TEST REPORT: NEW OLDS '88'

HOT ROD

The Automotive "HOW-TO-DO-IT" Ma

ENGINE ADAPTORS

NEW POWER for YOUR CAR

FEBRUARY 1957

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INDEX CHART

SEE PAGE 38

Here's what happens when you "throw the book" at your . . .

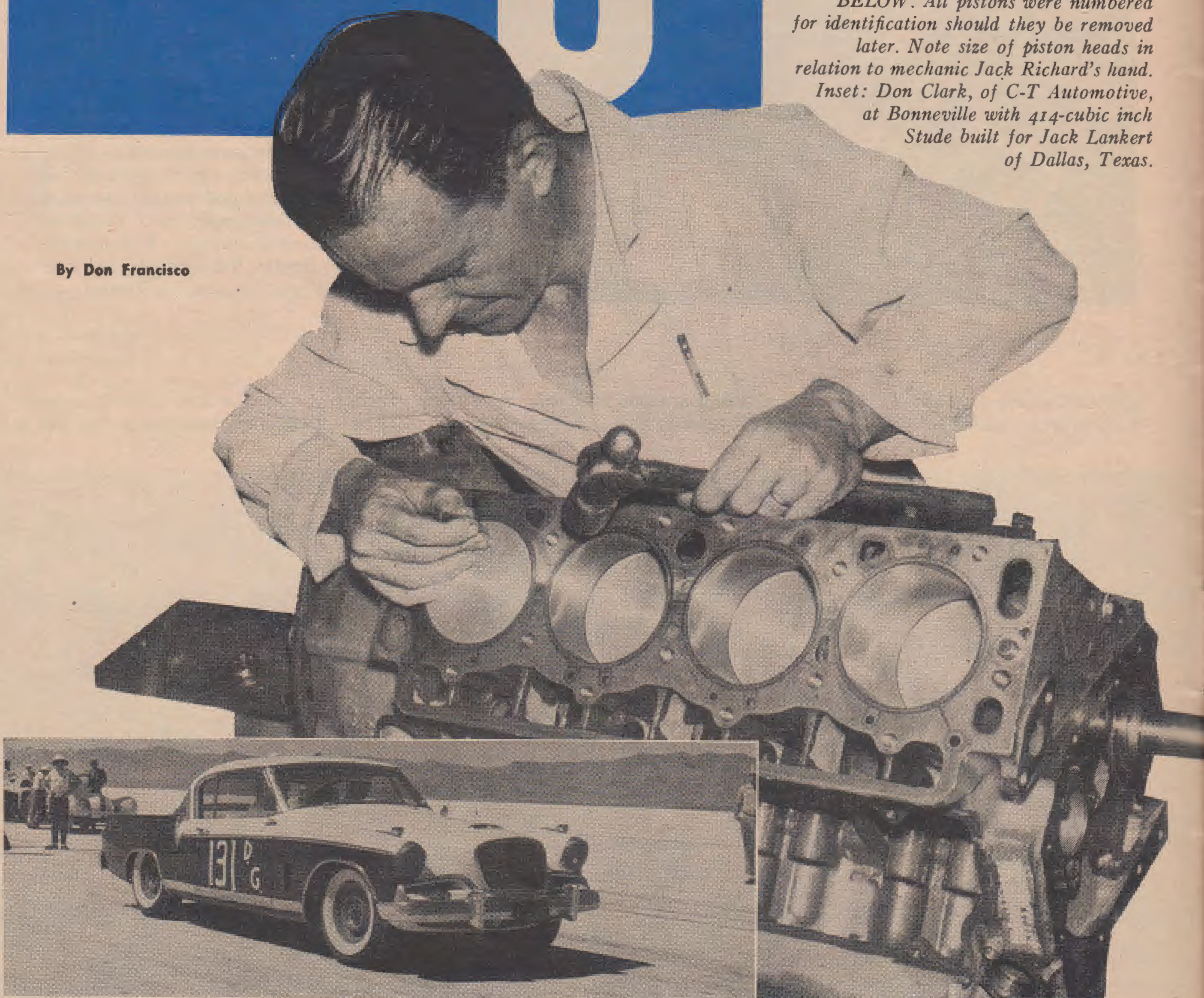
STUDE, PACKARD, NASH or HUDSON BIG 8

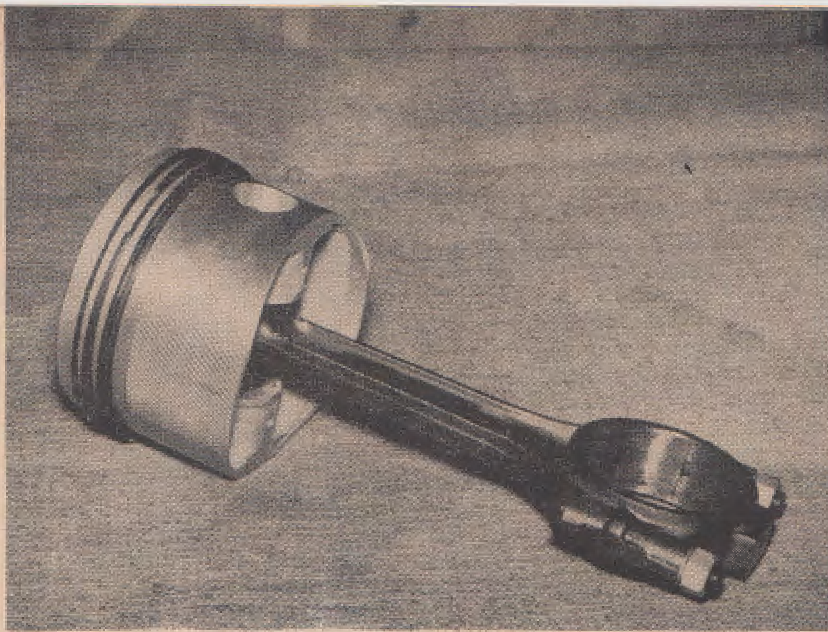
By Don Francisco

It was a happy day for motorists in general when the big wheels who design the automobiles most of us drive got the "go" fever not so long ago and borrowed some of the hot rodders' sacred devices to make them stock equipment on their formerly dull machines.

The men of Detroit, Dearborn, South Bend, etc., started their revolution slowly. First, they dumped the L-head design, then they started boring and stroking, annexed dual exhaust systems, upped compression ratios, went crazy with big valves and wilder cam grinds, added four-throat carburetors and then dual four-throats, and then leveled off with a better ignition system through the use of twelve-volts. All this added up to quite agreeable transportation that was something of a pleasant shock to the average Joe who, before this,

BELOW. All pistons were numbered for identification should they be removed later. Note size of piston heads in relation to mechanic Jack Richard's hand. Inset: Don Clark, of C-T Automotive, at Bonneville with 414-cubic inch Stude built for Jack Lankert of Dallas, Texas.





One of the rod and piston assemblies used in the engine. The rod is stock but the piston is Jahns racing type with knurled skirt. Piston rings are by Grant.

didn't know such things were possible. The man who used to look down his nose at anything he thought was a hot rod became eager to buy one of the factory versions when he discovered what enjoyable automobile performance was.

One of the more lightly disguised factory hot rods was the 1956 Studebaker Golden Hawk. The Golden Hawk is only one of a series but it is the greatest Hawk of them all from the standpoint of gittin' and goin'. The factory boys took a whole page, and, we might say, one of the better pages, out of the hot rodder's bible when they built this critter. They took the smallest and most streamlined car in their line and put a big, hairy engine in it, just as the rod boys have been doing for lo, these many years. It was a happy step in the right direction.

