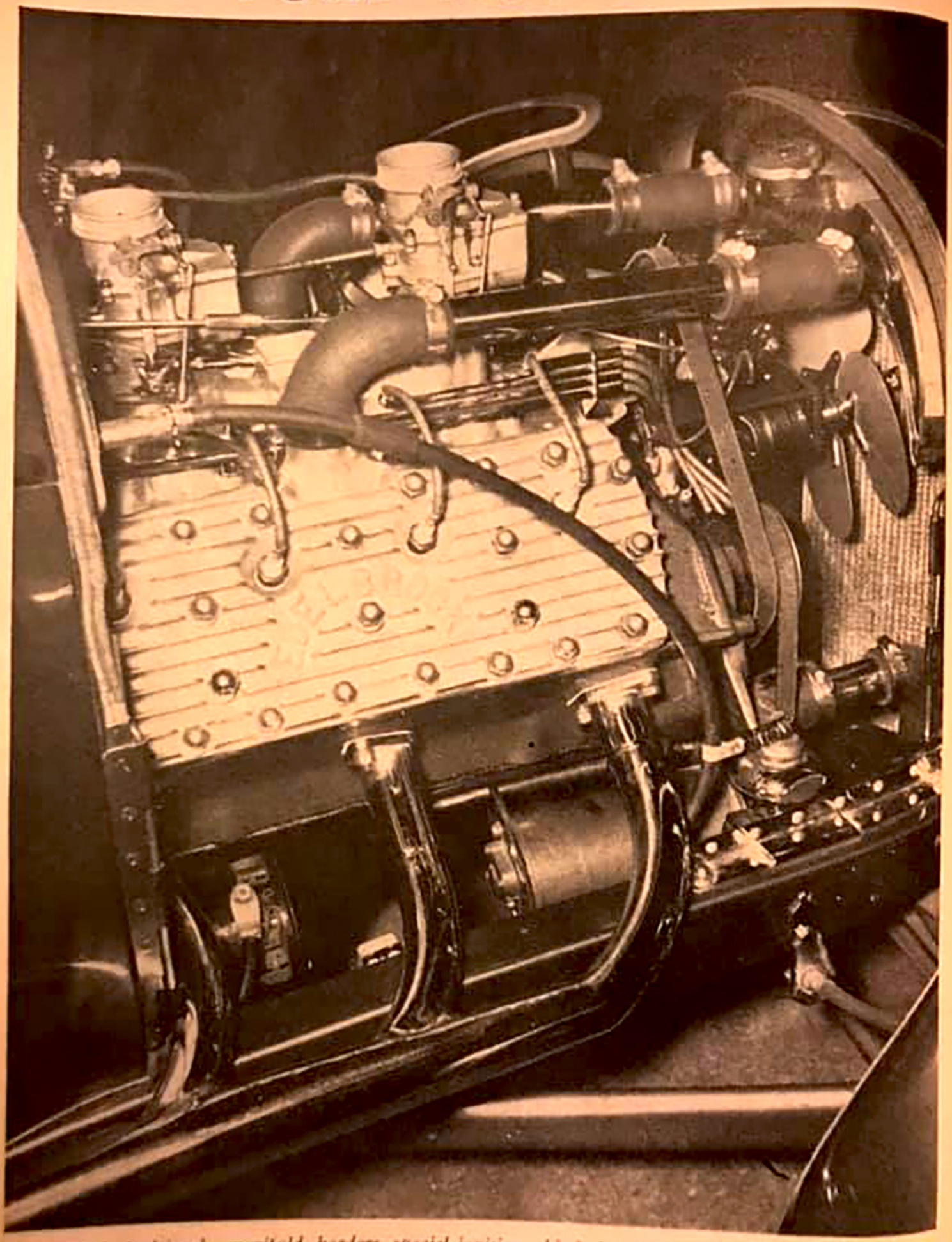
FORD FLATHEAD V8



With dual intake manifold, headers, special ignition, this is hot roadster mill. HOT ROD PHOTO

THE FORD flathead V8 engine, since its inception in 1932, has received more attention from amateur speed enthusiasts than any other production engine. Special heads, both valve in head and L head, have been made. Intake manifolds designed for two, three and four carburetors have been constructed. Camshafts have been ground to give almost any conceivable valve timing and lift, and adjustable tappets have been designed to facilitate the installation of these ground cams. Intake ports have been ground and polished and the cylinder blocks "relieved" to increase the "breathing" ability of the engine. Valve heads have been undercut to reduce the restriction in the valve ports and seat angles have been changed to increase the effective opening of the valves. Special solid skirt aluminum alloy pistons have been developed and are available in bore sizes up to and including 3½ inches and for strokes from ⅛ of an inch shorter than standard to ½ of an inch longer than standard. Crankshafts have been "stroked" and "de-stroked" and pistons have been designed to "pop up" out of the block as much as ½ of an inch. Flywheels have been "chopped" to increase acceleration and super light aluminum alloy flywheels have been made available. Exhaust ports have been enlarged and reshaped. Baffles have been installed in the center exhaust ports and special headers have been designed and built to reduce back pressure in the exhaust ports. Ignition systems have been converted and redesigned and special magnetos have been developed strictly for Ford V8 application. Special high capacity fuel pumps which fit only Ford V8 engines are now available.

