first and second shifter shaft hole. Press down on the steel ball, then insert the shifter shaft part way into the housing. Slide the first and second gear shifter shaft gate on the shaft, then install the first and second gear shifter fork on the shaft so the offset of the fork is toward the rear of the housing. Push the shaft all the way into the housing until the ball snaps into the groove of the shaft. Install the lock screw and the lock wire to secure the fork to the shaft. Install the third and high gear shifter shaft in the same manner. Install the expansion plugs in the shaft bores.

e. Transmission Assembly.

Lubricate all parts of the transmission with transmission grease before installation to prevent scoring when the transmission is put into operation. Always inspect all parts prior to assembling the transmission.

Tap the reverse gear idler shaft from the inside of the case until the shaft is flush with the inner edge of the case. Position the transmission case with the power take-off plate downward. Hold the two thrust washers in position at the end of the cluster gear to prevent the rollers from falling out of the cluster gear, then position the cluster gear in the bottom of the case. Install the third thrust washer between the case and rear washer.

Position the idler gear in the case, then install the idler gear shaft. Be sure the slotted end is at the rear edge of the case in the downward direction. Position the cluster gear in alignment with the holes in the case and push the dummy shaft out of the front end of the case with the cluster gear shaft. Be sure to keep the cluster

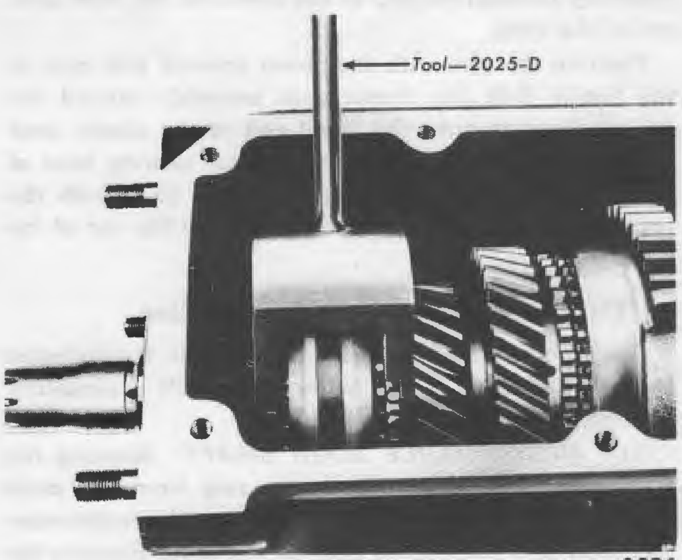

Fig. 35—Stop Yoke Tool Installation

gear shaft in contact with the dummy shaft to prevent any of the rollers from dropping inside the cluster gear. Align the slotted end of the cluster gear shaft with the rear edge of the case and in the downward position.

Install the main shaft pilot bearing rollers in the main drive gear. Place the oil baffle on the main drive gear. Position the main drive gear in the front bearing bore working from inside the case. Position the stop yoke tool (fig. 35) to prevent jamming the synchronizer rings.

Drive the main shaft bearing on the shaft with the tool shown in fig. 36, then install the bearing snap ring. Using the same tool, drive the rear bearing on the shaft and into the rear bearing bore, then install the rear bearing snap ring. Install the main drive gear snap ring on the main drive gear. Position the front bearing retainer and clutch housing on the front side of the transmission case, then secure the retainer and housing.

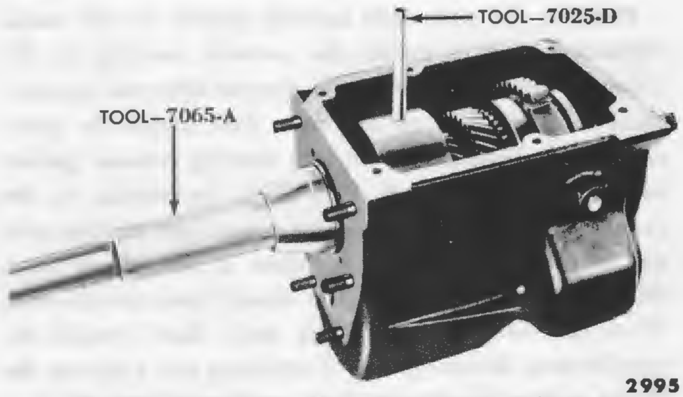

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Fig. 36—Main Drive Gear Bearing Installation

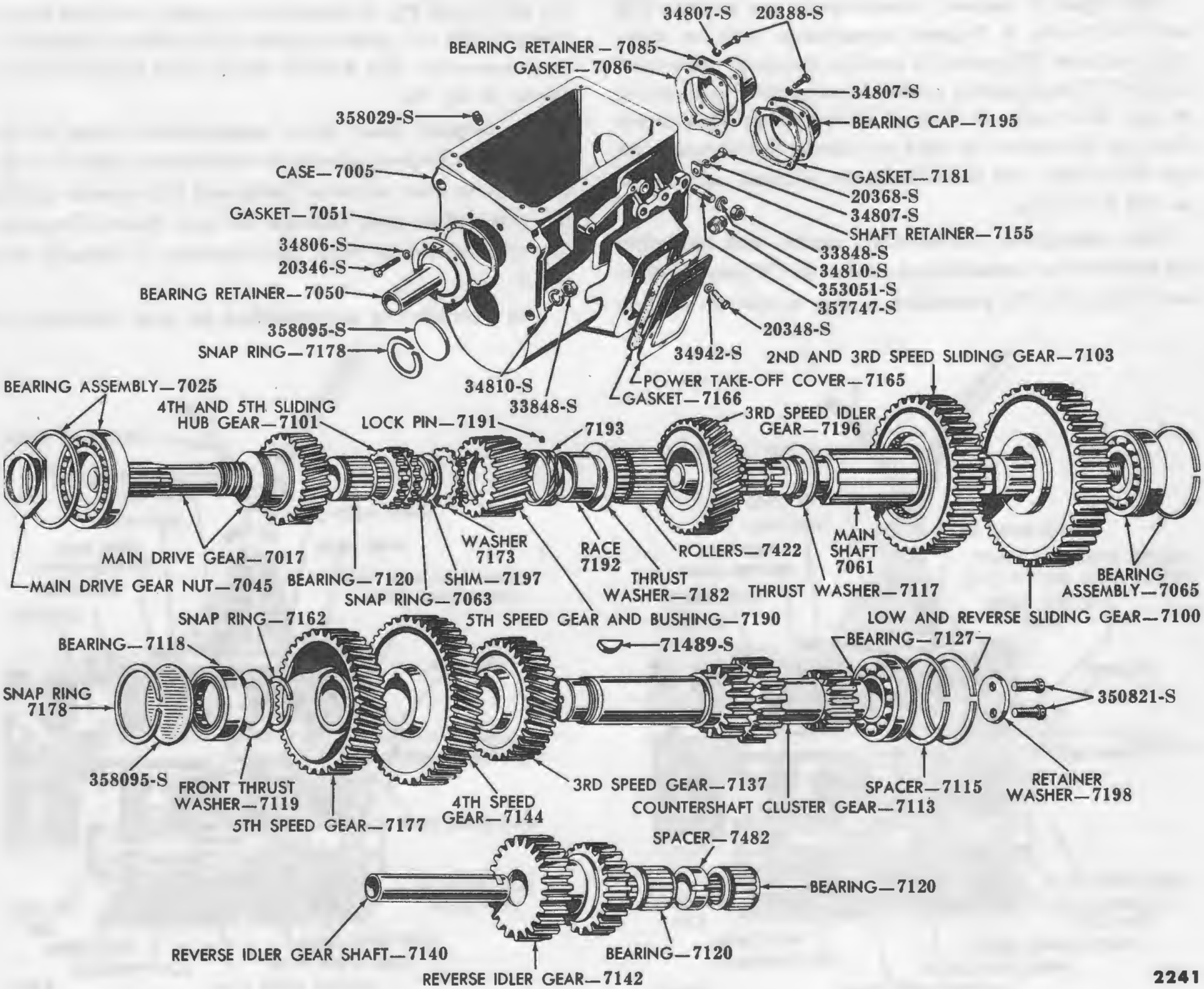

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Fig. 37—5-Speed Overdrive Transmission, Disassembled

Position the gear shift housing gasket on the transmission case, then install the gearshift housing on the transmission case. Position the reverse idler and countershaft retainer plate on the case, then install the plate cap screws. Position a new rear bearing retainer gasket on the transmission case, then place the retainer on the case. Install the retainer to case cap screws making sure the longest cap screw is installed in the proper hole. Position the speedometer gear spacer and speedometer drive gear on the rear of the main shaft. Install the speedometer driven gear and retaining nut. Position the flange and parking brake drum on the main shaft, then install the nut. Tighten the nut to the proper torque, then install the cotter pin.

f. Transmission Installation.

Install the clutch release bearing and hub assembly and connect the clutch release return spring. Place the transmission in position and align the transmission spline shaft with the clutch disk splines. Slide the transmission forward until the transmission is in position on the flywheel housing. Install the lock washers and cap screws which secure the transmission to the flywheel housing. Tighten the screws evenly to the proper torque. Connect the speedometer cable. Install the clutch equalizer shaft. Remove the support under the rear of the engine, then install the engine support bolts. Connect the coupling shaft, and install the floor pan and seat cushion. Refill the transmission with the correct amount of the proper grade lubricant.

6. 5-SPEED TRANSMISSION

Two types of 5-speed transmissions are used on F-7 and F-8 trucks. A 5-speed transmission with an overdrive ratio in fifth speed is used as standard equipment on the F-7 truck and is available as optional equipment on the F-8 truck. A 5-speed transmission with direct drive in fifth speed is used as standard equipment on the F-8 truck, and is available as optional equipment on the F-7 truck.

The description, disassembly, repair, and assembly for each of the transmissions are similar. Where a difference occurs in the procedure, a note is used to explain the difference. Fig 37 shows the 5-speed overdrive transmission with the parts arranged in the order of assembly or disassembly. The 5-speed direct drive transmission is shown in fig. 41.

The 5-speed direct drive transmission shown in fig. 38, and the 5-speed overdrive transmission shown in fig. 39 differ in gear ratios in fourth and fifth speeds and in the power flow path through the gear trains. However, the construction of both transmissions is basically the same.

The overdrive is accomplished by gear reduction in

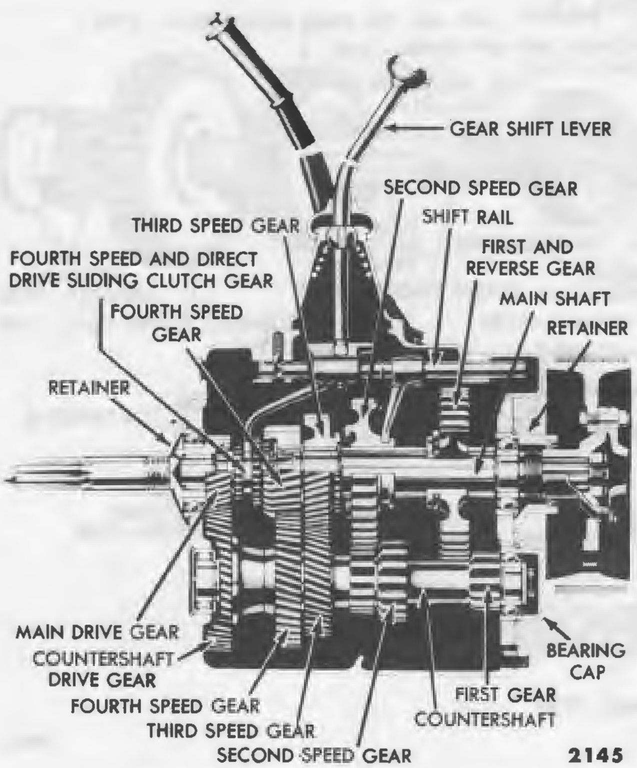

Fig. 38—5-Speed Direct Drive Transmission

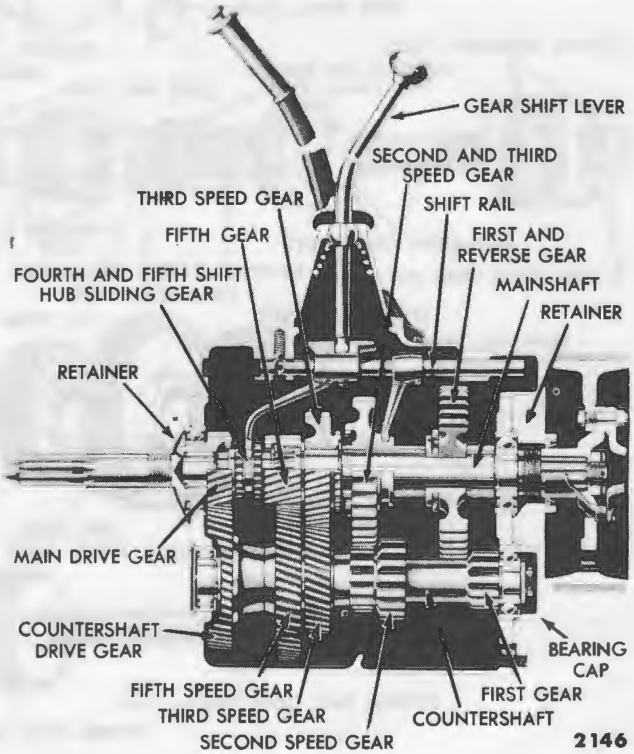

Fig. 39—5-Speed Overdrive Transmission

the transmission and not through a separate unit. When the five-speed overdrive transmission is in fifth speed or overdrive, the overdrive sliding clutch gear on the main shaft (fig. 40) is engaged with the main shaft overdrive gear. The power flow is now from the main drive gear through the countershaft drive gear, to the countershaft overdrive gear and up to the overdrive gear on the main shaft, from the overdrive gear on the main shaft through the overdrive sliding clutch gear to the main shaft. When in fourth speed or direct drive, the overdrive sliding clutch gear is engaged with the main drive gear, and the power flow is direct through the main shaft.

When the five-speed direct drive transmission is in fourth speed, the sliding clutch gear is engaged with the main shaft fourth speed gear (fig. 40), and the power flow is the same as the overdrive transmission when in overdrive or fifth speed. When in fifth speed or direct drive, the sliding clutch gear is engaged with the main drive gear, and the power flow is direct through the main shaft.

The five-speed direct drive transmission countershaft drive gear is larger than the fourth speed gear, whereas the five speed overdrive transmission countershaft drive gear is smaller than the overdrive gear.

Ball bearings are used to support the main shaft, the main drive gear, and the rear of the countershaft in both transmissions. Roller bearings are used as pilot bearings between the main drive gear and the main shaft and at the front end of the countershaft.

a. Transmission Removal.

Drain the lubricant from the transmission. Remove the seat. Remove the floor pan cover. Remove the hand brake lever and bracket assembly, linings and brake band. Disconnect the clutch release bearing return spring from the transmission. Remove the nuts from the bolts which attach the coupling shaft to the parking brake drum and companion flange at the transmission. Remove the center bearing mounting bolts (on long wheelbase vehicles), then separate the coupling shaft from the transmission. Disconnect the clutch equalizer shaft from the clutch release shaft. Disconnect the speedometer cable from the transmission. Remove the two transmission lower mounting nuts. Place a dolly or transmission jack under the transmission to support the transmission, then remove the two upper mounting nuts.

Move the transmission assembly straight away from the clutch housing, being careful to keep the main drive gear shaft in perfect alignment with the clutch disc until the transmission is free from the clutch disc and the clutch housing studs.

CAUTION: ***Be careful to prevent the weight of the transmission from binding in the clutch disc or on the clutch housing studs.***

b. Disassembly.

The following procedure illustrates and outlines the disassembly of the 5-speed direct and overdrive transmissions. Any structural difference in the two transmissions are noted in the text. Fig. 41 shows the 5-speed direct transmission disassembled.

(1) *REMOVE GEARSHIFT HOUSING.* Remove the cap screws and lock washers that secure the gearshift housing to the transmission case. Remove the gearshift housing and gasket from the transmission case.

(2) *REMOVE PARKING BRAKE DRUM.* Shift the transmission gears so two speeds are engaged at the same time. Remove the cotter pin from the flange nut. Remove the nut that secures the flange on the main shaft (fig. 42). Remove the flange and brake drum from the main shaft with a puller as shown in fig. 42.

(3) *REMOVE FIRST AND REVERSE SHIFT FORK.* Remove the rocker arm pivot bolt nut. Remove the rocker arm pivot bolt and the rocker arm from the transmission case. Remove the first and reverse fork shift rail cap screw and lock plate from the rear of the case. Pull the first and reverse fork shift rail from the transmission case with the puller shown in fig. 43. Remove the shift fork.

(4) *REMOVE MAIN SHAFT REAR BEARING RETAINER AND GASKET.* Remove the screws and lock washers that secure the main shaft rear bearing retainer to the transmission case. Remove the main shaft rear bearing retainer, gasket, and speedometer drive gear from the main shaft (fig. 37). Remove the oil seal from the bearing retainer. Remove the cap screws and lock washers that secure the countershaft bearing cap to the case, then remove the bearing cap. With the transmission still locked in two speeds, remove the locking wire, bearing retaining screws, and washer from the rear of the countershaft (fig. 37).

(5) *REMOVE MAIN DRIVE GEAR AND BEAR-*

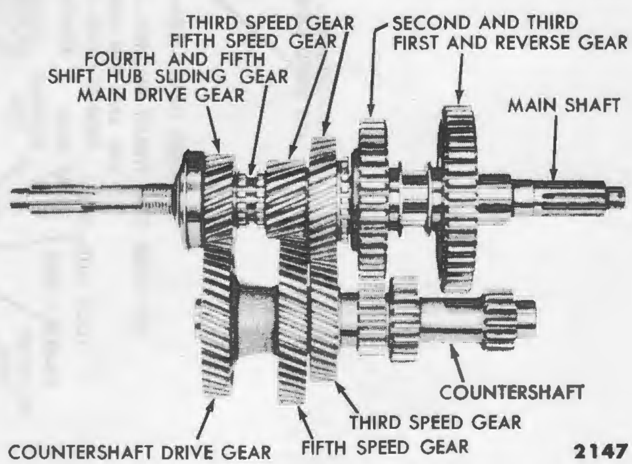

Fig. 40—5-Speed Overdrive Transmission Gear Train

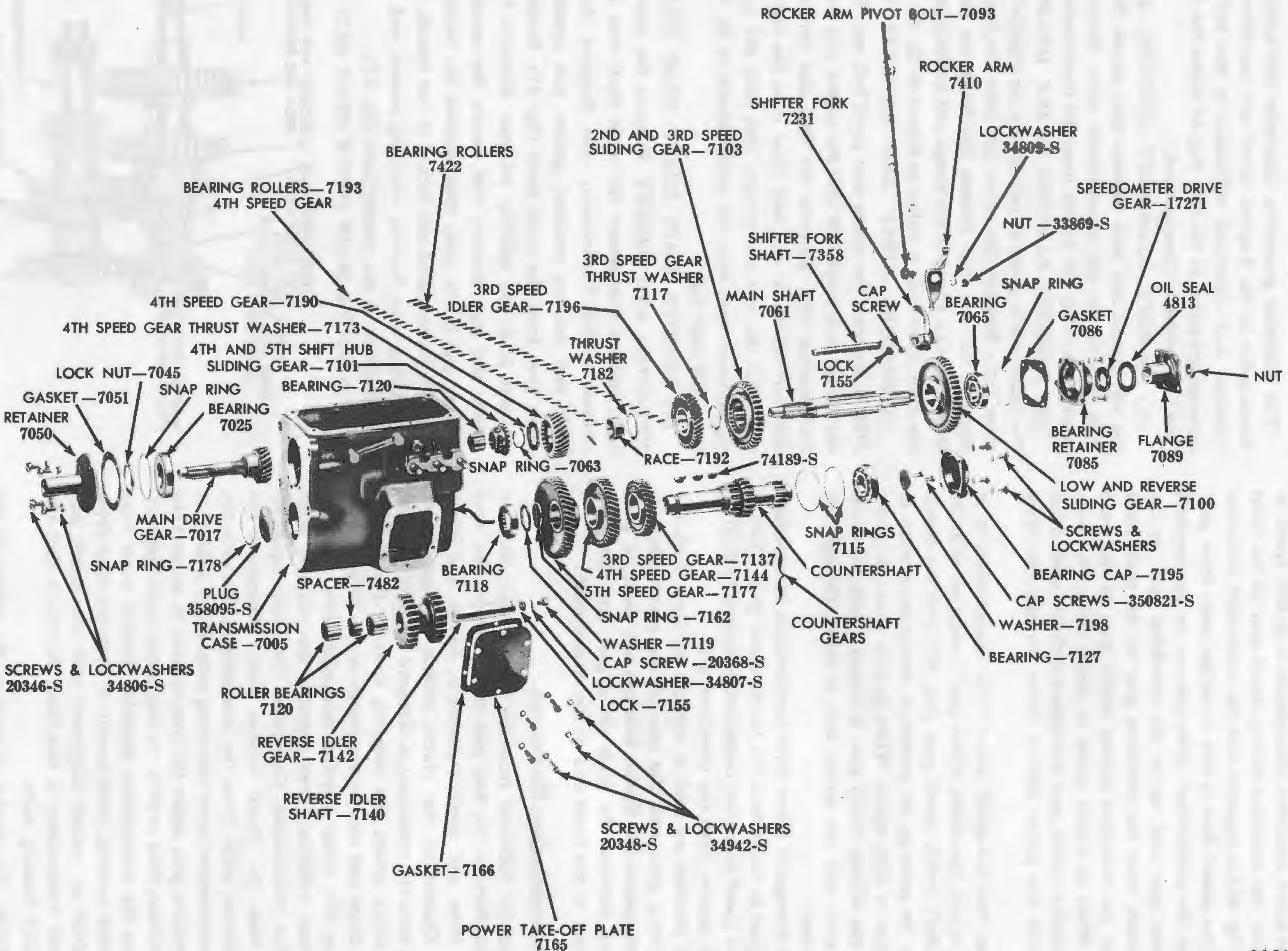

Fig. 41—5-Speed Direct Transmission, Disassembled

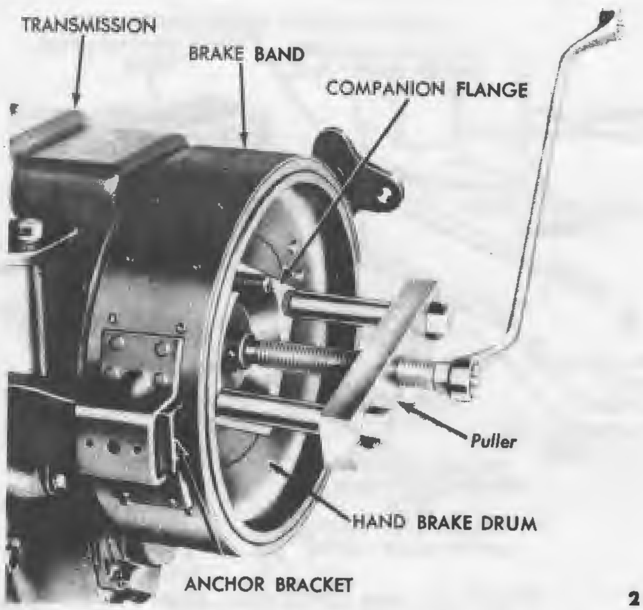

Fig. 42—Removing Flange and Brake Drum

ING ASSEMBLY. Remove the cap screws and lock washers that secure the main drive gear bearing retainer to the transmission case. Remove the retainer and gasket, then pull the main drive gear and bearing assembly out of the transmission case. Remove the main shaft pilot bearing from the pocket in the main drive gear.

(6) *REMOVE MAIN DRIVE GEAR BEARING.* Place the main drive gear in a vise equipped with brass jaws, and remove the nut that secures the bearing on the main drive gear shaft (fig. 44). Remove the main drive gear from the vice, and press the bearing off the shaft. Remove the snap ring from the groove in the main drive gear bearing.

(7) *REMOVE MAIN SHAFT ASSEMBLY.* Push the main shaft toward the rear of the transmission case until the main shaft rear bearing is pushed out of the case. Using a puller, remove the bearing from the end of the main shaft. Lift the front end of the main shaft

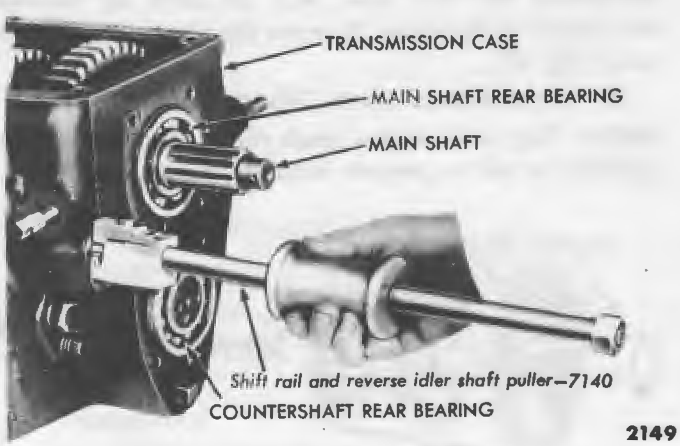

Fig. 43—Removing Shift Rail from Transmission Case

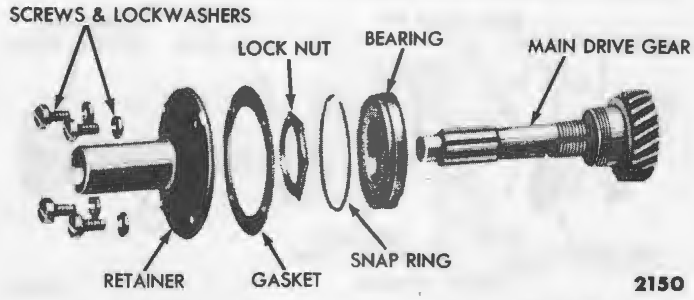

Fig. 44—Main Drive Gear, Disassembled

up until it clears the front of the case, then remove the main shaft assembly from the transmission case.

(8) *REMOVE REVERSE IDLER SHAFT AND GEARS.* Remove the cap screw and lock washer which attach the reverse idler shaft lock plate to the transmission case, and remove the lock plate. Remove the reverse idler shaft from the transmission case with the puller shown in fig. 43. Lift the reverse idler gear out of the transmission case, then remove the bearings and spacer from the reverse idler gear hub.

(9) *REMOVE COUNTERSHAFT ASSEMBLY.* Push the countershaft assembly toward the rear of the case until the countershaft rear bearing is forced out of the transmission case. Remove the bearing from the countershaft with a suitable puller. Raise the forward end of the countershaft assembly, then lift the countershaft assembly out of the transmission case.

(10) *REMOVE COUNTERSHAFT FRONT BEARING.* Remove the snap ring that secures the expansion plug in the countershaft front bearing bore. Remove the expansion plug, then pull the countershaft front bearing out of the case bore.

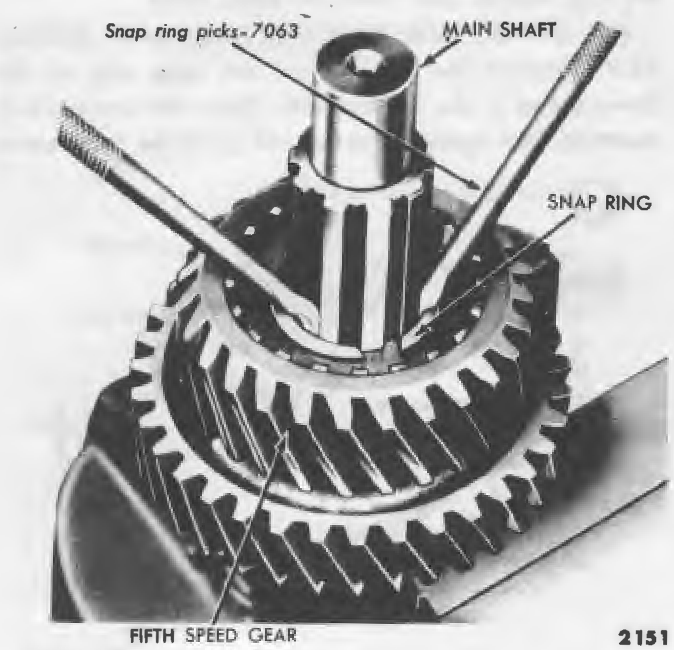

Fig. 45—Removing Snap Ring

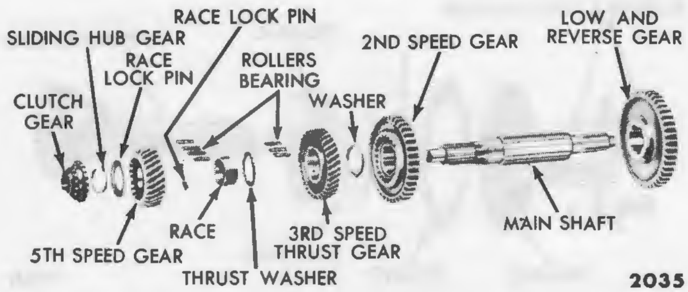

Fig. 46—Main Shaft, Disassembled

c. Disassembly of Sub-Assemblies.

The following procedures should be used when disassembling the various transmission sub-assemblies.

(1) *DISASSEMBLE MAIN SHAFT ASSEMBLY.* Remove the fourth and fifth speed shift hub sliding gear from the main shaft. Place the main shaft in a vise equipped with brass or lead jaws, and remove the snap ring that secures the gears on the main shaft as shown in fig. 45. Remove the fourth speed gear thrust washer, fourth speed gear and the roller bearings from the main shaft (fig. 46).

NOTE: ***If working on overdrive transmission, this is the overdrive gear and bushing.***

Remove the main shaft from the vise, and tap the forward end of the shaft lightly on a block of wood. This will cause the weight of the third speed gear to force the bearing race off the main shaft. Remove the bearing race, the race lock pin, and the fourth-speed gear washer. Remove the third-speed gear, the roller bearing, and the third-speed gear thrust washer from the main shaft. Remove the second speed gear and the low and reverse gear from the main shaft.

(2) *DISASSEMBLE COUNTERSHAFT ASSEMBLY.* Remove the washer and the snap ring at the forward end of the countershaft. Place the countershaft assembly in a hydraulic press, and press the three countershaft gears off the countershaft. Remove the gear keys from the shaft.

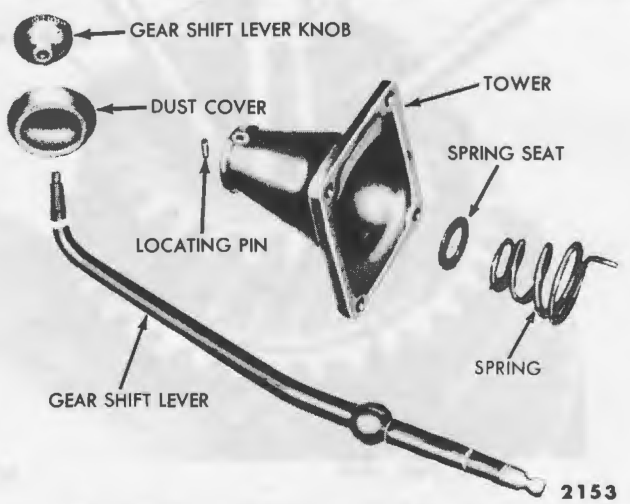

Fig. 47—Gearshift Lever, Disassembled

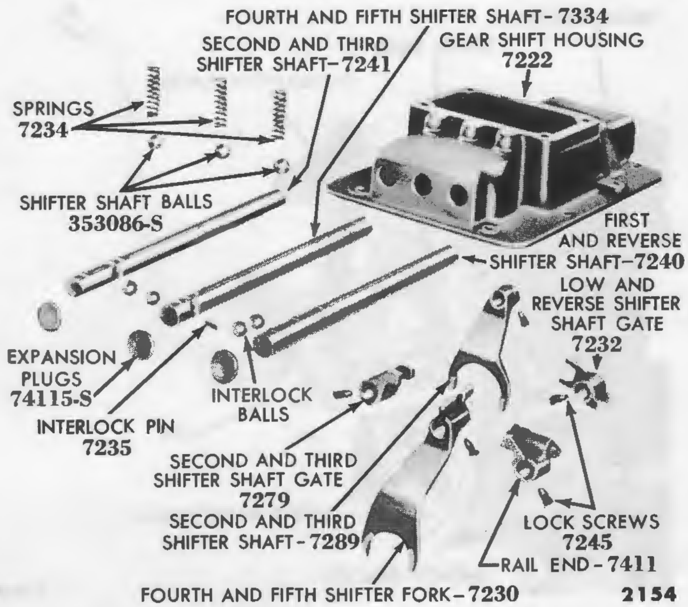

Fig. 48—Gearshift Housing, Disassembled

(3) *GEARSHIFT HOUSING.* It is not necessary to disassemble the gearshift housing assembly to determine if parts are worn. This can be done by a visual inspection. Note the condition of the shifter fork shafts and forks. If the shifter forks are excessively worn, or show evidence of binding when they are shifted into the various positions, it will be necessary to disassemble the gearshift housing assembly to make repairs. To disassemble the gearshift housing, use the following procedure.

(a) Disassemble Gearshift Lever and Tower Assembly. Remove the cap screws that secure the tower to the gearshift housing, and remove the tower. Remove the gearshift lever knob and dust cover. Place the tower in a vise with the bottom side up. Remove the shift lever support spring and the spring seat (fig. 47). To remove the shift lever, push the lever up through the bottom of the tower. Remove the pivot pin from the tower (fig. 47).

(b) Disassemble Shift Housing Assembly.

NOTE: ***Tag each shifter shaft fork, and lug as to its position to aid in proper location at assembly.***

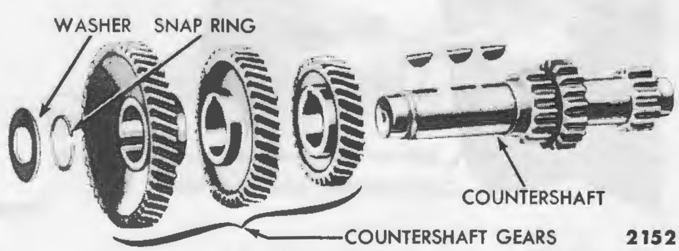

Fig. 49—Countershaft, Disassembled

Remove the expansion plugs from the housing. Shift all shifter shafts to neutral position. Remove the lock wires and lock screws from the shift forks and lugs. Push each shifter shaft out of the housing through the expansion plug holes.

CAUTION: ***Hold hand over the hole in the rail support as each shaft is removed to prevent the loss of the poppet balls and springs.***

Remove the interlock pin from the center shifter shaft. Remove the shifter shaft balls, springs, and the interlock balls from the shaft support (fig. 48).

NOTE: ***There are seven balls and three springs.***

d. Sub-Assembly Build-Up.

Clean and lubricate all parts before assembly as this will prevent scoring when transmission is first put into service.

(1) *ASSEMBLE COUNTERSHAFT.* Position the gear keys in the slots provided in the countershaft (fig. 49). Position the third-speed gear on the countershaft, then press the gear into place. Place the fourth-speed gear on the countershaft with the long hub toward the front, and press the gear into place.

NOTE: ***On the overdrive model, this is the overdrive gear.***

Place the countershaft fifth speed gear on the countershaft with the long hub toward the rear of the shaft, and press the gear into place. Install the snap ring and washer on the countershaft.

(2) *ASSEMBLE MAIN DRIVE GEAR AND BEARING ASSEMBLY.* Install the bearing on the main drive gear with the snap ring groove toward the forward or small end of the gear. Install the main drive gear bearing nut on the main drive gear (fig. 44).

Tighten the nut securely, then stake the nut in place with a center punch.

(3) *ASSEMBLE MAIN SHAFT.* Clamp the main shaft with the forward end up, in a vice equipped with brass or lead jaws. Install the third-speed gear thrust washer and the third-speed gear with the flat side of the hub facing upwards. Apply heavy grease to the third-speed gear bearing rollers, then install the rollers between the gear and the shaft. Place the fourth-speed gear thrust washer and bearing race on the shaft with the lock pin in place toward the front of the shaft. Install the fourth-speed gear on the main shaft with the tooth side of the hub facing upward.

NOTE: ***If working on overdrive transmission, this will be the overdrive gear and bushing assembly, no bearing rollers are required.***

Apply heavy grease to the fourth-speed gear rollers, and install the rollers between the gear and race. Install the splined fourth-speed gear thrust washer on the main shaft. Make sure the washer is pushed down far enough to permit installation of the snap ring. Thrust washers are available in three sizes; 0.124 inch, 0.120 inch, and 0.116 inch. Install a new snap ring in the groove in the main shaft. Make sure the snap ring is fully seated in the groove. If the snap ring does not fit tight against the splined washer, it will be necessary to install shims between the snap ring and the washer. Shims are available in two sizes; 0.005 inch and 0.003 inch. Remove the assembly from the vise. Install the fourth- and fifth-speed shift hub sliding gear on the main shaft with the large gear toward the rear (fig. 41).

NOTE: ***If working on overdrive transmission, install the recessed end of the sliding gear toward the rear.***

Install the second-and third-speed sliding gear on the main shaft with the internal teeth toward the front. Install the low and reverse sliding gear with the fork slot toward the front.

(4) *ASSEMBLE SHIFT HOUSING ASSEMBLY.* Slide the second- and third-gear shifter shaft into the housing bore from which it was removed. Insert the spring and shifter shaft ball into the hole in the shifter shaft support. Hold the poppet ball down, and slide the shifter shaft through the hole in the support. Slide the second- and third-shifter shaft gate on the shaft. Slide the second- and third-shifter fork on the shaft with the offset for the lock screw toward the rear of the housing. Position the shaft in the neutral position, then install the lock screws in the gate and fork. Lock the screws with locking wire.

Install two interlock balls in the cross bore of the gearshift housing shifter shaft support between the shaft previously installed and the center shaft bore. Insert the interlock pin in the hole in the fourth- and fifth-shifter shaft. Slide the shaft into the center bore of the housing. Install a spring and shifter shaft ball into the hole in the shifter shaft support. Hold the ball down, then slide the shifter shaft through the hole in the support. Install the fourth- and fifth-shifter fork on the shaft with the offset for the lock screw toward the rear. Position the shaft in the neutral position, then install the lock screw in the shifter fork. Lock the screw with locking wire.

Install the two remaining interlock balls in the cross bore of the rail support. Slide the first and reverse shifter shaft through the expansion plug hole. Install a spring and shifter shaft ball in the hole in the shaft support. Hold the ball down, and slide the shifter shaft through the hole in the support. Slide the low and reverse shifter shaft gate and the rail end on the shifter shaft then install the lock screws. Lock the screws with locking wire. Position the shaft in the neutral position, then install the expansion plugs.

(5) *ASSEMBLE GEARSHIFT LEVER AND TOWER ASSEMBLY.* Install the gearshift lever locating pin in the tower top. Place the tower in a vise

with the bottom side up. Install the lever in the tower, engaging the lever fulcrum ball with the head of the locating pin. Install the spring seat washer. Install the shift lever support spring. Install the dust cover and gearshift knob on the gearshift lever. Position the tower on the gearshift housing, then install the tower to housing lock washers and cap screws.

e. Assemble Transmission.

The following assembly procedure applies to both 5-speed transmissions:

(1) *INSTALL COUNTERSHAFT IN TRANSMISSION CASE.* Install the expansion plug in the transmission case countershaft front bore. Be sure to expand the plug enough to prevent any oil leakage. Install the expansion plug retainer snap ring. Install the countershaft front bearing in the case. Install the spacing washer on the forward end of the countershaft. Tip the rear of the countershaft down, and lower the shaft into the case. Push the countershaft forward, and at the same time enter the shaft into the front bearing. Place the rear bearing spacer ring on the bearing between the snap ring and the face of the case. Position the rear bearing on the countershaft with the snap ring toward the rear, and press it in place.

(2) *INSTALL REVERSE IDLER GEAR AND SHAFT.* Insert the two roller bearings and the spacer (fig. 41) into the hub of the reverse idler gear. Place the reverse idler gear assembly in position in the transmission case with the small gear toward the rear of the transmission case. Insert the reverse idler shaft through the hole provided in the transmission case, through the reverse idler gear, and into the forward support base. Drive the reverse idler shaft in until the forward face of the slot is flush with the transmission case and is aligned to permit installation of the locking plate. Install the reverse idler lock plate, and secure the plate with the lock washer and cap screw.

(3) *INSTALL MAIN DRIVE GEAR AND BEARING ASSEMBLY.* Position the main drive gear and bearing assembly in the forward end of the transmission case. Tap the pilot end of the main drive gear with a soft hammer until the snap ring on the bearing is seated against the case. Position a new gasket on the case, then install the retainer. Secure the retainer on the case with the lock washers and cap screws. Place the pilot bearing in the main drive gear hub.

(4) *INSTALL MAIN SHAFT ASSEMBLY.* Tilt the rear end of the main shaft assembly downward, then insert the end of the shaft through the main shaft bearing opening in the rear of the transmission case. Lower the front end of the main shaft in line with the pilot bearing, and move the main shaft assembly forward into position. Place the main shaft rear bearing on the main shaft with the snap ring in the outer race facing toward the rear. Tap the bearing onto the main shaft until the snap ring is seated against the transmission case. Install the speedometer drive gear on the main shaft.

(5) *INSTALL BEARING CAPS AND GASKETS.* Lock the transmission gears in two speeds at one time. Position the countershaft rear bearing retainer washer on the case, then secure the washer in place with two cap screws. Secure the screws with locking wire. Position the countershaft rear bearing cap and gasket on the case, then install the lock washers and cap screws.

Install a new oil seal in the main shaft rear bearing retainer. Position the bearing retainer and gasket on the case, then install the lock washers and cap screws.

(6) *INSTALL FIRST- AND REVERSE-SHIFT FORK.* Place the first- and reverse-shift fork in position in the transmission case with the fork engaged with the groove in the sliding gear. Insert the shift rail through the hole in the rear of the transmission case and through the shift fork. Drive the shift rail into the case until the edge of the lock slot is flush with the case. Install the shift rail lock plate, and secure it with a lock washer and cap screw. Place the first- and reverse-rocker arm in position in the case, and install the rocker arm pivot bolt, lock washer, and nut.

(7) *INSTALL PARKING BRAKE DRUM.* Position the brake drum and companion flange on the main shaft. Secure the drum and flange on the shaft with the flat washer, nut, and cotter key. Install the hand brake assembly on the brake anchor and support brackets.

(8) *INSTALL GEARSHIFT HOUSING.* Place a new gasket on the transmission case. Shift the transmission gears into neutral position. Place the gearshift housing in position on the transmission case, making sure the shift forks engage the slots in the gears. Install the lock washers and cap screws that secure the gearshift housing to the transmission case.

f. Transmission Installation.

Before installing the transmission in the vehicle be sure that the rear surface of the clutch housing is clean. Place the transmission on a suitable support. Position the transmission with the main drive gear splines in alignment with the clutch disc hub splines. Move the transmission toward the clutch, turning the main-drive gear as necessary to allow the splines to engage the mating splines in the clutch disc hub. Install the nuts that secure the transmission to the clutch housing. Install the speedometer cable. Connect the hand brake linkage to the transmission. Connect the coupling shaft and the clutch linkage. Connect the clutch release bearing return spring. Install the floor pan, then install the seat. Refill the transmission with the correct amount of the proper grade lubricant.

7. GEARSHIFT LINKAGE.

The gearshift lever, used with the remote type shift control, is spring loaded downward to be on a plane with the "second" and "high" gear position. This reduces the probability of shifting to reverse when shifting from the "first" speed to the "second" speed. It is necessary to lift up on the lever before shifting to "first" or "reverse" position.

On the 3-speed heavy duty transmission, a shift tube shifter lever assembly is connected to a bell crank with an idler lever rod. The opposite end of the bell crank is connected to the shifter shaft lever with an idler lever rod.

One end of a gear selector rod bell crank is connected with a link to a shift tube and steering column bracket cap and the other end of the bell crank is connected with a connecting rod to the transmission high and low selector lever. Fig. 50 shows the shifting mechanism parts in the order of assembly.

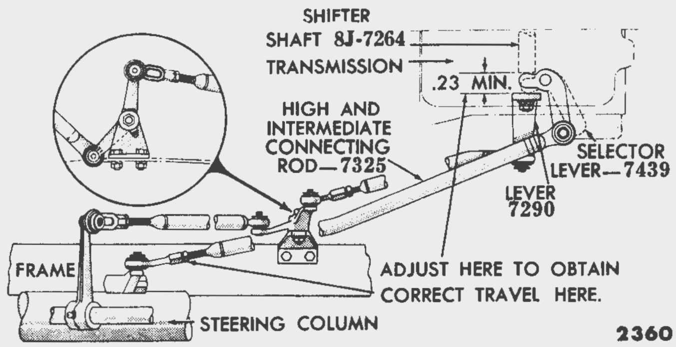

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Fig. 51—Linkage Adjustments (3-Speed Heavy Duty Transmission)

a. Adjustment.

To adjust the shift control rods on the 3-speed heavy duty transmission, position the gear shift lever in the neutral position to establish the correct position for the tube shifter lever. Adjust the idler lever rod assembly so that the clevis holes fit freely over the pins in both the idler lever and the tube shifter lever. Measure the selector lever travel as shown in fig. 51. The total travel starting from the full "in" position to the full "out" position must be 0.23 inch or greater. Adjust the high and intermediate connecting rod to give this travel.

To adjust the shift control rods on the 3-speed standard transmission, position the hand lever in neutral and adjust the second and high speed shift rod assembly to provide hand clearance at the instrument panel. Adjust the low and reverse lever connecting rod so the hand lever moves easily from the second and high shift plane to the low and reverse shift plane.

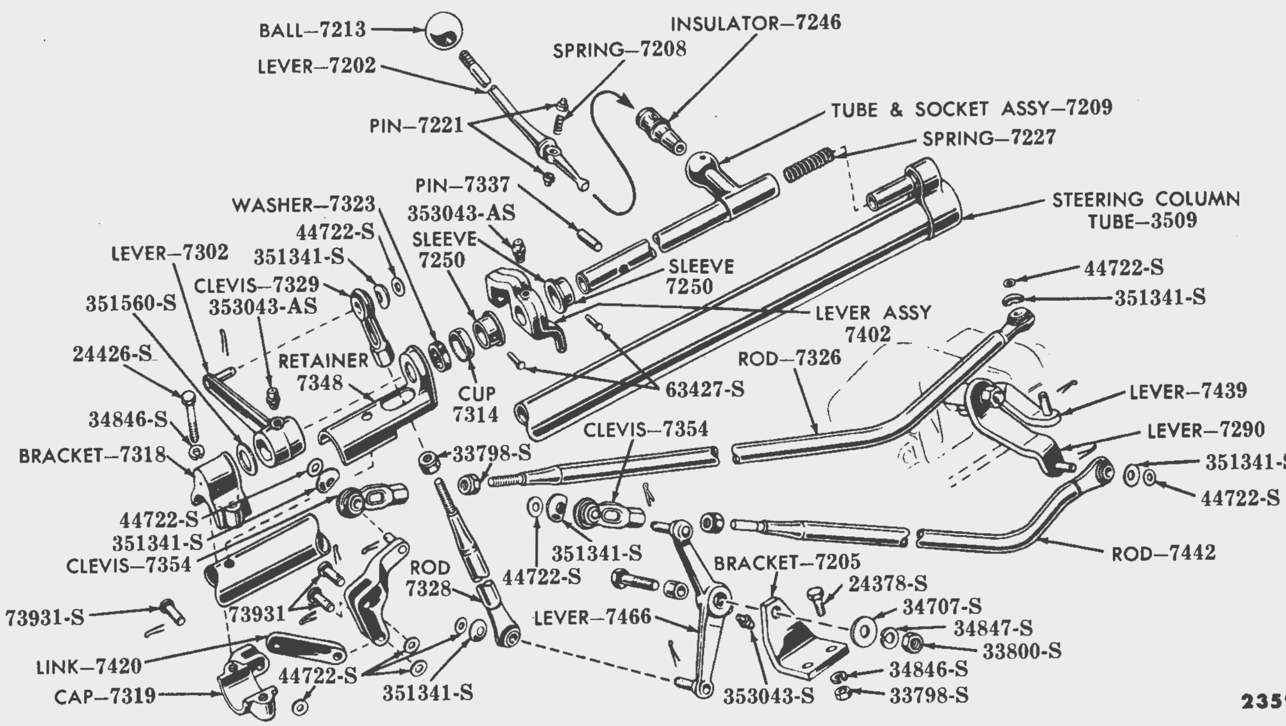

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Fig. 50—Remote Control Gear Shift (3-Speed Heavy Duty Transmission)

Part TWO
CHASSIS
Chapter
II
Rear Axles and Drive Lines

The Ford line consists of approximately one-hundred and eighty-four (184) different truck models, which are designed with gross vehicle weight ratings from 4700 to 22,000 pounds for conventional and cab-over-engine trucks and are used under all types of operating conditions. For this reason, a wide and versatile selection of rear axles is required to meet all of the various performance demands from operators of these trucks. The following is a list of the axle assemblies available by types and indicates the model application for each type.

Axle Type	*Model Application*
Integral Housing Hypoid	F-1
Split Housing Hypoid	F-6 and F-7
Split Housing Spiral Bevel	F-2, F-3, F-4, and F-5
Banjo Housing Spiral Bevel	F-8
Planetary Spiral Bevel (Two-Speed)	F-5, F-6 and F-8 (Optional Equipment)
Planetary Hypoid (Two-Speed)	F-7 (Optional Equipment)

This chapter, divided into six sections, contains service information on the rear axles and drive shafts used on all trucks. The model application, construction, replacement, overhaul and adjustment information on each axle type is given under the headings listed in the foregoing index. Service information on the drive lines is covered under "6. Drive Lines."

Certain service procedures are applicable to axles in general, regardless of type or size. To avoid repetition throughout the sections of this chapter, procedures of this type are given in the following paragraphs.

(1) *CLEANING*. All of the differential parts, except the bearings, should be soaked in a cleaning solvent to loosen the old solidified lubricant. All dirt, old lubricant, and gasket material should be removed from the axle parts with a stiff brush.

(a) BEARING CLEANING. Thorough bearing cleaning is important, since any small particles of grit left between the bearings and the races can cause excessive wear and premature bearing failure. The bearings should be soaked in clean kerosene or any other bearing cleaning fluid except gasoline, since parts cleaned in gasoline have a tendency to rust. Hold the bearing races to prevent rotation, then slush the bearings in the cleaning fluid to remove as much grit as possible. Brush the bearings with a soft bristled brush until all particles of grit have been removed. Rinse the bearings in some clean fluid, then dry the bearings with compressed air. Do not spin the bearings while drying.

(2) *INSPECTION*. The inspection of rear axle parts consists of a visual examination for excessive wear or damage. Whether or not the wear on any part is excessive can be determined by comparing the worn part with a new part.

(a) BEARING AND CUPS. Bearings and cups should be examined for cracks, chips, discoloring due to overheating, excessive wear, or other damage. Lubricate the bearings and check for roughness by turning the outer race by hand. Replace all damaged or worn bearings and cups. After the bearings have been inspected, coat the bearings with rear axle lubricant then wrap each bearing in a clean cloth until ready to use.

(b) AXLE HOUSING. The axle housing should be inspected for broken welds, missing or loose rivets, damaged threads and a bent or cracked housing.

The axle housing may be inspected for a bent condition after the axle assembly has been removed from the vehicle. First install the rear wheels, then install a Duby Toe Gauge between the rear wheels. Hold the wheels stationary, rotate the axle housing through 360°, and note the scale readings on the gauge. No variations in the readings while the housing is turning indicates a straight housing. Variable readings in excess of $\pm \frac{1}{2}$ degree show that the axle housing is bent and should be replaced.

The spring seat welds should be inspected to be sure they are not broken. Repair or replace as required.

(c) GEAR INSPECTION. Check all of the rear axle gears for chipped, cracked, or worn teeth. Check the clearances between mating parts and the thrust washer thickness.

(d) AXLE SHAFT INSPECTION. Inspect the axle shaft splines for evidences of twisting, cracking, or wear. The axle shaft should be inspected for torsional damage. Replace any axle shaft that has damaged splines or shows signs of torsional damage.

1. INTEGRAL HOUSING HYPOID REAR AXLE

The F-1 trucks are equipped with an integral housing hypoid rear axle equipped with a semi-floating type axle shaft (fig. 1).

The removal procedure, covering the integral housing hypoid rear axle, is given under the heading "a. Axle Removal." Disassembly information is given under "b. Axle Disassembly." Assembly and adjustment procedures are covered under "c. Axle Assembly and Adjustment," and installation details are given under the heading "d. Axle Installation."

The centerline of the pinion is offset below the center of the ring gear. The drive pinion is overhung on two high capacity tapered roller bearings with shim adjustment for correct mesh and bearing position. A deep cast rib reinforced housing around the pinion and a heavy one piece differential case to which the ring gear is bolted provide very rigid support, assuring accurate gear alignment under all operating conditions and eliminating the need for a ring gear thrust block.

The differential is the two-pinion type and has lubrized steel thrust washers installed behind the pinions and side gears.

A large removable cover plate on the housing permits the removal or installation of the differential assembly and drive pinion through the rear of the housing. This plate also facilitates inspection of the gears and adjustment without disturbing the housing or the brake line connections.

The axle housing is a ridged, integral type with steel axle tubes pressed into the sides of the center malleable iron carrier casting and securely welded into a strong one-piece unit. A breather is installed in the housing which prevents air pressure build-up.

The outer ends of the axle tubes are upset to provide an integral flange for mounting the brakes and axle shaft bearing assembly. Spring pads are welded to the axle tubes at the top and the heavy seat caps incorporate arms for the shock absorber attachment.

The wheel bearings are pre-lubricated single-row ball type and are securely pressed onto the axle shaft and backed by a safety locking ring. These bearings are permanently lubricated and do not require any periodic lubrication. Four bolts hold the brake backing plate and dust seal in place and secure the wheel bearing in the housing.

The axle shafts are tapered, heat-treated, steel forgings designed to support the vehicle weight as well as to transmit full driving torque to the wheels. The axle shaft inner ends are supported by, and splined to, the differential side gears. Axle shafts can be removed from the wheel end of the axle housing without removing the axle assembly from the vehicle.

a. Axle Removal.

Raise the rear of the vehicle, then disconnect the hydraulic brake hose from the hydraulic brake line at the rear axle. Disconnect the parking brake cable from the equalizer rod, then remove the screws which attach the brake cable brackets to the frame crossmember. Disconnect the drive shaft at the rear axle universal joint flange. Remove the nuts from the rear spring clips (U-bolts), then remove the spring clips. Roll the axle assembly away from the vehicle, then remove the wheels.

b. Axle Disassembly.

The complete disassembly of the rear axle is necessary if a thorough overhaul is desired. The disassembled view of the integral housing hypoid axle (fig. 2) shows all of the parts in their relative positions and should be referred to when performing disassembly and assembly procedures.

(1) *AXLE SHAFT REMOVAL.* Remove the Tinnerman nuts that secure the brake drum to the axle flange, and remove the brake drum. Remove the bolts that secure the brake carrier plate to the axle housing working through the hole provided in the axle shaft flange. Using the tool shown in fig. 3, pull the axle shaft assembly out of the housing. Be careful not to dislodge

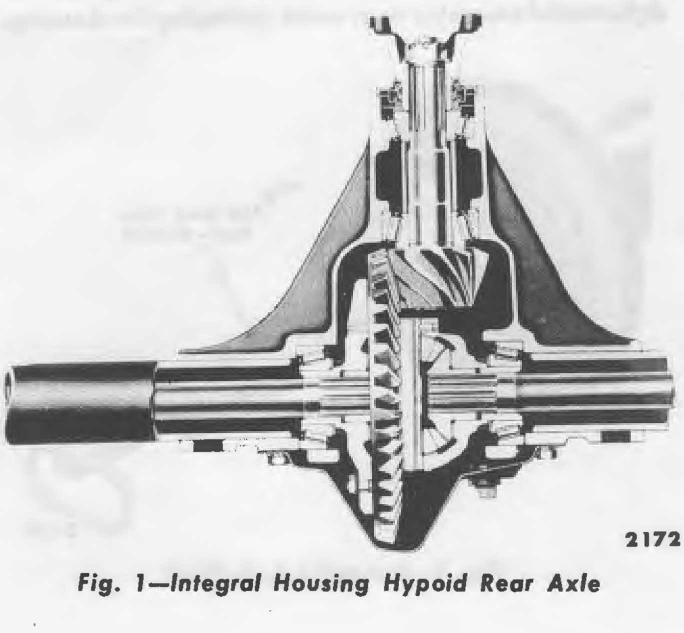

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Fig. 1—Integral Housing Hypoid Rear Axle

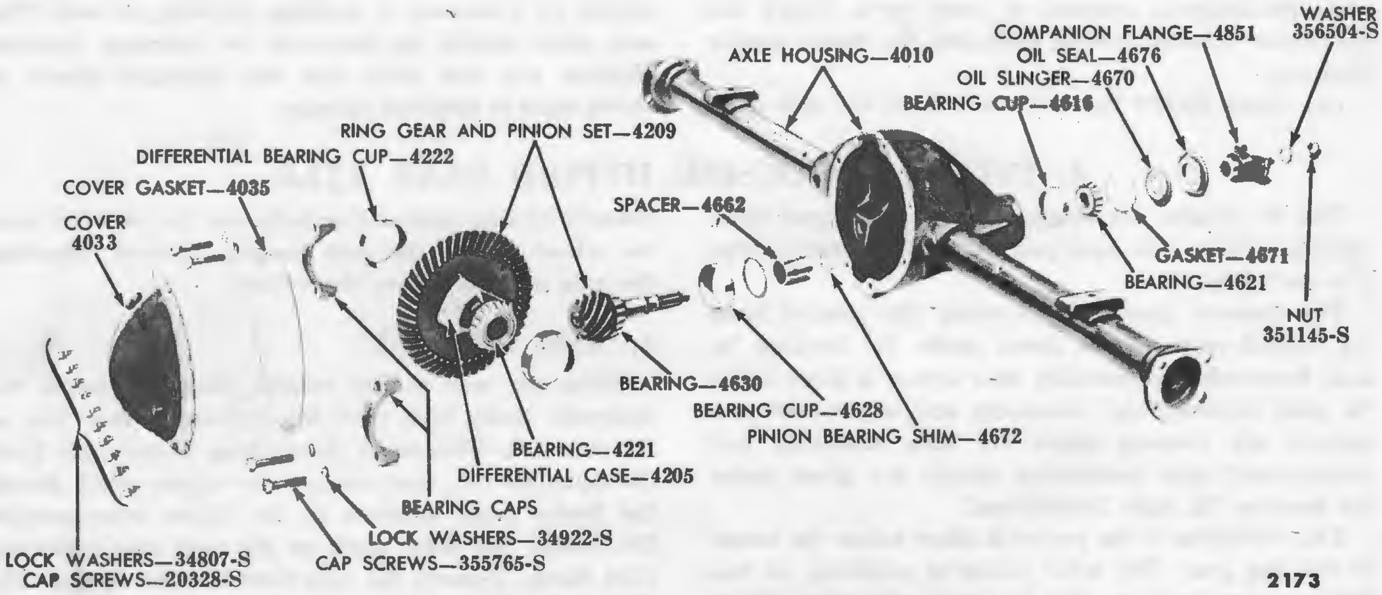


Fig. 2—Integral Housing Hypoid Rear Axle, Disassembled

the brake carrier plate or damage the oil seal in the housing. Install one nut to hold the brake carrier plate in place.

(2) *DIFFERENTIAL REMOVAL.* Drain the lubricant from the rear axle carrier and remove the rear cover.

Make sure the differential side bearing caps and the axle housing are clearly marked, then remove the differential side bearing caps.

Install the housing spreader (fig. 4), making sure the tool hold-down clamp screws are tight. Spread the housing until the differential assembly can be forced out with a small pry bar or a heavy screw driver.

CAUTION: ***Do not spread the housing more than necessary to remove the differential assembly. Remove the spreader immediately after lifting out the differential assembly to prevent springing the housing.***

(3) *DISASSEMBLE DIFFERENTIAL.* Remove the cups from the differential side bearings. Remove the differential side bearings as shown in fig. 5. Remove the differential adjustment shims. Pry the ring gear bolt locking plate tabs away from the ring gear bolt heads with a screwdriver. Remove the bolts (cap screws) and the ring gear. Drive out the pin which secures the differential pinion shaft in the case. Remove the differential pinion shaft, differential pinions, and thrust washers. Remove the differential side gears and thrust washers.

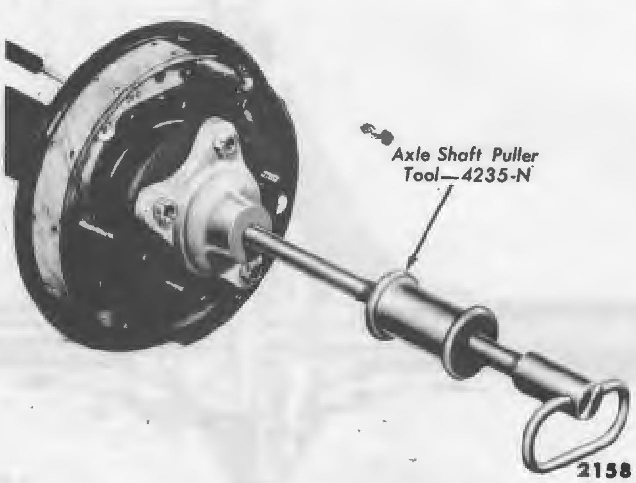


Fig. 3—Removing Axle Shaft

Fig. 4—Spreading Housing

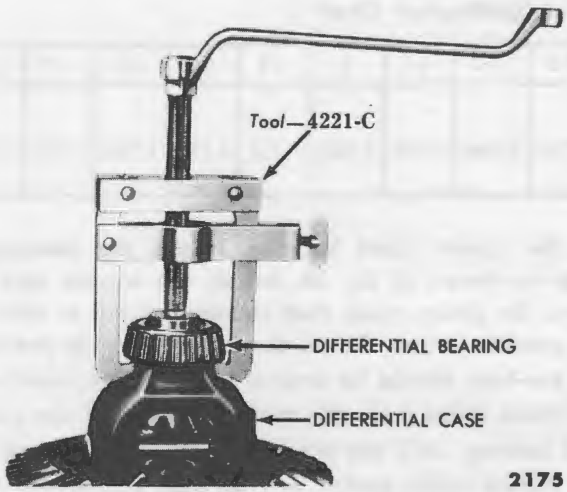


Fig. 5—Differential Side Bearings Removal

(4) *DRIVE PINION REMOVAL AND DISASSEMBLY.* Remove the nut and washer from the pinion shaft and at the same time hold the companion flange.

Remove the yoke with the tool shown in fig. 6.

Use a soft drift and drive the pinion out the rear of the axle housing.

Remove the pinion shaft oil seal, gasket, felt wick, felt retainer, pinion front bearing and shim pack.

Remove the pinion front bearing cup, pinion rear bearing cup and shim pack from the housing as shown in fig. 7.

Press the rear bearing from the pinion shaft and note the marking on the face of the pinion. The pinion face may be marked from —5 to +10, including zero. This mark is used to properly position the pinion assembly in the axle housing.

c. Axle Assembly and Adjustment.

The assembly of the rear axle includes the pinion depth adjustment and the ring gear and pinion adjustment. These adjustments must be made carefully to insure proper rear axle performance.

If the replacement of the ring gear and pinion is necessary, try to select a ring gear and pinion set with the same pinion mark as the one removed, then no additions or deductions from the shim packs will be necessary. If a "plus" marked pinion replaces a "minus" marked pinion, the pinion rear bearing cup must be removed, and shims equal to the differences between the markings deducted from the shim pack. A like amount of shims must be deducted from the shim pack between the front bearing and spacer. If a "minus" marked pinion is used to replace a "plus" marked pinion, it is necessary to add shims equal to the difference of the markings, and also to add an equal amount of shims to the pack between the front bearing and spacer. When a "plus" marked pinion replaces another "plus" marked pinion, shims must be deducted if the new pinion mark is higher, and added if it is lower, while the opposite applies if both pinions are "minus."

(1) *DIFFERENTIAL ASSEMBLY.* Lubricate all parts with differential lubricant. Install the differential side gears and thrust washers, the differential pinions and thrust washers, and the differenial pinion shaft in the case. Secure the pinion shaft in the case with the lock pin. Position the ring gear on the case and secure it in place with the cap screws and lock plates.

(2) *DIFFERENTIAL SIDE BEARING ADJUSTMENT.* Press new bearings on the differential assembly without shims, and install the bearing cups. Spread the axle housing, set the differential in the housing, then install the bearing caps. Tighten the cap screws just enough to keep the bearing caps in place.

Fig. 6—Companion Flange Removal

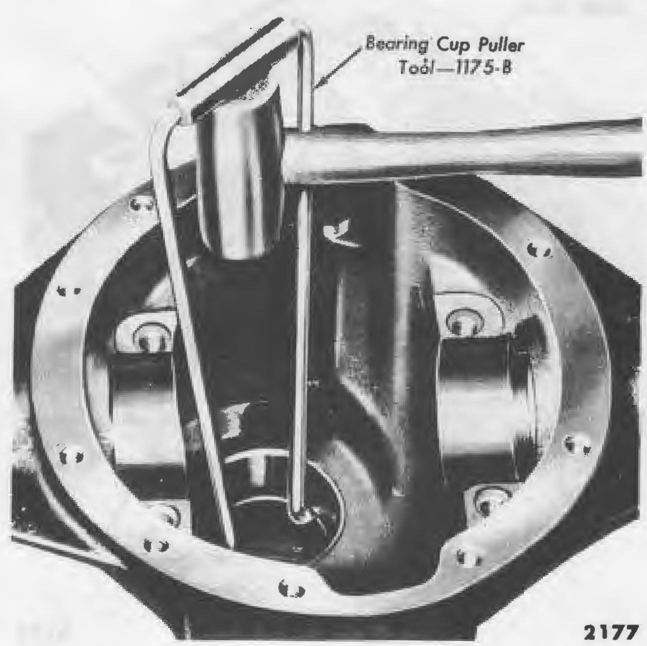


Fig. 7—Pinion Bearing Cup Removal

Table 1—Pinion Depth Measurements Calibration Chart

Pinion Marking	+10	+9	+8	+7	+6	+5	+4	+3	+2	+1	0	−1	−2	−3	−4	−5
F1 TRUCK 3.73:1 & 4.27:1 Micrometer Reading Tool No. 4020-A	1.740	1.741	1.742	1.743	1.744	1.745	1.746	1.747	1.748	1.749	1.750	1.751	1.752	1.753	1.754	1.755

Install the dial indicator on the housing as shown in fig. 8. Pry the differential assembly away from the dial indicator, using a screw driver behind the bearing cap, then set the indicator to zero. Pry the differential assembly toward the indicator, and note the indicator reading. This reading, plus 0.008 inch for pre-load, indicates the total amount of shims needed behind the differential side bearings. Remove the bearings caps and lift the differential assembly from the housing.

NOTE: ***Do not install shims behind the bearings at this time.***

(3) *PINION ASSEMBLY AND ADJUSTMENT.* Press the pinion rear bearing cup in the housing without shims. Press the pinion rear bearing on the pinion shaft, then install the pinion assembly in the housing. Install the pinion depth gauge tool as shown in fig. 9, then measure the pinion depth. The difference between the pinion depth measurement and the figure corresponding to the pinion marking in the chart (Table 1) determines the amount (in thousandths) of shims to be installed under the pinion rear bearing cup.

Install the pinion bearing spacer, the front bearing cup, pinion bearing shims in the amount of 0.065 inch, and the pinion front bearing. Install the companion flange as shown in fig. 10. Install the washer and the nut on the pinion shaft, then tighten the nut to 140-180 foot pounds torque. Check the pinion bearing pre-load. The pre-load should be from 6 to 12 inch-pounds. Add or remove shims from the shim pack behind the pinion front bearing until the proper pre-load is obtained. Install the oil baffle, gasket, and oil seal. Install the companion flange and nut. Tighten the nut to 140-180 foot-pounds, and install the cotter pin.

(4) *DIFFERENTIAL BACKLASH ADJUSTMENT.* Install the ring gear and differential assembly in the housing, and tighten the bearing caps lightly. Install the dial indicator with the button against the back face of the ring gear. Move the differential and ring gear assembly tight against the pinion gear, and set the dial indicator to zero. Move the differential and ring gear assembly toward the indicator, and note the reading.

This measurement, less 0.005 inch blacklash allowance, indicates the amount of shims to be placed behind the differential bearing on the ring gear side of the differential assembly. The balance of shims (the difference between the total amount of shims to be installed behind the differential side bearings and the amount to be installed behind the differential bearing on the ring gear side) will be installed under the bearing on the differential end of the assembly.

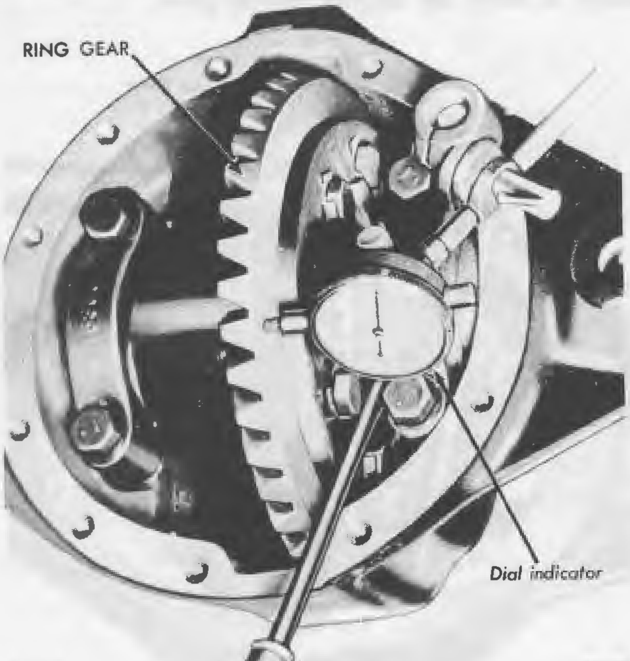


Fig. 8—Differential Assembly End Play Measurement

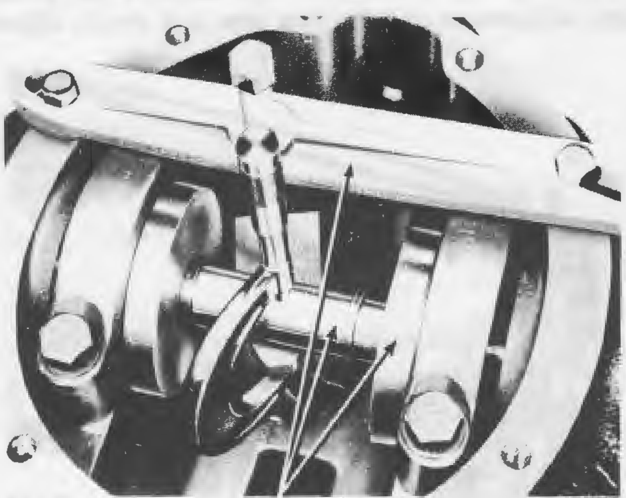


Fig. 9—Pinion Depth Check

EXAMPLE:

Reading recorded in paragraph (2) . . *0.070 inch*
Plus 0.007 to 0.009 inch pre-load . . *0.008 inch*
Total Reading . . . . *0.078 inch*

Reading recorded in paragraph (4) . . *0.043 inch*
0.003 to 0.008 backlash . . . . *0.005 inch*
Amount of shims under bearing at ring gear end of the differential assembly . . . . *0.043 —0.005 = 0.038 inch*
Amount of shims under bearing at differential end 0.078 —0.038 = 0.040 inch

Remove the bearing caps, and lift the differential assembly from the housing. Remove the differential side bearings, then install the proper amount of shims on each side of the differential case. Press the side bearings on the case until firmly seated against the shims.

(5) *DIFFERENTIAL INSTALLATION.* Install the housing spreader, and spread the housing until the

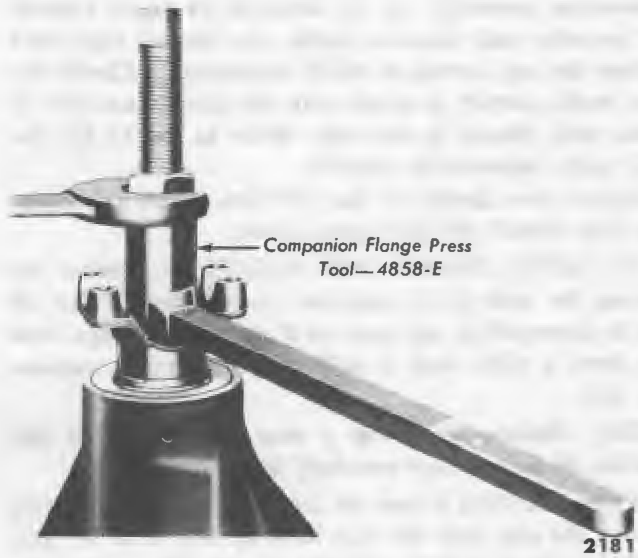
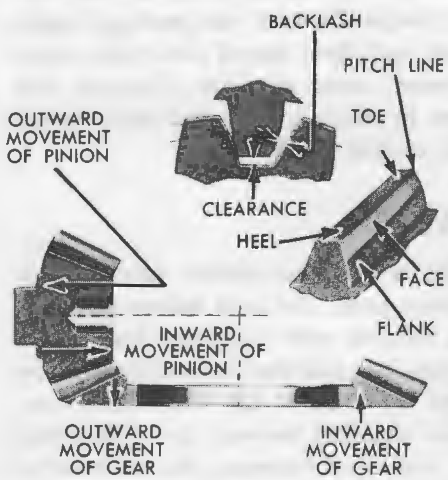


Fig. 10—Companion Flange Installation



GEAR NOMENCLATURE

PROPER TOOTH CONTACT

HEAVY FACE CONTACT
CORRECTION: Move Pinion "IN" toward Ring Gear, then Establish Correct Backlash.

HEAVY FLANK CONTACT
CORRECTION: Move Pinion away from Ring Gear, then Establish Correct Backlash.

CONTACT ON HEEL
CORRECTION: Decrease Backlash. Move Ring Gear toward Pinion.

CONTACT ON TOE
CORRECTION: Increase Backlash. Move Ring Gear away from Pinion. 2408

Fig. 11—Gear Tooth Contact Chart (Typical)

differential assembly can be installed in place. Loosen the spreader and remove. Install the bearing caps, and tighten the cap screws to 60-70 foot-pounds. Check the gear tooth contact to make sure the proper amount of shims were placed in the axle. Refer to fig. 11 for the gear tooth impressions contact.

Position a new gasket on the rear face of the axle housing, then install the rear cover plate.

(6) *AXLE SHAFT INSTALLATION.* Before replacing the axle shaft, examine the oil seal. If the oil seal is damaged in any way or if the feather edge does not form a tight seal, it will be necessary to replace the seal.

NOTE: ***Before installing a new oil seal, soak the seal in oil for at least one-half hour.***

When installing a new oil seal, use tool No. 1177-N, driving the seal into the axle housing true with the axis of the shaft and tight against the shoulder. After the seal is installed, check the outer diameter for tightness in the housing to avoid possible leaks. Remove the temporary nut holding the brake carrier plate to the housing. Lubricate the bearing bore in the axle housing, clean the brake plate surface, then install new gaskets between the retainer plate and brake carrier plate.

Slide the axle shaft assembly in place in the axle housing (using care not to damage the oil seal), at the same time entering the plines of the shaft in the splines of the differential gears. Push the axle shaft assembly in until the axle bearing is tight against the shoulder in the axle housing. Position the axle shaft retainer plate on the rear axle bolts and secure the shaft on the axle housing with the lock nuts. Tighten the nuts to 30-35 foot-pounds torque. Install the brake drum on the axle flange securing the drum with the Tinnerman nuts.

d. Axle Installation.

Install the rear wheels, then roll the axle assembly into position under the vehicle. Install the spring clips (U-bolts), washers and nuts. Tighten the nuts to 108-125 foot-pounds. Connect the drive shaft to the rear axle universal joint flange. Connect the parking brake cable to the equalizer rod, then install the brake cable brackets on the frame cross member. Connect the hydraulic brake hose to the rear axle hydraulic brake line, then lower the vehicle to the floor.

2. SPLIT HOUSING HYPOID REAR AXLE

The F-6 and F-7 model trucks are equipped with the split housing hypoid rear axle (fig. 12). A different axle assembly is used on each of the two truck models. While the relative size of the parts in the two axle assemblies varies, the construction of the two axles is the same.

The procedure for the removal of the split housing hypoid rear axle is given under "a. Axle Removal." "b. Axle Disassembly," presents the procedures necessary for the complete disassembly of the axle. The assembly and adjustment of the axle is covered under the heading "c. Axle Assembly and Adjustment." Installation information is given under the heading "d. Axle Installation."

The axle housing is the split type, each half consisting of a steel tube riveted into a cast housing. The spring seats are welded to the axle housing tubes. The outer ends of the tubes are machined for the installation of the wheel bearings, and are threaded for the installation of the wheel bearing adjusting nuts. Flanges, forged integral with the housing tubes, provide facilities for the installation of the brake backing plates. The differential side bearing cups are pressed into machined bores in the axle housing. Shims of various thicknesses are installed between the side bearing cups and the housing. These shims control side bearing pre-load and gear lash. A thrust block, mounted on a pin which is driven into a hole in the left-hand axle housing, limits the flexing of the ring gear under severe loads. The differential assembly is the four-pinion type and is mounted in a two-piece case. The case halves are held together with bolts, secured with nuts and lock wires.

Differential side bearings are the tapered roller type and are pressed onto the hubs of the differential case.

Thrust washers are installed between the differential side gears and the case, and between the differential pinions and the case.

The ring gear is riveted to the left-hand half of the differential case. If the ring gear is replaced, it is also necessary to replace the drive pinion, since these parts are serviced in matched sets.

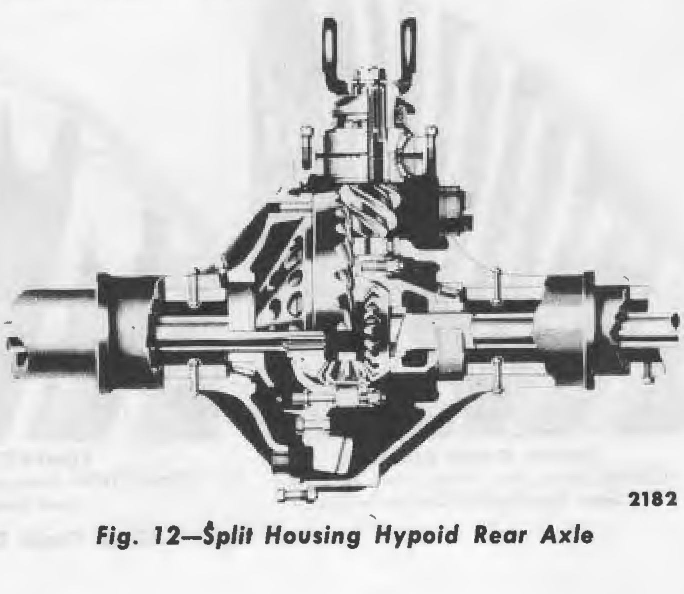


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Fig. 12—Split Housing Hypoid Rear Axle

The axle is equipped with a straddle mounted drive pinion assembly. The drive pinion bearings are the opposed, tapered roller type, and are pressed on the drive pinion shaft. The pilot bearing is the straight roller type, and is pressed on the inner end of the drive pinion and is retained with a snap ring. The pilot bearing seats in a machined bore in the left-hand axle housing. The drive pinion bearing cups are pressed into the drive pinion sleeve, and the sleeve is pressed into a bore in the left-hand axle housing assembly. The drive pinion and sleeve assembly may be removed from the axle housing, after the universal joint flange has been removed, by using puller screws in the holes provided in the pinion sleeve flange.

Shims of various thicknesses are installed between the drive pinion sleeve flange and the axle housing. These shims control the pinion depth in the ring gear and the backlash between the two gears.

A spacer is used between the inner and outer drive pinion bearings. This spacer is available in several thicknesses and is used to adjust the drive pinion bearing pre-load.

A spring loaded lip type oil seal is pressed into the drive pinion oil seal retainer. The retainer is installed over the drive pinion sleeve studs, and is retained with the same nuts which secure the drive pinion sleeve.

The universal joint flange is pressed onto the drive pinion shaft splines until seated against the thrust washer. The flange is secured on the shaft with a washer, nut, and cotter pin.

The axle shafts are the full-floating type, with the inner ends splined to match the splines in the differential side gears. The axle shaft flanges are attached to the hubs with studs, lock washers, and nuts. The stud holes in the axle shaft flanges are taper reamed for the installation of split tapered dowels.

a. Axle Removal.

Loosen the wheel stud nuts, then raise the rear of the vehicle. Remove the spring retainer which connects the hydraulic brake hose to the rear axle hydraulic brake pipe. Disconnect the coupling shaft at the rear axle universal joint flange. Remove the nuts and washers from the spring clips (U-bolts), then remove the spring clips. Roll the axle out from under the vehicle, then remove the wheels.

b. Axle Disassembly.

The complete disassembly of the rear axle is necessary if a thorough overhaul is desired. The disassembled view of the split housing hypoid rear axle (fig. 13) shows all of the parts in their relative positions and should be referred to when performing the procedures given in the following paragraphs:

(1) *AXLE SHAFT REMOVAL.* Drain the lubricant from the axle housing, then remove the axle shaft stud nuts and lock washers. Tap the axle shafts in the center

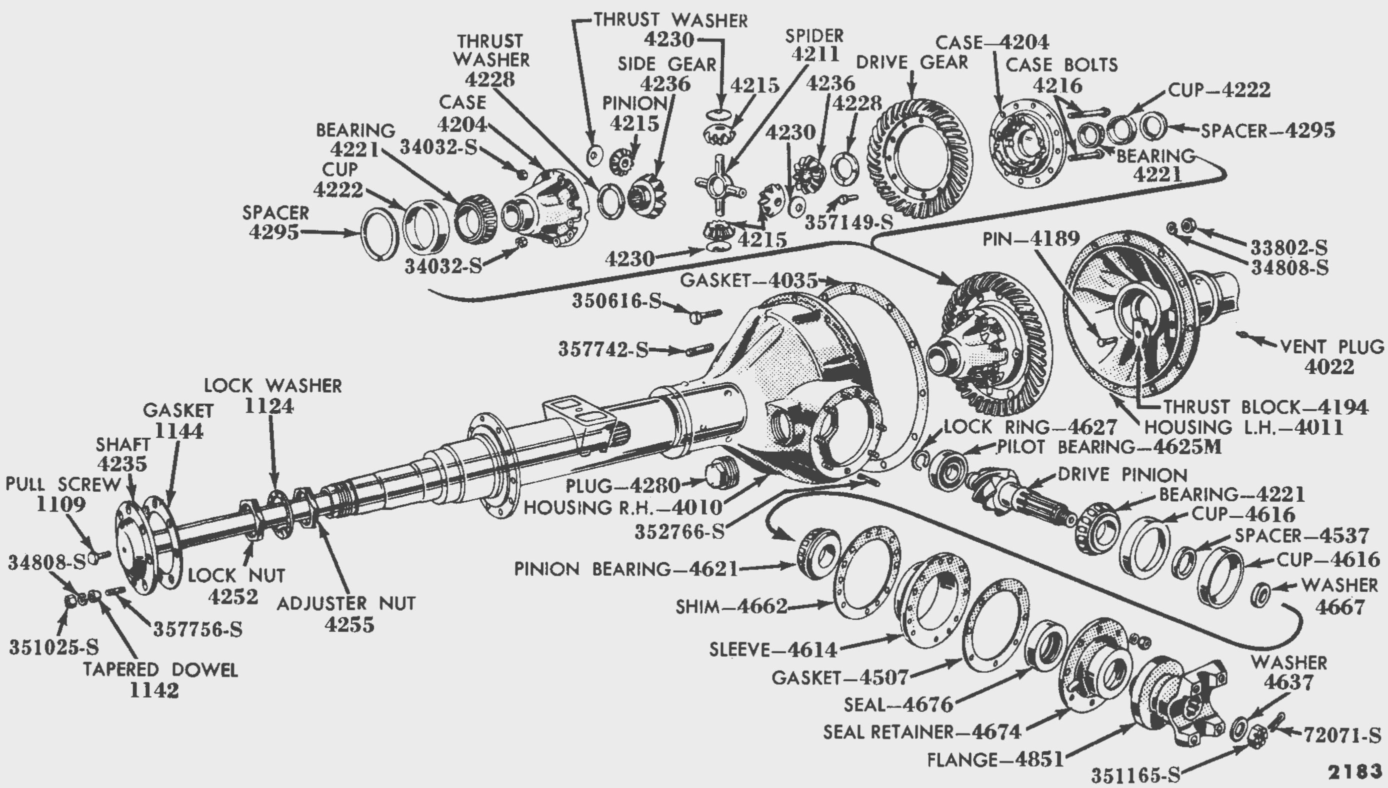

Fig. 13—Split Housing Hypoid Rear Axle, Disassembled

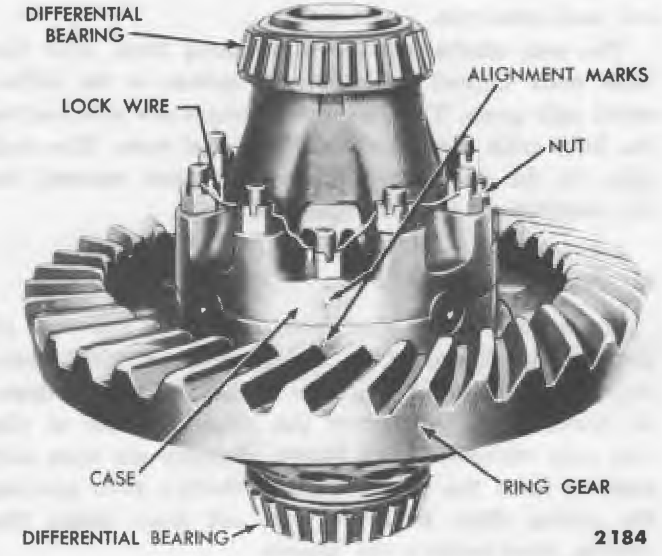

Fig. 14—Differential Case and Ring Gear Assembly

of the flange to free the tapered dowels, remove the dowels, and pull the axle shafts out of the rear axle housing. Remove the hub and drum assembly.

(2) *DIFFERENTIAL ASSEMBLY REMOVAL.* Insert a length of pipe, slightly smaller than the axle shaft, approximately two-thirds through the axle from the case side to prevent the differential assembly from dropping. Remove the nuts, washers, and bolts that secure the two halves of the rear axle housing, and separate the axle housing. Remove the differential assembly and the pipe from the axle housing.

(3) *DIFFERENTIAL DISASSEMBLY.* Mark the differential case halves with a punch or chisel before disassembling as this will aid in aligning the case when reassembling. Cut the lock wire and remove the bolts and nuts that secure the two halves of the case (fig. 14). Separate the case and remove the spider, pinions, side gears, and thrust washers. Remove the differential bear-

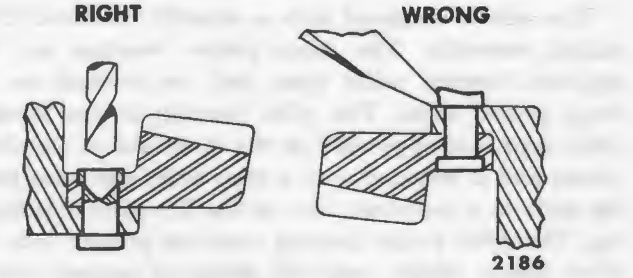

Fig. 16—Ring Gear Rivets Removal

ings with the tool shown in fig. 15. Centerpunch the ring gear rivet heads. Using a drill $\frac{1}{32}$ inch larger than the rivet body, drill through the rivet heads as shown in fig. 16. Press the rivets out and remove the ring gear from the case. Using a suitable puller, remove the differential bearing cups from each half of the axle housing. Note the amount of spacers that are behind each cup and wire the spacers to their respective axle housing half.

(4) *DRIVE PINION CAGE ASSEMBLY REMOVAL.* Hold the universal joint flange with the tool shown in fig. 17 and remove the nut and washer from the drive pinion shaft. Remove the flange from the drive pinion shaft with the tool shown in fig. 18. Remove the drive pinion bearing cover and oil seal assembly. Remove the drive pinion and cage assembly, using puller screws in the holes provided in the cage (fig. 19).

CAUTION: ***Do not drive the pinion from the inner end as this will damage the bearing lock ring groove.***

(5) *DRIVE PINION AND CAGE DISASSEMBLY.* Tap or press the drive pinion from the cage assembly. Remove the outer bearing from the cage. Remove the spacer or spacer combination from the drive pinion. Remove the rear thrust bearing, then remove the pilot bearing with the puller shown in fig. 20. Remove the oil seal assembly from the bearing cover. Remove the bearing cups from the cage assembly.

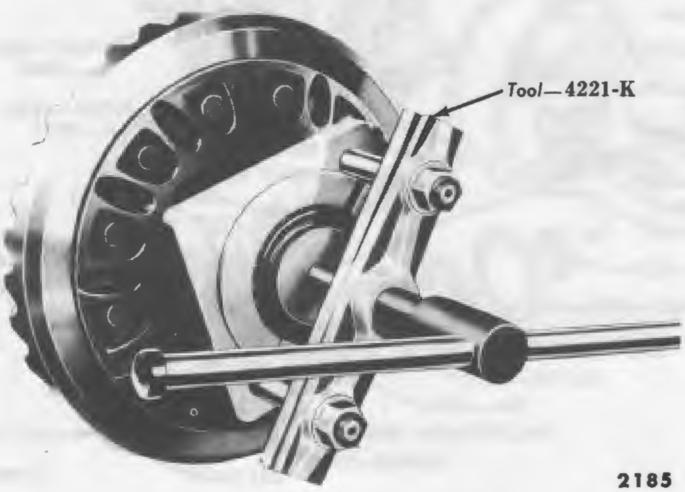

Fig. 15—Differential Side Bearing Removal

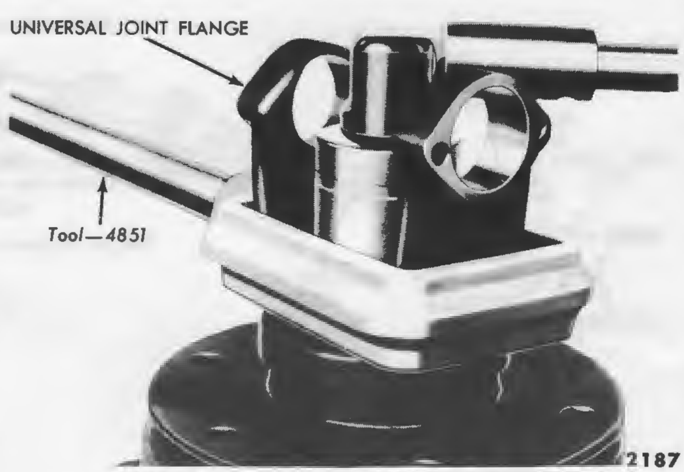

Fig. 17—Universal Joint Flange Holder

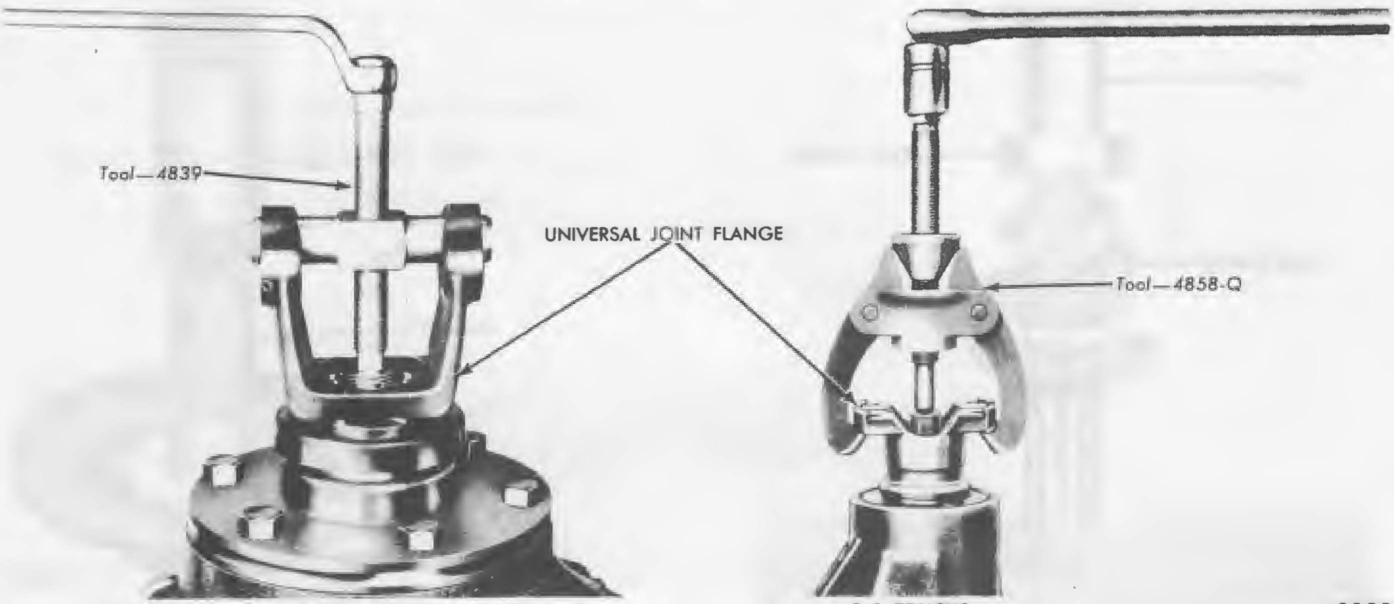

Fig. 18—Universal Joint Flange Removal

c. Axle Assembly and Adjustment.

The assembly of the rear axle includes the pinion bearing pre-load adjustment and the ring gear and pinion backlash adjustment. These adjustments must be made carefully to ensure proper rear axle performance.

It is essential that all parts be clean and free of chips or other foreign matter before assembling the axle.

(1) *DRIVE PINION AND CAGE ASSEMBLY.* Press the pilot bearing on the end of the drive pinion (fig. 21), using a sleeve that applies pressure on the inner race, until the bearing seats against the drive pinion face.

Install the lock ring that secures the pilot bearing on the pinion. Press the lock ring into the pinion groove with a pair of pliers. Install the bearing cups in the pinion bearing cage, and press them firmly against the pinion bearing cage shoulders. Lubricate the bearings and cups with light oil. Install the rear bearing on the pinion shank and insert the drive pinion and bearing assembly in the pinion bearing cage. Install the spacer or spacer combination on the pinion shank, then press the front bearing firmly against the spacer.

(2) *CHECKING DRIVE PINION BEARING PRELOAD.* Install a sleeve on the drive pinion shank that will apply pressure to the pinion bearing inner race. Place the drive pinion and cage assembly in a press (fig. 22) and apply 25,000 pounds pressure on the

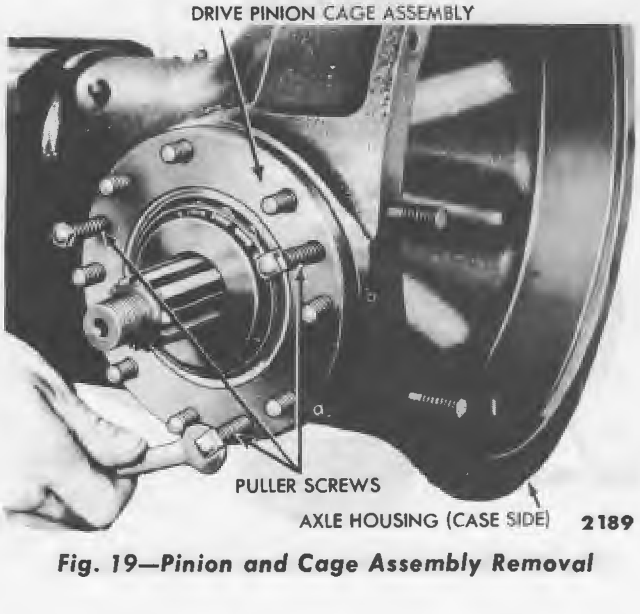

Fig. 19—Pinion and Cage Assembly Removal

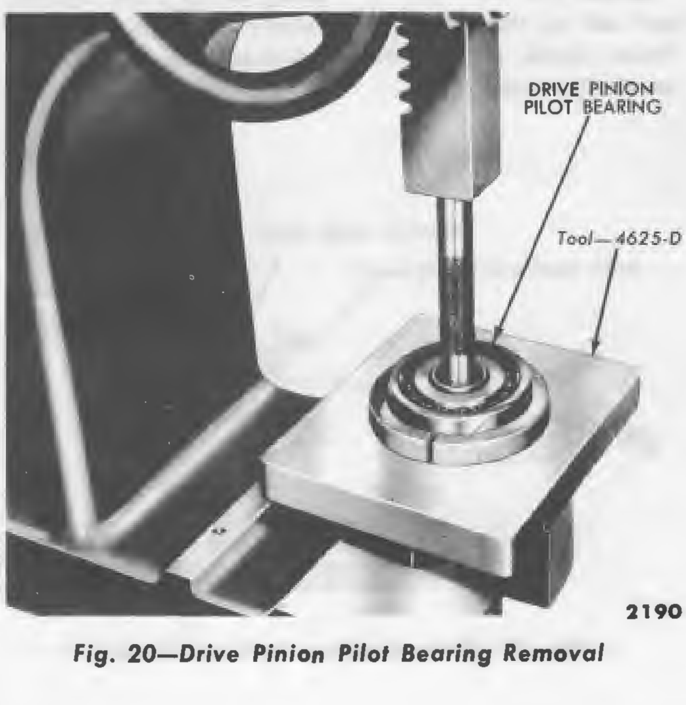

Fig. 20—Drive Pinion Pilot Bearing Removal

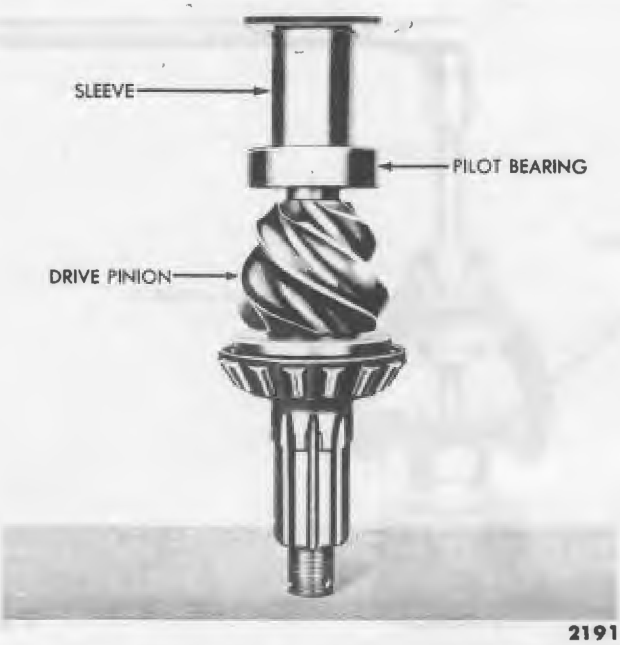

Fig. 21—Drive Pinion Pilot Bearing Installation

bearing. Wrap a soft wire around the cage and attach a pound-pull scale to the wire. Pull on the scale in a horizontal line and note the pull required to keep the cage rotating. If the rotating torque is not between 12 to 18 inch-pounds, install a thinner spacer to increase or thicker spacer to decrease the pre-load. If a press is not available, the yoke may be installed and the pinion nut tightened to 300-400 foot-pounds torque for checking the pre-load. Install a new oil seal in the drive pinion bearing cover with the tool shown in fig. 23.

NOTE: ***Soak new oil seals in oil at least one-half hour before installation.***

Install the drive pinion bearing cover, yoke, washer, and nut on the drive pinion shank. Tighten the drive pinion shank nut to 300-400 foot-pounds torque, and install the cotter key.

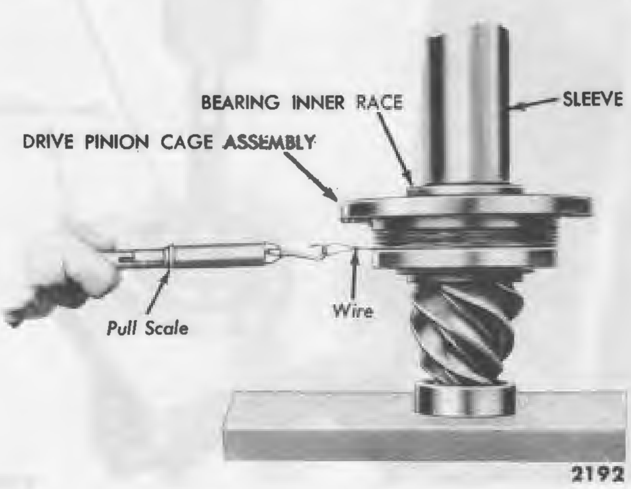

Fig. 22—Pinion Bearing Pre-Load Check

Fig. 23—Pinion Shaft Oil Seal Installation

(3) *DIFFERENTIAL ASSEMBLY.* Position the ring gear on the case, making sure it is tight on the case pilot. Install the rivets and upset them cold. When the correct rivet and rivet set is used, the head being formed will be at least 1/8 inch larger in diameter than the rivet hole. The diameter of the formed head should be at least 1/16 inch smaller than the pre-formed head as excessive pressure will cause distortion of the case holes and result in gear eccentricity.

Lubricate all differential parts with axle lubricant. Position a thrust washer and side gear in the ring gear half of the differential case assembly. Place the spider with the pinions and thrust washers in position (fig. 24) on the side gear. Install the remaining side gear and thrust washer. Align the marks on each half of the

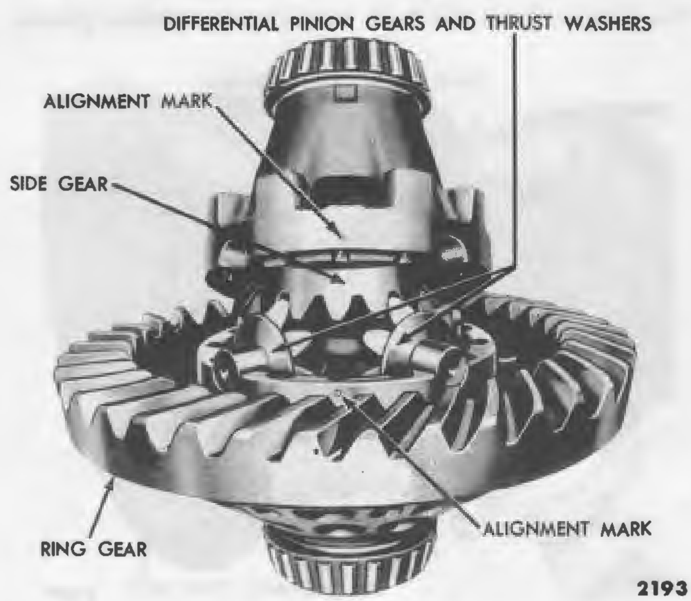

Fig. 24—Differential Gears and Case Assembly

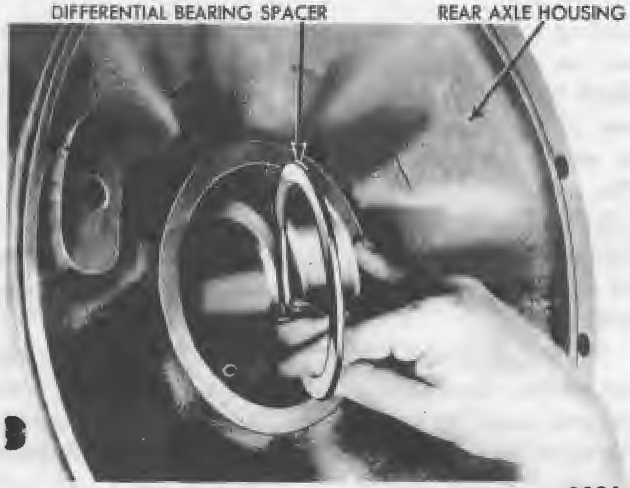

Fig. 25—Differential Bearing Cup Spacer Installation

case and place the two halves together (fig. 24). Install the bolts and nuts that secure the assembly together, and tighten the nuts to 80-110 foot-pounds torque. Lock the nuts with lock wire. Install the differential case bearings, using a press or suitable driver.

(4) *DIFFERENTIAL BEARING PRE-LOAD ADJUSTMENT.* Remove the thrust block from the rear axle housing. Install the differential bearing cups and spacers (fig. 25) in their original positions in the axle housing.

NOTE: ***Install the spacers with the chamfered edge toward the machined surfaces in the housing.***

Insert the pipe or support used in disassembly through the housing half. Place the differential and gear assembly over the pipe as shown in fig. 26, and slide the assembly into position. Install a new flange gasket. Position the other housing half in place, and secure the two halves together with six bolts equally spaced. Install a dial indicator on the housing as shown in fig. 27 with the dial shaft through the thrust block pin hole and

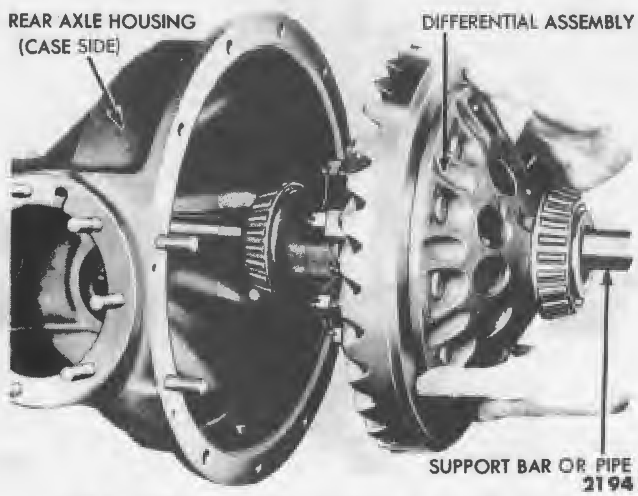

Fig. 26—Differential Assembly Installation on Support

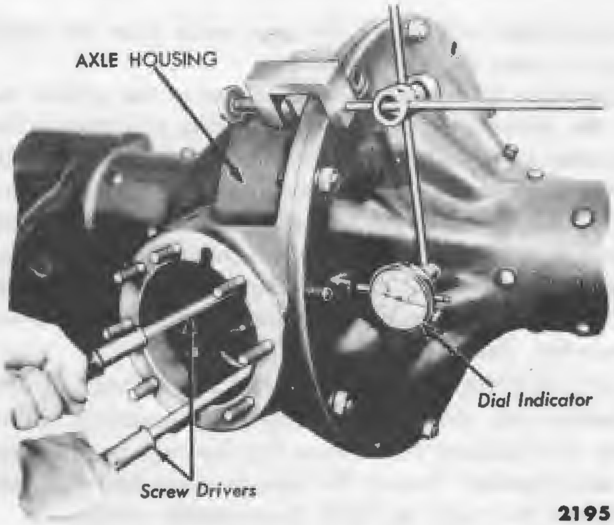

Fig. 27—Differential Bearing Pre-Load Check

against the ring gear. Using two screw drivers (fig. 27), check the gear assembly end play. The correct end play is from 0.000-0.005 inch.

NOTE: ***Both the differential bearing pre-load and gear lash are controlled by selective spacers, available in 0.004 inch thickness, which are installed between the bearing cups and axle housing halves.***

It is necessary to separate the axle housing halves and remove the differential bearing cups and assemble them each time the spacer thickness is changed. The gear may be moved toward the pinion, decreasing the gear lash, by decreasing the thickness of the spacer in the case half and increasing the thickness of the spacer by the same amount in the cover half. Reversing this

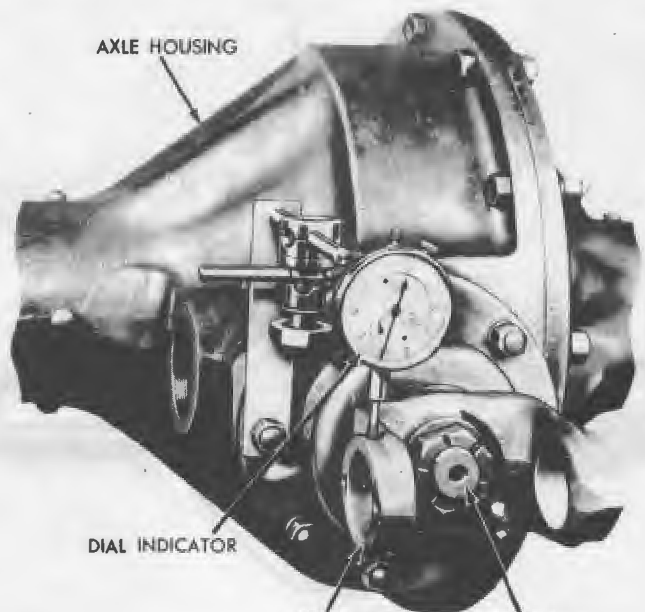

Fig. 28—Backlash Check

transposition will move the gear away from the pinion and increase the gear lash.

Increase or decrease the thickness of the spacer used in the cover half of the axle housing to obtain a free rotating gear with from 0.000 to 0.005 inch end play. After the end play has been established, add spacers to equal 0.008 inch plus the end play. After the adjustment is obtained, separate the axle housing, and move the differential assembly out on the support far enough to permit the installation of the drive pinion and cage assembly. Install the thrust block.

(5) *PINION CAGE ASSEMBLY INSTALLATION.* Position the drive pinion and cage assembly on the rear axle housing studs, then tap the cage in place with a soft hammer. Install the lock washers and stud nuts. Tighten the nuts to 70-90 foot-pounds torque.

(6) *CHECK GEAR BACKLASH.* Place the differential gear assembly in the axle housing then secure the two halves of the housing together with six bolts equally spaced. Tighten the bolt nuts to 85-95 foot-pounds torque. Install a dial indicator, as shown in fig. 28, with the stem two inches from the pinion shank center, and check the gear backlash. The amount indicated at this point will be double the actual gear lash. Transpose the spacers used in back of the differential bearing cups in the axle housing, decreasing the thickness of the spacer used on the side in the direction which the gear is to be moved, and increasing the thickness of the opposite spacer exactly the same amount as required to obtain a gear lash of 0.006-0.012 inch. The amount indicated on the dial indicator would be 0.012 to 0.024. After correct backlash is obtained, install the remaining bolts, washers, and nuts in the housing assembly, and tighten the nuts to 85-95 foot-pounds torque.

(7) *AXLE SHAFT INSTALLATION.* Install the hub and drums, then place a new gasket on the hub. Insert the axle shaft in the housing, turning the shaft as required to line up the shaft splines with the differential side gear splines. Install the tapered dowels, lock washers, and nuts on the studs. Tighten the nuts securely.

d. Axle Installation.

Install the wheels, then roll the axle assembly into position under the vehicle. Install the spring clips, washers and nuts. Tighten the nuts to 285-310 foot-pounds torque. Connect the coupling shaft to the rear axle universal joint flange. Connect the hydraulic brake hose to the rear axle hydraulic brake pipe. Lower the vehicle to the floor, then tighten the wheel stud nuts.

3. SPLIT HOUSING SPIRAL BEVEL REAR AXLE

Two types of split housing spiral bevel rear axles differing in the construction of the drive pinion assembly are used on Ford trucks. The split housing spirial bevel rear axle assembly installed as standard equipment on F-2, F-3, and early F-4 and F-5 trucks uses the tapered shaft drive pinion assembly (fig. 29). Late F-4 and F-5 trucks are equipped with split housing spiral bevel rear axles which use the splined shaft drive pinion assembly (fig. 30).

The removal procedure, which covers both of the split housing spiral bevel rear axle assemblies, is given under the heading "a. Axle Removal." Complete axle disassembly information is contained in "b. Axle Dis-

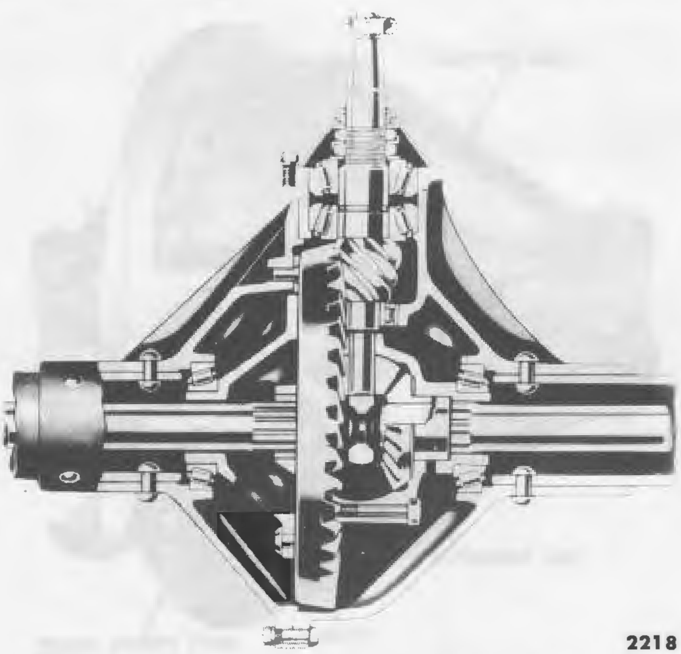

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Fig. 29—Split Housing Spiral Bevel Axle (Tapered Shaft Pinion)

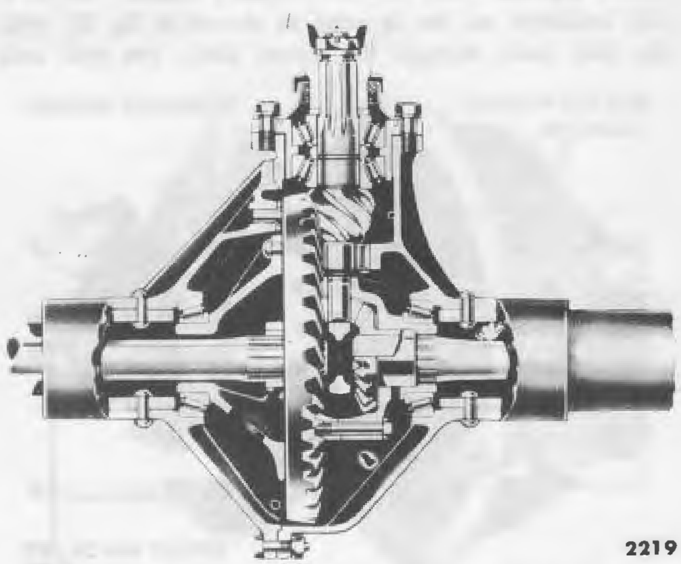

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Fig. 30—Split Housing Spiral Bevel Axle (Splined Shaft Pinion)

assembly." The assembly and adjustment information is given under the heading "c. Axle Assembly and Adjustment," and "d. Axle Installation" contains the axle installation procedure.

The axle housing is the split type, each half consisting of a steel tube rivited into a cast housing. The spring seats are welded to the axle housing tubes. The outer ends of the tubes are machined for the installation of the wheel bearings, and are threaded for the installation of the wheel bearing adjusting nuts. Flanges, forged integral with the housing tubes, provide facilities for the installation of the brake backing plates. The differential side bearings cups are pressed into machined bores in the axle housings. A thrust block, installed on a pin which is driven into an opening in the left-hand axle housing, limits flexing of the ring gear under severe loads.

The differential assembly is the four-pinion type, and is mounted in a two-piece differential case. The differential case halves are bolted together, and a lock wire is installed through the heads of the bolts. The differential side bearings are pressed onto the hubs of the differential case. Thrust washers are installed between the differential side gears and the case, and between the differential pinions and the case. The ring gear is riveted to the left-hand half of the differential case. If ring gear replacement is necessary, the drive pinion must also be replaced, since parts are serviced only in matched sets.

The drive pinion assembly, on F-2, F-3 and early F-4 and F-5 trucks, has a tapered drive pinion shaft. Pinion bearings are of the tapered roller type, and the pinion bearing cups (F-4 and F-5) are pressed into the drive pinion sleeve. The F-2 and F-3 trucks use a drive pinion assembly equipped with a one-piece pinion bearing cup which serves both bearings. A thrust washer is installed between the outer pinion bearing and the lock nut. The pinion bearings are pre-loaded by means of this lock nut. A lock washer is used to secure the bearing pre-load adjustment.

A lip type spring loaded oil seal is pressed into the oil seal retainer. A cork gasket is installed in a groove in the drive pinion sleeve to provide an additional lubricant seal. The oil seal retainer is attached to the axle housing by the same bolts which secure the drive pinion assembly to the housing. The propeller shaft flange is keyed to the drive pinion shaft and is retained on the shaft with a nut and a cotter pin.

The drive pinion assembly, used on late F-4 and F-5 trucks, has a splined drive pinion shaft. The pinion bearings are tapered roller type and are a press fit on the drive pinion shaft. The pinion bearing cups are pressed into the drive pinion sleeve until seated against a machined shoulder in the sleeve. A bearing spacer available in various thicknesses is installed between the pinion bearings. Bearing pre-load is controlled by the thickness of the bearing spacer used, assuming that the propeller shaft flange nut is tightened to the correct torque. The drive pinion pilot bearing is the straight roller type, and is retained on the inner end of the drive pinion by a snap ring. The pilot bearing seats in a machined bore in the right-hand axle housing.

A lip type spring loaded oil seal is pressed into the oil seal retainer, and seats against the oil seal felt. A cork gasket is installed in a groove in the drive pinion sleeve to provide an additional lubricant seal. The drive pinion sleeve and the oil seal retainer are bolted to the axle housing. A gasket is used between the oil seal retainer flange and the drive pinion sleeve flange.

Shims are installed between the pinion sleeve flange and the axle housing flange. These shims control the pinion depth and provide a means of adjusting the tooth contact and backlash. The propeller shaft flange is pressed onto the splined end of the drive pinion shaft and is retained on the shaft with a washer, nut, and cotter pin. The axle shafts are the full-floating type, with the inner ends splined to the differential side gears. The axle shaft flanges are attached to the hubs with studs, lock washers, and nuts. The stud holes in the axle shaft flanges are taper reamed for the installation of split tapered dowels. The axle shafts may be removed without removing the axle assembly from the vehicle.

a. Axle Removal.

Loosen the wheel stud nuts, then raise the rear of the vehicle. Disconnect the hydraulic brake hose from the rear axle hydraulic brake pipe. Disconnect the coupling shaft at the rear axle universal joint flange. Remove the nuts and washers from the spring clips (U-bolts) then remove the spring clips. Roll the axle out from under the vehicle, then remove the wheels.

b. Axle Disassembly.

The complete disassembly of the rear axle is necessary if a thorough overhaul is desired. The disassembled view of the split housing spiral bevel rear axle (fig. 31) shows all of the parts in their relative positions and should be referred to when performing the procedures given in the following paragraphs.

(1) *AXLE SHAFT REMOVAL.* Drain the lubricant from the axle housing, then remove the axle shaft stud nuts and washers. Tap the center of the axle shaft flange to loosen the tapered dowels, then remove the dowels. If puller screw holes are provided in the axle shaft flange, install the puller screws, then remove the axle shaft from the housing. Remove the hub and drum assemblies.

(2) *DIFFERENTIAL ASSEMBLY REMOVAL.* Insert a piece of pipe, slightly smaller than the axle

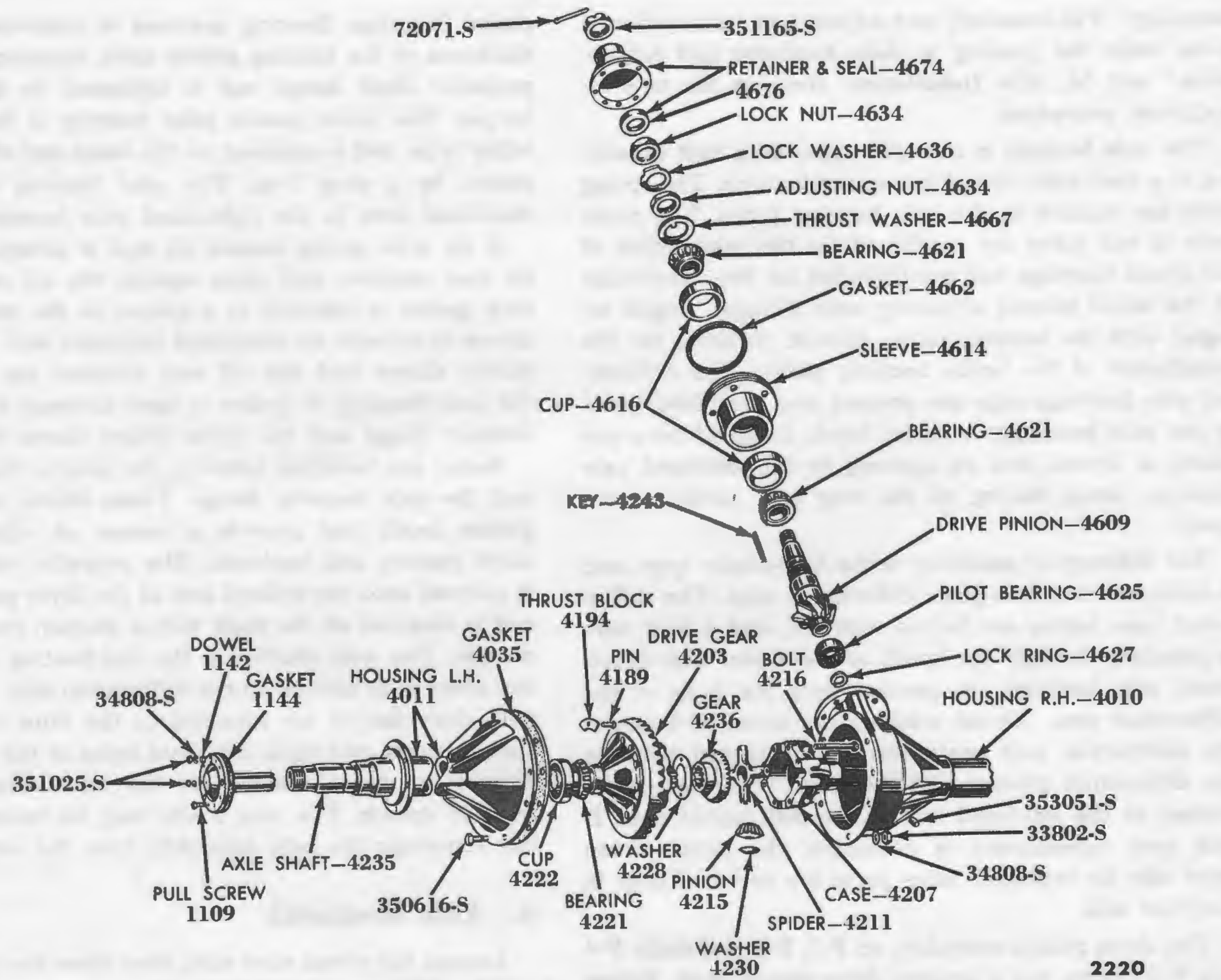

Fig. 31—Split Housing Spiral Bevel Rear Axle (Tapered Drive Pinion Type)

shaft splines, approximately two-thirds through the axle from the case side to prevent the differential assembly from dropping. Remove the nuts, washers, and bolts that secure the two halves of the rear axle housing, and separate the axle housing. Remove the differential assembly and the pipe from the axle housing. Remove the differential side bearing cups from the axle housing, using a puller which hooks behind the cups.

(3) *DIFFERENTIAL DISASSEMBLY.* Mark the differential case halves with a punch (fig. 14) before disassembling as this will aid in aligning the case when reassembling. Cut the lock wire and remove the bolts and nuts that secure the two halves of the case. Separate the case using a brass hammer if necessary and remove the spider, pinions, side gears, and thrust washers. Remove the differential bearings, using the tool shown in fig. 32.

Center-punch the drive gear rivet heads, then using a drill $\frac{1}{32}$ inch larger than the rivet body, drill through the rivet heads as shown in fig. 16. Press the rivets out and remove the drive gear from the case.

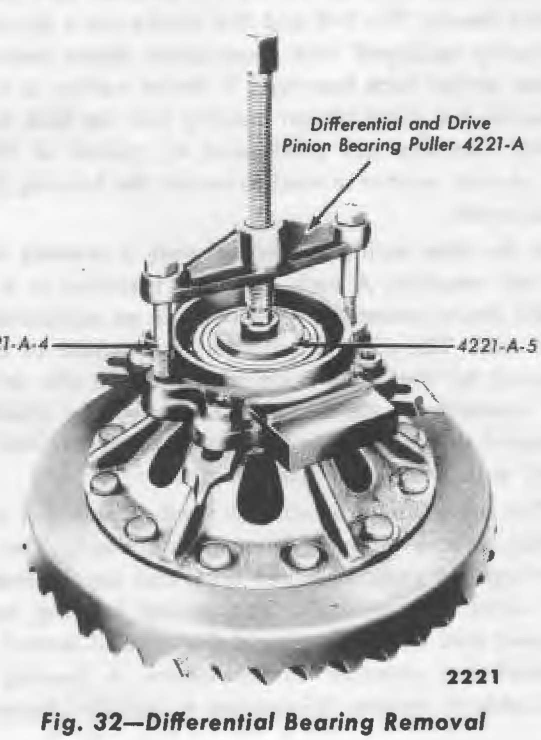

Fig. 32—Differential Bearing Removal

(4) *DRIVE PINION REMOVAL AND DISASSEMBLY.* The procedures in paragraph (a) apply to axles that are equipped with tapered shaft drive pinion assemblies. Paragraph (b) contains the removal and disassembly procedures for the splined shaft drive pinion assemblies.

(a) TAPERED SHAFT DRIVE PINION. Remove the cotter pin and nut that secures the universal joint flange to the drive pinion shaft, and remove the universal joint flange using a soft hammer. With a small chisel, remove the pinion shaft key from the pinion shaft. Remove the six cap screws that secure the drive pinion oil seal retainer and pinion bearing retainer to the axle housing, and remove the oil seal retainer and bearing retainer. Remove the pinion assembly from the axle housing as shown in fig. 33. Drive the drive pinion pilot bearing out of the axle housing bore.

Place the pinion assembly in a vise equipped with brass jaws. Bend the ears of the lock washer away from the pinion bearing lock nut. Remove the lock nut, lock washer, and bearing adjustment nut, using two thin open end wrenches. Remove the pinion sleeve, including the thrust washer, the drive pinion front bearing and the bearing cup from the drive pinion.

Remove the drive pinion rear bearing using the tool shown in fig. 34.

(b) SPLINE SHAFT DRIVE PINION. Hold the universal joint flange with the tool shown in fig. 17, then remove the cotter pin, nut, and washer from the drive pinion shaft. Remove the flange using the tool shown in fig. 18. Remove the pinion bearing cover and oil seal assembly. Remove the pinion bearing cover and oil seal assembly. Remove the pinion and cage assembly, using puller screws in the holes provided in the cage (fig. 19).

Tap the drive pinion assembly out of the cage, then remove the outer bearing from the cage. Remove the pinion bearing spacers from the drive pinion. Remove the rear pinion bearing, then remove the pilot bearing using the tool shown in fig. 20. Remove the oil seal assembly from the bearing cover, then remove the bearing cups from the cage assembly.

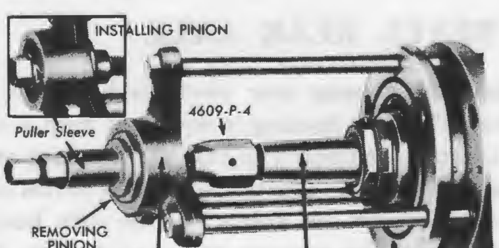

Fig. 33—Drive Pinion Removal or Installation (Typical)

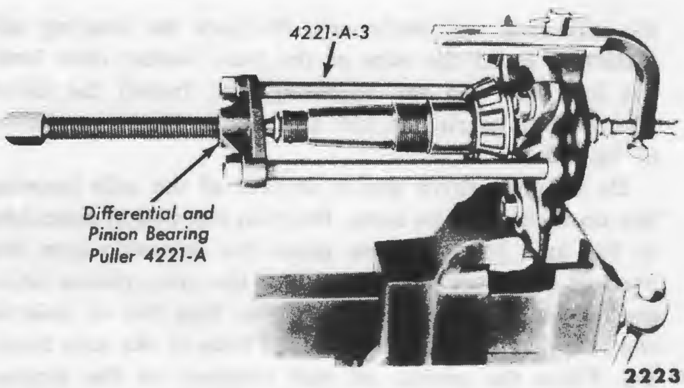

Fig. 34—Drive Pinion Bearing Removal

c. Axle Assembly and Adjustment.

The split housing spiral bevel rear axles are equipped with precision fit ring gears and pinions and do not require tooth contact or backlash adjustment. The pinion bearing pre-load adjustment is the only adjustment required when assembling the rear axle.

(1) *DRIVE PINION ASSEMBLY AND ADJUSTMENT.* The procedures for assembling and adjusting the tapered shaft drive pinion are given under the heading "(a) Tapered Shaft Drive Pinion." "(b) Splined Shaft Drive Pinion," contains the procedures for assembly and adjustment of the spline shaft drive pinion.

(a) TAPERED SHAFT DRIVE PINION. Place the drive pinion in a vise equipped with brass jaws. Apply a thin coat of rear axle lubricant on the bearings. Press the drive pinion rear bearing on the pinion and place the pinion bearing cup or sleeve on the pinion bearing. Place the drive pinion front bearing and the thrust washer on the pinion. Install the bearing adjusting nut and tighten the nut using two open end wrenches until 12 to 16 inch-pounds of torque is required to turn the pinion. After the correct adjustment is obtained hold the adjusting nut with a wrench and install the lock washer and lock nut. Tighten the lock nut while holding

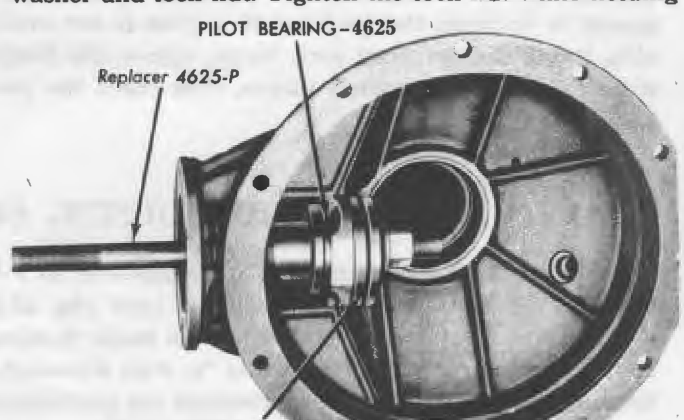

Fig. 35—Drive Pinion Pilot Bearing Installation

the adjusting nut stationary. Recheck the bearing adjustment. Bend the tabs of the lock washer over both the lock nut and the adjusting nut. Install the drive pinion pilot bearing in the axle housing bore as shown in fig. 35.

Be sure the drive pinion surface of the axle housing has no nicks or high spots. Position the pinion assembly in the axle housing, then press the assembly into the housing as shown in fig. 33. Place the drive pinion bearing retainer on the axle housing so that the *oil hole in the retainer lines up with the oil hole in the axle housing.* Place the pinion oil seal retainer on the pinion. Install the cap screws that secure the pinion and oil seal retainer to the axle housing. Place the key in the slot of the pinion, then tap the key in place with a brass hammer. Install the universal joint flange on the pinion. Install the nut and cotter pin that secure the flange to the pinion.

(b) SPLINED SHAFT DRIVE PINION. Press the pilot bearing on the end of the drive pinion using a sleeve that applies pressure on the inner race.

Install the pilot bearing lock ring in the pinion groove using a pair of pliers.

Press the bearing cups into the pinion bearing cage until firmly seated against the pinion bearing cage shoulders. Lubricate the bearings and cups with rear axle lubricant. Install the drive pinion rear bearing on the pinion. Insert the drive pinion and bearing assembly in the pinion bearing cage. Install the spacer or spacer combination on the pinion shaft then press the front bearing firmly against the spacer.

Install a sleeve on the drive pinion shaft that will apply pressure to the drive pinion front bearing inner race. Place the drive pinion and cage assembly in a press and apply 25,000 pounds pressure on the front bearing. Wrap a soft wire around the cage and, using a pound-pull scale, pull on a horizontal line. If the rotating torque is not within 12 to 18 inch-pounds, install a thinner spacer to increase the pre-load or a thicker spacer to decrease the pre-load. If a press is not available, install the universal joint flange, tighten the flange nut to 300-400 foot-pounds torque, then check the preload.

Install a new oil seal in the drive pinion bearing cover. Position the drive pinion and cage assembly over the studs on the rear axle housing, and tap in place with a soft hammer. Install the lock washers and stud nuts. Tighten the nuts to 70-90 foot-pounds torque.

(2) *DIFFERENTIAL ASSEMBLY AND INSTALLATION.* Lubricate all component parts with axle lubricant. Position the thrust washer and side gear in the ring gear half of the case assembly. Place the spider with the pinions and thrust washers in position. Install the remaining side gear and thrust washer. Align the marks on each half of the case and place the two halves together. Install the differential case bolts and nuts, then tighten the nuts to 80-110 foot-pounds torque. Lock the nuts with lock wire. Press the differential side bearings on the case hubs until seated against the case shoulders.

Press the differential bearing cups into the bores in the axle housing. Insert the pipe, used in disassembly, through the housing half. Place the differential and gear assembly over the pipe, then slide the assembly into position. Install a new flange gasket. Place the other housing half in position, and secure the two halves together with the bolts, lock washers and nuts.

(3) *AXLE SHAFT INSTALLATION.* Install the hub and drum assemblies on the axle housing, then install new gaskets on the hub flanges. Insert the axle shafts in the housing until the splines on the shafts mesh with the splines of the differential side gears. Install the tapered dowels, lock washers and nuts. Fill the rear axle with the correct amount of rear axle lubricant.

d. Axle Installation.

Install the rear wheels, then roll the axle assembly into position under the vehicle. Install the spring clips (U-bolts), lock washers and nuts. Tighten the spring clip nuts to the correct torque (165-185 foot-pounds on F-2 and F-3; 285-310 foot-pounds on F-4 and F-5). Connect the coupling shaft to the rear axle universal joint flange. Connect the hydraulic brake hose to the rear axle hydraulic brake pipe. Lower the vehicle to the floor, then tighten the wheel stud nuts.

4. BANJO HOUSING SPIRAL BEVEL REAR AXLE

The rear axle installed as standard equipment on F-8 trucks is the banjo housing spiral bevel type (fig. 36).

The procedure for the removal of the banjo housing spiral bevel rear axle is given under "**a.** Axle Removal." Heading "**b.** Axle Disassembly" contains the procedures for axle disassembly. The assembly and adjustment procedures are given in "**c.** Axle Assembly and Adjustment," and the installation procedure is given under "**d.** Axle Installation."

The axle housing rear cover is bolted to the axle housing The axle housing is equipped with a drain plug and a vent assembly. The rear spring seats are welded to the axle housing. The brake backing plates are riveted to flanges which are welded to the axle housing. The outer ends of the housing are machined for the installation of the wheel bearings, and are threaded to accommodate the wheel bearing adjusting nuts.

The differential carrier is a steel casting, reinforced with ribs and webs to increase rigidity. The carrier is attached to the axle housing with studs and nuts, and a gasket is installed between the carrier and the housing. The drive pinion assembly and the differential case assembly are mounted in the differential carrier and are removed as part of the carrier when the carrier is removed from the axle housing. The differential carrier assembly may be removed while the axle is still installed in the vehicle after the axle shafts have been removed and the drive shaft has been disconnected.

A thrust bock is mounted on the end of a screw which is threaded into an opening in the differential carrier. This thrust block limits the flexing of the ring gear under severe loads. The clearance between the thrust block and the back face of ring gear is adjusted by means of an adjusting nut which is threaded on the outer end of the thrust block screw.

The rear axle is equipped with an oil collector. The oil collector is installed through an opening in the differential carrier, and is kept in contact with the back face of the ring gear by the tension of the oil collector spring. The spring is installed in the tubular oil collector and is held in place by a cover which is attached to the carrier housing with cap screws.

The differential assembly is the four-pinion type, and is mounted in a two-piece case. The case halves are held together with cap screws which thread into the left-hand (flanged) half of the case. A lock wire is threaded through the heads of the cap screws to prevent accidental loosening. Thrust washers are used between the differential side gears and case and between the differential pinions and case.

The differential side bearings are the tapered roller type, and are pressed onto the differential case hubs. The bearing cups are retained by the side bearing adjusters and by the side bearing caps. The side bearing adjusters thread into the bores formed by the bearing caps and the differential supports. The bearing caps are attached to differential supports with long cap screws, secured with lock wires. The side bearing adjusting rings provide the means for adjusting the side bearing pre-load, and the back lash between the ring gear and the drive pinion. These adjustments are secured by the bearing adjuster locks, which are attached to the side bearing caps with cotter pins.

The axle is equipped with a straddle mounted drive pinion assembly. The drive pinion bearings are of the opposed tapered roller type, and are a press fit on the drive pinion shaft. The pilot bearing is the straight roller type pressed onto the inner end of the drive pinion, and is retained with a snap ring. The pilot bearing seats in a machined bore in the differential carrier. The drive pinion bearing cups are pressed into the drive pinion sleeve until seated against a shoulder in the sleeve. The drive pinion sleeve is pressed into a bore in the differential carrier. The drive pinion and sleeve assembly may be removed from the differential carrier, after the differential assembly has been removed, by using puller screws in the holes provided in the drive pinion sleeve flange.

Shims of various thicknesses are installed between the drive pinion sleeve and the differential carrier. These shims provide a means for adjusting the pinion depth in the ring gear and also the blacklash between the ring gear and the pinion.

A spacer is installed between the inner and outer drive pinion bearings. This spacer is available in several thicknesses and is used to adjust the drive pinion bearing pre-load.

A lip type spring loaded oil seal is pressed into the drive pinion oil seal retainer, until seated against the oil seal felt. The oil seal wipes against the outer diameter of the propeller shaft flange. A cork gasket, installed in a groove in the drive pinion sleeve flange provides additional sealing facilities. The oil seal retainer is attached to the differential carrier with the same bolts which secure the drive pinion sleeve on the carrier.

The propeller shaft flange is a press fit on the drive pinion shaft splines, and is retained on the shaft with a washer, nut, and cotter pin.

The axle shafts are the full-floating type, with the inner ends splined to the differential side gears. The axle shaft flanges are attached to the hubs with studs, lock washers, and nuts. The stud holes in the axle shaft flanges are taper reamed for the installation of split tapered dowels. The axle shafts may be removed without removing the axle assembly from the vehicle.

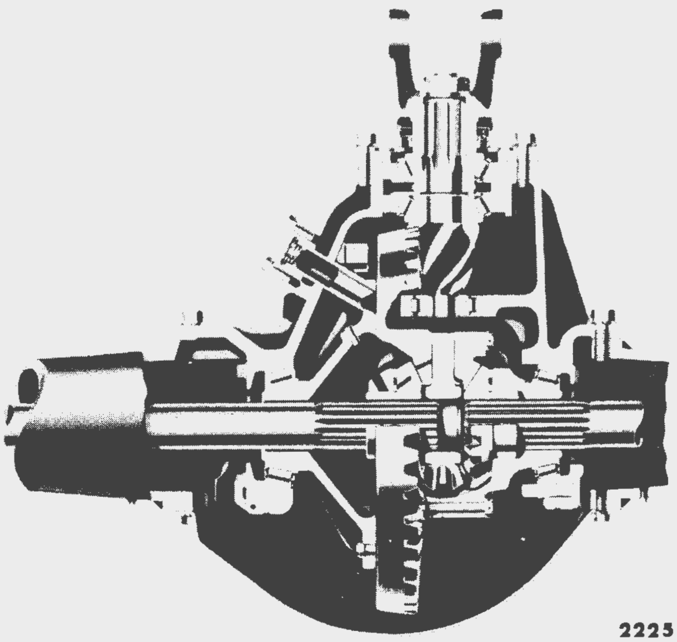

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Fig. 36—Banjo Housing Spiral Bevel Rear Axle

a. Axle Assembly Removal.

Loosen the wheel stud nuts, then raise the rear of the vehicle. Disconnect the hydraulic brake hose from the hydraulic brake pipe at the rear axle.

NOTE: ***If the vehicle is equipped with air brakes, bleed the air from the system, then disconnect the air brake hose from the rear brake chambers.***

Disconnect the coupling shaft from the rear axle universal joint flange. Remove the nuts and washers from the spring clips (U-bolts), then remove the spring clips. Roll the axle assembly out from under the vehicle, then remove the wheels.

b. Axle Disassembly.

The axle shafts or the differential carrier may be removed separately for minor repairs or adjustments. If a complete overhaul is desired, the rear axle should be completely disassembled. The disassembled view of the banjo housing spiral bevel rear axle (fig. 37) shows the component parts in their relative positions and should be referred to when performing the disassembly and assembly procedures.

(1) *AXLE SHAFT REMOVAL.* Drain the lubricant from the axle housing, then remove the axle shaft stud nuts and washers. Tap the axle shaft sharply in the center of the flange with a heavy steel hammer to free the dowels, then remove the dowels. Install the puller screws, then remove the axle shaft from the housing. Remove the hub and drum assemblies.

(2) *DIFFERENTIAL CARRIER REMOVAL.* Support the carrier assembly properly with a roller jack then remove the carrier to housing bolts and lock washers. Carefully withdraw the carrier assembly from the axle housing. Remove and discard the axle housing gasket.

(3) *DIFFERENTIAL CARRIER DISASSEMBLY.* Remove the oil distributor cover, gasket, spring and the oil distributor from the carrier. Loosen the thrust block lock screw, then back out the thrust screw to provide clearance between the thrust block and ring gear when the differential is removed. Mark the differential bearing caps and the carrier legs with a punch. These marks are to be used as a guide when installing the bearing

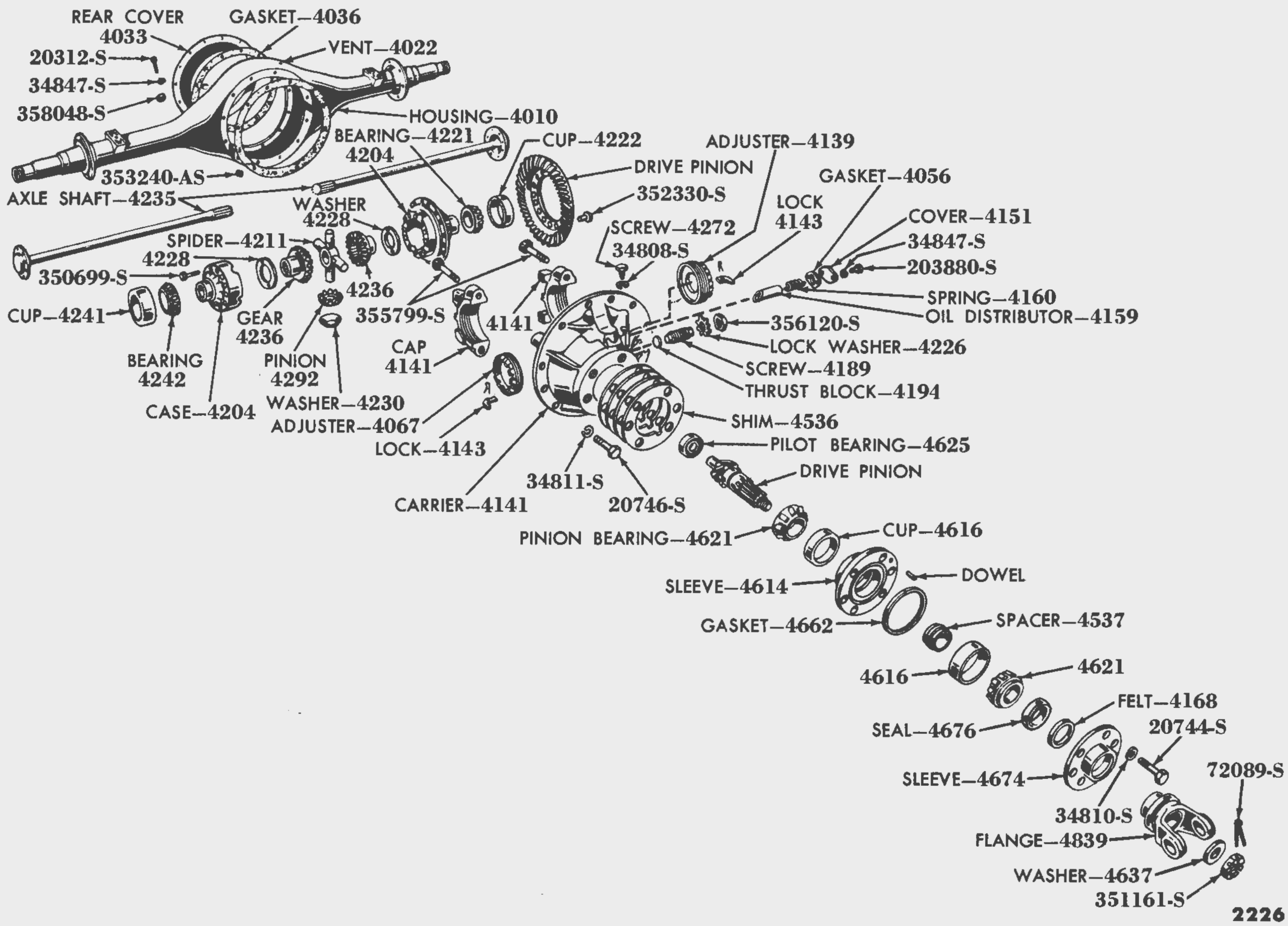


Fig. 37—Banjo Housing Spiral Bevel Rear Axle

caps. Remove the adjuster locks. Remove the bearing cap bolts and the bearing caps. Remove the side bearing adjuster, then lift the differential assembly out of the carrier. Remove the ring gear thrust block from the carrier.

(4) *DIFFERENTIAL DISASSEMBLY.* Mark the differential case halves with a punch (fig. 14) before disassembling as this will aid in aligning the case when reassembling. Cut the lock wire and remove the differential case bolts and nuts. Separate the case halves, using a brass hammer if necessary, then remove the side gears, spider, pinions, and thrust washers. Drive the differential side bearings off the case hubs using a brass drift and working through the holes in the case halves. Center punch the drive gear rivet heads. Drill through the rivet heads (fig. 16) using a drill $\frac{1}{32}$ inch larger than the rivet body. Press out the rivets and tap the drive gear off the case.

(5) *DRIVE PINION REMOVAL AND DISASSEMBLY.* Hold the universal joint flange and remove the cotter pin, nut and washer from the drive pinion shaft. Remove the flange using the tool shown in fig. 18. Remove the bolts and lock washers which attach the oil seal retainer and the pinion bearing sleeve to the differential carrier. Remove the pinion and sleeve from the carrier as an assembly. Remove the pinion bearing sleeve shims noting the quantity and thicknesses used. Remove the oil seal retainers, the front pinion bearing, and the pinion bearing spacer from the sleeve. Tap the drive pinion out of the pinion bearing sleeve. Press the drive pinion rear bearing off the shaft using a collar which will apply pressure on the bearing cone. Remove the pilot bearing with the tool shown in fig. 20.

c. Axle Assembly and Adjustment.

The assembly of the banjo housing sprial bevel rear axle includes the drive pinion bearing pre-load adjustment, the differential bearing pre-load adjustment, and the drive gear and pinion blacklash adjustment. These adjustments must be made carefully to ensure proper axle performance. Refer to fig. 37 for the relative position of the component parts.

(1) *DRIVE PINION ASSEMBLY AND ADJUSTMENT.* Press the drive pinion pilot bearing on the pinion, then stake the bearing in place. Press the pinion rear bearing on the shaft until seated against the back face of the pinion gear. Insert the drive pinion into the pinion bearing sleeve, then install the bearing spacer, front pinion bearing cup and the front bearing in the sleeve. Install a new felt grease retainer in the oil seal retainer, then press the oil seal into the retainer until flush with the retainer face. Install the retainer on the drive pinion, then install the universal joint flange, washer, and nut. Tighten the nut to 300-400 foot-pounds torque, then check the pinion bearing pre-load (fig. 22). If the bearing pre-load is not between 12-25 inch-pounds, use a thinner spacer to increase or thicker spacer to decrease the pre-load. After the correct pre-load has been obtained, install a new cotter pin in the shaft nut. Place the original amount of pinion bearing sleeve shims on the axle housing, then install the drive pinion and cage assembly in the housing.

(2) *DIFFERENTIAL ASSEMBLY.* Position the drive gear on the differential case, then rivet the gear to the case. Press the differential side bearings on the case halves. Assemble the pinions, side gears, spider, and thrust washers in the drive gear half of the differential case. Install the other half of the case making sure the punch marks on the case halves are aligned. Install the differential case bolts, nuts, and lock wires.

(3) *DRIVE GEAR ADJUSTMENT.* Install the thrust block screw in the axle housing, then place the thrust block on the screw. Place the side bearing cups over the side bearings, then position the differential assembly in the carrier. Position the bearing adjusters in the carrier, making sure the adjuster threads mesh with the threads in the carrier. Install the bearing cups in their original positions using the aligning marks as a guide. Tighten the bearing cap bolts enough to hold the adjuster snug but still permit their rotation. Tighten the adjusters hand-tight against the side bearing cups. Turn the left-hand adjuster until the drive gear meshes with the pinion gear loosely. Turn the right-hand adjuster as tightly as possible, then back off one notch. Mount a dial indicator on the carrier, then adjust the drive gear to obtain 0.006 to 0.010 inch blacklash. To reduce the blacklash, loosen the right-hand adjuster and tighten the left-hand adjuster the same number of notches. To increase the blacklash, perform the same operation in reverse. Check the gear tooth contact against the patterns shown in fig. 11. If tooth contact adjustment is necessary, the drive pinion position may be changed by varying the thickness of the shim pack between the pinion sleeve and the carrier. The drive gear position is adjusted by means of the side bearing adjusters. After the backlash and tooth contact adjustments have been made, tighten the bearing cap bolts securely. Install the adjuster locks and cotter pins. Tighten the thrust block screw until the thrust block touches the drive gear. Back off the screw at least $\frac{1}{6}$ turn but not more than $\frac{1}{4}$ turn to provide the proper clearance between the block and the drive gear. Tighten the thrust block lock nut while holding the screw in this position.

(4) *DIFFERENTIAL CARRIER INSTALLATION.* Install the oil distributor, spring, gasket, and cover on the differential carrier. Place a new carrier-to housing gasket on the axle housing, making sure the bolt holes

in the gasket are aligned with the holes in the housing. Place the differential carrier assembly on a roller jack, then roll the carrier into position. Start the carrier into the housing with four bolts equally spaced. Tighten the bolts alternately to draw the carrier squarely into the housing. Install and tighten the remaining carrier to housing bolts.

(5) *AXLE SHAFT INSTALLATION.* Install the hub and drum assemblies, then adjust the wheel bearings. Install the axle shaft flange gaskets, then insert the axle shafts into the axle housing. Rotate each shaft until the shaft splines mesh with the side gear splines and the stud holes in the shaft flange are aligned with the studs. Install the tapered dowels, then install the lock washers and stud nuts.

d. Axle Installation.

Install the wheels, then roll the axle assembly into position under the vehicle. Install the spring clips (U-bolts) and nuts. Tighten the nuts to 285-310 foot-pounds torque. Connect the drive shaft to the rear axle universal joint flange. Connect the hydraulic brake hose to the rear axle hydraulic brake pipe.

NOTE: ***If the vehicle is equipped with air brakes, connect the air brake hose to the rear brake chambers.***

Lower the vehicle to the floor, then tighten the wheel stud nuts.

5. PLANETARY TWO-SPEED

Planetary two-speed axles (fig. 38) are available, as optional equipment, for the F-5, F-6, F-7 (1951) and F-8 series trucks.

The two speed axle available for use on the F-5 and F-6 trucks is equipped with the spiral bevel type drive gear and pinion. The two-speed axle available for use on the F-8 truck is similar except for the size of the component parts and the construction of the drive pinion assembly.

A planetary hypoid two-speed axle is available as optional equipment for the F-7 truck. This axle is similar to the other two assemblies except it is equipped with the hypoid type drive gear and pinion.

The axle replacement procedures are given under the headings "a. Axle Removal and Disassembly" and "b. Axle Assembly, Adjustment, and Installation". Service information on the shift mechanism is covered under "c. Vacuum Shift Mechanism."

These procedures apply to all planetary two-speed rear axle assemblies, unless otherwise stated in the text.

The two-speed axles are equipped with banjo type housings. The axle housing cover is bolted to the housing. The spring seats and flanges for attachment of the brake backing plates are welded to the housing. The outer ends of the housings are machined for installation of the wheel bearings, and threaded to accommodate wheel-bearing adjusting nuts.

The differential carrier (fig. 39) is a steel casting

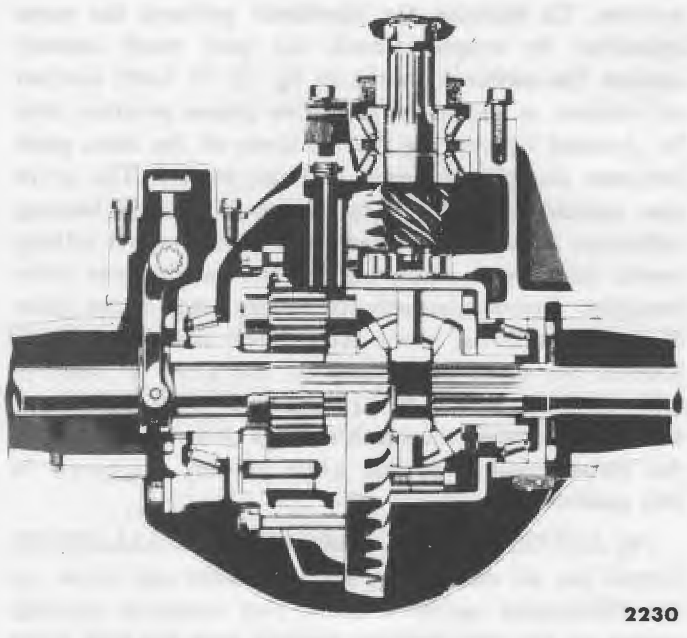


Fig. 38—Planetary Two-Speed Axle (F-8 Shown)

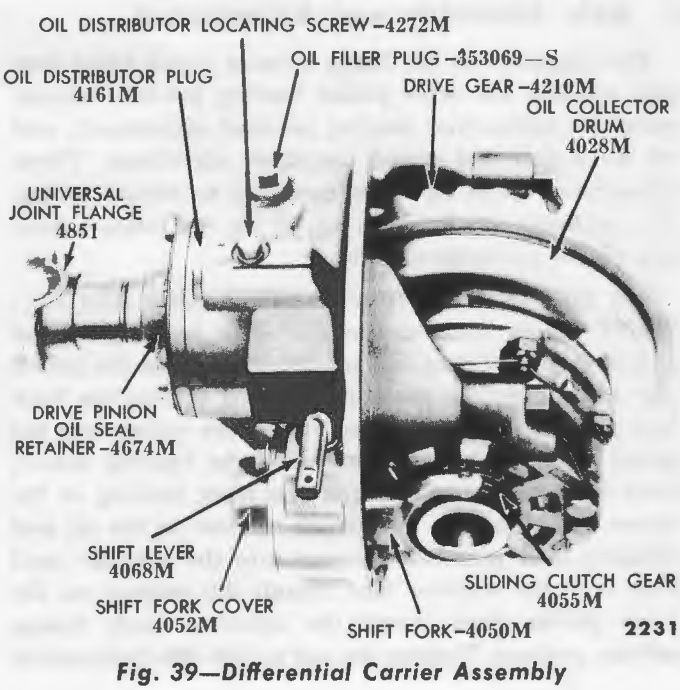


Fig. 39—Differential Carrier Assembly

reinforced with ribs and webs to increase rigidity, and is attached to the axle housing with cap screws. A gasket is used between the housing and the carrier.

The drive pinion assembly, differential assembly, planetary unit, shifting mechanism, and oil collector are removed as part of the carrier, when the carrier is removed from the axle housing.

The differential carrier may be removed, while the axle is still installed in the vehicle after the axle shaft has been removed and the couping shaft has been disconnected.

The oil distributor (fig. 40) is installed in an opening in the differential carrier, and is held in place by a spring which is retained by the oil distributor plug. An oil distributor locating screw keeps the distributor positioned so the beveled edge is next to the oil collector drum, which is mounted on the back face of the ring gear. Spring tension holds the oil distributor against the coil collector drum. The differential and planetary assembly is installed in a two-piece support case. The drive gear and oil collector drum are installed between the halves of the support case and retained in place by the same bolts which fasten the support case halves together. The support case is mounted in two opposed tapered roller bearings which are pressed on the support case hubs. The bearing cups are held in place by bearing adjusters, which thread into the bore formed by the bearing caps and the machined supports in the differential carrier. The bearing adjusters provide means for setting side bearing pre-load, and for adjusting backlash between the drive gear and the drive pinion. Bearing adjusters are secured in place by bearing adjuster locks. The left-hand lock is mounted on the left-hand bearing cap with two cap screws. The right-hand lock

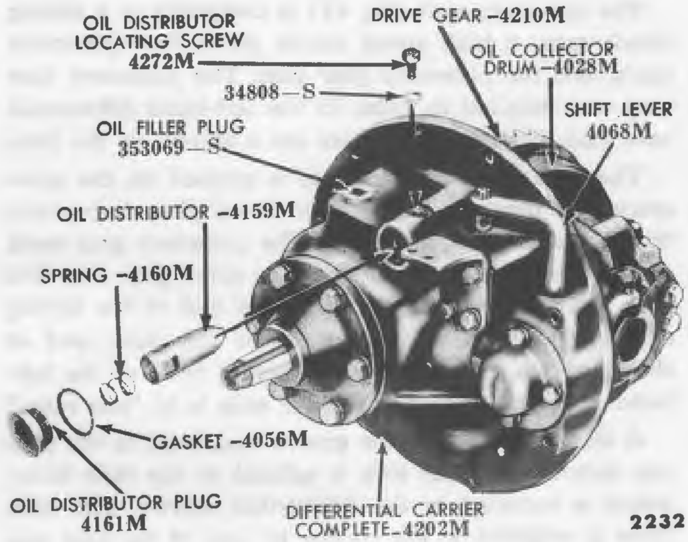


Fig. 40—Differential Carrier Oil Distributor

is fastened to the right-hand bearing cap with a cotter pin. Long stud bolts are used to attach each bearing cap to the differential carrier and a lock wire is installed through the heads of each pair of stud bolts.

The differential assembly is the four-pinion type, and is mounted in a two-piece case. Case halves are bolted together with stud bolts, which are secured with lock wires. A thrust washer is used between the differential case and the right-hand support case. Thrust washers are also installed between the differential pinions and case, and between the differential side gears and case. Thickness of the thrust washers should be checked when the differential is disassembled, and the thrust washers replaced if excessive wear is evident.

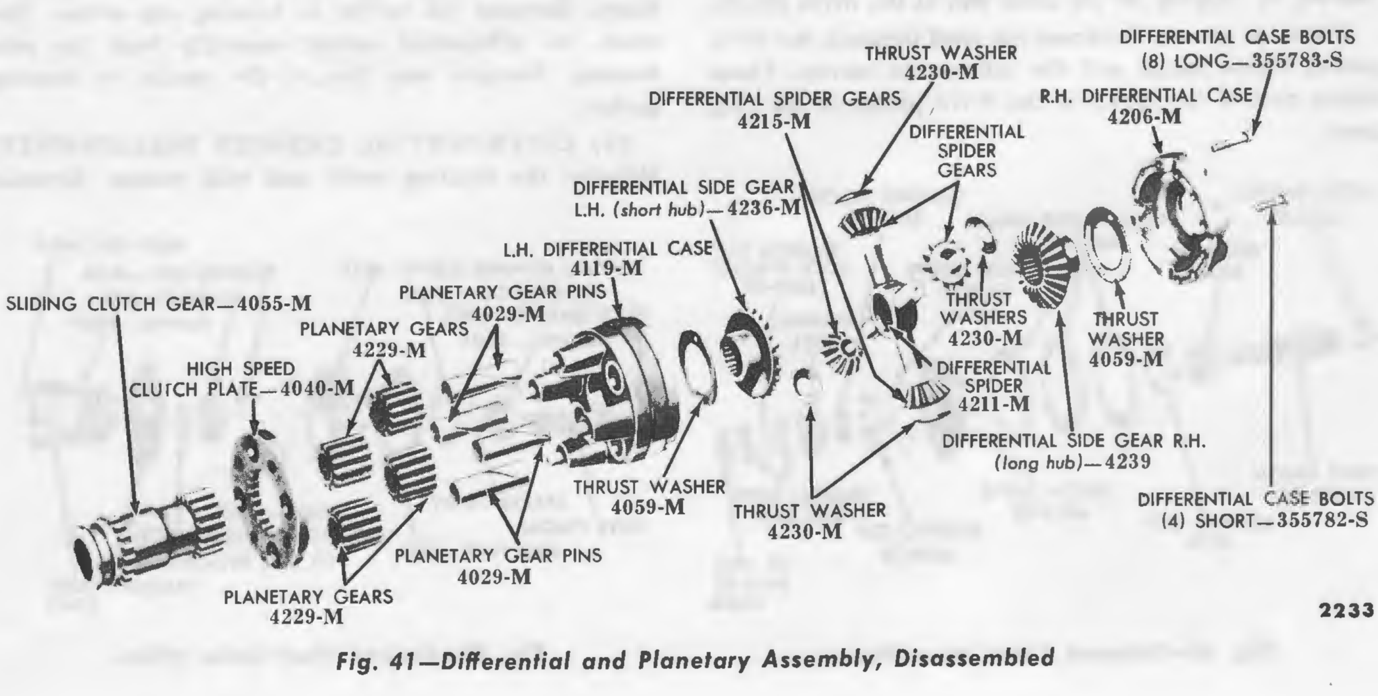


Fig. 41—Differential and Planetary Assembly, Disassembled

The planetary unit (fig. 41) is composed of a sliding clutch gear, a high speed clutch plate, four planetary gears, and the planetary gear pins. The planetary gear pins are installed in holes in the left-hand differential case, and the planetary gears are a slip-fit on the pins.

The high speed clutch plate is pressed on the planetary gear pins and on the four dowel pins, driven into the left-hand differential case. The planetary gear teeth mesh with the internal teeth of the drive gear, and also with the external teeth at the inner end of the sliding clutch gear. The external teeth at the outer end of sliding clutch gear mesh with internal teeth of the left-hand bearing adjuster when the axle is in "low ratio."

A shift fork rides in the groove machined in the sliding clutch gear. This fork is splined to the shift lever, which is installed in the differential carrier. The shift lever is retained in the carrier by one of the four cap screws which attach the shift fork cover to the carrier. A gasket is used between the shift fork cover and the differential carrier.

The two-speed rear axle, available for early production vehicles of the F-5 and F-6 series, is equipped with a drive pinion having a tapered shaft (fig. 42).

This drive pinion is straddle mounted in two opposed tapered roller bearings, which are pressed on the drive pinion shaft. The pilot bearing is the straight roller type, and is pressed on the inner end of the drive pinion. The pilot bearing seats in a machined bore in the differential carrier. The pinion bearing cups are pressed into the pinion sleeve until seated against the shoulder in the sleeve. The drive pinion sleeve is pressed into the bore of the differential carrier. The drive pinion and sleeve assembly may be removed from the carrier, after the differential and planetary assembly has been removed, by tapping on the inner end of the drive pinion.

Shims of various thickness are used between the drive pinion sleeve flange and the differential carrier. These shims control the depth of the drive pinion in the ring gear.

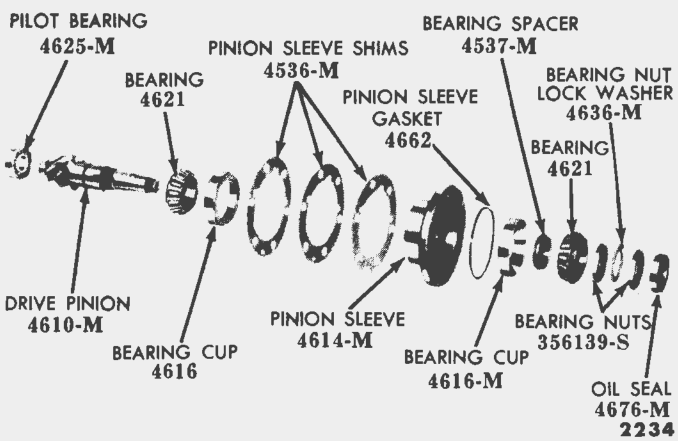


Fig. 42—Tapered Shaft Drive Pinion

A spacer is used between the inner and outer drive pinion bearings. Spacers are available in several thicknesses and are used to control the drive pinion bearing pre-load. The drive pinion is held in the pinion sleeve by the bearing adjusting nut, lock washer, and lock nut.

A spring loaded lip type oil seal is pressed into an oil seal retainer. This oil seal retainer is bolted to the differential carrier with the same cap screws which attach the drive pinion sleeve to the carrier. A cork gasket, used in the drive pinion sleeve, acts as an additional oil seal. The universal joint flange is keyed to the drive pinion shaft and retained with a nut and cotter pin.

The two-speed axles used on late production vehicles of the F-5 and F-6 series trucks and on all F-8 series trucks are equipped with drive pinions having splined shafts (fig. 43). The construction of this drive pinion is similar to the tapered shaft pinion, except the universal joint is splined to the drive pinion and the pinion is held in the pinion sleeve by the flange nut.

a. Axle Removal and Disassembly.

The removal of the two-speed axles and the full-floating type axle shafts may be accomplished by following the procedures given under "Banjo Housing Spiral Bevel Axle."

The disassembled view of the two-speed axle (fig. 44) shows the component parts in their relative positions, and should be referred to when performing the procedures given in the following paragraphs.

(1) *DIFFERENTIAL CARRIER REMOVAL.* Place the axle in low range, then remove the clevis pin from the diaphragm clevis. Remove the shift diaphragm and bracket assembly. It is not necessary to disconnect the diaphragm assembly from the hose, but fasten it to the frame. Remove the carrier to housing cap screws. Remove the differential carrier assembly from the axle housing. Remove and discard the carrier to housing gasket.

(2) *DIFFERENTIAL CARRIER DISASSEMBLY.* Remove the locating screw and lock washer. Remove

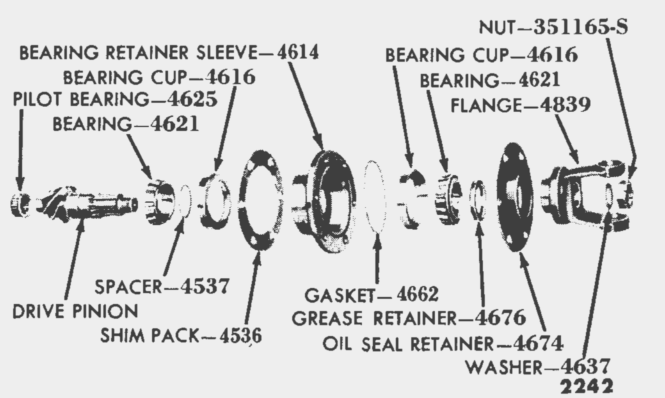


Fig. 43—Splined Shaft Drive Pinion

the oil distributor plug and gasket. Pull the oil distributor and spring out of the differential carrier.

Remove the three short cap screws and the one long cap screw and lock washers which hold the shift fork cover to the differential carrier. Note the location of the long cap screw which locks the shift lever in position. Remove the cover and gasket. Remove the shift fork plunger and spring from the shift fork. Pull the shift lever out of the shift fork. The shift lever felt washer and retainer should not be removed unless they are damaged or worn. Slide the shift fork from the housing. Pull the sliding clutch gear out of the differential carrier.

Mark the right-hand and left-hand bearing adjusters with a punch to aid in relocating the adjustment when reassembling. Remove the lock wires from the right-hand and left-hand differential bearing cap bolts and remove the bolts. Remove the right- and left-hand bearing caps, bearing adjusters, and locks. Lift the differential and planetary assembly out of the differential carrier.

Remove the lock wire and nuts from the bolts which hold the drive gear to the gear support cases. Remove the bolts. Tap the drive gear with a brass hammer and remove the right-hand gear support case. Remove the left-hand gear support case,, high speed clutch plate thrust washer, and oil collector drum. Slide the drive gear off the differential and planetary gear assembly.

(3) *DIFFERENTIAL AND PLANETARY GEAR DISASSEMBLY.* Remove the high speed cluch plate by tapping on each side alternately with a soft hammer. Remove the planetary gears and the planetary gear bronze pins (fig. 41). Remove the lock wire and 12 cap screws from the differential assembly and separate the right- and left-hand differential cases. Remove the differential side gears and thrust washers. Remove the differential spider gears and thrust washers and the differential spider.

(4) *DRIVE PINION REMOVAL.* Remove the cotter pin and nut which hold the universal joint flange on the pinion shaft and drive the universal joint flange off the pinion shaft, using a soft hammer. Remove the six cap screws which attach the pinion retainer assembly to the differential carrier. Drive the pinion assembly

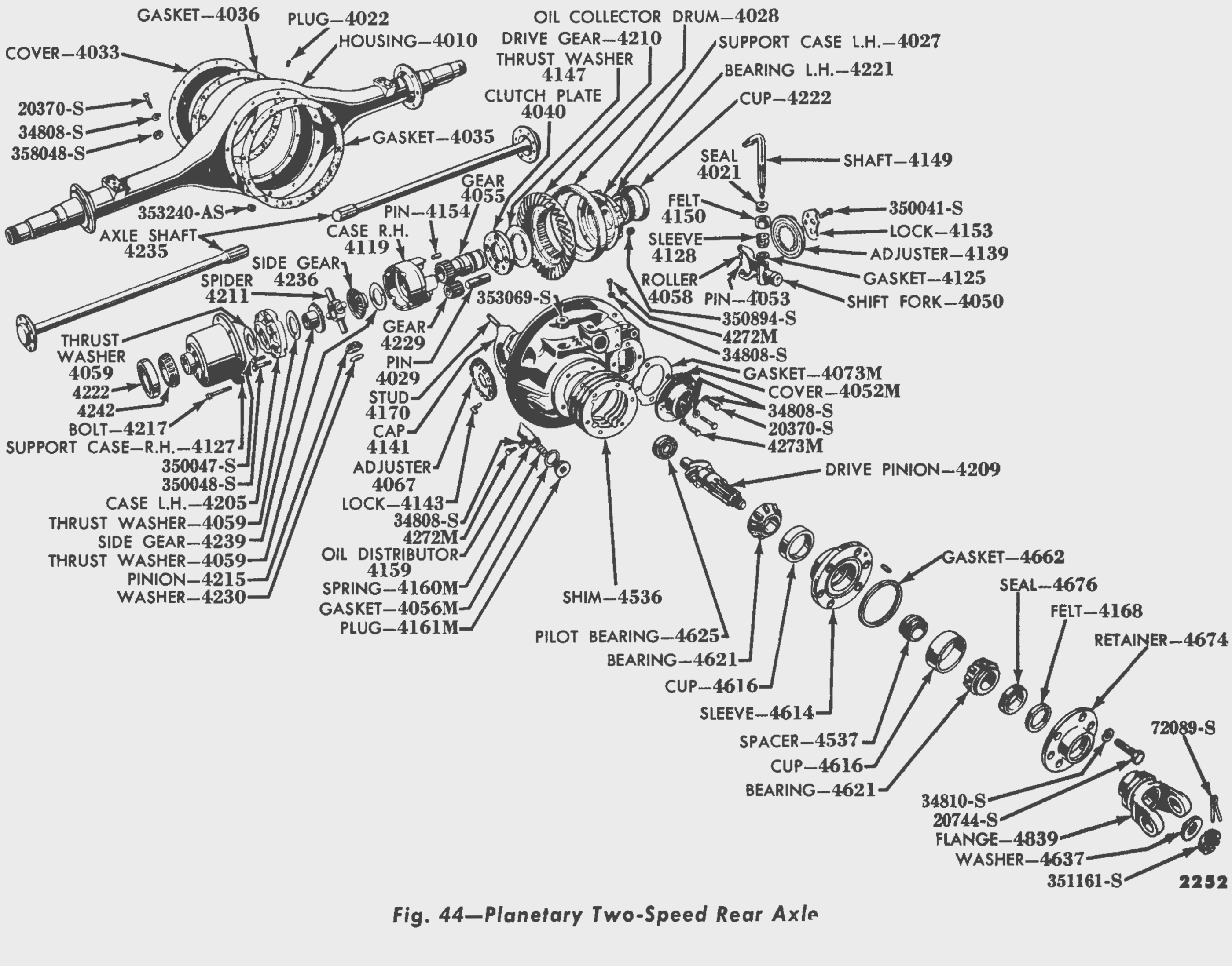


Fig. 44—Planetary Two-Speed Rear Axle

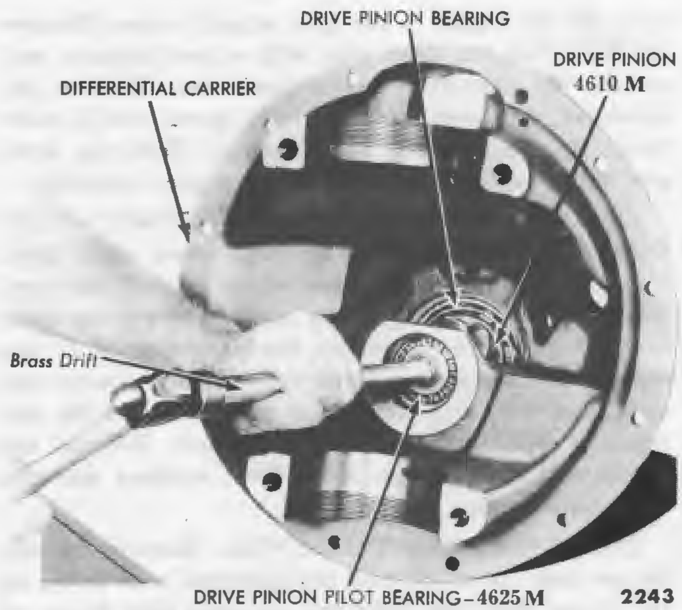


Fig. 45—Drive Pinion Removal

out of the differential carrier housing as shown in fig. 45.

(5) *DRIVE PINION DISASSEMBLY.* The disassembly procedure for the tapered shaft drive pinion is given under "(a) Tapered Shaft Drive Pinion." The disassembly procedure for the splined shaft drive pinion is covered under "(b) Splined Shaft Drive Pinion."

(a) TAPERED SHAFT DRIVE PINION. Place the drive pinion assembly in a vise. Bend the ears of the lock washer away from the pinion bearing adjusting nuts. Remove the pinion bearing nuts and lock washer, using two thin 2¼-inch open end wrenches. Lift the pinion sleeve, including the pinion bearing outer cone and pin-

Fig. 46—Differential Bearing Removal from Right-Hand Gear Support Case

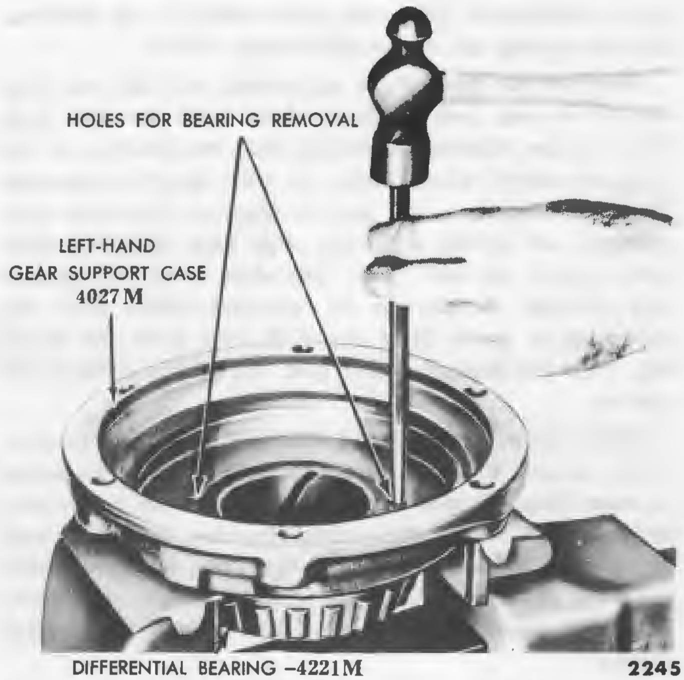


Fig. 47—Differential Bearing Removal from Left-Hand Gear Support Case

ion bearing spacer off the pinion shaft.

(b) SPLINED SHAFT DRIVE PINION. Remove the oil seal retainer from the drive pinion. Lift the pinion sleeve, including the front pinion bearing, off the pinion. Remove the pinion bearing spacer.

(6) *BEARING, BEARING CUP, AND OIL SEAL REPLACEMENT.* All bearings, bearing cups, and oil

Fig. 48—Differential Bearing Installation on Right-Hand Gear Support Case

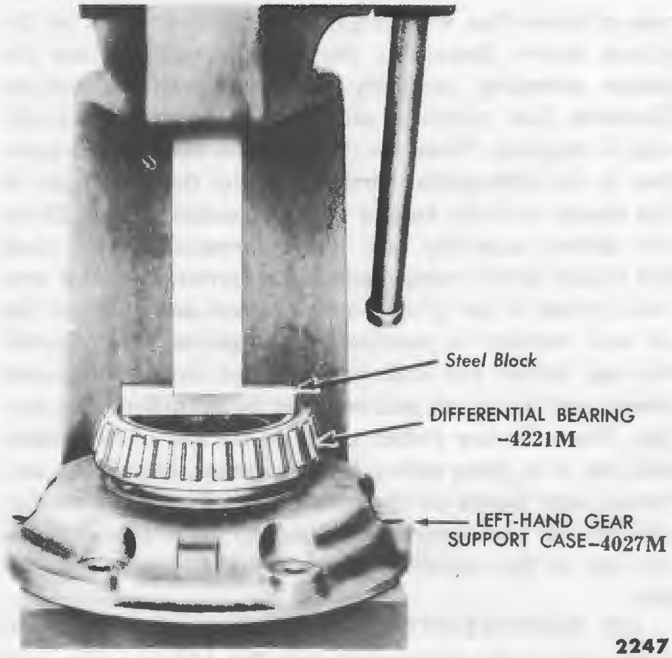


Fig. 49—Differential Bearing Installation on Left-Hand Case

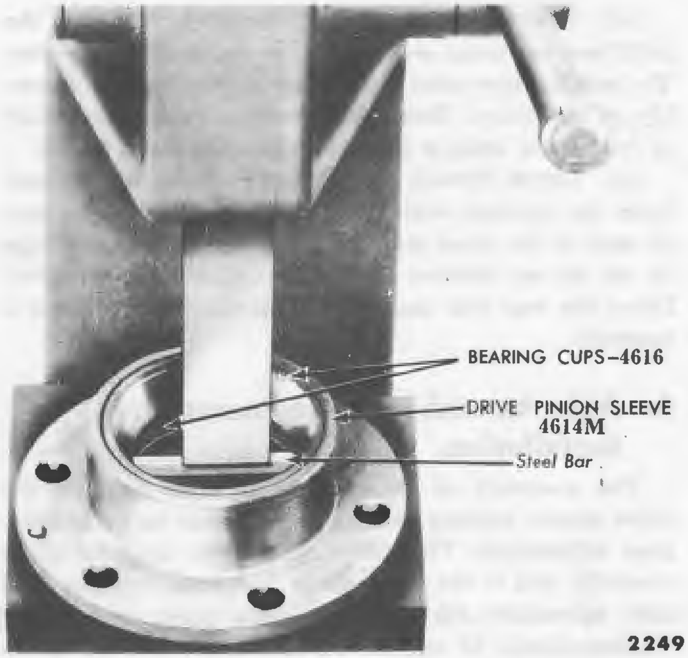


Fig. 51—Bearing Cup Removal from Pinion Sleeve

seals should be inspected and replaced, if necessary, following the procedure given in the following paragraphs:

(a) DIFFERENTIAL BEARINGS. Remove the bearing from either the right- or left-hand gear support case by using a drift and striking the bearing inner race on alternate sides through holes provided in the support cases (figs. 46 and 47). To install a new bearing on either the right- or left-hand support case, place either part in a press, and using a square steel block, press the bearing on the case until it is flush with the shoulder of the case (figs. 48 and 49).

(b) DRIVE PINION BEARING CUP. Place the drive pinion sleeve in a press. Insert a steel bar $3\frac{7}{16}$ inches long through the hole in the sleeve (fig. 50) between the bearing cups. Press out one of the pinion bearing cups (fig. 51). Turn the sleeve over and remove the other cup in the same manner. To install a new bearing cup, place the pinion sleeve in a press and, using a steel bar, press the cup in the sleeve until it is seated against the recess in the sleeve. Repeat this operation for the other cup.

(c) DRIVE PINION BEARING. Remove the rear pinion bearing from the pinion shaft, using a blunt chisel and tapping on the bearing cone between the teeth of the pinion. To install the pinion bearing, press the bearing on the pinion shaft as shown in fig. 52.

Fig. 50—Insert Steel Bar in Pinion Sleeve

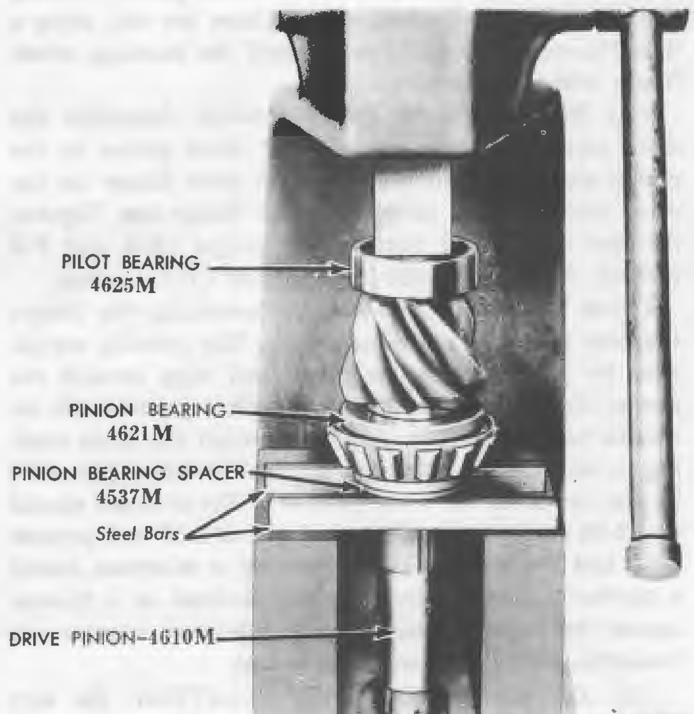


Fig. 52—Rear Bearing Installation on Pinion

(d) DRIVE PINION PILOT BEARING. Remove the pilot bearing, using an arbor press and a suitable collar. To install a new pilot bearing, press the bearing assembly on the pinion. Stake the bearing on the pinion shaft at four spots, using a bearing ball as shown in fig. 53.

(e) DRIVE PINION OIL SEAL. Remove the oil seal from the retainer with a small punch. Position a new oil seal in the drive pinion retainer with the sharp edge of the oil seal leather facing the inside of the retainer. Drive the seal into position with a wooden block and a hammer.

b. Axle Assembly, Adjustment and Installation.

The assembly of two-speed rear axles includes the drive pinion bearing pre-load adjustment and the drive gear adjustment. The axle adjustments must be made carefully and in the order given to ensure a proper rear axle operation. All bearings, cups, gears, and thrust washers should be coated with rear axle lubricant before installation to prevent scoring during initial operation.

(1) *DRIVE PINION ASSEMBLY AND ADJUSTMENT*. The procedure which applies to the tapered shaft drive pinion is given in subpar. (a). Subpar. (b) contains the procedure for the splined shaft drive pinion.

(a) TAPERED SHAFT DRIVE PINION. Place the pinion and bearing assembly, with the gear facing downward, in a vise equipped with brass jaws. Place the drive pinion sleeve and cup assembly over the rear pinion bearing with flange facing upward. Place the bearing spacer on the pinion. Install the front pinion bearing and the bearing adjusting nut. Tighten the nut, using a thin 2¼-inch open end wrench until the bearings rotate freely without end play.

(b) SPLINED SHAFT DRIVE PINION. Assemble the drive pinion bearings, spacer, and drive pinion in the pinion sleeve. Install the universal joint flange on the drive pinion shank, then install the flange nut. Tighten the nut to 200-250 foot-pounds torque (F-5 and F-6 trucks), and to 300-400 foot-pounds (F-8 trucks).

Check the bearing pre-load by measuring the torque required to rotate the pinion sleve. The rotating torque may be measured by wrapping soft wire around the sleeve, then pulling on the wire with a pound-scale attached to the wire (fig. 22). To convert the scale reading to inch-pounds, multiply the scale reading (pounds) by the radius of the scale (inches). The pre-load should be 12-25 inch-pounds (F-8 trucks) and 8-15 inch-pounds (F-5 and F-6 trucks). If the pre-load is incorrect, install a thicker spacer to decrease the pre-load or a thinner spacer to increase the pre-load. Bearing spacers are available in 12 different thicknesses.

(2) *DRIVE PINION INSTALLATION*. Be sure the differential carrier surface, contacted by the pinion sleeve, has no nicks or high spots. Place the same thickness of shims that were originally used in position on the pinion sleeve. Generally, these shims will position the pinion assembly correctly in the differential carrier. However, four shims of different thicknesses are available if required. Place the drive pinion assembly in position in the differential carrier. Line up the dowel pin in the sleeve with the hole in the differential carrier. Drive the pinion assembly into the differential carrier until the pinion sleeve seats against the carrier. Install a new cork gasket in the groove in the pinion sleeve. Place the oil seal retainer in position on the pinion shaft. Install the cap screws and lock washers that secure the pinion sleeve and pinion oil seal retainer to the differential carrier. Place the key (when used) in the slot of the pinion and tap it in place with a brass hammer. Install the universal joint flange on the pinion, then install the washer and the nut that secures the flange to the pinion. Tighten the nut to the correct torque, then install a new cotter pin.

(3) *DIFFERENTIAL ASSEMBLY*. Place the left-hand half of the differential case (fig. 41) in a vise with the planetary side facing downward. Place one of the differential side gear thrust washers in position in the case with the chamfered side facing upward. Place the differential left hand side gear (with the short hub) in position in the case. Install the four differential pinions and thrust washers on the differential spider and place the spider in the differential case. Place the differential right hand side gear (with the long hub) on the pinions. Install the remaining thrust washer on the hub of the side gear with the chamfered side facing downward. Place the right-hand half of the differential case in position over the differential spider and install the differential case bolts. Draw the bolts tight with a long handle wrench.

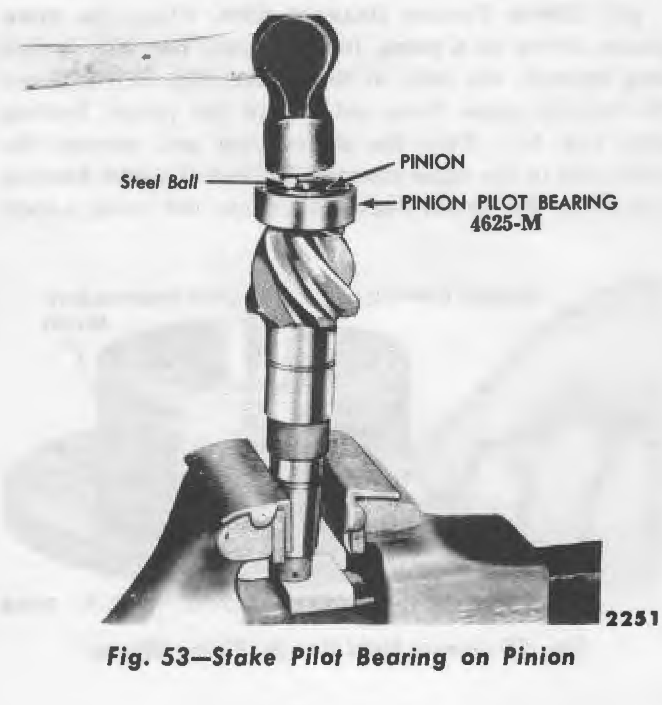


Fig. 53—Stake Pilot Bearing on Pinion

NOTE: ***When tightening the eight long bolts, use a 11/16 hex. socket wrench. A 12-point socket wrench will not fit these bolts properly. Lock the 12 bolts with lock wire.***

(4) *PLANETARY ASSEMBLY.* Place the differential assembly on the bench, and insert the four planetary gear pins in the holes in the differential case (fig. 41). Place the four planetary gears in position on the planetary gear pins. Assemble the high speed clutch plate on the planetary gear pins with the chamfered teeth facing the planetary gears. Tap the plate in place with a brass hammer.

(5) *DRIVE GEAR ASSEMBLY.* Place the right-hand gear support case in a vise with the bearing side facing downward. Position the gear support case thrust washer in the case. Place the differential assembly in the gear support case with the planetary end facing upward. Place the drive gear over the differential assembly with the teeth on the drive gear facing downward, mesh the planetary gears with the internal teeth on the drive gear. Line up the bolt holes in the drive gear with the bolt holes in the gear support case. Place the oil collector drum on the drive gear with the open side facing the gear. See that the tongues on the oil collector drum fit in the recesses on the drive gear. Apply oil to each side of the high speed clutch plate thrust washer and place it in position on the high speed clutch plate. Place the left hand gear support case on the drive gear and line up the bolt holes in the drive gear and both gear support cases. Install the six bolts through the gear support cases with the bolt heads against the flange of the right-hand gear support case. Install the nuts on the bolts and draw up tight with a long handled wrench. Secure the nuts with a lock wire.

(6) *DIFFERENTIAL CARRIER ASSEMBLY.* Position the differential and planetary assembly in the differential carrier. Install the bearing cups on the differential bearings. Install the left-hand bearing cap adjuster. Hold the bearing cap adjuster away from the adjuster threads in the differential carrier until both cap bolts are started, then lower the cap and adjuster into mesh with the threads in the differential carrier. Follow the same procedure to install the right-hand bearing cap and adjuster. Tighten the bolts on both bearing caps, and then loosen them one turn so that the adjusters can be turned to place the drive gear in the correct position.

(7) *DRIVE GEAR ADJUSTMENT.* Turn the left-hand adjuster, using a square bar approximately 12 inches long, until the drive gear loosely meshes with the pinion gear. Turn the right-hand adjuster as tightly as possible, then back it off one notch. This will determine the pre-load of the differential bearings. Adjust the drive gear to obtain the correct amount of backlash (0.006 to 0.010 inch) between the drive gear and pinion. To reduce the backlash, loosen the right-hand adjuster, and tighten the left-hand adjuster the same number of notches. To increase the backlash, loosen the left-hand adjusters, and tighten the right-hand adjuster the same number of notches. Check the backlash, using a dial indicator against the back side of the drive gear.

Check the gear tooth contact by painting several of the teeth on the drive gear with red lead. Turn the gear by hand in both directions to secure impressions of tooth contact. Compare the tooth patterns with those shown in fig. 11. When the correct contact is obtained on the drive side of the teeth, the contact on the coast side of the teeth will usually be satisfactory. If the tooth pattern indicates the backlash between the drive gear and pinion is incorrect, adjust the drive gear position by means of the adjusting rings. If the tooth contact indicates the drive pinion position is incorrect, it is necessary to vary the shim pack between the drive-pinion sleeve and the differential carrier.

After correct adjustment is obtained, use a long handle wrench and tighten the bearing cap bolts as much as possible. Secure the bolts with lock wire. Install the left-hand bearing adjuster lock on the left-hand bearing cap, and secure it with two cap screws. Secure the cap screws with lock wire. Install the right-hand bearing adjuster lock and secure it with a cotter pin.

(8) *DIFFERENTIAL CARRIER ASSEMBLY.* Install the sliding-clutch gear, then place the shift fork in position on the sliding clutch gear. Install the shift lever felt washer and retainer in the recess in the differential carrier. Install the shift lever through the hole in the differential carrier and in the splines in the shift fork. Install the spring and plunger in the shift fork. Place the cover and gasket in position on the differential housing, and secure it with the three short cap screws and one long cap screw and lock washers. The long screw goes in the bottom hole and must fit in the groove in the shaft.

Place the oil distributor and spring in position in the differential carrier. Install the oil distributor plug and gasket. Install the locating screw and lock washer.

(9) *DIFFERENTIAL CARRIER INSTALLATION.* Place a new differential carrier gasket on the axle housing. Position the differential carrier assembly on the axle housing, then install the cap screws and lock washers. Place the vacuum shift diaphragm bracket on the differential carrier, and then install the four cap screws.

Install the 2-speed axle by following the procedures under "Banjo Housing Spiral Bevel Axle."

c. Vacuum Shift Mechanism

The mechanism for shifting the two-speed axle is actuated by a vacuum in the high speed range and by springs in the low speed range. The vacuum shift system is composed of the vacuum control and check valve assembly, the axle shift diaphram assembly, the

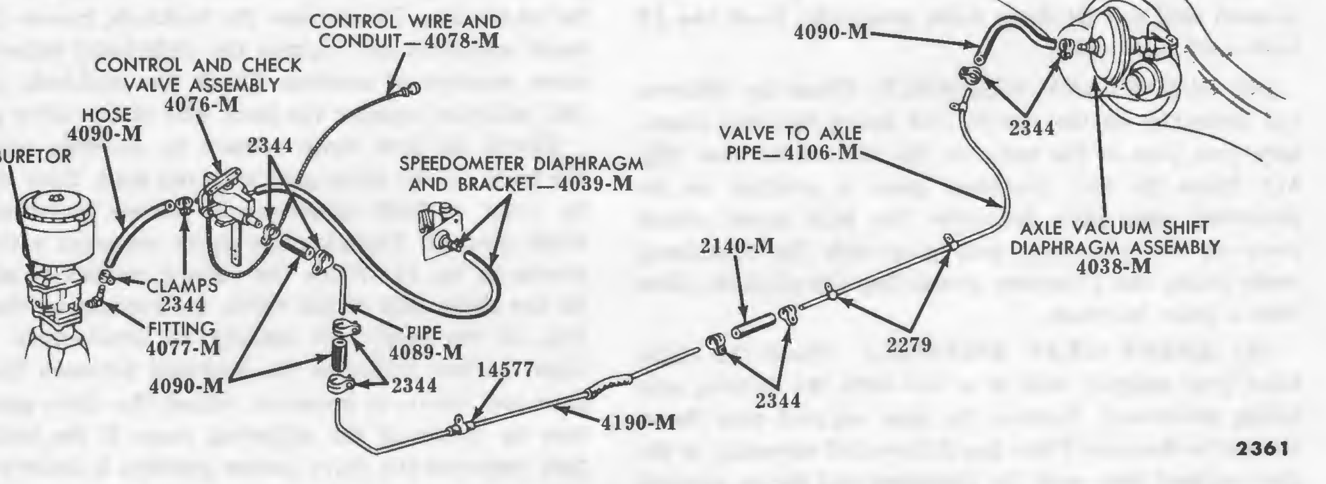


Fig. 54—Two Speed Rear Axle Control System

speedometer adapter and diaphragm assembly, and the interconnecting vacuum tight connections. Figure 54 shows the arrangement of the units of the two-speed rear axle control system.

(1) *VACUUM CONTROL AND CHECK VALVE.* The function of the vacuum control and check valve assembly is to control the vacuum or the passage of air through the system. The valve is acutated by movement of the control knob located on the dash.

When the control knob is pulled out, the control wire pulls the control lever downward and the control valve and the valve seat make an air tight seal. Thus there is an opening straight through the control valve body that is entirely sealed off from any air leaks. Since the check valve ball is spring loaded the ball immediately seats itself if the vacuum draw drops below the compression strength of the spring. With the ball seated the entire control system is vacuum tight. This condition exists when the system is under vacuum and the throttle is held wide open. Fig. 55 shows the position of the control valve parts when the axle is in high range. Fig. 56 shows what takes place in the control valve when the axle is shifted to low range. As the control knob is pushed in, the control wire pulls the control lever upward which lifts the plunger off the valve seat. When the plunger is raised, air enters the system through an air filter. The disc on the bottom of the plunger fills the bore of the check valve body and seals off the passage of air to the intake manifold.

(a) REMOVAL. Remove the cotter pin which secures

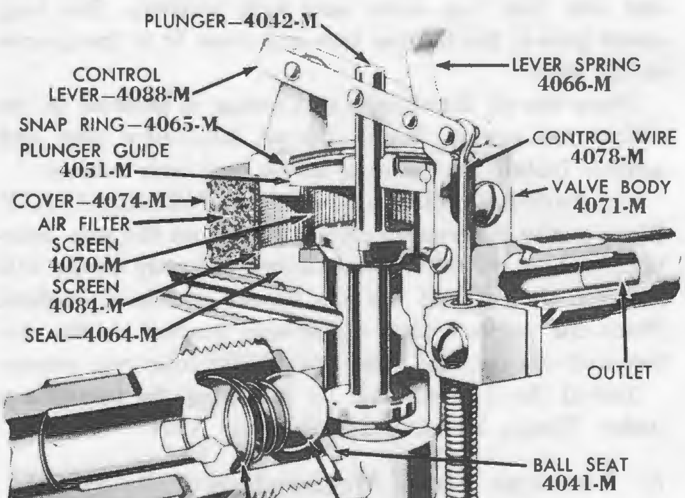


Fig. 55—Control Valve in High Range

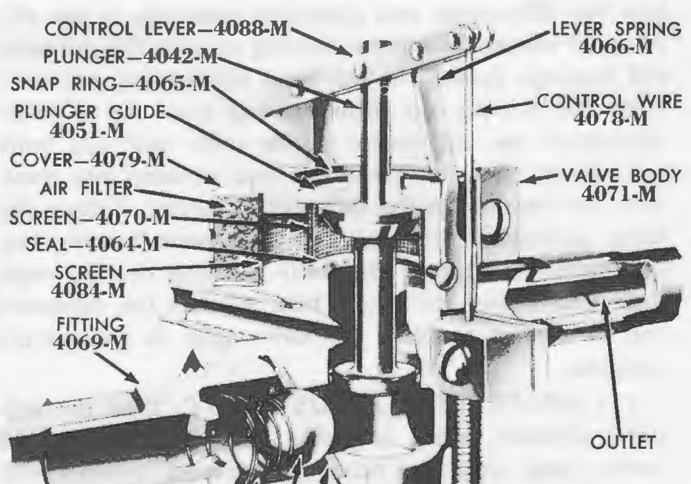


Fig. 56—Control Valve in Low Range

the control wire to the control lever. Loosen the lock screw, then remove the control wire and conduit from the valve body. Disconnect the vacuum line from the check valve body, then disconnect the diaphragm line. Remove the control valve from the mounting bracket. Remove the speedometer adapter line from the valve.