The '56 Golden Hawk was powered by one of the Packard line of V8 engines. This, of course, was made possible by the fact that Studebaker and Packard merged some time ago to form one corporation. Studebaker-Packard also built engines for other makes of cars in 1956 but they reserved the two largest models for their own use. One of these was a brute of 374 cubic inches and the other was a junior version of the brute with 352 cubic inches. The junior version was used in the Golden Hawk.

Both of the larger Packard engines have the same piston stroke of 3½ inches but they vary in their cylinder bore diameters. The brute has a bore of 4⅛ inches and junior a bore of 4 inches. In other respects, such as valve diameters and physical size, the engines are the same.

As could be expected, the performance of the '56 Golden Hawks, with their 275 advertised horsepower, was good, but also as could be expected, not good enough for some of the fellows that bought them. One of these fellows is Jack Lankert. Just what Jack expected from his Hawk we don't know, although the facts that he bought an overdrive-equipped stick-shift model and that he also drives a Chevrolet Cameo pickup with a full-house Chrysler V8 under its hood might be clues of some importance. His stable also embraces a Cad-powered '53 Stude coupe!

Jack took his Hawk to C-T Automotive in North Hollywood, California, and told Clem and Don (they own the joint) to give it the works. This in itself was a doing of some magnitude, in view of the fact that Jack lives in one of the settled areas—Dallas by name—of the great state of Texas, but he did it. And telling the boys at C-T to give a car the works is like opening the door at Fort Knox and inviting Charlie Hobo to help himself; Charlie won't miss a thing and neither will the gang at C-T.

As is customary with most engine conversions the first step at C-T was to pull the engine out of the Hawk and take it apart, piece by piece, to see just how it was put together. This was the first of the breed the C-T crew had been turned loose on and there were things they had to learn about it before they could give it the treatment. After poking and feeling and measuring here and there it was decided to bore the engine's cylinders an eighth of an inch and stroke its crankshaft three-eighths of an inch. This was just the start, of course, because there would be other things to do later.