With all this equipment available and with reworking of the block and component parts by owners or local speed shops, it is not surprising that so many different sizes and types of engines have been built. Ford V-8 and Mercury engine conversions rating from luke warm to red hot are used in all types of chassis, from fully road equipped sedans to lakes cars.

It is the intention to here describe the conversion of a stock Ford or Mercury flathead V8 engine to what might be called a "conservative" or not-too-expensive hot rod engine which can be driven on the streets and in traffic without undue roughness or discomfort for the driver. The use of special parts and reworking of materials has been kept to a minimum.

The average Ford or Mercury V8 engine, unless new or recently rebuilt, will probably need reboring before it will be usable for a conversion. It is just as essential in a conservative engine as it is in a full race engine that the cylinder walls are straight and round and that the piston rings keep the compression pressures in and the lubricating oil out of the combustion chamber. The amount of material to remove from the cylinders when reboring can vary from the minimum necessary to restore them to their original condition, to the maximum possible without unduly weakening the walls. Some blocks can be rebored larger than others but a good policy to follow for maximum oversizes is .125 of an inch on Ford blocks with a standard bore of 3 3/16 inches, and .1875 of an inch on Mercury blocks which have a standard bore of 3 3/16 inches. This gives a bore size of 3 3/10 inches or standard Mercury for the Ford, and 3⅜ inches for the Mercury. Mercury blocks have been bored .250 of an inch oversize without breaking into the water jacket but blocks with cylinder walls thick enough for this bore size are exceptional.

On this engine we shall limit the bore size to .125 of an inch oversize for the Ford and .100 of an inch for the Mercury block. This is done with an eye on the economy angle as these bore sizes permit the use of standard size replacement pistons and rings which cost approximately one half as much as the same parts for the larger oversizes. Replacement pistons are available in oversizes up to at least .100 of an inch for the Ford and Mercury, and standard Mercury pistons fit the .125 of an inch over Ford bore. The piston to wall clearance, for replacement type pistons, measured at the top of the piston skirt should be .001 of an inch to .0015 of an inch more than recommended by the manufacturer to reduce piston drag.

The piston rings should be of a dependable make and it is recommended to use a plain compression ring in the top groove, an expander type scraper ring in the second groove, and a cast iron expander type oil ring in the third groove. Four ring pistons are not generally used in competition engines because of the added drag caused by the fourth ring.

Piston rings should be a fairly easy push fit in the pistons when pushed with the palm of the hand. If the pin is fit too tight the piston will not be free to expand and contract along the piston pin and the piston may knock in the cylinder. The piston pin should also be an easy push fit in the connecting rod bushing, or so that it will just

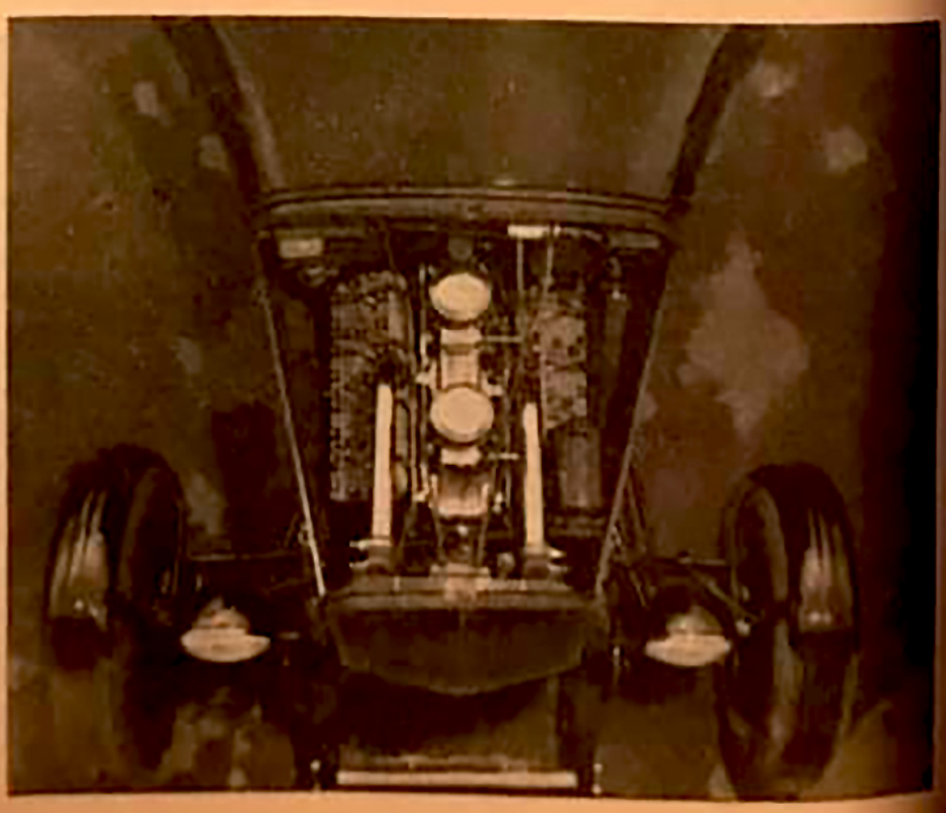
slide through the bushing by its own weight.