(b) DISASSEMBLY. Remove the cotter pins from the control lever, then remove the lever. Remove the snap ring, then remove the plunger, screen and plunger seal. Remove the check valve body from the control valve body, then remove the check valve ball, seat, spring, and spring retainer. Remove the control valve air filter cover from the control valve body. Remove the cover, the filter element, and the filter screen.

(c) INSPECTION AND PARTS REPLACEMENT. Clean the check valve ball seat, then inspect the seat for wear or deterioration. Replace the seat if worn or damaged.

Test the tension of the check valve ball spring. The spring should be just strong enough to hold the ball up against the ball seat.

Clean and inspect the control valve plunger seat. Replace the seat if worn or damaged. Clean the air filter element in cleaning solvent, then allow the element to dry before installation. The bores of the control valve body and the valve seats must be free of dirt before the valve seats are installed to ensure proper shifting.

(d) ASSEMBLY. Place the check valve ball seat in the control valve body bore, chamfered side down. Lay the ball on the seat, then position the spring seat and spring on the ball. Position the check valve body over the spring, then thread the body carefully into the control valve body to prevent cocking the spring.

Place the control valve plunger seal in the control valve body with the chamfered side down. Install the plunger, screen, and the plunger guide, then secure the parts in place with the snap ring. Install the control lever using new cotter pins to attach the lever to the plunger and the control valve body. Place the control lever in the high range position (fig. 55) then check the tension on the lever spring. There should be a slight pre-load on the spring with the lever in the high range position. The lever spring can be bent slightly to increase the pre-load if necessary. Place the air filter element in the air filter cover, position the filter screen on the control valve body, then install the filter cover.

(e) INSTALLATION. Insert the nipple on the control valve body into the speedometer adapter hose, then position the valve on the mounting bracket. Install the lock washer and the attaching nut. Install the control valve body to axle shift diaphragm line, then connect the vacuum line to the check valve body. Place the control wire and conduit in the clamp with the end of the conduit flush with the top face of the clamp, then tighten the clamp screw. Connect the control wire to the control lever using a new cotter pin. Test the connections as instructed under (4) "Lines and Connections."

(2) *AXLE SHIFT DIAPHRAGM ASSEMBLY.* The axle shift diaphragm assembly consists essentially of a diaphragm, mounted in a metal housing, a diaphragm push rod, and a spring. Fig. 57 shows the position of the axle shift diaphragm assembly when the axle is in the high range. When the control valve is shifted to high range, the air is withdrawn from the front side of the diaphragm by manifold vacuum. The atmospheric pressure behind the diaphragm causes the diaphragm to move forward and the push rod spring is compressed. Since the diaphragm is attached to the push rod, the forward movement of the diaphragm moves the push rod which in turn actuates the clutch shaft lever of the axle through the clevis and pin.

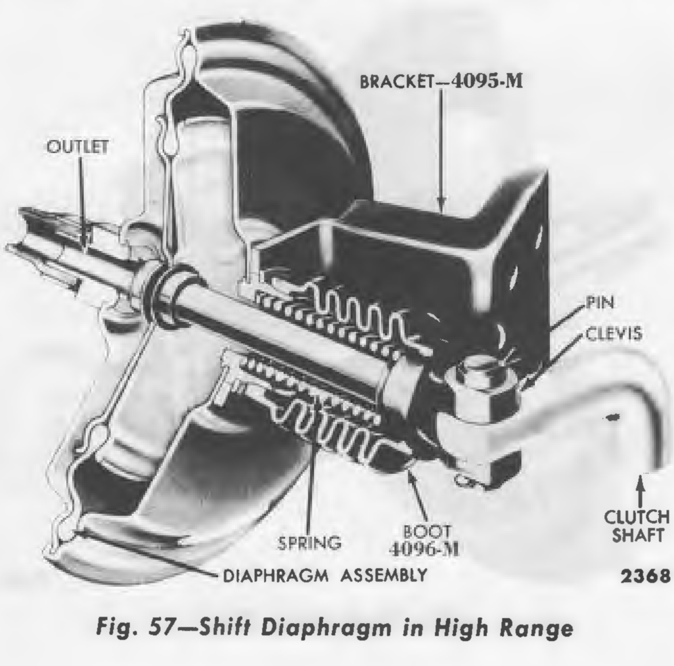


Fig. 57—Shift Diaphragm in High Range

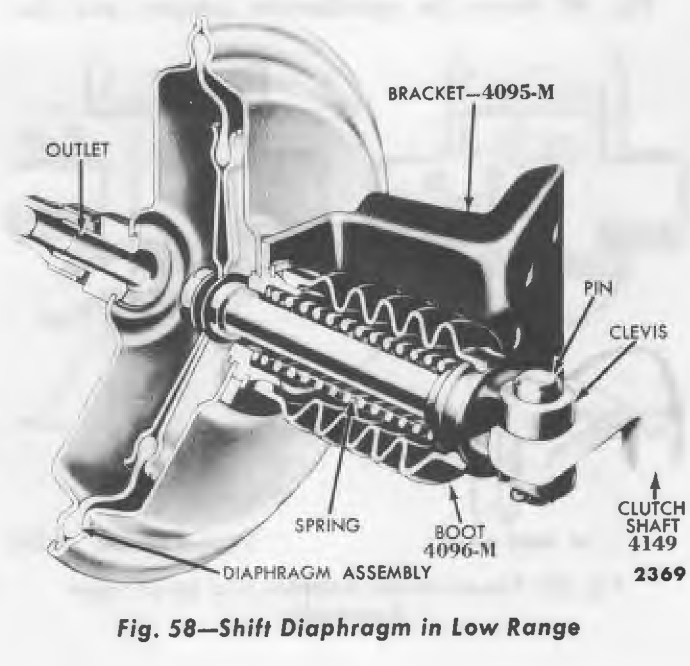


Fig. 58—Shift Diaphragm in Low Range

When the axle is shifted to low range, action of the control valve closes the system to manifold vacuum and permits air to enter the system. When the system is filled with air, the pressure on both sides of the shift diaphragm is balanced and the push rod spring exerts enough pressure from its compressed position to shift the axle into the low range (fig. 58).

The axle shift diaphragm assembly requires no periodic maintenance and must be replaced if it becomes damaged or inoperative.

(a) DIAPHRAGM ASSEMBLY REMOVAL. Loosen the hose clamp, then disconnect the hose from the assembly. Remove the cotter pin and clevis pin from the shift rod clevis. Remove the shift rod boot, then remove the snap ring which retains the diaphragm assembly.

(b) DIAPHRAGM ASSEMBLY INSTALLATION. Position the diaphragm assembly in the mounting bracket and install the snap ring. Place the shift rod boot over the shift rod, then check the amount of over-travel of the hole in the shift rod in relation to the hole in the clutch shaft. The travel of the shift rod should exceed the travel of the clutch shaft by approximately a half hole in both the high and low range. This over-travel assures that the full travel of the clutch shaft will be obtained and the axle will be held securely in gear.

Install the clevis pin and lock it with a new cotter pin. Position the hose on the diaphragm assembly hose fitting, then tighten the hose clamp. Test the installation as instructed in (4) "Lines and Connections."

(3) *SPEEDOMETER ADAPTER AND DIAPHRAGM ASSEMBLY.* This unit is mounted on the rear of the speedometer head. It consists of a small transmission, actuated by a rubber diaphragm, which compensates for variations in the speed of the drive shaft between high and low speed range of the axle. Fig. 59 shows the speedometer adapter and diaphragm assembly in the high and low range positions. The function of this unit is similar to the axle shift diaphragm. The center of the diaphragm is attached to a brass button which is piloted into a small coil spring. A shift rod is fastened to the top of the button and to the speedometer adapter shift rod. When the vacuum control valve is shifted to high range, the diaphragm moves downward. This compresses the spring and pulls the shift rod down, which in turn trips the speedometer adapter to high range. When the axle is shifted to low range, the diaphragm and shift rod are moved upward by the tension of the compressed spring. This movement shifts the speedometer adapter into low range.

Replace the diaphragm if it fails to shift the adapter to the high range. If the diaphragm fails to shift the adapter into the low range, replace the spring.

(4) *LINES AND CONNECTIONS.* Each unit of the connecting lines may be replaced, individually, if damaged. All hose and tubing must be free of foreign matter and the inside diameter of all hoses must be a wringing fit on the hose nipples. The installation of the hoses will be facilitated if the ends are dipped in gasoline. After any part of the connecting lines has been replaced, check the vacuum shift system for leaks as follows:

(a) LEAKAGE TEST. Place the vehicle on level ground with the parking brake released and the transmission in neutral. Start the engine with the axle shift button in the high range position. Race the engine for a few seconds, release the throttle and turn off the ignition switch. Measure the distance "D" in fig. 60 immediately. At the end of ten minutes, rock the truck by hand and remeasure distance "D." If "D" has not increased, the system can be considered vacuum tight. If "D" has increased, the system has a vacuum leak.

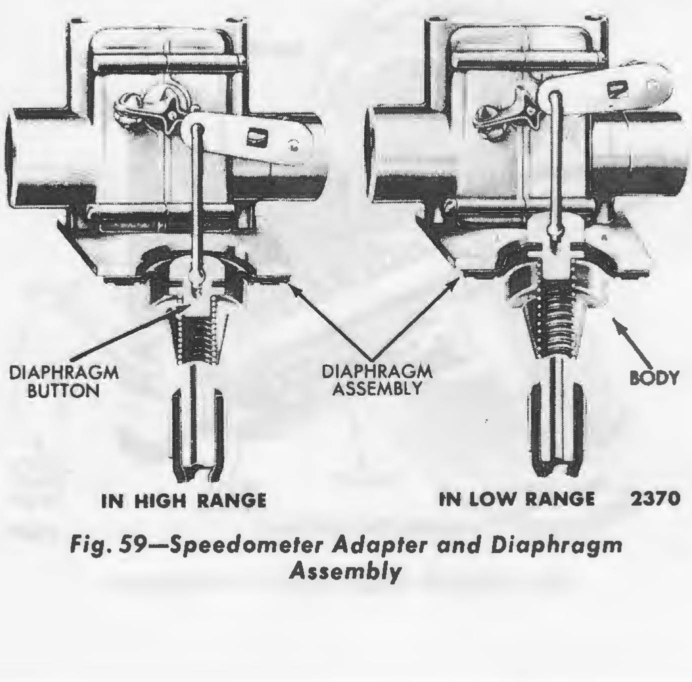


Fig. 59—Speedometer Adapter and Diaphragm Assembly

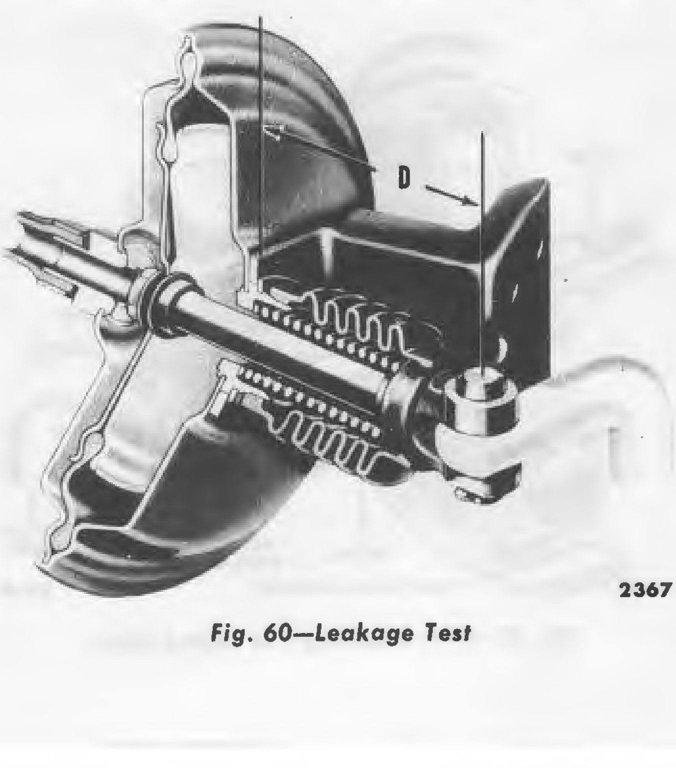


Fig. 60—Leakage Test

(b) Localizing Leakage. First check all connections. After all hose and tubing connections have been checked and tightened, re-test the system.

If the leak is still present, check the speedometer adapter vacuum shift diaphragm, the control and check valve, and axle shift diaphragm, in the order given.

6. DRIVE LINES

Power is transmitted from the transmission to the rear axle by means of a Hotchkiss, straight line drive type, drive line (propeller shaft).

The drive line is composed of the universal joints, connecting shafts, and the attaching flanges. The number of shafts and universal joints used depends on the truck wheelbase. The shorter wheelbase trucks use one drive shaft (fig. 61) which is attached to the transmission and rear axle through universal joints. This drive shaft is equipped with a slip joint to compensate for movement of the rear axle. The longer wheelbase trucks are equipped with a coupling shaft, which extends from the transmission to a rubber bushed center support, and a drive shaft which extends from the center support to the rear axle (figs. 62 and 63).

In multiple shaft drive line installation, the slip joint is located in the drive shaft. Drive shafts are balanced; therefore, if the vehicle is to be undercoated, cover the drive shaft to prevent getting any undercoating material on the shaft.

a. Universal Joint Replacement.

All universal joints are of the needle bearing type. The universal joint bearings are retained on the universal joint spiders by snap rings (F-1 through F-6) or by bearing caps and locks (F-7 and F-8). The replacement procedures for each universal joint type is given below.

(1) *SNAP RING TYPE.* Remove the snap ring (fig. 64) from under the yoke and around the needle bearing races. Using a drift approximately the same size as the needle bearing race, press one bearing race through the yoke. The opposite bearing will be partially forced out of the yoke and may be removed with a pair of pliers. Remove the spider from the yoke, then repeat the same procedure for the other pair of bearings.

NOTE: ***When removing the needle bearings from the spider, use care not to damage the bearings.***

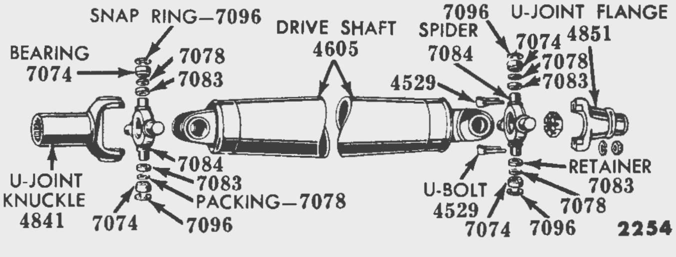


Fig. 61—Drive Line (F-1 Trucks)

To install, pack the needle bearings and spider recesses with universal joint grease. Place the spider in the yoke, press the bearings in place, and install snap rings.

(2) *LOCK TYPE.* Remove the bearing cap lock screws, cap locks, and caps (fig. 65). Remove the needle bearings from the spider, then remove the spider from the yoke. Remove the grease seals and retainers and relief valve from the spider.

Before installing, pack the recess in the spider with recommended lubricant. To install, thread the relief valve into the spider. Install the grease seals and retainers on the spider. Position the spider in the yokes, and install the needle bearings. Install the bearing caps and locks and secure them to the universal joint knuckle with the cap screws. Bend the tangs of the locks up against the cap screw heads.

b. Drive Shaft Replacement.

The drive shaft replacement procedure for all trucks follows:

(1) *F-1.* Remove the U-bolts securing the rear universal joint to the universal joint flange. Tape the universal joint bearings to the spider to prevent bearing loss. Pull the drive shaft toward the rear until the universal joint knuckle clears the mainshaft splines.

To install the drive shaft, slide the universal joint knuckle into position on the transmission mainshaft.

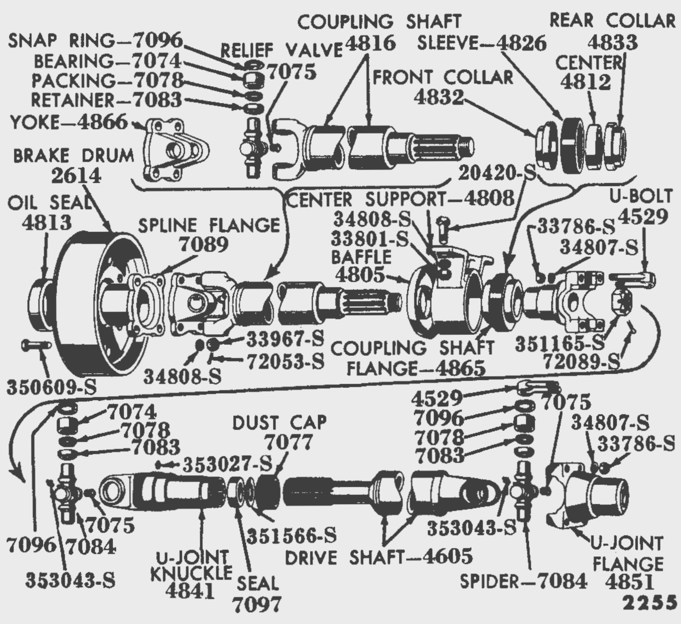


Fig. 62—Drive Shaft and Coupling Shaft

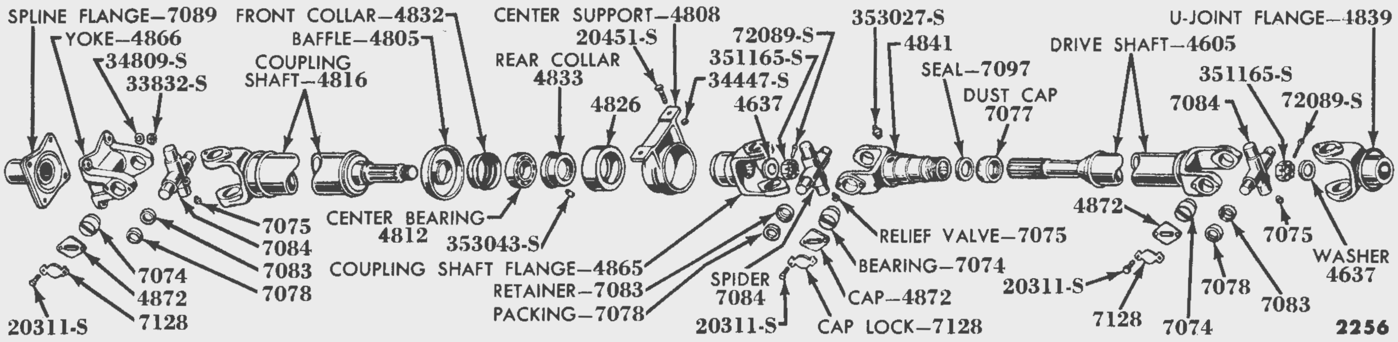


Fig. 63—Drive Shaft and Coupling Shaft (F-7 and F-8 Trucks)

Remove the tape from the bearings, then position the rear universal joint on the universal joint flange. Install the U-bolts which attach the universal joint to the flange.

(2) *F-2 THRU F-6.* Remove the U-bolts (fig. 61) from the front and rear universal joints, then remove the drive shaft. Tape the universal joint bearings to the spider to prevent bearing loss or damage.

To install, remove the tape from the universal joint bearings, then position the universal joints on the flanges. Install the U-bolts, lockwashers, and nuts.

(3) *F-7 AND F-8.* Remove the cap screws, locks, and bearing caps from the universal joints. Remove the universal joint bearings, then remove the spiders from the joints and remove the drive shaft.

To install, position the spider in the companion flanges then position the ends of the drive shaft on the spiders. Tap the universal joint bearings into place. Install the bearing caps, locks, and cap screws. Bend the lock tangs up against the cap screw heads.

c. Coupling Shaft Replacement.

Remove the nuts, lock washers, and bolts attaching the universal joint to the universal joint spline. Remove the U-bolts which attach the universal joint to the coupling shaft flange (F-2 thru F-6) or disassemble the drive shaft front universal joint (F-7 and F-8). Remove the nuts, bolts, and coupling shaft support from the frame cross member, then remove the coupling shaft and the support.

To install, place the universal joint at the forward end of the coupling shaft on the universal joint spline flange, then install and tighten the nuts. Attach the coupling shaft support to the cross member. Install the U-bolts which attach the universal joint to the coupling shaft flange (F-2 thru F-6); or assemble the drive shaft front universal joint (F-7 and F-8).

d. Support Bearing Replacement.

Remove the U-bolts which attach the universal joint to the coupling shaft flange (F-2 thru F-6); or disassemble the drive shaft front universal joint (F-7 and F-8). Wrap a piece of tape around the universal joint to prevent losing the needle bearings. Remove the nuts and lock washers from the bolts which attach the coupling shaft support to the cross member. Remove the nut holding the coupling shaft flange on the coupling shaft. Drive the flange off the coupling shaft splines, then remove the shaft support. Press the center bearing support sleeve, collars and bearing out of the support.

To install, coat the center bearing sleeve with hydraulic brake fluid, then press the sleeve into the support. Slide the support bearing into the sleeve, then install the collars. Install the support on the coupling shaft, then install the coupling shaft flange on the shaft splines. Install the nut securing the flange to the coupling shaft and secure the nut with a cotter pin. Attach the coupling shaft support to the cross member. Install the U-bolts which attach the universal joint to the coupling shaft flange (F-2 thru F-6); or assemble the drive shaft front universal joint (F-7 and F-8).

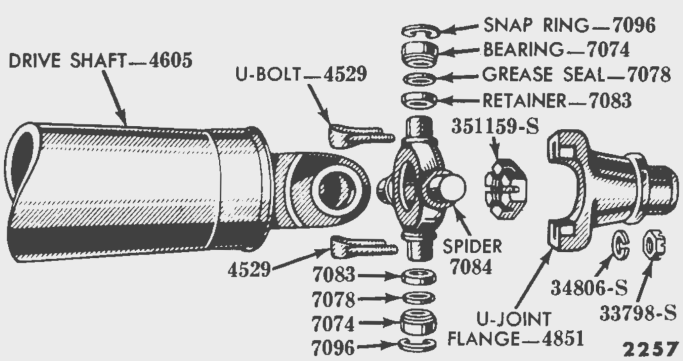


Fig. 64—Universal Joint (Snap Ring Type)

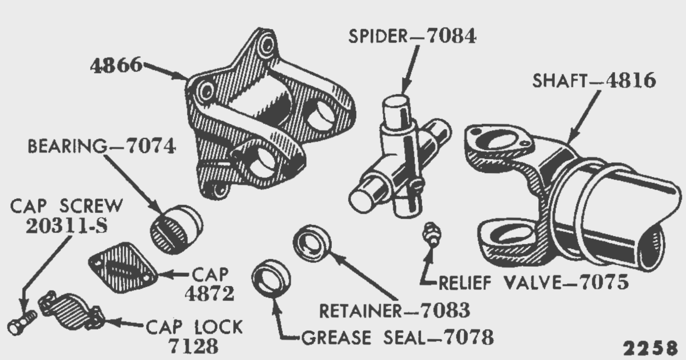


Fig. 65—Universal Joint (Lock Type)

Part TWO

CHASSIS

Chapter

III

Running Gear

The running gear includes all of the units which support the weight of the vehicle as well as the units which are used for directional control. These units are listed in the above index. Section 1 contains service information on checking and correcting frame alignment. The description and repair of the front axle is given in section 2. Section 3 contains replacement information on the springs. Section 4 includes service information on shock absorbers. Section 5 covers the removal, adjustment, and installation of the steering gear. Descriptions, replacement procedures, and adjustments of the steering connections are given in section 6. Wheel replacement and tire maintenance and replacement procedures are given in section 7. Section 8 contains the replacement and adjustment procedures for front and rear hubs and bearings and service information on oil seals.

1. FRAMES

The frame of a vehicle services two purposes. First, it provides support for the body, engine, power train, and other chassis units. Secondly, the frame maintains the chassis units in the correct relationship necessary to permit their normal operation.

The frame used on Ford trucks is the channel side rail type. The channel side rail frame has four, five, or six cross members, depending upon the wheelbase length. All cross members are riveted to the side rails.

a. Checking Frame Alignment.

If the frame becomes misaligned due to a collision, stresses result which can affect the normal operation of the various chassis units and can cause body and door misalignment. When a misaligned condition is suspected, refer to fig. 1 which shows true dimensions that may be used to check frame alignment on all **F** series trucks (F-1 through F-8).

If the vehicle body or cab is not removed from the vehicle frame, some of the dimensions shown in these illustrations may be difficult to measure. In this case, the diagonal or "X" checking method may be used. To ensure accuracy when using this method, the vehicle should be placed on a level floor and the points of measurement should be transferred carefully from the frame to the floor. In this method, points are selected along one side of the whole frame for which there are corresponding points on the opposite side of the frame.

b. Correcting Frame Alignment.

The frame side rails and cross members are formed from low carbon steel. Strength is imparted to frame members during the rolling and forming processes, but this hardness is sacrificed if heat is used during the frame straightening process. However, any attempt to cold-straighten a severely bent frame may cause ruptures of the welds (if any) and may also cause cracks in the bent part. If heat is needed to straighten a frame member, the member should never be heated to more than a dull red.

c. Frame Reinforcing.

After a bent frame member has been straightened it should be closely inspected. If cracks or strains show, the frame member should either be reinforced or replaced. Reinforcements can be made from channel, angle, or flat stock, the kind and length of the reinforcement used being dependent upon the nature of the crack. The reinforcement stock for frames can be of any non-alloyed steel with less than 0.30 carbon.

Before the reinforcement is welded to a cracked frame member, it is necessary to prepare the crack to ensure the soundness of the repair. To prevent the crack from spreading, a ⅛ inch hole should be drilled at the root of the crack. The crack should be ground out to form a slot which will allow the weld to penetrate to the surface of the reinforcement.

The proper location of the reinforcement plate is determined by the location of the crack. If the crack is at the bottom channel, the reinforcement plate should be welded to the bottom channel. If the crack is at the top it should be welded along the top channel. In cases where the crack extends along the side an additional plate should be welded to the side.

If it is necessary to replace a damaged frame member, the same method of attachment used originally should be employed. If bolts were used originally, the replacement bolts should be of the same specification as the original bolts.

To replace parts attached with rivets, drill off the rivet heads, and drive the old rivets out of the parts to be replaced. Install the new part and secure in place, using hot rivets.

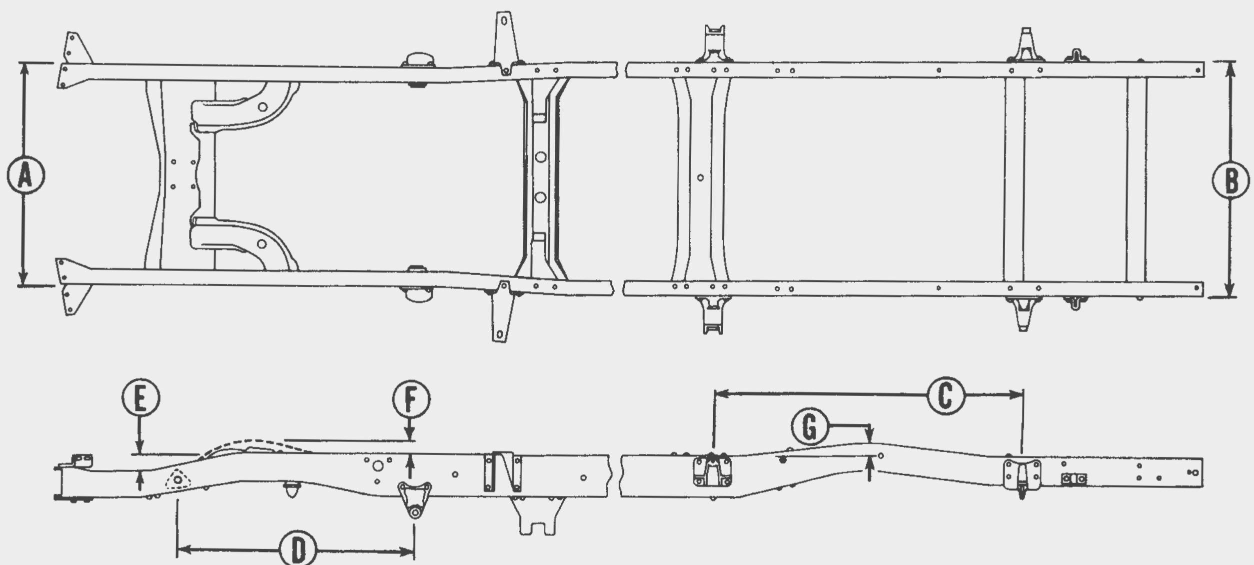
The instructions on welding given under Frame Welding should be followed when replacing riveted frame members.

d. Frame Welding.

In frame welding it is necessary to localize the heat if the steel hardness is to be retained. Therefore all welding must be done with arc welding equipment using mild steel coated electrodes. When welding a reinforcement to the frame side rail, the welds must run longitudinally only along the side of the reinforcement.

2. FRONT AXLE

The front axle is a steel forging of the I beam type with spindles secured by spindle bolts at each end. The weight of the vehicle on the axle is supported by spindle thrust bearings located between the spindles and the lower ends of the axle at each spindle. A spindle arm secured at each spindle is provided for turning the spindles. These arms are connected together by a single spindle connecting rod (tie rod). The spindle connecting rod is adjustable for establishing front wheel toe-in. The caster and camber angle are set in the axle at the time of manufacture and except for accidents or spring sag they will not change. This paragraph gives the



	A	B	C	D	E	F	G
	WIDTH FRONT	WIDTH REAR	¢ TO ¢ REAR SPRING HANGERS	¢ TO ¢ FRONT SPRING HANGERS	FRONT END DIP	FRONT AXLE KICK-UP	REAR AXLE KICK-UP
F-1	32	34	44	35 3/16	2 3/4	—	2
F-2	32	34	45	35 3/16	2 3/4	—	2
F-3	32	34	45	35 3/16	2 3/4	—	2
F-3 Par. Del.	32	34	45	35 9/16	2 3/4	2	3 1/4
F-4	32	34	44 1/2	35 1/2	2 29/32	—	—
F-5	32	34	44 1/2	35 1/2	2 29/32	—	—
F-5 C.O.E.	32	34	44 1/2	37 5/8	2 29/32	—	—
F-5 School Bus	32	34	51 5/64	35 1/2	2 29/32	—	—
F-6	32	34	44 1/2	35 1/2	2 29/32	—	—
F-6 C.O.E.	32	34	44 1/2	37 5/8	2 29/32	—	—
F-7	32	34	51 1/4	45 5/16	4	—	—
F-8	32	34	51 1/4	45 5/16	4	—	—

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Fig. 1—Truck Frame Diagram

replacement procedure of the complete axle assembly as well as replacement of spindle bolts and bushings.

a. Axle Assembly Removal.

Place a jack under the front axle and raise the truck until the front wheels are off the floor. Place a jack under each side of the frame just to the rear of the front springs. Lower the truck onto the frame jacks to remove the load from the front springs. Do not remove the jack from the axle, the jack will support the axle after the spring clips (U-bolts) have been removed.

Remove the front wheels. Disconnect the flexible hydraulic brake lines at the frame bracket. Disconnect the drag link from the spindle arm. On trucks equipped with front shock absorbers, disconnect the lower end of each shock absorber.

Remove the nuts from the spring U-bolts at each spring. Carefully roll the complete axle assembly out from under the frame.

If the axle I beam is to be replaced, the component parts attached to the axle assembly can be removed as described in a subsequent chapter.

b. Axle Assembly Installation.

With all the component parts properly assembled to the axle, carefully position the assembly under the truck.

Place the axle caster wedge between the front axle and each spring with the thick edge of the wedge toward the rear of the vehicle. Place the spring U-bolts in position over the axle bumper brackets. Make sure the spring tie bolts are centered in the holes provided in the axle. Install the nuts and lock washers on the spring U-bolts to secure the axle to the front springs. Connect the drag link to the spindle arm. Connect the hydraulic brake hose. If equipped with shock absorbers, connect the lower end of each shock absorber to the axle. Install the front wheel. Bleed the brakes. Raise the truck to remove the frame jacks, then lower the front of the vehicle. Check and if necessary adjust the wheel toe-in if the axle has been disassembled, lubricate all necessary points.

c. Spindle Bolt and Bushing Replacement.

If inspection shows spindle bushing wear, it is advisable to install a complete spindle blot and bushing kit.

(1) *SPINDLE ASSEMBLY REMOVAL.* Raise the truck and remove the wheel. Remove the spindle nut. Pull the hub and drum outward off the spindle until the outer wheel bearing is near the end of the spindle. Remove the grease retainer and outer bearing from the spindle, then slide the hub and drum off the spindle.

On F-1 through F-6 series trucks, remove the bolts which secure the brake carrier plate to each spindle. It is not necessary to disconnect the hydraulic brake lines. Remove the brake carrier plate from the spindle and swing the brake carrier plate to one side so as not to interfere with the work.

On F-7 and F-8 series, the brake carrier plate is riveted to the spindle flange.

Disconnect the drag link at the spindle arm. Remove the spindle connecting rod (tie rod). Remove the nut from the spindle bolt locking pin (figs. 2 and 3) and drive the pin out of the axle.

On F-7 and F-8 trucks remove the oil seal retainer spring, felt retainer, and oil seal at the top of the spindle bolt (fig. 3). Pull the spindle bolt out from the top as shown in fig. 4.

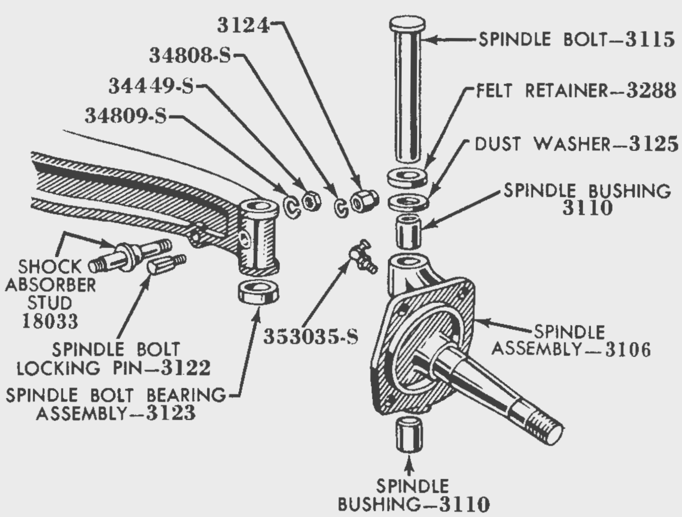

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Fig. 2—Spindle Bolt, Disassembled (F-1 through F-6)

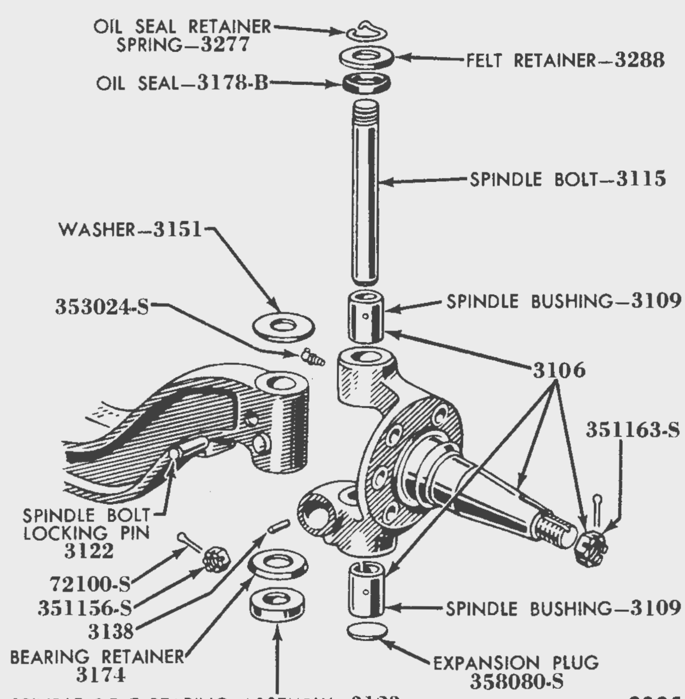

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Fig. 3—Spindle Bolt, Disassembled (F-7 and F-8)

On F-1 through F-6 trucks, drive the spinde bolt out, working from the bottom.

Remove the spindle assembly from the axle.

Place the spindle assembly on a bench. Drive the bushings out of the spindle. If proper tools are not available, the bushing can be removed by driving a small center punch between the bushing and the spindle at the split end of the bushing. This will collapse the bushing for easy removal.

Clean the spindle bores thoroughly and make certain the lubricating holes are not plugged.

Position the bushing on the spindle with the lubricating hole in line with the lubrication fitting. Press new bushings into the spindle and line ream them to the required size. Clean all metal shavings from the bushing after reaming and apply a light coat of oil to each bushing.

(2) *INSTALLATION.* Place the spindle in position on the axle. Insert the spindle bolt bearing between the bottom of the axle and the spindle (figs. 2 and 3). On the F-1 through F-6 trucks, first install the felt retainer and dust washer on the spindle bolt. Line up the notch in the spindle bolt with the spindle bolt locking pin hole in the axle. Drive the spindle bolt through the axle until the notch and hole are in line. Fasten the spindle bolt in place with a new lock pin. Install the lock washer and nut on the lock pin.

On F-7 and F-8 trucks, the oil seal, felt retainer, and oil seal retainer spring (fig. 3) can be installed after the spindle bolt has been installed and locked in place with the lockpin. Install the spindle connecting rod tube and connect the drag link to the spindle arm. Install the brake carrier plate assembly if it was removed. Install the hub, and drum assembly, and wheel. Lubricate the spindle bolt, then check and if necessary adjust the toe-in.

3. SPRINGS

Trucks are quipped with longitudinal leaf, front and rear springs. The front springs are fastened to spring shackles which are mounted in spring brackets. The spring brackets are riveted to the frame. The spring leaves are held in alignment by four spring clips. Each spring is fastened to the axle by two U-bolts.

a. Front Springs.

Front spring removal procedure is given for all trucks under "(1) Removal." The installation procedure given under "(2) Installation" also applies to all trucks.

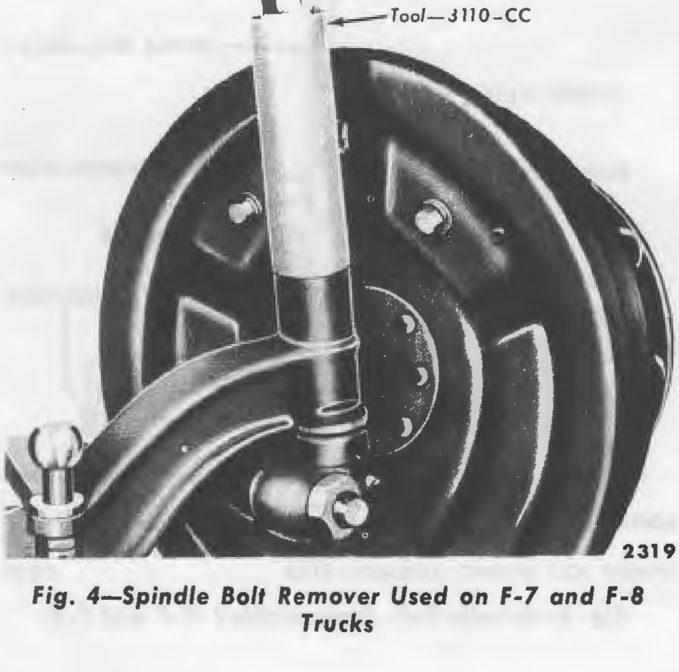

Fig. 4—Spindle Bolt Remover Used on F-7 and F-8 Trucks

(1) *REMOVAL.* Raise the truck frame until the weight is off the springs but so the wheels still remain on the floor. Remove the nuts from the lower shackle bolt and bracket bolt and drive the bolts from the shackle and bracket. Remove the nuts from the two U-bolts which secure the spring to the axle (fig. 5).

(2) *INSTALLATION.* Place the spring in position and align the front spring eye with the spring bracket (fig. 5). With the grease fitting on the shackle bolt facing outward, insert the shackle bolt through the bracket and spring. Install the nut and draw it up snug, then back off the nut one-third turn. Install the cotter pin. Place the shackle bars in position on the spring shackle bracket. With the grease fitting on the shackle lock facing outward, insert the shackle bolt through the shackle bars and bracket. Install the nut and draw it up snug, then back it off one-third turn.

Raise the rear end of the spring and align the spring eye with the shackle bars. Insert the shackle bolt through the shackle bar and spring eye with the grease

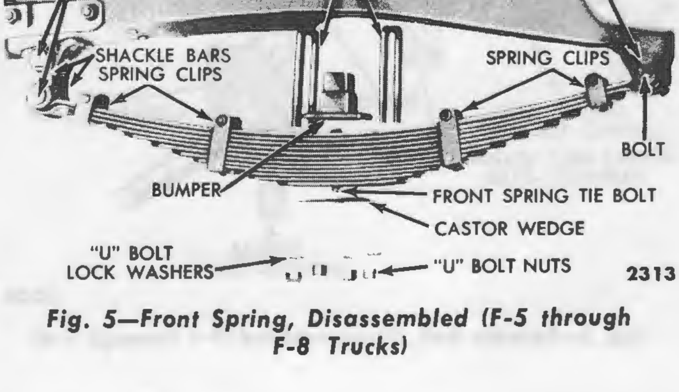

Fig. 5—Front Spring, Disassembled (F-5 through F-8 Trucks)

fitting facing outward. Install the nut and draw it up snug, then back the nut off one-third turn. Install cotter pins through the upper and lower nuts.

Place the axle caster wedge between the axle and the spring with the thick edge of the wedge toward the rear of the truck. Place the spring U-bolts in position over the spring clip plate and through the holes in the axle. Make sure the spring tie bolt is in the hole provided in the axle.

Install the lock washers and nuts on the U-bolts. Lower the truck to the floor and tighten the spring U-bolt nuts to the specified torque.

b. Rear Springs.

The removal and installation procedures for rear springs for light duty, heavy duty, and extra heavy duty trucks are basically the same. The only difference is that the F-6 through F-8 trucks are also equipped with auxiliary springs. The following procedure applies to all models.

(1) *REMOVAL.* Raise the rear of the frame until the weight is off the springs but the wheels still remain on the floor. Remove the nuts from the spring U-bolts (figs. 6 and 7) and drive the U-bolts out of the spring seat cap.

If equipped with an auxiliary spring, remove the auxiliary spring and spacer (fig. 7).

Remove the shackle bolt lock pins from each end of the spring (fig. 6). Working from the inner side of the frame, insert a drift in the hole provided in the frame for removing the shackle bolt. Drive the shackle bolt out of each spring eye. Remove the spring from the truck.

(2) *INSTALLATION.* Position the spring on the axle, making sure the spring tie bolt is in the hole provided in the axle. Drive the shackle bolt through the shackle and spring eye and line the shackle bolt groove with the lock pin in the shackle. Install the lock pin, washer and nut (fig. 6). Repeat this operation to install the shackle bolt at the opposite end of the spring. If equipped with an auxiliary spring, position the spacer and auxiliary spring (fig. 7) on the main spring.

Place the U-bolt plate on top of the spring at the tie bolt, and put the U-bolts over the spring assembly and axle. Install the seat cap, lock washers, and nuts on the U-bolts. Lower the truck to the floor and tighten the U-bolt nuts to the specified torque. Lubricate the shackle bolts.

4. SHOCK ABSORBERS

The shock absorbers used on Ford trucks are either the direct-acting type or the rotary vane type.

The direct acting type is installed as stanrdard equipment, both front and rear, on all F-1, F-2, and F-3 (parcel delivery) trucks. The F-3 (standard) truck is equipped with the direct acting type front shock absorbers as standard equipment. Rear shock absorbers of the direct-acting type are available as optional equipment only for the F-3 (standard) truck.

Rotary vane type front shock absorbers are available as optional equipment for F-4, F-5, F-6, F-7, and F-8 trucks.

The lubrication, adjustment, and replacement of the rotary vane type shock absorber is covered under, "a. Rotary Vane Type."

The procedures for checking the action of a direct-acting shock absorber and for the replacement of defective units is given under, "b. Direct-Acting Type."

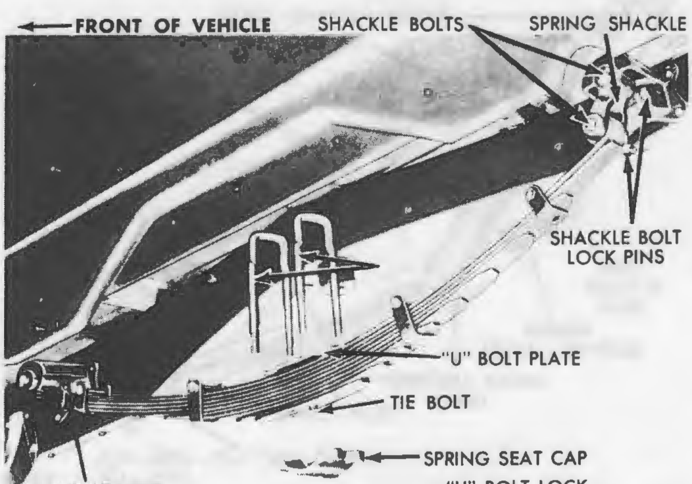

Fig. 6—Rear Spring, Disassembled (F-4 and F-5 Trucks)

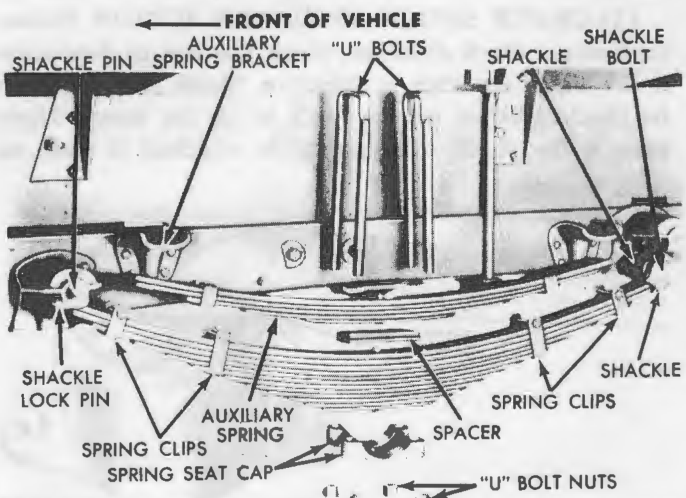

Fig. 7—Rear Spring, Disassembled (F-6 through F-8 Trucks)

a. Rotary Vane Type.

Maintenance on this type shock absorber is limited to adjustment, lubrication, and replacement of the complete assembly.

(1) *LUBRICATION.* The fluid level should be checked each fall and spring or every 5000 miles whichever occurs first. If necessary, refill the unit with shock absorber fluid 8A-19541 as follows: Clean all loose dirt from around the filler plug and remove the plug. Add fluid to the filler plug level. Disconnect the shock absorber link and move the arm up and down several times to eliminate the air from the reservoir and then recheck the level and add fluid if necessary.

(2) *ADJUSTMENT.* The rotary vane type is adjusted by a needle valve pointer. A factory setting mark is provided on the shock absorber arm (fig. 8) to indicate the correct adjustment for average operating conditions. To increase the resistance within the unit turn the needle valve pointer clockwise. Decrease the resistance by turning the needle valve pointer counterclockwise. The needle valve pointer should be moved only one or two serrations at a time due to the sensitivity of this adjustment.

(3) *REPLACEMENT.* Remove the shock absorber link to arm lock nut. Drive the bolt out of the link and shock absorber arm. Remove the shock absorber to frame bolts and remove the shock absorber.

To install, position the shock absorber on the frame and install the retaining bolts. Align the holes in the link and the arm, install the bolt, then install and tighten the sef-locking nut.

b. Direct Acting Type.

The direct acting type shock absorber is a sealed unit and is not adjustable. If the shock absorber is defective it must be replaced as a complete assembly.

(1) *CHECK SHOCK ABSORBER ACTION.* Before replacing a shock absorber, check the unit to determine if the shock absorber is defective. Shock absorbers can be checked either on the truck or on the bench. However if the shock absorber to be checked is used on

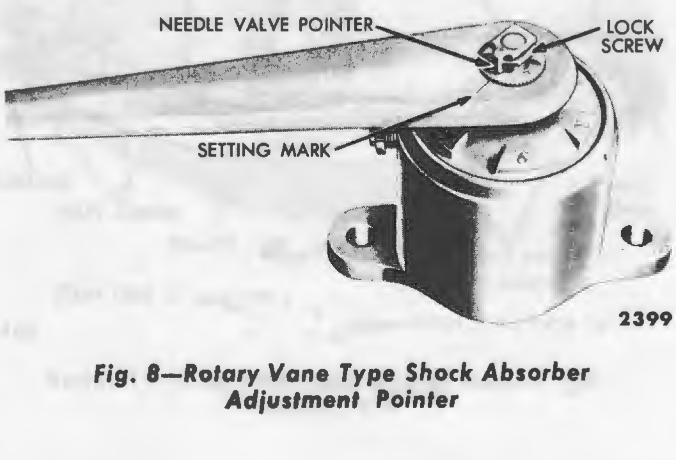

Fig. 8—Rotary Vane Type Shock Absorber Adjustment Pointer

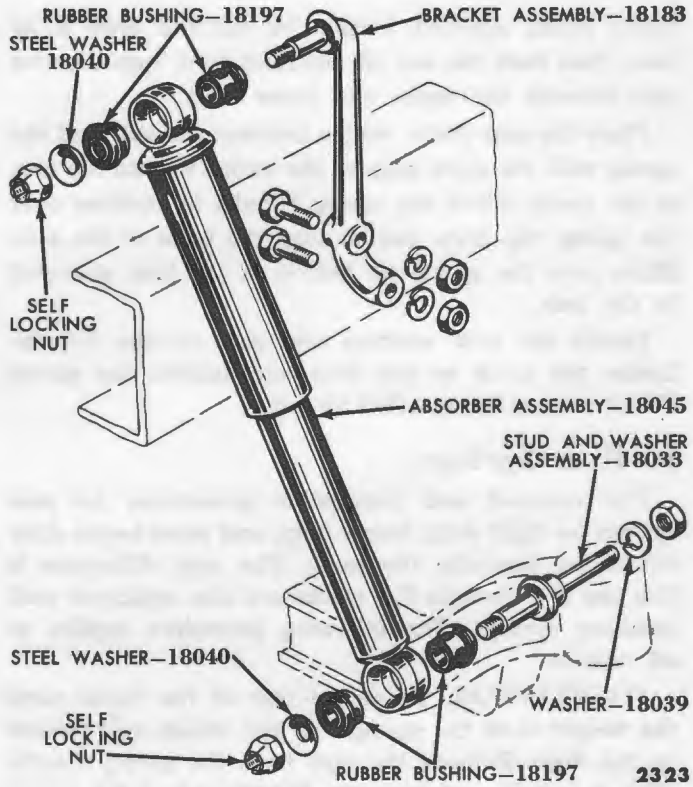

Fig. 9—Front Shock Absorber (Direct Acting Type)

heavier trucks, it should be removed.

To check the shock absorber when mounted on the truck, grasp the bumper and jounce the truck up and down. If the shock absorbers are in good condition, the truck will immediately settle to normal position after the bumper is released. If the truck continues to jounce, or remains displaced, the shock absorber is defective and must be replaced.

To check a shock absorber removed from a truck, clamp the lower end (small diameter) in a vise in a

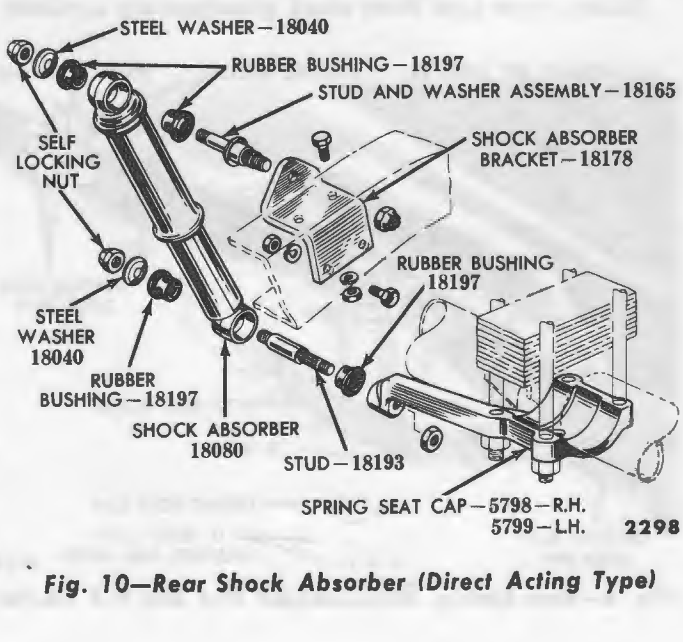

Fig. 10—Rear Shock Absorber (Direct Acting Type)

near vertical position and pump a few times to expel any air. A good shock absorber will have a steady drag in both directions when operated by hand. If it operates without any drag, or is very hard to operate, it should be replaced.

(2) *REPLACEMENT.* To replace either the front or rear shock absorber, remove the self-locking nut, steel washer, and rubber bushings (figs. 9 and 10) at the upper and lower ends of the shock absorber. Remove the shock absorber.

Before installing a new shock absorber, replace the rubber bushings. Position the shock absorber on the mounting brackets with the larger diameter at the top. Install the rubber bushing, steel washer and self-locking nut. Tighten the nut until it rests against the shoulder of the stud.

5. STEERING GEAR

The worm and roller type steering gears used on Ford trucks are all similar in design, but vary in size, method of attachment to the frame, and type of roller construction. The F-1, F-2, and F-3 (conventional) trucks are equipped with a single row needle bearing sector shaft roller. The F-3 Parcel Delivery, F-4, F-5, F-6, F-7, and F-8 trucks are equipped with a dual row needle bearing sector shaft roller (fig. 11).

On all truck models (except C.O.E. and Parcel Delivery), the steering gear is mounted on the inside of the left-hand side rail. On C.O.E. and Parcel Delivery trucks, the steering gear is mounted on the outside of the left-hand side rail.

Steering gear service procedures are given in this section under the following headings; "**a.** Adjustment," "**b.** Steering Wheel Replacement," "**c.** Steering Gear Removal," "**d.** Steering Gear Disassembly," "**e.** Steering Gear Inspection," "**f.** Steering Gear Assembly," and "**g.** Steering Gear Installation."

a. Adjustment.

Disconnect the steering drag link from the steering arm. Loosen the steering column tube to instrument panel bracket to be sure the shaft is not binding. Loosen the lock nut, and turn the sector shaft thrust adjusting screw in a counterclockwise direction. This removes the load from the worm imposed by the close meshing of the roller and worm.

Turn the steering wheel in one direction to its limit of travel. Using a scale, measure the pull required at the rim of the wheel which is required to start the wheel to rotate. The worm bearing pre-load is satisfactory if the effort required is ¼ to ¾ pound pull on F-1, F-2, and F-3 trucks, and ½ to 1 pound pull on all other model trucks. If the pre-load is not within the required limits, remove the gaskets (shims) from underneath the steering gear housing end plate (fig. 11) to increase the pre-load. Add gaskets (shims) if the pre-load is greater than the maximum allowable limit.

After the steering shaft worm pre-load has been correctly established, turn the steering wheel from one stop all the way to the other counting the total number of turns. Turn the wheel back exactly halfway to the center position. Turn the sector shaft thrust adjusting screw in a clockwise direction until all end play is removed from the sector shaft. Check the worm and sector roller mesh. Using the scale, measure the effort required to turn the wheel through the center position. The final mesh adjustment should be between 1 and 2 pounds pull on F-1, F-2, and F-3 trucks and 1½ and 2½ pounds pull on all other model trucks.

After the proper adjustment has been obtained, tighten the lock nut. Secure the steering column tube to the instrument panel bracket arm.

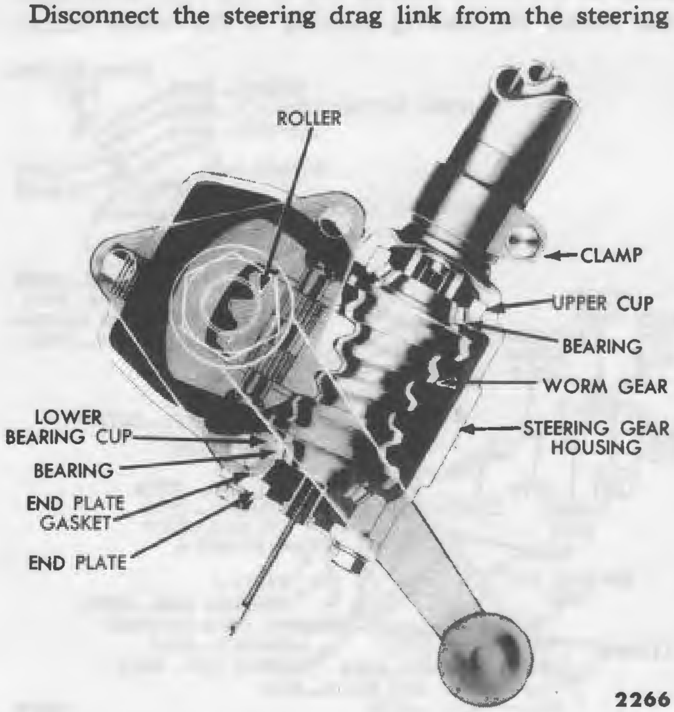

Fig. 11—Steering Gear Assembly (F-4 through F-8)

Fig. 12—Steering Wheel Removal

b. Steering Wheel Replacement.

Disconnect the horn wire at the connector at the bottom of the steering gear case. Remove the horn button by pressing it down and turning it counterclockwise. Remove the spring and horn wire from the steering shaft. Remove the steering wheel nut, and pull the steering wheel as shown in fig. 12.

To install the steering wheel, place it on the steering shaft with the single spoke of the steering wheel facing straight down. Using a wood block, tap the steering wheel in the center of the hub until it is firmly seated on the steering shaft. Install the steering wheel nut and stake the end of the shaft to the nut in one place. Install the horn wire through the spring and the steering shaft. Install the horn button, then connect the horn wire to the connector at the bottom of the steering gear case.

c. Steering Gear Removal

Remove the steering wheel. Remove the steering gear and brake pedal plate. Remove the two cap screws which secure the steering gear bracket to the instrument panel.

NOTE: ***On F-7 and F-8 trucks, remove the floor transmission cover plate, loosen the engine rear mounting bolts, jack up the transmission about 1¼ inches, and remove the engine oil dipstick and tube.***

Raise the front end of the truck. Remove the nut that secures the steering gear arm to the steering gear sector shaft. Using a puller, remove the steering gear arm. Remove the three bolts which secure the steering gear housing to the frame. Loosen the steering column clamp. Remove the steering gear from underneath the truck.

d. Steering Gear Disassembly.

Drain the lubricant from the steering gear housing. Remove the steering sector shaft housing cover and gasket from the steering gear housing (fig. 13). Remove the sector shaft and roller assembly. Remove the steering gear housing end plate and tube assembly and gaskets (shims) from the housing. Remove the steering worm bearing lower cup and the lower bearing from the housing. Slide the steering column tube and bearing assembly out of the housing. On all steering gears except the F-1, F-2, and F-3 trucks, remove the steering shaft felt seal from the top of the steering gear housing.

Slide the shaft and worm assembly out of the steering gear housing, then remove the upper bearing and cup. To remove the sector shaft bushings, press the bushings and grease retainer out of the housing.

e. Steering Gear Inspection.

Inspect the worm and the roller for scores, cracks, or chips. Inspect the worm shaft bearing cups for pits, wear, or other damage and the roller bearings for cracked or chipped rollers.

Check the sector shaft for wear at the bushing locations. Check the sector shaft in its bushings. Replace all parts that are damaged or worn beyond specified limits.

f. Steering Gear Assembly.

If the sector shaft bushings have been removed, press new bushings into the housing. The inner bushing must be pressed in flush with the inside edge of the housing and the outer bushing should be flush with the lower edge of the grease retainer counterbore. Burnish the bushings to the proper size. Install the grease retainer with point of leather facing inward toward the flow of grease.

Install the upper bearing cup and bearing in the steering gear housing. Slide the steering gear shaft and worm assembly into the housing. Position the lower bearing, the lower cup, the same gaskets previously removed and the steering gear housing end plate and tube assembly on the housing. Tighten the cap screws to the proper torque. On all models except the F-1, F-2, and F-3, trucks, install the steering shaft felt seal over the steering shaft at the top of the steering gear housing.

Position the sector shaft and roller assembly, gasket, and steering sector housing cover on the steering gear housing. Tighten the cover cap screw to the proper torque.

g. Steering Gear Installation.

To install the steering gear, work from underneath the truck and position the steering gear assembly in place on the frame. Install, but do not tighten the bolts that secure the steering housing to the frame. Secure

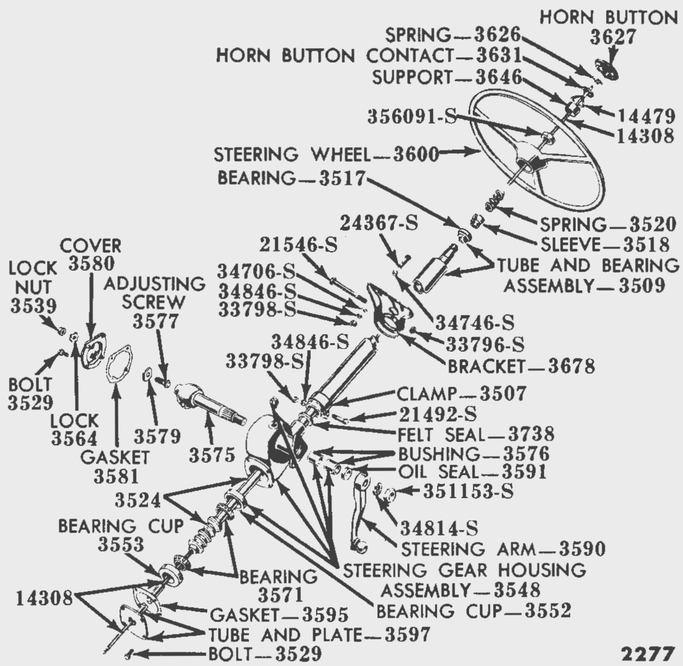

Fig. 13—Steering Gear (F4, F-5 and F-6 Trucks)

the steering gear bracket to the instrument panel, making sure the rubber pad is in place between the bracket and the instrument panel. Tighten the steering gear to frame mounting bolts to 45-60 foot-pounds torque. Install the steering gear arm, lockwasher, and nut on the steering gear sector shaft. Tighten the nut to 115-125 foot-pounds torque. Lower the front of the truck.

NOTE: ***On F-7 & F-8 trucks, install the oil dipstick and tube, lower the transmission, tighten the engine rear mounting bolts, and install the transmission floor cover plate.***

Install the steering gear and brake pedal plate. Install the steering wheel. Fill the steering gear housing to the level of the filler plug with the proper lubricant.

6. STEERING CONNECTIONS

The steering connections include all the assemblies required to transmit the steering effort from the steering gear sector shaft to the front wheels (figs. 14 and 15). These assemblies are: The steering arm, the drag link, the spindle connecting rod, and the spindle arms. The adjustment and replacement procedures necessary to properly service these assemblies are described under the following: **a.** Spindle Connecting Rod Replacement, **b.** Drag Link Adjustment, and Replacement.

a. Spindle Connecting Rod Replacement.

The construction of the spindle connecting rods used on the various truck models is shown in fig. 16.

To replace the spindle connecting rod or rod ends, proceed as follows:

(1) *REMOVAL.* Remove the cotter pin and nut from each spindle connecting rod end ball stud. Support the spindle arms near the studs, then tap the studs out of the arms, using a soft metal hammer. Loosen each rod and clamp bolt, then remove the rod ends from the spindle connecting rod tube.

(2) *INSTALLATION.* Thread each spindle connecting rod end an equal distance into (or onto) the spindle connecting rod tube. Insert the rod end ball studs into the spindle arms, with the ball stud seals installed in their original positions. Install the nuts and cotter pins on the rod and ball studs. Lubricate the connecting rod end and adjust the toe-in.

b. Steering Drag Link.

All truck models are equipped with a one-piece drag link, having a manual adjustment feature at both ends (fig. 17).

(1) *DRAG LINK ADJUSTMENT.* Remove the cotter pins from each end of the drag link. Tighten each drag link plug until the drag link ball springs are fully compressed. Back off each plug to the first cotter pin hole, then install new cotter pins.

(2) *DRAG LINK REPLACEMENT.* Remove the cotter pin and unscrew the drag link ball plug at the rear end of the drag link. Turn the steering wheel so that the steering gear arm moves toward the rear of the vehicle, and remove the outer ball seat and the drag link from the steering gear arm ball. Remove the dust clamp and shield. Remove the inner ball seat, spring, and spring seat from the drag link. Remove the cotter pin, and unscrew the drag link ball plug at the

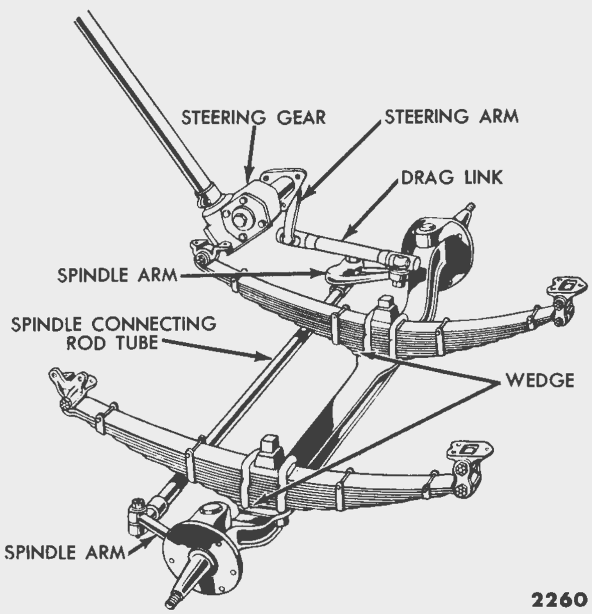

Fig. 14—Steering Gear and Connections (F-4, F-5, and F-6)

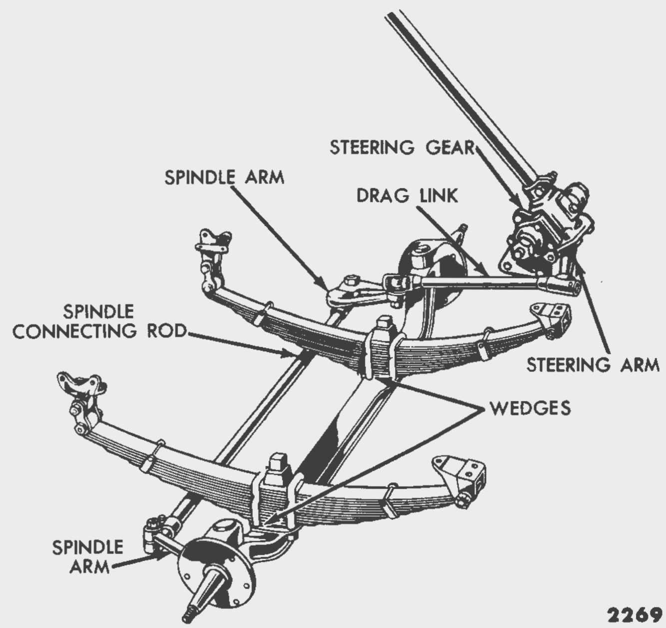

Fig. 15—Steering Gear and Connections, C.O.E. and Parcel Delivery

forward end of the drag link. Pull the drag link back, and remove the spring seat, spring, and ball seat from the drag link. Remove the drag link from the spring ball arm. Remove the dust shield and clamp.

When assembling the drag link on all models except C.O.E. and parcel delivery trucks, be sure the springs are installed as shown in fig. 17, as this method of assembly relieves the road shocks from the steering gear in both directions. On C.O.E. and parcel delivery models, install the spring between the ball plug and the ball seat at the sector shaft end of the drag link, and between the ball seat and the bottom of the drag link socket at the spindle arm end of the drag link.

To install the drag link, install a new drag link grease retainer and cap on the steering arm and steering gear arm ball if the old ones are worn or damaged. Insert the inner ball seat in position in the front end of the drag link. Install dust shield and clamp.

NOTE: ***The front end of the drag link can be identified by the location of the ball joint hole which is approximately 1½ inches from the end.***

Install the drag link on the spindle arm ball. Insert the outer ball seat, spring, and spring seat in the end of the drag link. Install the plug and draw it up tight, fully compressing the spring. Back the plug off to the first cotter pin hole and install the cotter pin.

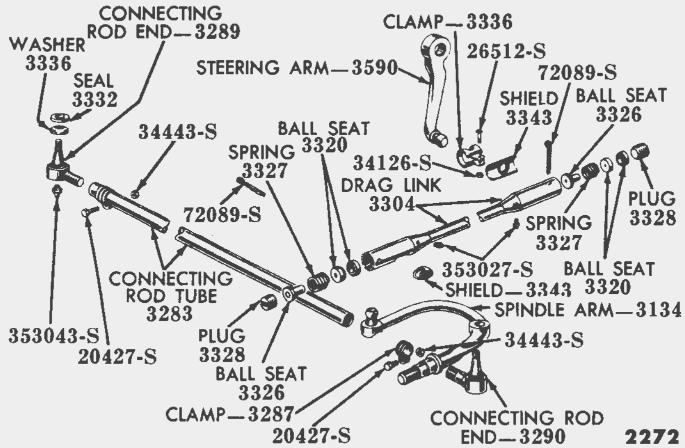

Fig. 17—Drag Link, Disassembled

Insert the spring seat, spring, and inner ball seat in the rear end of the drag link. Install the dust shield and clamb. Install the drag link on the steering arm. Insert the outer ball seat. Install the plug and draw it up tight, fully compressing the spring, then back it off to the first cotter pin hole and install the cotter pin. Lubricate the drag link with pressure gun grease.

7. WHEELS AND TIRES

The wheels used on all F-series trucks, except the late 1950 and all 1951 F-7 and F-8 trucks, are formed steel disc stampings which are riveted to the rim. Late 1950 and all 1951 F-7 and F-8 trucks are equipped with cast weels and removable rims. Four different types of rims, shown in fig. 18, are used on the various vehicle models.

Wheel replacement information applicable to all vehicles is given under "a. Wheel Replacement." Tire maintenance data covering all cars and trucks is given under "b. Tire Maintenance."

Tire replacement procedures and a description of the different rims by rim type, are given under "c. Tire Replacement."

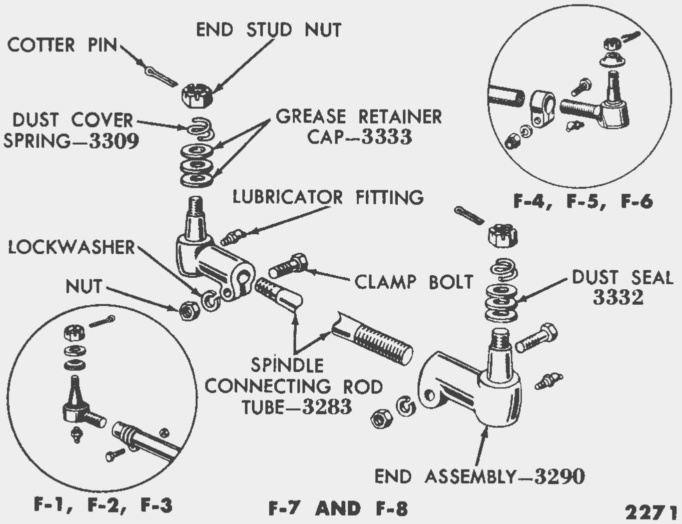

Fig. 16—Spindle Connecting Rods

a. Wheel Replacement.

Wheel stud nuts must be inspected and tightened regularly to avoid accidental loosening of the wheels. Any failure to keep the wheel stud nut tight might result in elongation of the stud holes in the wheels or other damage.

On new vehicles or after each wheel removal, check and tighten the wheel stud nuts after the first 100 miles

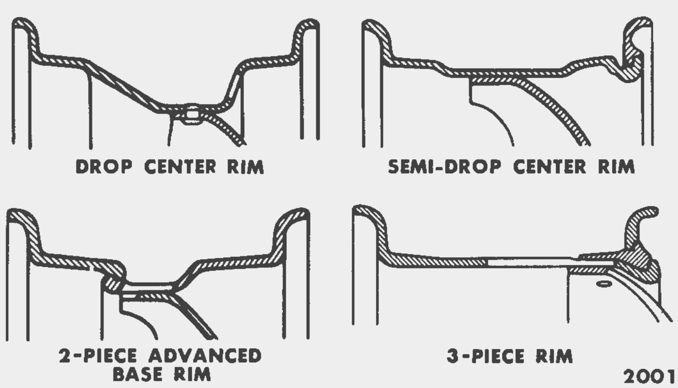

Fig. 18—Wheel Rim Types

of service. After each wheel removal, remove dirt, grease, or other foreign material from mating surfaces of the wheel and hub. Be sure the wheel stud nuts are free from grease or oil. With the axle jacked up, install the wheels and stud nuts. Tighten the nuts sufficiently to hold the wheel firmly in position. Always tighten opposite nuts to assure drawing the wheel (or wheels) evenly against the hub.

Lower the vehicle to the ground and tighten the nuts to the recommended torque as follows: F-1, F-2, F-3, and F-3 Parcel Delivery truck wheels require 65-75 foot-pounds torque. The recommended torque for F-4 through F-8 truck wheels nuts is 400-500 foot-pounds, except for F-7 and F-8 trucks with cast wheels. The wheel nuts on F-7 and F-8 trucks with cast wheels should be tightened to 130-140 foot-pounds torque.

The 400-500 foot-pounds torque may be obtained by using a wheel stud wrench having a 3-foot handle and applying a 150 pound force at the end of the wrench handle.

EXAMPLE: ***A man weighing 150 pounds applies all of his weight at the end of the wrench handle. The length of the handle (3 ft.) multiplied by the man's weight (150 lbs.) equals 450 foot-pounds torque. If the man's weight is greater than the 150 pounds, his weight should be applied at a point proportionately closer to the stud end of the wrench handle.***

On dual wheels, be sure to back off the outer nut before tightening the inner nut. Then tighten the outer nut.

b. Tire Maintenance.

Maintenance of the correct inflation pressure is one of the most important elements of tire care. The inflation pressure recommendations must be followed to obtain the best vehicle performance and tire life.

Under-inflation causes excessive wear on the shoulders of the tire tread, over heating, and will make the tire more susceptible to bruising.

Over-inflation weakens the tire cords and is the cause of many blow-outs. Equal air pressure should be maintained in all tires on the same axle.

Unequal pressure in front tires may cause hard steering. Unequal pressure in rear tires may result in loss of braking efficiency and weaving of the vehicle.

Tires should be cross-switched twice a year or every 5000 miles, as shown in fig. 19.

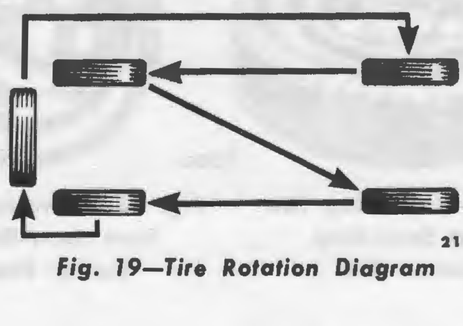

Fig. 19—Tire Rotation Diagram

Cross-switching permits the use of the spare tire on the road and prevents deterioration of the spare tire caused by lack of use.

In the event of spotty wear on the front tires, cross-switching puts the front tires on the rear wheels where they again become round and true.

On trucks with dual wheels, tire rotation is not necessary. However, it is important that dual tires be matched so that the diameters are within ¼ inch, with the smaller diameter tire installed on the inner wheel to conform to road contour.

c. Tire Replacement.

Certain general precautions should be observed when removing or installing tires on all rim types. These are as follows:

1. Always be sure the tire is completely deflated before attempting to remove the tire from the rim.
2. Place the inner tube, and flap when used (F-2 through F-8 Trucks only), in the tire with the valve stem at the balance mark on the tire.
3. Be careful not to damage the tire bead when using tire irons to pry the tire bead over the edge of the rim during tire installation or removal.
4. After the tire and tube have been mounted on the rim, inflate the tube to the recommended air pressure, then deflate the tube and again inflate to the recommended air pressure. This procedure will eliminate the possibility of the tube being folded in the tire casing.
5. When mounting a tire, coat the tire with vegetable soap. This will make it easier to force the beads over the edge of the wheel, both when the tire is mounted and when it is again demounted. It will also protect the beads from damage.

In addition to the foregoing, certain precautions are given below which are peculiar to each rim type and must be observed.

(1) *DROP CENTER.* The drop center rim, shown sectionally in fig. 20, is used on the F-1 and F-2 model trucks. This type rim is used with both standard and

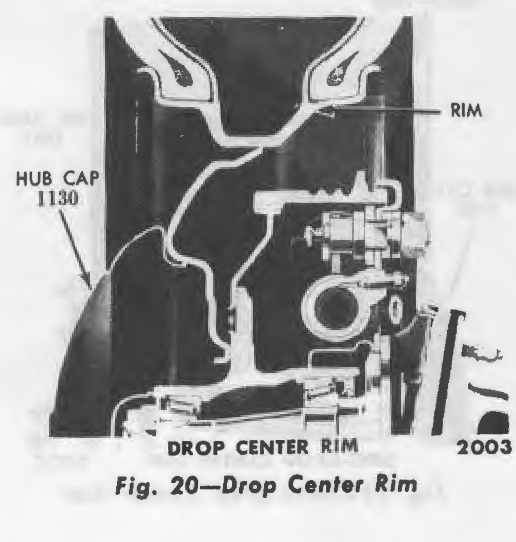

Fig. 20—Drop Center Rim

super balloon-type tires. This type rim has a well in the center which provides the space for the tire beads during tire removal.

A 5-degree tapered bead seat on this type rim allows the tire bead to fit tighter, prevents rust and corrosion of the rim, and allows the beads to loosen easily during tire removal.

To remove the tire from a drop center rim, remove the valve core to deflate the inner tube completely. Loosen both tire beads from the wheel rim ledges, using a tire iron if necessary. With the wheel lying flat on the floor, stand on the tire with feet about 15 inches apart opposite the valve, and force the tire bead off the rim ledge and into the drop center well part of the wheel rim.

CAUTION: ***Care should be taken that the soft rubber tip on the inner side of the tire bead is not damaged by the tire iron, as such damage will have a tendency to chafe the inner tube.***

Insert two tire irons about 8 inches apart between the tire bead and the wheel rim near the valve, and pry the short length of the bead over the wheel rim. Leaving one tire iron in position, follow around the wheel rim with the other tire iron to remove the remainder of the bead. Remove the tube. Stand the wheel in an upright position with the bead in the drop center part of the rim at the bottom. Insert the tire iron between the bead and the wheel rim at the top side of the wheel, and pry the wheel out of the tire.

To install the drop center wheel, install the valve core in the inner tube valve stem, inflate the tube until it is barely rounded out, and insert it in the tire casing. See that the balancing mark on the casing is opposite the valve stem. Before mounting the tire casing on the wheel, apply soft vegetable soap on the tire beads. Place the tire on the wheel rim, guiding the valve through the valve hole. Push the bottom bead down into the drop center part of the rim at the valve, and force the remaining portion of the bear over the rim. A tire iron may be needed to pry the last portion of the bead over the rim. At a point on the opposite side of the wheel from the valve, insert a tire iron between the top bead and the wheel rim, prying the bead over the rim. Holding this iron in position, continue prying with the other iron, working around the rim until the bead is in place. Inflate the tube slowly, and see that the tire is centered on the rim on both sides. This "centering" may be done by bouncing the tire after approximately 15 pounds of air pressure has been added. Finish inflating the inner tube to the recommended pressure.

(2) *SEMI-DROP CENTER.* The semi-drop center rim, shown sectionally in fig. 21, is used as standard equipment on the F-3 Parcel Delivery model truck. This rim is 5½ inches wide, 16 inches in diameter, and has 5-degree bead seats.

A continuous wheel rim ring, which fits into a groove in the rim, is used to hold the tire on the rim and must be removed from the rim in order to remove the tire.

To remove the tire from a semi-drop center rim, remove the wheel from the truck. Remove the valve core to deflate the inner tube completely.

NOTE: ***Make sure the tire is completely deflated before attempting to remove the tire from the rim.***

Place the wheel on the floor with the side ring up. Insert the straight end of the rim tool in the notch, and pry the side ring down to unseat the tire beads.

With the help of the tire iron, continue around the rim until the tire bead is loose (fig. 22).

To remove the side ring, insert the straight end of the rim tool into the notch, and, holding the opposite side of the ring in the gutter groove, pry the ring out and up. Work the rim tool and the tire iron around the rim to remove the ring. Turn the wheel over, and loosen the tire bead from the rim by hammering the hook end of the rim tool between the rim flange and the tire bead.

Pry the tire bead away from the wheel taper, continuing around the rim until the tire is loose in the well of the rim. Stand the tire upright and, with the lower portion of the beads in the wheel well, pry the upper part

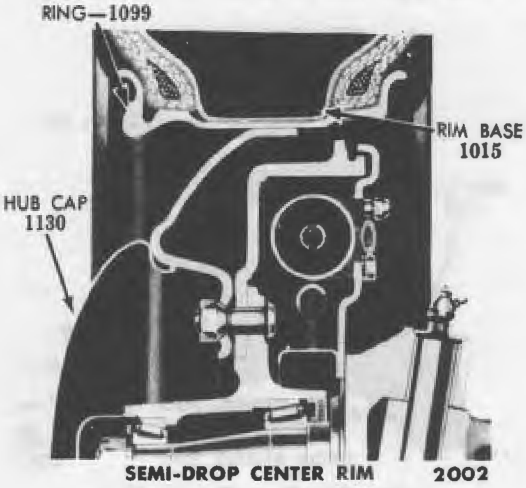

Fig. 21—Semi-Drop Center Rim

Fig. 22—Loosening Tire Bead Semi-Drop Center Rim

Fig. 23—Removing Tire from Semi-Drop Center Rim

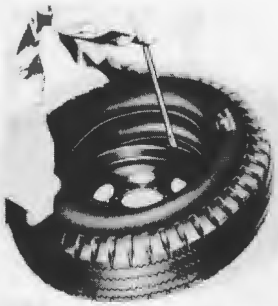

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Fig. 24—Forcing Bead Over Rim on Semi-Drop Center Rim

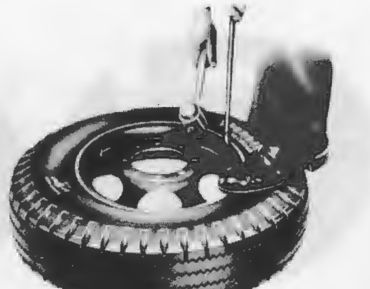

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Fig. 25—Forcing Ring Over Gutter of Semi-Drop Center Rim

of the beads over the edge of the rim with the tire iron and the rim tool (fig. 23). Remove the tire.

To install the tire, place the inner tube and the flap in the tire so that the valve stem is at the balancing mark on the tire. Place the wheel on the floor with the gutter side up. Place the tire on the rim and insert the valve stem into the valve hole.

Using the tire iron and the rim tool, start on each side of the valve and work around the tire until the lower bead is in the well (fig. 24). To install the upper bead, start at a point opposite the valve and press the bead over the rim gutter and into the rim well with knee pressure. Force the remainder of the bead over the rim gutter with the tire iron.

If the side ring is distorted or warped, straighten it with a soft hammer. Place half the side ring opposite the notch in the rim gutter groove so that the scalloped or cutaway portions of the ring span the rim gutter. Insert the straight end of the rim tool into the ring notch, and pull the ring on the rim, at the same time forcing the ring over the gutter with a soft hammer (fig. 25). CAUTION: ***The side ring must be entirely seated beneath the entire circumference of the gutter, otherwise it will be blown off during inflation or when vehicle is in operation. When inflating tire, do not stand in front of side ring.***

(3) *2-PIECE RIM.* The 2-piece rim, shown sectionally in fig. 26, is used as standard equipment on F-3,

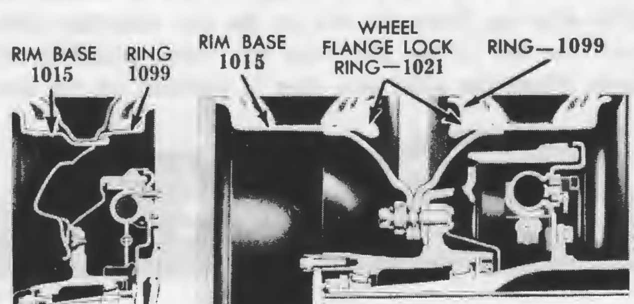

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Fig. 26—Two and Three Piece Rim Installation

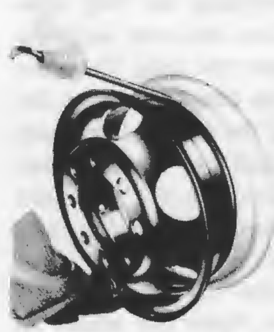

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Fig. 27—Removing Ring from 2-Piece Rim

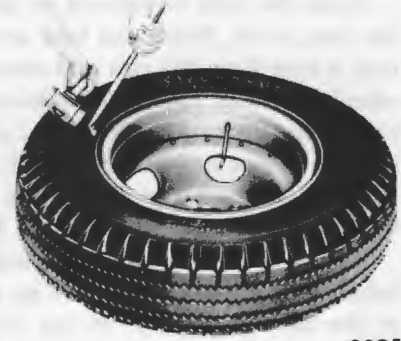

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Fig. 28—Loosening Tire Bead

F-4, F-5, F-6, and F-7 model trucks (1949 and 1950) and as optional equipment on F-3 Parcel Delivery and late 1950 and 1951 F-7 trucks.

The tire bead seats on the two-piece rim have a 5-degree taper to facilitate tire replacement. A continuous type side ring which locks over the flange of the rim base holds the tire on the rim. After the side ring has been removed, the tire can be removed from the rim base.

NOTE: ***To remove the ring from a rim without a tire, stand the wheel on end so that the tool slot of the ring is at the top, and the lower portion of the ring is in the rim well. Insert the rim tool between the ring slot and the gutter of the rim, lift the ring over the gutter, then pry the ring off the rim (fig. 27).***

Remove the wheel from the truck, and remove the valve core to deflate the inner tube. Make sure the tire is completely deflated before attempting to remove it from the rim.

Place the wheel on the floor with the ring side up. Insert the hook end of the rim tool between the ring flange and the tire bead, and continuing around the ring, pry the tire off the tapered seat of the ring (fig. 28).

Remove the ring by pressing the side of the ring opposite the double embossing, down into the rim well. Insert the straight end of the rim tool into the notch between and below the double embossing (fig. 29).

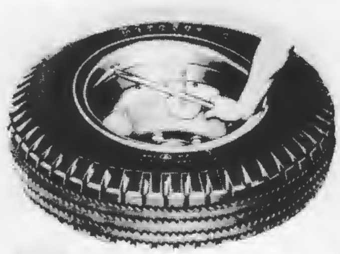

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Fig. 29—Removing Ring From Gutter

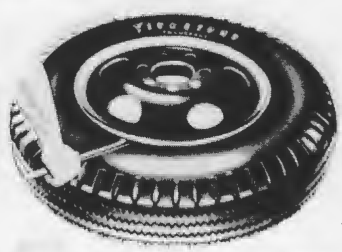

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Fig. 30—Removing Tire From Rim

Force the tool downward to disengage the ring from the rim gutter. Work the tool around the rim until the ring is free from the rim and remove the ring. Turn the wheel over and loosen the opposite tire bead from the rim by hammering the hook end of the rim tool between the rim flange and the tire bead, and pry the tire bead away from the taper, continuing around the rim until the tire is free. Remove the tire from the rim (fig. 30).

To mount the tire on a 2-piece rim, place the inner tube and the flap in the tire so that the valve stem is at the balancing mark on the tire. Place the wheel on the floor with the gutter side facing up. Place the tire on the rim with the valve inserted in the valve hole and pointing downward.

Place the side ring in position with the notch about 3 inches from the valve stem (fig. 31). Hook the section of the ring opposite the notch under the gutter so the cutaway, or scalloped, portions of the ring retaining bead spans the rim gutter (fig. 32).

Insert the straight end of the rim tool in the notch, and pull the side ring on the rim, at the same time forcing the ring over the gutter with a soft hammer (fig. 33). Remove the tool and continue to drive the ring down until the ring is entirely engaged in the gutter. CAUTION: ***Press down on the ring as shown in fig. 34 and make sure the ring will rock or teeter. This is your assurance that the ring is properly and completely seated around the gutter. If a portion of the ring is riding on the top of the gutter, it will become cocked, and will be blown off during inflation, or after the vehicle is in operation. When inflating the tire do not stand in front of the locking ring.***

(4) *3-PIECE RIMS.* Information on the rim and tire removal and installation for vehicles equipped with disc wheels is given under "(a) Disc Wheels." Similar information on the cast wheel is given under "(b) Cast Wheels."

(a) DISC WHEELS. The 3-piece rim, shown sectionally in fig. 26, is used as standard equipment on all F-8 model trucks and on late 1950 and 1951 F-7 trucks equipped with cast wheels. This type rim is 7 inches wide, 20 inches in diameter, and has a 5-degree tapered

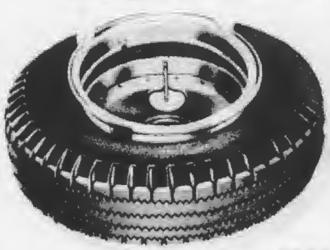
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Fig. 31—Placing Ring In Position

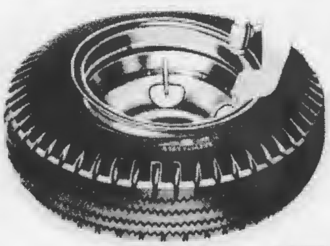
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Fig. 32—Starting Ring On Gutter

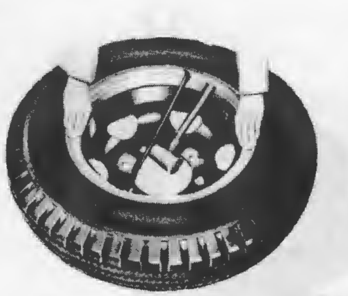
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Fig. 33—Driving Ring In Place on Gutter

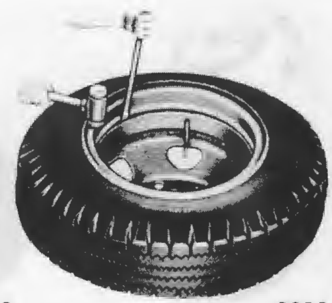
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Fig. 34—Rocking Side Ring

bead seat. A continuous side ring is used to hold the tire on the rim. The side ring is held in place by a split type locking ring which seats in a groove in the rim base. The locking ring must be removed before the side ring can be removed. Removal of the side ring permits removal of the tire.

To remove the tire from a 3-piece rim, remove the wheel from the truck and remove the valve core to deflate the inner tube. Make sure the tire is completly deflated before attempting to remove it from the rim.

Place the wheel on the floor with the ring side facing upward. Insert the straight end of the rim tool in the depression in the locking ring, and press down on the side ring to loosen the tire bead from the tapered seat (fig. 25). Continue around the ring until the tire is completely free from the bead seat.

Insert the straight end of the rim tool in the notch provided in the locking ring and pry the locking ring out of the gutter (fig. 36).

Then lift out the locking ring, and remove the side ring (fig. 37). Turn the wheel over, and loosen the tire bead from the rim by hammering the hooked end of the rim tool between the rim flange and the tire bead, and pry the tire bead away from the taper, continuing around the rim until the tire is free. Remove the tire from the rim.

To install the tire, always place the inner tube and flap in the tire so that the valve stem is at the balancing mark on the tire. Place the wheel on the floor with the gutter side up. Place the tire on the rim with the valve stem inserted in the slot with the valve pointing upwards. Place the solid side ring in position on the tire,

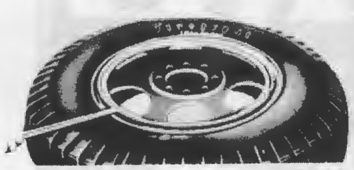
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Fig. 35—Loosening Side Ring from Tire Bead

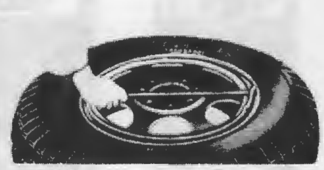
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Fig. 36—Inserting Tool Into Removing Notch

and insert the tapered toe of the split locking ring between the rim and the side ring (fig. 38).

Using a soft hammer, drive the locking ring into place (fig. 39), starting at one end of the split ring and progessively driving the ring into the gutter until the entire ring is seated.

CAUTION: *Ring must be entirely seated around the entire circumference of rim as shown in fig. 40. Be sure the split ends are engaged in the gutter, otherwise the ring will be blown off during inflation or after the vehicle is in operation. When inflating the tire, do not stand in front of the locking ring.*

(b) CAST WHEELS. The late 1950 and all 1951 F-7 and F-8 trucks are equipped with cast wheels with a removable rim as shown in fig. 41. The rim is fastened to the wheel with six clamps evenly spaced around the rim. Although the cast type wheels are standard equipment on F-7 and F-8 trucks, the tire removal is identical on disc type wheels which are available as optional equipment.

(1) REMOVE RIM AND TIRE FROM WHEEL. Apply the hand brake and block one or more wheels to prevent the truck from rolling. Raise the wheel. Remove the nuts from the rim clamps and remove the clamps. Lift the rim and tire from the wheel.

With dual rear wheels, lift off the outer rim and tire, remove the spacer rim, and the inside rim and tire assembly.

(2) TIRE REPLACEMENT. The removal and installation of the tires on vehicles equipped with cast wheels and the 3-piece rim is identical to the procedure used on 7.0 inch disc wheels with 3-piece rim.

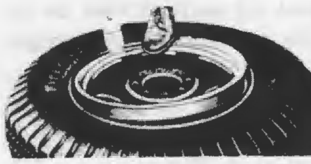
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Fig. 39—Starting Lock Ring with Hammer

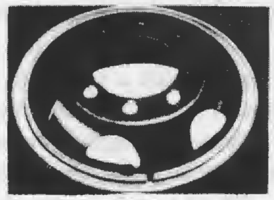
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Fig. 40—Side Ring and Locking Ring Properly Seated

(3) INSTALL TIRE AND RIM ON WHEEL. On trucks equipped with dual wheels, place inner tire and rim on wheel (or spider). Care must be taken to see that the rim rides up high enough on the tapered retainer flange of the inner section of the wheel, as the rim has a tendency, when mounting, to slide down on the tapered surface. Place the spacer between the inner and outer rim. Place outer tire and rim on wheel and install the six clamps on the wheel (fig. 41). First tighten the top clamp fairly tight so that the spacer will push the inner rim up on the tapered surface of the inner section of the wheel. Then tighten the bottom clamp. This will have a tendency to center the rim on the wheel. Tighten the other four clamps alternately and evenly. Torque all wheel nuts to 130-140 foot-pounds.

The same procedure should be followed in tightening the clamps on the front wheel.

The lateral or side run-out should not exceed 1/8 inch for the front rims and 1/4 inch for the dual rear rims.

8. HUBS AND BEARINGS

The description and adjustment of front hubs and bearings and the replacement of front hub oil seals is given in "a. Front Hubs and Bearings." Similar service information on rear hubs, bearings, and oil seals is contained in "b. Rear Hubs and Bearings."

a. Front Hubs and Bearings.

Tapered roller bearings are used in the front hubs on all trucks. The front hub and wheel bearings are all similar in construction. All hubs are equipped with demountable brake drums (figs. 42-44). Two tapered roller type wheel bearings, inner and outer, are used in each hub and an adjusting nut is used to lock these bearings in position. Front hubs and bearings may be disassembled and assembled by referring to figs. 42-44

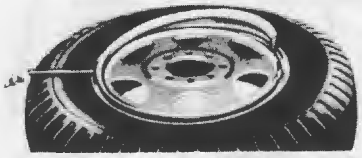
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Fig. 37—Removing Locking Ring

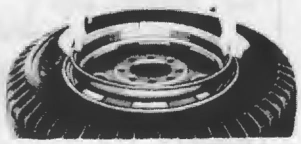
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Fig. 38—Placing Locking Ring Between Side Ring And Tire Bead

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Fig. 41—3-Piece Rim Installed on Cast Wheel (Dual Wheels Shown)

for the relative position of the component parts.

Front wheel bearing cups and oil seals should be removed with a tool that pulls the cup absolutely straight out without damage to the cup or hub.

When installing wheel bearing cups or seals, make sure the parts are squarely seated in the front hub.

The front hubs on the F-1 through F-8 truck models have demountable brake drums which are attached to the hub with screws or bolts.

Illustrations are used to show the construction and the sequence of assembly or disassembly for the various types of hubs.

The construction of the hub and bearings used on the F-1, F-2, F-3 and F-3 Parcel Delivery models is shown in fig. 42.

F-4, F-5, and F-6 model hub and bearing construction is shown in fig. 43.

Figure 44 shows construction features of the hub and bearings used on the F-7 and F-8 truck. The hub used on the F-7 and F-8 models is equipped with an oil seal retainer which is pressed into the hub, an oil slinger which is bolted to the brake backing plate, a felt oil seal which is installed over the retainer followed by a steel oil seal washer and spacer.

(1) *ADJUSTMENT.* The adjustment procedure for front wheel bearings on all models is the same. To check the wheel bearing adjustment, jack up the front of the vehicle, grasp the tire at the sides, then alternately push inward and pull outward on the tire. If any looseness is felt, adjust the front wheel bearings as follows:

Remove the hub cap (F-1, F-2, and F-3 Parcel Delivery trucks), the front hub grease cup, and the cotter pin. Tighten the wheel bearing adjusting nut, while rotating the wheel back and forth, until a noticeable drag is felt. This will assure the proper seating of the wheel bearing cones and rollers. Back off the adjusting nut until the nearest slot in the nut is aligned with a hole in the spindle (about $\frac{1}{6}$ to $\frac{1}{4}$ turns). Lock the adjusting nut in this position by installing a new cotter pin. When the wheel bearings are properly adjusted, the wheel will rotate freely with no perceptible end play.

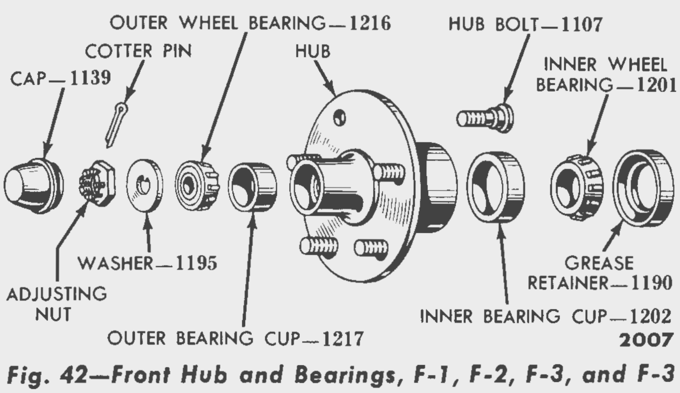

Fig. 42—Front Hub and Bearings, F-1, F-2, F-3, and F-3 Parcel Delivery

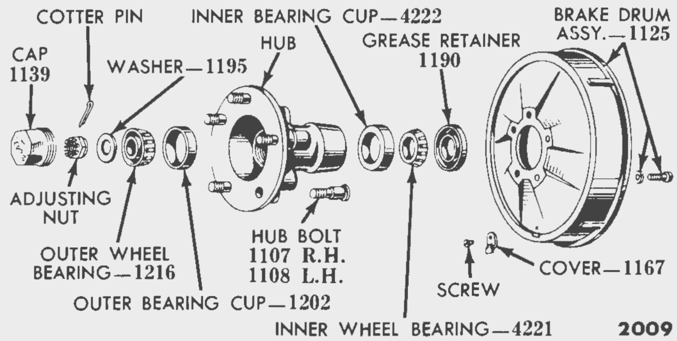

Fig. 43—Front Hub and Bearings, F-4, F-5, and F-6

(2) *OIL SEALS.* Oil seals are installed at the inner end of the hubs to prevent the possibility of lubricant leaking into the brake drums. The condition of the oil seals should be checked each time the wheel bearings are serviced. Always replace any seals that are damaged or in doubtful condition. Extreme care should be exercised when installing the hubs on the wheel spindles to prevent damaging the oil seals.

b. Rear Hubs and Bearings.

F-1 trucks are equipped with pre-lubricated, ball bearing type rear wheel bearings, mounted between the axle shaft and the axle. F-2 through F-8 trucks are equipped with opposed tapered roller rear wheel bearings mounted between the rear axle housing and the rear hub. Replacement information on rear wheel bearings is given under "(1) Bearing Replacement."

Rear wheel bearings of the ball bearing type do not require periodic adjustment. The opposed tapered roller type rear wheel bearing should be checked periodically and adjusted, if necessary, following the procedure outlines under "(2) Adjustment." All rear hubs are equipped with oil seals. The various types of seals used, the construction of the seals and the replacement procedures for all types is given under "(3) Oil Seals."

(1) *BEARING REPLACEMENT.* The F-1 truck rear wheel bearings (fig. 45) are single-row, prelubricated, sealed ball bearings which are pressed onto the axle shafts. An axle shaft bearing retainer ring is pressed onto the shaft to hold the bearing in position.

To remove the bearing, loosen the axle shaft bearing

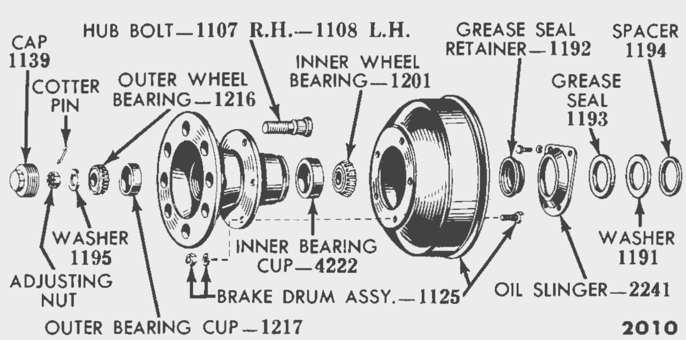

Fig. 44—Front Hub and Bearings, F-7 and F-8

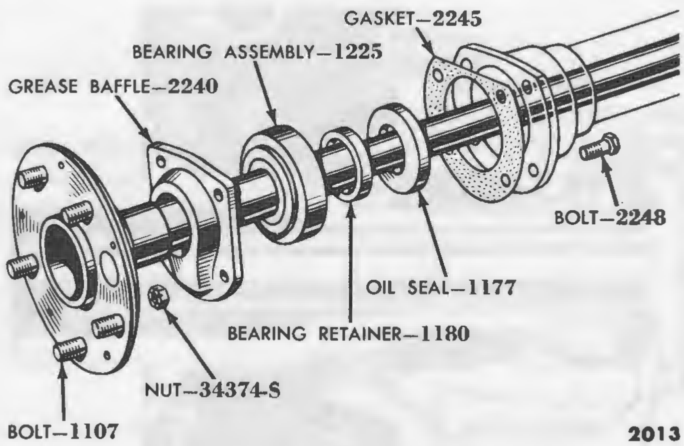

Fig. 45—Rear Hub and Bearings—F-1 Truck

retainer ring with the tool shown in fig. 46. If this tool is not available, the retainer ring can be loosened by using a chisel. Be sure not to damage the axle shaft during this operation.

Remove the axle shaft bearing, using a puller which will remove the bearing without damaging the axle shaft.

Remove bearings only when replacement is necessary since removal of the bearing renders it unfit for further use.

When installing a new bearing and retainer, be sure the bearing is seated against the shoulder on the axle shaft and the retainer is firmly pressed against the bearing.

Rear wheel bearings, used on F-2 through F-8 trucks, are all of the opposed tapered roller bearing type. An adjusting nut, threaded onto the end of the axle housing tube, retains the bearings in the correct position. An oil seal is installed at the inner end of each hub. On F-7 and F-8 model trucks, an oil seal is also installed at the outer end of each hub.

The inner and outer bearing cups are pressed into the hub. Bearing cups may be tapped out of the hub, using a brass drift and hammer. Inspect bearing cups for pits, corrosion, or discoloration due to overheating

Fig. 46—Loosening Rear Wheel Bearing Retainer Ring

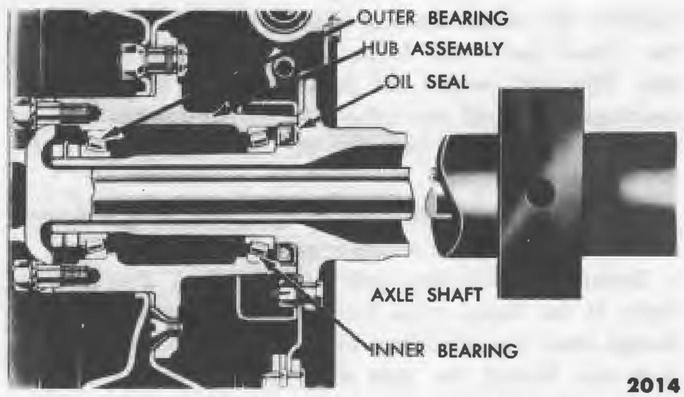

Fig. 47—Rear Hub and Bearings F-2 Trucks

or signs of irregular wear. Discard any bearing cups which have any of the above defects.

To install the bearing cups, use a tool that applies pressure evenly to the bearing cup and press the cup firmly against the hub shoulder.

Rear hub and wheel bearing construction on F-2 trucks (fig. 47) and F-3 trucks (fig. 48) is similar with the exception of the oil seal construction. This difference is readily discernible in figs. 47 and 48.

Rear hub and bearing construction on F-4, F-5, and F-6 trucks (fig. 49) and on F-7 trucks (fig. 50) is similar except for the type and location of the oil seals and the size of the component parts.

Rear hub and bearing construction, used on F-8 trucks, is shown in fig. 51. A spacer and grease retainer is pressed into the inner end of the hub and the adjusting nut at the outer end is equipped with a rear axle wiper oil seal assembly.

(2) *ADJUSTMENT*. Rear wheel bearings used on the F-1 model trucks do not require adjustment. All other model trucks have adjustable rear wheel bearings.

To check the wheel bearing adjustment, jack up the rear of the vehicle, grasp the tire at the sides, then alternately push inward and pull outward on the tire. If any looseness is noticed, the bearing should be adjusted.

To adjust the wheel bearing, remove the axle shaft, then remove the bearing lock nut and the lock washer.

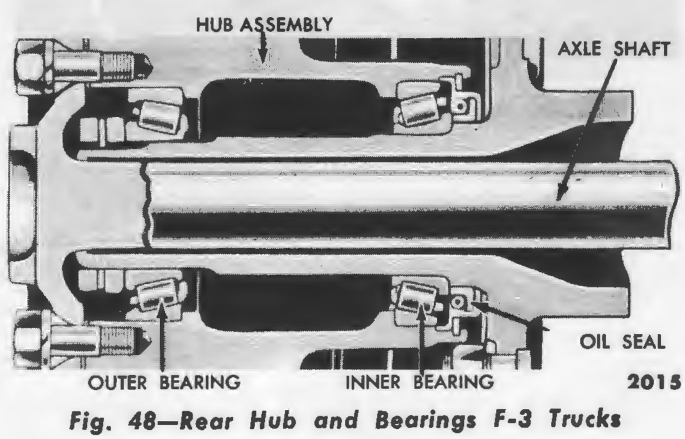

Fig. 48—Rear Hub and Bearings F-3 Trucks

Tighten the wheel bearing adjusting nut, while rotating the wheel back and forth, until a noticeable drag is felt. This will assure the proper seating of the wheel bearings. Back off the adjusting nut approximately 1/8 turn, to ensure free rotation of the wheel. Install the bearing lock washer.

NOTE: ***If the adjusting nut is equipped with a dowel, make sure the lock washer fits over the dowel.***

Install the bearing lock nut, drawing the nut up tight. If the flange type lock washer is used, bend one flange over the adjusting nut and one flange over the lock nut. Install the axle shaft and lower the vehicle.

(3) *OIL SEALS.* Oil seals are used at the inner end of the hubs on all trucks. Oil seals are also installed at the outer ends of the hubs on F-7 and F-8 trucks. These oil seals are used to prevent lubricant leakage into the brake drums.

Inner oil seals are either pressed into the bore of the hub or retained in the hub with a locking ring. The outer oil seal on F-7 trucks is installed over the axle shaft flange studs. The outer oil seal in F-8 trucks is installed in a groove in the adjusting nut lock nut, and is held in place by the axle shaft flange.

The condition of the oil seals should be checked each time the wheel bearings are serviced. Always replace any seals that are damaged or in doubtful condition.

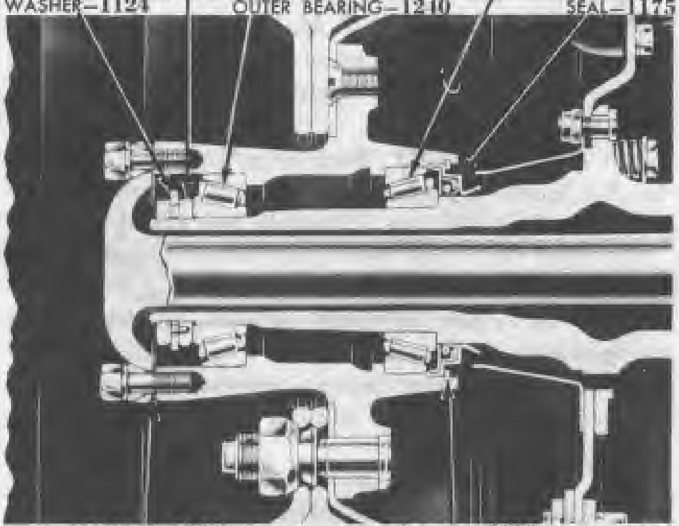

Fig. 49—Rear Hub and Bearings F-4, F-5 and F-6 Trucks

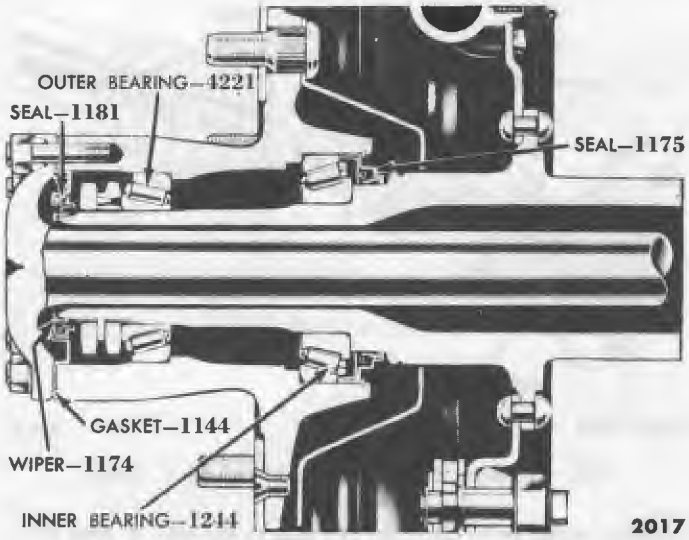

Fig. 50—Rear Hub and Bearings F-7 Trucks

Before installing a new leather oil seal, soak the seal in light engine oil for at least 30 minutes. Examine the surface of the axle housing tube, contacted by the lip of the oil seal, for roughness or irregularities which would impair the sealing action of the oil seal. All irregularities must be removed before the seal is installed.

Extreme care should be exercised, when installing the hubs, to prevent damaging the inner oil seals.

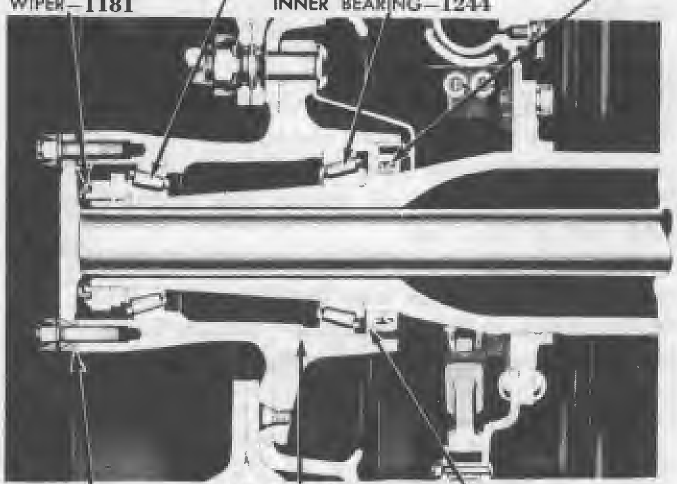

Fig. 51—Rear Hub and Bearing F-8

Part TWO

CHASSIS

Chapter

IV

Brakes

Service information on the brakes used on all F-series trucks is given in this chapter. A brief description of all brake types and the model application is covered under "1. Types, Description, and Model Application." Adjustment procedures are given under, "2. Adjustments." "3. Hydraulic Systems" contains a description of the hydraulic system including serviceability tests, with and without booster, and the procedure for bleeding the brake system. Complete repair and replacement procedures covering the wheel cylinders, brake master cylinder, and hydraulic pipes are also included.

The description, operation, and repair of the two types of hydraulic brake boosters used on Ford trucks is contained under "4. Hydraulic Brake Boosters." The six types of brake shoe assemblies are described and the disassembly and assembly procedures are given under

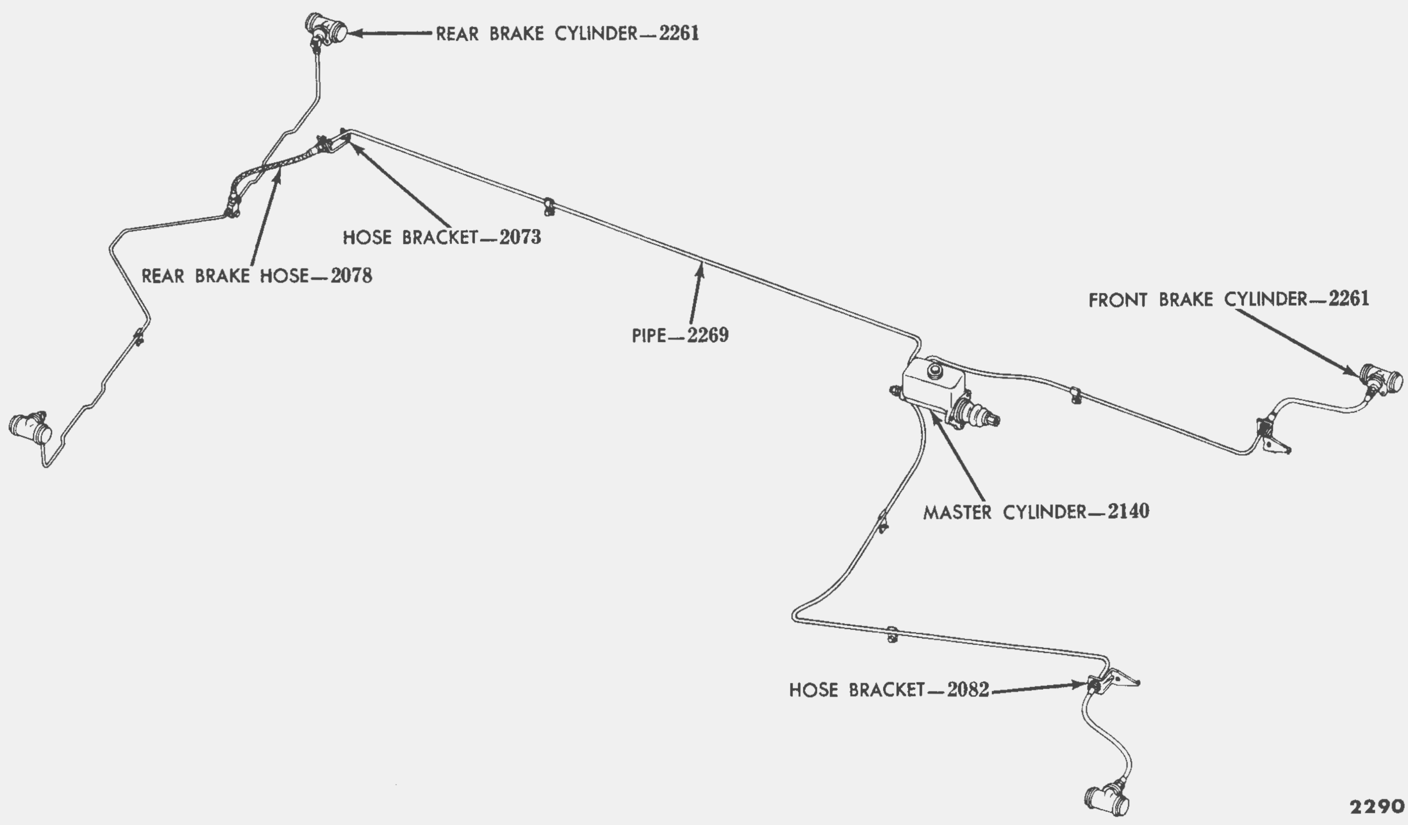

Fig. 1—Typical Hydraulic System (Without Booster)

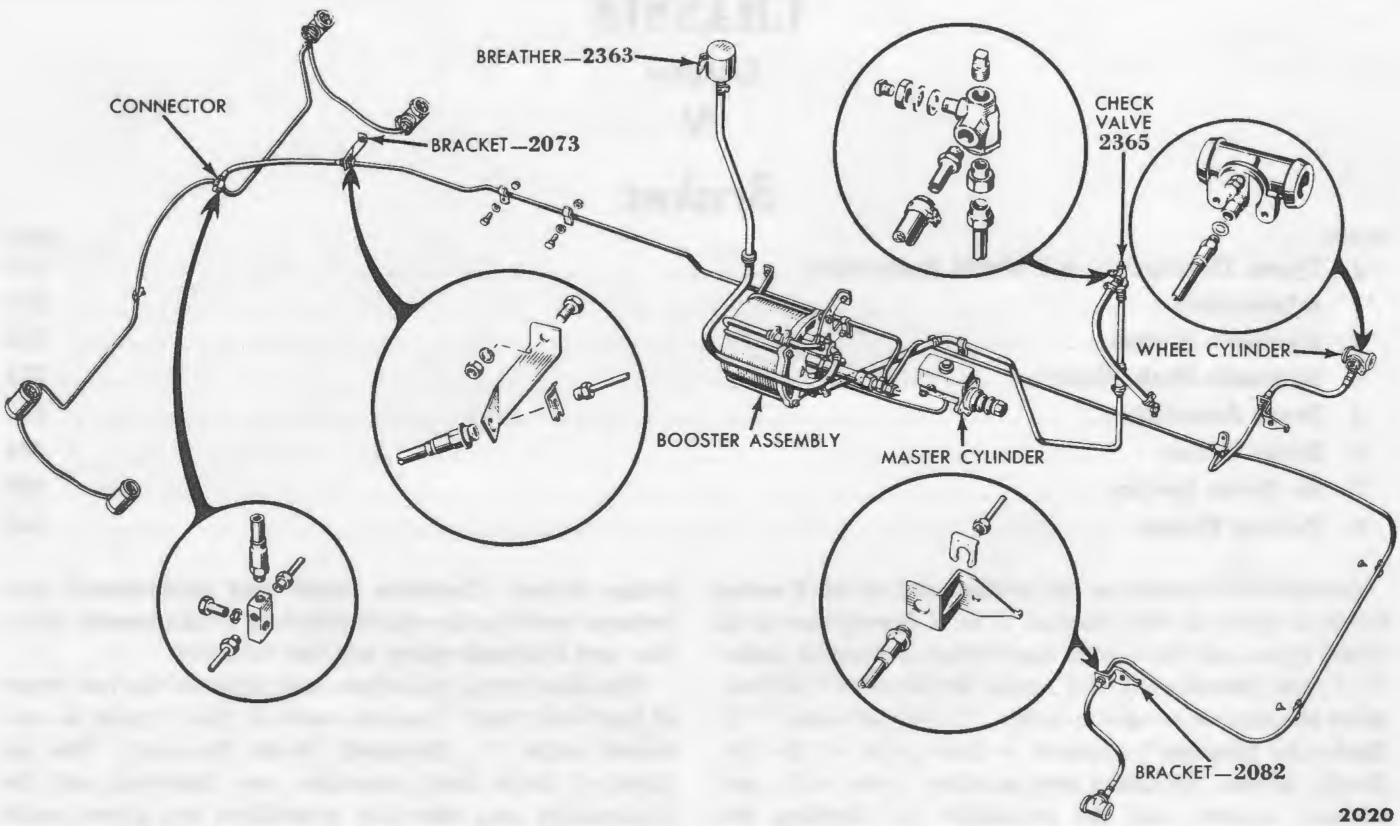

Fig. 2—Hydraulic Brake System with Vacuum Booster

"5. Brake Assemblies." Brake shoe relining is included in this section, "6. Brake Drums" gives brake drum mounting and reboring information.

The air brake system description, operation, adjustments, serviceability tests, and repair procedures are contained under "7. Air Brake System." The description and adjustment information on the two types of parking brakes are given under "8. Parking Brakes."

1. TYPES, DESCRIPTION, AND MODEL APPLICATION

Hydraulically operated brakes are used as standard equipment on all of the vehicles covered in this manual. The F-6, F-7, and F-8 model trucks are equipped with vacuum brake boosters as standard equipment. A vacu-

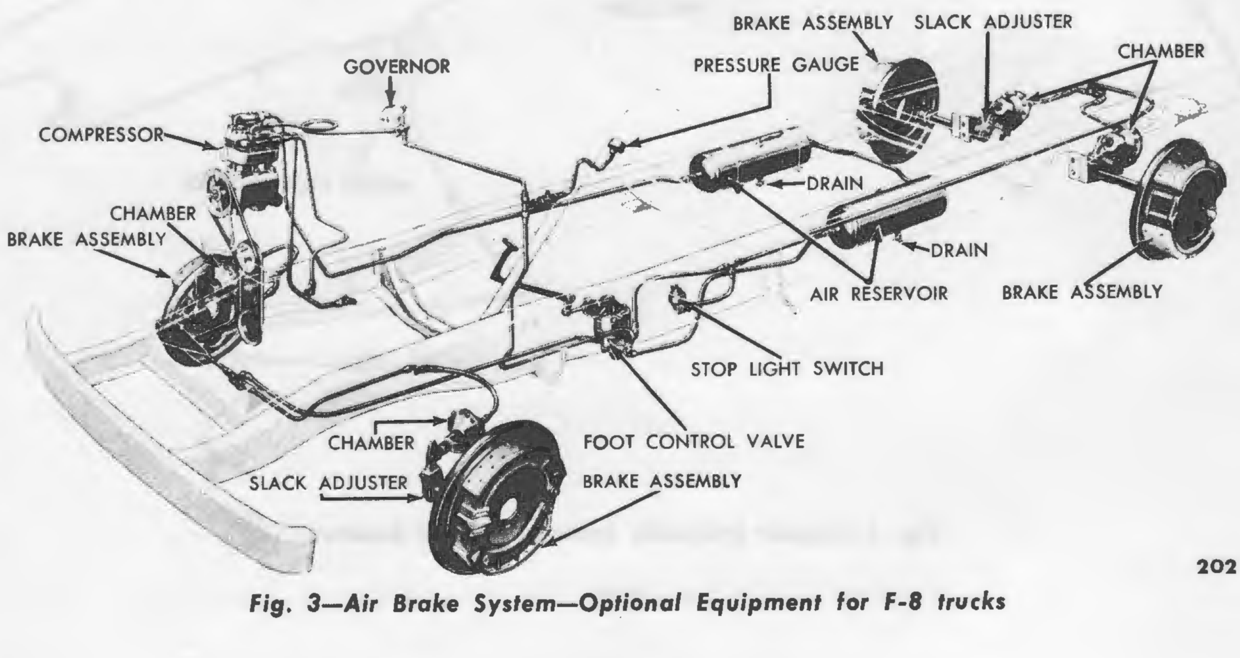

Fig. 3—Air Brake System—Optional Equipment for F-8 trucks

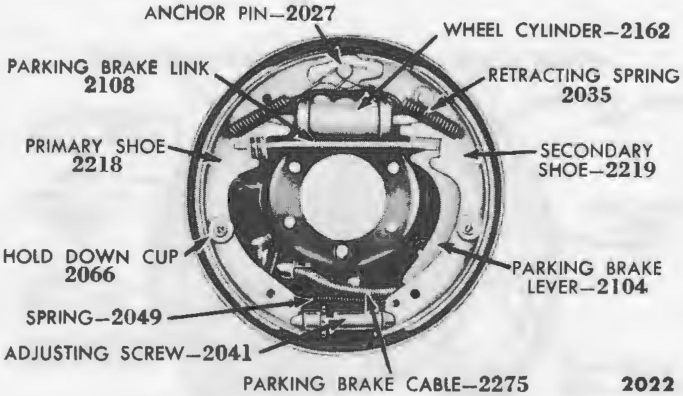

Fig. 4—Single Anchor Self-Energizing Brake

um brake booster is available as optional equipment for F-4 and F-5 model trucks. Air brakes are available as optional equipment on the F-8 model trucks.

A typical hydraulic brake system without booster is shown in fig. 1. The hydraulic system incorporating a brake booster is shown in fig. 2. The air brake system, available for F-8 trucks, is shown in fig. 3.

a. Brake Types.

The service brakes used are divided into six different types according to the brake assembly construction. A brief description of each type is given here.

(1) *SINGLE ANCHOR SELF-ENERGIZING.* This type may be identified by the single anchor pin located at the top of the brake, and by the adjusting screw located between the lower end of the brake shoes. The single anchor self-energizing type brake is shown in fig. 4.

(2) *UNI-SERVO SINGLE ANCHOR.* This brake assembly is similar in construction to the single anchor self-energizing brake except that the wheel cylinder has only one piston. Figure 5 shows the construction of the uni-servo single anchor type brake.

(3) *DOUBLE ANCHOR SELF-CENTERING.* The

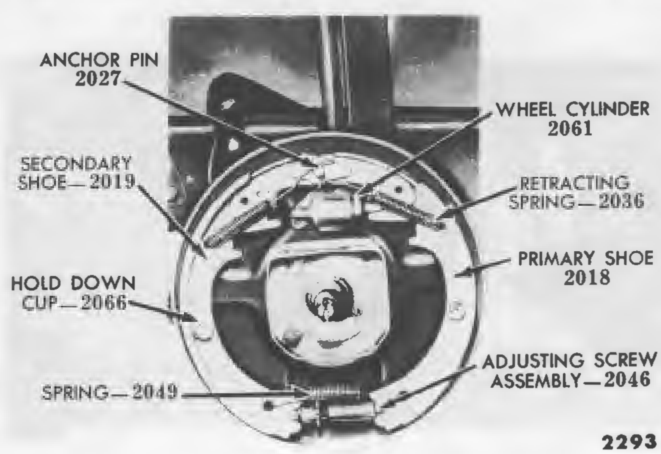

Fig. 5—Uni-Servo Single Anchor Brake

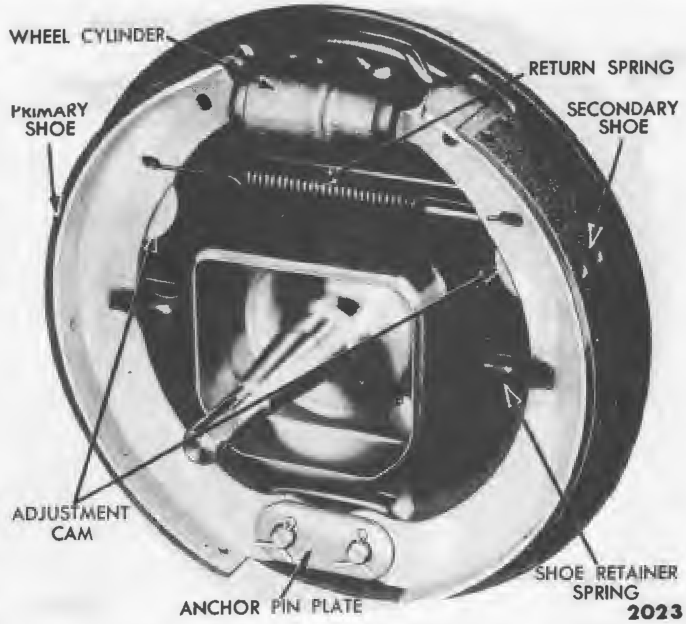

Fig. 6—Double Anchor Self-Centering Brakes

double anchor self-centering brakes shown in fig. 6 contain two shoes which are anchored at the lower ends on fixed anchor pines. Each shoe is slotted in such a manner as to allow self-centering of the shoe at the anchor.

(4) *DOUBLE ANCHOR.* Each brake shoe is held in place by a removable eccentric anchor pin, located at the lower end of the shoe. A bushing is installed between each anchor pin and each shoe. Two types of double anchor brakes are used. The differences in construction of the two types are shown in fig. 7 and fig. 8.

(5) *DOUBLE ANCHOR 2 CYLINDER SELF-CENTERING.* This type brake may be identified by the two wheel cylinders used in each brake assembly. The wheel cylinders are held in position by shoe anchor blocks as shown in fig. 9.

(6) *DUAL PRIMARY.* In the dual primary brake,

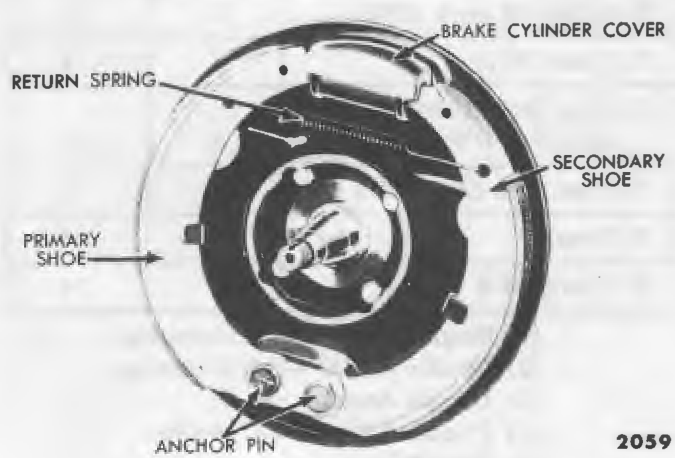

Fig. 7—Double Anchor Brake

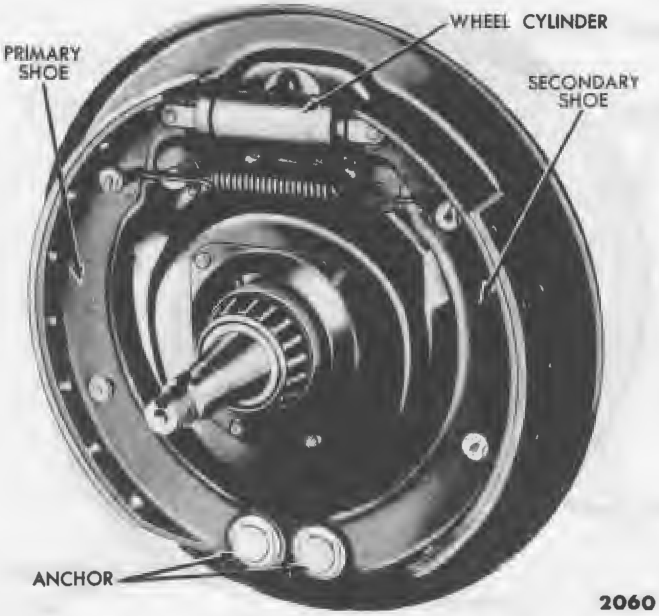

Fig. 8—Double Anchor Brake

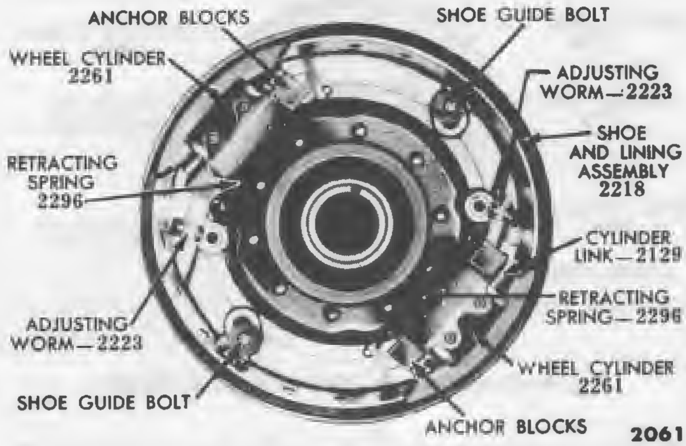

Fig. 9—Double Anchor Two-Cylinder Brake

each brake shoe is connected to a lever assembly, the lower end of which is fastened to an eccentric anchor pin. The dual primary brake assembly is shown in fig. 10.

b. Model Application.

The type of brake assembly used on each vehicle is given in Table 1.

Table 1—Brake Model Application

Model	*Front Brake Type*	*Rear Brake Type*
F-1	1	1
F-2 (1949-50 early 1951)	2	2
F-2 (late 1951)	6	1
F-3 (1949-50 early 1951)	2	3
F-3 (late 1951)	6	1
F-3 Par. Del. (1949-50 early 1951) F-4, F-5, F-6	3	3
F-3 Par. Del. (late 1951)	3	1
F-7 (early)	3	5
F-7 (late); F-8	3	4

(1) Single Anchor—Self-Energizing
(2) Double Anchor—Self-Centering
(3) Double Anchor
(4) Double Anchor—2-Cylinder
(5) Dual Primary
(6) Uni-Servo Single Anchor

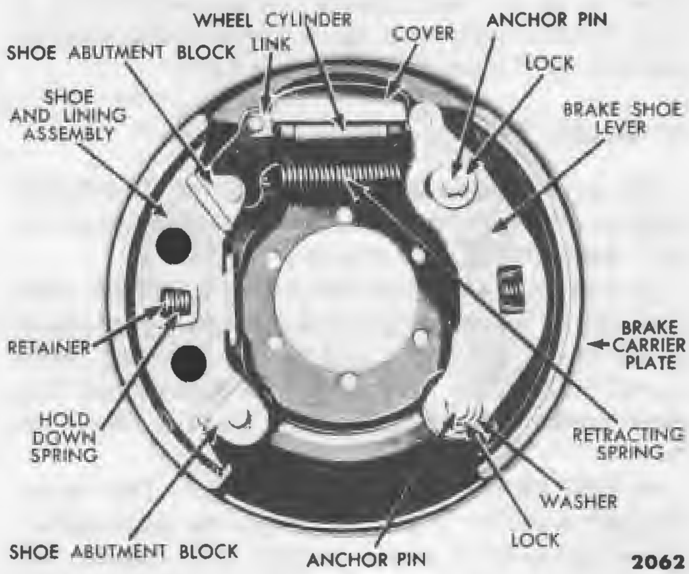

Fig. 10—Dual Primary Brake

Fig. 11—Brake Pedal Free Play (Typical)

2. ADJUSTMENTS

Brake adjustments are divided into two classifications, minor adjustment and major adjustment. A minor or brake shoe adjustment re-establishes the brake lining to drum clearance and compensates for normal lining wear. A major brake adjustment includes the adjustment of the brake shoe anchor pins in addition to the shoe adjustment.

Brake adjustment procedures for each brake type used on F Series trucks are given under headings which indicate the type of brake being serviced.

After a brake adjustment has been completed, check the brake pedal free play.

The pedal free play may be checked by hand pressure on the brake pedal and is considered to be the movement of the pedal before the push rod touches the master cylinder piston, fig. 11. When the brake pedal free play is less than ¼ inch or more than ½ inch, fig. 11, the need for brake pedal adjustment is indicated.

The brake pedal free play is adjusted by changing the length of the master cylinder push rod. Loosen the lock nut on the brake pedal to master cylinder rod (fig. 12). Rotate the master cylinder push rod until the pedal free play is within limits. Tighten the lock nut, while holding the push rod, to secure the adjustment.

a. Single Anchor Self-Energizing.

The brake shoe adjustment procedure is given under, "(1) Minor Adjustment." The anchor pin adjustment procedure is given under, "(2) Major Adjustment."

(1) *MINOR ADJUSTMENT*. Remove the adjustment hole cover from the brake support plate. Rotate the adjusting screw with a suitable tool until the shoe begins to drag against the drum. Back off the adjusting screw until the drum can be turned without shoe drag.

(2) *MAJOR ADJUSTMENT*. Rotate the drum until the feeler slot is opposite the lower end of the secondary or rear shoe. Insert a 0.010-inch feeler gauge through the adjusting slot in the drum. Move the feeler up along the secondary shoe, until the shoe assembly is wedged forward as far as possible. Turn the adjusting screw until the primary shoe contacts the drum securely and the secondary shoe is snug against the feeler. Back off the adjusting screw just enough to establish a clearance of 0.010 inch, one and one-half inches from each end of the secondary shoes. This adjustment will provide correct operating clearance for both the primary and secondary shoes.

If the 0.010 inch clearance cannot be obtained at both ends of the secondary shoe by rotating the adjusting screw, the anchor pin must be adjusted. Loosen the anchor pin nut just enough to permit moving the pin up or down by tapping the nut with a soft hammer. Do not back the nut off too far or the shoes will move out of position when the nut is tightened. To reduce the clearance between the lining and the drum at the anchor end of the secondary shoe, move the anchor pin away from the center of the axle or spindle. To reduce the clearance at adjusting screw end, move the anchor pin toward the center of the axle or spindle. Be sure to tighten the anchor pin nut securely with a 12-inch wrench. Recheck the secondary shoe clearance after tightening the nut.

b. Uni-Servo Single Anchor.

The construction of the uni-servo single anchor brake is the same as the single anchor self-energizing brake except for the wheel cylinder. However, the adjustment procedure is the same for both brake types. Therefore, to adjust the uni-servo single anchor brake, use the procedure given for the single anchor self-energizing brake.

c. Double Anchor Self-Centering.

The only adjustment required on the double anchor self-centering brake is the brake shoe to lining clearance.

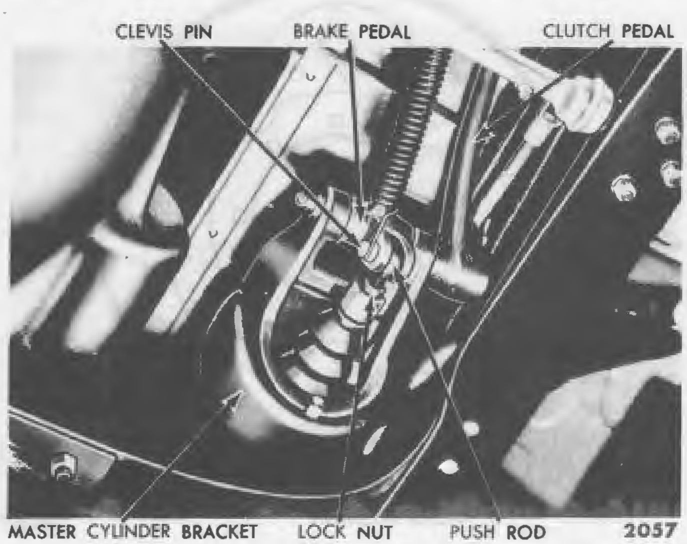

Fig. 12—Brake Pedal Free Play Adjustment

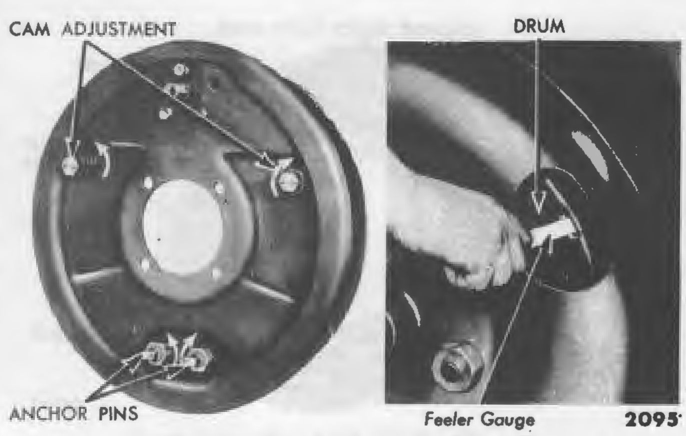

Fig. 13—Double Anchor Brake Adjustment

This adjustment is accomplished as follows:

Turn the adjusting cam of the forward shoe until the shoe is forced against the drum and causes a drag. Turn the cam in the opposite direction until the wheel can be turned without feeling any brake drag. Adjust the rear shoe in the same manner.

d. Double Anchor.

The double anchor brake requires the brake shoe to lining clearance adjustment; and in some cases, the anchor adjustment. The shoe adjustment procedure is given under, "(1) Minor Adjustment." The anchor adjustment is given under, "(2) Major Adjustment."

(1) *MINOR ADJUSTMENT*. Turn the adjusting cam of the forward shoe until the shoe is forced against the drum and causes a drag. Turn the cam in the opposite direction until the wheel can be turned without feeling any brake drag. Adjust the rear shoe in the same manner.

(2) *MAJOR ADJUSTMENT*. Turn the anchor pins, in the direction shown in fig. 13, until the brake shoe to drum clearance is 0.007 inch at the heel of each shoe, and 0.010 inch at the toe. Tighten each anchor pin nut securely to lock the anchor pin. Adjust the brake shoe to lining clearance.

e. Double Anchor 2-Cylinder.

Adjust the brakes when the brake pedal pad moves to within two inches of the floor board on hard brake applications. The brakes should be adjusted when the drums are at normal temperature. The adjustment is accomplished as follows:

Remove the adjusting slot covers from the backing plate. (fig. 14). Turn the adjusting worm with an Allen wrench in the direction of FORWARD wheel rotation to decrease the lining to drum clearance. Reduce the clearance until the lining "drags" on the drum. Turn the wrench in the opposite direction until the "drag" is relieved, depress the brake pedal to center the brake shoes, then turn the wrench an additional turn to provide working clearance. Repeat the above procedure on the second shoe. Replace the adjustment covers.

NOTE: ***Adjustment may be made with the vehicle resting on jacks or on the road. On jacks, the brake drag is checked by rotating the drum in the direction of forward rotation as adjustment is made. If adjusted on the road, the brake drag is checked by sound, tapping the drum with a hammer to determine whether the brake linings are "dragging on the drum." When the linings contact the drum the sound is deadened.***

f. Dual Primary.

Loosen the anchor pin lock nut with a 1¼ inch offset box wrench. Move the front anchor pin in the direction of wheel rotation when the vehicle moves forward, and the rear anchor pin in the direction of wheel rotation when the vehicle moves backward (fig. 15). Turn the anchor pins sufficiently to bring the lining into contact with the drum, then back off to allow a minimum running clearance. Check the running clearance by rotating the wheel in both directions.

3. HYDRAULIC SYSTEM

The differences in the hydraulic system, used on the various vehicle models are covered under the discussion of the different units.

Complete service information, including a brief description, on the hydraulic system is given in this section. "a. Serviceability Tests," contains information which helps to determine the condition of the overall system; "b. Bleeding Brake System," gives the procedure for bleeding the brake system on all vehicles; "c. Wheel

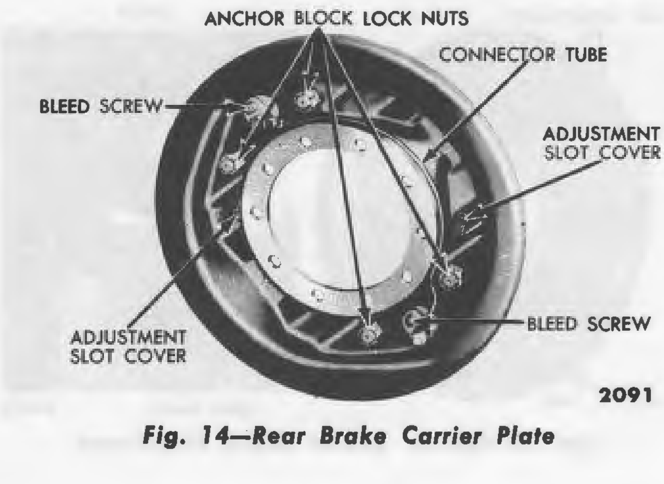

Fig. 14—Rear Brake Carrier Plate

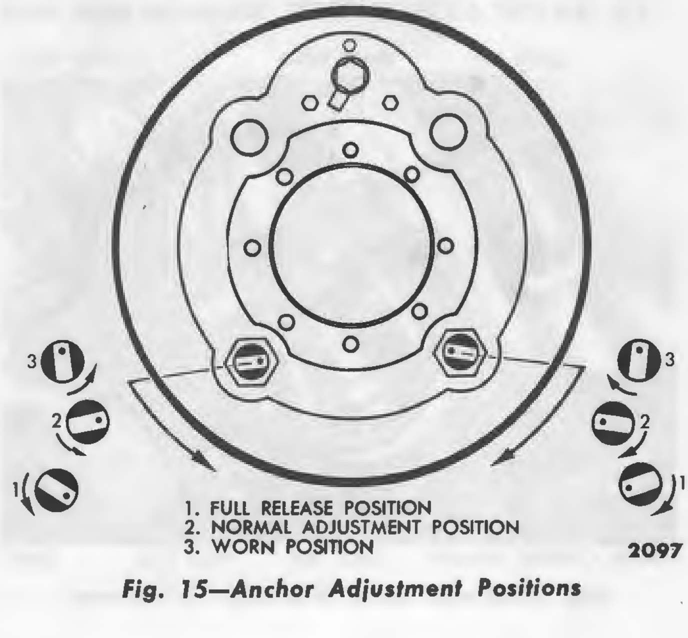

Fig. 15—Anchor Adjustment Positions

Cylinder," includes disassembly, assembly and repair of wheel cylinders used on each vehicle; "d. Master Cylinder", covers the description and repair of the master cylinder assembly; and "e. Hydraulic Pipe Replacement," gives information on when to replace pipes, as well as procedures for replacement.

The hydraulic brake system uses hydraulic fluid pressure to actuate the brake shoe assemblies. The standard hydraulic system consists of the master cylinder, the wheel cylinders, and the connecting brake pipe and hoses. Vacuum brake boosters are used on some truck models. The vacuum brake booster utilizes engine vacuum to provide additional line pressure which aids in applying the brakes.

a. Serviceability Tests.

The following serviceability tests are divided into two categories; tests on standard hydraulic systems, and tests on systems incorporating brake boosters.

(1) *SYSTEM WITHOUT BOOSTER.* Depress the brake pedal and observe the brake pedal travel. If the travel is greater than ½ the distance between the pedal pad and the floor pan, a minor brake adjustment or a major brake adjustment is necessary. If the pedal free travel is less than ¼ inch or more than ½ inch, adjust the brake pedal free play. Hold the brake pedal in the fully depressed position. If the pedal moves slowly toward the floor pan, check for faulty master cylinder check valve and leaks in the hydraulic system. If the brake pedal has a spongy feel, bleed the system.

Road test the vehicle and apply the brakes at about 20 m.p.h. to determine if the vehicle stops evenly and quickly.

(2) *SYSTEM WITH BOOSTER.* The serviceability tests of the brake system equipped with a booster are divided into three parts as follows: (a) System Performance Test, (b) Vacuum Tests, and (c) Hydraulic Pressure Tests.

(a) SYSTEM PERFORMANCE TEST. With the engine stopped, eliminate all vacuum from the system by depressing the brake pedal several times. Depress the pedal half way to the floor and note the effort required to hold the pedal in this position. Start the engine. If the vacuum system is operating properly, less foot pressure will be required to hold the pedal in the applied position. If no change is noticed in the pressure required to hold the pedal in this position, the vacuum system is not functioning properly and the vacuum tests should be performed.

Stop the engine and eliminate all vacuum from the system by depressing the brake pedal several times. Depress the pedal half way to the floor then maintain foot pressure on the pedal. If the pedal gradually moves downward under this pressure, the hydraulic system is leaking and the hydraulic pressure tests should be performed.

(b) VACUUM TESTS. Disconnect the pipe from the bottom of the check valve assembly and then connect a vacuum gauge to the valve. Run the engine at idle speed and check the reading on the vacuum gauge. The gauge should register 18 to 21 inches of vacuum. Stop the engine and note the rate of vacuum drop. If the vacuum drops more than one inch in 15 seconds, the check valve is leaking. If the vacuum reading does not reach 18 inches or is unsteady, an engine tune-up is needed.

Reconnect the vacuum pipe to the check valve.

(1) HYDROVAC. Disconnect the vacuum pipe from the brake booster end plate. Install a tee fitting in the end plate, then connect a vacuum gauge and the vacuum pipe to the fitting. Install a second vacuum gauge in place of the pipe plug in the booster control valve body.

Start the engine and note the vacuum reading on both gauges. If both gauges do not register manifold vacuum, air is leaking into the vacuum system. If both gauges register manifold vacuum, stop the engine and note the rate of vacuum drop on both gauges. If the drop exceeds one inch in 15 seconds on either gauge, air is leaking into the vacuum system. Tighten all vacuum connections and repeat the test. If leakage is still evident, the leak may be localized as follows:

Disconnect the gauge and vacuum pipe from the brake booster. Connect the gauge to the vacuum pipe. Start the engine and note the gauge reading. Stop the engine and check the vacuum drop rate. If the gauge does not register manifold vacuum or the vacuum drop exceeds one inch in 15 seconds, the leak is in the vacuum pipe or check valve connections.

Connect the hydraulic pressure gauge to the booster unit at the bleed screw in the end cap (output end of the unit). Reconnect the gauge and the vacuum pipe to the tee fitting.

NOTE: ***Be sure to bleed the air from the system at the point of attachment of the hydraulic gauge.***

Start the engine and notice the gauge readings. The vacuum gauge should read 18 to 21 inches of mercury, and the hydraulic gauge should read zero. Depress the brake pedal until the vacuum gauge returns to zero, and note the position of the brake pedal. The hydraulic gauge should read 700 pounds or more. If the unit does not perform properly, remove the unit for bench test or overhaul as required.

(2) HI POWER. Remove the pipe plug from the rear half of the booster chamber and install a vacuum gauge. With the engine running, depress the brake pedal with sufficient pressure to show a zero reading on the vacuum gauge. Hold the pedal in this position for one minute. Any downward movement of the pedal during this time

indicates a brake fluid leak. Any kick-back of the pedal indicates a vacuum leak.

b. Bleeding Brake System.

If air is allowed to get into the hydraulic system, the brake pedal will have a spongy action and it will be necessary to bleed the brakes to correct this condition. When any part of the braking system is disconnected, bleed the brakes, one wheel cylinder at a time, to be sure all air is expelled from the system.

NOTE: ***When bleeding brake assemblies equipped with two cylinders, always bleed the upper cylinder first.***

The procedure for bleeding a standard hydraulic system is given under, "(1) System without Booster." The procedure used for bleeding a system equipped with a brake booster is given under, "(2) System with Booster."

(1) *SYSTEM WITHOUT BOOSTER.* A hydraulic brake system may be bled manually, or pressure bleeding equipment may be used.

(a) MANUAL BLEEDING. Fill the master cylinder with brake fluid and keep the reservoir at least half full of fluid at all times during this operation. Attach a rubber drain tube to the bleeder screw at the wheel cylinder. Submerge the free end of the tube in a container partially filled with clean fluid. Loosen the bleeder screw and depress the foot pedal slowly by hand, allowing the return spring to return the pedal slowly to the "OFF" position. This produces a pumping action which forces fluid through the tubing and into the wheel cylinder, carrying with it any air that may be present.

Observe the flow of fluid from the hose. When air bubbles cease to appear in the fluid stream, close the bleeder connection. Repeat this operation at each wheel, until all wheel cylinders have been bled. Replenish the fluid in the master cylinder after each wheel cylinder is bled. Do not use withdrawn fluid. When the bleeding operation is complete, refill the master cylinder.

(b) PRESSURE BLEEDING. Make certain there is sufficient brake fluid in the bleeder tank, and that the tank is charged with 10 to 30 pounds air pressure. Fill the master cylinder with brake fluid and attach the hose from the bleeder tank to the master cylinder. Attach a rubber drain tube to the bleeder screw at a wheel cylinder. Submerge the end of the tube in a container partially filled with clean fluid. Loosen the bleeder screw and then open the valves on the bleeder tank to admit the pressure to the master cylinder. Observe the flow of fluid from the drain tube. When air bubbles cease to appear in the fluid stream, close the bleeder screw. When the bleeding operation is completed, refill the master cylinder.

(2) *SYSTEM WITH BOOSTER.* The brake booster must be bled first, using one of the following procedures, and then the wheel cylinders can be bled in the usual manner.

CAUTION: ***This operation must be done with the engine off and no vacuum in the power brake system.***

(a) MANUAL BLEEDING. Manual bleeding requires filling the master cylinder reservoir and pumping the brake pedal to force the fluid through the lines to expel all of the air from the system.

With the master cylinder reservoir filled, open No. 1 bleed screw on brake booster and attach a rubber drain tube to the bleed screw. Submerge the free end of the tube in a container partially filled with clean fluid. Depress the brake pedal slowly by hand. When the pedal has reached the toe board, allow it to return slowly to the released position. Repeat this procedure until fluid free from air bubbles comes from the submerged end of the tube. Using this method, bleed No. 1 and No. 2 bleed screws on the booster, and then proceed to the vehicle wheel cylinders.

(b) PRESSURE BLEEDING. Make certain there is sufficient brake fluid in the bleeder tank before starting and that the pressure is from 10 to 30 pounds per square inch. With the bleeder tank prepared, fill the master cylinder reservoir before attaching the hose from the bleeder tank to the reservoir. With the pressure from the bleeder tank to the reservoir applied to the master cylinder, bleed the booster first, starting with the bleed screw on the control valve (bleed screw No. 1). When a solid stream of fluid, free from bubbles is obtained, close bleed screw securely, and then bleed the booster hydraulic cylinder (bleed screw No. 2). Bleed the wheel cylinders in the recommended order.

c. Wheel Cylinder.

The wheel cylinders are mounted on the brake carrier plates. Each brake assembly is equipped with one wheel cylinder except the rear brake assemblies used on the late model F-7 trucks and on all F-8 trucks. These brake assemblies are equipped with two wheel cylinders.

(1) *CONSTRUCTION.* The construction of all wheel cylinders is basically the same. All wheel cylinders are of the straight bore type except the step-down type used on the 1949-50 and early 1951 F-2 front and rear brakes and on the F-3 front brakes. The duo-servo wheel cylinder contains two pistons, two rubber brake cylinder cups, and a piston return spring which is installed between the cups. Each end of the wheel cylinder is sealed by a rubber brake cylinder boot. Hydraulic fluid pressure, acting against the inner end of each wheel cylinder piston, forces the pistons outward to actuate the brake shoes. Each wheel cylinder is equipped with a bleeder screw to facilitate the brake bleeding operation. The construction of the bleeder screw is shown in fig. 16.

The uni-servo wheel cylinder used on late 1951 F-2 and F-3 front brakes contains one piston, brake cylinder cup, piston return spring, and brake cylinder boot.

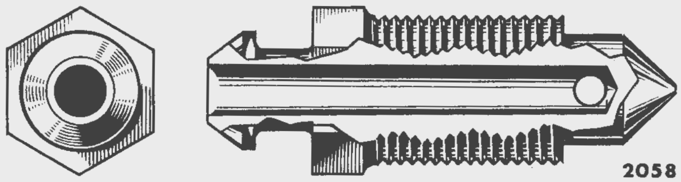

Fig. 16—Sectional View of Bleeder Screw

Hydraulic fluid pressure forces the piston outward against the primary brake shoe. The wheel cylinder is equipped with a bleeder screw.

The variation in construction of wheel cylinders used is shown in figs. 17 through 24.

(2) *DISASSEMBLY.* Before a wheel cylinder can be removed for disassembly, it is necessary to disconnect the hydraulic line at the wheel cylinder.

CAUTION: ***On vehicles equipped with hydraulic boosters, be sure the engine is stopped and there is no vacuum in the power brake system.***

After the wheel and brake drum have been removed, the wheel cylinders may be removed from the brake carrier plate. The manner in which the wheel cylinders are attached to the carrier plates on the various models is shown in figs. 17 through 24.

NOTE: ***On F-8 and late model F-7 truck rear brake assemblies, it is necessary to loosen the anchor block nuts before the wheel cylinder can be removed.***

Wheel cylinders may be disassembled by removing the rubber brake cylinder boots from the wheel cylinder housing, and then removing the pistons, cups, and piston return spring from the housing (figs. 17 through 24).

Clean all parts of the wheel cylinder in pure alcohol. Inspect the cylinder bore for rust, scores, or other damage and replace the cylinder if necessary. Inspect the rubber cups and boots for deterioration, incorrect size (growth), rough edges, and damage. Replace all parts that are not in good condition.

CAUTION: ***Do not use kerosene or gasoline for cleaning wheel cylinder parts.***

(3) *ASSEMBLY.* When assembling wheel cylinders, coat all of the parts with brake fluid before installing them in the cylinder.

For the correct position of the parts in the wheel cylinder, refer to the figure that applies. These figures are 17 through 24.

After the wheel cylinder has been installed be sure to bleed the hydraulic system.

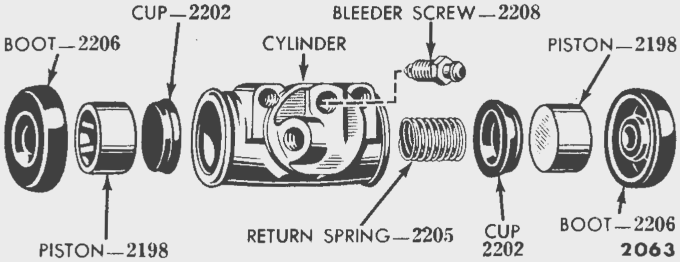

Fig. 17—Front and Rear Wheel Cylinder—F-1 Truck

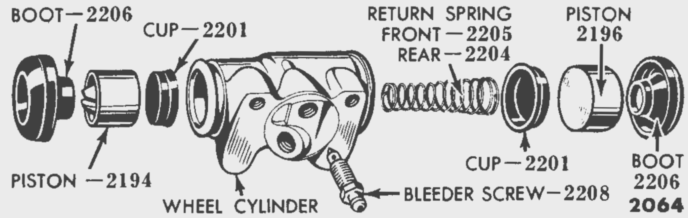

Fig. 18—Wheel Cylinder F-2 (Front & Rear) and F-3 (Front)

d. Master Cylinder.

The function of the master cylinder is to maintain a constant volume of brake fluid in the system at all times, and to transpose physical pressure on the brake pedal to hydraulic pressure on the wheel cylinder pistons.

(1) *CONSTRUCTION.* The master cylinder contains the brake fluid reservoir and the master cylinder operating mechanism in an integral housing. The construction of the operating mechanism in all master cylinders is essentially the same, except a check valve is not incorporated in master cylinders used in systems containing a hydrovac brake booster.

The piston is equipped with a rubber cup at the push rod end. The brake master cylinder primary cup is held against the piston by the piston return spring and retainer. On the standard hydraulic system, a check valve is used at the output end of the master cylinder to control the return flow of the hydraulic fluid from the wheel cylinders. On the hydraulic systems incorporating the hydrovac brake booster, the check valve is located at the booster. The master cylinder push rod seats in a depression in the piston, thus transferring movement of the brake pedal through the push rod to the piston. The piston end of the master cylinder is enclosed in a rubber boot. Detailed construction features of all master cylinders used on F series trucks are shown in figs. 25 and 26.

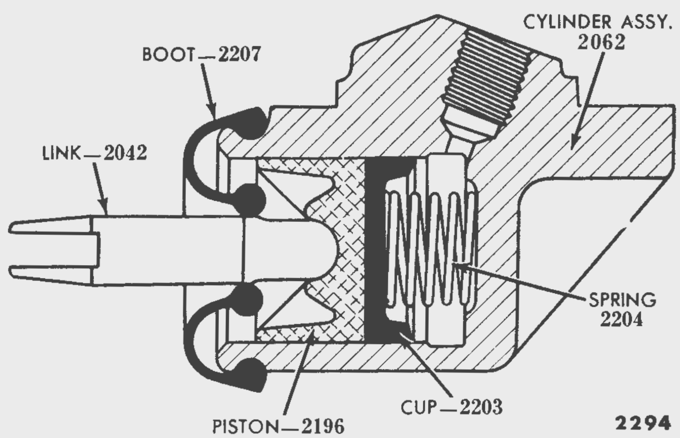

Fig. 19—Wheel Cylinder—Late 1951 F-2, F-3 (Front)

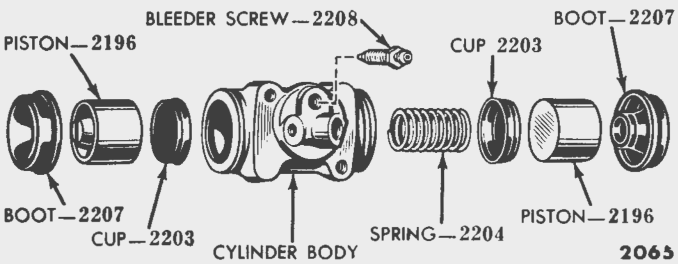

Fig. 20—Wheel Cylinder F-3 Par. Del. (Front & Rear and F-3 (Rear)

(2) *REMOVAL.* Disconnect the brake lines from the master cylinder and depress the brake pedal a few times to force all fluid from the master cylinder before removing the master cylinder for disassembly.

Remove the brake pedal return spring from the brake pedal clevis pin. Remove the brake pedal clevis pin from the brake pedal. Disconnect the stoplight switch wires at the stoplight switch. Disconnect the hydraulic brake lines from the master cylinder. Remove the three nuts, lock washers, and bolts that secure the master cylinder to the crossmember bracket, and remove the master cylinder.

(3) *DISASSEMBLY.* Before disassembling the master cylinder clean all dirt from the outside of the cylinder assembly, then remove the filler cap and gasket. Pull the rubber boot off the end of the master cylinder and remove the snap ring from the cylinder bore. Push the piston assembly primary cup, piston return spring, and check valve (when used) out of the cylinder bore.

(4) *ASSEMBLY.* Clean all parts in alcohol. Make sure the by-pass port, intake port, and air vent are open. Inspect the cylinder walls for scores or rust and recondition if required. Do not hone any more than necessary to remove scores or rust and obtain a smooth cylinder wall, since oversize pistons and cups are not available. Be sure to remove any burrs caused by honing from the by-pass port and intake ports.

Dip all internal parts of the master cylinder in hydraulic brake fluid before assembly. Master cylinders may be assembled by referring to figs. 25 and 26 for the relative positions of the component parts.

(5) *INSTALLATION.* Place the brake master cylinder in position on the crossmember bracket, and secure it to the bracket with three bolts, lock washers, and nuts.

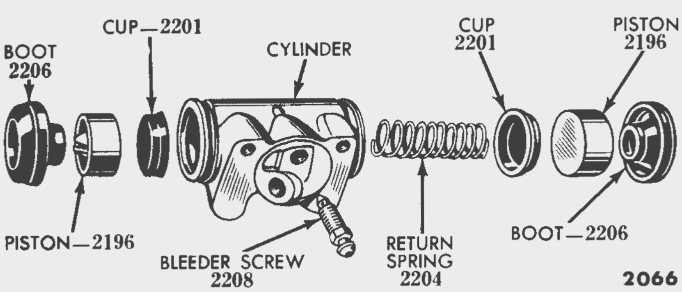

Fig. 21—Front & Rear Wheel Cylinder F-4, F-5 and F-6

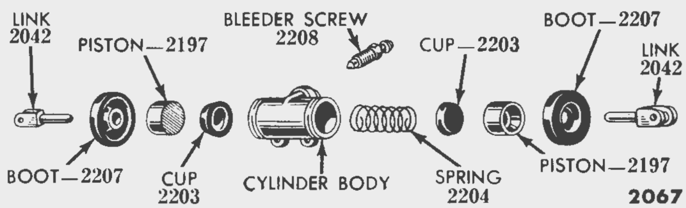

Fig. 22—Front Wheel Cylinder F-7 and F-8 Trucks

Connect the hydraulic brake lines to the master cylinder. Connect the stoplight switch wires to the stoplight switch at the bullet connections. Line up the brake pedal rod in the master cylinder with the brake pedal clevis and install the clevis pin and cotter pin. Connect the brake pedal return spring to the clevis pin. Bleed the brake system, then check the brake pedal free play.

e. Hydraulic Pipe Replacement.

Hydrogen welded steel pipe is used between the master cylinder and the brake booster (when used), between the booster and the frame connections, and between the rear axle tee fitting and the rear wheel cylinders. Flexible hose connects the brake pipe to the front wheel cylinders and to the rear axle tee fitting.

If a section of the brake pipe becomes damaged, the pipe should be replaced with pipe of the same size and quality. Copper tubing is not satisfactory for use as brake pipe in a hydraulic system. Brake pipe is available in 25 foot rolls from the Ford Parts Department. The replacement pipe should be the same length and shape as the damaged pipe.

All brake pipe should be flared properly to ensure

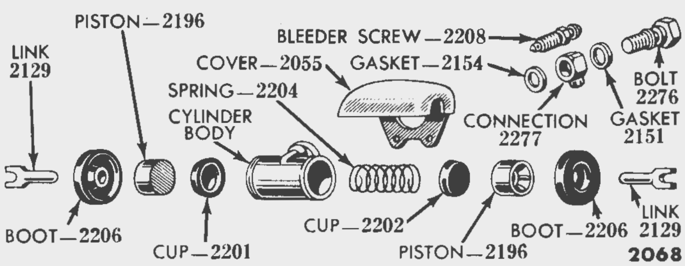

Fig. 23—Rear Wheel Cylinder, Early F-7 Trucks

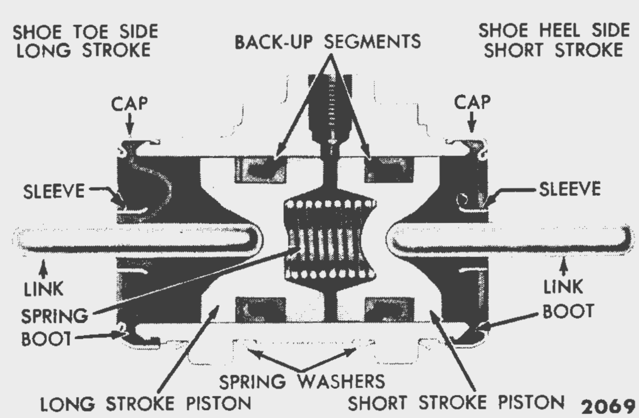

Fig. 24—Rear Wheel Cylinder, F-8 and late F-7 Trucks

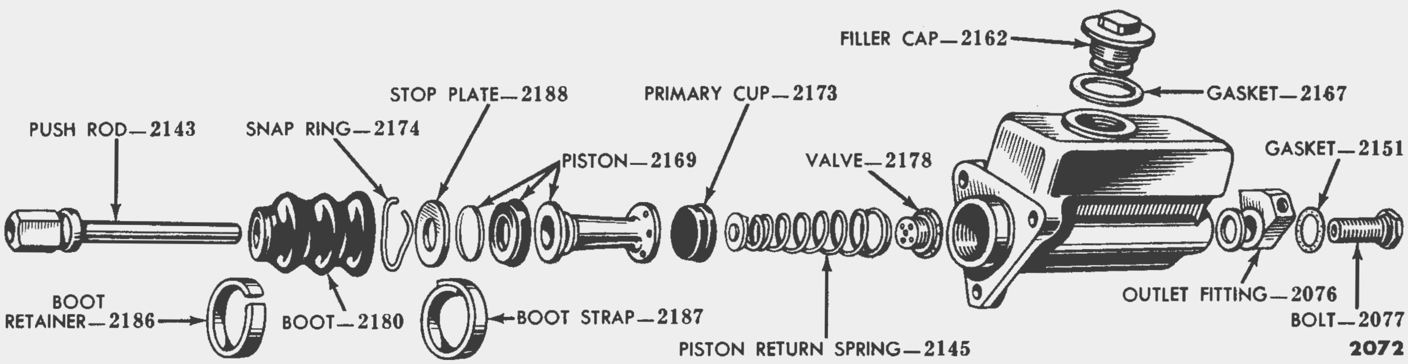

Fig. 25—Brake Master Cylinder F-2, F-3, F-3 Par. Del., F-4, F-5, and F-6, Typical of F-1

leakproof connections. The two-stage flaring method, shown in fig. 27, must be used.

When replacing hydraulic pipe, use new gaskets and tighten all connections securely.

4. HYDRAULIC BRAKE BOOSTERS

Two types of hydraulic brake boosters are used on Ford trucks. One is called the "Hi-Power" Booster and the other is called "Hydrovac."

The Hi-Power booster unit is used as standard equipment on F-6 model trucks, and as optional equipment on F-4 and F-5 model trucks, see fig. 28. The Hydrovac booster unit is used as standard equipment on the F-7 and F-8 truck (fig. 32).

The description, operation, and repair of each booster is covered in "**a.** Hi-Power," and "**b.** Hydrovac."

a. Hi-Power.

The Hi-Power brake booster consists of a vacuum power chamber, a hydraulically actuated vacuum control valve, and a hydraulic slave cylinder, all incorporated into a single sealed unit.

The vacuum check valve is of the spring loaded disc type and is installed in the system adjacent to the vacuum source for the purpose of maintaining a maximum vacuum in the system. A properly functioning check valve will open only when source vacuum is higher than system vacuum, thus excluding gasoline vapor from the system.

The power or booster chamber consists of two pressed steel sections divided by a rubber diaphragm and metal pressure plate assembly, all of which are held together as an assembly by a metal clamp ring. The outer bead of the rubber diaphragm acts as a support for the diaphragm and also as a seal between the two sections of the booster chamber. The push rod attached to the pressure plate extends through a support bushing and seals, and into the slave cylinder to actuate the slave cylinder piston whenever the pressure plate moves forward and backward in braking.

The rear half of the booster chamber is the control side and has a tractor to trailer outlet connection. A

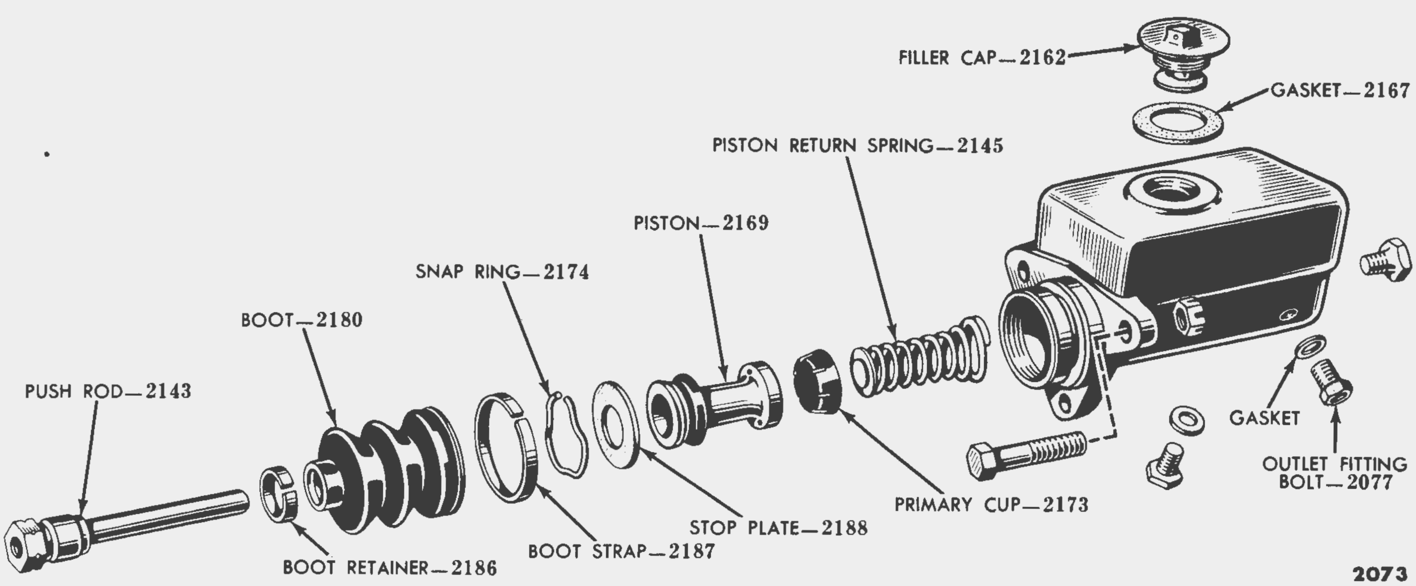

Fig. 26—Brake Master Cylinder F-7 and F-8

tube and hose connects this half of the chamber to the control valve. Air is admitted through the control valve into the chamber rear half, applying atmospheric pressure to the back face of the diaphragm.

The front half of the booster chamber supports the slave cylinder and control valve. A hose connected to the booster check valve and to the intake manifold provides a means by which air is exhausted from both halves of the chamber, thus creating a vacuum. A diaphragm return spring assists in brake release.

The control valve is mounted to, and is an integral part of the slave cylinder and is composed of a control valve disc assembly, control valve disc spring, control valve diaphragm return spring, control valve diaphragm, control valve plunger and piston assembly, and a seal. This valve is connected to the slave cylinder hydraulically by an internal passageway. Thus, fluid entering from the master cylinder through the slave cylinder at the slave cylinder fluid inlet passage, is directed to the control valve piston and causes the piston diaphragm and valve to operate and control the admission of atmospheric pressure. The control valve atmospheric intake is a hose connection which leads to the remote air cleaner located inside of the cab.

The slave cylinder is composed of a piston assembly, piston cup, check valve, check valve snap ring, check valve return spring, piston return spring, piston return spring retainer, cylinder and plug, and a bleeder screw.

Through the slave cylinder fluid inlet passage, hydraulic brake fluid is permitted to enter the slave cylinder by passing through the small holes in the side of the piston assembly and out through its end. This, however, only occurs for a short interval of the brake application or until the booster application begins. This permits physical foot pedal application in case of booster failure. If the piston does not operate in the short interval of time permitted, the by-pass will not close, then, with sufficient foot pedal pressure, the brake can be applied in the same manner as in the standard system. The hydraulic fluid inlet from the master cylinder is at the rear end of the slave cylinder, and the outlet to the wheel cylinder is at the front end of the slave cylinder. A bleeder screw is provided in the slave cylinder to permit bleeding of air from the hydraulic system.

(1) *OPERATION*. The following paragraphs describe the operation of the Hi-Power booster with the brakes released, and also when the brakes are applied. The key letters in the descriptions refer to fig. 29.

(a) BRAKES RELEASED. A hose from the vacuum check valve connects the booster chamber (C) and control valve to the engine manifold vacuum. When the brakes are in the released position, there is vacuum on both sides of the diaphragm and pressure plate assembly (B). This permits the return spring (D) to hold the diaphragm and pressure plate in the released position.

The vacuum passage is from the opening (S) which is the connection for the tube from the vacuum check valve—through the front section of the booster chamber (C) to opening (F) through the hollow portion of the control valve plunger (J) and the by-pass (A) to the rear section of the booster chamber.

A metal tube also connects the master cylinder to the slave cylinder opening (Q) to provide a passage for the brake fluid to and from the master cylinder. With the brakes in the released position, the brake fluid is under a constant pressure of approximately eight pounds per square inch which is controlled by the master cylinder return spring and check valve. This pressure is necessary to prevent leakage past the various piston cups and seals, and to assure that the brake shoes will be instantly responsive to the slightest pedal movement.

In order to maintain a proper equalization of this pressure throughout the entire brake system, an orifice (M) is provided through the slave cylinder piston and cup. This orifice is regulated by a spring controlled check valve (O) incorporated as a part of the slave cylinder piston.

(b) BRAKES APPLIED. When the brake pedal is initially

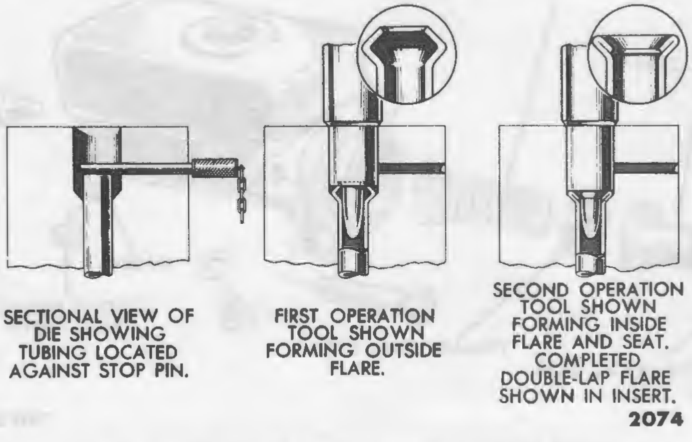

Fig. 27—Use of Brake Pipe Flaring Tool

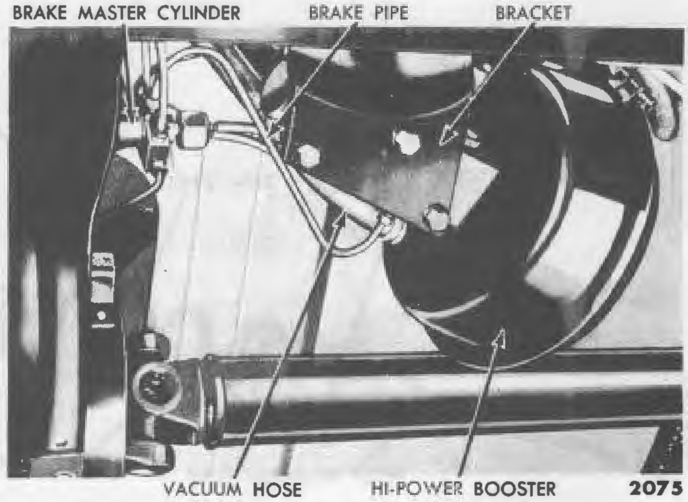

Fig. 28—Hi-Power Brake Booster Installation

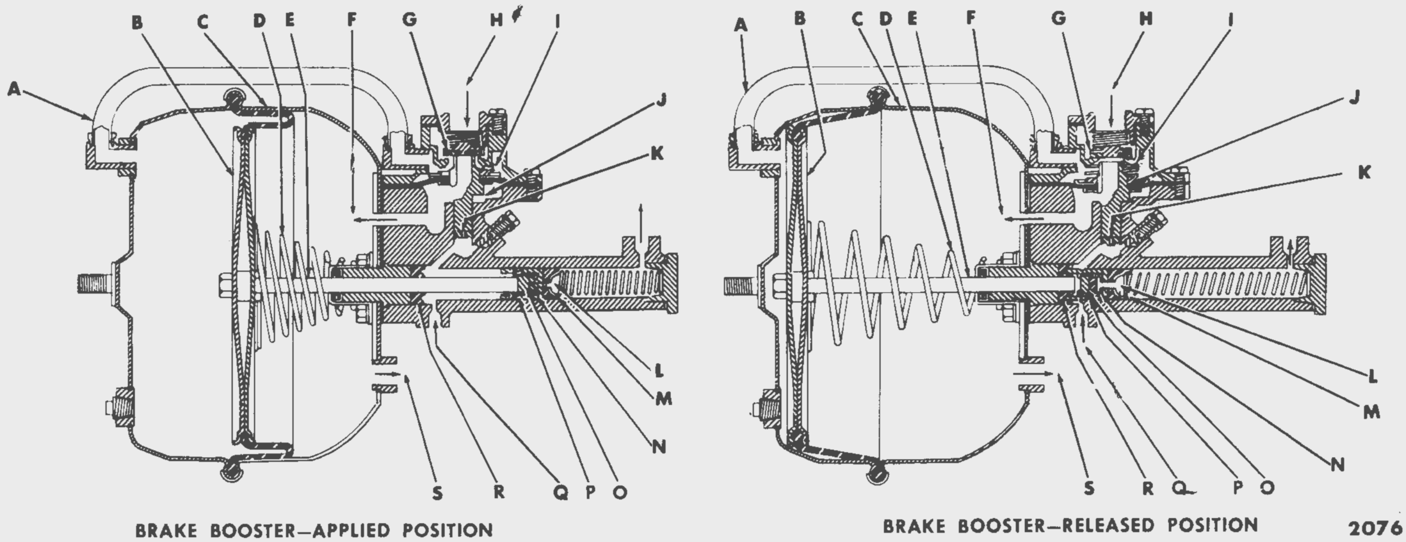

Fig. 29—Hi-Power Brake Booster—Sectional View

depressed for a brake application with the engine running, fluid passes out of the master cylinder through a tube to the slave cylinder inlet passage (Q), through the slave cylinder piston openings (P) to the control valve plunger and piston seal (J and K) and, also around the slave cylinder piston check valve (O) and through the piston and cup orifice (M) into the brake system. This displacement of fluid builds up the hydraulic line pressure. When the fluid pressure reaches approximately 40 pounds per square inch, the control valve plunger and piston (J) moves into contact with the rubber surface of the control valve disc (G). This seals the engine vacuum in the front section of the booster chamber. As the plunger continues to move, the control valve disc (G) is forced from its seat, admitting air under atmospheric pressure through the air cleaner and opening (H). This air passes through the by-pass tube (A) and replaces the vacuum in the rear section of the booster chamber.

The atmospheric pressure, in the rear section of the booster chamber, forces the diaphragm and pressure plate assembly (B) forward, causing the push rod (E) to move into the slave cylinder piston and in contact with the salve cylinder piston check valve (O) which seats the rubber surface of the check valve over the piston orifice (M), sealing the brake fluid in the slave cylinder and brake system.

As the atmospheric pressure forces the diaphragm and pressure plate assembly to move, the push rod moves the slave cylinder piston and cup forward in the cylinder to build up the hydraulic line pressure above that created by the master cylinder.

When the control valve plunger and piston assembly (J) has been fully opened, applying the entire output of the booster chamber, additional physical pressure can still be applied through the foot pedal and master cylinder by the driver.

With this booster the operator is aware of the amount of pressure being applied to the brakes through the pedal exactly the same as in a brake application on a truck without a booster. Although with this booster the required pedal pressure is proportionately less, braking power is in direct proportion to pedal travel and pedal pressure.

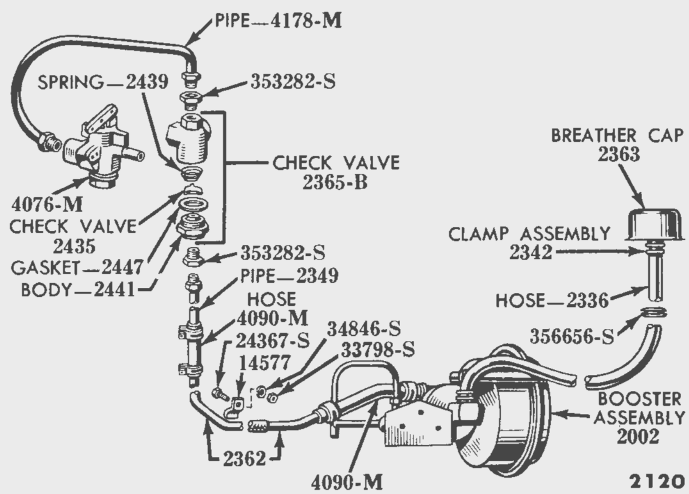

Fig. 30—Hi-Power Booster and Connection, Disassembled

If, at any time, the power chamber fails to function when the brake pedal is depressed, the brake fluid will by-pass through the slave cylinder piston openings (P) and the piston and cup orifice (M), and permit the brakes to be applied by the master cylinder the same manner as a truck that is not equipped with a booster. However, greater effort on the part of the driver will be required to stop the truck, and caution must be exercised if it becomes necessary to operate without the booster.

When the brake pedal is released, it relieves the hydraulic pressure from the master cylinder through opening (Q), permitting the control valve diaphragm return spring (I) to return the control valve plunger (J) to the released position, and allows the control valve disc (G) to seat and close the atmospheric opening. When this occurs, vacuum is admitted through the hollow section of the control valve plunger (J) reducing the pressure in the rear section of the booster chamber. This permits the return spring (D) to force the diaphragm and pressure plate assembly (B) back to the released position, and at the same time the slave cylinder piston and cup are forced back against the push rod front seal (R) by the return spring (L).

As the push rod moves out of contact with the slave cylinder piston check valve (O), the return spring (M) forces the check valve open and permits the master cylinder return spring to equalize the fluid and pressure in the brake system.

(2) *REPAIR.* If tests indicate that the brake booster is not functioning properly, it will be necessary to repair the unit. Kits containing the parts most likely to need replacing are available through the Ford Parts Department.

(a) Removal. Depress the brake pedal several times to remove all vacuum from the system. Loosen the clamp, then remove the air intake tube from the booster (fig. 30). Disconnect the master cylinder to booster hydraulic line at the booster. Disconnect the vacuum tube to booster hose at the booster. Remove the brake booster to mounting bracket bolts and lockwashers, then remove the booster (fig. 28).

NOTE: ***Do not remove the breather in the cab or the controls on the firewall unless operating conditions indicate repairs are necessary.***

(b) Disassembly. Remove the large nut at the end of the slave cylinder, and remove the washer, piston spring or springs, and retainer (fig. 31).

Mark both sections of the booster chamber so they can be assembled in their original positions.

Make punch marks on the flanges of the control valve and slave cylinder so that they can be assembled in their original positions. Remove the control valve to vacuum chamber tube. Remove the clamp ring, the rear section of the booster chamber, and the diaphragm and pressure plate assembly with the return spring.

Remove the five screws which fasten the front section of the booster chamber to the slave cylinder. Remove the seal retainer, the front section of the booster chamber, and the push rod bushing.

Remove the three screws holding the valve cover to the control valve and remove the cover. Lift out the valve disc spring and valve disc.

Remove the six bolts and screws from the control valve body. Lift the control valve body, diaphragm return spring, and the control valve plunger and diaphragm assembly from the slave cylinder body.

Remove the push rod seal from the rear end of the slave cylinder.

With the booster chamber diaphragm push rod, push the slave cylinder piston and rubber piston cup out the front end of the slave cylinder.

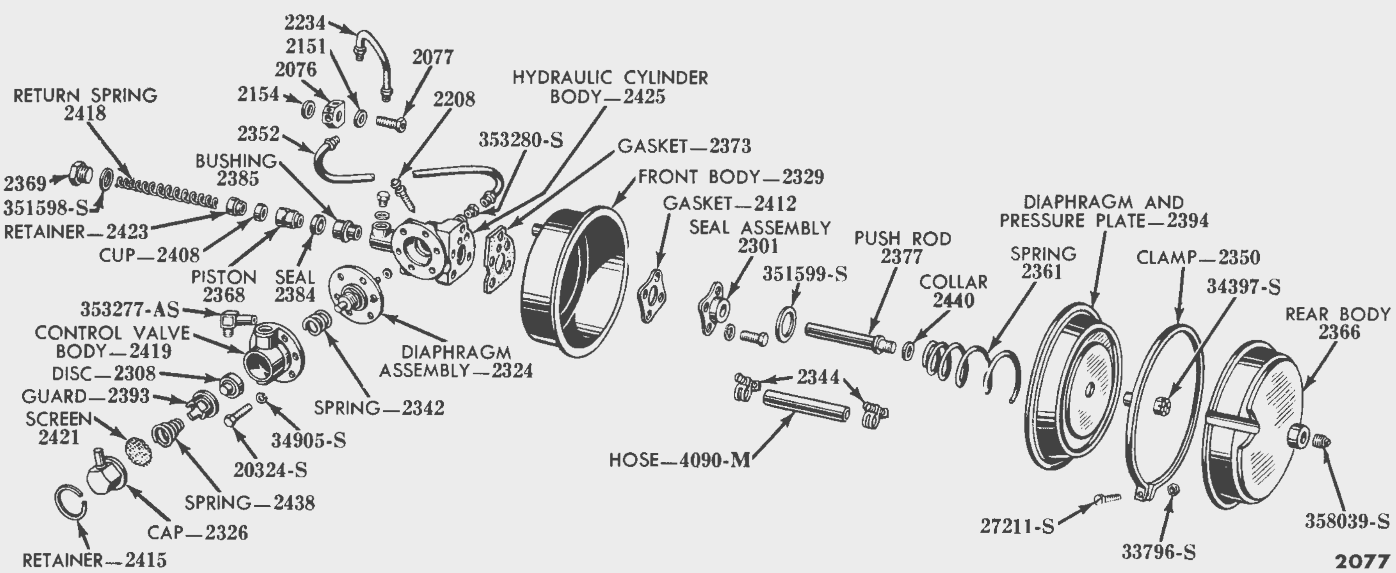

Fig. 31—Hi-Power Booster Brake, Disassembled

(c) INSPECTION. Wash all of the metal parts in dry-cleaning fluid. Wipe them thoroughly with clean rags, and use compressed air to dry all internal passages.

Replace all worn or damaged parts. Kits which contain the parts most likely to need replacement are available from the Ford Parts Department. If, upon examination, there is any evidence of wear or corrosion in the control valve plunger or slave cylinder bores, it is recommended that the slave cylinder body be replaced.

Always replace the control valve diaphragm, all rubber cups, seals, and springs. If the seat in the control valve is damaged, replace the control valve body.

The slave cylinder piston assembly should be thoroughly cleaned to ensure proper application and release of the check valve. It should not be necessary to replace this assembly unless a definite hydraulic leak is evident before disassembly. If leakage in the slave cylinder does occur, replace the piston assembly, rubber cup, seal, control valve plunger, and piston seal.

(d) ASSEMBLY. Assemble the booster unit parts in the order shown in fig. 31. Install the front seal assembly in the slave cylinder body before the push rod bushing and front section of the booster chamber are assembled to the slave cylinder body. It is essential that the booster chamber, as well as the control valve and slave cylinder, be assembled according to the scratch and punch marks made during disassembly.

When assembling the control valve diaphragm, washers, and nut to the plunger and piston assembly, apply a small amount of shellac to the threads to prevent leakage.

The control valve diaphragm, as well as the booster chamber diaphragm, can be installed in any position.

Apply hydraulic brake fluid to all slave cylinder internal parts and to the cylinder bore before assembling.

(e) INSTALLATION. Position the brake booster on the mounting bracket, then install the mounting bolts using new lockwashers (fig. 28). Connect the vacuum tube to booster hose to the booster. Tighten the hose clamps securely. Connect the master cylinder to booster hydraulic line to the booster.

Connect the air intake tube to the booster. Tighten the clamp securely.

Perform the serviceability tests outlined for a hydraulic brake system with booster.

b. Hydrovac.

The hydrovac is mounted by support brackets to the truck frame (fig. 32). These brackets serve only to support the unit and are not subject to reaction stresses from the forces exerted by the power cylinder.

The booster consists of three basic units; a power chamber, a control valve, and a hydraulic cylinder, all combined into one self-contained, compact, sealed unit. It is connected hydraulically into the truck hydraulic brake line between the master cylinder and the brake wheel cylinders. The hydraulically actuated vacuum control valve controls the degree of brake application or release. This control valve consists of a hydraulic actuated piston, a diaphragm, and a vacuum and an atmospheric poppet valve assembly.

The vacuum power cylinder contains a single piston and a push rod that connects the vacuum piston to the hydraulic piston of the hydraulic cylinder. The hydraulic cylinder contains a piston check valve and a residual line pressure check valve.

The residual line pressure check valve incorporated in the fitting at the outer end of the hydraulic cylinder,

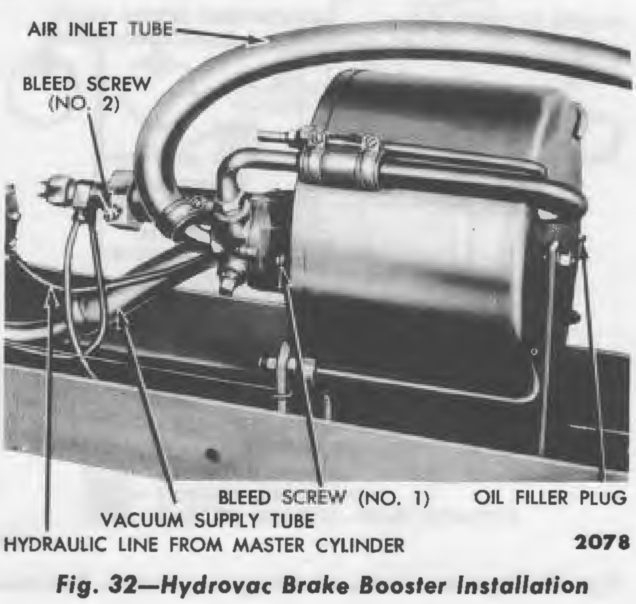

Fig. 32—Hydrovac Brake Booster Installation

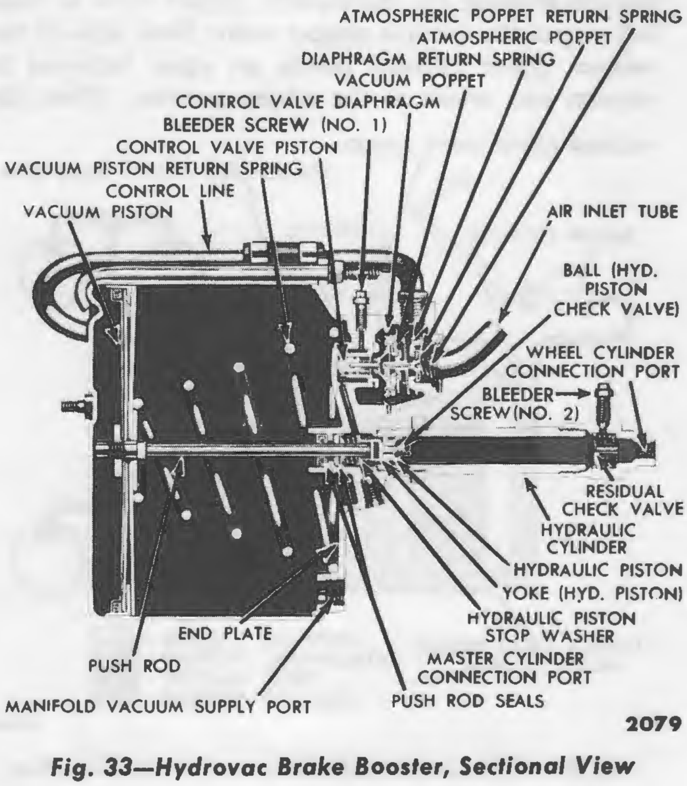

Fig. 33—Hydrovac Brake Booster, Sectional View

serves the purpose of the check valve normally incorporated in the vehicle master cylinder.

The internal working parts of the hydrovac are shown in fig. 33.

The vacuum check valve is the spring-loaded disc type and is installed in the system adjacent to the vacuum source for the purpose of maintaining maximum vacuum in the system. A properly functioning check valve will open only when source vacuum is higher than system vacuum, thus excluding gasoline vapor from the system.

(1) *OPERATION*. As the brake pedal is depressed (fig. 34) the hydraulic pressure developed within the master cylinder forces the brake shoes against the drums in the conventional manner. When sufficient pressure is developed within the system, the pressure applied to the hydraulic piston of the control valve moves the control valve into the applied position, closing the vacuum valve and opening the atmospheric valve which admits air to the control side of the vacuum power cylinder. As air is admitted, the forces acting upon the vacuum power cylinder piston are transmitted directly to the hydraulic piston through the push rod. As the hydraulic piston starts to move, the piston check valve closes, trapping fluid under pressure ahead of the piston.

The total hydraulic pressure created and transmitted to the wheel cylinders is the sum of the pressure developed as a result of the vacuum power cylinder push rod thrust and the pressure received by the booster from the master cylinder.

As the brake pedal is released (fig. 35), the pressure within the control valve hydraulic piston chamber is reduced allowing the atmospheric poppet valve to close and reopen the vacuum poppet valve. Both sides of the vacuum power cylinder piston are again balanced in vacuum and return to the release position. When the hydraulic piston nears the release end of its stroke, its check valve reopens, thus permitting the full release of the brakes.

(2) *REPAIR*. If the tests performed indicate that the brake booster is not functioning properly, it will be necessary to repair the unit. Kits containing the parts most likely to need replacing are available through the Ford Parts Department.

The following paragraphs describe the removal, disassembly, inspection, assembly, and installation procedures for the brake booster.

(a) REMOVAL. Depress the brake pedal several times to remove all vacuum from the system. Loosen the brake booster air inlet tube clamp, then remove the tube (fig. 32). Disconnect the master cylinder to booster hydraulic line at the booster. Disconnect the vacuum tube to booster hose at the booster. Remove the wires and hydraulic lines from the stop light switch. Remove the brake booster to mounting bracket bolts, then remove the booster.