A few minutes with a slipstick brought to light some interesting information on the changes the boring and stroking would make in the engine. The most startling of these was that the displacement would be boosted to a staggering 414 cubic inches. This is an increase of 62 cubic inches, or 17.6 percent. Of this increase, 38 percent would be due to the boring and the other 62 percent to the stroking. Piston head area would be increased from 12.55 square inches to 13.36 square inches, or 14 percent. Individual cylinder capacity would jump from 44 cubic inches to 51.75 cubic inches. The compression ratio would automatically be boosted from the stock 9.5 to 1 to approximately 11 to 1, which is plenty high for gasoline. So much for figures.

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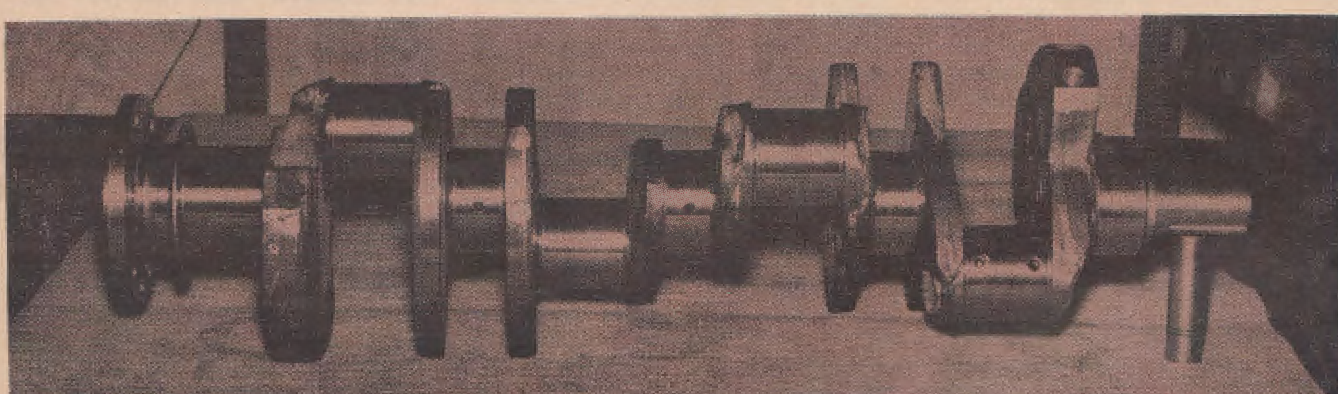


The three-eighths-inch stroker crankshaft used in the Packard engine in the Hawk was stroked by C-T's very successful welding process and then balanced in their shops. Balancing process involves entire crankshaft and rod and piston assembly.

Boring the cylinders in the block an eighth-inch oversize presented no problems because of the more than adequate thickness of their walls. From the apparent thickness of the walls after the boring it looked as though the cylinders could have been enlarged at least another quarter of an inch without any trouble at all; however, this is just speculation and not to be taken for the gospel truth.

The cylinders were finished to a diameter .008 of an inch larger than the top of the skirts of the Jahns three-ring pistons that were to be fitted. Ring grooves in the pistons are 5⁄64 of an inch wide for the top and middle rings and 3⁄16 of an inch for the oil ring. Piston pins supplied with the pistons are stock diameter.

After the pistons were fitted to the cylinders their skirts were knurled to enlarge them a total of .006 of an inch. Knurling is a commercial process of creating hundreds of raised marks on the skirts of pistons to make the diameter of the skirts larger. Knurling helps stabilize a piston in its cylinder and when it has worn down to its working height it provides an additional benefit of reducing the friction of the skirt on the wall of the cylinder.

The piston pin bushing in the connecting rods and the pin holes in the pistons were honed to an easy push fit for the pins and then the rods and pistons were cleaned thoroughly and the pistons assembled on the rods. Conventional wire-type locks retain the full-floating pins in the pistons.

The piston and rod assemblies were aligned on an aligning fixture to bring the axis of the pistons into alignment with the vertical centerline of the rods. This is a necessary operation because it is possible for a rod to be bent or for the pin bore to be off slightly in a piston. Either of these conditions causes undue loads on the rod's bearing and higher than normal friction between the piston and the walls of its cylinder.