Although economy, consistent with improved performance, is the keynote of this conversion, there is one item in the Ford and Mercury flathead V8 engines of which it might be said that the best can be none too good. By this we refer to the connecting rods. Rods wear in the big end bore and in some cases will stretch, resulting in an out of round, or oblong, bearing bore. Rods in this condition will cause excessive wear on the inserts, which may result in complete failure of the bearing as well as insert noise. Upon examination of a Ford rod it will be seen that a bolt is not used to hold the cap in place as in other types of rods but extensions, or projections, on each side of the rod forging are machined to form studs over which the rod cap is installed. Connecting rod failure, in the majority of cases, occurs at the point of connection of the stud to the rod itself. This type of failure is usually brought on by high rpm in low or second gear. Under these conditions the load on the engine is not great and the inertia forces of the rod and piston may over stress the studs of old rods which may have been weakened by normal metal fatigue. A failure of this type may well result in the complete destruction of an engine, or at best necessitate extensive repairs to the block and component parts. The price of new connecting rods cannot be considered excessive when it is balanced against what may possibly happen when old rods are used. It is not impossible for new rods to fail but the odds are all against the old rods lasting very long.

When T slot or split skirt pistons are used they must be assembled on the rods so the slot or split will be on the left, or driver's side, of the block when the cylinder number on the rod is facing the front of the block. After the pistons have been assembled on the connecting rods the rods must be aligned to correct any bent or twisted condition which may be present. If the rods are bent or twisted the piston skirt will not be parallel with the cylinder wall and the piston may knock or cause misalignment of the rod on the crankshaft bearing, shortening the life of the bearing. Be sure not to forget to install the pin locks after the rods are aligned.

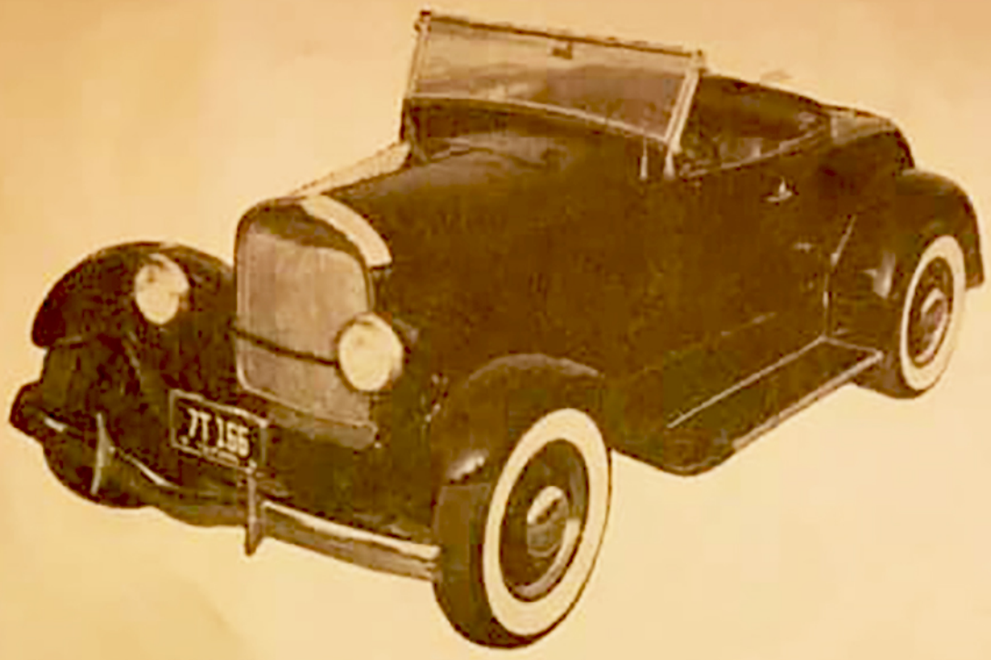
Before the piston rings are installed on the pistons they should be checked in the cylinder in which they are to be used to be sure the clearance between the ends of the rings is within the limits specified by the manufacturer. If this gap is insufficient the ring ends will butt together when the heat in the cylinder expands the ring, and either break the ring or score the cylinder, or both. Care should be exercised when installing the rings on the pistons that they are not opened excessively and permanently distorted.

A gas tight seal at the valve seats is just as important as a good ring seal but is considerably less expensive to acquire. After the valve assemblies have been removed from the block and disassembled, the valves should be inspected for wear on the stem and if worn excessively, or if the valve head has been refaced to the point where the upper edge is becoming thin, the valve should be discarded and replaced. After the valves have been



The flathead Ford engine stayed for many years as the hot rodders' favorite.

HOT ROD PHOTOS



It appears pretty and almost innocent . . . until you try to pull away from it at a boulevard stop.

inspected they must be ground on a valve refacer, preferably of the wet type, until the seat is free of pits and true with the stem. The refacer will show up any valves with bent stems or excessively warped heads and these must also be replaced.