(b) DISASSEMBLY. Loosen the hose clamps and slide the hose off the end of one cylinder tube. Loosen the lock nut, and screw the hydraulic cylinder from the end plate. Hold the end cap in a vise and unscrew the hydraulic cylinder. Remove the copper gasket and bleed screw from the end cap. Remove the residual line pressure check valve by taking out the snap ring, washer, and spring.

Remove the control valve housing and valve parts by removing the holding screws. Remove the air inlet tube retaining ring. Scribe a line across the cylinder shell and end plate so these can be reassembled in their original position. Remove the hook bolts, then remove the cylinder shell.

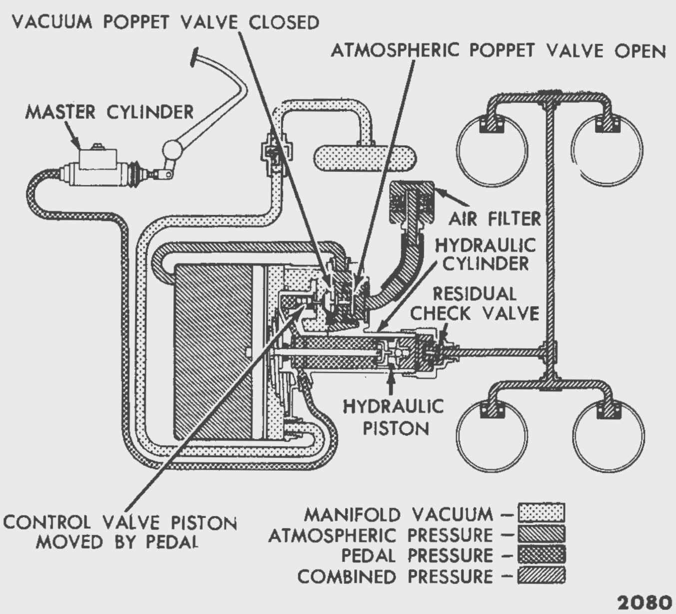

Fig. 34—Hydrovac Booster Diagram, Brakes Applied

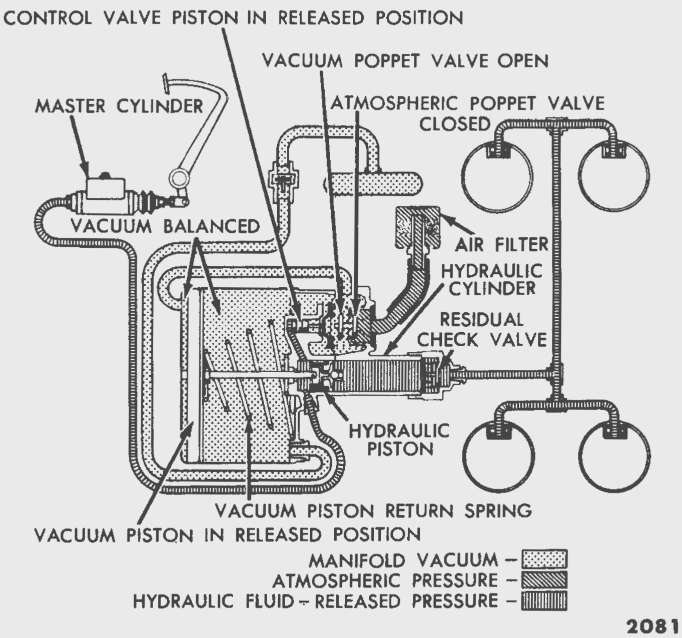

Fig. 35—Hydrovac Booster Diagram, Brakes Released

Compress the piston return spring by pressing down on the end plate, and install the hook clamps as illustrated in fig. 36. Remove the hydraulic piston from the push rod by sliding the retainer spring back and removing the pin. Remove the hook clamps. This allows the vacuum piston and spring to come out.

Disassemble the hydraulic piston by first removing the snap ring. Then, disassemble the spring cup, spring, and ball as shown in fig. 36.

Place the end plate over the pins of the end plate holding fixture, see fig. 37.

Clamp the fixture in a vise. Remove the retainer ring using a special tool, then remove the stop washer. Remove the hydraulic valve piston fitting with a 1⅛-inch socket wrench. Press out the valve piston, and remove the cups from the valve piston.

Remove the hydraulic cylinder end seal. Remove the snap ring, and then remove the push rod seal cup parts. Lift the end plate from the fixture, and place it upon two wooden blocks. Drive out the push rod leather seal assembly using a flat-end rod or drift. The disassembly procedure for the vacuum piston in the early type hydrovac differs from the late type disassembly procedure.

(1) EARLY TYPE. The vacuum piston can be disassembled to replace the leather piston packing or other parts. Place the push rod in a vise and clamp the hexagonal section. Remove the staked nut and lift the parts from the push rod.

(2) LATE TYPE. Remove the push rod lock ring from the groove in the piston guide. Remove the spring washer, then lift out the push rod, spring, bottom spring washer, and the bottom lock ring.

Place the guide sleeve in a vise and clamp the hexagonal section. Remove the vacuum piston retaining nut, then lift the piston plates from the push rod.

Remove the guide sleeve to body gasket, washer, and nut. Loosen the outer lock nut, then remove the assembly

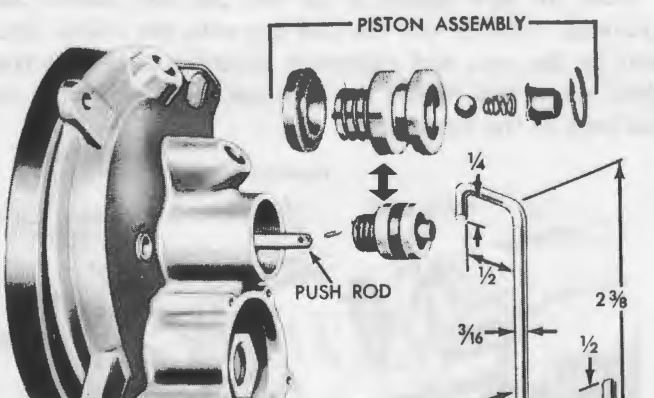

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Fig. 36—Hydrovac Piston Removal

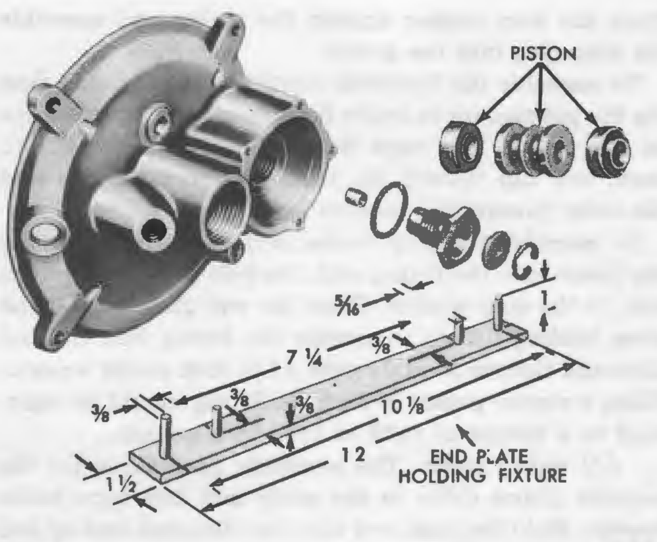

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Fig. 37—End Plate Disassembly

from the vise. Remove the lock nut, gasket, and guide sleeve. Remove the piston guide by drawing it into the cylinder shell.

(c) INSPECTION. Wash all metal parts in a cleaning fluid. Wipe thoroughly with clean rags, and dry all air passages with compressed air.

Replace all worn or damaged parts. Kits containing the parts most likely to need replacement are available from the Ford Parts Department. If the bore of the vacuum cylinder shell is corroded or rusted, polish with fine emery cloth or steel wool. If the cylinder shell is badly pitted or scored, it should be replaced.

Inspect the vacuum poppet seat, and replace the seat if damaged or badly pitted. All rubber parts should be replaced with new parts. The poppets can be replaced without replacing the control housing, as a poppet repair kit is available. The original poppet valves can be removed by using a punch to separate the two valves.

(d) ASSEMBLY. Press the push rod leather seal into the end plate with the lip of the seal toward the hydraulic cylinder side of the end plate. Assemble the push rod hydraulic seal parts as illustrated in fig. 36, the stop washer with chamfered side down, the seal cup with the lip of the cup up, the retainer washer with the flat side next to the cup, and the spring with the small end down.

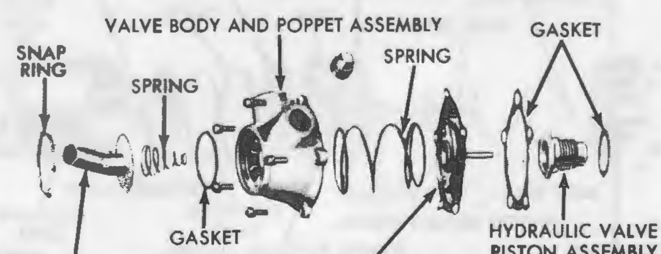

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Fig. 38—Hydrovac Control Valve, Disassembled

Place the stop washer against the spring and assemble the snap ring into the groove.

To assemble the hydraulic control valve (fig. 38), first dip the piston cups in brake fluid then assemble the cups on the piston. The cups should be assembled back to back, one cup toward the hydraulic pressure side and the other toward the vacuum side.

To assemble the stop washer and retainer ring, insert the piston into the fitting with the hole end of the piston next to the stop washer. Place the end plate on the end plate holding fixture. Assemble the fitting into the end plate and tighten securely with a 1⅛ inch socket wrench. When a copper gasket is used the fitting should be tightened to a torque of 1100 to 1300 inch-pounds.

(1) EARLY TYPE. The assembly procedures for the vacuum piston differ in the early and late type brake booster. Hold the push rod with the threaded end up and assemble the piston parts (fig. 39) as follows: the flat washer over the threaded end of the push rod, the large diameter piston plate with the chamfered side of the hole up, the guide rubber seal ring over the threads. Place the special assembly ring over the piston plate, and assemble the following parts: The leather packing with the lip of the packing up, the smaller diameter piston plate with the chamfered side of the hole down. Cut wicking to the required length, and assemble the wicking against the inner face of the lip of the leather packing. Assemble the expander ring inside of the wicking with the gripper points up, and notch at the loop end of the expander ring under the clip located near the opposite end of the expander ring. Assemble the retainer plate with cut-out portion over the loop of the expander ring, then thread the nut onto the push rod finger tight. Clamp the hexagonal section of the push rod in a vise and securely tighten the nut. Care must be taken to prevent the retainer plate from shifting while tightening the nut. Stake the nut at two places.

(2) LATE TYPE. Assemble the piston parts in the same manner as for the early type hydrovac. Then hold the piston guide in a vertical position and install the washer and gasket over the threaded end. With the assembly ring still in position on the vacuum piston, turn the assembly upside down and install it on the piston guide. Tighten the retaining nut, and stake in

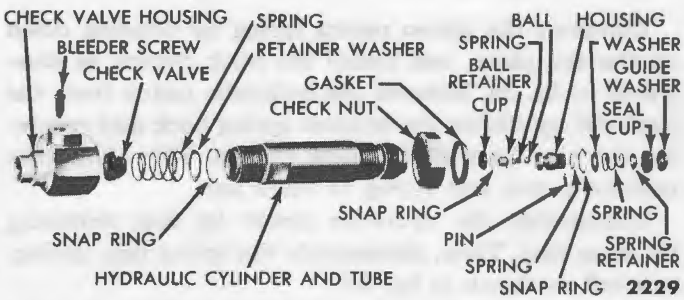


Fig. 40—Hydraulic Cylinder and Check Valve, Disassembled

two places. Care must be used to prevent the retainer plate from shifting when the nut is tightened.

Clamp the hexagonal section of the piston guide in a vise. Install the bottom lock ring, lower spring washer, spring, and upper spring washer on the push rod. Place the push rod into the piston guide and secure with a *new* lock ring in the piston guide groove. Make sure the lock ring is fully seated.

Place the vacuum piston return spring over the push rod with the small end of the spring next to the vacuum piston, and carefully guide the push rod through the leather seal in the end plate. Use hook clamps to hold the end plate and piston together. Wash the hydraulic cylinder piston parts in alcohol, and assemble the parts as illustrated in fig. 36. Dip the hydraulic piston cup in brake fluid before assembly.

NOTE: ***The lip of the piston cup extends toward the check valve end of the piston.***

Attach the hydraulic piston to the push rod by means of a retainer pin. Slide the retaining spring over the hole in the piston to hold the retainer in place.

Assemble the check valve parts (fig. 40) into the end cap in the following order: check valve, spring, washer, and lock ring. Be sure to place the lock ring in its groove.

Place the new gasket in the end cap and thread the hydraulic cylinder into the end cap with the milled flats next to the cap, and tighten it securely. Assemble the bleed screw and thread the lock nut on the cylinder to the limit of the threads.

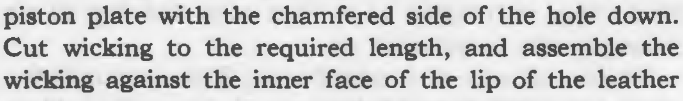


Fig. 39—Hydrovac Vacuum Piston, Disassembled

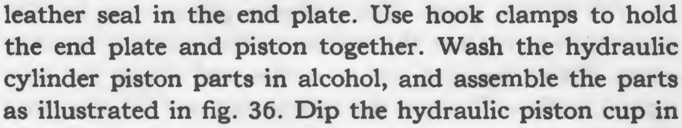


Fig. 41—Control Valve Assembly, Typical

Place the hydraulic cylinder end seal in the end plate against the shoulder (fig. 40). Assemble the check nut seal on the hydraulic cylinder tube next to the check nut. Guide the lip of the piston cup into the bore of the cylinder. Thread the cylinder in by hand, until the end of the cylinder bottoms firmly against the end seal. Do not tighten the cylinder or the lock nut at this time. Remove the hook clamps.

Place the gasket on the end plate. Dip the piston leather in brake fluid (do not use ordinary oil), and allow the excess fluid to drain off. Coat the inside of the cylinder shell lightly with air cylinder oil. Insert the piston into the cylinder by tipping the piston. Line up the end plate with the scribed marks made previously. Attach the hook bolts, and tighten each bolt evenly, until all bolts are uniformly tight.

Place guide pins in the end plate as shown in fig. 41, and carefully assemble the control valve parts as illustrated. Guide pins can be made by cutting the heads off No. 8-32 x 2½-inch machine screws. Remove the guide pins, one at a time, and replace with a screw and lock washer. When assembling the diaphragm, return spring, and control valve body, extreme care should be taken not to distort the diaphragm in compressing the spring. Place the vacuum hose in place and tighten the clamps. Align the bleed screw in the end cap with the bleed screw in the end plate and tighten the check nut securely.

Inspect the booster to see that all bolts, nuts, washers, and screws are in place, and that all tubes, clamps, and fittings are securely tightened. After a major overhaul, vacuum, hydraulic leakage, and operational tests should be made.

(e) INSTALLATION. Position the brake booster on the mounting bracket, then install the mounting bolts using new lock washers (fig. 32).

Connect the wires and hydraulic lines to the stop light switch. Connect the vacuum tube to booster hose to the booster. Tighten the hose clamps securely.

Install the master cylinder to booster hydraulic line.

Connect the air inlet tube to the booster. Tighten the hose clamp securely.

Perform the serviceability tests outlined for a hydraulic brake system with booster.

5. BRAKE ASSEMBLIES

The brakes used on Ford trucks are divided into six types of brake shoe assemblies. The model application for each type is given in Table 1. The description of these assemblies and the disassembly and assembly procedures are covered in this section under the following headings: "a. Single Anchor Self Energizing," "b. Uni-Servo Single Anchor," "c. Double Anchor Self Centering," "d. Double Anchor," "e. Double Anchor Two Cylinder" and "f. Dual Primary." This section also includes the brake shoe relining procedure which is given under the heading "g. Brake Shoe Relining."

a. Single Anchor Self-Energizing.

The single anchor self energizing brake assembly contains two shoes mounted on the brake carrier plate assembly. The forward shoe is the primary shoe and the rear shoe is the secondary shoe. The upper ends of the shoes are held against the anchor by two return springs. Each shoe is held against the brake carrier plate by a hold-down spring pin, a spring, and two cups. A brake adjusting screw assembly and a spring are used to hold the shoes in the correct position in relation to each other.

(1) *DISASSEMBLY.* After the wheel and drum have been removed (fig. 42), disconnect the return springs with the special tool shown in fig. 43, then remove the anchor pin plate. Remove the brake shoe hold-down cups, springs and pins. Disconnect the hand brake cable at the rear brakes. Remove the brake shoes. After the shoes are removed, the adjusting screw and spring may be removed by moving the anchor pin ends of the shoes together.

CAUTION: ***Wire the wheel cylinder caps in place. Do not depress the brake pedal while the brake drum is removed.***

(2) *ASSEMBLY.* Prior to installing the shoes, lubricate all points of contact between the brake shoe and the other brake parts with Lubriplate.

Connect the two shoes by installing the adjusting screw and spring. Install the pins and place the brake shoe assembly on the backing plate. Be sure to place the

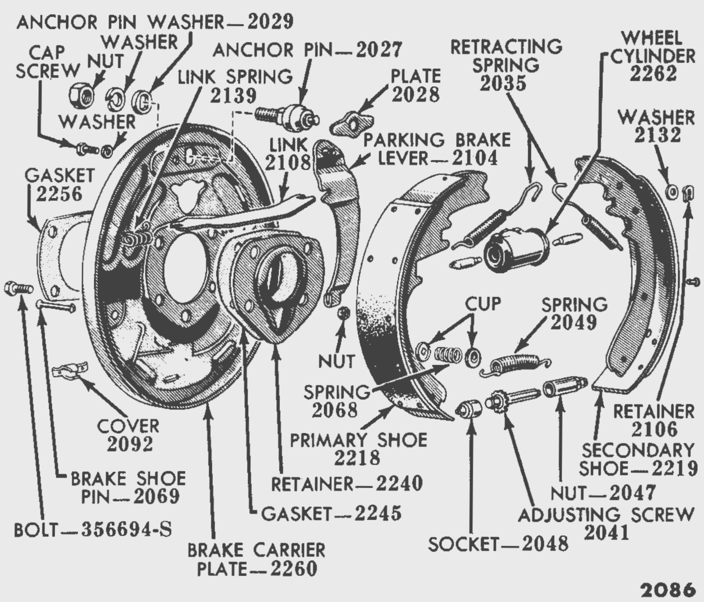


Fig. 42—Single Anchor Self Energizing Brake Assembly F-1 Truck

secondary shoe to the rear and the primary shoe to the front. Install the hold-down cups and springs (fig. 42). Install the return springs with the tool shown in fig. 44. Install the drums and adjust the brakes.

b. Uni-Servo Single Anchor.

The uni-servo single anchor brake assembly (fig. 5) construction is essentially the same as the single anchor self-energizing brake assembly with one exception. The front brake wheel cylinder has only one piston which acts on the forward shoe.

The disassembly and assembly procedures, and the brake shoe and anchor adjustments may be performed by following the procedures outlined for the single anchor self-energizing brake assembly.

c. Double Anchor Self-Centering.

The double anchor self-centering brake assembly contains two shoes mounted on the brake carrier plate assembly. The forward shoe is the primary shoe and the rear shoe is the secondary shoe. The upper ends of the shoes are held in contact with the wheel cylinder pistons by the brake shoe return spring. The lower end of each shoe is mounted on an anchor pin which is integral with the brake carrier plate. An anchor pin bushing is installed between each shoe and anchor pin. The shoes and bushings are held in place by the brake shoe anchor pin plate which is retained on the anchor pins with cotter pins. The brake shoe movement is further controlled by brake shoe guide springs. The guide springs are installed in slots in the brake carrier plate.

The rear brake assembly contains the same mechanism as the front brake assembly and, in addition, contains the parking brake operating lever, link, and attaching parts.

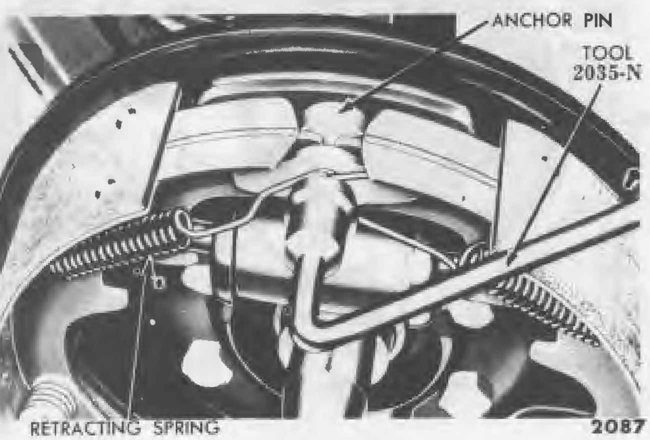


Fig. 43—Removing Brake Shoe Return Spring, Tool No. 2035-N

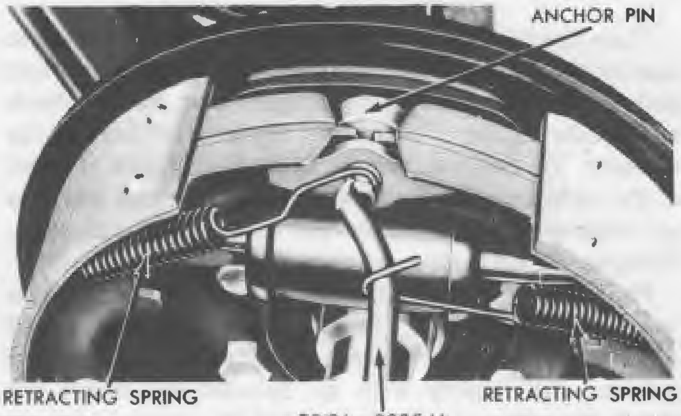


Fig. 44—Installing Brake Shoe Return Spring, Tool No. 2035-N

CAUTION: ***Do not depress the brake pedal while the brake drum is removed.***

Install a suitable clamp on the wheel cylinder. Remove the brake shoe return spring. Remove the cotter pins from the anchor pins, then remove the anchor pin plate. Remove the brake shoes, anchor pin washers, and anchor pin bushings. On rear brakes, unhook the parking brake cable and remove the parking brake link and lever.

(2) *ASSEMBLY.* Lubricate all points of contact between the brake shoes and the other parts of the brake assembly with Lubriplate. Position the brake shoes on the brake carrier plate making sure the upper ends of the shoes are inserted in the slots in the wheel cylinder and the web of the shoes is in the brake shoe guide springs in the slots in the wheel cylinder. Position the anchor pin bushings and washers on the anchor pins.

NOTE: ***On rear brakes, install the parking brake link and lever and connect the cable.***

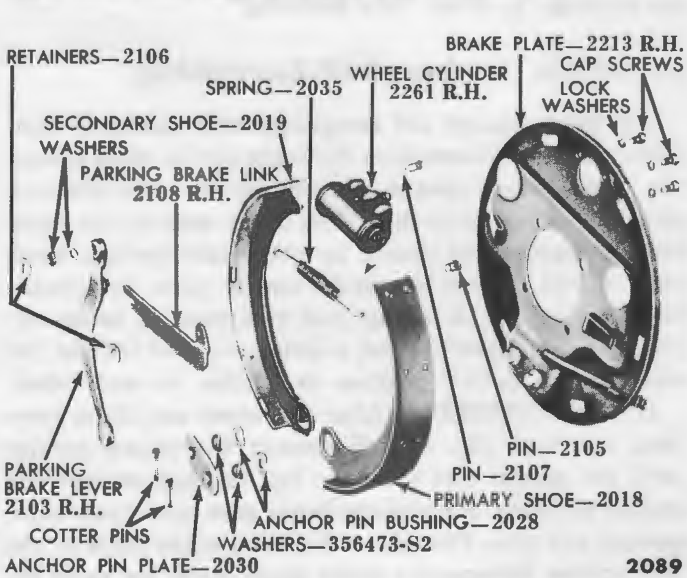


Fig. 45—Double Anchor Self Centering Brake Assembly (Rear Shown)

Install the anchor pin plate using new cotter pins to secure the plate in place. Install the brake shoe return spring, then remove the wheel cylinder clamp. Turn the shoe adjustment cams all the way back, then install the drum assembly and the wheel. Adjust the brakes.

d. Double Anchor.

The double anchor brake assembly contains two shoes mounted on the brake carrier plate assembly. The forward shoe is the primary shoe and the rear shoe is the secondary shoe. The upper ends of the shoes are held in contact with the wheel cylinder pistons by the brake shoe return spring. The lower end of each shoe is mounted on an anchor pin which is riveted to the brake carrier plate. An eccentric anchor pin bushing is installed on each anchor pin in each brake shoe. The anchor pin bushings and brake shoes are held in place by the brake shoe anchor pin plate which is secured to the anchor pins with cotter pins. The brake shoe movement is further controlled by the brake shoe guide springs, which are installed in slots in the brake carrier plate.

The rear brake assembly contains the same mechanism as the front brake assembly and, in addition, contains the parking brake operating lever, link, and the attaching parts.

(1) *DISASSEMBLY.* Remove the wheel and drum assembly (fig. 46).

CAUTION: ***Do not depress the brake pedal while the brake drum is removed.***

Install a suitable clamp on the wheel cylinder. Remove the brake shoe return spring. Remove the nuts and lock washers from the anchor pins, then remove the anchor

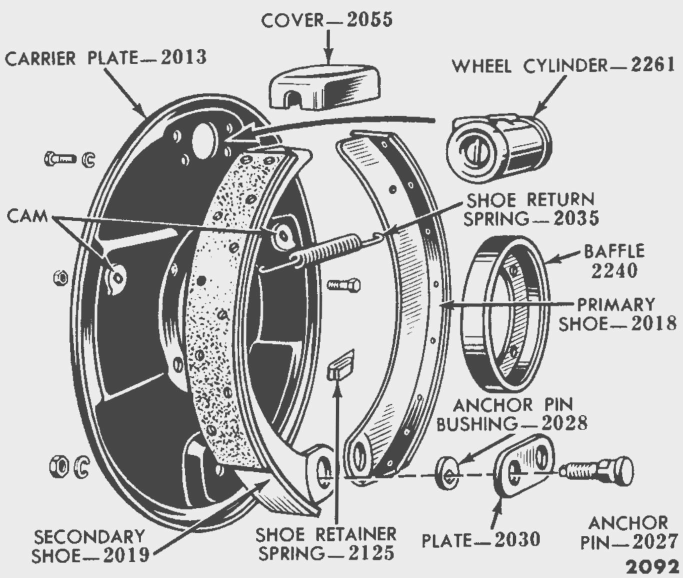


Fig. 46—Double Anchor Brake Assembly, F-3 (Rear and F-3 Parcel Del., F-4, F-5, F-6 Trucks

pins and the anchor pin plate. Remove the brake shoes and the anchor pin bushings. On rear brakes, disconnect the parking brake cable and remove the parking lever and link, if used.

(2)*ASSEMBLY.* Lubricate all points of contact between the brake shoes and the other parts of the brake assembly with Lubriplate. On rear brakes, install the parking brake lever and link and connect the cable, if used.

Position the brake shoes on the brake carrier plate making sure the upper ends of the shoes are inserted in the slots in the wheel cylinder and the web of the shoes is in the brake shoe guide springs. Place the anchor pin plate and the anchor pin bushings on the anchor pins. Line up the bushing holes in the brake shoes with the anchor pin holes in the brake support plate, then install the anchor pins, bushings, and plate. Turn each anchor pin, while pushing outward on the shoes, until the anchor pin bushings enter the holes in the brake shoes. Install the lock washers and nuts on the anchor pins finger tight. Install the brake shoe return spring. Turn the anchor pins until the punch marks face each other, then tighten the anchor pin nuts. Turn the shoe adjustment cams all the way back, then install the drum assembly and the wheel. Adjust the brakes.

e. Double Anchor 2-Cylinder.

This brake used on late F-7 rear wheels and F-8 rear wheels is a "floating shoe" type which has two identical shoes arranged on the backing plate so that their toes are diagonally opposite (fig. 9). Two double end wheel cylinders are arranged so that one cylinder is mounted between the toe and heel of each shoe. An equal amount of hydraulic force is then applied at each end of each shoe. The wheel cylinders are not bolted directly to the backing plate, instead they are held in position by shoe anchor blocks which are bolted to the backing plate. Each anchor block serves as a shoe stop and shoe centering point and provides the fulcrum around which the shoe pivots when the brake is applied (fig. 47).

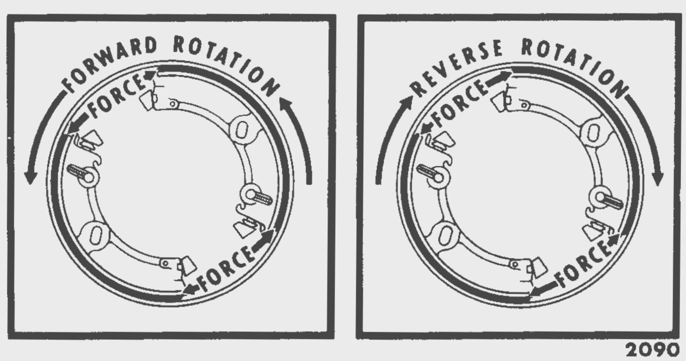


Fig. 47—Schematic View Showing Direction of Forces Upon Brake Application

Both shoes are always primary shoes (forward acting), independently actuated in either direction of rotation. Shoes anchor at either toe or heel depending upon the rotation of the brake drum. A pivot pad is placed at both the shoe toe end and the shoe heel end. The pad at the toe is an integral part of the shoe adjustment screw, a component of the adjusting mechanism which is placed in the shoe toe of this brake. The adjusting screw is held in the shoe toe by means of a worm wheel which threads onto the screw. The worm wheel in turn meshes with a worm which is rotated to effect brake adjustment. The worm has an Allen head so that it can easily be turned with a ⅜ inch Allen wrench. Adjusting slots in the brake backing plate provide access to each of the shoe adjusting worms.

Upon brake application the wheel cylinder pistons apply force against toe and heel of each shoe. Upon contact of the brake lining with the drum, self-energization (shoe wrapping action caused by drag of the drum on the linings) wraps both shoes into the drum (fig. 47). If the vehicle is moving forward, the shoe heels are wrapped against their anchor blocks by the drum rotation. If the vehicle is moving in reverse, the shoe toes are forced against their anchor blocks. The anchor block sides are aligned on the axle radius. Upon contact with the anchor blocks the shoes pivot, and at the same time, move radially along the anchor block sides until they are centered in relation to the drum.

(1) *DISASSEMBLY.* These brakes can be serviced without removing hubs or disturbing wheel bearings. Simply remove the wheels and remove the screws holding the drum to the hub.

NOTE: ***Mark drum and hub so that they will be reinstalled in the same position.***

Whenever the brake shoes are removed, always dismantle the adjusting mechanism and clean all oil, grease, and dirt from the parts and from the chambers within the shoes.

NOTE: ***If the wheel cylinder connecting tubes and the bleeder screws are removed, mark the wheel cylinder ports to which the connecting tube is attached to assure correct assembly. Difficulty will be encountered in the bleeding operation if the tube is assembled in the wrong location.***

To remove the brake shoe retracting spring, remove the shoe guide bolt nut, lock washer, and the washer holding the shoe in place. Remove the shoes.

To remove the adjusting mechanism, rotate the adjusting worm, threading it free of the worm wheel.

Remove the worm retainer snap ring from the shoe. Remove the end thrust washers, the sleeve, the worm, and the worm wheel.

(2) *ASSEMBLY.* To assemble the adjusting mechanism, fig. 40, assemble the thrust washers, the sleeve, the worm, and the worm wheel.

NOTE: ***Assemble all parts dry.***

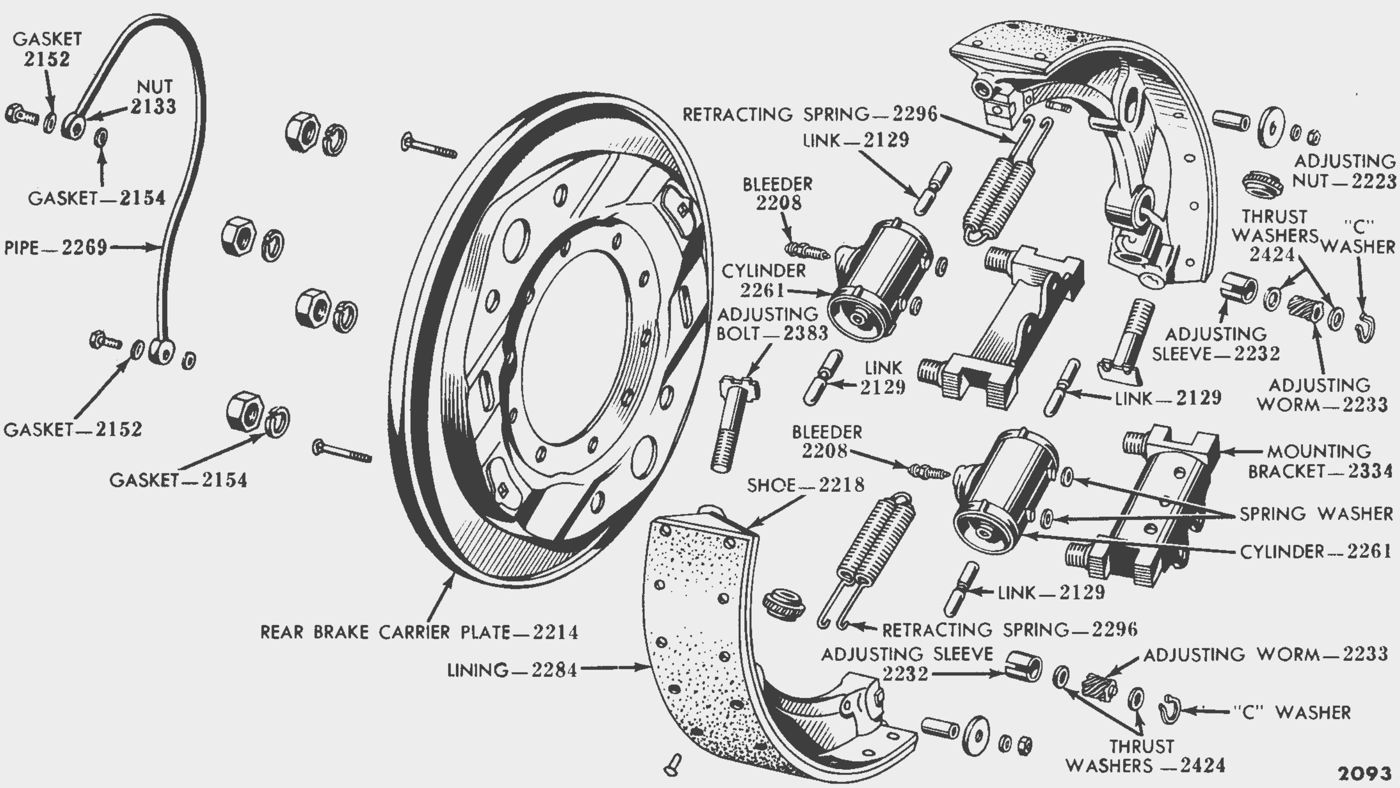


Fig. 48—Double Anchor 2-Cylinder

The sleeve slot must face the worm wheel to allow the worm and the wheel to mesh. Install the worm retainer snap ring into the groove in the shoe. Install the adjusting worm in the worm wheel and adjust to the full OFF position.

NOTE: ***The curved side of the pad on the adjusting screw must be in the proper position to permit it to rock on the anchor block when the shoes are installed on the backing plate.***

(3) *REPLACEMENT OF THE SHOE ASSEMBLIES.* For the best results new shoe and lining assemblies should have the brake lining of the correct thickness ground to the proper radius concentric with the brake drum. If the brake linings are not ground it may be necessary to readjust the brakes after the linings have "worn in." Install one shoe on the backing plate making sure the adjusting worm is aligned with the adjustment slot in the backing plate.

NOTE: ***It is possible to install the shoe in the reverse position. However, if so installed the brake cannot be adjusted.***

Install the shoe guide sleeve on the guide bolt and assemble the guide washer, the lockwasher and the lock nut. Tighten the nut securely. Repeat the above procedure for the other shoe. Install the shoe retracting springs.

f. Dual Primary.

The dual primary brake used on early F-7 rear wheels is a "floating shoe" type which has two identical shoes (fig. 10). Linings of equal length and identical material are riveted to interchangeable shoes. A straight bore hydraulic wheel cylinder actuates the lever arms to apply pressure at the center of the shoes by means of movable pressure blocks. The shoes are self-centering and rotation is prevented by self-aligning abutment blocks bearing against the angled faces of the shoes.

Each shoe is held in a brake shoe lever assembly by a spring and retainer. The upper slot of the brake shoe lever assembly fits on the stationary brake shoe anchor pin and is held in position by the lock ring and washer. The lower end of the brake shoe lever assembly fits on an adjustable brake shoe anchor pin. An upper brake shoe and lever spring holds the two shoes against the wheel cylinder push rod.

(1) *DISASSEMBLY.* Pry the brake shoe and lever spring and spring retainer from the recess with a small screwdriver. Remove the shoe and lining assembly from the levers. Remove the lock rings and flat washers from the stationary and adjustable anchor pins. Lift the levers from the anchor pins and remove the pressure and abutment blocks. Remove the return spring.

(2) *ASSEMBLY.* Position the abutment blocks and install the right or left-hand lever. Levers are not reversible due to the large hole in the inner face for the adjustable anchor pin. Hook the shoe return spring between the lever installed and the opposite lever. Position the lever over the stationary anchor pin. Bump with hand to position over the adjustable anchor pin. Install the abutment blocks and tap the lever into position. Install flat washers and lock rings, then rotate the anchor pins to full release position. Use brake lubricant to retain the pressure block in position on the shoe and lining assembly and position the lever. Position the shoe as shown in fig. 49. Hold the spring and retainer (with spring compressed) in an adjustable open-end wrench or vise grip pliers and tap into position with the retainer toward the drum (fig. 50).

g. Brake Shoe Relining.

If the distance from the surface of the lining to the rivet head is less than 1/32 inch, then the shoes should

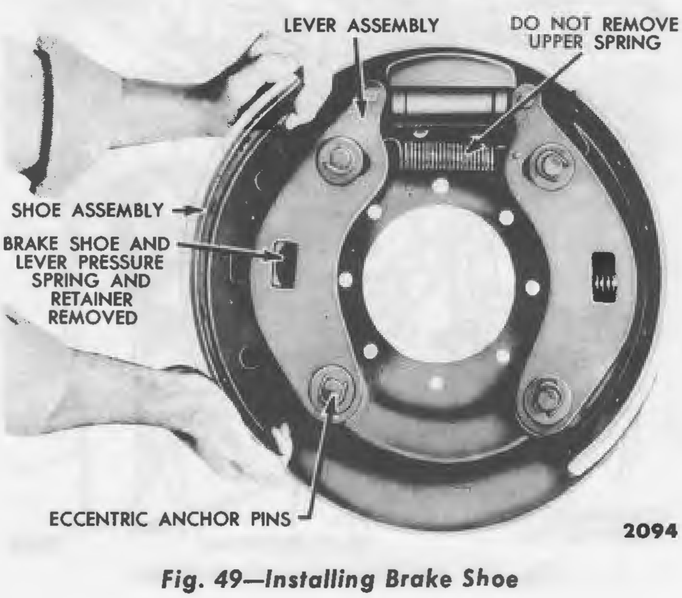


Fig. 49—Installing Brake Shoe

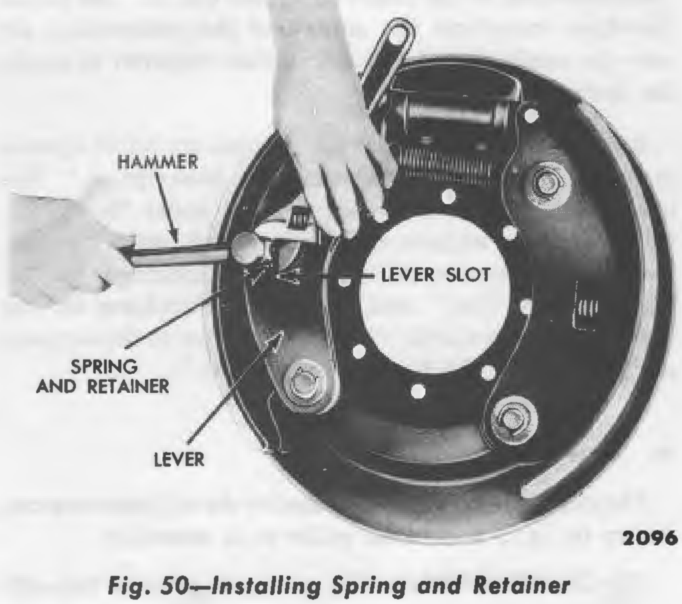


Fig. 50—Installing Spring and Retainer

be relined. Failure to replace lining when this condition exists may cause irreparable damage to the brake drums. Brake shoes should be inspected for distortion and for looseness between the rim and web. If any of these conditions exist, discard the shoe. If shoes are serviceable remove the old rivets to remove the old lining. Thoroughly clean the surface of the shoe rim and remove any burrs or high spots. Ford lining kits are available for either front or rear brakes. Each kit contains two primary linings, two secondary linings, and the necessary rivets. These linings are ground in production and do not require grinding after installation.

When riveting new linings always install the two center rivets first, then work out to the end rivets. On some truck models the secondary lining is shorter than the primary lining. If this condition exists, install the shorter lining on the heel end of the shoe.

NOTE: ***Do not permit oil or grease to come in contact with the lining.***

After riveting is completed, the lining must seat snugly against the shoe with no more than 0.005 inch separation midway between rivets.

6. BRAKE DRUMS

The brake drums used on all truck models are of the demountable type. Demountable drums may be removed from the hubs without removing the hub from the axle. Brake drums are slotted, on some models, so that the brake lining to drum clearance can be checked.

a. Brake Drum Mounting.

Three different methods of mounting the brake drums are used. The F-1 truck front brake drums are secured with speed nuts which are installed on the hub bolts. The F-1 truck rear brake drums are attached to the rear hub flange with cap screws. On all other models with demountable brake drums, the drums are attached to the hub flange with slotted machine screws.

b. Reboring.

Brake drums that are rough, scored or out of round should be rebored to provide a smooth drum surface. If oversize linings are used, the drums must be rebored in an amount equal to the increased thickness of the linings. Otherwise, it would be impossible to obtain the specified lining to drum clearance. When reboring brake drums, do not exceed the maximum reboring limits or the drums may be weakened to the extent that failure could occur under severe operating conditions.

7. AIR BRAKE SYSTEM

The air brake system, available as optional equipment for the F-8 truck, incorporates four-wheel, air pressure operated, mechanical brakes with two internal expanding brake shoes in each drum. The air brake equipment consists of the units which maintain the supply of compressed air and the units which control the flow of the compressed air to the brake chambers (fig. 3). The brake chambers transform the energy of the compressed air into the mechanical force and motion required to apply the brakes.

A description of the unit used in the air brake system is contained under the heading "a. Description." The operations of these units are covered under "b. Operation," and the adjustments are covered under "c. Adjustments." Serviceability tests are indluded in "d. Serviceability Test," and the repair procedures for the various units available thru the Ford parts department are given under the heading "e. Repair."

a. Description.

The description of the units used in the air brake system, shown in fig. 3 is covered under each assembly.

(1) *COMPRESSOR.* The compressor is a two-cylinder, single-acting, reciprocating, single stage type, with a displacement of 7¼ cubic feet per minute at 1250

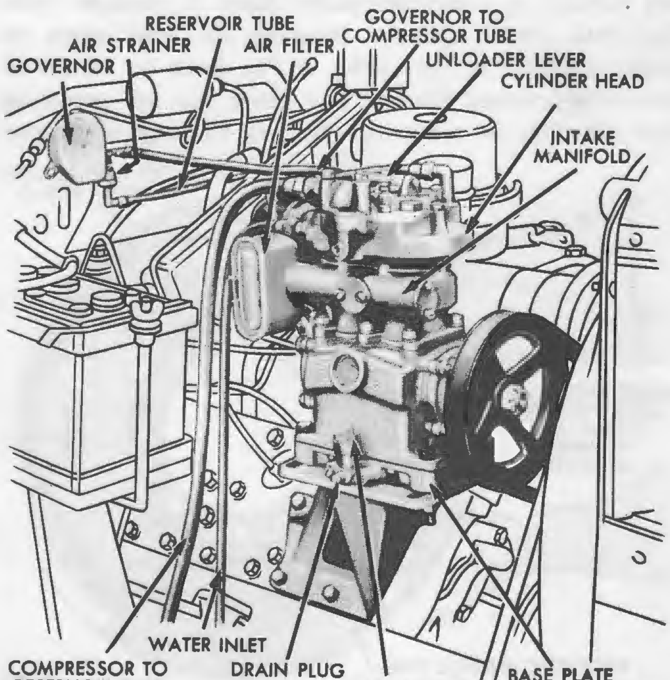


Fig. 51—Air Compressor Installation

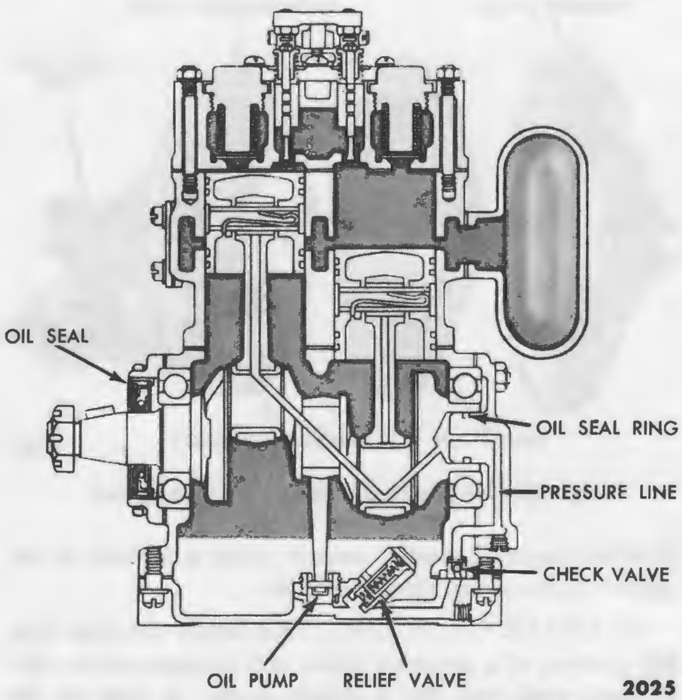


Fig. 52—Sectional View of Compressor

r.p.m. The cylinders have a bore of 2 1/16 inches with a piston stroke of 1½ inches.

The compressor is mounted on the right-hand side of the engine (fig. 51) and is driven by a V-belt from the fan shaft pulley. The engine to compressor ratio is 1 to 0.718.

The compressor has a self-contained oil pump and oil supply (fig. 52). A minimum oil pressure of five pounds per square inch is required at the minimum speed, and a minimum oil pressure of 15 pounds per square inch is required at the maximum recommended speeds. The

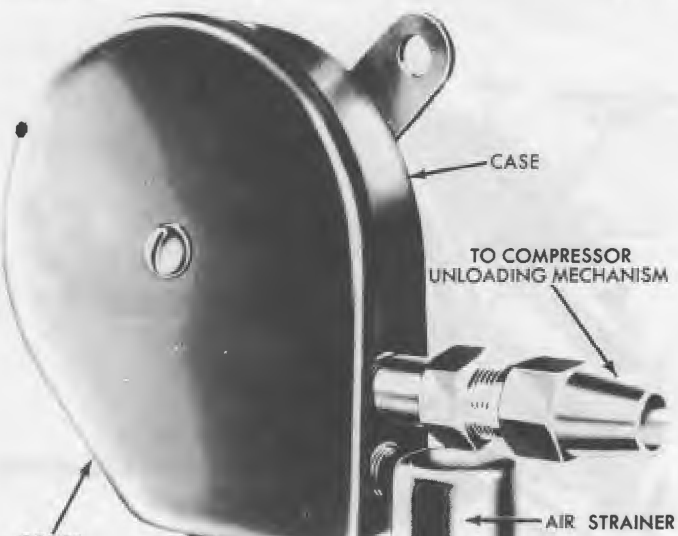


Fig. 53—Air Compressor Governor

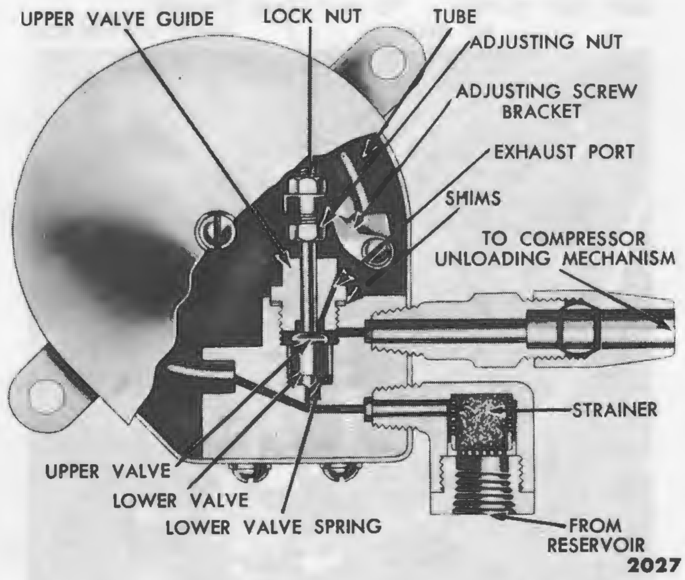


Fig. 54—Internal Construction of Governor

pressure lubrication is supplied to the upper and lower connecting rod bearings and splash lubrication is used to supply the oil to the ball type main bearings and the cylinder walls. The crankcase capacity is one pint, and the oil level is measured by a bayonet extension on the oil filler plug. The oil level should never be below the bottom end of the bayonet extension.

The compressor head is water cooled. The water supply is obtained from the engine block. Slightly more than 1½ horsepower is required to drive the compressor at 1250 r.p.m. when delivering the air at a pressure of 90 pounds per square inch.

(2) *GOVERNOR.* The compressor governor shown in fig. 53 controls the cut-in and cut-out action of the compressor. The governor is equipped with a Bourden tube

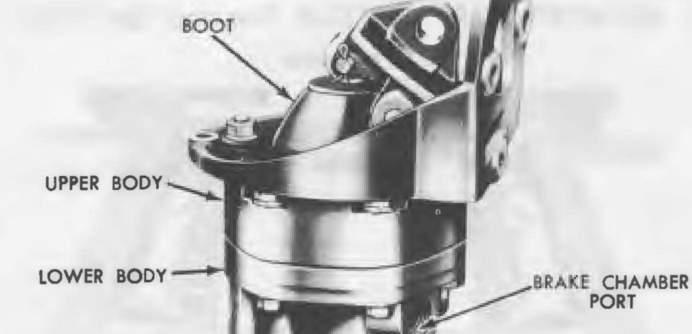


Fig. 55—Air Brake Foot Control Valve

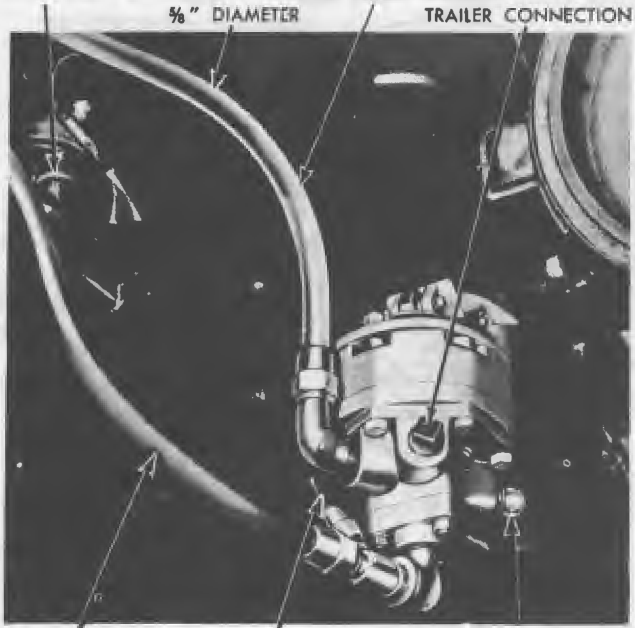


Fig. 56—Foot Control Valve—Installation

which is curved and tends to straighten under internal pressure. One end of the tube is connected by a mechanical link to a valve as shown in fig. 54.

(3) *FOOT OPERATED BRAKE VALVE.* The brake valve (figs. 55 and 56) is a pre-loaded type, and is mounted underneath the floor on the left side of the vehicle. The brake pedal is the same as the one used with the hydraulic brake and is in the same location but is adjusted closer to the floor. It is connected to the valve assembly by an adjustable link.

(4) *RESERVOIRS.* The reservoirs are connected in the air brake system as shown in fig. 57. Drain cocks are provided at the bottom of each reservoir. A safety valve is installed on the top side of the right reservoir.

When servicing the reservoirs, installation of the air tube between the reservoirs can be facilitated by loosening the reservoirs from the frame.

(5) *STOP LIGHT SWITCH.* The stop light switch

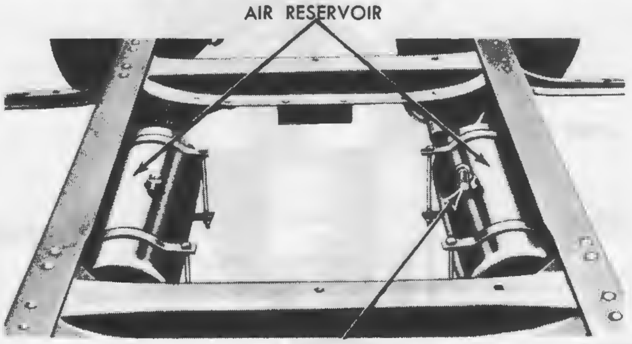


Fig. 57—Air Reservoirs Installation

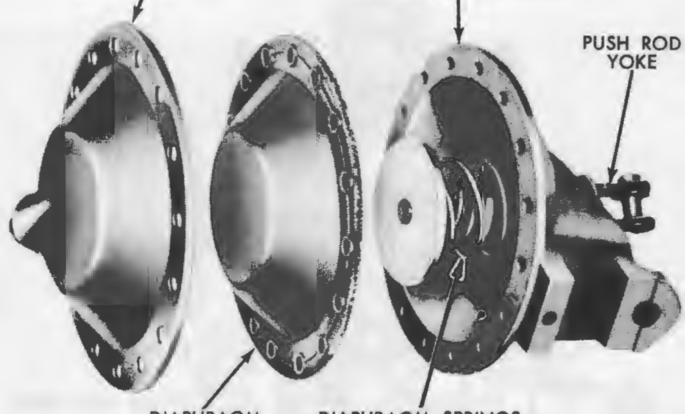


Fig. 58—Air Brake Chamber, Disassembled

is an air operated electric switch which is located in the system as shown in figs. 3 and 56.

(6) *BRAKE CHAMBERS.* Each brake chamber (fig. 58) consists of a pressure plate, non-pressure plate, diaphragm, push rod, and a return spring. A yoke on the push rod connects the push rod to the slack adjuster which is mounted on the brake camshaft.

The front brake chambers are six inches in diameter with an effective area of nine square inches and a maximum stroke is 1¾ inches.

The rear brake chambers are 9⁹⁄₁₆ inches in diameter with an effective area of 24 square inches. The maximum stroke is 2¼ inches.

The rear brake chambers are installed on the rear axle as illustrated in figs. 59 and 60.

(7) *SLACK ADJUSTERS.* The rear slack adjuster is a 360° rotating worm and gear type (fig. 61). It consists of a hardened steel gear which is splined to the brake

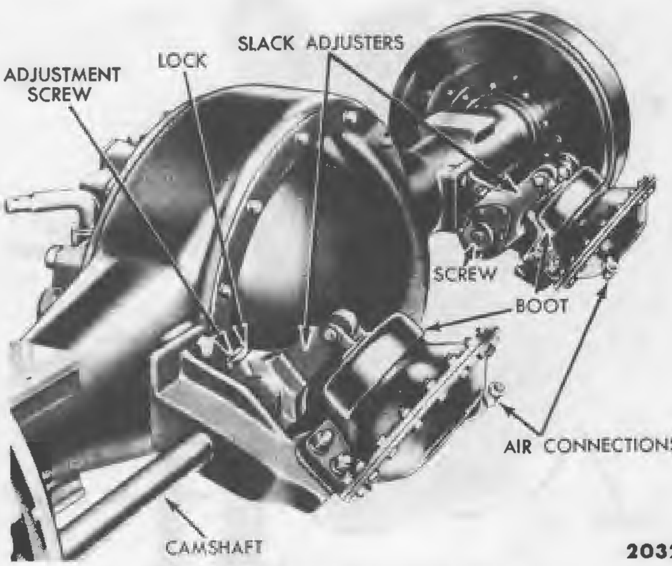


Fig. 59—Rear Brake Chamber and Slack Adjuster Installation

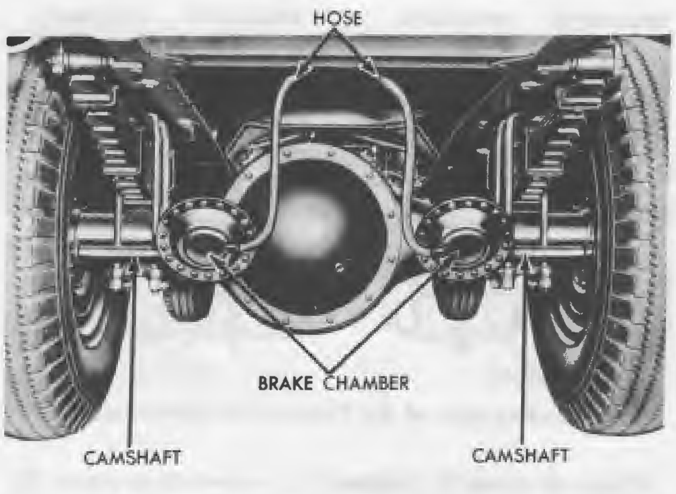


Fig. 60—Air Brake Installation on Rear Axle

camshaft, a brake lever, and a hardened steel worm shaft and worm which are mounted in the lever above the gear. Spiral teeth on the worm mesh with teeth in the gear. Turning the worm shaft causes rotation of the camshaft in relation to the brake lever. During the brake operation the entire slack adjuster rotates bodily with the camshaft. A collar locks the adjusting worm when the adjusting wrench is removed.

The front brake slack adjusters are rod and lever type and consist of two levers, one astride the other (fig. 62). The inner lever is clamped to serrations on the brake camshaft; the outer lever is attached to the inner lever with an adjusting rod screw. This screw is retained in the outer lever with a retainer, washer, and spring. and screws into a tapped hole in a steel pin in the outer end of the inner lever. When the screw is turned, the inner lever and camshaft rotate in relation to the outer lever. The retainer washer has projections which lock the screw in place after adjustment.

(8) *FRONT SHOES AND LININGS.* The brakes at each front wheel (fig. 63) have two shoes which pivot on individual anchor pins at one end and are expanded at the other end during the brake application by a constant lift type cam. This cam is forged integral with the shaft and acts against the hardened steel wear plates

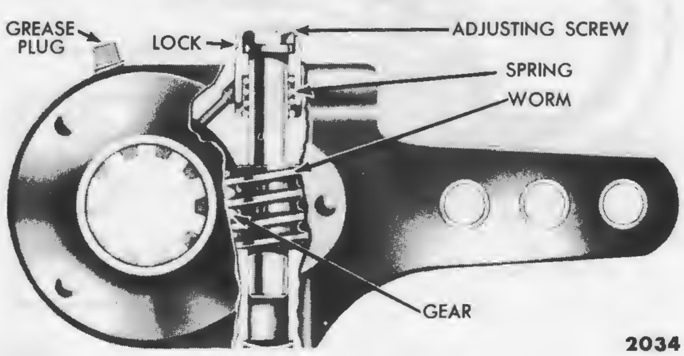


Fig. 61—Rear Slack Adjuster, Sectional View

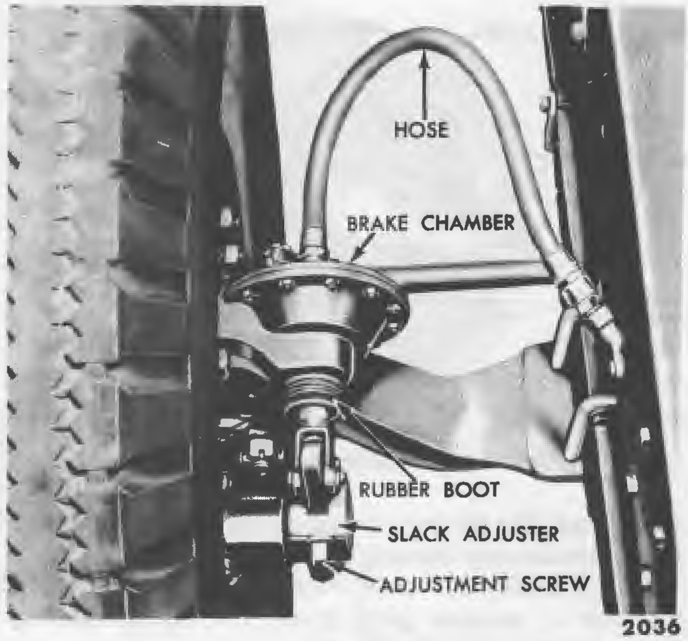


Fig. 62—Front Slack Adjusters and Chamber Installation

attached to the brake shoes. Replaceable bronze bushings are used at both camshaft and anchor pins. The anchor pins are eccentric to permit shoe adjustment. A brake shoe return spring holds both shoes firmly against the cams, as shown in fig. 63. A one-piece type lining is riveted to each shoe.

(9) *REAR SHOES AND LININGS.* The brakes at each rear wheel (fig. 64) have two shoes which pivot on individual anchor pins at one end and are expanded at the other end by constant lift S-type cams. The two brake shoe return springs hold the shoe ends firmly against the cams. Two bolted-on lining blocks are used on each shoe. For identification, the edge of the primary shoe lining is painted blue and the edge of the secondary shoe lining is painted yellow.

The cam end of each shoe is equipped with a hardened

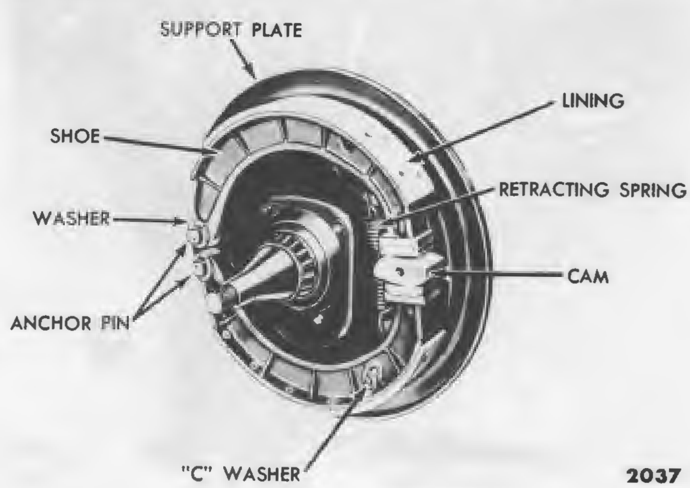


Fig. 63—Front Brake Assembly

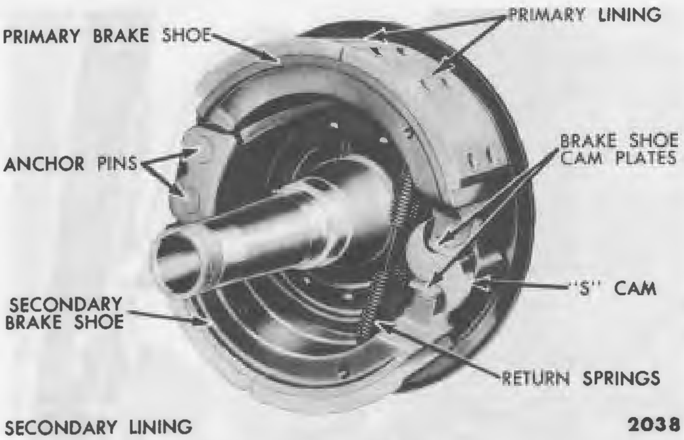


Fig. 64—Rear Brake Shoe Assembly

wear plate. The anchor pin end of each shoe is equipped with a replaceable bushing.

(10) *RESERVOIR AIR PRESSURE GAUGE.* The reservoir air pressure gauge is mounted on the steering column as shown in fig. 65.

b. Operation.

The compressor runs continuously while the engine is operating. Actual compression of air is controlled by the governor which acts in conjunction with the unloading mechanism. The governor limits pressure by opening the unloader valve and stopping compression (fig. 66) when system pressure has built-up to maximum pressure (100-105 lbs.), or by closing the unloader valve and starting compression when system pressure has dropped to a minimum pressure (80-85 lbs.).

Fig. 65—Air Pressure Gauge Installation

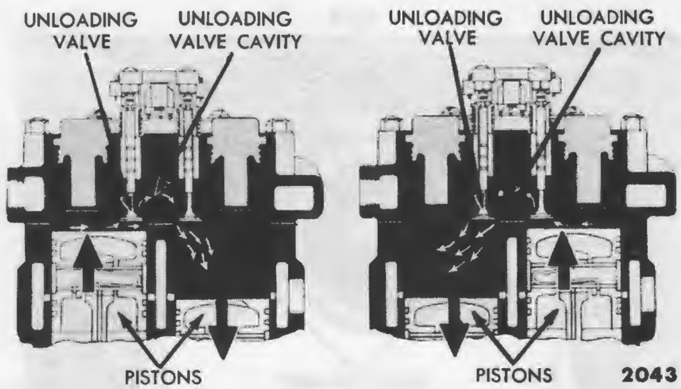


Fig. 66—Passage of Air During Non-Compression

When air pressure reaches the maximum pressure for which the governor is set, air pressure forces the lower valve off its seat which lifts the upper valve against the downward force of the tube, and at the same time seats the upper valve against its seat (fig. 67). This action closes the exhaust port and the air travels through and around the lower valve, into the compressor unloading diaphragm cavity, opening the compressor unloading valves, and stopping the compression of air.

When the air pressure drops to the minimum setting, force of the tube overcomes the air pressure holding the upper valve against its seat and forces the upper valve down which forces the lower valve down and closed.

In this position, the exhaust port is open, opening the unloading line to the atmospheric pressure which permits the compressor unloading valves to seat and the compressor to resume compression (fig. 68).

During the downward stroke of the piston, a partial vacuum is created above the piston, and as the piston nears the bottom of the stroke, it uncovers the intake port, and air which has entered the cylinder is trapped above the piston. The piston compresses the trapped air until the pressure lifts the discharge valve (fig. 69).

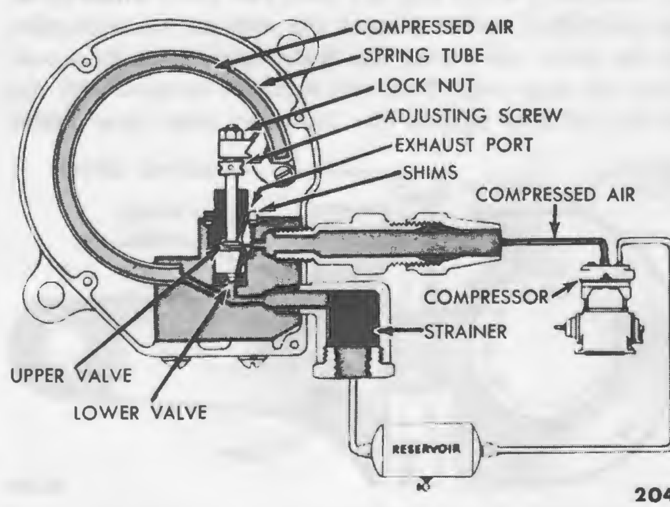


Fig. 67—Governor Cutout Position—Not Compressing

Air is then discharged through the discharge line into the reservoir.

When the piston starts the downward stroke, the discharge valve returns to its seat, preventing compressed air in the reservoir from returning to the cylinder. The above cycle is repeated twice for each revolution of the compressor crankshaft.

The brakes are applied or released by depressing or releasing the brake pedal. This operates the brake valve which controls the air pressure that is used to operate the brakes. As long as the brake pedal is in the released position, the inlet valve in the brake valve is held closed, sealing the reservoir air pressure in the connecting lines, shown in fig. 3, while the exhaust valve is held open so that all of the air pressure in the brake chamber and in the connecting lines is exhausted to the atmosphere.

As the brake pedal is depressed, the exhaust valve in the brake valve is closed and the inlet valve is opened, permitting the air pressure from the reservoir to pass through the brake valve into the brake chambers. This air pressure in the brake chambers causes the brake chamber push rods to move the slack adjusters so the cams are rotated, forcing the brake shoes against the brake drum, thus applying the brakes.

The distance the brake pedal is depressed determines the air pressure delivered to the brake chambers. The inlet valve closes automatically when the desired pressure is obtained. As the brake pedal is released, the exhaust valve is opened so that the air pressure in the brake chambers is permitted to exhaust to atmosphere. When pressure in the brake chamber is exhausted, force of the brake chamber and the brake shoe return springs returns the brake chamber push rods, slack adjusters, and brake shoes to their normal positions, thus releasing the brakes.

The pressure regulating spring balances the air pressure against the foot pedal pressure so that the air pressure delivered to the brake is proportional to the pressure applied at the pedal.

c. Adjustment.

Certain units of the air brake system require adjustment to provide continued effective braking. The procedures for adjusting these units are given here under headings which indicate the unit being serviced.

(1) *SLACK ADJUSTERS.* Apply the brakes and measure the travel of the brake chamber push rod. The travel should be kept to the minimum without brakes dragging. The maximum travel at which brakes should be readjusted is 1⅜ inches for the front and 1¾ inches for the rear brakes.

NOTE: ***Adjustment of the yoke on the brake chamber push rod should not be changed. When new, the yoke is adjusted so that the slack adjuster-brake chamber push rod angle is slightly greater than 90° when the brakes are properly adjusted and the brakes are applied. Brake lining wear will not change this angle as long as slack adjusters are kept adjusted to compensate for lining wear.***

To adjust the rear slack adjuster (fig. 61) depress the lock sleeve and turn the hexagon head of the worm shaft clockwise. The lock sleeve must come back out and engage the hexagon head of the worm shaft lock adjustment. Turn the screw on the front slack adjuster (fig. 62) to adjust the front brakes.

Adjust the front brake chamber push rod travel to ⅝-inch and the rear chamber push rod to ¾-inch travel.

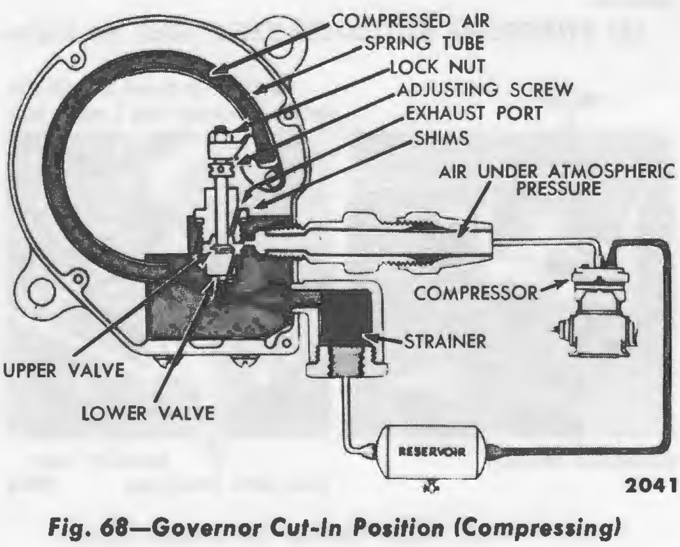


Fig. 68—Governor Cut-In Position (Compressing)

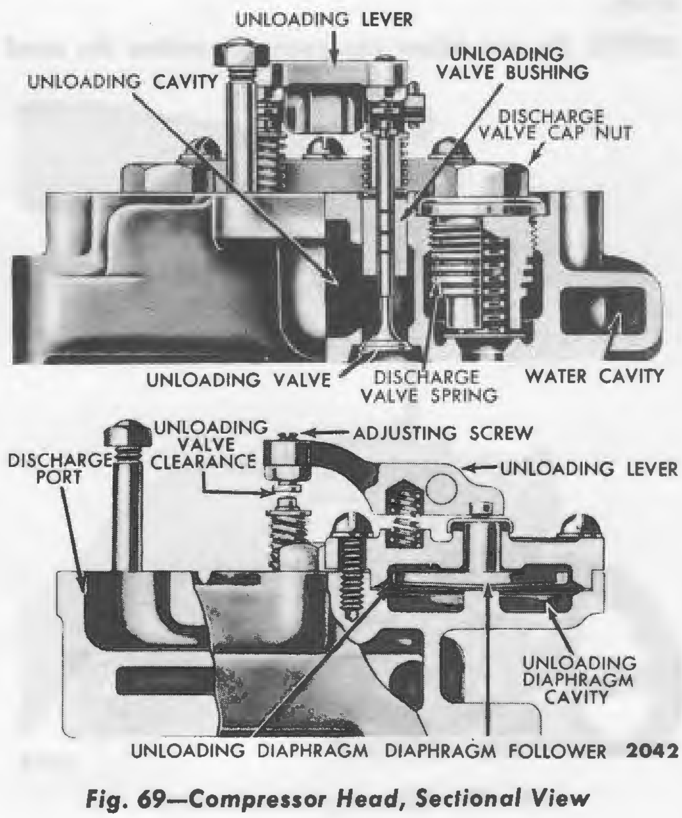


Fig. 69—Compressor Head, Sectional View

(2) *COMPRESSOR DRIVE BELT.* Loosen the compressor and slide the compressor away from the fan until ½ inch belt deflection is established. Tighten the compressor mounting bolts. Since no guide is provided for the compressor location, caution should be taken to assure good alignment of the compressor and the fan pulley.

(3) *UNLOADING VALVE CLEARANCE.* The unloading valve must have a clearance of 0.010 to 0.015 inch between the valve stem and the rocker arm.

To adjust the clearance, loosen the adjusting screw lock nut (see fig. 70), and turn the adjusting screw out to increase the clearance, or in to decrease the clearance. When the correct clearance of 0.010 to 0.015 inch is established, tighten the adjusting screw lock nut. Then recheck the gap. This adjustment must be made with valves in cut-in (compressing) position.

(4) *GOVERNOR.* To adjust the governor (fig. 54), remove the cover and loosen the adjustment screw lock nut. Turn the adjustment nut clockwise to raise the cut-in pressure and counterclockwise to lower the pressure, then tighten the lock nut.

To increase the air pressure range, remove the adjusting screw bracket from the tube and the upper valve guide from the governor body. Remove one or more shims from underneath the valve guide until an air pressure range from 15 to 20 pounds is obtained. Install the valve, valve guide, and adjusting screw bracket. Check for leakage at the exhaust port with the governor in both the cut-in and cut-out positions, and install the cover.

NOTE: ***Do not adjust the governor unless the need for adjustment is first confirmed by a check with an accurate master air pressure test gauge.***

(5) *AIR RESERVOIR SAFETY VALVE.* To set the safety valve, loosen the lock nut, and turn the screw clockwise to increase the pressure setting, or counterclockwise to decrease the pressure setting. The valve should be set to relieve pressure at 150 p.s.i. Tighten the lock nut after making the proper adjustment.

(6) *BRAKE PEDAL STOP.* Connect a master air pressure gauge in the air line that goes from the brake valve to the brake chamber. Operate the engine with the compressor cut-in until full reservoir pressure is obtained. Place a 0.109-inch thickness gauge between the brake valve actuating arm roller and the cap, and adjust the brake valve adjusting screw until the valve delivers two to seven pounds air pressure. Remove the thickness gauge and make sure there is zero clearance between the brake valve roller and cap. Adjust the connecting rod (fig. 71) to six inches in length, then adjust the pedal stop so that it stops the pedal travel with brakes applied after the brake valve delivers full reservoir pressure to the brake chambers. Remove the master gauge.

d. Serviceability Test.

If the air brake system is not functioning properly, the following serviceability tests will help localize the cause of the malfunction.

(1) *DRAIN RESERVOIRS.* With the air brake system charged, open the drain cocks in each reservoir. Close the drain cocks after all moisture is drained from the reservoirs.

(2) *CHECK STOP LIGHT SWITCH.* With all air pressure exhausted from the air brake system, start the engine and move the brake valve to applied position. Observe the pressure registered by the dash gauge when the stop light lights. Stop lights should light before the dash gauge registers 10 pounds pressure. Release the brakes.

(3) *PRESSURE BUILD-UP TEST.* With the engine

Fig. 70—Adjusting Unloader Valve

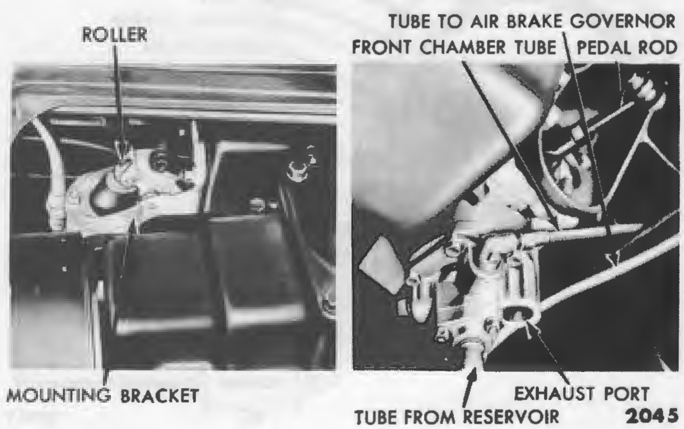


Fig. 71—Foot Brake Control Valve Installation

running at fast idle speed, observe the time required to raise the pressure in the air brake system from 50 to 90 pounds. This should not take longer than five minutes.

(4) *GOVERNOR SETTING TEST.* With the engine still running, observe the dash gauge pressure at which the governor cuts out, stopping any further compression. The governor should cut out between 100 and 105 pounds pressure. Slowly reduce the pressure in the brake system by making a series of brake applications and observe registered pressure at which the governor cuts in and compression is resumed. The governor should cut in between 80 and 85 pounds dash gauge pressure. Do not adjust the governor unless the need for adjustment is confirmed by checking its settings with an accurate master air pressure test gauge as the trouble may be in the gauge unit on the dash.

(5) *LEAKAGE TEST.* With the engine stopped and the brakes released, observe the rate of drop in air pressure registered by the dash gauge. The rate of drop should not exceed two pounds per minute. With the brakes fully applied, the rate of drop should not exceed three pounds per minute.

If leakage in either of the above tests is excessive, check all of the units and connections for air leakage.

(a) COMPRESSOR. With the engine stopped, discharge valve leakage can be detected by carefully listening at the compressor for the sound of escaping air. Coat the compressor and unloading box cover with soap suds (with the governor cut out) to check for leakage past the unloading diaphragms. Leakage of a 1-inch soap bubble in three seconds is permissible.

(b) GOVERNOR. Remove the cover, and with the governor in its cut-out position, test for leakage by applying soap suds to the exhaust port. Repeat the test with the governor in its cut-in position. Leakage which causes a 1-inch soap bubble in three seconds is permissible in either test.

(c) BRAKE VALVE. With the pedal fully released coat the exhaust port with soap suds to check for leakage. With the pedal fully applied, coat the exhaust port with soap suds to check for leakage. Leakage causing a 1-inch soap bubble in one second is permissible.

(d) SAFETY VALVE. Coat the end of the safety valve with soap suds. Leakage causing a 3-inch soap bubble in three seconds is permissible.

(e) BRAKE CHAMBERS. With the brakes fully applied, coat the bolt and flanges holding the diaphragm in place with soap suds and coat the rubber boot with soap suds. No leakage is permissible.

e. Repair.

The repair procedures given cover only the units or parts which are available for service from the Ford Division.

When brakes are serviced, it is very important that the brakes remain in a balanced condition. It is advisable to replace brake lining on both ends of the axle at the same time when it is necessary to replace the lining on one end. Always replace brake chamber diaphragms in pairs, and lubricate cam surfaces and other brake parts all around the vehicle. Make sure that the brake chamber and brake shoe return springs are of equal strength.

(1) *COMPRESSOR.* To remove the compressor, drain the cooling system, and open the drain cock at the air reservoir. Disconnect the water tubes and the air lines at the compressor. Remove the compressor mounting bolts, disconnect the drive belt, and remove the compressor.

To install the compressor, position the compressor on the mounting bracket. Install the mounting nuts, bolts and washers, but do not tighten the bolts. Install the compressor drive belt, and adjust the belt tension. Be sure the compressor pulley is aligned with the pulley on the fan. Connect the air and water lines to the compressor. Fill the cooling system, and close the drain cock on the air reservoir. Check the compressor oil level.

(2) *GOVERNOR.* Open the drain cock at the air reservoir. Disconnect the air lines at the governor, and remove the governor.

Position the governor on the dash, and tighten the mounting bolts. Connect the air lines to the governor, and close the drain cock at the air reservoir. Test the governor for serviceability.

(3) *FRONT BRAKE SHOE AND CAMSHAFT.* To remove the brake shoes (fig. 72) remove the wheel, hub, and drum assembly. Then remove the brake shoe retracting spring from the brake shoes and the lock washer and retainer from each anchor pin. Slide the brake shoes off the anchor pins.

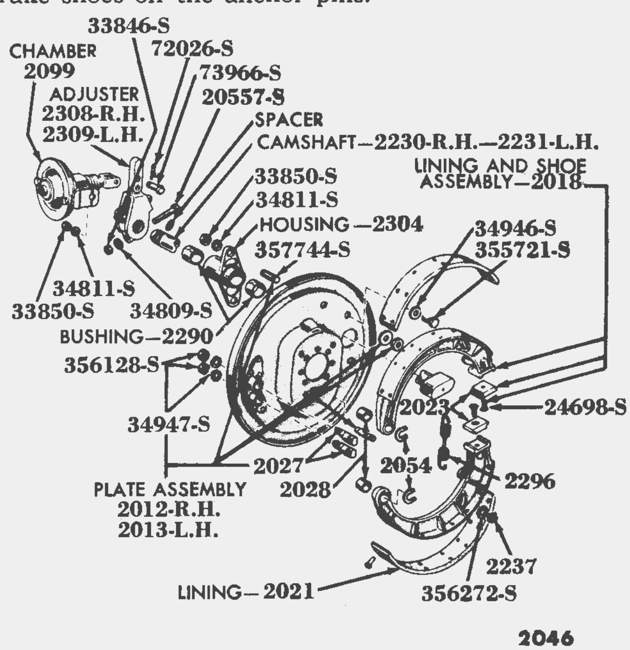


Fig. 72—Front Brake, Disassembled

Mark the position of the slack adjuster on the camshaft, then disconnect and remove the slack adjuster from the camshaft. Pull the camshaft out of the brake support plate. Check the anchor pins and the bushings for wear, and replace if required. Inspect the camshaft bushing. Replace if worn or distorted. Check the brake shoe return spring tension, and replace if required. Measure the thickness of the brake lining at the center of the shoe, and replace, if required.

To replace the brake shoe bushing, drive the worn bushing out of the brake shoes. Press the new bushing into place, and ream the new bushing to size.

To install the camshaft, slide it into position, install the brake shoes, and tighten the anchor pin lock nuts. Then install the slack adjuster, lining up the marks, and connect the chamber clevis with the pin in the upper hole of the slack adjuster. Install the wheels.

(4) *REAR BRAKE SHOES AND CAMSHAFT.* Remove the rear axle shaft, wheel, and hub. Remove the dust shield and the cap screw holding the anchor pin locking plate. Drive the anchor pin out of the shoe assemblies. Then remove the brake shoe return springs, and lift the shoes out of the brake spider (fig. 73).

To remove the camshaft shown in fig. 74, mark the position of the adjuster on the camshaft, then remove the slack adjuster. Remove the camshaft set screw lock wire, and loosen the set screw. Remove the collar, and pull the camshaft out of the brake spider (fig. 75).

To install the camshaft, slide the camshaft into position in the brake spider. Install the slack adjuster lining up the locating marks. Place the collar on the camshaft and lock the camshaft in position by tightening the collar set screw.

Lubricate the anchor pins, cams, and brake shoe plates. Position the shoes on the spider, and install the anchor pins. Lock the pins in position with the lock plate and

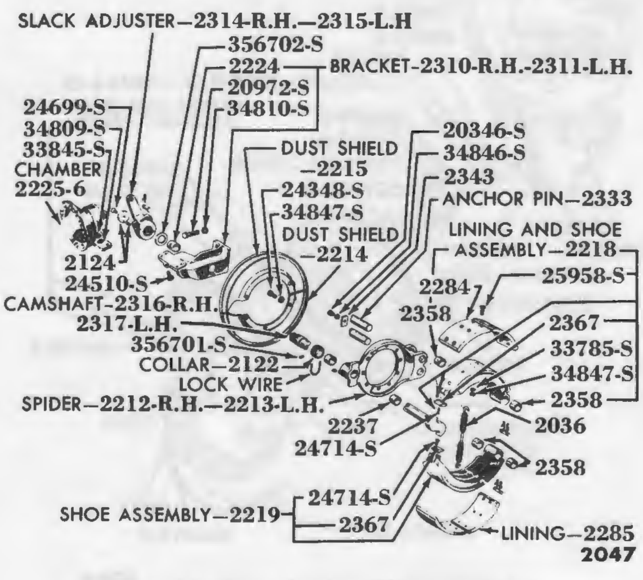


Fig. 73—Rear Brake, Disassembled

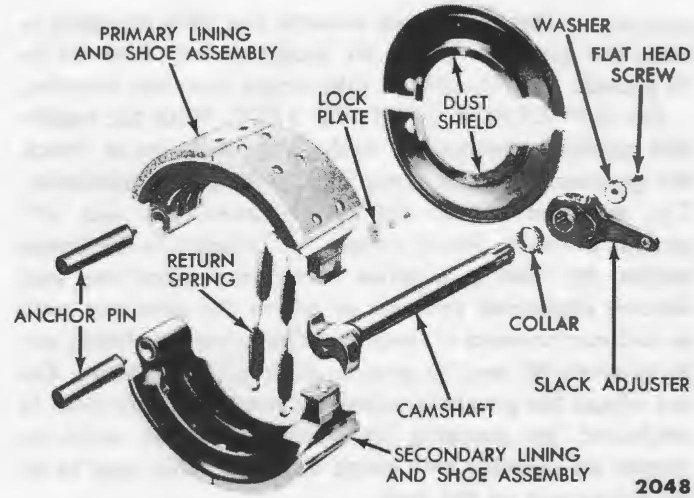


Fig. 74—Rear Brake Shoes and Camshaft Removed from Spider

screw. Install the brake shoe return springs. Install the dust cover, wheel, hub, and axle.

(5) *SLACK ADJUSTER.* Remove the clevis pin attaching the slack adjuster to the brake chamber push rod. Remove the bolt (front) or screw and the dowelled washer (rear) attaching the slack adjuster to the camshaft. Slide the slack adjuster off the shaft.

NOTE: ***To remove the left rear slack adjuster, loosen the lock collar and move the camshaft toward the brake shoe about one inch so the slack adjuster will clear the differential housing when it is removed from the camshaft.***

Place the slack adjuster on the camshaft, and secure with the dowelled washer and screw (rear) or bolt (front).

NOTE: ***On late models, the slack adjuster is retained on the camshaft by a snap ring.***

Connect the brake chamber push rod to the slack adjuster with the clevis pin and the cotter pin. Lubricate the slack adjuster, and adjust the brakes. Screws retaining the rear slack adjuster should be staked to prevent loosening.

NOTE: ***On the left rear adjuster, be sure to lock the camshaft collar in the correct position.***

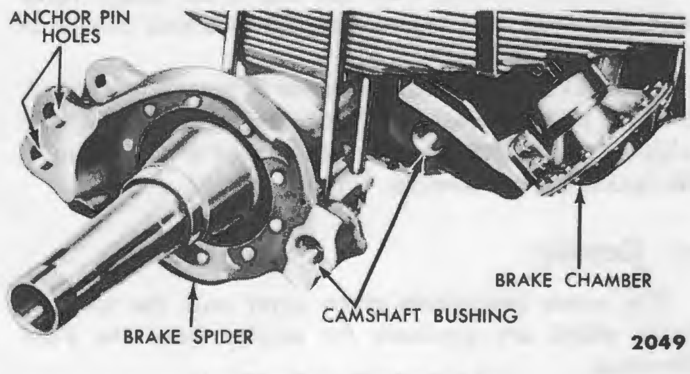


Fig. 75—Rear Brake Spider

(6) *FOOT CONTROL VALVE.* Remove the brake valve assembly from the vehicle. Mark the position of the lower body to the upper body and the mounting bracket to the upper body. Notice the position of at least one long cap screw. Remove the mounting bracket and the actuating arm. Remove the upper body and lower body. Remove the rubber boot. Lift out the diaphragm and spring assembly. Loosen the cap from the spring cage by clamping the spring cage hex nut.

NOTE: ***Do not score or damage the spring cage.***

Remove the spring cage cap. Hold the plunger with a rod through the exhaust hole in the plunger, then loosen the nut. Use caution in removing the shims, and be sure to use the same shims when the unit is assembled. Remove the lock ring, then remove the diaphragm assembly.

To assemble the unit (fig. 76) position a new grommet on the plunger assembly. Slide the diaphragm on the plunger, and secure with the lock ring. Position the large shims, spring, small shims, and spring cage. Use a punch to hold the unit and tighten the nut, then stake the nut securely. Screw in the spring cage cap and install the rubber boot. Position the upper body on the body, install the bolts in their proper locations and tighten the nuts. Install the mounting bracket and tighten the nuts. Install the assembly on the vehicle.

(7) *BRAKE CHAMBER.* Bleed all air from the system, then disconnect the air line. Disconnect the push rod yokes from the slack adjuster. Remove the mounting nuts and the brake chamber assembly (fig. 77).

Position the air brake chamber assembly on the mounting bracket, secure with the yoke pin and cotter pin, then connect the air line to the assembly. Adjust the brakes.

(8) *BRAKE CHAMBER DIAPHRAGM.* Before disassembling the brake chamber, be sure to mark the pressure plate and the non-pressure plate so the air inlet opening will be at the correct angle when the brake chamber is reassembled.

NOTE: ***The diaphragm can be removed from the chamber without removing it from the truck.***

Remove all bolts and nuts clamping the outer edges of the diaphragm between the two plates.

NOTE: ***On the rear chambers be sure to mark the location of the three tapped holes. The coarse thread tap screws are used in those holes.***

Remove the diaphragm. Position a new diaphragm in the pressure plate with the edge of the diaphragm inside the cupped flange of the pressure plate. Position the pressure plate and diaphragm on the non-pressure plate, being sure the air inlet opening in the pressure plate is in the proper location, as previously marked. Install the nuts and bolts. Tighten the nuts just enough to ensure

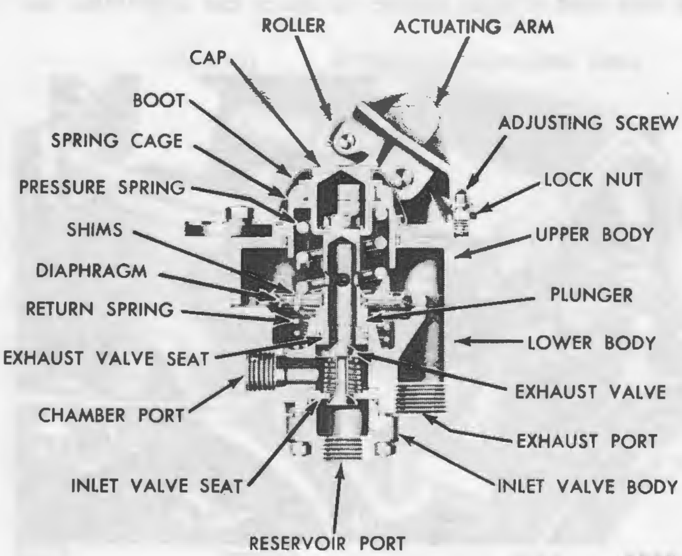


Fig. 76—Control Valve Sectional View

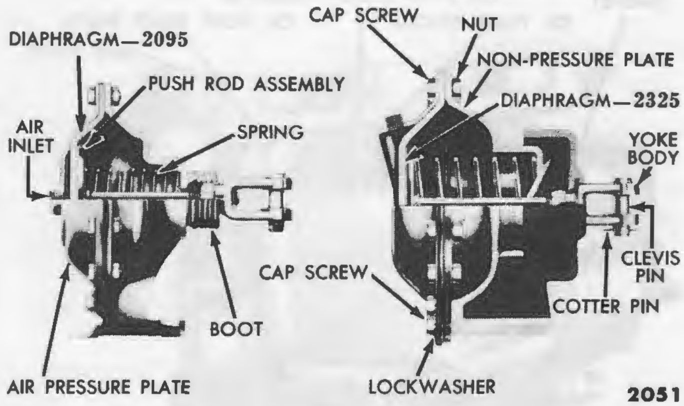


Fig. 77—Brake Chamber Assemblies

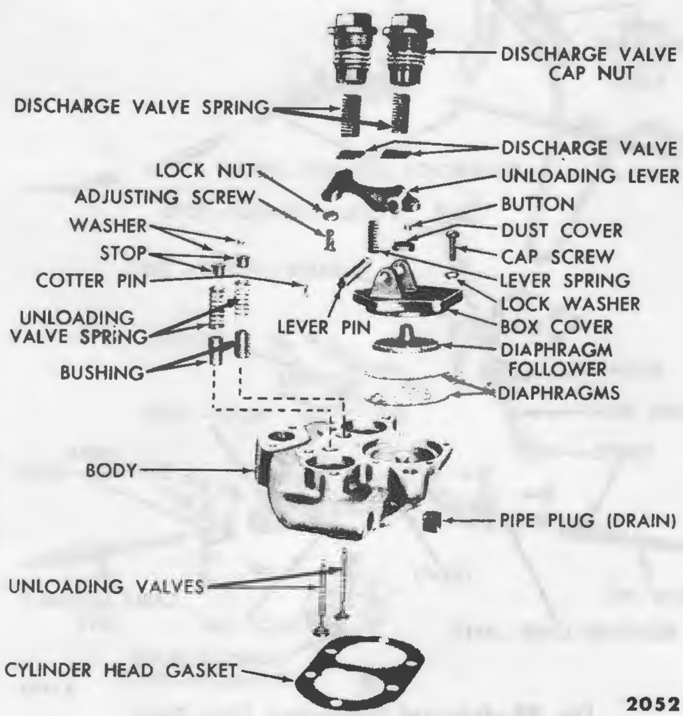


Fig 78—Cylinder Head Disassembled

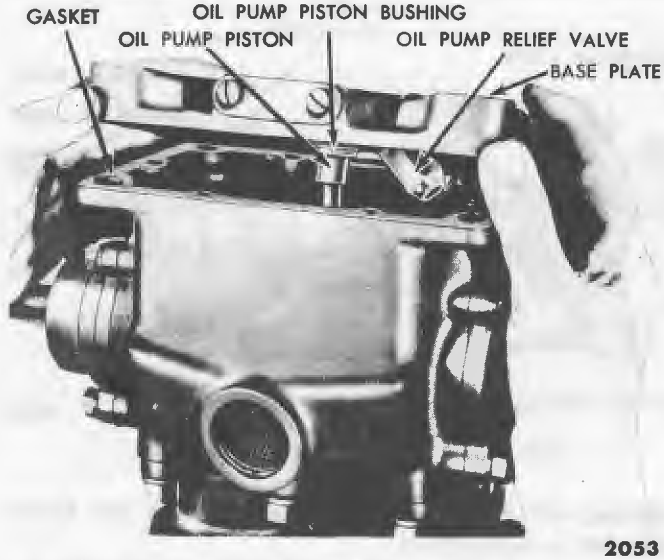


Fig. 79—Installing Base Plate on Compressor

an air-tight seal without distorting the diaphragm.

(9) *CYLINDER HEAD*. Remove the cylinder head from the compressor block. In some instances it may be necessary to tap the cylinder head lightly with a rawhide hammer to break the gasket joint. Scrape the cylinder head gasket off the cylinder head and block. Remove the cotter pins from the unloading lever. Drive out the unloading lever pin and remove the unloading lever, spring, and dust guard. Remove the machine screws attaching

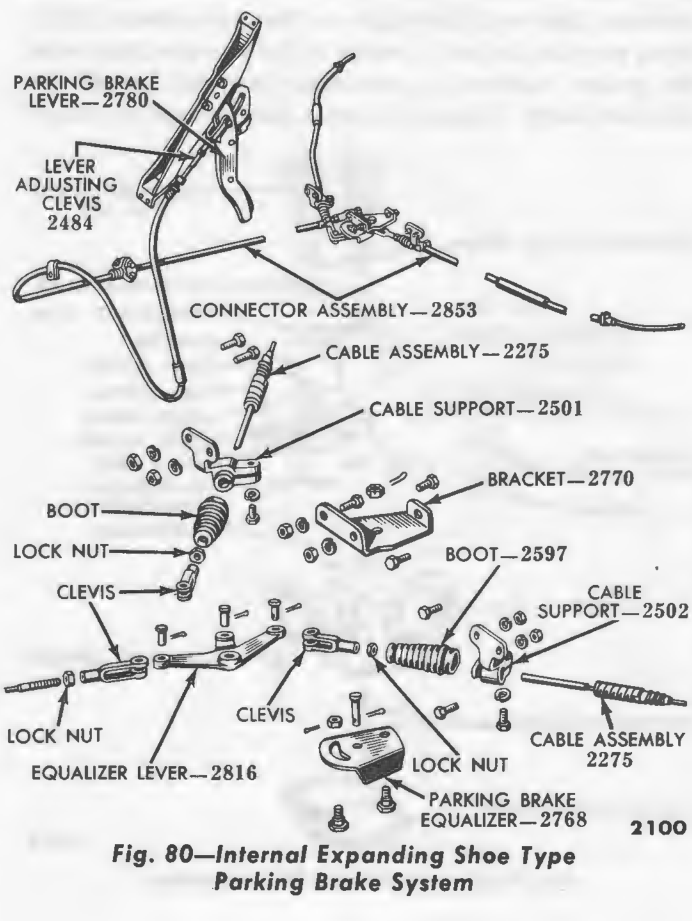


Fig. 80—Internal Expanding Shoe Type Parking Brake System

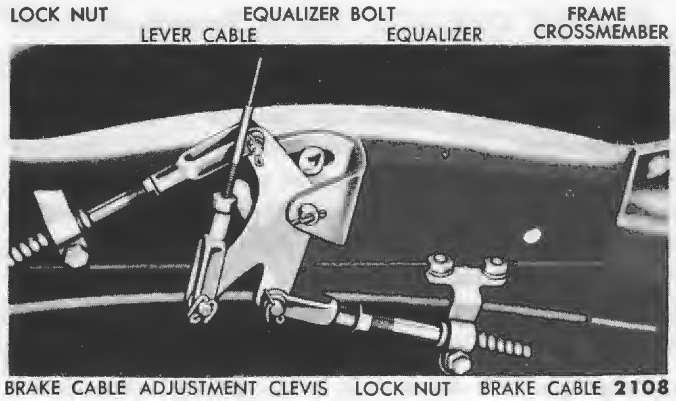


Fig. 81—Hand Brake Equalizers

the unloading box cover to the cylinder head. Lift the box cover, then remove the diaphragm follower and the two diaphragms. Remove the discharge valve cap nuts and lift out the discharge valve springs and discharge valves.

Compress the unloading valve springs by hand, and remove the spring retaining rings. Remove the unloading valve stops and unloading valve springs. Remove the unloading valves by pushing them out the bottom of the cylinder head body.

To assemble the cylinder head (fig. 78) insert each unloading valve into the cylinder head from the bottom side, and hold in position with wooden blocks. Install the unloading valve springs and place a stop on each spring. Compress each spring by hand and insert a retainer washer over the stop. Position each discharge valve spring and discharge valve cap over the discharge valve (fig. 78). Tighten each nut.

To install the unloading diaphragms, position the two unloading diaphragms in the opening in the top of the cylinder head body after lubricating the diaphragms with a thin coat of light engine oil. Place the diaphragm fol-

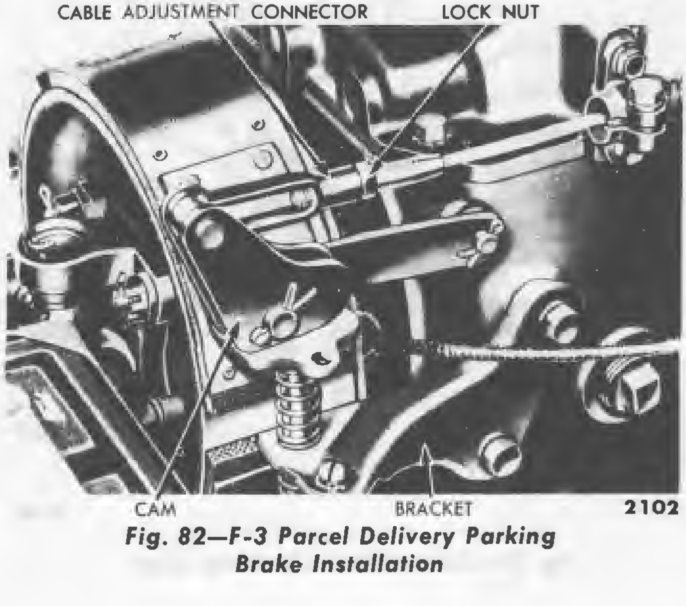


Fig. 82—F-3 Parcel Delivery Parking Brake Installation

lower in position on the diaphragms with the post upward. Place the unloading box cover in position over the diaphragm follower post. Attach the unloading box cover to the cylinder head body with the machine screw and lock washers. Tighten all machine screws gradually and evenly.

Check for leakage past the unloading diaphragms by applying 100 pounds air pressure through the unloading diaphragm cavity port, and applying soap suds all over the unloading box cover. Leakage in excess of a 1-inch soap bubble in three seconds is not permissible.

Install a new cylinder head gasket so that the cutaway portion of the gasket will line up with the unloading valves with the cylinder head in position.

NOTE: ***Do not use sealing compound when installing a head gasket.***

Position the cylinder head on the cylinder block, and tighten the nuts on the cylinder head studs.

(10) *OIL PUMP RELIEF VALVE.* Remove the base plate, and unscrew the oil pump relief valve.

Install the new oil pump relief valve in the compressor base plate and tighten securely. Position the oil pump screen in the base plate and install the retaining ring. Install a new oil pump check valve gasket in the bottom of the crankcase, and position a new base plate gasket in the bottom of the crankcase. Position the base plate

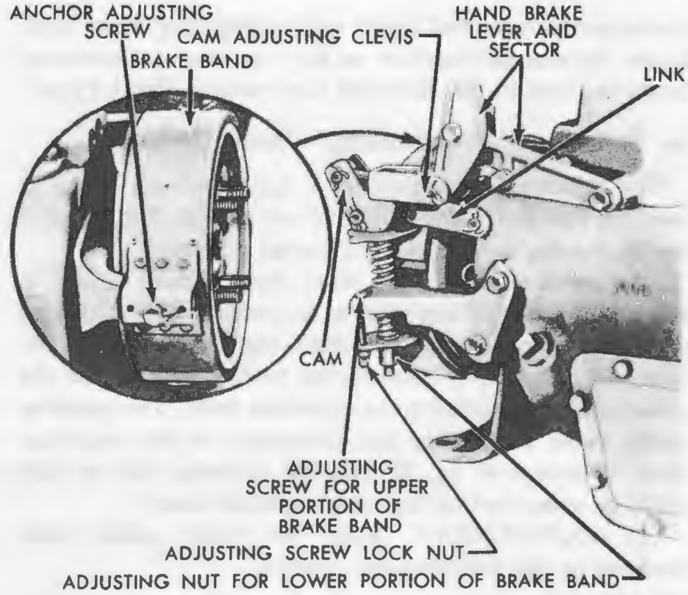


Fig. 84—Adjusting External Contracting Type Brake Band

assembly on the bottom of the crankcase (fig. 79), being sure the oil pump piston engages the oil pump bushing in the base plate, and install the dowel screw at the end of the base plate. Install the remaining attaching screws and tighten securely.

8. PARKING BRAKES

Two types of parking brakes are used on Ford trucks. The F-1 and the 1949, 1950 and early 1951 F-2 and F-3 trucks except the F-3 parcel delivery are equipped with a rear wheel, cable controlled, internal expanding type brake (same shoes are used for the service brakes). Service information on the internal expanding type brake is given under "**a.** Internal Expanding Shoe Type."

The late 1951 F-2 and F-3 and the F-3 parcel delivery and F-4 through F-8 model trucks are equipped with a

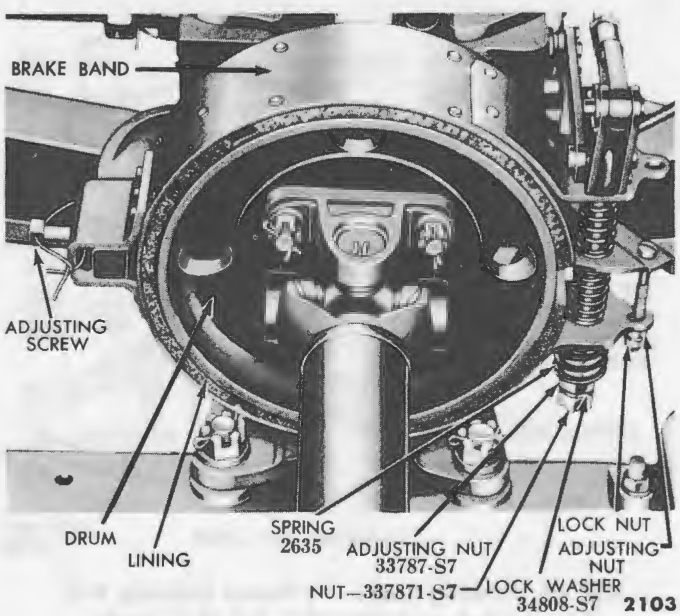


Fig. 83—External Contracting Type Parking Brake Band and Drum

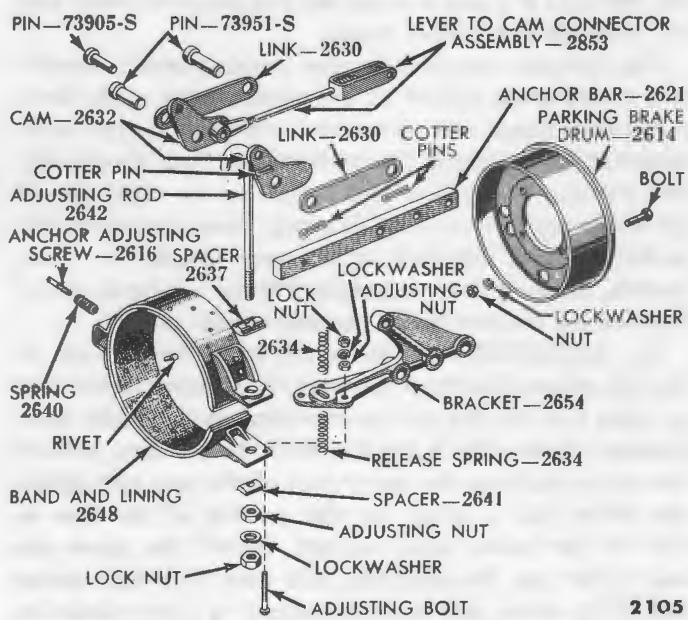


Figure 85—Parking Brake F-7 and F-8 Trucks

transmission mounted drum and contracting band type brake. Service information on the transmission mounted brake is given in "b. External Contracting Band Type."

a. Internal Expanding Shoe Type.

The internal expanding shoe type parking brake is used on F-1 and 1940, 1950 and early 1951 F-2 and F-3 model trucks, except the F-3 parcel delivery.

The internal expanding shoe type parking brake is actuated by a hand brake lever mounted on the left-hand side of the steering column below the instrument panel. One end of a cable is connected to the handle and the other end is connected to an equalizer lever. Two parking brake cable assemblies are connected to the equalizer lever as shown in fig. 80 and the opposite end of each cable is connected to the parking brake lever.

(1) *ADJUSTMENT*. Push the hand brake lever forward to the full released position.

NOTE: ***Adjust the service brakes before attempting to adjust the hand brake.***

Apply just enough pressure to the brake pedal to position the rear brake shoes firmly against the brake drums. With the shoes contacting the brake drums, adjust each rear brake cable until the excess slack is removed from the cable (fig. 81). Check the brakes to make sure they are not dragging. With the hand brake lever applied, adjust the cables so that the bolt will be in the center of the equalizer slot. Adjust the hand lever to equalizer cable so that, with the foot brake applied, ½ inch movement of the hand brake lever is possible before all of the slack in the cables is removed.

b. External Expanding Band Type.

The contracting band type parking brake is used on the late 1951 F-2 and F-3 and the F-3 parcel delivery and F-4 through F-8 model trucks.

The external contracting type parking brake consists of a brake drum bolted to the transmission main shaft companion flange and an external contracting type band mounted on the rear of the transmission (figs. 82 and 83). The parking brake lever is mounted on the right side of the transmission on all models except those equipped with parking brakes installed on the rear drums. On these models, the hand lever is mounted at the left-hand side of the steering column under the instrument panel.

(1) *ADJUSTMENT*. Move the hand brake lever to the full released position. Observe the position of the cam to make sure the flat portion is resting on the brake band bracket. If the cam is not flat with the bracket, remove the clevis pin from the upper part of the cam and adjust the clevis rod to allow the flat portion of the cam to rest on the brake band bracket. Install the clevis pin and cotter pin. Remove the lock wire from the anchor adjusting screw, and turn the adjusting screw clockwise until a clearance of 0.010 inch is established between the brake lining and the brake drum at the anchor bracket. Loosen the lock nut on the adjusting screw for the lower half of the brake band, and adjust the screw to establish a 0.010 inch clearance between the lining and the brake drum at the lower half of the brake band (fig. 84). Tighten the lock nut. Turn the upper band adjusting rod nut until a 0.010 inch clearance is established between the upper half of the band and the drum. Be sure to install the lock wire in the anchor adjusting screw.

(2) *BRAKE BAND REMOVAL*. Release the parking brake, then remove the floor pan. Remove the adjusting rod clevis pin (figs. 85 and 86). Remove the parking brake band adjusting rod and the adjusting bolt. Remove the anchor clip adjusting screw. Slide the brake band and lining assembly off the brake drum. Pull the brake band and lining assembly off over the propeller shaft.

(3) *INSPECTION AND RELINING*. Inspect the drum braking surface for roughness or scoring. Replace the drum if it is worn or damaged. Inspect the brake lining and replace it if the distance between the lining braking surface and the heads of the rivets is less than 1⁄32 inch.

When relining a parking brake band, follow the same procedures used for relining the service brakes.

(4) *BRAKE BAND INSTALLATION*. Position the brake band and lining assembly on the brake drum (figs. 85 and 86). Install the anchor clip adjusting spring and screw. Install the parking brake band adjusting bolt and the adjusting rod. Install the adjusting rod clevis pin then install the floor pan. Adjust the parking brake.

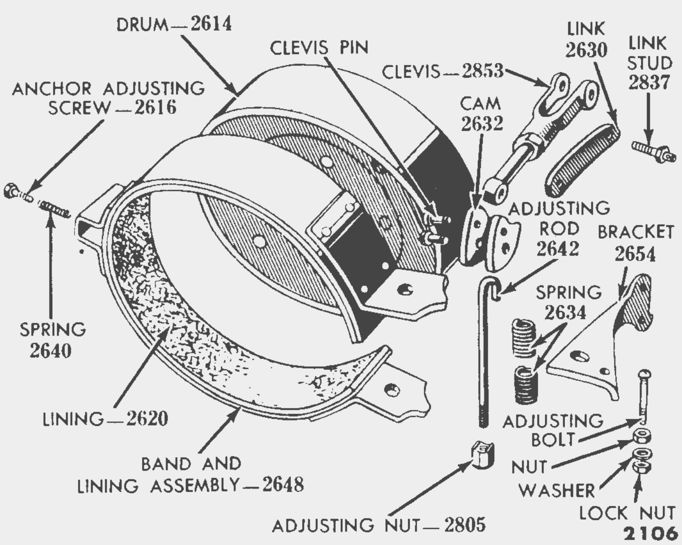


Fig. 86—Parking Brake F-3 Parcel Delivery F-4, F5, and F-6 and Late 1951 F-2, F-3 Trucks

Part THREE

ELECTRICAL AND ACCESSORIES

Chapter

I

Electrical Systems

Information on tests, adjustments, and repair of units in the electrical system are contained in this Chapter. The Chapter is divided into five sections arranged as shown above, covering the "sub-systems," to help you in locating the information you want.

Specifications on electrical units will be presented throughout the write-up in this Chapter to give you the information as it is required. They will also be found in Part FIVE of the manual for ready reference when you are only in need of specifications on electrical units.

1. GENERATING SYSTEM AND BATTERY

A schematic wiring diagram (fig. 1) of the generating circuit shows the internal connections and windings of the various units. Color codes are shown to aid in tracing the circuit. Wire sizes are given as a guide for replacing any of the wires in the circuit. Fig. 2 presents a pictorial diagram of the generating circuit showing the physical location of the generating system units and connecting wires in the vehicle. The standard truck generating system is shown and is typical of other installations.

The generator and generator regulator are precision built units and the equipment to make tests in the generating system must be accurate. Voltmeters must be accurate within 0.05 (½ of one tenth) volt within the range of 6 to 7 volts and ammeters within one ampere at 30 to 35 amperes to permit correct settings of the regulator. The meters on Ford approved equipment should be calibrated once a year and the date of calibration stamped on the meter face. It is recommended that this practice be followed by operators with other than approved equipment to maintain their meters at acceptable accuracy.

Certain tests outlined in this section are illustrated in schematic and in pictorial form. The schematic illustrates the internal connections of the Ford Diagnosis Test Set so these connections can be duplicated when this equipment is not available (compare figs. 21 and 22, for example). The Ford Diagnosis Test Set is a combination of accepted instruments incorporated into a single machine. The various circuits involved in the tests can be selected by means of switches without the necessity of changing connections. As a result, the time required to test units and circuits on the vehicle is reduced in many cases by as much as 50%.

Where applicable, the tests are divided into "on the vehicle" and "on the test bench" procedures. Either procedure can be followed depending on the equipment available for the tests.

a. Generator.

Ford generators are shunt (parallel) wound, two brush, high output generators. The generating system is a positive (+) ground system. Generator output is controlled by means of a regulator connected between the armature and field and the field is grounded internally (fig. 1).

The generator mounted on both the 6-cylinder engine and on the 8-cylinder engine is shown in fig. 3.

(1) *GENERATOR TESTS.* Four generator test procedures are outlined here: "(a) Generator Output Test"

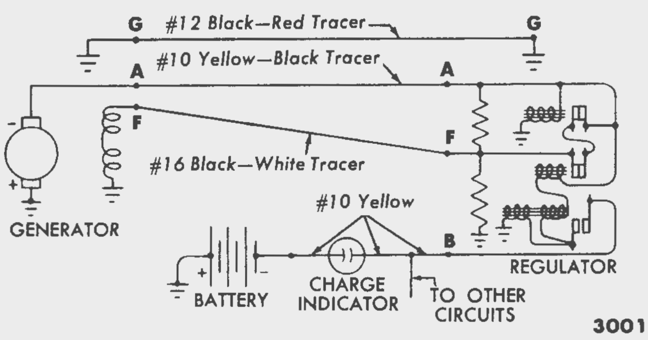


Fig. 1—Generating System Circuit (Schematic)

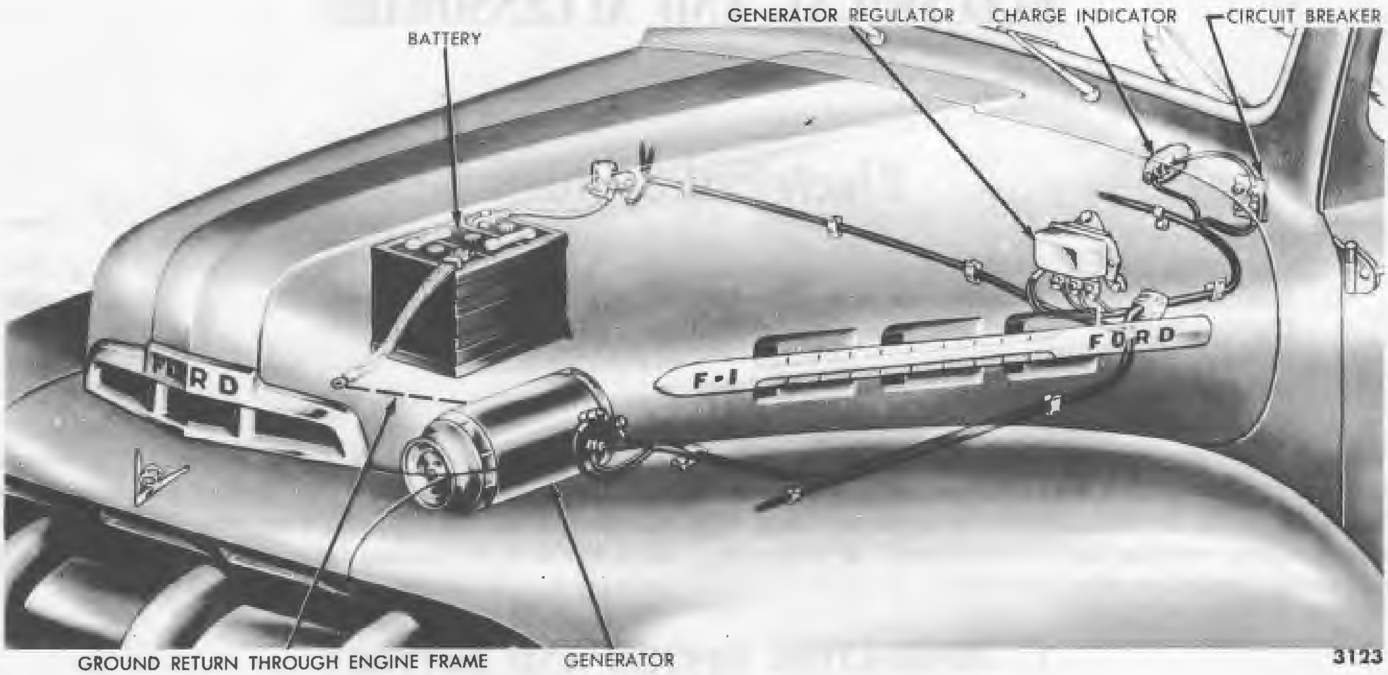


Fig. 2—Generating System Circuit (Pictorial)

illustrated in figs. 4, 5, and 6, "(b) Armature and Field Open Circuit Test" illustrated in figs 7 and 8, "(c) Armature and Field Grounded Circuit Test" (figs. 9 and 10) and "(d) Armature Short Circuit Test" (fig. 11).

The equipment involved in these tests is listed below:

0-5, 0-50, 0-100 } ammeter
0-9 voltmeter
"Growler" tester

Storage Battery and assorted connecting wires and jumper wires equipped with suitable connectors.

The voltmeter and ammeter are included as part of the Diagnosis Test Set. The meter range of voltage or current can be changed by means of selector switches.

If the Ford Generator and Regulator Test Bench is available, the generator tests can be made with this equipment. The generator is mounted on a bench and driven by a constant speed motor. The test connections and meters are located convenient to the operator.

(a) GENERATOR OUTPUT TEST. The procedure for testing generator output on the engine is slightly different than the procedure used when the test is made on the test bench. If a generator and regulator test bench, fig. 6, is available, test the generator output as outlined in *(2)* "Test Bench." To test the output of the generator on the vehicle proceed as follows (see figs. 4 or 5).

(1) ON THE ENGINE. Disconnect the regulator "ARM" and "FIELD" wires. Connect a jumper wire from the generator "ARM" terminal to the generator "FIELD" terminal and the negative lead of a 0-50 ammeter to the generator "ARM" terminal. Start the engine and immediately connect the AMMETER positive lead to the battery. Run the engine at 1500 r.p.m. and read the current output on the ammeter. The generator output should reach or exceed 35 amperes (60 amperes on 8BA-10002-C generator).

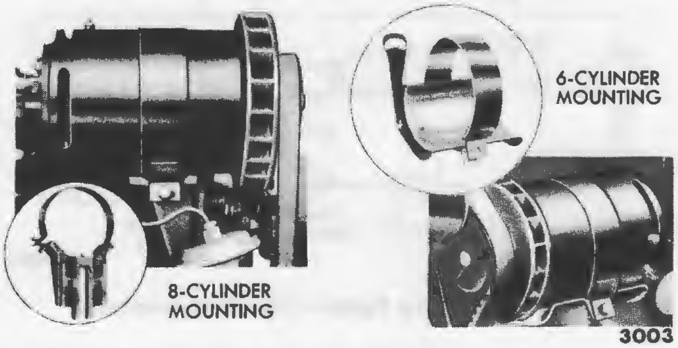


Fig. 3—Generator Mounted on 6- and 8-Cylinder Engines

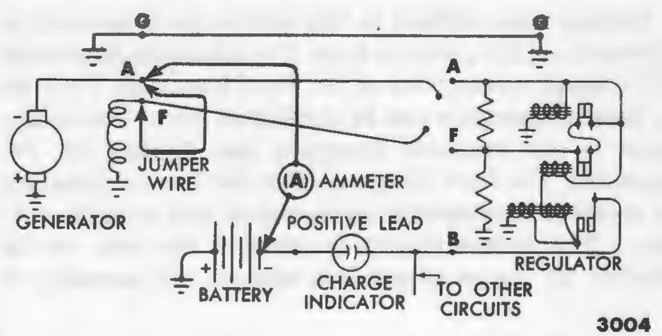


Fig. 4—Generator Output Test (Schematic Circuit)

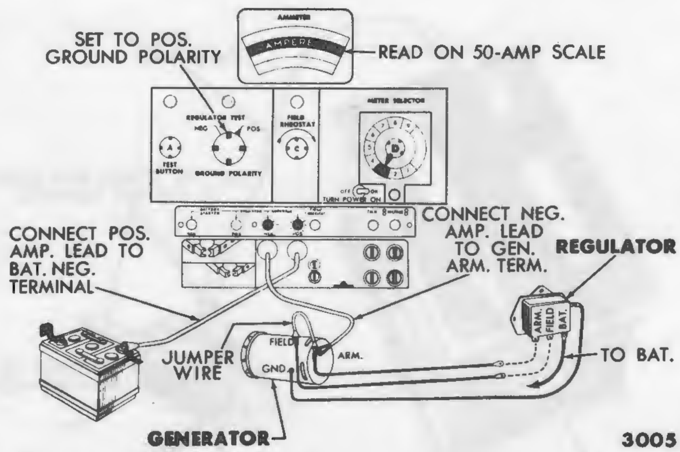


Fig. 5—Generator Output Test (Ford Diagnosis Test Set)

NOTE: ***Stop the engine and disconnect test leads as soon as the test is completed to prevent overheating the generator.***

(2) TEST BENCH. When the generator output test is performed on the test bench, a resistance built into the machine, is inserted in the field circuit to change output while the generator r.p.m. remains constant.

(b) ARMATURE AND FIELD OPEN CIRCUIT TEST. An open circuit in the armature can sometimes be detected by examining the commutator for evidence of burning. The spot burned on the commutator is caused by an arc formed every time the commutator segment connected to the open circuit passes under a brush.

An open circuit in the armature may be checked by means of a test light, one lead of which is held on one commutator segment while each of the other segments are touched with the other lead. If the test light fails to light, an open circuit exists.

An open circuit test of the field can be made on the

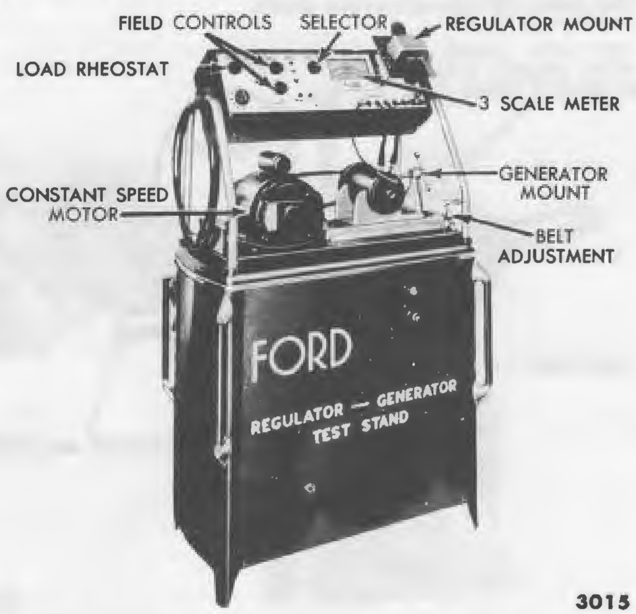


Fig. 6—Generator and Regulator Test Bench

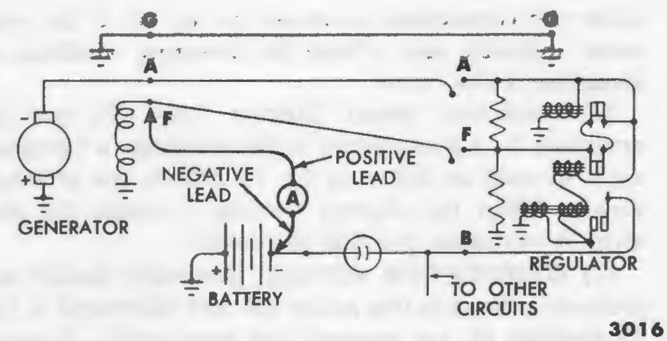


Fig. 7—Open Circuit Test of Field

vehicle as described below in "(1) Open Circuit Test of Field (On Vehicle)" or on the test bench as described in "(2) Open Circuit Test of Field (On Test Bench)."

(1) OPEN CIRCUIT TEST OF FIELD (ON VEHICLE). Disconnect the "FIELD" lead from the generator terminal. Connect a 0-5 ammeter from the battery to the "FIELD" terminal as shown in fig. 7. The normal current draw, as indicated by the ammeter, should be 1½ to 2½ amperes. If there is little or no current flow the field has a high resistance or is open.

(2) OPEN CIRCUIT TEST OF FIELD (ON TEST BENCH). The field circuit can be tested on the bench in the same manner as described in the "on vehicle" test above with the exception that a return lead must be used to connect the generator frame to the battery (fig. 8).

(c) ARMATURE AND FIELD GROUNDED CIRCUIT TEST (TEST BENCH ONLY). To test the field windings for a grounded circuit, remove the "GRD" terminal stud from the generator frame. Make the voltmeter and battery connections as shown in fig. 9. If the voltmeter indicates any voltage, the field coils are grounded.

NOTE: ***Be sure the "GRD" terminal stud is not touching the housing.***

To determine if the armature windings are grounded,

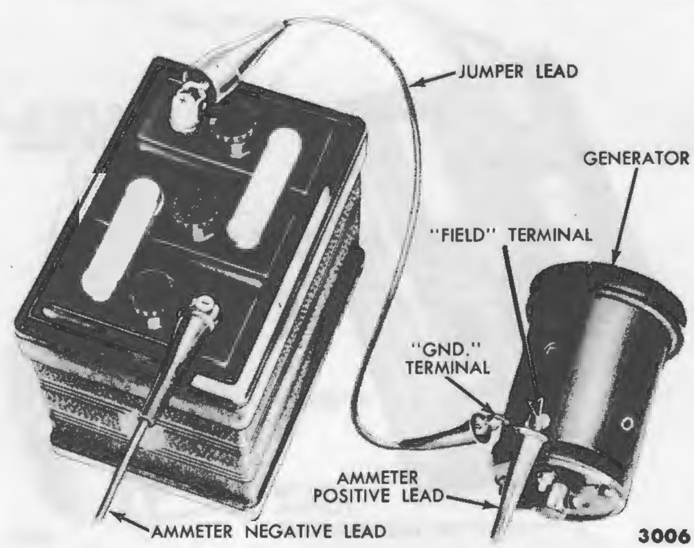


Fig. 8—Open Circuit Test of Field (on Bench)

make the connections as shown in fig. 10. If the voltmeter indicates any voltage the armature windings are grounded to the frame.

(d) ARMATURE SHORT CIRCUIT TEST. To test the armature for a short circuit in the windings, a "growler" must be used as shown in fig. 11. Rotate the armature slowly. When the shorted winding is under the steel strip, it will cause the strip to vibrate.

(2) *GENERATOR REPAIR*. Generator Repair procedures outlined in this paragraph and illustrated in figs. 12 through 18, are removal and installation, disassembly, commutator turning and undercutting, armature replacement, and brush replacement.

In many cases it will not be necessary to completely disassemble the generator to accomplish repair or replacement of certain parts. "(c) Armature Replacement," "(d) Commutator Turning and Undercutting" and "(e) Brush Replacement" are procedures which eliminate the steps in disassembly that do not apply to these particular operations.

(a) REMOVAL AND INSTALLATION. Disconnect the armature, field, and ground wires at the generator terminals. Remove the generator belt and the support band bolt and lockwasher. Remove the generator.

NOTE: ***While removing generator, observe which of the two locating holes in the generator frame is used to keep the generator pulley in alignment with the belt and other pulleys.***

To install the generator, first clean the mating surfaces of the mounting cradle, generator frame, and support band. Install the generator in the cradle. Be sure the correct locating hole is over the pin in the cradle so the generator pulley is aligned with the belt and other pulleys. Install the support band bolt with a lockwasher and tighten the bolt securely. Install the armature, field, and ground leads on the generator terminals.

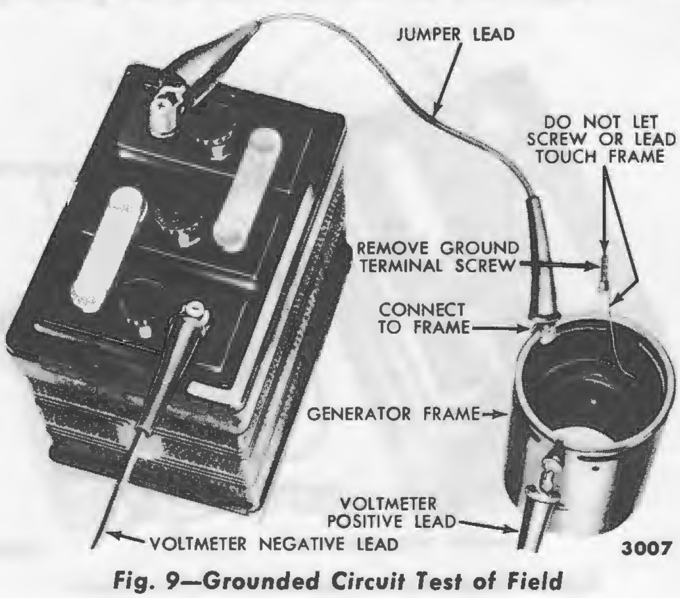


Fig. 9—Grounded Circuit Test of Field

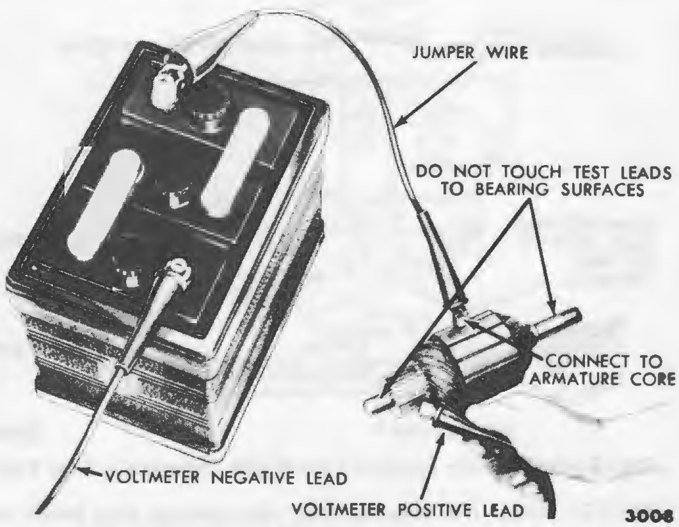


Fig. 10—Grounded Circuit Armature Test

Install the generator belt and adjust the belt tension.

(b) COMPLETE DISASSEMBLY. Use the procedure outlined below when it is necessary to completely disassemble a generator for such purposes as drive end bearing replacement and field coil replacement.

Fig. 12 illustrates the generator completely disassembled. Part names and numbers are included to aid you if it is necessary to make replacements. Only the basic part number is used; when ordering parts refer to your parts book for the necessary prefix and suffix.

(1) DISASSEMBLY. Remove the two generator through bolts and the brush end plate. Slide the armature assembly out the other end of the frame. Do not lose the locating dowels if they drop out of the end plates. Clamp the armature in a vise equipped with soft jaws and remove the retaining nut, lockwasher, pulley, and woodruff key from the armature shaft. Slide the front end plate off the armature shaft.

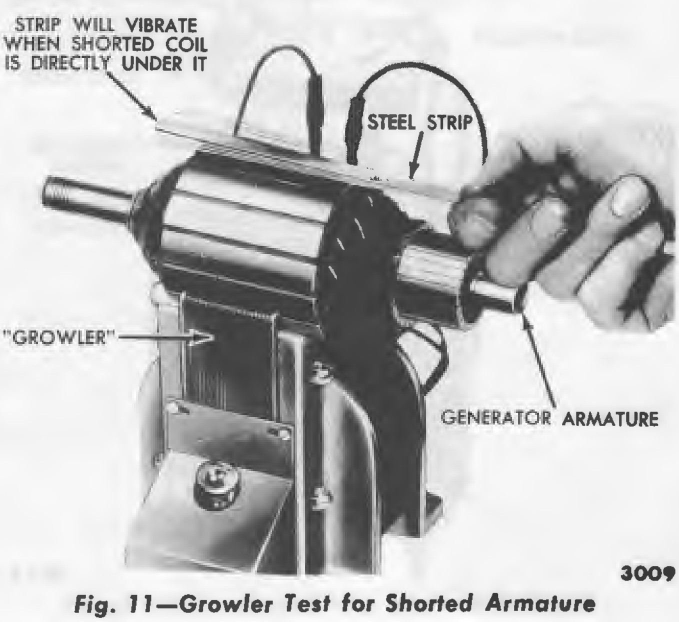


Fig. 11—Growler Test for Shorted Armature

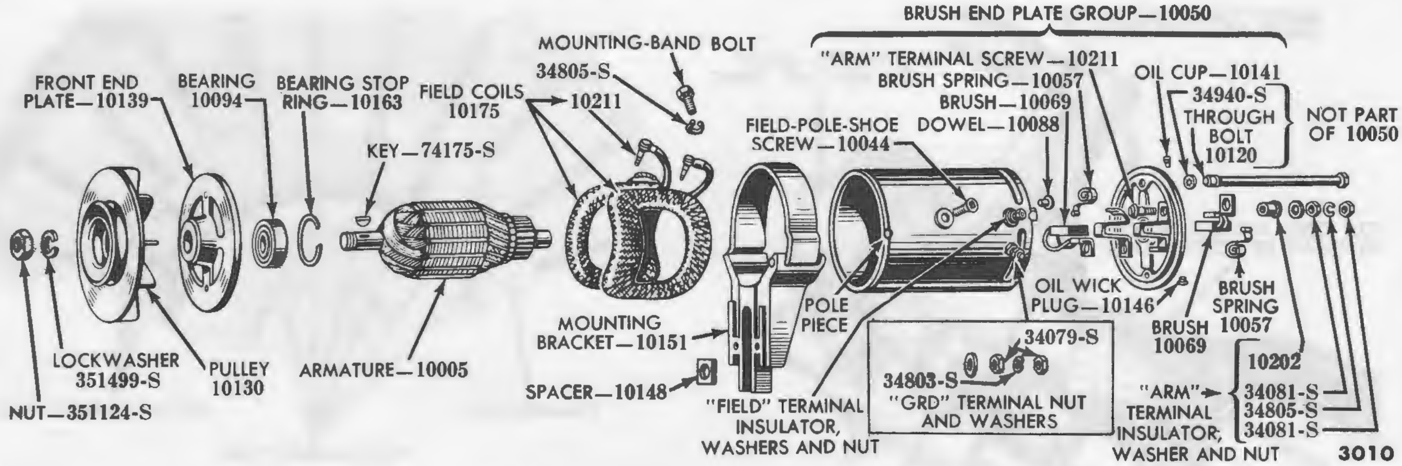


Fig. 12—Generator Disassembled (8 cyl.)

NOTE: ***Be sure to remove any burrs from the keyway before removing the front end plate.***

Pry out the bearing stop ring (snap ring) and push the bearing out of the front end plate.

Remove the "ARM" terminal screw and negative brush from the brush end plate. Remove the ground brush screw and the ground brush.

Remove the "FIELD" and "GRD" terminal screws from the generator frame and unscrew the field pole shoe screws as shown in fig. 13. The arbor press prevents the tool from slipping out of the screw socket. Slide the pole shoes and field windings out of the frame and separate the windings and shoes.

(2) CLEANING AND INSPECTION. Wash all parts except the armature, field coils, and front bearing in solvent and dry the parts thoroughly. Wipe off the armature and field windings, the commutator, and the armature shaft.

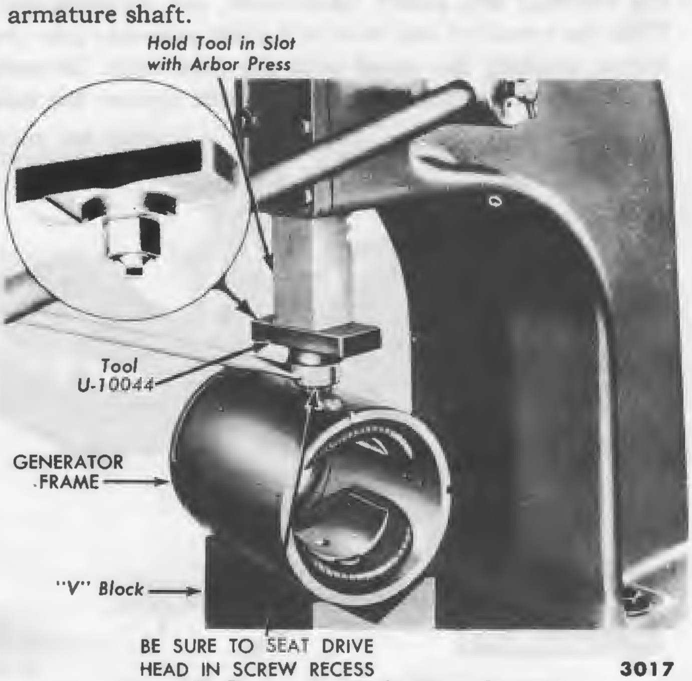


Fig. 13—Removing Pole Shoe Screws

Check the condition of the bearings. If the front end bearing is worn or has lost its lubricant it must be replaced. If the brush end plate bushing is worn or scored, replace the brush end plate assembly.

Check the armature winding for worn insulation, overheating, and unsoldered connections. Check the field windings for worn insulation and unsoldered connections at the terminal screws. Resolder any connections as required. Replace the armature or the field coils if the insulation is worn.

Check the commutator for runout and uneven or scored surfaces. Turn down the commutator and undercut the mica if necessary.

Inspect the brush end plate for cracks, poor insulation, or loose rivets. Replace the end plate if it is cracked or if the negative brush insulation is broken or cracked. Tighten any loose brush holder rivets.

Check the brush spring tension. If the tension is not within the limits of 26 to 34 oz., replace the springs.

(3) ASSEMBLY. Install the field coils on the pole

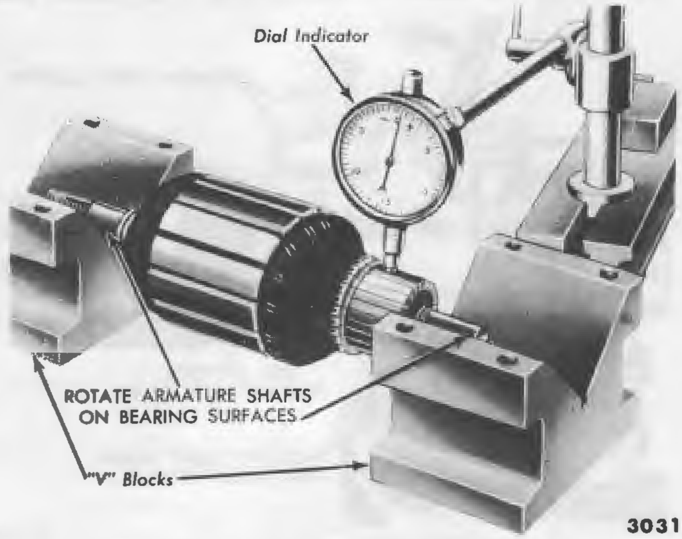


Fig. 14—Checking Commutator Runout

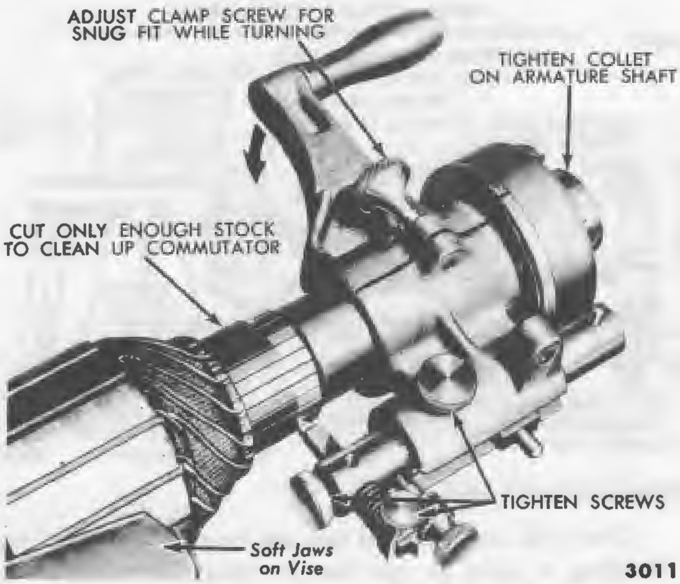


Fig. 15—Turning Generator Commutator

shoes and mount the shoe and coil assemblies in the frame. Tighten the field pole shoe screws (fig. 13).

NOTE: ***As the screws are tightened, strike the frame several sharp blows with a soft faced hammer to seat and align the pole shoes.***

Install the "GRD" terminal screw, washer, and nut in the frame. Install the "FIELD" terminal screw, insulators, washer, and nut in the frame.

Insert the brushes in the brush holders, install the "ARM" terminal screw and insulators, and install the ground brush screw. Move the brushes back in the holders until the brush springs ride against the side of the brushes to retain them in the retracted position.

Install the bearing in the front end plate and insert the bearing stop ring. Slide the plate on the armature shaft (with the snap ring toward the armature windings) and install the woodruff key, pulley, lockwasher, and

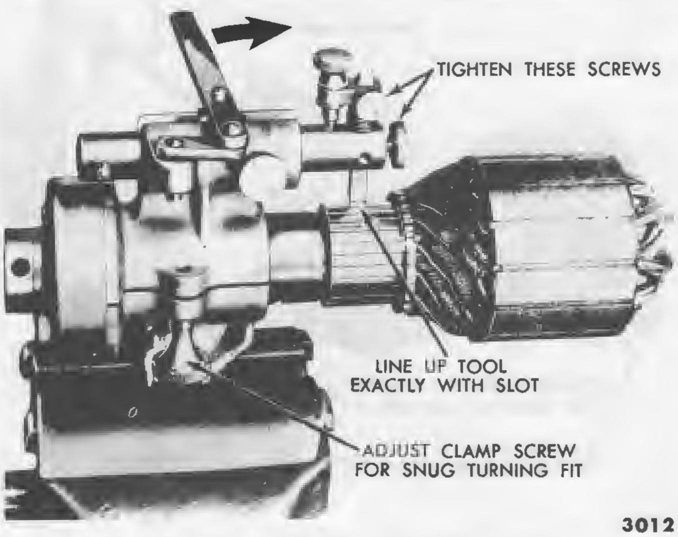


Fig. 16—Undercutting Generator Commutator

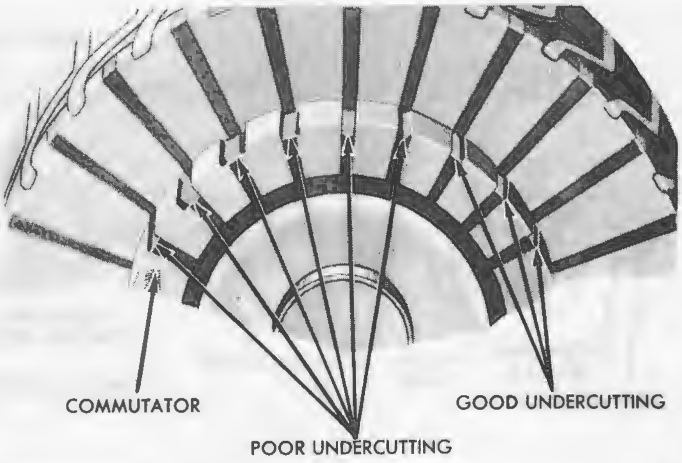


Fig. 17—Examples of Proper and Improper Undercutting

retaining nut. Install the armature and front end plate assembly in the frame, locating the dowel in the frame groove. Install the brush end plate (aligning the dowel and frame groove) and install the through bolts with lockwashers. Use a piece of stiff wire with a hooked end to reach through the ventilating slots and position the brush springs on top of the brushes. Lubricate the brush end plate bearing with a few drops of engine oil.

(c) ARMATURE REPLACEMENT. Remove the two through bolts and the brush end plate. Slide the armature and front end plate assembly out of the frame. Clamp the armature in a vise equipped with soft jaws and remove the retaining nut, lockwasher, pulley, and woodruff key. Remove any burrs or scratches from the keyway or shaft and slide the drive end plate off the shaft.

Install the front end plate on the new armature. Install the woodruff key, pulley, lockwasher, and retaining nut. Slide the armature and front end plate assembly into the frame, aligning the dowel with the frame slot. Retract the brushes until the brush springs ride against the side

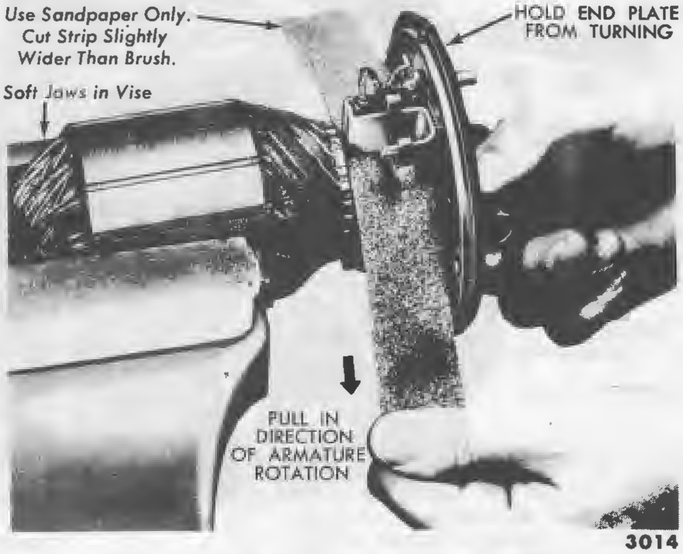


Fig. 18—Seating Generator Brush

of the brushes and install the brush end plate (aligning the dowel and the frame slot). Install the through bolts with lockwashers.

Use a piece of stiff wire with a hooked end to reach through the ventilating slots and position the brush springs on top of the brushes. Lubricate the brush end plate bearing with a few drops of engine oil.

(d) COMMUTATOR TURNING AND UNDERCUTTING. Check commutator runout as shown in fig. 14. If the surface of the commutator is rough or more than 0.001 inch out of round, turn it down in a lathe or with a turning and undercutting tool, see fig. 15. Remove no more copper than necessary to clean up the commutator.

After the commutator is turned down, undercut the mica between the bars 1/32 inch below the copper using the undercutting tool as shown in fig. 16. Figure 17 illustrates samples of proper and improper undercutting. Polish the commutator with 00 to 000 *sandpaper* to remove all burrs.

NOTE: ***Brush out all particles of copper from the mica insulation between the commutator segments.***

(e) BRUSH REPLACEMENT. Replace generator brushes when they are worn to 1/2 inch. Always change both brushes when replacement is required.

Remove the two through bolts from the generator frame. Remove the brush end plate and the armature and front end plate assembly from the generator frame. Disconnect the brush terminals and remove brushes. Clean the carbon and dirt from the brush end plate. Repair or replace the insulation between the brush holders and end plate and the "ARM" terminal and end plate if it is worn or cracked. Make sure the new brushes slide freely in the brush holders. Seat the new brushes by sanding them in as shown in fig. 18.

Retract the brushes until the brush springs ride against the side of the brushes to retain them in the retracted position. Install the armature and front end plate assembly and the brush end plate (aligning the dowels and the frame slots). Install the through bolts with lockwashers. Use a piece of stiff wire with a hooked end to reach through the ventilating slots and position the brush springs on top of the brushes. Lubricate the brush end plate bearing cup with a few drops of engine oil.

b. Generator Regulator and Circuit.

The increased electrical load placed on the generator by the heater, radio, and accessories calls for increased capacity in the generating system. High output generators require a means of control to keep the system within safe operating limits. Lights and radio tubes burn out prematurely, ignition contacts are burned, and the battery uses excessive water if generator voltage is excessive. If the voltage is too low the battery will not receive a charge to replace that used in starting. Further, this control must be automatic, to make the vehicle safer and easier to operate. The present day Ford regulator has not only been designed to exercise automatic control over the generating system, but it also will compensate for seasonal temperature changes.

CAUTION: ***The temperature compensation built into the regulator causes the regulator voltage to change with changes in temperature. Therefore, it is necessary to establish a standard for regulator operating temperature and ambient (surrounding***

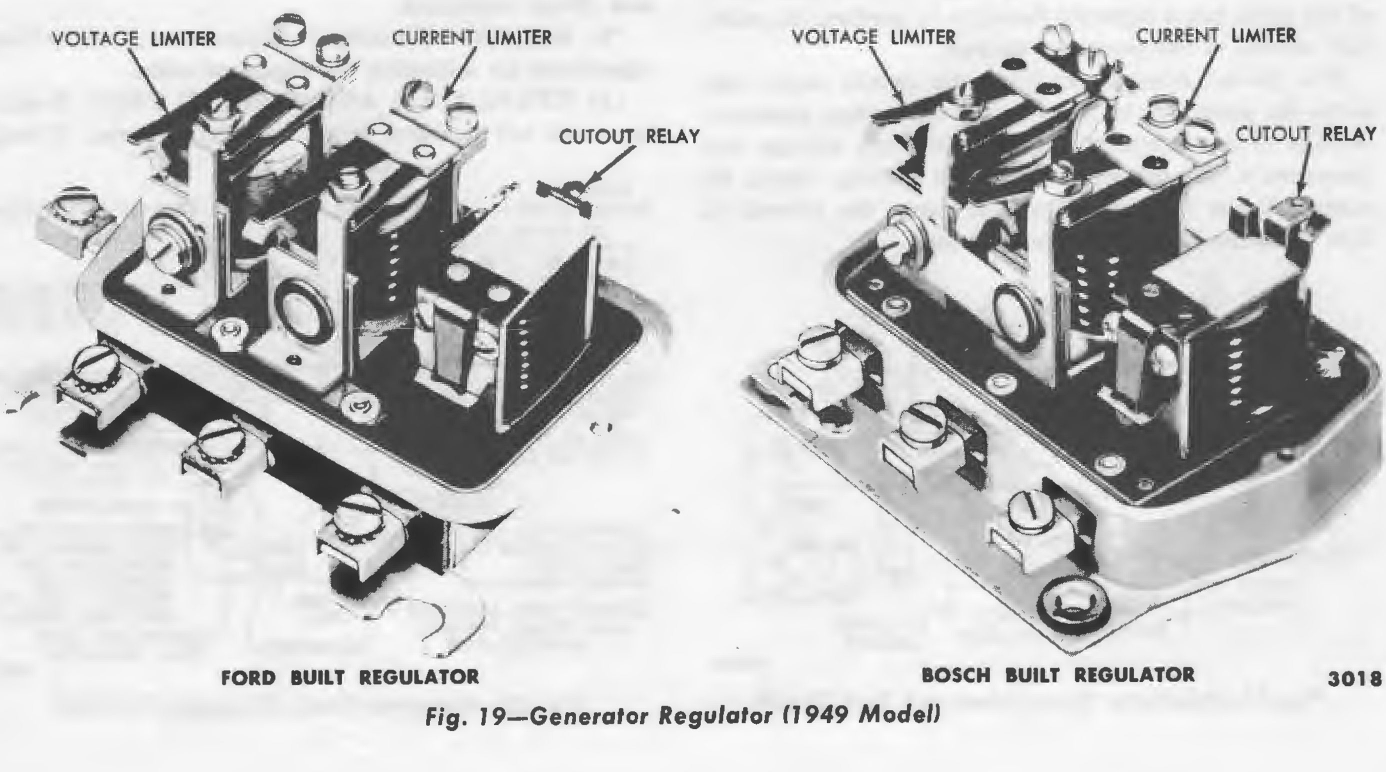
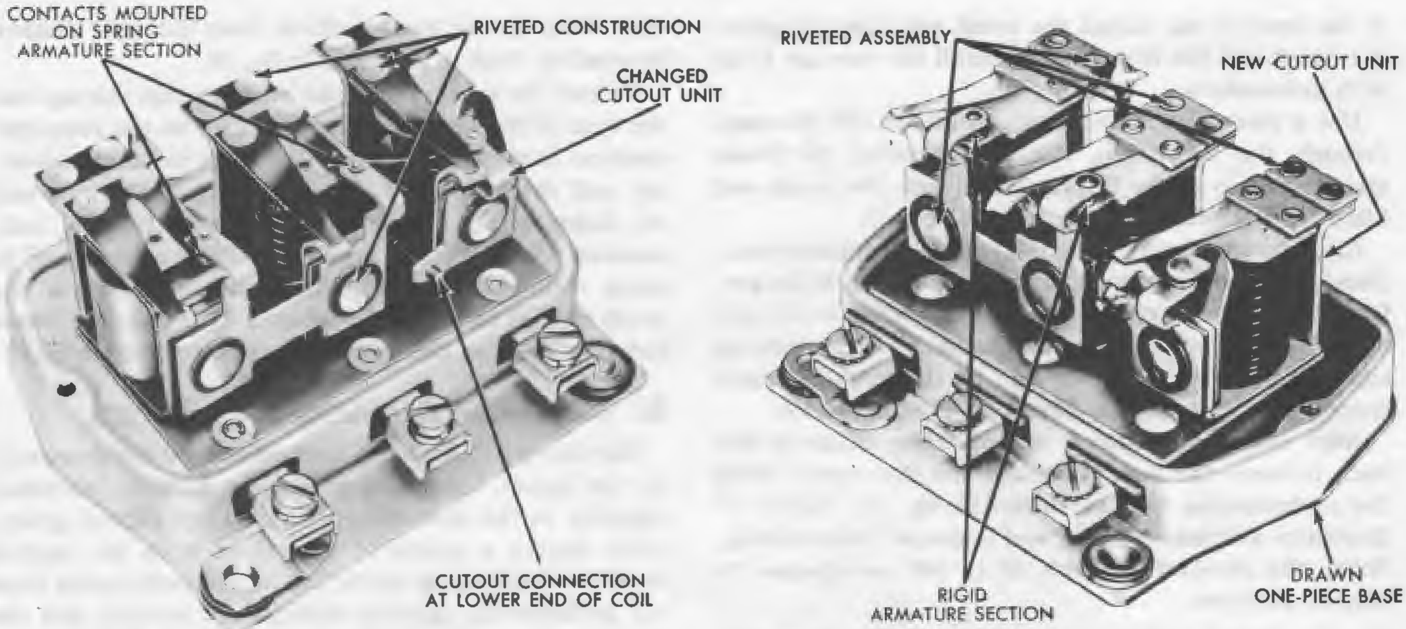


Fig. 19—Generator Regulator (1949 Model)



BOSCH BUILT (8M 10505 A2) **FORD BUILT (8M 10505 A1)** 3019

Fig. 20—Generator Regulator (1950 and 1951 Models)

air) temperature when the voltage limits are specified. The limits on voltage regulation and cut-in voltage are given for an ambient of 70°-80°F. and the regulator at "Normal" operating temperature. "Normal" temperature is defined as the temperature of the regulator after ½ hour of operation in the vehicle or after the regulator has been heated until it becomes stabilized.

The generator regulator is composed of three control units mounted as an assembly (figs. 19 and 20). Each of the units has a separate function to perform to maintain control of the generator output.

The cut-out relay is an automatic switch which connects the generator to the external load when generator voltage is approximately equal to battery voltage and disconnects the generator when its voltage drops far enough below battery voltage to cause the current to flow from the battery to the generator.

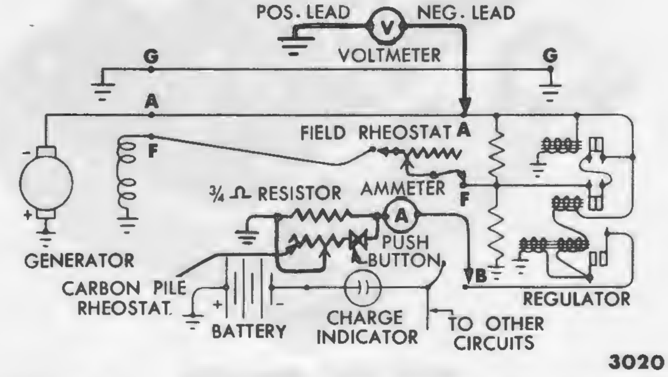


Fig. 21—Regulator Tests (Schematic Test Circuit)

The voltage limiter holds generator voltage to a predetermined setting as long as the voltage of the generator is high enough to operate the voltage limiter.

The current limiter protects the generator windings by limiting to a maximum the amount of current supplied by the generator.

The procedures presented here will appear under the following headings:

"*a*. Regulator and Circuit Tests," outlining methods of testing certain voltage, voltage limit, current limit, and circuit resistance.

"*b*. Regulator Electrical Adjustment," describing operations for adjusting the regulator units.

(1) *REGULATOR AND CIRCUIT TEST.* Regulator tests are outlined below in "(a) Cut-out, Voltage

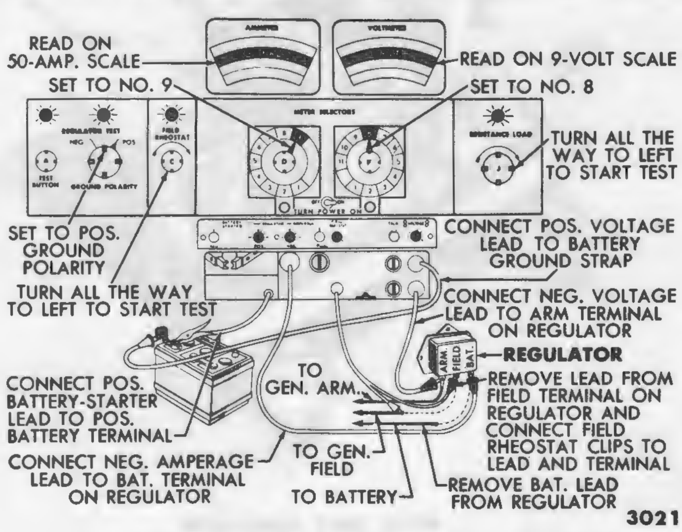


Fig. 22—Regulator Tests (Diagnosis Test Set)

Limit, and Current Limit Tests." Test procedures for the circuit are outlined in "(b) Circuit Resistance Test."

The instruments and equipment for making the tests are incorporated in the Diagnosis Test Set. For operators having other than Ford approved equipment, the particular meters and test equipment needed are listed below:

0-50 } ammeter
0-100 }
0-0.9 voltmeter
0-9 voltmeter
50 ohm field rheostat (2 amp. rating)
¾ ohm resistor (15 amp. rating)
Carbon pile rheostat (heavy duty)
Assorted connecting wires equipped with suitable connectors.

Regulator tests can be made on the vehicle as outlined below or on a Ford Generator and Regulator Test Bench, if it is available. The advantage of using the test bench is the reduction of time required to heat the regulator to normal operating temperature. The test bench is equipped with a radiant heating unit which can bring the regulator up to normal temperature in a few minutes. When the test bench is used to make the regulator test be sure the regulator is mounted in the same position as it is in the vehicle and that the regulator is checked against the same type generator used on the vehicle.

(a) Cut-Out, Voltage Limit, and Current Limit Tests. (On Vehicle). Be sure the regulator is at "normal" operating temperature (equivalent to the temperature after 30 minutes of operation on the vehicle). Connect the test equipment as shown in figs. 21 and 22. Start the engine and run it at approximately 1500 r.p.m. Decrease the resistance in the field circuit and the voltage output of the generator indicated by the voltmeter will increase until the cut-out closes. The cut-out closing will be indicated by a rise of the ammeter needle and a "dip" of the voltmeter needle. The maximum voltage at the time the voltmeter needle dips or drops back will be the closing voltage of the cut-out relay. This operation should be repeated to accurately determine the closing voltage of the cut-out.

Reduce the resistance in the field circuit to zero (turn FIELD RHEOSTAT KNOB (C) all the way to the right on the Diagnosis Test Set). The ammeter should show an approximate 10 ampere load. Read the voltage regulation on the voltmeter scale. Speed the engine momentarily to see if the voltage remains regulated.

With engine speed at 1500 r.p.m. press the push button to connect the carbon pile rheostat and slowly decrease the resistance until the voltmeter reading drops to 6.5 volts. The ammeter will indicate the setting of the current limiter.

Remove all test leads except the voltmeter leads. Install the "BAT" and "FIELD" leads on the regulator terminals. Run the engine at 1500 r.p.m. and read the voltage regulation (under battery load) on the voltmeter.

NOTE: ***The voltage reading will usually be low when the engine is first started because the battery is partially discharged. After a few moments of operation the voltage will rise to the original value.***

(b) Circuit Resistance Test. For the purpose of this test, the resistance values of the circuit have been converted to voltage drop readings. Connect the test equipment as shown in figs. 23 and 24 to measure voltage drop around the circuit.

Crank the engine for 15 seconds with the ignition switch OFF to partially discharge the battery. Then start the engine and run it at approximately 1500 r.p.m.

Touch the voltmeter positive lead to the center of the negative battery post (fig. 23 or 24, connections marked ①) to check the generator to battery circuit. The voltage drop should be less than 0.6 volt.

If the voltage drop in the generator to battery circuit exceeds 0.6 volt, locate the exact part of the circuit wiring causing the trouble by contacting the positive lead to other points in the circuit. Connect the lead to the "ARM" terminal of the regulator (connections marked ②); the voltage drop should be less than 0.1 volt. Connect the lead to the "BAT" terminal of the regulator (connections marked ③); the voltage reading should be

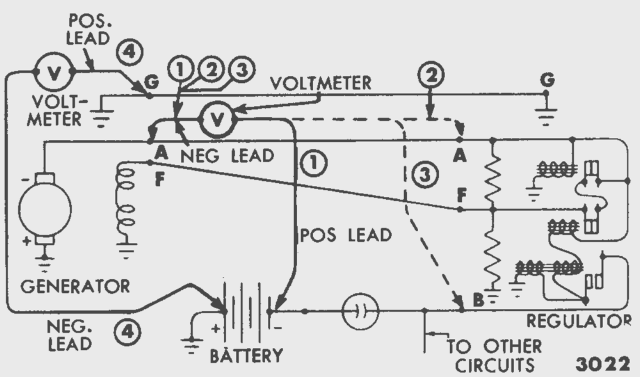


Fig. 23—External Circuit Test (Schematic Test Circuit)

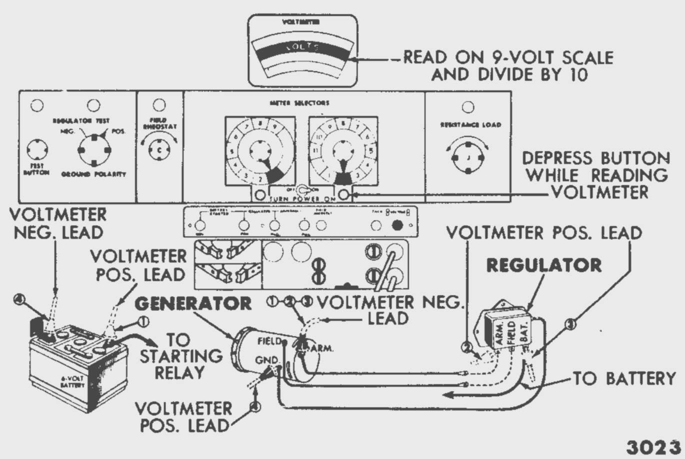


Fig. 24—External Circuit Test (Diagnosis Test Set)

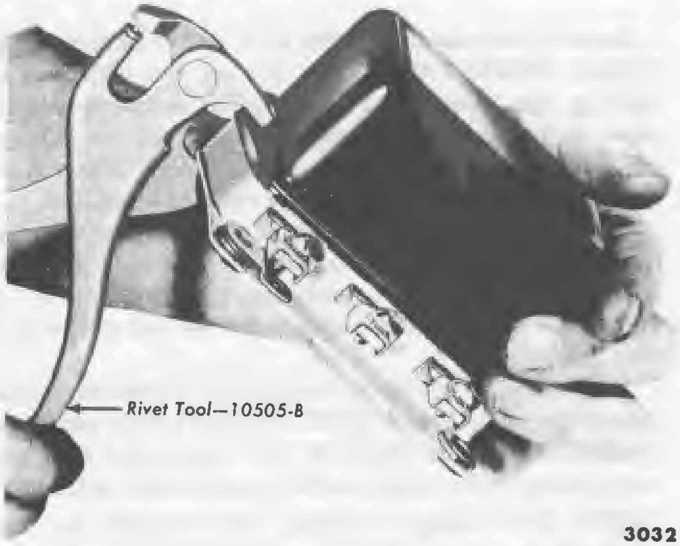


Fig. 25—Removing Regulator Cover (One Piece Regulator Base)

less than 0.35 volt. If both these readings are within limits, the excessive resistance is in the regulator to battery wires.

Check the battery to generator ground circuit by connecting the voltmeter as shown in fig. 23 or fig. 24 (connections marked ④); the voltage reading should be less than 0.1 volt.

(2) *REGULATOR ELECTRICAL ADJUSTMENT*. Final adjustment of the regulator must be checked with the regulator at normal operating temperature. The regulator can be brought to normal operating temperature very rapidly if a Ford Generator and Regulator Test Bench is available. The Test Bench is equipped with a radiant heating unit to raise the temperature of the regulator in a short period of time. The voltage and current limiter units in the model 8M and 8A regulators

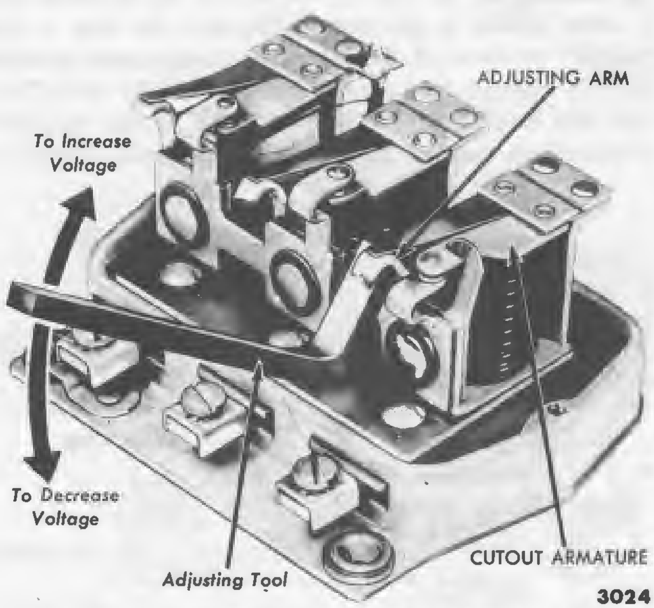


Fig. 26—Adjusting Cut-In Voltage (1950 and 1951 Models 8M and 8A)

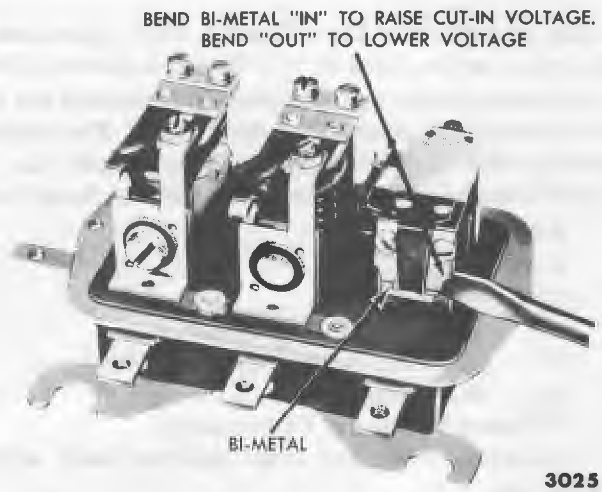


Fig. 27—Adjusting Cut-In Voltage (1949 Regulators)

(1950 and 1951 models) are adjusted in the same manner as in previous models. However, a different cutout relay is used and the adjusting procedure is given below in "(a) Adjust Cut-In Voltage." For any of the adjustments given below, remove the cover as shown in fig. 25.

NOTE: ***After adjustments are made recheck the settings with the cover in place.***

(a) ADJUST CUT-IN VOLTAGE. If the regulator is one of the 1950-1951 models (the cutout unit is similar in appearance to the other two units), the cut-in voltage is increased by bending the adjusting arm upward, or decreased by bending it downward (fig. 26).

The 1949 model regulator cut-out (with the bimetal bracket retaining the armature spring) is adjusted by bending the bimetal inward to increase cut-in voltage, or outward to decrease the voltage (fig. 27).

(b) ADJUST VOLTAGE LIMIT. If the voltage limit is less than specified, increase the spring tension by bending the adjusting arm upward, fig. 28. To decrease the

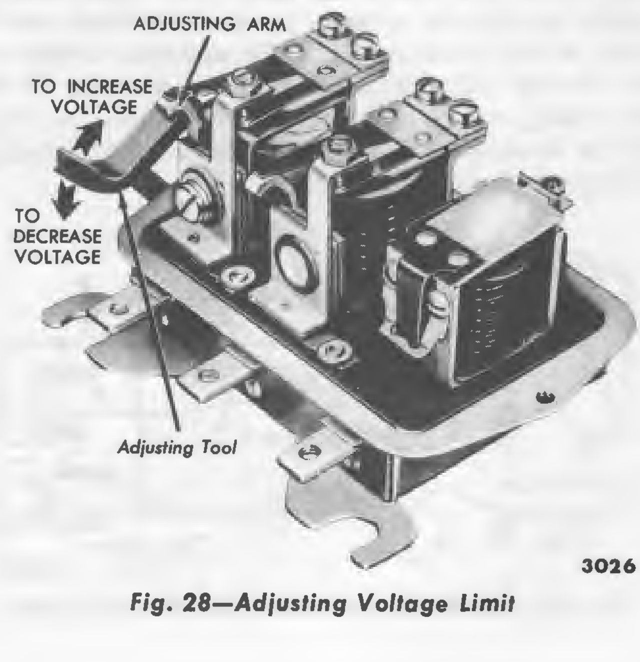


Fig. 28—Adjusting Voltage Limit

voltage, bend the adjusting arm downward.

(c) ADJUST CURRENT LIMIT. If the current limit is less than specified, increase the spring tension by bending the adjusting arm upward, see fig. 29. To decrease current limit, bend the adjusting arm downward.

(3) *REGULATOR REMOVAL AND INSTALLATION*. Disconnect the "ARM," "FIELD," and "BAT" leads at the regulator terminals. On 1949 model regulators, also disconnect the "GRD" lead. Remove the three mounting screws and the regulator.

NOTE: ***It is advisable to disconnect a battery cable when working on the regulator to prevent an accidental short circuit of the "BAT" lead to ground.***

To install the regulator, place it in position and install the mounting screws. Be sure to mount the ground wire terminal under the mounting screw that contacts the ground strap on the regulator base (1950-1951 model regulators). Connect the "ARM," "FIELD," and "BAT" leads to the regulator terminals. On 1949 regulators, connect the lead to the "GRD" terminal of the regulator. Reconnect the battery cable.

c. Battery.

The primary function of the storage battery in the generating system is, as its name implies, to store energy for starting the engine and to operate electrical units when the generator is not delivering sufficient output.

A cutaway view of the battery (fig. 30) illustrates the internal construction.

(1) *BATTERY EQUIPMENT*. Ford approved battery equipment includes (a) Fast Charger, (b) battery Charge Tester (open circuit voltage tester), and (c) Diagnosis Test Set. A hydrometer is also very useful in battery testing.

(a) FAST CHARGER. The Fast Charger places a full charge in a battery in a short period of time and automatically shuts off the charge by means of a thermostat control when the battery temperature reaches 125° F. The 125° maximum limit on temperature is recommended by the battery manufacturer. No battery undergoing fast charge will reach a "full charge" condition until its temperature rises to 125° F. The Fast Charger is equipped with battery test equipment to permit testing batteries before and after full charge.

(b) BATTERY CHARGE TESTER. The Battery Charge Tester provides a clean, convenient, and rapid means of testing battery state of charge. A sensitive voltmeter measures the open circuit voltage of each cell and indicates the charge in the battery on the voltmeter scales.

It eliminates the removal of battery electrolyte from the battery (as compared to the hydrometer check) preventing acid burns on the operator, clothes, and car finish. In many cases it is impossible to test the battery with the hydrometer because the electrolyte is below the plates and cannot be drawn out of the cell.

(c) DIAGNOSIS TEST SET. The Diagnosis Test Set includes a battery tester in one of the test circuits. The battery is tested by causing current to flow from the battery at a rate according to the battery size and measuring the terminal voltage of the battery under load. The voltmeter scale is calibrated to read state of charge or condition.

(d) HYDROMETER. The Hydrometer shows state of charge in a battery by measuring electrolyte specific gravity. A temperature correction scale is included in the hydrometer barrel to obtain a true specific gravity reading.

(2) *BATTERY TESTS AND CONCLUSIONS*. Tests

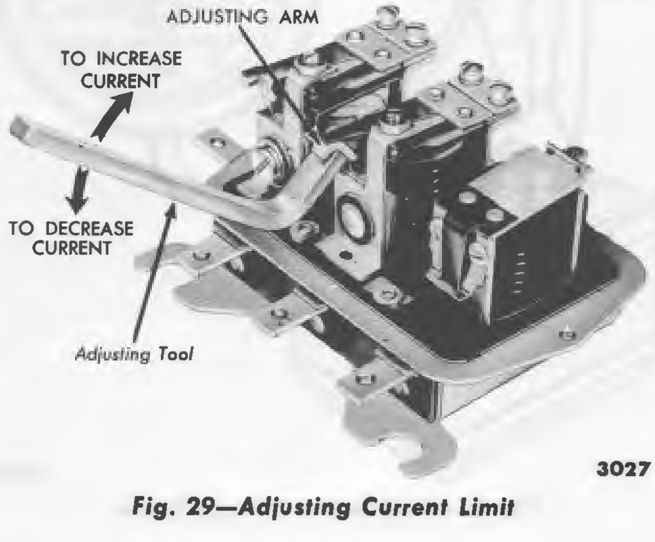


Fig. 29—Adjusting Current Limit

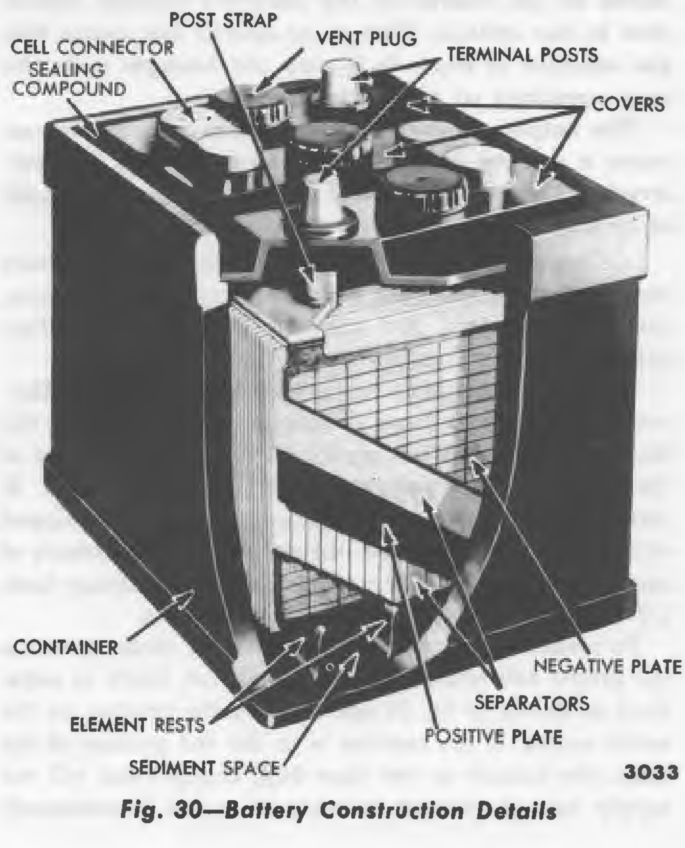


Fig. 30—Battery Construction Details

tery clips to the battery terminals and set selector switches as shown in fig. 32. Turn the Resistance Load Knob (J) slowly clockwise until the ammeter needle points to the capacity of the battery under test. Read the state of charge of the battery on the voltmeter scale. If the pointer is in the red range (less than 60% charged), the battery will not supply enough current to start in extremely cold weather. When the pointer is in the yellow range (approximately 65% charged), the starting power is questionable.

(b) Ford Fast Charger. Connect the battery clips to the battery terminals. Set the battery size selector to the ampere hour rating of the battery, fig. 33. Depress the test button halfway for 15 seconds, then depress it fully and read the battery condition on the bottom scale. If the pointer is in the red portion of the scale (less than 60% charged), the battery will not supply enough current to start in extremely cold weather.

(b) AFTER CHARGE TESTS. The after charge tests are used to determine the condition of a battery. The battery must be fully charged or the results of the test will be inaccurate. The test is the same as that used in the before charge test with the exception that the top scale is used on the Ford Fast Charger.

If the meter reading obtained in the tests described below will not hold steady in the green range of the scale and falls back rapidly or if the reading is in the red range of the scale, the battery is worn out and battery failure can be predicted for the immediate future (the first cold morning). If the meter reads in the middle range of the scale, the battery may hold up for a short while, but eventually will fail. The middle range indicates that a battery has lost approximately 40% of its capacity. The loss is caused by wear, internal damage, or shedding of the active plate material from the plates.

(1) FORD DIAGNOSIS TEST SET. Connect the battery test leads to the battery terminals and set selector switches as shown in fig. 32. Turn the Resistance Load Knob slowly clockwise until the ammeter needle points to the capacity (ampere hours) of the battery under test. The voltmeter will indicate the condition (remaining capacity) of the battery.

(2) FORD FAST CHARGER. Connect the battery leads to the battery terminals. Set the battery size selector to the ampere hour rating of the battery (fig. 34). Depress the test button halfway, for 15 seconds, then depress it fully and read the battery condition (remaining capacity) on the top scale.

(3) *CARE OF BATTERIES IN STOCK*. The oldest batteries should be sold first. A slow discharge occurs during storage and the number of "boost" charges required by a battery before it is finally sold will be reduced by rotating stocks properly.

NOTE: ***The date of manufacture of the battery is stamped on one of the center cell connector buttons.***

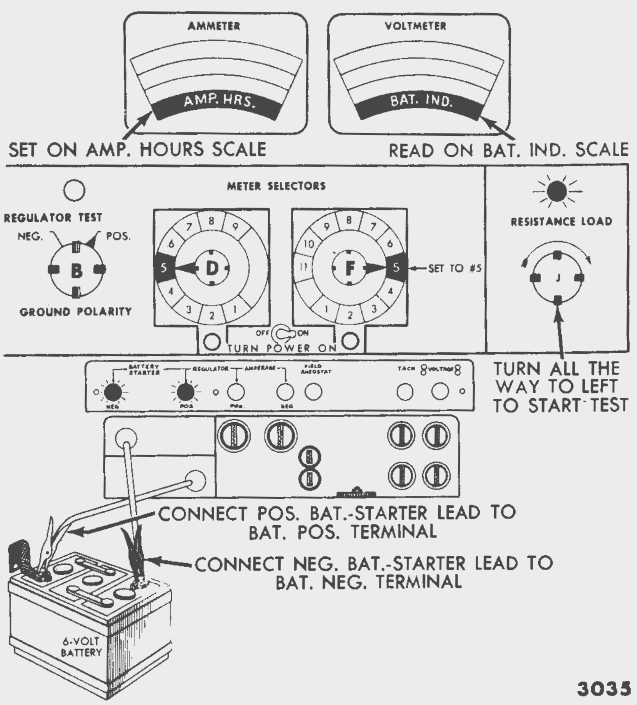


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Fig. 32—Diagnosis Test Set Connections

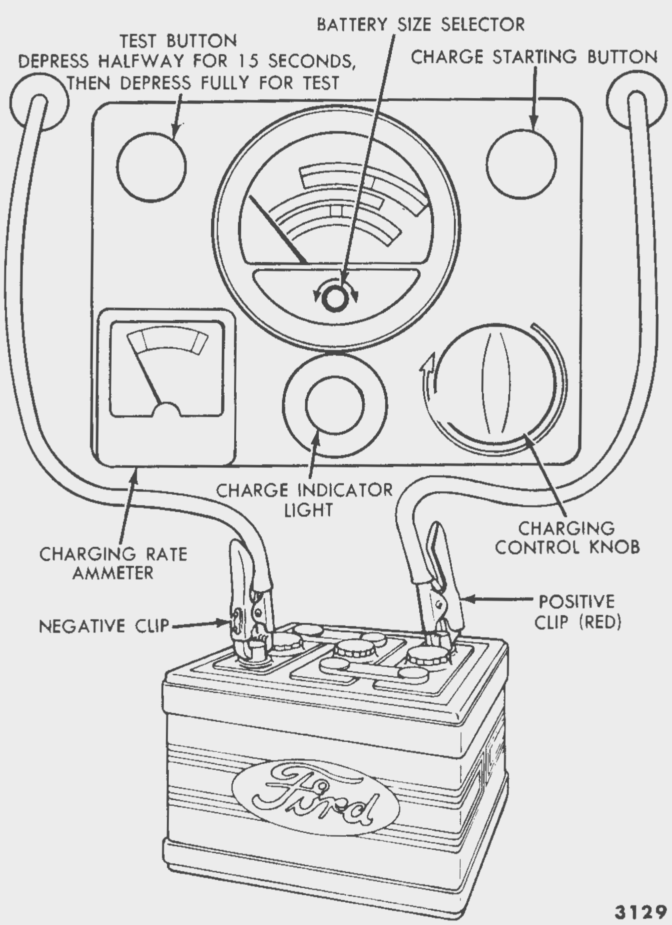

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Fig. 33—Ford Fast Charger Test Connections

The letter represents the month (A—January, B—February, C—March, etc.) and the numeral represents the year (8—1948, 9—1949, 0—1950, etc.). Thus, the code L-9 would signify a battery was manufactured in December, 1949.. Beginning the latter part of 1950 a three character code was instituted. The first character represents the month and appears as 1-2-3-4-5-6-7-8-9-0-A-B. The second character designates the week of the month and is shown as 1-2-3-4-5. The third character which denotes the year is shown as 0-1-2, etc. Thus the code B-3-0, indicates a battery was manufactured during the third week of December, 1950.

To assure trouble-free operation on a new battery installation, the battery should be fully charged at the time it is installed. The state of charge should also be recorded on the battery certificate.

(4) *BATTERY CHARGING*. As previously stated, the Fast Charger can be used to charge a battery rapidly and safely. It places the charge in the battery at the 100 ampere rate recommended for fast charging and carries on the charge until battery temperature reaches 125° F. The procedure for fast charging is outlined below in "(a) Fast Charge."

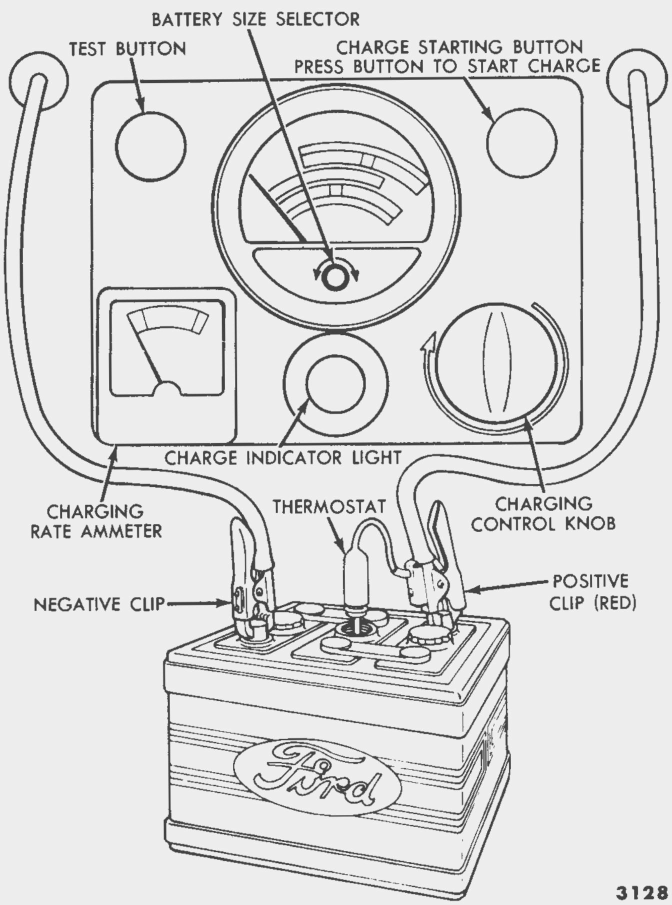


Fig. 34—Fast Charge Procedure

In addition, the Fast Charger can be used for slow charging on new or stocked batteries to bring them to a full charge. The slow charge procedure is described below "(b) Slow Charge."

Wash all dirt from the battery and clean the battery terminals before placing it on charge.

NOTE: ***Do not allow any dirt to enter the cells.***

Bring the electrolyte to the correct level in the cells. If the battery is extremely cold, allow it to warm up before adding water as the level will rise due to expansion in the cell chamber.

(a) FAST CHARGE. Make the connections as in fig. 34. You will note that the thermostat control is placed in the center cell filler opening. If the battery has a "level fill" type of vent plug, be sure the center cell vent is held open to prevent electrolyte from overflowing while on charge. Set the charging control selector up until the charging rate is 100 amps. (or slightly under).

NOTE: ***Do not exceed 100 amps charging rate.***

(b) SLOW CHARGE. When the fast charger is used for slow charging, connect the batteries in *parallel* (fig. 35).

NOTE: ***Never connect batteries in series for slow charging on the fast charger, it will damage the rectifier unit.***

The charging control selector is set to "slow charge" for this operation. It is recommended that four or more batteries be connected in parallel for slow charge.

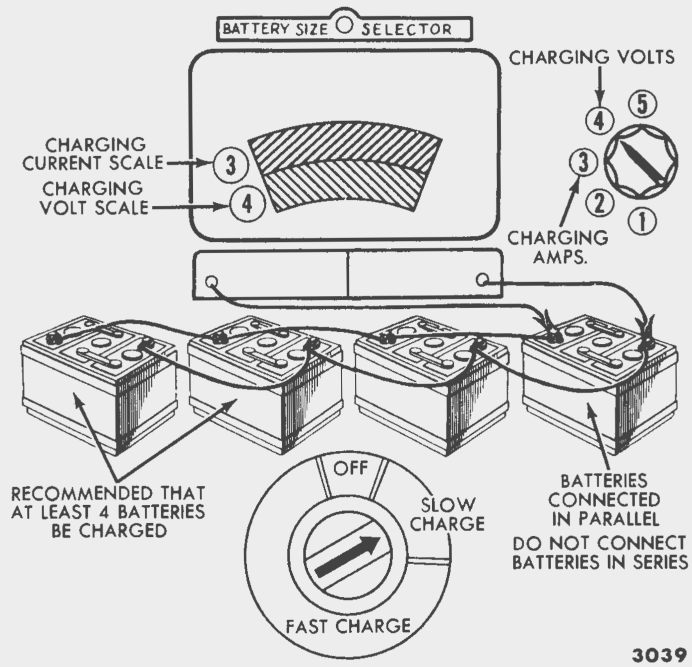


Fig. 35—Slow Charge Procedure

2. STARTING SYSTEM

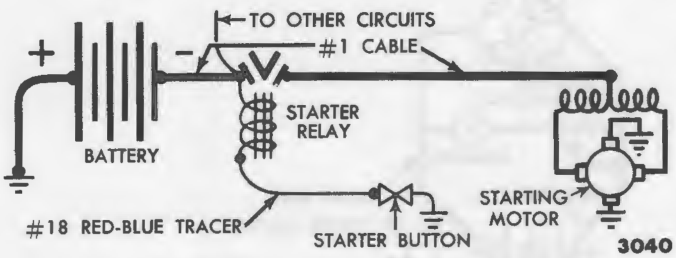


Fig. 36—Starter Circuit (Schematic)

The function of the starting system in the vehicle is to crank the engine at a high enough speed to permit it to start. The system includes the starter motor and drive, the battery, a remote control push button type starter switch, and heavy circuit wiring.

A schematic diagram of the starter circuit, shown in fig. 36, illustrates the internal connections of the starting system units. Figure 37 is a pictorial view of the starting system of the standard Ford truck showing the wiring and location of the various units.

Heavy cables, connectors, and switches are used in the starting system because of the large current required by the starter motor while it is cranking the engine. The amount of resistance in the starting circuit must be kept to an absolute minimum to provide maximum current for the starter motor operation. Loose connections, corroded relay contacts, and partially broken cables will result in slower than normal cranking speed, and may even prevent the starter motor from cranking the engine.

a. Starter Motor and Circuit.

The starter motor used in Ford trucks is a four-brush series wound unit. The circuit to the starter motor is completed by means of a relay controlled by a push-button switch mounted on the instrument panel. The return circuit is through the starter motor housing, engine block, and battery ground strap to the battery.

Figure 38 illustrates the starter mounted on the 8-cylinder engine. The mounting is the same on the 6-cylinder with the exceptions as noted.

(1) *STARTER MOTOR AND CIRCUIT TESTS.* Five different tests of the starter motor and its circuit are described here under headings that indicate the nature of the test. The arrangement of these tests is not intended to indicate an order of procedure. The selection of which test is to be made is controlled by the circumstances encountered, usually as a result of analyzing troubles as covered in trouble shooting, or as a part of a preventive maintenance plan. The separate tests are:

"(a) Starter Load Test." When this test is performed in conjunction with the "Starter No-Load Test," it will determine if the starter motor is faulty or if the engine has excessive friction.

"(b) Starter No-Load Test." This is a quickly performed test that will uncover such faults as open or shorted windings, rubbing armature, and bent armature shaft.

"(c) Armature and Field Open Circuit Test." As the

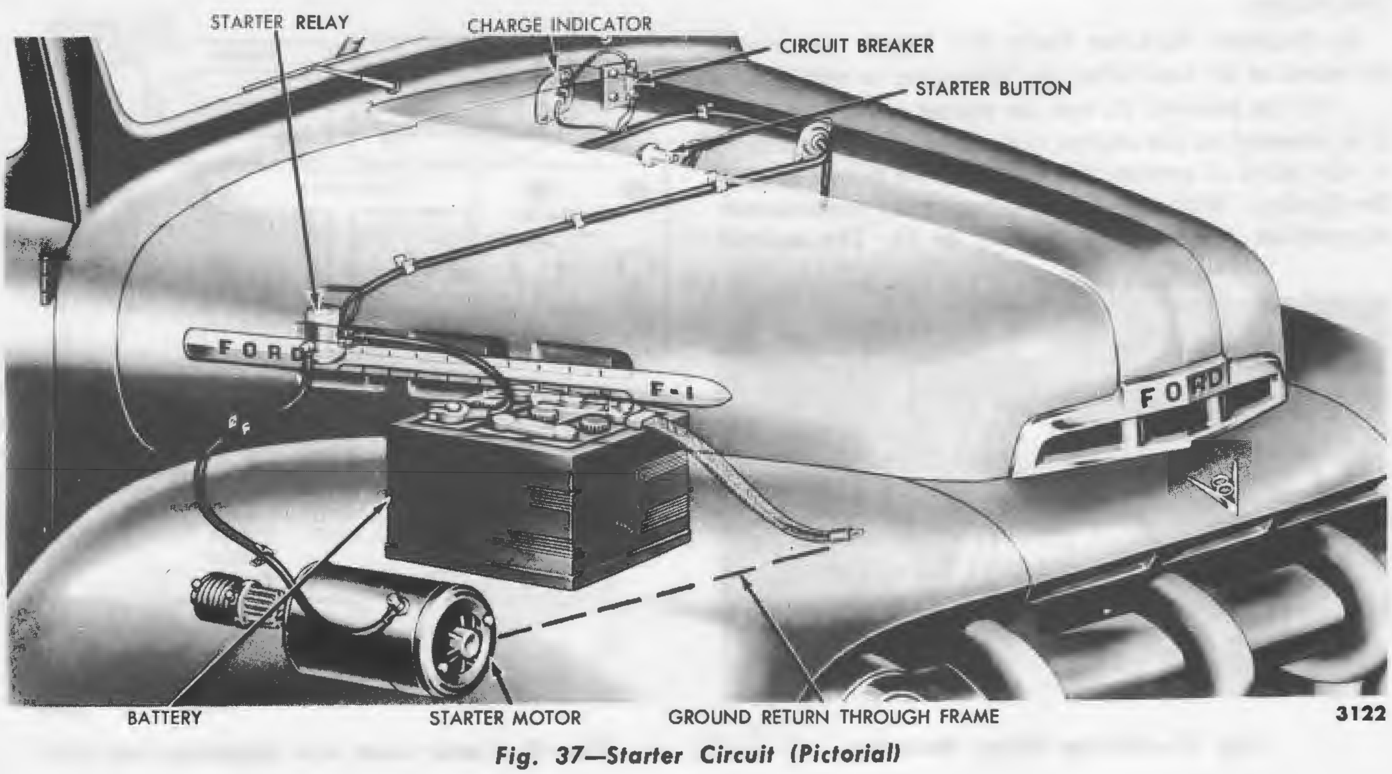


Fig. 37—Starter Circuit (Pictorial)

name implies, this test will determine if the starter motor windings have an open circuit.

"(d) Armature and Field Grounded Circuit Test." This test will determine if winding insulation has failed, permitting a conductor to touch the frame or armature core.

"(e) Starter Circuit Test." Excessive resistance in the starter circuit can be determined from the results of this test.

The test procedures outlined can be made with the "Ford Diagnosis Test Set." If the test set is not available, the following equipment will be needed.

0-0.9 Voltmeter
4-6 Expanded scale voltmeter
0-50 } Ammeter
0-300 }
Carbon Pile Rheostat (Heavy Duty)
Assorted connecting wires and jumper wires equipped with suitable connectors.

(a) Starter Load Test. Connect the test equipment as shown in figs. 39 or 40. Be sure that no current is flowing through the ammeter and carbon pile rheostat portion of the circuit (rheostat at maximum resistance). Crank the engine with the ignition OFF and determine the exact reading on the voltmeter.

Stop cranking the engine and reduce the resistance of the carbon pile until the voltmeter indicates the same reading as that obtained while the starter cranked the engine. The ammeter will indicate the starter current draw under load. This reading should be a maximum of 190 amperes with the engine at normal operating temperature.

(b) Starter No-Load Test. The starter motor can be tested at no load either on the engine or test bench.

(1) On Engine. To test the starter at no load while it is mounted on the engine, the engine must be running at idle speed to prevent the starter drive from engaging the flywheel. With the engine idling, make the ammeter connections as shown in figs. 41 or 42. The no-load

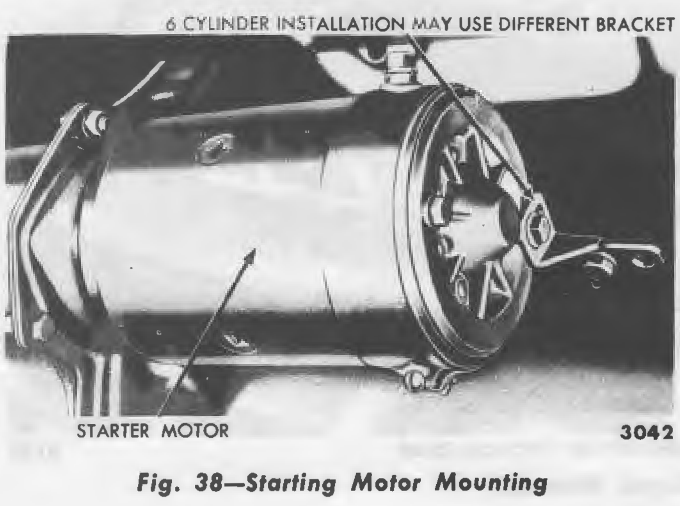


Fig. 38—Starting Motor Mounting

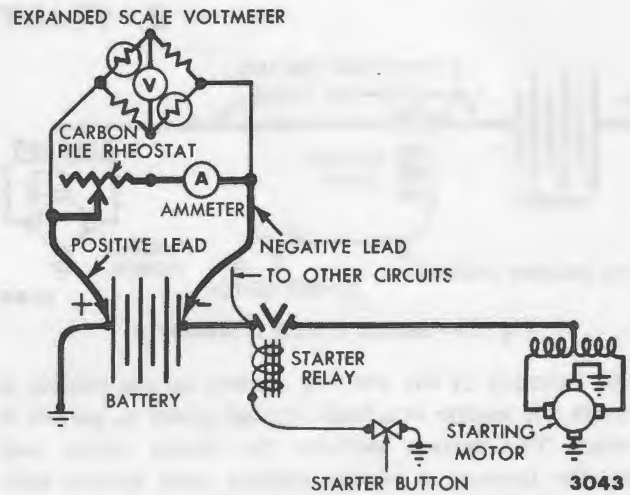


Fig. 39—Starter Load Test (Schematic)

current draw on the ammeter should be 45-60 amperes.