As with most strokers, it was necessary to grind slots in the lower end of each of the cylinders to provide clearance for the rod assembly in the cylinder directly opposite. In other words, the slots ground in one bank of cylinders were to provide clearance for the rods in the other bank. The exact spots for the slots were found by installing the crankshaft temporarily in the block and then inserting a rod and piston assembly, less rings, in one of the cylinders of each bank and securing them to their respective crankpins. The crankshaft was then rotated by hand and the spots where the ends of the cap retaining bolts and the lock nuts on the bolts hit the ends of the cylinders were marked. The rod and piston assemblies were removed from the block and grooves were ground in the same relative location in the cylinders of both banks. The grooves were ground to a depth of approximately 1⁄4 of an inch and to a width of about 3⁄4 of an inch. There is plenty of material in the area where the slots must be ground so there is little chance of grinding into the water jacket if one uses reasonable caution during the grinding.

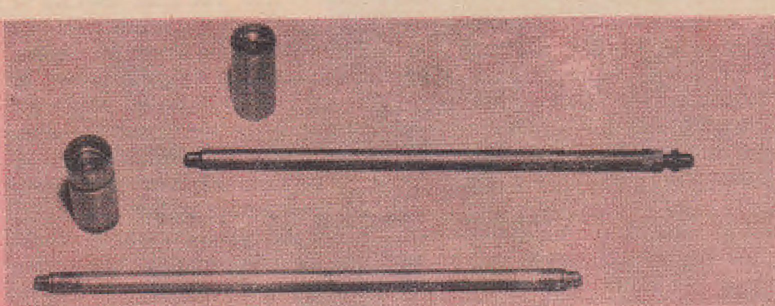
After a thorough cleaning of its internal and external surfaces and the installation of new camshaft bearings, the block was ready to go.

The crankshaft was stroked with the regular C-T welding process that involves enlarging the crankpins by laying bead after bead of welding rod on them with an arc welder. The pins are then ground to size but on a new center to give the throws the desired stroke. The crankpins on the Packard shaft have large holes through their centers that caused one side of each of them to be somewhat thinner than the opposite side after they had been ground for the new stroke. This condition made the shaft something of an unknown quantity but from all indications the stroked pins are strong enough to carry the load because so far they haven't given any trouble under severe running conditions.

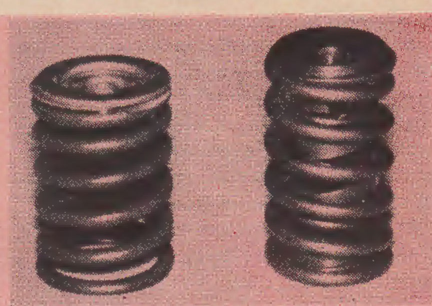
When the shaft's main bearing journals and crankpins were ground they were finished to diameters slightly smaller than the smaller diameter allowed by the factory tolerances. The theory behind the smaller journals and crankpins is to allow a bit more running clearance for the bearings than they would have if they were of the specified diameters and thereby permit a greater quantity of lubricating oil to flow through them for better lubrication and cooling. If done in moderation, a slight amount of additional bearing clearance can be a good thing in an engine to be run mostly at high speed but if carried to an extreme additional clearance can lead to short bearing life and excessive oil consumption. The excessive oil consumption could result from the inability of the piston rings to control the greater quantities of oil that would be thrown onto the cylinder walls by the bearings as the crankshaft rotated.

Factory tolerance for the main bearing journals is from 2.50 inches for the larger diameter to 2.499 inches for the smaller diameter. However, to restore them to their original round condition, the journals were to be ground to the standard undersize of .010 of an inch, which would make the low side of the tolerance 2.489 inches. To provide the desired additional clearance, the journals were finished to 2.488 inches, which is .001 of an inch smaller than the tolerance would allow for a .010-inch undersize journal. Tolerance for the crankpins is from 2.503 inches for the larger diameter to 2.2497 for the smaller diameter. The pins were finished to 2.2490 inches, which is .0007 (seven ten-thousandths) of an inch smaller than allowed by the low side of the tolerance. After the grinding was finished, the journals and pins were polished with a motor-driven emery belt.

The entire crankshaft and connecting rod and piston assembly was balanced to precision tolerances on the specialized balancing equipment in C-T's shop. The parts that were balanced included the pistons, connecting rods, crankshaft, flywheel, and clutch pressure plate and cover



The Packard pushrod and hydraulic valve lifter, bottom, and Iskenderian chilled cast-iron lifter and adjustable pushrod used with reground cam.



Left, stock Packard spring. Right, special dual spring and hardened retainer washer.

assembly. Rebalancing of these parts of a V8 engine after any of them have been altered in any way or been replaced is absolutely essential. The vibration characteristics of the engine depend on the balance of these parts as a unit, making balancing an operation as important as any other in the construction of the engine.

A set of Grant piston rings, consisting of a plain compression ring for the top groove, a scraper type for the second groove, and a cast-iron type with an expander for the third groove, were fitted to the cylinders individually and their ends filed to give them a minimum gap clearance of .019 of an inch. Establishing the correct gap clearance is important when installing new piston rings because the gap allows the rings to expand when they become hot without the danger of the ends butting together and causing the rings to buckle and break.

