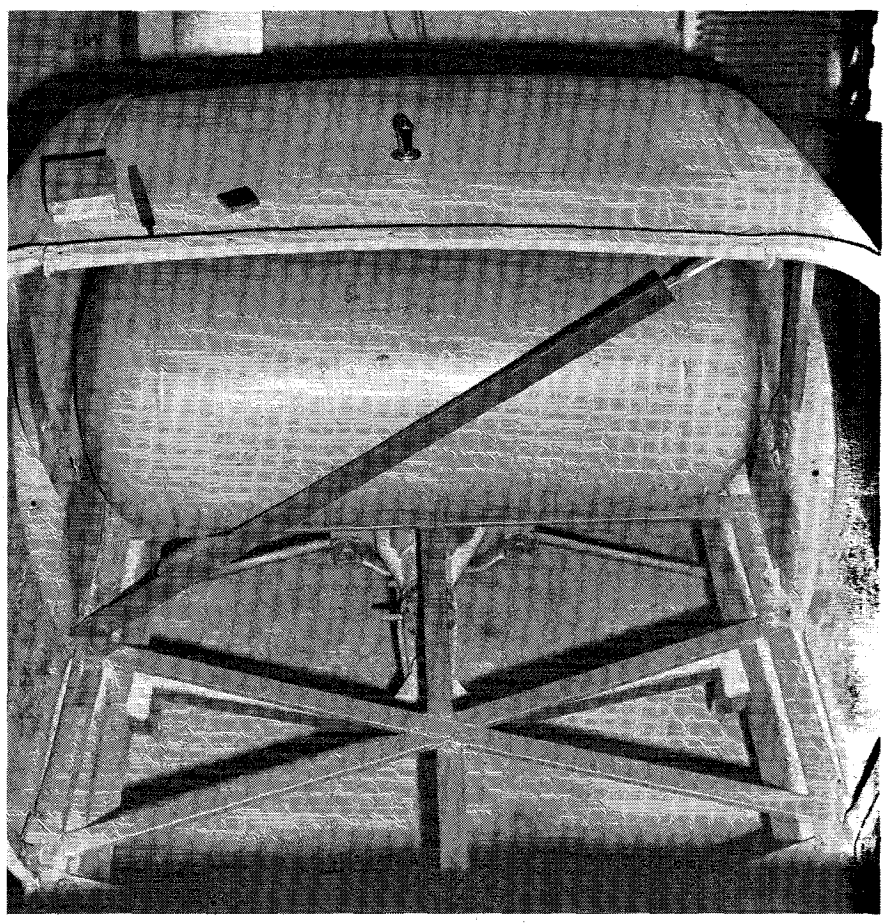
Six Appeal

Low-pollution hot rod power from a turbocharged, propane-burning Ford inline.

TEXT AND PHOTOS BY JAY STORER

If you went to the average drag race, car show or street rod run, you could probably put all of the 6-cylinder fans there into a telephone booth. No one seems to dig inline engines so much anymore, what with the plethora of efficient-performing small-block V-8's now available (or *bent*-8's, as inline enthusiasts are wont to call them). But, as anyone with a memory that goes back to the Wayne-head Jimmy or Frontenac-Ford era can tell you, don't ever make the mistake of ruling out inline motors for hot-rodding purposes. The 4-banger Offys they run at Indy put out over 200 hp *per cylinder!*