(2) On Test Bench. If the starting motor is removed from the engine, the no-load test can be performed on the test bench. Connect the starter motor to a battery with an ammeter in the circuit as shown in fig. 43. The starter motor will run at no load and the current draw indicated on the ammeter should be 45-60 amperes.

(c) Armature and Field Open Circuit Test (Test Bench Only). An open circuit armature may sometimes be detected by examining the commutator for evidence of burning. The spot burned on the commutator is caused by an arc formed every time the commutator segment connected to the open-circuit winding passes under a brush.

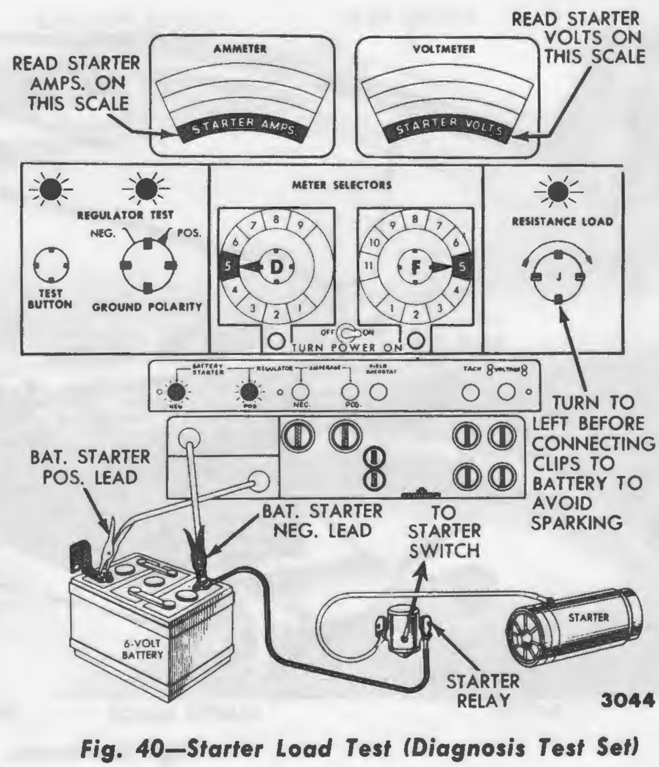


Fig. 40—Starter Load Test (Diagnosis Test Set)

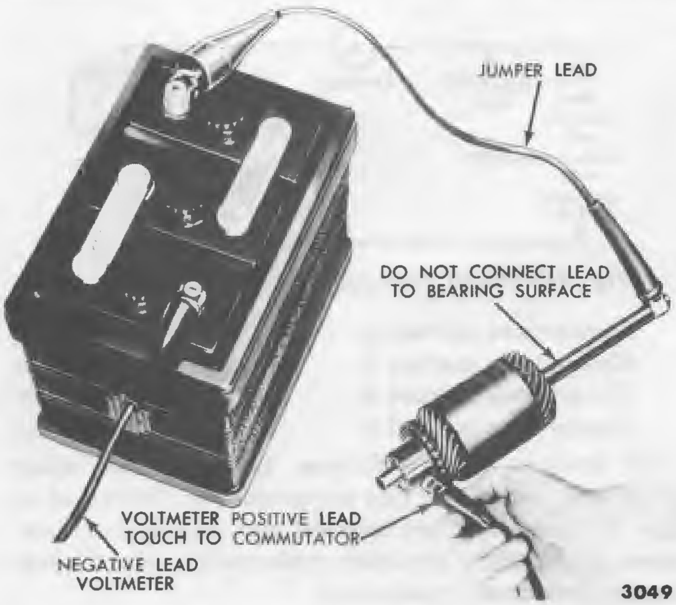


Fig. 45—Grounded Circuit Armature Test

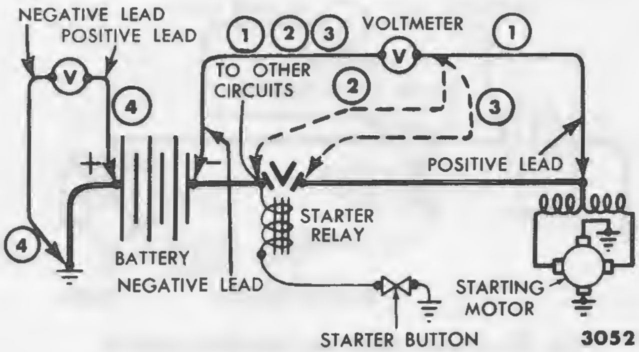


Fig. 47—Starter Circuit Test (Schematic)

ing it finger tight. Tighten both through bolts and then tighten the oil pan bolt.

(b) Complete Disassembly. Use the following procedure when it becomes necessary to completely overhaul the starter.

Figure 49 illustrates the starter motor completely disassembled. Part names and numbers are included to aid you if it is necessary to make replacements. Only the basic part number is used; when ordering parts refer to your parts book for the necessary prefix and suffix.

(1) disassembly. Remove the starter drive, through bolts and rear end plate, fig. 49. Be sure to remove all burrs from the shaft to prevent scoring the rear end plate bushing. Remove the armature. Remove the cover band.

Remove the brushes from their holders and remove the brush end plate. Unscrew the ground brush screws and remove the ground brushes. Remove the nut and washers from the terminal. Unscrew the two field-pole-shoe screws as shown in fig. 50. The arbor press prevents the wrench from slipping out of the screw.

Remove the pole shoes and field coils from the frame. It will be necessary to collapse the field coils to remove the starter terminal screw. Unsolder the terminal screw from the field coils.

(2) cleaning and inspection. Wipe the field coils, armature, commutator and armature shaft with a clean cloth. Wash all other parts in solvent and dry the parts.

Inspect the armature windings for broken or burned insulation and unsoldered connections. Check the commutator for runout (fig. 14). Inspect the armature shaft and the two bearings for scoring and excess wear. Check the brush holders for broken springs and the insulated brush holders for shorts to ground. Check the brush

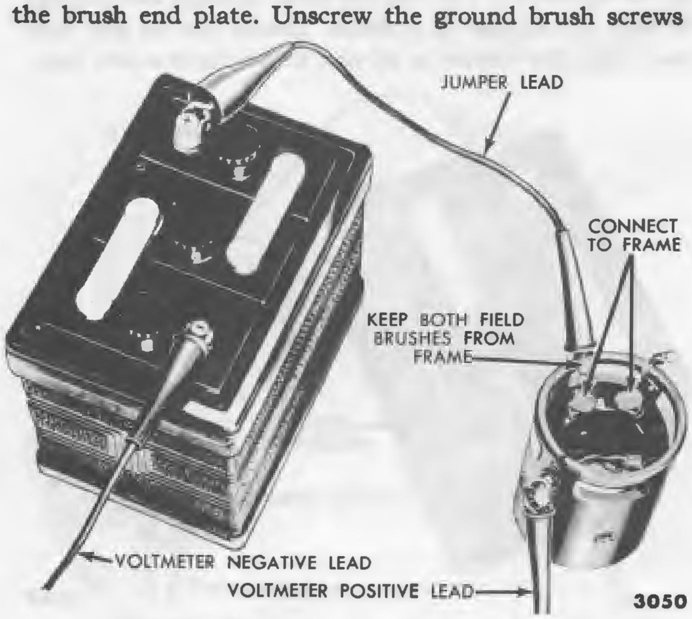


Fig. 46—Grounded Circuit Test of Field

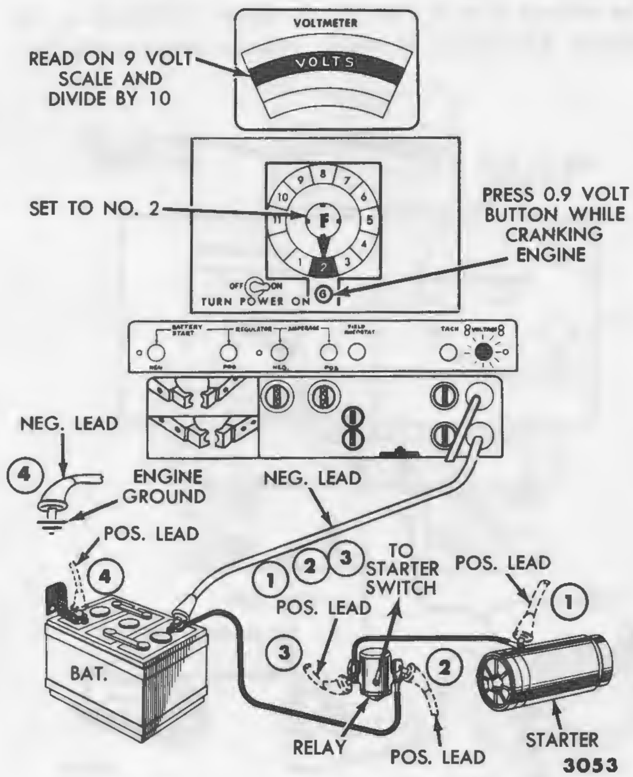


Fig. 48—Starter Circuit Test (Diagnosis Test Set)

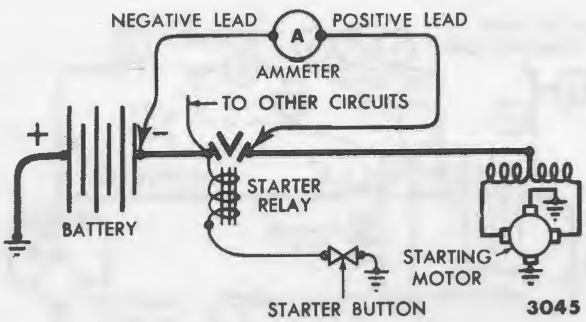


Fig. 41—Starter No-Load Test (Schematic)

An open circuit test of the field can be made on the test bench by connecting a voltmeter and battery as shown in fig. 44. Since the starter field is divided, it will be necessary to check each half of the field separately. If no voltmeter reading is obtained, the coil is open.

(d) Armature and Field Grounded Circuit Test (Test Bench Only). To determine if armature windings are grounded, make the connections as shown in fig. 45. If the voltmeter indicates any voltage, the windings are grounded.

Grounded field windings can be detected by making the connections as shown in fig. 46. If the voltmeter indicates any voltage, the field windings are grounded.

(e) Starter Circuit Test. Make the test connections as shown in figs. 47 or 48. Crank the engine with the ignition OFF.

The voltage drop in the circuit will be indicated by the voltmeter. Maximum allowable voltage drop should be:

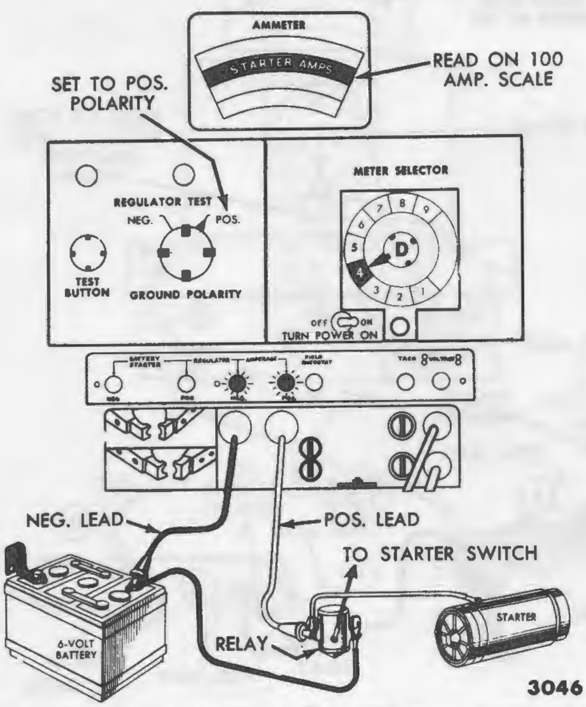


Fig. 42—Starter No-Load Test (Diagnosis Test Set)

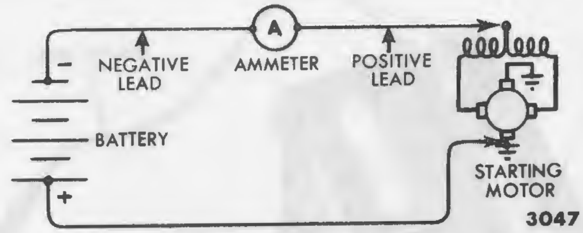


Fig. 43—Starter No-Load Test (On Test Bench)

Connections marked ① .... 0.5 volt
Connections marked ② .... 0.1 volt
Connections marked ③ .... 0.3 volt
Connections marked ④ .... 0.1 volt

(2) Starter Motor Repair. Starter motor repair procedures covered in this paragraph and illustrated in figs. 49 through 52 are removal and installation, complete disassembly, armature replacement, commutator turning and brush replacement.

In many cases it will not be necessary to completely disassemble the starter to accomplish repair or replacement of certain parts. "(c) Armature Replacement," "(d) Commutator Turning," and "(e) Brush Replacement" are procedures which eliminate the steps in disassembly that do not apply to these particular operations.

(a) Removal and Installation. In removing the starter motor first disconnect the starter cable at the starter terminal, then remove the bolt that holds the starter to oil pan attaching bracket to the oil pan. If the two through bolts are now loosened the entire starter motor may be removed.

NOTE: ***It may be necessary to tilt the starter motor slightly to clear the starter drive around the flywheel.***

When installing the starter motor, assemble the motor to the engine keeping the terminal screw vertical and on top of the starter. Tighten the outer through bolt enough to hold the starter in position. Install the oil pan bolt that holds the starter to oil pan attaching bracket, leav-

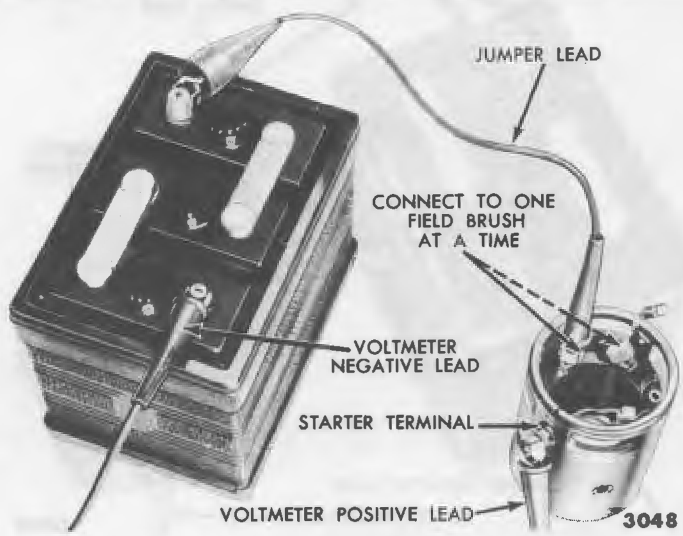


Fig. 44—Open Circuit Test of Field

oil pan attaching bracket may now be installed. Install the brushes in their holders being sure to center the brush springs on the brushes. Place the cover band on the starter and tighten the clamp screw. Install the starter drive.

(c) ARMATURE REPLACEMENT. Remove the starter drive, through bolts, rear end plate, and cover band. Be sure to remove all burrs from the shaft to prevent scoring the rear end plate bushing. Remove the armature.

Before installing the new armature, pull the brushes from their holders. Slide in the armature, and install the rear end plate and through bolts.

NOTE: ***The end plate dowel must be aligned with the slot in the starter frame.***

Replace the brushes in their holders and center the brush springs on the brushes. Install the starter drive.

(d) COMMUTATOR TURNING. Check the commutator runout as shown in fig. 14. If the surface of the commutator is rough or more than 0.002 inch out-of-round, turn it down in a lathe or with a turning tool, see fig. 51.

Polish the commutator with 00 or 000 *sandpaper* to remove all burrs left by the turning operation. Be sure no copper particles remain on the insulation between the segments.

NOTE: ***It is not necessary to undercut the mica on the starter motor commutator.***

(e) BRUSH REPLACEMENT. Replace the starter brushes when they are worn to 0.33 inch in length. Always change the complete set of brushes when any replacement is required.

Loosen and remove the cover band. Remove the two through bolts from the starter frame. Remove the brushes from their holders. Remove the brush-end plate and the armature rear end plate assembly. Unsolder the brush leads from the field coils. Unscrew the ground brush terminal screws and remove the ground brushes.

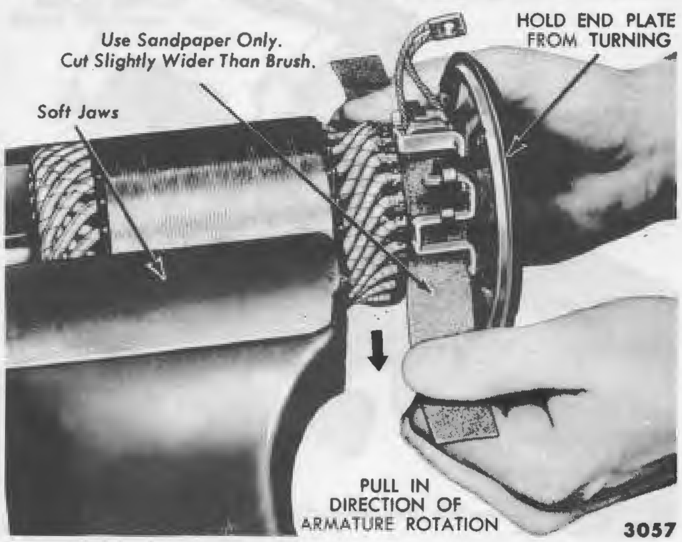


Fig. 52—Seating Starter Motor Brush

Clean the carbon and dirt from the brush end plate. Replace the brush end plate if the insulation between the field brush holder and the end plate is cracked or broken. Make sure the new brushes slide freely in the holders. Seat the new brushes by sanding (fig. 52).

Solder the new field brushes to the field coils. Connect the new ground brushes to the starter frame with the terminal screws. Install the brush end plate. Slide the armature rear end plate assembly in place.

NOTE: ***Make sure the locating dowels in both the brush-end plate and rear-end plate are located in the slots in the starter frame.***

Replace the two through bolts in the starter end plates. Place the brushes in their holders. Be sure to center the brush springs on the brushes. Install the cover band and tighten the clamp screw.

b. Starter Drive.

A spring type starter drive, fig. 53, is used on all trucks except F-7 and F-8, which use the barrel type starter drive shown in fig. 54.

Procedures covered in this section are: "(1) Removal and Installation," "(2) Cleaning and Inspection," and "(3) Repair."

(1) *REMOVAL and INSTALLATION.* The spring type starter drive is removed from the starter shaft by removing the two spring screws, the starter drive head, and the drive spring. Remove the woodruff key, and the shaft and pinion assembly can be taken from the starter shaft.

The barrel type drive (used on F-7 and F-8) is removed by taking out the drive pin located in the end of the starter drive. Remove the lock ring, anchor plate, and spring. Remove the drive pin. Slide the drive assembly off the shaft.

To install the drive assembly, line up the pin hole with the hole in the shaft. Insert the pin. Install the spring, anchor plate and lock ring.

When installing the spring type starter drive, be sure the tip of the drive head set screw enters the set screw seat in the starter shaft. Bend the tabs of the lock plates plates against the spring screws.

(2) *CLEANING AND INSPECTION.* A sticking starter drive can be cleaned in kerosene. Use a brush to remove grease and dirt from the worm threads and run

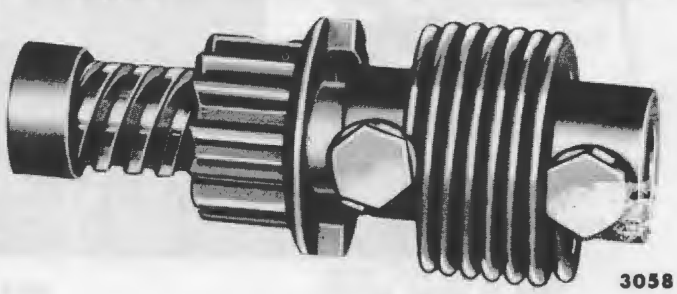


Fig. 53—Spring Type Starter Drive

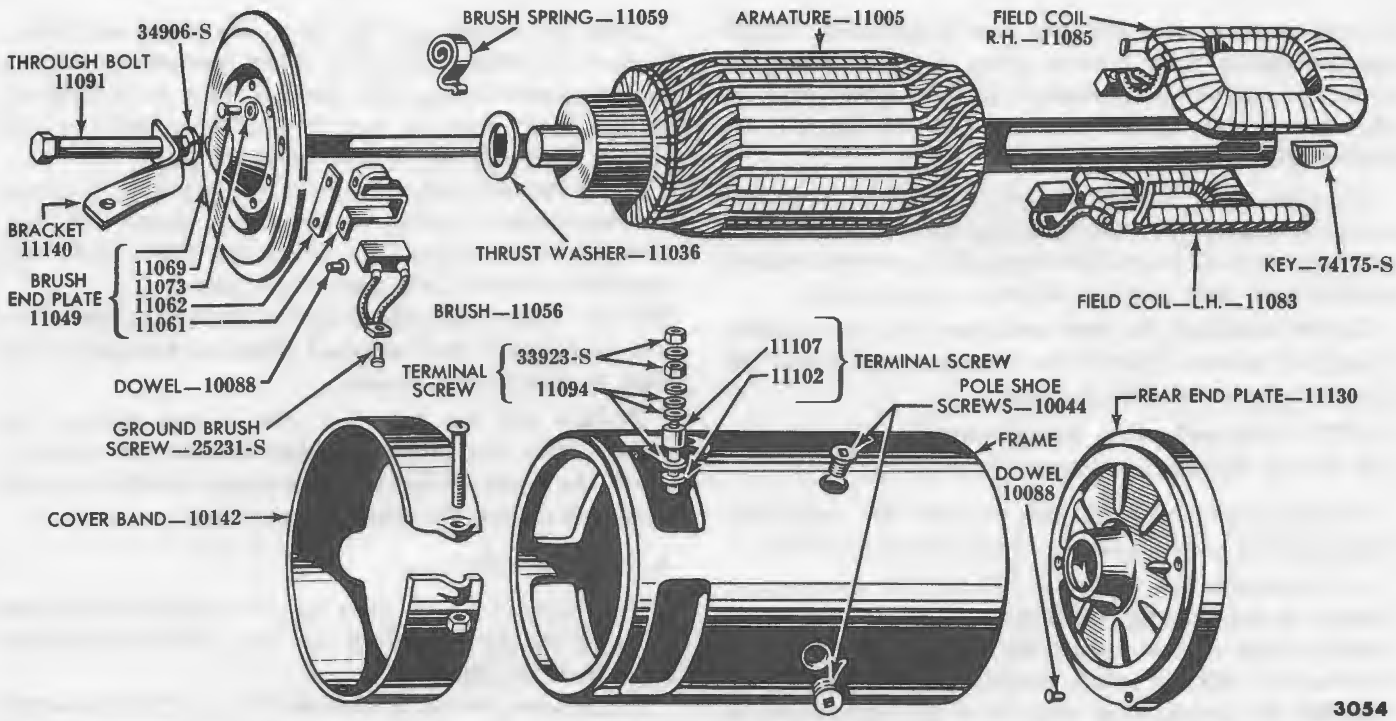


Fig. 49—Starter Motor—Order of Assembly or Disassembly

spring tension. It should be 48-56 oz. Replace the springs if the tension is not within limits. Inspect the field coils for burned or broken insulation. Check the field brush solder connections, and lead insulation.

(3) ASSEMBLY. Solder the leads of both field coils to the terminal screw. Install the coils with the terminal screw entered through the housing and install the field pole shoes and screws.

NOTE: ***As the screws are tightened, strike the frame several sharp blows with a soft-faced hammer to seat and align the pole shoes.***

Fig. 50—Removing Pole Shoe Screws

Install the insulator washers and terminal nut. Install the screws that connect the ground brushes to the starter frame. Install the brush end plate making sure the brush-plate dowel is located in the slot in the starter frame.

CAUTION: ***Do not pinch the brush leads between the end plate and the frame.***

Place the thrust washer on the commutator end of the shaft, slide the armature in place and install the rear end plate with the end plate dowel located in the starter frame slot. The through bolts along with the starter to

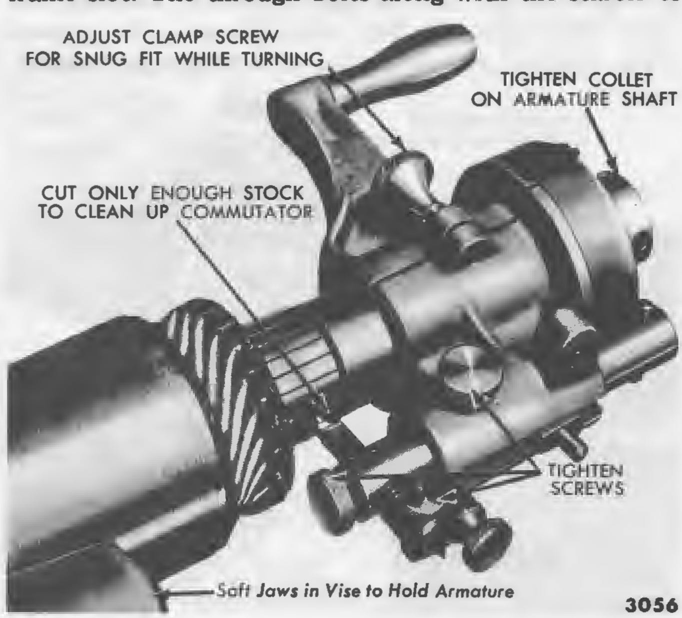


Fig. 51—Turning Starter Motor Commutator

the pinion back and forth on the threads until all grit is removed.

NOTE: ***Do not oil the starter drive. It should work freely after cleaning in kerosene.***

Inspect the pinion for burrs and broken or badly worn teeth. Check the action of the pinion on the worm threads. It should slide freely on the threads. Check the drive spring to see if it is cracked or broken, or the end loops or tangs are bent.

If any of the pinion teeth are badly worn, burred, or broken, it will be necessary to replace the pinion. Replace the drive spring if it is cracked, bent or broken.

(3) *REPAIR*. Smooth down any small burrs on the pinion teeth. If the pinion teeth are burred, be sure to check the teeth in the flywheel gear for burrs. If any of the parts are worn or broken and need replacing see "(a) Disassembly and Assembly (Spring Type)" or "(b) Disassembly and Assembly (Barrel Type)" below.

(a) DISASSEMBLY AND ASSEMBLY (SPRING TYPE.) Remove the drive from the shaft. Any of the parts may then be replaced since the drive is disassembled when removed.

To assemble the drive, replace the shaft and pinion assembly, install the woodruff key, starter drive head, spring, lockwashers, and screws. A disassembled view of the drive is shown in fig. 55.

A drive spring can be replaced on the spring type drive without removing the drive from the starter shaft.

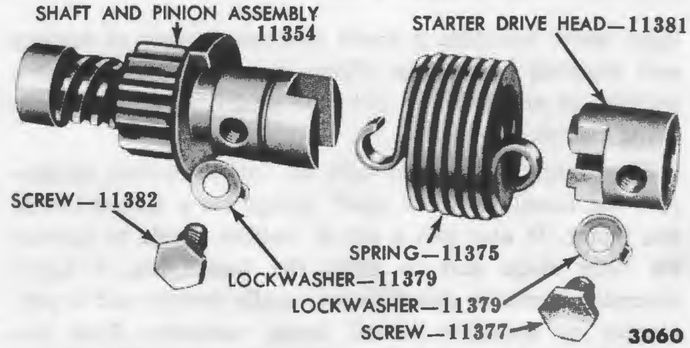


Fig. 55—Spring Type Starter Drive (Disassembled)

Remove the two screws from the drive head and the shaft and pinion assembly. Slip the spring off the head. After replacing the spring and screws, be sure to bend the lock washer tangs against the screw heads.

(b) DISASSEMBLY and ASSEMBLY (BARREL TYPE). Remove the drive from the shaft. Pry the retainer ring from the barrel and remove the drive shaft assembly. The meshing spring may then be removed from the barrel.

To assemble the barrel type drive, place the meshing spring and drive shaft assembly in the barrel. Install the retainer ring holding the drive shaft assembly to the barrel. Install the pin fastening the drive shaft assembly to the starter shaft. Place the spring in position with the tang in the slot of the drive shaft assembly anchor plate. Install the outer anchor plate and snap the lock ring on to the drive shaft assembly. A disassembled view of the barrel type drive is shown in fig. 56.

3. LIGHTING SYSTEM

An effective and efficient automotive lighting system is necessary for safe driving. The owner is required by law to keep the lighting system on his vehicle in good operating condition. Usually, the owner relies on his dealer for this service. Certain adjustments can be made periodically, to keep the lighting system operating at maximum efficiency.

Wiring diagrams are presented in figs. 57 and 58. Assembly and disassembly operations are illustrated when it is necessary to show details or changes in procedure.

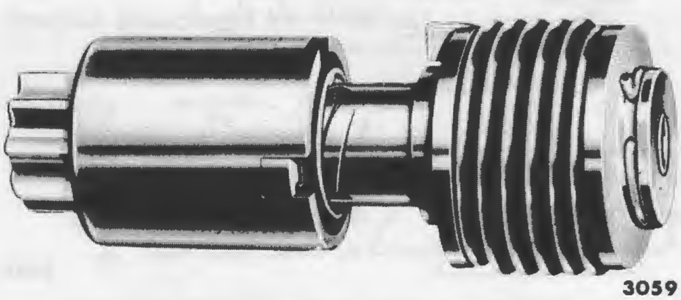


Fig. 54—Barrel Type Starter Drive

a. Headlight Alignment.

Two methods of headlight alignment are presented: "(1) Ford Headlight Tester," for dealers equipped with the approved Ford Tester, and "(2) Wall Screen," for those who do not have the Ford Tester.

Either test should be performed with the vehicle located on a reasonably level floor. The vehicle should be empty, the tires inflated to the recommended pressure, and the headlights on "high beam."

(1) *FORD HEADLIGHT TESTER*. The Ford head-

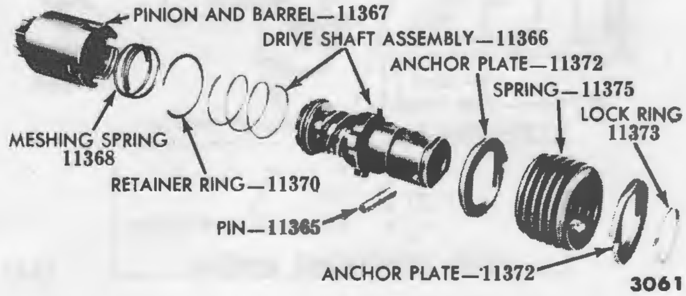


Fig. 56—Barrel Type Starter Drive (Disassembled)

light tester provides a rapid accurate means of testing and aligning headlights. Floor space requirements are reduced to an area only two feet longer than the vehicle being tested.

The tester is equipped with an optical system to project the headlight "hot spot" image on a screen inside the tester. It also has a set of bubble levels to correct for floor slope and to align the headlights, a light-intensity meter to check beam candle power, and a protractor to measure lateral beam variation from the centerline of the vehicle.

The headlight tester must first be corrected to the floor slope in the portion of the shop in which it is to be used. If the position of the tester can be fixed, only one check of floor slope is required. The procedure for the floor slope correction is outlined below in "(a) Correct Tester for Floor Slope." "(b) Test Headlight Alignment" describes the procedure to use in checking headlights. Where it is necessary to adjust the headlights, follow the procedure in "(c) Adjust Headlight Alignment."

(a) Correct Tester for Floor Slope. The procedure for correcting the tester to the floor slope is illustrated in fig. 59. Note that the trouble light on the Ford Diagnosis Test Set is used as a convenient reference level in the procedure. If the test set is not available, use a floor stand trouble light about 24″ to 30″ high for this purpose. The dial used to set the tester for headlight beam deflection must be set and kept at zero for this procedure.

The order in which the various steps of the procedure are to be made is given by the letters "A," "B," "C," etc., in the illustration.

(b) Test Headlight Alignment. To test the alignment of the headlights, locate the truck approximately at right angles to the tester floor rail with the truck centerline near the center of the rail. Align the tester with the hood centerline as shown in fig. 60. Be sure the horizontal protractor is at zero.

Set the headlight-beam scale to three inches down (black scale) at 25 feet and the horizontal protractor to zero. Place the rubber pad of the tester against the center of the headlight lens (fig. 61) and observe the projection of the headlight "hot spot" on the screen inside the tester. The ideal setting of the headlights would center the "hot spot" on the zero cross hairs inside the tester.

The allowable variation from the ideal setting is ±1½ inches vertical and ±3 inches horizontal. If the headlights are beyond these limits, they should be adjusted.

To determine the exact amount of variation, tilt the headlight tester with the vertical-adjustment knob until the "hot spot" is centered on the horizontal cross hair inside the tester. Adjust the headlight-beam scale until the bubble is in the center of the glass. The beam deflection can be read from the dial directly, as "inches deflection at 25 feet." The red scale shows positive or upward deflection. The black scale shows negative or downward deflection.

Now adjust the horizontal protractor until the beam "hot spot" centers on the vertical cross hair. The protractor will read lateral deflection from the car's centerline directly in degrees of angle, or as inches at 25 feet.

(c) Adjust Headlight Alignment. Headlight alignment is adjusted by means of two screws located under the headlight trim ring (fig. 62).

(2) *WALL SCREEN.* To align the headlights by means of a wall screen, a level portion of the shop floor is required. Lay out the floor and wall as shown in fig. 63.

Next, establish the headlight centerline by subtracting 30 inches from the actual height of the headlight lens center from the floor (see Table 1), and adding this dimension to the 30-inch reference line obtained by sighting over the uprights (dimension "B", fig. 64). Draw a horizontal line 3 inches below, and parallel to, the headlight centerline. Then draw the headlight center-

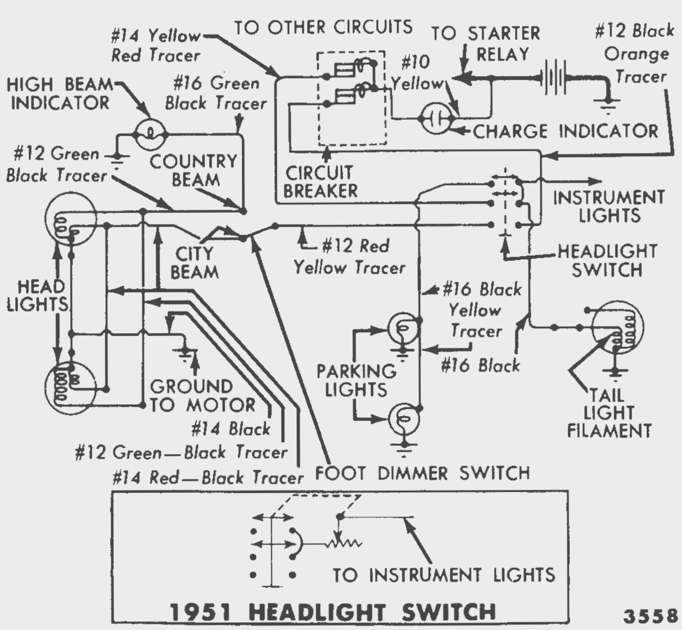


Fig. 57—Headlight Circuit Diagram

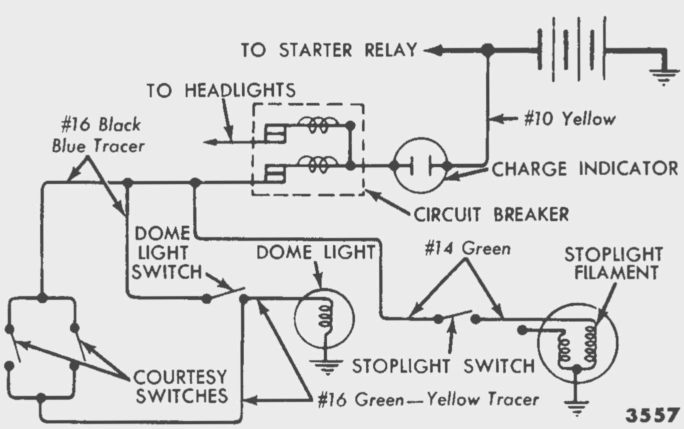


Fig. 58—Dome-Light and Stop-Light Diagram

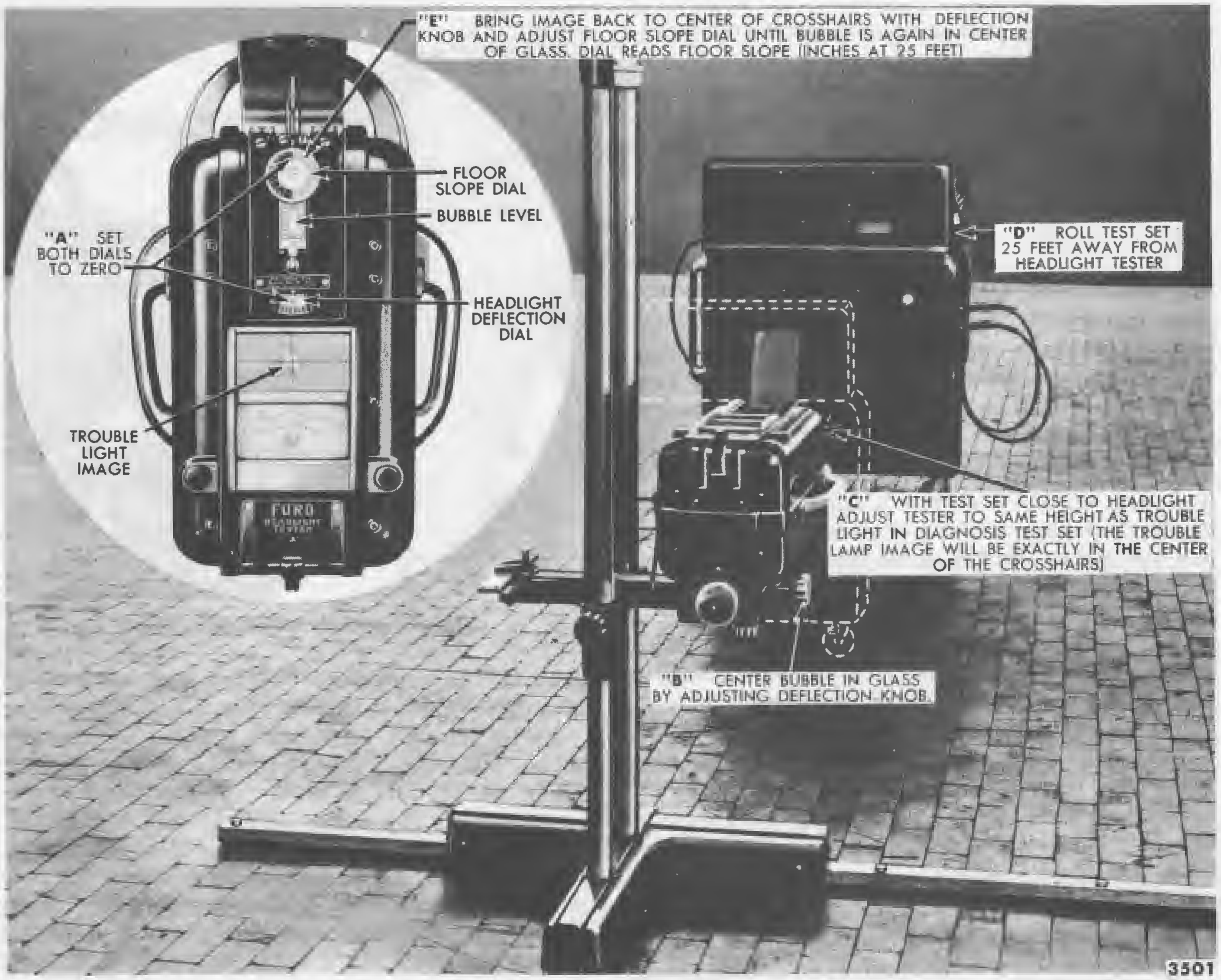


Fig. 59—Correcting Tester for Floor Slope

lines on the screen (dimension "A", fig. 64, 39¾ inches for conventional trucks; 49¾ inches for parcel delivery, C.O.E., and F-7 and F-8).

Position the vehicle as described in fig. 69. The center of intensity of the upper beam should fall on the screen as shown in fig. 64.

Table 1—Headlight Height

Model	Tire Size	Headlight Height (In.)
F-1	6.50 x 16	30⅛
F-2, F-3	7.50 x 16	32
F-3	7.00 x 17	32
F-3 (Par. Del.)	7.50 x 17	37⅓₂
F-4	7.00 x 18	34½
F-5, F-6 C.O.E.	7.50 x 20	35½
F-5, F-6	7.50 x 20	36
F-7	9.00 x 20	39
F-8	10.00 x 20	39½

b. Bulb Replacement.

Replacement of bulbs in the lighting system is illustrated in figs. 65 through 75. These illustrations cover headlights, road lights, spotlights, parking lights, tail, stop, and license plate lights, domelights, and instrument lights.

(1) *HEADLIGHTS.* The headlight is shown disassembled in fig. 65. Remove the retaining screw and headlight trim ring. Loosen the retaining ring screws and rotate the retaining ring counter clockwise and remove it. The headlight bulb may now be pulled forward far enough to disconnect the wiring assembly plug.

Plug in the new bulb and place in position, making sure the locating tabs are placed in the positioning slots. Install the retaining ring, rotating it clockwise under the screws and tighten the screws. Hook the trim ring at the top, pull it down into position and replace the screw.

(2) *ROADLIGHTS.* The roadlight is shown disassembled in fig. 66. Remove the retaining screw and trim

ring. The bulb may then be removed and the two terminal wires disconnected.

Attach the terminal wires to the new bulb, place the bulb in the retaining ring, and install the trim ring and retaining screw.

(3) *SPOTLIGHT.* The spotlight is shown disassembled in fig. 67. Remove the clamping screw and retaining ring, this allows the removal of the spotlight bulb. The two connecting wires may then be removed and a new bulb installed and the retaining ring fastened in place.

(4) *PARKING LIGHT.* To replace the bulb in the parking light remove the retaining screws, retaining ring, lens, and gasket as shown in fig. 68 or 69. The bulb is the single contact bayonet type. After the bulb is replaced, the gasket, lens and retaining ring are then replaced.

(5) *TAIL, STOP AND LICENSE PLATE LIGHTS.* The truck tail and stop light is shown disassembled in fig. 70. To replace the bulb, remove the retaining ring, lens and gasket. The bulb is the bayonet type, removed by pushing in, twisting, and pulling out the bulb.

The panel truck tail and stop light is illustrated in fig. 71. To replace the bulb, remove the two trim plates, loosen one lens retainer, and remove the other. Remove the lens and gasket to gain access to the bulb.

The panel truck license plate is shown in fig. 72. Remove the retaining ring screws, retaining ring, lens, and gasket. The bulb may then be removed.

(7) *INTERIOR LIGHTS.* A truck dome light is shown disassembled in fig. 73. The bulb is accessible when the cover is removed.

CAUTION: ***Do not use larger than 3 Candle Power bulb in dome lights equipped with a plastic lens.***

(8) *INSTRUMENT LIGHTS.* The instrument panel light bulbs can be replaced by pulling out the individual light sockets from the rear of the panel (figs. 74 and 75).

c. Switches.

Illustrated procedures for the replacement of the headlight switch, beam-control switch, stop-light switch, dome-light switch and ignition switch are given here.

(1) *HEADLIGHT SWITCH.* Remove the control knob and shaft from 1950 and 1951 models by pressing the spring-release button on the switch housing with the knob in the OFF position. Turn the shaft slightly and pull it out of the switch. On 1949 models, the shaft is released by inserting a small screw driver in a slot provided in the switch housing and compressing the retainer inside the housing. Turn the shaft slightly and pull it out of the switch.

Unscrew the mounting nut as shown in fig. 76. Remove the switch and disconnect the wires.

To install the switch, connect the wires to their terminals, insert the switch in the instrument panel, and

Fig. 61—Test Headlight Alignment

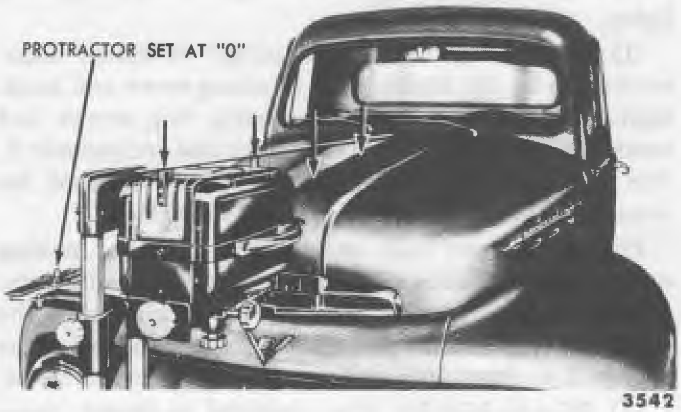


Fig. 60—Align Tester with Vehicle

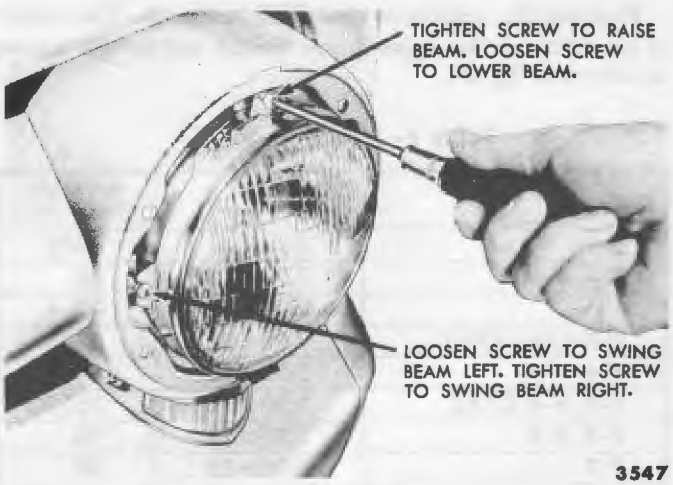


Fig. 62—Headlight Adjustment

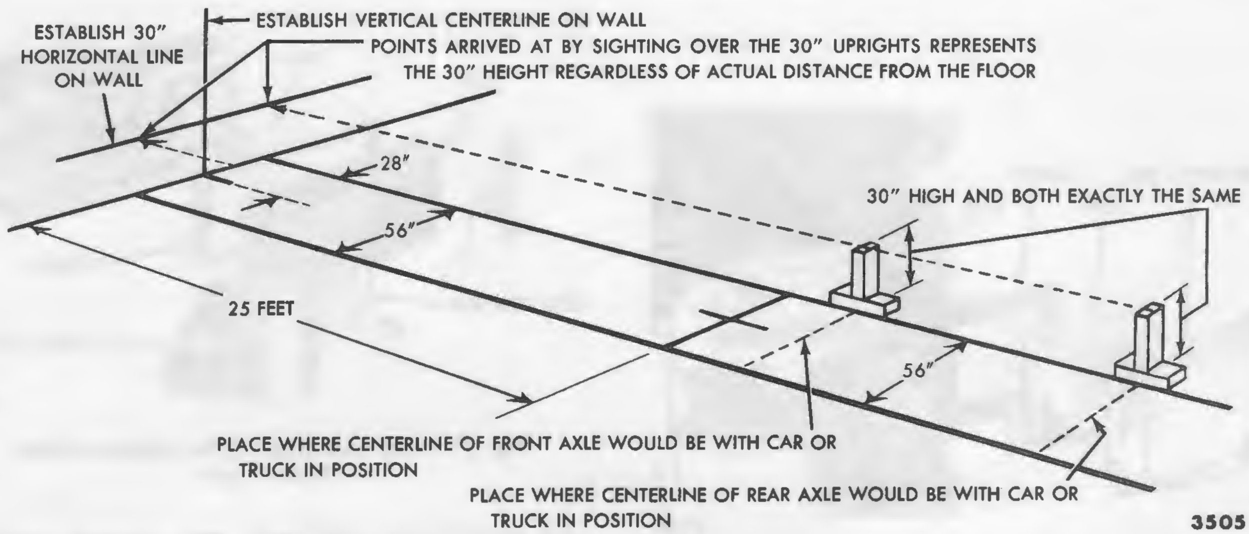


Fig. 63—Floor and Wall Layout

install the mounting nut. Install the knob and shaft assembly by inserting it all the way into the switch until a distinct click is heard. In some instances it may be necessary to rotate the shaft slightly until it engages the switch-contact carrier.

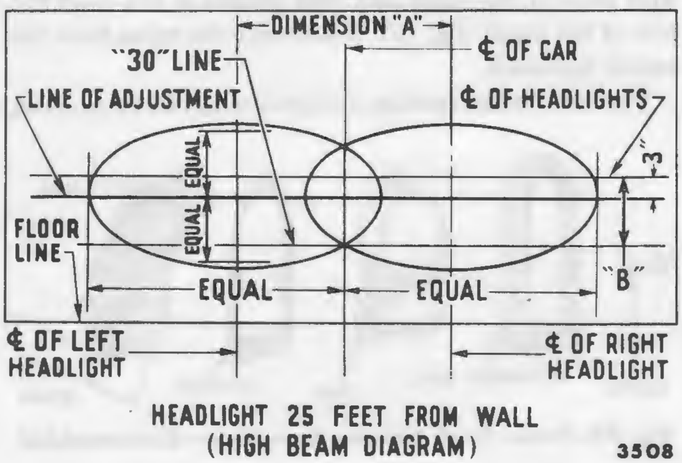


Fig. 64—Wall Screen

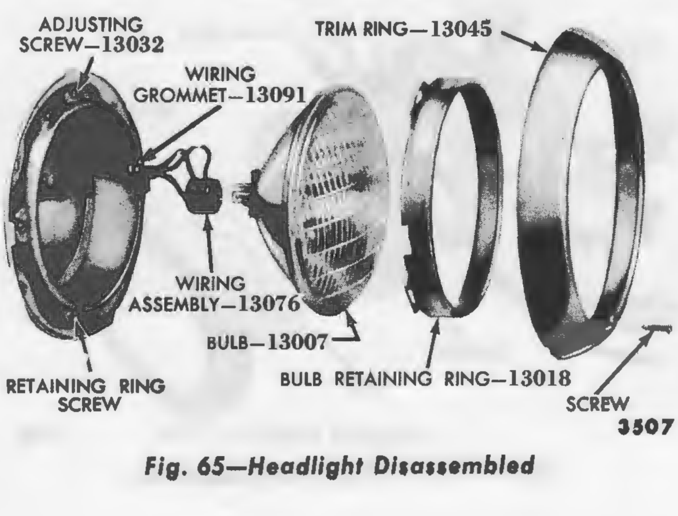


Fig. 65—Headlight Disassembled

(2) *HEADLIGHT BEAM CONTROL SWITCH.* Lay the floor mat back from the area of the switch, and remove the mounting screws (fig. 77). Remove the switch and disconnect the three wires at the switch.

Install the switch by connecting the wires to the

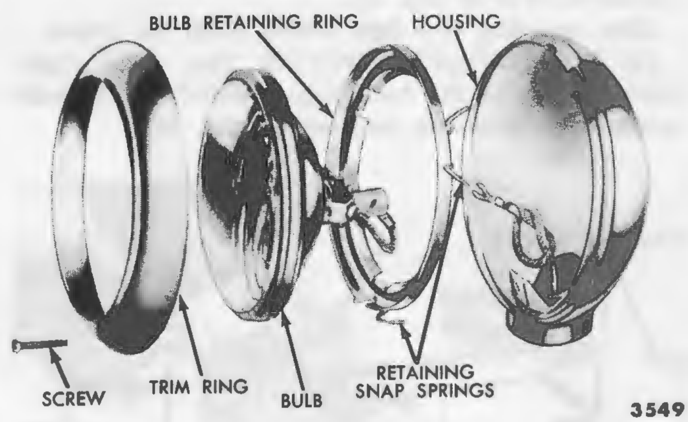


Fig. 66—Roadlight Disassembled

Fig. 67—Spotlight Disassembled

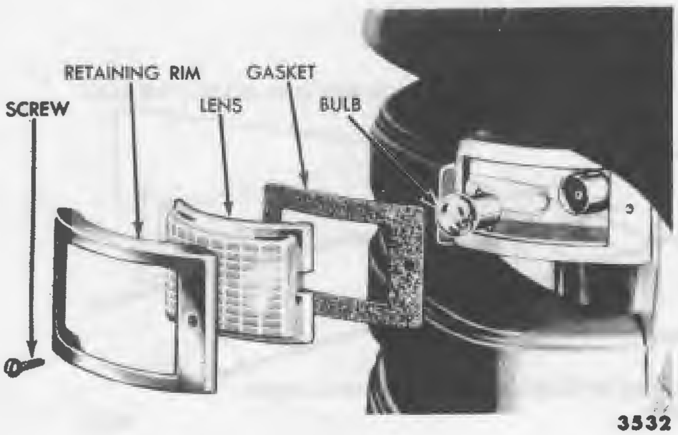


Fig. 68—Parking Light Disassembled (1949-1950)

switch terminals, inserting the switch through the toe board, and securing it with the screws. Replace floor mat.

(3) *STOP-LIGHT SWITCH.* Disconnect the wires at the bullet connectors and unscrew the switch from the master cylinder (fig. 78).

After installing stop light switch bleed the brakes.

(4) *DOME-LIGHT SWITCH.* The dome light switch is part of the dome light assembly. It is made accessible by removing the assembly (fig. 73).

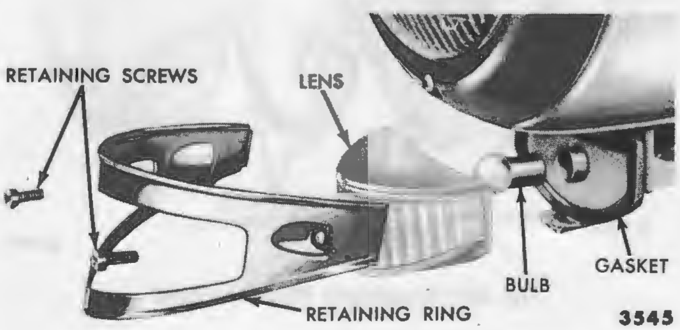


Fig. 69—Parking Light Disassembled (1951)

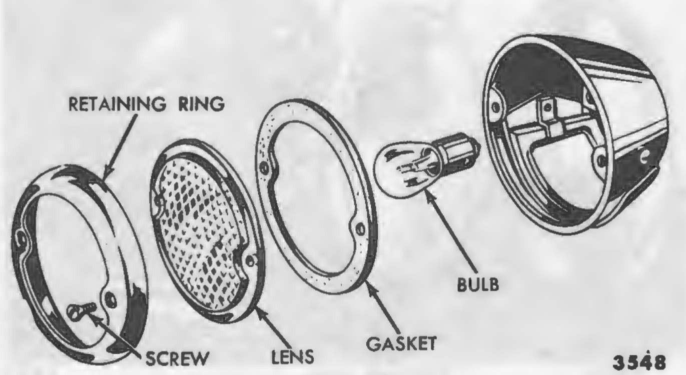


Fig. 70—Tail, Stop, and License Plate Light—Disassembled

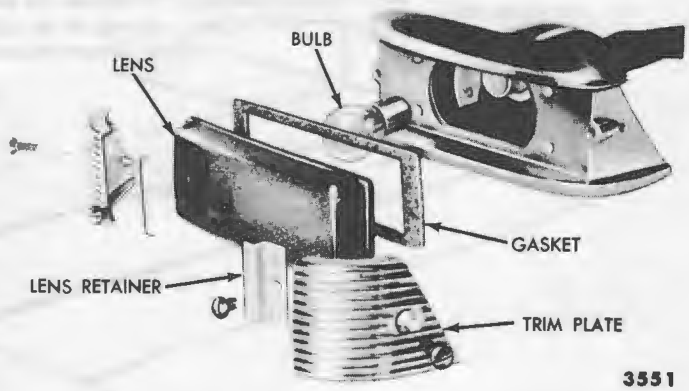


Fig. 71—Tail and Stop Light—Disassembled (Panel Truck)

(5) *IGNITION SWITCH.* The ignition switch is removed and installed from 1949 and 1950 trucks at the rear of the instrument panel. The bezel must first be removed by prying it away from the panel. Be careful not to scratch the finish on the panel. The ignition switch can now be removed by turning it ⅛ turn clockwise (viewed from the driver's position) until the lugs line up with slots in the panel and then pulling it out from the rear of the panel (fig. 79). Disconnect the wires from the switch terminals.

The 1951 model ignition switch is removed by pressing

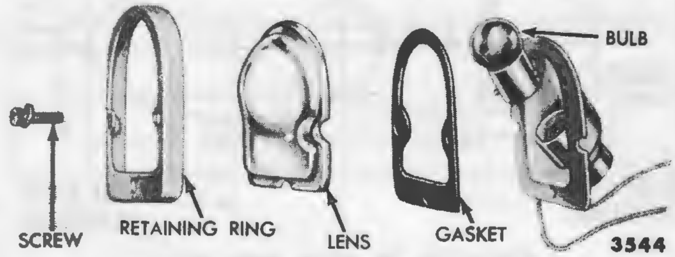


Fig. 72—Panel Truck License Plate Light—Disassembled

Fig. 73—Dome Light—Disassembled

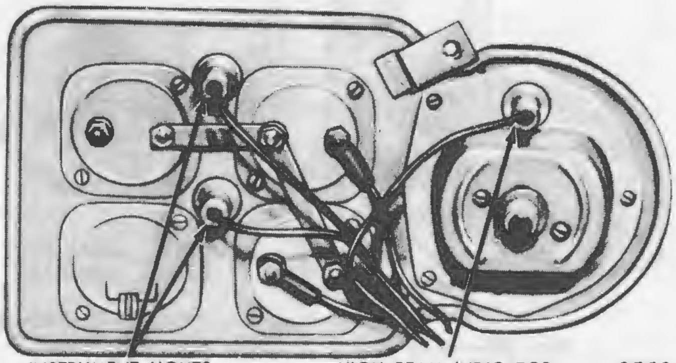


Fig. 74—Instrument Panel Lights (1949 and 1950)

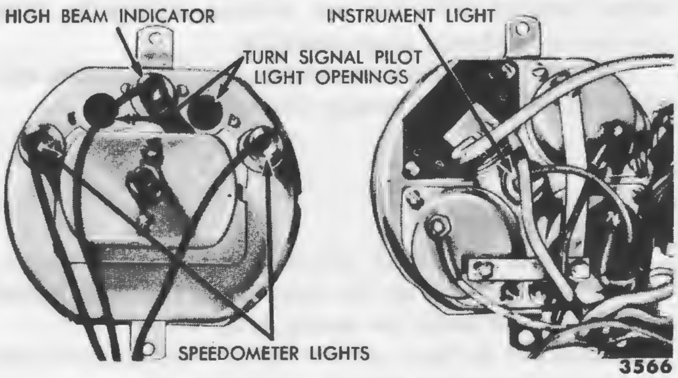


Fig. 75—1951 Instrument Panel Lights

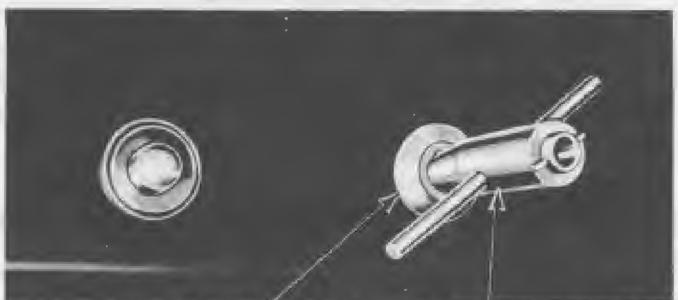


Fig. 76—Removing Headlight-Switch Mounting Nut

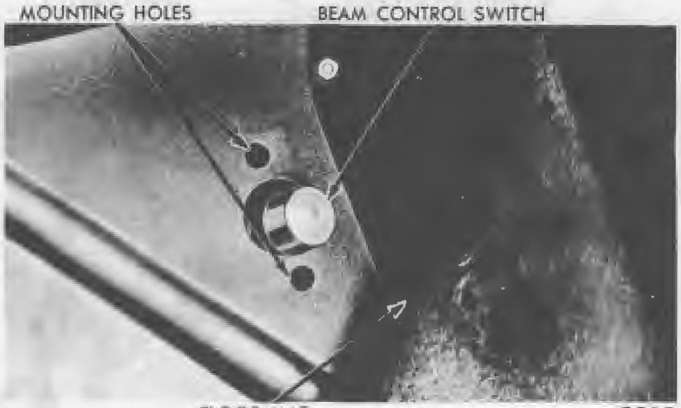


Fig. 77—Headlight Beam Control Switch

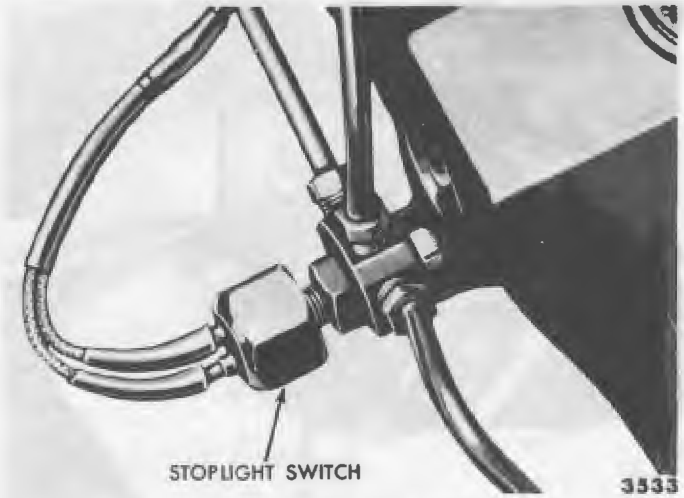


Fig. 78—Stop-Light Switch

in the switch body from the rear of the panel, rotating it ¼ turn counterclockwise (fig. 80), then removing the switch at the rear of the panel.

When installing the switch on 1949 and 1950 models, be sure to align the small projection behind the top lug with its slot in the panel, to keep the switch from rotating.

d. Circuit Breaker and Fuses.

All trucks use a combination circuit breaker assembly (figs. 81 and 82). One of the circuit breakers prevents overload of the headlight circuit and the other prevents overload of the balance of the lighting circuits.

The action of the breaker is thermostatic in nature. If the current becomes excessive, the bi-metal breaker arm heats, pulls away from the contact point, and breaks the circuit. When the breaker cools, contact is again made and the circuit is restored. The breaking action is positive with no "fluttering" of the contacts.

Breaker assemblies are mounted on the rear of the instrument panel, as shown in fig. 83. They can be

Fig. 79—Removing Ignition Switch (1949 and 1950)

Fig. 80—Removing Ignition Swtch (1951)

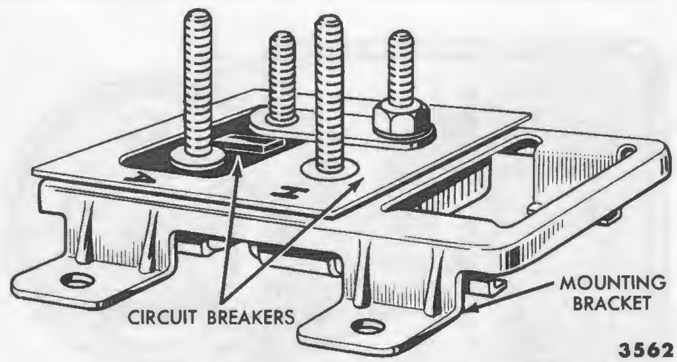


Fig. 82—1951 Circuit Breaker Assembly

removed by disconnecting the wires at the breaker and fuse terminals and removing the mounting screws. Individual breaker units are not serviced separately, they can be replaced only as an assembly.

1951 circuit breakers are mounted at the opposite end of the panel from the breaker shown in fig. 92.

4. HORNS

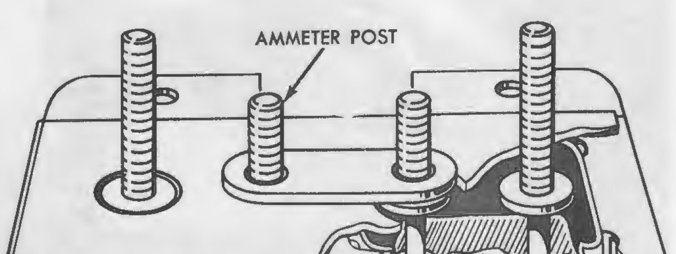
Deluxe trucks are equipped with a pair of tuned horns controlled by means of a relay. The horn button closes the relay contacts completing the circuit to the horns. One of the horns has a high pitched tone; the other has a low pitched tone.

a. Tests and Adjustment.

The horn test procedure describes the current and voltage test under "(1) Current Draw Test". "(2) Adjustment" describes the tone adjustment on the horn.

(1) *CURRENT DRAW TEST*. Connect a voltmeter and ammeter to the horn and a voltage supply as shown in fig. 84. The normal current draw for the horns at 6.2 to 7.2 volts is 15 to 17 amperes.

(2) *ADJUSTMENT*. Tone is adjusted by changing the contact gap (fig. 85). Connect the horn as described in "(1) Current Draw Test" above. Back off the lock nut and adjust the tone-adjusting nut until the current is within the limits for the horn being adjusted. Then tighten the lock nut and recheck the current draw.



Fg. 81—Truck Circuit Breaker Assembly (1949 and 1950)

b. Replacement.

The horns on deluxe cab conventional and C.O.E. trucks are mounted on the hood brace (fig. 86). Parcel delivery model horns are shown in fig. 87.

Disconnect the horn wires at the terminals, remove the mounting screws and remove the horns.

To install, place the horn in position and install the mounting screws. Install the horn wire.

c. Horn Button Removal.

The horn button assembly (fig. 88) can be removed by pressing down evenly on the button and turning it counterclockwise until it lifts out. It is advisable to disconnect the bullet connector at the lower end of the steering column to prevent the horn from sounding during this operation.

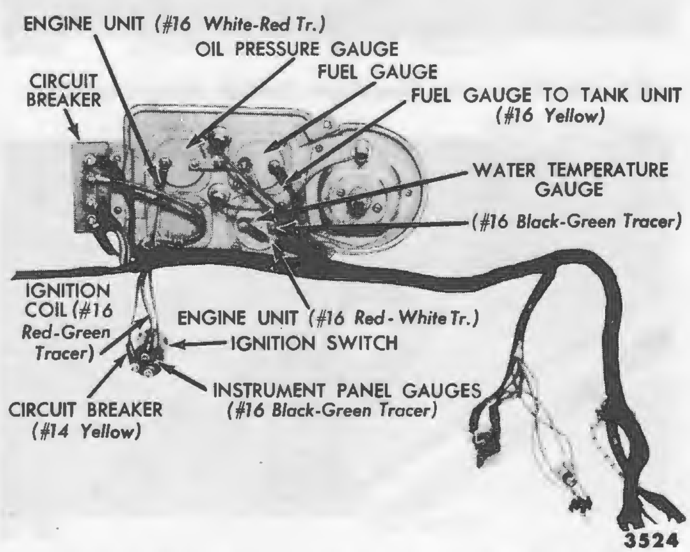


Fig. 83—Circuit Breaker Location (1949 and 1950)

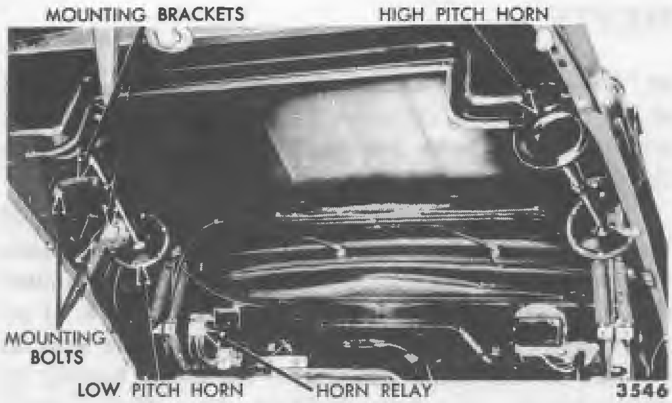


Fig. 86—1951 Horn Installation (Deluxe Cabs)

tacts. The cycle then repeats. Since the current to the heating coil in the tank unit must also flow through the heating coil in the gauge unit, the amount of heat supplied to the gauge unit is the same as that in the tank unit and is controlled by the average current flowing through the circuit due to the repeated opening and closing of the contacts in the tank unit. With the tank empty, the gauge bimetal therefore assumes the same relative position as the tank unit bimetal and the pointer is at the "E" position on the gauge.

When the tank is filled, the float rises with the fuel level in the tank and the cam moves the grounded contact toward the bimetal arm, increasing the tension holding the contacts closed. A greater amount of current is required to heat the tank unit bimetal arm enough to cause it to open the contacts. A similar greater bending of the bimetal arm in the gauge unit results in a movement of the needle toward the "F" (full position point) of the scale.

Because the bimetal changes temperature rather

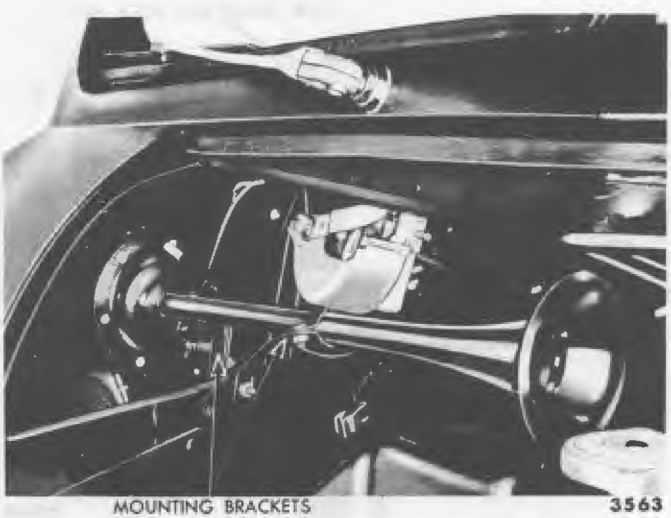


Fig. 87—Horn Installation (Parcel Delivery)

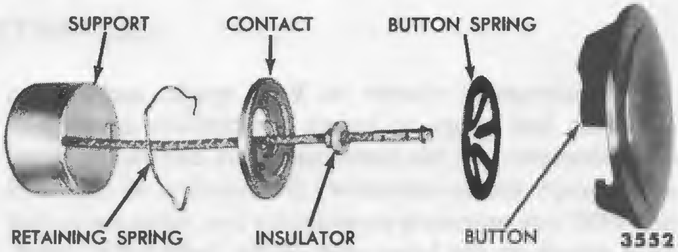


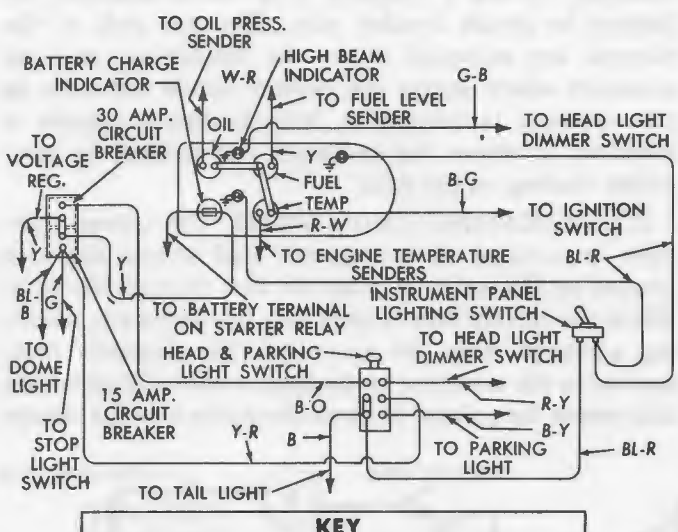
Fig. 88—Horn Button—Disassembled

slowly, the effects of sudden changes in fuel level are reduced and a steady reading of the average level in the tank is indicated by the gauge.

(2) *FUEL GAUGE SYSTEM TEST.* Tests of the fuel gauge system are divided into "(a) Gauge Unit Test" and "(b) Sending Unit Test." The method presented for testing the fuel gauge unit can also be used to check the temperature gauge unit and the oil pressure gauge unit.

(a) GAUGE UNIT TEST. Connect a voltmeter and variable resistor to the gauge terminals as shown in fig. 93.

Disconnect the sending unit to gauge wire at the tank unit and turn the ignition switch ON. Adjust the resistance until a voltmeter reading of 1.5 volts is obtained. The gauge pointer should read approximately ½ scale. CAUTION: ***Be sure the full resistance is in the circuit before connecting the leads to the gauge unit to prevent any possibility of applying too much voltage to the gauge.***



KEY

B	Black	G-B	Green—Black Tracer
B-G	Black—Green Tracer	R-W	Red—White Tracer
B-O	Black—Orange Tracer	R-Y	Red—Yellow Tracer
B-Y	Black—Yellow Tracer	W-R	White—Red Tracer
BL-B	Blue—Black Tracer	Y	Yellow
BL-R	Blue—Red Tracer	Y-R	Yellow—Red Tracer
G	Green		

3553

Fig. 89—Instrument Cluster Circuits (1949 and 1950)

5. INSTRUMENTS

The instrument cluster on Ford trucks includes an ammeter, fuel gauge, oil gauge, temperature gauge, and a speedometer. All the instruments are electrically operated except the speedometer. Illumination of the 1949 and 1950 instruments is provided by two lights controlled by a switch on the lower part of the instrument panel. 1951 instruments are illuminated by three lights controlled by a rheostat on the lighting switch.

This section contains information on operating principles and tests of the various units in the instrument cluster assembly. A circuit diagram showing the connections of the gauges and lights in the 1949 and 1950 assembly is shown in fig. 89. The 1951 instrument cluster circuit is shown in fig. 90.

The instrument cluster assembly can be removed by first disconnecting the instrument wires, then removing the light sockets, the speedometer cable, and the two mounting screws. The cluster can be lifted out at the rear of the instrument panel. When installing the cluster, be sure to move all wiring and control cables away from the opening in the instrument panel (fig. 91).

Individual instruments can be removed without removing the assembly. Disconnect the instrument wires, remove the slotted mounting screws which retain the instrument in the cluster assembly, and remove the instrument.

a. Charge Indicator.

The charge indicator used is a magnetic loop type ammeter. It has a magnetic loop which encircles the battery to circuit breaker wire. The two ends of the element are mounted inside the instrument near an armature which moves the pointer across the scale as the armature is rotated. A large horseshoe magnet is mounted to return the armature and pointer to zero-center reading on the scale.

(1) *OPERATING PRINCIPLES.* The charge indicator is operated by a magnetic field around the wire created by the action of a current flow through the wire. When the current flow is such that the battery is receiving a charge from the generator, the magnetic field, applied to the armature by the loop, rotates the armature and causes the pointer to move clockwise into the charge or "C" scale. When the flow of current through the wire is in the opposite direction (battery discharging), the armature and pointer are rotated counterclockwise into the discharge or "D" scale.

(2) *CHARGE-INDICATOR TEST.* A simple test of the charge indicator is made by turning the headlights ON with the engine not running. The meter pointer should move toward the "D" or discharge scale. If no movement of the needle is observed, check the loop on the rear of the meter housing to see if the battery to circuit breaker wire passes inside the loop. If the wire is in the loop and the meter does not indicate a discharge, the meter is inoperative.

NOTE: ***If the meter pointer moves toward the "C" or charge scale when the headlights are turned ON, the wire passes through the loop in the wrong direction. Feed the wire through in the opposite direction to correct this condition.***

b. Fuel Gauge.

The fuel gauge consists of a sending unit located on the gas tank and a remote register unit (fuel gauge) mounted in the instrument cluster. The sending unit makes use of a bimetal element and heating coil to control the average current flowing through the gauge circuit. The position of the gauge pointer is controlled by another bimetal and heating coil. The fuel gauge circuit is shown in fig. 92.

(1) *OPERATING PRINCIPLES.* When the fuel tank is empty, the contacts in the tank unit are just touching (see fig. 92). With the ignition switch ON, current flows through the circuit and warms the tank unit bimetal by means of the heating coil, causing the bimetal to bend and the contacts to open. The current is interrupted, allowing the bimetal to cool and close the con-

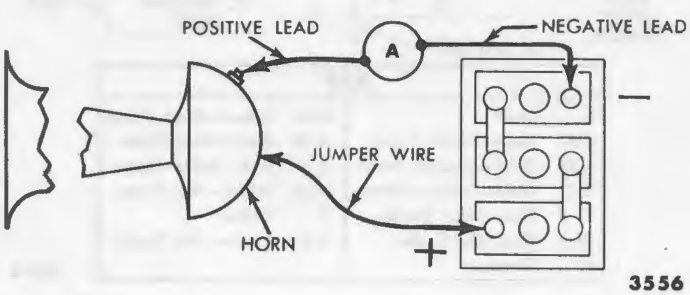


Fig. 84—Horn Current Draw Test

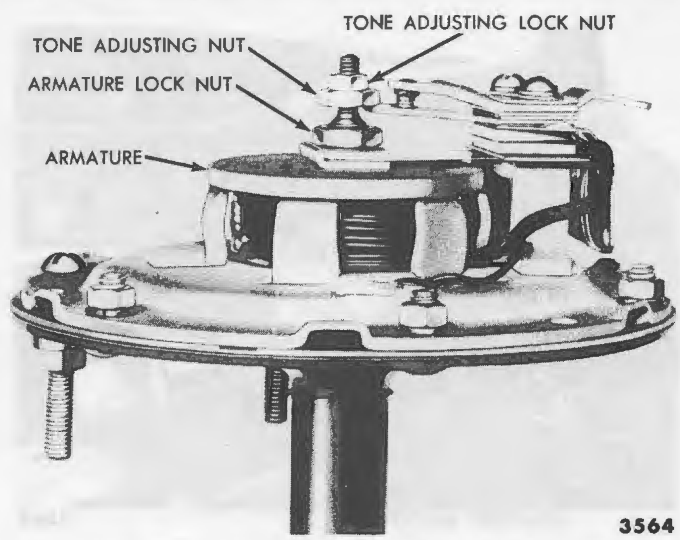


Fig. 85—Horn Adjustments

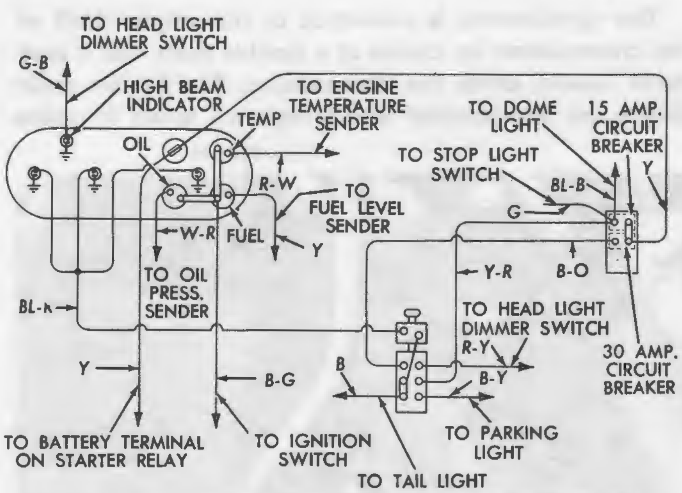
(b) SENDING UNIT TEST. The sending unit can be tested by substituting a new gauge for the existing gauge unit. Determine the approximate fuel level in the tank. Remove the wires from the old gauge unit and connect in the new gauge unit. If the new gauge registers correctly, the sending unit is good. If the pointer of the new gauge does not indicate or moves all the way to the opposite stop, the sending unit is faulty.

c. Oil Pressure Gauge.

The oil pressure gauge consists of a sending unit on the engine and a remote register unit in the instrument cluster. It operates on the same principle as the fuel gauge with the exception that the tension on the sending unit bimetal is varied by variation in the oil pressure against a diaphragm on which the grounded contact is mounted. The oil-gauge circuit is shown in fig. 94.

(1) *OPERATING PRINCIPLES.* When there is no oil pressure, the contacts in the sending unit are just touching, and the gauge pointer registers at the "0" position. Any increase in oil pressure bends the diaphragm, which in turn increases the tension on the bimetal arm. More heat must be supplied to cause the contacts to open and a resulting increase in average current flow to supply this heat, also heats the bimetal arm in the gauge unit. The gauge bimetal deflects the pointer to show the oil pressure reading on the gauge face.

(2) *OIL PRESSURE GAUGE SYSTEM TEST.* Tests of the oil pressure gauge system are described below in "(a) Gauge Unit Test" and "(b) Sending-Unit Test."



KEY			
B	Black	G-B	Green—Black Tracer
B-G	Black—Green Tracer	R-Y	Red—Yellow Tracer
B-O	Black—Orange Tracer	R-W	Red—White Tracer
B-Y	Black—Yellow Tracer	W-R	White—Red Tracer
BL-B	Blue—Black Tracer	Y-R	Yellow—Red Tracer
BL-R	Blue—Red Tracer	Y	Yellow
G	Green		

3554

Fig. 90—Instrument Cluster Circuit (1951)

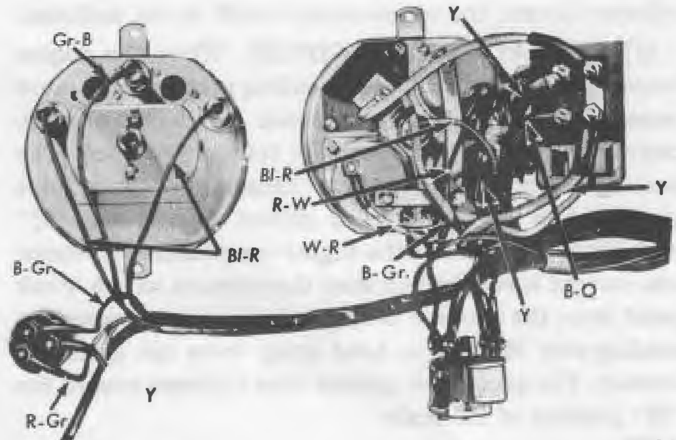


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Fig. 91—Instrument Cluster (1951)

(a) GAUGE UNIT TEST. Perform the same test described for the fuel gauge and illustrated in fig. 93. The oil gauge pointer should read approximately ½ scale.

(b) SENDING UNIT TEST. The sending unit can be tested by substituting a new gauge for the existing gauge unit. Start the engine to determine if the new gauge registers oil pressure. If no reading is obtained, check the sending unit to gauge wire. If the wire is not broken and all connections are tight, replace the sending unit.

(3) *SENDING UNIT REPLACEMENT.* Sending units are removed and installed on the 8-cylinder engine by using a special tool as shown in fig. 95. On the 6-cylinder engine the sending unit is accessible and a standard wrench can be used for removing or installing it.

d. Temperature Gauge.

The temperature gauge consists of a sending unit mounted in the cylinder head and a remote register unit mounted on the instrument panel. On 8-cylinder models, a thermal switch is also included in the circuit (fig. 96) to register boiling temperature in the second cylinder bank. The principle of operation is similar to the fuel gauge except the tension on the sending-unit bimetal is varied by engine temperature. In the 6-

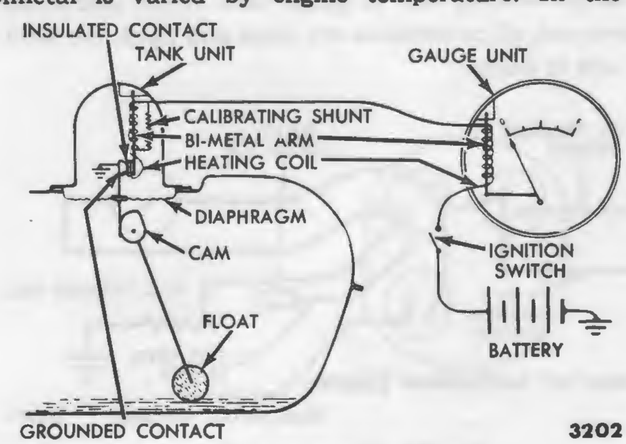

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Fig. 92—Fuel Gauge Circuit

cylinder circuit, the temperature switch is not included.

(1) *OPERATING PRINCIPLES.* When the engine is cold, the bimetal arm in the sending unit has maximum tension holding the contacts closed. Maximum average current is necessary to cause the contacts to open. The heating effect of the current causes the gauge unit bimetal arm and pointer to deflect toward the "C" position of the scale. As the engine temperature increases, less current is required to keep the contacts at the break point since the increase in engine temperature causes the sending-unit bimetal to bend away from the grounded contact. The gauge-unit pointer then registers toward the "H" position of the scale.

The center mark on the gauge face is considered "Normal" operating temperature and the "H" mark is the boiling temperature.

On 8-cylinder engines, the thermal switch can be identified by the two terminal connectors (the sending unit has only one connector). The switch is set to open at 200-212°F. With a sending unit in one cylinder bank and the switch in the other cylinder bank, the gauge unit will indicate a boiling condition in either bank. This arrangement is necessary because of the possibility of one bank operating hotter than normal due to restricted coolant flow.

(2) *TEMPERATURE GAUGE SYSTEM TEST* Three tests of the temperature gauge system are outlined below under the following headings "(a) Gauge Unit Test," "(b) Sending Unit Test," "(c) Thermal Switch Test."

(a) Gauge Unit Test. Perform the same test described for the fuel gauge and illustrated in fig. 93. The temperature-gauge pointer should read approximately ½ scale.

(b) Sending Unit Tests. The sending unit can be tested by substituting a new gauge unit for the existing one. Start the engine and allow it to warm up to normal temperature. If no reading is indicated on the new gauge, check the sending unit to gauge wire. If the wire is not broken and all connections are clean and tight, the sending unit is faulty.

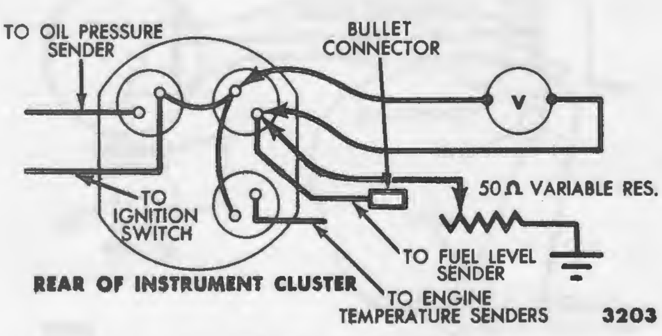


Fig. 93—Gauge Unit Test

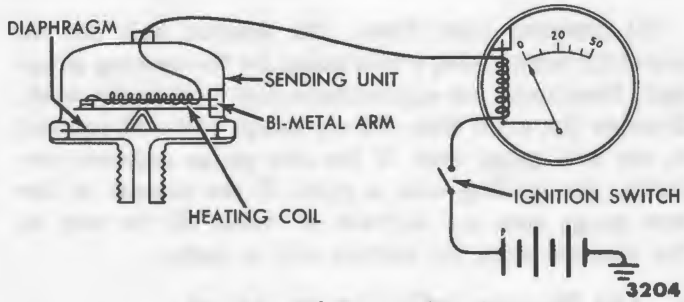


Fig. 94—Oil Gauge Circuit

NOTE: ***On 8-Cylinder engines, remove a wire from one terminal of the thermal switch and connect it to the other terminal during this test.***

(c) Thermal Switch Test. The thermal switch should be closed at all temperatures below boiling. The switch can be tested with a test light and battery, an ohmmeter, or a dwell meter. It should show continuity (i.e. the test light should be "on," the ohmmeter should read "0" ohms, or the dwell meter should read 100% dwell) when the test leads are connected to the switch terminals.

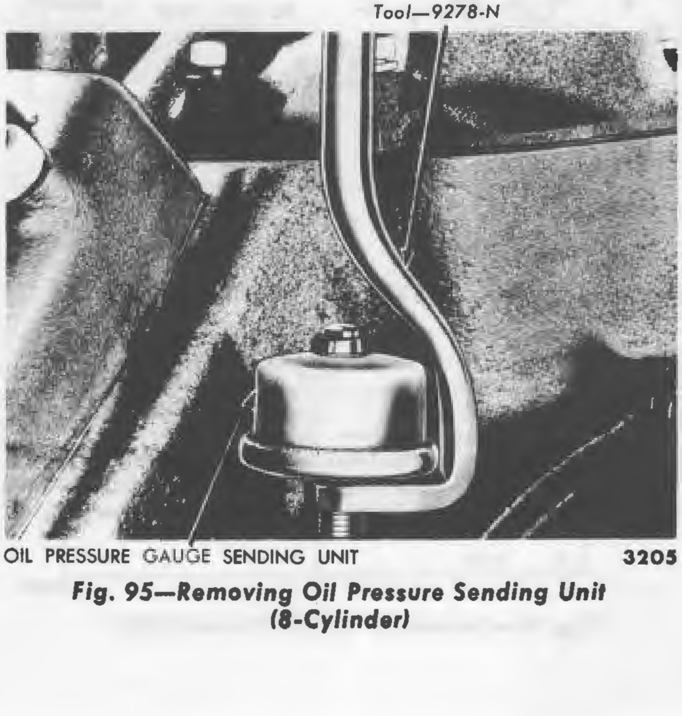
The switch can also be tested to determine if it will open at boiling temperatures by placing the bulb in boiling water and testing it with a test light and battery, an ohmmeter, or a dwell meter. After a short time of immersion the switch should open.

(3) Sending Unit or Thermal Switch Replacement. The sending unit or the thermal switch can be removed by disconnecting the wire (s) at the unit terminals and unscrewing the unit from the cylinder head.

e. Speedometer.

The speedometer is connected to the output shaft of the transmission by means of a flexible shaft and a gear drive located inside the transmission. The flexible shaft drives the speedometer which registers speed in miles

Tool—9278-N



OIL PRESSURE GAUGE SENDING UNIT 3205

Fig. 95—Removing Oil Pressure Sending Unit (8-Cylinder)

per hour and also drives an odometer which records distance traveled in miles and tenths of a mile.

(1) *SPEEDOMETER TESTS.* The procedure recommended for testing odometer accuracy is to drive the vehicle over a "measured mile" and determine the readings increase on the odometer by subtracting starting mileage from finishing mileage. Speedometer accuracy can be checked by comparing the speedometer in question against one known to be accurate while the two vehicles are moving at the same speed.

Most cases of speedometer inaccuracy are due to a change to non-standard tire sizes without changing the speedometer drive gear ratio. Table 2 shows the correct speedometer drive gear ratio to use for various tire sizes.

(2) *SPEEDOMETER CABLE REPLACEMENT.* To replace the speedometer drive cable, disconnect the cable housing at the speedometer and pull the cable out of the housing. Insert a new cable all the way into the housing and twist it slightly to make sure the squared drive engages in the transmission drive bushing.

NOTE: ***If a speedometer cable is broken, it will be necessary to disconnect both ends of the cable housing in order to remove the broken sections.***

The housing is fastened to the transmission by means of a clip and screw as shown in fig. 97.

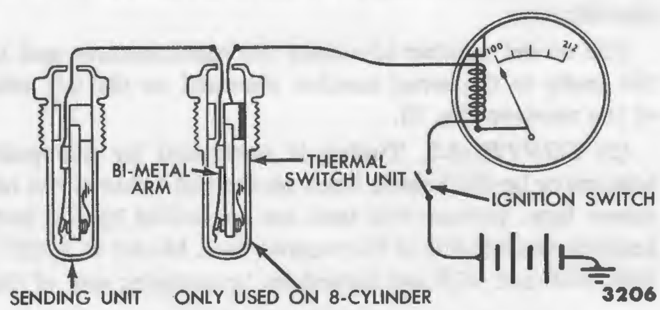


Fig. 96—Temperature-Gauge Circuit

3210

Fig. 97—Speedometer Cable Housing—Transmission Mounting

Table 2—Tire Size and Speedometer Gear Ratio

Tire Size	Axle Ratio	Driving Gear Teeth	Driven Gear Teeth
6:00 x 16	3.73	8	22
	3.92	8	23
	4.27	6	19
6:50 x 16	3.73	8	21
	3.92	8	22
	4.27	6	18
	4.86	6	21
6:50 x 20	5.14	6	18
	5.83	6	21
	6.67	5	20
	6.33/8.81	5	19
7:00 x 16	4.86	6	20
7:00 x 17	4.86	6	19
7:00 x 18	5.14	6	19
	5.83	6	21
7:00 x 20	5.14	6	18
	5.83	6	20
	6.67	5	19
	6.33/8.81	6	22
7:50 x 16	4.86	6	19
7:50 x 17	4.86	6	18
7:50 x 20	5.14	7	20
	5.83	6	19
	6.2	6	21
	6.67	6	22
	6.8	5	19
	7.2	5	20
	5.83/8.11	6	19
	6.33/8.81	6	21
7:50 x 20-8	6.33/8.81	6	21
7:50 x 20-10	6.33/8.81	6	21
8:25 x 20	5.14	7	19
	5.83	6	19
	6.2	6	20
	6.67	5	18
	5.83/8.11	6	19
	6.33/8.81	6	20
	4 speed trans. 6.8	5	18
	4 speed trans. 7.2	5	19
	5 speed trans. 6.8	4	15
	5 speed trans. 7.2	4	16
9:00 x 20	6.8	4	14
	7.2	4	15
	7.16	4	15
	6.5/8.87	4	13
10:00 x 20	7.16	4	14
	6.5/8.87	4	13

Part THREE

ELECTRICAL AND ACCESSORIES

Chapter II

Accessories

Accessories used on Ford trucks are designed to add to the owner's pleasure, comfort, and safety. Occasionally certain operations are necessary to return the accessory units to normal operating condition. Test, adjustment, and repair procedures are given in this chapter to aid you in performing these operations.

The material in this chapter has been divided as shown above in the table of contents.

Circuit diagrams will be included with each of the electrical accessories.

1. RADIO

Radio receivers used in Ford trucks are factory tuned and adjusted and under normal operating conditions will give trouble-free service over long periods. However, occasional difficulties may arise, and the material in this section is presented to guide you in making tests, minor repairs, and minor adjustments of the radio receiver. A pictorial diagram showing the radio connections is given in fig. 1.

The material has been divided under headings as follows:

"**a.** General Information," for model identification, accessibility, controls, etc.

"**b.** Tests and Adjustments," covering current draw tests, antenna tests, push-button adjustment, antenna trimmer adjustments, etc.

"**c.** Minor Repairs," outlining mechanical repair to the tuning mechanism, pilot light replacement, etc.

a. General Information.

The material covered has been arranged as follows: "(1) Model Identification," "(2) Controls," "(3) Chassis Connectors," "(4) Chassis Mountings," "(5) Accessibility," and "(6) Removal and Installation."

(1) *MODEL IDENTIFICATION.* Two models of radio receivers were supplied for the 1949 Ford trucks.

Two receiver models are supplied for 1950 trucks and one model for 1951. Table 1 gives information on model identification.

The model number identifies the manufacturer and is the prefix to the serial number stamped on the left side of the receiver (fig. 2).

(2) *CONTROLS.* Tuning is controlled by five push buttons or by the tuning knob on the right side of the receiver face. Volume and tone are controlled by the dual knob on the left side of the receiver face. Model 9ZF, 8ZT, 0ZF, 0CF and 1CF are turned on by pressing any of the

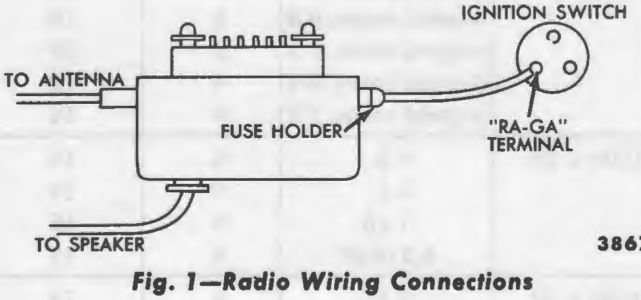


Fig. 1—Radio Wiring Connections

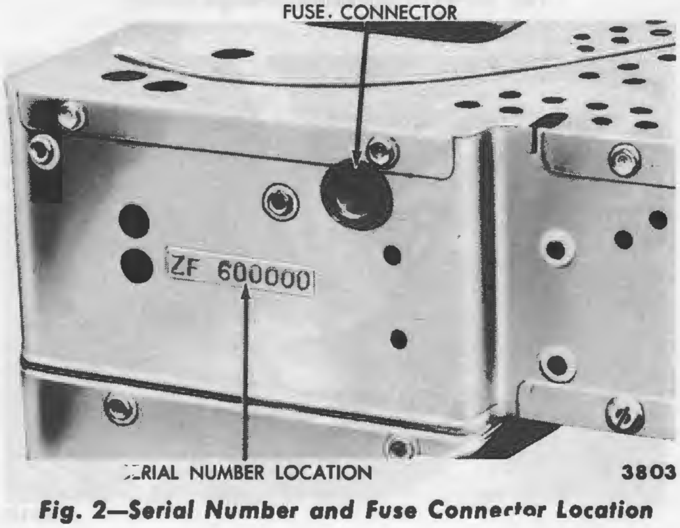


Fig. 2—Serial Number and Fuse Connector Location

(d) Remove the nut and lockwasher from the stud (two studs on '51 models) on the rear of the chassis, and press the bracket away from the stud.

(e) Grasp the chassis with both hands, push it forward, and tilt it toward the toeboard until the unit clears the instrument panel as shown in fig. 7.

To install the chassis, perform the following steps in order:

(a) Lift the receiver into position in the instrument panel with both hands (fig. 8). Be sure the control shafts and dial housing slide through the panel openings.

(b) Steady the chassis with one hand, and install the panel mounting nuts finger-tight.

(c) Slide the stud (two studs on '51 models) on the rear of the receiver chassis through the mounting bracket, and install the nut and lock washer. Be sure all control cables and wiring are clear of the receiver chassis.

(d) Tighten the panel mounting nuts, and install the control knobs.

(e) Connect the speaker plug, "A" lead and fuse, and push antenna lead firmly into connector.

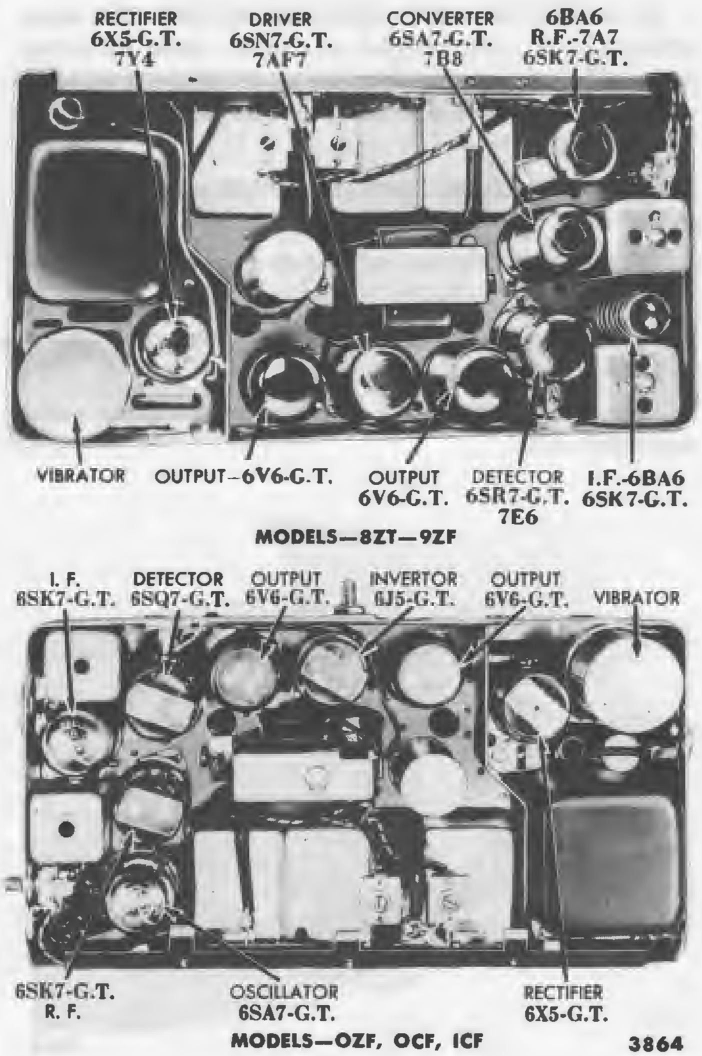


Fig. 6—Tube Arrangement

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Fig. 7—Removing Receiver Chassis

b. Tests and Adjustments.

Three tests of the radio are outlined below under paragraph headings which indicate the nature of each test. The order in which the tests appear is not intended to indicate a step-by-step procedure in testing the radio. Circumstances encountered as a result of trouble shooting will control which tests are to be made.

Minor adjustments on the radio receiver are given below in "(4) Adjustments."

(1) *RECEIVER VOLT-AMPERE TEST.* Connect an ammeter and voltmeter to the receiver as shown in fig. 9. Note that substitute "A" lead and plug is used to eliminate the necessity of disconnecting the receiver "A" lead at the ignition switch. With the receiver turned on and warmed up, the normal current draw at 7.2 volts should be 7.0 to 8.5 amperes.

(2) *ANTENNA OPEN CIRCUIT TEST.* The antenna can be tested for an open circuit by connecting a

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Fig. 8—Installing Receiver Chassis

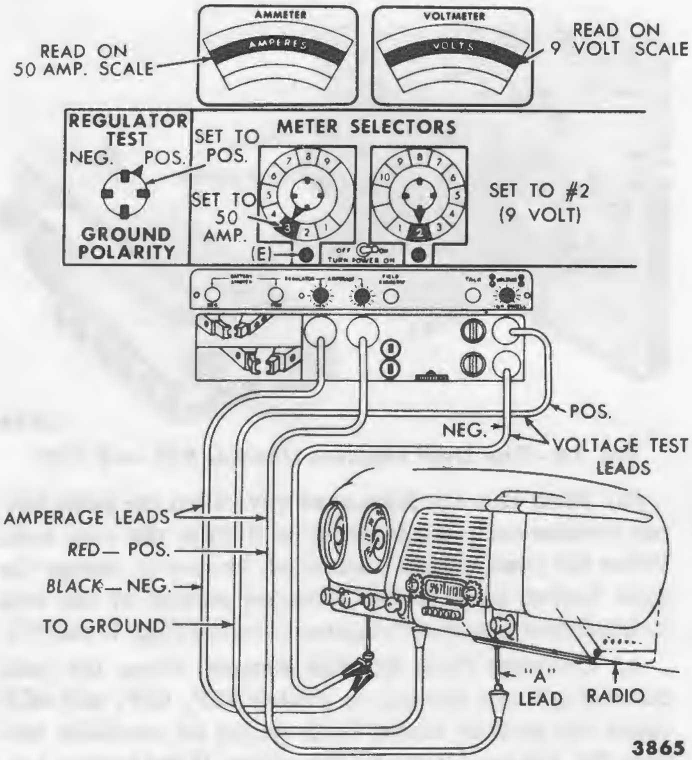

Fig. 9—Receiver Volt Ampere Test

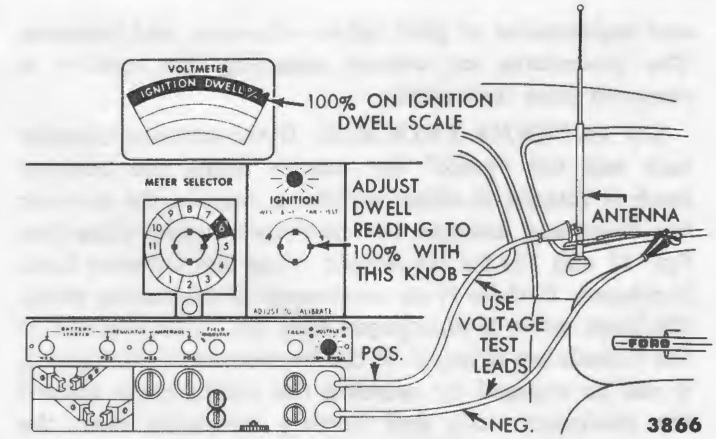

Fig. 11—Antenna Short Circuit Test

dwell test meter to the antenna and lead-in as shown in fig. 10. The dwell reading should be 100% for a good antenna. Be sure to calibrate the dwell meter to 100% before making the test.

(3) *ANTENNA SHORT CIRCUIT TEST*. Connect the dwell test meter as shown in fig. 11, to check the antenna for a grounded circuit. The dwell reading should be 0% for a good antenna.

(4) *ADJUSTMENTS*. The procedures given are for adjusting the receiver while it is mounted in the vehicle. Be sure to warm up the receiver for several minutes before attempting the ajustment.

(a) **Antenna Trimmer.** Extend the antenna to maximum length. Tune in the weakest station between 12 and 16 on the dial and reduce volume until the station is barely audible. Turn the antenna trimmer knob, fig. 4, slowly in either direction until a peak of volume is reached.

(b) **Push Button.** Adjustment of the push buttons must be made during daylight hours due to the high sensitivity of the receiver.

Tune in the desired local station with the manual tuning knob. The station is correctly tuned when the deepest bass tone is heard with the tone control in any position. Reduce volume to a low value, and loosen the desired push button by turning the button counterclockwise ONE turn.

Push the button in until it bottoms and release the button carefully. Tighten the button securely by turning it clockwise.

Adjust the remaining buttons and check all positions for "repeat" accuracy. Repeat the procedure for any buttons that shift from the correct tuning point.

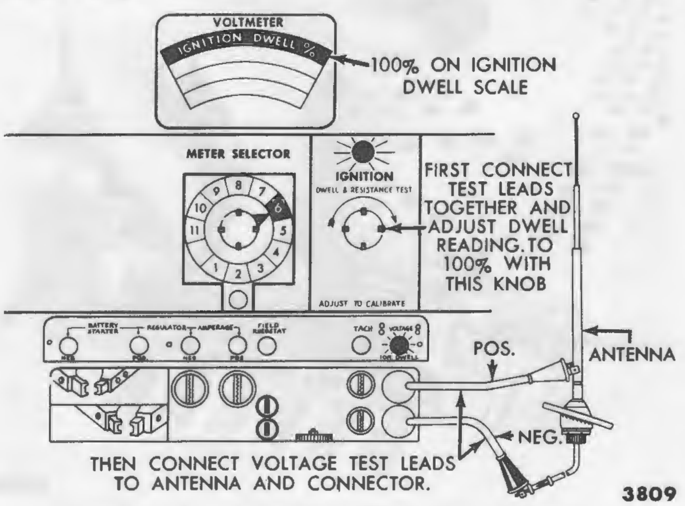

Fig. 10—Antenna Open Circuit Test

c. Minor Repairs.

Procedures that can be used by a repair mechanic to do minor repair on the radio receiver are outlined here. Minor repair involves mechanical adjustments and corrections of the tuning mechanism and antenna trimmer

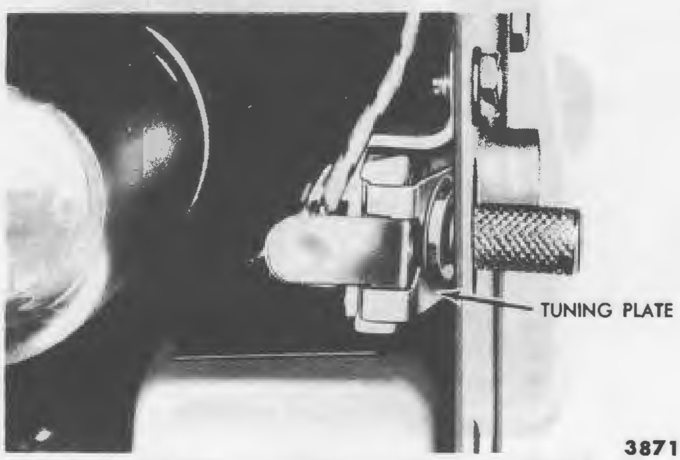

Fig. 12—Antenna Trimmer (Model 1CF)

and replacement of pilot lights, vibrators, and antenna. The procedures are written assuming the receiver is removed from the vehicle.

(1) *ANTENNA TRIMMER*. If the antenna trimmer unit will not "peak" the volume when the trimmer knob is rotated in either direction, remove the receiver top cover and examine the condenser tuning plate (see figs. 12 and 13) for movement while the trimmer knob is rotated. If there is no movement of the tuning plate, the knob screw is disengaged fron the adjusting nut or the threads are stripped. If the knob screw is disengaged, it can be engaged by pressing the tuning plate toward the condenser body and turning the knob until the screw moves into the nut. If threads are stripped, the condenser must be replaced (Major Repair).

(2) *PILOT LIGHT REPLACEMENT*. Remove the front housing assembly on models 9ZF, 0ZF, and 0CF (fig. 14), and on model 1CF (fig. 15). On the 1949 and 1950 models lift the socket assembly from the mounting, strip and replace the lights. On the 1951 model the socket assembly cannot be removed from the mounting strip but the pilot lights can be easily removed from the sockets.

(3) *TUNING MECHANISM*. Minor repairs that can be performed on the tuning mechanism are: "(a) Clutch Release Adjustment" (for inoperative push buttons), "(b) Push Button Replacement," "(c) Sticking Push Button Repair," and "(d) Tuning Mechanism Rattle Elimination."

(a) Clutch Release Adjustment. To repair inoperative or hard operating push buttons, check the clutch release clearance. The clutch should release when any tuning push button is depressed about ¼ inch.

The clutch is adjusted by repositioning the clutch plate (clutch plate with set screws) or by bending the clutch release arm fork at point "A" shown in fig. 16 (pinned clutch plate).

Fig. 13—Antenna Trimmer (Models 9ZF, 0CF and 0ZF)

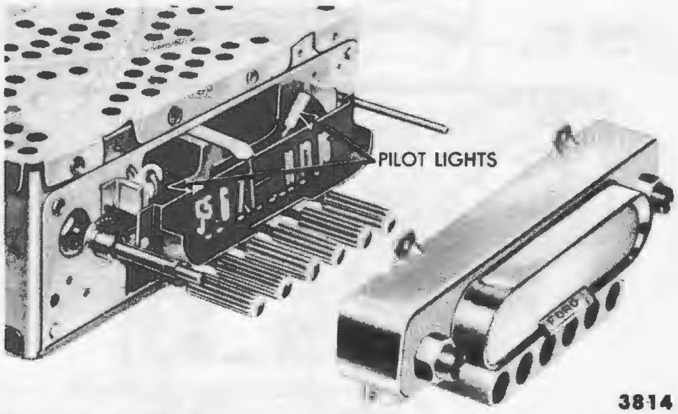

Fig. 14—Pilot Light Location (Models 9ZF and 0ZF)

(b) Push Button Replacement. Turn the push button counterclockwise to unscrew it from the cam lock. When the push button is installed, be sure to engage the push button screw in the threaded portion of the cam lock before attempting to tighten the screw (figs. 16 and 17).

(c) Sticking Push Button Repair. When the push buttons will not release, on models 9ZF, 0ZF, and 0CF check the manual tuning shaft spring for excessive tension (fig. 16) by depressing the spring. If the button now releases, the tension is excessive. Bend the spring to relieve excess tension. Do not bend the spring too much or the clutch will slip.

On the other models, check the push button mechanism for binding by visually inspecting the moving parts. If any of the parts are bent, straighten them carefully. If any part of the tuning mechanism is broken, a major repair is necessary.

(d) Tuning Mechanism Rattle Elimination. Tuning mechanism rattles can be caused by tuning knobs, metal push buttons, or dial and pointer linkage.

Tuning knob rattles are eliminated by spreading the retaining spring inside the knob until the knob is tight on the shaft.

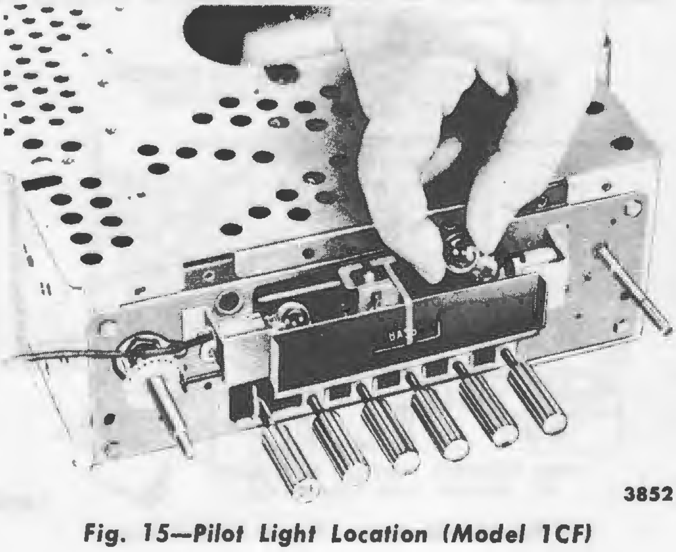

Fig. 15—Pilot Light Location (Model 1CF)

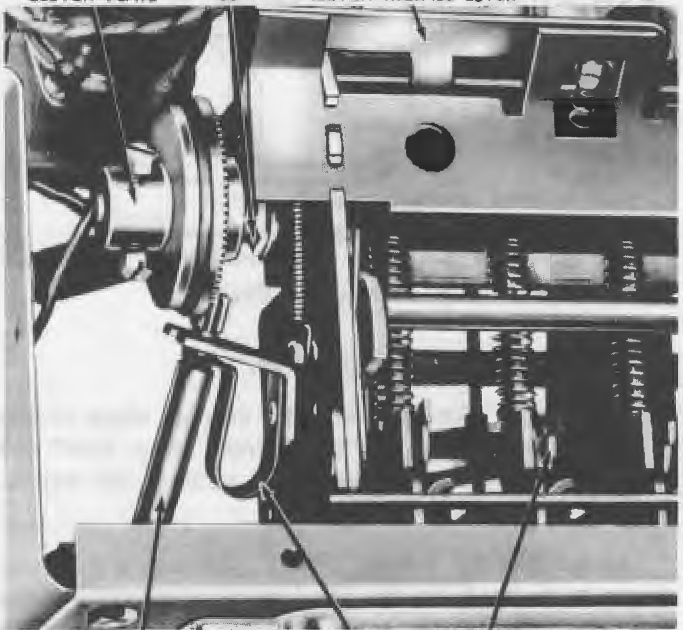

Fig. 16—Clutch and Push Button Mechanism

Push button rattle in models 0ZF and 0CF (with metal push buttons) can be eliminated by cementing a strip of 1/16 inch felt to the inner surface of the front housing as shown in fig. 18.

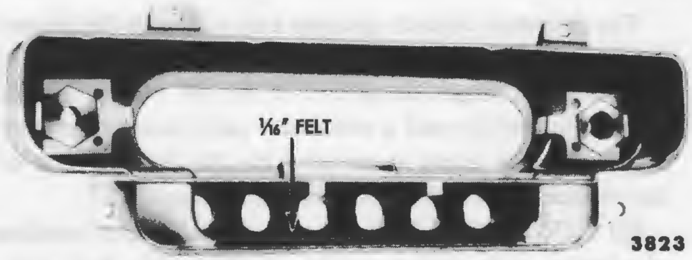

Fig. 18—Felt Antirattle Strip

(4) *VIBRATOR REPLACEMENT.* Remove the vibrator by prying under the vibrator case with a small screw driver through the ventilating holes in the receiver case. When the new vibrator is installed, be sure it is firmly seated in the vibrator socket. The vibrator can be plugged in only when the prongs are correctly oriented with the socket.

(5) *ANTENNA.* A broken antenna mast may be replaced without removing the mounting base assembly, fig. 19, by removing the small hex nut from the mast base. When the mast is replaced, torque the mast base nut to 15 inch-pounds.

2. HEATER

Heaters used on Ford vehicles are all basically the the same.

A circuit daigram is shown in fig. 21 to aid in tracing the heater electrical circuit.

The material presented here has been divided under the headings shown below:

"a. General Information," outlining operating principles, accessibility, controls, etc.

"b. Tests and Adjustments," describing a current draw test and control adjustments.

a. General Information.

The information given here appears under the headings "(1) Operating Principles" and "(2) Accessibility."

(1) *OPERATING PRINCIPLES.* Two heater models have been used: A fresh air type (fig. 20) and a recirculating type heater. The heater blower in the fresh air type couples to an outlet provided in the right-hand fender well assembly. A valve in the duct is operated by a control located on the dash panel, allowing the selection of outside air for ventilation or heating, or for recirculating the air within the cab.

The temperature of the heated air is controlled by a thermostat valve that automatically regulates the flow of water from the cylinder block to the heater. This valve is operated and adjusted for temperature by the temperature control knob on the heater control panel. When no heat is desired, the temperature control knob is pushed in all the way. This closes the heat control valve, allowing no water to circulate through the heater core.

NOTE: ***1951 Fresh Air Heaters do not use a thermostat valve but have a mechanical damper valve which directs the inlet air either through the core or directly into the cab.***

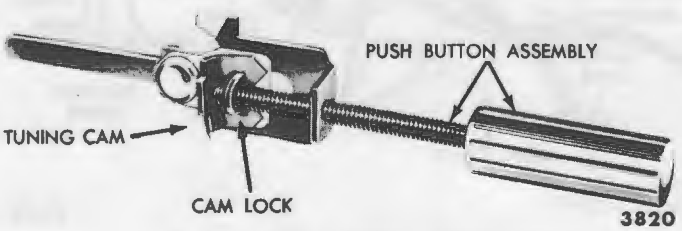

Fig. 17—Push Button Assembly

Fig. 19—Antenna Disassembled

The defroster control operates two valves in the heater housing, one in each of the defroster outlets.

Two speed ranges are provided for the blower fan by means of a switch and a resistance unit mounted on the switch. Blower speed is reduced by the introduction of the resistance in series with the blower motor.

(2) *ACCESSIBILITY.* The fresh air heater consists of a heater unit, motor and blower assembly, heat control unit, defroster tubes, nozzles, and controls located on the heater control panel. Individual units of the heating system can be removed with ease if service is required. The heater installation is illustrated in fig. 22.

The dash panel is provided with pierced holes for the heater blower installation. The large hole is covered with a metal plate pressed on from the engine side of the dash The smaller holes for connections are provided with knockout plugs. The dash insulator pad has the mounting holes partially pierced, making it necessary to cut only a small portion of the pad to remove the hole-opening plugs.

The 1951 heater control unit is shown disassembled in fig. 23.

The blower switch is attached with a special nut and can be removed by using a special wrench after unscrewing the switch knob.

Removal and installation of the deluxe heater blower motor and fan is accomplished as shown in fig. 24 after first removing the blower housing and name plate. After installing the blower and fan, be sure the ground connection is clean and tight.

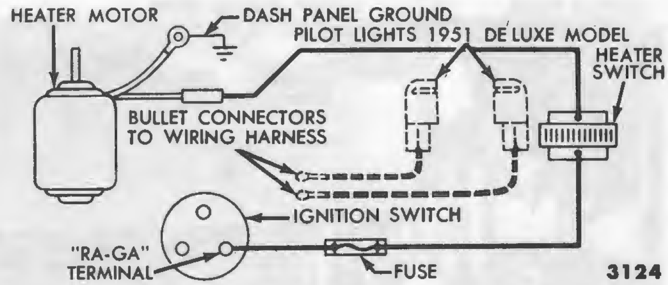

Fig. 21—Heater Circuit

b. Tests and Adjustments.

A procedure for checking the current draw of the blower motor is given in "(1) Current Draw Test" and "(2) Heater Control Adjustment," outlines the adjustment of the control unit.

(1) *CURRENT DRAW TEST.* Connect a 0-50 ammeter as shown in fig. 25. The blower motor will operate independently of the control switch, and the current draw of the motor will be indicated on the ammeter. Normal current draw should be 6.5 amperes for the 1949 blower motor and 10 amperes for 1950 and 1951 blower motors.

(2) *HEATER CONTROL ADJUSTMENT.* The two defroster controls and the heat valve control must be adjusted so that the three valves are completely closed when the knobs are all the way in. Adjust each Bowden wire at the valve end so that the valves are completely closed when the knob is 1/16 inch to 1/8 inch from the all-in position.

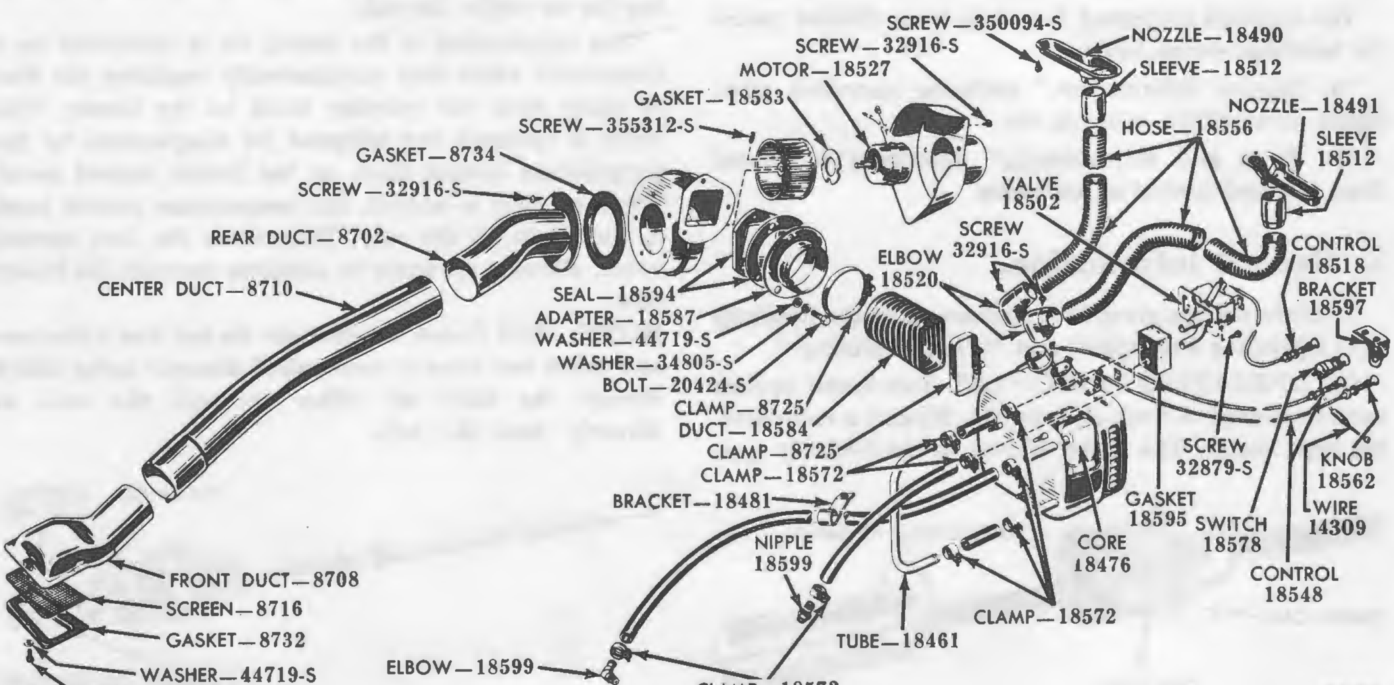

Fig. 20—Fresh Air Heater

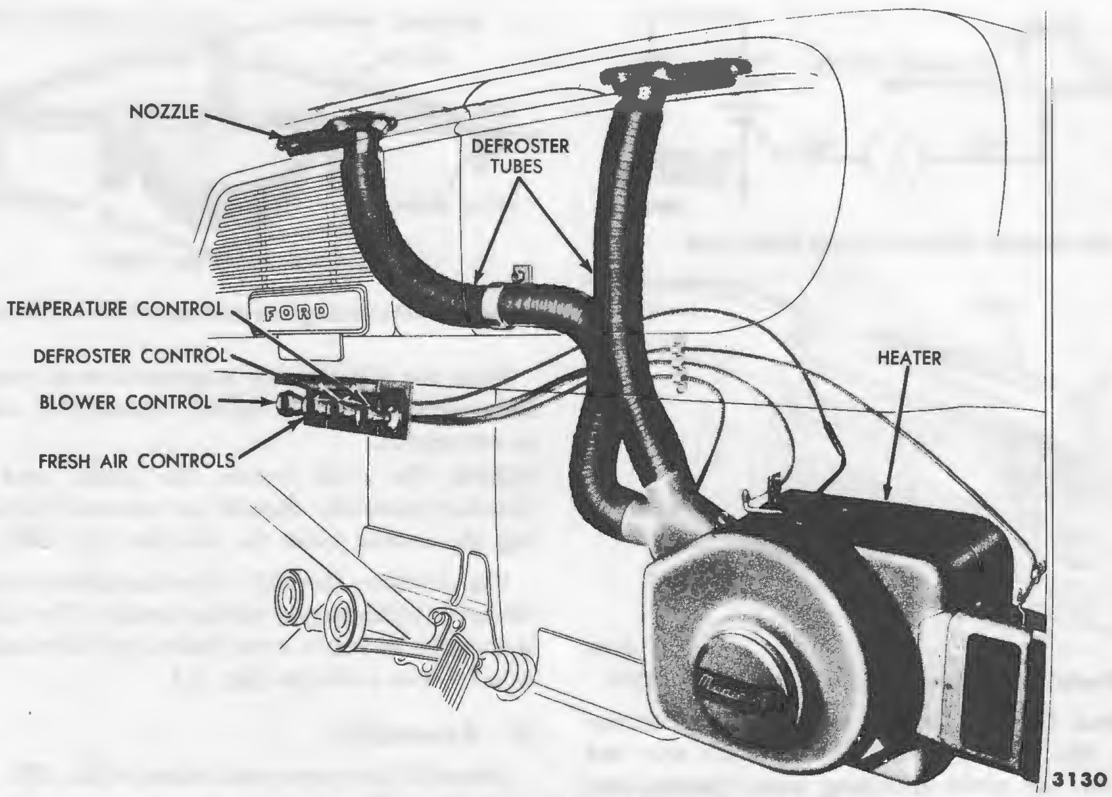

Fig. 22—Heater Installation (1951 Deluxe Cab)

3. WINDSHIELD WIPER

The windshield wiper used on Ford trucks is shown in fig. 26. The wiper motor is mounted on the left hand wiper assembly. A linkage connects the right hand wiper blade to the motor.

NOTE: ***1951 trucks have the wiper motor mounted in the center of the mounting bracket as shown in fig. 27.***

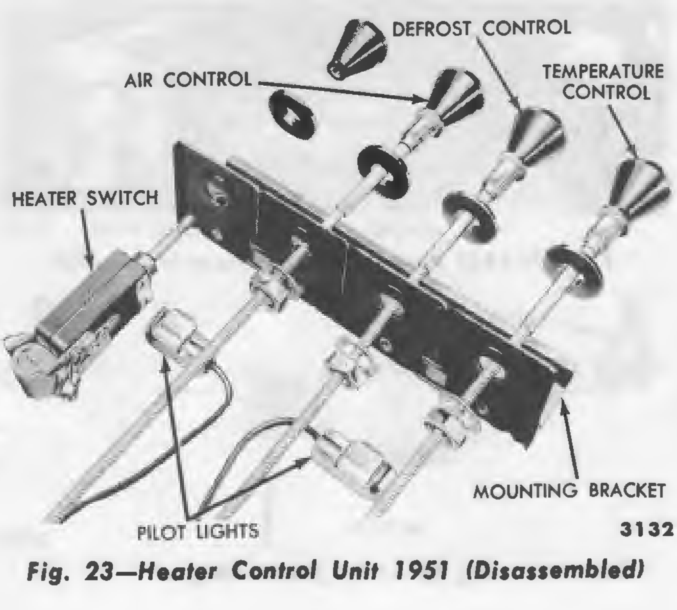

Fig. 23—Heater Control Unit 1951 (Disassembled)

a. Disassembly.

To remove the motor assembly for service, disconnect the vacuum line and wiper linkage, remove the control

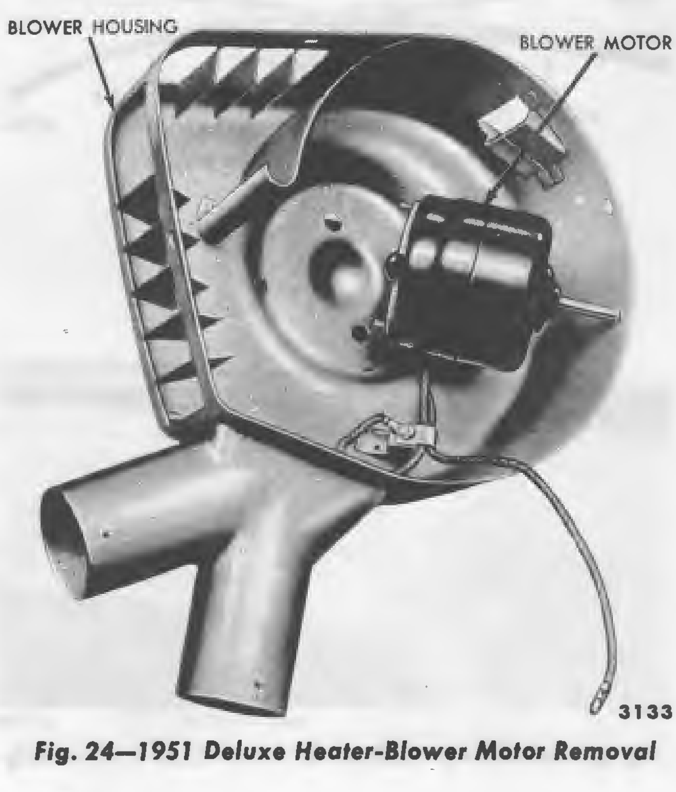

Fig. 24—1951 Deluxe Heater-Blower Motor Removal

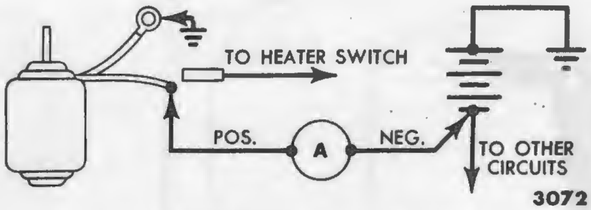

Fig. 25—Heater Motor Current Draw Test

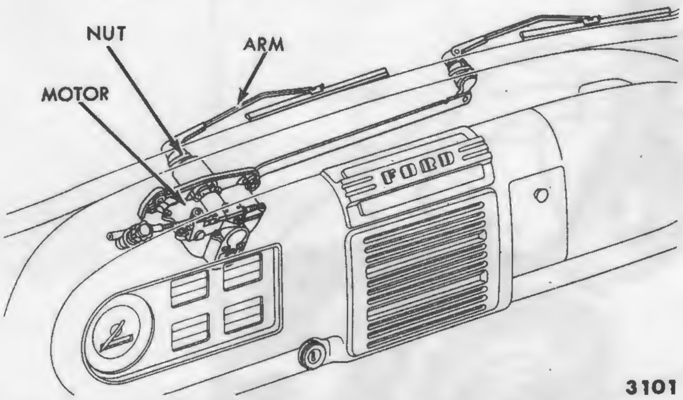

Fig. 26—Windshield Wiper Installation (1949 & 1950)

assembly from the instrument panel with a special wrench (fig. 28). Lift off the left-hand wiper arm and blade. Remove the pivot attaching nuts, spacers, and washers. The motor assembly can now be pulled out.

The motor can be taken off the adaptor by removal of the two mounting screws.

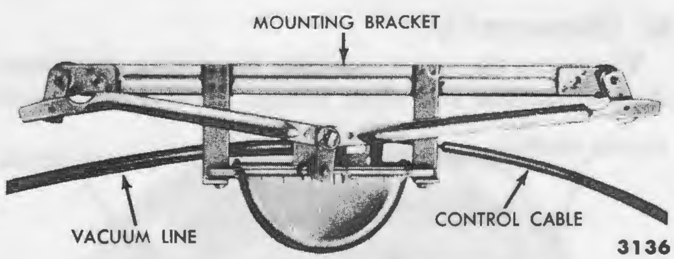

Fig. 27—1951 Windshield Wiper

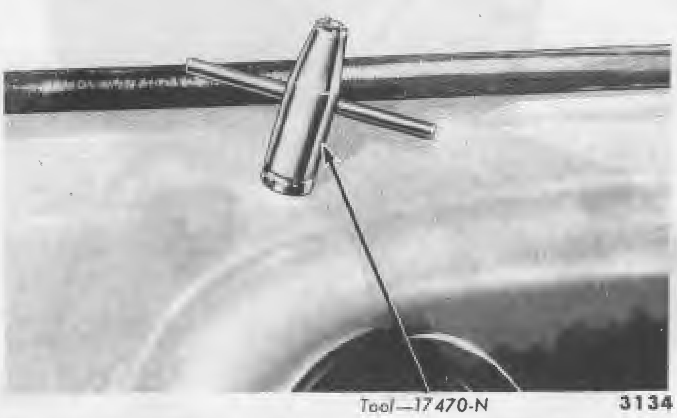

Fig. 28—Removing Windshield Wiper Control Assembly

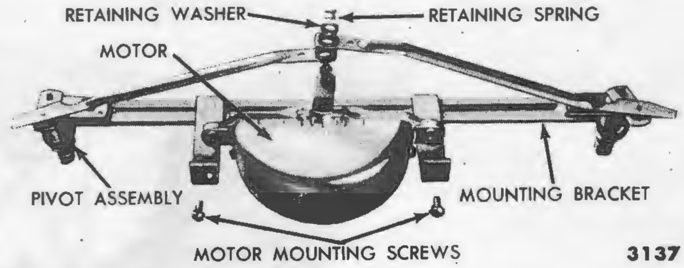

Fig. 29—Mounting Bracket and Motor—Disassembled

Since the wiper motor is serviced as an assembly, it is recommended that no further disassembly of the motor be attempted.

NOTE: ***On 1951 trucks, the motor and mounting bracket assembly should be removed before removing the motor from the bracket (fig. 29).***

Fig. 30 shows the 1951 wiper installation on the parcel delivery (with electric vacuum assist). The vacuum assist is required by law in some states. An electrically operated wiper is also available (fig. 31).

b. Assembly.

Assemble the motor and adaptor (fig. 29).

Apply sealing compound to the pivot shafts and insert the pivot shafts through the mounting holes. Install the washers, spacers, and nuts. Connect the link and secure it with the retainer clip. Install the instrument panel control with a special wrench (fig. 28). Screw the control knob on the shaft.

Run the engine momentarily with the wiper control OFF to bring the pivot shafts to their rest position. Install the blades so they are flat against the lower edge of the windshield.

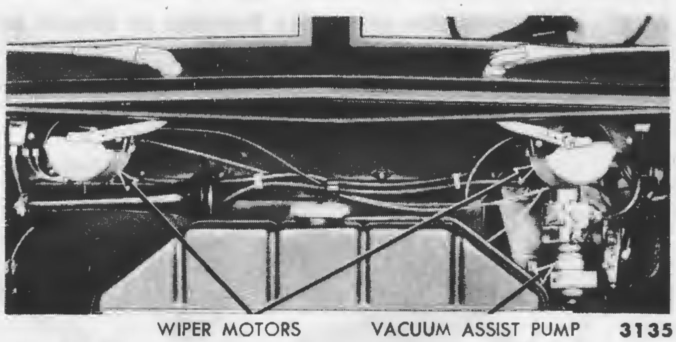

Fig. 30—1951 Parcel Delivery Wiper Installation

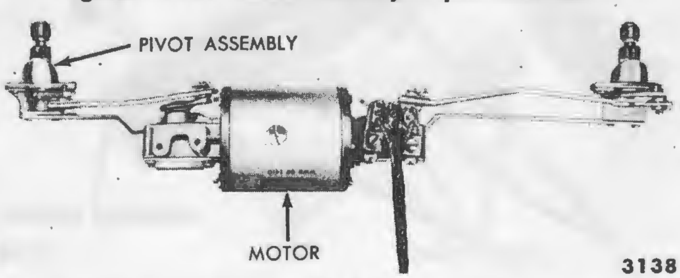

Fig. 31—1951 Electric Wiper

Part FOUR

BODIES AND CABS

Chapter

I

Construction and Maintenance

This chapter describes the basic procedures required for servicing truck cabs. These procedures are designed to assist the serviceman in performing the necessary steps to prevent cab difficulties.

Most types of cab repairing should be done by persons specially trained in body repair work. A thorough understanding of the operation of the tools and equipment required and a knowledge of the internal construction of the various types of Ford cabs are essential. Accordingly, the illustrations shown in Section 1 and the alignment procedures given in Section 2 are designed for the trained body repairman. The various cab maintenance suggestions given in Section 3 can be performed by any competent serviceman.

1. CONSTRUCTION DETAILS

The construction details of the truck cabs for the different model trucks are illustrated rather than described. Each of the illustrations in this section shows clearly one of the major parts of a truck cab. In cases of complete or partial panel replacement, it is very helpful to know where and how that particular panel is fastened.

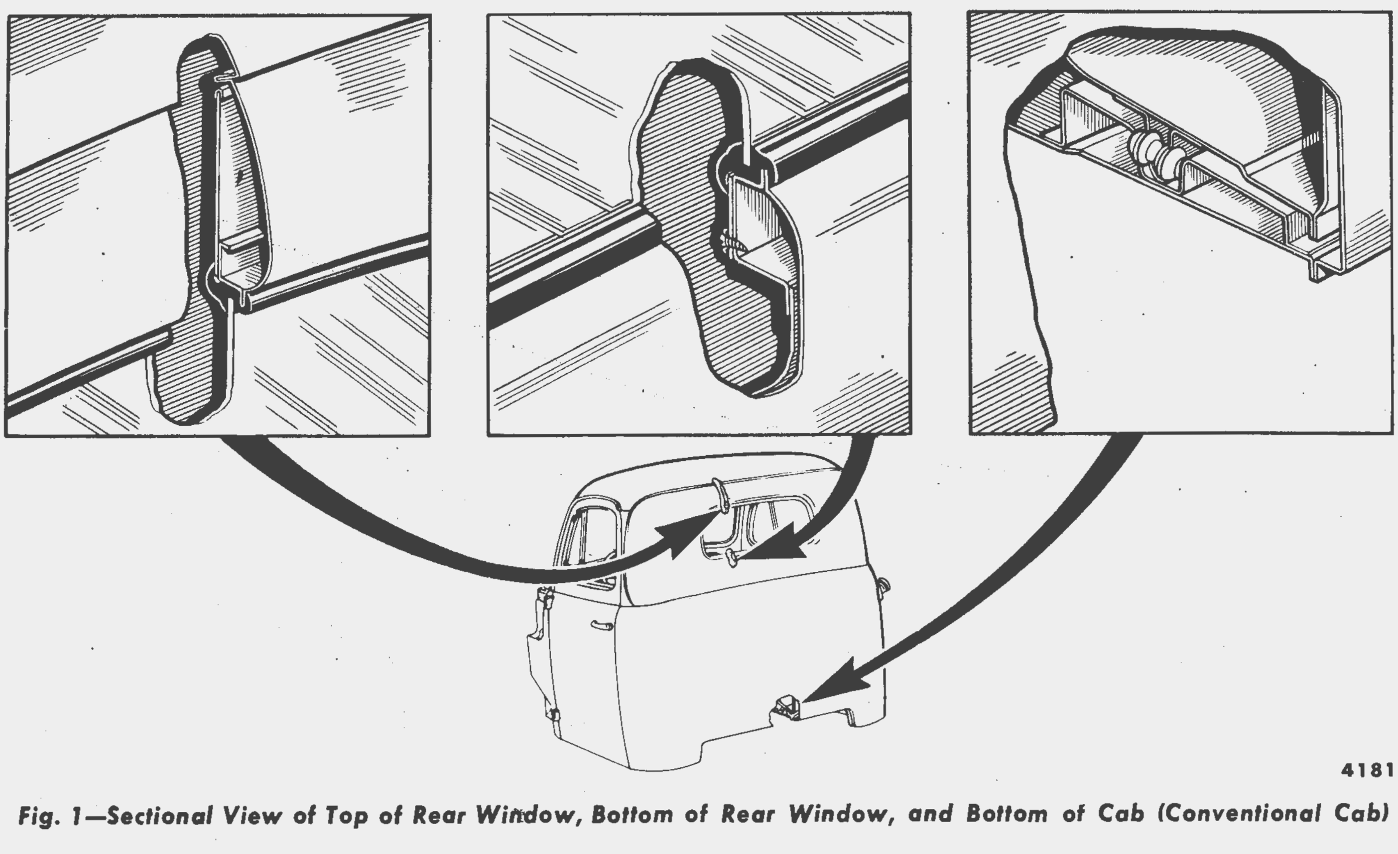

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Fig. 1—Sectional View of Top of Rear Window, Bottom of Rear Window, and Bottom of Cab (Conventional Cab)

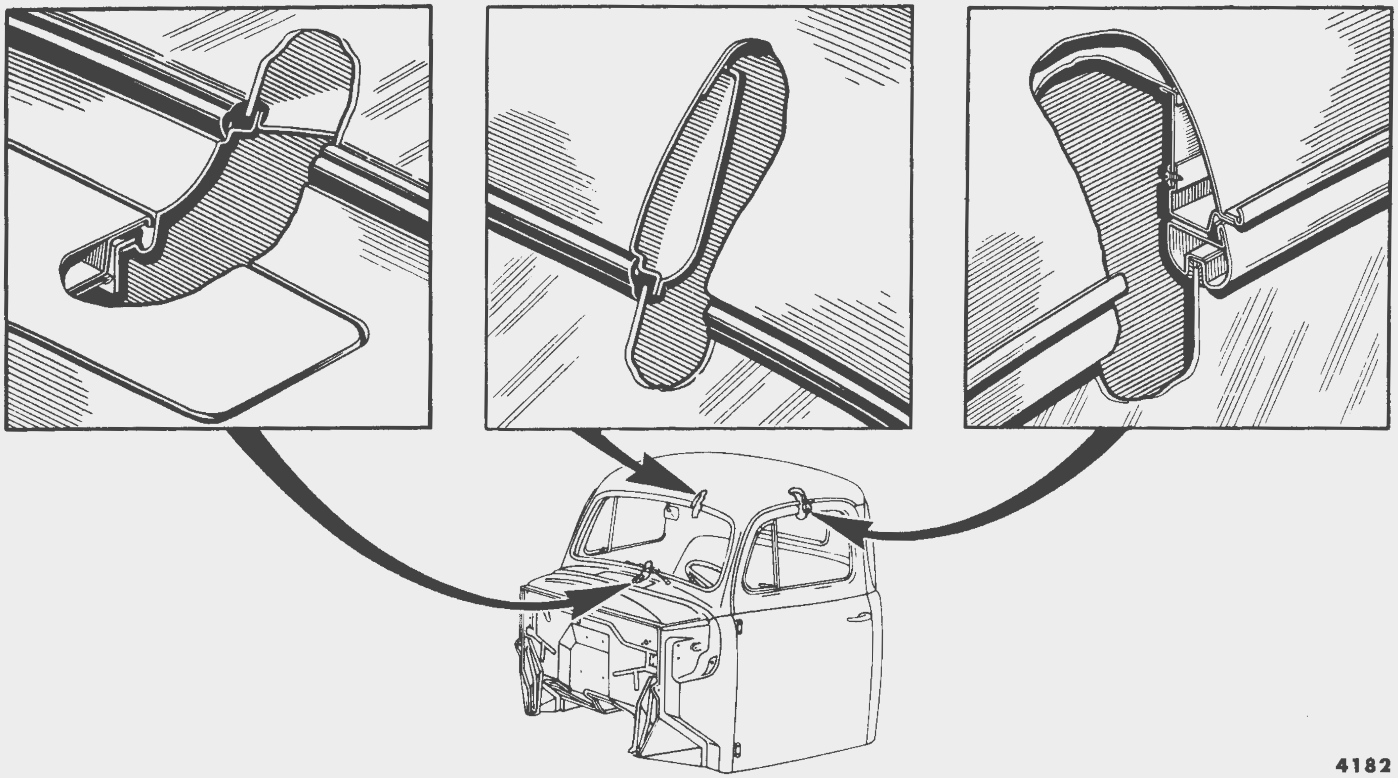


Fig. 2—Sectional View of Top of Door Glass and Drip Rail, Top of Windshield, and Bottom of Windshield (Conventional Cab)

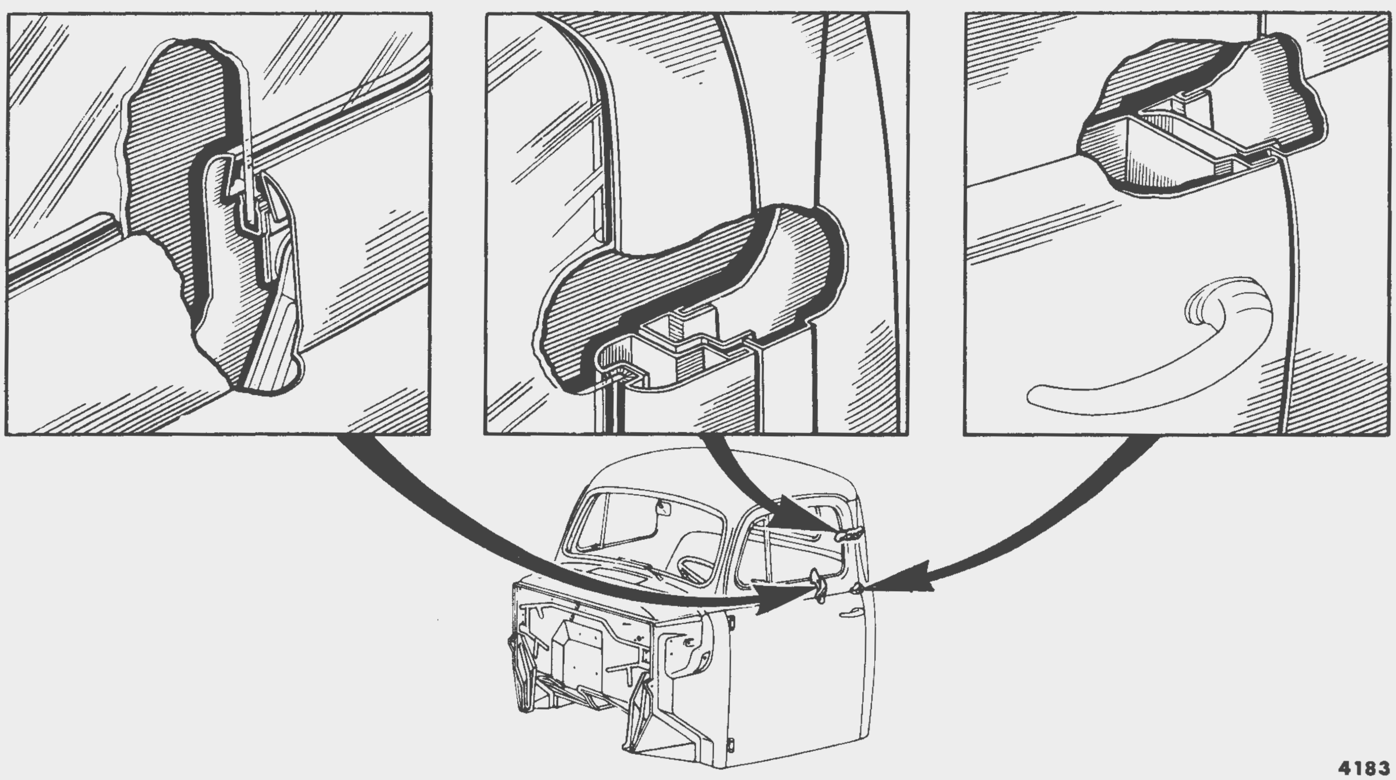


Fig. 3—Sectional View of Rear of Door Glass, Bottom of Door Glass, and Rear of Above the Handle (Conventional Cab)

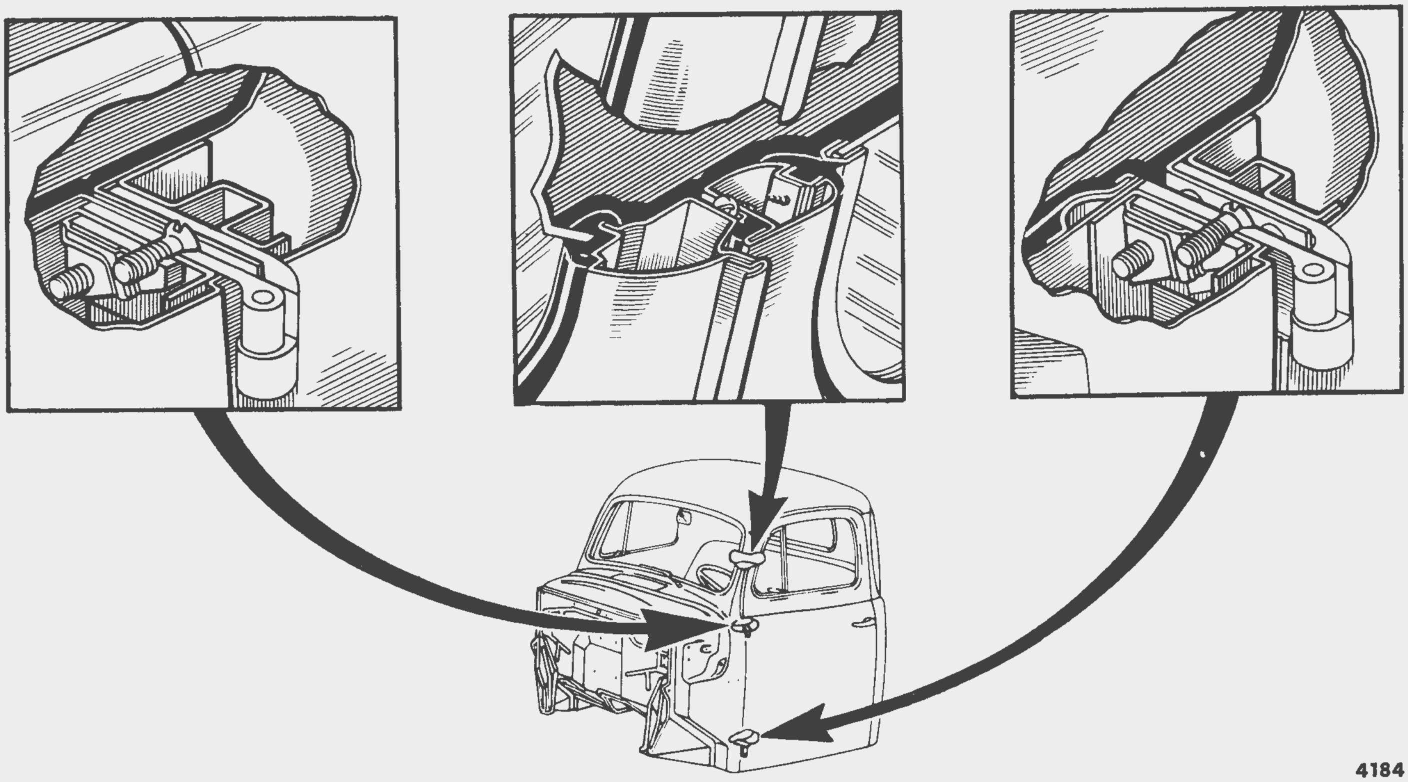


Fig. 4—Sectional View of Front Pillar and Upper and Lower Door Hinges

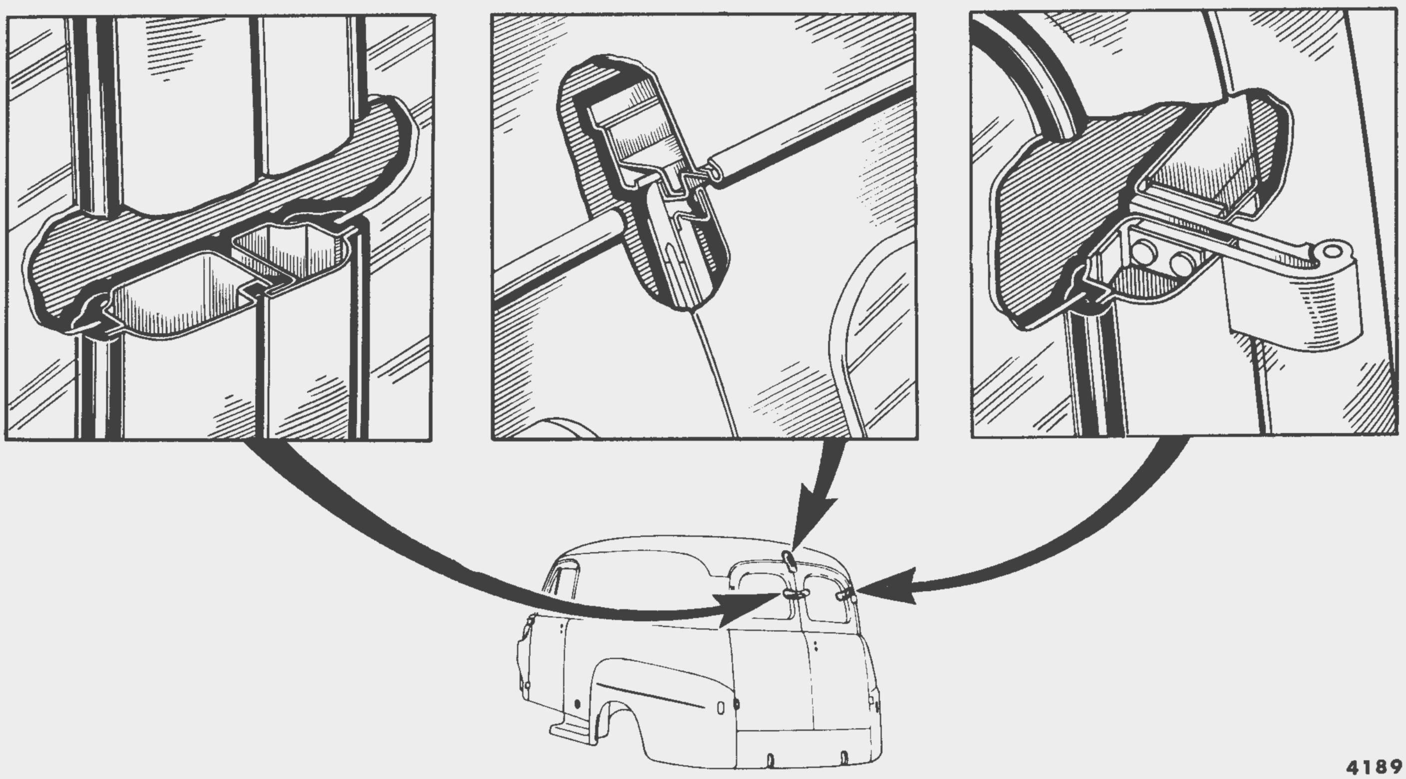


Fig. 5—Sectional View of Rear Door at Drip Rail and Door Latch, Rear Door at Center, and Door Glass and Upper Hinge (Panel Delivery)

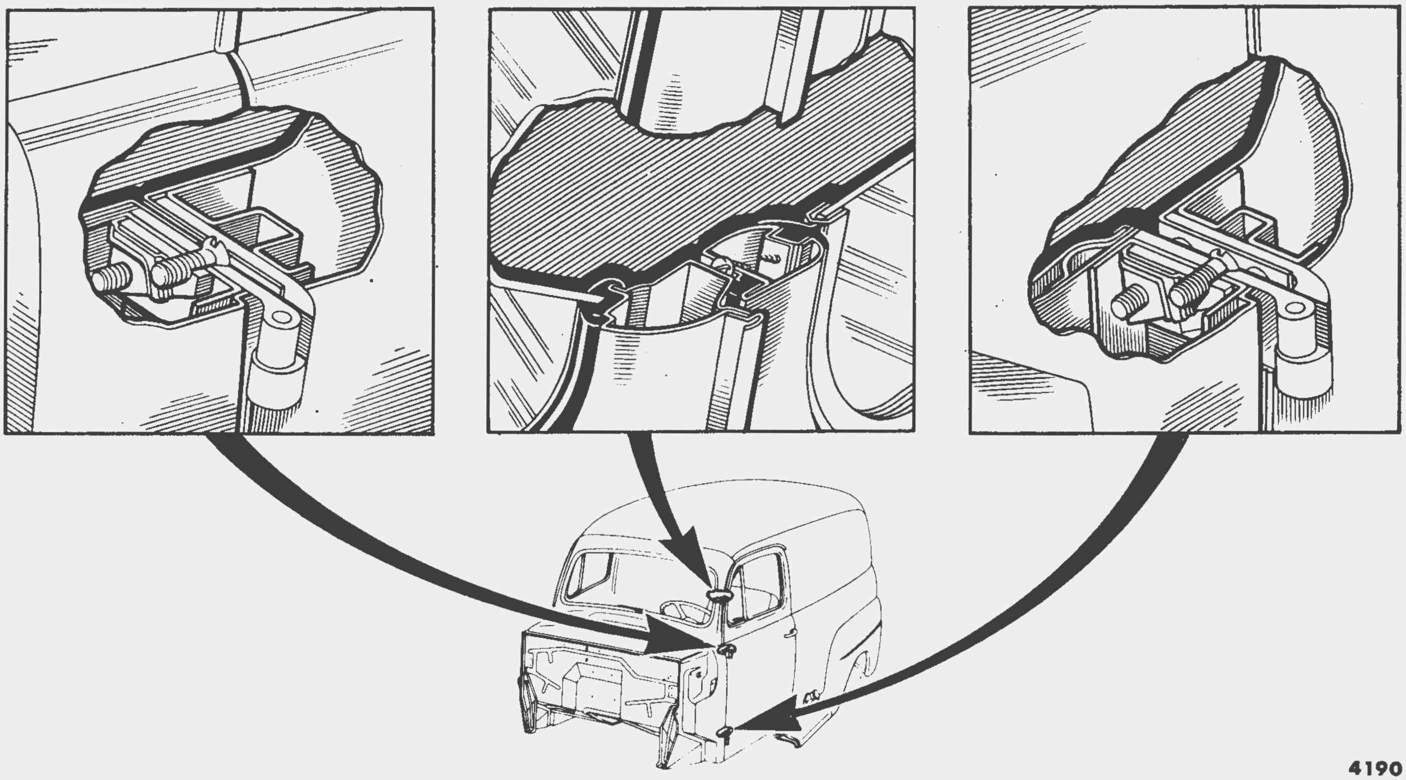


Fig. 6—Sectional View of Front Pillar and Upper and Lower Door Hinges

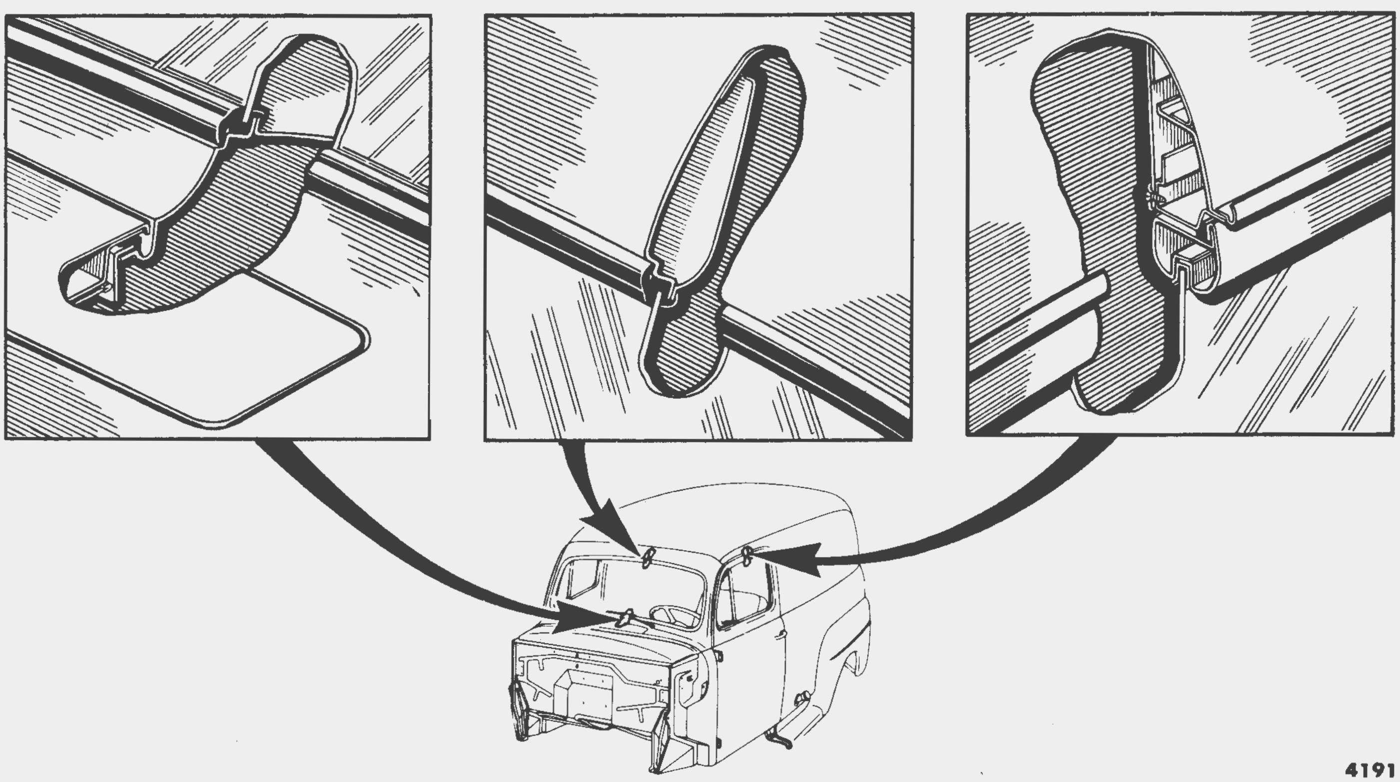


Fig. 7—Sectional View of Top of Door Glass, Top of Windshield, and Bottom of Windshield (Panel Delivery)

2. DOOR ALIGNMENT

Misaligned doors can be the cause of excessive vibration and rattling. Also a misaligned door will not fit the door opening tight enough to effect a good seal against the weather. Doors can become misaligned in any number of different ways. All of the methods of door alignment on Ford trucks are described and illustrated in this section.

To correct misalignment, it is usually necessary to shift the door in one direction or another. This in most cases can be done without removing the door from the truck. However, if the door or hinge must be removed, it will be necessary to split the tack welds (fig. 9) around the hinge with a sharp chisel. In the event that the door is removed, it is not necessary to tack weld the hinge.

Before attempting to align a door, make an inspection to determine in what direction the door can be shifted. As an example, a door that is sagged cannot in some cases be corrected by spreading the lower door hinge. The first step is to determine the space available between the door and the opening in the body. This will establish where and how the door can be shifted to obtain proper alignment.

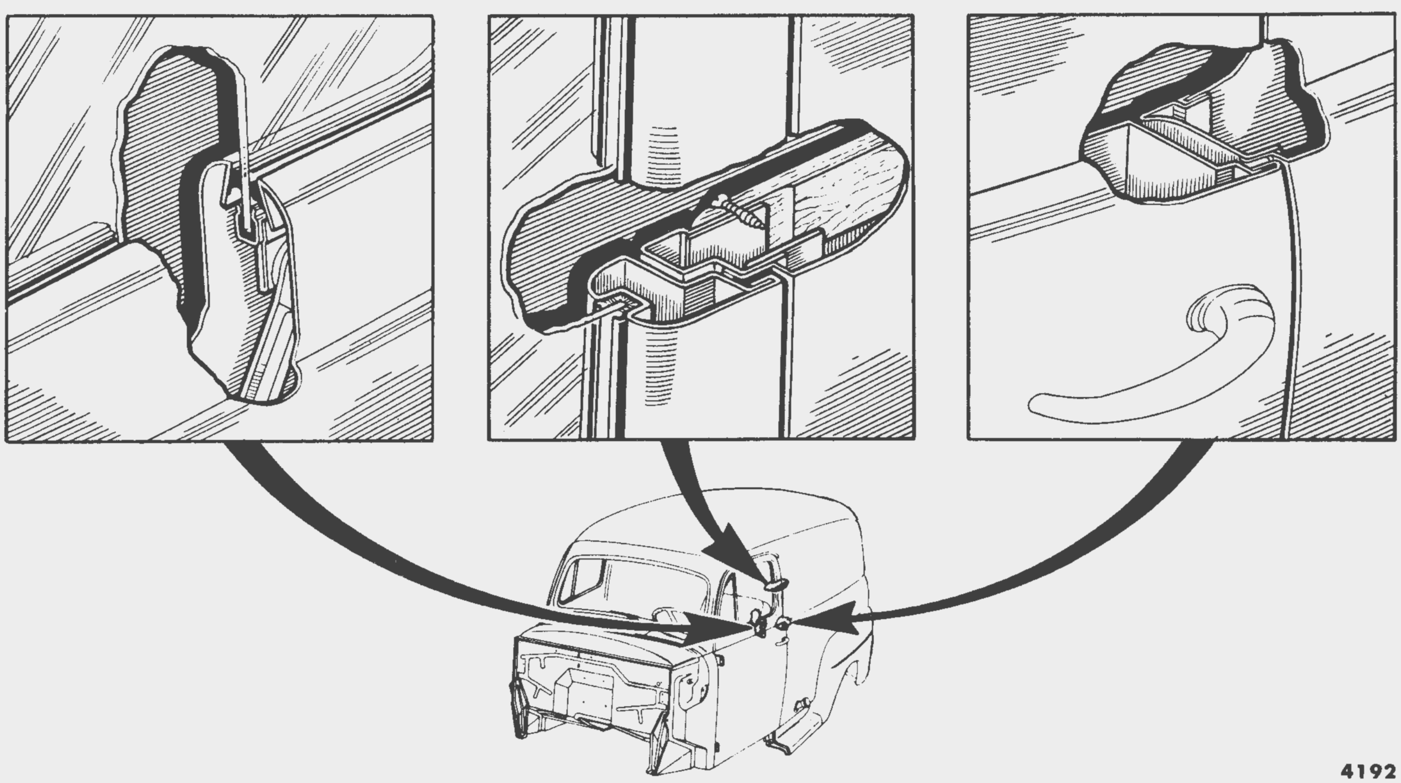
A sagged door is usually caused by the door being opened beyond the limit of the hinge or check strap. This shifts the door close to the lock pillar, and it will not close without scraping against the lock pillar.

The procedures given in the following paragraphs take into account all the possible conditions of door misalignment. A method for correcting each of these conditions is also given.

a. Sagged Door.

If it is determined that the door can be shifted toward the lock pillar, place a fiber block between the leaves of the lower hinge. Carefully close the door to spread the lower hinge. Do not overspread the lower hinge. Continue to repeat this operation until the sag has been corrected (fig. 9).

If inspection reveals that the door cannot be shifted toward the lock pillar, it is necessary to work with the upper hinge. The hinge in this case must be bent and should be removed and straightened to its original shape. Before installing the door (or hinge if removed), check the hinge surfaces on the pillar to make certain they are not pulled out of shape. If necessary, place a spoon against the pillar, then hammer against the back face of the spoon to bring the metal back in place. Install the door or hinge, and re-cement the weatherstrip to the hinge pillar.



4192

Fig. 8—Sectional View of Rear of Door Glass, Bottom of Door Glass, and Rear of Door Above the Handle

b. Twisted Door.

If the door does not fit the contour of the body, determine what part of the door requires straightening: the upper, lower, or center portion. To do this type of repair, it is advisable to use tools which are designed specifically for this type of work. However, some door straightening may be accomplished by using a rubber mallet as shown in figs. 10 through fig. 13.

Before attempting to align the door, first lower the glass to prevent breakage. Make a visual inspection to determine what portion of the door does not fit properly. If necessary, the fit can be checked with a piece of paper placed between the door and door opening. With the door closed, the paper should pull out with a slight drag if the door fits properly. This check should be made at the upper and lower corners of the door and at the center. In some cases, the door contour may be greater than the body contour. This would be indicated by a tight fit at the upper and lower parts of the door with excessive clearance at the center. If this condition exists, it will be necessary to move the upper or lower parts of the door away from the body.

To move the upper part of the door away from the body, place the mallet between the door and body then carefully slam the door against the mallet as shown in fig. 10.

To move the lower part of the door away from the body, place the rubber mallet between the body and the lower part of the door. Carefully slam the door against the mallet as shown in fig. 11. Repeat the above procedure if necessary until the proper contour is obtained.

If the inspection shows the upper or lower parts of the door to be away from the body and tight at the center, it will be necessary to move the ends inward.

To move the upper part of the door inward, place the mallet between the door and body at the belt line as shown in fig. 12. Carefully slam the door against the mallet until the proper contour is obtained.

To move the lower part of the door toward the body, place the mallet slightly below the body belt line as shown in fig. 13. When bending the lower part of the door inward, it may be necessary to apply heat to the lock face of the door.

After final alignment is obtained readjust the striker plate to take up any clearance.

3. GENERAL BODY MAINTENANCE

Everyone concerned with the servicing of trucks should assume the responsibility of seeing that each vehicle has the proper care and gives complete performance satisfaction. Just as competent engineers and machinists frequently clean their units and periodically tighten all mountings, so should the same attention be given to trucks as owners and drivers prefer to operate clean and rattle-free vehicles.

The following describes the methods used in performing this important but often neglected phase of truck servicing.

a. Eliminating Rattles.

Most rattles are caused by a loose bolt or screw. All body bolts and screws should be tightened immediately after the first 1000 miles of vehicle operation. Regular bolt and screw inspection and tightening should be performed during all the years of usage. In the event tightening the bolts and screws located on such assemblies as the doors and hood does not eliminate the rattles, the trouble is probably caused by misalignment or improper adjustment. If this is the case, follow the adjustment and alignment procedures for these assemblies.

Rattles and squeaks are sometimes caused either by weatherstripping, rubber bumpers, or anti-squeak material slipping out of position or becoming lost. Applying additional cement or other adhesive and replacing the material in the proper location will eliminate this difficulty.

b. Interior Cleaning.

The interior of a truck should be regularly cleaned. The inside metal trim should be wiped with a damp cloth or chamois.

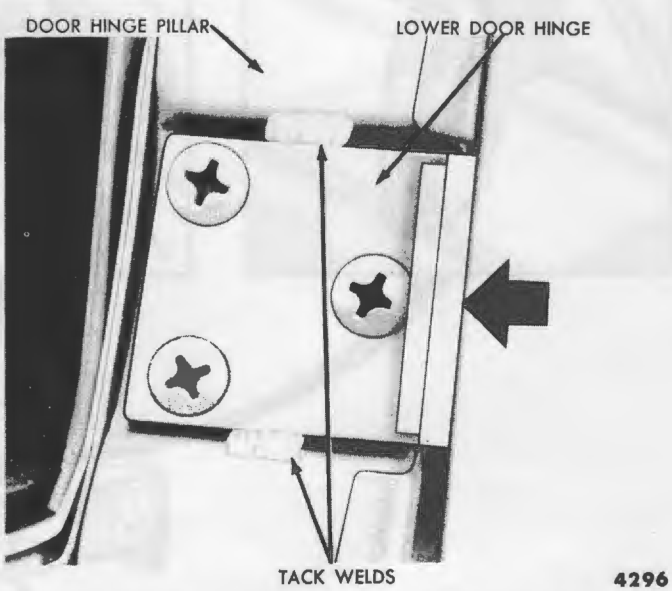


Fig. 9—Fibre Block in Position at Lower Hinge to Correct Sag

To clean leather trim, apply saddle soap to the surfaces, and rub the soap with a damp cloth. Using another cloth that has been dampened with clean water, rub the leather until it is thoroughly dry. If desired, liquid wax may be applied to the leather to assist in restoring and maintaining the original luster.

NOTE: *Never use cleaning fluids on leather as most cleaning solutions contain ingredients that cause leather to deteriorate.*


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Fig. 10—Forcing Upper Part of Door Away from Body


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Fig. 11—Forcing Lower Part of Door Away from Body

c. Exterior Cleaning.

The outside finish should be frequently washed. Never wipe the painted surfaces with a cloth. Dusting the finish when it is dry tends to rub the dust and dirt into the baked enamel which leaves a sandpaper effect on the surface. Washing the vehicle whenever it has accumulated an excessive amount of dirt and road salt will keep the finish bright and attractive and eliminates the necessity of using polish. If the finish does become dull and unattractive, it may be restored to its original brilliancy by applying liquid polish.

All the various preparations required to maintain and restore the original appearance of both the inside and outside of a truck are available at all Ford dealers.


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Fig. 12—Forcing Upper Part of Door Inward


4291

Fig. 13—Forcing Lower Part of Door Inward

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part FOUR

BODIES AND CABS

Chapter

II

Hardware, Glass, and Interior Trim

The service most frequently needed on door or window operating mechanisms is adjustment. These are not complex units, so the disassembly is quite easily accomplished. This chapter gives you an adjustment and replacement procedure for the door locking mechanism, window regulators, and the door glass and ventilator assemblies on all trucks. In addition, sections covering the windshield and rear window and the interior trim are also included.

When you are dealing with hardware or interior trim there is one major consideration to be remembered. Many of the hardware parts have two different lengths or size screws holding them to the panels. When removing a trim part, note the length of the screws which secure it in place, and make sure they are installed again in their original location.

1. DOOR LOCKING MECHANISM

The door locking mechanism consists of the door lock, lock cylinder, inside and outside handles, striker plate, and the linkage connecting these units. In order to assure proper operation, all of these units must be taken into consideration when service operations are performed. As an example, a door lock will not function properly if the remote control linkage or outside door handle is out of adjustment.

Door misalignment is also a direct cause for lock failure. Doors that are not properly aligned will place excessive strain on the engaging parts of the lock and striker plate and premature wear will result.

The locking mechanism must have lubricant to function properly. In addition to the periodic lubrication, it is important that all moving parts of the lock mechanism be lubricated when service operations are performed. This not only applies to the specific units being replaced or repaired, but also to the related units.

The following paragraphs describe the repair and adjustment procedure for all the parts related to the locking mechanism on all body types.

a. Outside Door Handle (All Models).

No adjustment or lubrication is required on the door handle.

(1) *REMOVAL.* Work through the access hole provided on the door face and remove the handle lock screw, then pull the handle out of the door (fig. 1).

To remove the rear door handle from a parcel delivery truck, remove the handle collar retaining screw.

(2) *INSTALLATION.* Position the gasket on the door handle. Insert the shaft of the handle into the door until the shaft enters the lock. Install the handle lock screw through the access hole provided in the door (fig. 1).

b. Striker Plate.

The striker plate is only adjustable "in" or "out." The "up" and "down" movement of the door is controlled by a separate dovetail on the door (fig. 1). The dovetail

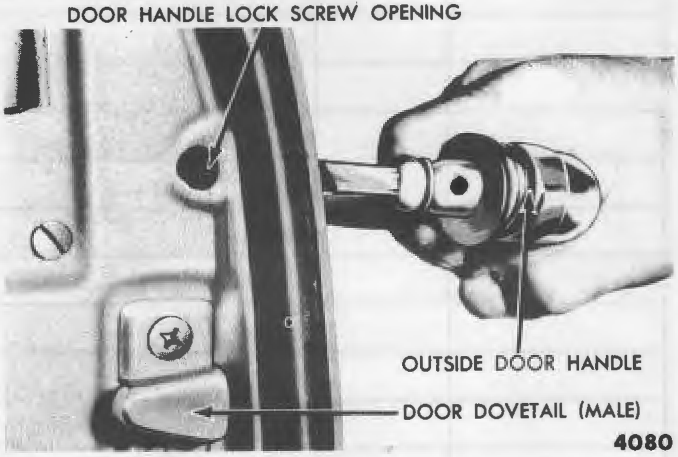

Fig. 1—Outside Door Handle Removal

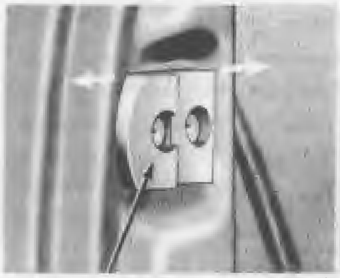

Fig. 2—Striker Plate Adjustment

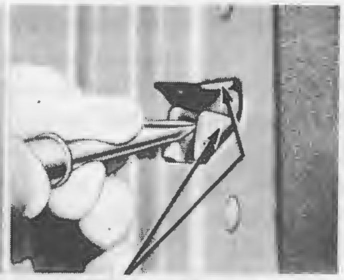

Fig. 3—Removal of Sliding Blocks from Dovetail Housing

enters between two sliding blocks on the pillar, and is not adjustable.

The striker plate should be adjusted either "in" or "out" so the door will close with a normal swing, yet hold the door closed tight enough to prevent the door from rattling.

To adjust the striker plate (fig. 2), loosen the two screws and move the striker plate to the desired position. Tighten the screws securely after making the adjustment.

If the door has excessive sag, the alignment must be corrected to prevent wear on the sliding blocks in the dovetail housing. Proper door alignment is obtained when the dovetail on the door enters exactly in to the center or not less than $\frac{1}{32}$ inch below the center of the two sliding blocks on the lock pillar.

The sliding blocks are serviced separately. If the sliding blocks require replacement, force each block back into the dovetail housing with a screw driver, then raise each block out of the housing (fig. 3).

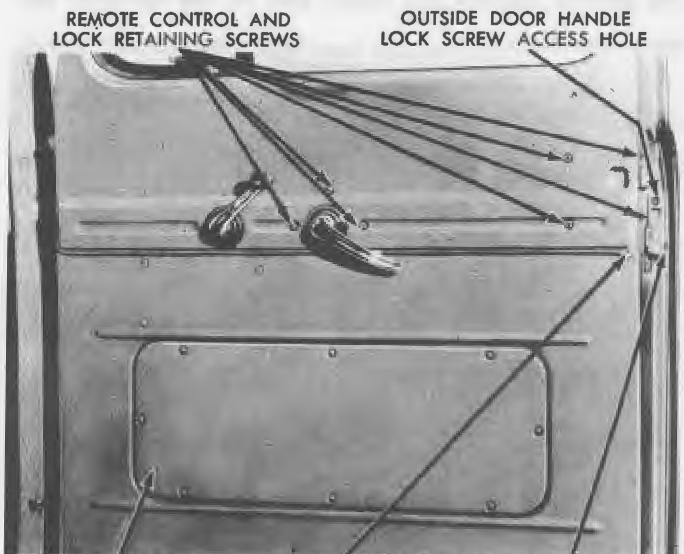

Fig. 4—Truck Door Inner Panel

Fig. 5—Removal of Door Lock and Remote Control

Before installing new sliding blocks make certain the springs are not broken. After installation, lubricate the sliding blocks and dovetail with a wax stick.

c. Door Locking Cylinders.

When replacing a door lock cylinder, it is recommended that a complete set be installed. The set includes the ignition switch as well as both door lock cylinders. If only one lock cylinder is replaced it is necessary to carry an extra key. It is not possible to adapt the old key to fit the replacement lock.

NOTE: ***The lock cylinder used on the panel delivery is replaced in the same manner.***

(1) *REMOVAL.* Loosen the lock screw located in the access hole under the weatherstrip which is in line with the dovetail and pull the cylinder out of the door.

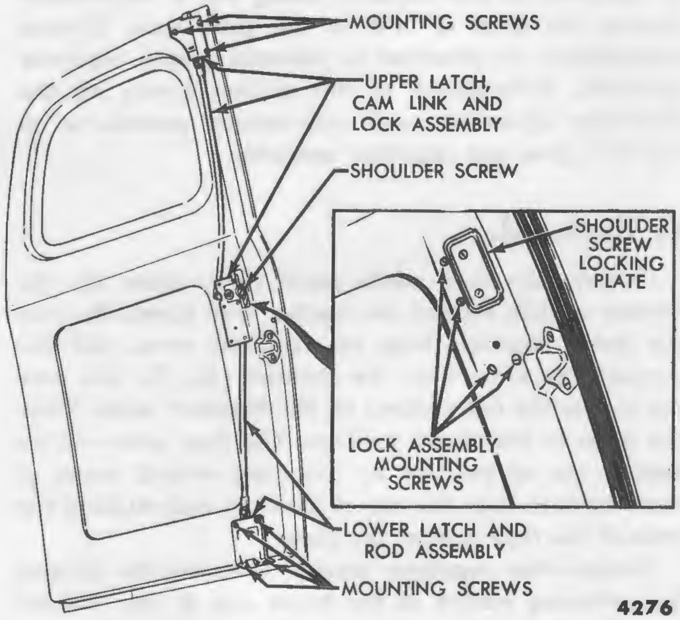

Fig. 6—Panel Delivery Rear Door Lock Assembly

(2) *INSTALLATION.* When installing the lock cylinder on 1951 deluxe models, it will be necessary to remove the trim panel in order to guide the lock cylinder shaft into the lock. Turn the key in the lock cylinder to the unlocked position. With the lock cylinder in this position, insert a long pin through the guide hole provided in the inner door panel (fig. 4). Guide the end of the lock shaft into the lock assembly. Tighten the lock cylinder set screw.

d. Lock Replacement.

The following paragraphs cover the replacement of door locks on all models. Also included is the replacement of the lock and linkage on the panel delivery rear door.

(1) *DOOR LOCK.* When replacing the door lock it is necessary to remove the remote-control linkage and the door lock as an assembly from the door. The door lock and remote-control linkage are serviced as an assembly.

(a) REMOVAL. Remove the outside-door handle and lock cylinder assembly from the door. Remove the inner door panel cover plate (fig. 4). On the deluxe models, remove the trim panel. Remove the inside door handle and the screws that secure the remote control base to the inner panel (fig. 4). Remove the door lock retaining screws. Remove the remote control and door lock as an assembly through the opening in the panel as shown in fig. 5.

(b) INSTALLATION. Lubricate all movable parts in the door lock as well as the remote control linkage with 8A-19586-A lubricant before they are installed.

Raise the remote control and lock assembly into position on the door. Install and tighten the screws at the door lock. Install the screws at the remote control base (fig. 4). Install the outside door handle and door lock cylinder. Install the inner door panel cover plate or leather trim panel if working on the 1951 deluxe model. Install the inside door handle.

(2) *PANEL DELIVERY REAR DOOR LOCK REPLACEMENT.* Remove the outside door handle and lock cylinders. Remove the shoulder screw locking plate located on the inner panel of the rear door (fig. 6).

Work through the locking plate hole and remove the shoulder screw from the cam link and rod assembly.

Remove the screws which secure the lock assembly to the door inner panel.

Remove the screws which secure the access hole corner plate at the top of the door. Lift the plate, cam link, and rod out of the door as an assembly. It will be necessary to turn the plate slightly in order to remove the assembly.

Remove the cover plate at the bottom of the door and lower the rod and lock assembly through the bottom access hole.

To install, insert the lower rod and lock assembly through the bottom access hole and secure the lock to the door inner panel. Lower the cam link and upper rod through the top access hole in the door. Install the cap screw which secures the cam to the lock assembly. Install the door handle. Install the cover plates over the access holes.

2. WINDOW REGULATORS

Glass regulator failure is usually due to either lack of lubricant, or the regulator being out of adjustment causing the glass to bind in the glass runs. Various adjustments are provided to maintain proper regulator operation. Information in this section covers all the necessary adjustment and replacement procedures on the door glass and regulator assembly.

a. Removal.

Remove the door inside panel cover plate. On the Deluxe models, remove the leather trim panel. Remove the spring retainers from the regulator arms, and disconnect the arms from the channel (fig. 7). Use care not to lose the felt washers on the regulator arms. Raise the glass to the closed position. The door glass can be held in the up position by wrapping several pieces of masking tape over the top of the door and sticking the ends of the tape against the glass.

Remove the regulator handle. Remove the division bar retaining screws at the lower end of the division bar (fig. 7) to allow clearance for removing the regulator assembly. Remove the regulator assembly retaining screws. Spread the lower end of the division bar

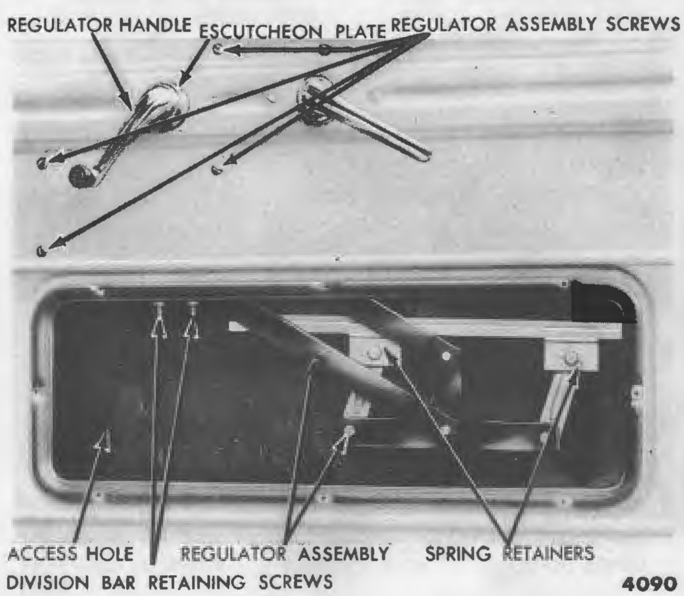

Fig. 7—Door Access Opening

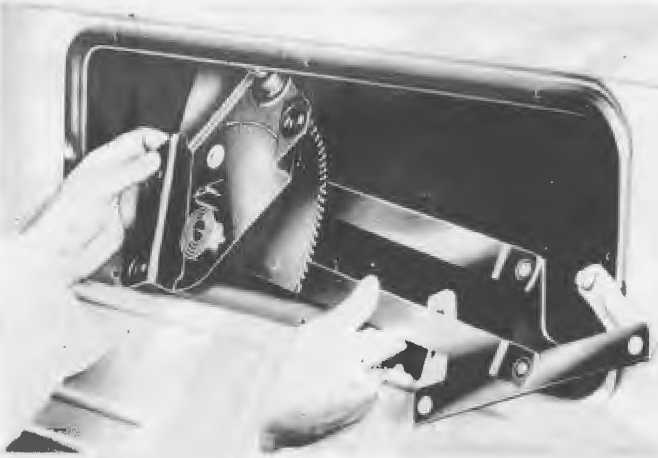
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Fig. 8—Removing Regulator Assembly

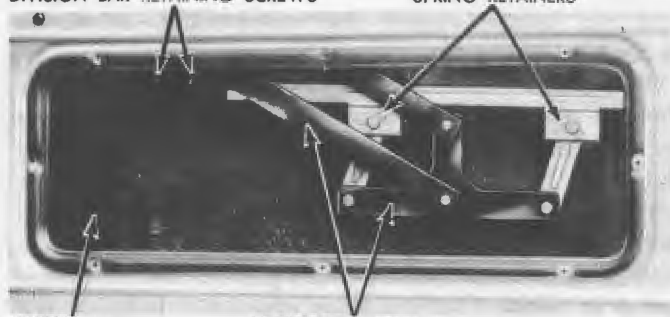

Fig. 10—Door Inner Panel with Cover Plate Removed

away from the inner panel, then lower the regulator assembly through the access opening as shown in fig. 8.

b. Installation.

Before installing the regulator assembly, apply 8A-19586-A lubricant or its equivalent to all movable parts.

Raise the regulator assembly into position through the door access opening (fig. 8). Install and tighten the regulator screws (fig. 7). Lower the door glass, and attach the regulator arms. Be sure the felt washers are properly installed between the arms and glass channel. Install the spring retainers at the regulator arms. Install the retaining screws at the lower end of the division bar (fig. 7). Install the regulator handle. Install the inside panel cover plate or trim panel.

3. DOOR GLASS AND VENTILATOR ASSEMBLY

This section covers the replacement of the door glass and ventilator assemblies on conventional C.O.E. cabs. Detailed information regarding the various adjustment procedures required to maintain proper operation of these assemblies also is included.

It is essential that correct door glass and ventilator adjustment be maintained at all times. An improperly adjusted door glass or ventilator assembly will cause excessive rattling and permit water and cold air to enter into the vehicle. These annoying conditions can be eliminated by following the simple methods of adjusting the door glass and ventilators described in this section.

a. Door Glass Replacement.

To assure a proper fit, it is recommended that only genuine Ford approved glass be used.

(1) *REMOVAL.* Remove the inside panel cover plate or the leather trim panels on the 1951 deluxe model. Remove the screw at the upper end of the divi-

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Fig. 9—Division Bar Upper Retaining Screw


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Fig. 11—Removing Door Glass from C.O.E.

sion bar located under the weatherstrip as shown in fig. 9.

Remove the retaining screws at the lower end of the division bar (fig. 10). Lower the glass, and remove the spring retainers from the regulator arms then disconnect the arms.

On the conventional cab, remove the glass through the access opening. On the C.O.E. cab, remove the weatherstrip located at the upper edge of the door inner panel to obtain the necessary clearance. Remove the glass through the top as shown in fig. 11.

(2) *INSTALLATION*. On conventional cabs, install the door glass through the access opening. On C.O.E. cabs, install the door glass through the top, then install the weatherstrip along the top edge of the inner panel.

Connect the regulator arms to the glass channel. Make sure the felt washers are properly installed between the arms and the channel. Install the spring retainers at each regulator arm. Adjust the lower ends of the division bar so the ventilator glass seals properly against the division bar. Install the division bar screws at the top and bottom. Install the door glass weatherstrip screws along the top. Install the inside panel cover plate or trim panel.

b. Division Bar and Ventilator Assembly.

It is necessary to remove the door glass as described before the ventilator assembly can be removed.

(1) *REMOVAL*. Lower the division bar, and remove it through the access opening as shown in fig. 12.

Remove the screws which secure the ventilator assembly to the door, see fig. 13 for location of the screws. Remove the ventilator assembly from the door as shown in fig. 14.

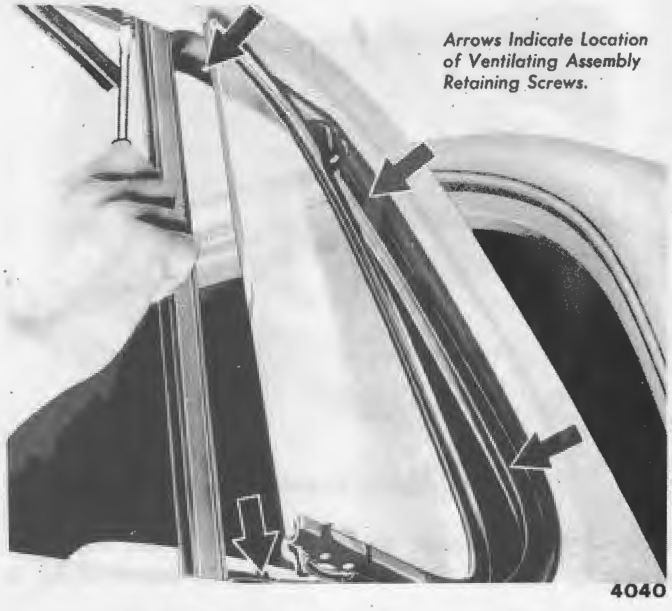

Fig. 13—Location of Ventilator Retaining Screws

(2) *ADJUSTMENT*. If the ventilator operates too freely, or will not stay open, increase the spring tension by tightening the adjusting nut located at the lower pivot. If the ventilator binds or is hard to operate loosen the adjusting nut to decrease the spring tension.

Apply lubricant 8A-19586-A to the ventilator pivot before installation.

(3) *INSTALLATION*. Lubricate the lower pivot on the ventilator assembly. Position the ventilator assembly on the door. Install the screws that secure the ventilator assembly to the door. Insert the division bar through the access opening and into position in the door. Do not install the division bar screw until the door glass has been installed.

Fig. 12—Division Bar Removal

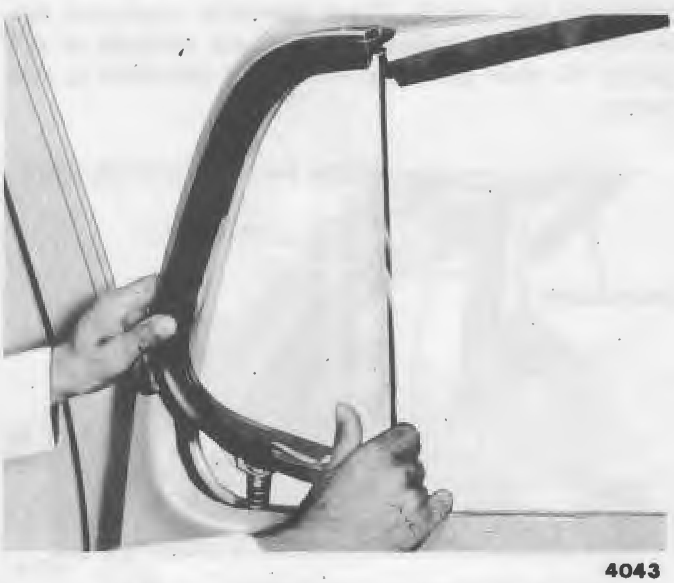

Fig. 14—Ventilator Assembly Removal

4. WINDSHIELD AND REAR WINDOW

When installing windshield and rear window glass, several precautions are necessary to insure proper sealing against water leaks. It is essential that all old cement and broken glass be removed from the glass channel in the rubber weatherstrip. The body flange should be inspected for roughness or uneven edges. It is recommended that genuine Ford approved glass be used to insure proper fit in the body.

a. Windshield Replacement.

The procedure for replacing the windshields is basically the same for all models of trucks. This procedure is given in the following paragraphs, along with the necessary hints or reminders for special models.

(1) *REMOVAL.* Bend down the retaining tabs located under the outer lip of the weatherstrip (fig. 15).

Deluxe model windshields are equipped with a chrome finish strip, and the retaining tabs are not used.

On the F-3 Parcel Delivery truck, the windshield retaining tabs are located inside the truck. Remove the windshield wiper arms. Loosen the inner side of the weatherstrip around the body flange.

With the flat of your hand, apply pressure at the lower corner of the windshield (fig. 16). Use gloves to protect your hands when performing this operation. After the glass is out at the corner, apply pressure toward the center until the glass is completely off the body flange. Remove the glass from the weatherstrip.

(2) *INSTALLATION.* If inspection shows the body flange edge to be rough or uneven, apply cellulose tape over the surface to provide a smooth surface for sealing. Insert the glass into the center section of the weatherstrip and stretch the weatherstrip around the glass. Make sure the glass is well seated in the channel. Apply rubber cement (part No. 8A-19552-B) between the glass and weatherstrip on both sides of the glass. Install a strong cord (chalk line) all around the inner lip of the weatherstrip. Then position the windshield in the opening.

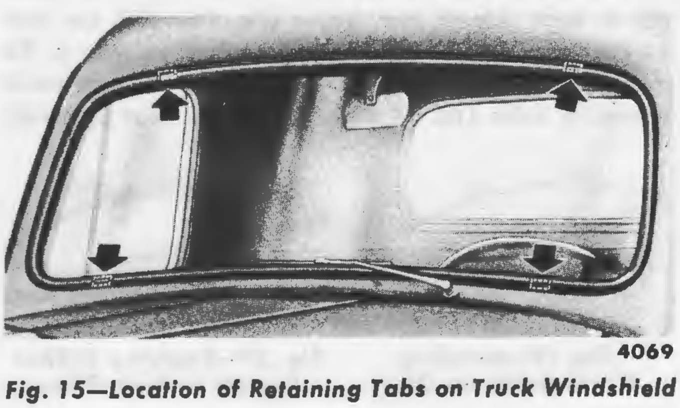

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Fig. 15—Location of Retaining Tabs on Truck Windshield

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Fig. 16—Removing Windshield

NOTE: ***A light application of liquid soap to the weatherstrip will facilitate installation. Do not use oil or grease.***

Press the glass firmly against the body flange. Start at the top and work around the corners to pull the cord out of the weatherstrip as shown in fig. 17. After the cord is removed, carefully strike the glass with the palm of the hand to seat the weatherstrip tightly over the body flange. Bend the windshield retaining tabs (fig. 15) up to their original positions. On deluxe models, install the chrome finish strip over the weatherstrip.

b. Rear Glass Replacement.

The rear glass is installed from the inside of the vehicle. The glass is held in the body by a rubber

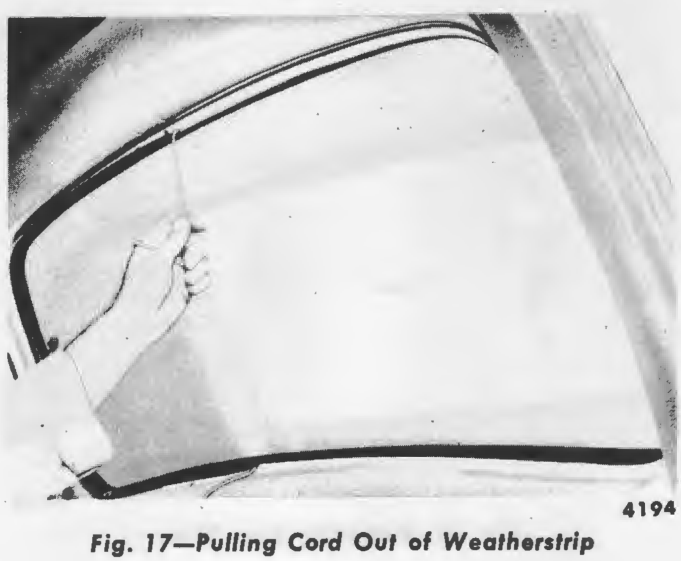

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Fig. 17—Pulling Cord Out of Weatherstrip

weatherstrip around the glass. This procedure, if followed carefully, eliminates the possibility of glass breakage when it is necessary to remove the glass for other purposes such as lead lining replacement.

(1) *REMOVAL.* From outside the cab, apply pressure against a corner of the rear glass as shown in fig. 18. Apply pressure until the weatherstrip begins to roll off the body flange. Move toward the opposite end and continue to apply pressure until the weatherstrip is completely off the body flange.