After the valves have been refaced the seats in the block should be inspected for looseness or cracks. If any of the seat inserts are loose they should be replaced or tightened by peening the block lightly around the circumference of the seat. Any cracks found must be repaired before the seats can be ground. Seats should be ground with a suitable hard seat grinder until the seat is free of pits or scratches and is true with the grinder pilot. After grinding the seats for the proper angle they should be narrowed to approximately 1/16 of an inch in width. Seats should be narrowed from both the top and bottom to position the seat in the center of the valve face. Valves and seats which have been properly ground do not need to be lapped unless one wishes to do so as a check on the grinding. Lapping should be done with fine compound and the seats and valves should be thoroughly cleaned of compound when finished. Valves marked "F Ford T" on the heads may be used as either intake or exhaust valves but valves marked "Ford R" may be used only as intake valves.

When the valves have been refaced and thoroughly cleaned they may be reassembled with the guides and springs. If there is any doubt as to the condition of the old guides they should be replaced. Lincoln Zephyr valve springs should be used with a reground camshaft as their increased tension, which is approximately 50% greater than stock springs, forces the valves and tappets to follow the cam lobe and prevents "floating" of the valves. Zephyr springs should be assembled on the guides with the closed coils of the springs toward the upper end of the guide. Care must be taken to place the valve assemblies where they will not be damaged or rearranged in order that the correct valve will be assembled in the proper valve port.

When a ground cam is installed in an engine the valves must either be lengthened by building up the bottom of the stem with Stellite welding rod, or longer tappets of the stock type must be installed, or adjustable tappets must be used. This addition in length is necessary to make up for the amount of material ground off the heel of the cam to increase the valve lift. Adjustable tappets are slightly heavier in weight than stock tappets but this additional weight does not seem to affect their operation when Zephyr valve springs are used. Wrenches designed to hold the tappets while they are being adjusted are supplied with each set of tappets but are often found impractical. Instead of trying to use these wrenches many engine builders drill holes, approximately 7/32 of an inch in diameter and 1/4 of an inch above the floor of the valve chamber, in each tappet boss to enable a punch or piece of welding rod to be inserted in the hole and through one of the slots in the side of the tappet. With such an arrangement the tappet is prevented from rotating and can be adjusted quite easily. The adjusting screws in these tappets are self locking and therefore do not

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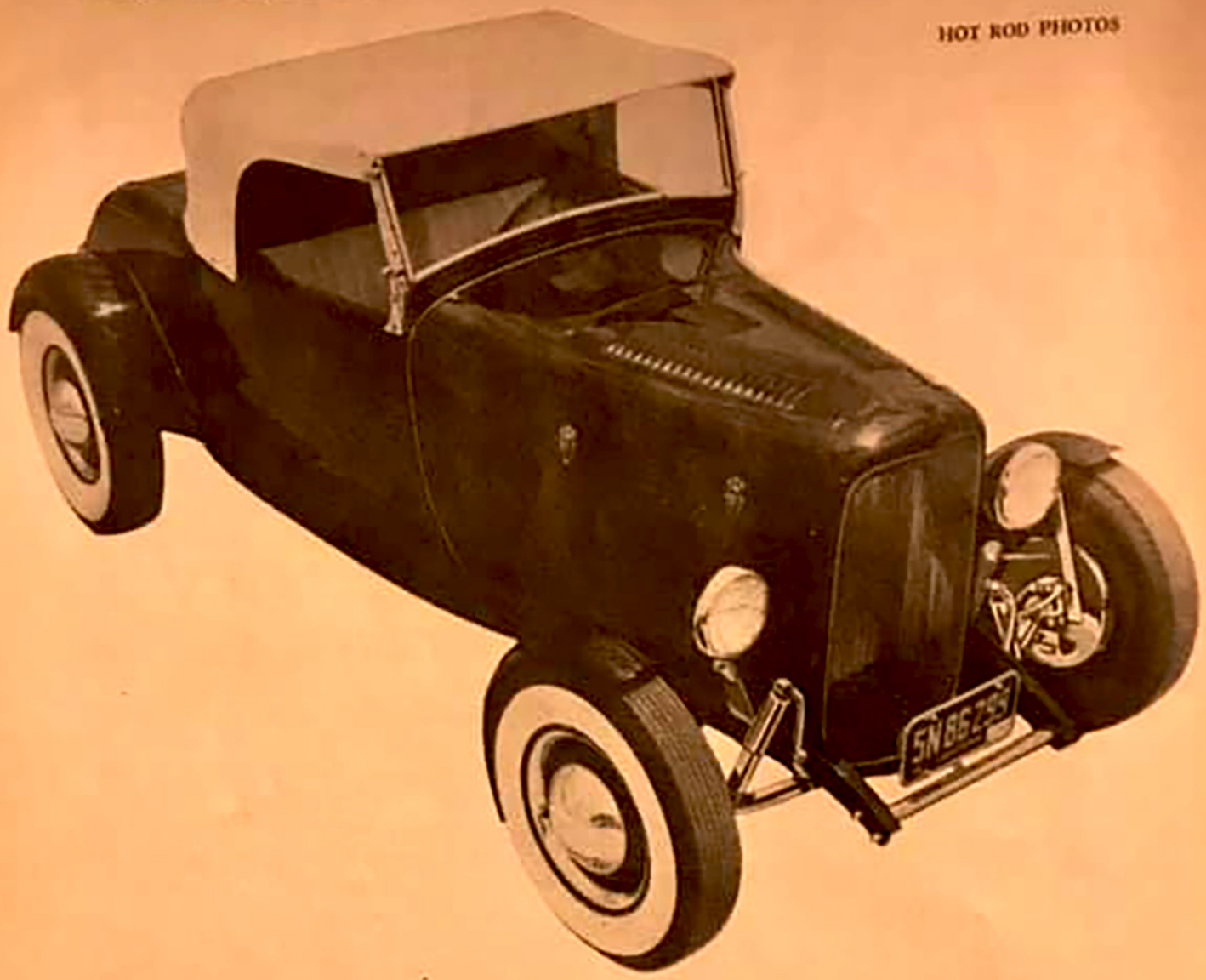


This type of hot rod is very popular, nice for the street but adaptable for dry lake performance.