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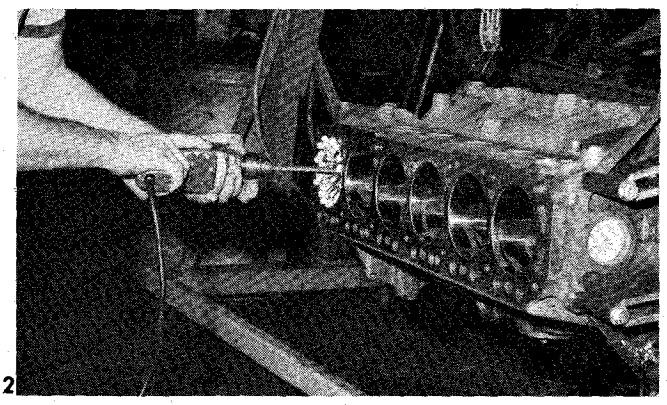
I'd been wanting to build a traditional hot rod roadster ever since I moved from the chill of New England to the sun of So. Calif., with the only problem being making all the decisions about the theme of the car: what kind of engine/trans combo to run, what rear end, etc. When I finally latched onto a '32 Ford roadster body and a pair of rails, all this winter day-dreaming became realizable, and I had to decide what I was going to build. I had had forked-8 engines in every other car I'd had—and they look and sound neat; so, naturally, I had visions of a torquing 455 Olds or high-winding, GMC-blown, small-block Chevy living in that space ahead of the motheaten firewall. But having worked on a few stories with venerable speed scientist Ak Miller, these childish fantasies went out the proverbial window.

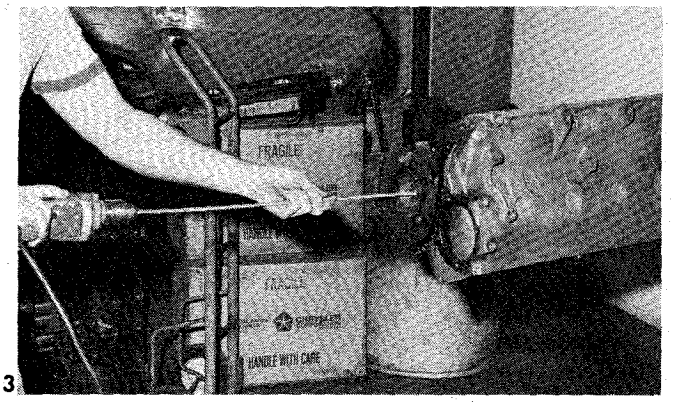
Ak, familiar in racing circles from Bonneville to Pikes Peak to drag racing, has become in the last 10 years or so sort of the patron saint of all Ford fans. In the last few years, Ak has been specializing in "odd" engines such as the Ford 6, Pinto 4-banger and Capri V-6. He has always felt a close relationship to the average high-performance buff on the street, and budget street machines that "do everything right" are what he's after. It's high time, says Ak, to return to sensible street performance cars rather than gas-guzzling, multi-cube insurance hogs. As someone with an engineering background who saw the energy/pollution problem coming a long time ago, he's been hard at work on ways to achieve horsepower without increasing fuel consumption or emissions. Ak Miller Enterprises' (9238 Bermudez, Pico Rivera, Calif. 90660) main stock in trade now is turbocharging and propane conversions, and they have kits available for a number of different applications—not restricted entirely to Fords, either. They also sell AiResearch turbos and parts to make your own setup, and have made installations on everything from minicars to a 4-cam V-8 Aston-Martin Lagonda.

WHY A TURBO?

Busy as he is, Ak is always a fountain of knowledge to anyone with a question and he has no jealously guarded "speed secrets" hidden in the rafters of his mind or his Pico Rivera shop. "A lot of what you read and hear in hot rodding circles about how an engine works or what makes it go is so much romance and crud," says Ak dryly. "An engine is simply an air pump and generally obeys simple laws of physics at all times." As a myth-exploder of the first order, Ak is the kind of hardened automotive veteran whom you can't be around long without learning something. He's been in and out of more races, factory R&D labs, books and skinned-knuckle episodes than most of us could experience in a lifetime. So, after listening attentively to the "Pico Rivera Flash" or "the world's oldest hot rodder," the engine choice for a modern/traditional highboy roadster slowly narrowed itself down to one: a 6-cylinder Ford, turbocharged and running on propane gas. This became the basis for the "Clean Street Power Project '32" series that ran in *Rod & Custom* magazine until it was combined this year with *Hot Rod.* The issues of September '72, February and June '73, and April '74 contained articles on the chassis work, but this is the first report on the unusual (for a street roadster) powerplant.