(2) *INSTALLATION.* Clean the channel in the weatherstrip and the body flange. Stretch the weatherstrip over the glass as shown in fig. 19. Make sure the glass is seated firmly in the weatherstrip.

Apply rubber cement (8A-19552-B) between the glass and weatherstrip (fig. 20). Apply the rubber cement to both sides of the glass.

Insert a piece of cord (chalk line) around the inner lip of the weatherstrip allowing both sides to overlap. Apply liquid soap around the inner side of the weatherstrip. Position the glass on the cab. It is necessary to have a helper to withdraw the cord while the glass is held firmly against the body as shown in fig. 21.

After the cord is carefully pulled loose, strike the glass with the palm of your hand to seat the weatherstrip over the body flange. Clean the glass after installation and perform a water test.

5. SEATS AND INTERIOR TRIM

When service operations are performed on the interior trim of a truck, special attention should be given to cleanliness. Place a cover over the seats and other inside sections of the vehicle that may become soiled from contact with dirty hands, tools, and clothing. When removing cab hardware or trim, make sure the screw driver is firmly seated in the slots of the screw. An unsightly scratch usually results when a screw driver is permitted to slip. If these simple precautions are observed, much time and expense will be saved by both the owner and the serviceman.

a. Seat Assembly.

Three types of drivers seats are used in the various truck models. Replacement procedures for each type seat are given in the paragraphs below. Care and cleaning of the seat fabric is also covered.

(1) *CLEANING.* If leather or imitation leather becomes soiled, its original luster may be restored by applying saddle soap and briskly rubbing the material with a cloth dampened in clear water. Wipe off the area with a damp cloth, then rub dry with a clean soft cloth. The friction produced by the dry cloth will restore the surface to its original luster.

NOTE: ***Cleaning fluids of any nature will cause this type of trim material to deteriorate.***

(2) *SEAT ADJUSTMENT.* The driver's seat is adjustable to provide a comfortable position for the driver.

Conventional truck seats are equipped with two adjustments (fig. 22). The lever at the left-hand front corner is used for positioning the seat "fore" or "aft." An adjusting screw is provided at each side of the seat back frame for tilting the seat back to the position desired.

The cab-over engine truck drivers seat is adjusted "up" or "down" by turning the adjustment screw knob located at the front of the seat (fig. 23).

The Parcel delivery and panel truck seats are adjustable "fore" or "aft" only.

(3) *SEAT ASSEMBLY (CONVENTIONAL CAB).* To remove the seat back, remove the seat back pivot pin at each side of seat frame (fig. 24). Tilt the seat back forward, then raise the seat back to remove it. To replace the seat track assembly, remove the seat track mounting bolts (fig. 24). Lift the entire seat assembly

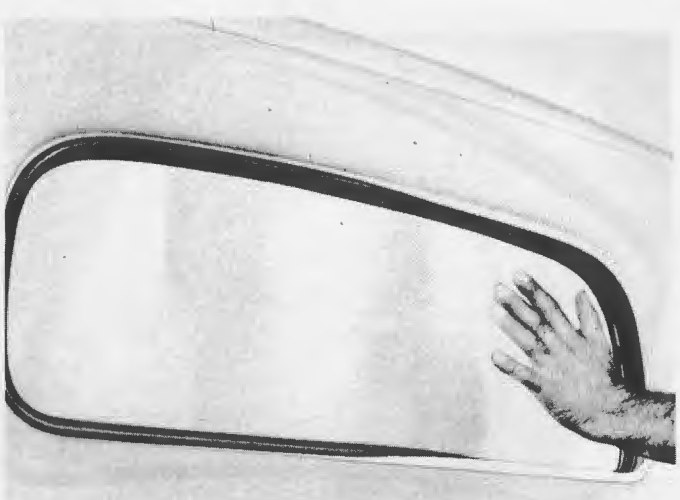

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Fig. 18—Removing Rear Glass

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Fig. 19—Installing Weatherstrip on Glass

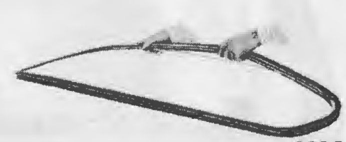

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Fig. 20—Applying Rubber Cement to Rear Glass

Fig. 21—Installing Rear Glass

out of the cab. From the underside of the seat remove the four bolts which secure the track to the seat frame. Remove the seat from the track.

Before installing the seat track, lubricate the track and adjustment lever linkage with dripless penetrating oil.

(4) *SEAT ASSEMBLY (PARCEL DELIVERY).* The seat and back assembly used in the Parcel Delivery truck is shown in fig. 25. Replacement of the parts that make up the assembly are as follows:

(a) SEAT BACK. To replace the seat back, remove the clevis pin connecting the seat back to the seat. Lift the seat back off the seat cushion assembly.

(b) SEAT CUSHION ASSEMBLY. Remove the seat back. From the underside of the seat, remove the four screws which secure the seat to the track assembly (fig. 25). Remove the seat.

(c) SEAT TRACK. Remove the seat with the seat back attached as an assembly from the track. Remove the four cap screws which secure the track assembly to the support assembly (fig. 25). Remove the track assembly. Before installing the track assembly, lubri-

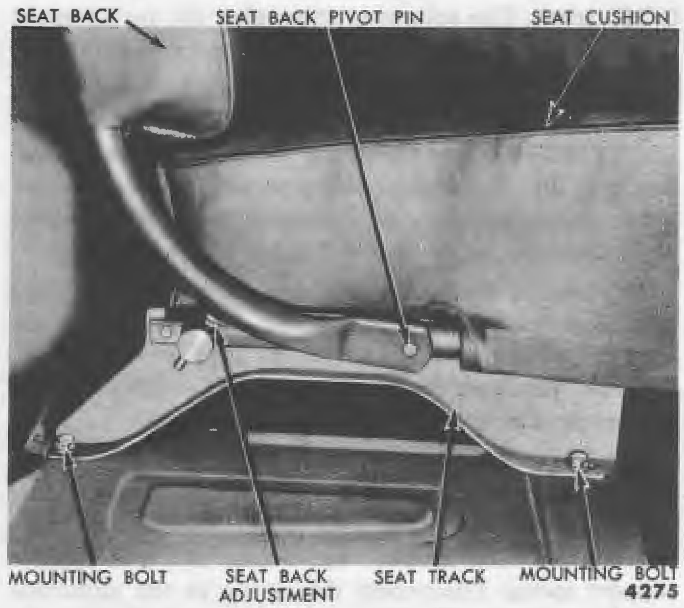


Fig. 24—Seat and Back Assembly (Conventional Cab)

cate the track rails and adjustment linkage with dripless penetrating oil.

(d) SEAT SUPPORT. Remove the track with the seat and back attached from the seat support as an assembly. Remove the nut and pivot bolt at the lower end of the seat support (fig. 25). Remove the seat support.

(5) *SEAT ASSEMBLY (C.O.E. TRUCK).* The seat and seat back are serviced as an assembly on the

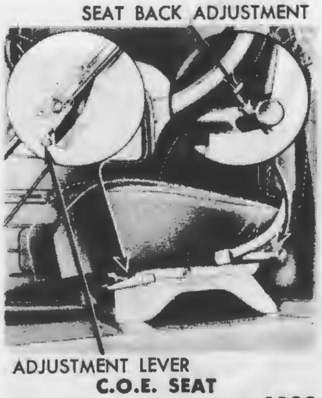


Fig. 22—Seat Adjustment (Conventional Truck)

Fig. 23—Seat Adjustment (C.O.E. Truck)

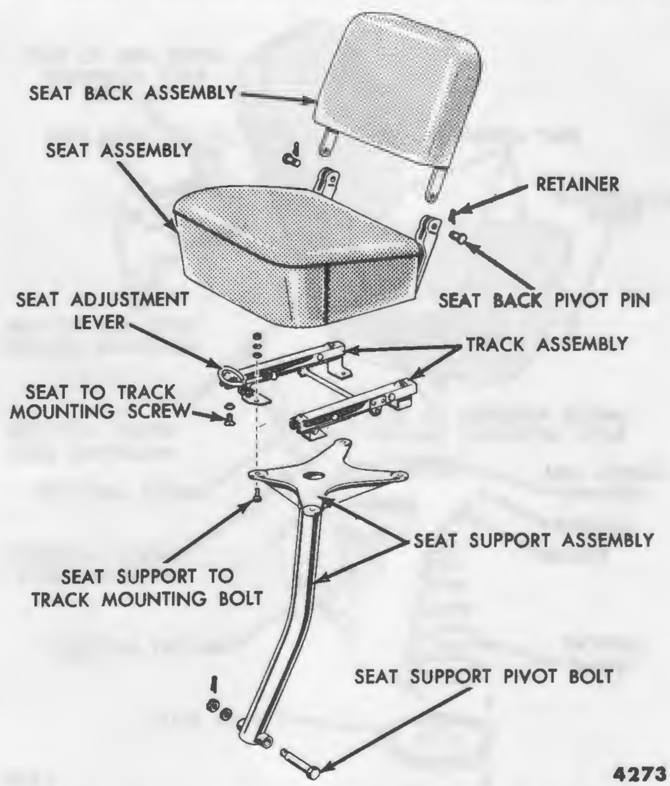


Fig. 25—Seat Assembly (Parcel Delivery)

C.O.E. truck. The following steps give the replacement procedure for the parts that make up the seat assembly.

(a) SEAT AND SEAT BACK ASSEMBLY. Disconnect the upper end of the shock absorber from the seat back (fig. 26). Disconnect the upper arms at the seat back. Remove the clevis pins which secure the seat to the lower arms (fig. 26) and remove the seat and seat back assembly.

(b) SHOCK ABSORBER. Remove the nut, washers and bolt from each end of the shock absorber. Note the location of the washers to assure proper installation.

When installing the shock absorber, position it with the larger diameter at the top

(c) SEAT SUPPORT SPRING. Disconnect the lower end of the schock absorber at the floor bracket (fig. 26). Remove the cap screws which secure the lower arm to the floor bracket to release the lead on the support spring. Disconnect the spring at the underside of the seat and remove the spring from the spring seat.

b. Door and Roof Trim Panels.

The following door and roof panel replacement procedures apply only to the deluxe model trucks.

Upper and lower interior trim panels are used on the doors. When replacing the lower trim panel, use care not to bend the sides and corners of the panel.

The roof trim panel is made of sound proof material, and a spun glass pad separates the trim from the metal roof panel.

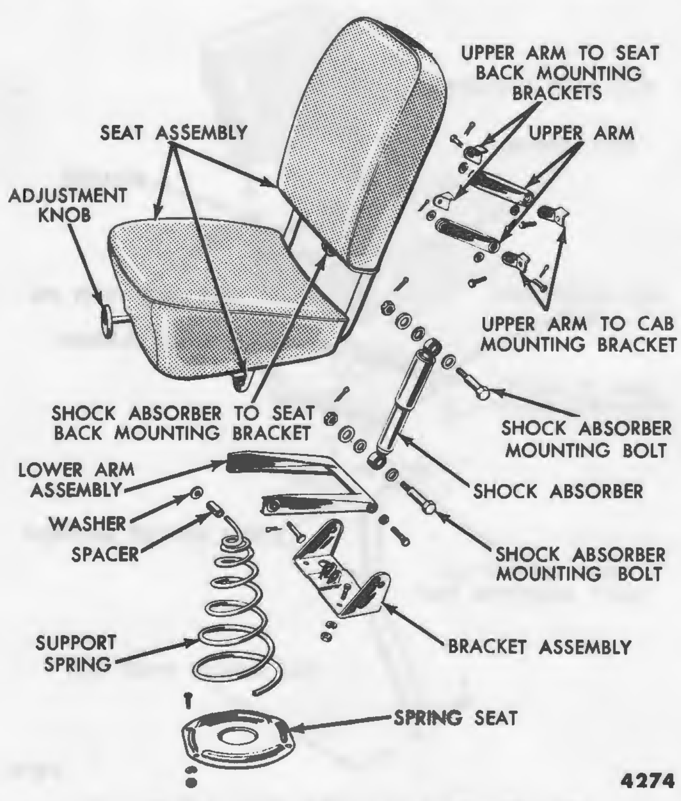


Fig. 26—Seat Assembly (C.O.E. Truck)

Fig. 27—Removing Pin from Handle

(1) *DOOR TRIM PANEL REPLACEMENT*. Remove the arm rest screws and the arm rest from the door: Remove the inside door handle and window regulator handle pins as shown in fig. 27, then remove the handles. Remove the two upper trim panel to door screws. Use the palm of your hand to push up on the trim panel until the panel is free of the retainer at the top. Then remove the panel from the door. Lift the lower trim panel out of the retainer and off the door. Remove the jute padding and the water repellent cover from the door.

To install a door trim panel, coat the edges of the water repellent cover with trim cement, and position

Fig. 28—Installing Pin in Handle

the cover on the door. Make sure the bottom edge of the cover enters into the door access opening. Coat the strips of jute padding with rubber cement, then position the strips on all four sides of the cover. Position the lower trim panel in the panel retainer. Hook the upper trim panel over the retainer on the door and secure it to the door with the two screws. Position each escutcheon plate and inside door handle and window regulator handle on the door and install the handle pins as shown in fig. 28. Position the arm rest on the door, and install the two arm rest screws.

(2) *ROOF TRIM PANEL REPLACEMENT.* Remove the screws which secure the roof side trim panels to the cab. Remove the dome light assembly and disconnect the dome light wire at the bullet connection. Unscrew the dome light switch ring. Remove the screws attaching the roof trim panel above the rear window. Remove the screw attaching the roof trim panel to the roof at the center of the cab. Pull the roof trim panel out of the windshield header. If the spun glass padding is torn or otherwise damaged, it should be replaced.

Before installing the roof trim panel, make sure the spun glass padding is firmly cemented to the roof panel. Position the forward side of the roof trim panel in the windshield header. Install the roof trim panel to roof panel screw at the center. Install the trim panel to cab screws in the holes above the rear window. Install the dome light assembly and the dome light switch ring. Position the roof side trim panel and install the side trim panel to cab screws.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part FOUR

BODIES AND CABS

Chapter

III

Front End Sheet Metal and Running Boards

This chapter describes the replacement procedures for the front fenders, the radiator grille and the connecting panels that comprise the front end sheet metal assembly on trucks. The replacement procedures for complete cab assemblies, platform bodies, hoods, and running boards are also included.

The front end sheet metal assembly may be removed and installed as a complete unit, or each assembly may be individually replaced. The radiator grilles are designed so the component parts may be serviced separately. The parts included with the hood assembly are also replaceable. In cases of severe damage, it is often advantageous for the serviceman to remove a complete assembly rather than attempt to repair or replace an individual unit.

Adjustments are provided to aid in maintaining proper hood operation. These adjustments are described in this chapter. It should be remembered that these are only minor adjustments and will not correct serious hood misalignment. In cases of serious hood misalignment, it is necessary to either replace the hood or the defective parts.

1. FRONT END SHEET METAL REPLACEMENT

It is sometimes expedient to remove the entire front end sheet metal assembly as a unit to facilitate engine removal or mechanical repairs. In the event of a collision which results in serious damage to a majority of the parts of the front end assembly, it is sometimes more economical to replace the entire assembly.

A replacement procedure for each different type of truck body is given here. The headings where this information is given are indicative of the truck model discussed.

a. Front End Removal (Conventional Cab).

Raise the hood. Disconnect the headlight wires at the bullet connections. Remove the headlight ground wire screw which is secured to the radiator grille upper panel assembly. Remove the fender apron to cowl bolt (fig. 1).

Remove the fender to fender splash pan self-tapping screws, then remove the splash pan. Remove the fender to running board bolts. Remove the fender apron to frame bolt. Remove the three fender support bracket to radiator support mounting bolts from one side of the vehicle (fig. 2). Repeat these operations on the opposite side. With a helper, carefully lift the front end sheet metal off the vehicle as a complete unit.

b. Front End Installation (Conventional Cab).

Before installing the front end assembly, make sure all anti-squeak materials are in their proper position and securely fastened.

Place the front end assembly in position on the truck. Align the holes in the fender support bracket with the holes in the radiator support then install the three bolts, lockwashers, and nuts. Install the fender apron to frame bolts, lockwashers, and nuts. Install the fender apron to cowl bolt, lockwasher, and nut. Install the fender to running board bolts, lockwashers, and nuts. Connect the headlight wires at the bullet connections. Be sure the wire color and size are matched. Secure the ground wire to the radiator upper panel.

After completing the installation, check and if necessary adjust the hood to fit the opening between the fenders.

c. Front End Removal (C.O.E. Cabs).

Raise the hood, disconnect the headlight wires at the bullet connections. Remove the screw which secures the ground wire to the radiator grille upper panel. Remove one front wheel to allow sufficient clearance in order to lift the front end assembly off the vehicle. Working under the fender, remove the cotter pin, nut, spacer, and bolt which secures each fender to the cowl (fig. 3).

Remove the fender to running board bolts. Remove the fender support bracket to radiator support bolts (fig. 4). With a helper, tilt the complete assembly toward the side from which the wheel has previously been removed. Carefully lift the complete front end assembly off the truck.

d. Front End Installation (C.O.E. Cabs).

Before installing the front end assembly, make sure all anti-squeak materials are in their proper position and fastened securely.

Position the front end assembly on the truck. Install the fender support bracket to radiator support bolts, lockwashers and nuts. Insert the cowl to fender bolts through the cowl bracket at the top of each fender. Working under the fender, install the spacer, nut, and cotter pin. To avoid collapsing the bracket do not over tighten the nut. Install the fender to running board bolts, lockwashers, and nuts. Install the front wheel. Connect the headlight wiring in the bullet connectors. Be sure wire color and size are matched. Secure the headlight ground wire to the radiator grille upper panel.

After completing the installation, check and if necessary adjust the hood to fit the opening between the fenders.

2. RADIATOR GRILLE

The radiator grille on all the various trucks is composed of several separate parts. Procedures are given here according to model for replacing the grille as a unit. Procedures are also given for replacing several of the more important or functional pieces of the grille separately. These procedures are given under headings which are descriptive of the information covered.

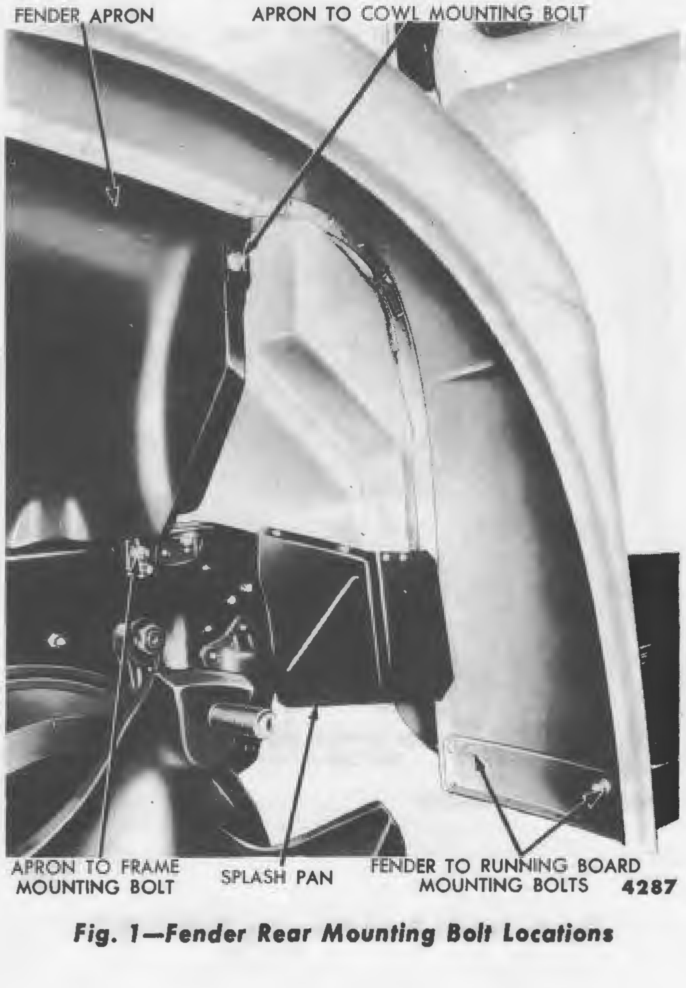


Fig. 1—Fender Rear Mounting Bolt Locations

Fig. 2—Fender Front Mounting Bolt Locations

a. 1949-50 Trucks (Conventional or C.O.E.).

Although the conventional and C.O.E. trucks differ in appearance, the replacement procedures for the major parts of the grille are basically the same on both models. These procedures do not apply to Parcel Delivery Trucks.

(1) *GRILLE REPLACEMENT.* The grille must be replaced as a complete assembly which includes the headlight support panels, and the chrome moldings over the grille bars, if the truck is so equipped. These moldings can be serviced separately if the need arises. To remove the complete assembly, raise the hood and disconnect the headlight and parking light wires at the bullet connections located at the inner side of the radiator grille. Disconnect the ground wire which is secured to the radiator grille upper panel. Remove the bolt which secures the grille support brace (fig. 5) and the headlight wire junction block to the grille. Remove the grille to upper panel cap screw located under the front top center of the upper panel. From the underside of the lower panel, remove the lower panel to grille cap screw. From under the fenders, remove the grille to fender and fender skirt bolts. Also from under the fenders, remove the grille to fender apron bolts, then remove the grille assembly from the truck.

To install the grille position it on the truck. Align the holes in the grille with the holes in the fender aprons, and install the grille to apron bolts, lockwashers, and nuts. Install the grille to fender and fender skirt bolts, lockwashers, and nuts. At the underside of the lower panel, install the lower panel to grille cap screw and lockwasher. At the front top center of the upper panel, install the upper panel to grille cap screw and lockwasher. Install the support brace and junction block to grille bolt, lockwasher, and nut. Connect the headlight and parking light wires at the bullet connections. Be sure the wire color and size are matched.

(2) *HOOD PANEL REPLACEMENT.* Raise the hood, and remove the support brace (fig. 5) to hood panel bolt. Remove the hood panel to upper panel cap screws. Remove the hood panel from the truck.

To install the hood panel position it on the truck and align the holes in the hood panel with the holes in the upper panel. Install the support brace to hood panel bolt, lockwasher, and nut. Lower the hood and check it for proper alignment and make any necessary adjustments.

(3) *UPPER PANEL REPLACEMENT.* Raise the hood, and remove the hood panel assembly (fig. 5). From under the fenders, remove the upper panel to fender skirt bolts. Remove the grille to upper panel cap screw located under the center top of the upper panel. Remove the upper panel assembly from the truck.

To install, position the upper panel on the truck. Install the upper panel to grille cap screw and lockwasher. Working under the fenders, install the six upper panel to fender skirt bolts, lockwashers, and nuts. Install the hood panel assembly. Lower the hood. Check the hood for proper alignment and make any necessary adjustments.

(4) *LOWER PANEL REPLACEMENT.* From the under side of the lower panel, remove the two lower panel to lower shield assembly cap screws (fig. 5). Working under the truck, remove the six lower panel to

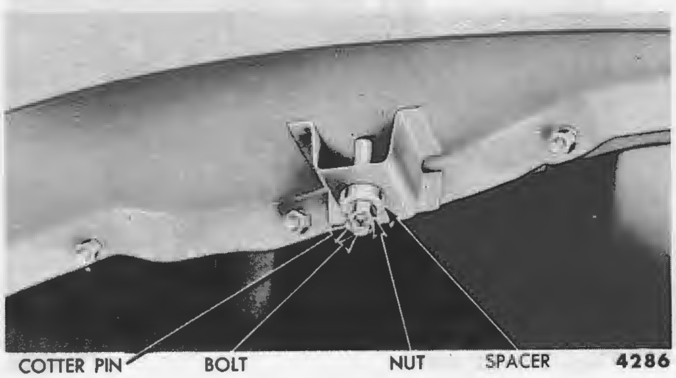


Fig. 3—Fender to Cowl Mounting Bolts

Fig. 4—Fender Front Mounting Bolts C.O.E.

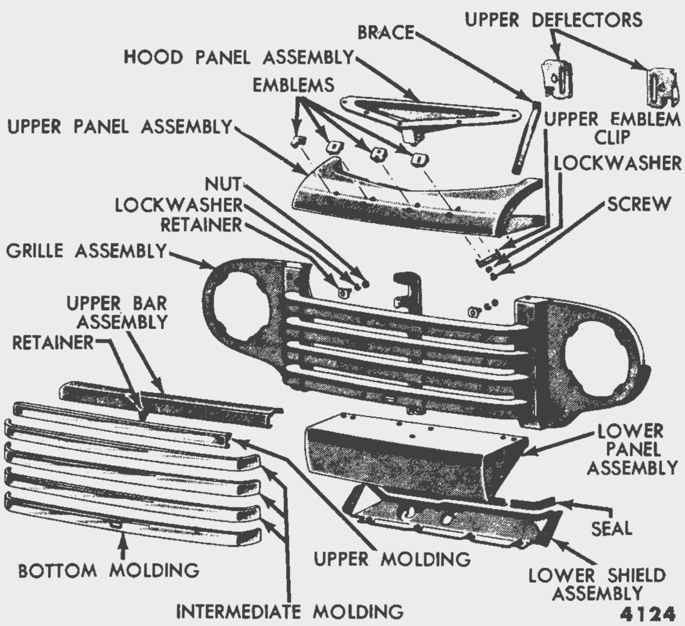


Fig. 5—Radiator Grille Assembly (Conventional and C.O.E.)

fender bolts. Remove the lower panel assembly and anti-squeak material from the truck.

To install, position the anti-squeak material and the lower panel on the truck. Install the six lower panel to fender bolts, lockwashers, and nuts. Install the two lower panel to lower shield cap screws.

b. Parcel Delivery Truck.

Adjustment and replacement procedures for the grille assembly the upper panel assembly, and the lower panel assembly used on parcel delivery trucks are given here. The headings indicate the material covered.

(1) *UPPER PANEL HINGE AND LOCK ADJUSTMENT.* To adjust the upper panel hinges loosen the hinge to body cap screws. Shift the hinges in the elongated holes until the proper fit is obtained. This adjustment permits the upper panel assembly to be either raised or lowered or moved forward or backward.

If the upper panel assembly is not locking properly, bend the lock tabs located in the body section above the upper panel assembly until the proper adjustment is obtained.

(2) *GRILLE REPLACEMENT.* Raise the radiator grille upper panel (fig. 6). Disconnect the headlight and parking light wires at the bullet connectors. Remove the wing nuts attaching the grille assembly to the supports located at each side of the radiator, then remove the grille assembly from the truck.

To install the grille, position the assembly on the truck. Install the four flat washers, lockwashers, and wing nuts which secure the grille assembly to the supports. Connect the headlight and parking light wires at the bullet connections.

(3) *UPPER PANEL REPLACEMENT.* Raise the upper panel (fig. 6). Remove the upper panel hinge to

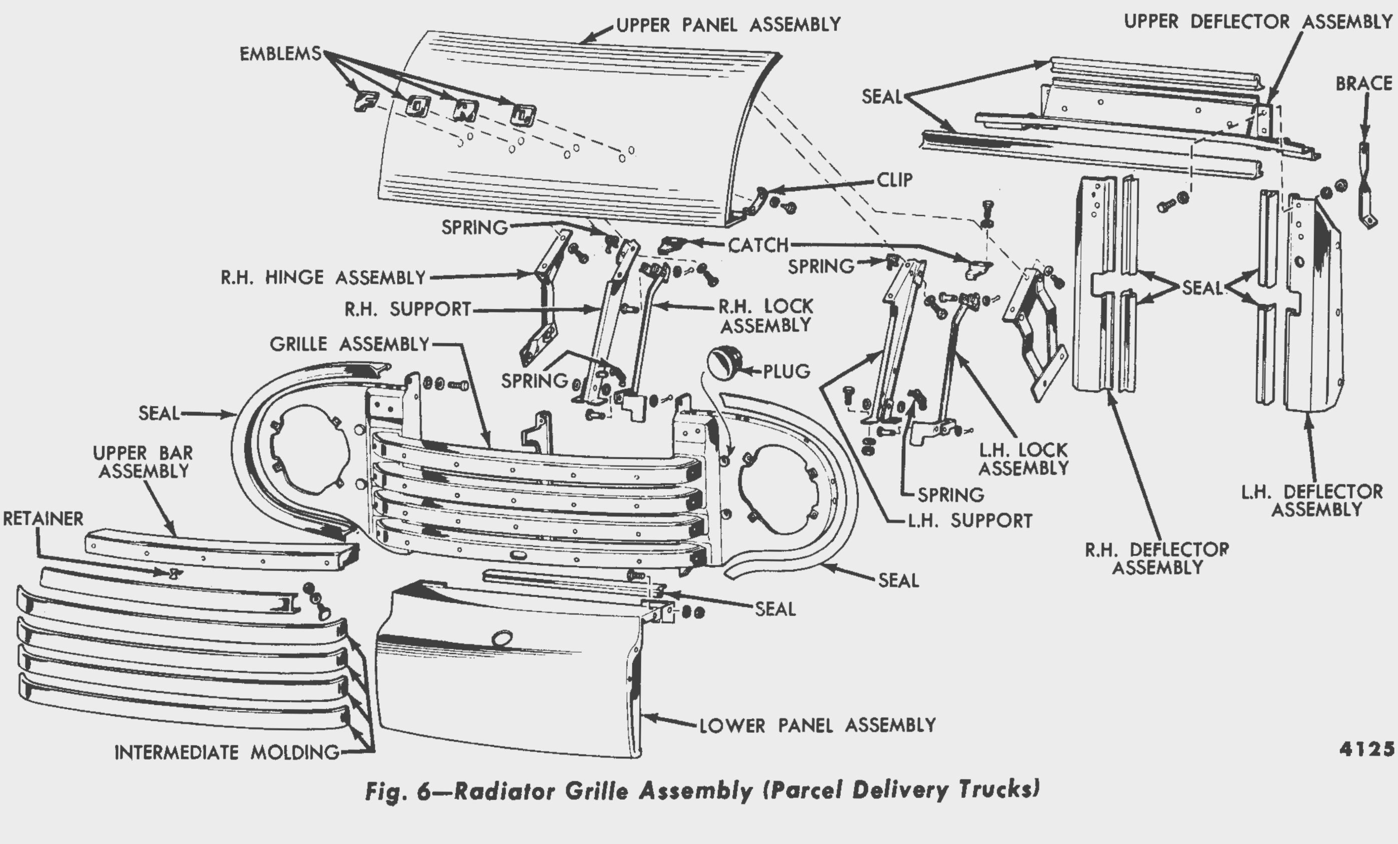


Fig. 6—Radiator Grille Assembly (Parcel Delivery Trucks)

upper panel cap screws. Remove the upper panel and support from the truck.

To install the upper panel place it on the truck and align the holes in the panel with the holes in the hinges. Install the lockwashers and cap screws. Lower the panel and check the operation of the panel. If the panel is not fitting or locking properly, make the necessary adjustments.

(4) *LOWER PANEL REPLACEMENT.* From outside the truck, remove the top lower panel to cowl side panel bolts (fig. 6). From the inside, remove the remaining panel to cowl bolts. Remove the lower panel and seal.

To install the lower panel assembly, install the seal, then position the panel assembly on the truck. Align the holes in the panel with the holes in the cowl side panel and install the eight bolts, lockwashers, and nuts.

c. 1951 Trucks (All Models).

The replacement procedures for the radiator grille, upper panel, and lower panel assemblies used on all trucks are given here.

NOTE: ***With the exception of the radiator grille assembly, the replacement procedures for the Parcel Delivery trucks are the same as those described under b above.***

(1) *GRILLE REPLACEMENT.* Disconnect the headlight wires at the bullet connections located behind the grille. Disconnect the headlight ground wire from the panel. Remove the parking light lens. From under the fender, remove the headlight support panel to grille bolts (fig. 2). Remove the grille support to grille lower bolt. Remove the three grille to lower panel bolts. Tilt the radiator grille assembly forward, then lift the assembly out of the truck.

To install the grille, position the assembly on the truck and install the lower panel to grille bolts. Install the grille support to grille bolt, lockwasher, and nut. Install the grille to headlight support panel bolts located behind each headlight. Install the parking light glass and lens. Connect the headlight wires at the bullet connections and attach the headlight ground wire to the panel.

(2) *UPPER PANEL REPLACEMENT.* Raise the hood, and remove the grille support to grille upper bolt. Disconnect the headlight wires at the bullet connections located under the upper panel and remove the headlight ground wire from the panel. From under the fenders, remove the upper panel to fender bolts, then remove the upper panel from the truck.

To install the upper panel position the assembly on the truck, then install the upper panel to fender bolts, lockwashers, and nuts. Insert the headlight wires in the bullet connectors under the upper panel and attach the headlight ground wire to the panel. Install the grille support to grille bolt, lockwasher, and nut. Lower the hood. If the hood does not lock properly, adjust the lock mechanism located on the upper panel.

(3) *LOWER PANEL REPLACEMENT.* Remove the parking light assembly. From under the fenders, remove the lower panel to fender skirt bolts (fig. 2). Remove the lower panel to radiator grille bolts. Remove the lower panel to headlight support panel bolts, then lift the lower panel off the truck.

To install the lower panel, align the holes in the panel with the holes in the headlight support panels and install the bolts, lockwashers, and nuts. Install the lower panel to radiator grille bolts. Working under the fenders, install the lower panel to fender skirt bolts, lockwashers, and nuts. Install the parking light lens.

3. HOOD AND COMPONENT PARTS

The hood is provided with various adjustments to maintain proper hood alignment and operation, unless the hood has been damaged, the adjustments described here should correct hood misalignment.

Because of the differences in design, the adjustment and replacement procedures for hoods used on the conventional cab and the C.O.E. cab are described separately.

a. Conventional Cab.

When replacing a hood or hood parts, use care not to scratch the chrome and paint.

(1) *LOCK DOWEL ADJUSTMENT.* The hood lock is adjustable to maintain the proper space between the front edge of the hood and the upper grille panel. This adjustment will not center the hood between the front fenders. If the hood requires shifting from side to side, it will be necessary to adjust the hinge brackets.

If the front of the hood fits too tight or requires slamming to lock the hood, turn the dowel outward. If the hood has excessive clearance or is loose on the dowel, turn the dowel inward. Loosen the lock nut at the end of the dowel. On 1948-50 models, the lock nut is located at the bottom of the dowel (fig. 7), and on the 1951 models, the lock nut is located at the top (fig. 8). Turn the dowel with a screw driver until the proper fit is obtained. Tighten the lock nut after making the adjustments.

After this adjustment is made, check to make certain the lock dowel enters exactly in the center of the lock plate.

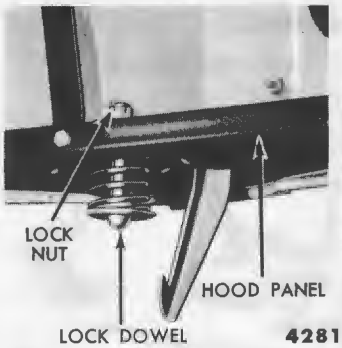


Fig. 7—Lock Dowel (1948-50 Conventional)

Fig. 8—Lock Dowel (1951 Conventional)

Lubricate the hood locking mechanism with dripless penetrating oil. Use stainless wax on the locking dowel.

The rubber bumpers should be checked periodically and replaced if they are flattened, worn, or missing.

To install rubber bumpers, dip them in liquid soap. This will ease the installation and also prevent the rubber tips from being torn off.

When hood hinge adjustments are made always check the locking action to make certain the lock dowel is centered on the lock plate.

To center the lock dowel with the lock plate on 1948 through 1950 trucks, bend the lock dowel mounting bracket in the direction required by striking the end of the dowel with a rubber mallet.

On the 1951 trucks, this adjustment can be made at the lock plate. To make this adjustment, loosen the screws which secure the lock plate (fig. 9) to the upper panel, then shift the lock plate in the elongated holes until the lock dowel centers in the lock plate.

(2) *BRACKET ADJUSTMENT*. To adjust the hood brackets (fig. 10), remove the cardboard panels located at each inner corner of the cowl. Loosen the bracket screws (fig. 11). Shift the bracket in the elongated holes until the proper fit is obtained. This adjustment permits the hood to be raised or lowered at the rear, or moved forward or backward.

(3) *HOOD REPLACEMENT*. Remove the cotter pin from the clevis at the top of each hood hinge (fig. 12). Place a support under the hood to keep it in

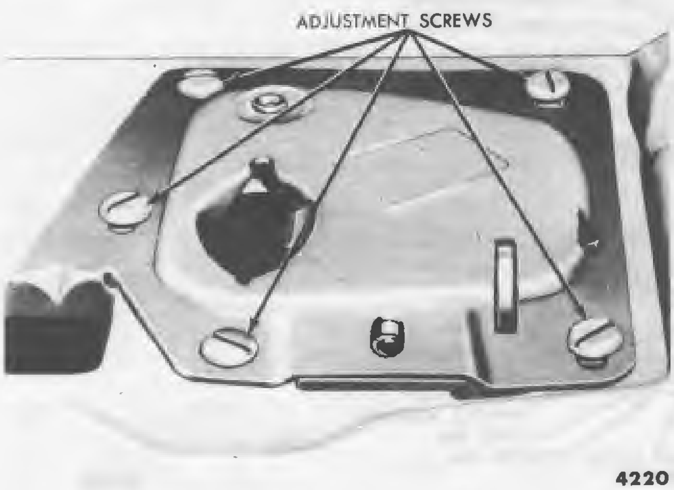


Fig. 9—Hood Lock Plate (1951)

Fig. 10—Hood Hinge and Bracket Assemblies (Conventional)

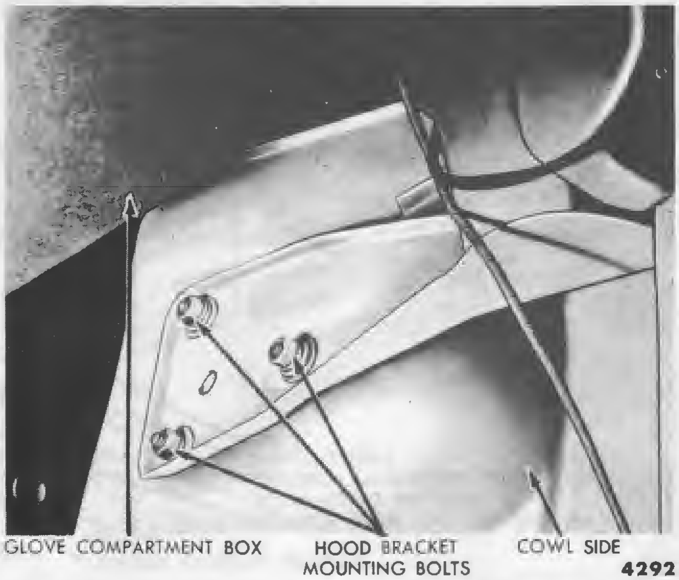


Fig. 11—Hood Bracket Mounting Bolts (Conventional)

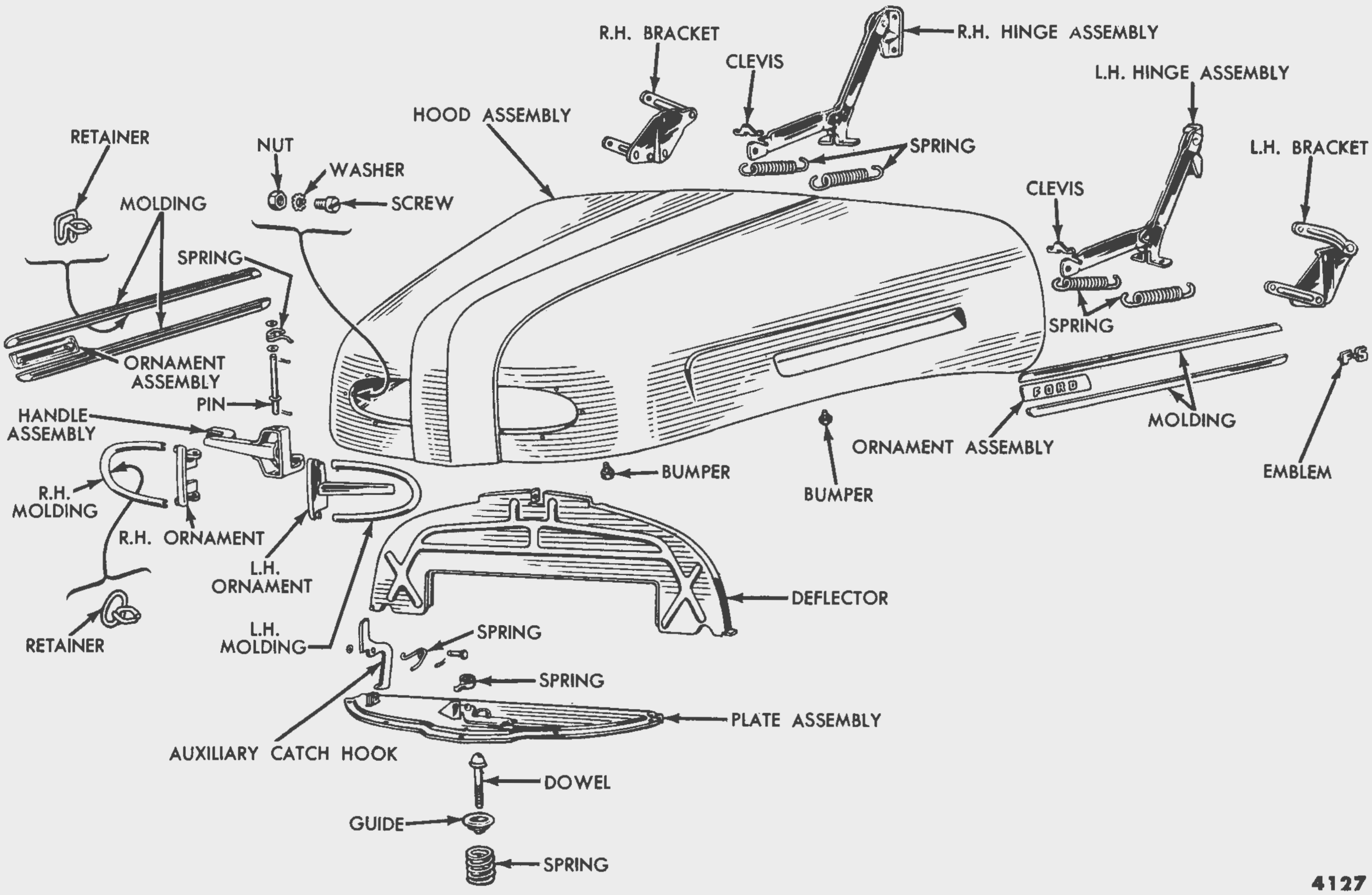


Fig. 12—Hood Assembly (Conventional Cab)

the raised position, then remove the lockwires and cap screws from the bracket assembly (fig. 10). Remove the support and hood assembly from the vehicle.

To install the hood, place the assembly on the truck and support it in the raised position. Install the hood to bracket flat washers, lockwashers, and cap screws. Install the lockwires in the heads of the hood to bracket cap screws. Install new cotter pins in each clevis to attach the hinges to the hood. Remove the support, lower the hood, and make any necessary adjustments.

(4) *HOOD BRACKET REPLACEMENT.* Raise and support the hood assembly. Remove the hood to

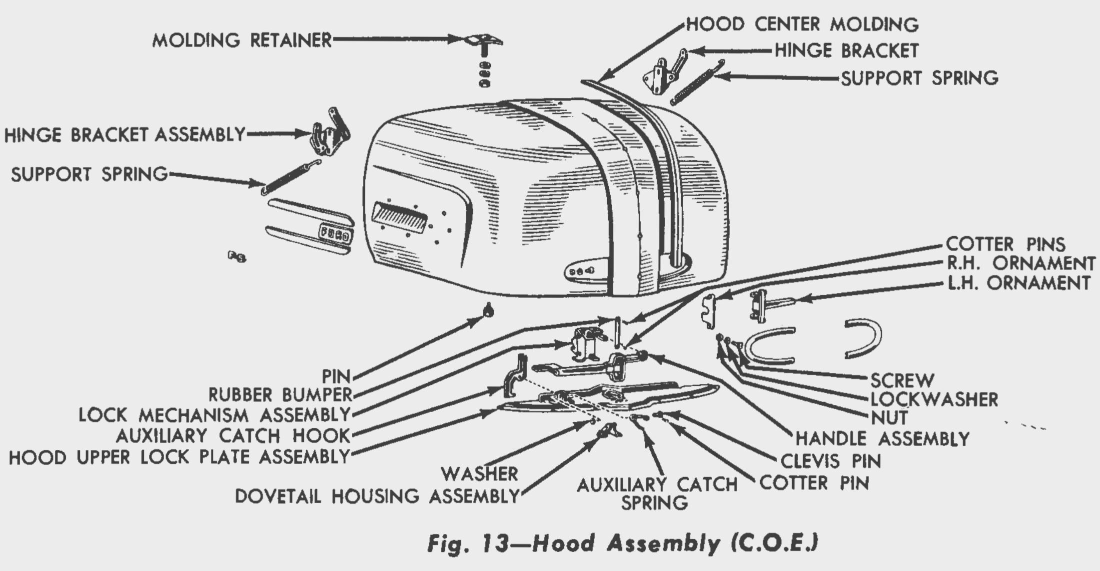


Fig. 13—Hood Assembly (C.O.E.)

bracket lockwire and cap screws (fig. 10). From inside the cab, remove the bracket to cowl side panel nuts and bolts (fig. 11), then remove the bracket assembly.

To install the bracket assembly, align the holes in the bracket with the holes in the cowl side panel, and install the bolts, lockwashers, and nuts. Install the hood to bracket flat washers, lockwashers, and cap screws. Install the lockwire in the heads of the hood to bracket cap screws. Remove the support, lower the hood, and make any necessary adjustments.

(5) *HOOD HINGE REPLACEMENT.* Raise and support the hood assembly. Remove the cotter pin from the clevis at the top of the hinge. Remove the hinge to cowl cap screws (fig. 10), and the hinge assembly from the cowl.

To install, align the holes in the hinge bracket with the holes in the cowl and install the lockwashers and cap screws. Using a new cotter pin, attach the upper part of the hinge assembly to the hood. Remove the support.

(6) *HOOD AUXILIARY CATCH HOOK REPLACEMENT.* Remove the cotter pin attaching the auxiliary catch spring clevis to the upper plate assembly. Remove the spring, flat washer, clevis, and hook from the upper panel (fig. 12).

To install, position the hook and install the spring, clevis, and flat washer. Install a new cotter pin in the clevis. Lower the hood and check the operation of the auxiliary catch hook. If necessary, bend the hook to obtain the proper alignment.

(7) *HOOD LOCKING HANDLE REPLACEMENT.* Remove the lock plate to hood cap screws and the lock plate assembly from the hood (fig. 12). Remove the cotter pins at each end of the lock handle pin. Remove the lock handle spring. Remove the lock handle to hood bolt and the lock handle assembly from the hood.

To install, position the lock handle assembly, and install the lock handle to hood bolt, washers, and nut. Install the lock handle spring and pin. Install the cotter pins in the holes located at each end of the pin. Align the holes in the lock panel assembly with the holes in the hood, and install the lockwashers and cap screws.

b. C.O.E. Cabs.

Refer to fig. 13 for the locations of the component parts of the hood.

(1) *HOOD BRACKET ADJUSTMENT.* To adjust the hood brackets, remove the cardboard panels located at each inner corner of the cowl. Loosen the bracket screws at the cowl (fig. 14). Shift the hinges in the elongated holes until the proper hood fit is obtained. This adjustment permits the hood to be raised or lowered and moved forward or backward.

(2) *HOOD LOCK MECHANISM AND LOCK DOVETAIL HOUSING ADJUSTMENT.* To adjust the lock mechanism (fig. 13), loosen the lock mechanism bolt. Shift the bolt in the elongated hole until the hood is making proper contact with the dovetail. To adjust the locking dovetail housing, loosen the dovetail housing to upper panel cap screws (fig. 15). Shift the screws in the elongated holes until the hood assembly is locking properly.

(3) *HOOD REPLACEMENT.* Raise and support the hood assembly. Remove the bracket to hood lockwires and bolts. Remove the support and hood assembly from the truck.

Fig. 14—Hood Bracket Mounting Bolts (C.O.E.)

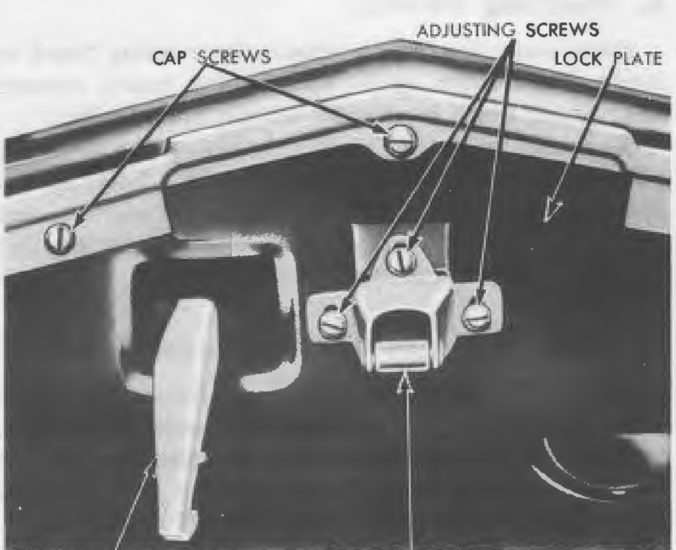


Fig. 15—Hood Dovetail Housing Adjustment (C.O.E.)

To install the hood place the assembly on the truck and support it in the raised position. Align the holes in the hood with the holes in the brackets, and install the bolts, lockwashers, and nuts. Install the lockwires in the heads of the bracket to hood bolts. Remove the support, lower the hood, and make any necessary adjustments.

(4) *HOOD HINGE LINK BRACKET ASSEMBLY REPLACEMENT.* Unhook the hood support spring. Detach the bracket assembly from the hood as described above. From inside the cab, remove the bracket to cowl side panel nuts and bolts (fig. 14). Remove the bracket assembly and hood support spring from the cowl side panel.

To install, align the holes in the bracket assembly with the holes in the cowl side panel, then install the bolts, lockwashers, and nuts. Attach the bracket assembly to the hood. Install the hood support spring. Lower the hood, and make any necessary adjustments.

(5) *HOOD AUXILIARY CATCH HOOK REPLACEMENT.* Remove the cotter pin from the clevis which secures the auxiliary catch spring to the lock plate assembly (fig. 13). Remove the spring, flat washer, clevis, and hook from the upper panel.

To install, position the hook in place on the hood, and install the spring, clevis, and flat washer. Install a new cotter pin in the clevis. Lower the hood and check the operation of the auxiliary catch hook. If necessary, bend the hook to obtain the proper alignment.

(6) *HOOD LOCK MECHANISM AND LOCK HANDLE REPLACEMENT.* Remove the lock plate to hood cap screws (fig. 15), and the lock plate from the hood. Remove the lock mechanism to lock plate cap screws and the lock mechanism from the lock plate.

Remove the lock handle to hood cap screws. Remove the cotter pins from each end of the lock handle pin, then remove the pin and handle from the hood.

To install, position the lock handle and pin on the hood. Install new cotter pins in the holes located at each end of the lock handle pin. Install the three lock handle to hood washers and cap screws.

Align the holes in the lock plate with the holes in the hood, and install the lockwashers and cap screws. Position the auxiliary catch hook in place on the hood, then install the spring, clevis, and flat washer. Install a new cotter pin in the clevis. Align the holes of the hood lock mechanism with the holes in the lock plate, and install the four bolts, lockwashers, and nuts. Lower the hood, and check the operation of the hood auxiliary catch hook. If necessary, bend the hook to obtain the proper alignment.

4. FENDERS AND RUNNING BOARDS

The fenders and running boards used on Ford trucks are basically the same on all models. This section describes the replacement procedures for running boards and front and rear fenders. When replacing a running board or fender for some reason other than its being damaged, use care not to scratch the paint.

a. Running Boards.

From under the fender, remove the running board to fender bolts. From under the running board, remove the running board bracket to running board bolts.

To install, place the running board on the brackets. Align the holes in the brackets with the holes in the running board, and install the bolts, lockwashers, and nuts. Working under the fender, install the running board to fender bolts, lockwashers, and nuts.

b. Front Fenders (Conventional Cabs).

From under the fender, remove the fender to radiator grille bolts. Remove the fender to fender skirt bolts. Remove the fender to fender apron bolts. Remove the fender to running board bolts. Remove the fender to dash panel bolts, then lift the fender off the truck.

NOTE: ***If it becomes necessary to replace a front fender on C.O.E. cabs, it is recommended that the***

Fig. 16—Steering Column and Plate

fender and grille assembly be removed from the truck as a unit.

To install, support the fender in position on the truck and install the fender to dash panel bolts, lockwashers, and nuts. Install the fender to running board bolts, lockwashers, and nuts. Install the fender to fender skirt bolts, lockwashers, and nuts. Install the fender to radiator grille bolts, lockwashers, and nuts.

c. Rear Fenders (Pickup).

Remove the rear wheel. Remove the bolts which secure the fender to the running board. Remove the bolts which secure the running board to the running board brackets, then remove the running board from the truck.

To install, place the running board in position on the brackets, then install the running board to bracket bolts, lockwashers, and nuts. Install the running board to fender bolts, lockwashers, and nuts. Install the rear wheel.

5. CAB REPLACEMENT

The cab assembly used on Ford conventional and C.O.E. trucks may be replaced as complete unit. Because of the differences in their design, the replacement procedures for the conventional cab are described separately from the C.O.E. cab.

a. Cab Removal (Conventional).

Remove the steering wheel. Disconnect all wiring, lines, and linkage that are secured to the cowl on the engine side or pass through the cowl into the driver's compartment. Remove the steering column floor board bracket (fig. 16). Remove the steering column opening plate at the floor board. Remove the clutch and brake pedal pads. Remove the floor mat. Remove the transmission gear shift lever assembly. Disconnect the fuel

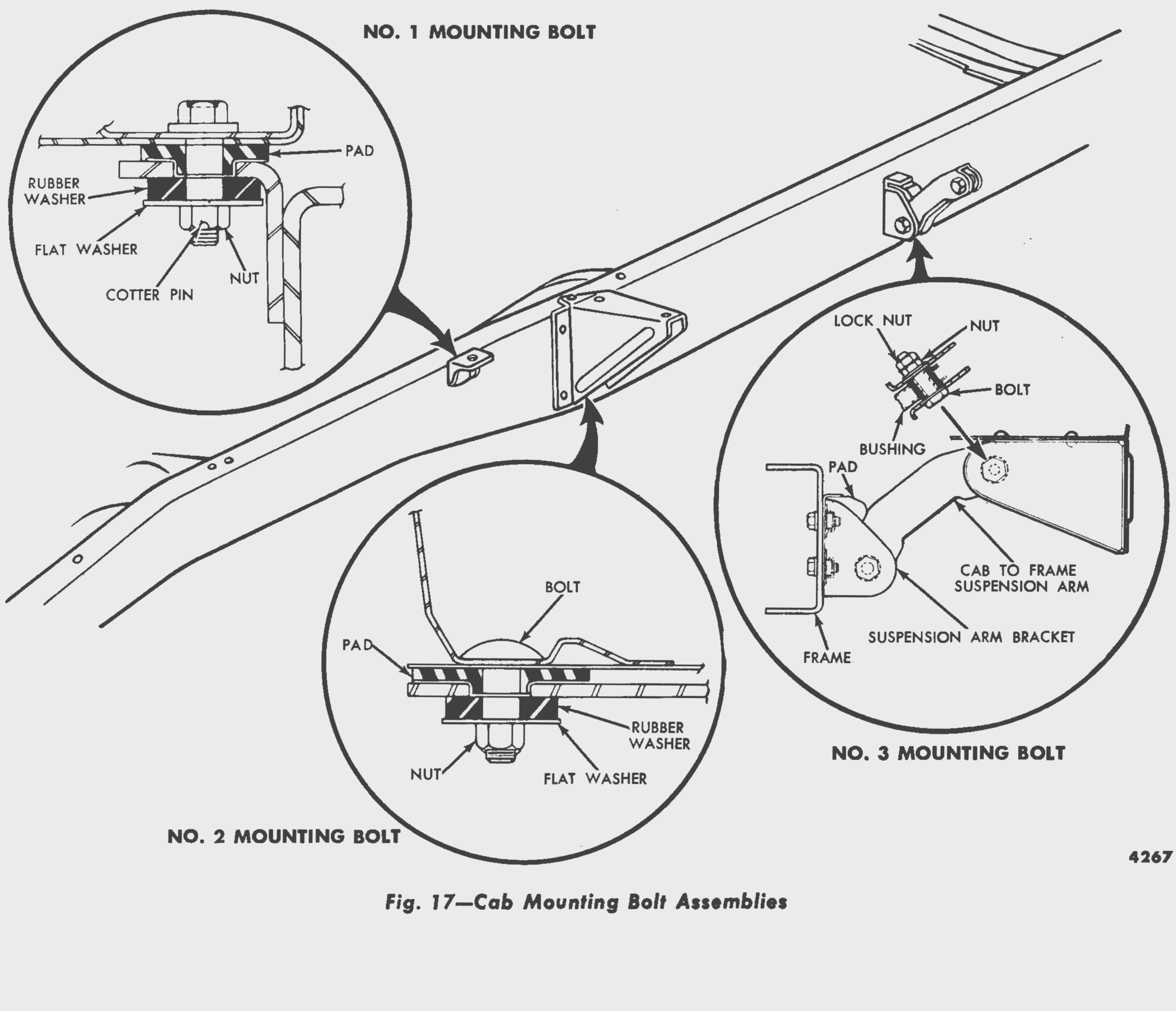


Fig. 17—Cab Mounting Bolt Assemblies

line at the fuel tank. Remove the fender splash pans from under the fenders. Remove the cab hold-down bolts (fig. 17) at each side of the frame.

b. Cab Installation (Conventional).

Before installing the cab assembly, check the condition of the suspension arm bushing at the suspension arm bracket. If the bushing has become soft or worn, it should be replaced.

Place the cab assembly in place on the frame. Shift the cab on the frame until the holes in the cab mounting brackets are aligned with the holes in the frame. Install the No. 3 mounting bolt bushings, bolts, flat washers, lock nuts, internal tooth washers, and nuts. Before tightening these nuts, make sure the mounting bolt nuts at the frame end of the suspension arms are tight (fig. 18). This should be done to prevent cocking the bushings.

Working under the cab, install the No. 2 cab to frame mounting bolts, square pads, rubber washers, flat washers, and nuts. Install the No. 1 cab to frame mounting bolt and lockwasher assemblies, square pads, rubber washers, flat washers, nuts, and cotter pin.

Install the fender splash pans. Connect the fuel line at the fuel tank. Install the transmission gear shift lever assembly. Install the steering gear column opening plates. Install the floor mat. Install the clutch and brake pedal pads. Install the steering column bracket on the instrument panel. Install and connect all wiring, lines, and linkage that have been removed. Install the steering wheel.

c. Cab Removal (C.O.E.).

Remove the steering wheel. Disconnect all wiring, lines, and linkage that are secured to the cowl on the engine side or pass through the cowl into the driver's compartment. Remove the steering gear column bracket at the instrument panel. Remove the clutch and brake pedal rubber pads. Remove the floor mat. Remove the steering column opening plate at the floor board. Remove the transmission gear shift lever assembly. Remove the engine cover. Disconnect the fuel line at the fuel tank. Remove the fender splash pans. Remove the center and rear corner cab skirt assemblies.

Remove the assemblies lock wire, bolt, flatwasher and tension spring, from the No. 1 cab mounting bolt see fig. 19. Remove the cotter pin, nut, washer, bolt, and bushing from the No. 2 mounting bolt. Remove the nut, internal tooth washer, lock nut, washer, bolt, and bushing from the No. 3 mounting bolt. Repeat this operation on the opposite side. Raise the cab assembly over the steering column and off the sub frame.

d. Cab Installation (C.O.E.).

Before installing the cab assembly, check the condition of the No. 2 and No. 3 suspension arm bushings. If any of the bushings are soft and flabby, they should be replaced. Check the condition of the anti-squeak located under the cab at the No. 1 bolt (fig. 20). If the anti-squeak is frayed out of shape, it should be replaced.

Place the anti-squeak in position on the sub frame at the No. 1 cab mounting bolt. Place the cab assembly in position on the sub frame. Install the No. 3 cab mounting bolt bushings, bolts, washers, locknuts, internal tooth washers, and nuts. Before tightening these nuts, make sure the mounting bolt nuts at the frame end of the suspension arms are tight. This should be done to prevent distorting the rubber bushings. Install the No. 2 cab mounting bolt bushings, bolts, washers, nuts, and cotter pins. Use the same precaution before tightening the nuts as described above for the No. 3 mounting bolt. Install the No. 1 mounting bolt tension springs, flat washers, bolts and lockwires. Install new lockwire.

Install the center and rear corner cab skirt assemblies. Install the fender splash pans. Connect the fuel line at the fuel tank. Install the engine cover. Install the gear shift lever assembly. Install the steering column opening plate. Install the floor mat. Install the clutch and brake pedal pads. Install the steering column bracket at the instrument panel. Install and connect all wiring, lines, and linkage that have been removed. Install the steering wheel.

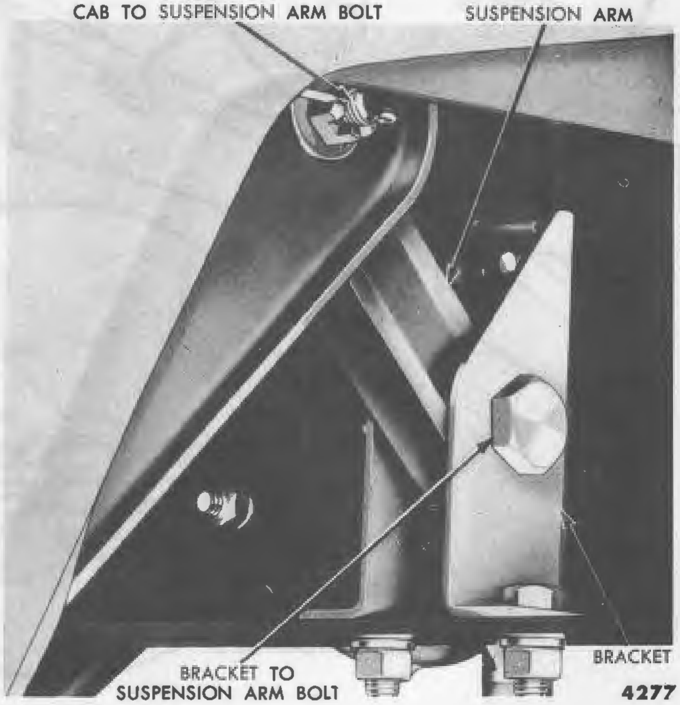


Fig. 18—Cab to Frame Suspension Arm (Conventional)

6. PLATFORM BODY REPLACEMENT

The platform bodies manufactured by the Ford Motor Company are so designed that they can readily be replaced in cases of severe damage or when the owner desires to use a different type body. The following describes the replacement procedures for the pickup and stake platform type bodies.

a. Pickup Body.

If a pickup body is being replaced because of excessive damage, always inspect the frame assembly for misalignment before installing the platform body.

(1) *REMOVAL.* Disconnect the taillight wiring at the frame. From under the body, remove the bolts that secure the body assembly to the frame. If the bolts cannot be removed with a wrench because of excessive accumulations of rust, road salt, tar, etc., cut the bolts with a chisel or hacksaw. At the front of the body, remove the bolts that secure the body to the frame brackets. At the rear of the body, remove the bolts located under the tail gate which secure the body to the frame. Remove the fender to running board bolts, then raise the body and fender assemblies off the frame.

(2) *INSTALLATION.* Before installing the platform body on the frame, inspect the condition of the anti-squeak located at each body to frame mounting bolt hole. If the anti-squeak is excessively worn, it should be replaced.

Place the platform body and fender assemblies on

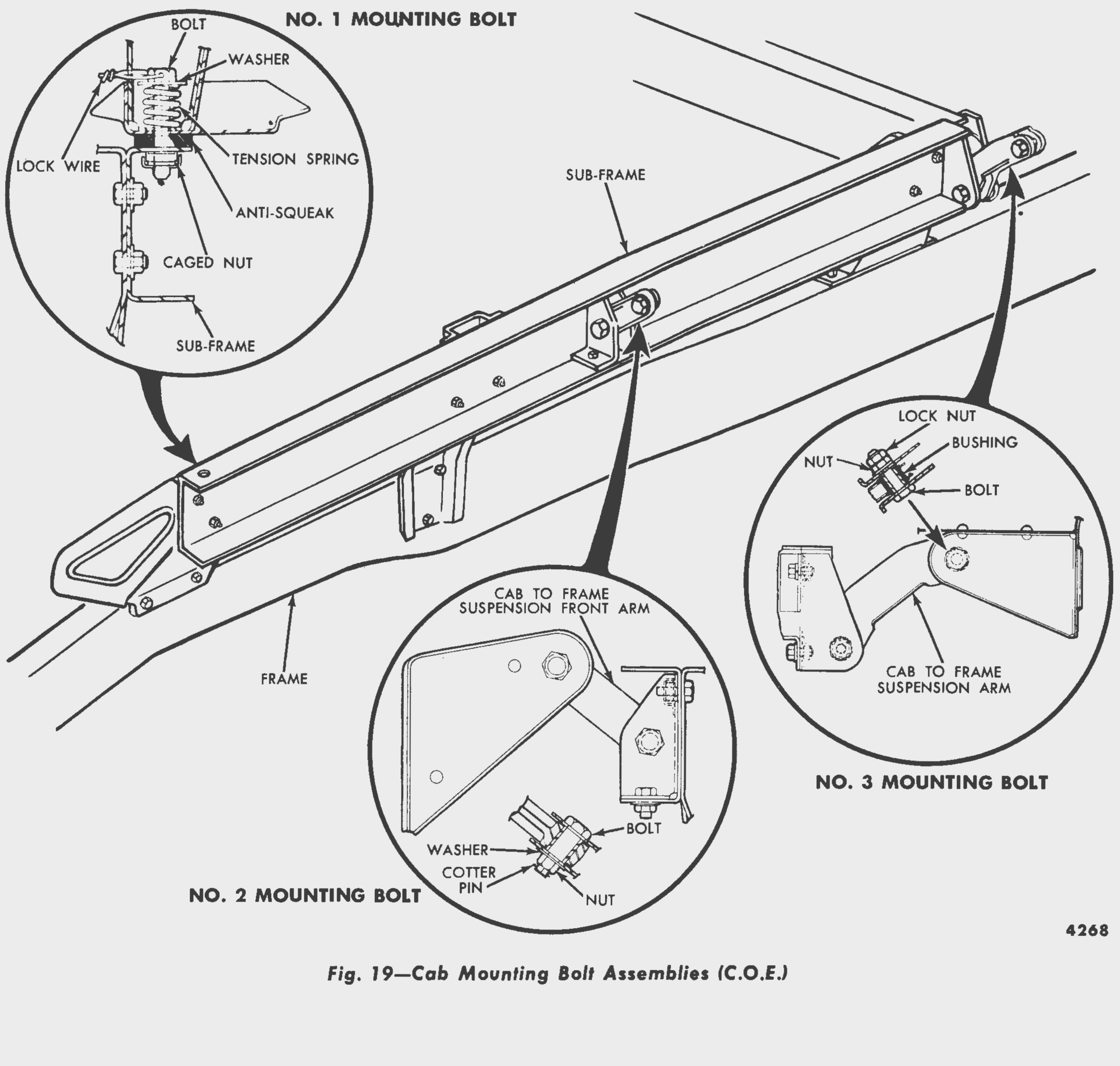


Fig. 19—Cab Mounting Bolt Assemblies (C.O.E.)

the frame. Align the holes in the body floor with the holes in the frame and install the bolts, washers, and nuts. Install the body to frame bracket bolts, washers, and nuts located under the tail gate. At the front of the body, install the body to frame bracket bolts, washers and nuts. Install the fender to running board bolts, lockwashers, and nuts. Connect the taillight wiring.

b. Stake Body.

When replacing a stake platform body assembly, make sure the platform assembly is mounted on the frame in the original position. An incorrectly positioned platform assembly can cause excessive load strain and chassis wear which may result in body or frame damage.

(1) *REMOVAL.* Remove the bolts that secure the wood (longitudinal) sills to the frame at the rear (fig. 21). Scribe a line on the frame around the forward ends of the wood sills. This should be done so that the forward ends of the sills will be located in the original positions. Remove the nuts, lockwashers and plates from the U-bolts that secure the wood sills to the frames (fig. 22). Remove the body rack assemblies, then lift the platform body assembly off the frame.

(2) *INSTALLATION.* Position the platform body on the frame. Make sure the forward ends of the wood sills (longitudinal) contact the lines previously scribed on the frame. Install the U-bolts, plates, lockwashers, and nuts. Install the bolts, lockwashers, and nuts that

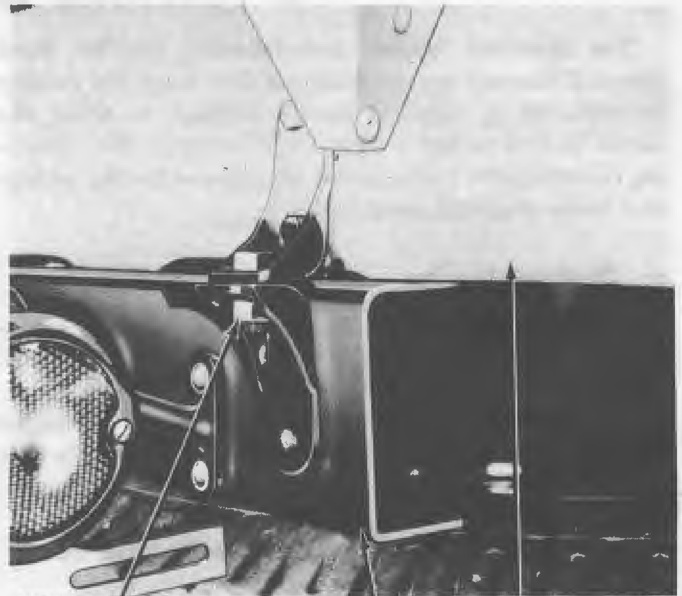


Fig. 21—Stake Platform Body Mounting at Rear

secure the body to the frame at the rear. Install the body rack assemblies.

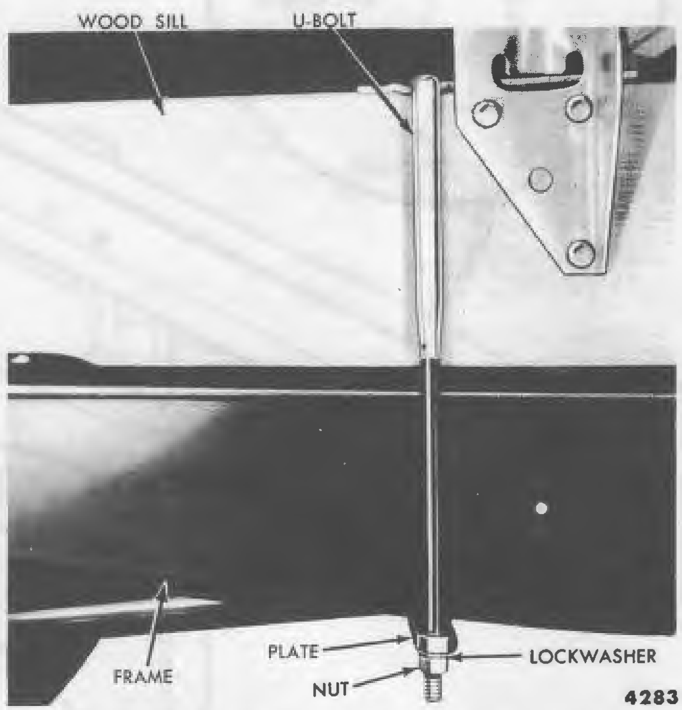


Fig. 22—Stake Platform Body to Frame Mounting

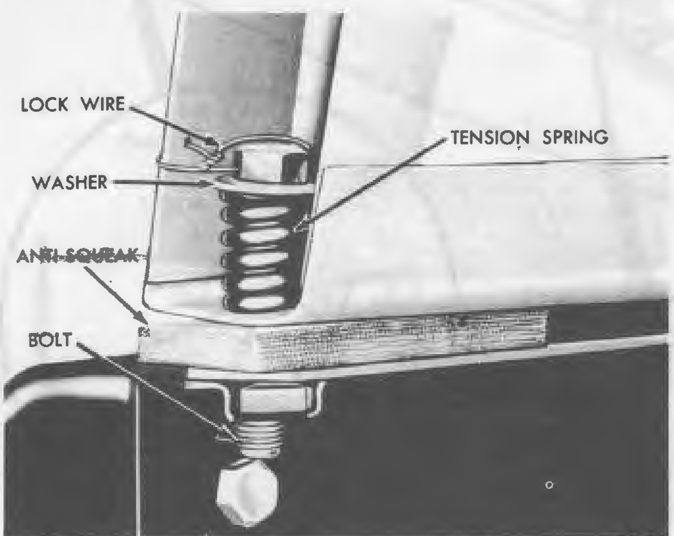


Fig. 20—No. 1, Cab Mounting Bolt (C.O.E.)

Part FIVE

MAINTENANCE, TROUBLE SHOOTING, AND SPECIFICATIONS

Chapter

I

Maintenance Procedures

Repair and adjustment operations, of course, deal with specific parts or systems. Maintenance services however are operations wherein different services on a number of parts or systems are grouped for performance at one time. Some maintenance operations are groupings of things that should be done to the vehicle as a whole at a certain mileage interval. Other maintenance operations have to do with performance or control of the vehicle. The various maintenance procedures covered in this chapter are listed in the section titles above.

1. ENGINE TUNE-UP

An engine tune-up operation is intended to restore an engine to normal operating condition. It is a corrective procedure and not merely a checking procedure. Only parts and units influencing engine performance are considered when tuning an engine. This includes cylinder compression, ignition system, fuel system, engine vacuum, and combustion analysis. The procedure is made in steps which are listed below under headings which describe the nature of the test or corrective measure.

(a) Test Cylinder Compression. Operate the engine until normal operating temperature is reached. Remove all spark plugs. Set the throttle to the wide open position and leave it open for this test. Test the compression of each cylinder (fig. 1).

The compression of all cylinders should be uniform within ten pounds.

A reading of more than ten pounds above normal indicates carbon or lead deposits in cylinder.

A reading below normal indicates leakage at the rings, valves, or gasket.

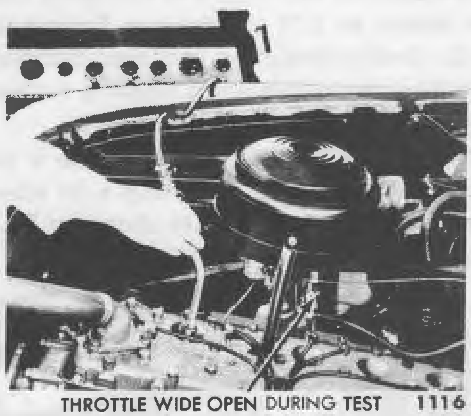
Leakage must be eliminated and deposits of lead or carbon must be removed to bring compression within the ten pound limit before tune-up is resumed.

(b) Tighten Cylinder Head and Manifold. Compression leaks may be stopped by tightening cylinder head nuts or bolts (fig. 2) providing the heads are not warped and the head gasket is in good condition. Tighten cylinder head bolts to 65-70 foot pounds torque, and head nuts to 50-55 foot pounds torque. Tighten the intake and exhaust manifold bolts and nuts to 25-30 foot pounds torque.

(c) Clean, Adjust, and Install Spark Plugs. Sandblast the spark plugs, wipe the porcelain clean, file the electrode tips lightly and adjust the spark gap (0.025-0.028 inch). Test the plugs in an approved spark plug tester. Replace any plugs that have broken or chipped porcelain, badly burned electrodes or do not check satisfactorily on tester. Install spark plugs with new spark plug gaskets and tighten to 24-30 foot-pounds.

(d) Clean and Inspect Battery Cables. Remove cables from battery. Clean battery terminals and cable connectors. Inspect battery case for cracks and leaks. Replace deteriorated connectors and cables with worn insulation. After connecting cables to the battery, cover the terminals and connectors with a film of petrolatum to retard further corrosion.

(e) Test Charging System. Check the battery (fig. 3) and recharge or replace if necessary to insure dependable service. Check generator output and regulator.



THROTTLE WIDE OPEN DURING TEST 1116

Fig. 1—Checking Cylinder Compression

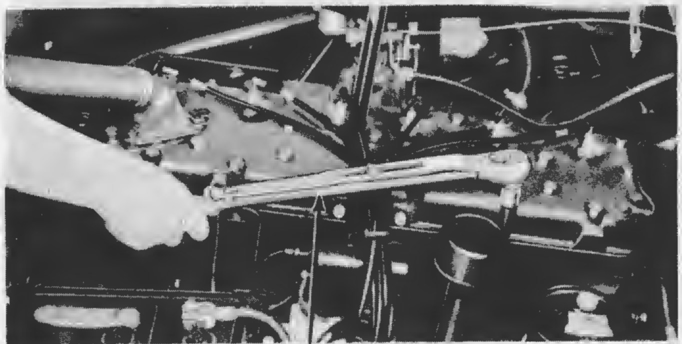


Fig. 2—Tightening Cylinder Head Bolts

Repair or replace faulty generator. Adjust regulator if necessary.

(f) TEST DISTRIBUTOR. Test the distributor vacuum advance on the distributor stroboscope (fig. 4) and make adjustments, repairs, or replacements as required. On new distributor points set the gap on the 8-cylinder distributors at 0.014 to 0.016 inches and on the 6-cylinder distributors at 0.024 to 0.026 inches.

After the distributor points are worn in, a dwell indicator can be used to set the points at 58 to 63 percent dwell.

(g) TIME IGNITION. Disconnect the vacuum line between distributor and carburetor to eliminate the possibility of any vacuum advance. Start the engine and operate it at idle speed. Check timing with a timing light (fig. 5) and make the necessary adjustments to align the pointer and the timing mark. Connect the distributor vacuum line after completing the adjustment.

(h) CLEAN AND INSPECT THE DISTRIBUTOR CAP. Clean and inspect the distributor cap for cracks or other damage. Terminal housing sockets should be free from carbon deposits.

(i) CHECK IGNITION PRIMARY CIRCUIT AMPERAGE. Check the primary circuit amperage with a Diagnosis Test set. The amperage draw with engine stopped should be 5 to 5.5 amps and with engine at idle speed the amperage draw should be 2.75 to 3.0 amps. Inspect the wires visually for faulty insulation and poor connections. If the amperage is not within limits repair or replace wiring in the primary circuit.

(j) TEST SPARK INTENSITY. Determine if the spark from each spark plug wire will jump a 14 kilovolt gap setting by using a sparkmeter as shown in fig. 6.

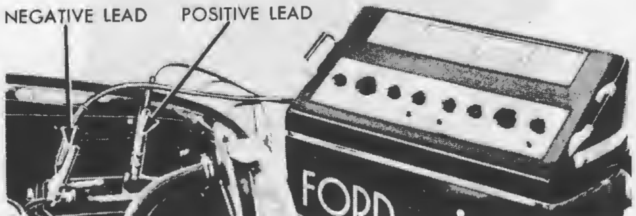


Fig. 3—Checking Battery

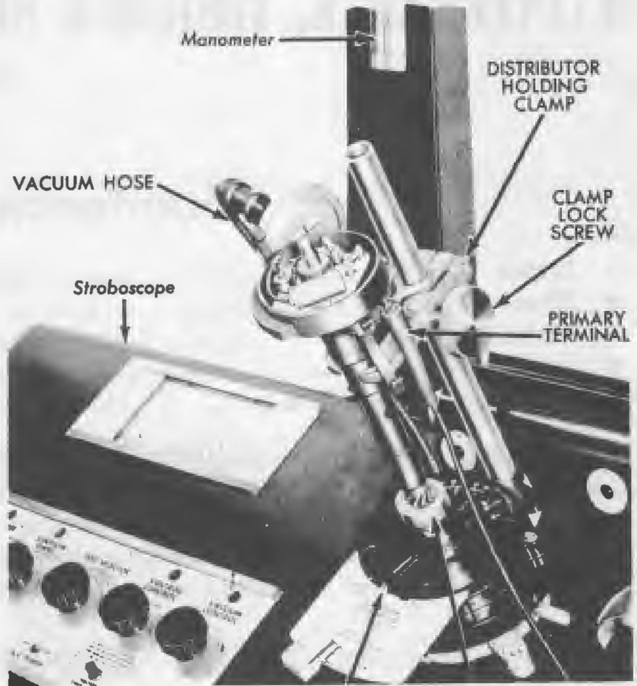


Fig. 4—Checking Distributor on Stroboscope

If the spark is unsatisfactory at all spark plugs, trouble exists in the coil, condenser, rotor, internally in the distributor, or the external primary circuit.

If the spark is unsatisfactory at some but not all of the spark plug wires, the trouble is in the wire itself, the wire is not seated in the housing socket or the terminal housing is shorted.

A quick check on spark intensity can be made with the engine idling. Disconnect one spark plug lead at a time and hold it 3/16 inch from the cylinder head. If the spark jumps this gap regularly, it is satisfactory

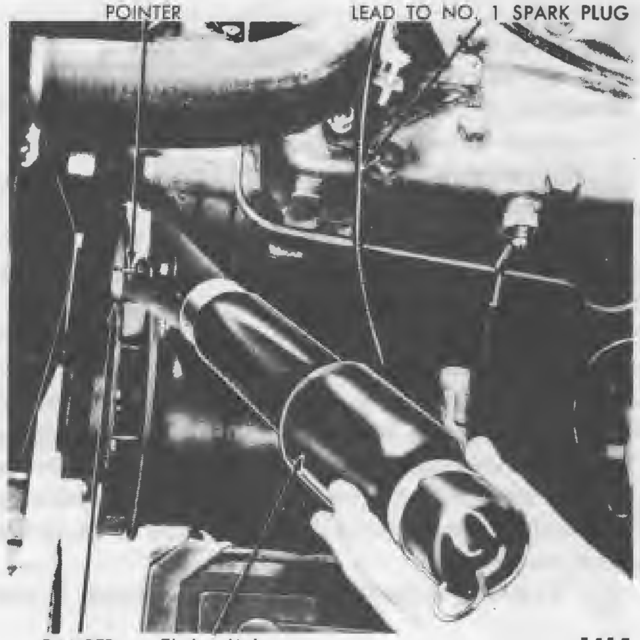


Fig. 5—Checking Timing with Timing Light

(k) TEST ENGINE VACUUM. Check the engine manifold vacuum at idle speed (fig. 7).

If the vacuum is lower than normal (18 to 21 inches Hg), check for leakage at the vacuum lines and intake manifold. Check carburetor idle adjustment.

If the vacuum is still below normal or is erratic, it is an indication of bad rings, sticky valves, weak valve springs, or leaking gaskets.

(l) TEST FUEL PUMP PRESSURE. Check the fuel pump pressure as shown in fig. 8. If the pressure is not within 4 to 5 p.s.i. for 6-cylinder engines and 3.5 to 4.5 for 8-cylinder engines, replace or repair the pump.

(m) TEST FUEL PUMP VACUUM. Check the fuel pump vacuum (fig. 8). If the vacuum is below 10 inches Hg or if the vacuum drops rapidly when the engine is stopped, it is necessary to replace or repair the pump.

(n) INSPECT AND CLEAN FUEL PUMP. Remove the fuel pump bowl and clean the screen. Clean out sediment bowl and reinstall, using a new gasket.

(o) CLEAN CARBURETOR. Disassemble and clean the carburetor and throttle body.

NOTE: ***The upper idle discharge hole is continually exposed to manifold pressure when carbon deposits form on the throttle body and prevent the throttle plate from closing.***

Use a gauge to set the float level. Reassemble carburetor and install.

(p) CLEAN AIR CLEANER. Clean the air cleaner, remove obstructions, and reinstall. If the air cleaner is the oil bath type, refill to indicated level with engine oil.

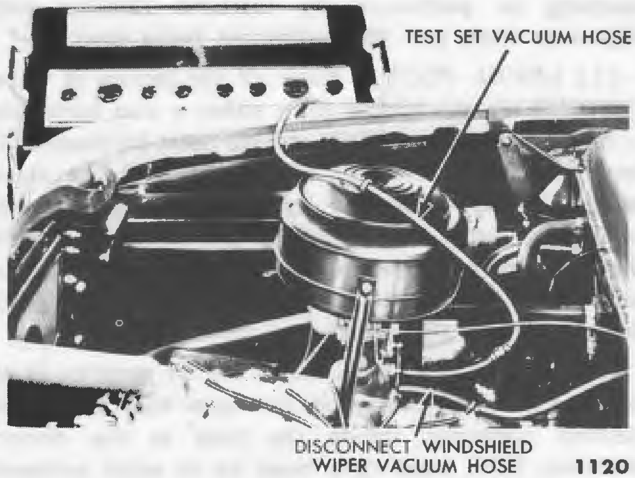


Fig. 7—Checking Manifold Vacuum

(q) ADJUST CARBURETOR IDLE. Connect vacuum gauge and correct any leaks at intake manifold, windshield wiper, or distributor lines. Set the idle speed at 475 to 500 r.p.m. Set the idle fuel adjustment to the point of highest engine r.p.m. Reset the idle speed if required.

NOTE: ***If the mixture is too rich when the idle fuel adjustment is all the way in, either the throttle body is dirty or the idle adjustment screw is not seating.***

(r) ANALYZE ENGINE COMBUSTION. Test the engine fuel-air ratio and acceleration pump operation with an engine combustion analyzer.

(s) ROAD TEST. Road test the vehicle as a final check on the work performed.

2. WHEEL ALIGNMENT

Front wheel alignment involves all the factors affecting the running and steering of the front wheels. All of these factors must be considered when checking and adjusting wheel alignment. For this reason, it is essential that a definite checking procedure, such as outlined in the paragraph "Checking Procedure," be followed.

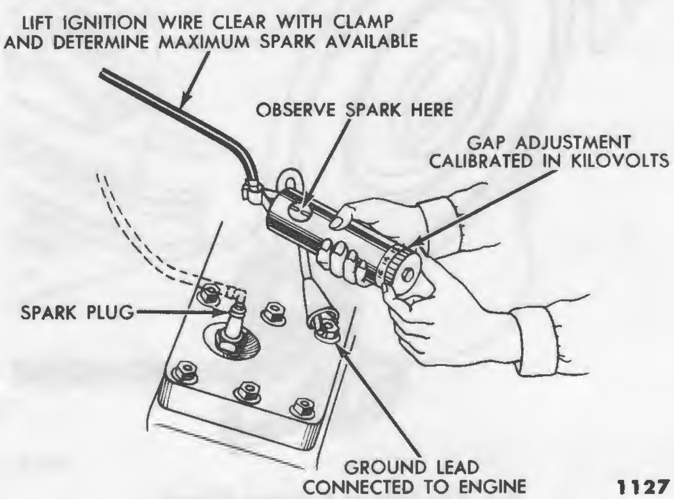


Fig. 6—Checking Spark Intensity

The correction of wheel alignment factors is discussed under "Correction of Factors."

a. Checking Procedure.

Different makes of equipment may be used for checking the factors of wheel alignment provided the results obtained are accurate. The illustrations in this section show one type of portable equipment which can be used. It is essential that wheel alignment

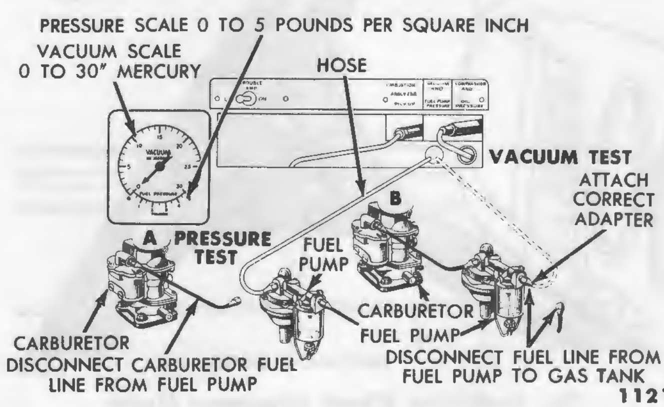


Fig. 8—Fuel Pump Pressure and Vacuum Test

checking be performed by someone familiar with alignment work and the equipment being used.

(1) *LEVEL FLOOR.* Since all the factors of wheel alignment are established from either a true horizontal or a true vertical plane, the vehicle must be reasonably level when the factors of wheel alignment are measured. The large, runway type of wheel alignment equipment automatically levels the vehicle. If portable equipment is used, white spots should be painted on the floor to indicate areas that are level enough for checking wheel alignment.

(2) *INFLATE TIRES.* Check the air pressure in all the tires. If the pressure does not agree with the recommended pressures, inflate the tires to the correct pressures. Both front tires must be at same pressure.

(3) *STRAIGHT AHEAD POSITION.* Establish the position of the steering wheel in relation to the steering column when the front wheels are in the straight ahead position. To accomplish this, drive the vehicle straight ahead and place a mark on the steering wheel hub and steering column as shown in fig. 9.

To place the front wheels in the straight ahead position at any time during the checking procedure, align the mark on the steering wheel hub with the mark on the steering column.

(4) *CHECK WHEEL BEARINGS.* Raise the front wheels off the floor. Grasp the wheels at each side and push in and pull out. If any free play is noticed adjust the wheel bearings.

(5) *CHECK SPINDLE BUSHINGS.* With the front wheels off the floor, grasp the wheels at the top and bottom (fig. 10) and shake the wheels while observing the movement of the brake plates. If the brake plates move more than $\frac{1}{32}$ inch, rebush the spindles.

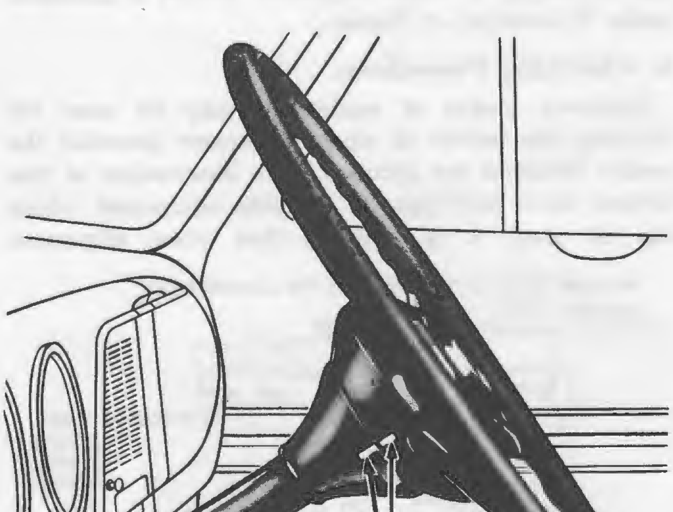


Fig. 9—Stering Wheel Alignment Marks

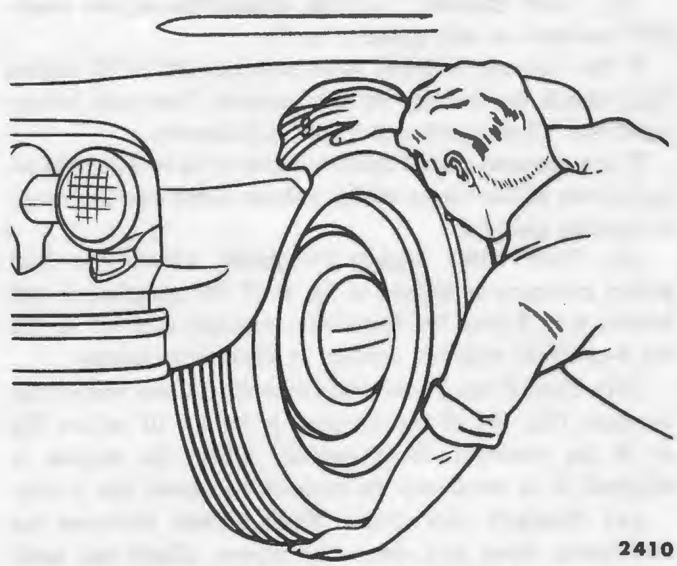


Fig. 10—Spindle Bushing Check

(6) *CHECK LINKAGE.* Grasp the front of the front wheels, push them apart then pull them together while observing the spindle connecting rod (tie rod) and drag link ends for looseness. Replace worn parts.

(7) *CHECK MOUNTING BOLTS.* Check the steering gear mounting bolts and tighten if required.

Tighten the spring U bolts and spring center bolt.

(8) *CHECK WHEEL BALANCE.* Spin each front wheel with a wheel spinner as shown in fig. 11. A wheel that is out of balance will cause the front of the truck to shake. Balance the wheels if required.

(9) *CHECK CAMBER.* Position the truck with the front wheels in center of the white level spots on floor.

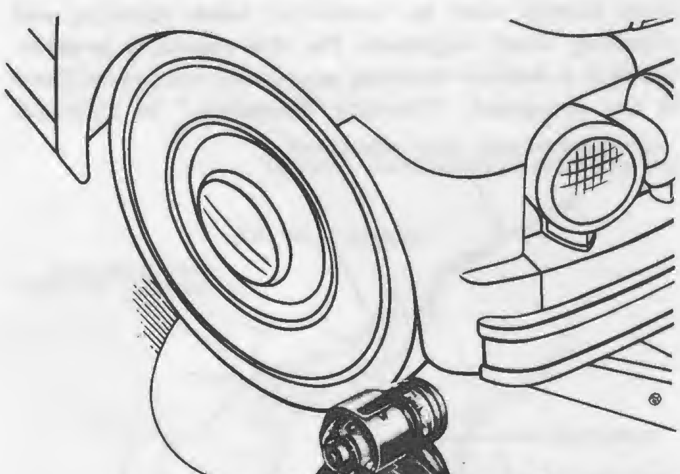


Fig. 11—Wheel Balance Check

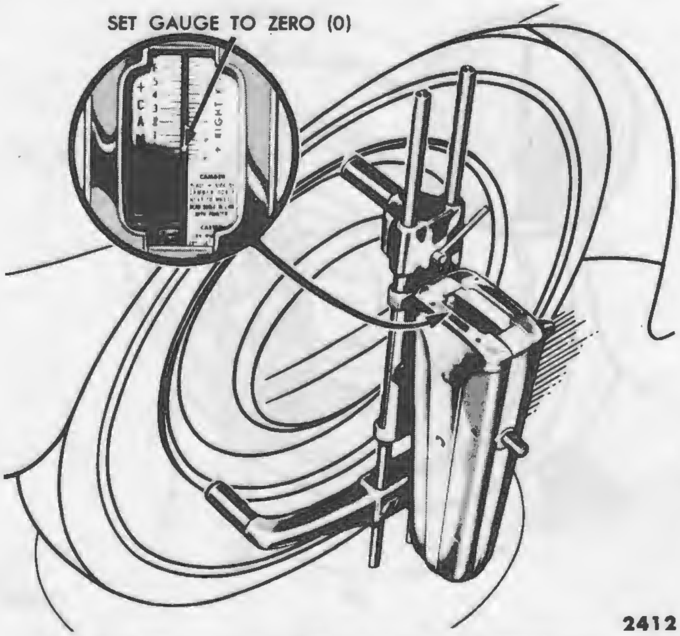


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Fig. 12—Checking Parallel Plane of Wheel

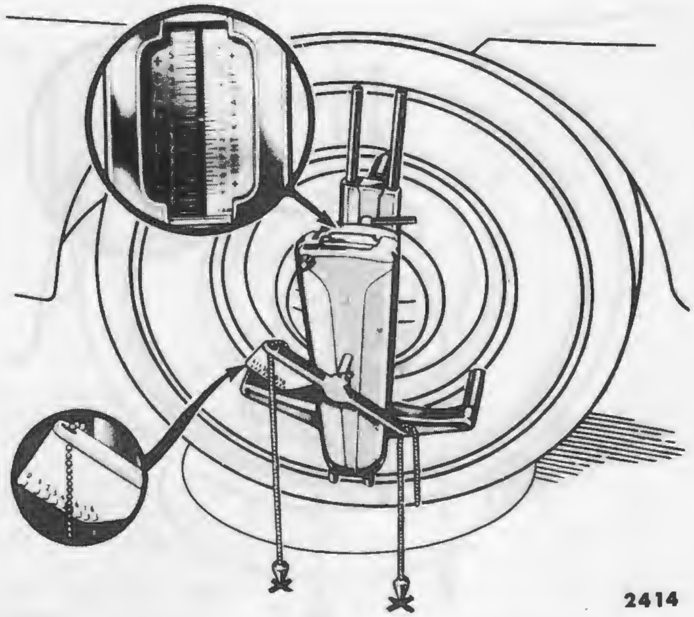

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Fig. 14—Checking King Pin Inclination

(a) INSTALL GAUGE HOLDER. Adjust the gauge holder set screws to insure a firm grip on the rim. Adjust the gauge holder rod to the approximate center of the wheel, and tighten the rod set screws. Place the gauge holder on the wheel with the three set screws held firmly against the outer edge of the rim, and turn the clamping handle ¼ turn clockwise to secure the holder in place (fig. 12).

CAUTION: *Make sure that all three contact points are seated firmly against the rim.*

(b) ESTABLISH THE PARALLEL PLANE OF WHEEL. Raise the front wheels off the floor. Install the gauge on the gauge holder spindle with the "+" side of the camber scale toward the wheel (fig. 12).

Rotate the wheel slowly and observe the range of movement of the pointer on the scale. This will indicate the amount of wheel wobble or run-out. If the wheel wobble or run-out exceeds ⅛ inch replace the wheel, or install the wheel on the rear. If the run-out is not excessive, stop the wheel at the point where the pointer is in the exact center of the total pointer movement.

Apply the brakes firmly with a brake pedal jack, or

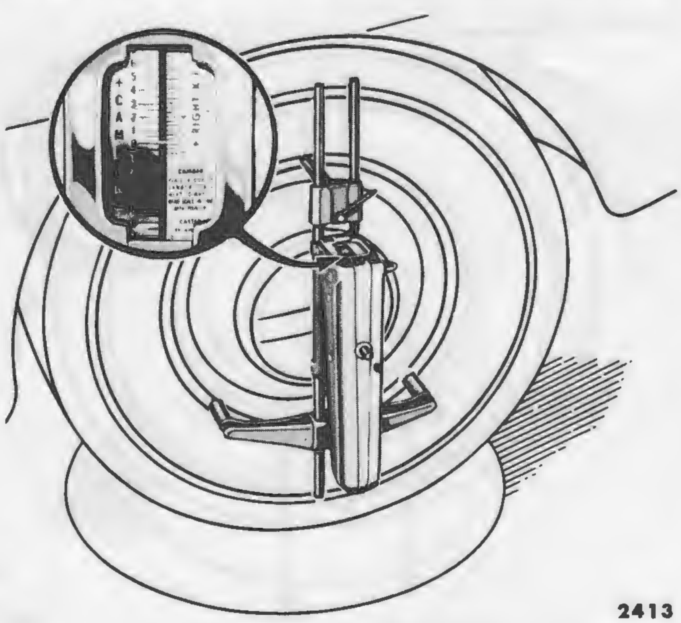

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Fig. 13—Checking Camber

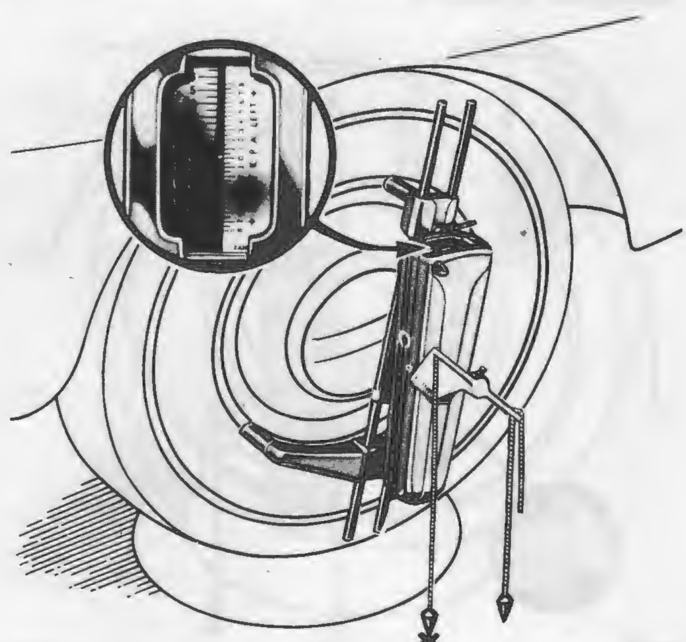

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Fig. 15—Measuring 20 Degree Outward Turn

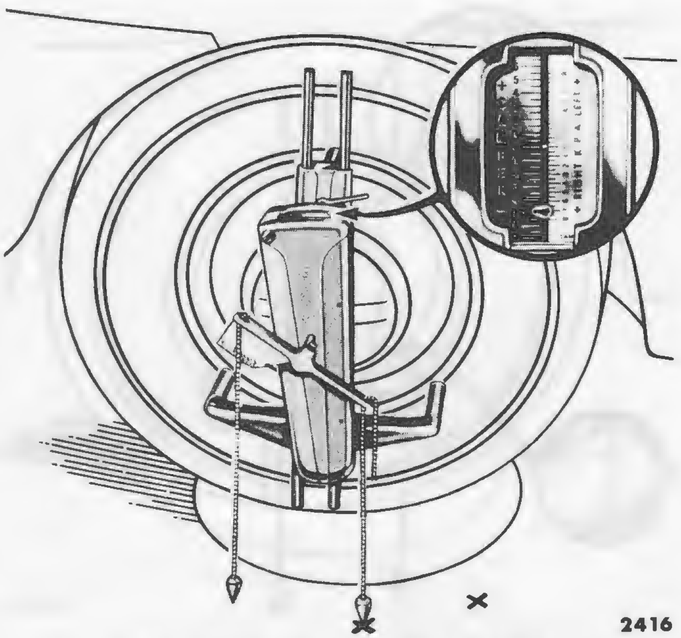

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Fig. 16—Measuring 20 Degree Inward Turn

turn one brake cam adjustment screw until the brake shoes hold the wheel in this position.

Turn the wheels to the straight ahead position by aligning the pencil marks on the steering wheel hub and steering column tube (fig. 9). Make sure the gauge holder rods will clear the floor, then lower the weight of the car on the front wheels. Read and record the camber on the camber scale (fig. 13). Repeat the operation on the other wheel. If the camber is incorrect, check the king pin side inclination. If the camber angle is within the specified limits, omit the king pin inclination procedure.

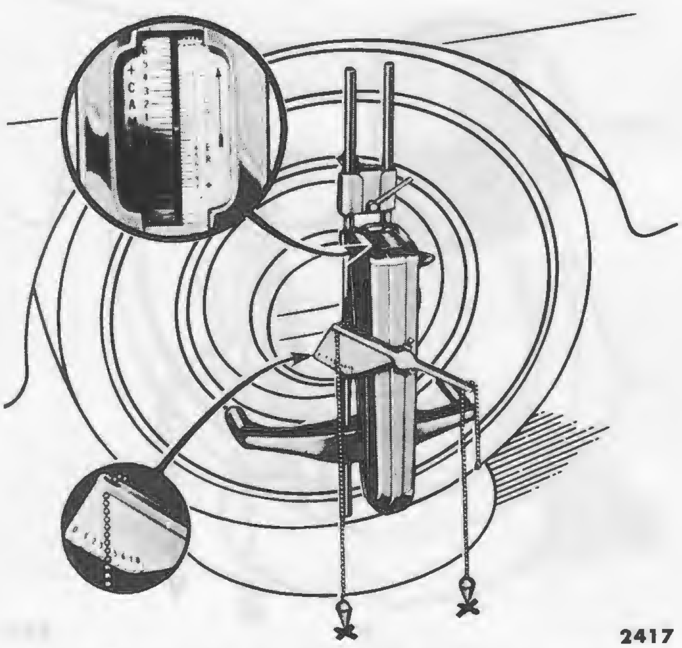

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Fig. 17—Checking Caster

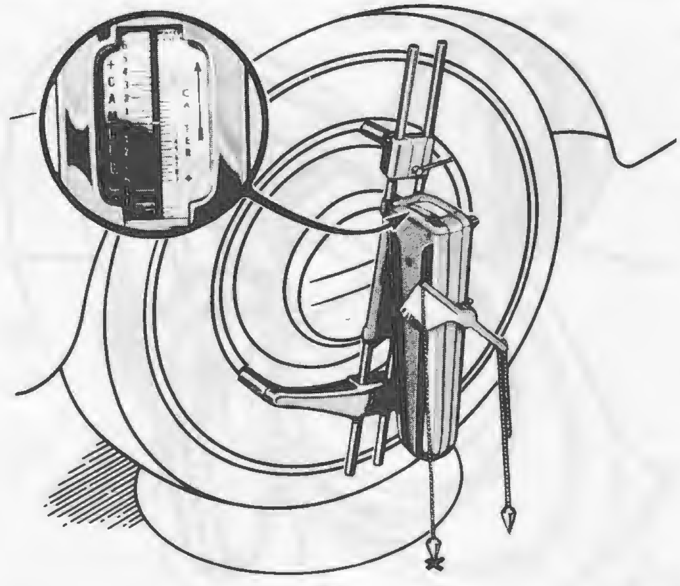

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Fig. 18—Front Plumb Bob in Alignment with Rear Mark

(10) *CHECK KING PIN INCLINATION.* When checking king pin inclination and caster, it is necessary to turn the wheels out 20 degrees and then in 20 degrees. The use of portable turntables will greatly facilitate this turning of the wheels, especially on heavy duty trucks. When using portable turntables, it is necessary to place blocks under the rear wheels. These blocks must be the same height as the turntables to maintain the level position of the vehicle.

If turntables are not available, the 20 degree turns can be measured by use of the turn indicator as outlined in the following procedure.

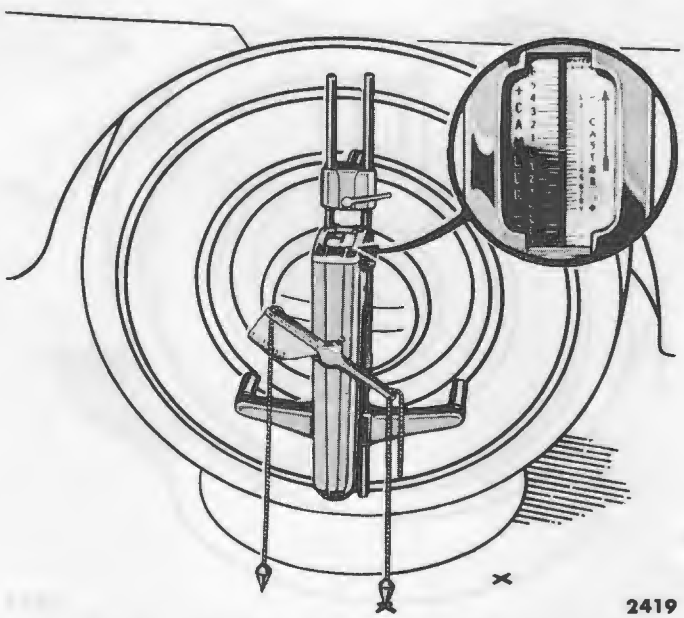

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Fig. 19—Rear Plumb Bob in Alignment with Front Mark

The following chart lists the turn indicator pendant chain position for all trucks.

F-1, F-2 6
F-3, F-4 .... 5½
F-5, F-6 5
F-7, F-8 4

Raise the wheels off the floor and turn the wheels to the straight ahead position. Lower the wheels and install a brake pedal jack.

Remove and reinstall the gauge on the gauge holder spindle, using the hole through the gauge at right angles to the caster and camber checking position (fig. 14).

Install the turn indicator on the gauge holder spindle. Set the indicator so the chain will be in line with the numeral listed in the turn indicator chart for the vehicle being checked. Tighten the thumb screws to hold the indicator in the desired position. Place the wheels in the straight ahead position. Adjust the chains in the turn indicator slots so the plumb bobs just clear the floor. Draw two short lines on the floor in line with the plumb bobs at right angles to the wheel.

Move the gauge assembly until the pointer is in alignment with the zero (0) on the camber scale, and tighten the thumb screw to secure the gauge at this position (fig. 14).

Raise the front wheels clear of the floor. Adjust the plumb bobs to just clear the floor.

Turn the wheels until the front plumb bob is in alignment with the rear mark on the floor (fig. 15). Lower the wheels. Adjust the zero (0) on the king pin inclination scale in line with the pointer.

Raise the wheels clear of the floor. Turn the wheels until the rear plumb bob is in alignment with the front mark on the floor (fig. 16). Lower the wheels, then note the reading on the king pin inclination scale.

(11) *CHECK CASTER.* Install the gauge on the gauge holder spindle using the same hole as used for checking camber.

Install the turn indicator on the spindle. Set the indicator so the chain will be in line with the numeral listed in the turn indicator chart for the vehicle being checked. Tighten the thumb screw to hold it in the desired position (fig. 17).

Place the wheels in the straight ahead position by aligning the pencil mark on the steering wheel hub and steering column tube (fig. 9). Raise the front wheels clear of the floor.

Turn the wheels until the front plumb bob is in line with the rear mark on the floor (fig. 18). Lower the wheels and turn the wheels to correct any misalignment of the plumb bob with the floor mark. Turn the knob on the gauge until the zero (0) on the caster scale is in line with the pointer. Raise the wheels clear of the floor. Turn the wheels until the rear plumb bob is in line with the front mark on the floor (fig. 19). Lower the wheels, and correct any misalignment with the mark on the floor. Read and record the caster angle and then remove the pedal jack.

(12). *CHECK TOE.* Push the vehicle backwards approximately six feet, then pull the vehicle forward about three feet. Place a telescope type toe-in gauge between the wheels at the front with the ends of the gauge bearing against the side walls of the tires and both pendant chain ends just touching the floor (fig. 20). Set the scale so the pointer registers zero (0). Pull the truck forward until the gauge is brought into position to the rear of the front axle with both pendant chains just touching the floor. Read the scale, the pointer will register the toe.

b. Correction of Factors.

The following paragraphs contain the corrective procedures for camber, caster, and toe. King pin inclination is a "built in" factor and cannot be corrected except by the installation of new parts.

(1) *CAMBER CORRECTIONS.* The camber adjustment, on solid front axles with longitudinal springs, is accomplished by bending the axle beam.

Figure 21 illustrates a typical set-up which can be used to increase the camber angle on light duty trucks using this type suspension. Figure 22 illustrates a typical set-up for deceasing the camber angle on light duty trucks.

The same set-ups apply to heavy duty and extra heavy duty trucks; but due to the increased size of the axle beam, heavier tools are required to handle the increased pressure.

In all cases, it is important that the bend be made between the spring pad and the spindle pin, otherwise the spring pads will be thrown out of parallel with each other.

When making camber corrections with tools of this type, pull the bottom of the jack forward, as the pressure is applied, so that the set-up hangs at approximately the same angle as the spindle pin (caster angle). This will prevent fore and aft bends from occurring in the axle beam.

NOTE: ***Use the combination of blocks or shims that hold the set-up in the best position.***

Fig. 20—Checking Toe with Duby Toe Gauge

(2) *CASTER CORRECTION.* The caster angle is controlled by the angle of the front spring pads. The front spring pads must be parallel to each other. Any change in the caster angle is due either to the axle being twisted as the result of an accident or to spring sag.

Since these axles are not equipped with a radius rod, the caster angle changes as the load on the front axle is increased, or as the springs sag.

If the springs have sagged, caster can be adjusted by replacing the springs or by installing tapered shims between the springs and the spring pads. An equal amount of shims should be installed on both sides.

CAUTION: ***When installing tapered shims to increase the caster angle, make certain that the front spring tie bolts extend through the shims, anchoring the springs to the axle.***

(3) *TOE ADJUSTMENT.* If the toe-in is incorrect, loosen the clamp bolts at each end of the spindle connecting rod tube; then rotate the tube until the correct toe-in is obtained.

Tighten the clamp bolts, then re-check the toe-in to make sure no change occurred when the bolts were tightened.

3. BRAKE ADJUSTMENT

Brake adjustments are divided into two classifications, minor adjustment and major adjustment. The minor brake adjustment merely re-establishes the brake lining to drum clearance and compensates for normal brake lining wear. The need for minor adjustment is usually determined by the lack of correct brake pedal reserve.

A major brake adjustment is recommended when new shoes are installed, when brakes are relined, or when the minor adjustment does not give satisfactory brake operation.

a. Minor Adjustment.

Before making a minor brake adjustment, remove one front wheel and check for the following conditions:

(1) Brake drum scored, out-of-round, or bell-mouthed.

(2) Brake lining coated with brake fluid or grease.

(3) Brake lining worn to less than $\frac{1}{32}$ inches from the top of the rivet (or bolt) heads.

(4) Brake lining not making full contact with the drum.

If any of the foregoing conditions are in evidence, a minor brake adjustment will not give satisfactory breaking performance and the need for a major brake adjustment is indicated.

NOTE: ***It may be assumed that the condition of the linings and drums at the other three wheels is approximately the same as found at the wheel removed.***

To re-establish the proper lining to drum clearance, use the procedures given previously in this manual under the discussion of the various brake types.

b. Major Adjustment.

A major brake adjustment includes the adjustment of the brake shoes and the anchor pins. Before making a major brake adjustment, the following operations must be performed:

(1) Remove all four brake drums and clean the brake assemblies.

(2) Perform all of the inspections included under a minor adjustment.

(3) Inspect all brake pipes and hoses for leakage, kinks, or deterioration.

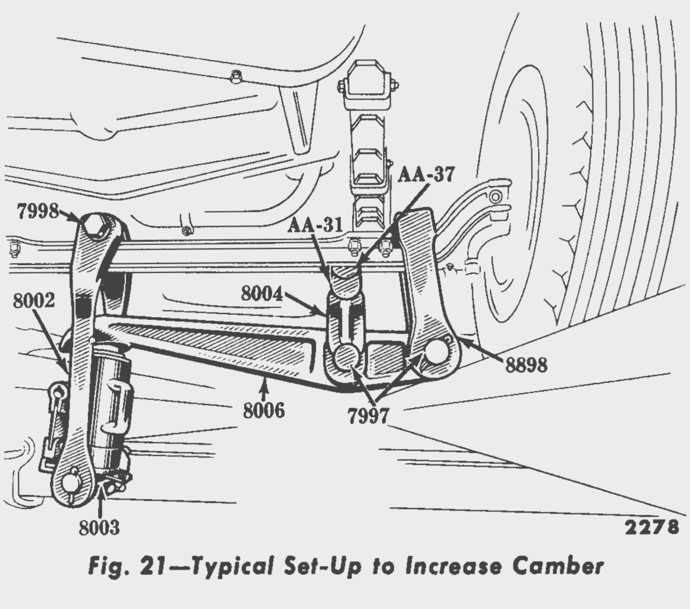


Fig. 21—Typical Set-Up to Increase Camber

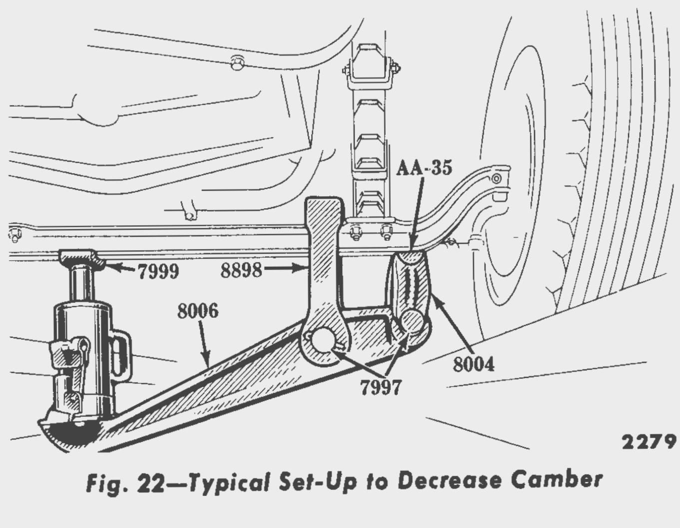


Fig. 22—Typical Set-Up to Decrease Camber

(4) Lubricate the surfaces of the backing plate contacted by the shoes, the adjusting screw, the anchor pins and the adjusting cams with Lubriplate.

After the foregoing operations have been performed, adjust the brake shoes and anchor pins then adjust the hand brake linkage.

Check the brake pedal free play and adjust if required.

Bleed the hydraulic system if existing conditions warrant the performance of this operation.

4. LUBRICATION

The importance of proper lubrication cannot be overstressed. Proper lubrication means the application of the correct lubricant, at the right place, and at the right time. The numerals in fig. 23 indicate the units of the vehicle that require periodic lubrication. Information on the type of lubricant required for each particular unit and the method of application is given below.

The units which do not require periodic lubrication are listed under the heading "**a.** Units Requiring No Periodic Lubrication Service." The recommendations on oil changes are given under the heading, "**b.** Oil Changes." Transmission and rear axle capacities are listed under "**c.** Capacities." Units which require periodic lubrication are listed in "**d.** 1000 Mile Lubrication," "**e.** 5000 Mile Lubrication," and "**f.** 10,000 Mile Lubrication."

a. Units Requiring No Periodic Lubrication Service.

The clutch release bearing, clutch pilot bearing, starting motor, shock absorbers, and the fan on all 6-cyl. engines and F-7 and F-8 trucks are lubricated at the time of the adjustment or replacement and do not require periodic lubrication. Lubrication information on these units is included in the adjustment or replacement procedure for each unit.

b. Oil Changes.

The crankcase should be drained and refilled with new oil four times each year, every 2000 miles, or when oil is diluted or polluted.

If the vehicle is new or the engine has been overhauled, the engine oil should be changed after the first 300 miles of operation.

Each time the oil is changed remove the oil bath air cleaner. Clean the sump and refill it to the level mark with the same grade of engine oil as used in the engine. Occasionally wash the filter element in cleaning fluid.

(1) *OIL RECOMMENDATIONS.* SAE 30 oil for temperatures above + 32°F.; 20W for temperatures between + 32°F. and + 10°F.; 10W for temperatures between + 10°F. and — 10°F.; 5W for temperatures below — 10°F.

In commercial service, the engine oil is frequently subjected to higher temperatures than in passenger car service; consequently, the oil is more subject to deterioration. Varnish on the pistons, valve stems, and tappets causes sluggish engine operation. Sludge may eventually clog the oil pump screen, oil passages, and oil control rings.

REGULAR or straight mineral motor oil is satisfactory for use in light commercial vehicle engines under normal driving conditions.

PREMIUM motor oil can be used in commercial service where operating conditions are normal or average, and thus ensure satisfactory operation if occasional heavy duty service is required.

While premium oil will give satisfactory results under most conditions, HEAVY DUTY oil, which is recommended for use in heavy duty truck operations, will give equally satisfactory results in all types of service. The heavy duty motor oils contain detergent compounds and tend to hold in suspension the foreign contaminants which normally would be deposited on the engine parts.

c. Capacities.

The capacity for each type of transmission is given under (1) *TRANSMISSION.* Rear Axle capacities are listed under (2) *REAR AXLE.*

(1) *TRANSMISSION.* The transmission capacities given in Table 1 are for a dry transmission.

(2) *REAR AXLE.* The rear axle capacities listed in Table 2 are measured only to the level of the filler plug. Avoid overfilling the differential since this forces lubricant past the seals and may damage the brake assemblies.

Table 1—Transmission Capacities

TYPE	REFILL PTS.
3-Speed	2¾
3-Speed Heavy Duty	6
4-Speed	5
4-Speed Synchro-Silent	8
5-Speed	10

1000 MILE LUBRICATION

PRESSURE GUN GREASE

1. **SPINDLE BOLTS** — 2 FITTINGS, EACH SPINDLE
2. **SPINDLE CONNECTING RODS** — 1 FITTING, EACH END
3. **DRAG LINK** — 1 FITTING, EACH END
4. **CLUTCH & BRAKE PEDAL SHAFT** — 1 FITTING
5. **SPRING PINS & SHACKLE PINS** — 3 FITTINGS, EACH SPRING
6. **CLUTCH RELEASE SHAFT & EQUALIZER** — 3 FITTINGS
7. **COUPLING SHAFT SUPPORT BEARING** — 1 FITTING. ALL F-SERIES EXCEPT F-1; 110" C.O.E.; 104" PARCEL DEL'Y.
8. **REMOTE CONTROL GEARSHIFT MECHANISM** — 3 FITTINGS
9. **SLIP JOINT** — 1 FITTING. ALL F-SERIES EXCEPT F-1; 110" C.O.E.; 104" PARCEL DEL'Y.
10. **AIR BRAKE CAMSHAFT** — DO NOT OVER-LUBRICATE. WHEN DRUMS ARE REMOVED, LUBRICATE CAM WITH WHITE WATERPROOF GREASE 8L-19586-A.

ENGINE OIL

11. **GENERATOR—OIL CUP** — FEW DROPS. DO NOT OVER-LUBRICATE.
12. **AIR BRAKE VALVE ROLLER**

- **HOOD HINGES & LATCH**

13. **DISTRIBUTOR—OIL CUP** — FEW DROPS. WHEN DISTRIBUTOR CONTACTS ARE SERVICED, LUBRICATE CAM WITH LIGHT COATING OF FORD DISTRIBUTOR GREASE 8A-19575. CAUTION: DO NOT ALLOW LUBRICANT TO GET ON FACE OF POINTS.

GEAR OIL

14. **STEERING GEAR CASE** — SAE 90
15. **UNIVERSAL JOINTS** — SAE 140
16. **TRANSMISSION** — SUMMER—SAE 140; WINTER—SAE 90

MAINTENANCE

17. **BREATHER CAP** — WASH SCREEN WITH CLEANING FLUID, DRY, & WET WITH ENGINE OIL. CHECK DAILY UNDER SEVERE DUSTY CONDITIONS.

DRIPLESS PENETRATING OIL

- **ACCELERATOR CROSS SHAFT** — SPRAY

18. **SPRINGS** — SPRAY

- **CLUTCH LINKAGE, HAND-BRAKE CABLES & EQUALIZER** — SPRAY
- **DOOR HINGES**

HYPOID OR MULTI-PURPOSE LUBRICANT

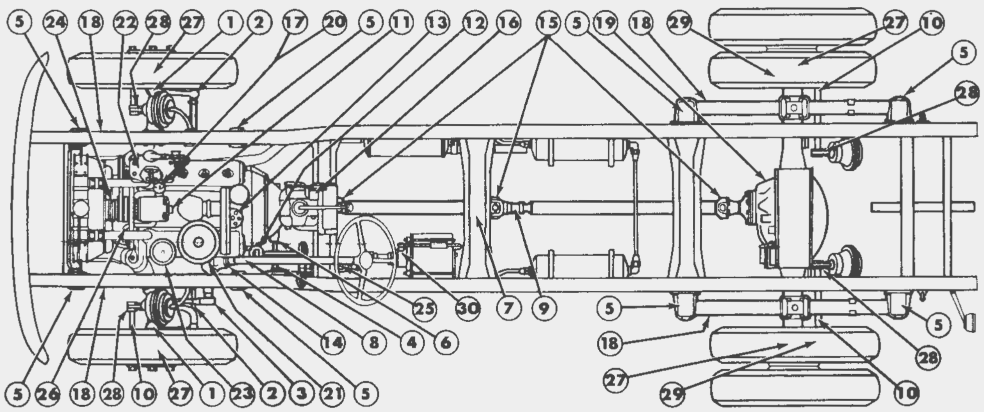
19. **REAR AXLE (TWO-SPEED & HYPOID SINGLE SPEED)** — TEMPS ABOVE 100°F.—SAE 140; TEMPS BELOW 100°F.—SAE 90; F-1—SAE 90 FOR ALL SEASONS. F-6, F-7 & F-8—SAE 80 FOR TEMPS LOWER THAN—10°F.

MILD E.P. GEAR OIL OR MULTI-PURPOSE LUBRICANT

19. **REAR AXLE (SINGLE-SPEED SPIRAL BEVEL)** — SUMMER—SAE 140; WINTER—SAE 90

WAX STICK

- **LOCK STRIKER PLATES**



2000 MILE LUBRICATION

ENGINE OIL

20. **CRANKCASE** — DRAIN & REFILL EVERY 2000 MI. OR 4 TIMES A YEAR. TEMPS ABOVE +32°F.—SAE 30; TEMPS ABOVE +10°F.—SAE 20 OR 20W; TEMPS ABOVE −10°F.—SAE 10W; TEMPS BELOW −10°F.—SAE 5W. REGULAR OIL—LIGHT COM'L. VEHICLES UNDER NORMAL DRIVING CONDITIONS. PREMIUM OIL—NORMAL CONDITIONS & OCCASIONAL H.D. SERVICE. HEAVY DUTY OIL—H.D. OPERATIONS.
21. **OIL BATH AIR CLEANER** — REMOVE CLEANER—CLEAN, & REFILL SUMP TO LEVEL MARK WITH ENGINE OIL. CHECK DAILY, WHEN DUSTIER. OCCASIONALLY WASH FILTER ASSEMBLY IN CLEANING FLUID.
22. **AIR BRAKE COMPRESSOR CRANKCASE** — DRAIN & REFILL WITH 1 PINT. CHECK LEVEL DAILY & ADD, IF REQUIRED.

MAINTENANCE

22. **AIR BRAKE COMPRESSOR CRANKCASE BREATHER SCREEN** — WASH SCREEN IN CLEANING SOLVENT. UNDER DUSTY CONDITIONS, CLEAN DAILY, IF REQUIRED.
22. **AIR BRAKE COMPRESSOR STRAINER** — WASH ELEMENT IN CLEANING SOLVENT. UNDER DUSTY CONDITIONS, CLEAN DAILY, IF REQUIRED.

4000 MILE LUBRICATION

MAINTENANCE

23. **OIL FILTER CARTRIDGE** — REPLACE EVERY 4000 MILES. ADD 1 QT. ENGINE OIL TO OIL PAN FOR FILTER ABSORPTION.

20,000 MILE LUBRICATION

AIR CYLINDER OIL—M-4856

30. **VACUUM BRAKE BOOSTER** — 20,000 MILES OR ONCE A YEAR, FILL TO LEVEL OF FILLER PLUG.

5000 MILE LUBRICATION

(INCLUDE 1000 MILE PROCEDURES WITH FOLLOWING)

ENGINE OIL

24. **FAN** — F-1 THROUGH F-6, 8 CYLINDER. ADD 1 OZ. TURN FAN UNTIL OIL HOLE IS AT BOTTOM, DRAINING EXCESS OIL.

FORD BRAKE FLUID—8A-19542

25. **BRAKE MASTER CYLINDER** — ADD FLUID TO LEVEL (¼" FROM TOP)
26. **CRANKCASE VENTILATION EXT. TUBE** — F-7 & F-8. CLEAN FILTER SCREEN. UNDER DUSTY CONDITIONS, CHECK EVERY 1000 MILES.

10,000 MILE LUBRICATION

(INCLUDE 1000 & 5000 MILE PROCEDURES WITH FOLLOWING)

GEAR OIL

16. **TRANSMISSION** — TWICE YEARLY OR EVERY 10,000 MILES, DRAIN, FLUSH & REFILL. SUMMER—SAE 140 (SAE 90 WITH REMOTE SHIFT); WINTER—SAE 90 (SAE 80 WITH REMOTE SHIFT)
19. **REAR AXLE** — TWICE YEARLY OR EVERY 10,000 MILES, DRAIN, FLUSH & REFILL. (SEE 1000 MILE PROCEDURES FOR LUBRICANTS TO BE USED IN VARIOUS TYPES OF AXLES.

FORD WHEEL BEARING LUBRICANT—8A-19585

27. **WHEEL BEARINGS (EXCEPT F-1)** — REPACK ONCE A YEAR OR EVERY 10,000 MI.

PRESSURE GUN GREASE

28. **POWER BRAKE SLACK ADJUSTER**
29. **POWER BRAKE ANCHOR PINS** — (10,000 MILES, OR WHEN DRUMS ARE REMOVED) DO NOT OVER-LUBRICATE

ENGINE OIL

- **VACUUM BRAKE BOOSTER AIR CLEANER** — WASH ELEMENT IN CLEANING SOLVENT, DRY, & WET WITH OIL.

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Fig. 23—Lubrication Chart

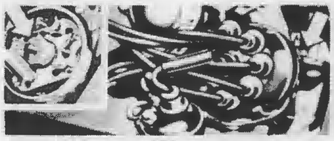
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Fig. 24—Distributor

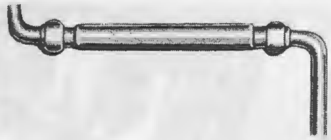
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Fig. 25—Accelerator Cross Shaft

Table 2—Rear Axle Capacities

TYPE	REFILL PTS.
Integral Housing Hypoid	3
Split Housing Spiral Bevel	3
Split Housing Spiral Bevel–Heavy Duty	5
Split Housing Hypoid	10
Split Housing Hypoid–Heavy Duty	11
Banjo Housing Spiral Bevel	22
Planetary Two-Speed–Spiral Bevel	15
Planetary Two-Speed–Hypoid	20
Planetary Two-Speed–Heavy Duty	19

d. 1000-Mile Lubrication.

The locations of the units to be lubricated are indicated in fig. 23. Detailed instructions for lubricating these units are given below.

(1) *DISTRIBUTOR.* Lubricate the distributor with a few drops of engine oil (fig. 24). When the distributor contacts are serviced, lubricate the cam with a light coating of Ford distributor grease 8A-19575.

CAUTION: ***Do not allow any lubricant to get on the face of the points.***

(2) *ACCELERATOR CROSS SHAFT.* Lubricate the accelerator cross shaft (fig. 25) with dripless penetrating oil.

(3) *GENERATOR.* Lubricate the generator (fig. 26) with a few drops of engine oil. Use care not to drip oil on generator brushes. Do not over-lubricate.

(4) *GOVERNOR BASE (F-7, F-8).* Lubricate with a few drops of engine oil. (fig. 27).

(5) *TRANSMISSION.* Check transmission oil level and add gear oil to level of filler plug if required. Summer SAE 140 (SAE 90–remote shift); winter SAE 80.

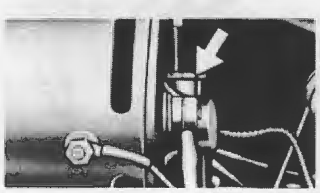
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Fig. 26—Generator

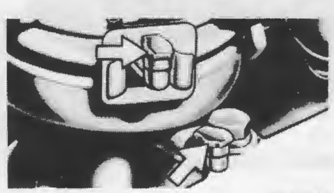
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Fig. 27—Governor Base

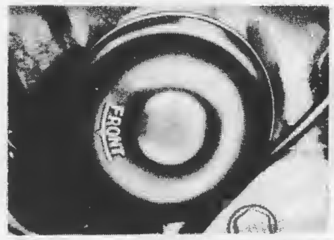
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Fig. 28—Breather Cap

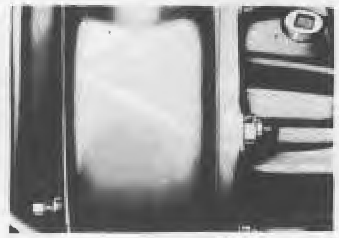
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Fig. 29—Rear Axle

(6) *BREATHER CAP.* Wash the breather cap screen (fig. 28) with cleaning fluid, allow to dry, then wet with engine oil. Check daily under severe dusty conditions.

(7) *REAR AXLE.* Check the lubricant and add lubricant to level of filler plug if required (fig. 29).

(a) F-1, F-5 (WITH TWO-SPEED), F-6, F-7, AND F-8. In summer, use Hypoid or Multi-Purpose lubricant SAE-90 (SAE-140 for temperatures above 100°F.). In winter, use Hypoid or Multi-Purpose lubricant SAE-90 (SAE-80 for temperatures below −10°F.).

(b) F-2, F-3, F-4, AND F-5 (WITH SINGLE SPEED). In summer, use Mild E.P. or Multi-Purpose lubricant SAE-140. In winter, use Mild E.P. or Multi-Purpose lubricant SAE-90 (SAE-80 for temperatures below −10°F.).

(8) *STEERING GEAR CASE.* Add SAE 90 gear oil to the steering gear case as required. Before removing the filler plug, clean all dirt from around the plug.

(9) *HOOD HINGES AND LATCH.* Lubricate the hood hinges and latch (fig. 30) with engine oil.

(10) *DOOR HINGES–OUTSIDE DOOR HANDLES, AND STRIKER PLATES.* Lubricate the door hinges and outside door handles with dripless penetrating oil, and use stainless wax on the door striker plates (fig. 31).

(11) *SPRING PINS AND SHACKLE PINS.* Lubricate the spring pins and shackle pins (fig. 32) with pressure gun grease. Make sure the grease is forced out each end of the spring bushing and shackle.

(12) *DRAG LINK.* Lubricate the drag link with pressure gun grease (fig. 33).

(13) *SPINDLE BOLTS.* Lubricate the spindle bolts (two fittings each bolt) with pressure gun grease. Make

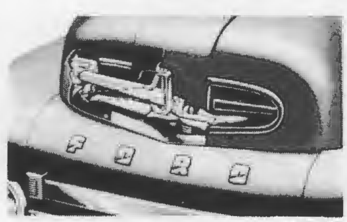
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Fig. 30—Hood Hinges and Latch

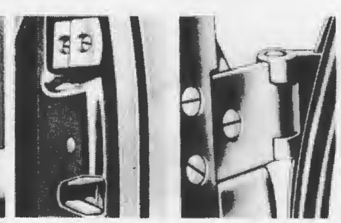
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Fig. 31—Door Hinges, Outside Door Handles, and Striker Plates

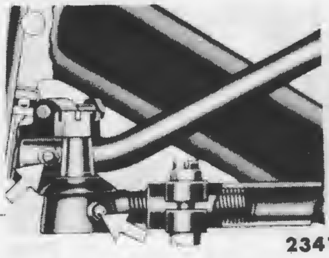

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Fig. 32—Spring Pins and Shackle Pins

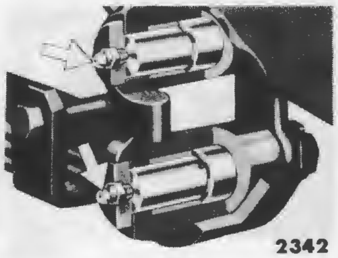

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Fig. 33—Steering Drag Link

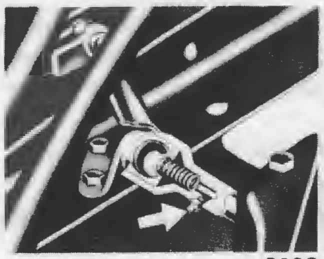

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Fig. 34—Clutch Release Shaft and Equalizer Shaft

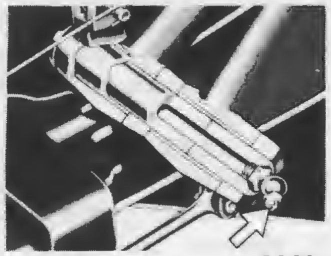

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Fig. 35—Clutch and Brake Pedal Shaft

sure the grease is forced out around the spindle.

(14) *SPINDLE CONNECTING ROD.* Lubricate spindle connecting rod (pressure gun grease) (fig. 33).

(15) *CLUTCH RELEASE EQUALIZER SHAFT.* Lubricate the clutch release equalizer shaft with pressure gun grease (fig. 34).

(16) *CLUTCH AND BRAKE PEDAL SHAFT.* Lubricate the clutch and brake pedal shaft with pressure gun grease (fig. 35).

(17) *UNIVERSAL JOINTS AND SLIP JOINT.* Lubricate the universal joints with SAE 140 gear oil.

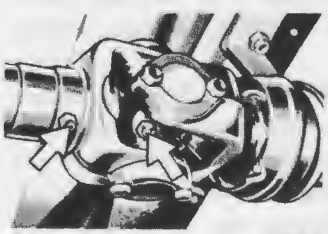

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Fig. 36—Universal Joints and Slip Joint

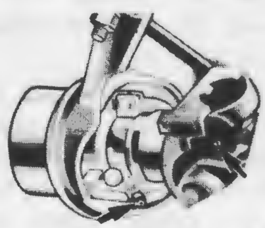

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Fig. 37—Coupling Shaft Support Bearing

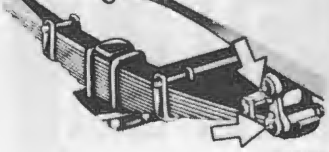

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Fig. 38—Springs

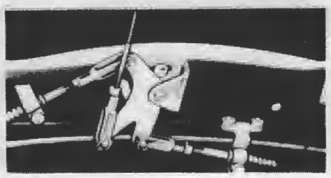

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Fig. 39—Hand Brake Cables

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Fig. 40—Remote Control Gearshift Levers

Lubricate slip joint (pressure gun grease) (fig. 36).

(18) *COUPLING SHAFT SUPPORT BEARING (ALL F SERIES EXCEPT F-1; 110 INCH C.O.E.; AND 104 INCH PARCEL DELIVERY).* Lubricate coupling shaft support bearings and slip joint with pressure gun grease (fig. 37).

(19) *SPRINGS.* Spray the springs with dripless penetrating oil (fig. 38).

(20) *LINKAGE.* Spray clutch linkage, hand-brake cables (fig. 39), and equalizers with dripless penetrating oil.

(21) *REMOTE CONTROL GEARSHIFT LEVERS.* Lubricate gearshift levers with pressure gun grease (fig. 40).

(22) *WATER PUMPS.* Lubricate the water pumps equipped with an oil cup with engine oil.

(23) *AIR BRAKE CAMSHAFT.* Lubricate the brake camshaft (fig. 41) with pressure gun grease every 1000 miles, using care not to over-lubricate. Whenever wheels and drums have been removed, lubricate the cams with white waterproof grease 8L-19586-A.

(24) *BRAKE VALVE ROLLER.* Lubricate the brake valve roller and actuating arm with engine oil every 1000 miles (fig. 42).

(25) *AIR COMPRESSOR.* Wash the air compressor intake strainer element (fig. 43) in a solvent every 2000 miles. Under dusty conditions, clean daily if required.

(26) *AIR COMPRESSOR CRANKCASE*

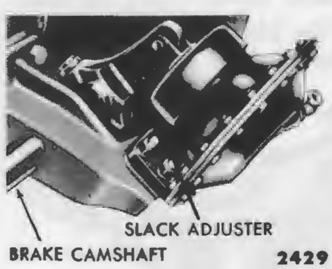

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Fig. 41—Air Brake Camshaft

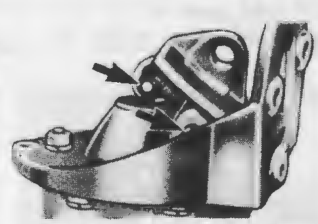

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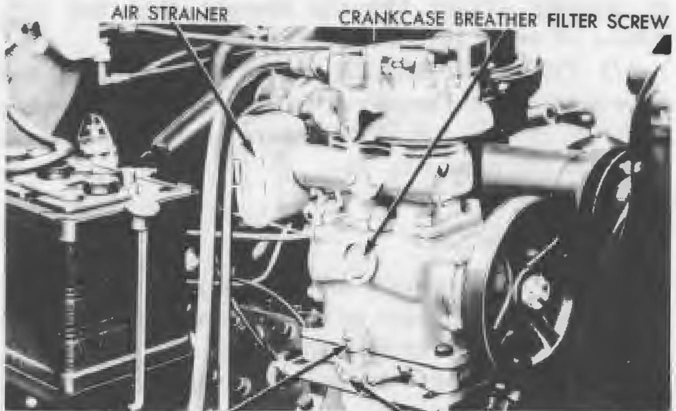
Fig. 42—Brake Valve Roller



2431

Fig. 43—Compressor

BREATHER FILTER SCREEN. Wash the crankcase breather filter screen (fig. 43) in a cleaning solvent every 2000 miles. Under dusty conditions, clean daily if required.

(27) *AIR COMPRESSOR CRANKCASE.* Drain and refill the air compressor crankcase with 1 pint of engine oil every 2000 miles. Check oil level daily (fig. 43).

e. 5000-Mile Lubrication.

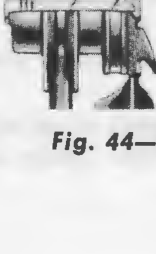
All of the 1000-Mile Lubrication procedures should be included with the following lubrication operations. Figure 23 shows the location of each unit to be lubricated.

(1) *FAN (F-1 THROUGH F-6 8-CYLINDER ENGINE).* Remove the screw plug and add 1 ounce of engine oil. Turn the fan until the oil hole is at the bottom, and drain excess oil. Install the screw plug. Use care not to allow the excess oil to drain on the fan belt (fig. 44).

(2) *BRAKE MASTER CYLINDER.* Check the master cylinder brake fluid level (correct level ½" from top) and add Ford Brake Fluid 8A-19542, if required (fig. 45).

CAUTION: ***Always clean any dirt from around the filler plug before removing it from the master cylinder.***

(3) *OIL FILTER CARTRIDGE.* Install a new cartridge when the dipstick shows dirty oil, or at every 4000 to 5000 miles.



2432

Fig. 44—Fan

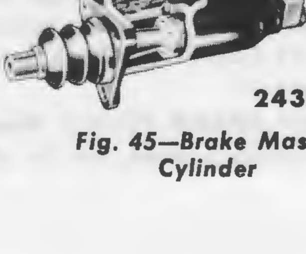


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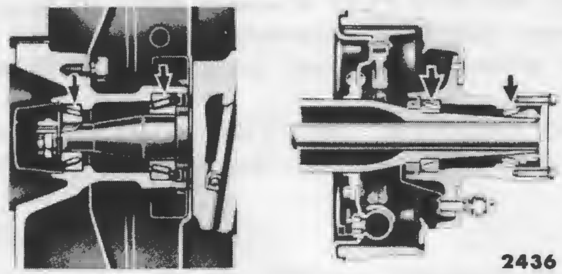
Fig. 45—Brake Master Cylinder



2436

Fig. 46—Front and Rear Wheel Bearings

f. 10,000-Mile Lubrication.

Both the 1000 and 5000-Mile Lubrication procedures should be included with the following operations. Figure 23 shows the location of each unit to be lubricated.

(1) *FRONT AND REAR WHEEL BEARINGS.* Repack the wheel bearings (except F-1 truck) with Ford Wheel Bearing Lubricant, 8A-19585, once a year or at least every 10,000 miles. Replace if they are pitted or discolored from overheating (fig. 46).

(2) *REAR AXLE.* Drain, flush, and refill the rear axle (fig. 29) at least twice yearly, or every 10,000 miles. The lubricants to be used for the various types of axles are as follows:

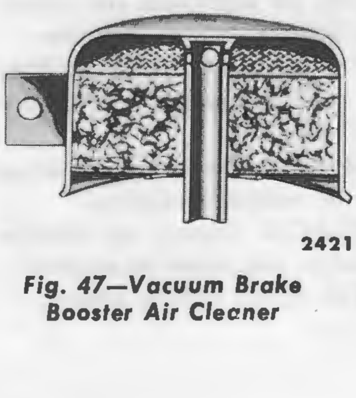
(a) F-1, F-5 (WITH TWO-SPEED), F-6, F-7, AND F-8. In summer, use Hypoid or Multi-Purpose lubricant SAE-90 (SAE-140 for temperatures above 100°F.). In winter, use Hypoid or Multi-Purpose lubricant SAE-90 (SAE-80 for temperatures below −10°F.).

(b) F-2, F-3, F-4, AND F-5 (WITH SINGLE SPEED). In summer, use Mild E.P. or Multi-Purpose lubricant SAE-140. In winter, use Mild E.P. or Multi-Purpose lubricant SAE-90 (SAE-80 for temperatures below −10°F.).

For temperatures BELOW 10°F. use SAE hypoid or multi-purpose lubricant in F-6, F-7, and F-8 trucks.

(3) *TRANSMISSION.* Twice yearly, or at least every 10,000 miles, drain, flush, and refill the transmission with gear oil. Summer SAE 140 (SAE 90 with remote shift); winter SAE 80.

(4) *SLACK ADJUSTER.* Lubricate the slack adjuster (fig. 2429) with pressure gun grease every 10,000 miles.



2421

Fig. 47—Vacuum Brake Booster Air Cleaner

2422

Fig. 48—Vacuum Brake Booster

(5) *ANCHOR PINS.* Whenever drums are removed, or every 10,000 miles, lubricate the brake anchor pins with pressure gun grease using care not to over-lubricate.

(6) *VACUUM BRAKE BOOSTER AIR CLEANER.* Wash the brake booster air cleaner element in cleaning solvent. Dry the element, then wet with engine oil every 10,000 miles (fig. 47).

(7) *VACUUM BRAKE BOOSTER.* Remove the filler plug. Fill the booster cylinder to level of filler plug with air cylinder oil M-4856 once a year or at least every 20,000 miles (fig. 48).

5. PREVENTIVE MAINTENANCE

Lubrication and inspection, plus the adjustments or repairs indicated by the inspections, will maintain the performance of a vehicle at peak efficiency. It is desirable to perform operations that prepare the vehicle for the approaching seasons, twice yearly, or at least every 5000 miles under normal operating conditions.

a. 1000-Mile Inspection Service.

At 1000 mile intervals perform the following operations in addition to the 1000 mile lubrication service.

(1) *HOSE, BELTS, AND LINES.* Make a visual inspection of the condition of the radiator hose connections, belts, fuel lines, and hydraulic brake lines.

(2) *EXHAUST SYSTEM AND SPRINGS.* Check the exhaust system for loose connections and rusting. Tighten connections and replace rusted parts. Check for broken leaves. Replace parts where necessary.

(3) *BATTERY TERMINALS.* Clean the battery terminal connections and the battery terminals. Tighten securely and coat lightly with petrolatum.

(4) *BATTERY.* Check the state of charge of the battery and replenish the water. Recharge or replace the battery as required.

(5) *LIGHTS.* Check the condition and operation of all lights. Replace burned out bulbs.

(6) *TIRES.* Inflate the tires to recommended pressure. Examine tires for cuts, cracks, or unusual wear.

(7) *WINDOWS AND INTERIORS.* Clean interior of vehicle and all window glass.

(8) *TWO-SPEED AXLE.* Clean the vacuum shift control valve air filter.

b. 5000-Mile Inspection Service.

At 5000 mile intervals perform the following operations in addition to the lubrication service:

(1) *DOORS.* Check doors for alignment and adjust striker plates. Clean drain holes at bottom of doors.

(2) *WEATHERSTRIPS AND RUBBER BUMPERS.* Replace missing or worn weatherstrips or rubber bumpers on the doors, and hood.

(3) *WINDOW OPERATION.* Check the operation of all windows, and repair or replace if required.

(4) *EXTERIOR SURFACES.* Inspect all exterior surfaces for rust and corrosion, and repair as required.

(5) *COOLING SYSTEM.* Check cooling system:

Test the concentration and level of the anti-freeze or radiator coolant. If signs of excessive rust are apparent, drain and flush the cooling system.

Inspect the radiator cap operation, replace if required.

Check the condition of all hoses and tighten the connections (including heater hose). Replace worn hose.

(6) *BELTS.* Inspect and adjust the fan and generator belts. Replace if they are cracked or badly worn.

(7) *REAR AXLE.* Tighten the differential carrier to housing stud nuts. Check the exterior of the axle housing for evidence of lubricant leakage.

(8) *OIL PAN.* Examine the oil pan for leakage and if required tighten the screws to the specified torque.

(9) *STARTER MOTOR.* Tighten the starter motor mounting bolts (15-20 foot-pounds). Tighten cable connections securely.

(10) *EXHAUST SYSTEM.* Check exhaust system: Tighten the exhaust pipe muffler brackets and clamps. Replace parts where necessary.

Torque all exhaust manifold nuts and cap screws (25-30 foot-pounds), and at the same time check exhaust manifold for cracks or leaks. Repair or replace parts.

(11) *FUEL SYSTEM.* Tighten the fuel tank hold down bolts and fuel line connections at the fuel tank.

Drain a quantity of fuel from the tank to remove any accumulation of water or sediment in the tank.

(12) *WHEEL NUTS.* Tighten all wheel nuts to the specified torque.

(13) *WINDSHIELD WIPERS.* Check the windshield wiper blades and the operation of the windshield wipers. Repair or replace if required.

(14) *BRAKES.* Check the brake system as follows:

Remove one front drum and examine the brake lining. Replace the brake lining if it is worn to within $\frac{1}{32}$ inch of the rivet heads or if the lining is grease soaked.

If brake lining is satisfactory, install the wheel and check the service brake pedal reserve. Readjust the brake shoes when the pedal reserve is less than one half of the distance to the floorboard.

Check brake pedal free travel and adjust if required. If pedal operation is spongy, bleed brakes.

Check and adjust the parking brake lever travel.

(15) *CLUTCH.* Check and adjust the clutch pedal free travel.

(16) *SPARK PLUGS.* Remove all spark plugs, wipe the porcelain clean, file the electrode tips lightly and

sand blast each plug. Set the gap to 0.025-0.028 inches. Test each spark plug in an approved spark plug tester. Replace all plugs that do not perform to specifications on spark plug tester, have broken or chipped porcelain, or badly burned electrodes. Install the spark plugs.

(17) *COMPRESSION.* Test the compression of each cylinder. Cylinders with the compression below normal indicate leaking valves or rings. Higher than normal compression indicates excessive carbon accumulation.

(18) *CYLINDER HEAD.* Tighten all cylinder head bolts, in the proper sequence, to the specified torque.

(19) *BATTERY.* Remove battery cables, and clean battery and cable connectors. Inspect battery case for cracks or leaks. Inspect the cables for worn insulation or deteriorated connectors. Replace or repair if required. Inspect the battery hold-down clamp and carrier. Repair or replace if required. Tighten hold-down nuts to 10-15 inch lbs. Install cables and tighten connectors.

(20) *WIRE CONNECTIONS.* Tighten the wire connections at the generator, generator regulator, coil, and the starting motor relay.

(21) *GENERATOR.* Test generator output, and if below specifications, replace or rebuild generator.

(22) *GENERATOR REGULATOR.* Test the cut-in voltage of the generator regulator and generator voltage and current regulator. Adjust regulator if required, or replace regulator if necessary.

(23) *GENERATOR CIRCUIT.* Test circuit for excessive resistance and make necessary corrections.

(24) *STARTER MOTOR CURRENT DRAW.* Check starter motor current draw under load and no load. Rebuild or replace starting motor if necessary.

(25) *IGNITION PRIMARY CIRCUIT.* Check the ignition primary circuit resistance and visually inspect the wires for faulty insulation or poor connections. Replace wire and tighten connections as required.

(26) *DISTRIBUTOR.* Check the distributor:

Examine the distributor cap and rotor for cracks, carbon tracks, or other damage. Replace if required. Inspect the distributor points. Replace if dirty, oily, pitted, or burned. Check breaker plate for excessive wobble and recondition distributor if required.

Install distributor cap and check all high tension wires for damage, corroded terminals, or looseness in distributor cap terminal socket. Replace if required.

Check the distributor point per cent of dwell. Reset the contact spacing if required.

(27) *IGNITION TIMING.* Set the ignition timing.

(28) *SPARK INTENSITY.* Determine if the spark from each spark plug wire is satisfactory. If not, make necessary corrections.

(29) *CARBURETOR.* Check the carburetor:

Remove, disassemble, and clean the carburetor, including the removal of carbon deposits from the throttle barrel. Make repairs and replacements as required. Set the float level, assemble, and install the carburetor.

Adjust carburetor idle. Set the idle speed. Set the idle fuel adjustment to the point of highest engine r.p.m. Reset the idle speed adjustment if required.

(30) *FUEL PUMP.* Check the fuel pump as follows:

Clean fuel pump sediment bowl. Install the fuel pump bowl. Check the fuel pump vacuum. If the vacuum is less than 10 inches, repair or replace the pump.

Check fuel pump pressure. If reading is not within 4-5 lbs. (3½-4½ lbs. 8 cyl.) repair or replace pump.

(31) *TEST ENGINE VACUUM.* Connect the vacuum gauge and check vacuum at engine idle speed. If the vacuum is lower than normal (18 to 21 inches mercury), correct any vacuum leaks at the intake manifold, windshield wiper, distributor, or other vacuum lines.

(32) *ANALYZE ENGINE COMBUSTION.* Test the engine combustion air-fuel ratio and accelerating pump operation as a check on work performed.

(33) *WHEEL BEARINGS.* Check front wheel bearings. If any free play is noticed, adjust bearings.

(34) *SPINDLE BUSHINGS.* Check front wheel spindle bushings. If excessive movement is noticed, rebush the spindles.

(35) *STEERING CONNECTIONS.* Check steering connections for looseness. Replace parts as required.

(36) *STEERING GEAR.* Check the steering gear mounting bolts, and tighten if required.

(37) *SPRINGS.* Check the springs as follows:

Inspect the springs for sagging, broken leaves, or broken tie-bolts. Repair or replace springs if required.

Torque the spring clips (U-bolts) to the specified torque. Tighten the spring center bolt.

(38) *TWO-SPEED AXLE.* Check the vacuum hose for leakage and tighten all connections. Replace parts where necessary.

(39) *GOVERNOR (F-7 AND F-8 ONLY).* Check governor and reset if required.' Replace seals.

(40) *ROAD TEST.* Road test the vehicle.

c. 10,000-Mile Inspection Service.

At 10,000 mile intervals, include the following operations in addition to the lubrication and performance assurance procedures:

(1) *WHEEL BEARINGS.* Repack front wheel bearings.

(2) *BRAKES.* Inspect all brake wheel cylinders for leakage. Repair or replace leaking cylinders.

(3) *HEADLIGHTS.* Check and align headlights.

(4) *WHEEL ALIGNMENT.* Check the wheel alignment and steering control.

(5) *PARKING BRAKE (TRANSMISSION TYPE).* Check the condition of the parking brake lining. If the lining shows excessive wear, replace it.

If the lining is in good condition, check the lining to drum clearance. Adjust the brake if necessary.

Part FIVE

MAINTENANCE, TROUBLE SHOOTING, AND SPECIFICATIONS

Chapter

II

Trouble Shooting

In the preceding Chapter, instructions are given for preventive maintenance procedures. This chapter is intended to provide the necessary guiding information so that you can quickly and easily locate the source of trouble for any symptom which may be reported to you by the truck owner.

Several things should be kept in mind when you are "Trouble Shooting" for the cause of a certain symptom. The main thing to remember is the difference between preventive maintenance and diagnosis.

Diagnosis is the establishment of facts; that is, to find out whether or not the trouble suspected actually exists, then, by the application of a definite procedure in a logical sequence, to locate the cause of the trouble in a particular system or unit, so that it can be eliminated. Preventive maintenance is a periodic check-up and correction of an entire unit of the vehicle.

It is important that you be able to recognize the need for preventive maintenance, when for example, you begin diagnosing for a certain complaint and find the entire unit on which you are working in a state of disrepair or maladjustment. In a case like this it is more economical, and a better job will result, if you recommend to the owner that he have a tune-up, or brake overhaul, etc., depending on which unit or system you are working.

A section is devoted to each of the major units of the vehicle with which trouble might be experienced. These sections are in turn divided under headings which are descriptive of the different troubles which might be encountered on that particular unit or system. This arrangement enables you to quickly and easily locate the cause of the trouble.

1. POWER PLANT

The various factors controlling efficient power plant operation are outlined in this section and are identified below under headings as follows: "a. Engine", "b. Fuel System", "c. Ignition System", and "d. Cooling System".

In some symptoms you will find a heading "Preliminary Instructions". The information contained under this heading points out some of the causes which can be readily observed and eliminated.

a. Engine.

Poor engine performance can be attributed to the engine or to forces on the vehicle that tend to retard its motion. Dragging brakes or misaligned wheels cause the engine to work harder and poor engine performance results.

Engine performance depends on proper fuel distribution, correctly timed ignition, normal uniform compression, properly regulated flow of fuel air mixture to the cylinders, and unobstructed flow of exhaust gases.

Engine trouble symptoms are discussed under the following headings with instructions of what to do to satisfy the above conditions and regain good engine performance.

(1) *ENGINE DOES NOT DEVELOP FULL POWER (TOP SPEED AND/OR ACCELERATION LOW).* If the engine does not develop full power, has a low top speed, or slow acceleration, it is advisable to perform a complete engine tune-up. In most cases this will correct the trouble and will eliminate much of the following procedure. If the tune-up was performed by someone else, or if it did not correct the trouble, proceed as follows, omitting consideration of such factors that are known to be right.

(a) PROCEDURE. A diagnosis of the compression, the ignition, and the fuel system should be made in sequence according to the trouble shooting map in fig. 1.

(1) ANALYZE THE COMBUSTION. If possible, analyze the combustion while the owner is present so that he may observe the results of the test. Test the air-fuel ratio and accelerating pump operation. If the carburetor

ENGINE TROUBLE SHOOTING

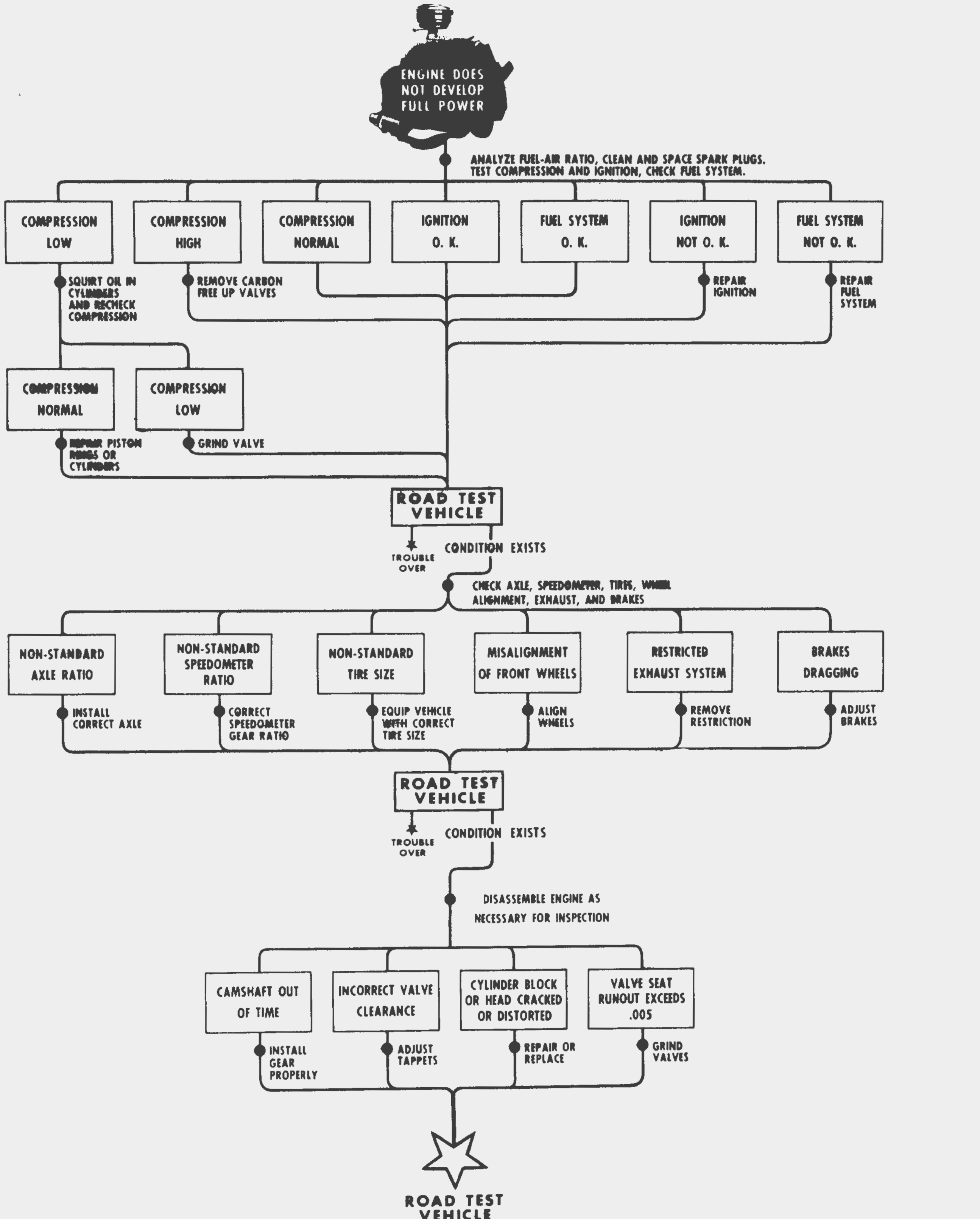


Fig. 1—Engine Trouble Shooting

is at fault, clean and adjust the carburetor.

(2) TEST THE CYLINDER COMPRESSION. Test the compression pressure of each cylinder. If the compression pressure is above normal, excessive deposits are indicated. Remove the carbon or lead deposits.

If the compression is below normal, excessive clearance exists between the piston rings and the cylinder walls or the valves are not seating properly.

Squirt a small quantity of light engine oil into each cylinder and re-test the compression. If the compression is now normal, the valves are seating properly and repairs to the piston rings, pistons, or cylinders are indicated. If the compression is still below normal, grind the valves and perform an engine tune-up.

(3) TEST THE IGNITION. Remove each spark plug wire and hold the end of the wire 3/16 inch from the cylinder head. If the spark jumps the gap, the ignition system is operating correctly. If the ignition is found to be at fault, make adjustments or replacements.

(4) CHECK THE FUEL SYSTEM. Test the fuel pump pressure and vacuum. If the pump pressure and vacuum is satisfactory, check the fuel pump capacity. Check the fuel lines for obstruction. If the fuel pump is faulty, repair or replace the fuel pump. If the fuel lines are restricted, blow out the lines with compressed air, or replace the defective lines.

(5) ROAD TEST THE VEHICLE. After checking and correcting the troubles found, road test the vehicle.

(b) ADDITIONAL POSSIBLE CAUSES. If the performance is still below normal after completing the above procedure, check for additional possible causes listed below.

(1) BRAKES DRAGGING WHEN HOT. Make sure the brake pedal has the necessary free travel and the brake master cylinder vent is not obstructed.

(2) EXCESSIVE EXHAUST BACK PRESSURE. If it is suspected that there is excessive back pressure due to clogged muffler, sticking exhaust thermostat, clogged or bent tail pipe, etc., road test the vehicle with the exhaust pipe disconnected during the test.

(3) CAMSHAFT OUT OF TIME. If either the camshaft gear or the crankshaft gear have been replaced, if major repairs have just been made, or if the main bearings have been replaced, the timing marks may be out of alignment. Remove the gear cover and inspect timing.

(4) TOO LITTLE VALVE CLEARANCE. Too little valve clearance resulting in the valve not completely closing when hot will result in loss of power, poor performance, and burned valves. Check the valve clearance.

(5) TOO MUCH VALVE CLEARANCE. Too much valve clearance resulting in the valves opening late and closing early will result in loss of power, poor performance, and noise. Check the valve clearance.

NOTE: ***Valve lobe cam wear can result in insufficient valve lift.***

(6) MISALIGNMENT OF FRONT WHEELS. Observe the type of wear on the front tires to determine if the toe adjustment is correct. Adjust the spindle connecting rods if required.

(7) STANDARD EQUIPMENT. Make sure the vehicle has the correct tire size, correct axle ratio, speedometer gear ratio, and the correct cylinder heads.

(2) *ENGINE RUNS UNEVENLY AND BACKFIRES THROUGH CARBURETOR.* Make certain that the choke is operating correctly and that the engine has reached operating temperature. Check the spark plug wires for correct position on distributor and plugs.

(a) PROCEDURE. Check the distributor for shorts and check the fuel system for faulty parts or clogged lines.

(1) CHECK DISTRIBUTOR CAP. Inspect the distributor cap. If the cap is cracked or shorted, replace the cap.

(2) CHECK FUEL SYSTEM. Make sure that the fuel pump and connections are not leaking. The fuel tank vent should be open and unrestricted. Inspect the flexible line at the intake side of the fuel pump and replace it if there is any indication of leakage. Remove the fuel tank cap and blow compressed air back through the fuel line to remove any obstructions.

(a) Test Fuel Pump. Check the fuel pump pressure vacuum and capacity. If the pump operation is not within specifications, remove the fuel pump, and make the necessary repairs or replacements.

(b) Clean and Adjust Carburetor. Remove, disassemble, and clean the carburetor. Make necessary repairs. Set the float level. Set the accelerating pump link in the proper hole for the prevailing temperature. Make sure accelerator linkage permits a full throttle opening.

(c) Test Engine Vacuum. Tighten the intake manifold screws or nuts. Connect a vacuum gauge to the windshield wiper connection of the intake manifold and observe the reading while the engine idles. If the vacuum is lower than normal, it is probably due to leakage. Points at which the manifold vacuum may leak are: vacuum lines (distributor or windshield wiper), intake manifold gasket, or intake manifold.

(d) Remove and Disassemble Carburetor. Remove and disassemble the carburetor. Clean all parts and examine the float for leakage. Examine the condition of the float valve and seat. Check the size of the main metering jets. Make repairs as required and set the float level. If the fuel system is operating properly, the valves are probably sticking. Free up the valves.

(3) *ENGINE MISFIRES AT HIGH SPEED.* If the engine misfires at high speed, check the ignition.

(a) TEST DISTRIBUTOR AND COIL. Remove the distributor and follow the procedure given in the trouble shooting map in fig. 2.

(1) IF DISTRIBUTOR IS FAULTY. If the distributor is faulty, make the necessary repairs.

(2) IF COIL IS FAULTY. Replace the coil.

(3) IF IGNITION IS SATISFACTORY. If the distributor

and coil are in good working order, check the fuel system.

(b) Check Fuel System. Check the fuel system for overall operation with a combustion analyzer.

(1) FAULTY UNITS IN FUEL SYSTEM. Make corrections to the carburetor, fuel pump, or fuel lines.

(2) IF THE FUEL SYSTEM IS SATISFACTORY. If all other conditions are satisfactory, misfiring at high speed may be caused by sticking valves. If the valves are sticking, free up the action.

(4) *ENGINE STARTS BUT FAILS TO KEEP RUNNING.* If the engine starts and stops after a short period of running and cannot again be started, the most probable cause is that fuel is not reaching the carburetor.

(a) Procedure. Clear all fuel lines, test the gasoline for water, and make a fuel pump check.

(b) Additional Possible Causes. In rare cases, the ignition coil or condenser will allow the engine to start but will fail to deliver a spark when hot. Turn the ignition switch ON. Crank the engine and test the spark intensity with a spark meter. If the spark will not jump a 14 kilovolt gap setting, test the coil and condenser on the distributor test set when at operating temperature. Replace the faulty unit.

(5) *ENGINE BACKFIRES BUT WILL NOT START.* This symptom indicates that the spark plugs are not firing in their proper order, either due to the ignition high tension system being shorted, the spark plug wires being transposed, or the camshaft out of time. Perform the following in the order given.

(a) Procedure. Wipe all dust and moisture from the exterior of the distributor, coil, spark plugs, and spark plug wires, and again attempt to start the engine.

If the engine still fails to start, make sure each spark plug wire is attached to the correct spark plug. Make sure the spark plug wires are installed in the correct terminals of the distributor cap, and check the interior of the distributor for dampness. Replace the distributor cap if there is evidence of shorting.

If the above procedure has not corrected the trouble, the camshaft is probably out of time, remove the engine front cover and correct the camshaft timing.

(6) *ENGINE CRANKS BUT WILL NOT START.* This trouble often is caused by temporary conditions which can be readily observed.

(a) Procedure. Check for ignition shorts due to dampness and for vapor lock or flooded engine.

(1) PRELIMINARY INSTRUCTIONS. Turn the ignition switch ON, check the fuel supply, then use the procedure given below that fits the existing conditions.

(a) If Engine Is Wet. If the engine is wet, wipe all moisture from the distributor cap, coil, spark plugs, and spark plug wires.

(b) If Engine Is Hot. If the engine is hot, hold the foot throttle open and crank the engine. This clears away vapor lock which may be present.

(c) If Engine Is Flooded. If the engine is flooded (due to repeated attempts to start while the carburetor was choked, or to over-manipuation of the foot throttle and accelerating pump), push the choke button IN and depress the accelerator pedal all the way. Crank the engine several revolutions to exhaust the surplus fuel.

(d) If Engine Is Extremely Cold. If the engine is extremely cold, make certain that the choke is working and pull the choke button out to the stop. Hold the clutch pedal down. With the ignition switch ON, press the starter button.

(e) If Engine Cranks Slowly. Make sure the battery is fully charged and the viscosity of the engine oil is correct for the prevailing temperature. If the engine still fails to start after the above instructions have been followed, fuel is not being delivered to the engine or the ignition system is at fault.

(2) DETERMINE IF FUEL IS BEING DELIVERED TO THE CARBURETOR. The procedure for doing this varies according to the type of carburetor used on the engine.

(a) Fuel Supply to Carburetor. On the 8-cylinder engine remove a drain plug from the carburetor float chamber. If gasoline runs from the drain it indicates fuel is being delivered to the carburetor. On the 6-cylinder engine, remove the carburetor air cleaner and observe if a spray of gasoline is coming from the accelerator pump spray nozzle (located inside of the air throat of the carburetor) each time the throttle is fully opened. If a spray is observed, fuel is being delivered to the carburetor.

(b) Fuel Not Reaching Carburetor. If no gasoline is observed at the drain on the 8-cylinder or at the pump discharge nozzle on the 6 cylinder, fuel is not reaching the carburetor. Check sediment bowl for water, clean out fuel lines, and inspect fuel pump.

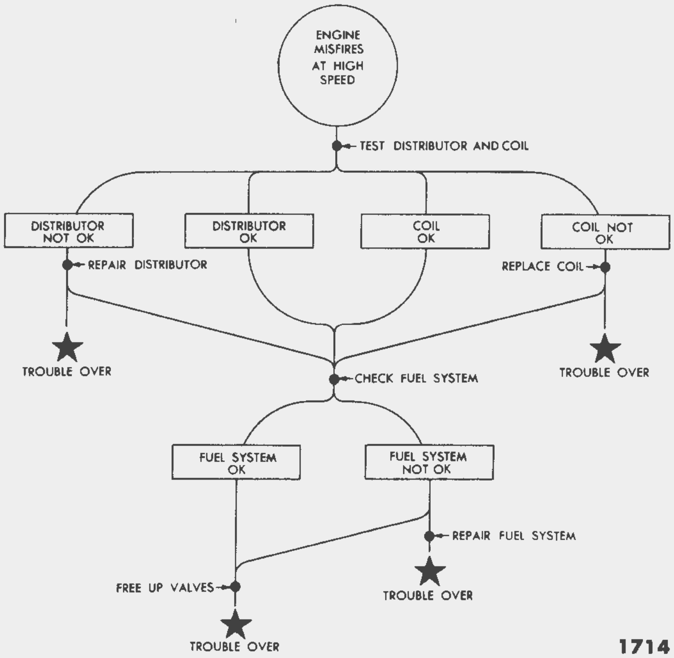


Fig. 2—Engine Misfires At High Speed—Road Map

(3) DETERMINE IF CURRENT IS BEING DELIVERED TO SPARK PLUGS. Turn the ignition switch ON. Remove the wire from any spark plug and hold the wire terminal $\frac{3}{16}$-inch from the cylinder head while the engine is being cranked. If a spark does not jump this gap, the ignition is at fault, follow the procedure for the symptom under the heading "c. Ignition System" that applies to your case.

(7) *ENGINE MISFIRES ON FAST ACCELERATION OR HARD PULL.* The most probable cause for misfiring on fast acceleration or hard pull is the ignition.

(a) PROCEDURE. Check spark intensity at the spark plugs, accelerating pump action, and fuel level in carburetor float chamber.

(1) TEST SPARK AT SPARK PLUG WIRES. Run the engine at idle speed. Remove the wire from No. 1 spark plug and hold it $\frac{3}{16}$-inch from the cylinder head and observe if the spark jumps regularly without missing. Make this test at each spark plug wire. If a satisfactory spark is obtained from each spark plug wire, proceed with "*(2)* Clean Space or Replace Spark Plug" below. If an unsatisfactory spark or no spark is obtained at any of the wires, follow the procedure for the symptom given under "c. Ignition System" that most nearly applies.

(2) CLEAN, SPACE OR REPLACE SPARK PLUGS. Clean and space plugs or replace damaged or faulty plugs.

(3) CHECK ACCELERATING PUMP ACTION. Make sure the accelerating pump link is in the proper hole for the prevailing temperature. Remove the air cleaner and observe if a spray of gasoline comes from the pump discharge nozzle (located inside of the carburetor air throat) each time the throttle is opened fully. Repair or replace the carburetor if no spray or a very light spray is observed (pump mechanism or check valve faulty).

(4) CHECK FLOAT LEVEL AND CLEAN CARBURETOR. Remove and clean the carburetor thoroughly. Reset the float level if required.

(b) ADDITIONAL POSSIBLE CAUSE. If performance is still below normal, test the compression of each cylinder and make corrections as required. Run the engine at idle speed and observe if any of the valves are noticeably noisy. Abnormally noisy valves indicate sluggish valve action. Make the necessary correction.

b. Fuel System.

The fuel system consists of a tank, pump, carburetor, manifold, and the various connecting lines. Dirt and other foreign materials should be kept from entering this system as they clog lines and cause carburetor valves to leak or stick. As a rule the carburetor does not fail suddenly but progressively impairs engine performance. Fuel pump trouble is most commonly traced to incorrect rocker arm travel or to a worn diaphragm.

(1) *EXCESSIVE FUEL CONSUMPTION.* Low engine speed through low gear and driving with a constant accelerator position conserves fuel. The engine uses a minimum amount of fuel when properly tuned.

(a) FUEL CONSUMPTION DATA. Some variation in fuel consumption is to be expected at higher elevations. Atmospheric conditions likewise are factors and the result will be affected by air temperature and pressure.

(b) PRELIMINARY INSTRUCTIONS. So many factors can result in excessive fuel consumption that it usually is advisable to recommend engine tune-up operations which will eliminate much of the following procedure, or, in most cases, will correct the trouble. If the engine tune-up was performed by someone else, or if it has not corrected the trouble, proceed as follows, omitting consideration of such factors as are known to be right.

(1) BRAKES AND TIRES. Make sure the brakes are not dragging and the tires are properly inflated.

(2) EXHAUST. Make sure the exhaust tail pipe is not bent or plugged with mud so as to restrict the exhaust. An exhaust control valve which has become inoperative and sticks in the closed position, will cause excessive fuel consumption. Repair or replace.

(3) WHEEL ALIGNMENT. Observe the type of wear on the front tires to determine whether the toe adjustment is correct and adjust the toe if required.

(4) SPARK PLUG GAP. Make sure gaps are correct.

(5) ACCELERATING PUMP. Make sure the accelerating pump link is in the correct position for the prevailing atmospheric conditions.

(6) IGNITION. Run the engine at idle speed. Remove the wire from No. 1 spark plug, hold the wire $\frac{3}{16}$-inch from the cylinder head, and observe if the spark jumps the $\frac{3}{16}$-inch gap regularly without missing. Make this test at each of the spark plug wires. If an unsatisfactory spark is delivered from any of the wires, follow the procedure under "c. Ignition System" that applies.

(c) PROCEDURE. Having made the above preliminary check, road test the vehicle to verify the complaint of excessive fuel consumption. To correct excessive fuel consumption, begin with the operations that require the least amount of time. If this does not correct the trouble, it is necessary to remove the fuel pump or carburetor for repair or replacement as necessary.

(1) TEST FUEL CONSUMPTION. Use a mileage tester having a $\frac{1}{10}$-gallon measure, and multiply the speedometer reading by 10 to obtain the miles per gallon. The test must be made on a straight and level road, and must be taken both with and against the wind to arrive at the average miles per gallon. If possible, have the owner along during the test. Make one test while driving the vehicle yourself. If the fuel consumption is normal make a second test with the owner driving.

(2) OBSERVE OWNER'S DRIVING HABITS. While the

owner is driving, observe his driving habits and tactfully point out to him any practices that may account for the excessive fuel consumption. Let him see how quickly $\frac{1}{10}$-gallon of fuel burns during acceleration in second.

(3) CHECK IGNITION TIMING ON THE ROAD. If the fuel consumption is found to be higher than normal, accelerate the engine with the brakes partially applied to slow down the car. If a ping is not heard, it indicates the ignition timing is late. Adjust the timing.

NOTE: ***If the above procedure has not corrected the excessive fuel consumption proceed as follows omitting operations that have been performed.***

(4) CLEAN AIR CLEANER. Clean the filter element of the air cleaner. Replace the dampening pad in the cover of the filter if it is restricting the air flow. If the engine is equipped with an oil bath air cleaner, clean it thoroughly and refill to the specified level with the correct grade of oil.

(5) CHECK CARBURETOR ON THE ENGINE. With the air cleaner removed, make sure the choke valve opens fully each time the choke button is pushed IN. Make the necessary adjustments. If the carburetor is equipped with a vacuum-operated power valve, run the engine at idle speed and turn the idle fuel adjusting screws completely closed. If the engine continues to run, if only for a short period, it indicates the power valve is leaking and must be replaced. Readjust the idle screws.

(6) TIME IGNITION. If the previous road test indicates the timing is late, advance the ignition timing to obtain a slight ping. Check the vacuum line to the distributor for air leaks or being clogged.

(7) CLEAN AND SPACE SPARK PLUGS AND TEST ENGINE COMPRESSION. Clean and space the spark plugs. Replace any faulty plugs. Test the compression of each cylinder. Make the necessary repairs.

(8) CHECK FUEL PUMP. Check the fuel pump pressure and vacuum. If the pressure and vacuum is satisfactory, check the fuel pump capacity. If the fuel pump is not within the required specifications, remove the fuel pump. Make the necessary repairs or replacements.

(9) REMOVE AND DISASSEMBLE CARBURETOR. Remove and disassemble the carburetor. Clean all parts, examine the float, float valve and valve seat. Check the size of the main metering jets.

Make necessary repairs as required and adjust the float level. On carburetors equipped with a power valve, test the valve for leakage. If the power valve leaks install a new gasket or replace the valve.

(d) ADDITIONAL POSSIBLE CAUSES. The above procedure will correct excessive fuel consumption in nearly every case. However, several other conditions are possible if the trouble still is not corrected.

(1) BRAKES DRAGGING WHEN HOT. Make sure that the brake pedal has the necessary free travel and that the brake master cylinder vent is not obstructed.

(2) HAND BRAKE DRAGGING. Owner may not be releasing the hand brake fully after each application.

(3) EXCESSIVE EXHAUST BACK PRESSURE. If you suspect there is excessive exhaust back pressure due to clogged or bent tail pipe, etc., make a fuel consumption test using a mileage tester with the exhaust pipe disconnected during the test. Compare the results of this test with test results when the exhaust pipe is connected.

(4) CAMSHAFT OUT OF TIME. The camshaft may be out of time if either the crankshaft or camshaft gear has been replaced, major repairs have been made, or if the main bearings have been replaced. Remove the gear cover and inspect the timing marks for proper alignment.

(5) TOO LITTLE VALVE CLEARANCE. Too little valve clearance results in valves not completely closing when hot. Check valve clearance.

(6) TOO MUCH VALVE CLEARANCE. Too much valve clearance results in valve opening late and closing early. Check valve clearance.

(7) ENGINE TIGHTNESS. Wrong size parts may have been installed. This is particularly true if piston rings have been installed without sufficient end gap.

(8) VALVES STICKING. It is possible for the valve action to be sluggish during operation and not show up as noisy during engine idle.

(2) *FUEL NOT REACHING THE CARBURETOR.* A clogged or broken fuel line or a faulty fuel pump most commonly cause this trouble.

(a) PRELIMINARY INSTRUCTIONS. Check the supply of fuel in the fuel tank. Make sure tank vent is open.

(b) PROCEDURE. First check the flexible tube on the intake side of the fuel pump as it is readily accessible. Check for water or ice in the tank or fuel lines. If the tank and lines are open and clean, the trouble lies in the pump.

(1) CHECK FUEL LINE. Remove the flexible tube from the fuel pump and replace the tube if it leaks air or if the fuel passage is obstructed.

NOTE: ***The lining of this tube may come loose and obstruct the passage under suction; also some replacement tubes may collapse under suction.***

Remove fuel tank filler cap and blow out fuel line.

(2) CHECK FOR WATER IN FUEL TANK. Remove the drain plug and drain any accumulation of water or sediment from the tank. In freezing weather, water in the fuel tank will freeze and may prevent fuel from entering the fuel line. Drain tank at room temperature.

(3) CHECK FUEL PUMP. Remove the fuel line between the pump and the carburetor. Blow through the line to make sure it is not clogged. With the ignition switch OFF, crank the engine with the starter. If a free flow of fuel is not evident, the fuel pump is faulty and must be repaired or replaced. If the fuel pump and the fuel line are found satisfactory, it indicates an obstruction in the carburetor. Remove the carburetor and clean the carburetor float valve mechanism.

(3) *CARBURETOR FLOODS.* Flooding is caused by a sticking choke, high fuel pump pressure, or carburetor float set too high. On hot days, fuel may "percolate" from the carburetor bowl into the intake manifold while the engine is not operating.

(a) PRELIMINARY INSTRUCTIONS. In addition to the engine running unevenly, a strong odor of gasoline usually is present when the carburetor is flooding. If the carburetor flooding is due merely to overchoking, open the throttle wide and crank engine to exhaust rich gases.

(b) PROCEDURE. Free up choke action, check fuel pump pressure, inspect float level and condition of float.

(1) CHECK CARBURETOR CHOKE ACTION. Remove the air cleaner, operate the choke rod, and observe if the carburetor choke plate opens freely. If the choke action is faulty, make necessary corrections.

(2) CHECK FUEL PUMP PRESSURE. Test the fuel pump pressure with the engine running at idle speed. If the pressure is found to be higher than normal, make the necessary repairs or replacements.

(3) REMOVE AND DISASSEMBLE CARBURETOR. Remove and disassemble the carburetor, then clean all parts. Examine the float for leakage and check the condition of the float needle valve and seat. Make repairs as required and set the float level. Install the carburetor.

(4) *FUEL MIXTURE TOO LEAN.* This indicates an insufficient supply of fuel passing through the carburetor for the volume of air drawn in by the engine. Obstructed fuel lines, low fuel pump pressure, or a leaking intake manifold may be the cause.

(a) PROCEDURE. Clear out lines, test and replace fuel pump if necessary, clean up carburetor, and tighten vacuum lines and intake manifold holddown nuts.

(1) TEST FUEL TANK AND LINES. Make sure the fuel pump and connections are not leaking. Make sure the fuel tank vent is open. Remove the flexible line at the intake side of the fuel pump and replace the line if there is any indication of leakage. Remove the fuel tank cap then blow compressed air back through the fuel line.

(2) TEST FUEL PUMP. Check the fuel pump pressure and vacuum. If the fuel pump pressure and vacuum is satisfactory, check the fuel pump capacity. If the fuel pump is not operating within the limits, remove the fuel pump and make the necessary repairs or replacements.

(3) CLEAN AND ADJUST CARBURETOR. Remove, disassemble, and clean the carburetor. Make all necessary repairs. Set the float level. Install the accelerating pump link in the proper hole for the prevailing temperature. Make sure the throttle linkage permits full opening.

(4) TEST ENGINE VACUUM. Tighten the intake manifold screws or nuts. Connect a vacuum gage to the windshield wiper connection of the intake manifold and observe the reading as the engine idles. If the vacuum is lower than normal, it is probably due to leakage. Points at which the manifold vacuum may leak are: Vacuum lines (distributor or windshield wiper), intake manifold gasket, or a cracked or loose intake manifold.

c. Ignition System.

The ignition system is composed of a primary and a secondary circuit. The battery, ignition switch, primary coil, distributor points, and condenser are in the primary circuit. The secondary coil, rotor, distributor cap, and spark plugs compose the secondary circuit. Each part is discussed in the trouble symptoms below.

(1) *NO SPARK AT ANY SPARK PLUG WIRE.* This indicates trouble in the primary circuit or the high tension wire between the coil and the distributor.

(a) PRELIMINARY INSTRUCTIONS. Turn the ignition switch on. Hold the end of one spark plug wire 3/16 inch from the cylinder head while the engine is being cranked. Repeat this procedure in turn at each spark plug wire.

If none of the spark plug wires produce a spark this symptom applies. If a spark jumps the gap from any one or several wires, this symptom does not apply.

When no spark is being delivered at any of the spark plug wires, the engine will not run, and it is evident that something is wrong with the circuit. The following procedure is designed to quickly locate the immediate cause of trouble, so that the engine can be started.

Schematic drawings of the ignition circuits are shown in figs. 3 and 4. The numbers appearing in these drawings establish the locations of units in the circuits.

EXAMPLE: ***In the following instructions and in the drawings, ⑦ refers to the coil terminal of the ignition switch to coil wire.***

(b) PROCEDURE. Check for good connections and firmly seated terminals, then continue as follows:

(1) CHECK COIL TO DISTRIBUTOR HIGH TENSION WIRE. Replace the coil to distributor high tension wire if the insulation is worn or damaged at any point where it passes near metal parts of the engine. Make sure the terminal ⑯ is soldered to the wire and is firmly seated into the coil terminal socket. Make sure the coil to distributor primary wire is making good contact at both ends. If trouble still exists, proceed as follows:

(2) CONNECT AMMETER BETWEEN BATTERY AND COIL. Connect an ammeter between the battery negative terminal ⑭ and the battery terminal of the ignition coil ⑦. Turn the ignition switch off. Crank the engine with the starter, observe the ammeter reading while the engine is cranking, then follow the proper procedure under the heading agrees with your observation.

(a) If the Engine Starts. If the engine starts, the trouble is in the primary circuit from the negative (hot) side of the starter relay to the battery terminal of the ignition coil ⑬ to ⑦.

NOTE: ***Do not run the engine for more than five minutes with the wires connected in this manner.***

Momentarily disconnect the ammeter lead from the battery ⑭ to stop the engine. If the ammeter now reads zero, crank the engine, a little at a time (with the starter), until a continuous reading is obtained (distributor points closed). Disconnect the ammeter leads from the battery and coil terminals. Disconnect the battery wire from the coil terminal ⑦. Turn the ignition switch on. Connect the ammeter positive lead to the terminal ⑦ of the coil.

Working from the coil toward the battery, contact the ammeter negative lead consecutively to each of the primary circuit terminals ⑦ to ⑬ until an ammeter reading from 3 to 7 amperes is obtained. The faulty part of the circuit is between the terminal where a zero reading was obtained and the terminal where 3 to 7 ampere reading is obtained.

Clean corroded terminals, tighten terminals, and repair or replace parts at fault.

(b) If Ammeter Reads Zero When Engine Is Cranked. If the ammeter reads zero as the engine is cranked, the trouble is in the primary circuit from the battery terminal ⑦ of the coil to the grounded side ① of the distributor contact points.

Ground the condenser insulated terminal ④.

If the ammeter now reads zero, make sure the coil to distributor primary wire is not broken and that it is making good contact at both ends ⑥ and ③. If the ammeter still reads zero, replace the coil.

If the ammeter reads 3 to 7 amperes when the condenser is grounded, the trouble is in the distributor points or the primary circuit contact ③ to the breaker arm assembly. Replace or adjust distributor points, or repair primary circuit contact ③.

(c) If Engine Does Not Start and Ammeter Reads 3 to 7 Amperes. If the engine does not start and the ammeter reads from 3 to 7 amperes as the engine is cranked, the trouble is in the condenser or the ignition secondary circuit.

Tighten the ignition condenser terminal screws ② and ④.

Remove the high tension wire ⑯ from the coil. Connect a jumper wire into the high tension terminal ⑯ of the coil. Hold the other end of this jumper wire $3/16$ inch from the cylinder head while the engine is cranked with the starter. Observe the quality of the spark from the end of the jumper wire.

If there is no spark, remove the condenser for test, or replace it with one known to be good. If this has not corrected the trouble, replace the coil.

If the spark from the jumper wire is satisfactory, the trouble is a grounded secondary circuit in the distributor rotor or distributor cap. Remove and test the rotor. Replace the rotor if the test indicates high tension circuit leaks externally due to carbon tracks or cracked insulation between the electrode and the distributor shaft. If the rotor is satisfactory, carefully examine the distributor cap for carbon tracks to the distributor housing, due to moisture or foreign matter. Clean the cap with lacquer thinner. Replace cap if it has permanent carbon tracks.

(2) *SATISFACTORY SPARK FROM SOME BUT NOT ALL SPARK PLUG WIRES.* The trouble lies within the distributor cap or the remainder of the secondary circuit to the spark plugs.

(a) PRELIMINARY INSTRUCTIONS. Test the spark from the end of each spark plug wire at idle speed. The spark should jump a 14 kilovolt gap continuously. A spark that fails to jump this gap regularly without missing is considered a weak spark.

DEFINITION: ***A satisfactory spark is one that will, without missing, regularly jump a spark gap equivalent to the resistance offered by a correctly spaced spark plug under the compression pressure encountered in the operation of the engine.***

The fact that a satisfactory spark is obtained from some spark plug wires eliminates from consideration those factors that affect equally the output of all the spark plug wires (the primary circuit).

The following procedure takes into account each of the factors that could account for this symptom in the order of their probability.

The numbers appearing in the schematic drawings of the ignition circuits are to establish locations of the terminals referred to in the test (figs. 3 and 4).

(b) PROCEDURE. An unsatisfactory spark at some but not all of the spark plug wires indicates faulty insulation or series resistance (air gap) in the high tension circuit.

(1) CHECK SPARK PLUG WIRES. Replace spark plug

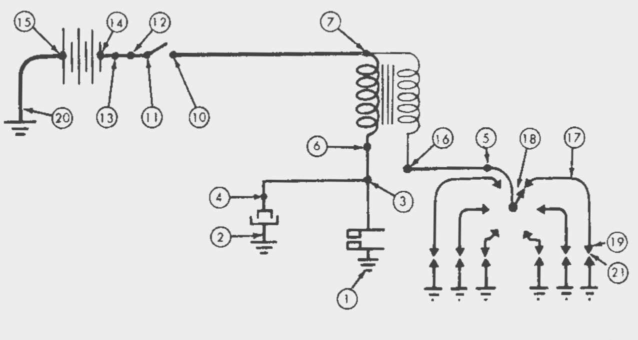


Fig. 3—6-Cylinder Ignition

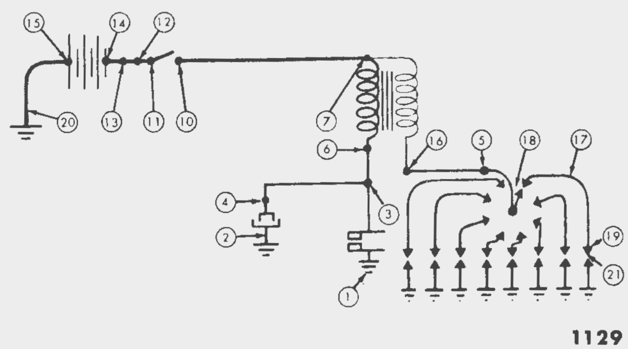


Fig. 4—8-Cylinder Ignition

wires if the insulation is damaged. Make sure all spark plug wires are soldered to their terminals. Make sure the spark plug wire terminals and the terminal sockets are free from corrosion and the wires are firmly seated in the distributor cap. If the above procedure has not corrected the trouble proceed as follows:

(2) INSPECT DISTRIBUTOR CAP. Remove the distributor cap and clean the cap with lacquer thinner. Replace the distributor cap if it is burned or has carbon tracks. Make sure spark plug wires seat firmly in sockets.

(3) *INTERMITTENT SPARK AT ALL SPARK* PLUGS. The trouble is in primary circuit or coil to distributor lead.

(a) PRELIMINARY INSTRUCTIONS. Test the spark from the end of each spark plug wire at idle speed. A spark that fails to jump a 14 kilovolt spark setting continuously is considered an intermittent spark and the following procedure applies.

When the spark delivered at the end of the spark plug wire is satisfactory but intermittent, the primary ignition circuit is logically given first consideration in the diagnosis procedure. The fact that between "misses" the spark is satisfactory, precludes the possibility that the trouble is in the secondary circuit. The exception would be in relatively rare cases of intermittent break-down of the insulation in the coil, or when moisture, oil, or foreign matter is allowed to accumulate in sufficient quantity on the distributor cap or distributor rotor to conduct the high tension circuit intermittently to ground.

The numbers in the following text refer to the terminals in figs. 3 and 4.

(b) PROCEDURE. Tighten connections, replace or adjust the contact points, test coil, and test condenser.

(1) TIGHTEN CONNECTIONS. Tighten all connections in the primary circuit, including both terminals of the condenser ② and ④ and both ends of both battery cables ⑬, ⑭, ⑮, and ⑳.

Make sure the coil to distributor high tension wire terminal ⑯ is soldered to the wire and seated all the way into the high tension terminal of the coil.

If the trouble still exists, proceed as follows:

(2) ADJUST OR REPLACE DISTRIBUTOR POINTS. Replace or adjust the distributor points if required. Make sure the breaker arm is not binding on its bearing and the spring tension is correct. Reset the timing, and again test the quality of the spark. If the spark is still intermittent, proceed with "(3) Test Coil and Condenser".

(3) TEST COIL AND CONDENSER. Test the coil output. Test the condenser capacity, leakage, and series resistance. If the coil and condenser are both satisfactory, examine the distributor cap, housing, and rotor for moisture, oil, or foreign matter which might cause an intermittent leak of high tension current to ground. Remove oil and foreign matter with lacquer thinner and replace the parts having carbon runs imbedded in the surface.

(4) *WEAK SPARK AT ALL SPARK PLUG WIRES.* The trouble lies in the primary circuits. A weak spark at all plugs is caused by units that have an equal effect on all the wires.

(a) PRELIMINARY INSTRUCTIONS. With the engine idling test the quality of the spark from the end of each spark plug wire. The spark should jump a 14 Kilovolt gap (about $3/16$ inch). This test assures sufficient spark energy at the spark plug terminals when under 120 pounds compression. If the spark jumps this gap regularly without missing, it is satisfactory. If a satisfactory spark is obtained from some but not all spark plug wires refer to symptom "Satisfactory Spark from Some But Not All Spark Plug Wires".

The following procedure applies only where a weak spark is obtained from all of the spark plug wires.

The entire primary circuit including the distributor points has an equal effect at all spark plug wires. The condenser, coil, distributor rotor, and rotor gap have an equal effect at all spark plug wires. The high tension wire from the coil to the distributor also influences the output of all plug wires. These units control spark intensity.

It is possible for all spark plug wires or all terminals to leak, however, this is considered unlikely. For this reason, the following procedure considers the more probable causes first, in the order of their accessibility.

(b) PROCEDURE. Since the ignition secondary output is dependent on the primary voltage the condition or state of charge of the battery is an important consideration. If the battery will not crank the engine, recharge or replace the battery.

(1) REMOVE ANY EXCESSIVE RESISTANCE IN THE PRIMARY CIRCUIT. The ignition primary circuit is tested in two steps as follows:

(a) Test Distributor Point Dwell. Measure the distributor point dwell.

If the dwell is within 58-63 percent limits proceed with "*(b)* Test Battery To Coil Resistance."

NOTE: ***When the points are new, be sure to also check the gap setting with a feeler gauge (0.014-0.016 8-Cylinder; 0.024-0.026 6-Cylinder).***

If the dwell is not within these limits, replace points that are visibly burned or pitted and adjust points to obtain the correct gap setting.

(b) Test Battery To Coil Resistance.

NOTE: ***Since the output of the ignition secondary circuit is limited by the strength of the primary circuit, extra resistance in the primary circuit reduces output.***

Disconnect the battery wire from the coil ⑦ and install an ammeter in series at this point. Connect a voltmeter from the battery negative terminal to ground. Turn the ignition switch on. If ammeter reading is zero, crank the engine to close the distributor points.

Divide the voltage reading by the amperage reading to determine total resistance of the primary circuit.

EXAMPLE: ***6.2 Volts divided by 5.2 amperes, equals 1.19 ohms.***

Total resistance of the ignition primary circuit is normally 1.2 ohms cold or 1.4 ohms when hot.

If the resistance of the primary circuit is higher than normal, leave the ammeter connected in series and connect the voltmeter in parallel in turn to each of the units in the circuit. Replace units having high resistance.

Normal resistance of the individual units is:

Unit	Hot	Cold
Ignition switch	0.02 ohms	0.02 ohms
Ignition coil (primary)	1.31 ohms	1.15 ohms

If the trouble still exists, proceed as follows:

(2) TEST CONDENSER COIL, AND DISTRIBUTOR POINTS. Test coil, condenser, and distributor points in the following sequence.

(a) Test Coil and Condenser. Remove the high tension wire from the coil and install a 12-inch long jumper wire in its place. Turn the ignition switch on. Hold the end of the jumper wire 3/16 inch from the cylinder head while the engine is being cranked.

If the spark jumps this gap regularly, both the coil and condenser are satisfactory. Proceed with "*(b)* Remove Resistance In High Tension Circuit."

If the spark fails to jump a 3/16-inch gap, replace the condenser with one known to be good. If the spark is now satisfactory, the trouble has been corrected. If the spark still fails to jump this gap, remove and test the ignition coil output on the distributor stroboscope. If this test reveals the coil to be unsatisfactory, replace the coil. If this test reveals the coil to be satisfactory, proceed with "*(c)* Adjust or Replace Distributor Points."

(b) Remove Resistance In High Tension Circuit. Clean the distributor cap and rotor with lacquer thinner. Replace these parts if any carbon tracks are visible or if the electrodes have eroded to the extent that the rotor gap has been increased.

Replace the rotor if there is any indication that it shorts through to the distributor shaft under load.

Make sure all high tension wire terminals are soldered to the wires and that their terminal sockets are free from corrosion.