Installation of the crankshaft and rod and piston assemblies in the block was accomplished without difficulty. Factory-quality bearing inserts with micro-thin bearing surfaces were used on the main bearing journals and crankpins. Better quality bearings would be welcome for engines of this type but at the present time they aren't available.

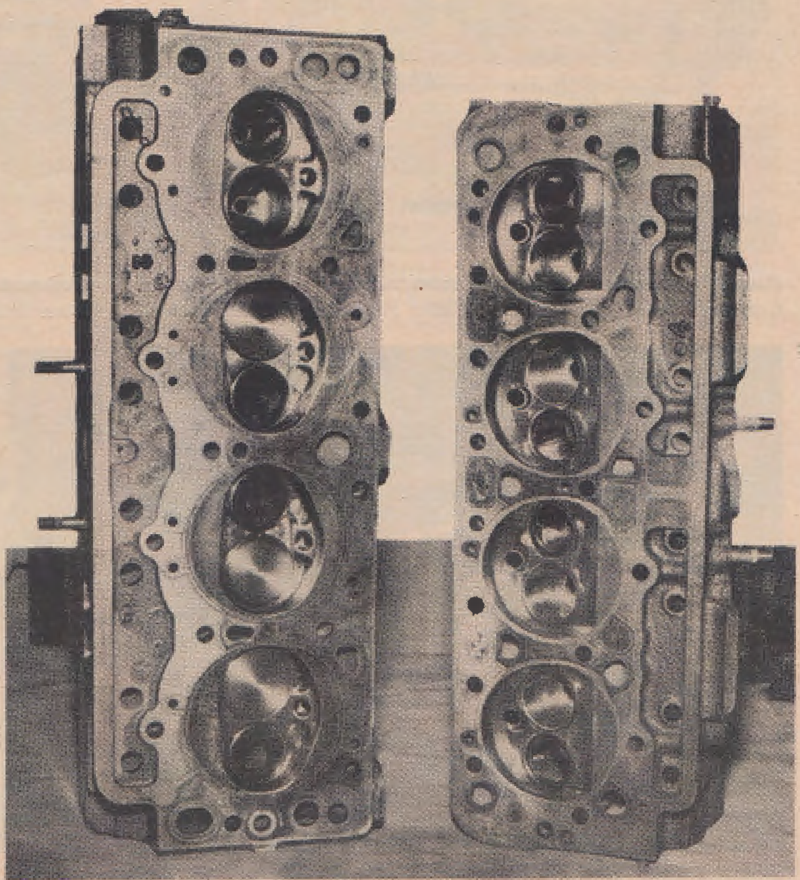
When flathead Ford and Mercury engines were at the peak of their popularity it was possible to buy high-quality rod bearing inserts with cadmium-nickel or cadmium-silver bearing material for them and in many instances these bearings were the salvation of the engine, but such high-quality bearings aren't being made for the more modern engines and it is necessary to get along with what is available. However, the bearings in most late model engines haven't been too critical a factor as far as material is concerned because they have sufficient area to carry the loads imposed on them. Other features of the newer engines that have helped prolong bearing life are their much stiffer crankcases and crankshafts that do not flex as much as those in earlier types of engines. Flexibility in a crankshaft or crankcase can cause localized areas of high pressure between the shaft's journals and its bearings.

The stock cylinder heads were reworked to the extent of grinding and smoothing their intake and exhaust ports and passages to the same dimensions as the openings in stock gaskets and enlarging their valve seats slightly to match the larger diameters of the valve faces. The finished intake ports measured 1¾6 inches wide by 2¼6 inches long, the end exhausts were 1⅛ by 2¼6 inches, and the center exhausts were 1⁷⁄₁₆ by 2¼6 inches. The center exhaust ports of these engines are "siamese" ports that serve the two middle cylinders of the cylinder banks. Combustion chambers in the heads were not altered in any way.

Valve seats in the heads were finished to widths of approximately 1/16 of an inch for the intakes and 3/32 of an inch for the exhausts. Factory specified seat angles are 29 degrees for the intakes and 44½ degrees for the exhausts but this is cutting it a little close for the average shop to duplicate. Thirty and 45 degrees should be close enough for all practical purposes. Stock valves were used but the intakes were lightened a fraction by taking a cut of .030 of an inch from the top surface of their heads. Diameters of the valves are 2 inches for the intakes and 1.688 inches for the exhausts.

A special set of dual valve springs was used in place of the stock single-spring setup, but before the dual springs could be installed it was necessary to reduce the outer diameter of the heads' integral valve guides with a special cutter to enable the inner springs to slide over the guides. For outer springs a set of Oldsmobile (1952 to '55) springs were used and the inners are special Iskenderian springs. At their specified installed length of 1 13/16 inches the springs exert a combined pressure of 125 pounds with the valves on their seats. Special Iskenderian hardened spring washers were used with stock split retainers. Stock washers have been found to be too weak to hold the tension of dual valve springs at high engine speeds. When a washer fails, it slides over the split locks and allows the valve to drop into the cylinder. This isn't good.