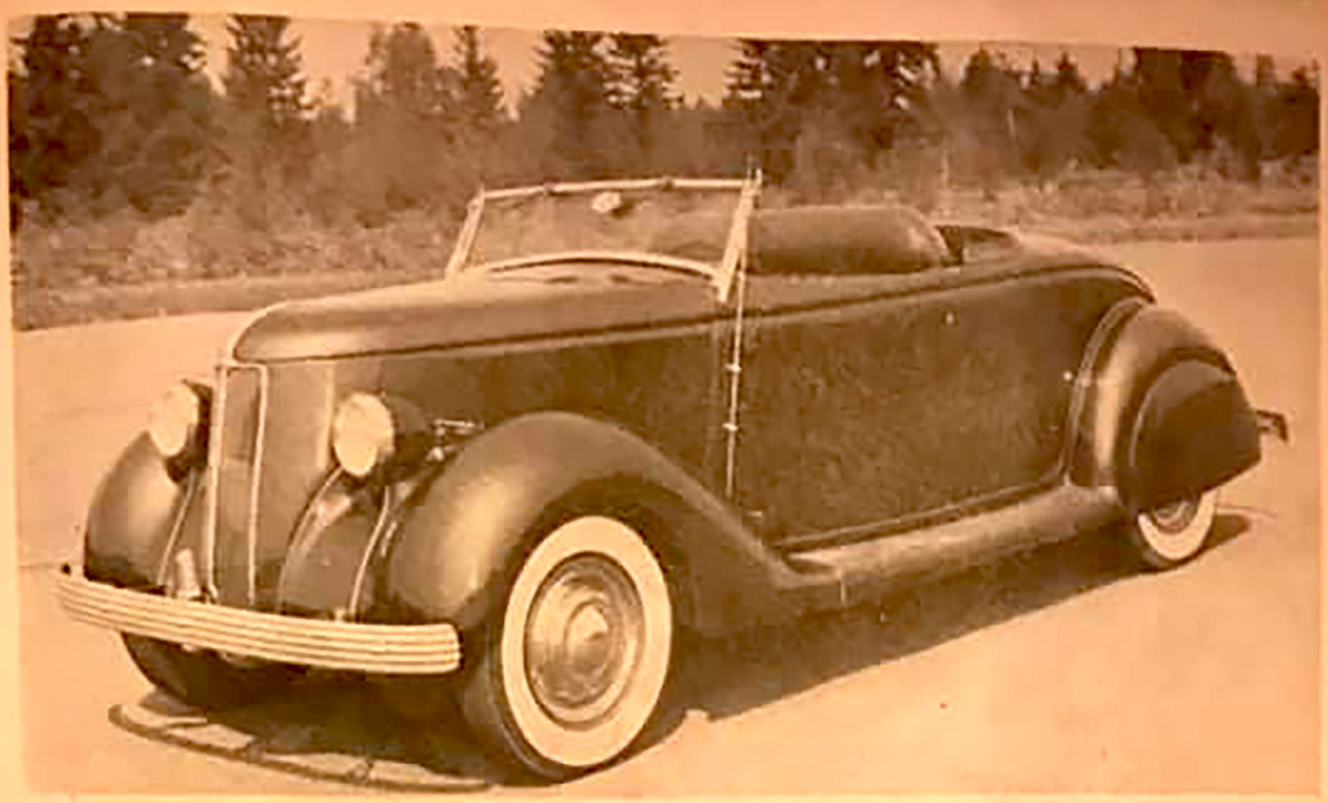
require lock nuts, simplifying the adjusting procedure.

The camshaft selected for this engine is a ¾ grind, a grind which performs well at low engine speeds and has good acceleration characteristics in an engine of this size. The cam and crankshaft gears should be replaced to eliminate any possibility of gear knocks or variations in the valve timing.

Porting and relieving have not been mentioned in connection with this engine, the reason being that the advantage to be gained by porting and relieving an engine of this type does not justify the expense involved. Of course if one has the equipment and wishes to do his own work, polishing the ports would be permissible on this engine, but it should not be relieved unless special heads are to be used.

The crankshaft bearing journals should be inspected for nicks or scores and each journal should be checked in at least four places with a micrometer to determine the amount of undersize, taper or out of round condition. Any journal with a taper of more than .001 of an inch, or out of round more than .001 of an inch, should be reground to the next standard undersize. Journals that are not round, or within the tolerances specified, may throw excessive amounts of oil on the cylinder walls, causing abnormal oil consumption. Out of round or tapered journals may also shorten the life of the bearing inserts.