(c) Adjust or Replace Distributor Points. Replace the distributor points if they are burned or misaligned. Establish the correct dwell on the distributor stroboscope. Reset the distributor timing.

d. Cooling System.

The cooling system is thermostatically controlled to regulate engine operating temperature and provide for a short engine warm-up period. This system fails to cool the engine sufficiently when the supply of coolant is low, circulation is stopped due to blocked passages, deposits of lime and rust prevent heat transfer through the water jacket walls, thermostats stuck in the closed position, or the water pump drive belt slips.

(1) *ENGINE OVERHEATS.* The engine will overheat when there is insufficient transfer of heat to the coolant and the air passing over the engine.

(a) PRELIMINARY INSTRUCTIONS. The various factors that control the cooling of the engine are designed to provide a liberal margin of safety. In most cases correction or adjustment of these controls will re-establish adequate cooling.

(1) PROPER DRIVING. Mountain driving requires operation through whatever transmission gear ratio is required to keep the engine from lugging. By using the higher ratios, the engine speed and consequently the fan speed and water circulation are increased, thus providing adequate cooling.

(2) ANTI-FREEZE To prevent loss of coolant due to evaporation a permanent type anti-freeze may be used. This raises the boiling point of the coolant and eliminates overheating attributable to loss of coolant.

(b) PROCEDURE. Check for leakage and operation of parts as outlined below:

(1) CORRECT EXTERNAL LEAKAGE. Fill the cooling system and idle the engine. Inspect all hose and hose connections for leakage. Tighten connections or replace hose as required. Inspect the radiator cap for tightness and note the condition of the gasket. If leakage is observed at the cylinder head gaskets, replace the gaskets (including remove carbon). Inspect the radiator for leakage, and repair or replace if required. Rust spots or wet spots on the radiator core are an indication of radiator leakage even though there is no dripping.

(2) ADJUST THE FAN AND WATER PUMP BELTS. Adjust or replace the fan and water pump belts if required.

(3) CHECK EXHAUST SYSTEM. Inspect the exhaust pipes, muffler, and tail pipe for evidence of dents, kinks, collapse, or restrictions of any kind. Make any necessary corrections. Move the counterweight on the exhaust thermostat valve through the entire range of action. If the counterweight arm sticks in any position, or if the counterweight is loose on the shaft, the passage of exhaust gases may be restricted. Remove the exhaust thermostat valve assembly and free up the action or replace the unit.

(4) CLEAN RADIATOR CORE. If the air flow through the radiator is restricted (insects, leaves, grease, dirt, etc.), clean the fins and air passages.

(5) TIME IGNITION. Time the ignition and check spark advance.

(6) CHECK RADIATOR HOSE. Inspect the radiator hose and replace any hose that has become soft or collapsed.

(7) CHECK THERMOSTATS. Remove each thermostat and place in hot water. Thermostats should operate according to the temperatures given in specifications. High temperature thermostats used in connection with hot water heaters open at slightly higher temperature. Replace any faulty thermostats.

(8) FLUSH COOLING SYSTEM. Use Ford Cooling System Cleaner to flush out rust and dirt from the cooling system.

(9) CHECK FOR INTERNAL LEAKAGE. Drain the oil from the engine oil pan and check for water in the oil. If you find an abnormal amount of water in the oil, remove the spark plugs and see if water is present at the plug holes. With the engine cold, fill the radiator to the top. Remove the fan belt so that the water pumps will not operate. Run the engine at fast idle for 60 seconds. If water runs out of the radiator filler pipe or overflow, or if bubbles come to the surface of the water in the radiator, leakage exists between one or more of the cylinders and the cooling system. If leakage is evident from any of these inspections, check the cylinder head nuts or bolts, using a torque wrench. If the nuts or bolts do not show signs of looseness, remove the cylinder head and inspect for faulty gaskets or heads. Examine the cylinder block in the vicinity of the valve ports for cracks. Replace the cylinder head gaskets or make necessary corrections in case of a cracked block. When installing heads, tighten bolts to 65-70 foot-pounds.

(c) ADDITIONAL POSSIBLE CAUSES. Deposits on water jacket walls cause overheating by preventing the transfer of combustion chamber heat to the coolant.

(1) LIME DEPOSITS. If the engine continues to overheat, remove the cylinder heads and inspect the water openings in the cylinder heads and cylinder block for excessive lime deposits. If excessive lime deposits are present, the cylinder block and heads must be replaced as flushing will not remove lime deposits.

NOTE: ***Excessive deposits of lime are the result of using hard water having a high mineral content in the cooling system. Use soft water.***

(2) *ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE.* This symptom is caused by incorrect temperature gauge readings or thermostats leaking.

(a) PRELIMINARY INSTRUCTIONS. With the ignition OFF, the temperature gauge should read HOT. Turn the ignition ON. If the gauge now reads COLD, proceed with (b). If the gauge still reads HOT, the temperature gauge circuit is open.

(b) PROCEDURE. Start the engine and allow it to idle. Cover the front of the radiator core until the engine temperature is at least normal. If the gauge still reads COLD, the sending unit is at fault.

(1) GAUGE NOT AT FAULT. If the gauge is not at fault, remove and test the thermostats.

(2) THERMOSTATS NOT AT FAULT. If the thermostats are in good condition but the engine still fails to reach operating temperature or fails to heat in reasonable time, the exhaust thermostat valve may be faulty. Remove and inspect valve. Replace it if not in good condition.

2. SUSPENSION, STEERING GEAR, AND TIRE WEAR

Steering control and tire wear complaints are described as one or several of the following symptoms. The factors accounting for these troubles are listed in Table 1, and the order of their likelihood is indicated under the symptom by numbers appearing opposite separate factors.

a. Tire Wear.

The type of tire wear (whether normal or abnormal) often indicates the cause. All tire wear falls into two broad classifications: around the tire (fore and aft wear) or across the tire wear.

The bottom (contact area) of the tire is or should be stationary with respect to the ground at the time of contact, regardless of the speed of the vehicle.

Any resistance to rolling or any tendency to spin will cause movement of the tire on the surface of the road and consequent wear.

If a particular spot on the tire leaves the road at a different point than where it contacts the road crosswear will result. This is caused by toe-in, toe-out or excessive distortion due to high camber.

The rolling radius of the tire is always less than the actual radius, and fore and aft, or around the tire wear, results. Camber (in effect making a cone of the wheel) causes the tire to have several different rolling radii. Under-inflation or overloading reduces the rolling radius.

b. Wander.

Wander is a term used to designate a tendency of the vehicle to slightly turn to one side or the other when the driver is trying to drive straight ahead.

EXAMPLE: ***Assuming the road is smooth and straight, after a short distance the car veers toward the right side of the road without the driver having turned the steering wheel. The driver then turns the steering wheel to straighten the course but in so doing he oversteers. The car now veers to the left, and so on, with the result that the driver is continually working to keep the car traveling straight ahead.***

c. Pull to One Side.

Pull to one side is a tendency for the vehicle to turn toward one side when the driver is trying to drive straight ahead. As a result the driver keeps a constant pull on the steering wheel to drive straight.

Table 1—Causes of Trouble and Order of Probability

Factors	Symptoms													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Tire wear	Wander	Pull to one side	Wheel tramp	Cupped tires	Road sway	Jerky steering	Shimmy	Loose steering	Hard steering	Hard turning when stationary	Erratic steering when braking	Tire squeal on turns	Looseness and noise
1 Tire pressure	1	2	1	11	1	1		1		1	1		1	
2 Tight spindle bearings		1				2				2				
3 Loose spindle bearings	6				4		9	2	1					5
4 Loose connecting rod ends	14	11		6	3			4	3					3
5 Loose drag link ends	15	10		5	2			3	2					4
6 Loose spring clips (U bolts)		14		8	5	7		6	5			6		
7 Broken spring tie bolts	13	12	6	9	6	8		7	6			5		8
8 Tire overload	5	18			8	4				6	7			
9 Broken spring	11	13	5	10	7	9		8	7			4		9
10 Loose steering gear mountings		15		7		6		5	4					2
11 Wheel balance	8			1	9		4							
12 Steering gear bind						5				3	2			
13 Caster low		4		4			10							
14 Bent spindle		16	14				8			7			4	
15 Camber plus side inclination unequal			9		13								3	
16 Toe-in too great	2	9											2	
17 Radial run-out				2	10		5							
18 Lateral run-out				3	11		6							
19 Unequal brake adjustment	10		3									1		
20 Bent spindle arm		17	13										5	
21 Camber low		3								5				
22 Caster high										4	3			
23 Caster uneven		5	8											
24 Camber plus side inclination high		6									4			
25 Camber plus side inclination low		7									5			
26 Steering gear off center			10				1							1
27 Spring sag	12					10								
28 Loose or worn shock absorber				12		3								6
29 Cupped tires				13			3							
30 Over-size tires								9			6			
31 Unequal tire diameter	7		2											
32 Bent rear axle housing	16		11											
33 Bent frame	20		12											
34 Dragging brakes	3		15											
35 Camber high	4													
36 Camber uneven			7											
37 Tight wheel bearings			4											
38 Loose wheel bearings												3		7
39 Toe-in too little		8												
40 Incorrect drag link adjustment							2							
41 Not tracking	9													
42 Rear axle toe-in	17													
43 Rear axle toe-out	18													
44 Rear axle camber	19													
45 Out-of-round brake drum					12							2		
46 Bent pitman arm							7							

d. Wheel Tramp.

Wheel tramp is a violent vertical motion of the wheels that develops at high speed. Wheel tramp is disagreeable and dangerous and is a destructive force that places undue strain on the entire vehicle.

e. Cupped Tires.

If the rolling radius of the tire is below normal due to overloading or under-inflation or if the tire grooves are inadequate, cupping will result. Camber causes the tire to have several different rolling radii and cupping will result. Continued operation of a vehicle that has front wheel tramp or shimmy will result in cupped tires.

f. Road Sway or Body Roll.

Road sway or body roll is a term used to designate a tendency of the vehicle to rock while driving in a cross wind. Body roll has a tendency to cause the driver to lean and at the same time turn the steering wheel. As a result, this causes the vehicle to weave or sway from side to side.

g. Jerky Steering.

The most common cause of jerky steering or road shock is failure to have the steering gear in mid-position. A bruised tire causing a blister, or a boot in the tire, could cause jerky steering.

h. Shimmy.

Shimmy is a term used to designate a tendency of the front wheels to oscillate about the spindle bolts. This movement of the front wheels may or may not be transmitted through the steering wheel. Low-speed shimmy usually starts while crossing railroad tracks or driving over a rough surface.

i. Loose Steering.

Loose steering is a looseness in the wheel and spindle assembly, steering connections or steering gear, including looseness where the steering gear housing is secured to the frame.

j. Hard Steering.

Hard steering can usually be attributed to tightness of the steering gear mesh adjustment or spindle bolt bearings. Incorrect front wheel alignment or under-inflated tires could likewise cause hard steering.

k. Hard Turning When Stationary.

Hard turning when stationary is caused by under-inflated tires, tight steering gear or spindle bolt bearings. High or low camber plus king pin side inclination could, likewise, cause hard steering when stationary.

l. Erratic Steering When Braking.

Erratic steering when the brakes are applied usually can be attributed to oil soaked brake lining, out-of-round drums, or under-inflation of the tires. These conditions cause the vehicle to have a tendency to turn when the brakes are applied.

m. Tire Squeal on Turns.

A certain amount of slippage results between the tire and the road surface when a vehicle is turned at high speed and an occasional squeal will be heard from a vehicle in perfect alignment. The tendency to squeal is increased with under-inflation. Incorrect spindle arm angle (toe-out on turns) could increase the slippage (spindle arm angle is not critical).

n. Looseness and Noise.

A number of factors must be considered when attempting to eliminate looseness or noise in the front suspension. The condition may be caused by just one of these factors or by a combination of several. Therefore, it is necessary to take all of the factors into consideration to avoid overlooking a possible cause of the complaint.

3. BRAKES

Brake trouble shooting consists of three major divisions due to the three braking systems used on Ford trucks. They are the standard hydraulic system, the hydraulic system incorporating a vacuum operated brake booster and the air brake system. On vehicles equipped with brake boosters, test the system to discover if the trouble is in the booster or the hydraulic system. Then follow the symptom given below which applies.

a. Brakes Lock During Vehicle Operation.

On hydraulic systems, locked brakes may be due to a restricted by-pass port in the master cylinder, improperly adjusted linkage, swollen piston cups, or dirt in the brake fluid.

NOTE: *If the brakes are locked preventing movement of the vehicle, open the bleeder screw momentarily. A few drops of fluid will come out, relieving*

the pressure, thus freeing the brakes. This is merely a temporary expedient and does not correct the cause of the trouble.

Adjust the brake pedal if required. If adjustment of the brake pedal free travel is not required, or if it does not correct the trouble, replace the master cylinder piston and cup assembly.

On vehicles equipped with a brake booster, the atmospheric valve may be held open due to dirt drawn in through the air cleaner. Overhaul the booster and clean the air cleaner to correct the failure.

On vehicles equipped with air brakes, check the operation of the system, and repair or replace units as required.

b. Brakes Do Not Apply.

A normal pedal travels just far enough to develop the hydraulic pressure required to apply the brakes. If air has entered the hydraulic system, the brake pedal will have a "spongy" feel when depressed and may travel all the way to the floor board without developing sufficient hydraulic pressure to stop the vehicle.

Air will enter the hydraulic system if the fluid in the master cylinder is too low, excessive clearance exists between the brake linings and the drums, or if the pistons of the wheel cylinders are not held firmly in place when the tension of the brake shoe retracting springs is removed while servicing the brakes.

Bleed the hydraulic system to eliminate air that has entered the system.

On vehicles equipped with air brake systems, if no pressure is indicated, proceed with subparagraph (1) below. If air pressure is indicated, proceed with subparagraph (2) below.

(1) *NO AIR PRESSURE INDICATED.* If no air pressure is indicated in the system, make sure the compressor drive belt is not broken or slipping. Replace or adjust the drive belt as necessary.

If the drive belt is satisfactory, check the air compressor unloader valve clearance. The unloader valve should have 0.010 to 0.015 inch clearance between the valve stem and rocker arm. Adjust the unloader valves if necessary. If the unloader valves have the correct clearance, and there is still no air, replace the air compressor.

(2) *AIR PRESSURE INDICATED.* If there is air pressure in the system, depress the brake pedal and listen for air leaks in the brake control valve, air lines, and brake chambers. Repair or replace the defective parts as necessary. If there are no air leaks, install a master air pressure gauge in the air line connecting the control valve to the brake chambers. Again depress the brake pedal and observe the master gauge. If there is no air indicated on the gauge, inspect the air lines for kinks. If the air lines are not kinked, replace or repair the brake control valve.

c. Low Pedal Reserve.

During normal operation a little of the brake lining wears away each time the brakes are applied. This wear is compensated for by means of a minor brake adjustment.

d. Uneven, Noisy, Grabbing, or Hard Brakes.

Uneven, noisy or severe brake action or an excessively hard brake can be caused by a combination of conditions, all of which require the removal of the drums before the cause of the trouble can be located. When these troubles exist, nothing is to be gained by attempting to name the cause before the drums are removed and an inspection is possible. A major brake adjustment with the recommended repairs or replacements will correct any of these troubles.

On vehicles equipped with brake boosters, the booster may be inoperative. Tighten all connections and clean the booster air cleaner.

e. Air Brakes Slow on Application and Release.

Check the air pressure to eliminate the possibility of insufficient air pressure in the system due to leaks. Lubricate the brake linkage to make sure it is not binding. Check the brake valve, air lines, and tubes for any restriction.

4. ELECTRICAL AND INSTRUMENTS

Trouble shooting or diagnosis is required before actual repairs are made in the electrical system. Even where an obvious fault makes the replacement of a unit necessary, you must still find out why the unit failed. The trouble shooting procedures given here will aid you in making a correct diagnosis. When a trouble is diagnosed correctly, unnecessary repairs are prevented, the time the vehicle is out of service will be decreased, and the repairs that are made will be permanent.

Some of the tests used in the trouble shooting procedures have been described previously in the manual. Other tests which apply to trouble shooting alone, will be presented in the procedures.

a. Generating System.

Three "symptoms" or end results of all the various causes or troubles are possible in the generating system. These symptoms may not be described correctly to you by the owner of the vehicle so you must first determine the correct symptom by testing or by analyzing the indications given to you by the owner. Once you have confirmed the symptom you can immediately begin to isolate the cause by following the road map that illustrates the procedure in outline form.

Table 2 lists the three symptoms and the various causes of trouble. The order of the numbers in each symptom column indicates either the most probable cause of the symptom or the cause which is easiest to eliminate by testing.

The Trouble Shooting Table gives more detailed information on the various causes of the symptom than the road map (Fig. 5.). The road map of the particular symptom groups several of these details into a single test, however, the results of the test indicate which particular trouble is the one causing the symptom. The letters and numbers in the body of the road map refer to headings in the Trouble Shooting write-up.

The symptoms used as headings for the procedures and have been arranged in the following order: "(1) Battery Low In Charge", "(2) Generator Output Low", and "(3) High Charging Rate".

(1) *BATTERY LOW IN CHARGE.* Indications pointing to this symptom are: Slow cranking, hard starting, and headlights dim at idle engine speed. Causes of this symptom are: The generator belt can be worn or loose and slipping over the generator pulley. The battery may be in such a poor condition that it will not hold or take a charge. The generator may not be producing its rated output. Regulator units may be out of adjustment or in need of repair. Excessive resistance may exist in the generator-to-battery circuit or in the battery-to-ground circuit.

Before starting the following procedure, to confirm the symptom, check state of charge of the battery. Likewise, check the generator belt adjustment and condition; if the belt is missing or too loose, this might be all that is needed.

(a) RECHARGE OR REPLACE BATTERY. Recharge the battery and make a high rate discharge test. Replace the battery if the high rate discharge test indicates it is worn out or under capacity. If the battery is worn out it may have been the cause of the "Battery Low" symptom. If battery tests OK, proceed as follows:

(b) CHECK GENERATOR OUTPUT. Test the generator output to determine if the generator is at fault. If the output reaches or is greater than the rating of the generator for the generator under test, proceed with *(2)* below. If the output is less than rated amperes, follow the procedure outlined in *(1)* below.

(1) OUTPUT LESS THAN RATED. If the current output of the generator does not reach the rated output, connect a heavy jumper wire from the battery ground post to the generator ground terminal. Repeat the generator output test. If the output now reaches or exceeds rated output, follow the procedure in *(a)* below. If the output is still less than rated, the generator is at fault. Refer to "(2) Generator Output Low".

(a) Output Now OK. If the output now reaches or exceeds rated output, the generator or the battery are not properly grounded to the engine frame. Remove the generator from its mounting bracket and scrape or sand the paint or dirt from the inner surface of the bracket strap and the corresponding surface of the generator frame. Remove the mounting bracket from the engine and scrape or sand the paint and dirt from the bracket-

Table 2—Generating System Causes of Trouble

Causes	Symptoms (1) Battery Low in Charge	(2) Generator Out-Put Low	(3) High Charging Rate
Excessive Resistance in Battery to Ground Circuit	20	1	
Dirty Commutator	3	2	
Open Circuit Field	4	3	
Short Circuit Field	5	4	
Open Circuit Armature	6	5	
Short Circuit Armature	7	6	
Shorted Brush Holder	8	9	
Worn Generator Brushes	9	7	
Brushes Stuck in Holder	10	8	
Regulator Contacts Stuck	12		1
Loose or Worn Generator Belt	1		
Battery Worn Out	2		
Burned or Corroded Regulator Contacts	11		
Cut-in Voltage High	13		
Cut-in Voltage Low	14		
Voltage Regulation High			2
Voltage Regulation Low	15		
Current Limit Low	16		
Regulator Not Grounded	17		
Burned or Corroded Cut-out Contacts	18		
Excessive Resistance in Armature-to-Battery Circuit	19		

to-engine mating surfaces. Replace the bracket and generator and adjust the generator belt. Replace the battery-to-ground cable if it is corroded or partially broken. Clean the cable connections at the battery and engine and tighten connections.

(2) OUTPUT NORMAL. If generator output is normal, test the regulator to determine if it is properly adjusted or in need of repair. If the regulator is not OK, follow procedure in *(a)* below. If the regulator checks OK, follow procedure in *(b)* below.

(a) Regulator Not OK. If any of the regulator units are improperly adjusted or in need of repair, repair and/or adjust the faulty unit.

(b) Check External Circuit Resistance. Check the external circuits to determine if it has excessive resistance. If the resistance is excessive, follow procedure in *(2)* below. If resistance is normal, proceed as follows:

(1) If the resistance (voltage drop) is equal to or less than specified in the test, the battery is low in charge due to improper operation by the owner. Excessive night driving or use of accessories, insufficient operation of vehicle, accidental discharge of battery (lights, ignition, radio, etc., left on overnight), improper starting procedure (flooding engine, not using choke properly, etc.), or too heavy a grade of engine oil for the local climate could take more current from the battery than the generator can replace. Instruct the owner in proper operation of his vehicle.

(2) If the resistance (voltage drop) is greater than that specified in the test, locate the exact part of the circuit with the excessive resistance and follow *(a)*, *(b)*, *(c)*, or *(d)* below:

(a) If the resistance is in the generator to regulator circuit, clean and tighten cable connections. Recheck the voltage drop. If it is still excessive, replace the cable.

(b) If the resistance is in the regulator cut-out contact, disconnect the "BAT" wire from the regulator terminal. Remove the cover from the regulator. Remove oil and dirt from the cut-out contact surfaces by pulling a clean piece of bond paper or other lint-free substance between the contact surfaces while holding contacts closed on the paper. Examine soldered connections to see that they are in good condition. Recheck the voltage drop. If it is still excessive replace the regulator.

(c) If the resistance is in the regulator to battery circuit, clean and tighten cable connections (regulator "BAT" terminal, battery terminal of starting relay, battery-to-starting-relay-cable connection on battery post). Examine all cables to see that they are in good condition. If the voltage drop is still excessive on recheck, check the connections at the circuit breaker to see that they are clean and tight. Replace cables where necessary.

NOTE: ***Most of the trouble causing excessive resistance in the external circuit will be found in this portion of the circuit.***

(d) If the resistance is in the battery to ground circuit, clean and tighten cable connections. Recheck voltage drop. If it is still excessive, replace the cable.

(2) *GENERATOR OUTPUT LOW.* This symptom usually is uncovered by the "generator output test" under "(1) Battery Low In Charge" above. Generator output could be low due to a dirty commutator, open or short circuit in the field, armature, brushes, or brush holders, or the brushes can be worn too short or sticking in brush holder and not making good contact on the commutator.

Figure 6 illustrates the "Generator Output Low" Road Map which outlines the procedure by means of the various tasks and conclusions drawn from the tests.

(a) SQUIRT SOLVENT ON COMMUTATOR. Squirt Carbon Tetrachloride on the commutator through the gen-

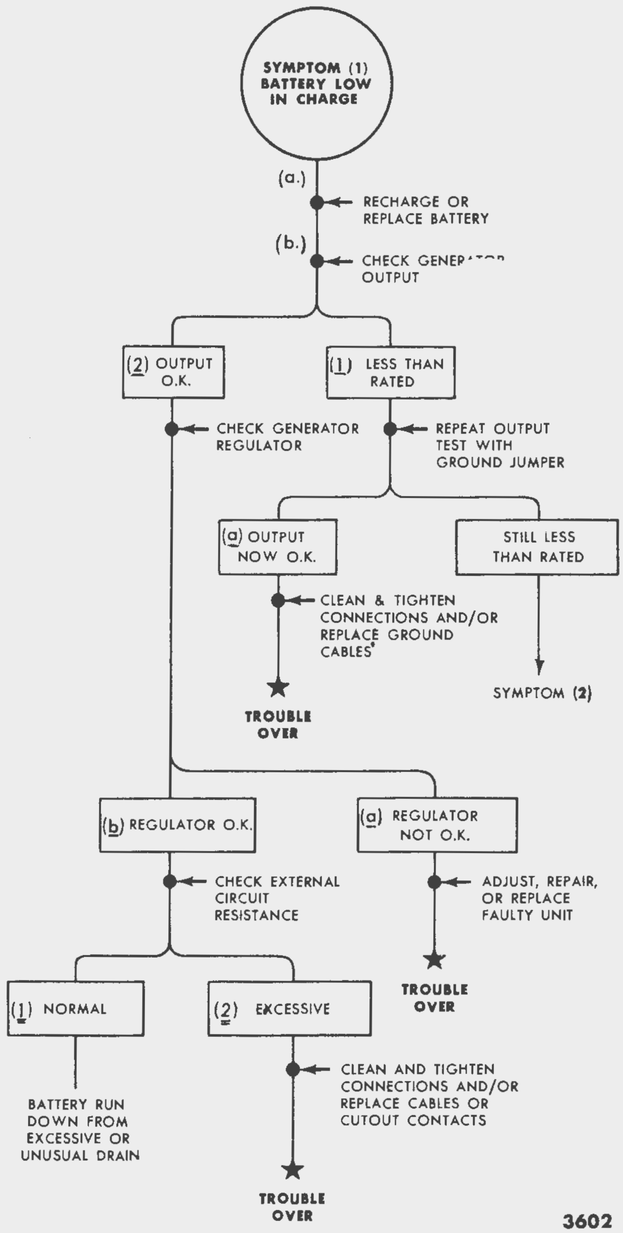


Fig. 5—Battery Low In Charge—Road Map

erator frame ventilating slots to determine if the commutator is oily or dirty. If dirt or oil is present, the Carbon Tetrachloride will momentarily dissolve the dirt or oil on the commutator and permit the brushes to make better electrical contact. Test the generator output. If the output is now normal, proceed with *(1)*. If the output is still less than rated, proceed with *(2)*.

(1) OUTPUT NOW NORMAL. If the output now reaches rated amperes, the commutator is oily or dirty. Remove the generator from the car and disassemble it. Clean the commutator surface with fine sandpaper (not emery cloth or emery paper) and scrape out the slots between the commutator segments to remove dirt and carbon particles. If necessary, turn down the commutator in a lathe and undercut the mica. Reassemble the generator and install it. Adjust generator belt tension.

(2) OUTPUT STILL LESS THAN NORMAL. If the output is still less than normal, perform the electrical tests of the generator on the vehicle, as illustrated in fig. 7, to determine the exact part of the generator causing trouble. If the field checks short or open, follow *(a)*. If the armature checks short or open follow *(b)*. If the brushes are high resistant or shorted, follow *(c)*.

(a) Field Open or Shorted. If the test shows the field has an open or short circuit, remove the generator, disassemble it, and repair the condition, if possible. If no repairs can be made, replace the field coils and reassemble the generator. Mount the generator on the engine and adjust the generator belt tension.

(b) Armature Open or Shorted. If the armature test shows the armature circuit to have an open or short, remove the generator, disassemble it and repair the condition, if possible. If the repair can not be made replace the armature and reassemble the generator. Mount the generator and adjust the generator belt tension.

(c) Brushes High Resistant or Shorted. If the brush test shows the brushes to be open or shorted, remove the generator, disassemble it, and repair the condition, if possible. If the brushes are stuck in the holder, replace the end plate and brushes. Replace the brushes if they are worn to less than one-half inch. If the negative brush holder is shorted to ground repair the insulation if possible. If not replace the end plate and reassemble the generator. Install generator and adjust belt tension.

(3) *HIGH CHARGING RATE.* Indications of this symptom are: Generator, lights, or radio tubes burn out prematurely, the battery requires too frequent refilling, and ignition contacts are burned. The most common cause of these troubles is high voltage, and the first step of trouble shooting is to correct possible high voltage regulation. In cases where the generator itself burns out, in addition to the high voltage a high setting of the current limiter could account for the failure.

In certain instances, the owner may believe the charging rate is high. However, he may be relying only on the position of the charge indicator needle. This instrument tells the direction of current flow (to the battery-"charge"; from the battery-"discharge") not the amount of current flow.

(a) CHECK VOLTAGE REGULATION. Check the voltage regulation. If the voltage regulation is high follow (b) below. If the regulation is OK, instruct the owner in regard to the purpose of the charge indicator.

(b) INSPECT AND ADJUST VOLTAGE REGULATOR. Remove the regulator cover and depress the voltage regulator armature to see if the contacts are stuck and will

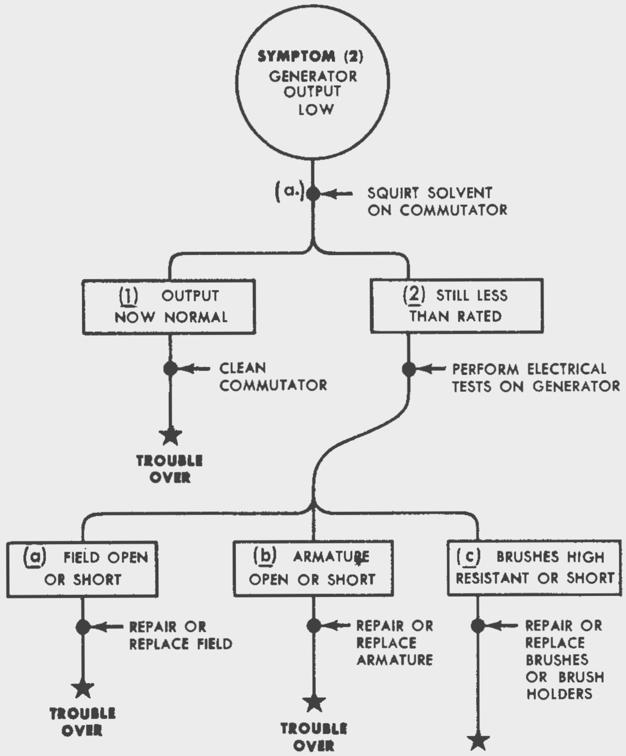


Fig. 6—Generator Output Low—Road Map

A- CONNECT AMMETER TO FIELD TERMINAL (CONNECTIONS MARKED ①)
B- DIVIDE CURRENT INTO 6.0 AND COMPARE WITH FIELD RESISTANCE SPECIFICATIONS. (LOW RESISTANCE INDICATES SHORTED COILS, HIGH RESISTANCE INDICATES POOR OR BROKEN CONNECTIONS)
C- CONNECT AMMETER TO ARM TERMINAL (CONNECTIONS MARKED ②)
D- CURRENT SHOULD BE 30-40 AMPERES (50-60 AMPERES FOR HEAVY DUTY GENERATOR)
E- IF CURRENT IS LOW, PRESS DOWN BRUSHES. IF CURRENT BECOMES NORMAL, BRUSHES ARE STICKING.
F- IF CURRENT IS HIGH, LIFT NEGATIVE BRUSH FROM COMMUTATOR. CURRENT SHOULD DROP TO ZERO. IF ANY CURRENT FLOWS WITH BRUSH LIFTED, BRUSH HOLDER IS SHORTED.

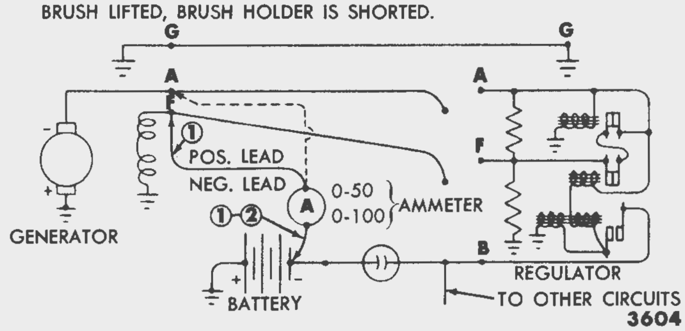


Fig. 7—Electrical Test of Generator—Diagram and Procedure

not open. Check the contacts and replace the regulator if the contacts are burned or oxidized.

If the points are not sticking and are in good condition, adjust the voltage regulation to the specified limits. Recheck the setting with the cover in place.

b. Starting System.

In many cases of starting system trouble, the owner has discharged his battery before calling for assistance. At the time the trouble occurs owner is more interested in getting his engine started quickly than in knowing the cause of the trouble. A road service procedure is presented to aid the service man in such cases of starting trouble. The road service is not a part of the diagnosis procedure. Diagnosis appears under the various symptoms of starting system troubles.

When answering a service call take a fully charged battery and two heavy cables four feet long (equipped with suitable connectors) or a portable Fast Charger.

If the stalled vehicle is near an electric outlet (110-volt AC) use the fast charger to give a "boost" charge to the battery. About 15 minutes of charging is sufficient to permit starting the vehicle.

If a 110-volt AC outlet is not available, use the booster battery for starting. Turn the ignition switch on and pull the choke control out. Connect the negative lead of the booster battery to the starting motor terminal of the starter relay. Connect the positive lead of the booster battery to the negative post of the battery in the car. As soon as this connection is made, the starter should crank the engine. If the starting motor spins but will not crank the engine, the starter drive requires repair or replacement.

If the engine cranks but will not start, the trouble is in the engine (fuel, ignition, engine parts) and not in the starting system. If the engine will not crank with the battery connected as above, engine parts may be seized or the starting motor may be faulty. If the engine cranks but cannot be started with the booster battery, attempt to start it by pushing the owner's vehicle with your service truck. If it still will not start, push or tow the vehicle to the shop for a complete diagnosis.

Table 3 lists the three symptoms and troubles that can cause the symptoms. The order of the numbers in each symptom column indicates either the most probable cause of the symptom or the cause which is easiest to eliminate by testing.

The trouble shooting table presents more detailed information on the various causes of the symptom than the road map (fig. 10 or 11). The road map groups several of these details into a single test; however, the results of the test will indicate the particular trouble causing the symptoms.

Be sure to follow these procedures carefully. Once the method and steps are fixed in your mind you will not have to re-read them on each job. Eventually, the road map type illustration will be all that you need.

The procedures are arranged so that the symptoms appear as headings as follows: "(1) Engine Will Not Crank When Starter Button Is Pressed", "(2) Starting Motor Spins But Will Not Crank Engine", and "(3) Engine Cranks Slowly".

(1) *ENGINE WILL NOT CRANK WHEN STARTER BUTTON IS PRESSED.* Several causes will individually result in the symptom "Engine Will Not Crank When Starter Button Is Pressed":

The battery may be discharged. The starter button and starter relay may be inoperative. The ciruuit may be open or high resistant. Water may have leaked into cylinder causing hydrostatic lock. The starter drive may be locked. The starting motor may be faulty or inoperative. Figure 10 illustrates the road map for the symptom.

(a) CHECK BATTERY. Test the state of charge of the battery. If the battery is discharged, follow *(1)*. If the battery is charged, follow *(2)*.

(1) BATTERY DISCHARGED. Recharge the battery and make a high rate discharge test. Replace the battery if the test indicates it is worn out or under capacity.

(2) BATTERY CHARGED. If the battery is charged, press the starter button to crank the engine. If the engine will not crank and the relay does not click, see *(a)*. If the relay clicks, see *(b)*. If the starting motor spins but

Table 3—Starting System—Causes of Trouble

Causes	Symptoms (1) Engine Will Not Crank	(2) Starting Motor Spins but Will Not Crank Engine	(3) Engine Cranks Slowly
Battery Low in Charge	1		2
Battery Worn Out	2		3
Excessive Circuit Resistance	5		4
Worn Starter Brushes	6		6
Dirty Starter Commutator	7		7
Open or Short Circuit Starter Windings	8		8
Excessive Engine Friction	11		9
Dirty Starter Drive		1	
Starter Drive Broken or Worn		2	
Improper Viscosity Engine Oil			1
Locked Starter Drive	10		
Starting Relay Control Switch Faulty	3		
Starter Relay Inoperative	4		
High Resistance in Relay Contacts			5
Hydrostatic Lock	9		

will not crank the engine, see "(2) Starting Motor Spins".

(a) Relay Does Not Click. Connect a ground jumper to the starter button terminal (fig. 8, connection marked ①). If the engine cranks, replace the starter button. If the engine does not crank, connect the ground jumper to the starter button terminal of the relay (fig. 8, connection marked ②). If the engine now cranks, replace the relay-to-starter-button wire. If the engine still does not crank, replace the starter relay.

(b) Relay Clicks. If the relay clicks when the starter button is pressed, connect a heavy jumper from the relay battery terminal to the relay starting motor terminal (fig. 8 or fig. 9, connection marked ③). If the engine starts, replace the relay. If the engine does not start, observe the spark when connecting and disconnecting the jumper. If there is a heavy spark see *(2)* below. If the spark is weak or if there is no spark at all, proceed as follows:

(1) If the spark at the relay is weak when the jumper is connected, inspect the battery-starter cables for corrosion and broken conductors. Check the ground cable to see if it is broken or badly corroded. Inspect all cable connections. Clean and tighten them if necessary. Replace any broken or frayed cables. If the engine still will not crank, the trouble is in the starting motor and it must be repaired or replaced.

(2) If a heavy spark is obtained when the jumper wire is connected, remove all the spark plugs and attempt to crank the engine with the starting motor.

If the engine cranks with the spark plugs removed, water has leaked into the cylinders causing hydrostatic lock. The cylinder heads must be removed and the cause of internal coolant leakage determined and repaired.

If the engine will not crank, rock the vehicle back and forth with the transmission in high gear or loosen the starter mounting bolts to free the starter pinion. If the starter drive is locked, remove starting motor from the engine and examine the starter-drive pinion for burred or worn teeth. Examine the teeth on the flywheel-ring gear for burrs and wear. Replace the pinion or the flywheel-ring gear if they are worn or damaged.

If the starter drive is not locked, remove the starting motor from the engine and perform the no-load current test. The motor should run freely. Compare the reading obtained from the ammeter with the no-load draw specification for the starting motor. If the current reading is below specifications, the starting motor is high resistant and should be repaired. If the current reading is above normal, the starting motor is running slower than it should at idle due to tight bearings, a bent shaft, or the armature rubbing the field poles. A shorted coil in the starting motor also causes the current reading to be high. Disassemble the starting motor and determine the cause. Repair if possible, or replace the starting motor.

If the no-load current reading of the starting motor is

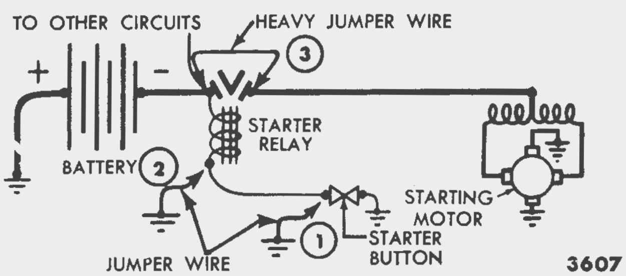


Fig. 8—Test Starting Circuit

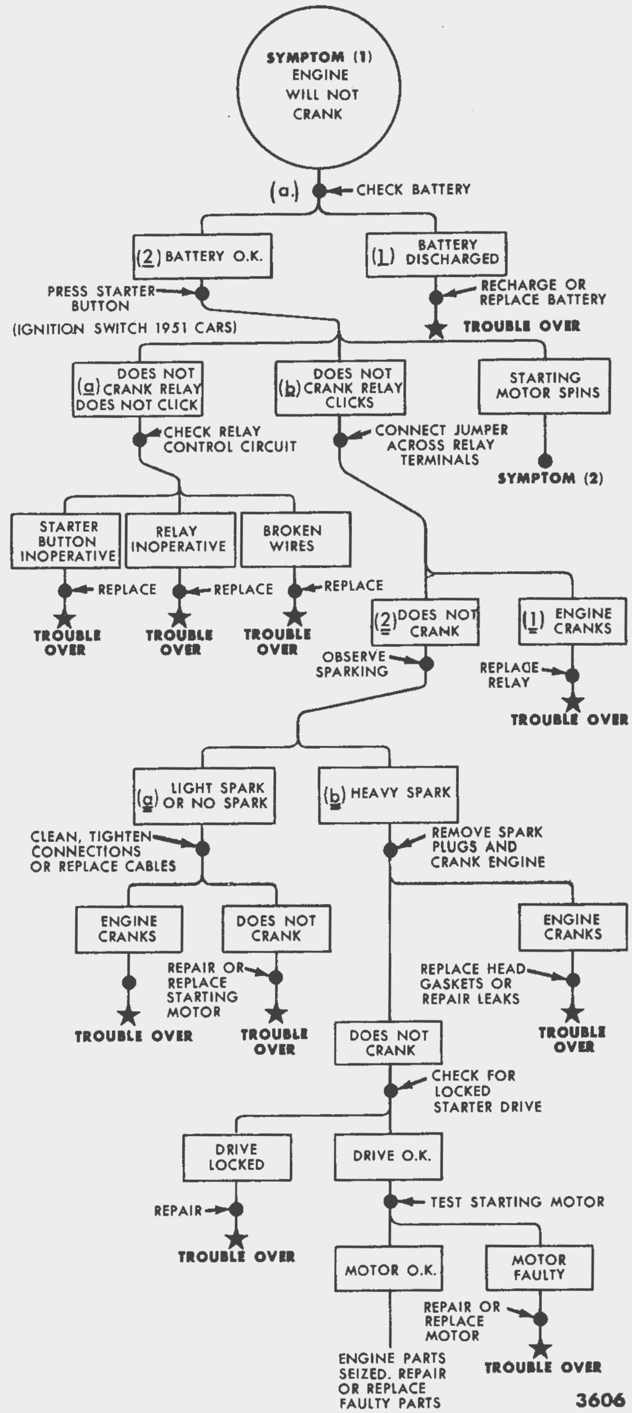


Fig. 10—Engine Will Not Crank—Road Map

normal, the engine is seized and cannot be turned by the starter. Disassemble the engine and repair or replace the defective parts.

(2) *STARTING MOTOR SPINS BUT DOES NOT CRANK ENGINE.* If the starting motor spins but will not crank the engine, the starter drive is dirty or worn and is sticking on the starting motor shaft.

Remove the starting motor from the engine and disassemble the starter drive. Clean the starter parts in kerosene and/or replace worn or damaged parts as required. Reassemble the starter drive and mount the starting motor on the engine.

CAUTION: ***Do not use oil to lubricate the starter drive. It should work freely when cleaned in kerosene.***

(3) *ENGINE CRANKS SLOWLY.* Several causes may result in the symptom "Engine Cranks Slowly:" The battery may be low in charge. There may be excessive resistance in the starting motor circuit. The starting motor may be faulty. The engine may have excessive friction.

Figure 11 shows the road map for this symptom.

(a) TEST BATTERY. Test the state of charge of the battery. If the battery is low in charge follow *(1)*. If the battery is charged follow *(2)*.

(1) BATTERY DISCHARGED. Recharge the battery and make a high rate discharge test. Replace the battery if the test indicates it to be worn out or under capacity.

(2) BATTERY CHARGED. If the battery is charged, test the external circuit voltage drop. If the voltage drop is excessive follow *(a)* "Resistance Excessive". If the voltage drop is normal follow *(b)* "Resistance Normal."

(a) Resistance Excessive. If the resistance (voltage drop) is greater than that specified in the test, locate the exact part of the circuit with excessive resistance and follow *(1)*, *(2)*, *(3)*, or *(4)* below.

(1) If the resistance is in the battery-to-starter-relay-cable, clean and tighten cable connections. Recheck the voltage drop. If it is still excessive, replace the cable.

(2) If the resistance of the starter relay contacts is excessive, replace the starter relay.

(3) If the resistance is in the starter-relay-to-starter-motor cable, clean and tighten cable connections. Recheck voltage drop. If excessive replace cable.

(4) If the resistance is in the battery-to-ground cable, clean and tighten cable connections. Recheck voltage drop. If it is still excessive replace the cable.

NOTE: ***Some vehicles have a bonding strip as part of the ground circuit which must not be overlooked.***

(b) Resistance Normal. If the resistance is normal, test the starting motor current draw while the motor is cranking the engine. If the current draw is normal or excessive, see *(2)* below. If starter current is low (normal 140-190 amperes), proceed as follows:

(1) Remove the starting motor from the engine and disassemble the motor. Determine the cause of the trouble and repair it if possible. If not, replace the faulty part, reassemble the starter, and mount it on the engine.

(2) Test the starting motor current draw at no-load. If the current draw is above or below specifications, remove the starting motor from the engine and disassemble the motor. Determine the cause of the trouble and repair it if possible. If not, replace the faulty part, reassemble the starter, and mount it on the engine.

If the current draw at no load is normal, the starter is OK. The engine has excessive friction and its cause must be determined. Repair or replace faulty parts.

c. Lights, Horns, and Instruments

As is true in diagnosing any trouble, what the owner states is wrong merely reflects his impression. For this reason the first step in trouble shooting is to establish the facts, making the necessary correction where the fault is found before proceeding with the next step.

A quick analysis of the entire electrical system to isolate individual circuits causing trouble is made by determining if current is available at various points in the main circuit. These tests are all made without leaving the driver's seat and no equipment is required. These tests are as follows: Press horn button (momentarily).

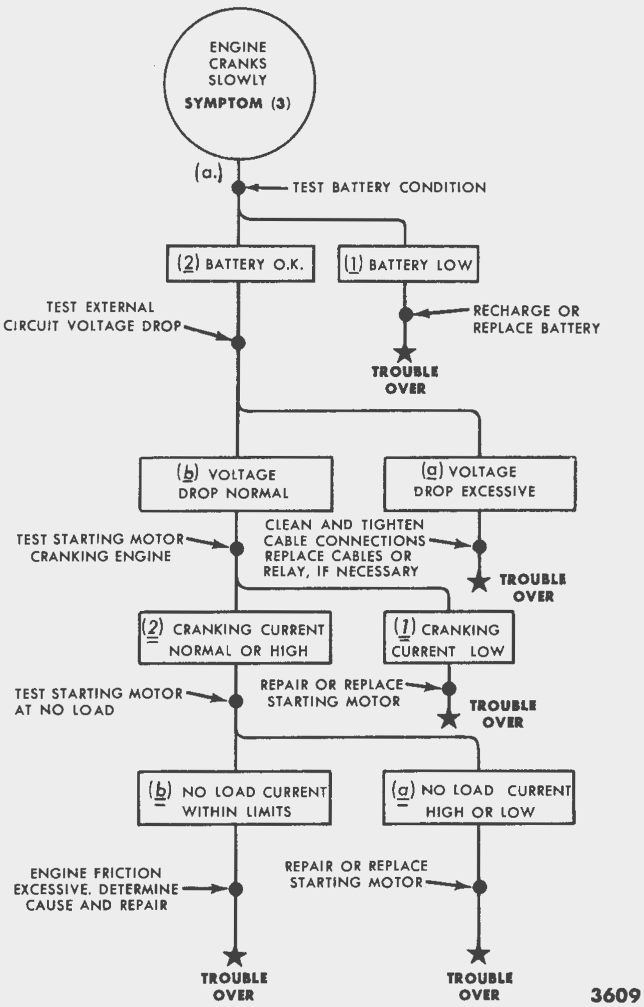


Fig. 11—Engine Cranks Slowly—Road Map

Press starter button (momentarily). Turn ignition switch on (15 seconds). Turn dome light on (momentarily).

NOTE: ***If vehicle is not equipped with dome light, turn on headlights.***

Based on observations during the above tests, the following diagnosis can be made:

Horn Sounds. If the horn sounds, the battery and the battery cables are OK.

Horn Does Not Sound. If the horn does not sound and if the starter engages, instruments register, and the lights light, the trouble is in the horn circuit, follow symptom "(4) Horn Does Not Sound" below.

Starter Engages. If the starter engages, battery, cables, and starter relay are OK.

Starter Does Not Engage. If the starter does not engage, but the horn does sound, follow procedure in heading "b. Starting System".

Instruments Register. If the instruments register, the battery, cables, and circuit to circuit breaker are OK.

No Instruments Register. If none of the instruments register and the lights do not light, the trouble is in the wire running from the starter relay to the circuit breaker. If none of the instruments register but the lights light, the trouble is in the ignition switch or main feed wire to the instruments.

Some But Not All of the Instruments Register. If some but not all of the instruments register, follow the procedure under *(6)* through *(9)* below.

Lights Light. If dome (or head) lights light, the battery, cables, circuit-to-overload circuit breaker and the circuit breaker are OK.

Lights Do Not Light. If the lights do not light, the battery cable is loose, the main feed wire is disconnected at the switch or headlight loom, or the wire is broken.

(1) *HEADLIGHTS FLICKER FROM BRIGHT TO DIM.* If all lights flicker from bright to very dim, the overload circuit breaker is operating as a result of a grounded or shorted wire in that particular circuit. Set the headlight switch to headlight position. Observe the reaction as you switch from high to low beam with the beam control switch. Follow (a), (b), or (c) below, whichever applies. If the lights flicker when on low beam, the short is in that circuit, likewise, the short is in the high beam circuit if the high beam lights are on.

(a) UPPER BEAM ONLY FLICKERS. If the lights flicker only when the beam control switch is in the upper beam position, the "short" is in the upper beam circuit from the beam control switch to the headlights.

(b) LOWER BEAM ONLY FLICKERS. If the lights flicker only when the beam control switch is in the lower beam position, the "short" is in the lower beam circuit from the beam control switch to the headlights.

(c) BOTH BEAMS FLICKER. If the lights flicker in both high or low beam, set the headlight switch to the parking light position. Follow *(1)* or *(2)* below.

(1) LIGHTS STILL FLICKER. If the lights still flicker, a short exists in the taillight circuit.

(2) LIGHTS NO LONGER FLICKER. If the lights no longer flicker, a short exists between the headlight switch and the beam control switch.

(2) *INDIVIDUAL LIGHTS DO NOT LIGHT.* When one or several lights do not light and other lights do, the fault usually is in the bulb itself. However, some light bulbs are easily replaced while others present more difficulty. The ease with which the particular bulb can be replaced determines the order of procedure.

(a) BULB READILY ACCESSIBLE. Replace the bulb. If this does not correct the trouble, proceed with (b).

(b) BULB DIFFICULT TO REPLACE. Turn the lights on. Disconnect the wire at the bullet connector nearest to the bulb and momentarily ground the "hot" wire. Follow *(1)* or *(2)* below, whichever applies.

(1) SPARK OCCURS. If a spark occurs, connect the wire and replace the bulb or any wiring that runs from that point to the bulb.

(2) NO SPARK OCCURS. If no spark occurs, an open circuit exists between the point that was grounded and the light switch. Make necessary repairs.

(3) *ONE OR MORE LIGHTS BURN OUT REPEATEDLY.* Lights burn out prematurely because of high voltage, loose or corroded connections or excessive vibration. The normal life of a bulb at a given voltage is shown in Table 4.

Clean and tighten all electrical connections in the circuit involved, including the battery cable connections. Test the generator voltage regulation and adjust or replace the regulator if required.

(4) *HORN DOES NOT SOUND.* In some cases the horn may have been disconnected by someone without the owner's knowledge. The following procedure takes this possibility into account.

Reconnect any wires that may have been disconnected at either the horn relay or the bottom of the steering column and follow (a) or (b) below, whichever applies.

(a) HORN SOUNDS. If the horn sounds when connecting the wires, follow the procedure outlined in "(5) Horn Sounds Continuously".

(b) HORN DOES NOT SOUND. If the horn does not sound when all of the wires are connected, press the horn

Table 4—Bulb Life at Various Applied Voltages

Voltage at Source	Approximate Life (Hours)
6.1	3300
6.5	1425
6.9	645
7.3	322
7.7	160
8.1	87

button. If the horn still does not sound, disconnect the main feed wire at the horn relay and ground it momentarily and follow *(1)* or *(2)* below, whichever applies.

(1) SPARK OCCURS. If spark occurs, the wire can be considered satisfactory. Connect one end of a jumper wire to the main feed wire. Momentarily contact the other end of the jumper wire to each horn wire. If each horn sounds, replace the horn relay. If the horns do not sound, repair or replace the horns.

(2) NO SPARK OCCURS. If no spark occurs, an open circuit exists between the end of the wire that was grounded and the starter relay. Repair the wire.

(5) *HORN SOUNDS CONTINUOUSLY.* To stop the horn from sounding, disconnect the horn button wire from the bullet connection at the lower end of the steering column or at the horn relay, whichever is more accessible. If the horn continues to sound, disconnect the horn wires from the horn relay.

If the horn stops sounding when the horn button wire is disconnected, repair or replace the horn button wire or horn button. If the horn continues to sound after the horn button wire is disconnected, the trouble is in the relay or the wire between the bullet connection and relay. Repair the wire or replace the relay.

(6) *CHARGE INDICATOR INOPERATIVE.* Turn the headlights on. If the ammeter does not show a discharge, replace the ammeter. If the ammeter shows a discharge, the trouble (if any) is in the generating system (see a. "Generating System" above).

(7) *FUEL GAUGE INOPERATIVE.* Turn the ignition switch ON and observe the fuel gauge. Follow (a) or (b), whichever applies.

(a) GAUGE READS OVER THE FULL MARK. If the indicator hand goes beyond the scale on the opposite side of the gauge, a wire in the fuel gauge circuit is shorted (grounded). Repair or replace the wire.

(b) GAUGE READS LESS THAN FULL. If the gauge reads less than full or fails to register, momentarily short the fuel gauge terminal (yellow) wire to ground with a jumper wire until the needle reaches the highest reading on the gauge, then immediately remove the grounded wire. Follow *(1)* or *(2)*, whichever applies.

WARNING: ***Leaving the wire grounded after the maximum reading is obtained is likely to result in damage to the gauge.***

(1) GAUGE READS FULL. If the needle reaches the maximum travel on the scale when the wire is grounded, either the fuel tank unit or the wire connecting the fuel tank unit and gauge is at fault. Turn the ignition off and connect a grounded jumper wire to the sending unit terminal. Turn the ignition switch on momentarily. If the gauge begins to indicate the tank unit is at fault and must be replaced. If the gauge does not indicate, the connecting wire is broken. Make the necessary repairs.

(2) GAUGE FAILS TO READ. If the gauge on the instrument panel does not register when the wire is grounded, replace the gauge.

(8) *OIL PRESSURE GAUGE INOPERATIVE.* Turn the ignition switch ON, and observe the oil pressure gauge. Follow (a) or (b) below, whichever applies.

(a) GAUGE READS BEYOND HIGHEST READING. If the indicator hand goes beyond the scale on the opposite side of the gauge, a wire from the dash unit to the engine unit in the oil gauge circuit is shorted (grounded). Repair or replace the wire.

(b) GAUGE READS LOW. Connect a jumper wire to the black and yellow wire at the oil pressure gauge terminal. Momentarily touch the jumper wire to ground until the needle reaches the highest reading on the scale, then immediately remove the jumper wire.

WARNING: ***Leaving the wire grounded after the maximum reading is obtained is likely to result in damage to the gauge.***

If the gauge on the instrument panel does not register when the jumper wire is grounded, replace the gauge.

If the needle reaches the maximum travel on the scale when the wire is grounded, the engine unit or the oil pressure is at fault. Make the necessary repairs.

(9) *TEMPERATURE GAUGE INOPERATIVE.* Turn the ignition switch ON and observe the temperature gauge (engine should be at normal temperature). Follow (a) or (b) below, whichever applies.

(a) INDICATOR AT THE "C" POSITION ALL THE TIME. This symptom indicates a short in the gauge circuit or a defective dash unit. To check the circuit, proceed with steps *(1)* through *(4)* below.

(1) Disconnect the wire leading to the engine unit at the terminal on the dash unit. Turn on the switch. If the indicator remains at "C" position, replace the dash unit. If the indicator moves toward the "H" position, a short exists in the wiring from the dash unit to the engine units, or one of the engine units is shorted. To determine where the fault lies, proceed with *(2)* below.

(2) Connect the wire at the dash unit, and disconnect the wire at the thermal switch unit. Do not ground. Turn on the switch, and if the indicator registers at the "C" position, a short exists in the wiring between the thermal switch unit and the dash unit. Repair or replace the wiring. If the indicator moves toward the "H" position, the short is in one or the other engine units, or their connecting wire. Follow the procedure under *(3)* below.

(3) Connect the wire leading from the dash unit at the thermal switch unit. Disconnect the other wire at the thermal switch. Do not ground. Turn on the switch, and if the indicator remains at the "C" position, the thermal switch unit is grounded. Replace the defective unit. If the indicator moves toward the "H" position, the fault lies in the engine sending unit or connecting wire. Follow the procedure under *(4)* below.

(4) Connect the wire between the engine units to the thermal switch unit and disconnect the other end at the sending unit. Do not ground. Turn on the switch. If the indicator remains at the "C" position, a short exists in the wire between the engine units. Replace the defective wire. If the indicator moves toward the "H" position, the fault lies in the sending unit. Replace the unit.

(b) INDICATOR AT THE "H" POSITION ALL THE TIME. Turn on the switch. Observe the gas and oil dash units. If they are inoperative, correct the power supply circuit from the ignition switch to the dash instruments. If the gas and oil dash units are operative, see *(1)* below.

(1) Momentarily short the wire leading from the dash unit to the engine unit at the dash unit terminal. If the indicator remains at the "H" position, replace the dash unit. If the indicator moves toward the 'C" position, an open circuit is indicated, see *(2)* below.

(2) Disconnect the wire leading from the dash unit at the thermal switch unit. Turn on the switch. Momentarily short the wire. If the indicator remains at the "H" position, an open circuit exists in the wire leading from the dash unit to the engine unit. Repair or replace the wire. If the indicator moves toward the "C" position, follow the procedure under *(3)* below.

(3) Turn on the switch. Momentarily ground the thermal switch unit terminal leading to the sending unit. If the indicator remains at the "H" position, the thermal switch unit is defective, replace the unit. If the indicator moves toward the "C" position, see *(4)* below.

(4) With the switch ON, momentarily short the terminal of the sending unit. If the indicator remains at the "H" position, the wire between the engine units is open. Repair or replace wire. If indicator moves toward "C" position, sending unit is defective. Replace unit.

5. ACCESSORIES

The trouble shooting procedures given here for the more complicated accessory units will aid in locating and eliminating causes of accessory troubles. The procedures are arranged as follows under headings which identify the particular accessory:

a. Radio.

Procedures for the location and elimination of minor troubles interfering with normal receiver operation, are presented here under headings that describe the nature of the trouble. Each procedure either locates the minor trouble or determines that the receiver should have a major repair. Major repair on the radio should only be made by a competent radio repairman. Determine the nature of the trouble and turn to the heading that most nerly describes the trouble. Follow the procedure presented under this heading.

(1) *NO RECEPTION.* Check the fuse at the "A" terminal of the receiver. If the fuse is burned out, see "(a) Fuse Burned Out". If the fuse is good, see "(b) Fuse Good".

(a) FUSE BURNED OUT. If the fuse is burned out, remove the vibrator, and connect a 0-50 ammeter in series with the "A" lead on the vehicle and a substitute "A" plug (receiver Volt AMP Test). Replace the burned out fuse, turn the receiver on, and observe the ammeter. Normal current (with the vibrator removed) should be 3.8 to 4.25 amperes.

If the current is below the limits given, push all tubes firmly into their sockets. If all tubes are seated properly and the current is still low, one or more tube filaments may be burned out. A tube with a burned out or broken filament will be cool to the touch as compared with a tube having a good filament. Replace any such tubes and the vibrator. When the vibrator and all tubes are normal, the current is 7.0 to 8.5 amperes. If the receiver still will not operate, remove for major repair.

If the current is more than the limit given above, remove the receiver for major repairs.

(b) FUSE GOOD. If the fuse is not burned out, check the antenna for a short or open circuit. If the antenna is not shorted or open circuited, plug in a new speaker. If the replacement speaker does not correct the trouble, check the receiver current draw. Normal current (with vibrator) is 7.0 to 8.5 amperes.

If the current is below normal by 3 to 4 amperes, install a new vibrator. If the current is slightly below normal, check for a burned out tube as outlined above under the heading "(a) Fuse Burned Out."

If the receiver does not respond by sounding "alive," remove for major repair.

(2) *WEAK RECEPTION.* When reception is limited to a few strong local stations, adjust the antenna trimmer as described previously to align the receiver to the antenna.

If the reception is not improved, check the antenna for a short or open circuit. If the antenna is shorted, remove it from the vehicle, and inspect the insulator for moisture or foreign matter. Clean or dry the insulator and install the antenna.

If the antenna is "open," disconnect the antenna lead from the receiver and antenna base, and check it for continuity by contacting the dwell leads to the center prongs of the two connector plugs. Replace the lead if it checks open circuited. If the lead is not "open," the connector plug is not making contact with the antenna base. Clean the center contact of the connector plug and the antenna base contact.

If normal reception is not restored by the above test and adjustments, remove the receiver for major repair.

(3) *NOISY OR INTERMITTENT RECEPTION.* The cause of noisy or intermittent reception can be isolated by finding out when the noise occurs. If it occurs while the vehicle is at a standstill with the engine not running, the trouble lies in the radio receiver. If the noise occurs while the vehicle is standing with the motor running, it is caused by ignition or electrical units on the vehicle. If the noise occurs only while the vehicle is in motion, it is caused by wheel and tire static, or by vibration of the gas gauge sender unit.

(a) NOISY WHILE STANDING (ENGINE NOT RUNNING). With the vehicle standing and the engine not running, tune in a local station and jar the side of the receiver case with the hand.

NOTE: ***Do not use a mallet or hammer to jar the receiver chassis.***

Make sure the connector plugs are firmly seated. If the connectors are secure and the noisy reception continues as the receiver is jarred, remove the bottom cover and tap the tubes gently with the finger tips. If the receiver becomes noisy as any particular tube is tapped, replace the defective tube. If none of the tubes are noisy, the receiver must be removed for major repair.

(b) NOISY WHILE STANDING (ENGINE RUNNING). If the receiver is not noisy with the engine off, but becomes noisy when the engine is running, inspect the installation of suppression equipment (condensers and resistors). Substitute new parts if necessary. Make sure all condensers are properly grounded.

On 1950 model OZF radio receiver, it may be necessary to use the following procedures to reduce interference if the above procedure does not correct the trouble.

Install a condenser (part No. 8M-18826) from the terminal of the oil pressure gauge sending unit to ground.

OZF Models—Place a section of shielding over the loud speaker leads and ground the shield to the receiver chassis.

(c) NOISY WHEN VEHICLE IS MOVING. If the noise occurs only when the vehicle is moving, it is caused by wheel and tire static. Install static collector springs and anti-static powder.

(4) *SPEAKER RATTLE OR "BUZZ".* Speaker rattle or "buzz" while the radio is operating is caused by the voice coil rubbing on the center pole piece of the speaker magnet, by a torn speaker cone, by foreign material coming in contact with the cone, or by a defective tube in the receiver. The voice coil is thrown out of alignment by a twisting or bending of the speaker frame when the speaker unit is improperly mounted on the instrument panel. To determine if the speaker is at fault, substitute a good service speaker before removing the suspected unit.

If the reception is not improved, substitute tubes as described above under the heading "Noisy While Standing (Engine Not Running)". In the event that the speaker or tubes are not the cause of the trouble, the receiver must be removed for major repair.

(5) *DISTORTION AFTER DRIVING SOME DISTANCE.* This symptom is generally caused by faulty tubes. Substitute a new tube in turn for each tube in the set until the distortion clears up.

(6) *AUTOMATIC TUNING DOES NOT OPERATE.* The tuning unit in all receivers is a pre-positioned cam mechanism. If the automatic tuning does not operate, remove the receiver from the vehicle and repair the unit.

If the stations are not tuned correctly, readjust the push buttons.

(7) *MECHANICAL VIBRATION ON ROUGH ROADS.* Check the receiver chassis mounting nuts. Retighten if necessary. If the mounting bracket at the rear of the receiver is not stiff enough, place a large flat washer under the nut on the engine side of the dash panel. The washer prevents "oil canning" of the panel and results in an apparent stiffening of the bracket.

b. Heater.

Three symptoms of heater trouble are given below as "(1) Insufficient or No Heat", "(2) Insufficient or No Defrosting", and "(3) Insufficient or No Ventilation".

(1) *INSUFFICIENT OR NO HEAT.* The automatic temperature control unit could cause insufficient heat. With the engine at operating temperature and the temperature control lever at high, feel of the heater unit, it should be warm. If it is cool, the temperature control unit could be defective, not allowing the water to circulate through the heater.

NOTE: ***On 1949 trucks check the small copper tube on the bottom of the automatic control unit, it should not touch the heater case or control cables.***

If the control unit is not at fault, inspect the control cables. Make sure the cables are correctly installed, not kinked, and that they allow full travel of both the temperature-control valve and the air-control valve.

Incorrect water flow could also cause insufficient heat. Check the water hoses to see that they are not kinked or collapsed (possibly due to water outlet elbow pointing in wrong direction). Check the thermostat for proper installation and operation. It may be necessary to use a higher temperature thermostat and permanent anti-freeze in cold climates. Make sure the heater unit is not at fault (improper heater core construction, such as no water baffle in core tank). If this condition exists, it may be deflected by touching the heater. The left side of the heater will run cold on full water rate, if there is no water baffle.

If the trouble has not already been found, inspect the heater blower for a blown fuse or loose wires. Check for a poor ground, fan loose on motor shaft, blower wheel or housing damaged (preventing rotation), foreign objects in blower, and damaged or burned out heater switch.

Air leaks in the ventilation system should next be checked. Look for grommets missing in the dash or a missing felt pad around the accelerator rod. Make certain the air intake screens and the honeycomb of the heater core are not clogged with leaves, etc.

Test for body air leaks caused by poor or missing seals around the doors or windows or loosely fitting doors.

(2) *INSUFFICIENT OR NO DEFROSTING.* All of the preceding trouble shooting procedures also apply to this subject.

In addition, check the defroster control cable; it should be connected properly to allow full travel of the defroster valves. Make sure the defroster hoses are connected, the defroster dampers are tight on the control shafts, the defroster nozzles are clear and attached, and the slot in the windshield molding is properly formed.

6. POWER TRAIN

Corrective measures can only be taken after a correct diagnosis has been made of the trouble. This is important when working on units that are costly to disassemble, such as a transmission or rear axle.

a. Transmission.

Always check the possibility that trouble may exist in other closely associated units, such as: axle, drive shaft, universal joint or clutch, before removing the transmission from the vehicle.

(1) *NOISY TRANSMISSION.* A limited amount of transmission gear noise is normal but if the noise is objectionable check the lubricant. Add or refill transmission with recommended lubricant as required. The noise may be caused by worn or damaged parts. Replace parts as necessary or overhaul the transmission. Tighten transmission mounting bolts, if they are loose.

(2) *TRANSMISSION SHIFTS HARD.* Check the clutch release linkage adjustment, and adjust or repair the clutch release mechanism as required. Inspect the transmission controls for binding caused by bent or worn parts, and replace or repair damaged and worn parts.

Check for correct type of lubricant, drain and refill with recommended type of lubricant.

(3) *TRANSMISSION JUMPS OUT OF GEAR.* The transmission may jump out of gear when the shifting mechanism is not properly shifted. Be sure to completely engage the mating gears before releasing the clutch pedal. Move the gearshift lever until the steel ball engages the notch in the shift rod.

Check for excessive end play due to wear in shift forks, fork grooves in sliding gears, thrust washers, mainshaft or countershaft bearings, clutch pilot bearing or bushing. Replace the worn parts to correct.

Check the alignment of the transmission and add shims as required.

b. Clutch.

If the clutch slips, chatters, grabs, or will not disengage, adjust the clutch pedal free travel. If this does not correct the trouble, it will be necessary to remove the clutch for repairs.

c. Drive Shaft.

Excessive noise or vibration may be due to lack of proper lubrication, improper assembly of universal joints, worn universal joint bearings or journals, or a sprung drive shaft.

d. Rear Axle.

Quite commonly a muffler roar, tire noise, wheel bearing noise, body drumming, etc., are improperly diagnosed as rear axle noise. Therefore, after checking all possible external causes, the following should be considered while on road test:

Select a level, asphalt or black-top road as this type of road surface minimizes tire noise.

Drive the vehicle far enough to bring the axle lubricant to operating temperatures. (Approximately 10 miles at 50 m.p.h.)

A heavy-pitched, continuous rumble, which increases as the vehicle speed is increased, and is noticeable on acceleration between the speeds of 15 to 50 m.p.h., and is most pronounced between the speeds of 25 to 35 m.p.h., indicates that the wheel bearings are at fault or the drive pinion or differential bearings are improperly adjusted.

Coast noise will be more pronounced by allowing the vehicle to coast from the speed of 50 m.p.h., through the speed range of 15 m.p.h., with the clutch engaged and the throttle closed. If the noise is heavy and irregular on the coast, check the condition of the pinion front bearing and check the drive pinion bearing preload adjustment. Bearings improperly adjusted, worn, scored, or rough will aggravate axle noises.

Part FIVE
Chapter
III
Specifications

1. WHEELS AND TIRES

Model	Tire Size and Ply Rating	Wheel Part No.	Wheel Type	Rim Type	Dia. Bolt Circle (In.)	No. of Bolts	Offset (Inches)	Dish (Inches)	Infla-tion Pres-sure	Max. Load Capacity (Lbs.)	Static Load Rad. (In.)	Revs. per Mile
F-1	PT *6.00 x 16-4	8C-1015	16 x 4½K	DC	5.5	5	.62		28	915	13.4	738
	PT 6.00 x 16-6	8C-1015	16 x 4½K	DC	5.5	5	.62		36	1065	13.4	738
	PT 6.50 x 16-6	8C-1015	16 x 4½K	DC	5.5	5	.62		36	1215	13.5	731
	PT 15"-6	7RC-1015	15 x 5.50-F	SDC	5.5	5	.62		40	1500	13.9	715
F-2	PT *6.50 x 16-6	7RD-1015-B	16 x 6L	DC	6.5	8	.56		36	1215	13.4	735
	PT 7.00 x 16-6	7RD-1015-B	16 x 6L	DC	6.5	8	.56		36	1395	14.3	693
	7.00 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1440	14.5	683
	PT 7.50 x 16-6	7RD-1015-B	16 x 6L	DC	6.5	8	.56		36	1560	14.7	673
	7.50 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1650	14.9	667
	7.50 x 16-8	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		55	1860	14.9	667
F-3	*7.00 x 17-6	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		45	1575	15.3	654
	7.00 x 17-8	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		55	1775	15.3	654
	7.50 x 17-8	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		60	2100	15.9	625
F-3 Par. Del.	*7.00 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1440	14.5	683
	7.50 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1650	14.9	667
	7.50 x 16-8	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		55	1860	14.9	667
	7.00 x 17-6	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		45	1575	15.3	654
	7.50 x 17-8	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		60	2100	15.9	625
F-4	*7.00 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	55	2000	16.8	591
	6.50 x 20-6	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	50	1700	16.3	609
	7.00 x 18-8	7RTL-1015	18 x 5.0	2 pc.	8.0	5		4.75	55	1850	15.9	625
F-5 and F-5 C.O.E.	*6.50 x 20-6	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	50	1700	16.3	609
	6.50 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	†65	1950	16.3	609
	7.00 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	55	2000	16.8	591
	7.00 x 20-10	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	†70	2250	16.9	590
	7.50 x 20-8	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	60	2375	17.5	570
	7.50 x 20-10	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
	8.25 x 20-10	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	65	2900	18.2	546
F-5 School Bus 158" W.B.	*6.50 x 20-6	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	50	1700	16.3	609
	7.00 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	55	2000	16.8	591
	7.50 x 20-10	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
F-6 School Bus 194" W.B.	*7.50 x 20-8	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	60	2375	17.5	570
	7.50 x 20-10	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
	8.25 x 20-10	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	65	2900	18.2	546
F-6 and F-6 C.O.E.	*7.50 x 20-8	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	60	2375	17.5	570
	7.50 x 20-10	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
	8.25 x 20-10	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	65	2900	18.2	546
	8.25 x 20-12	7RT-1015-B	20 x 6.0	2 pc.	8.0	5		5.50	75	3150	18.3	546
F-7	*8.25 x 20-10	7EQ-1015-D	20 x 6.5	2 pc.	10.0	8		6.0	65	2900	18.2	546
	8.25 x 20-12	7EQ-1015-D	20 x 6.5	2 pc.	10.0	8		6.0	75	3150	18.3	546
	9.00 x 20-10	7EQ-1015-D	20 x 6.5	2 pc.	10.0	8		6.0	65	3450	19.1	520
	9.00 x 20-10	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	65	3450	19.1	520
	9.00 x 20-12	7EQ-1015-D	20 x 6.5	2 pc.	10.0	8		6.0	†80	3850	19.2	520
F-8	*9.00 x 20-10	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	65	3450	19.1	520
	9.00 x 20-12	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	†80	3850	19.2	520
	10.00 x 20-12	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	70	4000	19.5	509

Wheels and Tires (cont'd) **(Cast Wheel)**

Model	Tire Size and Ply Rating	Rim Part No.	Wheel Type	Rim Type	Inflation Pressure	Max. Load Cap. (Lbs.)	Static Load Rad. (In.)	Revs. per Mile
F-7	*8.25 x 20-10	8Q-1020	20 x 6.5	3 pc.	65	2900	18.2	546
	8.25 x 20-12	8Q-1020	20 x 6.5	3 pc.	†75	3150	18.3	546
	9.00 x 20-10	8Q-1020	20 x 6.5	3 pc.	65	3450	19.1	520
	9.00 x 20-12	8Q-1020	20 x 6.5	3 pc.	†80	3850	19.2	520
F-8	*9.00 x 20-10	8QH-1020-A	20 x 7.0	3 pc.	65	3450	19.1	520
	9.00 x 20-12	8QH-1020-A	20 x 7.0	3 pc.	†80	3850	19.2	520
	10.00 x 20-12	8QH-1020-A	20 x 7.0	3 pc.	70	4000	19.5	509
	10.00 x 20-12	8QH-1020-B	20 x 7.0	3 pc.	70	4000	19.5	509

†High pressure tires Not Recommended on front wheels
*Standard Equipment
DC—Drop Center
SDC—Semi-Drop Center
PT—Passenger Type

2 pc.—2 piece advance wide base rim
3 pc—3 piece advance wide base rim

2. BRAKES

1125 Front Drums

Model	Part No.	I.D. (Inches)	Max. Dia. Boring Limits (Inches)
F-1	8C-1125	11	11.060
F-2, F-3 (1949-50-early 51)	8D-1125	12	12.020
F-2, F-3 (late 1951)	1D-1125-B	12	12.020
F-3 Par. Del.	8J-1125	13⅛	13.195
F-4, F-5, F-6; F-5 and F-6 C.O.E.	7RT-1125-D	14	14.020
F-7, F-8 (Std. and Air Brakes)	7EQ-1125-C	16	16.063

1126 Rear Drums

Model	Part No.	I.D. (Inches)	Max. Dia. Boring Limits (Inches)
F-1	8C-1126-A	11	11.060
F-2 (1949-50-early 51)	8D-1126	12	12.020
F-2 (late 1951)	1D-1126-B	12	12.060
F-3 (1949-50-early 51)	8Y-1126	14	14.020
F-3 (late 1951)	1D-1126-B	12	12.060
F-3 P. Del. (1949-50-early 51)	8J-1126	13⅛	13.195
F-3 P. Del. (late 1951)	1D-1126-B	12	12.060
F-4, F-5, F-6, F-5 and F-6 C.O.E.	7RT-1126-A	15	15.060
F-7 (1949)	7EQ-1126-B	16¼	16.340
F-7 (1950-51)	8Q-1126-A	15	15.090
F-8	7EQH-1126	16	16.090
F-8 (Air Brakes)	8QH-1126-A	16½	16.590

2018 Front Brake Primary Shoe

Model	Part No.	Lining Length (Inches)	Lining Width (Inches)	Lining Thickness (Inches)
F-1	8C-2018	11²⁹⁄₃₂	2	3/16
F-2, F-3 (1949-50-early 51)	59C-2018	13½	1¾	3/16
F-2, F-3 (late 1951)	1D-2018-A	11½	2	3/16
F-3 P. Del.	8J-2018	14 9/16	2	¼
F-4, F-5, F-6, F-5 and F-6 C.O.E.	92Y-2018-A	15 33/64	2	¼
F-7, F-8	7EQ-2018	16 13/32	2¼	¼

2018-2370 Rear Brake Primary Shoe

Model	Part No.	Lining Length (Inches)	Lining Width (Inches)	Lining Thickness (Inches)
F-1	8C-2218-B	11 29/32	1¾	3/16
F-2 (1949-50-early 51)	59C-2018	13½	1¾	3/16
F-3 (1949-50-early 51)	92Y-2018-A	15 33/64	2	¼
F-2, F-3 (late 1951)	1D-2018-A	11½	2	3/16
F-3 P. Del. (1949-50-early 51)	8J-2018	14 9/16	2	¼
F-3 P. Del. (late 1951)	1D-2018-A	11 9/16	2	3/16
F-4, F-5, F-6, F-5 and F-6 C.O.E.	91T-2018-A	16⅝	3½	5/16
F-7 (1949)	7EQ-2370	15 37/64	3½	⅜
F-7 (1950-51)	8Q-2218	15 37/64	5	⅜
F-8	7EQH-2218-B	17	5	⅜

Front Brake Secondary Shoe

Model	Part No.	Lining Length (Inches)	Lining Width (Inches)	Lining Thickness (Inches)
F-1	8C-2019	$11\frac{29}{32}$	2	$\frac{3}{16}$
F-2, F-3 (1949-50-early 51)	59C-2019	$10\frac{3}{8}$	$1\frac{3}{4}$	$\frac{3}{16}$
F-2, F-3 (late 1951)		$12\frac{31}{32}$	2	$\frac{3}{16}$
F-3 P. Del.	8J-2019	$12\frac{17}{64}$	2	$\frac{1}{4}$
F-4, F-5, F-6, F-5 and F-6 C.O.E.	92Y-2019-A	$10\frac{3}{4}$	2	$\frac{1}{4}$
F-7, F-8	7EQ-2019	$12\frac{13}{64}$	$2\frac{1}{4}$	$\frac{1}{4}$

Rear Brake Secondary Shoe

Model	Part No.	Lining Length (Inches)	Lining Width (Inches)	Lining Thickness (Inches)
F-1	8C-2219-B	$11\frac{29}{32}$	$1\frac{3}{4}$	$\frac{3}{16}$
F-2 (1949-50-early 51)	59C-2019	$10\frac{3}{8}$	$1\frac{3}{4}$	$\frac{3}{16}$
F-3 (1949-50-early 51)	92Y-2019-A	$10\frac{3}{4}$	2	$\frac{1}{4}$
F-2, F-3 (late 1951)		$12\frac{31}{32}$	2	$\frac{3}{16}$
F-3 P. Del. (1949-50-early 51)	8J-2019	$12\frac{1}{4}$	2	$\frac{1}{4}$
F-3 P. Del. (late 1951)		$12\frac{31}{32}$	2	$\frac{3}{16}$
F-4, F-5, F-6, F-5 and F-6 C.O.E.	91T-2019-A	$11\frac{33}{64}$	$3\frac{1}{2}$	$\frac{5}{16}$
F-7 (1949)	7EQ-2370	$15\frac{37}{64}$	$3\frac{1}{2}$	$\frac{3}{8}$
F-7 (1950-51)	8Q-2218	$15\frac{37}{64}$	5	$\frac{3}{8}$
F-8	7EQH-2218-B	17	5	$\frac{3}{8}$

2061-2062 Front Brake Wheel Cylinder

Model	Part Number	Dia. (Inches)
F-1	8C-2061-B RH 8C-2062-B LH	$1\frac{1}{16}$ $1\frac{1}{16}$
F-2, F-3 (1949-50-early 51)	21A-2061 RH 21A-2062 LH	$1\frac{3}{8}$ x 1 $1\frac{3}{8}$ x 1
F-2, F-3 (late 1951)		$1\frac{1}{8}$
F-3 P. Del.	8J-2061 RH 8J-2062 LH	$1\frac{3}{8}$ $1\frac{3}{8}$
F-4, F-5, F-6, F-5 and F-6 C.O.E.	8T-2061	$1\frac{1}{4}$
F-4, F-5, F-6, F-5 and F-6 C.O.E. (1951)	91T-2010 91T-2011	$1\frac{1}{4}$
F-7, F-8	7EQ-2061	$1\frac{1}{4}$

2061-2262 Rear Brake Wheel Cylinder

Model	Part Number	Dia. (Inches)
F-1	8M-2261-A RH 8M-2262-A LH	1 1
F-2 (1949-50-early 51)	21A-2061 RH 21A-2062 LH	$1\frac{3}{8}$ x 1 $1\frac{3}{8}$ x 1
F-3 (1949-50-early 51)	92Y-2261	$1\frac{3}{8}$
F-2, F-3 (late 1951)		$1\frac{1}{8}$
F-3 P. Del. (1949-50-early 51)	8J-2261 RH 8J-2262 LH	$1\frac{1}{4}$ $1\frac{1}{4}$
F-3 P. Del. (late 1951)		$1\frac{1}{8}$
F-4, F-5, F-6, F-5 and F-6 C.O.E.	91T-2261	$1\frac{1}{2}$
F-4, F-5, F-6, F-5 and F-6 C.O.E. (1951)	91T-2209-2210	$1\frac{1}{2}$
F-7 (1949)	7EQ-2261	$1\frac{1}{2}$
F-7 (1949)	8Q-2261-A	$1\frac{3}{8}$
F-7 (1949-50-51)	8Q-2261-B	$1\frac{5}{8}$
F-8	7EQH-2261-B	$1\frac{3}{4}$

2140 Brake Master Cylinder

Model	Part Number	Piston Dia. (In.)	Stroke (In.)
F-1	91A-2140	$1\frac{1}{16}$	$1\frac{1}{4}$
F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 and F-6 C.O.E.	91T-2140	$1\frac{1}{4}$	$1\frac{7}{16}$
F-7, F-8	7EQ-2140	$1\frac{1}{2}$	$1\frac{7}{16}$

2614 Parking Brake Drum

Model	Part Number	Dia. (Inches)
F-2, F-3 (1951)		8
F-3 P. Del., F-4, F-5, F-6	OIT-2614	$7\frac{13}{16}$
F-5 and F-6 C.O.E.		$7\frac{13}{16}$
F-7, F-8	7EQ-2614	$9\frac{1}{2}$

2620 Parking Brake Lining

Model	Part Number	Length (In.)	Width (In.)	Thick-ness (In.)
F-2, F-3 (1951)		$23\frac{53}{64}$	$1\frac{3}{4}$	$\frac{3}{16}$
F-3 P. Del.	8J-2620-A, B	$23\frac{5}{64}$	$2\frac{1}{2}$	$\frac{1}{4}$
F-4, F-5, F-6, F-5 and F-6 C.O.E.	OIT-2620	$24\frac{5}{8}$	$2\frac{1}{2}$.	$\frac{1}{4}$
F-7, F-8	7EQ-2620-B, C	$29\frac{11}{16}$	3	$\frac{5}{16}$

2005 Brake Booster

Model	Part Number	Type	Dia. (In.)
*F-6, F-6 C.O.E. (1949)	59T-2005-A	Diaphragm	7½
*F-6, F-6 C.O.E. (1950-51)	8T-2005	Diaphragm	7½
F-7, F-8 (1949, early 1950)	7EQ-2005-A	Piston	9½
F-7, F-8 (late 1950, 1951)	7EQ-2005-B	Piston	9½

Slave Cylinder

Model	Diameter	Stroke	Displacement
F-6, F-6 C.O.E. 194" W.B. Sch.	1.0 in.	2 5/16 in.	1.815 cu. in.
F-7, F-8	13/16 in.	4 9/16 in.	2.36 cu. in.

*Special Equipment F-4, F-5, F-5 C.O.E.
Brake Pedal Free Travel—¼ to ½ inch.
Lining Wear Limit—1/32 inch from lining surface to rivet or bolt.
Lining to Drum Clearance—F-1—0.010 inch.

AIR BRAKES

Brake Size—Inches

Front	16 x 2¼
Rear	16½ x 5½

Brake Drum

	Front	Rear
Diameter	16 in.	16½ in.
Out-of-round (Max.)	0.010 in.	0.010 in.

Brake Lining

	Front	Rear
Length per Shoe	16¾ in.	8.7 in. (Per Block)
Width—Inches	2¼	5½
Thickness—Inches	5/16	¾

Brake Shoe Return Spring

	Front	Rear
Free Length—Inches	6.0	10.62
Length at 75 lbs. Load	6.88	11.50

Brake Shoe Camshaft

	Front	Rear
Diameter at Bushing	1.493"-1.495"	1.493"-1.495"
Bushing I.D.—Inches	1.499-1.501	1.499-1.501

Anchor Pins and Bushings
*All Dimensions Given in Inches

	Front	Rear
Pin Length	1.03	2.975-2.980
Pin Diameter	0.992-0.990	1.2475-1.2495
Bushing I.D. (Ream)	0.998-0.999	1.254-1.256
Bushing O.D.	—	1.501-1.504
Bushing Length	0.970-0.990	1.12
Dia. of Hole in Shoe (Ream)	1.061-1.063	1.497-1.499

Brake Chamber

Type	Front	Rear
	E	B
Overall Dia.—Inches	6	9 3/16
Effective Area (sq. in.)	9	24
Max. Stroke Available (in.)	1¾	2¼
Adjust when Stroke is (in.)	1⅜	1¾
Adjust Stroke to (in.)	⅝	¾
Spring Tension at 0 Stroke	13.5 lbs.	36 lbs.
Increase per Inch of Stroke	4 lbs.	11 lbs.
Max. Pressure per System (P.S.I.)	95	95

Slack Adjusters

	Front	Rear
Type	Rod & Lever	360° Rotating Worm & Gear
Length of Arm	5 in.	6 in.

Brake Pedal

Total Travel	4.5 in. (Approx.)
Stop Height	Set to Just Allow Reservoir Pressure at Chambers
Rod Length	6 in.

Brake Control Valve

Control Range	0-75 (P.S.I.)
Plunger Travel	0.557-0.599 in.
Max. Application Force	140 lbs. at Pedal

Air Reservoir Safety Valve

Release Pressure	150 P.S.I.

Stop Light Switch

Operating Pressure	5 P.S.I.

Air Compressor

Type	2-cyl. Water Cooled
Bore and Stroke—Inches	2 1/16 x 1½
Capacity	7¼ cu. ft. at 1250 R.P.M.
Oil Capacity	1 pint
Oil Type	Same Oil as Engine

Air Compressor Governor

Cut-out Pressure	100-105 P.S.I.
Cut-in Pressure	80-85 P.S.I.
Pressure Range	15-25 P.S.I.

Air Compressor Unloader Valves

Clearance	0.010-0.015 in.
Valve Spring Free Height	1 3/64 in.
Spring Height at 5.4-6.6 lbs.	¾ in.
Lever Spring Free Height	2 7/32 in.
Lever Spring Height at 7.7-8.7 lbs.	⅝ in.

3. WHEEL ALIGNMENT AND STEERING

Alignment

	Caster* Degrees		Camber† Degrees		Toe-in Inches		King Pin Inclination (Degrees)
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
**Model F-1, F-2 and F-3 Trucks	2½	4½	¼	1	0	1/16	8 ± ¼°
F-4, F-5, F-6 and F-5, F-6 C.O.E.	1	3½	¼	1	0	1/16	8¼ ± ¼°
All other "F" Series Trucks, Parcel Delivery and School Bus Models	1	3	¼	1	0	1/16	8 ± ¼°

*Maximum variation between wheels ½°

**F-2, F-3 without caster wedge, caster angles should be (−½° to +1½°)

†Maximum variation between wheels ¼°

3109-3110-3115 Spindle Bolt and Bushing

Model	Bushing Part No.	Mfg. Max. I.D. (Inches)	Bolt Part No.	Mfg. Min. O.D. (Inches)
F-1, F-2, F-3	51A-3110-A	0.81325	21A-3115-A	0.812
F-3 Par. Del.	8J-3110	0.938	8J-3115	0.936
F-4, F-5, F-6; F-5 C.O.E., F-6 C.O.E.	81T-3109-A	1.131	81T-3115-A	1.128
F-7, F-8	7EQ-3109	1.236	7EQ-3115	1.234

3504 Steering Gear

	F-1, F-2, F-3	F-4, F-5, F-6	F-3 Par. Del., F-5 C.O.E., F-6 C.O.E.	F-7 and F-8
Part Number	7RC-3504	7RT-3504	7RW-3504-B	7EQ-3504
Bearing Type				
Worm Gear	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller
Roller Gear	Needle Bearing	Needle Bearing	Needle Bearing	Needle Bearing
Sector Shaft	Bushing	Bushing	Bushing	Bushing
Steering Column Shaft at Steering Wheel	Oilless Bearing	Oilless Bearing	Oilless Bearing	Oilless Bearing
Worm Bearing End Play	0.003″ Max.	0.003″ Max.	0.003″ Max.	0.003″ Max.
Worm Bearing Pre-Load (Pull to keep wheel moving) (lbs.)	0-½	0-½	0-½	0-½
Steering Gear Lash Adjustment (Pull over center includes worm bearing load) (lbs.)	½-1½	½-1½	½-1½	½-1½
Steering Wheel Diameter	18	18	18	20

Steering Stop Adjustment

Model	Tire Sizes	Left	Right
F-1, F-2, F-3		Fixed Stops	
F-3 Parcel Delivery	7.00 x 16 7.00 x 17 7.50 x 16 7.50 x 17	4 5/16 3 15/16 3 13/16 3⅜	3½ 3 1/16 3.00 2⅝
F-4, F-5, School-bus, F-6	All Tire Sizes	2½	2⅜
F-5 C.O.E.	6.50 x 20 7.00 x 20	4¾ 4⅜	4¾ 4⅜
F-5 C.O.E. F-6 C.O.E.	7.50 x 20 8.25 x 20	3 5/16 2¾	3 5/16 2¾
F-7	8.25 x 20 9.00 x 20	4 7/16 3 9/16	3 3/16 2¼
F-8	9.00 x 20 10.00 x 20	3 5/16 3 5/16	1⅞ 1⅜

Torque Specifications

Part Name	Torque (foot-pounds)
Steering Gear to Frame Bolts	45-60
Steering Gear Sector Shaft Housing Attaching Screws	22-28
Steering Column Clamp Bolt	12-15
Steering Gear Housing Cap to Housing Screws	12-15
Steering Gear Arm to Sector Shaft Nut	115-125
Steering Wheel Attaching Nut	50-60
Spindle Connecting Rod Sleeve to Clamp Bolts	*

(*) 5/16 Bolt—15-20 foot-pounds; ⅜ bolt—25-30 foot-pounds.

4. REAR AXLE

4203-4209 Driving Gear and Pinion

Model	Part Number	Gear Ratio	No. of Teeth		Gear Backlash (Inches)		Pinion Bearing Preload—(inch-pounds)	
			Pinion	Drive Gear	Min.	Max.	Min.	Max.
F-1	8M-4209-B	4.27	11	47	0.003	0.008	8	12
	OM-4209	3.92	12	47	0.003	0.008	8	12
F-2, F-3, F-3 Par. Del.	OIY-4203-A	4.11	9	37	0.004	0.018	12	16
	OIY-4203-B	4.857	7	34	0.004	0.018	12	16
F-4, F-5	8T-4209-B	5.83	6	35	0.004	0.018	12	16
	8T-4209-C	5.14	7	36	0.004	0.018	12	16
F-5, F-5 C.O.E.	8T-4209-A	6.66	6	40	0.004	0.018	12	16
F-6, F-6 C.O.E.	8TH-4209-A	7.2	5	36	0.004	0.018	12	18
	8TH-4209-B	6.2	5	31	0.004	0.018	12	18
	8TH-4209-C	6.8	5	34	0.004	0.018	12	18
F-5, F-6—Conv. and C.O.E. (2-sp.)	8T-4209M-A	5.83-8.11	6	35	0.004	0.018	8	15
	8T-4209M-B	6.33-8.81	6	38	0.004	0.018	8	15
F-7	7EQ-4203-B	6.8	5	34	0.006	0.010	12	18
F-8	8QH-4209	7.16	6	43	0.006	0.010	12	25
F-8 (2-sp.)	7EQH-4209M	6.5-8.87	6	39	0.006	0.016	12	25

4211 Differential Pinion Shaft (Spider)

Model	Part No.	Mfg. Dia. (Inches)
F-1	8M-4211	0.7495
F-2, F-3, F-3 Par. Del.	61-4211	0.748
F-4, F-5, F-5 C.O.E.	79-4211-A	0.871
F-6 (2-speed)	OIT-4211-M	0.937
F-6, F-6 C.O.E. (Single Speed)	8TH-4211	0.873
F-7	7EQ-4211	0.996
F-8 (2-speed)	7EQH-4211	0.997
F-8 (single speed)	8QH-4211	0.937

4059-4228 Differential Side Gear Thrust Washers

Model	Part No.	Thickness (Inches)
F-1	8M-4228	0.030-0.032
F-2, F-3	61-4228	0.060-0.062
F-4, F-5	79-4228	0.058-0.062
F-6 (2-speed)	8IT-4228-M	0.061-0.063
F-6 (single speed)	8TH-4228	0.058-0.062
F-7	7EQ-4228	0.058-0.062
F-8 (2-speed)	7EQH-4059	0.061-0.063
F-8 (single speed)	8QH-4228	0.121-0.125

4215-4292 Differential Pinion Gears

Model	Part No.	Mfg. I.D. (Inches)
F-1	8M-4215	0.75495
F-2, F-3, F-3 Par. Del.	7RY-4215	0.753
F-4, F-5, F-5 C.O.E.	7RT-4215	0.878
F-6 (2-speed)	59T-4215-M	0.941
F-6 (single speed)	8TH-4215	0.877
F-7	7EQ-4215-B	1.004
F-8 (2-speed)	7EQH-4215	1.002
F-8 (single speed)	8QH-4292	0.937

4230 Differential Pinion Gear Thrust Washers

Model	Part No.	Thickness (Inches)
F-1	8M-4230	0.030-0.032
F-2, F-3	7RY-4230	0.061-0.063
F-4, F-5, F-6	7RT-4230	0.058-0.062
F-6 (2-speed)	OIT-4230-M	0.030-0.032
F-7	7EQ-4230	0.058-0.062
F-8 (2-speed)	7EQH-4230	0.030-0.032
F-8 (single speed)	8QH-4230	0.061-0.063

Torque Specifications

Part Number	Name	Size	Axle Type	Torque (Ft. Lbs.)
350634-S	Ring Gear to Differential Case Bolt	3/8-24	Integral Housing Hypoid—Truck	40-50
61-4216	Differential Gear Case Bolt	3/8-24	Split Housing	28-35
BB-4216-C	Differential Gear Case Bolt	1/2-13	Heavy Split Housing	78-88
34019-S2	Differential Assembly Nut	1/2-20	Split Housing Hypoid	96-106

Torque Specifications—Continued

Part Number	Name	Size	Axle Type	Torque (Ft. Lbs.)
355782-S 355783-S	Differential Assembly Bolt	7/16-14	Planetary Two-Speed	49-58
351045-S	Differential Drive Gear Assembly Nut	7/16-20	Planetary Two-Speed	62-69
350047-S 350048-S	Differential Assembly Bolt	1/2-13	Heavy Planetary Two-Speed	78-88
350894-S	Differential and Drive Gear Assembly Nut	9/16-8	Banjo Housing	135-150
20389-S	Drive Pinion Support Assembly Bolt	3/8-24	Split Housing	23-30
20972-S	Drive Pinion Support Assembly Bolt	9/16-12	Heavy Split Housing	87-97
20690-S	Drive Pinion Support Assembly Bolt	9/16-12	Planetary Two-Speed	87-97
33802-S	Driving Pinion Support Assembly Nut	7/16-20	Split Housing Hypoid	38-45
20744-S	Driving Pinion Support Assembly Bolt	9/16-12	Banjo Housing	87-97
20130-S2 20254-S2	Differential Carrier Head Assembly Bolt	9/16-14	Planetary Two-Speed	35-44
20746-S 20836-S	Differential Carrier Head Assembly Bolt	5/8-11	Heavy Planetary Two-Speed	122-137
33802-S2	Axle Housing Nut	7/16-20	Heavy Split Housing, also Hypoid	38-45
33786-S2	Axle Housing Nut	3/8-24	Split Housing	20-26
33832-S	Axle Housing Nut	1/2-20	Heavy Split Housing Hypoid	41-56
351159-S	Driving Pinion Yoke Nut	7/8-20	Split Housing	250-300
351165-S	Driving Pinion Yoke Nut	1″-20	Split Housing (All Types)	300-350
351161-S8	Driving Pinion Yoke Nut	1 1/4-12	Banjo Housing	700-900
351025-S8	Axle Shaft Flange Nut	7/16-20	Split Housing (All types except Heavy Split Hypoid)	62-69
33832-S	Axle Shaft Flange Nut	1/2-20	Heavy Split and Banjo Housing	84-93
351145-S	Driving Pinion Yoke Nut	3/4-16	Integral Housing Hypoid	100-150

Lubricant Capacity—Pints

Model	
*F-1, F-2, F-3, F-3 Par. Del.	3
F-4, F-5, F-5 C.O.E. and Sch. Bus	5
F-5, F-6, F-5 C.O.E. and F-6 C.O.E. (2-speed)	15
F-6, F-6 C.O.E. (Single Speed)	10

*F-1 Late 1951 only 3 1/2 pints.

Lubricant Capacity—Pints—Continued

Model	
F-7	11
F-8 (2-speed)	19
F-8 (Single-speed)	22

5. FRAME AND SPRINGS

5000 Frame

	A	B	C	D	E	F	G
	Width Front	Width Rear	℄ to ℄ Rear Spring Hangers	℄ to ℄ Front Spring Hangers	Front End Dip	Front Axle Kick-Up	Rear Axle Kick-Up
F-1	32	34	44	35 3/16	2 3/4	—	2
F-2	32	34	45	35 3/16	2 3/4	—	2
F-3	32	34	45	35 3/16	2 3/4	—	2
F-3 Par. Del.	32	34	45	35 9/16	2 3/4	2	3 1/4
F-4	32	34	44 1/2	35 1/2	2 29/32	—	—
F-5	32	34	44 1/2	35 1/2	2 29/32	—	—
F-5 C.O.E.	32	34	44 1/2	37 5/8	2 29/32	—	—
School Bus	32	34	51 5/64	35 1/2	2 29/32	—	—
F-6	32	34	44 1/2	35 1/2	2 29/32	—	—
F-6 C.O.E.	32	34	44 1/2	37 5/8	2 29/32	—	—
F-7	32	34	51 1/4	45 5/16	4	—	—
F-8	32	34	51 1/4	45 5/16	4	—	—

5310 Front Spring Specifications

Model	Spring Part Number	Number of Leaves	Capacity at Normal Loaded Height (lbs.)	Deflection Rate (lbs. per in.)	Height at Normal Load (Inches)	Length Loaded (Inches)	Width (Inches)	Bushing Dia. (Inches)
Std. on F-1	21C-5310-B	8	850	243	2.46	36	1.75	0.625
Std. on F-2, F-3 Option F-1	21Y-5310-A	8	1025	423	2.46	36	1.75	0.625
Std. on F-2, F-3	21Y-5310-B	9	1025	610	3.98	36	1.75	0.625
Std. on F-3 Par. Del.	8J-5310	10	1200	555	3.23	36	1.75	0.625
Std. on F-4, F-5, F-6 & F-5 Sch. Bus 158" W.B.	21T-5310-A	11	1375	673	2.84	36	2.00	0.750
Std. on F-6 Sch. Bus. 194" W.B. Option F-4, F-5, F-6	21T-5310-B	12	1975	845	2.84	36	2.00	0.750
Opt. on F-4, F-5, F-6 F-5 Sch. Bus	59T-5310	12	2000	1090	3.50	36	2.00	0.750
*Opt. on F-5, F-6, C.O.E. 134" & 158" W.B.	21W-5310-A	13	1825	610	3.93	38	2.25	0.750
Std. on F-5, F-6, C.O.E.	21W-5310-B	13	2050	685	3.93	38	2.25	0.750
Opt. on F-5, F-6, C.O.E.	8W-5310	14	2450	850	3.93	38	2.25	0.750
F-7, F-8	7EQ-5310-B	12	2250	860	4.30	46	2.50	0.875

*Standard on Short Wheelbase

5560-5580 Rear Spring Specifications

Model	Part Number	Number of Leaves	Capacity at Normal Loaded Height (lbs.)	Deflection Rate (lbs. per in.)	Height at Normal Load (Inches)	Length Loaded (Inches)	Width (Inches)	Bushing Dia. (Inches)
F-1 Panel Del. F-1 (Opt.)	21-C-5560-A	9	1050	230	2.84	45	2.00	0.750
F-1	21C-5560-B	10	1350	275	2.84	45	2.00	0.750
F-1 (Opt.)	21C-5560-C	11	1775	335	2.84	45	2.00	0.750
F-2 (Std.) F-3 (Opt.)	59Y-5560-A	12	1950	465	3.94	45	2.25	0.750
F-3 (Std.) F-2 (Opt.)	59Y-5560-B	13	2400	520	3.94	45	2.25	0.750
F-3 (Opt.)	59Y-5560-C	14	3000	640	3.94	45	2.25	0.750
F-3 Par. Del.	8J-5560-A	12	2000	465	3.04	45	2.25	0.750
F-3 Par. Del. (Opt.)	8J-5560-B	12	2325	510-660	3.04	45	2.25	0.750
F-4 (Std.) F-5, 5 C.O.E. (Opt.)	0IT-5560-A	10	3600	900	3.80	45	2.50	1.0
F-4, 5 & 5 C.O.E. (Opt.)	0IT-5560-B	7	1700	445	3.80	45	2.50	1.00
F-5, 6, 5 & 6 C.O.E. F-4 (Opt.)	0IT-5560-C	12	4300	1075	4.42	45	2.50	1.00
Sch. Bus	84T-5560	13	4300	836-1104	4.69	52	2.50	1.00
F-7 (Std.)	7EQ-5560-A	13	4750	1225	5.00	52	3.00	1.12
F-8 (Std.) F-7 (Opt.)	7EQ-5560-B	14	5750	1425	5.46	52	3.00	1.12
F-8 (Opt.)	7EQH-5560	13	6650	1650	5.60	52	3.00	1.12
F-6, F-6 C.O.E. (Std.) F-5, F-5 C.O.E. (Opt.)	*0IT-5588-B	5	1350	1350	2.29	32.50	2.50	
F-7, 8	*7EQ-5588	7	2050	975	3.18	37.50	3.00	

*Auxiliary Springs

Spring Clip Nut Torque Specifications (Foot-pounds)

Model	Front	Rear
F-1	108-125	108-125
F-2, F-3, F-3 Par. Del.	108-125	165-185

Spring Clip Nut Torque Specification—Continued

Model	Front	Rear
F-4, F-5, F-6	108-125	285-310
F-5, C.O.E., F-6, C.O.E., F-7 & F-8	165-185	285-310

6. ENGINES

General

Type	6-Cylinder		8-Cylinder	
	H	M	R	E
Horsepower	95 @ 3300 RPM	110 @ 3400 RPM	100 @ 3800 RPM	145 @ 3600 RPM
Taxable Horsepower	26.1	29.4	32.5	39.2
Bore (Inches)	3.30	3.50	3.187	3.50
Stroke (Inches)	4.40	4.40	3.75	4.375
Piston Displacement (cubic inches)	225.9	254	239.4	337
Compression Pressure @ Sea Level (p.s.i. @ r.p.m.)	110 @ 60	110 @ 60	110 @ 90	113 @ 110
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2
Oil Capacity (Qts.)	5	6	5	9
Compression Ratio	6.8:1	6.8:1	6.8:1	6.4:1
Torque Ft. Lbs. @ RPM	180 @ 1200	212 @ 1200	180 @ 2000	255 @ 1800

6010 Cylinder Block

Type of Engine	Cylinder Block Part Number	Mfg. Max. Bore Dia. (Inches)	Max. Width Valve Seat Face (Inches)	Max. Valve Seat Run-out (Inches)	Max. Allowable Out-of-round Bore (Inches)	Max. Allowable Oversize Bore (Inches)
H	7HA-6010-B	3.3024	0.062	0.005	0.003	0.060
R	8BA-6010	3.1899	0.060-0.080	0.005	0.0005	0.060
E	8EL-6010-B	3.502	0.065-0.080	0.005	0.0005	0.060
M	8MTH-6010	3.500	0.062	0.005	0.003	0.060

6505-6507 Valves

Type of Engine	Valve Part Number	Mfg. Clearance Valve Stem to Guide (Inches)	*Mfg. Valve Stem to Push Rod Clearance (Inches)				Mfg. Min. Stem Diameter (Inches)	Min. Valve Head Thickness (Inches)
			Exhaust		Intake			
			Min.	Max.	Min.	Max.		
H (1949 and Early 1950)	7HA-6505-A	0.0010-0.0031	0.013	0.015			0.3410	1/32
H (Late 1950 and 1951)	7HA-6505-A	0.0010-0.0031	0.017	0.019			0.3410	1/32
H (1949—Early 1950) & M	7HA-6507	0.0010-0.0031			0.009	0.011	0.3410	1/32
H (Late 1950) H (1951)	7HA-6507 1HA-6507-A	0.0010-0.0031			0.013	0.015	0.3410	1/32
R (Early 1949)	8BA-6505-A	0.0015-0.0035	0.014	0.016	0.010	0.012	0.3410	1/32
R (Late 1949 and 1950)	8BA-6505-A 8RT-6505-C	0.0015-0.0035	0.017	0.019	0.013	0.015	0.3410	1/32
R (1951)	1BA-6505-A	0.0015-0.0035	0.017	0.019			0.3410	1/32
R (1951)	1BA-6507-A	0.0010-0.0030			0.013	0.015	0.3415	1/32
E (Early 1949)	8EQ-6505-A	0.0022-0.0037	0.014	0.016			0.3410	1/32
E (Late 1949 and Early 1950)	8EQ-6505-B	0.0022-0.0037	0.014	0.016			0.3405	1/32
E (Late 1950 and 1951)	8EQ-6505-C	0.0022-0.0037	0.016	0.018			0.3405	1/32
E (Early 1949)	8EL-6507-A	0.0022-0.0037			0.010	0.012	0.3412	1/32
E	8EL-6507-B	**0.0022-0.0037			0.010	0.012	0.3412	1/32
E (Late 1949, 1950 and 1951)	8EL-6507	0.0015-0.0030			0.010	0.012	0.3412	1/32
M	8MTH-6505-A-B	0.0010-0.0031	0.014	0.016			0.3410	1/32

*Set clearance when engine is cold.

**Valve head diameter 0.070 inch oversize.

Letters "OH" are stamped on right side of block above No. 3 intake port on 6-cylinder engines with OHA 6250 camshaft.

All valves have 45° seat angle.

Valve Springs

Type of Engine	Valve Spring Part Number	Test Length (Inches)	Pressure (Pounds)
R	78-6513	2.13	40 to 43
H and M	OHA-6513-A	2.11	47 to 53
E	8EL-6513	1.68	62 to 68

6500 Valve Push Rods

Type of Engine	Valve Push Rod Part Number	Mfg. Clearance in Block (Inches)	Mfg. Minimum Push Rod Diameter (Inches)
H and M	7HA-6500-A	0.0005-0.0015	0.6240
R	8BA-6500-A	0.0007-0.0016	0.9992
E	8EQ-6500-A, B, C, D	0.0002-0.0012	0.7178

Valve Timing

Engine	Intake Opens (Degrees) B.T.C.	Intake Closes (Degrees) A.B.C.	Exhaust Opens (Degrees) B.B.C.	Exhaust Closes (Degrees) A.T.C.
H and M	11	41	48	10
R (Early 1949)	0	44	48	6
(Late 1949, 1950 and 1951)	5	44	48	3
E	14	45	50	9

6306 Crankshaft Gear

Type of Engine	Crankshaft Gear Part Number	Max. Gear Face Runout (Inches)
R (Early 1949)	48 6306-A	0.0015
R (Late 1949, 1950, and 1951)	8BA 6306-A	0.0015
H and M	7HA 6306-B	0.0015
E	1GA 6306-B	0.0015

6250 Camshaft

Type of Engine	Camshaft Part Number	†Max. Allowable Runout (Inches)	Min. Valve Lift. (Inches)		Wear Limit Camshaft Journals (Inches)	End Play (Inches)
			Intake	Exhaust		
M	8MTH 6250-A	0.005	0.3375	0.3335	1.924	0.003-0.006
R	7RA 6250-B	0.005	0.291	0.287	1.794	0.007-0.016
R	8BA 6250-A	0.005	0.291	0.287	1.794	0.007-0.016
R	8BA 6250-B	0.005	0.291	0.287	1.794	0.007-0.016
H	0HA 6250	0.005	0.3375	0.3335	1.924	0.003-0.006
M	8MTH-6250	0.005	0.3375	0.3335	1.924	0.003-0.006
E	8EQ-6250	0.005	0.360	0.360	1.924	0.003-0.006

*0.3315 with new design exhaust free valve (8EQ-6505-C).
†Center journal runout with end journals supported.

6256 Camshaft Gear

Type of Engine	Part Number	Back Lash Between Timing Gears (Inches)	Max. Gear Face Runout (Inches)
H and M	7HT 6256-A	0.002—0.003	0.002
R	7RA 6256-A	0.002—0.003	0.002
R	8BA 6256	0.002—0.003	0.002
E	1GA 6256-A	0.002—0.003	0.002

6261-6262-6263 Camshaft Bearings

Type of Engine	Part Number	Mfg. Max. Inside Dia. (Inches)	Clearance New Camshaft and Bearings (Inches)	Max. Clearance Used Camshaft and Bearings (Inches)
R	01A 6261-A	1.7985	0.001—0.002	0.005
R	01A 6262-A	1.7985	0.001—0.002	0.005
H and M	7HA 6262	1.9285	0.001—0.002	0.005
E	8EL 6262-A	1.9285	0.0013—0.0023	
E	8EL 6263-A	1.9285	0.0013—0.0023	

6108 Piston Assemblies

Type of Engine	Piston Assembly Part Number	Type of Piston	Piston Skirt Diameter Limits (Inches)	Fitting New Piston in New Bore		Fitting New Piston in Used Bore		Fitting Used Piston in Used Bore	
				*Gage Thickness (Inches)	Pounds Pull	*Gage Thickness (Inches)	Pounds Pull	*Gage Thickness (Inches)	Pounds Pull
R (Early 1949)	49T 6108-A	Standard	3.1855-3.1865	0.003	6-12	0.003	6-12	0.004	6-12
	49T 6108-C	0.020 inch O.S.	3.2055-3.2065						
	49T 6108-D	0.030 inch O.S.	3.2155-3.2165						
	49T 6108-E	0.040 inch O.S.	3.2255-3.2265						
	49T 6108-F	0.060 inch O.S.	3.2455-3.2465						
	49T 6108-G	0.0025 inch O.S.	3.1880-3.1890						
R (Late 1949, 1950, and 1951)	8BA 6108-A	Standard	3.1879-3.1891	0.0015	3-12	0.0015	3-12	0.003	3-12
	8BA 6108-B	0.0025 inch O.S.	3.1891-3.1903						
	8BA 6108-C	0.020 inch O.S.	3.2087-3.2079						
	8BA 6108-D	0.030 inch O.S.	3.2167-3.2179						
	8BA 6108-E	0.040 inch O.S.	3.2267-3.2279						
	8BA 6108-F	0.060 inch O.S.	3.2467-3.2479						
H (1949 and early 1950)	7HA 6108-A	Standard	3.2996-3.3008	0.003	6-12	0.003	6-12	0.003	6-12
	7HA 6108-D	0.020 inch O.S.	3.3180-3.3190						
	7HA 6108-E	0.030 inch O.S.	3.3280-3.3290						
	7HA 6108-F	0.040 inch O.S.	3.3380-3.3390						
	7HA 6108-G	0.060 inch O.S.	3.3580-3.3590						
H (Late 1950 and 1951)	0HA 6108-A	Standard	3.3003-3.3015	0.002	3-12	0.002	3-12	0.003	3-12
	0HA 6108-B	0.0025 inch O.S.	3.3016-3.3028						
	0HA 6108-C	0.020 inch O.S.	3.3191-3.3203						
	0HA 6108-D	0.030 inch O.S.	3.3291-3.3303						
	0HA 6108-E	0.040 inch O.S.	3.3391-3.3403						
	0HA 6108-F	0.060 inch O.S.	3.3591-3.3603						
M (Early 1950)	8MTH 6108-A	Standard		0.0015	5-10	0.002	5-10	0.003	5-10
	8MTH 6108-B	0.0025 inch O.S.							
	8MTH 6108-C	0.020 inch O.S.							
	8MTH 6108-D	0.030 inch O.S.							
	8MTH 6108-E	0.040 inch O.S.							
	8MTH 6108-F	0.060 inch O.S.							
M (Late 1950 and 1951) E (Late 1950 and 1951)	8MTH 6108-G	Standard	3.3989-3.5009	0.0015	5-10	0.002	5-10	0.003	5-10
	8MTH 6108-H	0.0025 inch O.S.	3.5014-3.5034						
	8MTH 6108-J	0.020 inch O.S.	3.5189-3.5209						
	8MTH 6108-K	0.030 inch O.S.	3.5289-3.5309						
	8MTH 6108-L	0.040 inch O.S.	3.5389-3.5409						
	8MTH 6108-M	0.060 inch O.S.	3.5589-3.5609						
E (1949 and early 1950)	8EQ 6108-A	Standard	3.4989-3.5009	0.0015	5-10	0.002	5-10	0.003	5-10
	8EQ 6108-C	0.020 inch O.S.	3.5189-3.5209						
	8EQ 6108-D	0.030 inch O.S.	3.5289-3.5309						
	8EQ 6108-E	0.040 inch O.S.	3.5389-3.5409						

NOTE: O.S. means "oversize"

NOTE: Four pistons of each type (standard and oversize) with skirt diameter variation in steps of 0.0003 inch are used for selective fitting of 0HA and 8BA pistons.

*Use ½ inch wide feeler gauge.

6135 *Piston Pins

Type of Engine	Part Number	Mfg. Clearance in Piston (Inches)	Wear Limit Clearance in Piston (Inches)	Mfg. Clearance in Connecting Rod Bushings (Inches)
H	7HA-6135	0.0001-0.0003	0.0007	0.0001-0.0003
R	49T-6135	0.0002-0.0005	0.0007	0.0002-0.0005
E	8EL-6135	0.0001-0.0004	0.0007	0.0002-0.0005
M	8EL-6135	0.0001-0.0002	0.0007	0.0001-0.0003

*Fit pins at 70° F.

6149 Piston Rings

Engine	Clearance in Piston Grooves (Inches)			End Gap of Ring in Cylinder Bore (Inches)		Oversizes Available for Service (Inches)	When Bore Taper Does Not Exceed 0.006 Inch	When Bore Taper Is Between 0.006 and 0.015 Inches
	Top Rings	Second Rings	Lower Rings	Com-pression Rings	Oil Rings			
R	0.0015-0.0030	0.0010-0.0025	0.001-0.003	0.007-0.047	0.007-0.047	0.020, 0.030, 0.040, 0.060*	Use expander type rings	Use steel section type rings
H	0.0015-0.0030	0.0010-0.0025	0.001-0.0025	0.007-0.047	0.007-0.047	0.020, 0.030, 0.040, 0.060	Use expander type rings	Use steel section type rings
M E (Late 1950 and 1951)	0.0015-0.0030	0.0010-0.0025	0.0010-0.0030	0.008-0.047	0.007-0.047	0.020, 0.030, 0.040, 0.060	Use expander type rings	Use steel section type rings
E (1949 and Early 1950)	0.002-0.0035	0.0015-0.0035	0.0015-0.0030	0.007-0.047	0.007-0.047	0.020, 0.030, 0.040, 0.060	Use expander type rings	Use steel section type rings

*Split Skirt Piston only.

6200 Connecting Rod

Type of Engine	Connecting Rod Part Number	Mfg. Max. Diameter Crankpin End (Inches)	Mfg. Dia. Piston Pin Bushing (Inches)	Mfg. Side Clearance Total (Inches)	Max. Out-of-Round Bore (Inches)
H	7HA-6200	2.4235	0.8506	0.006-0.014	0.002
R (Early 1949)	8BA-6200	2.2910	0.7506	0.006-0.020	0.002
R (Late 1949, 1950 and 1951)	OBA-6200	2.2910	0.7506	0.006-0.020	0.002
E	8EL-6200	2.5520	0.8506	0.006-0.014	0.002
M	8MTH-6200	2.4235	0.8506	0.003-0.007	0.002

Note: Allowable bend or twist in connecting rod is 0.002 inch as checked on connecting rod aligner.

6211 Connecting Rod Bearings

Type of Engine	Connecting Rod Bearing Part Number	Undersize Bearings Available (Inches)	Mfg. Crankpin Clearance (Inches)	Bearing Crush Clearance (Inches)
H and M	7HA-6211	0.002, 0.010, 0.020, 0.030	0.0004-0.0027	0.001-0.003
R (Early 1949)	8BA-6211	0.002, 0.010, 0.020, 0.030, 0.040	0.0005-0.0030	0.001-0.003
R (Late 1949, 1950 and 1951)	OBA-6211	0.002, 0.010, 0.020, 0.030, 0.040	0.0005-0.0030	0.001-0.003
E	8EQ-6211-A	0.010, 0.020, 0.030, 0.040	0.0005-0.0025	0.001-0.003

6303 Crankshaft

Type of Engine	Crankshaft Part Number	*Mfg. Main Journal Diameter (Inches)	Mfg. Crankpin Journal Diameter (Inches)	Mfg. Crankshaft End Play (Inches)
H (Early 1949)	7HA 6303	2.8732-2.8740	2.2980-2.2988	0.004-0.008
H (Late 1949, 1950, and 1951)	8HA 6303	2.8732-2.8740	2.2980-2.2988	0.004-0.008
R	8BA 6303	2.498-2.4990	2.138-2.1390	0.002-0.006
M	8HA 6303	2.8732-2.8740	2.2980-2.2988	0.004-0.008
E	8EQ 6303	†2.8729-2.8740	2.3991-2.4000	0.004-0.008

†Front and Center journals. Rear journal — 2.8724-2.8735

*Max. allowable journal taper 0.001 inch

Max. allowable out-of-round journals 0.0015 inch.

6331 Rear Main Bearings

Type of Engine	Bearing Part Number	Nominal Size	Bearing Thickness (Inches)	Crankshaft Diameter (Inches)	Mfg. Clearance Between Bearing and Shaft (Inches)
H	0HA 6331-A	Standard	0.09575/0.09625	2.8736/2.8740	0.0004-0.0022
	0HA 6331-B	Standard	0.09615/0.09665	2.8732/2.8736	
	7HA 6331-F	Standard	0.0953/0.0958	2.8732/2.8740	0.0005-0.0032
	7HA 6331-G	0.002 inch U/S	0.0963/0.0968	2.8712/2.8720	
	7HA 6331-H	0.010 inch U/S	0.01003/0.1008	2.8632/2.8640	
	7HA 6331-J	0.020 inch U/S	0.1053/0.1058	2.8532/2.8540	
	7HA 6331-K	0.030 inch U/S	0.1103/0.1108	2.8432/2.8440	
R	8BA 6331-A	Standard	0.0852/0.0855	2.498/2.499	0.001-0.0026
	8BA 6331-C	0.010 inch U/S	0.0902/0.0905		
	8BA 6331-J	0.020 inch U/S	0.0952/0.0955		
	8BA 6331-L	0.002 inch U/S	0.0862/0.0865		
	8BA 6331-N	0.030 inch U/S	0.1002/0.1005		
	8BA 6331-U	0.040 inch U/S	0.1052/0.1055		
M	8MTH 6331-H	Standard	0.09575/0.09625	2.8736/2.8740	0.0004-0.0021
	8MTH 6331-J	Standard	0.09615/0.09665	2.8732/2.8736	
	8MTH 6331-A	Standard	0.0953/0.0958	2.8732/2.8740	0.0005-0.0032
	8MTH 6331-B	0.002 inch U/S	0.0963/0.0968	2.8712/2.8720	
	8MTH 6331-C	0.010 inch U/S	0.1003/0.1008	2.8632/2.8640	
	8MTH 6331-D	0.020 inch U/S	0.1053/0.1058	2.8532/2.8540	
	8MTH 6331-E	0.030 inch U/S	0.1103/0.1108	2.8432/2.8440	
	*8MTH 6331-F	0.020 inch U/S	0.1053/0.1058	2.8532/2.8540	
	*8MTH 6331-G	0.030 inch U/S	0.1103/0.1108	2.8432/2.8440	
E	8EQ 6331-A	Standard	0.0953/0.0958 0.09575/0.09625	2.8724/2.8735	0.0004-0.0029
	8EL 6331-A	Standard	0.095/0.0958	2.8730/2.8735	
	8EL 6331-B	0.002 inch U/S	0.0963/0.0968	2.8710/2.8715	
	8EQ 6331-B 8EL 6331-C	0.010 inch U/S	0.1003/0.1008	2.8630/2.8635	
	8EQ 6331-C 8EL 6331-D	0.020 inch U/S	0.1053/0.1058	2.8530/2.8535	
	8EQ 6331-D 8EL 6331-E	0.030 inch U/S	0.1103/0.1108	2.8430/2.8435	
	8EQ 6331-E 8EL 6331-F	0.040 inch U/S	0.1153/0.1158	2.8330/2.8335	

*Overall length 0.015 inch oversize.

6333 Front and Intermediate Main Bearings

Type of Engine	Bearing Part Number	Nominal Size	Bearing Thickness (Inches)	Crankshaft Diameter (Inches)	Mfg. Clearance Between Bearing and Shaft (Inches)
R	81A 6333-A	Standard	0.0852/0.0855	2.498/2.499	0.001-0.0026
	81A 6333-C	0.010 inch U/S	0.0902/0.0905		
	81A 6333-F	0.020 inch U/S	0.0952/0.0955		
	81A 6333-L	0.002 inch U/S	0.0862/0.0865		
	81A 6333-N	0.030 inch U/S	0.1002/0.1005		
	81A 6333-R	0.040 inch U/S	0.1052/0.1055		
H and M	0HA 6333-A	Standard	0.09575/0.09625	2.8736/2.8740	0.0004-0.0022
	0HA 6333-B	Standard	0.09615/0.09665	2.8732/2.8736	
	7HA 6333-B	0.002 inch U/S	0.0963/0.0968	2.8712/2.8720	0.0005-0.0032
	7HA 6333-C	0.010 inch U/S	0.1003/0.1008	2.8632/2.8640	
	7HA 6333-D	0.020 inch U/S	0.1053/0.1058	2.8532/2.8540	
	7HA 6333-E	0.030 inch U/S	0.1103/0.1108	2.8432/2.8440	

6338 Front Main Bearings

Type of Engine	Bearing Part Number	Nominal Size	Bearing Thickness (Inches)	Crankshaft Diameter (Inches)	Mfg. Clearance Between Bearing and Shaft (Inches)
E	8EQ 6338-A	Standard	0.0953/0.0958 0.09575/0.09625	2.8735/2.8740* 2.8729/2.8734†	0.0004-0.0029
	8EL 6338-A	Standard	0.0953/0.0958	2.8735/2.8740	
	8EL 6338-B	0.002 inch U/S	0.0963/0.0968	2.8715/2.8720	
	8EQ 6338-B 8EL 6338-C	0.010 inch U/S	0.1003/0.1008	2.8635/2.8640	
	8EQ 6338-C 8EL 6338-D	0.020 inch U/S	0.1053/0.1058	2.8535/2.8540	
	8EQ 6338-D 8EL 6338-E	0.030 inch U/S	0.1103/0.1108	2.8435/2.8440	
	8EQ 6338-E 8EL 6338-F	0.040 inch U/S	0.1153/0.1158	2.8335/2.8384	

*Marked with red color.
†Marked with blue color.

6342 Intermediate Main Bearings

Type of Engine	Bearing Part Number	Nominal Size	Bearing Thickness (Inches)	Crankshaft Diameter (Inches)	Mfg. Clearance Between Bearing and Shaft (Inches)
E	8EQ 6342-A	Standard	0.0953/0.0958 0.09575/0.09625	2.8735/2.8740 2.8729/2.8734	0.0004-0.0029
	8EL 6342-A	Standard	0.0953/0.0958	2.8735/2.8740	
	8EL 6342-B	0.002 inch U/S	0.0963/0.0968	2.8715/2.8720	
	8EQ 6342-B 8EL 6342-C	0.010 inch U/S	0.1003/0.1008	2.8635/2.8640	
	8EQ 6342-C 8EL 6342-D	0.020 inch U/S	0.1053/0.1058	2.8535/2.8540	
	8EQ 6342-D 8EL 6342-E	0.030 inch U/S	0.1103/0.1108	2.8435/2.8440	
	8EQ 6342-E 8EL 6342-F	0.040 inch U/S	0.1153/0.1158	2.8335/2.8340	

6375 Flywheel

Type of Engine	Flywheel Part Number	Max. Allowable Runout (Inches)	Max. Depth Cut for Refacing (Inches)	Max. Allowable Ring Gear Runout (Inches)
H (Early 1949)	2GA 6375*	0.005	0.045	0.010
H (Early 1949)	2GT 6375	0.005	0.045	0.010
H (Late 1949, 1950 and 1951)	8HC 6375*	0.005	0.045	0.010
H (Late 1949, 1950 and 1951) M	8HT 6375	0.005	0.045	0.010
R	8RC 6375*	0.005	0.045	0.010
R	8RT 6375	0.005	0.045	0.010
E	8EQ 6375	0.005	0.045	0.010

*114 inch wheelbase Series F-1 Truck only.

6600 6-Cylinder Oil Pump

Measurement	Dimension (Inches)
Mfg. Max. Body Inside Diameter	2.258
Wear Limit Body Inside Diameter	2.260
Mfg. Maximum Shaft Diameter	0.5195
Shaft Diameter Wear Limit	0.5170
Shaft End Play	0.008-0.012
Mfg. Max. Outer Rotor Outside Diameter	2.249
Outer Rotor Outside Diameter Wear Limit	2.246
Mfg. Clearance Outer Rotor to Pump Body .	0.005-0.010
Wear Limit Outer Rotor to Pump Body Clearance	0.012
Rotor Thickness Wear Limit	0.998
Mfg. Max. Clearance Inner to Outer Rotor	0.006
Wear Limit Inner to Outer Rotor Clearance	0.010
Mfg. Max. Clearance Inner Rotor to Cover	0.0005-0.003
Wear Limit Rotor to Cover Clearance	0.005
Max. Allowable Cover Plate Wear	0.001
Backlash Between Oil Pump and Camshaft Gears	0.003-0.005
Relief Valve Spring Pressure	12.76 Lbs. ± 2 Ounces @ 1.14 Inches

6600 8-Cylinder Oil Pump

Measurement	Dimension (Inches)	
	R Engine	E Engine
Mfg. Max. Body Inside Diameter (Inches)	2.150 (1949) 2.204 (1950-51)	2.2175
Mfg. Clearance Bushing and Shaft	0.0005-0.0025	0.0005-0.0025
Backlash Between Oil Pump and Camshaft Gears	0.003-0.005	0.003-0.005
Mfg. Clearance Oil Pump Driven Gear and Shaft	0.002-0.0035	0.002-0.0035
Max. Allowable Clearance Between Driven Gear and Housing	0.005	0.005
Relief Valve Spring Pressure	12 Lbs. ± 2 Ounces @ 1.14 Inches	12.42 Lbs. ± 8 Ounces @ 2.18 Inches

Torque Limits

Part	Torque (Foot-Pounds)		
	R Engine	H & M Engine	E Engine
Main bearing bolts	95-105	95-105	120-130
Cylinder head bolts	65-70	65-70	65-70
Oil pan to cylinder block	15-18	15-18	15-18
Oil pan to rear engine plate	10-15	10-15	
Flywheel bolts	75-85	75-85	75-85
Exhaust manifold	25-30	25-30	25-30
Intake manifold	23-28	25-30	25-30
Oil pump to cylinder block	12-15	10-15	10-15
Oil pump cover plate	7-10	7-10	7-10
Oil filter to cylinder block or head	23-28	25-30	25-30
Cylinder front cover	12-15	15-18	15-18
Water pump	23-28	27-32	30-35
Water outlet elbow	12-15	13-19	20-25
Fuel pump	6-9	15-20	23-28
Rear oil seal retainer		10-15	5-8
Valve chamber cover		4-7	
Clean out plate to oil pan	10-15	10-15	5-10
Generator bracket	55-70	30-40	55-60
Camshaft gear	15-20	15-20	15-18
Pressure plate assembly	17-20	17-20	15-18
Rear plate to block		50-60	50-60
Clutch housing to transmission	40-50	40-50	40-50
Clutch housing to block	37-42	37-42	45-50
Starter to engine rear plate	15-20	15-20	15-20
Damper to crankshaft		45-55	120-130
Conn. rod nuts	45-50	45-50	52-60
Intake to exhaust manifold		30-35	

7. CLUTCH AND TRANSMISSION

Transmission Type	Usage		Gear Type	Gear Ratios					
	Standard	Optional		1st	2nd	3rd	4th	5th	Rev.
3-Speed (Light Duty)	F-1 (1949-50 only)		All Helical	2.819	1.604	1.0			3.625
3-Speed Light Duty Remote Shift	F-1 (1951 only)		All Helical	2.78	1.62	1.0			3.63
3-Speed Heavy Duty Center Shift		F-1, 2, 3, 4, 5; F-5 C.O.E. & Sch. Bus	Helical 2nd, 3rd; Spur 1st, Rev.	3.714	1.871	1.0			4.588
3-Speed Heavy Duty Remote Shift	F-3 Par. Del. F-5 Par. Del.		Helical 2nd, 3rd; Spur 1st, Rev.	3.714	1.871	1.0			4.588
4-Speed Trans.	F-2, F-3, F-4, F-5, F-6, F-6 C.O.E.	F-1	All Spur	6.4	3.090	1.690	1.0		7.820
4-Speed Synchro-Silent	F-6 with M Engine	F-5, F-6 and F-4	Helical 2nd, 3rd, 4th; Spur 1st, Rev.	6.4	3.090	1.690	1.0		7.820
5-Speed Overdrive	F-7	F-8	Helical 3rd, 4th, O.D.; Spur 1st, 2nd, Rev.	6.060	3.50	1.80	1.0	.799	6.0
5-Speed Direct 5th	F-8	F-7	Helical 3rd, 4th, 5th; Spur 1st, 2nd, Rev.	7.58	4.38	2.40	1.48	1.0	7.51

Intermediate Gear End Play—Inches

3-Speed—Light	51A-7102	0.003-0.011
3-Speed—Heavy	8D-7102	0.003-0.016
4-Speed (Synchro-Silent) (3rd Sp. Gear)	8MTH-7101	0.003-0.016
4-Speed (Synchro-Silent) (2nd Sp. Gear)	8MTH-7100	0.005-0.024
5-Speed—Direct (4th Sp. Gear)	7EQ-7017	0.000-0.021
5-Speed—Direct (3rd Sp. Gear)	7EQ-7103	0.003-0.044
5-Speed—Overdrive (3rd Sp. Idler Gear)	7EQ-7196	0.000-0.027

Countershaft Cluster Gear End Play—Inches

Type	Part No.	Mfg.
3-Speed—Light	8M-7113	0.0045-0.0185
3-Speed—Heavy	8D-7113	0.006-0.020
4-Speed	BB-7113-A	0.009-0.021
4-Speed (Synchro-Silent)	8MTH-7113	0.006-0.020

7563 Clutch Pressure Plate

Model	Part Number	Diameter (Inches)	Spring Color	Pedal Free Travel (Inches)
F-1 (3-speed trans.)	19A-7563-A	10	Blue	1⅛-1⅜
F-1 (4-speed trans.), F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E.	51-7563-A	11	Gray	1⅛-1⅜
F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (Opt.) and School Bus (Std.)	8MTH-7563-A 81B-7563-A	11	Brown	1⅛-1⅜
F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (4-speed trans.)	8MTH-7563-A	11	Brown	1⅛-1⅜
F-7, F-8	7EQ-7563-B 8Q-7563	12	Light Blue	1⅜-1⅝

7550 Clutch Disc

Model	Part Number	Used With	Disc Diameter (Inches)	Spring Color
F-1 (3-speed trans.)	51A-7550-A	19A-7563-A	10	Gray
F-1 (4-speed trans.), F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (Except School Bus)	59T-7550-A	51-7563-A	11	Black
F-2, F-3, F-3 Par. Del., F-4, F-5, F-6 (Opt.), School Bus (Std.)	59T-7550-B	8MTH-7563-A 81B-7563-A	11	Black
F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (4-speed trans.)	59T-7550-B	8MTH-7563-A	11	Black
F-7, F-8	8Q-7550-A	8Q-7563	12	Black

8. COOLING

8005 Radiator

Type of Engine	Truck Model	Radiator Part Number	System Capacity (Quarts)
H and M	T, TH, TL, W, WH	7HT 8005-A	18
H	C, D, J, Y	8HC 8005-B	17
R	C, D, Y	8RC 8005-C	23
R	T, TH, TL, W, WH	8RT 8005-A & C	23
E	Q, QH	8Q 8005	37

8512 Water Pump Impeller

Type of Engine	Impeller Part Number	Clearance Between Impeller and Water Pump Housing (Inches)
R	8BA 8512	0.030-0.050
E	8EL 8512-B	0.040-0.050
H and M	7HA 8512	0.030-0.040

8520 Water Pump Bushing

Type of Engine	Part Number	Mfg. Clearance Between Bushing and Shaft (Inches)
R	7RA-8520-B	0.0010-0.0025

8575 Thermostats

Type of Engine	Part Number	Opens at (° F)	Fully Open (° F)
H, M and E	7HT 8575-B 7HA 8575-A3	157-162	177-182
E	8HT 8575-A	157-162	177-182
E	7HA 8575-B3	148-153	168-173
H and M	7HT 8575-C 7HA 8575-C	177-182	195
R	8RT 8575-B	148-153	168-173

8577-8620 Generator, Water Pump, and Fan Belt Deflections

Type of Engine	Belt Part Number	Truck Model	Deflection (Inches)	Location to Measure Deflection
R	21A 8577-A	C, D, Y, T, TH, TL, W, WH	½	Between fan and crankshaft pulley
E	*8EQ 8577-A	Q, QH	½	Between fan and crankshaft pulley
E	**8EQH 8577	QH	½	Between fan and crankshaft pulley
H	7HA 8620-A	C, D, J, Y	¼	Between generator and water pump
H and M	7HT 8620-A	T, TH, TL, W, WH	¼	Between generator and water pump
R	7RA 8620-C	C, D, Y	½	Between generator and left-hand water pump
R	7RT 8620-A	T, TH, TL, W, WH	½	Between generator and left-hand water pump
E	8EL 8620-A	Q, QH	½	Between generator and water pump

*Do not use with air compressor.
**Use with air compressor.

9. FUEL SYSTEM

9510 Carburetor

		Carburetor Part Number					
		7HT 9510-A	7HW 9510	8RT 9510-A 7RT 9510-A	8EQ 9510-A 8EQH 9510-A&E	8MTH 9510-A	8MWH 9510-A
Type of Engine		H	H	R	E	M	M
Truck Model		C, D, Y, T, TH, TL	J, W, WH	C, D, Y, T, TH, TL, W, WH	Q, QH	TH	WH
Main Metering Jet Sizes (Inches)	Standard	0.064	0.064	0.051	0.054	0.064	0.064
	5000 to 10,000 feet altitude	0.062	0.062	0.049	0.052	0.062	0.062
	10,000 to 15,000 feet altitude	0.060	0.060	0.047	0.050	0.060	0.060
Float Setting Using Float Level Gauge (Inches)		1.322-1.353	1.180-1.200	1.322-1.353	⅛-3/16	1.283-1.315	1.180-1.200
Nozzle Bar Part Number		1GA 9922		91A 9922-B 91A 9923-B			
Part Number of Drilled Part		7HA 9518		8BA 9518	8EQ 9518 8EQH 9518	8MTH 9518	8MWH 9518
Upper Idle Discharge Holes	Drill Number	53	53	60 & 65	63	53	53
	Size (Inches)	0.0595	0.0595	0.040 & 0.035	0.0387	0.0595	0.0595
Lower Idle Discharge Holes	Drill Number	63	63	56	56	63	63
	Size (Inches)	0.037	0.037	0.0465	0.0465	0.037	0.037
Power Valve Vacuum Limits for Opening (Inches Hg)		6½-7½	6½-7½	6-6½	6½-7½	6½-7½	6½-7½
Upper Distributor Vacuum Hole	Drill Number	56	56	56	65	56	56
	Size (Inches)	0.0465	0.0465	0.0465	0.035	0.0465	0.0465
Lower Distributor Vacuum Hole	Drill Number	55	55	55	54	55	55
	Size (Inches)	0.052	0.052	0.052	0.055	0.052	0.052

9350 Fuel Pump

Type of Engine	Fuel Pump Part Number	Pressure (Pounds per Square Inch)	Vacuum (Inches of Hg)	Max. Allowable Time to Pump One Pint at Idle R.P.M. (Seconds)
H and M	7HA 9350-B	4-5	10½	45
R	*7RA 9350-C	3½-4½	10	45
R	**7RA 9450-E	3½-4½	10	45
H and M	1HA 9350	4-5	10½	45
R	1RA 9350	3½-4½	10	45
E	8EQ 9350-A	3½-4½	10	45

*Standard except in the state of California.
**Standard in the state of California only.

9002 Fuel Tank

Truck Model	Part Number	Capacity (Gallons)
C, D, Y, T, TH, TL, W, WH, Q, QH (Closed Cab)	7C 9002	20
C, D, Y (Panels)	7HC 9002	17
C, D, J, Y (Panels)	8C 9002	17.12
T, TL, TH, Q, QH	*8T 9002-A—†7RT 9002	25
T, TH, 194" School Bus	7R4T 9002	30

*1951 †1948-50

10. GENERATING SYSTEM

10.000 Generator

GENERATOR ELECTRICAL SPECIFICATIONS							GENERATOR MECHANICAL SPECIFICATIONS					
Part Number	Watts	Eng. R.P.M. Chg. Starts	Max. Rate Amp.	Max. Rate Eng. R.P.M.	Field	Armature	Pulley O.D. (In.)	BRUSHES No.	BRUSHES Orig. Length (In.)	BRUSHES Spring Tension (Oz.)	Pulley No.	Mounting Bracket No.
8BA-10000-D	245	400	35	900	81A-10175	8BA-10005-A	3.32	2	.86	24-36	8BA-10130-H	8BA-10151-C
8EQ-10000-A	285	580	40	1070	7RA-10175	8EH-10005	3.32	2	.86	24-36	8RY-10130-A3	7EH-10151
8HA-10000-A	245	390	35	890	81A-10175	8BA-10005-A	3.08	2	.86	24-36	8HA-10130-A3	7HA-10151
8HC-10000-A, C	245	415	35	940	81A-10175	8BA-10005-A	3.32	2	.86	24-36	8HC-10130-A3	8BA-10151-A
8HT-10000-A, C	245	490	35	1110	81A-10175	8BA-10005-A	3.92	2	.86	24-36	8HT-10130-A3	8HA-10151-A
8RC-10000	245	415	35	935	81A-10175	8BA-10005-A	3.32	2	.86	24-36	8BA-10130-A3	8BA-10151-C
8RT-10000-C	245	520	35	1180	81A-10175	8BA-10005-A	3.92	2	.86	24-36	8RT-10130-A3	8BA-10151-C
8RY-10000-C	245	415	35	1000	81A-10175	8BA-10005	3.32	2	.86	24-36	8RY-10130-A3	8BA-10151-C
8BA-10001-E	285	400	40	1000	7RA-10175-B	8EH-10005	3.09	2	.86	24-36	8BA-10130-H	8BA-10151-C
8HA-10001-C	285	400	40	1000	7RA-10175-B	8EH-10005	3.08	2	.86	24-36	8HA-10130-A3	7HA-10151
8H4T-10000-A	320	520	45	1100	7RA-10175-B	8EH-10005	3.32	2	.86	24-36	8HC-10130-A3	7HA-10151
8BA-10002-C*	425	270	60	580	8BA-10175-B	8BA-10027	3.20	4	1.10	24-36	8BA-10130-B2	8BA-10151-B
8EL-10002-B	285		40		7RA-10175-B	8EH-10005		2	.86	24-36		
OHA-10000-A	245	390	35	890	7RA-10175-A	OA-10005-A	3.08	2	.86	26-34	8HA-10130-A3	**
OHA-10000-B	285	390	40	1060	81A-10175	8EH-10005	3.08	2	.86	26-34	8HA-10130-A3	**

*Installed on 8 cyl. **Mounting provisions provided on end plates.

10505 Generator Regulator

Part Number	Type	Cut In Voltage Min.	Cut In Voltage Max.	Voltage Regulation Min.	Voltage Regulation Max.	Amp. Regulation Min.	Amp. Regulation Max.	Replace In Service By
5EH-10505-C	Standard Tropical	6.6	7.0	7.2	7.6	38	42	8L-10505
*51A-10505-C2, A2	Standard	6.0	6.3	7.0	7.3	30	33	8A-10505
*51A-10505-D2, B2	Tropical	6.0	6.3	6.8	7.1	30	33	8A-10505
51A-10505-A1	Standard & Tropical	6.6	7.0	7.2	7.6	30	34	8A-10505
51A-10505-H	Standard	6.6	7.0	7.2	7.6	34	38	8M-10505
51A-10505-J	Tropical	6.6	7.0	7.0	7.4	34	38	8M-10505
8BA-10505-A	Special	5.9	6.2	7.1	7.3	55	60	
8A-10505	Standard	6.0	6.6	7.2	7.6	30	34	
8M-10505	Standard	6.0	6.6	7.2	7.6	34	38	
8L-10505	Standard	6.0	6.6	7.2	7.6	38	42	
8R4T-10505	School Bus	6.0	6.6	7.2	7.6	43	47	

*Cold Setting Voltage. All other regulator voltage settings are for regulator at normal operating temperature in ambient (surrounding air) temperature of 70-80° F.

10655 Batteries

Part Number	Volts	Plates	Amp. Hours*
01A-10655-A	6	17H	120
01A-10655-C	6	15H	100
81A-10655-A2	6	17L	100
81A-10655-B2	6	15L	90

H—High Plates. L—Low Plates. *—Amp. hrs. @ 20 hr. rate.

11. STARTING SYSTEM

11002 Starting Motor

Part Number	Normal Engine Cranking Speed	Max. Torque		Teeth in Pinion	Teeth in Ring Gear	Gear Ratio	No Load Amperage
		Pound Ft.	Load (Amp.)				
7RA-11001	100	15	550	10	112	11.2	45-60
7HA-11001	100	15	550	10	112	11.2	45-60
8EQ-11001 A & B	100	15	550	10	120	12	45-60
8HA-11001	100	15	550	9	114	12.7	45-60
1BA-11001-A	100	15	550	10	112	11.2	45-60
1HA-11001-A	100	15	550	9	114	12.7	45-60

11350 Starter Drive

Part Number	Type	Teeth Pinion	Used On
B-11350	Spring	10	7RA-11001, 7HA-11001-A, 1BA-11001-A
29B-11350	Barrel	10	8EQ-11001
8HA-11350	Spring	9	8HA-11001

11005 Armature

Part Number	Used On
18-11005	1BA, 1HA-11001-A 7RA, 7HA-11001
52-11005	8EQ-11001

11083-5 Field Coils

Part Number	Used On
18-11083-L.H.	All
18-11085-R.H.	All

11005 Brushes

Part Number	Mfg. Length (Min.) (Inches)	Wear Limit (Inches)	Brush Spring Tension (Ounces)
18-11055	0.455	0.330	48-56

12. IGNITION

12120 Distributor Base Upper Bushing

Type of Engine	Bushing Part Number	Mfg. Outside Dia. Limits (Inches)	Mfg. Inside Dia. Limits (Inches)
H, M and R	7RA-12120	0.7485-0.7490	0.4685-0.4695
E	8EQ-12120	Upper 0.7485-0.7490 Lower 0.6615-0.6620	0.4685-0.4690

12175 Distributor Shaft and Cam Assembly

Type of Engine	Part Number	Mfg. Min. Dia. (Inches)	End Clearance (Inches)
H	7HA-12175-A-B	0.4675	0.002-0.005
R (1949 and Early 1950)	7RA-12175-C	0.4675	0.002-0.005
R (Late 1950 and 1951)	OBA-12175	0.4675	0.002-0.005
E	8EQ-12175	0.4675	0.002-0.005

12029 Coil

Type of Engine	Coil Part Number	Primary		Secondary		Ignition Coil Amperage Draw	
		No. Turns	Resistance (Ohms)	No. Turns	Resistance (Ohms)	Engine Stopped	Engine Idling
All	8BA-12029	240	1.05-1.15 (75° F)	21000	4100 (75° F)	5.0-5.5	2.75-3.0

12300 Condenser

Type of Engine	Part Number	Capacity (Microfarads)	Min. Leakage (Megohms)	Max. Series Resistance (Ohms)
All	7RA-12300-C	*0.21-0.25	5	**1

*At room temperature (70° F).
**Measured on a Ford Distributor Stroboscope.

12405 Spark Plugs

Type of Engine	Part Number	Type	Size	Gap (Inches)	Torque (Ft.Lbs.) Cast Iron Head
All	OIT-12405	H-9	14 MM	0.025-0.028	24-30

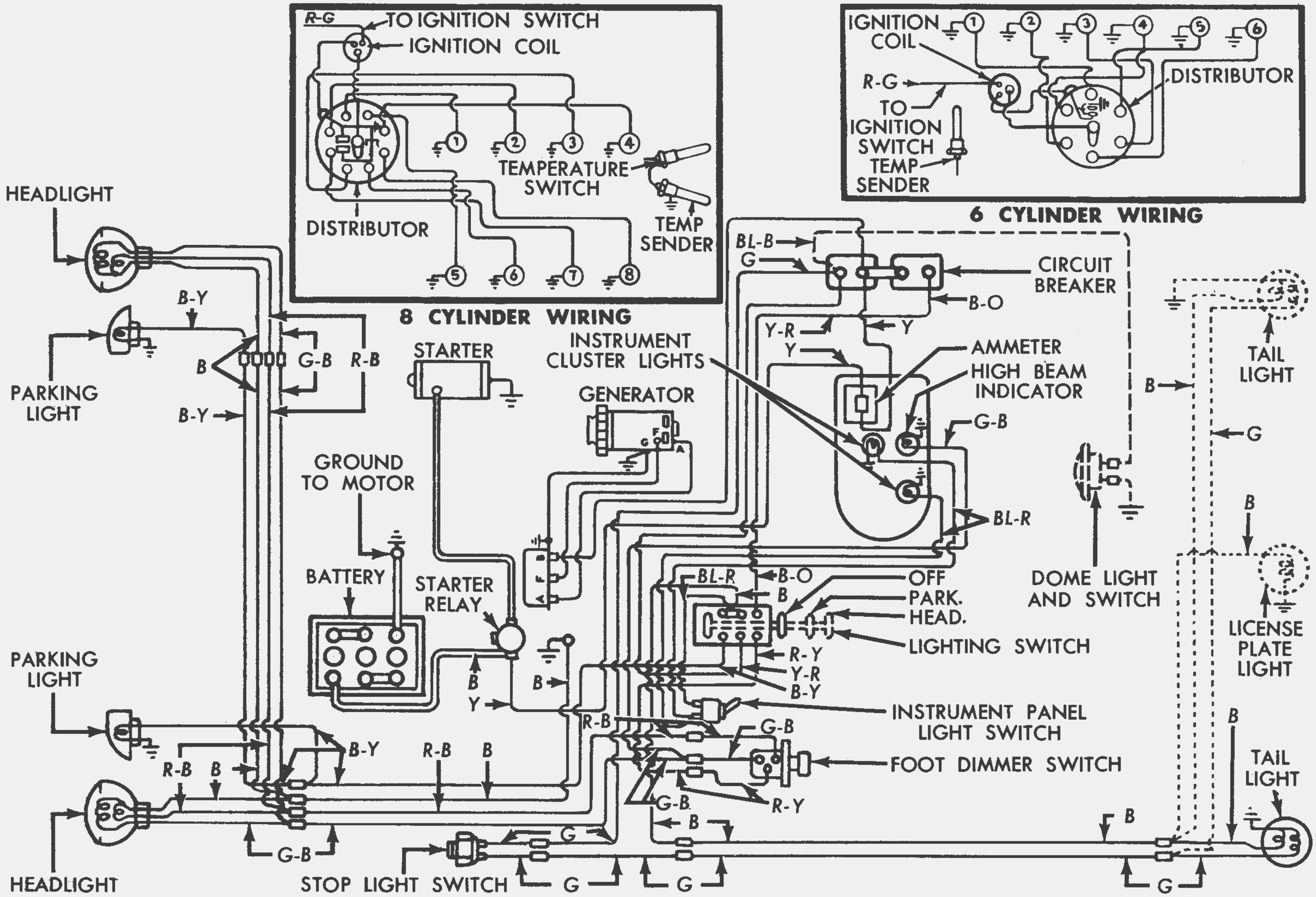
12127 Distributor

Type of Engine	Distributor Part Number	Initial Advance Crank-shaft Degrees BTC	Distributor Advance W.O.T.			Total Advance W.O.T. Crankshaft Degrees		Breaker Arm Spring Tension (Ounces)	Point Gap (Inches)	Dwell Contact at Idle Speed (Percent)	Advance Characteristics		Vacuum (Inches of Mercury)	Distributor Vacuum at Carburetor	
			Crankshaft Degrees Min.	Crankshaft Degrees Max.	Engine R.P.M.	Min.	Max.				Distributor R.P.M.	Distributor Degrees		Engine R.P.M.	Vacuum (Inches Hg)
H	7HA 12127	0	21	23	4000	21	23	17-20	0.024-0.026	58-63	200 500 1000 1500 2000	0 -0 1¾-3 5½-6¾ 11½-13 8½-9¾ 10½-11½	0 0.4 1.4 5.5 2.9 4.1	800 1000 2200 2400	0.5-0.7 1.2-1.6 4.8-6.6 4.9-6.7
R (Early 1949)	7RA 12127-C	2	15	17	4000	17	19	17-20	0.014-0.016	58-63	200 500 1000 1500 2000	0-0 1¼-2¼ 4¼-5¼ 6¼-7¼ 7½-8½	0 0.4 1.7 2.8 3.7	800 1000 2200 2400	2.0-2.9 3.5-4.8 4.7-6.4 4.6-6.2
R (Late 1949 and Early 1950)	8BA 12127	2	20	22.5	4000	22	24.5	17-20	0.014-0.016	58-63	200 500 1000 1500 2000	0-0 0-1 5.2-6.2 8¾-10 10-11¼	0 0.30 1.32 2.85 3.7	800 1000 2200 2400	2.0-2.9 3.5-4.8 4.7-6.4 4.6-6.2
R (Late 1950 and 1951)	OBA 12127	2	20	22.5	4000	22	24.5	17-20	0.014-0.016	58-63	200 500 1000 1500 2000	0-0 0-1 5.2-6.2 8¾-10 10-11¼	0 0.30 1.32 2.85 3.7	800 1000 2200 2400	2.0-2.9 3.5-4.8 4.7-6.4 4.6-6.2
E	8EQ 12127-B	4	20½	22½	3200	24½	26½	17-20	0.014-0.016	58-63	200 400 1000 1600	0-0 1½-3 7¼-8¼ 10¼-11¼	0 0.25 1.3 2.7		
M	8MTH 12127	0	18½	20½	3200	18½	20½	17-20	0.024-0.026	58-63	200 500 1000 1400 1600	0-0 2-3 6¼-7¼ 10½-12 9¼-10¼	0 0.4 1.3 3.6 2.6		

13. HEAD LIGHTS

Headlights

Model	Headlight Height Inches		Center Line of Truck to Headlight Inches	
	1949-50	1951	1949-50	1951
F-1 (6.50-16)	30⅛	30 5/16	19⅞	23 13/16
F-2 (7.50-16)	32	31 13/16	19⅞	23 13/16
F-3 (7.00-17)	32	32 7/16	19⅞	23 13/16
Parcel Deliv. F-3 (7.50-17)	37.04	37 1/16	24⅞	23 13/16
F-4 (7.00-18)	34½	35⅛	19⅞	23 13/16
F-5, F-6 (7.50-20)	36	36 11/16	19⅞	23 13/16
F-5, F-6 C.O.E. (7.50-20)	35½	36¾	24⅞	23 13/16
F-7 (9.00-20)	39¼	40 3/16	24⅞	23 13/16
F-8 (10.00-20)	40	40 9/16	24⅞	23 13/16



KEY TO ABBREVIATIONS

B—Black	G—Green
B-O—Black with Orange Tracer	*G-B—Green with Black Tracer*
B-Y—Black with Yellow Tracer	*R-B—Red with Black Tracer*
BL-B—Blue with Black Tracer	*R-Y—Red with Yellow Tracer*
BL-R—Blue with Red Tracer	*Y—Yellow*

Y-R—Yellow with Red Tracer

PANEL & DELUXE CAB, ONLY ————

PANEL TRUCK ONLY - - - - - -

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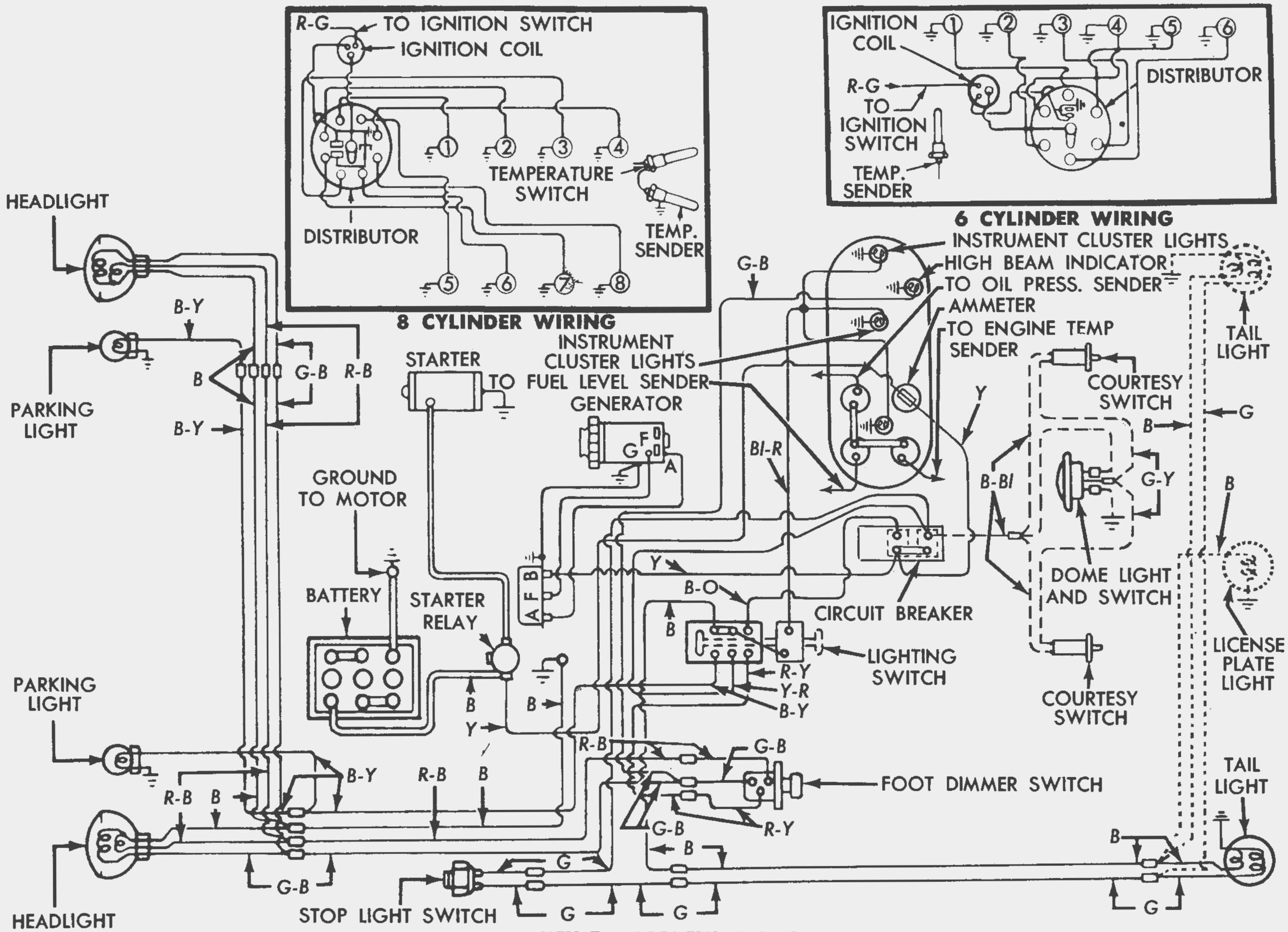
Fig. 1—Circuit Diagram (1949-1950)



KEY TO ABBREVIATIONS

B—Black	*G—Green*
B-BL—Black with Blue Tracer	*G-B—Green with Black Tracer*
B-O—Black with Orange Tracer	*R-B—Red with Black Tracer*
B-Y—Black with Yellow Tracer	*R-Y—Red with Yellow Tracer*
BL-B—Blue with Black Tracer	*Y—Yellow*
BL-R—Blue with Red Tracer	*Y-R—Yellow with Red Tracer*

PANEL & DELUXE CAB, ONLY ————
PANEL TRUCK ONLY ---------

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Fig. 2—Circuit Diagram (1951)

15. TOOLS AND EQUIPMENT

Throughout this manual the use of various tools and equipment is involved in the performance of the service operations described. These tools and the equipment permit you to do the job better and in some instances the operation can not be satisfactorily performed without the particular tool or its equivalent.

The labor saved by the use of special tools generally amounts to savings far in excess of the cost of the tool.

Any shop performing services on Ford cars will find it is advisable to secure these tools or their equivalent.

The inclusion of the names of the particular manufacturers shown should not be interpreted as a reflection against any other tools or equipment or manufacturer. The Ford Motor Company's interest in this respect lies in its desire to help service organizations of all kinds to better serve Ford products.

The numbers shown in the various columns are the tool suppliers' number by which they identify the particular tool. Where a tool number appears under more than one tool suppliers' name, each supplies a tool for the same purpose. In the case of tools, the number agrees with the basic part number of the part or assembly on which the tool is used.

Test Equipment

Diagnosis Test Set — Stroboscopic Timing Light — Distributor Stroboscope — Headlight Tester and Stand
Regulator—Generator Test Stand — Battery Charge Teste1
Supplier: Heyer Products Company, Belleville, New Jersey

Tool List

Supplier		Name	Illus. on Page No.
Manzel	K. R. Wilson		
1175-AA		Oil Seal Puller—Universal Type	
1175-B		Remover—rear hub grease retainer and front and rear pinion bearing cup	165
1175-D		Replacer—pinion shaft oil seal	172
1175-E		Replacer—rear axle oil seal	—
2296		Spreader—rear brake return spring	232
3110-G		Reamer—king pin bushing—upper	—
3110-H		Reamer—king pin bushing—lower	—
3115-B		Remover—king pin	198
3130		Remover—steering arm	—
4000-A		Spreader—differential housing	164
4020-A		Gauge—pinion depth	166
4221-C		Remover—differential bearings	165
4221-K		Remover—differential bearings	170
4235		Remover—axle shaft and bearing	164
4625-D		Remover—drive pinion pilot bearing	171
4658-B		Replacer—pinion bearing and companion flange	—
4839		Remover—drive pinion flange	171
4851		Holder—drive pinion flange	170
4858		Remover—companion flange	165, 167
	6005-N	Remover and replacer—camshaft bearings	67, 68
6254-B		Replacer—camshaft oil pump gear	67
6254-C		Remover—camshaft oil pump gear	67
6256-AA		Drill fixture and drill—timing gear	—
6256-AB		Remover—timing gear	33, 51
6256-BB		Replacer—timing gear	34, 51
6261		Remover and replacer—camshaft bearing	35
6306-C		Replacer—crankshaft gear and damper	36
6306-G		Remover—crankshaft gear	36, 68, 86
	6306-N	Replacer—crankshaft gear	36, 68, 86

Supplier		Name	Illus. on Page No.
Manzel	K. R. Wilson		
	6306-P	Remover—crankshaft gear	36
6316-D		Remover—vibration damper	30, 47
	6316-N	Remover—vibration damper	30, 47
6510-B		Remover—valve stem guide	32
6510-D		Reamer—valve stem guide	32
6510-H		Replacer—valve stem guide	32
	6510-N	Replacer—valve guide	32
	6510-O	Remover—valve stem guide	32
6513-A		Lifter—valve	31
6518		Replacer—valve locks	31
	6518-N	Replacer—valve stem locks	31
	6614-N	Remover—oil pump and distributor drive gear	67
6656-B		Remover—oil pump idler shaft	—
	6656-N	Remover—idler shaft oil pump gear	—
7025-C		Remover—main drive shaft bearings	150
7025-D		Stop Yoke—main gear bearings	152
7063		Remover—snap ring	—
7065-A		Replacer—main drive shaft bearings	153
7111-A		Countershaft dummy	150
7140		Remover—Idler gear countershaft and shifter arm shaft	157
9350		Assembly tool—fuel pump rocker arm	—
9350-A		Flexing tool—fuel pump vacuum diaphragm	—
9524		Assembly tool—carburetor air horn	117
9550-B		Gauge—fuel level	108
10505-C-2		Wrench—generator regulator adjusting	258, 259
	12132-P	Replacer—distributor shaft bushings	101
	12132-Q	Burnisher—distributor drive shaft bushings	102
12150-A		Wrench—distributor adjustment	97, 98
	12150-N	Wrench—distributor adjustment	97, 98
	12151-N	Tension scale—distributor points	96

Supplier Address

Manzel Inc., 315 Babcock Street, Buffalo, N. Y. — K. R. Wilson, 215 Main Street, Buffalo, N. Y.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

1952 FORD

F-SERIES TRUCKS

SHOP MANUAL

SUPPLEMENT

FORD DIVISION
FORD MOTOR COMPANY

FORM 7099-52D

April, 1952

FOREWORD

The information presented in this manual supplements that given in the 1949-50-51 Truck Shop Manual. The service procedures in this supplement cover only the three new truck engines: the 6-cylinder, 215 cubic inch; the 8-cylinder, 279 cubic inch; and the 8-cylinder, 317 cubic inch top-valve engines. Since service procedures for repairing the 279 and 317 cubic inch engines are almost identical, they are covered in a single Chapter.

Specifications are given for all parts and systems of the 1952 trucks.

You will note that the Chapters are listed in the same manner as they were in the 1949-51 Shop Manual. PART ONE—POWER PLANT contains the two engine Chapters and the Ignition, Fuel, and Cooling Chapter. PART FIVE—SPECIFICATIONS has only one Chapter which carries the same number as the Specifications Chapter (III) in the 1949-51 Manual.

Chapter I "EAG Series 215 Cubic Inch 6-Cylinder Engine" contains complete repair procedures for this engine.

Chapter II "8-Cylinder 317 Cubic Inch and 279 Cubic Inch Engines" contains the procedures for repairing or overhauling these engines.

Chapter III "Ignition, Fuel, and Cooling System" gives repair procedures for each of these systems on the new engines.

PART FIVE, Chapter III "Specifications" presents specifications on all the 1952 truck components.

Torque wrench specifications are presented immediately following the Table of Contents.

The Table of Contents provides a convenient index so you can readily locate the information you desire. The Chapters are divided into sections covering major components or sub-assemblies and each of these sections has a page reference which will direct you to the portion of the manual in which you are interested.

Throughout the supplement, the top of each left-hand, even-numbered page shows the name of the Chapter and the top of each right-hand, odd-numbered page presents the name of the section involved. Regardless of where you open the manual, a glance at the top of the two pages will tell you exactly what subject is discussed at that point.

FORD DIVISION
FORD MOTOR COMPANY
SERVICE DEPARTMENT

TABLE OF CONTENTS

Part ONE — POWER PLANT

CHAPTER I—EAG SERIES 215 CUBIC INCH 6-CYLINDER ENGINE

CHAPTER II—8-CYLINDER 317 CUBIC INCH AND 279 CUBIC INCH ENGINES

CHAPTER III—IGNITION, FUEL, AND COOLING SYSTEMS

Part FIVE — SPECIFICATIONS

CHAPTER III—SPECIFICATIONS

TORQUE WRENCH SPECIFICATIONS (FT. LBS.)

STEERING

Steering Gear to Frame Bolts	45-60
Steering Gear Sector Shaft Housing Attaching Screws	22-28
Steering Column Clamp Bolt	12-15
Steering Gear Housing Cap to Housing Screws	12-15

Steering Gear Arm to Sector Shaft Nut	115-125
Steering Wheel Attaching Nut	50-60
Spindle Connecting Rod Sleeve to Clamp Bolts	*

(*) 5/16 Bolt—15-20 foot-pounds; 3/8 bolt—25-30 foot-pounds.

REAR AXLE

Ring Gear to Differential Case Bolt	3/8-24	Integral Housing Hypoid—Truck	40-50
Differential Gear Case Bolt	3/8-16	Split Housing	28-35
Differential Gear Case Bolt	1/2-13	Heavy Split Housing	78-88
Differential Assembly Nut	1/2-20	Split Housing Hypoid	96-106
Differential Assembly Bolt	7/16-14	Planetary Two-Speed	49-58
Differential Drive Gear Assembly Nut	7/16-20	Planetary Two-Speed	62-69
Differential Assembly Bolt	1/2-13	Heavy Planetary Two-Speed	78-88
Differential and Drive Gear Assembly Nut	9/16-8	Banjo Housing	135-150
Drive Pinion Support Assembly Bolt	3/8-24	Split Housing	23-30
Drive Pinion Support Assembly Bolt	9/16-12	Heavy Split Housing	83-97
Drive Pinion Support Assembly Bolt	9/16-12	Planetary Two-Speed	87-97
Driving Pinion Support Assembly Nut	7/16-20	Split Housing Hypoid	38-45
Driving Pinion Support Assembly Bolt	9/16-12	Banjo Housing	87-97
Differential Carrier Head Assembly Bolt	7/16-14	Planetary Two-Sneed	35-44
Differential Carrier Head Assembly Bolt	5/8-11	Heavy Planetary Two-Speed	122-137
Axle Housing Nut	7/16-20	Heavy Split Housing, also Hypoid	38-45
Axle Housing Nut	3/8-24	Split Housing	20-26
Axle Housing Nut	1/2-20	Heavy Split Housing Hypoid	41-56
Driving Pinion Yoke Nut	7/8-20	Split Housing	250-300
Driving Pinion Yoke Nut	1″-20	Split Housing (All Types)	300-350
Driving Pinion Yoke Nut	1 1/4-12	Banjo Housing	700-900
Axle Shaft Flange Nut	7/16-20	Split Housing (All types except Heavy Split Hypoid)	62-69
Axle Shaft Flange Nut	1/2-20	Heavy Split and Banjo Housing	84-93
Driving Pinion Yoke Nut	3/4-16	Integral Housing Hypoid	100-150

SPRING CLIP NUT

Model	Front	Rear
F-1	108-125	108-125
F-2, F-3, F-3 Par. Del.	108-125	165-185

Model	Front	Rear
F-4, F-5, F-6	108-125	285-310
F-5, C.O.E., F-6, C.O.E., F-7 & F-8	165-185	285-310

ENGINES

Part / Engine (Cu. In.)	215	239	254	279 and 317
Main bearing bolts	95-105	95-105	95-105	120-130
Cylinder head bolts	65-70	65-70	65-70	80-90
Oil pan to cylinder block	—	15-18	15-18	—
Oil pan to rear engine plate	—	10-15	10-15	—
Flywheel bolts	75-85	75-85	75-85	75-85
Exhaust manifold	23-28	25-30	25-30	23-28
Intake manifold	23-28	23-28	25-30	23-28
Oil pump to cylinder block	30-35	12-15	10-15	12-15
Oil pump cover plate	7-10	7-10	7-10	7-10
Oil filter to cylinder block or head	17-23	23-28	25-30	17-23
Cylinder front cover	7-10	12-15	15-18	23-28
Water pump	23-28	23-28	27-32	23-28
Water outlet	23-28	12-15	13-19	23-28
Fuel pump	10-15	6-9	15-20	23-28

Part / Engine (Cu. In.)	215	239	254	279 and 317
Rear oil seal retainer	—	—	10-15	—
Valve chamber cover	8-10	—	4-7	8-10
Clean out plate to oil pan	—	10-15	10-15	—
Generator bracket	30-40	55-70	30-40	23-28
Camshaft gear	45-50	15-20	15-20	23-28
Pressure plate assembly	17-20	17-20	17-20	17-20
Rear plate to block	—	—	50-60	—
Clutch housing to transmission	23-28	40-50	40-50	50-70
Clutch housing to block	45-50	37-42	37-42	45-50
Starter to engine rear plate	15-20	15-20	15-20	15-20
Damper to crankshaft	45-55	—	45-55	55-60
Conn. rod nuts	45-50	45-50	45-50	45-50
Intake to exhaust manifold	23-28	—	30-35	—

Part ONE

POWER PLANT

Chapter

I

EAG Series 215 Cubic Inch 6-Cylinder Engine

The EAG series truck 6-cylinder engine has a displacement of 215 cubic inches. The engine is rated at 101 horsepower with a $3\frac{9}{16}$ inch cylinder bore and a 3.6 inch stroke. The exterior features of the engine are illustrated in figs. 1 and 2.

Complete removal, repair, and installation procedures covering all the component parts of this engine as listed above are included in this Chapter.

Always use new gaskets when making repairs or replacements. A complete engine overhaul gasket kit is available for service.

1. ENGINE REMOVAL AND INSTALLATION

The EAG series 215 cubic inch 6-cylinder engine is standard equipment in F-1 through F-5 conventional model trucks, in the F-3 parcel delivery truck, and in the F-6 School Bus. Procedures for its removal and installation from each model are given under "**a.** Conventional Truck" and "**b.** Parcel Delivery Truck." The procedures include mounting the engine on a work stand.

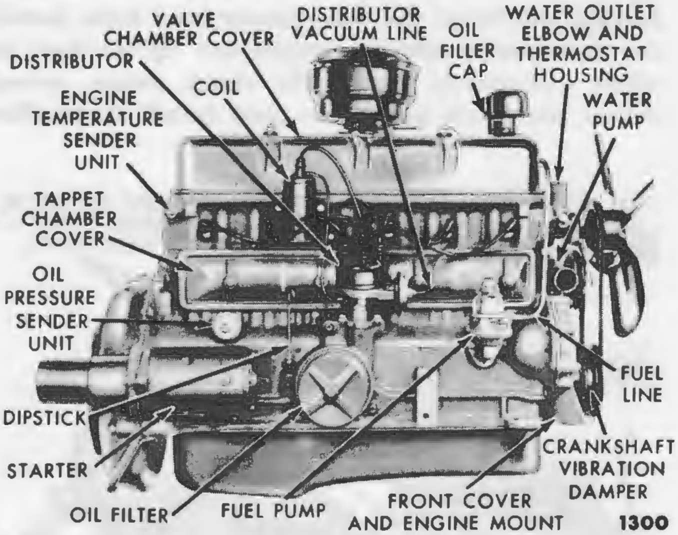

Fig. 1—EAG Series Engine (Right Hand View)

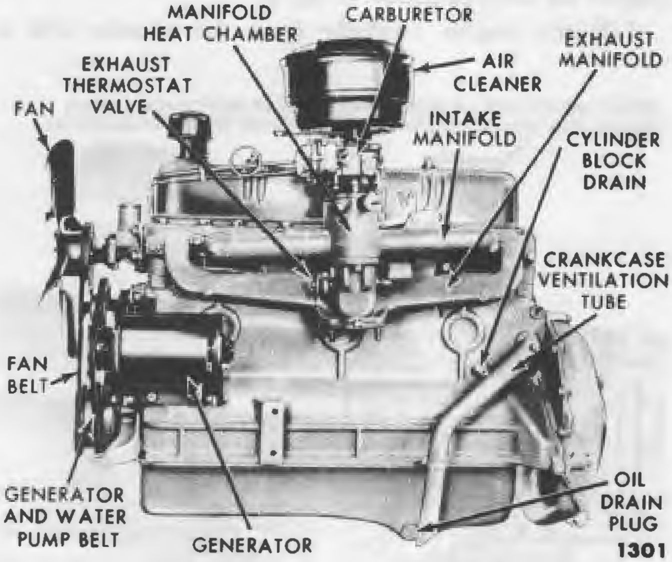

Fig. 2—EAG Series Engine (Left Hand View)

a. Conventional Truck.

The procedure for removing the engine from the conventional truck will also apply to the school bus chassis.

(1) *REMOVAL.* Drain the coolant from the radiator and engine. Remove the hood. Disconnect the battery ground cable at the engine. Disconnect the engine temperature sending unit wire, the oil pressure sending unit wire, and the ignition primary coil wire. Disconnect the cable at the starter motor.

Disconnect the generator wires and the windshield wiper vacuum hose. Disconnect the choke control, hand throttle control, and accelerator rod and spring at the carburetor. Remove the air cleaner and tape the carburetor opening closed. Disconnect the radiator upper hose at the engine, the lower hose at the radiator, and the heater hose at the engine.

Remove the fan and bracket assembly and the fan belt. Remove the fan shroud and the radiator. Disconnect the muffler inlet pipe and pull the pipe away from the manifold. Shut off the fuel valve at the tank and disconnect the flexible line to the fuel pump.

NOTE: ***If the engine and transmission are to be removed as an assembly, disconnect the driveshaft and pull it out of the transmission extension. Remove the transmission extension support bolts. Use the rear notch in the lift bracket for proper engine balance.***

If the engine is to be removed without the transmission, remove the transmission retaining bolts and disconnect the clutch return spring. Support the transmission with a jack.

Remove the engine front support nuts. Install the engine lift bracket shown in fig. 3.

Lift the engine carefully from the chassis with a portable crane (fig. 4). Do not allow the engine to damage engine compartment or grille sheet metal.

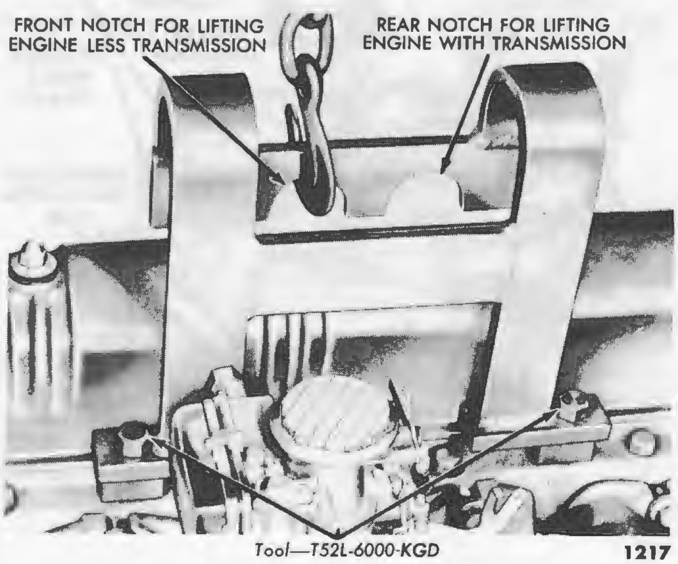

Fig. 3—Engine Lift Bracket

Fig. 4—Removing Engine

Mount the engine on a work stand using the proper engine stand adaptor (fig. 5). Remove the engine lift bracket.

(2) *INSTALLATION.* Install the lift bracket, take up the weight of the engine with a portable crane, and remove the engine from the work stand. Install the engine in the chassis.

NOTE: ***After the transmission shaft enters the clutch bearing and plate, it may be necessary to place the transmission in gear and rotate the crankshaft to permit the splines to enter the clutch disc.***

Install the engine front support washers and nuts and tighten the nuts. Install cotter pins. Remove the lift bracket and install the two cylinder head bolts. Install the transmission retaining screws and tighten them to 45-50 foot-pounds. Install the clutch return spring. Adjust the clutch pedal free play. Install the muffler

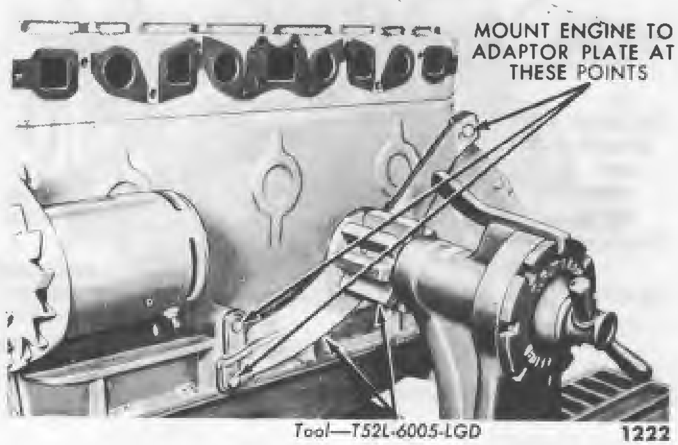

Fig. 5—Mounting Engine on Work Stand

inlet pipe with a new gasket. Install the lockwashers and nuts and tighten the nuts to 23-28 foot-pounds.

Install the radiator. Attach the shroud to the radiator and connect the radiator and heater hose. Install the fan and bracket assembly. Intall the fan belt and adjust the belt tension.

Connect the flexible fuel line to the fuel supply line and turn on the fuel valve at the tank.

Connect the accelerator rod and spring, the choke wire, the hand throttle, and the vacuum hose at the carburetor. Install the air cleaner. Connect the generator wires. Connect the ignition coil wire, the engine temperature sending unit wire, and the oil pressure sending unit wire. Connect the starter cable and the battery ground cable.

Install the hood. Fill the radiator with coolant. Warm up the engine and check for coolant leaks and oil leaks. Adjust the valve lash. Adjust the carburetor idle. Check the ignition timing.

b. Parcel Delivery.

Parcel delivery trucks require the engine to be removed through the side door.

(1) *REMOVAL.* Remove the engine compartment rear cover and latch open the front cover. Drain the coolant from the radiator and engine. Remove the radiator support bar. Disconnect the upper and lower radiator hose. Remove the shroud from the radiator and hang the shroud over the fan. Remove the radiator support assembly with the radiator. Remove the shroud. Remove the weatherstrip retaining panel at the rear edge of the engine compartment opening.

Remove the air cleaner and flexible tube. Disconnect the generator wires, the ignition coil primary wire, oil pressure sending unit wire, engine temperature sending unit wire, vacuum hose, starter cable, and battery ground cable. Disconnect throttle linkage, choke wire, and heater hose.

Disconnect the muffler inlet pipe and pull it away from the manifold. Disconnect the clutch return spring and the hand brake cable where it is clipped to the transmission. Disconnect the flexible fuel pump line.

Install the engine lift bracket (fig. 3). Project the lift arm of the portable floor crane through the right hand door and take up the load of the engine with the crane. Remove the engine front support nuts. Remove the bolts securing the transmission to the flywheel housing. Support the transmission with a jack.

Move the engine far enough forward to clear the transmission mainshaft. Lift the engine and carefully maneuver it through the door. Install the engine on the work stand as shown in fig. 5.

(2) *INSTALLATION.* Take up the weight of the engine with the floor crane and remove the engine from the work stand. Guide the engine through the right-hand door opening and lower it carefully into the engine compartment. Shift the transmission into gear and move the engine back, aligning the mainshaft with the clutch until the mainshaft starts into the clutch plate. It may be necessary to turn the crankshaft to align the clutch disc splines with those on the mainshaft.

Install the transmission retaining bolts and tighten them to 40-50 foot-pounds. Lower the engine to the front supports and install the front support nuts and cotter pins. Remove the engine lift bracket and install the two head bolts (torque 65-70 foot-pounds).

Connect the hand brake cable to the clip on the transmission. Connect the clutch return spring, muffler inlet pipe, fuel pump line, starter cable, battery cable, and heater hose. Adjust clutch pedal free play. Connect the generator wires, ignition coil wires, engine temperature sending unit wire, and oil pressure sending unit wire. Connect the throttle linkage, choke wire, and vacuum hose. Install the air cleaner and connect the flexible tube to the carburetor.

Install the weather strip retainer, lower the compartment front cover, and install the engine compartment rear cover. Lay the fan shroud over the fan, and install the radiator and support assembly. Connect the radiator hose. Fasten the fan shroud to the radiator. Install the radiator support bar and hood. Fill the cooling system. Run the engine until it is warm and check for coolant leaks and oil leaks. Adjust the valve lash. Adjust the carburetor idle. Check the ignition timing.

2. MANIFOLDS

A chamber is built into the intake manifold center section where the carburetor and exhaust manifold are attached. An exhaust control valve, located in the exhaust manifold directs exhaust gases into this chamber when the engine is cold to provide for faster intake manifold warm-up.

NOTE: ***Do not remove manifolds when they are hot. They may warp and make reassembly difficult.***

Manifold Replacement procedures are covered under "**a.** Conventional Truck" and "**b.** Parcel delivery."

a. Conventional Truck.

Lift up the hood and place the fender aprons on the fenders.

(1) *REMOVAL.* Remove the air cleaner and car-

buretor. Disconnect the throttle linkage and remove the bell crank from the manifold.

Disconnect the muffler inlet pipe from the exhaust manifold and pull the pipe away from the flange. Remove the manifold to head retaining bolts and lift the manifold assembly off the head. Remove the intake port ring inserts and gaskets.

Remove the nuts and bolt holding the manifolds together and separate the manifolds. A disassembled view of the conventional truck manifolds is shown in fig. 6.

(2) *CLEANING.* Clean the gasket surfaces on the manifolds and the cylinder head. Clean the outside of the manifold with solvent.

(3) *INSPECTION.* Inspect the manifold for cracks especially around the heat chamber or support bolt lugs in the intake manifold. Make sure all gasket surfaces are free from projections that may interfere with sealing. Replace the manifold if it is cracked or otherwise damaged.

(4) *INSTALLATION.* Place the intake manifold over the studs on the exhaust manifold. Install the lockwashers, nuts, and bolt and tighten the nuts and bolt finger tight. Install new inserts and gaskets in the intake manifold, coat the mating surfaces lightly with graphite grease, and place the manifold assembly in position against the cylinder head. Install the manifold hold down bolts and lockwashers and tighten the bolts to 23-28 foot-pounds, tightening from the center to the ends. Tighten the bolt and nuts retaining the manifolds together to 23-28 foot-pounds. Install a new exhaust outlet flange gasket and slide the muffler inlet pipe over the studs in the exhaust manifold. Install the nuts and lockwashers and torque the nuts to 23-28 foot-pounds.

Connect the accelerator linkage to the bell crank on the manifold. Install the carburetor and connect the linkage to the carburetor and bell crank. Install the air cleaner.

b. Parcel Delivery.

Remove the engine compartment rear cover. Open the compartment front cover and fasten it with the hook.

(1) *REMOVAL.* Disconnect the air cleaner tube and remove the carburetor. Disconnect the accelerator shaft at the manifold bell crank. Disconnect the muffler inlet pipe and pull the pipe away from the manifold flange. Remove the manifold hold-down bolts and lift the manifold assembly from the head. Remove the gaskets and inserts.

Remove the nuts and the bolt holding the manifolds together and separate the manifolds. A disassembled view of the manifolds is shown in fig. 7.

(2) *CLEANING.* Clean the gasket surfaces on the manifolds and the cylinder head. Clean the outside of the manifolds with solvent.

(3) *INSPECTION.* Inspect the manifolds for cracks, especially around the intake manifold heat chamber and support bolt lugs.

Make sure all gasket surfaces are free from projections that may interfere with sealing.

(4) *INSTALLATION.* Place the intake manifold over the studs in the exhaust manifold. Install the lockwashers, nuts, and bolt and tighten the nuts and bolt finger tight. Install new gaskets and inserts in the intake manifold, coat the mating surfaces lightly with

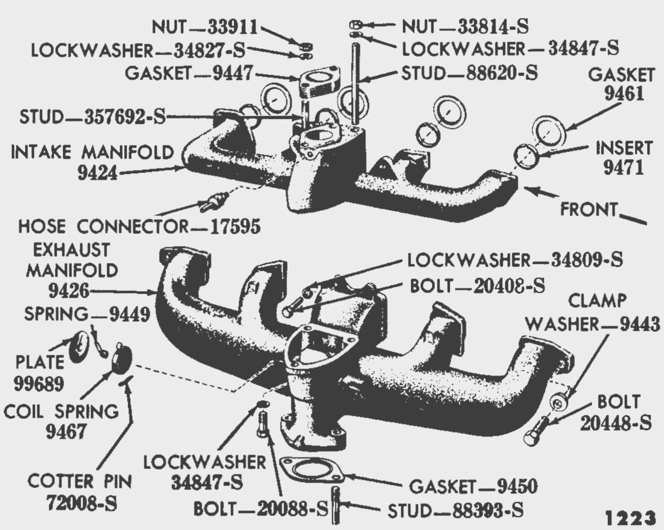

Fig. 6—Manifold (Conventional Truck) Disassembled

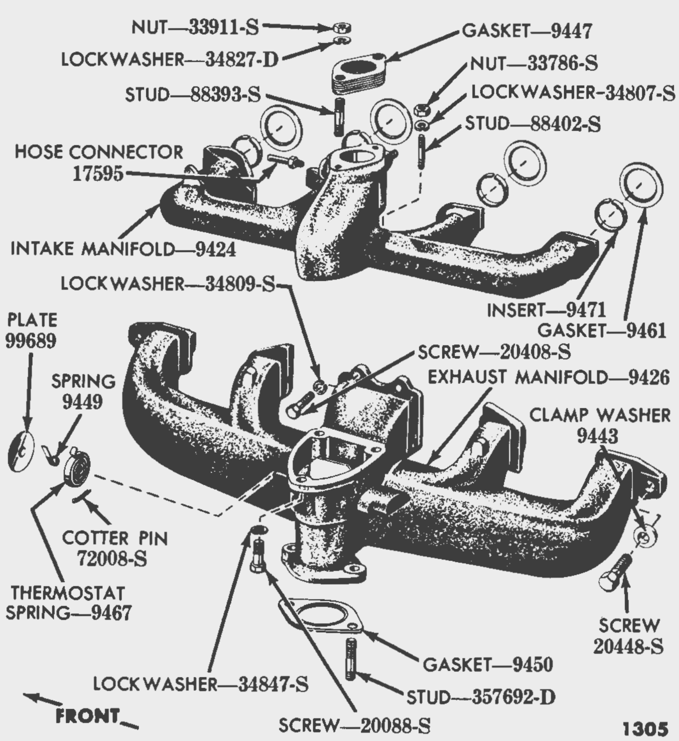

Fig. 7—Manifold (Parcel Delivery) Disassembled

graphite grease and place the manifold against the cylinder head. Install the manifold bolts and washers. Tighten the bolts to 23-28 foot-pounds torque from the center to the ends. Tighten the bolt and nuts retaining the manifolds together to 23-28 foot-pounds. Install a new exhaust outlet flange gasket and slide the muffler inlet pipe over the studs. Install the nuts and lockwashers and tighten the nuts to 23-28 foot-pounds torque.

Connect the accelerator linkage. Install the carburetor and connect the carburetor linkage. Install the air cleaner tube. Install the engine compartment rear cover and close the front cover.

3. CYLINDER HEAD

The cylinder head is cast from the same high grade iron as is used for the cylinder block. Cylinder head distortion is kept to a minimum because the expansion and contraction due to temperature change is the same for both head and block. The head carries the valves and valve rocker arm mechanism, the manifold assembly, water outlet, fan guide, and fan assembly.

Procedures given below cover only the removal, cleaning, inspection, and installation of the cylinder head. Where the procedure differs for the parcel delivery truck a note will be given to indicate the difference. Disassembly of the cylinder head and valve mechanism is covered under "Valves and Valve Mechanism" later in this Chapter.

a. Removal.

Open the hood and install fender covers.

NOTE: ***On the parcel delivery, remove the engine compartment rear cover and open the front cover.***

Drain the cooling system. Disconnect the radiator and heater hose at the cylinder head outlet elbow. Disconnect the windshield wiper vacuum line from the manifold. Remove the air cleaner.

NOTE: ***On the parcel delivery, remove the air cleaner tube.***

Remove the valve chamber cover.

Disconnect the fuel line at the fuel pump and carburetor and the distributor vacuum line at the distributor and carburetor, and remove the two lines. Disconnect the spark plug wires and remove the spark plugs. Remove the screws retaining the ignition coil to the head and allow the coil to hang from the distributor. Disconnect the engine temperature sending unit wire. Remove the fan assembly.

Remove the cap screw and clip from No. 6 rocker arm support bracket. Pull the oil feed line out of the bracket and then pull it out of the block with pliers (fig. 8). Be carefull not to damage the line.

Loosen all rocker arm adjusting screws to remove the valve spring load from the rocker arms. Slide the rocker arms away from the push rods and remove the rods (fig. 9).

NOTE: ***The rocker arms at each end of the engine cannot be moved. Leave these push rods in place.***

Identify the push rods so they can be reinstalled in the same place from which they were removed.

Remove the manifold hold down bolts and pull the manifold assembly away from the head allowing it to be supported by the muffler inlet pipe. Install the cylinder head holding fixture brackets (which are shown installed on the head in fig. 12) for convenience in lifting the head and to protect the gasket surfaces.

Remove all cylinder head bolts. Install the cylinder head guide studs shown in fig. 10. Lift the cylinder head

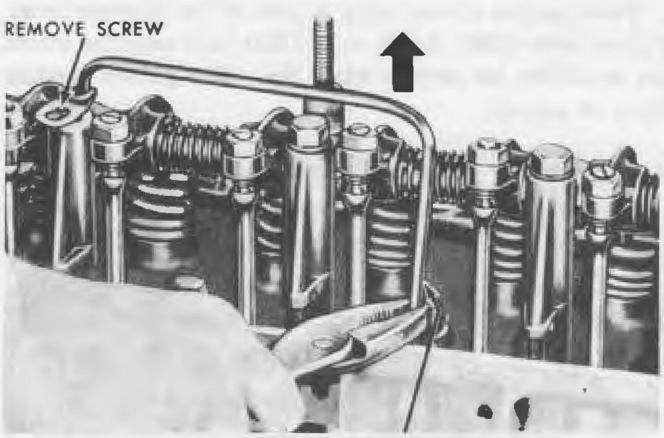

Fig. 8—Removing Oil Line

Fig. 9—Removing Push Rods

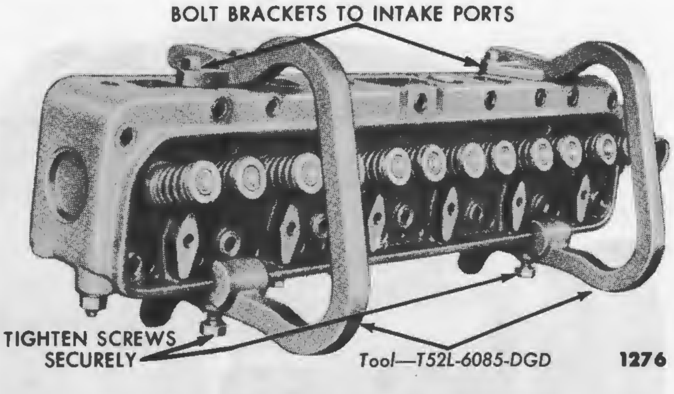

Fig. 12—Cylinder Head Holding Fixture

head and remove the shaft assembly. The cylinder head is shown mounted in the holding fixture in fig. 12.

Pull out the oil drain line and clip from the No. 1 bracket. Remove the cotter pins at each end of the rocker arm shaft and remove the flat washers and spring washers. Remove the plugs at each end of the shaft. Slide the rocker arms, springs, and brackets off the shaft. Be sure to identify the parts (fig. 13).

Clean the carbon out of the combustion chambers before removing valves. Compress the valve springs with the tool shown in fig. 14, remove the valve stem locks, and release the springs. Remove the sleeve, valve spring cap retainer, spring, and valve. Discard the intake valve seals. Identify all valve parts.

b. Valve and Seat Refacing.

A rotatable type valve (fig. 15) is used for both intake and exhaust valves. The valve tends to rotate slightly each time it is lifted from the seat. The valve and seat should be lightly lapped after regrinding or installing new valves. Use a medium grade lapping compound.

(1) *VALVE CLEANING AND INSPECTION.* Scrape carbon and lead deposits from the head and stem of the valve. Remove varnish from the valve stem.

Check the valve for a burned or warped head or a bent or scored stem. Discard any defective valves.

(2) *VALVE GUIDE INSPECTION AND REPAIR.* Measure the valve guide diameter (fig. 16) and the valve stem diameter. If the clearance is more than 0.004 inch for the intake or more than 0.005 inch for

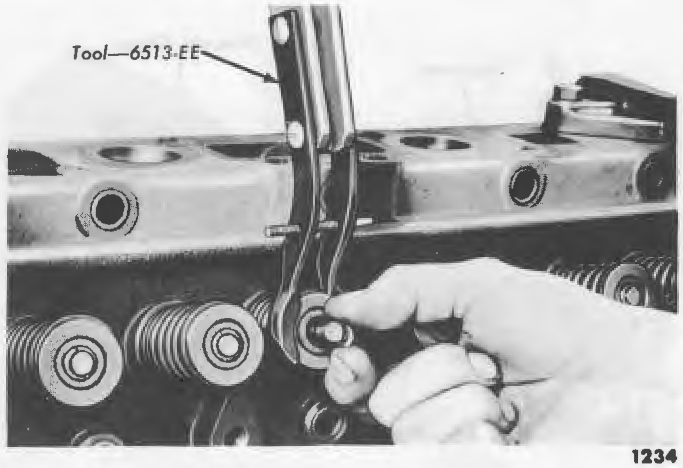

Fig. 14—Removing Valve Stem Locks

the exhaust valves, ream out the guide and install the next oversize valve. Use the piloted reaming tool shown in fig. 17 with a tap wrench. Be sure to clean out all chips and metal particles. Regrind the valve seats when the guides are reamed.

NOTE: ***The valve guide reamers are piloted to fit a standard hole (0.003 inch oversize reamer) 0.003 inch oversize hole (0.015 inch oversize reamer), and 0.015 inch oversize hole (0.030 inch reamer). Be sure to use the reamers in sequence when reaming from standard to oversize holes.***

(3) *REFACING VALVES.* Grind the valve face at a 45° angle on a valve refacing machine as shown in fig. 18. Grind off only enough stock to remove pits or grooves from the valve face. If the edge of the valve head is less than 1/32 inch thick after grinding, replace the valve. Grind the valve stem ends if they are grooved or scored. Check the valve face runout. If it exceeds 0.002 inch, regrind the face. If it still exceeds 0.002 inch after regrinding, discard the valve.

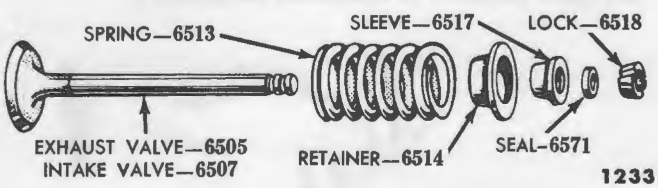

Fig. 15—Valve and Related Parts

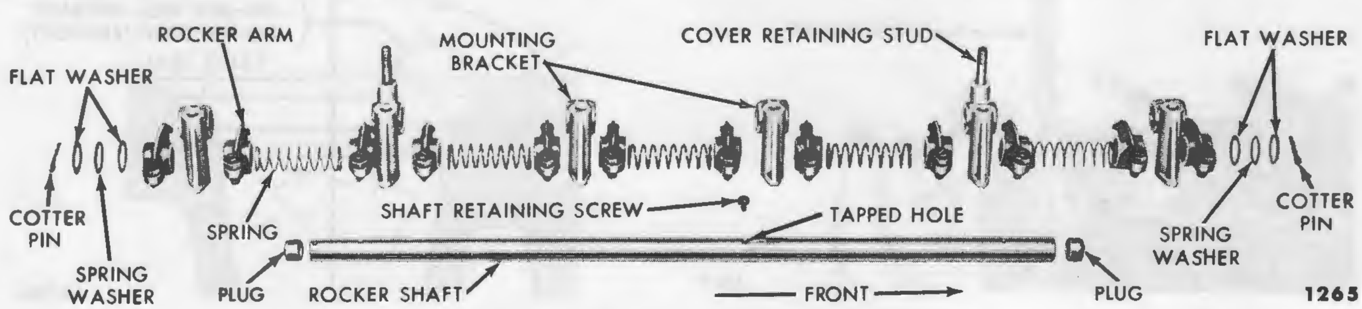

Fig. 13—Rocker Mechanism—Disassembled

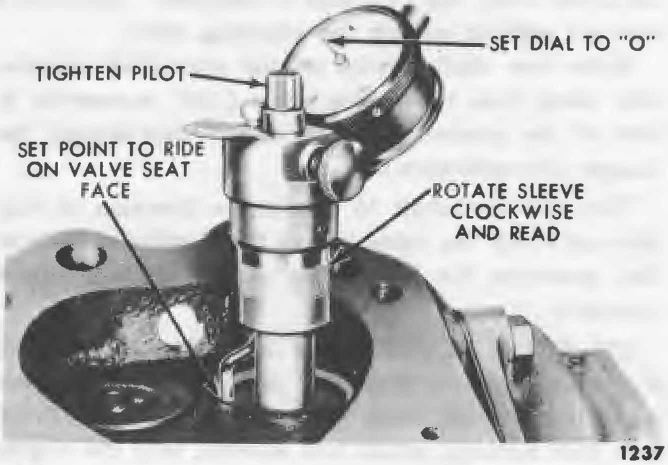

Fig. 20—Checking Valve Seat Runout

ing them (valve closed) and observing the runout. If any runout is observed be sure to check the rod between centers as described above.

d. Cylinder Head Assembly.

Oil all moving parts with engine oil. Lay out the shaft and rocker mechanism parts as shown in fig. 13. Install a flat washer, spring washer, another flat washer, plug, and a cotter pin in one end of the shaft. Do not peen the plug; it should be a free fit in the shaft. Install the parts in the order shown in fig. 13. Install the screw retaining the shaft to the No. 3 support bracket. An assembled view of the rocker arm, shaft, and bracket is shown in fig. 22.