The benefits of supercharging an internal combustion engine should be apparent to anyone who has had even a brush with the automobile cult. The more fuel and air you can

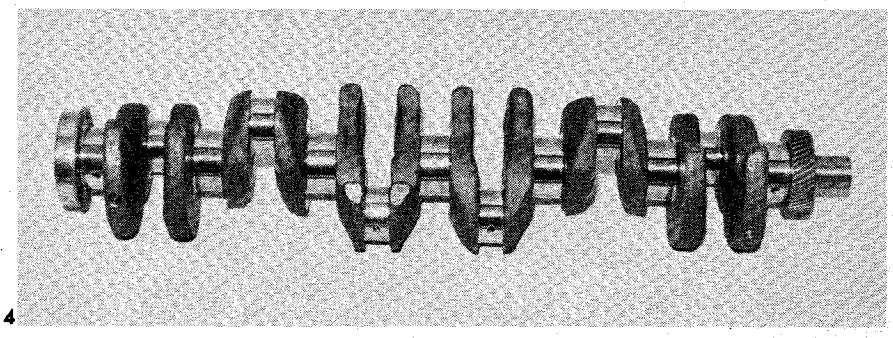




1. There'll be no seating in the '32 rumbleseat when this propane tank is mounted. Using LPG fuel in a street rod may be unusual, but will allow our 300-in. Ford 6 to run clean and strong—without mixture problems.

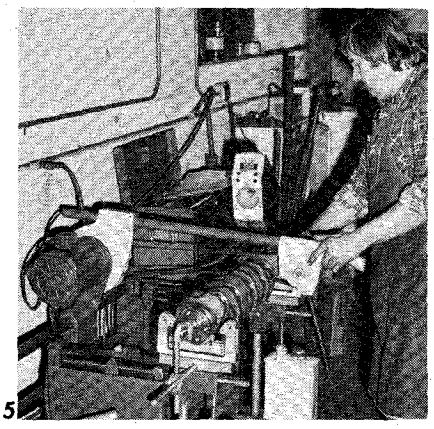
2. Larry Atherton of A&W Performance Products final-hones our 240 motorhome block with a Flex-Hone, which leaves a beautiful, oil-retentive surface on the cylinder walls.

3. A smaller Flex-Hone with a long shaft was used to hone the new cam bearings for good break-in and no sharp edges on the bearings to nick the cam during installation.



4. Our 240-in. 6 was stroked to 300 ins. with this forged-steel beauty. Heavy-duty truck crank (C5TZ-6303-D) is a drop-in in the block, but you must use different rods, pistons.

5. Inline cranks can't be balanced 100% because the throws are not at 90°, but Alan Welch of Automotive Balancing spins ours up to improve on the factory balancing. Alan then polished the journals for good oil flow and low friction/wear.



6. With heavy crank set in place, all the main caps were torqued down except the fifth main, which is the thrust cap on this engine.

cram into a combustion chamber, the more power comes out, and a supercharger just provides the extra pressure above atmospheric to fill those cylinders. A turbocharger does this too, but unlike mechanically driven, positive-displacement blowers like the familiar GMC, a turbo takes no power from the engine to drive it. On a typical fuel Chrysler with a tight GMC 6-71 with overdrive, it may take as much as 100 hp to drive the blower. A turbocharger is driven by the flow of exhaust gases over a turbine, with no wasted energy, and the more hot exhaust your engine pumps out, the faster the turbine goes, making your engine put out more power and more exhaust, and so on. On a street-driven car there are even more advantages. Ordinary mechanical blowers work all the time your engine is running, so your lower-end and head gasket are under this pressure at all times, whether you need it or not. With a turbo, you select the right size relationship of the turbine wheel to the inside size of the housing, and you can then make the boost come in as much as you want when you want it. Because it doesn't work all the time, your fuel economy will be roughly the same as unblown, unless you're heavier with your right foot. Even better, before your vacuum-pressure gauge actually shows any boost, the turbo is lowering vacuum by moving towards the pressure side—and in this range your engine's efficiency is helped considerably. It's easy to switch from street trim to racing trim, too. Since one of the ways to limit boost with a turbo is to restrict the exhaust, you can run 8 lbs. on the street and just by dropping off the exhaust system, whoosh down the strip with 10 or 12 lbs. boost!