An Iskenderian hard-faced "E2" camshaft actuates the valves through Iskenderian chilled-iron lifters, adjustable pushrods, and stock 1.6 to 1 rocker arms. Adjustable pushrods were necessary because the original valve train had hydraulic lifters and no means of adjusting valve lash.



For comparison, Cadillac head was placed next to one of the Packard heads. Additional length of Packard head is indicative of the engine's huge size.

Valve timing with the E-2 camshaft is as follows: Intake valves open 18 degrees before top center and close 58 degrees after bottom center, and the exhausts open 56 degrees before bottom center and close 20 degrees after top center. Lift of both the intake and exhaust valves is .420 of an inch. Lash for all valves is .018 of an inch.

When the camshaft was installed in the cylinder block a check was made of the clearance between the upper side of the lower end of the connecting rods and the camshaft as the crankshaft was rotated slowly by hand. In some engines

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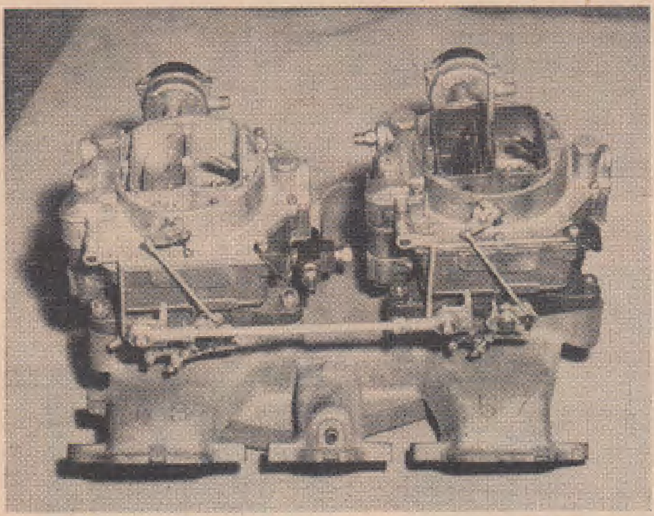
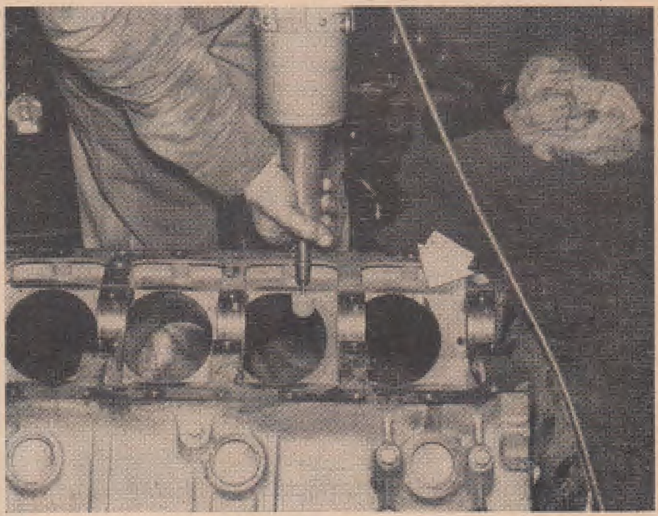
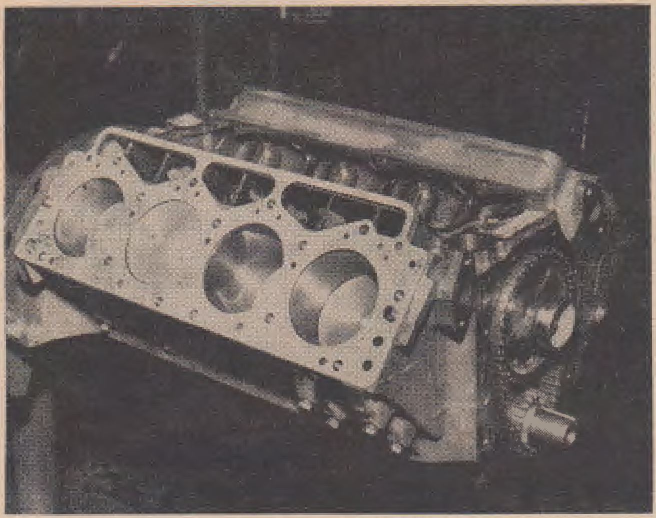