Install a valve in the port from which it was removed

Fig. 21—Checking Valve Spring Pressure

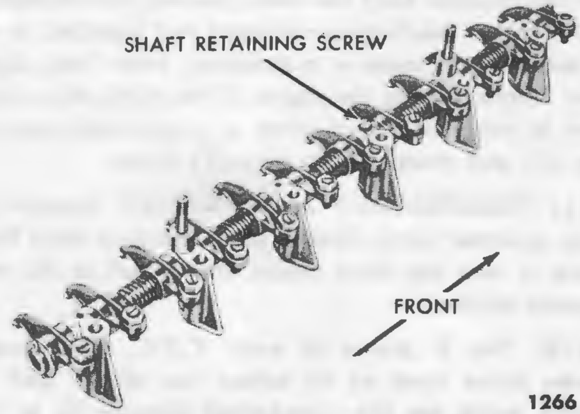

Fig. 22—Rocker Arm and Shaft Assembly

or to which it was fitted. Install the valve spring with the closed coil near the head, valve spring seat, and sleeve. Compress the spring, install the seal and install the locks as shown in fig. 14. Repeat the operation for each valve. Be sure to use new seals on the valves.

Place the rocker arm assembly on the head, install the four center bracket screws, and torque them to 35-40 foot-pounds. Install the oil drain line, clip, and retaining screw on No. 1 bracket and torque the screw to 35-40 foot-pounds.

NOTE: ***The No. 6 bracket retaining screw is installed when the head is replaced on the engine.***

Replace the cylinder head on the engine using a new gasket.

e. Valve Lash Adjustment.

Valve lash is adjusted by means of a ball end set screw and lock nut at the push rod end of the rocker arm.

Fig. 23—Checking Valve Lash

If the cylinder head has been removed and reinstalled or the rocker mechanism removed and installed, it will be necessary to make a preliminary valve lash adjustment before starting the engine. If the valve lash adjustment is made for the purpose of engine tune-up, omit step (1) and proceed with step (2) below.

(1) *PRELIMINARY ADJUSTMENT.* Remove the valve chamber cover. Rotate the crankshaft until No. 1 piston is near top dead center at the end of the compression stroke.

NOTE: ***No. 1 piston is near T.D.C. compression stroke when both of its valves are closed and the timing mark on the crankshaft damper is in line with the pointer.***

Check the intake and exhaust valve lash for No. 1 cylinder with a feeler gauge (fig. 23). If the lash is not 0.013-0.015 inch (intake-cold) or 0.015-0.017 (exhaust-cold), loosen the adjusting screw lock nut and adjust the screw until this clearance is obtained. Tighten the lock nut without moving the adjusting screw.

Make two chalk marks on the crankshaft damper 120° away from the timing mark. (120° represents ⅓ turn of the crankshaft or ⅓ of the way around the damper circumference).

Turn the crankshaft ⅓ turn in the direction of rotation and check the valve lash of No. 5 cylinder. Repeat this operation for No. 3, No. 6, No. 2, and No. 4 cylinders.

(2) *FINAL ADJUSTMENT.* Run the engine until it reaches normal operating temperature. With the engine warmed up, check the valve lash for 0.014-0.016 inch (hot setting), intake and exhaust, with the engine idling or with the procedure outlined above. Replace the valve chamber cover with a new gasket cemented to the cover only. Do not exceed 8-10 foot-pounds torque on the cover nuts or the cover will be distorted.

5. OIL PAN, FILTER, OIL PUMP, AND PRESSURE RELIEF VALVE

Procedures for repair and replacement of the oil pan, filter, oil pump, and pressure relief valve are presented below.

a. Oil Pan.

Removal, cleaning, inspection, and installation procedures for the oil pan are given under headings descriptive of the operation. The oil pan is shown in fig. 24.

(1) *REMOVAL.* Drain the crankcase. Pull the dip stick out of the tube. Remove the oil pan retaining screws and remove the pan and gasket.

(2) *CLEANING.* Wash the pan in solvent and dry it thoroughly. Brush any dirt or metal particles from the inside of the pan. Scrape off old gasket material from the gasket surface of the pan.

(3) *INSPECTION.* Check the pan for cracks, holes, or warping at the gasket surface. Check for damaged drain plug threads. Repair any cracks or holes, or replace the pan if repairs cannot be made.

(4) *INSTALLATION.* Make sure the gasket surface of the block is clean. File off any burrs around the threaded bolt holes. Tie the oil pan gasket to the pan with string through two bolt holes at opposite ends of the pan.

Hold the pan in place against the block and install a screw finger tight at each end of the pan. Remove the string ties and install the remaining screws. Tighten the screws from the center outward with a large screwdriver.

NOTE: ***After tightening all screws, be sure to check to see that the center screws have not loosened.***

Replace the dip stick. Fill the crankcase with the proper grade and quantity of engine oil. Run the engine and check the pan for oil leaks.

b. Oil Filter.

The full-flow type oil filter filters the entire output of the pump before the oil enters the lubrication system

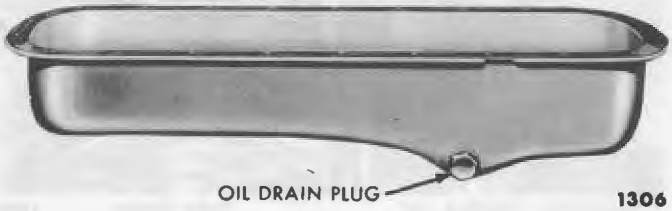

Fig. 24—Oil Pan

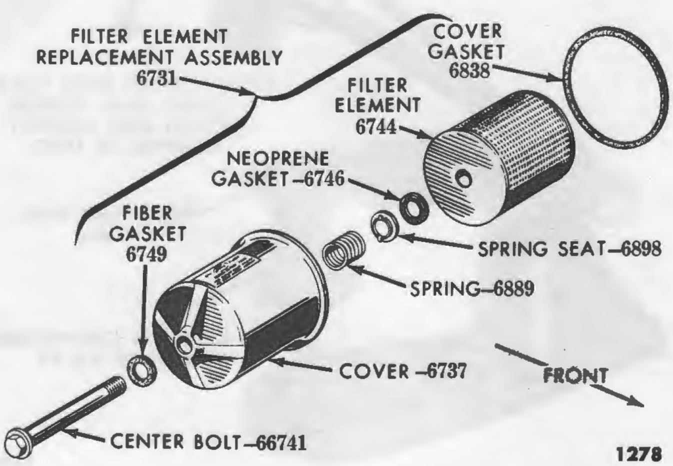

Fig. 25—Oil Filter—Disassembled

of the engine. A built in by-pass provides oil to the system in case the filter element becomes clogged. The by-pass is located in the hollow center bolt and consists of a spring loaded valve. When the element is clean and oil will flow through it, the pressure difference between the inner and outer faces of the valve is not great enough to overcome the spring pressure behind the valve. When the element is dirty and will not permit a sufficient flow of oil, the pressure on the inner face of the valve drops, and the pressure difference between the valve faces is enough to cause the valve to open. Oil by-passes the element, maintaining a supply to the lubrication system.

(1) *REMOVAL.* Place a drip pan on the floor directly under the filter. Remove the center bolt holding the filter to the block. Remove the filter assembly and gasket.

(2) *DISASSEMBLY.* Remove the filter element, gasket, washer, and spring from the housing. Remove the center bolt and gasket. The filter is shown disassembled in fig. 25.

(3) *CLEANING.* Wash all parts in solvent. Blow out the hollow center bolt. Make sure all the openings are clean.

(4) *ASSEMBLY.* Use new gaskets when assembling the filter. Place the center bolt with a new fiber gasket through the cover. Install the spring, spring seat, new neoprene gasket, and filter element on the bolt. Be sure the spring seat is fastened to the spring with the tangs.

CAUTION: ***Be sure there is only one gasket between the spring seat and the element. If two gaskets are used, the oil by-pass port may be partially covered.***

(5) *INSTALLATION.* Install a new gasket in the block recess.

NOTE: ***Do not use any sealing compounds.***

Install the filter assembly against the gasket, tightening the bolt just enough so the filter housing touches the gasket. Rotate the housing slightly in each direction

Fig. 26—Location of Oil Pump Mounting Bolts

to make sure it seats evenly against the gasket. Tighten the center bolt to 20-25 foot-pounds torque.

NOTE: ***It will be necessary to use a box wrench fitting, in conjunction with the torque wrench, to tighten the oil filter center bolt. Do not exceed the 25-foot-pound limit or the filter cover may be crushed.***

Start the engine and allow it to idle until lubrication is fully established, then increase the engine speed and check for leaks around the filter. Check the oil level in the crankcase and add oil if necessary.

CAUTION: ***It is important that the filter housing does not leak because the full output of the pump passes through the filter and oil inside the filter is at the same pressure as the lubrication system.***

c. Oil Pump and Pressure Relief Valve.

A gear type oil pump is mounted inside the crankcase in line with the distributor. The pump is driven by means of a slot in the distributor shaft and a tang on the end of the oil pump shaft. The pressure relief valve is incorporated in the oil pump housing.

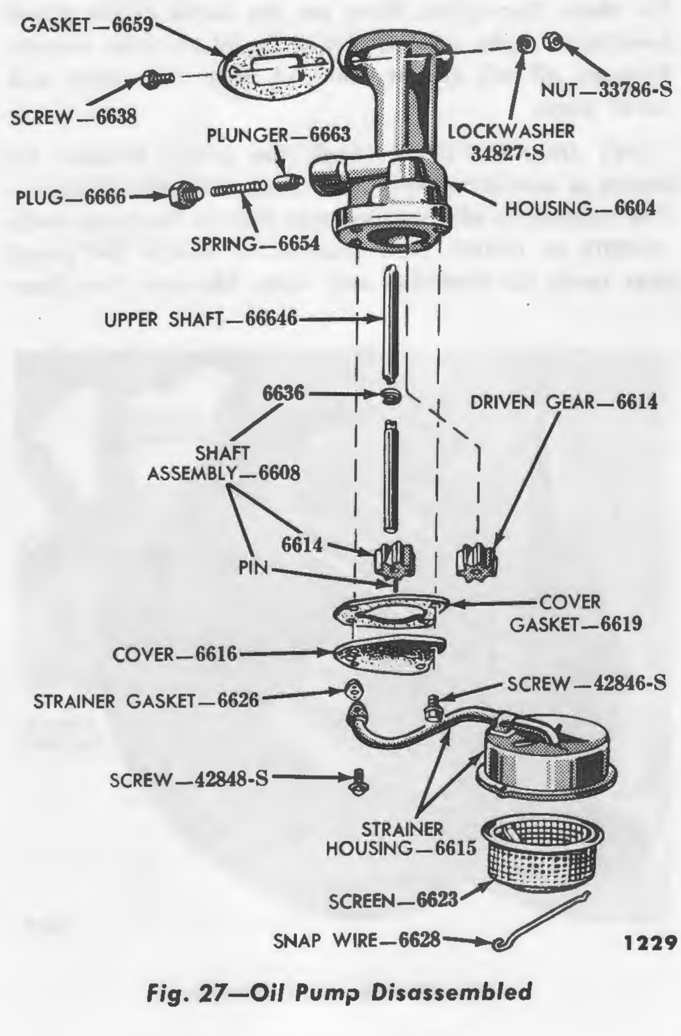

Fig. 27—Oil Pump Disassembled

Oil pump removal, disassembly, cleaning, inspection, assembly, and installation procedures are presented below. The pressure relief valve is covered in the disassembly and assembly procedures for the pump.

(1) *REMOVAL.* Drain the oil and remove the oil pan. Remove the distributor. Remove the two nuts and lockwashers retaining the pump to the cylinder block. Remove the pump and gasket.

NOTE: ***If the oil pump mounting bolts turn in the block, the oil filter must be removed in order to hold one of the mounting bolts which is located inside the filter housing, (fig. 26).***

(2) *DISASSEMBLY.* Remove the screen assembly retaining screws, the screen assembly, and gasket. Remove the cover retaining screws, cover, and gasket. Push the pump drive shaft and drive gear assembly from the pump housing. Remove the driven gear. Remove the oil pressure relief valve plug, spring, and plunger.

Remove the snap wire retaining the pump screen and remove the screen from the housing. The oil pump and screen are shown completely disassembled in fig. 27.

(3) *CLEANING.* Wash all the parts in solvent and dry them thoroughly. Blow out the inside of the pump housing to make sure no dirt or metal particles remain. Remove all old gasket material from the pump and cover plate.

(4) *INSPECTION.* Check the pump housing for cracks or excessive wear. The pump shaft should have a free running fit without excessive play in the pump body (0.0005 to 0.0025 inch clearance). Check the pump gear teeth for scratches and wear. Measure the clearance between the outside diameter of the gears and the pump housing. It should be no greater than 0.005 inch. Check the compression of the relief valve spring. It should be 9.82 pounds plus or minus 2 ounces when the spring is compressed to 1.56 inches. Replace any worn or defective parts.

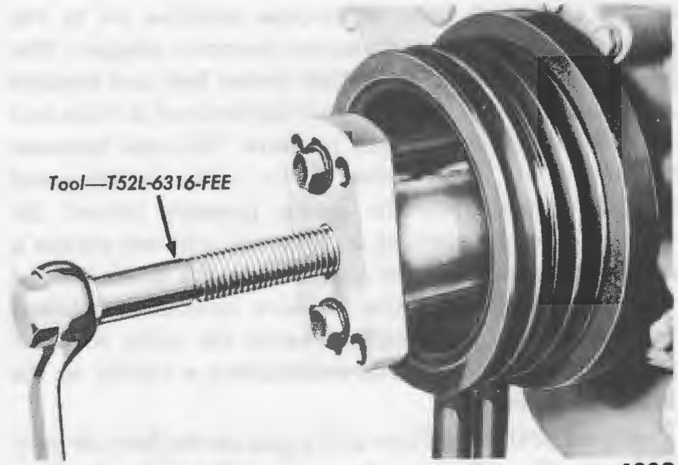

Fig. 29—Damper Removing Tool

(5) *ASSEMBLY.* Apply a light coat of engine oil to all moving parts. Place the snap ring on the groove on the upper end of the lower drive shaft. Snap the tang of the intermediate shaft into the fork of the lower shaft, making certain the snap ring is seated in the groove in both shafts. Slide the drive gear and shaft assembly into the housing. Install the pump driven gear, the cover plate gasket, the cover plate, and the retaining screws. Torque the screws to 10-12 foot-pounds. Install the pressure relief valve plunger, spring, and plug. Tighten the plug to 33-38 foot-pounds.

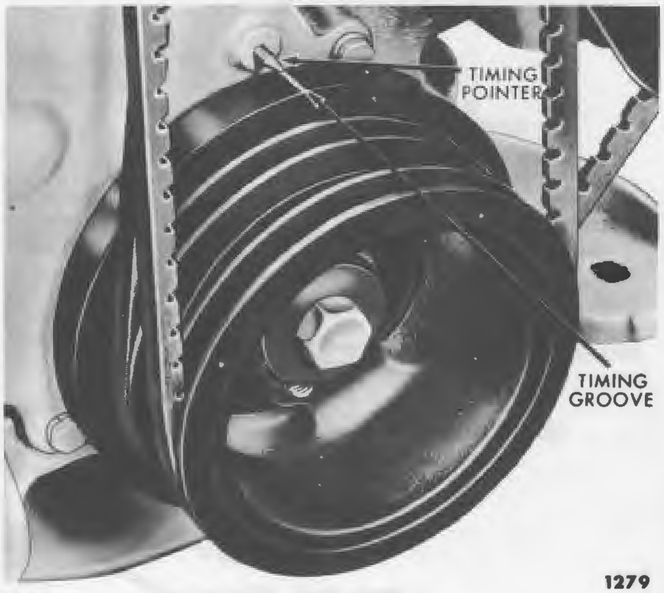

Fig. 28—Vibration Damper

Fig. 30—Installing Damper

Install the screen in the screen cover and secure it with the snap wire. Install the gasket, screen and cover assembly, and retaining screws. Tighten the screws to 10-12 foot-pounds. Rotate the pump shaft by hand to make sure it turns freely.

(6) *INSTALLATION.* Place a new gasket on the retaining bolts, slide the pump mounting flange over the retaining bolts, and install the lockwashers and nuts. Torque the nuts to 35-40 foot-pounds.

Install the oil filter (if it was removed) and the oil pan. Install the distributor. Fill the crankcase with the proper grade and quantity of oil.

Run the engine and check oil pressure to check if the pump is operating properly.

6. CRANKSHAFT DAMPER

The 6-cylinder engine is equipped with either a rubber-type damper (fig. 28) or a viscous type damper which is keyed to the crankshaft and retained with a capscrew and washer. Two threaded holes are provided in the damper to faciltate its removal.

a. Removal.

Remove the radiator. Remove the generator and fan belts. Remove the fan and bracket. Remove the retaining bolt and washer from the end of the crankshaft. Install the damper removing tool on the damper as shown in fig. 29 and pull the damper from the crankshaft.

b. Installation.

Lubricate the crankshaft with oil and white lead mixture. Align the damper keyway with the key on the crankshaft and start the damper on the shaft. Press the damper on the shaft (fig. 30). Install the washer and retaining bolt and torque the bolt to 45-55 foot-pounds. Install the generator belt. Install the fan assembly and fan belt. Adjust the belt tension. Install the radiator.

7. CYLINDER FRONT COVER AND OIL SEAL

The engine front cover is a one piece casting retained to the cylinder block by ten hex-head screws and to the oil pan by two screws. Two dowels are used to locate the cover on the block. The ignition timing pointer is pressed into the cover. The cover also forms the engine front support.

Procedures for cover removal, inspection, oil seal replacement, and installation are given below.

a. Removal.

Remove the radiator. Remove the fan and generator belts. Remove the fan assembly. Remove the crankshaft damper. Remove the oil pan. Remove the front support nuts. Raise the engine with a jack far enough for the front cover to clear the support bolts. Remove the cover retaining screws, the cover, and the gasket.

b. Inspection.

Check the cover for cracks and for damage to the Gasket surface. Replace the cover if it is cracked.

c. Oil Seal Replacement.

Drive out the old seal with a pin punch. Clean out the recess in the cover and install a new seal with the tool shown in fig. 31. Coat the new seal with grease to reduce friction when installing. Drive the seal in until it is fully seated in the recess. Check the seal to be sure the spring did not come out during the installation.

d. Installation.

Position a new gasket on the block, place the cover on the cylinder block, and install the retaining screws. Torque the screws to 6-9 foot-pounds. Lower the engine on the front supports and install the nuts and cotter pins. Install the oil pan. Install the damper. Install the fan assembly. Install the generator and fan belts and adjust the belt tension. Install the radiator.

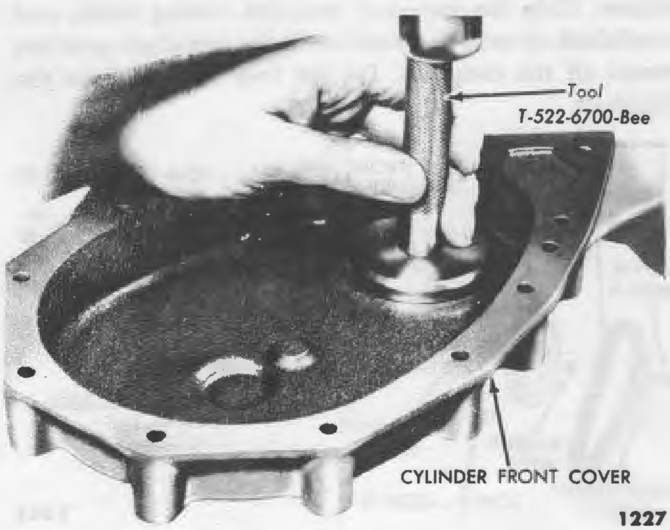

Fig. 31—Installing Oil Seal

8. CAMSHAFT SPROCKET, CAMSHAFT, AND BEARINGS

The camshaft is supported by four bearings which are pressed into the block. It is driven by a sprocket and timing chain in mesh with a sprocket on the crankshaft. An eccentric on the camshaft contacts the fuel pump rocker arm which operates the fuel pump. The camshaft sprocket is keyed to the camshaft and is retained by a bolt and washer. Camshaft thrust is controlled by a plate behind the gear bolted to the front of the block. The plate is located between the camshaft sprocket and a shoulder on the camshaft.

Procedures for removal, inspection and installation of the camshaft sprocket, timing chain, camshaft, and bearings are given below. The procedures are written to include the steps necessary for removal and installation when the engine is in the vehicle. If the engine is removed, eliminate any steps not applicable. The camshaft and related parts are shown in fig. 32.

a. Camshaft Sprocket and Timing Chain.

To make the sprocket and chain accessible, remove the radiator, crankshaft damper, and engine front cover.

(1) *INSPECTION.* Check the wear on the timing chain and camshaft sprocket by taking up the slack on the driving side of the chain and then measuring the outward deflection on the slack side of the chain, fig. 33. Total outward deflection should not be more than ½ inch.

Replace a camshaft sprocket with broken or chipped teeth. If the timing chain and camshaft sprocket slack is excessive, replace the sprockets and chain.

(2) *REMOVAL.* Before removing the camshaft sprocket, it is advisable to align the timing marks as shown in fig. 34.

Remove the camshaft sprocket retaining bolt and washer. Slide the camshaft sprocket, timing chain, and crankshaft sprocket forward until the camshaft sprocket comes off the camshaft. Do not lose the key from the camshaft.

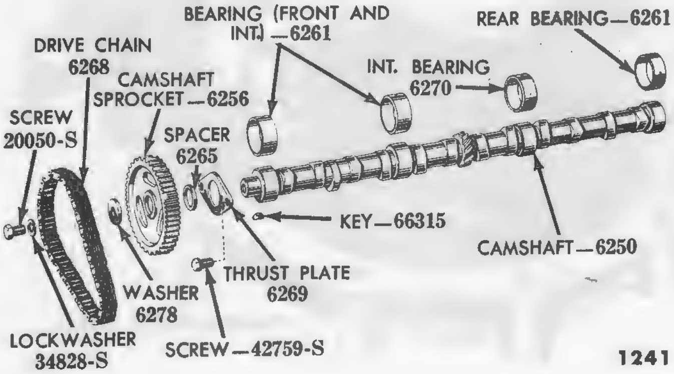

Fig. 32—Camshaft and Related Parts

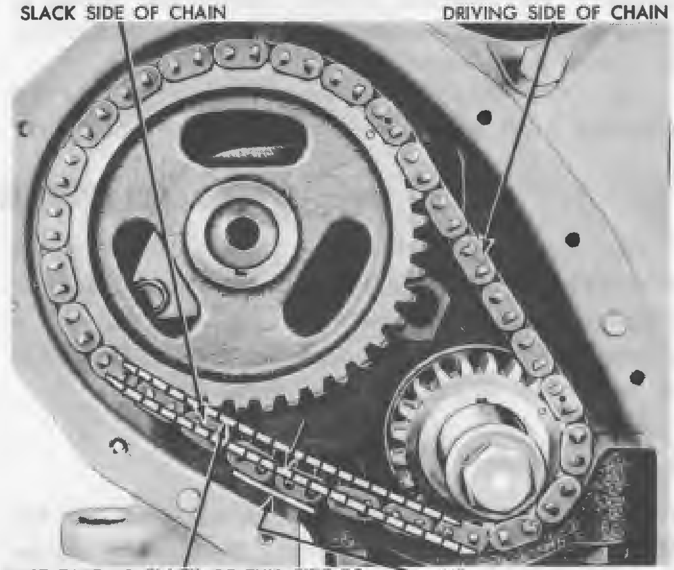

Fig. 33—Checking Timing Chain Deflection

(3) *INSTALLATION.* Place the timing chain over the crankshaft sprocket and insert the camshaft sprocket in the timing chain so the timing marks of both sprockets and the chain are aligned (fig. 34). Align the key in the camshaft with the camshaft sprocket keyway and slide the assembly into position. Recheck the timing.

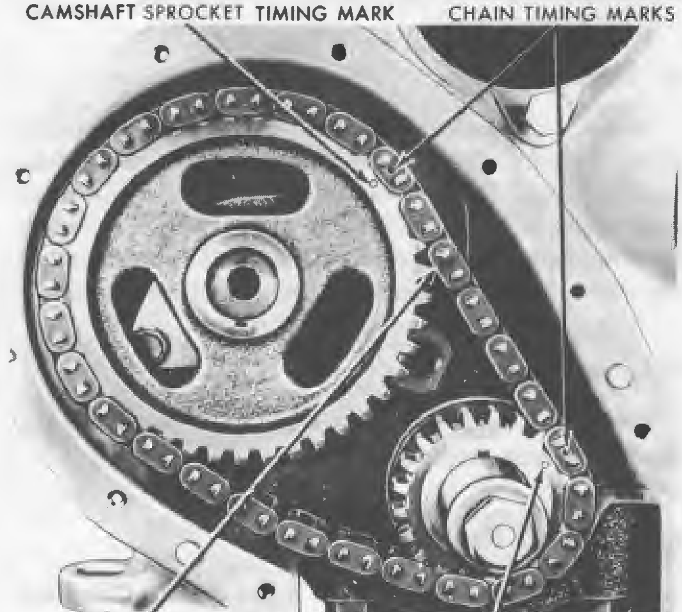

Fig. 34—Aligning Timing Marks

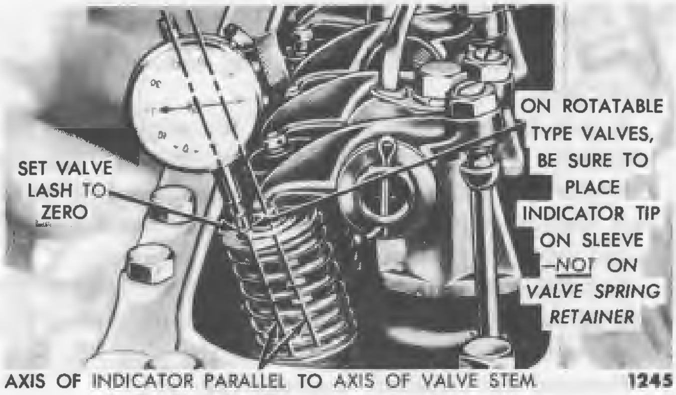

Fig. 35—Valve Lift Measurement

Install the washer and retaining bolt. Torque the bolt to 45-50 foot-pounds.

Install the cylinder front cover, crankshaft, damper, and radiator.

b. Camshaft.

It will be necessary to replace the camshaft when the lobes are worn to such an extent that valve lift is less than 0.335 inch for intake and 0.330 inch for exhaust. Check the valve lift with a dial indicator as shown in fig. 35. The valve lash must be zero.

(1) *REMOVAL.* Remove the grille and radiator. Remove crankshaft damper and cylinder front cover. Remove the rocker arm cover and the valve push rod covers. Remove all push rods. Lift the tappets and hold them with spring clothes pins or rubber bands.

NOTE: ***If the engine is removed from the vehicle, and mounted on a work stand, position it front end up and pull the tappets away from the camshaft to facilitate camshaft removal. Be sure the oil pan is either drained or removed before inverting engine.***

Remove the distributor. Remove the fuel pump. Remove the camshaft sprocket and timing chain. Remove the screws retaining the thrust plate and remove the thrust plate. Carefully remove the camshaft.

CAUTION: ***Do not gouge the camshaft bearings with the cam lobes when removing the camshaft.***

(2) *INSPECTION.* Check the camshaft journals for grooves or scratches. Measure the journal diameter for wear and out of round. Replace the camshaft if the journals are more than 0.001 out of round. Measure the front camshaft bearing inside diameter. The difference in measurement between the bearing and camshaft journal (amount of clearance) should be 0.001 to 0.003 inch for a new camshaft and bearings, and not over 0.005 inch for a used camshaft and bearings. If the front bearing is worn excessively it can be assumed that all bearings are probably worn to this extent.

Check the fuel pump eccentric for wear. Inspect the distributor drive gear for worn or damaged teeth.

Replace the camshaft or bearings if any of the above conditions exist.

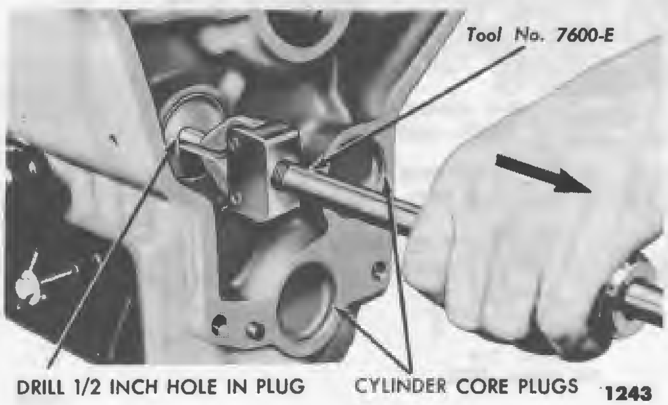

Fig. 36—Removing Camshaft Bore Plug

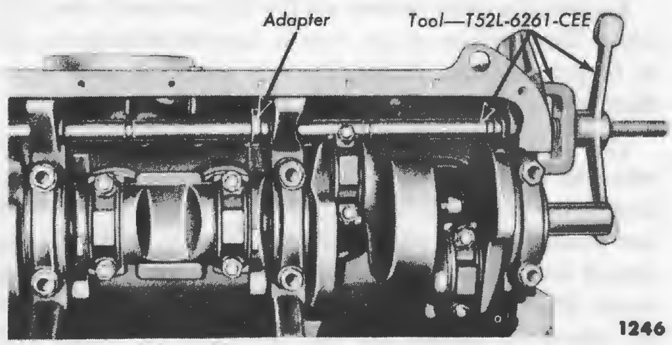

Fig. 37—Removing or Installing Camshaft Bearings

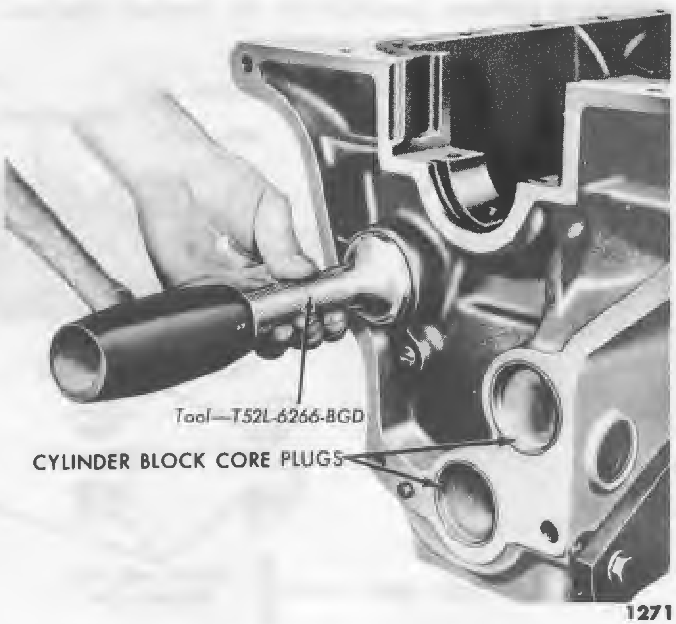

Fig. 38—Installing Camshaft Bore Plug

Inspect the wear pattern on the lift portion of the cam lobes. The surface of the cam is tapered slightly to aid in tappet rotation. If the taper is worn off over more than half the face of the cam, replace the camshaft.

(3) *INSTALLATION.* Slide the camshaft carefully into the bearings. Install the thrust plate and secure it with the retaining screws. Torque the screws to 15-18 foot-pounds. Check the camshaft end play. It should not exceed 0.006 inch. Install the camshaft sprocket, timing chain, front cover, and crankshaft damper. Install the fan assembly. Install the fan and generator belts and adjust belt tension. Release the tappets and install the push rods.

Install the distributor and adjust the initial timing. Install the fuel pump. Install the tappet chamber cover with a new gasket cemented to the cover and torque the retaining screws to 8-10 foot-pounds from the center outward. Adjust the valve lash. Install the rocker arm cover with a new gasket and torque the nuts to 8-10 foot-pounds. Install the radiator and grille.

c. Camshaft Bearing Replacement.

Replace camshaft bearings if the clearance exceeds 0.005 inch.

It will be necessary to remove the engine from the vehicle to replace camshaft bearings. The bearings are available pre-finished to size for standard and 0.015 inch undersize journal diameters. No. 1 bearing insert is not interchangeable with the other inserts.

(1) *REMOVAL.* Remove the camshaft. Drill a ½" hole in the plug at the rear camshaft bearing plug. Use the tool shown in fig. 36 to remove the plug.

Remove the camshaft bearings (fig. 37).

(2) *INSTALLATION.* Position the bearing at the bearing bore and press it in place with the tool shown in fig. 37. Be sure the oil hole in the bearing lines up with the oil hole in the bore.

Clean out the plug recess in the camshaft rear bore. Coat the outer rim of a new plug lightly with No. 2 Permatex. Install the plug with the tool shown in fig. 38. Install the camshaft.

9. FLYWHEEL, CRANKSHAFT, AND BEARINGS

Procedures for removal, inspection and replacement of the flywheel, crankshaft, and bearings are covered here under headings descriptive of the operation. The crankshaft and related parts are shown in fig. 39.

a. Flywheel.

The rear face of the flywheel is used as a friction surface which is engaged by the clutch disc. The flywheel ring gear is secured to the flywheel by means of a shrink fit. The engine should be removed from the vehicle to perform operations on the flywheel. Remove the flywheel housing, clutch pressure plate and disc.

(1) *INSPECTION.* Flywheels having a burned or scored surface should be replaced.

Check flywheel runout by mounting a dial indicator as shown in fig. 40. The indicator should be touching the outer edge of the clutch disc area. Rotate the flywheel and observe the indicator reading. Total runout should not exceed 0.005 inch. Examine the ring gear for cracks, damaged teeth or looseness on the flywheel.

(2) *REMOVAL.* Remove the transmission and clutch housing. Mark the clutch assembly so it can be

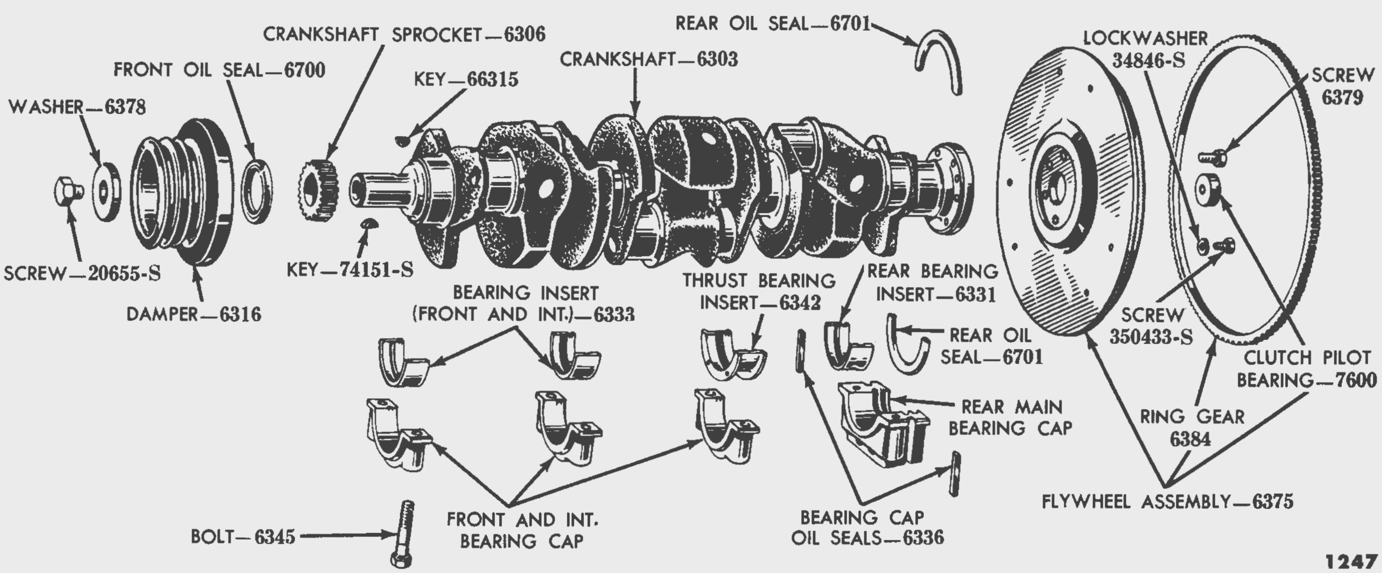

Fig. 39—Crankshaft and Related Parts

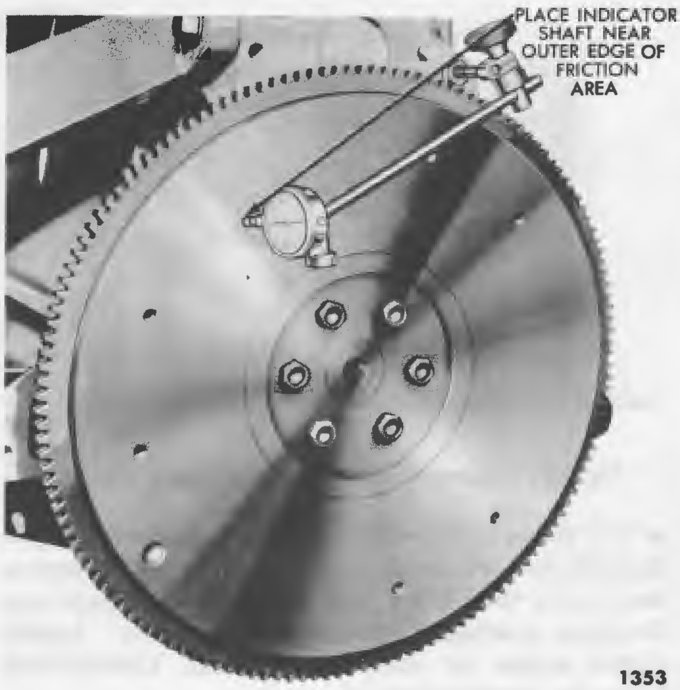

Fig. 40—Checking Flywheel Run Out

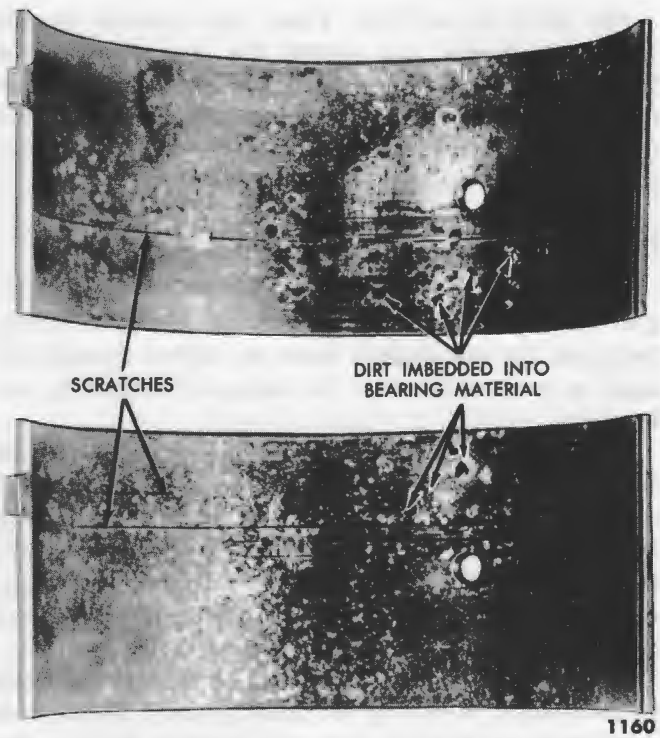

Fig. 42—Bearing Scratched by Dirt

replaced in the same position and remove the clutch assembly. Remove the flywheel bolts and pull the flywheel off the crankshaft.

(3) *RING GEAR REPLACEMENT.* To remove the old gear, drill a $1\frac{7}{32}$ inch hole nearly through the gear and cut the remaining portion of the gear with a chisel. Heat the new ring gear evenly until the gear expands enough to slip on the flywheel, then position the gear on the flywheel, and allow it to cool. The ring gear run out must not exceed 0.010 inch (fig. 41).

CAUTION: ***Do not heat any portion of the gear to a temperature higher than 500°F. If this limit is exceeded, the temper will be removed from the gear.***

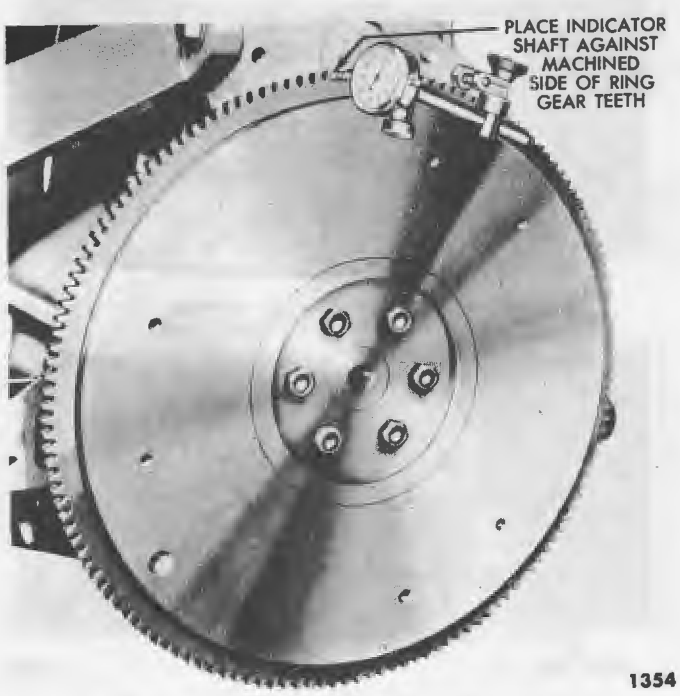

Fig. 41—Checking Ring Gear Run Out

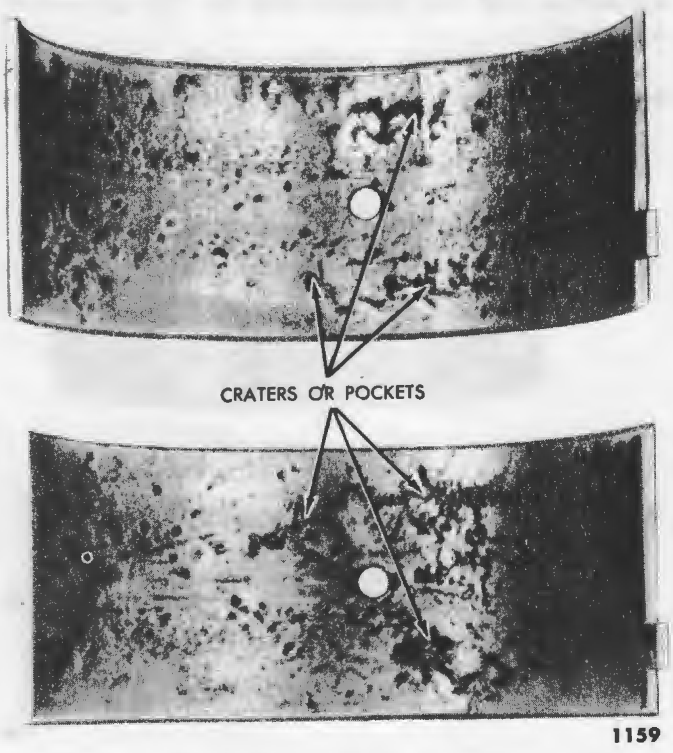

Fig. 43—Fatigue Failure of Bearing

(4) *INSTALLATION.* Place the flywheel on the crankshaft flange and install the mounting screws. Torque the screws in sequence across from each other to 75-85 foot-pounds. Align the clutch disc and install the clutch assembly using a clutch pressure plate compressor. Install the flywheel housing.

b. Crankshaft.

The crankshaft is made of cast nodular iron with integral counterweights and is statically and dynamically balanced. Oil distribution holes are drilled through the shaft to pressure lubricate the main and connecting rod bearings.

(1) *REMOVAL.* Remove the engine and install it on a work stand. Remove the flywheel housing, clutch assembly, starter, and engine rear plate. Mark the clutch assembly so it can be reinstalled in the same position. Remove the flywheel. Remove the damper, front cover, camshaft sprocket and timing chain. Remove the oil pan and the oil pump screen housing assembly.

Make sure all bearing caps are marked so they can be re-installed in exactly the same position. Remove all connecting rod bearing caps and bearings. Remove the main bearing caps and bearings. Mark all bearings so they can be installed in the same location from which they were removed. Remove the crankshaft.

(2) *INSPECTION.* Examine the shaft for cracks. Grooved or scored main or crank pin journals will cause bearing failure and should be reground for undersize bearings. Light scores or scratches can be removed with an oilstone and then polished with No. 320 grit polishing paper.

(3) *MEASURING CRANKSHAFT JOURNALS.* Measure each journal with a micrometer at a minimum of four places to determine size, out of round, and taper. Journals that are out of round more than 0.0015 inch or have more than 0.001 inch taper must be reground. Standard crankshaft journal diameters are: 2.4980-2.4988 inches for main journals and 2.2980-2.2988 inches for crankpin journals.

(4) *REGRINDING CRANKSHAFT.* If it is necessary to regrind the crankshaft, select the next undersize bearing and regrind the journals to give 0.0005-0.0021 inch clearance in the bearings. If it is necessary to regrind the journal more than 0.030 inch, discard the crankshaft.

Always grind the same radii at the ends of the journals as the shaft had originally. Too small a radius will

Fig. 45—Bearing Failure Due to Tapered Journal

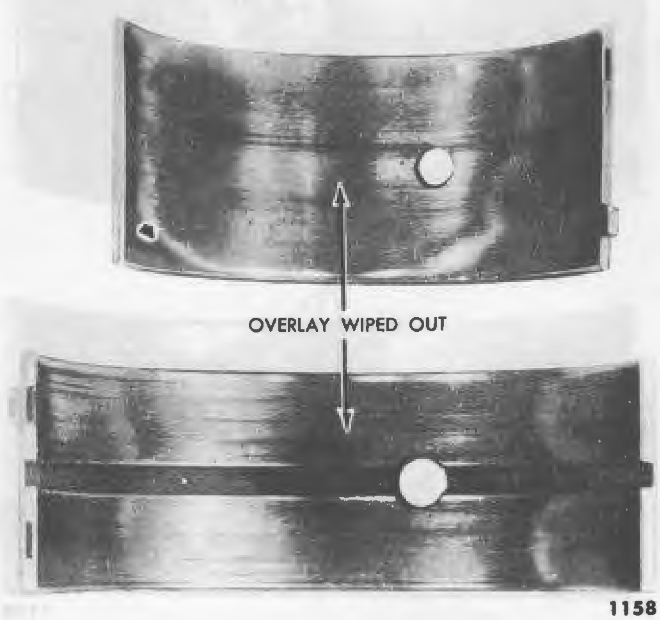

Fig. 44—Bearing Failure Due to Lack of Oil

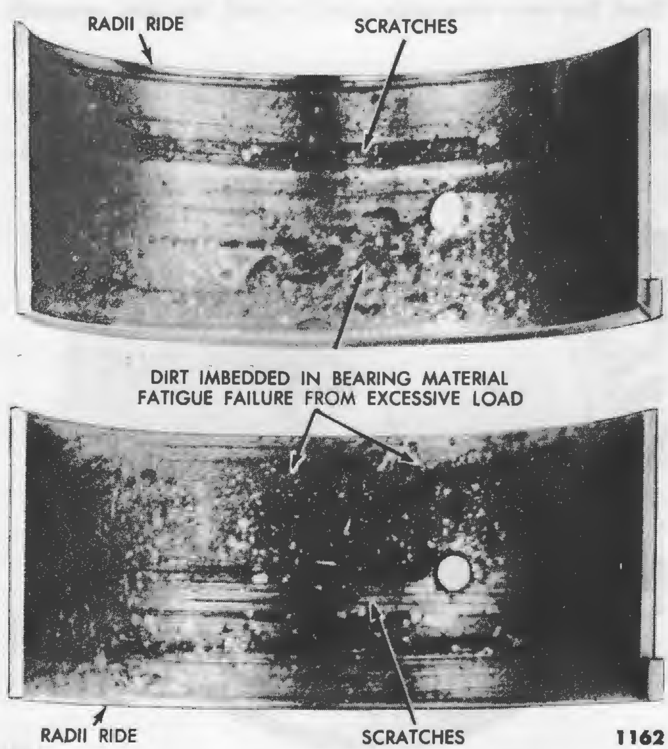

Fig. 46—Bearing Showing Radius Ride

cause fatigue failure of the crankshaft; too large a radius causes bearing failure due to "radius ride" of the bearing.

Use No. 320 grit polishing paper and engine oil to polish the journal after grinding.

(5) *INSTALLATION.* Be sure that all bearing inserts, bores, and the crankshaft journals are clean. Apply a light coat of engine oil to the journals and bearing inserts. Install the inserts in the block. Carefully lower the crankshaft into the bearings. Be careful not to damage the thrust bearing surfaces. Install the main bearing cap inserts in the caps and install the caps in the block. Install the cap bolts finger tight, pry the crankshaft forward to align the thrust bearing faces, and tighten all bearing cap bolts to 95-105 foot-pounds.

Install the flywheel. Align the clutch disc, compress the clutch pressure plate springs, and install the pressure plate assembly. Install the engine rear plate and the flywheel housing. Install the starter motor. Install the crankshaft sprocket, the camshaft sprocket, and the timing chain. Install the front cover. Install the damper. Install the engine in the vehicle.

c. Main Bearings.

Steel backed copper-lead inserts are used to support the crankshaft. Care should be used in fitting main bearings to obtain the proper clearance.

Main bearing inserts that are scratched, show fatigue pockets, or have the overlay wiped out, should be replaced.

A bearing that has only light scratches may be re-used providing the clearances are satisfactory. Scratched bearings are shown in fig. 42. Fatigue failure can be recognized by the breaking away of the bearing overlay

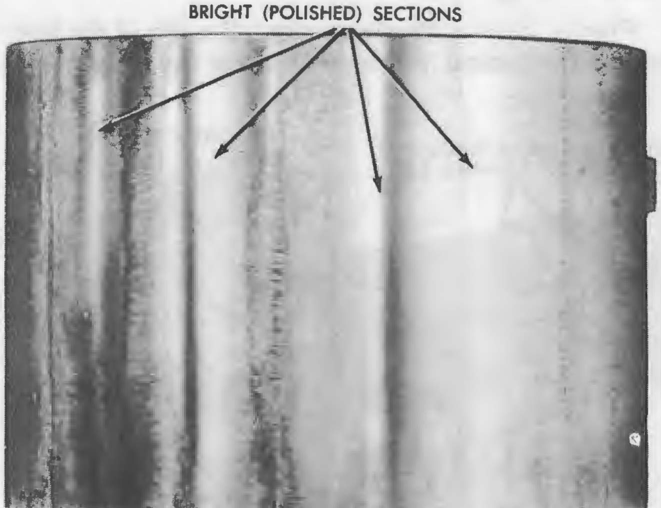

Fig. 47—Bearing Showing Bright Spots Due to Improper Seating

Fig. 48—Removing Main Bearing Insert

material (fig. 43). Figure 44 shows two bearings with the overlay wiped out.

A bearing showing signs of excessive wear on one side of the bearing half (fig. 45) indicates a tapered bearing journal. The journal should be reground to the next undersize to remove the taper and undersize bearings fitted. Similarly, bearings showing excessive wear at the center or end of the bearing around the circumference (fig. 46) indicate high spots on the bearing journal which should be corrected before the engine is rebuilt.

Bearings that show bright sections across the back of the bearing (fig. 47) indicate the bearings have been loose in the bore either because of an undersize outside diameter, or because of the bearing bore being too large, or by the bearing not having sufficient "crush."

Bearings showing bright spots on the journal face of the bearing indicate dirt lodged between the bearing insert and the bearing bore.

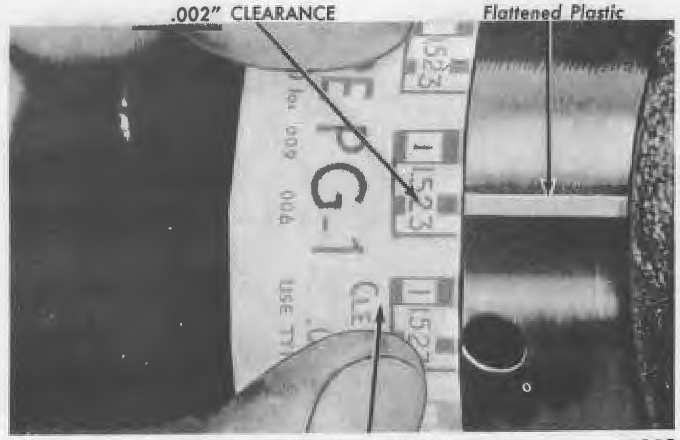

Fig. 49—Measuring Flattened Plastigage

Fig. 50—Rear Bearing Cap Seals

Crankshaft end play is controlled by the No. 3 main bearing flanges.

If the crankshaft has been removed, the bearing inserts can be easily replaced. However, the inserts can be removed and replaced without removing the crankshaft.

NOTE: ***Special care must be taken when installing the rear main bearing cap to prevent oil leakage past the two sets of seals. Use the procedure presented under "(4) Replacing Rear Oil Seals" when the cap is installed.***

(1) *REPLACEMENT WITHOUT REMOVING CRANKSHAFT.* After the bearing cap has been removed, a special tool designed for removing the upper bearing insert may be inserted in the oil hole in the crankshaft. Figure 48 shows the tool in position ready to bear against the insert. When the crankshaft is rotated in the direction opposite to engine rotation the tool will force out the bearing insert. This tool should be used with caution to avoid damaging the bearing.

To install the upper main bearing insert, place the plain end of the bearing over the shaft on the locking

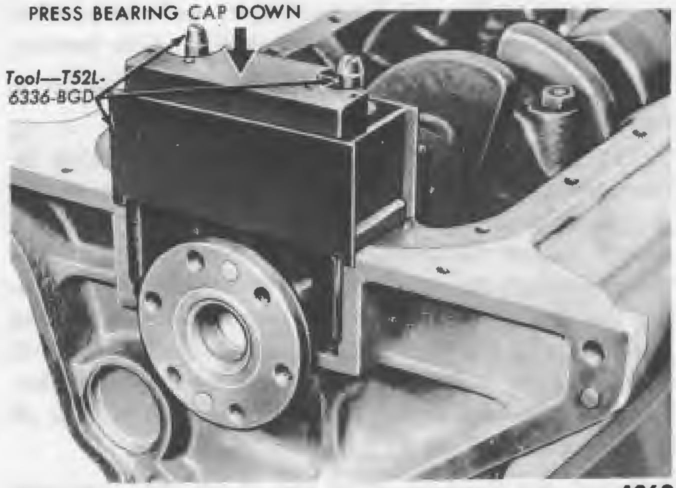

Fig. 52—Installing Rear Bearing Cap

tang side of the shaft. Using the same tool, rotate the crankshaft in the direction of engine rotation until the bearing seats itself.

(2) *FITTING MAIN BEARINGS (PLASTIGAGE METHOD).* If the engine is removed from the vehicle, drain the oil, remove the oil pan and invert the engine. Remove the bearing cap and wipe the oil from the bearing and journal. Keep the other bearing caps tight while checking the fit of a bearing.

NOTE: ***If the bearing fit is checked while the engine is in the vehicle it will be necessary to support the weight of the crankshaft. The shaft can be supported by placing a thin rubber pad between the cap insert and journal of two bearings that are not being checked. Tighten these bearing cap bolts enough to hold the crankshaft up against the block half of the main bearing inserts.***

Place a piece of Plastigage the full width of the bearing on the journal (or in the bearing cap). Install the

Fig. 51—Forming and Cutting Oil Seal

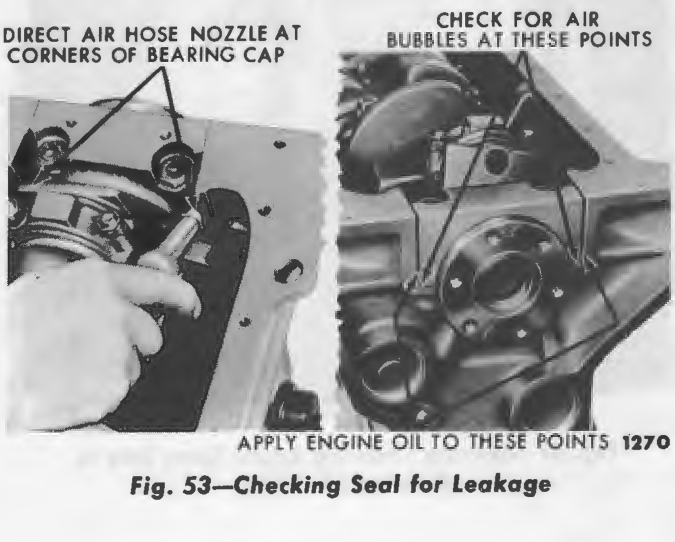

Fig. 53—Checking Seal for Leakage

bearing cap and torque the retaining bolts to 95-105 foot-pounds.

CAUTION: ***Do not turn the crankshaft while the Plastigage is between the bearing and the journal.***

Remove the bearing cap. Without moving the plastic, check its width (at the widest point) with the graduations on the Plastigage container as shown in fig. 49.

NOTE: ***Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal, be sure to fit the bearing to the maximum diameter of the journal. If the bearing is fitted to the minimum clearance of 0.0005 on the minimum diameter of the journal, and the journal is out-of-round 0.0005 or more, interference between the journal and bearing will result in rapid failure of the bearing.***

If the bearing clearance is not over 0.0021 inch or less than 0.0005 inch, the bearing insert is satisfactory. If the clearance is not within limits, try the selective fit bearing to bring the clearance within the 0.0005-0.0021 inch limit. If the selective fit bearings do not bring the clearance below 0.0021 inch, it will be necessary to regrind the crankshaft journals for use with the next undersize bearing.

NOTE: ***If the flattened plastic is not uniform in width from end to end, the journal or bearing is tapered. Be sure to check the journal with micrometers if the flattened plastic indicates more than 0.001 inch difference.***

(3) *CHECKING CRANKSHAFT END PLAY.* To check the crankshaft end play, push the crankshaft toward the rear of the engine. Place a dial indicator against the rear side of the crankshaft flange with the indicator shaft parallel to the crankshaft axis. Set the dial to zero and then push the crankshaft forward.

If the dial indicator shows more than 0.008 inch or less than 0.004 inch play, the main thrust bearing insert should be replaced with a new insert to obtain proper end play. The manufacturers crankshaft end clearance is 0.004-0.008 inch.

NOTE: ***If the end play is less than 0.004 inch check the thrust bearing faces for scratches or dirt. If the bearing is not scratched or dirty, reinstall it, aligning the faces before tightening cap bolts by prying the crankshaft forward. Recheck the end play.***

(4) *REPLACING REAR OIL SEALS.* The rear main bearing cap contains the lower half of the crankshaft journal oil seal and the cap itself is sealed to the block by two tapered vertical seals (fig. 50).

Be sure to use the seal forming tool and the bearing cap guide fixture when installing the seals and cap.

Remove the crankshaft. Remove the rear bearing inserts. Pry out the old seals from the rear bearing cap and block. Clean the seal grooves thoroughly.

Install a new journal oil seal in the bearing cap groove. Form the seal and cut it off flush with the edge of the tool shown in fig. 51. Use a sharp knife and leave no ragged edges.

Repeat the procedure to form the upper half of the seal in the cylinder block groove. Install the bearing inserts. Lay the crankshaft in the block bearing halves, using care not to damage the thrust bearing.

Install the bearing cap with seals into the guide fixture. The seals must be even with the parting edge of the cap. Install the cap guide studs in the block. Place the bearing caps and fixture assembly on the pilot studs and slide the bearing cap over the pilot studs and through the guide (fig. 52). Press the bearing cap carefully into place. Coat the surfaces lightly with grease to reduce friction during installation.

NOTE: ***Be sure the cap to block seals do not shift while the cap is being installed. The seal must be seated all the way down to prevent oil leakage at the parting edge of the cap and block.***

Install the bearing cap bolts and torque them to 95-105 foot-pounds. The vertical cap-to-block seals should extend approximately $\frac{3}{64}$ inch above the block to insure a good seal against the oil pan gasket.

Check the cap to block seals by applying oil to the outer edges of the bearing cap. Apply compressed air to the corners of the cap inside the block (fig. 53) and check the oil at the ouside edge for bubbles. If any bubbling is apparent, it wil be necessary to remove the cap and reinstall it, making sure the cap to block seals seat all the way to the corner of the cap.

10. CONNECTING RODS, PISTONS, AND RINGS

This section gives the removal, inspection, and installation procedures for connecting rods, pistons, and pins. Complete data is given on the fitting of all bearings and the fitting of new rings and pistons.

a. Remove Piston and Connecting Rod Assemblies.

Remove the oil pan and cylinder head.

Before removing a piston from the engine, cut away any cylinder bore ridges that may be present at the upper part of each cylinder.

Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. Position the ridge remover in the cylinder and adjust the ridge remover pilot to the cylinder size. Make sure the cutter is at the top side of the roller bar and that the cutter does not extend beyond the roller. Make sure the ridge remover shoes are tight. Hold the ridge remover tightly against the block and turn the arbor clockwise with a wrench (fig. 54).

CAUTION: *Never cut into the ring travel area in excess of 1/32 inch when removing ridges.*

Remove the ridge remover from the cylinder bore. Turn the crankshaft until the piston is at the top of its stroke and carefully remove the cloth with the cuttings from the piston head. Clean the carbon from the piston head and cylinder block before removing the piston from the block.

Turn the crankshaft until the rod of the piston being removed is down. Remove the nuts from the connecting rod bolts. Lift the rod bearing cap from the rod and push the rod and piston assembly out the top of the cylinder with the handle end of a hammer. Do not scratch the crank pin or the cylinder wall when removing the piston and rod. Repeat this procedure for each assembly.

NOTE: *Each rod and bearing cap is numbered from 1 to 6 from the front to the rear end of the engine. The numbers on the rod and bearing cap must be on the same side when re-installing them into their respective cylinder bores. If a connecting rod is ever transposed from one block or cylinder to another, make sure all the bearings are refitted and that the number on the rod is restamped to correspond with the new cylinder number.*

b. Disassembly of Piston and Connecting Rod Assemblies.

Mark the pistons for identification of the piston with the bore and rod for assembling purposes.

Remove the piston rings with the tool shown in fig. 55. Remove and discard the piston pin retainers at each end

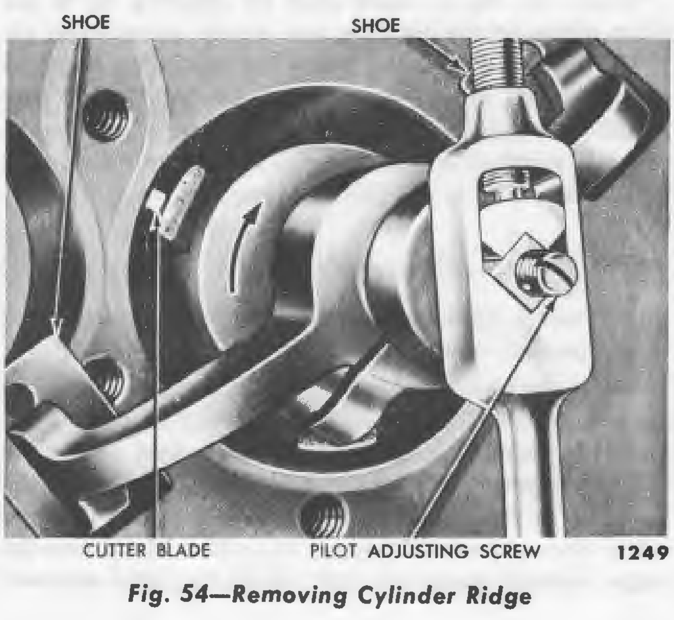

Fig. 54—Removing Cylinder Ridge

Fig. 55—Removing Rings

of the piston pin. Drive the piston pin out of the piston (fig. 56).

Remove the rod bearing cap and the bearing inserts after identifying the inserts for reassembly with the same rod and cap if the inserts are to be used again. The piston and rod is shown disassembled in fig. 57.

c. Cleaning Piston and Connecting Rod Assemblies.

Clean the piston ring grooves with a ring groove cleaner (fig. 58). Be sure the carbon is completely removed from the grooves. Brush out any particles of

Fig. 56—Removing Piston Pin

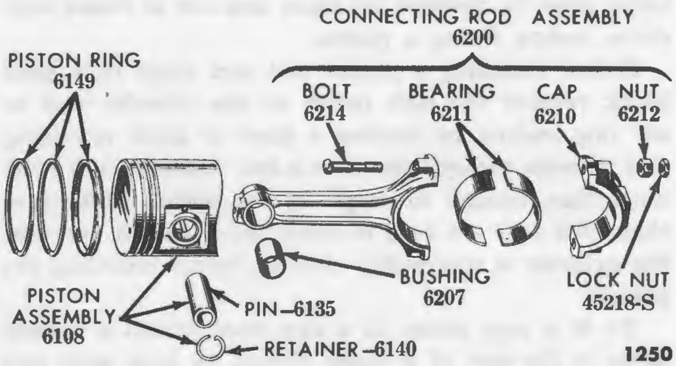

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Fig. 57—Piston and Connecting Rod

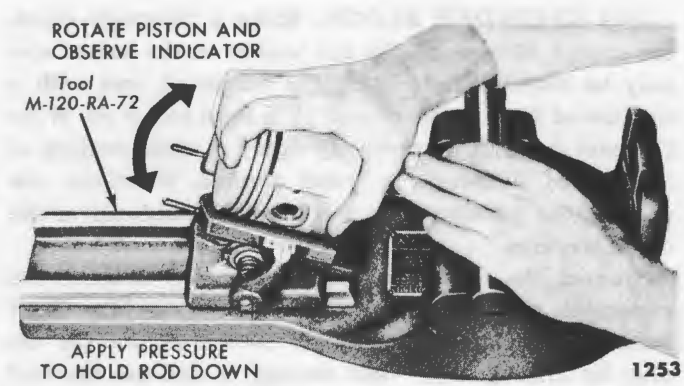

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Fig. 59—Check Connecting Rod Alignment

carbon that remain after the tool is removed.

Clean all the parts and passages in solvent. Never use caustic cleaning solution. Thoroughly clean the rod bore and the back of the bearing inserts.

d. Inspection of Piston and Connecting Rod Assemblies.

Connecting rod bolts or nuts with damaged threads, and rods with deep nicks, signs of fractures, scored bore, or bore out of round more than 0.002 inch should be replaced.

Use a new piston pin to check the piston pin bushing in the connecting rod for wear. The pin should have a 0.0001 inch to 0.0003 inch clearance in the rod bushing. If the new pin falls through the bore by its own weight, ream the bushing for the next oversize pin or replace the connecting rod.

Connecting rods with twists or bends should be replaced or corrected. Check every connecting rod for alignment on a fixture after fitting the piston pins (fig. 59). If the rod is twisted more than 0.012 inch or if it is bent more than 0.004 inch, it should be replaced.

(1) *CONNECTING ROD BEARINGS.* Replace bearings inserts that are scored, have the overlay wiped out, show fatigue failure, or are badly scratched (figs. 42 through 47).

Install the bearing inserts in the cap and rod section. The bearing should snap into place and remain there. If the bearing slides in freely and will fall out readily, the bearing has lost its spread and should be replaced. Check the inside edge of the bearing at the parting line for sharp burrs. Remove the burrs if any are apparent. The parting edges of the bearings should be free of dirt or other foreign particles.

(2) *PISTONS.* Inspect pistons for fractures at the ring lands, skirt, and pin bosses. Replace pistons showing signs of excessive skirt clearance, wavy ring lands, fractures, or damage from detonation. Spongy eroded areas near the edge of the piston top are caused by detonation. In some instances holes are also burned through the piston top.

(3) *PISTON PINS.* Replace piston pins showing signs of fractures or etching. Piston pins that show wear or fit loose in the piston or rod bushing should be replaced. Replace all piston pin retainers. Do not use pliers to install these retainers. Spiral them into the piston with the fingers.

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Fig. 58—Cleaning Ring Grooves

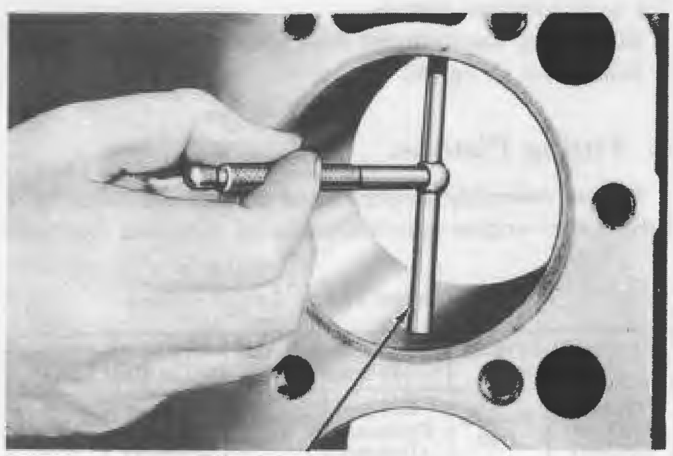

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Fig. 60—Measuring Cylinder Bore

(4) *CYLINDER BLOCK.* Make a thorough check for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light motor oil. Wipe the part dry and immediately apply a white coating of zinc oxide dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area.

Inspect the cylinder bores for scoring. Inspect the expansion plugs for rust at the edge of the plug. Rust indicates leakage. If leakage is indicated, remove the plug by drilling a ½" hole through it and use the tool shown in fig. 36 to remove the plug. Replace a new plug with the tool shown in fig. 38. Always use a sealer when installing new plugs or leakage may result.

Check the cylinder bore for taper, out of round, and wear. Use a cylinder bore gauge, telescope gauge, or inside micrometers. Only experienced personnel should be permitted to take these measurements.

Record measurements taken as follows:

Lengthwise of the block, measure and record as "A" the diameter of the cylinder at the top of the cylinder where the greatest ring wear occurs. Also lengthwise of the block, measure and record as "B" the cylinder diameter at the bottom of the piston skirt travel.

Crosswise of the block, measure and record as "C" the diameter at the top of the cylinder at the greatest wear point. Measure and record as "D" the diameter at the bottom of the cylinder, crosswise of the block.

Reading "A" compared to reading "B" and reading "C" compared to reading "D" indicates cylinder taper. If the taper is greater than 0.015 inch the cylinder must be rebored and honed for the next oversize piston. However, a cylinder rebore should be recommended if the cylinder taper exceeds 0.008 inch.

Reading "A" compared to reading "C" and reading "B" compared to reading "D" indicates whether or not the cylinder is out of round. If the out of round exceeds 0.003 inch, the cylinders must be rebored and honed for the next oversize piston.

Measuring the cylinder bore with a telescope gauge is illustrated in fig. 60.

e. Fitting Pistons.

Proper assembly tolerances of pistons are required if satisfactory engine operation is to be obtained. Cylinder bores must be checked for taper and out of round condition before fitting a piston.

Before installing a piston and new rings in a used block, remove the high polish on the cylinder wall to aid ring seating by passing a hone or glaze removing tool through the cylinder bore a few times. Do not hone more than enough to rough up the polish. Make sure that oiled rags are used to catch the hone grit and that the cylinder is thoroughly cleaned before installing the pistons.

To fit a new piston in a new bore, attach a tension scale to the end of a feeler ribbon ½ inch wide and having the correct feeler ribbon thickness as given in Table 1.

Position the feeler on the side of the piston 90° from the piston pin hole. Invert the piston, then push the piston in the cylinder so the end is about ¾ inch below the top of the block. Keep the piston pin bores parallel with the crankshaft axis. Pull out the feeler gauge while noting the scale reading (fig. 61).

The pull limits for new pistons and used pistons in new or used bores is given in Table 1.

If the scale reading is greater than the maximum allowable pull, check for a damaged piston, try another piston, or hone the cylinder bore to obtain the proper fit. If the scale reading is less than the minimum allowable pull, try another piston. If none can be fitted, rebore the cylinders to the next oversize piston.

NOTE: ***It is not necessary to rebore all cylinders, if the reboring will permit the use of up to 0.040 inch oversize pistons.***

Table 1—Piston Fitting Specifications

Fitting New Piston In New Bore		Fitting New Piston In Used Bore		Fitting Used Piston In Used Bore	
Gauge Thickness (Inches)	Pounds Pull	Gauge Thickness (Inches)	Pounds Pull	Gauge Thickness (Inches)	Pounds Pull
0.0015	5-10	0.002	5-10	0.003	5-10

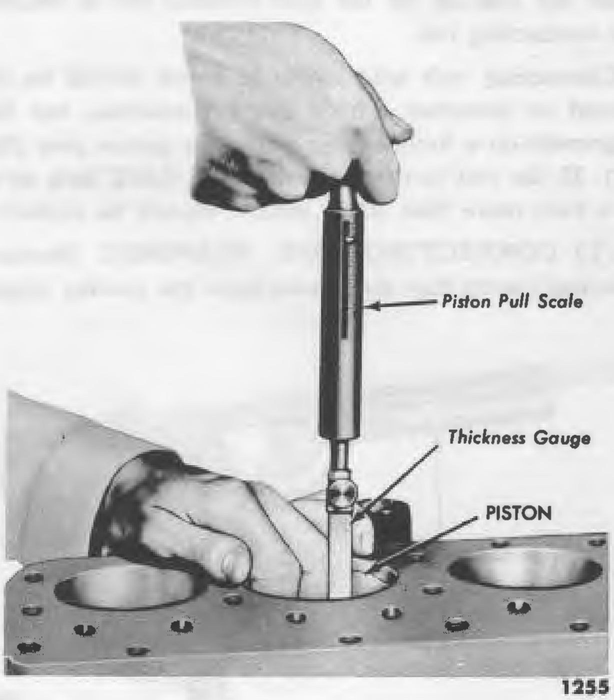

Fig. 61—Fitting Piston

f. Boring Cylinder Block.

To assure maximum engine performance and balance of the reciprocating parts of the engine, all cylinders must be bored to the same size, when the 0.060 inch oversize piston is used, even though only one cylinder requires reboring and the others are within tolerance. Manufacturers recommendations on how to use boring equipment should be followed and the work performed only by experienced personnel.

Bore the cylinder with the most wear first to determine the proper oversize. If the cylinders will not clean up at 0.060 inch oversize, the block must be replaced.

When reboring the cylinders allow 0.0015 inch stock for honing to a final finish. Use a number 220 to 280 grit hone for this operation.

CAUTION: ***Thoroughly clean the block to remove all particles of abrasive after the honing operation.***

g. Fitting Piston Pins.

Check the piston pin fit in the piston. Piston pins must be a free fit in the piston pin bore at normal room temperature (70°F.).

If oversize piston pins are to be used, or if the piston pins are too tight, use an expansion type piston pin bore reamer. Place the reamer in a vise and revolve the piston around the reamer.

Set the reamer to the size of the piston bore, then expand reamer very slightly and trial ream the bore in the piston using a pilot sleeve of the nearest size to maintain alignment of the piston pin bores.

CAUTION: *Take a very light cut.*

Check the reamed hole size using the new piston pin to be used in the piston being reamed as a gauge. If the bore is small expand the reamer slightly and make another trial cut, then repeat the procedure outlined until a piston pin fit is obtained.

Similarly ream all the pistons in which pins need to be fitted, checking each with the pin to be used in the piston. Repeat the procedure for fitting the pins to the connecting rod bushings.

h. Fitting Piston Rings.

Install the piston ring in the cylinder bore. Invert the piston and use the top to push the ring about halfway into the bore to true the ring with the cylinder bore. Measure the ring gap with a feeler gauge. The gap should be 0.007-0.047 inch (all rings). If the gap is less than the minimum limit the ring will have to be removed and the ends filed until the proper clearance is obtained.

After the rings have been fitted in the cylinder bore, they should be immediately installed on the piston or identified with the piston and cylinder bore in which they are to be installed.

Check the ring to groove clearance on the proper piston for the cylinder as shown in fig. 62.

The rings should have the following clearance:

Ring	Clearance in Piston Groove (inch)	End Gap of Ring in Cyl. Bore (inch)
Top Compression	0.0020 - 0.0035	0.007 - 0.047
2nd Compression	0.0015 - 0.0030	0.007 - 0.047
Oil Ring	0.0010 - 0.0025	0.007 - 0.047

Three different type rings are available in sets for service, the standard ring, the expander ring, and the steel section ring.

The standard (snap type) is designed for use in a new engine.

The expander type is designed for use, after a light honing operation, in a cylinder bore with a small amount

Fig. 62—Checking Ring Clearance

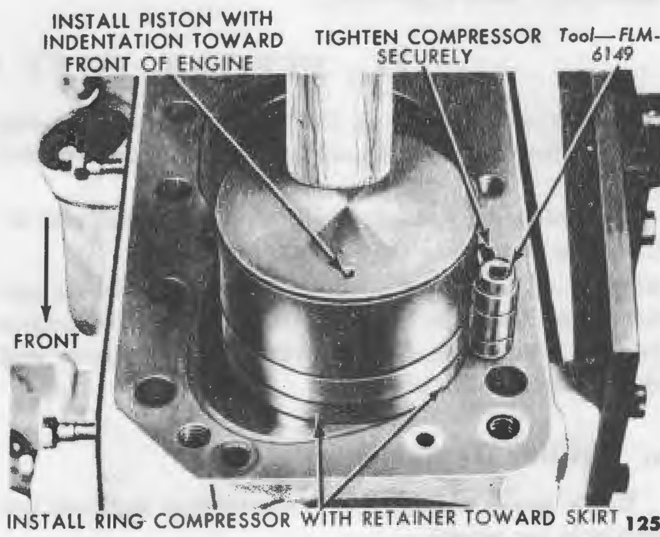

Fig. 63—Installing Piston

of taper, to correct an oil consumption condition.

The steel section type ring should be used in cylinders where the taper of the cylinder bore is very great, or to correct excessive oil consumption conditions when the customer does not want the cylinders rebored.

Bore "glaze" should be removed to aid piston ring seating.

i. Fitting Connecting Rod Bearings (Plastigage Method).

Place a piece of Plastigage the length of the insert in the cap bearing insert. Install the cap and tighten to 45-50 foot-pounds.

NOTE: ***Do not turn the crankshaft with Plastigage in place.***

Remove the bearing cap and use the Plastigage scale to measure the width of the flattened piece of plastic at the widest point.

NOTE: ***If the crankpin is out-of-round, be sure to fit the bearing to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter of the crankpin with minimum clearance of 0.0005 inch and the crankpin is out of round 0.0005 or more, interference will result in rapid failure of the bearing.***

If reading is not over 0.0021 inch or not less than 0.0005 inch, the fit is satisfactory. If the clearance is greater than 0.0021 inch, try another selective fit bearing to bring the clearance within the 0.0021 inch limit. If the clearance is still excessive, regrind the crankshaft and fit undersize bearing inserts.

NOTE: ***If the flattened plastic is not uniform from end to end in its width, the journal or bearing is tapered. Be sure to check the journal with micrometers for taper if the flattened plastic indicates more than 0.001 inch difference.***

Rotate the crankshaft after the bearing is installed to be sure the bearing is not too tight.

j. Assembly.

Lubricate all parts with light engine oil.

NOTE: ***The oil squirt hole should be toward the camshaft side of the engine when assembly is installed.***

Position the connecting rod in the piston and push the pin into place.

Insert new piston pin retainers by spiraling them into the piston with the fingers. Do not use pliers to install retainers. Install the piston rings.

Insert the bearing halves in the rod and cap.

k. Installation.

Oil the cylinder wall with light engine oil. Make sure the ring gaps are equally spaced around the circumference of the piston. Compress the rings with a compressing tool and push the piston in with a hammer handle (fig. 63) until it is slightly below the top of the cylinder.

NOTE: ***Install the piston with the indentation in the piston head toward the front of the engine.***

Turn the crankshaft throw to the bottom of its stroke. Oil the crankpin and push the piston all the way down until the rod bearing seats on the crankpin. Install the bearing cap (line up the stamped numbers) and tighten the retaining nuts to 45-50 foot-pounds torque. Install new pal nuts and tighten to 3-3½ foot-pounds torque (or finger tight plus 1/3 turn).

Install the oil pan and cylinder heads. Install the engine in the vehicle. Fill the crankcase with the proper grade and amount of lubricant. Fill the cooling system. Start the engine and run it at idle speed. Make sure there is sufficient oil pressure. Check the temperature to make sure the engine does not overheat.

11. MUFFLER, INLET PIPE, AND OUTLET PIPE

The exhaust system on the 6-cylinder truck consists of a muffler, an exhaust outlet pipe, and a muffler inlet pipe.

The following procedure covers the removal and installation of units of the exhaust system.

NOTE: ***After replacing any part of the exhaust system, it is advisable to loosen all the frame attaching bracket clamps to relieve twists in the system and then retighten the clamps.***

a. Muffler Replacement.

Extra heavy double-wall construction mufflers are available for service.

(1) *REMOVAL.* Loosen muffler inlet and outlet pipe clamps. Slide clamps away from the muffler, the inlet pipe, and the outlet pipe. Loosen front and rear outlet pipe clamps and disengage outlet pipe from muffler by sliding the outlet pipe to the rear. Remove the muffler from the inlet pipe.

(2) *INSTALLATION.* Place the muffler in position on the inlet pipe and slide the outlet pipe into the muffler. Place the inlet pipe and outlet pipe clamps in position on the muffler and tighten clamps. Tighten the front and rear outlet pipe clamps.

b. Outlet Pipe Replacement.

The outlet pipe is attached to the frame by flexible sound deadening materials which not only prevent the exhaust noises from being conducted through the chassis frame but also relieve the exhaust system from twisting or bending stresses.

(1) *REMOVAL.* Loosen the muffler outlet pipe clamp, leaving the clamp on the muffler. Remove the outlet pipe front and rear support clamps and disengage the outlet pipe from the muffler.

(2) *INSTALLATION.* Position the outlet pipe in the muffler and tighten the clamp. Place the outlet pipe rear support bracket clamp on the outlet pipe. Install the front support bracket clamp and tighten the nut. Position the rear outlet pipe clamp on rear bracket and tighten the nut.

c. Inlet Pipe Replacement.

The muffler inlet pipe is designed to give the exhaust gases leaving the exhaust manifolds a direct through passage to the muffler, thereby increasing the over-all efficiency of the exhaust system.

(1) *REMOVAL.* Loosen the muffler inlet pipe clamp. Remove the two nuts holding the inlet pipe to the exhaust manifold, then remove the gasket. Disengage the inlet pipe from the muffler by sliding the inlet pipe forward.

(2) *INSTALLATION.* Place the inlet pipe in the muffler. Install a new gasket on the exhaust outlet flange studs. Slide the inlet pipe flange over the studs and secure the pipe to the exhaust manifold with the two nuts and lockwashers. Tighten the nuts to 23-28 foot-pounds. Tighten the muffler inlet pipe clamp.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part ONE

POWER PLANT

Chapter

II

8-Cylinder 279 Cubic Inch and 317 Cubic Inch Truck Engines

Ford Truck 8-cylinder engines, series EAL and EAM, are used in F-7 and F-8 trucks. The EAL engine used in the F-7 truck has a displacement of 279 cu. in. with a $3\frac{9}{16}$ inch bore and a 3.5 inch stroke. The EAM engine used in the F-8 truck has a 317 cu. in. displacement with a 3.8 inch bore and a 3.5 inch stroke.

Repair and maintenance operations are performed on either engine in exactly the same manner. The parts used in these engines are interchangeable with the following exceptions: cylinder block, pistons and rings, piston pins, carburetor, governor, and cylinder heads.

The location of externally mounted parts of the engine can be noted in figs. 1 and 2.

Complete repair procedures given below are supplemented with illustrations. The procedures are presented in the order shown in the table of contents at the beginning of the chapter. An engine overhaul gasket kit is available for service.

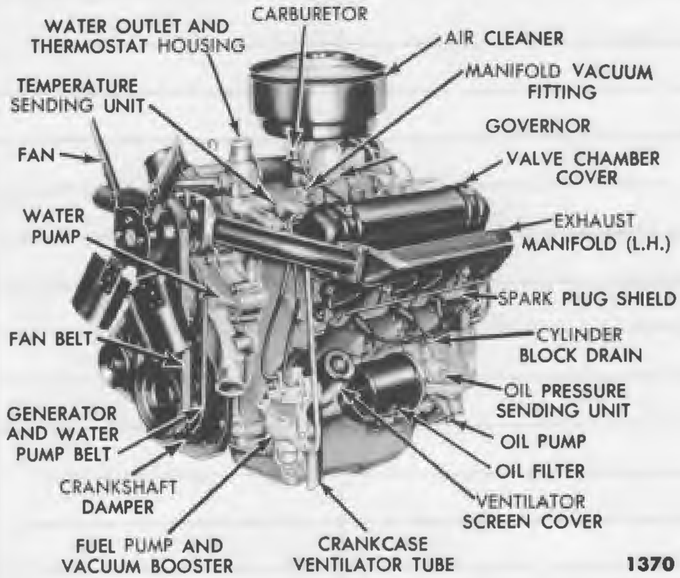

Fig. 1—EAM or EAL Series Engine (Left Hand View)

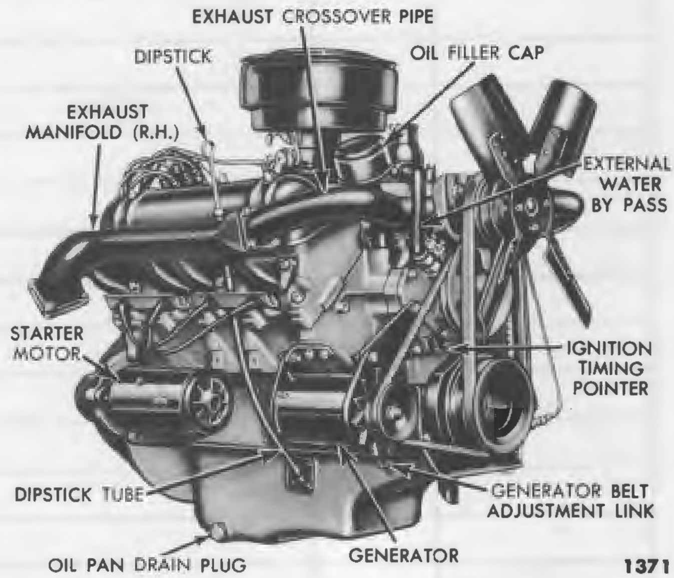

Fig. 2—EAM or EAL Series Engine (Right Hand View)

1. ENGINE REMOVAL AND INSTALLATION

The procedure given below will apply for either the F-7 or the F-8 truck engine.

a. Removal.

Disconnect the battery ground strap to avoid short circuits. Shut off the tank valve in the fuel line under the cab. Drain the cooling system. Remove the hood.

Disconnect the oil pressure sender wire. Disconnect the radiator hose at the engine. Disconnect the heater hose at the engine. Remove the fan assembly. Remove the radiator. Remove the carburetor air cleaner.

Disconnect the generator wires at the generator, the starter cable at the starter, and the engine temperature sending unit wire.

Remove the high tension wire and the coil primary wire at the distributor. Disconnect the choke wire, hand throttle, and accelerator rod and spring at the carburetor.

Disconnect the flexible inlet line at the fuel pump. Disconnect the windshield wiper hose (if vacuum wipers are used), and the brake vacuum booster hose.

Disconnect the muffler inlet pipe and pull the pipe away from the manifold.

Place a jack under the transmission. Remove the screws retaining the flywheel housing to the engine.

Remove the cotter pins and retaining nuts from the engine front mounts.

Install the lifting sling (fig. 3) and carefully lift the engine with a portable floor crane (or chain fall).

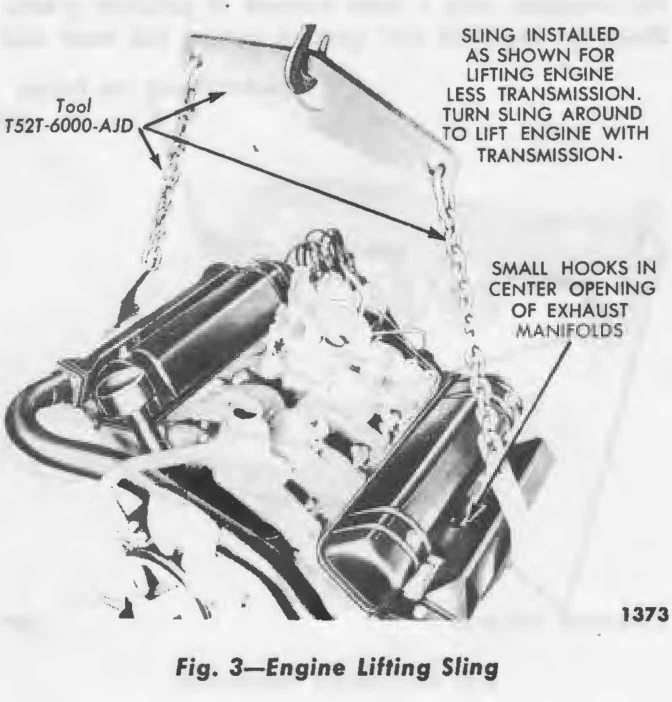

Fig. 3—Engine Lifting Sling

Raise the engine enough to clear the frame front cross-member. Raise the transmission jack until it supports the transmission to keep this alignment.

Pull the engine forward until it clears the transmission, then lift it out of the vehicle.

Install the engine on a work stand with the adaptor shown in fig. 4.

b. Installation.

Align the front support mounts in the frame cross-member.

Remove the engine from the work stand with the lifting sling and crane. Lower the engine carefully in the frame, aligning it with the transmission shaft. Slide the clutch over the transmission shaft. If necessary, turn the crankshaft to align the shaft splines with the clutch disc splines. Install the screws retaining the flywheel housing to the block.

Lower the engine on the front mounts, install the washers, nuts, and cotter pins. Install the clutch equalizer shaft clevis pin and cotter pin. Check the clutch free play. Adjust, if necessary.

Connect the muffler inlet pipe. Connect the throttle linkage, hand throttle, and choke wire. Connect the wiper vacuum hose (if vacuum wipers are used) and the flexible fuel line to the pump. Connect the vacuum brake booster hose if the truck has booster brakes.

Connect the generator wires, the engine temperature sending unit wire, the oil pressure sending unit wire, the ignition primary and secondary wire, and the starter cable.

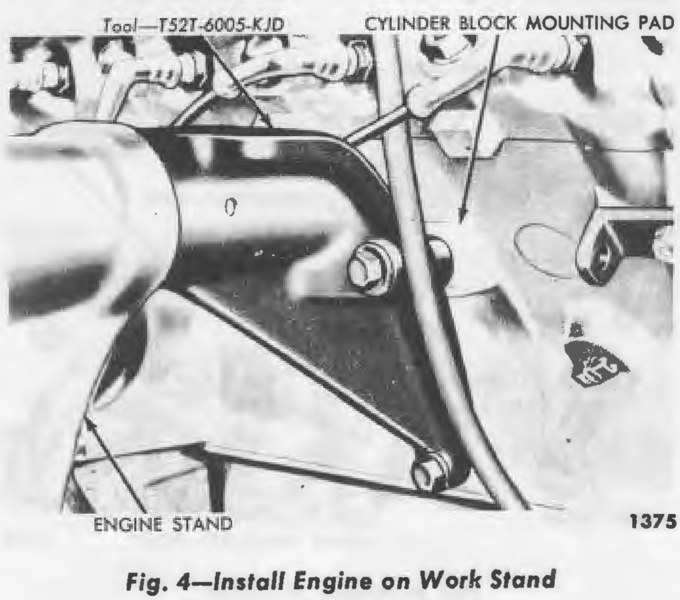

Fig. 4—Install Engine on Work Stand

Install the radiator. Install the two springs, washers, nuts, and cotter pins on the radiator support bolts. Connect the radiator hose. Connect the hose to the engine.

Connect the hood hinges with the two bolts. Fill the cooling system. Turn on the fuel tank valve under the cab. Connect the battery ground strap. Fill the crankcase with the proper grade and quantity of engine oil.

Run the engine until it is thoroughly warmed up, and check for coolant and oil leaks. Check the valve lash and the ignition timing.

2. MANIFOLDS

Procedures for removal, cleaning and inspection, and installation of intake and exhaust manifolds are presented below.

a. Intake Manifold.

The intake manifold is bolted to the cylinder heads and straddles the center portion of the block. The manifold and carburetor can be removed as an assembly.

(1) *REMOVAL.* Remove the air cleaner. Disconnect the throttle linkage, choke wire, carburetor fuel line, distributor vacuum line, and governor vacuum lines. Disconnect the vacuum booster line at the manifold fitting. Disconnect the engine temperature sending unit wire. Drain the radiator. Disconnect the upper radiator hose.

Remove the water by-pass flange screws from the outlet elbow. Remove the manifold retaining screws and the four clamps and lift the manifold and gaskets from the block. The manifold is illustrated in fig. 5.

(2) *CLEANING AND INSPECTION.* Wash the grease and oil from the outside of the manifold.

Inspect the manifold for cracks and warped gasket surfaces. Replace warped or cracked manifold. Be sure the gasket surfaces of the manifold are free from nicks, burrs, or bad scratches.

(3) *INSTALLATION.* Install the manifold with new gaskets and align the bolt holes in the gaskets and manifold with the cylinder head tapped holes. Install the manifold retaining screws (the four center screws use the clamps to bear against the manifold flanges) and torque the screws to 23-28 foot-pounds tightening from the center of the manifold outward in each direction.

Install the water by-pass screws. Connect the engine temperature sending unit wire. Connect the vacuum booster line, the distributor vacuum line, the carburetor fuel line, and governor vacuum line. Connect the choke wire and the throttle linkage. Install the air cleaner. Connect the upper radiator hose. Fill the cooling system.

b. Exhaust Manifolds.

Do not remove manifolds when they are hot or they may warp and make reassembly difficult.

(1) *REMOVAL.* Disconnect the crossover pipe from both manifolds. Disconnect the muffler inlet pipe from the right-hand manifold. Remove the oil dipstick and tube. Remove the screws, flatwashers, and manifolds. The manifolds are shown in fig. 6.

(2) *CLEANING AND INSPECTION.* Clean the gasket surfaces of the manifolds.

Inspect the manifolds for cracks or warped gasket surfaces. Replace cracked or badly warped manifolds.

(3) *INSTALLATION.* Coat the mating surfaces of the manifold with a light amount of graphite grease. Hold the manifold and gaskets against the head and

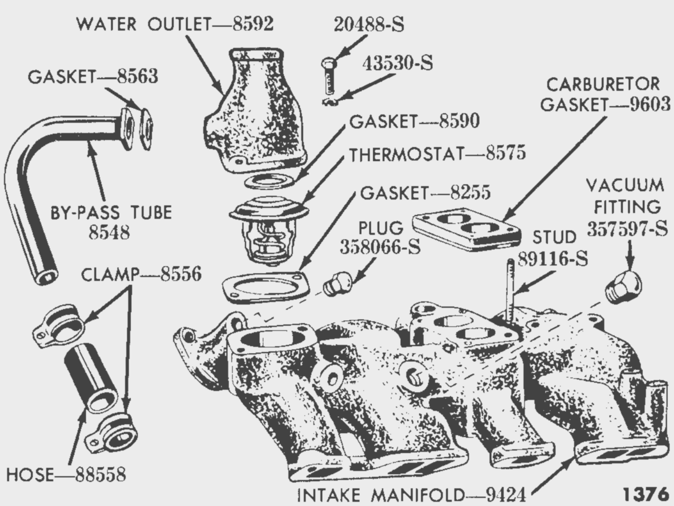

Fig. 5—Intake Manifold

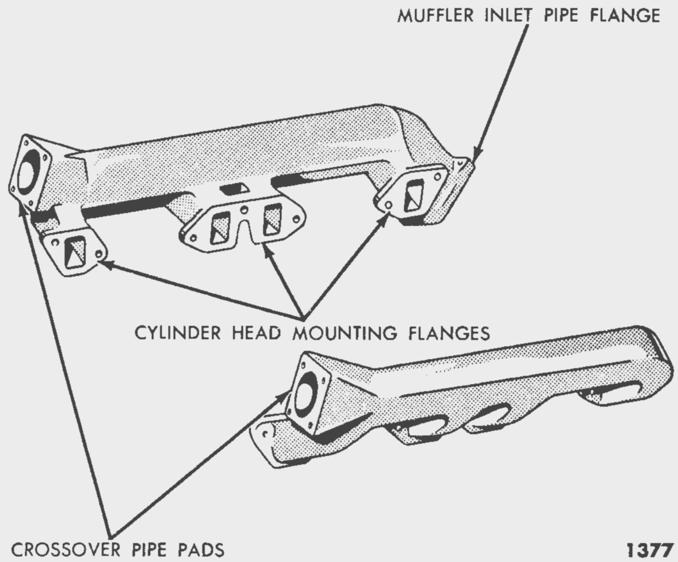

Fig. 6—Exhaust Manifolds

install the washers and retaining bolts. Torque the bolts to 23-28 foot-pounds from the center to the ends. Install the crossover pipe gaskets. Place the crossover pipe on the manifold studs and install the retaining nuts. Torque the nuts to 23-28 foot-pounds. Install the muffler inlet pipe.

3. CYLINDER HEADS

The cylinder head contains the valves and rocker mechanism. The intake manifold straddles the cylinder block and is bolted directly to the heads. Procedures given here cover only the removal, cleaning and inspection, and installation of the head. Disassembly of the cylinder head is covered under "Valves and Valve Mechanism" later in this chapter.

The left and right hand cylinder heads are interchangeable provided a water outlet plug is removed from one end of the head and a new plug installed in the other end. Cylinder heads serviced to the field will not have the water outlet plug installed so they can be used for either right or left-hand installations.

The plug is installed in the rear water passage of either cylinder head by using the tool shown in fig. 7. Be sure to apply a light coat of water resistant sealer to the sealing surface of the plug before it is installed.

a. Removal.

Drain the cooling system. Clean the outside of the valve chamber cover. Remove the cover. Disconnect the muffler cross over pipe and remove the exhaust manifold. Remove the intake manifold. Clean the outside of the tappet chamber cover and remove the cover. Disconnect the spark plug wires.

NOTE: ***On the right-hand cylinder head remove the ignition harness bracket from the rear corner of the head. Remove the oil dipstick and tube from the crank case. On vehicles equipped with air brakes, remove the air compressor.***

Release the spring tension on the rocker arms and remove the push rods (fig. 8). Identify the rods so they can be replaced in their original position.

NOTE: ***The two end push rods can be left in place and removed after the head is removed.***

Remove the cylinder head bolts. Install the cylinder head holding fixture using the four long screws from the intake manifold to secure the brackets to the head. Lift the cylinder head off the block. Do not pry between the head and block. Remove the head gasket.

b. Cleaning.

Remove carbon deposits from the combustion chambers and valve heads with a scraper and a wire brush. Be careful not to scratch the gasket surface of the head. Clean rust and dirt from the water passages.

c. Inspection.

Check the head for cracks and warped gasket surfaces. Check to see that all water passages are open. Make sure the gasket surfaces of both head and block are free from projections or scratches. Smooth off any projections or scratches with an oil stone.

d. Installation.

Apply a coating of head gasket sealer (8A-19554) to both sides of the new head gasket. Use the brush furnished to spread the sealer evenly over the entire gasket surface. Install the head gasket over the cylinder dowels and pilot studs as shown in fig. 9.

Fig. 7—Installing Cylinder Head Water Outlet Plug

Fig. 8—Removing Push Rods

Slide the cylinder head over the pilot studs in the cylinder block guiding the end push rods through the head. Remove the cylinder head fixture brackets, and the pilot studs. Coat the cylinder head bolt threads with water resistant sealer, install the bolts, and tighten them in the order shown in fig. 10 to 80-90 foot-pounds. Install the push rods centering them in the tappets and the ball end of the rocker lever screws. Adjust the valve lash (cold seting) to 0.010 inch (intake) and 0.020 inch (exhaust). Install the tappet chamber cover with a new gasket cemented to the cover. Tighten the nuts to 6-8 foot-pounds. Install the intake manifold using new gaskets. Install the exhaust manifold and reconnect the exhaust cross over pipe. Connect the radiator hose. Fill the cooling system.

NOTE: ***On the right-hand head, install the ignition harness bracket and the oil dipstick and tube. Install the air compressor (if the truck is so equipped).***

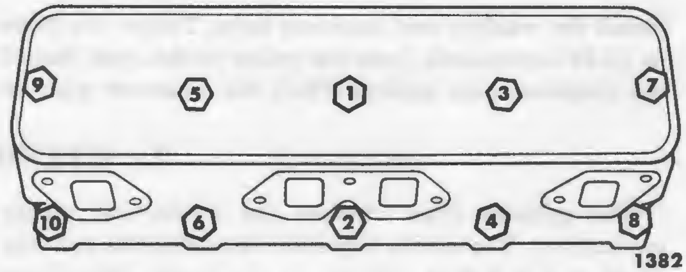

Fig. 10—Cylinder Head Bolt Tightening Sequence

Connect the spark plug wires. Run the engine until it is thoroughly warmed up and recheck the valve lash with the engine at idle. The valve lash (hot setting) should be 0.012 inch (intake) and 0.018 inch (exhaust). Install the valve chamber cover using a new gasket cemented to the cover and tighten the nuts to 6-8 foot-pounds.

4. VALVES, VALVE MECHANISM, AND VALVE LASH ADJUSTMENT

Procedures covering repair and replacement of valves and valve mechanism and the adjustment of valve lash are given here. The procedures include cylinder head disassembly.

Valve guides are an integral part of the cylinder head. Valves with 0.003, 0.015 and 0.030 inch oversize stems are available for service when the valve guides become worn or scored.

a. Cylinder Head Disassembly.

Remove the valve chamber cover. Drain the radiator. Remove the intake and exhaust manifolds. Loosen the rocker arm screws. Remove the rocker shaft bracket screws and remove the shaft assembly from the head. Remove the oil baffle plates. Pull the drain line from the end bracket. Remove the push rods identifying each rod with the rocker arm from which it was removed. Install the cylinder head holding fixture brackets and remove the cylinder head. The head is shown mounted in the holding fixture in fig. 11.

Remove the cotter pins at each end of the rocker arm shaft and remove the flat washers, spring washers, and plugs. Slide the rocker arms, springs, and brackets off the shaft. Be sure to identify the parts so they can be installed in their original position. The rocker mechanism is shown disassembled in fig. 12.

Remove the exhaust valve stem caps identifying the caps so they can be replaced on the same valve. Clean the carbon out of the combustion chamber. Compress the valve springs with the tool shown in fig. 13, remove the valve stem locks, and release the springs. Remove the intake valve sleeve, spring retainer, and spring. Remove and discard the intake valve seal and remove the valve. Remove the exhaust valve spring retainer, spring, and valve. Identify all valve parts so they can be re-

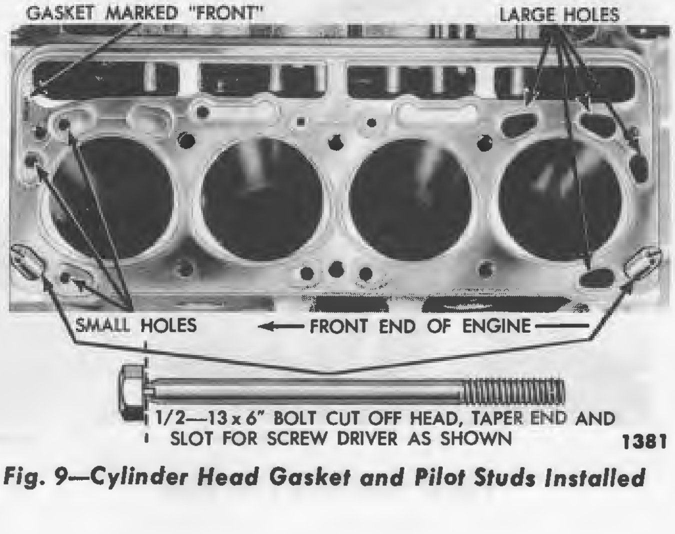

Fig. 9—Cylinder Head Gasket and Pilot Studs Installed

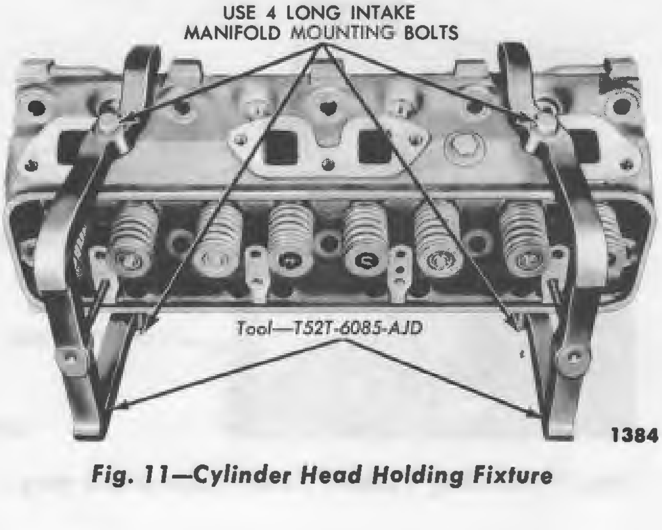

Fig. 11—Cylinder Head Holding Fixture

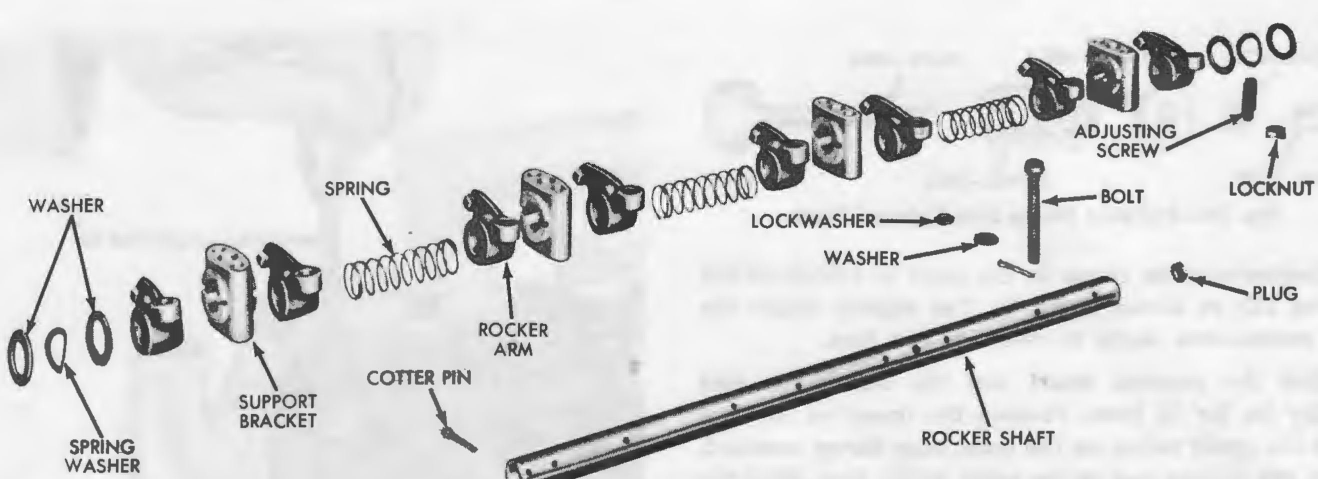

Fig. 12—Rocker Mechanism—Disassembled

placed in their original position.

b. Valves and Valve Seats.

A rotatable valve (fig. 14) is used for the intake and a free type valve (fig. 15) is used for exhaust. The exhaust valve seat has a hardened insert to increase seat life. Intake valve seats do not have inserts.

After regrinding valves and seats or installing new valves, the valve and seat should be lightly lapped to form a good seal. Use medium lapping compound.

(1) *VALVE CLEANING AND INSPECTION.* Scrape or wire brush carbon off the head and stem of the valve. Remove varnish from the valve stem. Check the valve for a burned or warped head or a bent or scored stem. Discard any defective valves.

(2) *VALVE GUIDE INSPECTION AND REPAIR.* Measure the valve guide diameter (fig. 16) and the valve stem diameter. If the clearance is more than 0.004 inch for the intake or more than 0.005 inch for the exhaust valve, ream out the guide for the next oversize

Fig. 13—Removing or Installing Valve Locks (6-Cylinder shown)

valve. Use the piloted reamer shown in fig. 17. Be sure to clean the guide and valve port thoroughly.

NOTE: ***The valve guide reamers are piloted to fit a standard guide bore (0.003 inch oversize reamer); 0.003 inch oversize bore (0.015 inch oversize reamer); and a 0.015 inch oversize bore (0.030 inch oversize reamer). Be sure to use the reamers in sequence when reaming from standard to 0.015 inch or 0.030 inch oversize bores.***

(3) *REFACING VALVES.* Grind the valve face at a 45° angle on a valve grinder. Grind off only enough stock to remove pits or grooves from the valve face. If the edge of the valve head is less than 1/32 inch thick after grinding, discard the valve.

Grind the valve stem ends if they are scored or grooved. Do not remove more than 0.010 inch from the end of the valve stem. Check the valve face runout. If it exceeds 0.002 inch, regrind the valve. If it still exceeds 0.002 inch runout after regrinding, discard the valve.

(4) *EXHAUST VALVE SEAT INSERTS.* Check the exhaust valve seat inserts for looseness in the head. If any of the inserts are loose, they should be removed and oversize inserts installed.

To remove the insert, drill two small holes into the insert approximately 180° apart. Do not drill all the way through the insert material. Crack the insert at the drilled holes with a chisel. Pry the old insert out of the head.

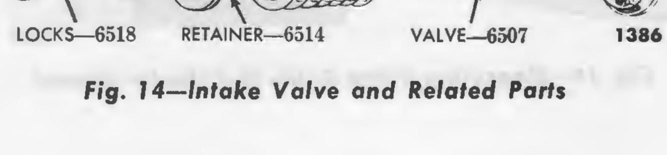

Fig. 14—Intake Valve and Related Parts

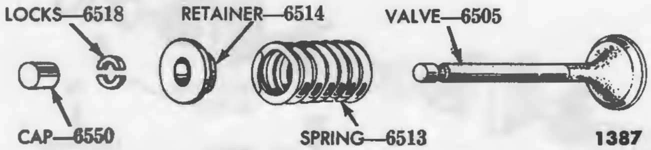

Fig. 15—Exhaust Valve and Related Parts

Counterbore the recess in the head to 1.6445-1.6455 inches I.D. as shown in fig. 18. Cut slightly below the old counterbore depth to clean up this face.

Chill the oversize insert and the installation tool in dry ice for ½ hour. Position the insert on the tool with the small radius on the outer edge facing outward. Pilot the driving tool in the valve guide, then drive the insert into the counterbore until it is fully seated. Do not peen the counterbore area around the insert. Reface the new insert.

CAUTION: ***The installation of the insert must be performed immediately upon removal of the tool and insert from the dry ice. Protect the hands with gloves when handling the chilled insert and tool.***

(5) *VALVE SEAT REFACING.* Clean the valve seats with a wire brush to remove all carbon. Clean the valve guides with a guide cleaner. Grind the seats with a valve seat grinder removing only enough stock to clean up pits or grooves. If the valve seat width is more than 0.070-0.080 inch (intake) or 0.095-0.105 (exhaust) after grinding, remove stock from the top and bottom edge to reduce the width (figs. 19 and 20). Keep the seat as near to the center of the valve face as possible. Use a 30° angle wheel to remove stock from the bottom and a 60° angle wheel to remove it from the top of the seat.

Check the valve seat runout with an indicator as shown in fig. 21. It should not exceed 0.003 inch.

(6) *TEST VALVE SPRING PRESSURE.* Check the valve spring pressure with the tool shown in fig. 22. The springs should exert a minimum pressure of 58 lbs. when compressed to a length of 1.8 inches.

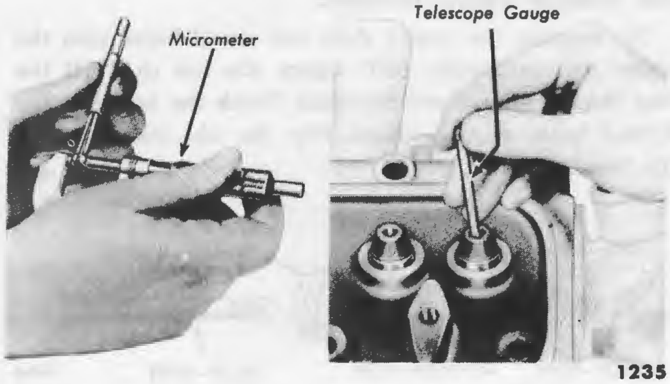

Fig. 16—Measuring Valve Guide (6-Cylinder shown)

Fig. 17—Reaming Valve Guide (6-cylinder shown)

c. Rocker Arm, Shaft, and Push Rod.

Check the rocker arm to shaft clearance. If the clearance is excessive, replace worn parts. Replace any rocker arm adjustment screws or lock nuts that have stripped threads. Replace any adjusting screws that are nicked.

Check the push rods between ball and cup centers with a dial indicator on the center of the rod. If the total indicator runout exceeds 0.020 inch, discard the rod. Do not attempt to straighten push rods. Check the ball end and socket end to make sure they are smooth. Replace push rods with nicked or scratched ends.

NOTE: ***A rough check for bent push rods can be made while they are installed in the engine by rotating them (valve closed) and observing the runout. If any runout is observed, be sure to check the rod between centers as described above.***

d. Cylinder Head Assembly.

Oil all moving parts with engine oil. Be sure the oil plugs are installed in each end of the rocker shaft. The plug should be installed cup side out. Do not peen the plugs tight, they should be a loose fit in the shaft to permit air to bleed as the shaft fills with oil. Install a flat

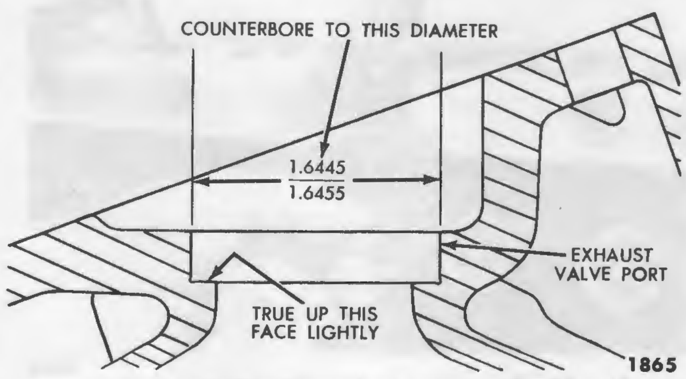

Fig. 18—Counterbore for Oversize Insert

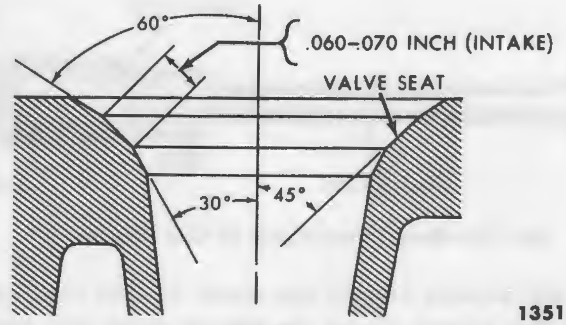

Fig. 19—Correct Valve Seat Width (Intake)

washer, spring washer, another flat washer, and a cotter pin in one end of the rocker shaft. Install the parts in the order shown in fig. 12.

Install a valve in the port from which it was removed or to which it was fitted. On intake valves, install the spring with the closed coil against the head. Install the spring seat and sleeve. Compress the valve spring and install the valve stem seal and the locks (fig. 13). On exhaust valves, install the spring with the closed coil against the head and install the spring seat. Compress the valve spring and install the locks.

NOTE: ***The exhaust free valve design requires a clearance of 0.0002-0.004 inch between the end of the valve stem and the inside of the cap (fig. 23) so the cap can carry the valve spring pressure permitting the valve to rotate. The clearance can be measured before the valve is installed with the micrometer tool shown in fig. 24. If the clearance is less than 0.0002 inch, grind off the end of the valve stem to provide the proper clearance. If the clearance is greater than 0.004 inch, lap the open end of the cap on a piece of fine emery paper on a smooth surface to reduce the clearance.***

Install the cylinder head on the engine. Remove the holding fixture brackets and the guide studs. Install the cylinder head bolts and tighten them to 80-90 foot-pounds in proper sequence.

Install the exhaust valve caps and the push rods in

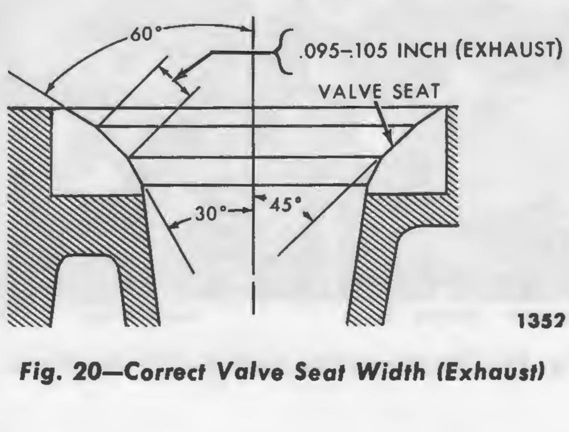

Fig. 20—Correct Valve Seat Width (Exhaust)

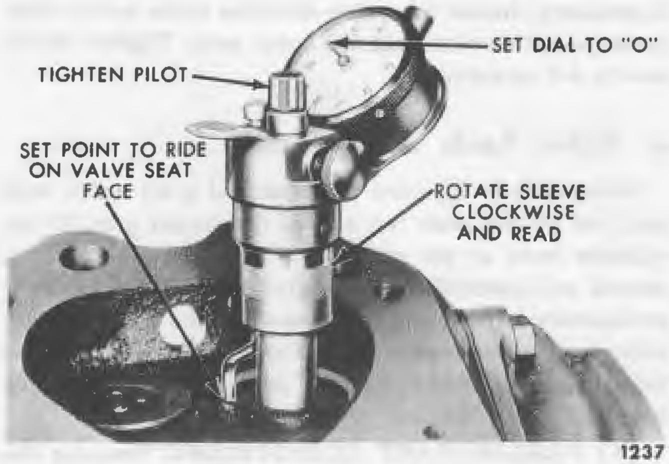

Fig. 21—Checking Valve Seat Runout (6-cylinder shown)

their proper location. Lay the oil baffle plates on the head. Place the rocker assembly on the plates and install the bracket retaining screws. Be sure to install the oil drain line on the same end bracket from which it was removed.

CAUTION: ***Be sure the rocker shaft supporting brackets are not upside down when the assembly is installed. There is a 0.020 inch difference in bracket height when reversed. Tightening the screws with the brackets reversed can result in a broken shaft.***

Tighten the bracket retaining nuts on the studs. Install the manifolds.

Make a preliminary valve lash adjustment. Fill the cooling system and run the engine until it is thoroughly warmed up. Recheck the valve lash, adjusting the lash

Fig. 22—Checking Valve Spring Pressure

if necessary. Install the valve chamber cover with a new cover gasket cemented to the cover only. Tighten cover nuts to 6-8 foot-pounds.

e. Valve Lash Adjustment.

Valve lash is adjusted by means of a set screw and lock nut on the push rod end of the rocker arm. If the cylinder head or the rocker mechanism have been removed and reinstalled, it will be necessary to make a preliminary adjustment before starting the engine. If the valve lash adjustment is made for the purpose of engine tune up, omit step (1) and proceed with step (2) below.

(1) *PRELIMINARY ADJUSTMENT.* Remove the valve chamber cover. Rotate the crankshaft until No. 1 piston is near top center at the end of the compression stroke.

NOTE: ***No. 1 piston is near T.C. compression stroke when both of its valves are closed and the timing mark on the damper is in line with the pointer.***

Check the intake valve lash with a 0.010 inch feeler gauge (fig. 25). Loosen the lock nut and adjust the screw until 0.010 inch clearance is obtained. Tighten the

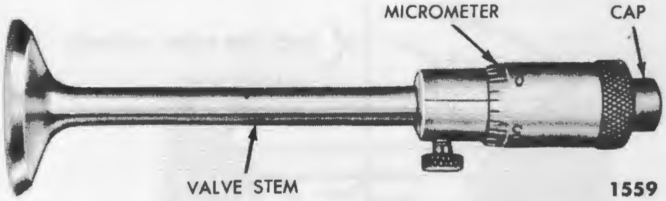

Fig. 24—Measuring Valve to Cap Clearance

lock nut without moving the screw. Torque the nut to 30-35 foot-pounds. Check the exhaust valve lash with a 0.020 inch feeler gauge.

Repeat the procedure for each set of valves, turning the crankshaft ¼ turn while checking the valves in the firing order (1-5-4-8-6-3-7-2).

(2) *FINAL ADJUSTMENT.* Run the engine until it is thoroughly warmed up. Check the valve lash with the engine idling. The valve lash setting (hot) is 0.012 inch for the intake, and 0.018 inch for the exhaust.

Replace the valve chamber cover with a new gasket cemented to the cover only. Torque the cover nuts to 8-10 foot-pounds. Do not exceed the 10 foot-pounds limit or the cover will be distorted.

5. OIL PAN, OIL FILTER, OIL PUMP AND PRESSURE RELIEF VALVE

The oil pump is externally mounted in the lower left-hand corner of the engine, and is driven by an intermediate shaft which fits into a slot in the distributor drive shaft. The pump uses an external inlet tube to pick up the oil from the oil pan (fig. 26). The oil inlet screen and tube assembly is bolted to the inside of the oil pan by two slotted head screws. The oil pan is sealed to the cylinder block by a one-piece cork gasket and the pan is retained by 21 slotted head screws. The oil filter is mounted to the block by means of a right angle adaptor. Both the adaptor and the filter must have a good seal to prevent oil leakage since the entire output of the pump flows through the filter before it is delivered to the oil lines in the block.

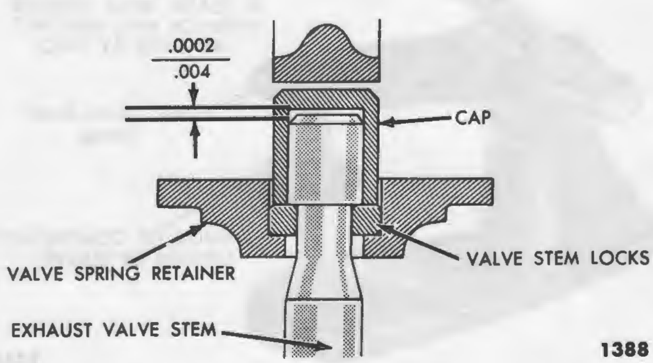

Fig. 23—Exhaust Free Valve Clearances

a. Oil Pan.

Removal, cleaning, inspection, and installation procedures are given under descriptive headings below. The oil pan is illustrated in fig. 27.

(1) *REMOVAL.* Drain the crankcase. Remove the three slotted head screws retaining the oil pump inlet tube to the oil pan and remove the oil inlet line from

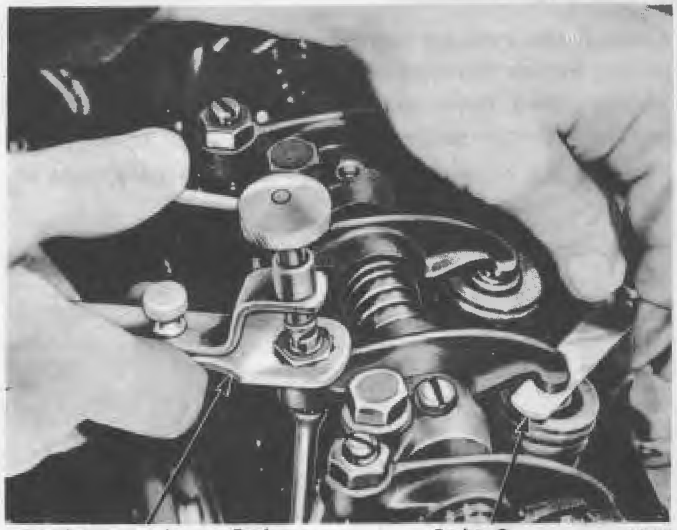

Fig. 25—Checking Valve Lash (6-cylinder shown)

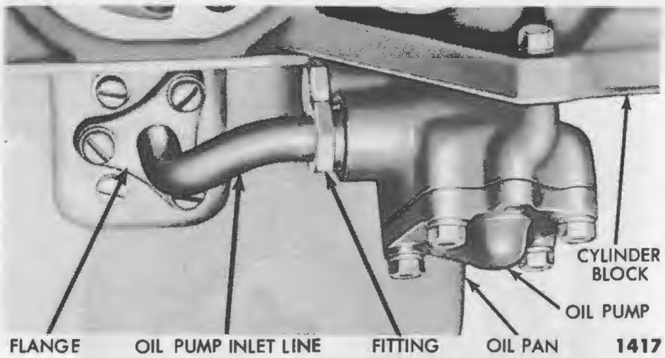

Fig. 26—Oil Pump and Inlet Tube

the pump. Remove the cap screw retaining the oil dip stick tube to the manifold and remove the dip stick and tube. Remove the screws retaining the oil pan to the block and remove the pan. If it is necessary to remove the oil pump inlet tube and screen assembly, remove the two screws on the outside of the oil pan and remove the assembly and gasket and the neoprene seal ring.

(2) *CLEANING.* Wash the pan in solvent and dry it thoroughly. Brush any dirt or metal particles from the inside of the pan. Scrape off old gasket material from the gasket surface of the pan.

(3) *INSPECTION.* Check the pan for cracks, holes, damaged drain plug threads, a loose baffle, or warping of the gasket surface. Repair any cracks or holes or replace the pan if repairs cannot be made.

(4) *INSTALLATION.* Tie a new gasket to the oil pan with string. Hold the pan in place and install two of the retaining screws. Remove the string ties, install the remaining screws, and tighten the screws from the center to the ends using a large screwdriver. Recheck the screws to make sure none have loosened. Install the oil dip stick tube and secure the retaining tab to the exhaust manifold. Install the oil dip stick. Install the oil pump inlet tube and seal in the pump. Do not tighten the fitting at this time. Place a new gasket and seal between the oil line flange and the pan and install and

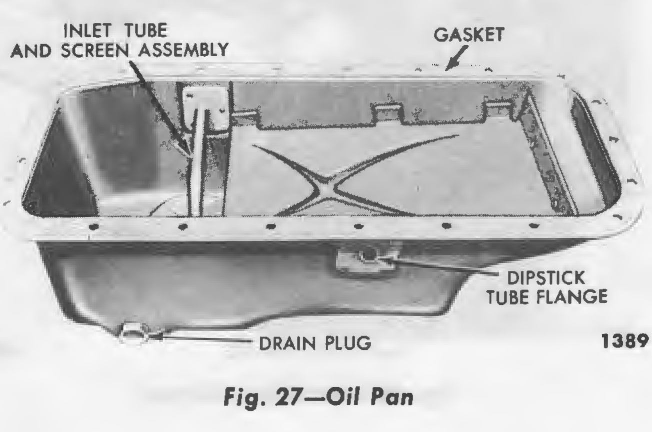

Fig. 27—Oil Pan

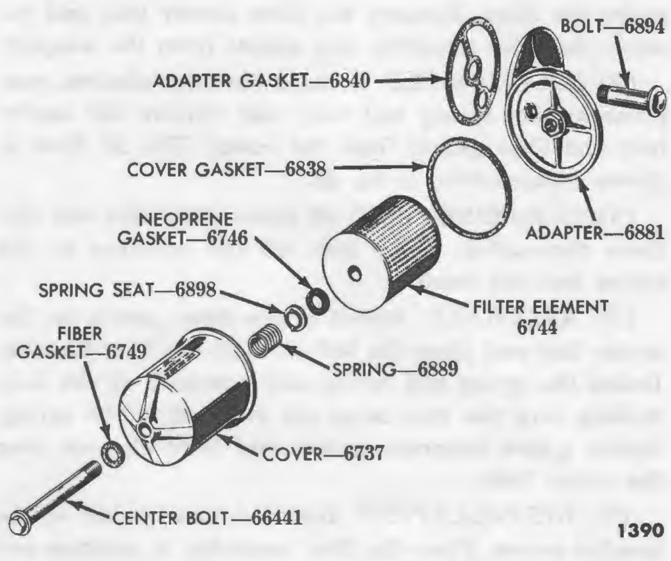

Fig. 28—Oil Filter—Disassembled

tighten the three screws. Tighten the oil line fitting in the pump to 10-12 foot-pounds.

b. Oil Filter.

The full-flow type oil filter filters the entire output of the pump before the oil enters the lubrication system of the engine. A built in by-pass provides oil to the system in case the filter element becomes clogged. The by-pass is located in the hollow center bolt and consists of a spring loaded valve. When the element is clean and oil will flow through it, the pressure difference between the inner and outer faces of the valve is not great enough to overcome the spring pressure behind the valve. When the element is dirty and will not permit a sufficient flow of oil, the pressure on the inner face of the valve drops, and the pressure difference between the valve faces is enough to cause the valve to open. Oil by-passes the element, maintaining a supply to the lubrication system.

(1) *REMOVAL.* Place a pan on the floor directly

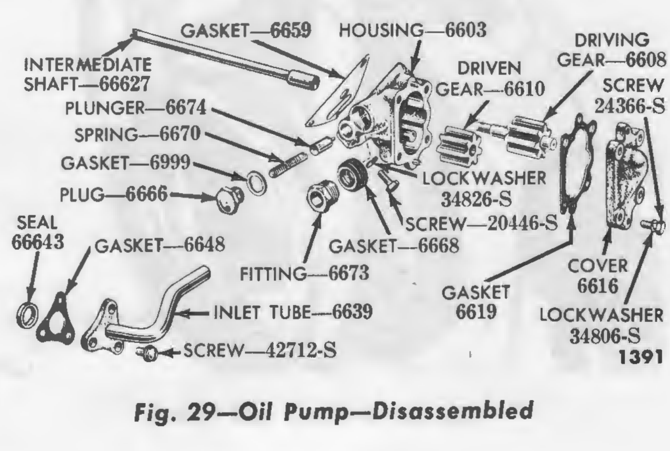

Fig. 29—Oil Pump—Disassembled

under the filter. Remove the filter center bolt and remove the filter assembly and gasket from the adaptor.

(2) *DISASSEMBLY.* Remove the filter element, neoprene gasket, spring and seat, and remove the center bolt and fiber gasket from the cover. The oil filter is shown disassembled in fig. 28.

(3) *CLEANING.* Wash all parts in solvent and dry them thoroughly. Make sure all the openings in the center bolt are clean.

(4) *ASSEMBLY.* Install a new fiber gasket on the center bolt and place the bolt through the filter housing. Install the spring and spring seat assembly on the bolt, making sure the seat tangs are engaged in the spring. Install a new neoprene gasket and filter element over the center bolt.

(5) *INSTALLATION.* Install a new gasket in the bracket recess. Place the filter assembly in position and thread the center bolt into the adaptor finger tight. Rotate the filter assembly slightly in each direction to make sure the filter housing seats evenly on the gasket. Tighten the center bolt to 20-25 foot-pounds.

NOTE: ***Be sure to check the oil filter housing with the engine warmed up and operating at a fast idle so that no oil leaks past the housing gasket or around the center bolt gasket.***

c. Oil Pump and Pressure Relief Valve.

A gear type pump is used to supply oil to the bearings of the engine. The oil pressure relief valve is mounted in the pump housing. The pump is driven by an intermediate shaft from the distributor drive gear.

(1) *REMOVAL.* Remove the pump inlet tube. Remove the three cap screws and lock washers securing the pump body to the block. Remove the pump and gasket and the intermediate shaft if it comes out with the pump.

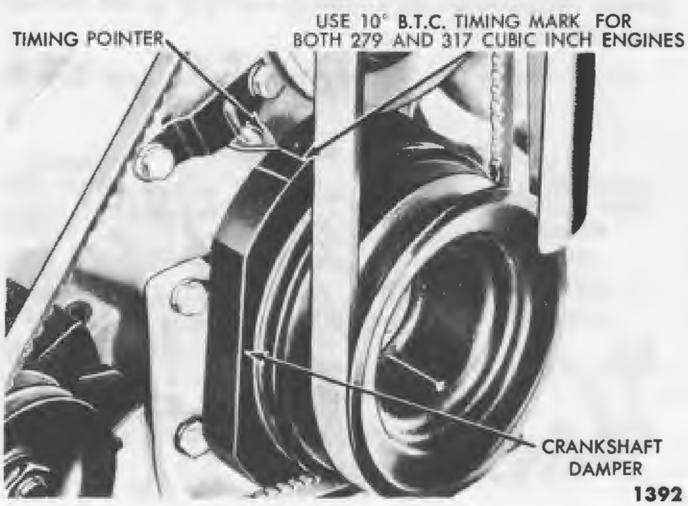

Fig. 30—Damper and Pulley

Fig. 31—Removing Damper

(2) *DISASSEMBLY.* Remove the four cap screws retaining the pump cover to the pump body. Remove the cover plate and gasket. Do not tap the pump drive shaft to drive the cover off the pump body. Remove the oil pump gear and shaft assembly and oil pump idler gear. Remove the oil pressure relief plug gasket, spring and plunger. A disassembled view of the oil pump is shown in fig. 29.

(3) *CLEANING.* Wash all parts in solvent and dry them thoroughly. Brush out the inside of the pump

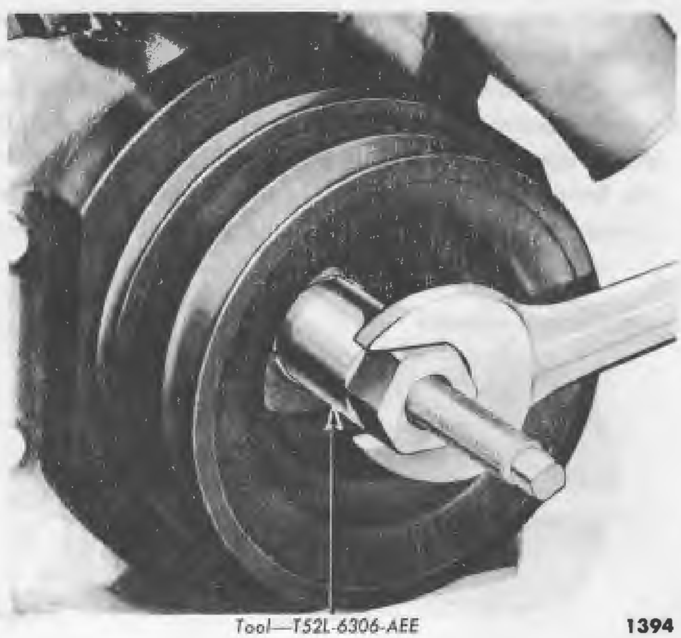

Fig. 32—Installing Damper

housing to make sure no dirt remains. Remove all old gasket material from the pump body.

(4) *INSPECTION.* Check the pump housing for cracks or excessive wear. The pump shaft should have a free running fit without excessive play in the bushing (0.0005 to 0.0025 inch clearance). Check the pump gear teeth for scratches or wear. Measure the clearance between the outside diameter of the gears and the pump housing. It should be no greater than 0.005 inch. Check the compression of the relief valve spring. It should be 7.83 pounds $\pm$ 2 ounces when the spring is compressed to 1.4 inches. Replace worn or defective parts.

(5) *ASSEMBLY.* Oil all parts thoroughly. Install the oil pressure relief valve plunger, spring and cover plug and gasket. Install the idler gear and the oil pump gear and shaft assembly. Install the cover plate with a new gasket and tighten the cover plate screws to 8-10 foot-pounds.

(6) *INSTALLATION.* Insert the oil pump intermediate shaft in the cylinder block and rotate it slightly until it engages the distributor shaft. Note the position of the tang in the extension shaft and set the tang in the oil pump shaft so that it will engage with the slot. Place the pump housing in position on the block with a new gasket, install the three retaining screws, and tighten them to 15-20 foot-pounds.

CAUTION: ***Do not use sealing compound on the gaskets. Do not attempt to force the pump in position if it will not seat against the block. The tang on the pump driving shaft may be out of alignment with the tang in the intermediate shaft. Realign the tang if necessary.***

6. CRANKSHAFT DAMPER

The 8-cylinder engine is equipped with a damper and pulley (fig. 30) which is keyed to the crankshaft and retained with a capscrew and washer. Two threaded bolt holes are provided in the damper to facilitate its removal.

a. Removal.

Remove the radiator. Remove the generator and fan belts. Remove the retaining bolt and washer from the end of the crankshaft. Install the damper removing tool and pull the damper from the crankshaft (fig. 31).

b. Installation.

Lubricate the crankshaft with a white lead and oil mixture. Line up the damper keyway with the key in the crankshaft and start the damper on the shaft. Do not hammer the damper to start it on the shaft. Press the damper on the shaft as shown in fig. 32. Install the damper retaining bolt and washer and tighten the bolt to 55-60 foot-pounds. Install the generator and the fan belts and adjust the tension. Install the radiator.

7. CYLINDER FRONT COVER

The cylinder front cover is a one piece casting which contains the crankshaft front oil seal. The water pump is mounted in the front cover. The engine front support also is retained by the front cover retaining screws.

a. Removal.

Drain the crankcase and remove the oil pan. Support the front of the engine on a jack. Remove the engine front support nuts and raise the front of the engine enough so the front support bracket clears the front

Fig. 33—Installing Oil Seal

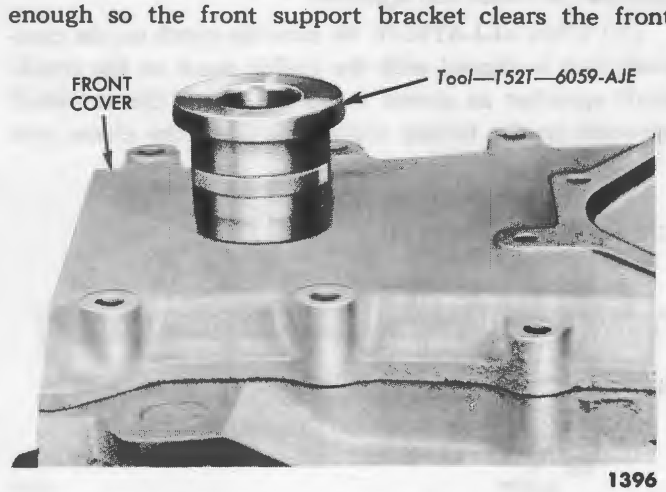

Fig. 34—Aligning Front Cover

mount bolts. Remove the screws retaining the front support bracket and the cover to the block. Remove the bracket, front cover, and gasket.

b. Front Oil Seal Replacement.

Drive out the old seal with a pin punch. Clean the seal recess thoroughly. Coat a new seal with grease and install the seal with the tool shown in fig. 33, driving it into the recess until it bottoms. Check the seal spring after the seal has been installed to be sure it is in the proper position in the seal.

c. Installation.

Install the cover with a new gasket. Align the front cover with the tool shown in fig. 34 to make sure the oil seal will be in proper alignment with the crankshaft. Position the front support bracket and install the six lower cover bolts. Install the water pump and retaining bolts. Tighten all cover bolts to 35-40 foot-pounds. Install the crankshaft damper. Lower the front of the engine and install the front support nuts. Install the oil pan with a new gasket. Fill the crankcase with the proper grade and quantity of engine oil.

8. CAMSHAFT SPROCKET, CAMSHAFT, AND BEARINGS

The camshaft is driven by means of a timing chain connecting the camshaft sprocket to the crankshaft sprocket. The camshaft and related parts are shown in fig. 35.

a. Camshaft Sprocket and Timing Chain.

The camshaft sprocket is bolted to the camshaft. It can be placed on the shaft in only one position since the bolt holes are unequally spaced.

(1) *INSPECTION.* Check the wear on the timing chain by taking up the slack on the driving side of the chain and then measuring the outward deflection of the slack side of the chain (fig. 36). Total outward deflection should not exceed ½ inch.

Replace a camshaft sprocket with broken or chipped teeth. If the timing chain slack is excessive, replace the sprockets and timing chain.

(2) *REMOVAL.* Remove the damper and cylinder front cover. Align the timing marks as shown in fig. 37. Bend down the retaining tabs on the lockplate and remove the three cap screws retaining the sprocket to the camshaft. Slide the sprocket off the camshaft and remove the chain and sprocket.

(3) *INSTALLATION.* Be sure the notch on the camshaft hub is aligned with the timing mark on the crankshaft sprocket as shown in fig. 38. Place the camshaft sprocket in the timing chain and place the chain over the crankshaft sprocket with the timing mark on the crankshaft sprocket and the timing mark on the camshaft sprocket aligned as shown in fig. 37.

Install a new lock plate and the three cap screws and tighten the cap screws to 15-18 foot-pounds. Bend the tabs on the lock plate against the screw heads. Install the cylinder front cover and the damper.

b. Camshaft.

The camshaft is supported by five insert type bearings in the cylinder block. End thrust of the camshaft is controlled by oil pressure and spring pressure against the end of a thrust piston in the forward end of the camshaft (fig. 39). The piston bears against a boss on the inside of the front cover.

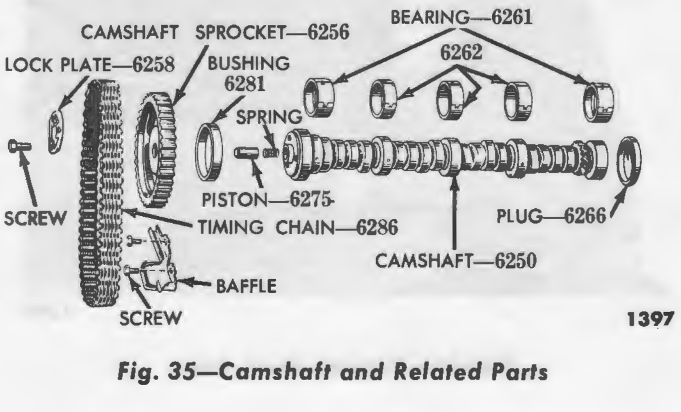

Fig. 35—Camshaft and Related Parts

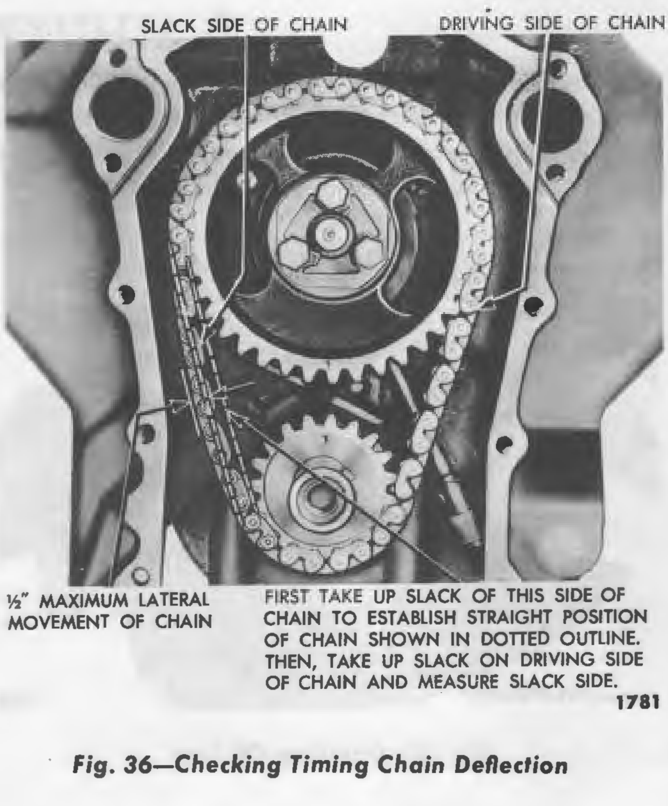

Fig. 36—Checking Timing Chain Deflection

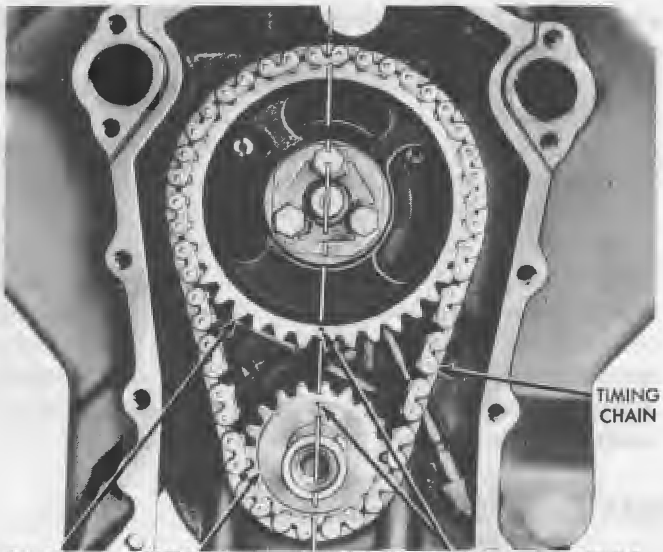

Fig. 37—Aligning Camshaft Sprocket

It will be necessary to replace the camshaft when the lobes are worn to such an extent that the valve lift is less than 0.338 inch (intake and exhaust). Check valve lift with a dial indicator as shown in fig. 40. Valve lash should be zero during this check.

(1) *REMOVAL.* Remove the crankshaft damper and cylinder front cover. Remove the timing sprocket and chain. Remove the fuel pump. Remove the distributor. Remove the valve chamber covers and release the tension on all push rods by slacking off the rocker arm adjustment screws. Remove the intake manifold and the tappet chamber cover. Remove the push rods by sliding the rocker arms sideways against the springs. It

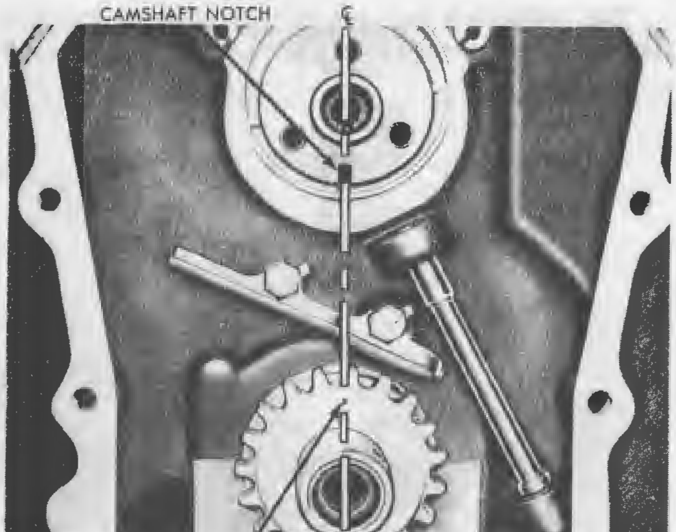

Fig. 38—Aligning Camshaft Notch

Fig. 39—Camshaft Thrust Plunger

will be necessary to remove the cotter pins and washers at each end of the rocker mechanism to move the end rocker arms far enough to pull the end push rods out. Remove the tappets. Keep the push rods and tappets in order so they can be replaced in their original position. Remove the camshaft thrust plunger and the eccentric collar. Carefully slide the camshaft out of the block. Be careful that the cam lobes do not gouge the bearing surfaces.

(2) *INSPECTION.* Check the journals for scratches or grooves. Measure the journal for wear and out of round. Replace the camshaft if the journals are more than 0.001 inch out of round or less than 1.924 inches in diameter. Measure the camshaft front bearing. The difference between the bearing and journal (amount of clearance) should be not more than 0.005 inch for a used camshaft and bearings. If the front journal to bearing clearance is excessive, it can be assumed that all bearings are worn and need replacement.

(3) *INSTALLATION.* Slide the camshaft carefully in through the bearings. Oil the tappets and slide them into place. Install the push rods. Install the eccentric collar (with the shoulder out, if the collar is equipped

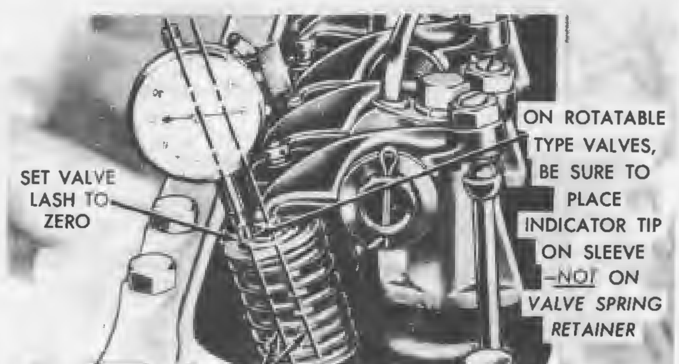

Fig. 40—Checking Valve Lift (6-cylinder shown)

with a shoulder). Install the sprocket making sure the camshaft, sprocket, and timing chain are properly aligned with the crankshaft sprocket. Install the camshaft thrust plunger spring, then install the plunger with the rounded end out. Install the cylinder front cover and the crankshaft damper. Adjust the valve lash. Install the valve chamber covers. Install the tappet chamber cover. Install the intake manifold. Install the fuel pump. Install the distributor and adjust the initial timing.

c. Camshaft Bearing Replacement.

Remove the engine and mount it on a work stand. Remove the flywheel, crankshaft, and the camshaft.

(1) *REMOVAL.* Remove the plug at the camshaft rear bearing bore by drilling a ½ inch hole through the plug and pulling it with the pilot bearing remover (7600-E). Use the bearing replacement tool shown in fig. 41 to pull the bearings out of the block.

(2) *INSTALLATION.* The same tool shown in fig. 41 is used to install the bearings. A bearing adapter with a larger flange is used to pull the bearing in the cylinder block. Be sure to align the oil holes in the camshaft bearings with the oiling holes in the cylinder block when the bearings are installed. After all the bearings are installed, install the camshaft rear bearing bore plug as shown in fig. 42. Coat the new plug with oil resistant sealer before installing it. Install the camshaft, the crankshaft, and the flywheel. Install the engine.

9. FLYWHEEL, CRANKSHAFT, AND BEARINGS

The crankshaft is supported by five main bearings. The center bearing controls end thrust in the crankshaft. The crankshaft has drilled passages to provide pressure lubrication to the connecting rod bearings. The crankshaft and related parts are shown in fig. 43.

a. Flywheel.

The flywheel is piloted on a shoulder and is retained to the crankshaft flange by six bolts. The flywheel can only be bolted on in one position.

(1) *INSPECTION.* Check flywheel runout with the dial indicator as shown in fig. 44. The runout should not exceed 0.005 inch. If the runout is in excess of this figure it will be necessary to remove the flywheel and check the mounting surfaces for nicks or dirt. Remount the flywheel and torque all screws evenly to 75-85 foot-pounds. Recheck the runout. If the runout is still excessive, machine the flywheel face to true it.

(2) *REMOVAL.* Remove the engine and mount it on a work stand. Remove the clutch housing and clutch pressure plate asembly. Remove the starter motor. Remove the six cap screws and the flywheel.

(3) *RING GEAR REPLACEMENT.* To replace a ring gear, drill a $^{17}/_{32}$ inch hole nearly through the ring gear on the engine side of the gear and cut the remaining portion with a chisel. Heat the new ring gear evenly until the gear expands enough to slip onto the flywheel, then position the gear on the flywheel. Make sure the gear is seated against the shoulder.

CAUTION: ***Do not heat any portion of the gear to a temperature higher than 500°F. If this limit is exceeded, the temper will be removed from the gear teeth.***

(4) *INSTALLATION.* Line up the holes in the flywheel with the tapped holes in the crankshaft flange. Start the flywheel on the flange and install the six bolts. Pull the flywheel up with two bolts diametrically opposite. Tighten all bolts to 75-85 foot-pounds. Align the clutch disc and install the clutch pressure plate and the clutch housing. Install the engine.

b. Crankshaft.

The crankshaft is made of cast nodular iron with integral counterweights and is statically and dynami-

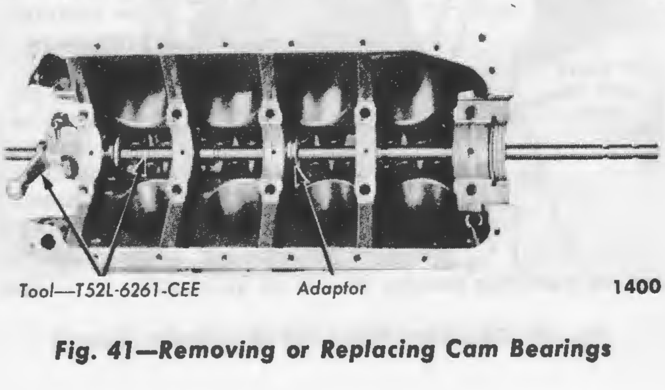

Fig. 41—Removing or Replacing Cam Bearings

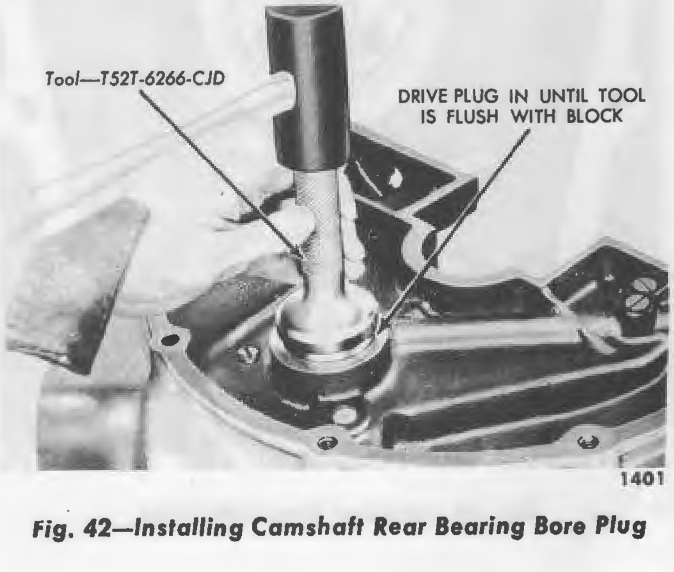

Fig. 42—Installing Camshaft Rear Bearing Bore Plug

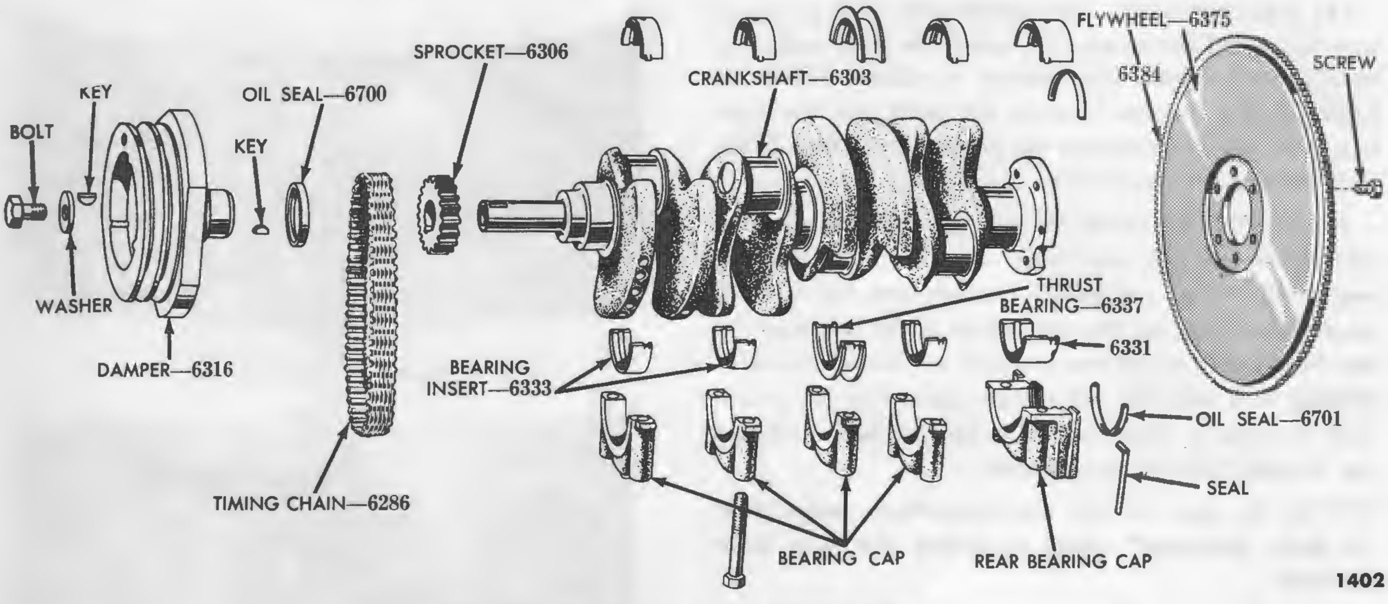

Fig. 43—Crankshaft and Related Parts

cally balanced. The full flow oil filter eliminates the need for sludge pockets.

(1) *REMOVAL.* Remove the engine from the vehicle and mount it on an engine workstand. Drain the oil. Remove the crankshaft damper and engine front cover. Remove the spark plugs. Remove the timing chain. Remove the clutch housing, clutch pressure plate assembly, and flywheel. Remove the oil pan. Remove the connecting rod bearing caps and carefully push the piston and rod assemblies up against the head. Do not damage valves with the piston. Remove the main bearing bolts and bearing caps, and lift the crankshaft out of the cylinder block. Do not damage the thust bearing surfaces. Mark all parts so they can be installed in their original position.

(2) *INSPECTION.* Examine the shaft for cracks. Grooved or scored bearing or crankpin journals will cause bearing failure. Regrind the journals to the next undersize if they are grooved. Light scratches on the journals can be removed with a hone and polished with No. 320 grit polishing paper.

(3) *MEASURING JOURNALS.* Measure each journal at a minimum of four places to determine size, out or round, and taper. Journals that are out of round more than 0.0015 inch or have more than 0.001 inch taper should be reground.

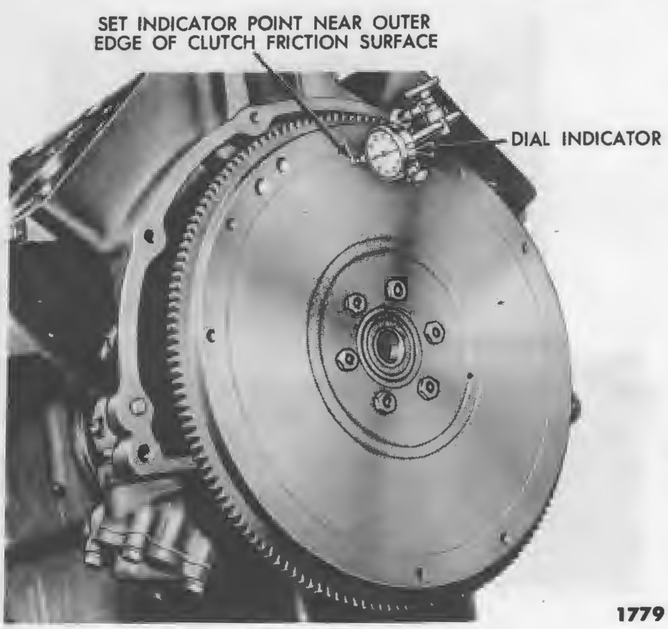

Fig. 44—Check Flywheel Runout

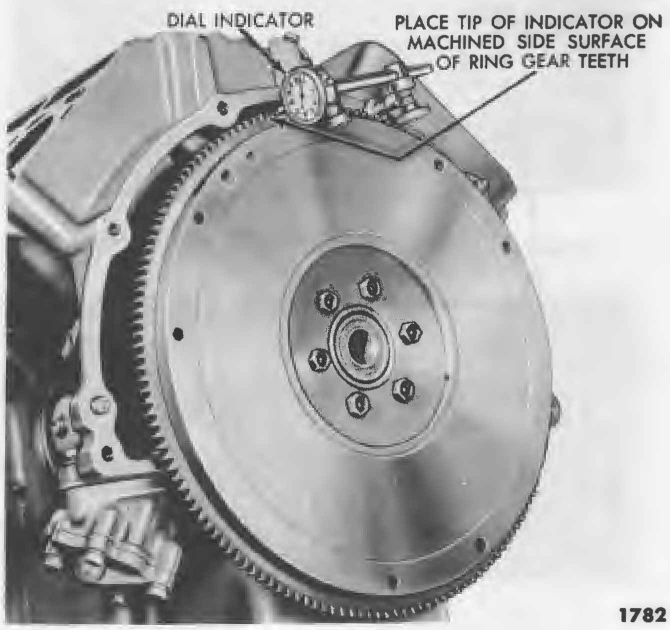

Fig. 45—Checking Ring Gear Runout

(4) *REGRINDING CRANKSHAFT.* If it is necessary to regrind the crankshaft, select the next undersize bearing and regrind the journal to obtain 0.0005 to 0.0021 inch clearance between the shaft and bearings. If it is necessary to regrind the journal more than 0.030 inch, discard the crankshaft.

(5) *INSTALLATION.* Be sure that all bearings and crankshaft journals are clean. Apply a light coat of engine oil to the crankshaft journals and the bearing inserts. Carefully lay the crankshaft in the bearings. Do not damage the thrust bearing surfaces. Install the main bearing caps with the bolts finger tight. Pry the crankshaft forward to align the thrust bearing faces. Tighten the bolts to 120-130 foot-pounds.

NOTE: ***Be sure to use the procedure under Par. "c Main Bearings" when replacing the rear main bearing.***

Install the timing chain, cylinder front cover, and the crankshaft damper. Install the oil pan with a new gasket. Install the flywheel, align the clutch disc, and install the clutch pressure plate assembly, and the clutch housing. Pull the piston and connecting rod assemblies against the crankshaft and install the bearing inserts and caps. Install the spark plugs. Install the engine in the vehicle. Fill the crankcase with the proper grade and amount of oil.

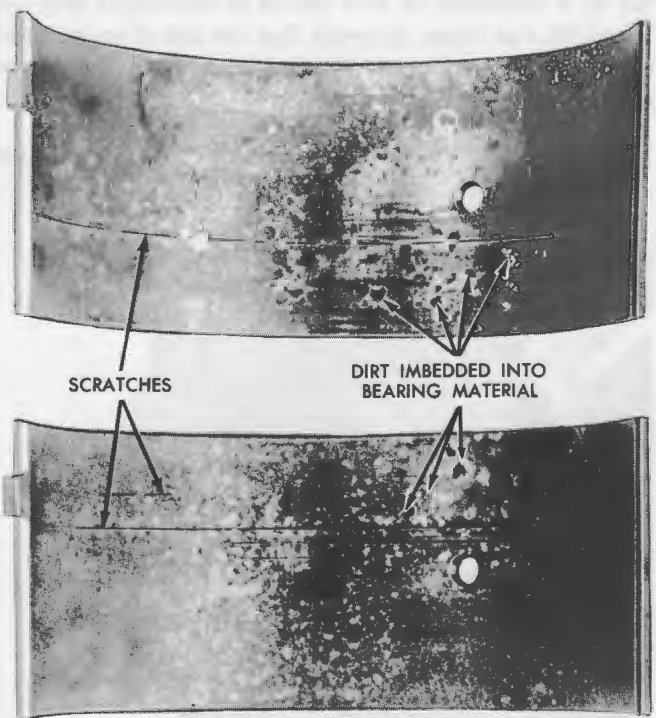

Fig. 46—Bearing Scratched by Dirt

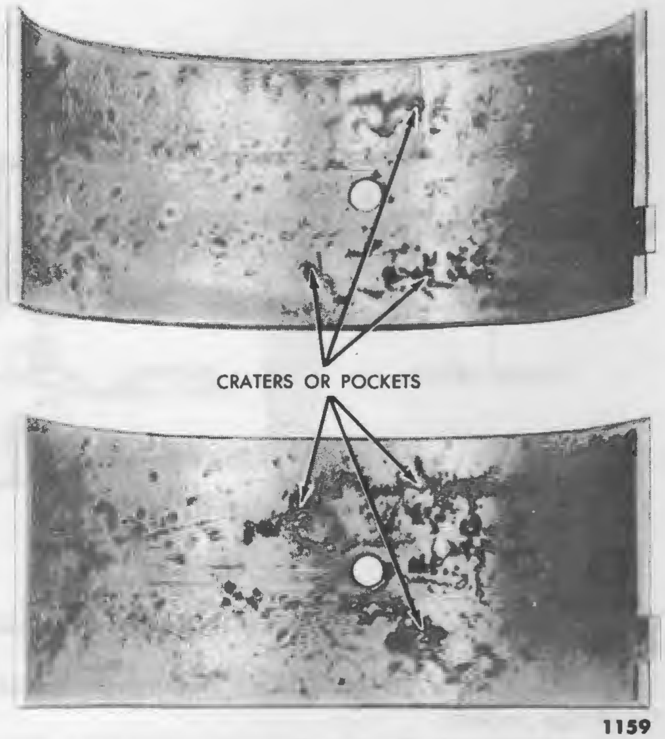

Fig. 47—Fatigue Failure of Bearing

c. Main Bearings.

The main bearings are copper-lead steel backed insert type.

Main bearing inserts that are scratched, show fatigue pockets, or have the overlay wiped out, should be replaced.

A bearing that has only light scratches may be reused providing the clearances are satisfactory. Scratched

Fig. 48—Bearing Failure Due to Lack of Oil

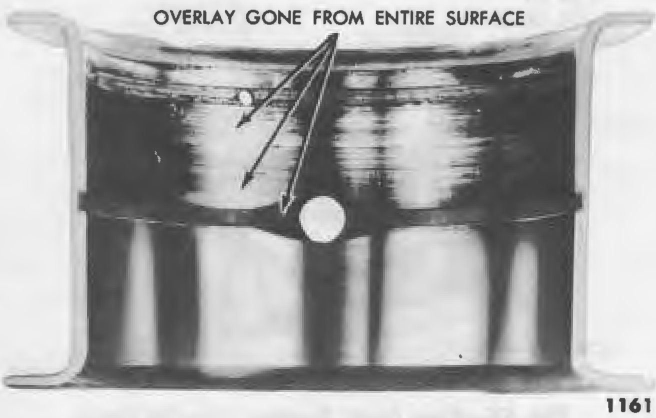

Fig. 49—Bearing Failure Due to Tapered Journal

bearings are shown in fig. 46. Fatigue failure can be recognized by the breaking away of the bearing overlay material (fig. 47). Figure 48 shows two bearings with the overlay wiped out.

NOTE: ***Any engine that has experienced rod or piston failure must have all the oil passages thoroughly cleaned before rebuilding the engine.***

A bearing showing signs of excessive wear on one side of the bearing half (fig. 49) indicates a tapered bearing journal. The journal should be reground to the next undersize to remove the taper and undersize bearings fitted. Similarly, bearings showing excessive wear at the center or end of the bearing around the circumference (fig. 50) indicate high spots on the bearing journal

Fig. 50—Bearing Showing Radius Ride

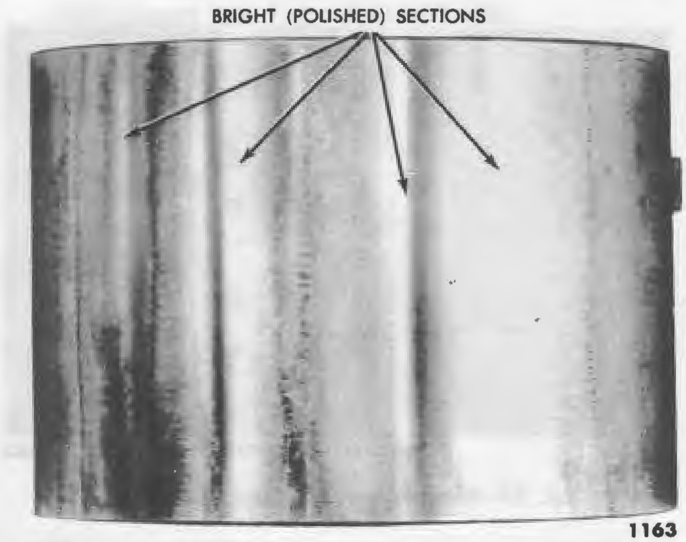

Fig. 51—Bearing Showing Bright Spots Due to Improper Seating

which should be corrected before the engine is rebuilt.

Bearing that shows bright sections across the back of the bearing (fig. 51) indicate that the bearings have been loose in the bore either because of an undersize outside diameter or because of the bearing bore being too large. Bearings showing bright spots on the bearing surface indicate dirt lodged between the bearing insert and the bearing bore.

Crankshaft thrust is controlled by the No. 3 (intermediate) bearing flanges.

If the crankshaft has been removed, the bearing inserts can be easily replaced. However the inserts can be removed and replaced without removing the crankshaft.

NOTE: ***Special care must be taken when installing the rear main bearing cap to prevent oil leakage past the two sets of seals. Use the procedure presented under "(4) Replacing Rear Oil Seals" when the cap is installed.***

The bearings can be replaced when the crankshaft is removed or they can be replaced without removing the

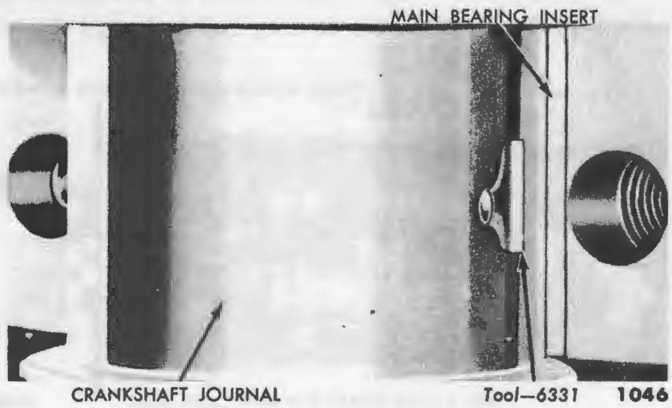

Fig. 52—Removing Main Bearing Insert

Fig. 53—Measuring Flattened Plastigage

crankshaft as described under "(1) Replacement Without Removing Crankshaft," below.

(1) *REPLACEMENT WITHOUT REMOVING CRANKSHAFT.* When using this procedure replace one bearing at a time leaving the other bearings securely fastened. Remove the bearing cap and the insert. Install the bearing removing tool as shown in fig. 52. Rotate the crankshaft to slide the bearing out of the block. Install a new bearing insert on the crankshaft journal and rotate the crankshaft in the opposite direction to that used for removal to replace the insert.

NOTE: ***Be sure the notch end of the bearing is placed correctly so that it will seat when rotated into position.***

Check the bearing fit of the new inserts as described below under "(2) Fitting Main Bearings (Plastigage Method)."

Install the new bearing insert in the cap, oil the crankshaft journal with engine oil and install the cap and insert. Tighten the main bearing cap bolts to 120-130 foot-pounds. Repeat the procedure for the remaining bearings if they need replacement. Install the oil pan.

(2) *FITTING MAIN BEARINGS (PLASTIGAGE METHOD).* Remove the bearing cap and wipe the oil

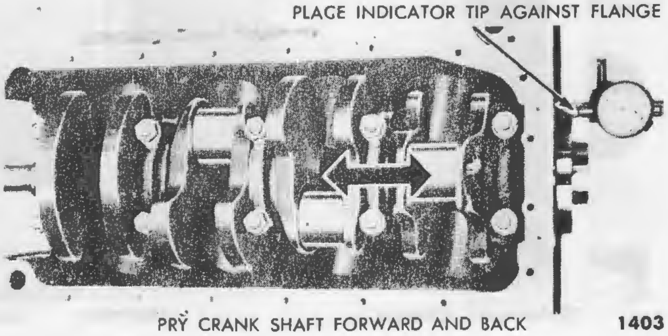

Fig. 54—Checking Crankshaft End Thrust

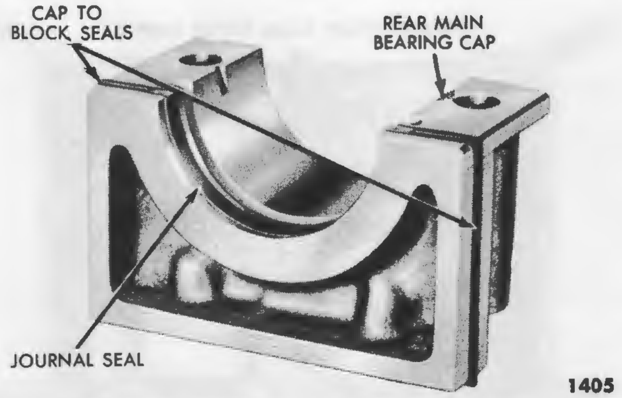

Fig. 55—Rear Main Bearing Cap Oil Seals

from the bearing and journal. Keep the other bearing caps tight while checking the fit of a bearing.

NOTE: ***If the bearing fit is checked while the engine is in the vehicle, it will be necessary to support the weight of the crankshaft. The shaft can be supported by placing a thin rubber pad between the cap insert and journal of two bearings that are not being checked. Tighten these bearing caps enough to hold the crankshaft up against the block half of the main bearing inserts.***

Place a piece of Plastigage the full width of the bearing on the bearing insert (or in the bearing cap).

Install the bearing cap and torque the retaining bolts to 120-130 foot-pounds.

CAUTION: ***Do not turn the crankshaft while the Plastigage is between the bearing and the journal.***

Remove the bearing cap. Without moving the plastic, check its width (at the widest point) with the graduations on the Plastigage container as shown in fig. 53.

NOTE: ***Normally, main bearings journals wear***

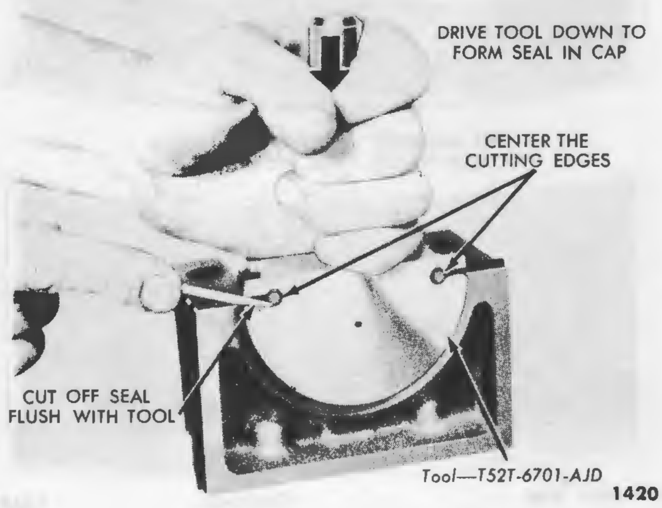

Fig. 56—Form and Cut Oil Seal

evenly and are not out-of-round. However, if a bearing is fitted to an out-of-round journal, be sure to fit the bearing to the maximum diameter of the journal. If the bearing is fitted to minimum clearance, interference may result in rapid failure of the bearing.

If the bearing clearance is not under 0.0005 inch or over 0.0021 inch, the bearing insert is satisfactory. If the clearance is greater than 0.0021 inch, try the slective fit standard bearing to bring the clearance within the 0.0005-0.0021 inch limit. If the selective fit bearings do not bring the clearance within limits, it will be necessary to regrind the crankshaft journals for use with the next undersize bearing.

NOTE: ***If the flattened plastic is not uniform in width from end to end, the journal or bearing is probably tapered. Be sure to check the journal with micrometers if the flattened plastic indicates more than 0.001 inch taper.***

(3) *CHECKING CRANKSHAFT END THRUST.* To check the crankshaft end play, push the crankshaft toward the rear of the engine. Place a dial indicator against the crankshaft flange, keeping the indicator axis parallel to the crankshaft axis. Set the dial to zero, pry the shaft forward and release the shaft. Read the indicator.

If the dial indicator shows more than 0.008 inch end play, the main thrust bearing insert should be replaced with a new insert to take up the thrust. The manufacturing crankshaft end clearance is 0.004-0.008 inch. Checking the crankshaft end thrust is illustrated in fig. 54.

NOTE: ***If the end play is less than 0.004 inch, check the thrust bearing faces for scratches or dirt. If the bearing is not scratched or dirty, reinstall it, aligning the faces before tightening the cap bolts by prying the crankshaft forward. Tighten cap bolts and recheck end play.***

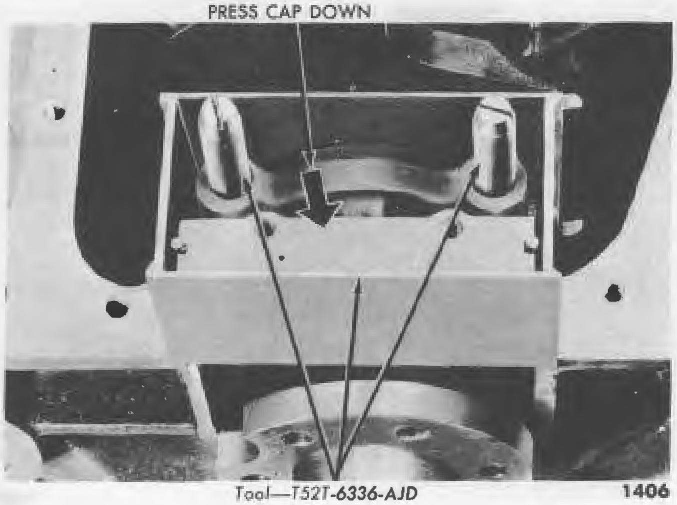

Fig. 57—Install Bearing Cap

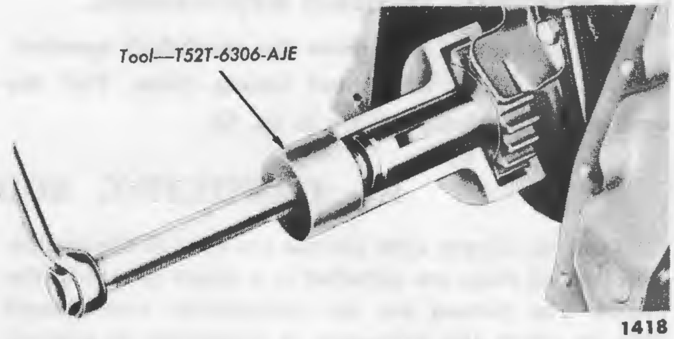

Fig. 58—Removing Crankshaft Sprocket

(4) *REPLACING REAR MAIN BEARING OIL SEALS.* Remove the crankshaft. Remove the bearing insert from the rear bearing cap and block. The rear main bearing cap oil seals are shown in fig. 55. Remove the old sealing material and clean the seal grooves in the bearing cap and the cylinder block bearing bore. Install new journal seals in the cap as shown in fig. 56 and cut the seals to the proper length. Use the same tool to form and cut the seal in the cylinder block bearing bore.

Install the bearing cap to block seals and press them into the groove. Lubricate the seals with grease to reduce friction. Install the crankshaft and insert the bearing cap guide studs into the cap bolt holes in the block. Install the bearing inserts. Install the bearing cap with the tool shown in fig. 57.

NOTE: ***Be sure to press the bearing all the way in to insure proper sealing of the bearing cap to cylinder block seals.***

Install the bearing cap bolts. Cut off the cap to block seals allowing approximately 0.080 inch to project below the oil pan gasket surface of the block to insure a good seal against the oil pan gasket.

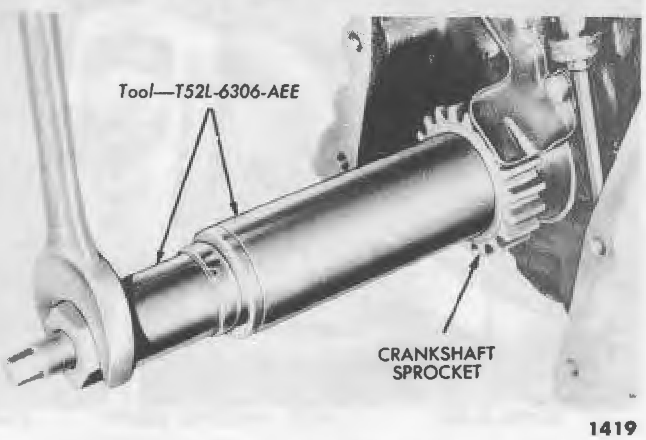

Fig. 59—Installing Crankshaft Sprocket

d. Crankshaft Sprocket Replacement.

If it is necessary to remove the crankshaft sprocket, remove the front cover and timing chain. Pull the sprocket with the tool shown in fig. 58.

Apply a light coating of white lead and oil mixture to the crankshaft. Slide the new sprocket on the shaft and align the keyway with the key. Press the sprocket against the crankshaft shoulder with the tool shown in fig. 59. Install the timing chain and the front cover.

10. CONNECTING RODS, PISTONS, AND RINGS

Four ring, slipper type pistons are used in this engine. The two oil rings are installed in a single groove in the piston. The pistons are the autothermic cam ground type in which the expansion is controlled to prevent loose piston fitting when the engine is cold.

a. Remove Piston and Connecting Rod Assembly.

Remove the oil pan. Remove the cylinder heads. Before removing the piston assemblies check for a ridge at the top of the cylinder bore formed by piston ring wear. If a ridge is present it will be ncessary to remove it with a ridge cutter shown in fig. 60, to prevent piston ring breakage and groove damage. Clean carbon from the piston and cylinder bore before removing pistons.

Remove the connecting rod pal nuts and the connecting rod nuts. Pull the cap off the rod and push the connecting rod and piston assembly up through the cylinder bore.

b. Disassembly.

Remove the piston rings with the tool shown in fig. 61. Remove the piston pin retaining clips and push the pin out of the piston and rod. If the piston assembly has been in long use and the pin has become "varnished" it may be necessary to drive the pin out with the tool shown in fig. 62. A disassembled view of the piston and connecting rod is shown in fig. 63.

c. Cleaning.

Clean the piston ring grooves with a groove cleaner (fig. 64). Clean carbon and sludge from the oil ring groove. Clean all parts in solvent. Be sure to clean the connecting rod bearing bore thoroughly.

d. Inspection of Piston and Connecting Rod Assemblies.

Connecting rods with deep nicks, signs of fractures, scored bore, or bore out of round more than 0.002 inch should be replaced.

Use a new piston pin to check the piston pin bushing in the connecting rod for wear. The pin should have a 0.0002 inch to 0.0004 inch clearance in the rod bushing. If the new pin does not have the proper clearance replace the connecting rod or install an oversize piston pin.

Connecting rods with twists or bends should be realigned. Check every connecting rod assembly for alignment on a fixture after fitting the piston pins (fig. 65).

(1) *CONNECTING ROD BEARINGS.* Replace bearing inserts that are scored, have the overlay wiped out, show fatigue failure, or are badly scratched (figs. 46 through 51).

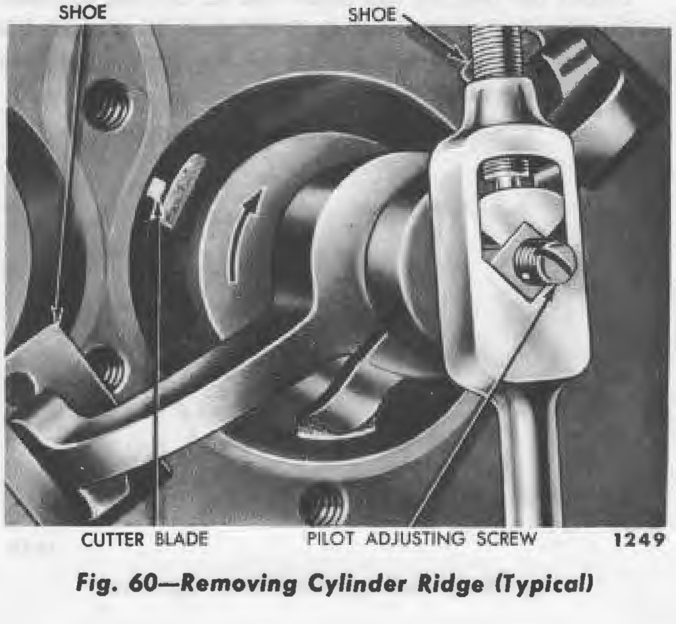

Fig. 60—Removing Cylinder Ridge (Typical)

Fig. 61—Removing Rings

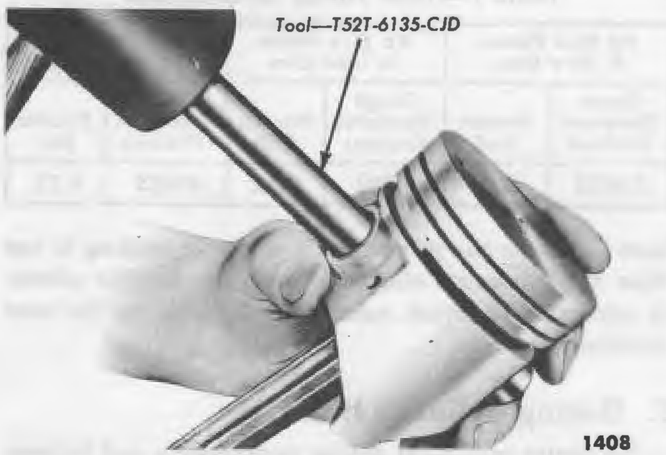

Fig. 62—Removing Piston Pin

Install the bearing inserts in the cap and rod section. The bearing should snap into place and remain there. If the bearing slides in freely and will fall out readily, the bearing has lost its spread and should be replaced. Check the inside edge of the bearing at the parting line for sharp burrs. Remove the burrs if any are apparent. The parting edges of the bearings should be free of dirt or other foreign particles.

(2) *PISTONS.* Inspect pistons for fractures at the ring lands, skirt, and pin bosses. Replace pistons showing signs of wavy ring lands, fractures, or damage from detonation. Spongy eroded areas near the edge of the piston top are caused by detonation. In some instances holes are also burned through the piston top. Replace any pistons that show excessive skirt clearance or ring groove wear.

(3) *PISTON PINS.* Replace piston pins showing signs of fractures or etching. Piston pins that show wear or fit loose in the piston or rod bushing should be replaced. Replace all piston pin retainers.

(4) *CYLINDER BLOCK.* Make a thorough check for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light motor oil. Wipe the part dry and immediately apply a white coating of zinc oxide dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area.

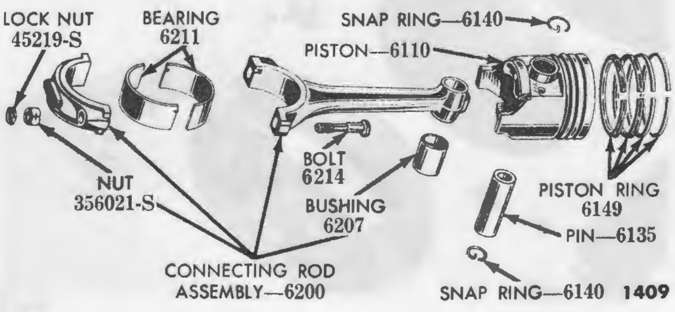

Fig. 63—Piston and Connecting Rod—Disassembled

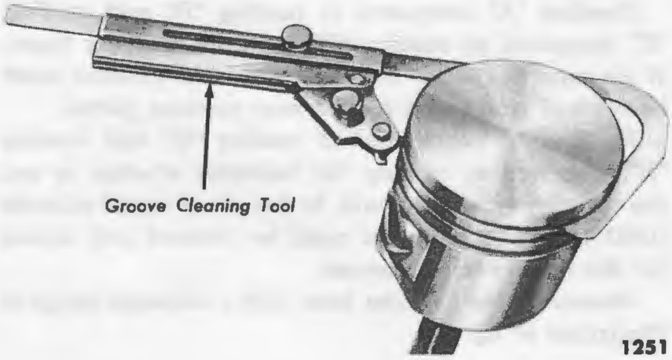

Fig. 64—Cleaning Ring Grooves

Inspect the cylinder bores for scoring. Inspect the core plugs for rust at the edge of the plug. Rust indicates leakage. If leakage is indicated, remove the plug by drilling a ½ inch hole through it and using the pilot bearing remover to pull it out. Replace with a new plug. Always use a sealer when installing new plugs or leakage may result.

Check the cylinder bore for taper, out of round, and wear. Use a cylinder bore gauge, telescope gauge, or inside micrometers. Only experienced personnel should be permitted to take these measurements.

Record measurements taken lengthwise and crosswise at the top and bottom of the ring travel in the bore as follows:

Lengthwise of the block, measure and record as "A" the diameter of the cylinder at the top of the cylinder where the greatest ring wear occurs. Also lengthwise of the block, measure and record as "B" the cylinder diameter at the bottom of the piston skirt travel.

Crosswise of the block, measure and record as "C" the diameter at the top of the cylinder at the greatest wear point. Measure and record as "D" the diameter at the bottom of cylinder bore, also crosswise of the block.

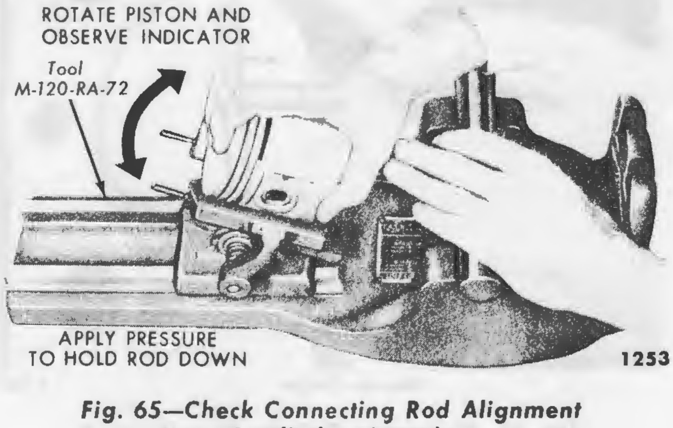

Fig. 65—Check Connecting Rod Alignment
(6-cylinder shown)

Reading "A" compared to reading "B" and reading "C" compared to reading "D" indicates cylinder taper. If the taper is greater than 0.015 inch the cylinder must be rebored and honed for the next oversize piston.

Reading "A" compared to reading "C" and reading "B" compared to reading "D" indicates whether or not the cylinder is out of round. If the out of round exceeds 0.003 inch, the cylinders must be rebored and honed for the next oversize pistons.

Measuring the cylinder bore with a telescope gauge is illustrated in fig. 66.

e. Fitting Pistons.

Proper assembly tolerances of pistons are required if satisfactory engine operation is to be obtained. Cylinder bores must be checked for taper and out of round condition before fitting a piston.

Before installing a piston and new rings in a used block, remove the high polish on the cylinder wall to aid ring seating by passing a cylinder bore glaze remover through the cylinder bore a few times. Make sure that oiled rags are placed to catch the hone grit and that the cylinder bore and crankcase are thoroughly cleaned before installing the piston.

To fit a new piston in a new bore, use the tool shown in fig. 67 with the correct feeler ribbon thickness as given in Table 1.

Position the feeler ribbon on the side of the piston 90° from the piston pin hole. Invert the piston, then push the piston in the cylinder so the end is about ¾ inch below the top of the block. Keep the piston pin bore parallel with the camshaft. Pull out the feeler gauge while noting the reading (fig. 67).

The pull limits for new pistons and used pistons in new or used bores is given in Table 1. If the reading is high, check the piston for nicks or scratches.

If the scale reading is still greater than the maximum allowable pull, try another piston or hone the cylinder bore to obtain the proper fit. If the scale reading is less than the minimum allowable pull, try another piston. If none can be fitted, rebore the cylinder to the next oversize.

Table 1—Piston Fitting Specifications

Fit New Piston In New Bore		Fit New Piston In Used Bore		Fit Used Piston In Used Bore	
Gauge Thickness (Inches)	Pounds Pull	Gauge Thickness (Inches)	Pounds Pull	Gauge Thickness (Inches)	Pounds Pull
0.0015	6-12	0.002	6-12	0.003	6-12

f. Boring Cylinder Block.

To assure maximum engine performance and balance of the reciprocating parts of the engine, all cylinders must be bored to the same size when the 0.060 inch oversize piston is to be installed, even though only one cylinder requires reboring and the others are within tolerance. Manufacturers recommendations on how to use boring equipment should be followed and the work performed only by experienced personnel.

Bore the cylinder with the most wear first to determine the proper oversize. If the cylinders will not clean up at 0.060 inch oversize, the block must be replaced.

When reboring the cylinders allow 0.0015 inch stock for final honing. Fit the pistons as described previously. CAUTION: ***Thoroughly clean the block to remove all particles of abrasive after the honing operation.***

g. Fitting Piston Pins.

Check the piston pin fit in the piston. Piston pins must be a hand-push fit in the piston pin bore at normal room temperature (70°F.).

If the oversize piston pins are to be used, or if the

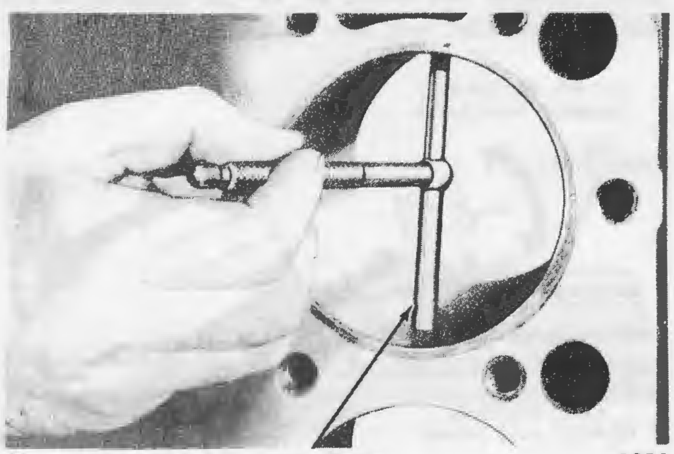

Fig. 66—Measuring Cylinder Bore (Typical)

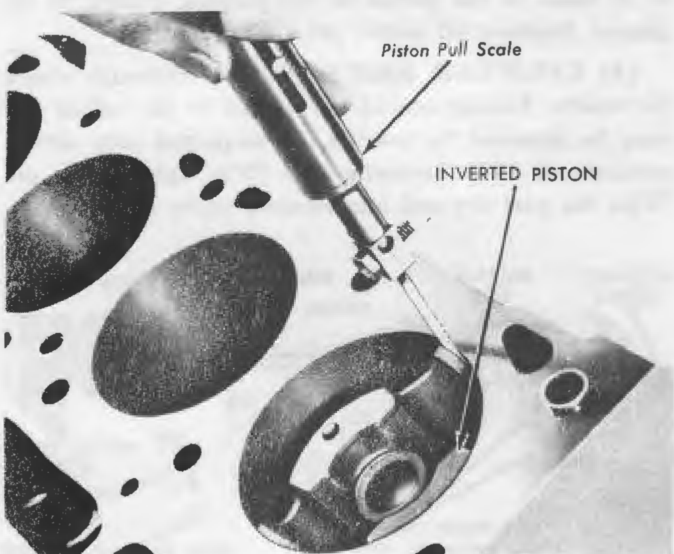

Fig. 67—Fitting Piston

piston pins are too tight, use an expansion type piston pin reamer. Place the reamer in a vise and revolve the piston around the reamer.

Set the reamer to the size of the piston bore, then expand reamer very slightly and trial ream the bore in the piston using a pilot sleeve of the nearest size to maintain alignment of the piston pin bores.

CAUTION: *Take a very light cut.*

Check the reamed hole size using a new piston pin as a gauge. If the bore is small, expand the reamer slightly and make another trial cut, then repeat the procedure outlined until a piston pin fit is obtained.

Similarly ream all the pistons in which pins need to be fitted, checking each with the pin to be used in the piston. Repeat above procedure for fitting the pins to the connecting rod bushings.

h. Fitting Piston Rings.

Install the piston ring in the cylinder bore. Invert the piston and use the top to push the ring about halfway into the bore to true the ring with the cylinder bore. Measure the ring gap with a feeler gauge (fig. 68). The gap should be 0.010-0.050 inch (all rings).

After the rings have been fitted in the cylinder bore, they should be immediately installed on the piston or identified with the piston and cylinder bore in which they are to be installed.

Check the ring to groove clearance on the proper piston for the cylinder as shown in fig. 69.

The rings should have the following clearance:

Ring	Clearance in Piston Groove (Inch)
Top Compression	0.0015-0.0030
2nd Compression	0.0010-0.0030
Oil Rings	0.0015-0.0035

CAUTION: ***If the side clearance is not within limits check the ring grooves in the piston. Do not attempt to remove any stock from rings.***

Three different type rings are available in sets for service: the standard ring, the expander ring, and the steel section ring.

The standard (snap type) is designed for use in a new engine.

The expander type is designed for use after a light honing job in a cylinder bore with a small amount of taper, to correct oil consumption.

The steel section type ring should be used in cylinders where the taper of the cylinder bore is very great, or to correct excessive oil consumption conditions, when the customer does not want the cylinders rebored. Bore "glaze" should be removed to aid piston ring seating.

Fig. 68—Checking Ring End Gap

Fig. 69—Checking Ring Clearance

i. Fitting Connecting Rod Bearings (Plastigage Method).

Place a piece of Plastigage the length of the insert in the cap bearing insert. Install the cap and tighten to 45-50 foot-pounds.

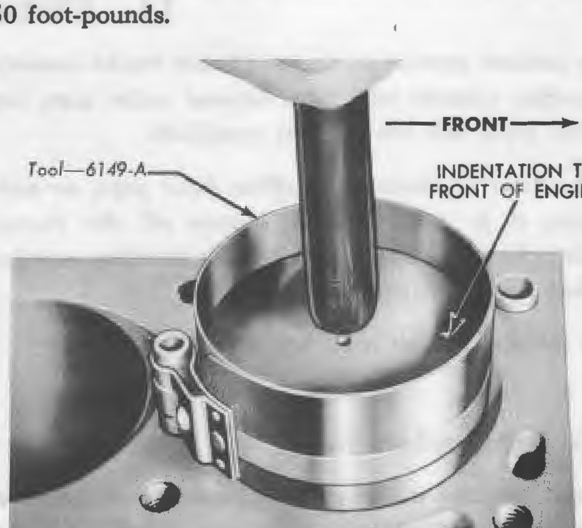

Fig. 70—Installing Piston

NOTE: *Do not turn the crankshaft.*

Remove the bearing cap and use the Plastigage scale to measure the width of the flattened piece of plastic at the widest point.