With all the parts to be used in the engine either renewed or replaced, the engine is now ready to be thoroughly cleaned and assembled. If the cylinders have been honed they must be cleaned with generous amounts of soapsuds and warm water to float the grit from the hone out of the pores of the metal. The block is then cleaned with kerosene or solvent and flushed with water pressure to remove all traces of old oil or metal grindings. Water should be forced through the oil passages in the block as a check to determine if they are free of obstructions. Particular attention should be given to the small hard-to-get-at places in the crankcase and valve chamber as the grit and grindings they may contain can contaminate the oil and possibly ruin the engine. Much of the drudgery of cleaning can be eliminated by



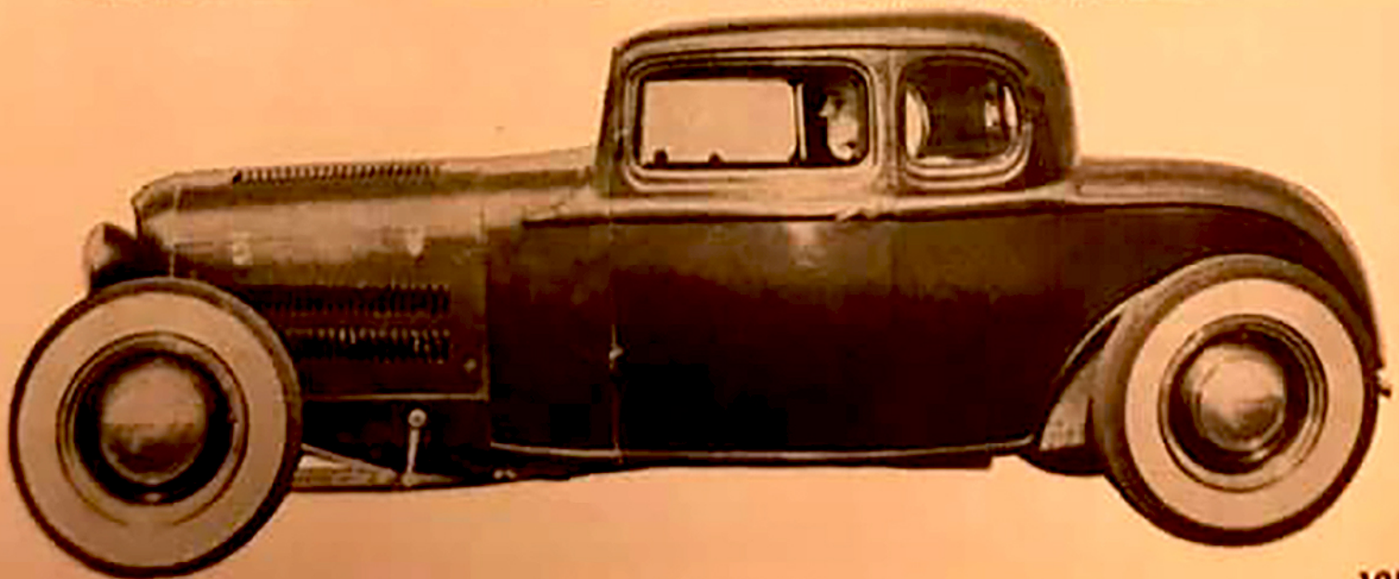
Good looking enough to squire your girl around in, this Ford is a bomb, too—when modified.

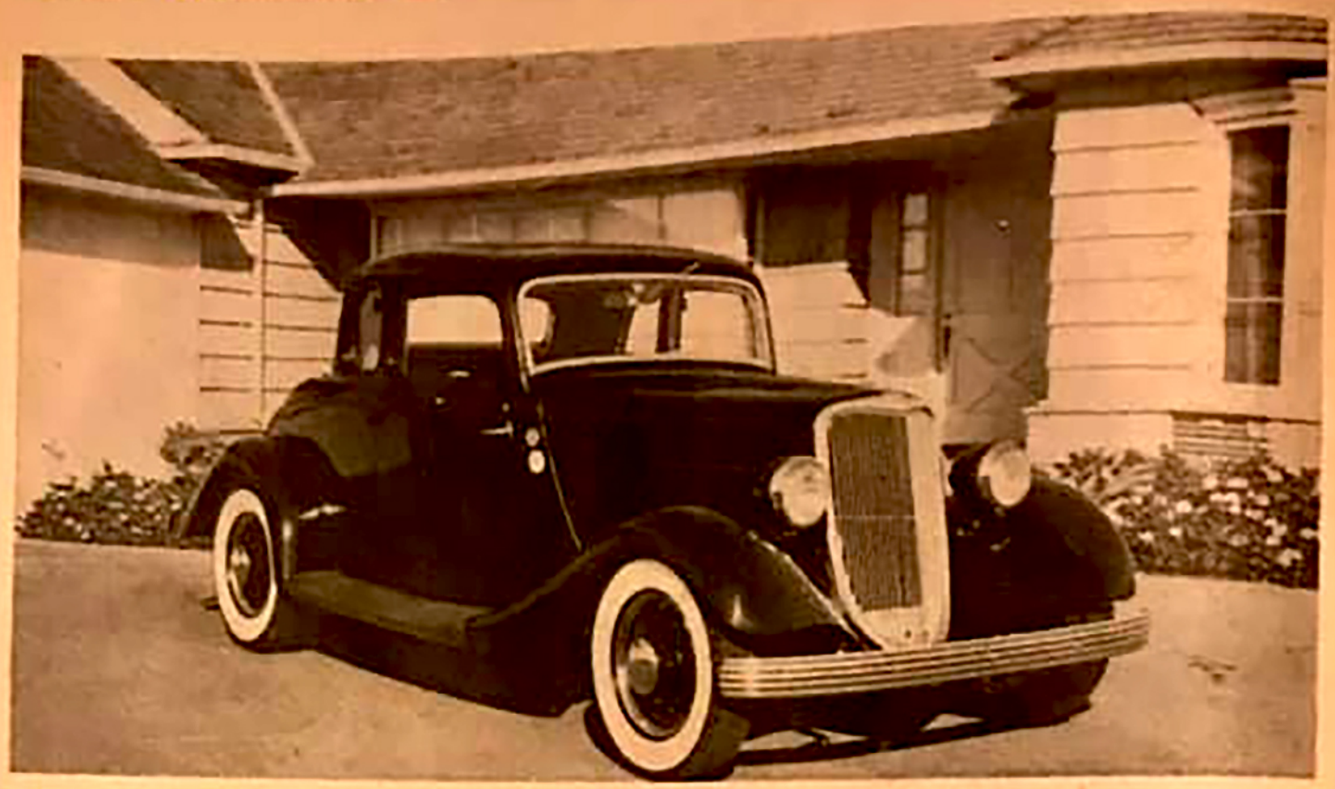
boiling the block in a hot solution of caustic soda or commercial cleaning solution. Most of these solutions are destructive to bearing materials, making it necessary to remove the main and camshaft bearings from the block before boiling. Blocks with poured main bearings must not be boiled unless the mains are to be re-poured, nor should the block be boiled after the boring and seat grinding has been completed as the new metal surfaces will rust quite rapidly. After the block has been thoroughly cleaned and dried the assembling can begin.