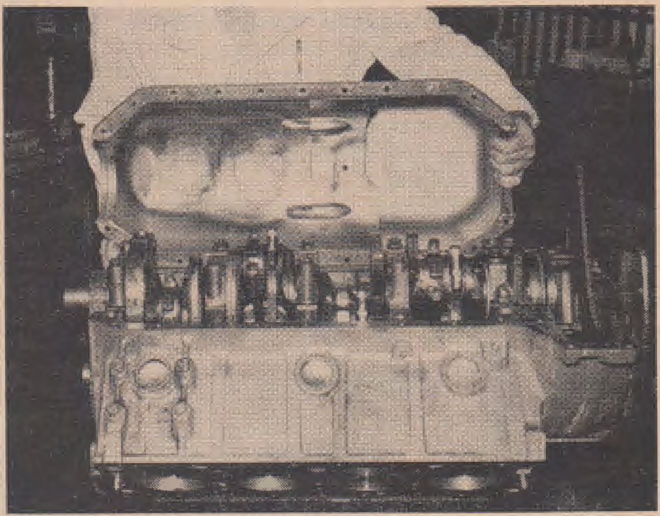
Packard Caribbean dual intake manifold used on the Stude V8. Carter carburetors shown were later replaced with Rochesters.



Common practice when stroking engines is that of notching the lower end of cylinders for con rod clearance. Arrow shows cut.



Although original head gaskets had 4¼-inch diameter cylinder openings, available replacements had only 4⅛-inch diameter.



Dimples were pounded into bottom of oil pan and baffle to make clearance for lower ends of con rods on front three throws.

a stroked crankshaft will cause interference between the rods and the camshaft because of the greater arc described by the rods as a result of the longer stroke. But in this engine all was well; all rods cleared the cam with room to spare.

Head gaskets that came on the engine had cylinder openings 4¼ inches in diameter which would have provided ample clearance for the overbore, but in the whole city of Los Angeles it was impossible to find a new set of gaskets of this type. The only ones that could be found had openings 4⅛ inches in diameter, the same as the cylinders. It was thought these gaskets would be satisfactory so they were given a coat of Aviation Permatex and installed and so far they haven't given any indication of trouble. One thing in the favor of the gaskets used on these engines is that they are of the steel, single-layer embossed type that gives so much better service than steel-asbestos or copper-asbestos gaskets. The heads were torqued to the factory specified tension of 60 foot-pounds.

Originally the oil pressure in the engine was forty pounds at all speeds and conditions and an effort was made to raise the pressure by inserting a flat washer about .050 of an inch thick between the outer end of the oil pressure relief valve spring and the cotter pin that holds the spring in the oil pump housing. This change raised the pressure to fifty pounds with SAE thirty oil in the crankcase.

When it came time to close the engine by bolting the oil pan onto the block it was found that the connecting rods on the front three of the crankshaft's crankpins hit the pan when the shaft was rotated. This condition was corrected by heating the pan in the interference areas and beating some dimples in its surface. Each of the dimples covered an area about three inches long and two inches wide and was approximately ⅜ of an inch deep. After this modification the pan was installed without difficulty.

Carburetion for the monster was increased from one to two carburetors by replacing the stock intake manifold with one made for a Packard "Caribbean." The Caribbean is the high-powered model of the Packard line and it has two carburetors as stock equipment. The manifold is a cast-iron affair that is in effect two logs side by side with an equalizer between them. Each log serves four of the engine's cylinders. Cast into the under side of the manifold is a heat chamber that is somewhat circular in shape and that has an outer diameter limited only by the manifold's width and length. Ports in the manifold measured $1\frac{3}{16}$ by $1\frac{15}{16}$ inches before they were ground to align them with the ports in the heads.

It was thought that the Caribbean manifold would bolt to the engine without any difficulty but it was found that the rear portion of its heat chamber rested on the breather pipe attached to the rear of the tappet chamber cover. To make room for the heat chamber, the top of the pipe was heated and partially flattened. Other than for this slight change the manifold went into place just like the stocker.

Stock manifolds and the original dual pipes comprise the exhaust system. The manifolds are quite large and they should have adequate capacity to handle the greater displacement of the bored and stroked engine without difficulty.

A Scintilla Vertex magneto was installed in place of the stock battery ignition. A magneto is hotter at high engine speeds than the stock distributor would be and a hot spark is necessary to fire the 11 to 1 compression ratio of the converted engine. The mag was adjusted to provide a maximum of 31 degrees advance. Stock spark plugs were installed for the running-in period. Plugs for this engine have ¾-inch reach, 14mm threads.

Golden Hawks are factory equipped with a mechanical tachometer driven by a take-off built into the ignition distributor, but when the tach drive was eliminated by the substitution of the magneto for the stock distributor it was decided to install a Sun Electric tachometer in place of the mechanical unit. The transmitter for the Sun head was mounted on the engine side of the firewall and the head was mounted in the instrument panel in the opening provided for the mechanical head. No alterations were necessary to the instrument panel or the head for the installation.