NOTE: *If the crankpin is out-of-round, be sure to fit the bearing to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter of the crankpin with minimum clearance of 0.0005 inch and the crankpin is out of round 0.0005 or more, interferences will result in rapid failure of the bearing.*

If reading is not over 0.0021 inch or not less than 0.005 inch, the fit is satisfactory. If the clearance is greater than 0.0021 inch, try another selective fit bearing to bring the clearance within the 0.0021 inch limit. If the clearance is still excessive, regrind the crankshaft and fit undersize bearing inserts.

NOTE: *If the flattened plastic is not uniform from end to end in its width, the journal or bearing is tapered. Be sure to check the journal with micrometers for taper if the flattened plastic indicates more than 0.001 inch difference.*

Rotate the crankshaft after the bearing is installed to be sure the bearing is not too tight.

j. Assembly.

Lubricate all parts with engine oil. Position the rod in the piston so the oil squirt hole is to your right with the indentation on top the piston away from you. Install the piston pin through the piston and rod and install the pin retainers at each end of the pin in the piston. Install the piston rings as shown in fig. 61. Position the ring gaps 120° apart. Install the insert bearings in the connecting rod and the connecting rod cap.

k. Installation.

Oil the piston rings, piston, connecting rod bearings, and cylinder walls with light engine oil. Install the piston ring compressor on the piston and insert the piston in the cylinder with the indentation toward the front of the engine. Be sure to install pistons in the same cylinder from which they were removed or to which they were fitted. If a new piston and connecting rod is to be installed be sure to stamp the cylinder number on the connecting rod and connecting rod cap so the numbers will face the outside of the engine when the assembly is installed. Push the piston into the cylinder as shown in fig. 70.

Be careful not to damage the crank pin journals with the connecting rod bolts when the piston is pushed all the way into the cylinder bore. Install the connecting rod cap and install the connecting rod cap bolts. Tighten the nuts to 45-50 foot-pounds. Install the connecting rod pal nuts and tighten them to 3-3½ foot-pounds (or finger tight plus ⅓ turn). Check connecting rod side clearance with a feeler gauge all the way around the crankpin. Total side clearance (both rods installed) should be 0.006-0.014 inch.

Install the oil pan. Install the cylinder heads and manifolds. Fill the crankcase with the proper grade and quantity of engine oil. Fill the cooling system.

11. EXHAUST SYSTEM

The exhaust system on the 8-cylinder trucks consists of a muffler, exhaust inlet pipe, exhaust outlet pipe, the crossover pipe, and the exhaust manifolds.

NOTE: *After replacing a muffler, inlet pipe, or outlet pipe, it is advisable to loosen all the frame attaching bracket clamps to relieve twisting strains and then retighten the clamps.*

The exhaust system is shown in fig. 71.

a. Muffler Replacement.

Loosen the inlet and the outlet pipe clamps. Remove the clamp support retaining bolts and slide the clamps away from the muffler. Pull the outlet pipe out of the muffler. Pull the muffler off the inlet pipe.

To install the muffler, place it in position on the inlet pipe. Install the outlet pipe and slide the clamps over the muffler. Install the clamp support retaining bolts and tighten the clamps.

b. Outlet Pipe Replacement.

Loosen the outlet pipe clamp and pull the pipe out of the muffler. To install, slide the pipe into the muffler and tighten the clamp.

c. Inlet Pipe Replacement.

Remove the nuts and lockwashers retaining the inlet pipe to the exhaust manifold flange, pull the pipe away from the flange, and remove and discard the gasket. Loosen the inlet pipe clamp and pull the pipe out of the muffler.

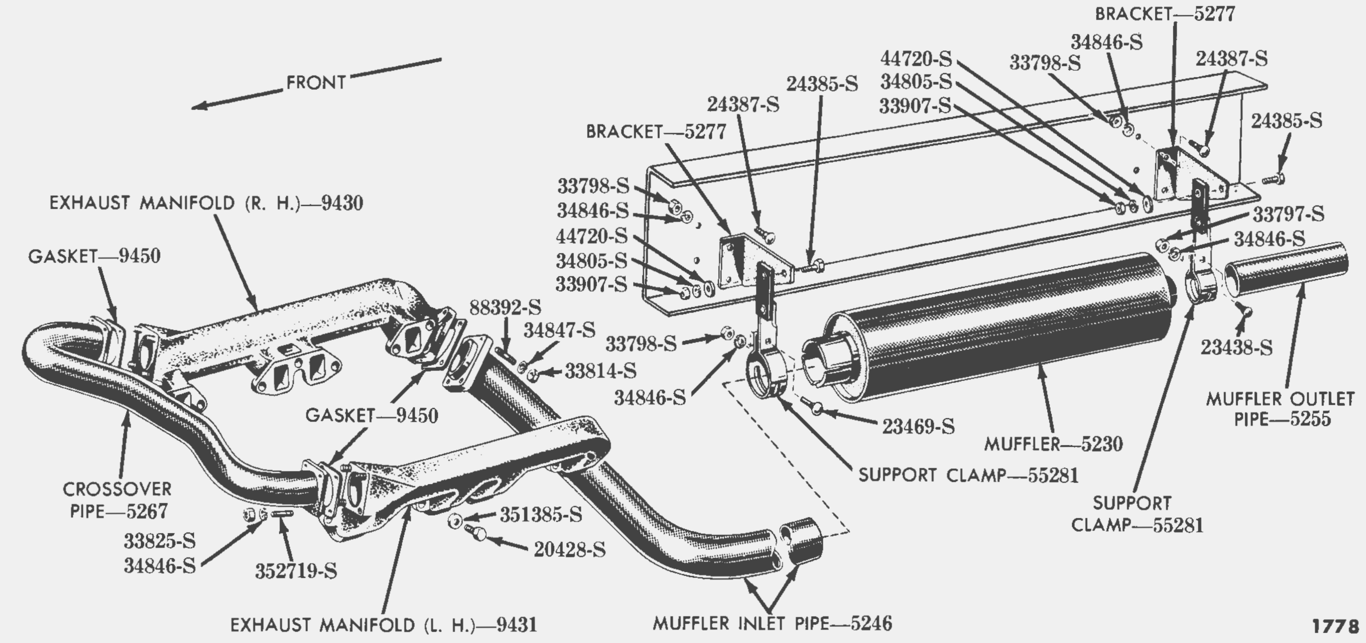

Fig. 71—8-Cylinder Truck Exhaust System

To install, slide the pipe into the muffler. Install a new gasket over the manifold flange studs, install the inlet pipe flange on the studs, and secure it with the lockwashers and nuts. Tighten the nuts to 23-28 foot-pounds. Tighten the inlet pipe clamp.

d. Crossover Pipe Replacement.

The crossover pipe is retained to each manifold by four nuts and lockwashers.

NOTE: ***On trucks equipped with air brakes, it will be necessary to remove the air compressor.***

(1) *REMOVAL.* Remove the nuts and lockwashers retaining the pipe to each manifold. Remove the left-hand manifold. Remove the crossover pipe and gaskets.

(2) *INSTALLATION.* Install new gaskets over the manifold studs. Position the crossover pipe on the right-hand manifold and install the left-hand manifold. Install the lockwashers and nuts retaining the crossover pipe and tighten the nuts to 23-28 foot-pounds.

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.

Part ONE

POWER PLANT

Chapter

III

Ignition, Fuel, and Cooling System

The ignition, fuel and cooling systems are all necessary components of the engine itself. However, due to the fact that service on these systems is performed separately from engine service, they have been grouped together here in one chapter. Another advantage to this grouping lies in the fact that most quick service operations involve one or more of these systems, and you have the service information necessary for performing quick service operations in one place, arranged in easy to find sections as listed above.

Information contained in this chapter includes adjustments, testing, replacement and repair of the parts which are included in the ignition system, fuel system, and cooling system.

1. IGNITION

The ignition system consists of the distributor assembly, the condenser, the coil, the spark plugs, and the necessary wires and terminals for connecting those units.

Information on how to perform all repairs and adjustments on the ignition system with the exception of the distributor, are given in this section.

Spark plug replacements, testing, and adjustment are covered in "**a.** Spark Plugs", "**b.** High Tension (Secondary) Wires" gives procedures for replacement of the secondary ignition wires on both the 6 and 8-Cylinder engines. Coil replacement and testing are procedures described in "**c.** Coil", "**d.** Timing" gives the engine ignition timing procedure.

a. Spark Plugs.

Spark plugs should be cleaned and inspected, adjusted, and tested at least every 5000 miles.

(1) *REMOVAL*. Pull the wire off each spark plug. Use compressed air to clean the area around each spark plug. Remove the plugs with a spark plug wrench. Be sure to remove the spark plug gasket when the plug is removed.

(2) *CLEANING*. The main object in cleaning plugs is to remove all of the carbon and lead deposits from the insulator, shell, and electrodes. This can be done on a sand blast cleaner. Do not prolong the use of the abrasive blast as it will wear the insulator and damage the plug. A thorough cleaning of spark plugs should always include removing carbon and other deposits from the threads with a stiff wire brush. These threads are the means of carrying the heat away from the plug. Any deposits will retard the heat flow from the plug to the cylinder head, causing overheating and pre-ignition.

The electrode construction (fig. 1) is such that the cleaning process sometimes does not remove the deposits from all surfaces of the electrodes. Therefore, it is important to clean the electrode surfaces with a small file. Dress the eletrodes to secure flat parallel surfaces on both the center and side electrode.

By removing the oxide coating on the surface and providing sharp edges on the electrodes, the voltage required to jump the gap is reduced and the spark plug performance is improved. A visual inspection will indicate when the plug has been properly cleaned. The insulator appearance should be white and the metal case clean.

After cleaning, examine the plug carefully for cracked or broken insulators, badly pitted electrodes, or other signs of failure and replace as required.

(3) *ADJUSTMENT*. Set the spark plug gap (0.025-0.028 inch). All adjustments should be made by bending the side electrode only.

(4) *TESTING*. After setting the gap, test the plugs on an approved tester. Compare the sparking efficiency of the cleaned and re-gapped plug with a new plug. Replace the plug if it fails to meet requirements.

During this test, check the plug for pressure leakage at the insulator seal. Apply a coating of oil to the shoulder of the plug where the insulator projects through the shell and the top of the plug where the center electrode and terminal project from the insulator. Place the plug under pressure and if air bubbles appear, the plug is leaking and must be replaced. If the plug is satisfactory, wipe it clean before installing it in the engine.

(5) *INSTALLATION*. Clean the area around the spark plug port, to insure proper seating of the plug gasket. Use a new gasket when installing a spark plug. Tighten each plug to 24-30 foot-pounds.

b. High Tension (Secondary) Wires.

The high tension wires include the wires connecting the distributor cap to the spark plugs, and the wire connecting the center terminal of the distributor cap to the center terminal of the ignition coil.

At regular intervals clean and inspect the wires for cracked insulation and loose terminals. If any of these conditions exist, replace the wires.

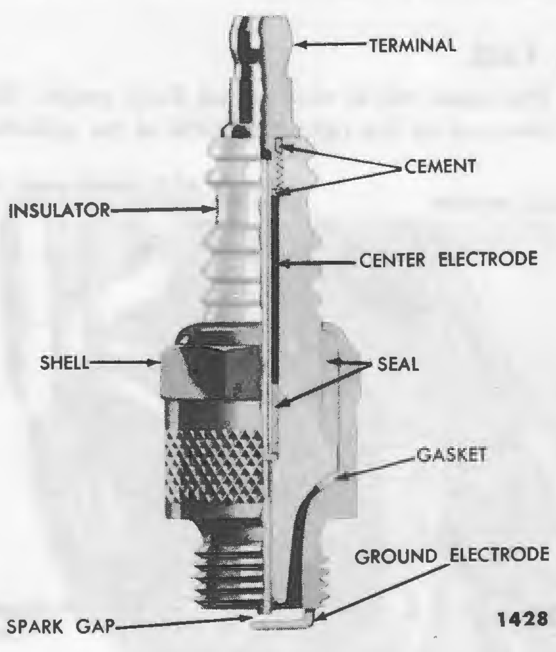

Fig. 1—Spark Plug Construction

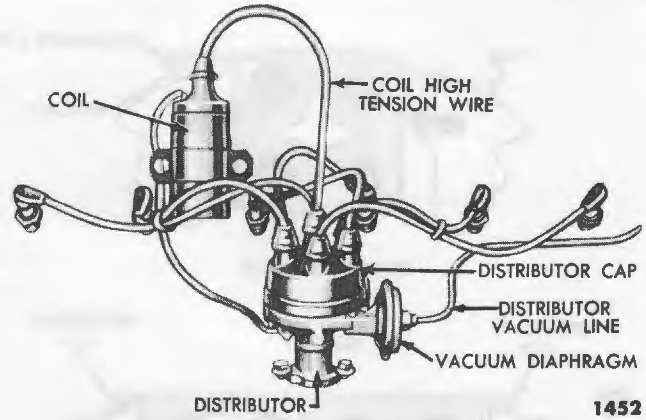

Fig. 2—6-Cylinder Ignition Wire Installation

(1) *REPLACEMENT (6-CYLINDER)*. A spark plug wire set for 6-cylinder engines is available for service. The 6-cylinder ignition wire installation is shown in fig. 2.

(a) Removal. Disconnect the wires at the spark plugs and at the distributor cap and remove them. Disconnect the ignition coil to distributor high tension wire assembly from the coil and distributor cap.

(b) Installation. Install the rubber rings on No. 1 & 2 wires and on No. 5 & 6 wires. Connect the proper wires to the proper spark plugs. Install the weather seals on the distributor end of the wires and insert the end of the wire in the correct socket in the distributor cap. Be sure the wires are forced all the way down into their sockets and that they are held firmly in position. Sockets are numbered to identify the correct socket for inserting the wire which will connect the distributor and the correct spark plug. Install the coil to distributor wire and push the weather seals into position.

(2) *REPLACEMENT (8-CYLINDER)*. When replacing the wires be sure to install the wires in the proper holes in the retaining brackets (fig. 3).

A spark plug wire set for the 8-cylinder truck engine is available for service.

To replace the high tension wires, remove the mount-

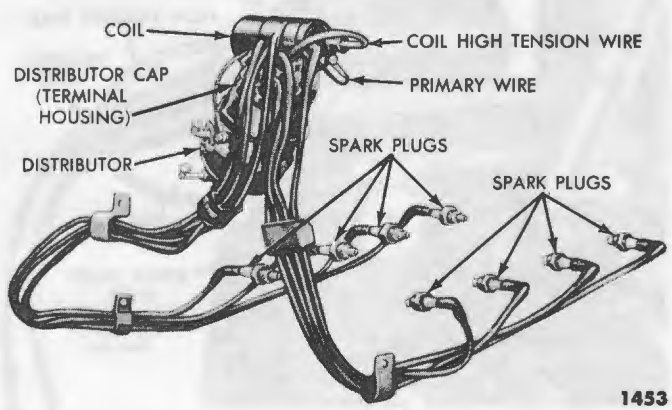

Fig. 3—8-Cylinder Ignition Wire Installation

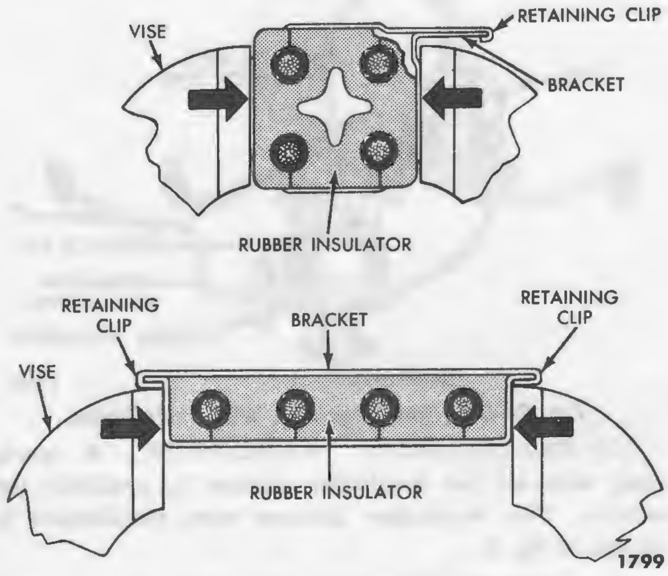

Fig. 4—Releasing Bracket Clips

ing brackets, disconnect the wires from the spark plugs and the distributor cap.

NOTE: ***The rubber shields covering the ends of the spark plug wires and the tips of the spark plugs must be handled with extreme care. Do not attempt to pull the wires and shields off the spark plugs without first rolling back the shields or they will break.***

Remove the high tension wires and brackets from the engine. To remove the old wires from the brackets, squeeze the brackets in a vise applying force in the direction shown in fig. 4 to release the bracket clips. Pull the rubber insulator out of the bracket and separate the wires and insulators.

Install new wires in the rubber insulators. Be sure the wires are positioned correctly in the insulator and the insulator is in the correct location with relation to the bracket mounting points on the engine (fig. 3).

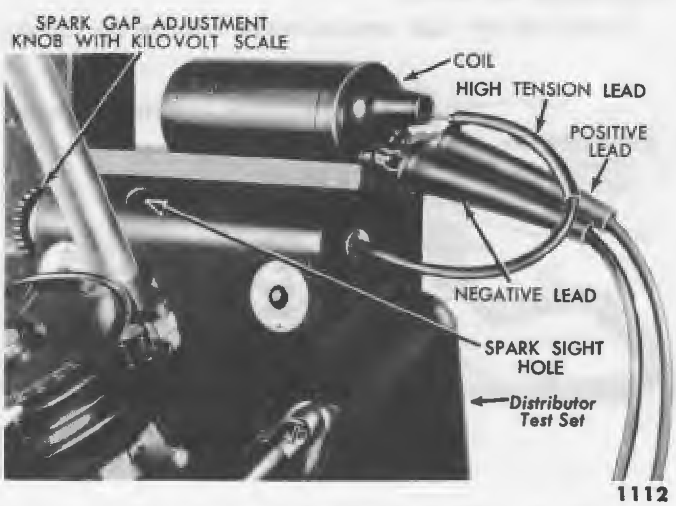

Fig. 5—Test Coil on Stroboscope

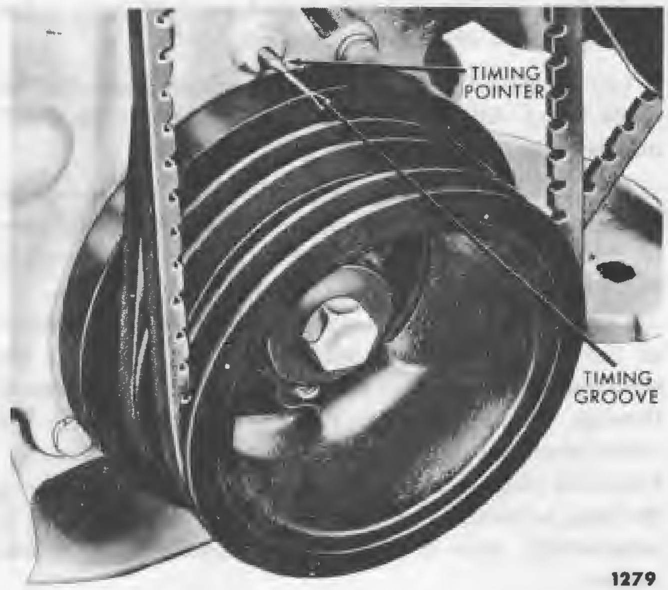

Fig. 6—6-Cylinder (215 cu. in.) Engine Timing Mark

Position the insulators in the brackets, squeeze the brackets in a vise, and snap the bracket tips under the retaining clips. Install weather seals on the distributor ends of the wires. Install the wires and brackets on the engine. Insert the wires in the proper distributor cap socket. Be sure the wires are forced all the way down into their sockets. No. 1 socket is identified by the number "1" on the cap. Install No. 1 wire in this socket and the remaining wires in the firing order 1-5-4-8-6-3-7-2. Connect the wires to the proper spark plugs. Install the coil to distributor high tension lead and push all weather seals into position.

c. Coil.

The same coil is used on all Ford trucks. This coil is mounted on the right hand side of the cylinder head

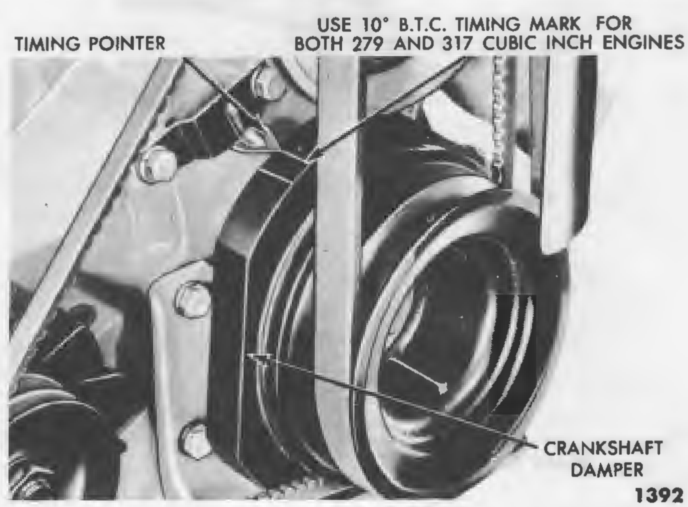

Fig. 7—8-Cylinder (279 and 317 cu. in.) Timing Mark

in the 6-cylinder engine. On the 8-cylinder engine the coil is mounted on the dash panel.

(1) *REMOVAL.* Disconnect the high tension lead and the primary leads from the coil. Remove the coil mounting screws and remove the coil.

(2) *INSTALLATION.* Place the coil in position and install the mounting screws. Insert the high tension lead into the coil socket and connect the primary wires to the coil. Push the weather seal tightly against the coil.

(3) *TESTING ON TRUCK.* Remove one spark plug wire and install a terminal adaptor in the wire terminal. Hold the end of the adaptor approximately $\frac{3}{16}$ inch from the cylinder head. Run the engine at idle speed. If the spark will jump the gap regularly, the coil and the condenser are satisfactory.

(4) *TEST ON DISTRIBUTOR STROBOSCOPE.* Install the coil on the test set as shown in fig. 5 and check the coil output. The spark should jump a 14 kilovolt setting regularly at 2000 R.P.M.

d. Timing.

The 6-cylinder engine is equipped with a damper having a groove timing mark. A pointer is pressed in the cylinder front cover. A pointer bolted to the engine front cover and a mark on the crankshaft damper are used to time the 8-cylinder engine.

When the pointer, as shown in fig. 6 or 7, is in line with the timing mark, No. 1 or No. 6 cylinder is in firing position, depending on which piston is on the compression stroke.

In order to place No. 1 piston on the compression stroke, use a compression gauge or block No. 1 spark plug hole with your thumb. Pressure will be high on the compression stroke.

(1) *INITIAL TIMING.* Align the rotor with the No. 1 spark plug wire terminal in the distributor cap, when the No. 1 cylinder piston is on the compression stroke and timing marks are aligned.

With the timing mark in line with the pointer, the distributor points should just start to open.

On the 6-cylinder engine, it may be necessary to rotate the distributor body approximately 15 degrees clockwise, and then slowly rotate it counterclockwise until the contacts start to open. Tighten the distributor lock plate cap screw.

NOTE: ***If the 6-cylinder distributor has been removed, be sure to align the oil pump tang so it will mesh with the slot in the distributor shaft when the distributor is reinstalled on the engine.***

On the 8-cylinder engine, rotate the distributor body approximately 15 degrees counterclockwise, then slowly rotate it clockwise until the points just start to open.

Start the engine and check the timing with the aid of a timing light.

NOTE: ***If the 8-cylinder governor body has also been removed, it will be necessary to align the tang on the oil pump shaft so it will mesh in the distributor shaft slot when the distributor and governor assembly is installed in the block.***

(2) *CHECKING TIMING WITH TIMING LIGHT.* Disconnect the distributor vacuum line before checking the timing.

Connect the timing light to the engine with the high tension lead on No. 1 spark plug (use the spark plug wire terminal adapter for 6-cylinder engines, or a distributor cap terminal adaptor for 8-cylinder engines), and the other two leads to the proper battery terminals. Clean the grease and dirt from the timing mark and, if necessary, cover the timing mark and pointer with white chalk. Start the engine and operate it at idle speed. Direct the light on the timing mark. It should flash just as the timing mark lines up with the pointer, indicating correct timing. The operator should stand so that his eye is in line with center of damper and timing pointer.

NOTE: ***Be sure to check the correct timing mark when checking timing on the 8-cylinder 279 cubic inch or 317 cubic inch engines. Refer to the illustration in fig. 7.***

If the timing mark and the pointer do not line up, rotate the distributor until the timing mark is in line with the stationary pointer.

To advance the timing on the 6-cylinder engine, rotate the distributor body counterclockwise; to retard the timing, rotate the distributor body clockwise.

On the 8-cylinder engine, advance timing by rotating the distributor body only (not the governor body) clockwise; retard timing by rotating the distributor body counterclockwise.

2. DISTRIBUTOR MINOR REPAIR AND ADJUSTMENTS

Ford distributors are known as the Loadomatic type, with the spark advance regulated by the vacuum differential at the carburetor. This distributor advance is operated by a vacuum unit mounted on the distributor. One side of this vacuum unit is connected to the breaker plate by direct linkage and the other side is connected by a vacuum line to the carburetor.

The spark advance characteristics are controlled by two breaker plate springs working against the distributor diaphragm (fig. 8). The amount of spark advance is determined by the amount of vacuum supplied to the distributor and by adjustment of the breaker plate springs.

The carburetor has a vacuum passage with openings at both the venturi tube and a point just above the throttle plate (fig. 9), so that the vacuum in the distributor line is at all times a combination of the carburetor throat and venturi vacuums. The lower opening is above the throttle plate when the engine is idling, and at idle speed the spark is retarded.

Under normal road load or part throttle operation the vacuum ("B" fig. 9) is high, and the spark will become fully advanced at 18 to 35 miles per hour.

When the engine is accelerating, the vacuum at the venturi increases as the engine speed increases; however, the manifold vacuum (vacuum at the throttle body throat) decreases considerably from the road load vacuum. The net result of these two changes is to lower the vacuum at the distributor diaphragm while the springs retard the spark advance from its road load setting. As the vehicle speed increases, the venturi vacuum and the manifold vacuum continue to increase.

The procedure for replacing, testing, or adjusting the distributor points, testing the condenser, and replacing the distributor is given below.

a. Distributor Points.

The distributor point assembly in the Loadomatic distributor consists of the stationary distributor point bracket assembly, breaker arm, and primary wire terminal. This assembly is mounted on the breaker plate as a unit and can be replaced without removing the distributor from the engine (fig. 8).

Although the distributor point assembly spring tension is set by the manufacturer, the tension should be adjusted, if it is not within specifications.

(1) *REMOVAL.* Disconnect the primary and condenser leads. Remove the screws which secure the point

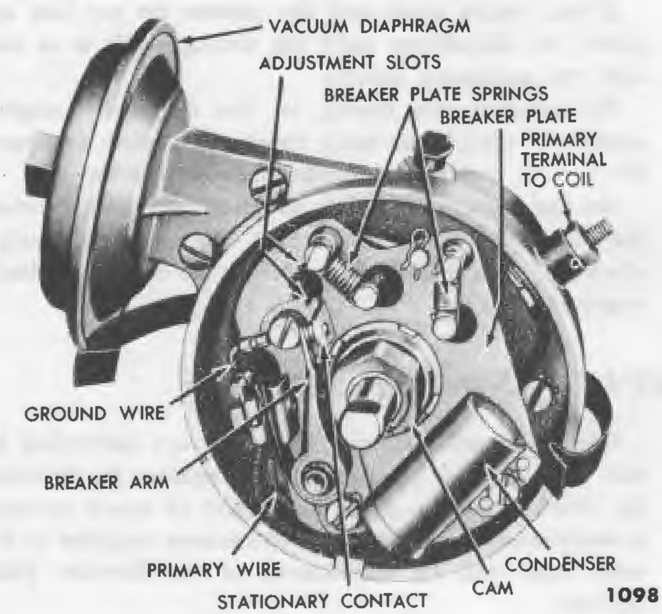

Fig. 8—Distributor (Typical)

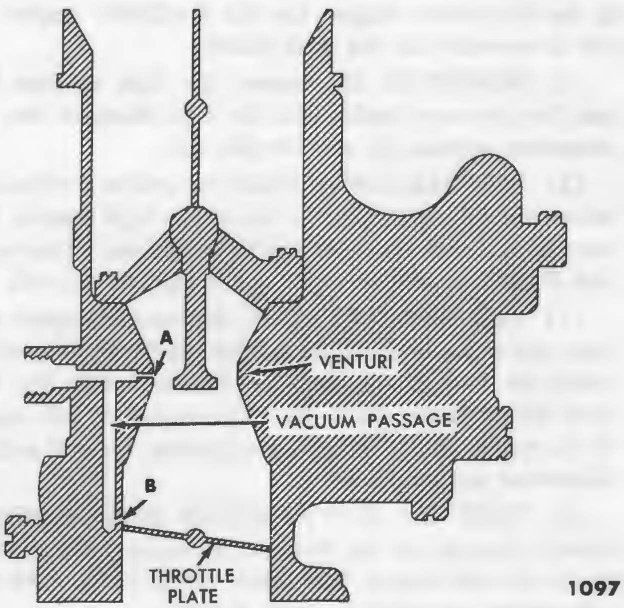

Fig. 9—Carburetor Vacuum Pasages (Typical)

assembly to the breaker plate. Remove the point assembly.

(2) *INSTALLATION.* Place the primary and condenser leads, lock washers, and nut on the point assembly primary terminal and tighten the nut securely. Position the point assembly on the breaker plate. Install the holding screws. Be sure the ground wire terminal is on the screw nearest to the adjustment slot and the lock washer is used under the screw at the opposite end. Adjust the distributor point spacing.

(3) *CHECKING SPRING TENSION.* Place the tension gauge as near as possible to the distributor points and push at right angle (90°) until the points just open (fig. 10). Read the spring tension and adjust the spring if outside specifications (17-20 ozs.).

(4) *ADJUSTING SPRING TENSION.* Disconnect the wires at the distributor point terminal, and loosen

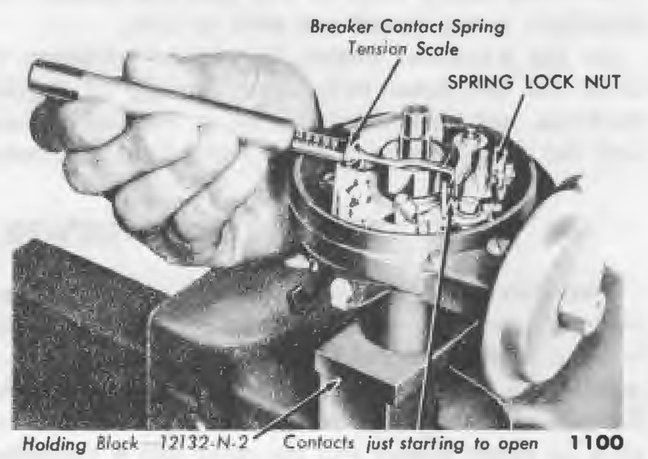

Fig. 10—Check Spring Tension (Typical)

the nut holding the spring in position. Move the spring toward the screw stud to increase the tension and in the opposite direction to decrease the tension. Tighten the nut securely and recheck the spring tension. After the proper tension is obtained, install the primary wires on the point assembly primary terminal and tighten the nut securely.

(5) *DISTRIBUTOR POINT SPACING ADJUSTMENT.* The distributor points can be adjusted with the distributor in the car or on a distributor stroboscope. Before adjusting the points, they should be examined and replaced if they are oily, severely pitted, badly oxidized, or have an excessive amount of foreign matter on the contact surfaces.

To increase point life and improve engine performance, it is important to adjust the point spacing accurately.

If the distributor point assembly is replaced or needs adjustment, crank the engine until the rubbing block rests on the peak of a cam lobe. Loosen the lock screws, insert a screw driver blade or adjusting blade of distributor adjusting wrench (fig. 11) in the adjustment slot, and turn it to obtain the proper point spacing (0.024-0.026 inch on 6-cylinder engine and 0.014-0.016 inch on 8-cylinder engine).

Tighten the lock screws and recheck the clearance between the distributor points. Always retime the ignition after adjusting the distributor point gap.

b. Condenser.

The condenser can be removed from the distributor, either when the distributor is in the engine or when it is removed from the engine.

(1) *REMOVAL.* Disconnect the condenser lead from the distributor point primary terminal and remove the screw that holds the condenser on the breaker plate. Lift the condenser out of the distributor.

(2) *INSTALLATION.* Position the condenser on the breaker plate. Install the condenser holding screw. Connect the condenser lead to the primary terminal.

(3) *TESTING.* Before removing the condenser to make a test, it is advisable to first make the test on the vehicle.

(a) TEST ON VEHICLE. This test is made at the same time as the coil test. If the spark is not satisfactory, it will be necessary to remove the condenser and test it on a distributor stroboscope test set.

(b) TEST ON DISTRIBUTOR STROBOSCOPE. Install the condenser on a distributor test set as shown in fig. 12. Test the condenser for leakage, series resistance, and capacity. Condenser capacity is 0.21 to 0.25 microfarads, leakage should be greater than 5 megohms at room temperature and series resistance should be one ohm or less.

c. Distributor.

The distributor must be removed from the engine when the vacuum advance is to be checked or adjusted.

(1) *REMOVAL.* Before removing the distributor from an engine which is timed correctly, be sure to scribe a mark on the distributor housing indicating the position of the rotor, and another mark on the engine and housing to indicate the position of the housing. The

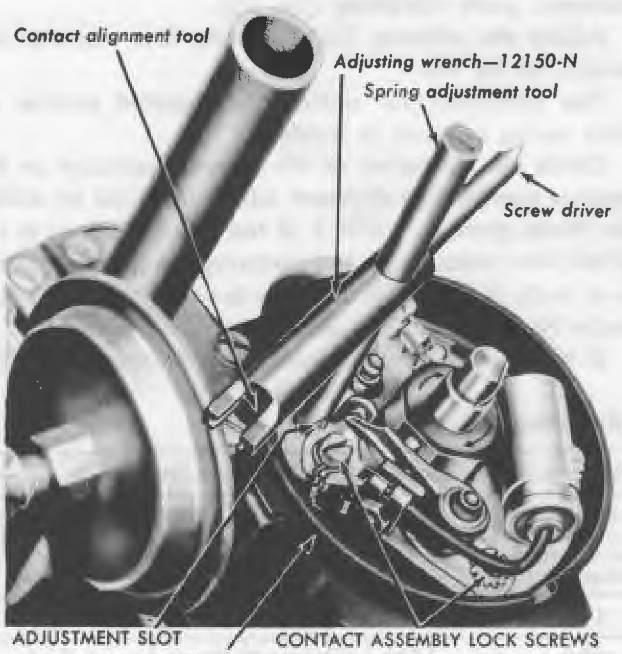

Fig. 11—Adjusting Point Gap (Typical)

Fig. 12—Test Condenser on Stroboscope

Table 1—Distributor Vacuum Advance

Distributor	Distributor R.P.M.	Distributor Degrees Min.	Distributor Degrees Max.	Vacuum (Inches of Mercury)
FAA-12127A (6 cylinder)	200	0	0	0
	500	3½	4½	0.5
	1000	8¼	9¼	1.8
	1000	14¾	16¼	6.5
	1500	11¾	13	3.8
	2000	14½	15¾	6.0
FAD-12127-C (8 cylinder) used on 317 cu. in.	200	0	0	0
	500	3⅛	4⅛	0.5
	1000	9⅞	10⅞	1.95
	1500	12⅞	13⅞	2.68
	2000	14½	15½	5.73
FAD-12127-C (8 cylinder) used on 279 cu. in.	200	0	0	0
	500	2	3	0.37
	1000	8¼	9¼	1.45
	1500	11½	12½	2.68
	2000	14	15	4.1

distributor can be reinstalled when the rotor is in line with the mark without rotating the engine crankshaft to obtain the proper timing.

Remove the distributor cap. Disconnect the primary wire and vacuum line. Remove the distributor hold-down bolts and remove the distributor assembly.

NOTE: ***On the 8-cylinder engine, remove only the retaining clamp and the distributor body.***

(2) *CHECK VACUUM ADVANCE.* Install the distributor on the stroboscope.

NOTE: ***It is advisable to keep a spare governor body as a testing fixture with the stroboscope to save time in testing advance characteristics of the 8-cylinder distributors. The extra operations necessary to remove and install the governor body on the engine will be avoided with this method.***

Connect the dwell lead and check the per cent dwell. If the dwell is not between 58 and 63 per cent and the point spacing is not within limits, it will be necessary to adjust the points. Check the breaker arm spring tension and adjust if required (17-20 ozs. Set the distributor speed at 200 R.P.M., hold the distributor breaker

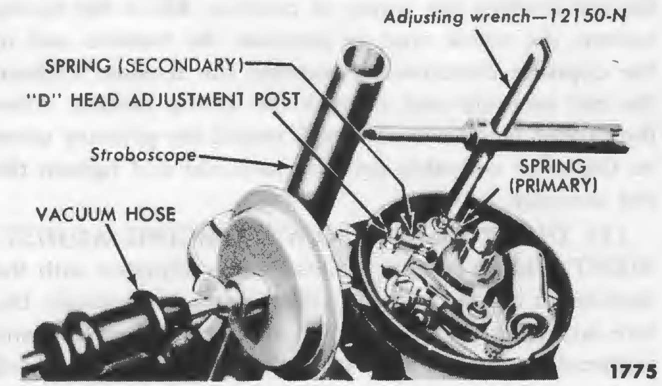

Fig. 13—Adjusting Spring Tension (Typical)

plate against the stops in full retard position, and rotate the distributor housing until the spark lines up with the zero degree position on the scale. Tighten the distributor holding clamp. Check the distributor according to the speed and vacuum settings given in Table 1.

Set the distributor speed to the proper R.P.M. and apply the required vacuum. Read the spark advance on the degree scale. If the spark advance is not within these specifications, adjust the tension on the springs.

(3) *VACUUM ADVANCE ADJUSTMENT.* Install distributor on a distributor stroboscope. Adjust the distributor point spacing. Set the distributor speed at 200 R.P.M., hold the distributor breaker plate against the stops in full retard position, and rotate the distributor housing until the timing light in the stroboscope base lines up with the zero degree position on the scale. Tighten the distributor holding clamps. Release the tension on the two retard springs by turning both adjustment posts clockwise (fig. 13).

Adjust the primary (light) spring first and the secondary spring last.

The procedure for setting the required tension on each spring in given in Table 2.

Check the operation of the vacuum advance at the various speeds. The degreees advance should be within the limits given in Table 1. If the spark advance is not within the limits under low vacuum, the primary spring is at fault. If the spark advance is not within the limits under high vacuum, the secondary spring is at fault.

If it is imposible to adjust both springs to give the

Table 2—Distributor Advance Adjusting Specifications

Distributor	Primary (Light) Spring Adjustment Procedure			Secondary (Heavy) Spring Adjustment Procedure		
	Set Distributor Speed to R.P.M.	Apply Vacuum (inches Hg) to distributor diaphragm	Turn Adjustment Post until Spark is advanced to (degrees)	Set Distributor Speed to R.P.M.	Apply Vacuum (inches Hg) to distributor diaphragm	Turn Adjusting Post until Spark is advanced to (degrees)
FAA-12127-A (6 cyl.)	400	0.32	1¼	1000	1.80	8¾
FAD-12127-C: 279 cu. in.	500	0.37	2½	1000	1.45	8¾
(8 cyl.) 317 cu. in.	500	0.5	3⅝	1000	1.95	10⅜

correct spark advance, one or both springs should be replaced, and the spark advance readjusted.

(4) *INSTALLATION.* Align the rotor with the mark previously scribed on the distributor body. Install the distributor in the engine, with the housing mark in alignment with the mark previously made on the engine. Tighten the hold down screw or the clamp. Check and adjust the ignition timing, using a timing light.

CAUTION: ***When installing the 6-cylinder distributor, be sure the oil pump tang engages the slot in the distributor shaft. If the tang is not engaged, the distributor body will not seat against the block, and possible breakage of the flange may result when the retaining screws are tightened. The same precaution must be taken when installing the 8-cylinder governor body.***

3. DISTRIBUTOR OVERHAUL

Before overhauling the distributor, it is advisable to test it on a stroboscope for variation of spark and vacuum advance. The test will give valuable information on distributor condition and indicate the parts which need replacement.

The procedures given below cover both the 6-cylinder and the 8-cylinder distributor.

a. 6-Cylinder Distributor.

The 6-cylinder distributor is mounted on the right side of the engine and retained by two screws and washers.

(1) *REMOVAL.* Disconnect the primary wire at the distributor. Disconnect the distributor vacuum advance line and remove the distributor cap. Remove the screws and lockwashers and pull the distributor out of the block.

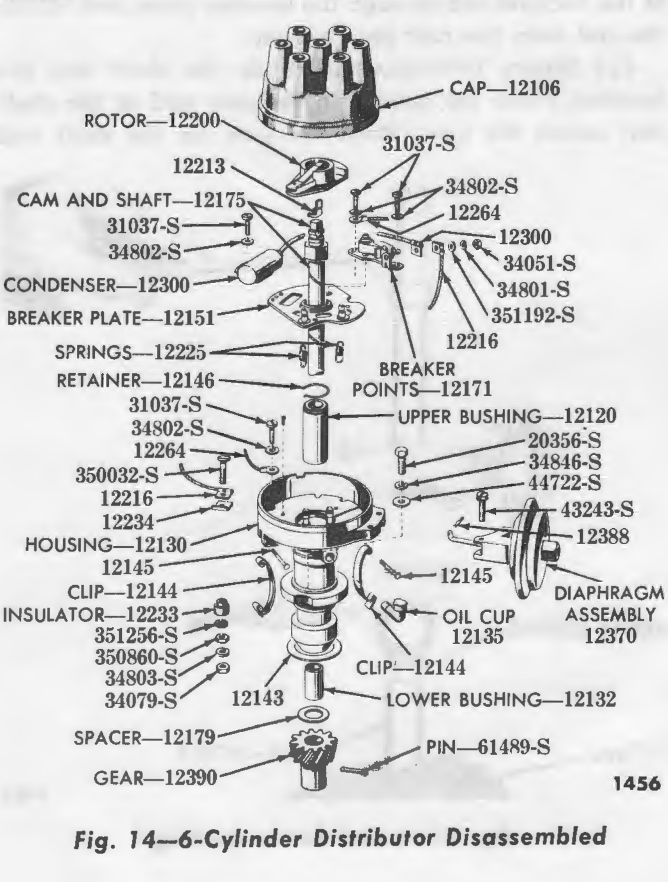

Fig. 14—6-Cylinder Distributor Disassembled

(2) *DISASSEMBLY.* If the vacuum unit, ground wire, and primary wire are in satisfactory condition, it is not necessary to remove these parts from the distributor housing. Figure 14 illustrates the 6-cylinder distributor parts in their relative positions.

(a) SHAFT AND CAM REMOVAL. File off the rivet head from the rivet retaining the distributor drive gear. Drive out the rivet with a punch (fig. 15). Remove the distributor gear as shown in fig. 16. Slide the distributor shaft out of the housing.

(b) BREAKER PLATE REMOVAL. Place the distributor housing in a holding block and clamp the block in a vise as shown in fig. 17. Remove the distributor point assembly. Remove the condenser. Remove the hair pin retainer and disconnect the vacuum advance rod and push the rod out of the plate. Release the tension on the return springs and disconnect the springs.

NOTE: ***Do not stretch the springs as this may distort them, making it difficult to obtain adjustment.***

Remove the lock ring attaching the breaker plate to the upper bushing. Lift the breaker plate from the housing. If it is necessary to replace the primary wire or ground wire, remove them at this time.

(c) INSPECTION. Inspect the distributor shaft and

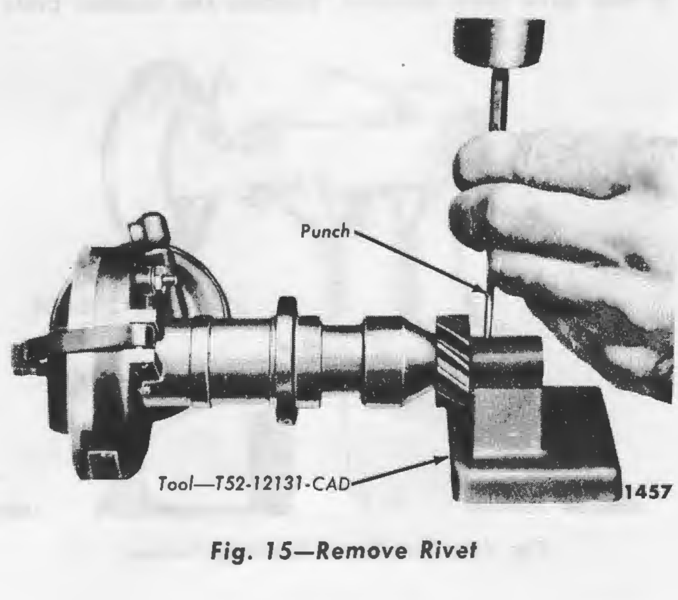

Fig. 15—Remove Rivet

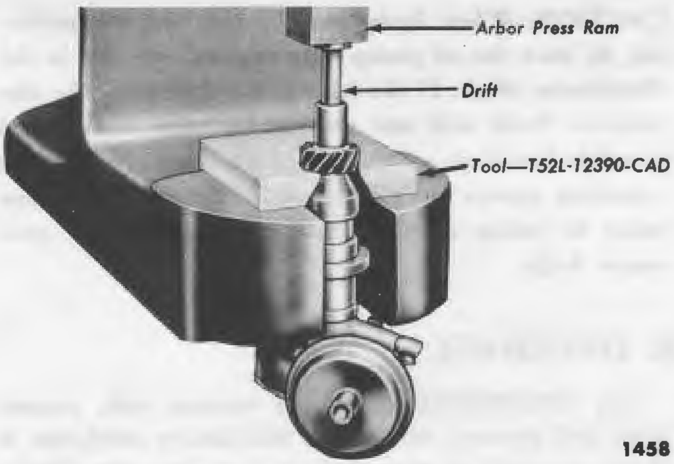

Fig. 16—Remove Gear

bushings for wear. The distributor shaft manufacturer's minimum diameter at the bushing is 0.4675 inch. The bushing maximum diameter is 0.469 inch.

(d) BUSHING REMOVAL. Drive out the lower bushing with the tool as shown in fig. 18. Invert the housing and drive out the upper bushing.

(e) BUSHING INSTALLATION. Place a new lower bushing in position on the bushing installation tool and install the bushing in the distributor housing as shown in fig. 19. Turn the tee handle on the tool until the lower bushing is flush with the distributor housing. Position the upper bushing in the housing with the lock ring end up. Install the bushing with the tool as shown in fig. 20. Turn the tee handle on the tool until the spacer bottoms firmly against the distributor housing. Burnish both bushings to the proper size with a burnishing tool as shown in fig. 21.

(f) BREAKER PLATE INSTALLATION. Install the ground wire and the primary wire on the distributor housing if they have been removed. Position the breaker plate

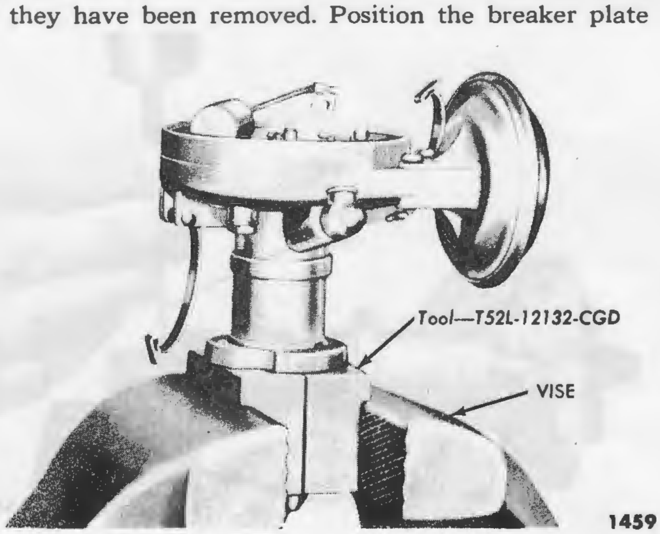

Fig. 17—Distributor Holding Fixture

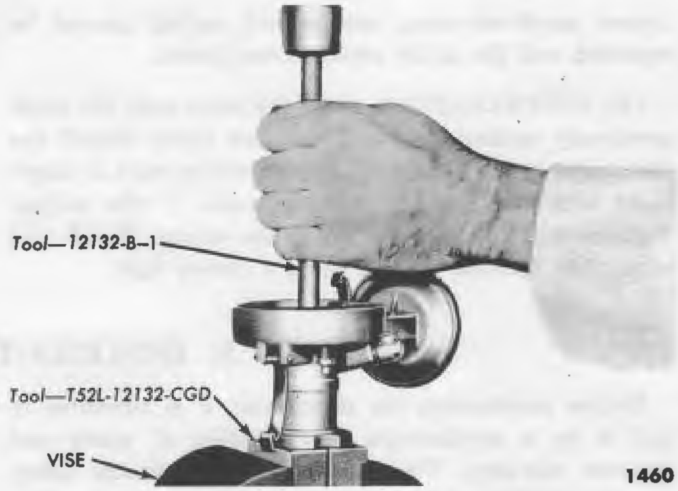

Fig. 18—Remove Lower Bushing

in the housing. Install the lock ring to secure the plate. Install the condenser and place the condenser lead, primary lead, lockwasher, and nut on the primary terminal. Install the distributor point assembly. Be sure the pivot pin enters the hole in the breaker plate.

Install the ground wire and the screw at the adjustment slot end of the breaker assembly and the screw and lockwasher at the opposite end of the assembly. Install the vacuum unit on the distributor housing if it has been removed. Install the two return springs on the adjustment and breaker plate post. Insert the tip of the vacuum rod through the breaker plate, and attach the rod with the hair pin retainer.

(g) SHAFT INSTALLATION. Slide the shaft into the housing. Place the spacer on the gear end of the shaft and install the gear. Press the gear on the shaft and

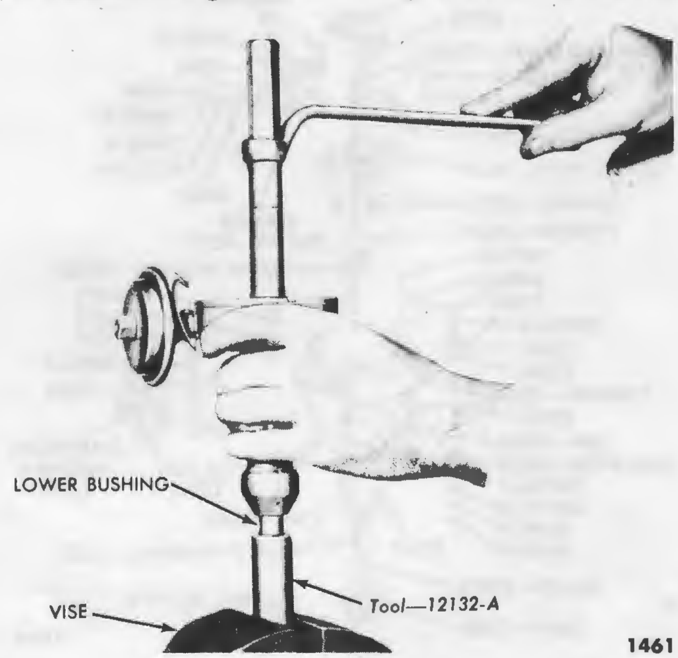

Fig. 19—Install Lower Bushing

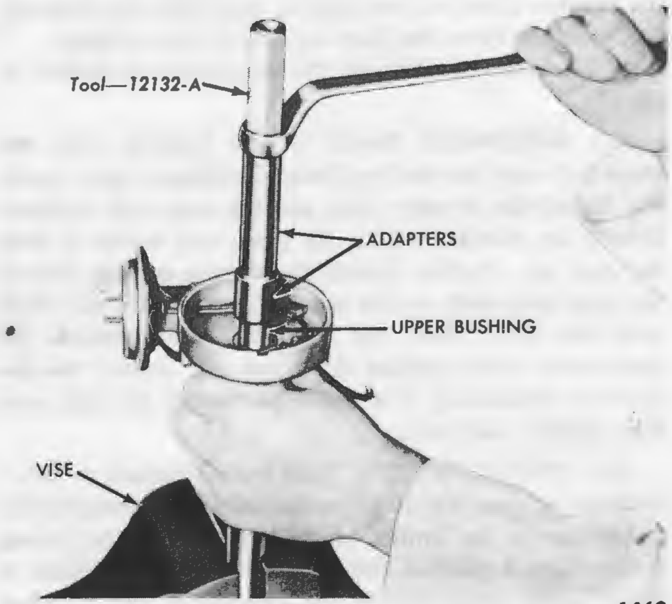

Fig. 20—Install Upper Bushing

check the end clearance with a feeler gauge (fig. 22). The clearance should be 0.005-0.008 inch.

Drill the shaft with a No. 30 (0.1285) drill. Install the pin through the gear and shaft and peen the pin head.

(h) ADJUSTMENT. Adjust the distributor point spacing. Install the distributor on the stroboscope and adjust the vacuum advance.

(i) INSTALLATION. Set the engine crankshaft so No. 1

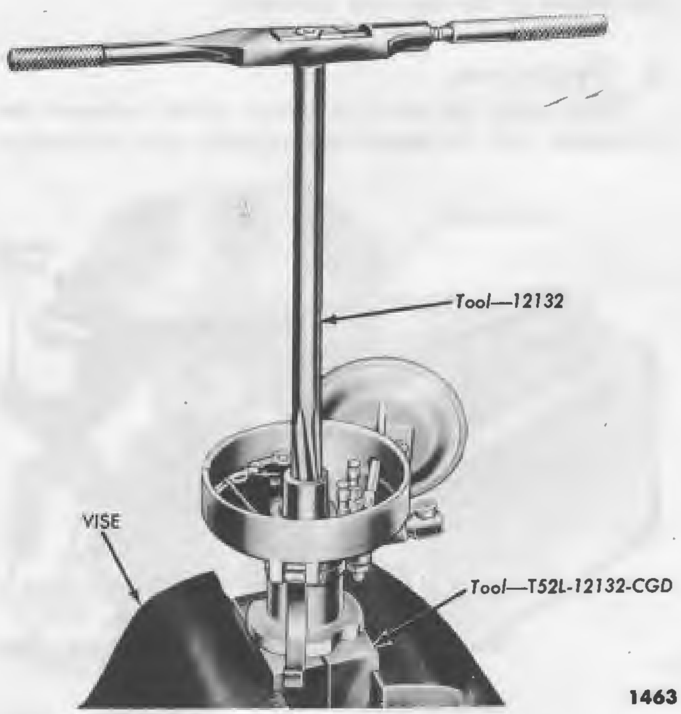

Fig. 21—Burnish Bushings

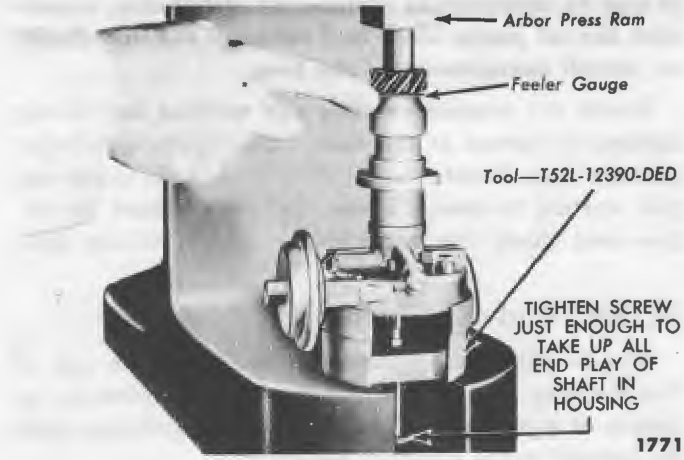

Fig. 22—Press on Distributor Gear

cylinder is on top dead center after the compression stroke (with the timing mark in line with the pointer) and install the distributor in such a position that the rotor points to No. 1 spark plug wire in the distributor cap terminal.

NOTE: *When installing the distributor, be sure the driving tang in the oil pump shaft engages the slot in the distributor. If the tang is not properly engaged, the distributor body will not seat against the block.*

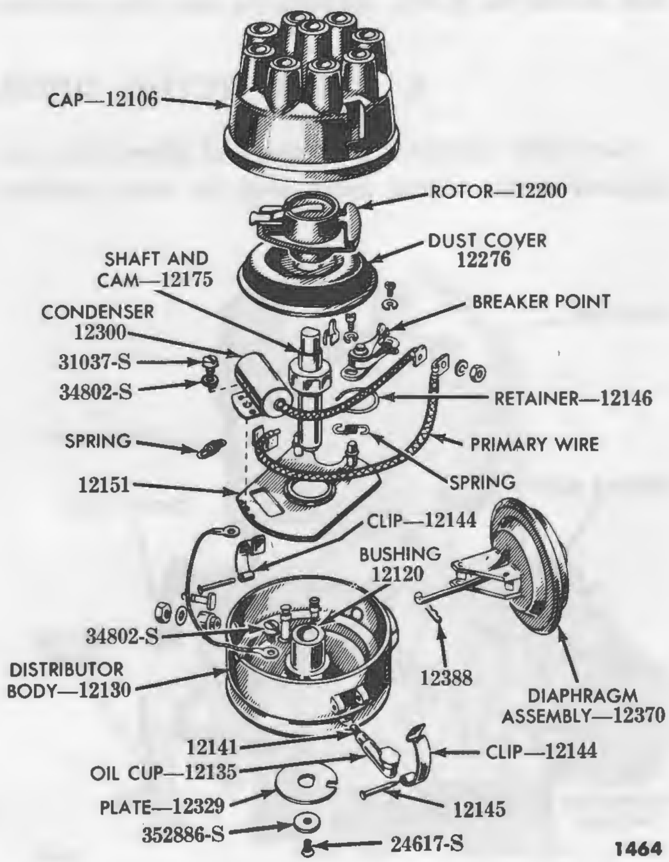

Fig. 23—8-Cylinder Distributor—Disassembled

It may be necessary to remove the distributor, reposition the oil pump shaft and reinstall the distributor to permit engagement of the tang.

Install the retaining screws and washers but do not tighten the screws at this time. Connect the distributor primary wire. Rotate the distributor until the points are just starting to open. Tighten the screws. Start the engine and check the initial timing with a timing light.

b. 8-Cylinder Distributor.

The 8-cylinder distributor is mounted at the rear of the cylinder block and is driven by the governor by means of a plate and driving pin. The distributor body is clamped to the governor housing.

(1) *REMOVAL.* Disconnect the primary wire at the distributor. Disconnect the distributor vacuum advance line and remove the distributor cap. Unscrew the clamp ring and lift the distributor off the governor housing.

(2) *DISASSEMBLY.* Remove the rotor, washer, felt, and dust cap. Remove the distributor point assembly. Remove the drive plate retaining screw, drive plate, and slide the cam and shaft out of the bushing.

Remove the vacuum rod retainer and push the rod out of the plate. Release tension on the return springs and remove the springs. Remove the snap ring retaining the breaker plate on the bushing and slide the plate off the bushing. Press the bushing out of the housing.

A disassembled view of the distributor is shown in fig. 23.

(3) *ASSEMBLY.* Install a new bushing with the same tool used for the 6-cylinder distributor upper bushing. Install the breaker plate and the snap ring retainer. Install the vacuum rod in the plate and secure it with the hair pin retainer. Install the return springs. Install the cam and shaft in the bushing and secure the shaft with the drive plate and retaining screw. Install the distributor points. Adjust the point gap. Adjust the distributor advance on a stroboscope. Install the dust cap, felt, washer, and rotor.

(4) *INSTALLATION.* Turn the crankshaft so No. 1 cylinder is near top dead center after the compression stroke (with the timing mark in line with the timing pointer), and position the rotor so that it will point to No. 1 spark plug wire in the distributor cap terminal when the housing is installed.

Place the distributor housing on the governor housing, engaging the slot in the drive plate with the drive pin in the governor. Turn the distributor body so the points are just starting to open. Tighten the clamp ring to hold the distributor body. Install the distributor cap. Install the distributor primary wire. Check the initial timing and adjust the distributor, if necessary.

4. CARBURETOR OPERATION AND ADJUSTMENTS

Carburetor operating principles and adjustments are covered in this section under headings which describe the nature of the material contained.

a. Operation.

While some variation in design exists between the 6-cylinder and 8-cylinder carburetors, each carburetor

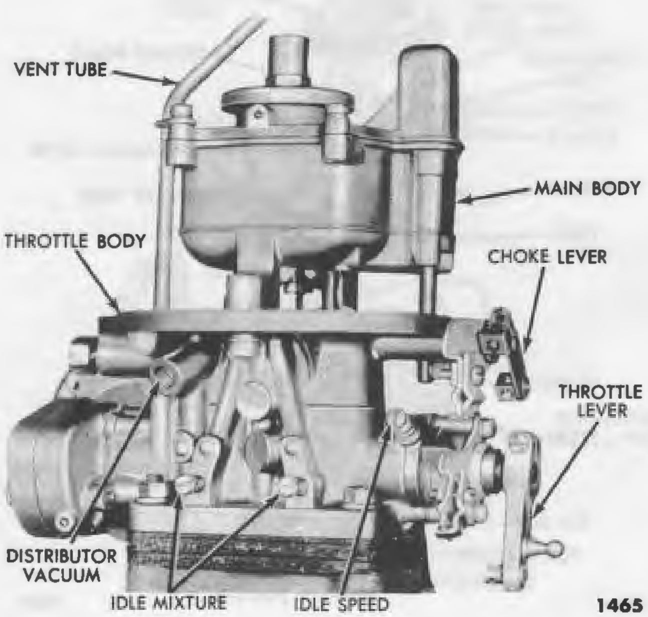

Fig. 24—8-Cylinder Carburetor

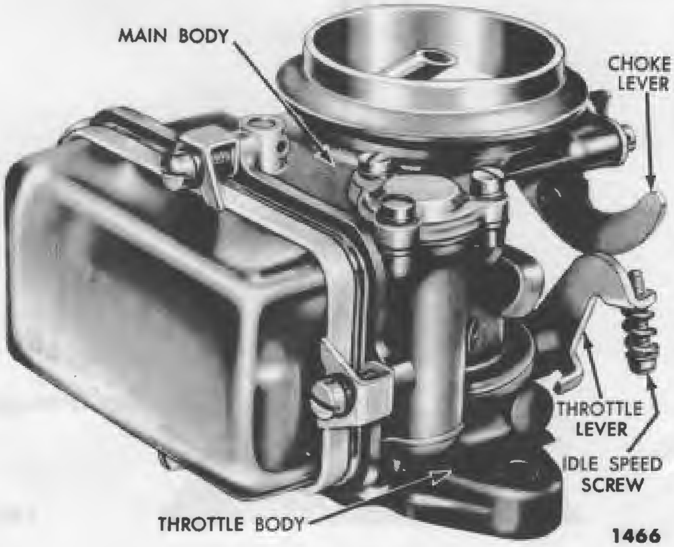

Fig. 25—6-Cylinder Carburetor

has four fuel circuits and the principles involved are the same for each. Minor variations in design are pointed out throughout this presentation.

Each system is designed to supply the correct quantity of fuel under a particular type of operation. The operating principles of these separate circuits are presented under the following headings: "(1) Idle Fuel System," "(2) Main Fuel System," "(3) Power Fuel System," and "(4) Accelerating System."

The 6- and 8-cylinder carburetor construction is illustrated in figs. 24 and 25.

(1) *IDLE FUEL SYSTEM.* The idling systems for the different Ford carburetors are illustrated in figs. 26 and 27.

The fuel from the carburetor bowl passes through the main metering jet and into the idle tube or passage. Air is introduced into the fuel stream by the idler air bleed. The idle mixture travels down the idle passages to the idle discharge holes.

When the engine is running at a speed of 450 r.p.m., the mixture is discharged from the lower hole. As the throttle plate opens and the speed is increased, the upper hole starts discharging in addition to the lower hole.

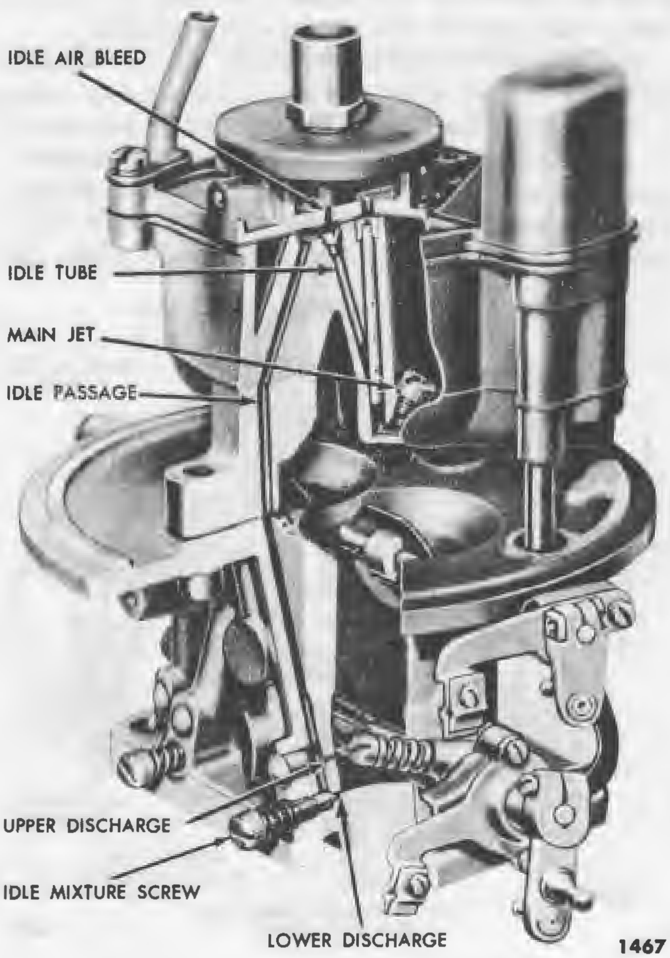

Fig. 26—8-Cylinder—Idle Fuel

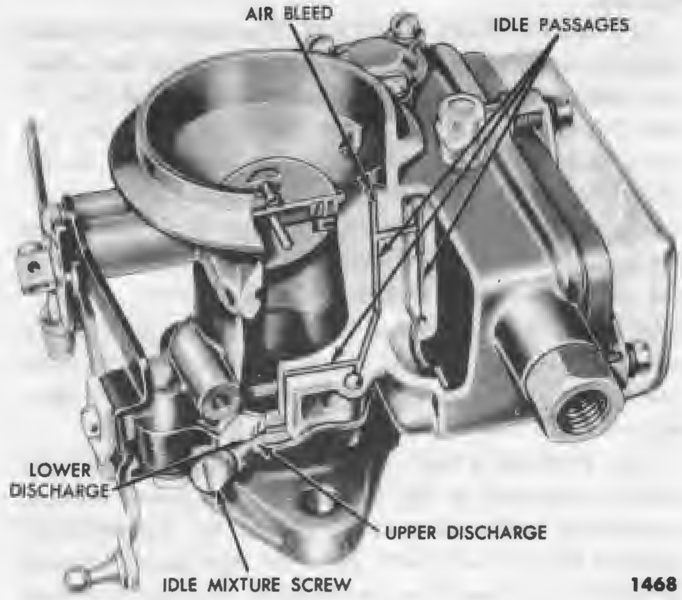

Fig. 27—6-Cylinder—Idle Fuel

The action and timing are such that the discharge from the upper hole reaches a maximum at about 900 r.p.m., and then gradually becomes less effective as the main nozzle starts to flow.

The lower discharge hole is provided with an idle adjusting screw. Turning this screw "out" gives a richer

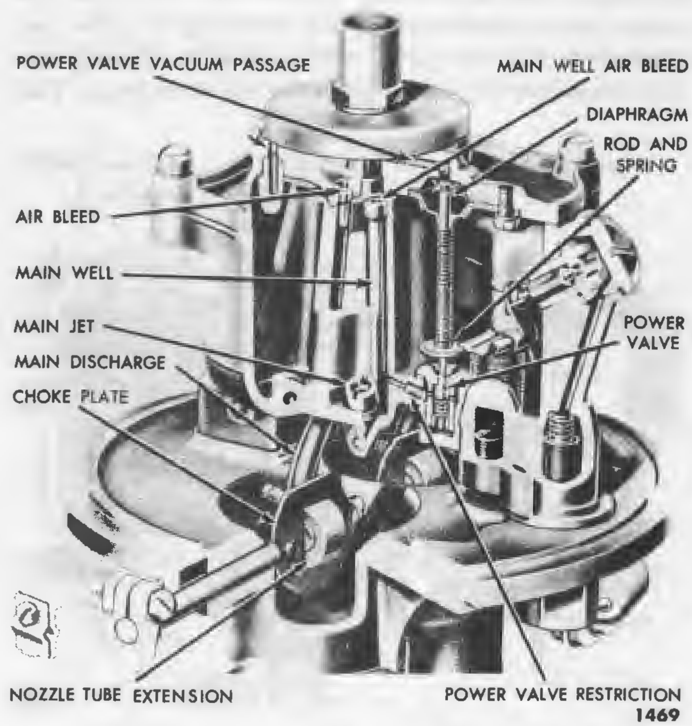

Fig. 28—8-Cylinder Carburetor—Main and Power Fuel System

mixture and turning the screw "in" gives a leaner mixture.

(2) *MAIN FUEL SYSTEM.* The main fuel system starts to operate as the idle system becomes less effective and the main nozzle starts to deliver fuel (fig. 28 and 29). This occurs at about 900 r.p.m. Between 900 r.p.m. and 1250 r.p.m. there is a definite blend of the idle system and the main metering system.

A supply of air is introduced into this mixture by the high speed air bleed before it is discharged through the vertical passage to the discharge outlets.

NOTE: ***In the 6-cylinder carburetor, the fuel is discharged directly against the lower side of the choke plate where it vaporizes and mixes with the air flowing through the carburetor.***

(3) *POWER FUEL SYSTEM.* The power fuel system is illustrated in figs. 28 and 29. The power vacuum diaphragm and spring are actuated by the manifold vacuum below the throttle plate. At road speed, vacuum is high at light loads but decreases as the load increases. The diaphragm actuated by the vacuum holds the operating rod off the power valve leaving the valve closed until the vacuum drops to about 6 to 6.5 inches of mercury, which is not high enough to resist the action of the spring on the operating rod.

Under load, as in climbing hills, or at high speeds, the vacuum drops because it becomes necessary to open the throttle wider in order to maintain speed. When the vacuum drops below 6.5 inches of mercury, on the 8-cylinder and below 6-6.5 inches on the 6-cylinder, the power valve is held open by the operating rod. The fuel then flows into the power valve chamber, through the high speed restriction, and into the main discharge. This

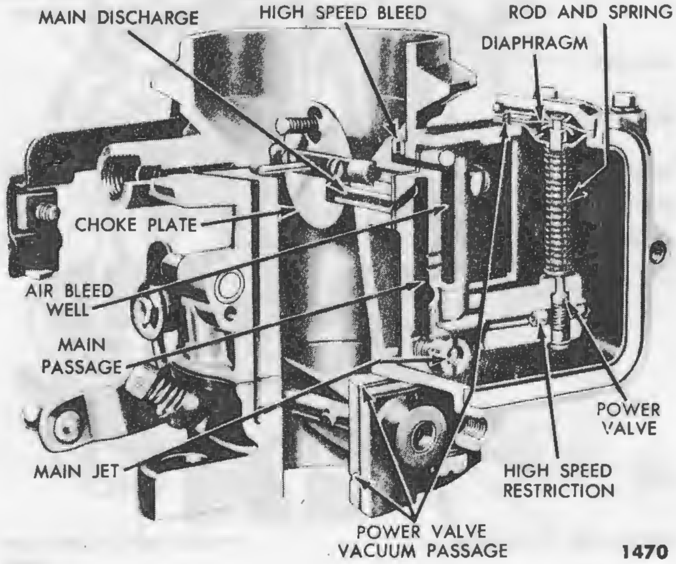

Fig. 29—6-Cylinder Carburetor—Main and Power Fuel System

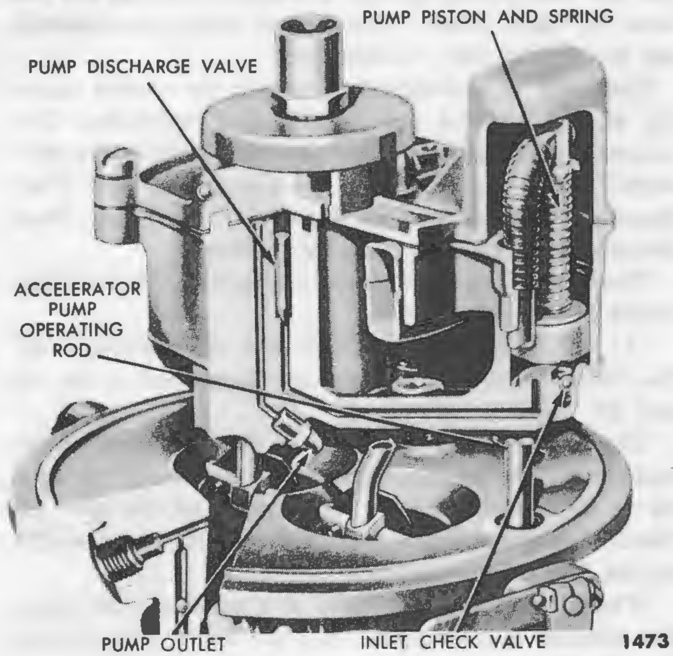

Fig. 30—8-Cylinder Carburetor—Accelerating System

gives the additional fuel required for high speeds, for heavy loads, and for low speeds at full throttle.

(4) *ACCELERATING SYSTEM.* The accelerating system illustrated in figs. 30 and 31 has a pump which is connected to the throttle linkage, and its function is to enrich the mixture temporarily for rapid acceleration. The fuel is drawn into the pump chamber, through the pump inlet passage, and the pump inlet ball check valve on the backward stroke of the pump piston (or

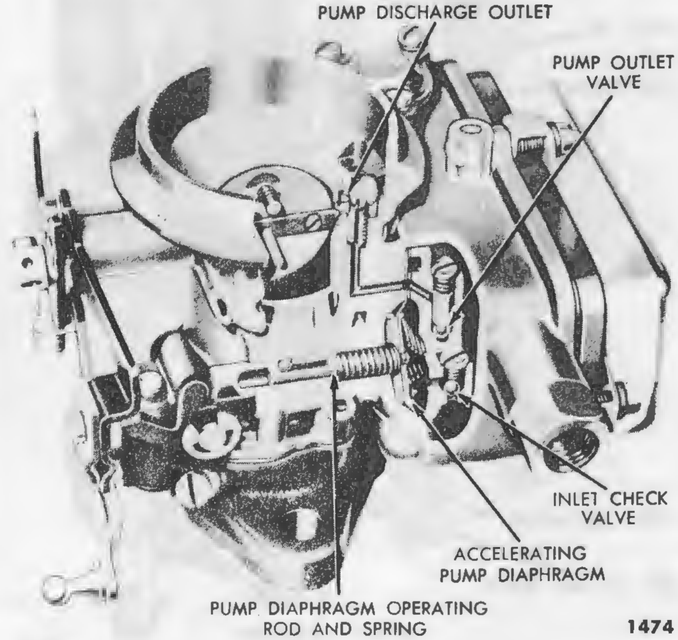

Fig. 31—6-Cylinder Carburetor—Accelerating System

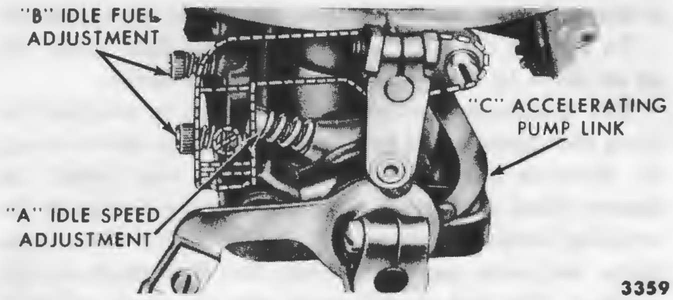

Fig. 32—Idle Adjustments—8-Cyl.

diaphragm). When the throttle is opened, the piston (or diaphragm) moves forward, closing the pump check valve and overcoming the weight of the pump discharge needle valve. The accelerating fuel then goes around this valve, and out the pump discharge nozzle.

The spring between the operating rod and the pump piston stem allows the pump operating rod to overrun the pump piston when the throttle is opened suddenly. This overrun causes the pump piston to be subjected to the pressure of the spring, thereby giving a prolonged steady discharge of the accelerating fuel.

b. Adjusting Idle Fuel Mixture.

The idle fuel mixture is controlled by the idle mixture adjusting screws. Turn the screw "in" to lean the mixture, and turn the screw "out" to enrich the mixture. Make the initial idle fuel adjustment by turning the idle adjustment screws "in" (6-cylinder carburetor has only one screw) until they lightly touch the seat. Then back the screws off approximately one turn.

CAUTION: ***Do not turn the screw against its seat tight enough to groove the point. If the screw is damaged, it must be replaced before proper idle adjustment can be obtained.***

Start the engine and allow it to run at idle speed until normal operating temperature is reached.

Adjust the idle mixture to the highest and steadiest manifold vacuum reading. If a vacuum gauge is not available, turn the adjusting screw out until the engine begins to "roll," then turn the screw "in" until the engine

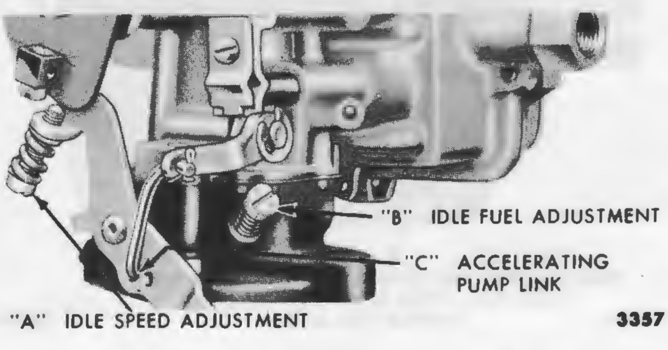

Fig. 33—Idle Adjustments—6-Cyl.

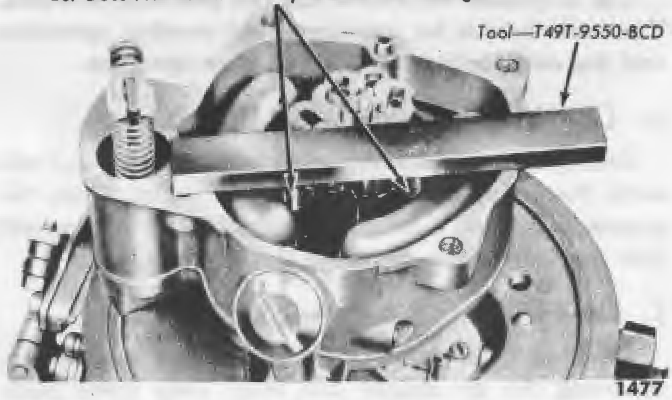

Fig. 34—Checking Fuel Level—8-Cyl.

slows down. Turn the screw out until an even smooth idle at the correct idle speed is obtained. It may be necessary to reset the idle speed stop screw after the correct idle mixture is obtained. Adjust both idle screws on the 8-cylinder carburetor until the engine idles smoothly.

c. Adjusting Idle Speed.

A stop screw controls the engine idle speed (figs. 32 and 33). Turn the idle stop screw "in" to increase the engine speed and "out" to decrease the engine speed. Idle speed should be 475 to 500 r.p.m.

d. Adjusting Accelerating Pump Stroke.

The quantity of fuel discharged by the accelerating pump is controlled by changing the position of the pump link in the throttle lever holes. On the 8-cylinder carburetor, three positions are provided, the shortest stroke (closest hole to the throttle shaft) is suitable for hot weather operation. The center hole should be used for average conditions. The longest stroke (hole farthest from throttle shaft) which provides the greatest accel-

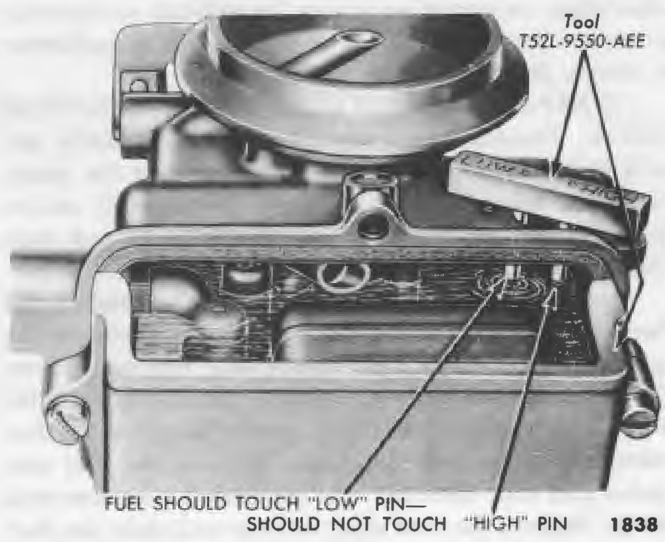

Fig. 35—Fuel Level Gauge (6-Cyl.)

erating charge is suitable for cold weather operation.

The 6-cylinder carburetor has two positions provided. The inner hole is for average or hot weather operation and the outer hole is for cold weather operation.

e. Checking Accelerating Pump.

Remove the air cleaner. Operate the throttle and observe the fuel flow from the discharge outlet. When the system is in good condition a quick steady stream will flow from the outlet when the throttle is opened.

f. Checking and Adjusting Fuel Level.

The 8-cylinder carburetor fuel level is checked by removing the air cleaner and main body cover plate and checking the fuel level with the tool shown in fig. 34. This dimension is checked from the flange surface of the main body to the level of the fuel in the fuel bowl.

To correct the float setting, bend the float lever tab up or down to bring the float within the limits.

The 6-cylinder carburetor fuel level is checked by using the dummy fuel bowl and fuel gauge shown in fig. 35. Remove the carburetor fuel bowl, and install the dummy bowl using the fuel bowl gasket and three of the retaining screws. Remove the power valve diaphragm cover and valve assembly. Place the fuel gauge in this opening. The fuel should touch the tip of the "LOW" gauge pin; should not touch tip of "HIGH" gauge pin.

If the fuel level is too high or too low, bend the float arm tab with the tool shown in fig. 36. Crank the engine to operate the fuel pump and recheck the fuel level.

NOTE: ***If the fuel level is too high, remove some fuel from the bowl before rechecking fuel level.***

5. 6-CYLINDER CARBURETOR OVERHAUL

The procedure for removing, overhauling, and installing the 6-cylinder carburetor is given under the following headings: "a. Removal," "b. Disassembly," "c. Cleaning," "d. Assembly," and "e. Installation."

a. Removal.

Remove the air cleaner. Disconnect the accelerator rod and choke wire from the carburetor. Remove the line connecting the fuel pump to the carburetor. Disconnect the distributor vacuum line. Remove the carburetor and gasket from the manifold.

b. Disassembly.

Use a separate container for the component parts of the sub-assemblies to facilitate cleaning, inspection, and reassembly. The throttle plate and shaft should not be removed from the throttle body. The choke plate and shaft should not be removed from the main body unless absolutely necessary as it may be difficult to correctly position these parts during installation. The carburetor is shown disassembled in fig. 37.

(1) *SEPARATE MAIN BODY FROM THROTTLE BODY.* Remove the accelerator pump link cotter pin and slide the upper end of the link out of the pump operating lever. Remove the two throttle body screws and lockwashers. Separate the throttle body and main body and remove the gasket.

(2) *DISASSEMBLE MAIN BODY.* Remove the fuel inlet fitting with a box wrench and remove the gasket. Remove the four clamp ring retainer screws, lockwashers, and clamps. Remove the clamp ring, the fuel bowl, and the fuel bowl gasket. Remove the fuel inlet seat screw and the gasket. Remove the fuel inlet valve and float assembly and the gasket from the main body. Remove the float shaft retainer and slide the shaft out of the assembly, releasing the float. Slide the fuel inlet needle assembly off the float lever tab. Remove the wire clip, spring, and plunger from the fuel inlet needle. Remove the three power valve diaphragm screws and lockwashers and lift the power valve diaphragm out of the main body.

NOTE: ***If the power valve diaphragm is known to be defective, separate the cover from the diaphragm and stem assembly and discard the diaphragm and stem assembly.***

Remove the five main well and power valve body screws and lockwashers, then remove the main well and power valve body. Remove the main jet with a jet removing wrench.

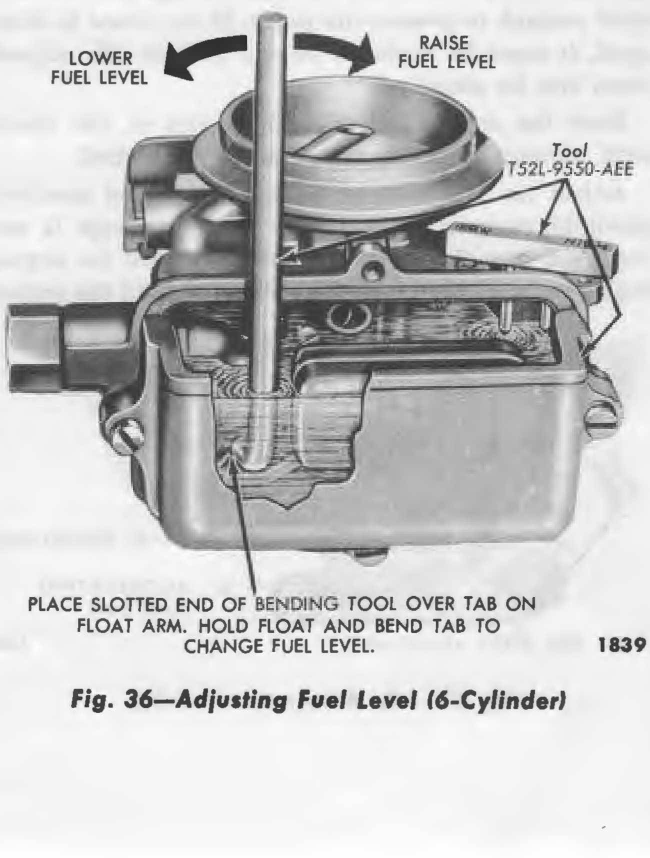

Fig. 36—Adjusting Fuel Level (6-Cylinder)

Remove the pump inlet check valve retainer and the pump discharge valve retainer from the main well body. Invert the body, allowing the pump inlet check valve ball, pump discharge valve ball, and pump discharge valve weight to fall out into the hand. Remove the pump return spring from the metal disc on the accelerating pump diaphragm. Remove the accelerating pump diaphragm and rod assembly from the main body. Remove the spacer gasket.

CAUTION: ***Pull the accelerating pump diaphragm and rod assembly straight out of the main body to avoid damaging the diaphragm.***

Press the pump rod sleeve toward the diaphragm until the pump rod sleeve retainer ball drops out. Remove the pump rod sleeve. Spread the notch in the pump operating lever retainer and pry the retainer off the stud. Remove the pump operating lever. Remove the pump discharge nozzle screw and pump discharge nozzle. Remove the distributor passage ball and retainer.

If it is necessary to remove the choke plate or shaft drive the distribution pin out of the shaft (fig. 38).

Remove the two choke plate screws and slide the choke plate out of the slot in the choke shaft.

NOTE: ***If the tips of the screws are flared excessively file off the flared out portion to avoid damaging the threads in the choke shaft. Be careful not to damage the choke shaft or venturi while filing the screws.***

Drive the choke shaft retainer pin out of the main body and remove the shaft and lever assembly. Remove the choke lever bracket.

(3) *DISASSEMBLE THROTTLE BODY.* Remove the idle adjusting needle and spring. Remove the pump link cotter pin and link.

c. Cleaning and Inspection.

Many carburetor troubles are the result of deposits accumulating in the carburetor. A thorough cleaning must be performed to assure the satisfactory performance of the carburetor.

(1) *CLEANING.* Soak all castings and metal parts in a cleaning solution to soften and loosen all foreign deposits. If a commercial carburetor cleaning solvent is not available, lacquer thinner or denatured alcohol may be used. Scrub away all remaining deposits with a stiff

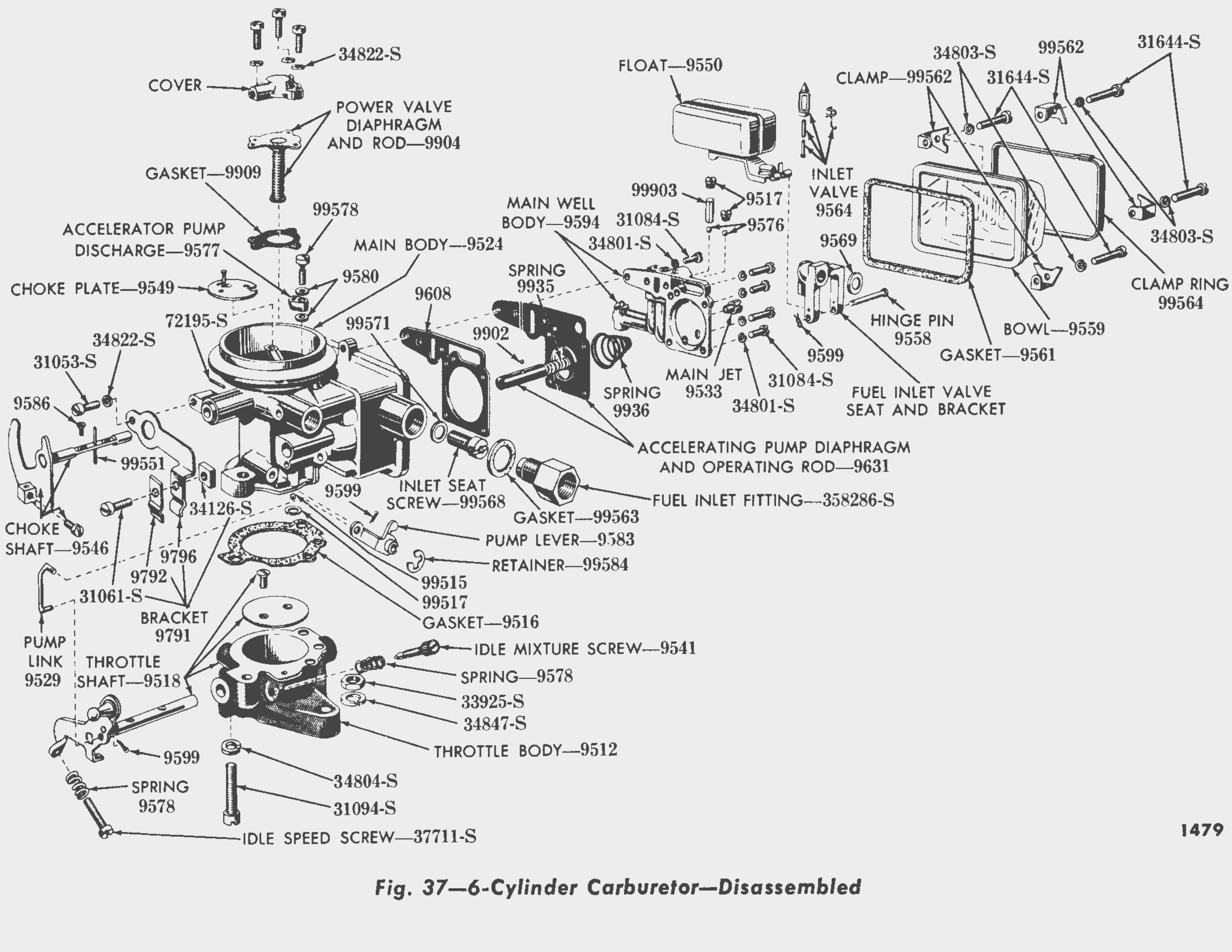

Fig. 37—6-Cylinder Carburetor—Disassembled

bristle brush. Blow out all passages in the casting with compressed air. Rinse the clean parts and castings in hot water to remove all traces of cleaning solution, and dry them with compressed air.

(2) *INSPECTION.* Replace the float if it leaks or if the assembly is damaged in any way. Replace the main body if the throttle plate edges are nicked or if the protective plating is damaged exposing bare metal to corrosion. Replace the choke plate if it is bent or the edges are badly nicked. Check the action of the poppet valve in the choke plate. If the spring is damaged or if the valve does not operate freely, replace the choke plate. Replace the choke lever and swivel assembly if the threads in the swivel are stripped or if it is not securely riveted to the lever.

d. Assembly.

Always install new gaskets when rebuilding the carburetor. A carburetor overhaul kit is available for service.

(1) *ASSEMBLE THROTTLE BODY.* Install the pump link in the throttle lever and secure it with the cotter pin. Install the idle adjusting needle and spring. Turn the needle in gently with the fingers until it seats, back it off one turn for preliminary idle adjustment. NOTE: ***Do not force the needle against its seat, to avoid grooving the tip of the needle.***

(2) *ASSEMBLE MAIN BODY.* Install the distributor passage ball, spring, and ball retainer. Install a new gasket on both sides of the pump discharge nozzle, then insert the special nozzle screw through the grooved side of the nozzle. Install the nozzle in the recess at the top of the venturi in the main body. Tighten the pump discharge nozzle screw, allowing the nozzle to turn clockwise until stopped by the edge of the recess in the main body. Position the choke bracket assembly on the protruding boss on the main body, but do not install the screw and washer. Slide the choke shaft and lever assembly into the main body. Drive the choke shaft retainer pin into the small vertical hole in the top of the choke shaft boss in the main body. Turn the choke lever so the swivel is directly beneath the choke shaft. Insert the plate in the slot in the shaft with the poppet valve spring on top of the plate.

CAUTION: ***Be careful not to damage the main nozzle with the edge of the plate.***

Turn the choke lever counterclockwise, centering the plate in the venturi opening, and install the two choke plate screws just tight enough to hold the plate.

NOTE: ***One of the two choke plate screws has a fillister head. This screw must be installed in the hole nearest the choke lever end of the shaft.***

Make sure the hole in the choke shaft for the distribution pin is aligned with the corresponding hole in the choke plate, then drive the distribution pin into position in the choke shaft. Brace the shaft on a length of brass tubing for this operation to prevent bending. Install the distribution pin so that the clearance between the throat of the venturi and the ends of the pin is equal on both sides when the plate is in the full open position. Check the choke plate for binding by moving it from the closed position to the open position. If it moves freely, tighten the two choke plate screws while holding the choke plate in the full closed position. Stake the choke plate screws. Install the choke bracket screw and lockwasher.

Place the pump operating lever on the stud in the main body and fit the pump operating lever retainer into the stud. Position the main well body spacer gasket in the main body. Place the spring on the pump diaphragm rod and press the pump rod sleeve into the rod to compress the spring. Drop the pump rod sleeve retainer ball into the hole in the sleeve. Position the pump assembly in the main body fuel bowl. Install the pump inlet check valve ball and retainer and the pump discharge valve ball weight and retainer in the main well body. Be sure the balls move freely in their chambers before installing the retainers.

Install the main jet in the main well body with the jet installing tool. Seat the large end of the pump return spring in the metal disc on the accelerating pump diaphragm. Position the main well body screws and lockwashers in the body. The two long screws are placed in the center top and center bottom holes; the short screws being used in the three remaining holes. Insert the power valve end of the main well body into the main body, then press the main well body into position against the spacer gasket as follows:

Apply pressure with the index finger against the protruding end of the pump rod sleeve, to fully compress the pump return spring, as the thumb presses the main well body into position. This will prevent the pump re-

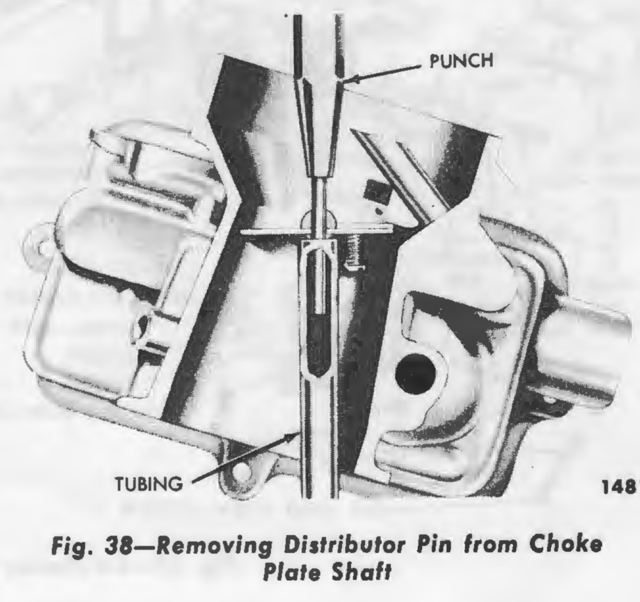

Fig. 38—Removing Distributor Pin from Choke Plate Shaft

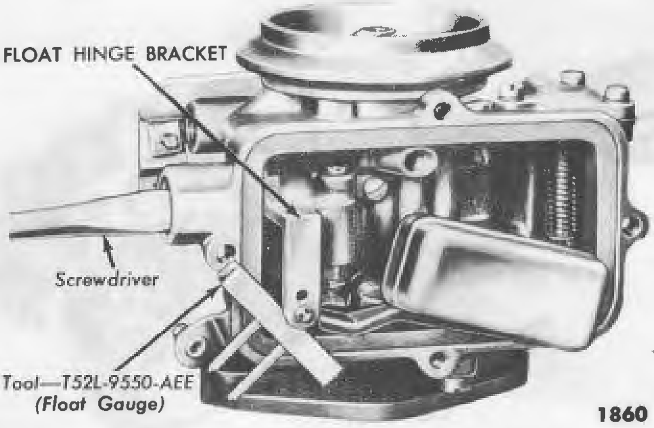

Fig. 39—Aligning Float Hinge Bracket

turn spring pressure from disturbing the alignment of the holes in the diaphragm spacer gasket and main body. Before releasing the pump rod sleeve, tighten the five main well body screws.

Position the power valve gasket, power valve diaphragm stem assembly, and the power valve body cover in the main body. Install the three power valve body cover screws and lockwasher.

Place the inlet needle spring over the fuel inlet needle plunger and insert these parts spring first into the hollow fuel inlet needle. Install the wire fuel valve clip on the fuel inlet needle. Clip the needle on the float lever tab. Guide the needle into the inlet needle seat and position the float lever between the two bracket arms on the fuel inlet needle seat. Install the float shaft and retainer.

NOTE: ***Do not attempt to interchange fuel inlet needles and seats; they are matched assemblies.***

Install the fuel inlet seat screw gasket on the retaining screw and insert the screw through the fuel inlet fitting boss on the main body. Place the seat gasket on the threaded end of the inlet seat screw which protrudes into the fuel bowl, set the float and fuel inlet valve assembly into position, and install the carburetor float gauge under the float hinge bracket as shown in fig. 39. Tighten the seat screw securely. Remove the gauge.

Invert the main body assembly and check the setting of the float with the cardboard gauge provided in the repair kit (fig. 40). If necessary, bend the tab on the float arm to bring the float setting within limits.

Install a new fuel bowl gasket into the recess in the

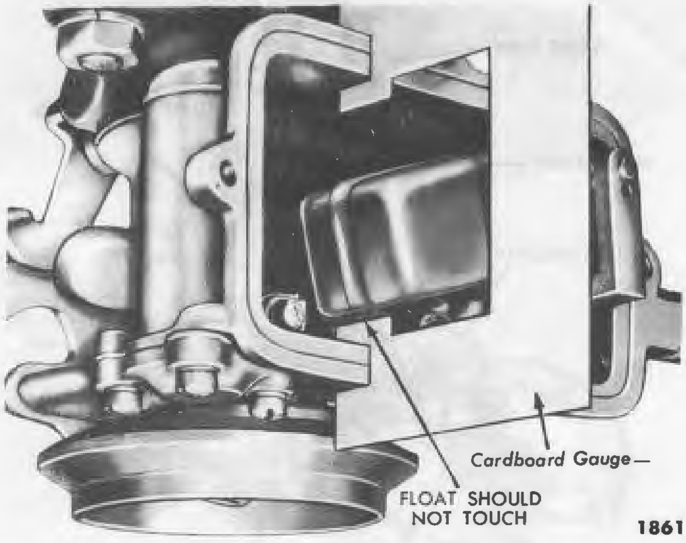

Fig. 40—Float Setting (Bench Test Only)

rim of the fuel bowl. Place the clamp ring in the glass fuel bowl and set the glass fuel bowl into position. Install the four clamps, screws, and lockwashers, tightening the two center screws and then the two end screws alternately, to evenly compress the gasket (approximately 8-10 inch pounds). Do not overtighten these screws, the bowl may crack. Install the inlet fitting and gasket.

(3) *ASSEMBLE THROTTLE BODY TO MAIN BODY.* Place a new throttle body to main body gasket on the throttle body and check the alignment of all holes in the gasket with the corresponding holes in the throttle body. Insert the two throttle body screws and lockwashers through the throttle body and gasket to maintain gasket alignment, then set the main body on the throttle body. Invert the carburetor and tighten the two throttle body screws evenly. Insert the upper end of the pump link through the hole at the end of the pump operating lever and install the cotter pin.

e. Installation.

Position a new gasket on the manifold. Place the carburetor on the manifold and secure it with the lockwashers and nuts. Tighten the nuts evenly. Connect the choke and throttle linkage to the carburetor. Connect the fuel line and the distributor vacuum line. Install the air cleaner and tighten the clamp. Check the float bowl fuel level and adjust the float, if necessary.

6. 8-CYLINDER CARBURETOR OVERHAUL

Repair procedures are given here for the carburetor used on the 8-cylinder F-7 and F-8 truck engines. The carburetor main body is enclosed inside the air cleaner when the cleaner is in position. The cleaner is retained to the carburetor by a through bolt.

a. Removal.

Remove the air cleaner. Disconnect the fuel line, distributor vacuum line, and governor vacuum lines at the carburetor. Disconnect the hand throttle, choke wire and accelerator rod and spring.

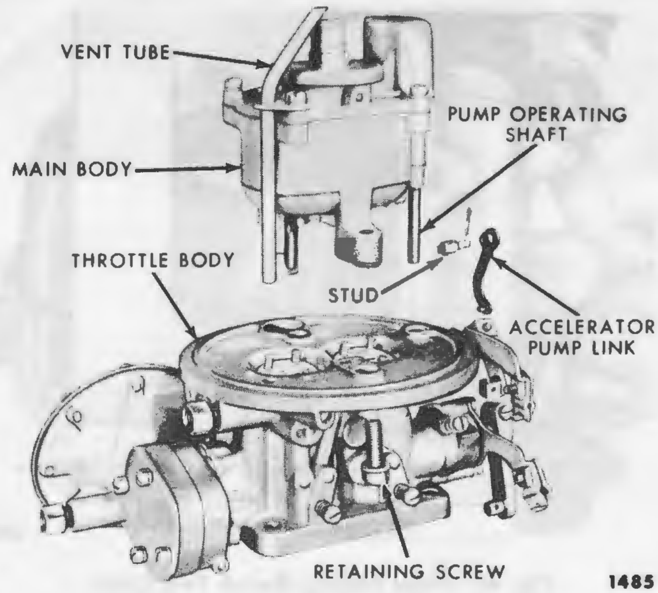

Fig. 41—Main and Throttle Body—Disassembled

Remove the mounting nuts and lockwashers. Remove the carburetor.

b. Disassembly.

Use a separate container for the component parts of both major sub-assemblies: the throttle body and the main body. Do not remove the throttle plates or the choke plates unless absolutely necessary because difficulty may be encountered when installing these parts to obtain their correct positioning.

(1) *SEPARATE MAIN BODY AND THROTTLE BODY.* Remove the accelerator pump link cotter pin and remove the link. Unscrew the link pin from the pump operating shaft. Remove the two retaining screws and lockwashers. Separate the throttle body and main body (fig. 41).

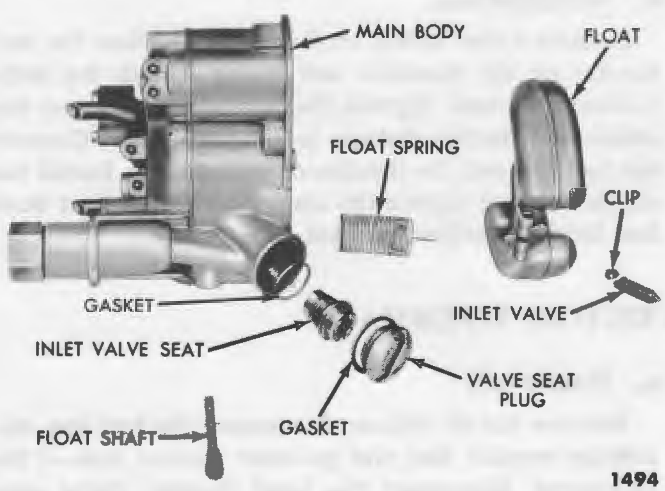

Fig. 42—Float and Valve Disassembled

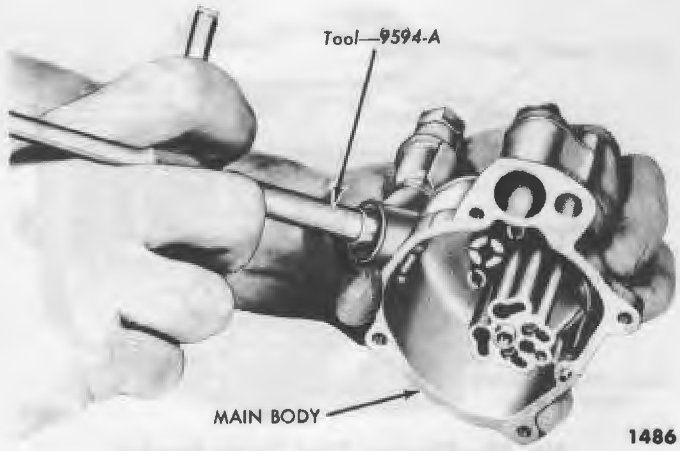

Fig. 43—Removing Float Valve Seat

(2) *DISASSEMBLE MAIN BODY.* Remove the center screw and plate. Remove the cover retaining screws and lift the cover and gasket from the float bowl. Remove the accelerator pump piston and operating rod. Unscrew the float hinge pin and remove the float and inlet needle (fig. 42). Remove the float valve seat plug and gasket. Remove the float valve seat and gasket (fig. 43). Remove the power valve diaphragm (fig. 44). Remove the main well tubes, the main metering jets (fig. 45), and the idle jet assemblies (fig. 46). The main body is shown disassembled in fig. 47.

(3) *DISASSEMBLE THROTTLE BODY.* Remove the idle fuel adjustment needles and springs. Remove the governor cover plate and gasket. Remove the governor spring. Remove the cotter pin from the vacuum rod and push the rod out of the governor lever. Remove the governor lever nut, lockwasher, and the lever. Remove the three retaining screws and remove the governor housing and diaphragm. Remove the throttle shaft seal, retainer, and spring.

If it is necessary to remove the throttle plates and shaft, remove the two screws retaining the throttle shaft housing and remove the housing. File the tips off the throttle plate screws and remove the screws. Slide the throttle plates out of the shaft. Remove the snap ring

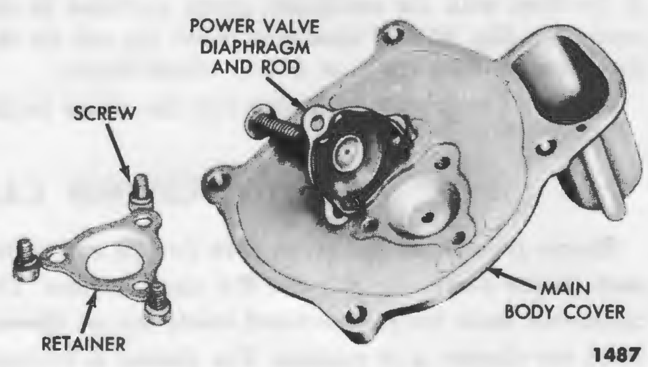

Fig. 44—Power Valve—Removed

retaining the throttle shaft bearing and slide the bearing and shaft out of the throttle body.

To remove the choke plates and shaft, file off the tips of the choke plate screws, remove the screws, and the choke plates. Slide the shaft out of the throttle body.

c. Cleaning and Inspection.

Wash all parts thoroughly in carburetor cleaning solution. In the absence of a commercial type cleaner, use alcohol or lacquer thinner. Blow out all passages with compressed air.

Replace any parts that are cracked, badly nicked or worn. Replace parts with stripped threads. Replace ridged idle fuel needles. Replace a bent or leaking float. Replace the float valve needle or seat if they are worn. Replace plugged idling jets or plugged main well tubes.

d. Assembly.

Assemble the sub-assemblies, then join the throttle body and main body together.

(1) *THROTTLE BODY ASSEMBLY.* If the throttle plates and shaft were removed, install the shaft and bearing and secure the bearing with the retainer. Slide the throttle operating shaft in the housing and install the lever and retaining pin.

Install the control shaft and housing on the throttle body with a new gasket. Install the throttle plates and secure them with the screws.

Close the throttle plates and hold the throttle body up to a light to check for centering of both plates in the bores. If the plates are not centered, loosen the screws, hold the shaft closed and tap the throttle body with a soft mallet to center the plates. Tighten the screws, then stake the ends of the screws.

A correctly installed throttle control shaft and lever will close the plates but will not open them.

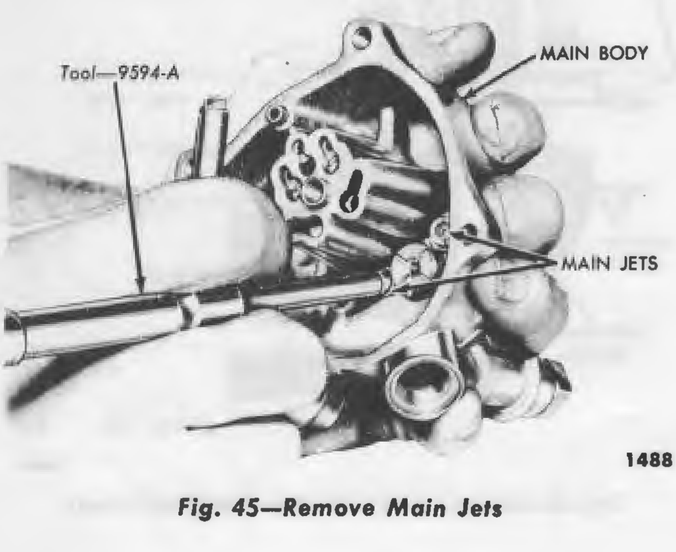

Fig. 45—Remove Main Jets

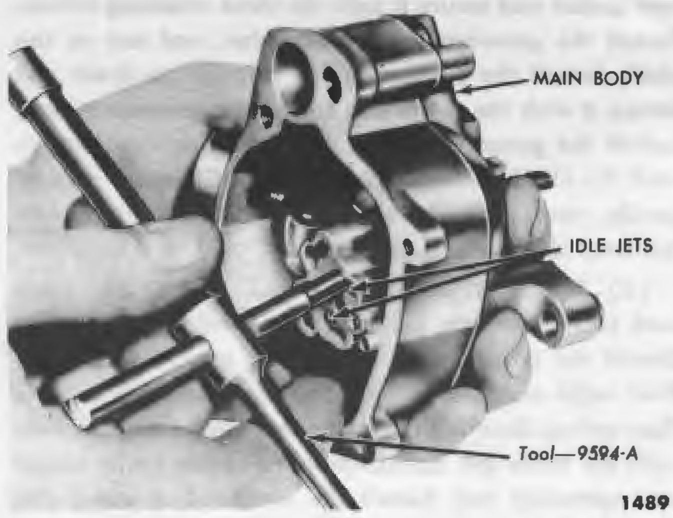

Fig. 46—Remove Idle Jets

Install the spring, retainer and throttle shaft seal on the governor end of the shaft with the seal shoulder inside the retainer. Install the governor housing with a

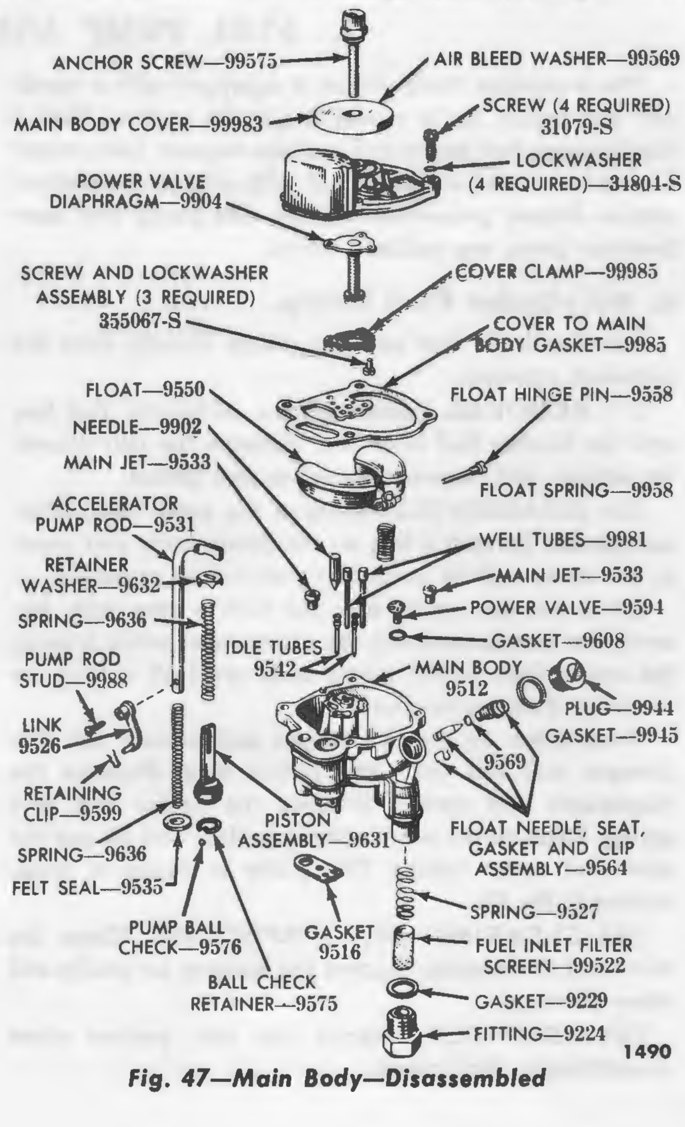

Fig. 47—Main Body—Disassembled

new gasket and secure it with the three retaining screws. Install the governor lever, lockwasher, and nut on the shaft. Install the diaphragm rod through the lever and secure it with the cotter pin. Install the governor spring. Install the governor cover plate with a new gasket. Install the idle fuel needles and springs. Close the needles gently, then back them out one full turn for a preliminary idle mixture adjustment.

(2) *MAIN BODY ASSEMBLY.* Install the main well tubes, the idle jet assemblies and the main jets. Install the power valve with a new gasket. Install the float valve seat and plug with new gaskets. Install the float spring, float, inlet needle valve, and secure the float with the hinge pin. Install the accelerating pump piston and operating rod. Install the accelerating pump discharge needle.

Install the power diaphragm assembly in the cover. Be sure that the edge of the diaphragm is visible all around to insure against leakage. Hold the cover in position on the bowl with a new gasket, and install the center screw and plate. Install the retaining screws. NOTE: ***One of the cover screws also secures the governor air vent tube which seats in the throttle body when the sub-assemblies are assembled.***

(3) *ASSEMBLE MAIN BODY AND THROTTLE BODY.* Install the main body on the throttle body with a new gasket. Be sure the main fuel tubes enter the small holes in the distribution rings on the choke shaft. Install the retaining screws. Install the accelerator pump link stud, pump link, and cotter pin.

e. Installation.

Install the carburetor and secure it with the retaining nuts and lockwashers. Tighten the nuts evenly. Install the fuel line and distributor vacuum line. Install the governor vacuum lines. Connect the accelerator rod and spring, hand throttle, and choke. Install the air cleaner.

7. FUEL PUMP AND VACUUM BOOSTER

The 6-cylinder truck engine is equipped with a standard fuel pump. Early model 8-cylinder engines have a combination fuel pump and vacuum booster. Late model 8-cylinder trucks are equipped with electric windshield wipers. Repair procedures for the fuel pump and combination pump are outlined below.

a. 6-Cylinder Fuel Pump.

The 6-cylinder fuel pump is driven directly from the camshaft eccentric.

(1) *REMOVAL.* Disconnect the carburetor fuel line and the flexible fuel inlet line. Remove the two mounting screws and remove the pump and gasket.

(2) *DISASSEMBLY.* Remove the glass bowl, filter, and gasket. Scratch a line on the pump body and cover so the cover will be in correct position on assembly.

Drive out the rocker arm pin with a long drift. Remove the screws retaining the pump cover while holding the cover tight to the pump body until all screws are removed. Remove the cover.

Press down on the diaphragm and unhook the diaphragm pull rod from the rocker arm. Remove the diaphragm and spring. Remove the rocker arm and spring. Remove the valve retaining plate and lift out the inlet and outlet valves. The pump is shown in cross-section in fig. 48.

(3) *CLEANING AND INSPECTION.* Clean the bowl and the housing. Inspect the housing for cracks and other damage.

(4) *ASSEMBLY.* Always use new gaskets when assembling a fuel pump.

Install the rocker arm spring, rocker arm, and the pin. Place the diaphragm spring and diaphragm in position on the body and hook the pull rod over the rocker arm.

Install valve gaskets and valves in the cover and secure them with the valve plate. Hold the rocker arm in the up position to compress the diaphragm spring and position the cover on the body aligning the scribed marks made before disassembly. Be sure the diaphragm

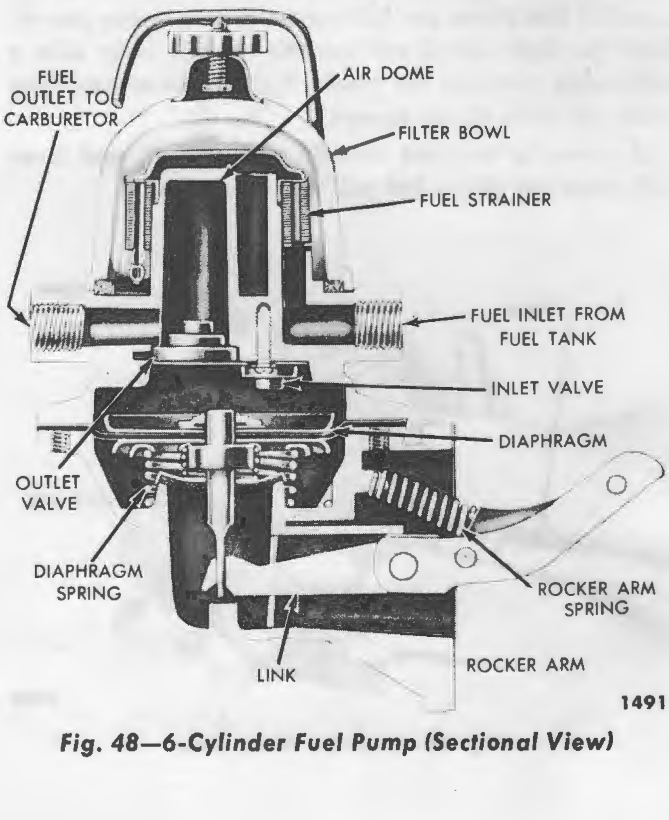

Fig. 48—6-Cylinder Fuel Pump (Sectional View)

edge shows evenly all around the outside edge of the cover. Install screws, tighten them evenly; then release the rocker arm. Install the filter, bowl gasket, and bowl.

(5) *INSTALLATION.* Install the pump on the cylinder block with a new gasket. Hold the pump against the mounting pad and install the retaining screws and lockwashers. Tighten the screws to 15-20 foot-pounds.

b. Fuel Pump and Vacuum Booster.

The combination fuel pump and vacuum booster used on early model F-7 and F-8 truck engines is shown in fig. 49.

The pump is driven from an eccentric on the front of the camshaft. A slip ring bushing transmits the eccentric motion to a push rod which, in turn, forces the rocker arm of the pump to move.

(1) *REMOVAL.* Pull off the vacuum hoses. Disconnect the carburetor fuel line and the flexible fuel inlet line. Remove the two mounting screws and remove the pump and gasket.

If it is necessary to replace the push rod, remove the engine front cover and use the tool shown in fig. 50 to spread the snap ring. Slide the rod out of the guides.

(2) *DISASSEMBLY.* Remove the bowl, gasket, and strainer. Remove the surge chamber from the fuel pump cover. Hold the cover against the pump body, remove the screws, and release the diaphragm spring. Remove the cover.

Hold the vacuum booster cover against the pump body, remove the screws, and release the cover and diaphragm. Remove the cover.

Drive out the rocker shaft. Press the two diaphragms against the pump body and remove the rocker arm links from the two pull rods. Remove the diaphragm and the rocker arm.

Remove the valve retainer and valves from the fuel pump cover. Scrape away the staking marks and remove the valves from the vacuum booster cover. Remove the valves from the pump body.

If the oil seals in the pump body must be replaced, scrape away the staking marks and remove the seal retainer and seal from the booster side of the body and the seal from the fuel pump side of the body.

(3) *CLEANING AND INSPECTION.* Clean the sediment bowl and the pump housing and covers. Blow out all cover passages. Inspect the housing and covers for cracks or damage. It is advisable to replace all parts in the assembly with the new parts included in the repair kit.

(4) *ASSEMBLY.* Install the seal in the fuel pump side of the body and stake it in place. Install the seal and retainer in the booster side of the body and stake them in place. Install the outlet valve in the pump body and stake it in place. Install the valves in the booster cover and stake them in place. Install the valves and retainer in the pump cover.

Install the booster diaphragm with the light spring between the diaphragm and pump body. Install the pump diaphragm with the pump spring and the cap against the diaphragm. Insert the booster rocker links through the diaphragm pull rod. Hook the fuel pump pull rod over the center (single) link. Install the rocker shaft and washer. Stake the end of the shaft.

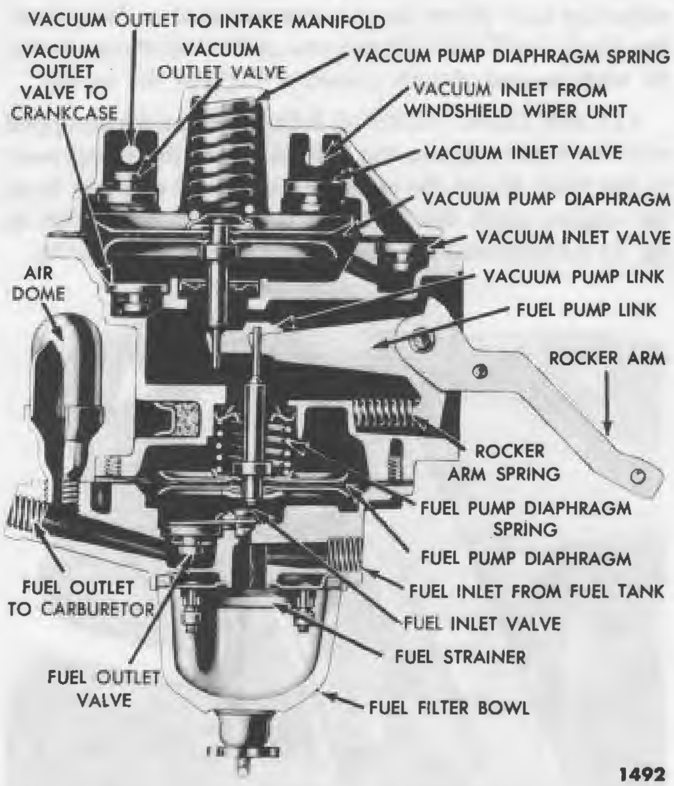

Fig. 49—Combination Fuel Pump and Vacuum Booster (Sectional View)

Fig. 50—Removing Pump Push Rod Snap Ring

Install the inlet valve in the pump body. Install the vacuum booster cover, spring, and spring seat over the diaphragm. Press the cover tight against the body and install the retaining screws. Install the fuel pump cover and hold it tight against the body. Install the retaining screws.

NOTE: ***Before tightening the cover screws, make sure the diaphragm edges show evenly all around the outside edge of the fuel pump cover and the vacuum booster cover.***

Install the surge chamber. Install the filter, filter bowl gasket, and the filter bowl. Tighten the bowl clamp.

(5) *INSTALLATION.* Place the pump in position on the block with a new gasket. Be sure the pump lever is under the push rod. Install the retaining screws and tighten them to 15-20 foot-pounds.

Connect the fuel lines and the vacuum hoses.

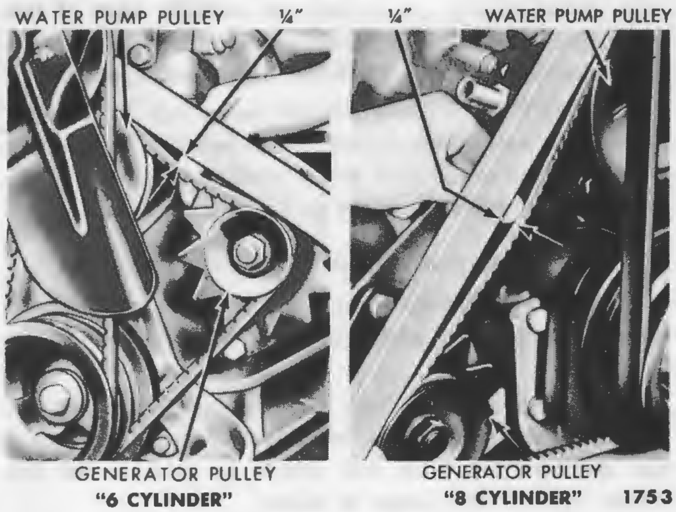

Fig. 52—Generator Belt Deflection

8. FANS AND BELTS

The fans used on the 6 and 8-cylinder Ford truck engines require no lubrication.

a. Fans.

Four-bladed fans are used on either 6 or 8-cylinder engines. Blades are replaced with the same procedure.

(1) *REMOVAL.* Remove the screws and lockwashers retaining the fan blades to hub. Remove the blades.

(2) *INSTALLATION.* Place the blades in position against the hub and install the cap screws and lockwashers. Tighten the screws securely.

b. Belts.

The procedure for adjustment of fan and generator belts is similar for both engines. The fan belt adjustment is independent of the generator belt adjustment.

(1) *FAN BELT.* Loosen the screws securing the fan bracket and adjust the bracket until the belt has a deflection as shown in fig. 51 with normal thumb pressure. Tighten the bracket securely.

(2) *GENERATOR AND WATER PUMP BELT.* Loosen the screw retaining the generator frame to the adjusting link. Move the generator toward or away from the block until the belt has the deflection shown in fig. 52 with normal thumb pressure. Tighten the screw.

(3) *AIR COMPRESSOR BELT.* On trucks equipped with air brakes, loosen the bolts securing the compressor to the base. Move the compressor toward or away from the engine until the belt has the deflection shown in fig. 53 with normal thumb pressure. Tighten the bolts.

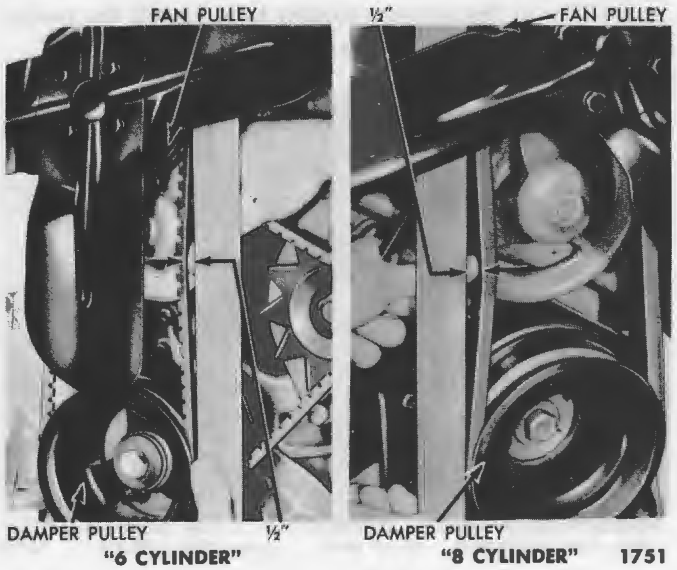

Fig. 51—Fan Belt Deflection

Fig. 53—Air Compressor Belt Deflection

9. WATER PUMPS

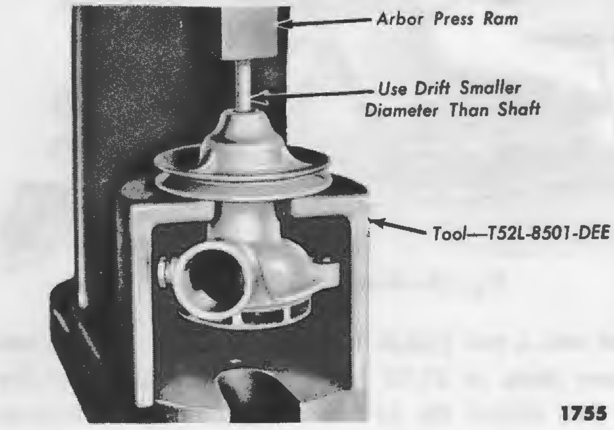

Fig. 54—Removing Pulley

A single water pump is used on the 6-cylinder and on the 8-cylinder engines. The pump bearings are self-lubricated. Kits are available for repairing the pumps.

a. 6-Cylinder Pump.

The pump is mounted directly on the cylinder block.

(1) *REMOVAL.* Drain the cooling system and disconnect the lower radiator hose and heater hose. Remove the fan and fan belt. Remove the generator belt. Remove the three bolts retaining the pump to the block, remove the pump, and the gasket.

(2) *DISASSEMBLY.* Press the shaft out of the pulley (fig. 54). Remove the snap ring retaining the bearing in the housing. Press the shaft out of the impeller and the pump body (fig. 55).

Press out the pump seal (fig. 56). Be sure the tool is not caught on the snap ring inside the pump housing. The 6-cylinder pump is shown disassembled in fig. 57.

(3) *ASSEMBLY.* Clean off any gasket material on the mounting face of the pump. Install a new seal in

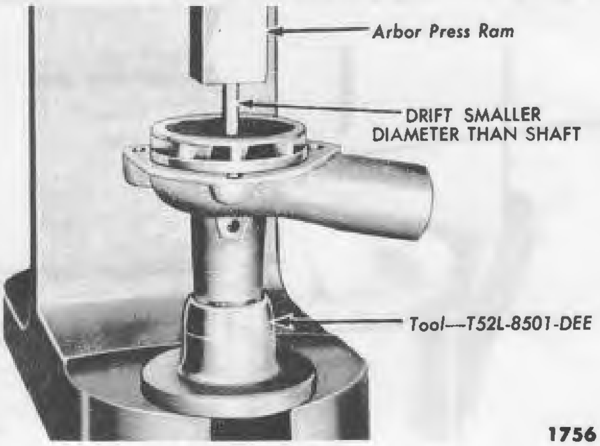

Fig. 55—Pressing Out Shaft

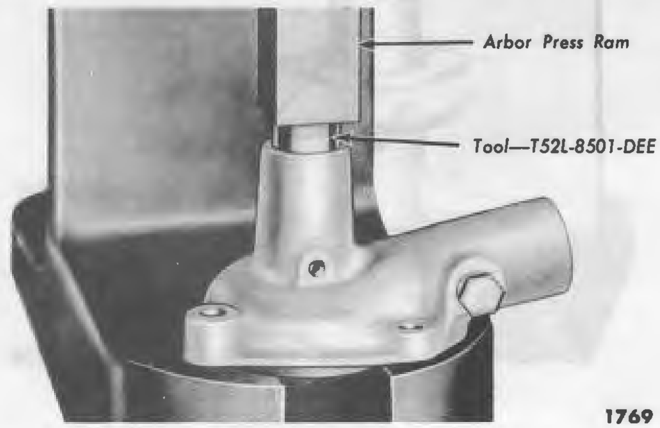

Fig. 56—Press Out Seal

the pump housing as shown in fig. 58. Coat the seal with waterproof sealer. Use the seal installing tool marked 8501-DD18 (for seal Part no. 7RA-8564-B1, B2).

Coat the bearing outer diameter lightly with grease and press the shaft and bearing into the pump housing applying pressure to the outer shell of the bearing.

Check the impeller thickness at the hub. If the thickness is 1.252-1.257 inches, shim up the impeller adapter ring with three equally spaced 0.020 inch shims between the ring and the counterbored tool base. Do not allow the shim stock to protrude into the space where the impeller is to be placed. If the impeller thickness is 1.232-1.237 inches, no shims are required.

Coat the seal rubbing face of the impeller lightly with grease. Press the shaft into the impeller (fig. 59). CAUTION: ***Press the shaft into the impeller just far enough so the pump housing lightly touches the face of the insert ring. If excessive pressure is exerted on the shaft after the rear face of the housing contacts the insert ring, the pump bearing will be damaged.***

The impeller to pump body clearance should be 0.020-0.030 inch after pressing on the impeller.

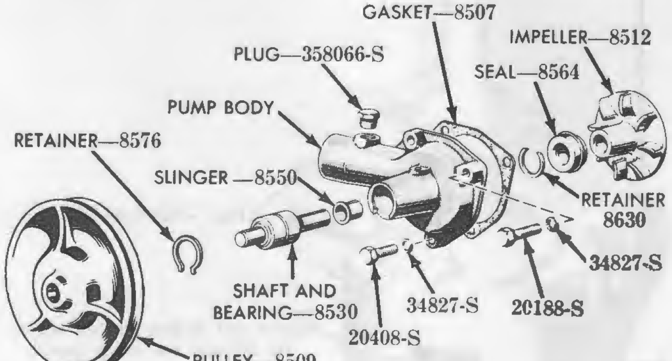

Fig. 57—6-Cylinder Water Pump—Disassembled

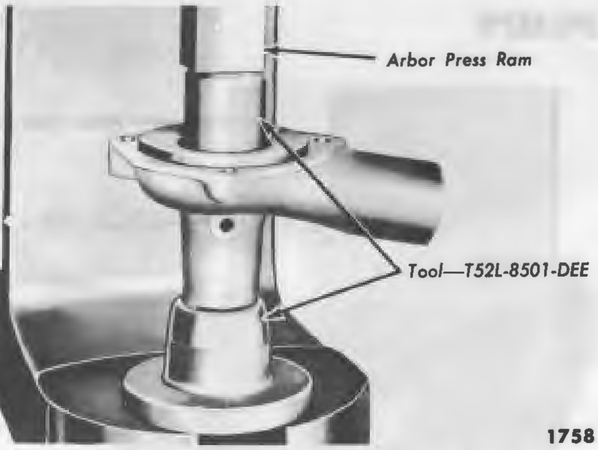

Fig. 58—Installing Seal

Tighten the set screw in the bottom of the fixture plate until the screw touches the end of the shaft. Do not lift the pump body off the fixture plate.

Install the snap ring in the housing. Press the water pump pulley on the shaft as shown in fig. 60. Be sure to hold the dimension shown in the illustration.

(4) *INSTALLATION.* Install the pump body on the

Fig. 61—Removing Snap Ring

block with a new gasket. Install the retaining screws and tighten them to 25-35 foot-pounds. Install the pulley and fan. Install the belt and adjust the belt tension. Connect radiator and heater hose. Fill the radiator.

b. 8-Cylinder Pump.

The pump is mounted into a recess in the cylinder front cover. It is driven by the generator belt.

(1) *REMOVAL.* Drain the cooling system. Disconnect the lower radiator hose and heater hose. Remove the fan and fan belt. Remove the generator belt. Re-

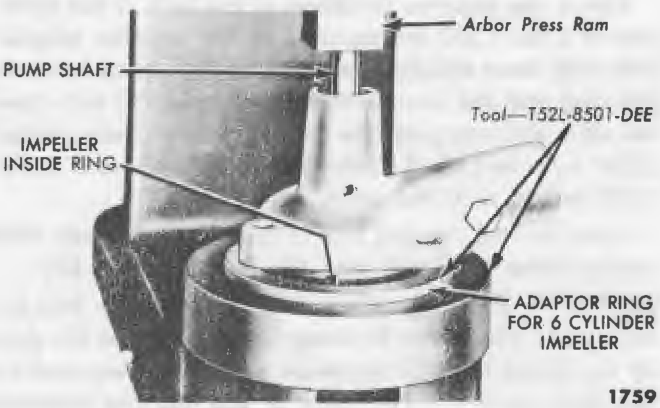

Fig. 59—Pressing Shaft into Impeller

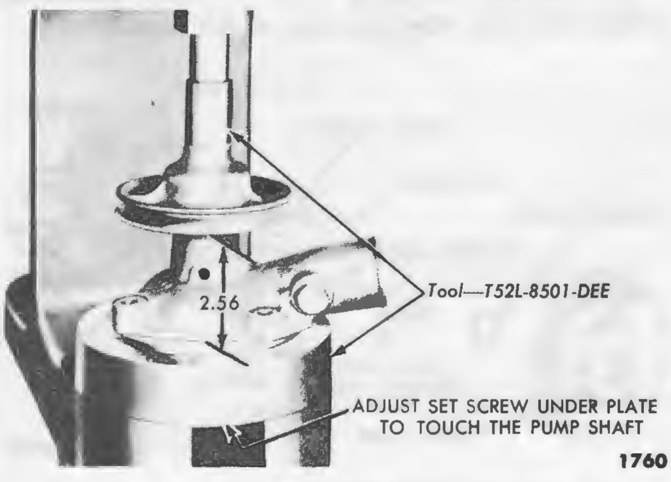

Fig. 60—Install Pulley

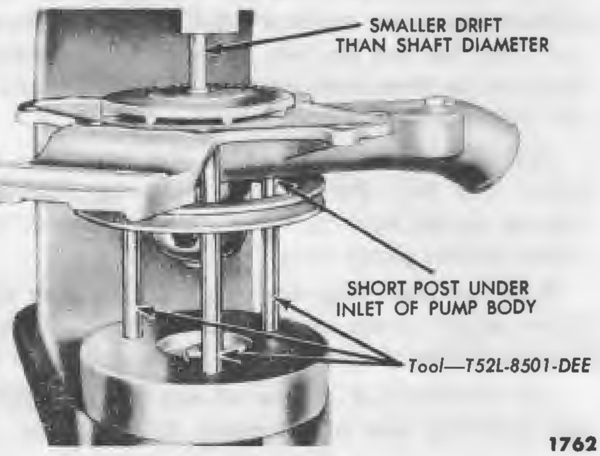

Fig. 62—Pressing Out Shaft and Pulley from Impeller

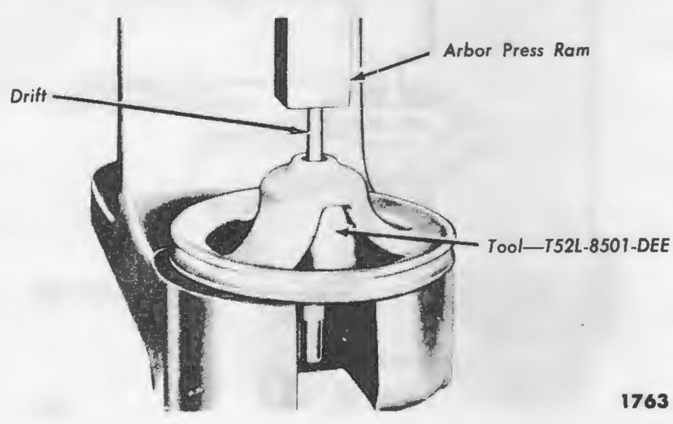

Fig. 63—Pressing Shaft Out of Pulley

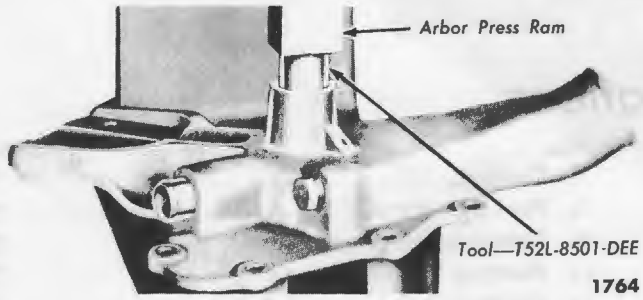

Fig. 64—Removing Pump Seal

move the bolts retaining the pump to the cover and remove the pump and gasket.

(2) *DISASSEMBLY.* Pry out the snap ring retaining the shaft in the housing (fig. 61). Press the shaft and pulley out of the impeller and housing (fig. 62).

Remove the snap ring from the shaft and press the shaft out of the pulley (fig. 63). Press out the pump seal (fig. 64). Make sure the tool is not pressing on the snap ring instead of the seal.

A disassembled view of the pump is shown in fig. 65.

(3) *ASSEMBLY.* Coat a new seal with waterproof sealer. Install the seal in the pump housing (fig. 66). Use the seal installing tool marked DD-18 (Seal No.

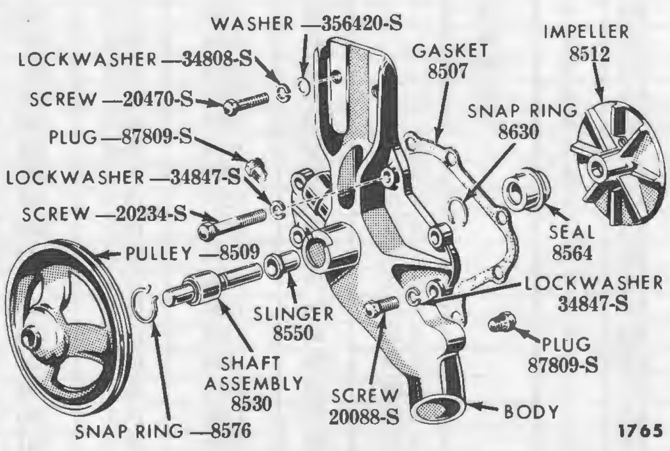

Fig. 65—8-Cylinder Water Pump—Disassembled

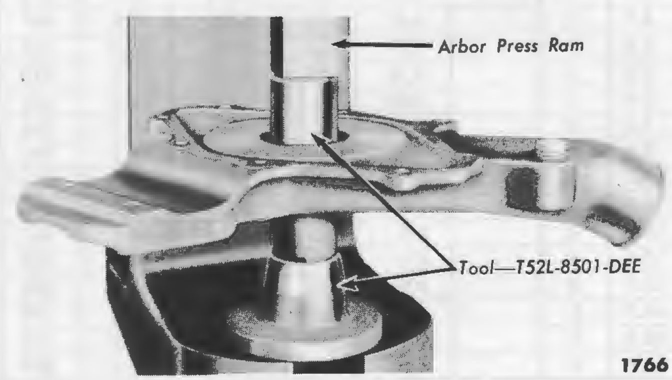

Fig. 66—Install Pump Seal

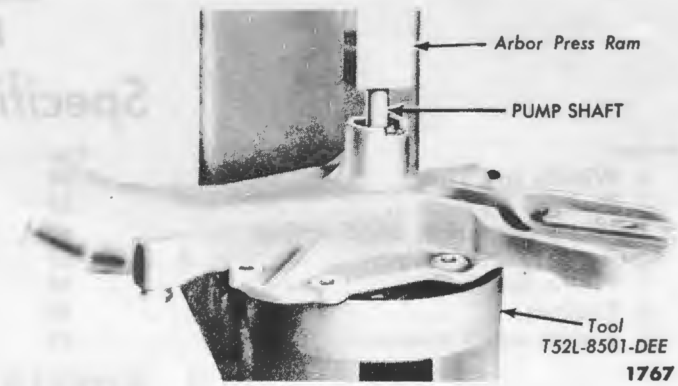

Fig. 67—Pressing Shaft into Impeller

7RA-8564-B1, B2). Coat the bearing O.D. with grease, and press the shaft into the pump housing, applying pressure to the outer shell of the bearing.

Coat the seal rubbing face of the impeller with grease, then press the shaft into the impeller as shown in fig. 67. The impeller to body clearance should be 0.025-0.035 inch.

CAUTION: ***Press the shaft into the impeller just far enough so the pump housing lightly touches the face of the tool plate to avoid damaging the bearing.***

Tighten the set screw in the bottom of the fixture until it just touches the end of the shaft. Do not lift the pump body. Install the snap ring in the housing. Install the two bolts in the upper bolt holes of the pump housing.

Press the pulley on the shaft (fig. 68). Be sure to hold the dimension shown in the illustration.

(4) *INSTALLATION.* Place the pump body on the front cover with a new gasket. Install the retaining screws and tighten them to 23-28 foot-pounds. Install the generator-water pump belt and adjust the belt tension. Install the fan and fan belt. Adjust the tension. Connect the radiator hose and heater hose. Fill the cooling system.

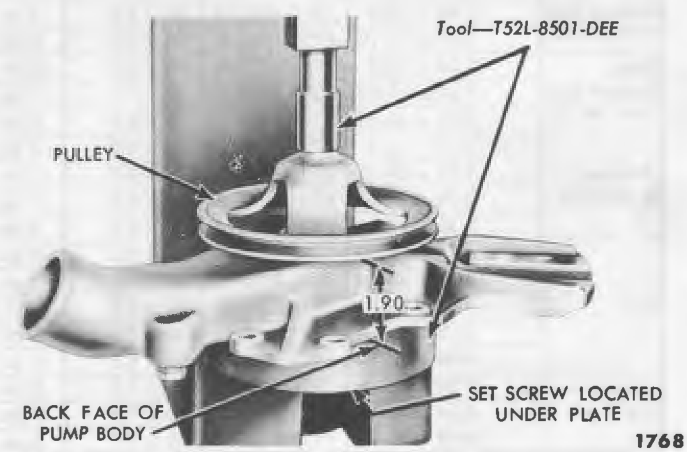

Fig. 68—Pressing Pulley on Shaft

Part FIVE

Chapter III

Specifications

1. WHEELS AND TIRES

Model	Tire Size and Ply Rating	Wheel Part No.	Wheel Type	Rim Type	Dia. Bolt Circle (In.)	No. of Bolts	Offset (Inches)	Dish (Inches)	Inflation Pressure	Max. Load Capacity (Lbs.)	Static Load Rad. (In.)	Revs. per Mile
F-1	PT *6.00 x 16-4	8C-1015	16 x 4½K	DC	5.5	5	.62		28	915	13.4	738
	PT 6.00 x 16-6	8C-1015	16 x 4½K	DC	5.5	5	.62		36	1065	13.4	738
	PT 6.50 x 16-6	8C-1015	16 x 4½K	DC	5.5	5	.62		36	1215	13.5	731
	PT 15″-6	7RC-1015	15 x 5.50-F	SDC	5.5	5	.62		40	1500	13.9	715
F-2	PT *6.50 x 16-6	7RD-1015-B	16 x 6L	DC	6.5	8	.56		36	1215	13.4	735
	PT 7.00 x 16-6	7RD-1015-B	16 x 6L	DC	6.5	8	.56		36	1395	14.3	693
	7.00 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1440	14.5	683
	PT 7.50 x 16-6	7RD-1015-B	16 x 6L	DC	6.5	8	.56		36	1560	14.7	673
	7.50 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1650	14.9	667
F-3	7.50 x 16-8	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		55	1860	14.9	667
	*7.00 x 17-6	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		45	1575	15.3	654
	7.00 x 17-8	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		55	1775	15.3	654
	7.50 x 17-8	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		60	2100	15.9	625
F-3 Par. Del.	*7.00 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1440	14.5	683
	7.50 x 16-6	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		45	1650	14.9	667
	7.50 x 16-8	8J-1015	16 x 5.50-F	SDC	6.5	8	.56		55	1860	14.9	667
	7.00 x 17-6	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		45	1575	15.3	654
	7.50 x 17-8	7RY-1015	17 x 5.5	2 pc.	6.5	8	.56		60	2100	15.9	625
F-4	*7.00 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	55	2000	16.8	591
	6.50 x 20-6	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	50	1700	16.3	609
	7.00 x 18-8	7RTL-1015	18 x 5.0	2 pc.	8.0	5		4.75	55	1850	15.9	625
F-5 and F-5 C.O.E.	*6.50 x 20-6	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	50	1700	16.3	609
	6.50 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	†65	1950	16.3	609
	7.00 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	55	2000	16.8	591
	7.00 x 20-10	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	†70	2250	16.9	590
	7.50 x 20-8	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	60	2375	17.5	570
	7.50 x 20-10	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
	▲8.25 x 20-10	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	65	2900	18.2	546
F-5 School Bus 158″ W.B.	*6.50 x 20-6	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	50	1700	16.3	609
	7.00 x 20-8	7RT-1015-A	20 x 5.0	2 pc.	8.0	5		4.75	55	2000	16.8	591
	7.50 x 20-10	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
F-6 School Bus 194″ W.B.	*7.50 x 20-8	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	60	2375	17.5	570
	7.50 x 20-10	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
	8.25 x 20-10	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	65	2900	18.2	546
F-6 and F-6 C.O.E.	*7.50 x 20-8	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	60	2375	17.5	570
	7.50 x 20-10	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	†75	2700	17.6	567
	8.25 x 20-10	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	65	2900	18.2	546
	8.25 x 20-12	8TH-1015-A	20 x 6.0	2 pc.	8.0	5		5.50	75	3150	18.3	546
F-7	*8.25 x 20-10	7EQ-1015-E	20 x 6.5	2 pc.	10.0	8		6.0	65	2900	18.2	546
	8.25 x 20-12	7EQ-1015-E	20 x 6.5	2 pc.	10.0	8		6.0	75	3150	18.3	546
	9.00 x 20-10	7EQ-1015-E	20 x 6.5	2 pc.	10.0	8		6.0	65	3450	19.1	520
	9.00 x 20-10	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	65	3450	19.1	520
	9.00 x 20-12	7EQ-1015-E	20 x 6.5	2 pc.	10.0	8		6.0	†80	3850	19.2	520
F-8	*9.00 x 20-10	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	65	3450	19.1	520
	9.00 x 20-12	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	†80	3850	19.2	520
	10.00 x 20-12	7EQH-1015	20 x 7.0	3 pc.	10.0	8		6.5	70	4000	19.5	509

Wheels and Tires (cont'd) **(Cast Wheel)**

Model	Tire Size and Ply Rating	Rim Part No.	Wheel Type	Rim Type	Inflation Pressure	Max. Load Cap. (Lbs.)	Static Load Rad. (In.)	Revs. per Mile
F-7	*8.25 x 20-10	8Q-1020	20 x 6.5	3 pc.	65	2900	18.2	546
	8.25 x 20-12	8Q-1020	20 x 6.5	3 pc.	†75	3150	18.3	546
	9.00 x 20-10	8Q-1020	20 x 6.5	3 pc.	65	3450	19.1	520
	9.00 x 20-12	8Q-1020	20 x 6.5	3 pc.	†80	3850	19.2	520
F-8	*9.00 x 20-10	8QH-1020-A	20 x 7.0	3 pc.	65	3450	19.1	520
	9.00 x 20-12	8QH-1020-A	20 x 7.0	3 pc.	†80	3850	19.2	520
	10.00 x 20-12	8QH-1020-A	20 x 7.0	3 pc.	70	4000	19.5	509
	10.00 x 20-12	8QH-1020-B	20 x 7.0	3 pc.	70	4000	19.5	509

†High pressure tires Not Recommended on front wheels
*Standard Equipment
DC—Drop Center
SDC—Semi-Drop Center
PT—Passenger Type
^Optional—Dual rear with 2-speed axle only
2 pc.—2 piece advance wide base rim
3 pc.—3 piece advance wide base rim

2. BRAKES

1125 Front Drums

Model	Part No.	I.D. (Inches)	Max. Dia. Boring Limits (Inches)
F-1	8C-1125	11	11.060
F-2, F-3	1D-1125-B	12	12.020
F-3 Par. Del.	8J-1125	13⅛	13.195
F-4, F-5, F-6; F-5 and F-6 C.O.E.	7RT-1125-D	14	14.020
F-7, F-8 (Std. and Air Brakes)	7EQ-1125-C	16	16.063

1126 Rear Drums

Model	Part No.	I.D. (Inches)	Max. Dia. Boring Limits (Inches)
F-1	8C-1126-A	11	11.060
F-2	1D-1126-B	12	12.060
F-3	1D-1126-B	12	12.060
F-3 P. Del.	1D-1126-B	12	12.060
F-4, F-5, F-6, F-5 and F-6 C.O.E.	7RT-1126-A	15	15.060
F-7	8Q-1126-A	15	15.090
F-8	7EQH-1126	16	16.090
F-8 (Air Brakes)	8QH-1126-A	16½	16.590

2018-2370 Brake Primary Shoe

Model	Part No.		Lining Length (Inches)		Lining Width (Inches)		Lining Thickness (Inches)	
	Front	Rear	Front	Rear	Front	Rear	Front	Rear
F-1	8C-2018	8C-2218-B	11²⁹⁄₃₂	11²⁹⁄₃₂	2	1¾	3/16	3/16
F-2, F-3	1D-2018-A	1D-2018-A	11½	11½	2	2	3/16	3/16
F-3 P. Del.	8J-2018	1D-2018-A	14 9/16	11 9/16	2	2	¼	3/16
F-4, F-5, F-6, F-5 and F-6 C.O.E.	92Y-2018-A	91T-2018-A	15 33/64	16⅝	2	3½	¼	5/16
F-7	7EQ-2018	8Q-2218	16 13/32	15 37/64	2¼	5	¼	⅜
F-8	7EQ-2018	7EQH-2218-B	16 13/32	17	2¼	5	¼	⅜

Brake Secondary Shoe

Model	Part No.		Lining Length (Inches)		Lining Width (Inches)		Lining Thickness (Inches)	
	Front	Rear	Front	Rear	Front	Rear	Front	Rear
F-1	8C-2019	8C-2219-B	11 29/32	11 29/32	2	1¾	3/16	3/16
F-2, F-3			12 31/32	12 31/32	2	2	3/16	3/16
F-3 P. Del.	8J-2019		12 17/64	12 31/32	2	2	¼	3/16
F-4, F-5, F-6, F-5 and F-6 C.O.E.	92Y-2019-A	91T-2019-A	10¾	11 33/64	2	3½	¼	5/16
F-7	7EQ-2019	8Q-2218	12 13/64	15 37/64	2¼	5	¼	⅜
F-8	7EQ-2019	7EQH-2218-B	12 13/64	17	2¼	5	¼	⅜

2061-2062 Front Brake Wheel Cylinder

Model	Part Number	Dia. (Inches)
F-1	8C-2061-B RH 8C-2062-B LH	1 1/16 1 1/16
F-2, F-3		1⅛
F-3 P. Del.	8J-2061 RH 8J-2062 LH	1⅜ 1⅜
F-4, F-5, F-6, F-5 and F-6 C.O.E.	91T-2010 91T-2011	1¼
F-7, F-8	7EQ-2061	1¼

2061-2262 Rear Brake Wheel Cylinder

Model	Part Number	Dia. (Inches)
F-1	8M-2261-A RH 8M-2261-A LH	1 1
F-2, F-3		1⅛
F-3 P. Del.		1⅛
F-4, F-5, F-6, F-5 and F-6 C.O.E.	91T-2209-2210	1½
F-7	8Q-2261-B	1⅝
F-8	7EQH-2261-B	1¾

2140 Brake Master Cylinder

Model	Part Number	Piston Dia. (In.)	Stroke (In.)
F-1	91A-2140	1 1/16	1 1/4
F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 and F-6 C.O.E.	91T-2140	1 1/4	1 7/16
F-7, F-8	7EQ-2140	1 1/2	1 7/16

2005 Brake Booster

Model	Part Number	Type	Dia. (In.)
*F-6, F-6 C.O.E.	8T-2005	Diaphragm	7 1/2
F-7, F-8	7EQ-2005-B	Piston	9 1/2

Slave Cylinder

Model	Diameter	Stroke	Displacement
F-6, F-6 C.O.E. 194" W.B. Sch.	1.0 in.	2 5/16 in.	1.815 cu. in.
F-7, F-8	13/16 in.	4 9/16 in.	2.36 cu. in.

2614 Parking Brake Drum

Model	Part Number	Dia. (Inches)
F-2, F-3	8D-2614	8
F-3 P. Del., F-4, F-5, F-6	OIT-2614	7 13/16
F-5 and F-6 C.O.E.	OIT-2614	7 13/16
F-7, F-8	7EQ-2614	9 1/2

2620 Parking Brake Lining

Model	Part Number	Length (In.)	Width (In.)	Thickness (In.)
F-2, F-3	8D-2620	24 5/8	2.0	5/32
F-3 P. Del.**	8J-2620-A, B	23 5/64	2 1/2	1/4
F-4, F-5, F-6, F-5 and F-6 C.O.E.	OIT-2620	24 5/8	2 1/2	1/4
F-7, F-8**	7EQ-2620-B, C	29 11/16	3	5/16

**3 pc. lining.
*Special Equipment F-4, F-5, F-5 C.O.E.
Brake Pedal Free Travel—1/4 to 1/2 inch.
Lining Wear Limit—1/32 inch from lining surface to rivet or bolt.
Lining to Drum Clearance—F-1—0.010 inch.

AIR BRAKES

	Front	Rear
Brake Size	16 x 2 1/4	16 1/2 x 5 1/2
Drum Dia.	16	16 1/2
Drum Out-of-Round	0.010	0.010
Lining Length	16 3/4	8.7*
Lining Width	2 1/4	5 1/2
Lining Thickness	5/16	3/4
Shoe Ret. Spring: Free Length	6.0	10.62
Length @ 75 Lbs.	6.88	11.50
Shoe Camshaft Dia.	1.493-1.495	1.493-1.495
Bushing I.D.	1.499-1.501	1.499-1.501
Anchor Pin Length	1.03	2.975-2.980
Pin Dia.	0.992-0.990	1.247-1.249
Bushing I.D. (Ream)	0.998-0.999	1.254-1.256
Bushing O.D.	—	1.501-1.504
Bushing Length	0.970-0.990	1.12
Shoe Hole Dia. (Ream)	1.061-1.063	1.497-1.489
Brake Chamber Type	E	B
Overall Dia.	6	9 3/16
Effective Area (Sq. In.)	9	24
Max. Stroke	1 3/4	2 1/4
Adjustable when stroke is:	1 3/8	1 3/4
Adjust stroke to:	5/8	3/4
Spring Tension at 0 Stroke	13.5 lbs.	36 lbs.
Increase per inch stroke	4 lbs.	11 lbs.
Max. Pressure (p.s.i.)	95	95
Slack Adjuster Type	Rod & Lever	Worm & Gear
Arm Length	5	6

Note: All dimensions in inches except where noted.
*Per Block.

Brake Pedal

Total Travel	4.5 in. (Approx.)
Stop Height	Set to Just Allow Reservoir Pressure at Chambers
Rod Length	6 in.

Brake Control Valve

Control Range	0-75 (P.S.I.)
Plunger Travel	0.557-0.599 in.
Max. Application Force	140 lbs. at Pedal

Air Reservoir Safety Valve

Release Pressure	150 P.S.I.

Stop Light Switch

Operating Pressure	5 P.S.I.

Air Compressor

Type	2-cyl. Water Cooled
Bore and Stroke—Inches	2 1/16 x 1 1/2
Capacity	7 1/4 cu. ft. at 1250 R.P.M.
Oil Capacity	1 pint
Oil Type	Same Oil as Engine

Air Compressor Governor

Cut-out Pressure	100-105 P.S.I.
Cut-in Pressure	80-85 P.S.I.
Pressure Range	15-25 P.S.I.

Air Compressor Unloader Valves

Clearance	0.010-0.015 in.
Valve Spring Free Height	1 3/64 in.
Spring Height at 5.4-6.6 lbs.	3/4 in.
Lever Spring Free Height	2 1/32 in.
Lever Spring Height at 7.7-8.7 lbs..	5/8 in.

3. WHEEL ALIGNMENT AND STEERING

Alignment

	Caster* Degrees		Camber† Degrees		Toe-in Inches		King Pin Inclination (Degrees)
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
**Model F-1, F-2 and F-3 Trucks	2½	4½	¼	1	0	1/16	8 ± ¼°
F-4, F-5, F-6 and F-5, F-6 C.O.E.	1	3½	¼	1	0	1/16	8¼ ± ¼°
All other "F" Series Trucks, Parcel Delivery and School Bus Models	1	3	¼	1	0	1/16	8 ± ¼°

*Maximum variation between wheels ½°
**F-2, F-3 without caster wedge, caster angles should be (−½° to +1½°)
†Maximum variation between wheels ¼°

3109-3110-3115 Spindle Bolt and Bushing

Model	Bushing Part No.	Mfg. Max. I.D. (Inches)	Bolt Part No.	Mfg. Min. O.D. (Inches)
F-1, F-2, F-3	51A-3110-A	0.81325	21A-3115-A	0.812
F-3 Par. Del.	8J-3110	0.938	8J-3115	0.936
F-4, F-5, F-6; F-5 C.O.E., F-6 C.O.E.	81T-3109-A	1.131	81T-3115-A	1.128
F-7, F-8	7EQ-3109	1.236	7EQ-3115	1.234

3504 Steering Gear

	F-1, F-2, F-3	F-4, F-5, F-6	F-3 Par. Del., F-5 C.O.E., F-6 C.O.E.	F-7 and F-8
Part Number	7RC-3504	7RT-3504	7RW-3504-B	7EQ-3504
Bearing Type				
Worm Gear	Tapered Roller	Tapered Roller	Tapered Roller	Tapered Roller
Roller Gear	Needle Bearing	Needle Bearing	Needle Bearing	Needle Bearing
Sector Shaft	Bushing	Bushing	Bushing	Bushing
Steering Column Shaft at Steering Wheel	Oilless Bearing	Oilless Bearing	Oilless Bearing	Oilless Bearing
Worm Bearing End Play	0.003″ Max.	0.003″ Max.	0.003″ Max.	0.003″ Max.
Worm Bearing Pre-Load (Pull to keep wheel moving) (lbs.)	0-½	0-½	0-½	0-½
Steering Gear Lash Adjustment (Pull over center includes worm bearing load) (lbs.)	½-1½	½-1½	½-1½	½-1½
Steering Wheel Diameter	18	18	18	20

Steering Stop Adjustment

Model	Tire Sizes	Left	Right
F-1, F-2, F-3		Fixed Stops	
F-3 Parcel Delivery	7.00 x 16	4 5/16	3½
	7.00 x 17	3 15/16	3 1/16
	7.50 x 16	3 13/16	3.00
	7.50 x 17	3⅜	2⅝
F-4, F-5, School-bus, F-6	All Tire Sizes	2½	2⅜

Model	Tire Sizes	Left	Right
F-5 C.O.E.	6.50 x 20	4¾	4¾
	7.00 x 20	4⅜	4⅜
F-5 C.O.E.	7.50 x 20	3 5/16	3 5/16
F-6 C.O.E.	8.25 x 20	2¾	2¾
F-7	8.25 x 20	4 7/16	3 3/16
	9.00 x 20	3 9/16	2¼
F-8	9.00 x 20	3 5/16	1⅞
	10.00 x 20	3 5/16	1⅜

4. REAR AXLE

Lubricant Capacity—Pints

Model	
*F-1, F-2, F-3, F-3 Par. Del.	3
F-4, F-5, F-5 C.O.E. and Sch. Bus	5
F-5, F-6, F-5 C.O.E. and F-6 C.O.E. (2-speed)	15
F-6, F-6 C.O.E. (Single Speed)	10

*F-1 only—3½ pints.

Lubricant Capacity—Pints—Continued

Model	
F-7	11
F-7 (2-speed)	20
F-8 (2-speed)	19
F-8 (Single-speed)	22

4203-4209 Driving Gear and Pinion

Model	Part Number	Gear Ratio	No. of Teeth		Gear Backlash (Inches)		Pinion Bearing Preload—(inch-pounds)	
			Pinion	Drive Gear	Min.	Max.	Min.	Max.
F-1	8M-4209-B	4.27	11	47	0.003	0.008	8	12
	OM-4209	3.92	12	47	0.003	0.008	8	12
F-2, F-3, F-3 Par. Del.	OIY-4203-A	4.11	9	37	0.004	0.018	12	16
	OIY-4203-B	4.857	7	34	0.004	0.018	12	16
F-4, F-5	8T-4209-B	5.83	6	35	0.004	0.018	12	16
	8T-4209-C	5.14	7	36	0.004	0.018	12	16
F-5, F-5 C.O.E.	8T-4209-A	6.66	6	40	0.004	0.018	12	16
F-6, F-6 C.O.E.	8TH-4209-A	7.2	5	36	0.004	0.018	12	18
	8TH-4209-B	6.2	5	31	0.004	0.018	12	18
	8TH-4209-C	6.8	5	34	0.004	0.018	12	18
F-5, F-6—Conv. and C.O.E.	8T-4209M-A	5.83-8.11	6	35	0.004	0.018	8	15
(2-sp.)	8T-4209M-B	6.33-8.81	6	38	0.004	0.018	8	15
F-7	7EQ-4203-B	6.8	5	34	0.006	0.010	12	18
F-7	7EQ-4209-A	7.2	5	36	0.006	0.010	12	18
F-7 (2 sp.)	2Q-4209-A	6.5-9.04	6	39	0.006	0.016	12	25
F-8	8QH-4209	7.16	6	43	0.006	0.010	12	25
F-8 (2-sp.)	7EQH-4209M	6.5-8.87	6	39	0.006	0.016	12	25

4211 Differential Pinion Shaft (Spider)

Model	Part No.	Mfg. Dia. (Inches)
F-1	8M-4211	0.7495
F-2, F-3, F-3 Par. Del.	61-4211	0.748
F-4, F-5, F-5 C.O.E.	79-4211-A	0.871
F-6 (2-speed)	OIT-4211-M	0.937
F-6, F-6 C.O.E. (Single Speed)	8TH-4211	0.873
F-7	7EQ-4211	0.996
F-7 (2-speed)	8Q-4211-A	0.937
F-8 (2-speed)	7EQH-4211	0.997
F-8 (single speed)	8QH-4211	0.937

4059-4228 Differential Side Gear Thrust Washers

Model	Part No.	Thickness (Inches)
F-1	8M-4228	0.030-0.032
F-2, F-3	61-4228	0.060-0.062
F-4, F-5	79-4228	0.058-0.062
F-6 (2-speed)	81T-4228-M	0.061-0.063
F-6 (single speed)	8TH-4228	0.058-0.062
F-7	7EQ-4228	0.058-0.062
F-7 (2-speed)	8Q-4228-A	0.061-0.065
F-8 (2-speed)	7EQH-4059	0.061-0.063
F-8 (single speed)	8QH-4228	0.121-0.125

4215-4292 Differential Pinion Gears

Model	Part No.	Mfg. I.D. (Inches)
F-1	8M-4215	0.75495
F-2, F-3, F-3 Par. Del.	7RY-4215	0.753
F-4, F-5, F-5 C.O.E.	7RT-4215	0.878
F-6 (2-speed)	59T-4215-M	0.941
F-6 (single speed)	8TH-4215	0.877
F-7	7EQ-4215-B	1.004
F-7 (2-speed)	8Q-4215-A	0.941
F-8 (2-speed)	7EQH-4215	1.002
F-8 (single speed)	8QH-4292	0.937

4230 Differential Pinion Gear Thrust Washers

Model	Part No.	Thickness (Inches)
F-1	8M-4230	0.030-0.032
F-2, F-3	7RY-4230	0.061-0.063
F-4, F-5, F-6	7RT-4230	0.058-0.062
F-6 (2-speed)	OIT-4230-M	0.030-0.032
F-7	7EQ-4230	0.058-0.062
F-7 (2-speed)	8Q-4230-A	0.030-0.032
F-8 (2-speed)	7EQH-4230	0.030-0.032
F-8 (single speed)	8QH-4230	0.061-0.063

5. FRAME AND SPRINGS

5000 Frame

	A	B	C	D	E	F	G
	Width Front	Width Rear	℄ to ℄ Rear Spring Hangers	℄ to ℄ Front Spring Hangers	Front End Dip	Front Axle Kick-Up	Rear Axle Kick-Up
F-1	32	34	44	35 3/16	2 3/4	—	2
F-2	32	34	45	35 3/16	2 3/4	—	2

5000 Frame (cont'd)

	A	B	C	D	E	F	G
	Width Front	Width Rear	℄ to ℄ Rear Spring Hangers	℄ to ℄ Front Spring Hangers	Front End Dip	Front Axle Kick-Up	Rear Axle Kick-Up
F-3	32	34	45	$35\frac{3}{16}$	$2\frac{3}{4}$	—	2
F-3 Par. Del.	32	34	45	$35\frac{9}{16}$	$2\frac{3}{4}$	2	$3\frac{1}{4}$
F-4	32	34	$44\frac{1}{2}$	$35\frac{1}{2}$	$2\frac{29}{32}$	—	—
F-5	32	34	$44\frac{1}{2}$	$35\frac{1}{2}$	$2\frac{29}{32}$	—	—
F-5 C.O.E.	32	34	$44\frac{1}{2}$	$37\frac{5}{8}$	$2\frac{29}{32}$	—	—
School Bus	32	34	$51\frac{5}{64}$	$35\frac{1}{2}$	$2\frac{29}{32}$	—	—
F-6	32	34	$44\frac{1}{2}$	$35\frac{1}{2}$	$2\frac{29}{32}$	—	—
F-6 C.O.E.	32	34	$44\frac{1}{2}$	$37\frac{5}{8}$	$2\frac{29}{32}$	—	—
F-7	32	34	$51\frac{1}{4}$	$45\frac{5}{16}$	4	—	—
F-8	32	34	$51\frac{1}{4}$	$45\frac{5}{16}$	4	—	—

Spring Specifications

Model	Spring Part Number	Number of Leaves	Capacity at Normal Loaded Height (lbs.)	Deflection-Rate (lbs. per in.)	Height at Normal Load (Inches)	Length Loaded (Inches)	Width (Inches)	Bushing Dia. (Inches)
Front Spring								
Std. on F-1	21C-5310-B	8	850	243	2.46	36	1.75	0.625
Std. on F-2, F-3 Option F-1	21Y-5310-A	8	1025	423	2.46	36	1.75	0.625
Opt. on F-2, F-3	21Y-5310-B	9	1025	610	3.98	36	1.75	0.625
Std. on F-3 Par. Del.	8J-5310	10	1200	555	3.23	36	1.75	0.625
Std. on F-4, F-5, F-6 & F-5 Sch. Bus 158″ W.B.	21T-5310-A	11	1375	673	2.84	36	2.00	0:750
Std. on F-6 Sch. Bus. 194″ W. B. Option F-4, F-5, F-6	21T-5310-B	12	1975	845	2.84	36	2.00	0.750
Opt. on F-4, F-5, F-6 F-5 Sch. Bus	59T-5310	12	2000	1090	3.50	36	2.00	0.750
**Opt. on F-5, F-6, C.O.E. 134″ & 158″ W.B.	21W-5310-A	13	1825	610	3.93	38	2.25	0.750
†Std. on F-5, F-6, C.O.E.	21W-5310-B	13	2050	685	3.93	38	2.25	0.750
Opt. on F-5, F-6, C.O.E.	8W-5310	14	2450	850	3.93	38	2.25	0.750
F-7, F-8	7EQ-5310-B	12	2250	860	4.30	46	2.50	0.875
Rear Spring								
F-1 Panel Std. F-1 (Opt.)	21-C-5560-A	9	1050	230	2.84	45	2.00	0.750
F-1 (Std.) (Opt. F-1 Panel)	21C-5560-B	10	1350	275	2.84	45	2.00	0.750
F-1 (Opt.)	21C-5560-C	11	1775	335	2.84	45	2.00	0.750
F-2 (Std.), F-3 (Opt.)	59Y-5560-A	12	1950	465	3.94	45	2.25	0.750
F-3 (Std.), F-2 (Opt.)	59Y-5560-B	13	2400	520	3.94	45	2.25	0.750
F-3 (Opt.)	59Y-5560-C	14	3000	640	3.94	45	2.25	0.750
F-3 Par. Del. (Std.)	8J-5560-A	12	2000	465	3.04	45	2.25	0.750
F-3 Par. Del. (Opt.)	8J-5560-B	12	2325	510-660	3.04	45	2.25	0.750
F-4 (Std.) F-5, 5 C.O.E. (Opt.)	0IT-5560-A	10	3600	900	3.80	45	2.50	1.0
F-4, 5 & 5 C.O.E. (Opt.)	0IT-5560-B	7	1700	445	3.80	45	2.50	1.00
F-5, 6, 5 & 6 C.O.E. F-4 (Opt.)	0IT-5560-C	12	4300	1075	4.42	45	2.50	1.00
Sch. Bus (Std.)	84T-5560	13	‡4300	836-1104	‡4.69	52	2.50	1.00
F-7 (Std.)	7EQ-5560-A	13	4750	1225	5.00	52	3.00	1.12
F-8 (Std.), F-7 (Opt.)	7EQ-5560-B	14	5750	1524	5.46	52	3.00	1.12
F-8 (Opt.)	7EQ-5560	13	6650	1650	5.60	52	3.00	1.12
F-6, F-6 C.O.E. (Std.) F-5, F-5 C.O.E. (Opt.)	*0IT-5588-B	5	1350	1350	2.29	32.50	2.50	
F-7, 8	*7EQ-5588	7	2050	975	3.18	37.50	3.00	

**Auxiliary Springs ‡5250 lbs. Capacity @ 3.60-4.10″ for F-6 Sch. Bus only.
*Standard on 110″ Wheelbase †Standard on 134″ and 158″ Wheelbase.

6. ENGINES

General

Type Cu. In.	6-Cylinder		8-Cylinder		
	215	254	239	279	317
Horsepower	101 @ 3500	112 @ 3500	106 @ 3500	145 @ 3800	155 @ 3900
Taxable Horsepower	30.4	29.4	32.5	40.6	46.2
Bore (Inches)	3.56	3.50	3.187	3.56	3.80
Stroke (Inches)	3.60	4.40	3.75	3.50	3.50
Piston Displacement (cubic inches)	215	254	239.4	279	317.5
Compression Pressure @ Sea Level (p.s.i. @ Cranking Speed)	130	110	110	115	115
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2
Oil Capacity (Qts.)*	5	6	5	8	8
Compression Ratio	7.0:1	6.8:1	6.8:1	7.0:1	7.0:1
Torque Ft. Lbs. @ RPM	185 @ 13-1700	217 @ 14-1700	194 @ 19-2100	244 @ 19-2100	284 @ 17-2000

*Add 1 quart with filter change.

6010 Cylinder Block

Type of Engine Cu. In.	Cylinder Block Part Number	Mfg. Max. Bore Dia. (Inches)	Max. Width Valve Seat Face (Inch)	Max. Valve Seat Run-out (Inch)	Max. Allowable Out-of-Round Bore (Inch)	Max. Allowable Oversize Bore (Inch)
215	EAA-6015-B	3.5649	—	—	0.0005	0.060
239	8BA-6010	3.1885	0.060-0.080	0.003	0.0005	0.060
254	8MTH-6010	3.500	0.062	0.003	0.0005	0.060
279	EAL-6010	3.5645	—	—	0.0005	0.060
317	EAD-6010	3.8024	—	—	0.0005	0.060

6085 Cylinder Head

Engine Cu. In.	Part No.	Max. Valve Seat Width Intake (Inch)	Max. Valve Seat Width Exhaust (Inch)	Max. Valve Seat Run-out (Inch)	†Mfg. Max. Valve Guide Bore (Inch)	Max. Allowable Oversize Guide (Inch)
215	EAA-6085	0.070	0.105	0.003	0.344	0.030
279	EAL-6085	0.070	0.105	0.003	0.344	0.030
317	EAM-6085	0.070	0.105	0.003	0.344	0.030

†Occasionally will be 0.003 inch oversize.

6108 Piston Assemblies

Engine Cu. In.	Fitting New Piston in New Bore		Fitting New Piston in Used Bore		Fitting Used Piston in Used Bore	
	*Gage Thickness (Inches)	Pounds Pull	*Gage Thickness (Inches)	Pounds Pull	*Gage Thickness (Inches)	Pounds Pull
215	0.0015	5-10	0.002	5-10	0.003	5-10
239	0.0015	3-12	0.0015	3-12	0.003	3-12
254	0.0015	5-10	0.002	5-10	0.003	5-10
279 & 317	0.0015	6-12	0.002	6-12	0.003	6-12

*Use ½ inch wide feeler gauge.

NOTE: Selective fit pistons are available for standard and oversize in 0.0003 inch increments. Oversize pistons available in 0.0025 inch (239 & 254 cu. in.), 0.005 inch (215, 279, & 317 cu. in.), 0.010 inch, 0.020 inch, 0.030 inch, 0.040 inch, and 0.060 inch sizes.

6200 Connecting Rod

Engine—Cu. In.	Side Clearance Total (Inches)
215	0.003-0.009
239	0.006-0.020
254	0.003-0.007
279 & 317	0.006-0.014

Note: Allowable bend in connecting rod-0.0005 per inch. Allowable twist in connecting rod is 0.0015 per inch.

6331 Crankshaft Main Bearings

Engine—Cu. In.	Journal Clearance (Inch)	Undersize Bearings Available (Inch)	Crankshaft End Play (Inch)
215	0.0005-0.0021	0.010, 0.020, 0.030	0.004-0.008
239	0.0010-0.0025	0.010, 0.020, 0.030	0.002-0.006
254	0.0005-0.0020	0.010, 0.020, 0.030	0.004-0.008
279 & 317	0.0008-0.0026	0.010, 0.020, 0.030, 0.040	0.004-0.008

6149 Piston Rings

Engine Cu. In.	Clearance in Piston Grooves (Inch)			End Gap of Ring in Cylinder Bore (Inch)	
	Top Rings	Second Rings	Lower Rings	Compression Rings	Oil Rings
215	0.0020-0.0035	0.0015-0.0030	0.0010-0.0025	0.007-0.047	0.007-0.047
239	0.0015-0.0030	0.0010-0.0025	0.0015-0.0030	0.007-0.047	0.007-0.047
254	0.0020-0.0035	0.0015-0.0030	0.0015-0.0030	0.007-0.047	0.007-0.047
279 & 317	0.0015-0.0030	0.0010-0.0030	0.0015-0.0030	0.010-0.050	0.010-0.050

6211 Connecting Rod Bearings.

Engine (Cu. In.)	Journal Clearance (Inch)	Undersize Bearings Available (Inch)
215	0.0005-0.0021	0.010, 0.020, 0.030
239	0.0008-0.0033	0.010, 0.020, 0.030, 0.040
254	0.0005-0.0020	0.010, 0.020, 0.030
279 & 317	0.0004-0.0020	0.010, 0.020, 0.030, 0.040

Selective fit bearings available in standard and undersize.

6375 Flywheel

Max. Runout—Flywheel Face..................0.005 in.
Max. Runout—Ring Gear.....................0.010 in.
Max. Depth of Refacing......................0.045 in.

6505-6507 Valves

Engine (Cu. In.)	Valve Part Number	Max. Clearance Valve Stem Guide (Inch)	Valve Lash (Hot) (Inch)				Mfg. Min. Stem Diameter (Inch)	Min. Valve Head Thickness (Inch)
			Exhaust		Intake			
			Min.	Max.	Min.	Max.		
215	EAA-6505-A	0.0030	0.014	0.016			0.3410	1/32
215	EAA-6507-A	0.0025			0.014	0.016	0.3415	1/32
239	1BA-6505-A	0.0034	0.017	0.019			0.3410	1/32
239	1BA-6507-A	0.0039			0.013	0.015	0.3405	1/32
254	8MTH-6505-B	0.0043	0.014	0.016			0.3405	1/32
254	1HA-6507-A	0.0037			0.009	0.011	0.3410	1/32
279 & 317	EAM-6505-E	0.0030	0.018	0.018			0.3410	1/32
279 & 317	EAM-6507-E	0.0025			0.012	0.012	0.3415	1/32

Valve Timing

Engine (Cu. In.)	Intake			Exhaust		
	Lash (Inch)	Opens (Degrees B.T.C.)	Closes (Degrees A.B.C.)	Lash (Inch)	Opens (Degrees B.B.C.)	Closes (Degrees A.T.C.)
215	0.015	13	68	0.015	55	22
239	0.013	24	72	0.017	59	14
	0.014	21	68	0.018	56	11
	0.015	17	64	0.019	52	7
254	0.010	11	41	0.014	48	10
279 & 317	0.010	18	58	0.020	56	20

6513 Valve Spring

Engine (Cu. In.)	Part No.	Test Length (Inches)	Pressure (Pounds)
215	EAA-6513	1.821	54-62
239	IBA-6513-A	1.89	39-44
254	OHA-6513-A	2.11	47-53
279 & 317	EAD-6513-A	1.80	64-70

6250 Camshaft

Engine (Cu. In.)	Camshaft Part Number	†Max. Allowable Runout (Inch)	Min. Valve Lift. (Inch)*		Wear Limit Camshaft Journals (Inches)	End Play (Inch)
			Intake	Exhaust		
215	EAA-6250-B	0.005	0.335	0.330	1.924	0.003-0.006
239	EAB-6250-A	0.005	0.328	0.328	1.794	0.007-0.016
254	8MTH-6250	0.005	0.3375	0.3335	1.924	0.003-0.006
279 & 317	EAM-6250-C	0.005	0.338	0.338	—	**

† Center journal runout with end journals supported. * Zero valve lash. ** End thrust controlled by plunger in camshaft.

6600 Oil Pump

Measurement	Engine (Cu. In.)			
	215	239	254	279 & 317
Max. Clearance Housing and Shaft (Inch)	0.0029	0.002	0.0029	0.0029
Backlash between oil pump and camshaft gears (Inch)	—	0.003-0.005	0.003-0.005	—
Max. Clearance Oil Pump Driven Gear and Shaft (Inch)	0.005	0.005	—	0.005
Max Allowable Clearance Gear to Housing (Inch)	0.005	0.005	—	0.005
Relief Valve Spring Pressure (Lbs. @ Inches Length)	9.82 @ 1.56	12 @ 1.14	12.76 @ 2.18	7.8 @ 1.40
Shaft End Play (Inch)	—	—	0.008-0.012	—
Wear Limit—Outer Rotor to Pump Clearance (Inch)	—	—	0.012	—
Wear Limit—Inner to Outer Rotor Clearance (Inch)	—	—	0.010	—
Wear Limit—Rotor to Cover Clearance (Inch)	—	—	0.005	—
Max Allowable Cover Plate Wear (Inch)	—	—	0.001	—

7. CLUTCH AND TRANSMISSION

Transmission Type	Usage		Gear Type	Gear Ratios					
	Standard	Optional		1st	2nd	3rd	4th	5th	Rev.
3-Speed (Light Duty)	F-1 (1949-50 only)		All Helical	2.819	1.604	1.0			3.625
3-Speed Light Duty Remote Shift	F-1 (1951 only)		All Helical	2.78	1.62	1.0			3.63
3-Speed Heavy Duty Center Shift		F-1, 2, 3, 4, 5; F-5 C.O.E. & Sch. Bus	Helical 2nd, 3rd; Spur 1st, Rev.	3.714	1.871	1.0			4.588
3-Speed Heavy Duty Remote Shift	F-3 Par. Del., F-5 Par. Del.		Helical 2nd, 3rd; Spur 1st, Rev.	3.714	1.871	1.0			4.588
4-Speed Trans.	F-2, F-3, F-4, F-5, F-6, F-6 C.O.E.	F-1	All Spur	6.4	3.090	1.690	1.0		7.820
4-Speed Synchro-Silent	F-6 with M Engine	F-5, F-6 and F-4	Helical 2nd, 3rd, 4th; Spur 1st, Rev.	6.4	3.090	1.690	1.0		7.820
5-Speed Overdrive	F-7	F-8	Helical 3rd, 4th, O.D.; Spur 1st, 2nd, Rev.	6.060	3.50	1.80	1.0	0.799	6.0
5-Speed Direct 5th	F-8	F-7	Helical 3rd, 4th, 5th; Spur 1st, 2nd, Rev.	7.58	4.38	2.40	1.48	1.0	7.51

Intermediate Gear End Play—Inches

3-Speed—Light	51A-7102	0.003-0.011
C-Speed—Heavy	8D-7102	0.003-0.016
4-Speed (Synchro-Silent) (3rd Sp. Gear)	8MTH-7101	0.003-0.016
4-Speed (Synchro-Silent) (2nd Sp. Gear)	8MTH-7100	0.005-0.024
5-Speed—Direct (4th Sp. Gear)	7EQ-7017	0.000-0.021
5-Speed—Direct (3rd Sp. Gear)	7EQ-7103	0.003-0.044
5-Speed—Overdrive (3rd Sp. Idler Gear)	7EQ-7196	0.000-0.027

Countershaft Cluster Gear End Play—Inches

Type	Part No.	Mfg.
3-Speed—Light	8M-7113	0.0045-0.0185
3-Speed—Heavy	8D-7113	0.006-0.020
4-Speed	BB-7113-A	0.009-0.021
4-Speed (Synchro-Silent)	8MTH-7113	0.006-0.020

7563 Clutch Pressure Plate

Model	Part Number	Diameter (Inches)	Spring Color	Pedal Free Travel (Inches)
F-1 (3-speed trans.)	19A-7563-A	10	Light Blue	1⅛-1⅜
F-1 (4-speed trans.), F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E.	51-7563-A	11	Gray	1⅛-1⅜
F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (Opt.) and School Bus (Std.)	8MTH-7563-A 81B-7563-A	11	Medium Brown	1⅛-1⅜
F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (4-speed trans.)	8MTH-7563-A	11	Medium Brown	1⅛-1⅜
F-7, F-8	7EQ-7563-B 8Q-7563	12	Light Blue	1⅜-1⅝

7550 Clutch Disc

Model	Part Number	Used With	Disc Diameter (Inches)	Spring Color
F-1 (3-speed trans.)	51A-7550-A	19A-7563-A	10	Gray
F-1 (4-speed trans.), F-2, F-3, F-3 Par. Del., F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (Except School Bus)	59T-7550-A	51-7563-A	11	Black
F-2, F-3, F-3 Par. Del., F-4, F-5, F-6 (Opt.), School Bus (Std.)	59T-7550-B	8MTH-7563-A*	11	Black
F-4, F-5, F-6, F-5 C.O.E., F-6 C.O.E. (4-speed trans.)	59T-7550-B	8MTH-7563-A*	11	Black
F-7, F-8	8Q-7550-A	8Q-7563	12	Black

*Heavy Duty

8. COOLING

8005 Radiator

Engine (cu. in.)	Capacity (qts.)
215 F-1 through F-3 and F-3 P. Del.	15
215 F-4, F-5, and Schl. Bus	16
239	23
254	19.3
279 and 317	24.75

8512 Water Pump Impeller

Engine (cu. in.)	Impeller Part No.	Clearance Between Impeller and Water Pump Housing (inch)
215	EAG-8512	0.020-0.030
239	8BA-8512	0.030-0.050
254	7HA-8512	0.030-0.040
279 and 317	EAM-8512	0.025-0.035

8577-8620 Generator, Fan, and Air Compressor Belt

Engine (cu. in.)	Deflection (inch)	Location to Measure Deflection
215	½	Between fan and crankshaft pulleys
215	¼	Between generator and water pump pulleys
239	½	Between fan and crankshaft pulleys
239	½	Between generator and L. H. water pump pulleys
254	¼	Between generator and water pump pulleys
279 and 317	½	Between fan and crankshaft pulleys
279 and 317	¼	Between generator and water pump pulleys

9. FUEL SYSTEM

9510 Carburetor

		Carburetor Part Number					
		EAG-9510-B	EAL-9510-A	8RT 9510-A 7RT 9510-A	EAM-9510-A	8MTH 9510-A	8MWH 9510-A
Type of Engine (cu. in.)		215	279	239	317	254	254
Truck Model		F-1 thru F-5	F-7	F-1 thru F-6	F-8	F-6	F-6 C.O.E.
Main Metering Jet Sizes (Inches)	Standard	0.064	0.060	0.051	0.060	0.065	0.065
	5000 to 10,000 feet altitude	0.062	0.058	0.049	0.058	0.063	0.063
	10,000 to 15,000 feet altitude	—	0.056	0.047	0.056	0.061	0.061
Float Setting Using Float Level Gauge (Inches)		*	Fuel Level ½″ ± 1/32	† 1.322-1.353	Fuel Level ½″ ± 1/32	1.283-1.315	1.180-1.200
Nozzle Bar Part Number		—	—	91A 9922-B 91A 9923-B	—	8MTH-9922	8MWH-9530-A
Upper Idle Discharge Holes	Drill Number	72	63	60 & 65	63	53	53
	Size (Inches)	0.025	0.037	0.040 & 0.035	0.037	0.0595	0.0595
Lower Idle Discharge Holes	Drill Number	60	56	56	56	63	63
	Size (Inches)	0.040	0.0465	0.0465	0.0465	0.037	0.037
Power Valve Vacuum Limits for Opening (Inches Hg)		6-6½	6-7	6-6½	6-7	6½-7½	6½-7½
Upper Distributor Vacuum Hole	Drill Number	52	54	56	54	56	56
	Size (Inches)	0.0635	0.055	0.0465	0.055	0.0465	0.0465
Lower Distributor Vacuum Hole	Drill Number	—	—	55	—	55	55
	Size (Inches)	—	—	0.052	—	0.052	0.052

*Fuel Level—Should be flush to 1/16″ below edge of float hinge hanger.
†1.275-1.305 on "hi-lift" nozzle bar carburetors.

9350 Fuel Pump

Type of Engine (cu. in.)	Fuel Pump Part Number	Pressure (Pounds per Square Inch)	Vacuum (Inches of Hg)	Max. Allowable Time to Pump One Pint at Idle R.P.M. (Seconds)
254	1HA-9350-G	4-5	10½	45
239	1BA-9350-G	3½-4½	10½	45
215	EAA-9350-E	4-5	10½	45
279, 317	EAM-9350-A	3½-4½	10½	45

9002 Fuel Tank

Truck Model	Capacity (Gallons)
Closed Cab	20
C.O.E.	20
Panel Delivery	17
School Bus	30

10. GENERATING SYSTEM

10000 Generator

GENERATOR ELECTRICAL SPECIFICATIONS							GENERATOR MECHANICAL SPECIFICATIONS					
			Max. Rate					BRUSHES				
Part Number	Watts	Eng. R.P.M. Chg. Starts	Amp.	Eng. R.P.M.	Field	Armature	Pulley O.D. (In.)	No.	Orig. Length (In.)	Spring Tension (Oz.)	Pulley No.	Mounting Bracket No.
FAA-10000-B	245	415	35	1070	81A-10175	OA-10005	3.00	2	0.86	26-34	FAB-10130-A2	*
FAA-10000-E	245	490	35	1428	81A-10175	OA-10005	3.80	2	0.86	26-34	8HT-10130-A3	*
FAA-10000-H	245	525	35	1250	81A-10175	OA-10005	3.80	2	0.86	26-34	8RT-10130-A3	8BA-10151-C
FAA-10000-J	245	415	35	1100	81A-10175	OA-10005	3.00	2	0.86	26-34	8BA-10130-A3	8BA-10151-C
FAB-10000-B	285	415	40	900	7RA-10175-B	8EH-10005	3.60	2	0.86	26-34	FAD-10130-A2	*
FAD-10000-A	320	400	45	960	7RA-10175-B	8EH-10005	3.00	2	0.86	26-34	FAB-10130-A2	*
FAB-10000-C	285	390	40	890	7RA-10175-B	8EH-10005	2.70	2	0.86	26-34	FAA-10130-A1	*
FAD-10002-A	425	**	60	580	8BA-10175	FAA-10027	**	4	1.10	24-36	**	**

*Mounting provisions provided on end plates. **Depends on application.

10505 Generator Regulator

Part Number	Type	Cut In Voltage		Voltage Regulation		Amp. Regulation	
		Min.	Max.	Min.	Max.	Min.	Max.
FAC-10505-A, B	F-1 thru F-6	6.0	6.6	7.4	7.8	34	38
FAD-10505-A	F-7 and F-8	6.0	6.6	7.4	7.8	38	42
FAE-10505-A	Schl. Bus	6.0	6.6	7.4	7.8	43	47
8BA-10505-A	Special	5.9	6.2	7.1	7.3	55	60

All voltage settings are given for regulator at normal operating temperature in ambient (surrounding air) temperature of 70-80°F.

10655 Batteries

Part Number	Volts	Plates	Amp. Hours*
01A-10655-A	6	17H	120
81A-10655-A2	6	17L	100
81A-10655-B2	6	15L	90

H—High Plates. L—Low Plates. *—Amp. hrs. @ 20 hr. rate.

11. STARTING SYSTEM

11002 Starting Motor

Part Number	Normal Engine Cranking Speed	Min. Torque @ 3.5 Volts		Teeth in Pinion	Teeth in Ring Gear	Gear Ratio	No Load Amperage
		Pound Ft.	Load (Amp.)				
FAC-11001-B	100	16	700	9	153	17.1	70
FAF-11001-A	100	16	700	10	112	11.2	70
FAG-11001-B	100	16	700	9	146	16.2	70
FAH-11001-A	100	16	700	9	114	12.7	70

11350 Starter Drive

Part Number	Type	Teeth Pinion	Used On
B-11350	Spring	10	FAF-11001-A
1CM-11350-C	Folo-Thru	9	FAB, FAC-11001-B
8HA-11350	Spring	9	FAH-11001-A

11083-5 Field Coils

Part Number	Used On
18-11083-L.H.	All
18-11085-R.H.	All

11005 Armature

Part Number	Used On
18-11005	FAF, FAH-11001-A
52-11005	FAC-11001-B
1CM-11005	FAG-11001-B

11055 Brushes

Part Number	Mfg. Length (Min.) (Inches)	Wear Limit (Inches)	Brush Spring Tension (Ounces)
18-11055	0.455	0.330	48-56

12. IGNITION

12029 Coil

Type of Engine	Coil Part Number	Primary		Secondary		Ignition Coil Amperage Draw	
		No. Turns	Resistance (Ohms)	No. Turns	Resistance (Ohms)	Engine Stopped	Engine Idling
All	8BA-12029	240	1.05-1.15 (75° F)	21000	4100 (75° F)	5.0-5.5	2.75-3.0

12300 Condenser

Type of Engine	Part Number	Capacity (Microfarads)	Min. Leakage (Megohms)	Max. Series Resistance (Ohms)
All	7RA-12300-C	*0.21-0.25	5	**1

*At room temperature (70° F).
**Measured on a Ford Distributor Stroboscope.

12405 Spark Plugs

Type of Engine	Part Number	Type	Size	Gap (Inches)	Torque (Ft.Lbs.) Cast Iron Head
All	OIT-12405	H-9	14 MM	0.028-0.032	24-30

12127 Distributor

Type of Engine (Cu. In.)	Distributor Part Number	Initial Advance Crankshaft Degrees BTC	Distributor Advance W.O.T.			Total Advance W.O.T. Crankshaft Degrees		Breaker Arm Spring Tension (Ounces)	Point Gap (Inches)	Dwell Contact at Idle Speed (Percent)	Advance Characteristics		Vacuum (Inches of Mercury)	Distributor Vacuum at Carburetor	
			Crankshaft Degrees		Engine R.P.M.						Distributor R.P.M.	Distributor Degrees		Engine R.P.M.	Vacuum (Inches Hg)
			Min.	Max.		Min.	Max.								
215	FAA-12127-A	2	29	31½	4000	31	33½	17-20	0.024-0.026	58-63	200 500 1000 1000 1500 2000	0 3½-4½ 8¼-9¼ 14¾-16¼ 11¾-13 14½-15¾	0 0.5 1.8 6.5 3.8 6.0		
239	OBA 12127	2	20	22.5	4000	22	24.5	17-20	0.014-0.016	58-63	200 500 1000 1500 2000	0-0 0-1 5.2-6.2 8¾-10 10-11¼	0 0.30 1.32 2.85 3.7	800 1000 2200 2400	2.0-2.9 3.5-4.8 4.7-6.4 4.6-6.2
254	8MTH 12127	0	18½	20½	3200	18½	20½	17-20	0.024-0.026	58-63	200 500 1000 1400 1600	0-0 2-3 6¼-7¼ 10½-12 9¼-10¼	0 0.4 1.3 3.6 2.6		
279	FAD-12127-C	10	28	30	4000	38	40	17-20	0.014-0.016	58-63	200 500 1000 1500 2000	0 2-3 8¼-9¼ 11½-12½ 14-15	0 0.37 1.45 2.68 4.1		
317	FAD-12127-C	10	29	31	4000	39	41	17-20	0.014-0.016	58-63	200 500 1000 1500 2000	0 3⅛- 4⅛ 9⅞-10⅞ 12⅞-13⅞ 14½-15½	0 0.5 1.95 3.4 4.8		

13. HEAD LIGHTS

Headlights

Model	Headlight Height Inches	Center Line of Truck to Headlight Inches
F-1 (6.50-16)	30 5/16	23 13/16
F-2 (7.50-16)	31 13/16	23 13/16
F-3 (7.00-17)	32 7/16	23 13/16
Parcel Deliv. F-3 (7.50-17)	37 1/16	23 13/16
F-4 (7.00-18)	35 1/8	23 13/16
F-5, F-6 (7.50-20)	36 11/16	23 13/16
F-5, F-6 C.O.E. (7.50-20)	36 3/4	23 13/16
F-7 (9.00-20)	40 3/16	23 13/16
F-8 (10.00-20)	40 9/16	23 13/16

SERVICE LETTER REFERENCE

Letter No.	Date	Subject	Changes Information on Page No.