Assembly should begin with the installation of the camshaft bearings. The holes in the bearings must line up with the oil holes and the fuel pump rod hole in the bearing bosses. Poured main blocks do not have insert cam bearings but the block can be align reamed and precision type bearings installed. Worn cam bearings can cause a loss of oil pressure.

Install the rear main bearing oil baffle in the block and rear main cap, using sealing compound on the outer circumference to prevent oil leaks at this point. Some blocks use this baffle only in the block as the main bearing cap is machined to be used without the baffle. Select the proper size main bearing inserts and install them in the block. Before installing the crankshaft check the oil passages in the crank to be sure they are clean and free of obstructions. Insert the bearings in the main caps and install the

You can call this a "classic" hot rod, as you find a three-quarter race flathead V8 under the hood.





This 1934 Ford hot rod is an excellent example of conservative styling for a fast machine.

caps and nuts. The nuts should be tightened with a torque wrench to a tension of 75 to 80 foot pounds and locked with safety wire. The crankshaft, if properly installed, should be free to revolve in the bearings without undue effort.

The camshaft and gear may now be installed, using extreme care to prevent scratching the bearings with the cam lobes, and making sure the timing marks on the gears are in line. Be sure the oil pump drive gear is in place on the rear of the camshaft. The oil pump idler gear, gear cover and gasket may now be installed, using five drilled head cap screws which are locked with safety wire.

If the dowels were removed from the crankshaft flange, replace them and bolt the flywheel and dowel retainer in place, using four regular flywheel cap screws, drawing the flywheel up evenly and securely. The cap screws have drilled heads and should be locked with safety wire.

Before installing the piston and rod assemblies, check the rod inserts, which should be cadmium nickel or cadmium silver for an engine of this type, to determine if they are the correct size for the crankshaft throws. The "spread" of the inserts should be also checked, which is done by measuring the outside diameter of the insert at the parting edge with a suitable micrometer caliper. This diameter should be 2.217 inches to 2.227 inches for Ford engines with crank-throw diameters of 1.999 inches standard, and 2.357 inches to 2.367 inches for Ford and Mercury crank-throw diameters of 2.139 inches standard. These measurements are the same for undersize inserts, as they are undersize on the inside diameter only. Inserts that do not measure within these limits can be corrected by placing the insert on a smooth piece of wood, parting edge down, and striking it lightly with a rubber mallet to increase the spread, or standing the bearing on one parting edge and tapping it lightly with the mallet on the opposite edge to decrease the spread.

A good piston ring compressor should be used when installing the piston assemblies in the block and extreme care must be exercised to prevent ring breakage when placing the compressor on the pistons and when inserting the pistons in the block. Tap the piston into the bore and guide the rod over the insert to prevent scratching the bearing. With the rod down on the crank pin and both halves of the insert in place, the rod cap, rod nut locks and nuts are installed and torqued to 40 foot pounds for plain nuts and 45 foot pounds for self-locking nuts. Rod nut locks are obtainable at Ford and Mercury dealers and consist of metal washers with ears which are bent after the nut has been tightened to lock the nut in place.