As the car was scheduled for some severe competition use immediately after it would be ready to run, it was fitted with a special clutch driven disc on which the friction facings had been both riveted and bonded directly to the disc. This makes a sturdy assembly but it eliminates the flexibility normally provided between the facings by the flexible steel member that usually holds them apart. Interposing a flexible member between the facings allows the disc to take up the load from the flywheel gradually and thereby transmit it to the transmission with less of a tendency for the clutch to chatter than it would have otherwise. However, eliminating the flexibility makes the plate assembly stronger and more capable of transmitting the greater torque of a modified engine without failing. For average driving it wouldn't be the wisest thing to modify a clutch in this manner but for competition purposes it is a good move. A stock pressure plate assembly and flywheel completed the torque transmitting link between the engine and the transmission.

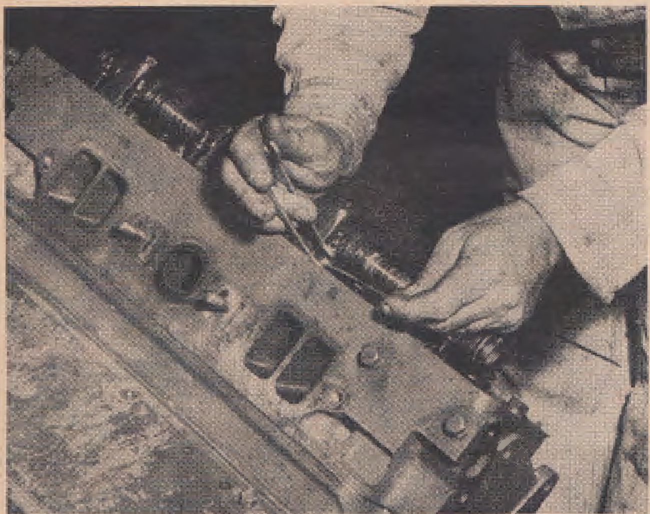
Almost before the new paint on the engine had dried, the car was on its way to Bonneville for the annual speed trials. During the week it was run through the traps several times and its best one-way speed was 141 mph. This was with the standard 3.92 to 1 rear axle ratio, which gives a ratio of approximately 2.74 to 1 in overdrive, and 8.00 by 15 Firestone "500" road tires on the rear wheels.

All was not well at Bonneville with the car. An experimental camshaft was tried first and then replaced with the F2, and trouble was had with the magneto. It was with the malfunctioning magneto that the car ran 141 mph.

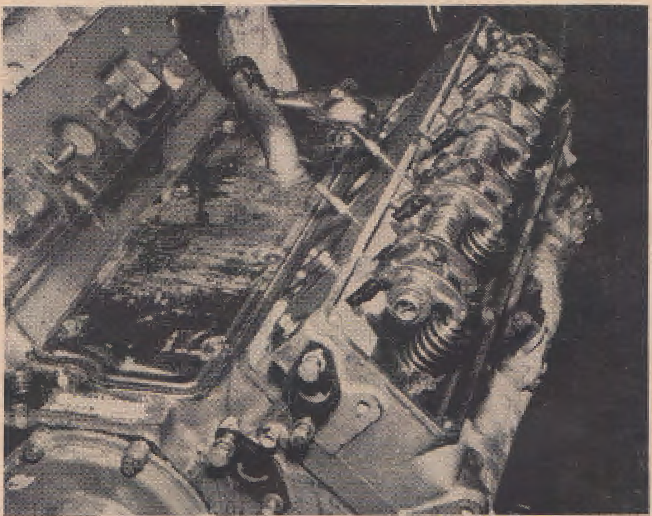
After Bonneville the car was taken back to C-T and a couple of minor changes were made to the engine. First, the magneto was taken care of by double-springing its breaker points so it would wind up as it should, and second, the Carter carburetors were replaced with a pair of Cadillac Rochesters. These particular carburetors have 1-inch primary venturis and $1\frac{3}{16}$-inch secondaries. After these changes the engine ran much better on the road but so far it hasn't been run in any more competition events.

On the road the car is a real bear. The big engine tows it practically without effort, making it a pleasure to drive either in town or on the open road.

That's about all there is to it. For you fellows with Golden Hawks who might be asking for even more performance than you are getting, C-T may have paved the way to happier days. For normal road use, just a boring and stroking job would be hard to beat, and for all-out performance you could include the rest of the goodies. Give it a blast—you'll like it.



Three wrenches are needed to adjust valve lash; one to hold pushrod, one to hold lock nut, one to turn adjusting screw.



Four of cylinder head's 15 cap screws hold rocker arm assembly to head. No modifications on rocker arms, stands, shafts.