After the pistons and rods are in place the tappets and valve assemblies may be inserted in the proper ports and the valve guides locked in position with guide locks. It is important that the guide locks are placed in the lock groove of both halves of each assembly, as it is possible to lock only

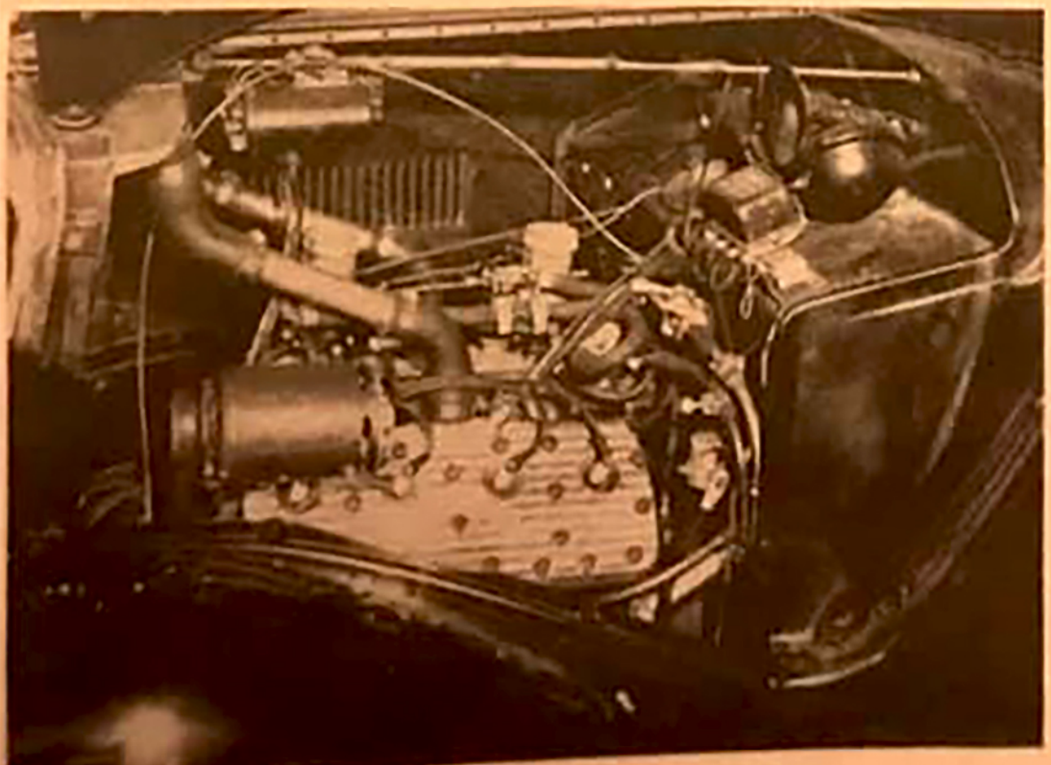
one half of the guide in position and allow the other half to protrude into the valve port and either hold the valve open or cause a knock.

To adjust the tappets the crankshaft is rotated until the tappet to be adjusted is resting on the heel, or low part, of the cam. Insert a punch or rod in the hole previously drilled in the tappet boss and through one of the slots in the tappet. The clearance between the tappet screw and valve stem may now be increased or decreased by turning the adjusting screw with a suitable wrench to obtain the clearance recommended by the cam grinder. Snap the valve chamber oil return hole baffle into place.

At this point it is possible to ascertain the amount of modifying necessary to be done on the stock cylinder heads to provide a suitable increase in compression. After the heads have been milled, or planed, .070 of an inch to .080 of an inch they must be checked on the block to determine the amount of material necessary to be removed to provide sufficient clearance over the pistons and valves. To check the clearance, place a strip of modeling clay approximately 3/16 of an inch wide and 1/8 of an inch thick across each piston and valve in one bank of the engine, at right angles to the crankshaft. Place two head gaskets and a cylinder head on this bank, run 5 or 6 nuts down securely to hold the head in place, and rotate the crankshaft at least two complete revolutions. A clearance of .050 of an inch to .060 of an inch is desired over the pistons and valves when one gasket is used under the head, so with two gaskets the thickness of the clay should be .050 of an inch or .060 of an inch plus .055 of an inch, the approximate thickness of a compressed head gasket, a sum of .105 of an inch to .115 of an inch. Remove the head and check the thickness of the clay, which can be done quite accurately with a suitable micrometer caliper. Subtracting the thickness of the clay from the desired .105 of an inch to .115 of an inch will give the amount of material which must be removed by doming or flycutting. After the heads have been machined and cleaned the clearance should be rechecked. Install the head gasket and head and torque the nuts to a tension of 50 to 60 foot-pounds.

Assembling the rest of the engine is routine as stock parts are used with the exception of the ignition, which may be equipped with double springs. Parts of the engine which require lubrication should be generously coated with a good brand of S.A.E. 30 or 40 oil when being assembled. A late model 80 pound oil pump is recommended in place of an early model 50 pound pump.

When starting the engine do not pour raw gasoline down the carburetor throat, but instead fill the carburetor bowl by blowing in the gas tank or by pouring gasoline directly into the bowl. Do not start the engine with the bowl cover off the carburetor as a backfire through the carburetor may ignite the fuel in the bowl. A reliable brand of oil, viscosity depending on the prevailing temperature of the locality, should be used in the engine to assure good lubrication during and after the break-in period. ■



Once considered full race, this engine is now ideal for street use.

HOT ROD PHOTOS