WHY PROPANE?

As I mentioned earlier, Ak has been concerned about the air quality problem since long before the legislators made a crusade out of it. The difference is that Ak has been *doing* something about automotive emissions. He's been working closely with the LPG (liquified petroleum gas) experts at Impco Carburetion (16916 S. Gridley, Cerritos, Calif.), who make propane carburetors for every application from Pintos to giant stationary engines. In many ways, propane is an ideal fuel for internal combustion engines. Because it is a vapor (by the time it reaches your engine) instead of a liquid, there are none of the usual mixture problems associated with gasoline. Propane doesn't thin out your engine oil and, in fact, it burns so clean that your engine can run *much* longer without wear. Refuse trucks, and other vehicles that must idle for long periods of time, are usually run on propane because it doesn't carbon up the combustion

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chambers. And, best of all, propane is a low-emissions fuel. Ak's two demonstrator cars, a Pinto and a Maverick—both with turbos and propane—run so clean that California Highway Patrol inspectors couldn't get readings on the exhaust at their roadside checks. A turbocharged, propane-burning Toyota engine used in the last Clean-Air Car Race had a catalytic muffler and the exhaust was actually cleaner than the freeway air going into the air cleaner! This sounded like the way I wanted to go: a trad-looking highboy that was modern underneath and a clean-air car at the same time. Imagine a hot rod that goes fast and doesn't pollute. Propane is ideal for turbocharged applications too, because with its 105-octane rating, you can safely run more boost or compression than with the low-quality gasoline we're getting today. Although there is some power loss when you convert to propane, with a turbocharger you gain back that plus a bunch more.

INLINE POWER

Drag racing fans should be familiar with the track record of the big Ford 6, such as in Bruce Sizemore's H/MP Maverick. A Special Vehicles Product Planner for Ford, Bruce has done extremely well with his budget 300-in. car, running times in the mid-11's with several records to his credit. Basically, there are two families of Ford 6's. The "small-6" line started with the old Falcon 144-in. motor, progressed to 170-in. and 200-in. versions and now, in the new cars, is 250 cu. ins. These are good engines, but they don't have as much to recommend them for high-performance work as does the "big-6" line. Although these are no longer produced, there are plenty around, with the basic one being the 240-in. engine which was used in big Fords, taxicabs, and light-duty F-100 pickups. Rarer, and found only in the pickup trucks, was the optional 300-in. 6. Both the 240 and 300 engines are identical except for the rods, pistons and crank, so parts swapping is easy. What makes this engine so perfect for a street rod are the removable intake and exhaust manifolds (part of the head on the smaller 6's), and a bulletproof lower-end with seven main bearings. And, being a truck engine, lots of *low-end* torque would be assured—while the turbocharger would give us the mid-range and top-end power to cover all the performance bases.

We couldn't locate a complete 300 engine, so we started with the 240. Oddly enough, ours came not from a passenger car, cab or truck, but from a Cortez motor home, whose owner pulled it out to install a 455 Olds and Toronado front-wheel drive! After stripping down the motor, a good hot-tank cleaning was first on the agenda. The lifter gallery side cover and rocker arm cover were sent out to the chrome shop, and the aluminum front cover was sent to Edelbrock for polishing. The roadster chassis had been completely boxed and reconstructed by Hamilton Automotive Industries in Van Nuys, Calif., and the motor was fitted to the chassis using stock F-100 pickup engine mounts and a single-point mount at the rear, with an F-100 rubber mount under the transmission. The C-4 automatic we used was the F-100 truck model and, in fact, came from one of the famous Bill Stroppe Baja race trucks. The motor and transmission package was offset an inch to the left in the chassis, to allow more room for the turbo and attendant plumbing, since both intake and exhaust manifolds on this engine are on the right side of the block.

SHORT-BLOCK

It seems funny to refer to this mon-

1. All of our rod and main journal clearances were checked with strips of Plastigauge. Since everything was new, they all checked out to between .0015-in. and .002-in. clearance.

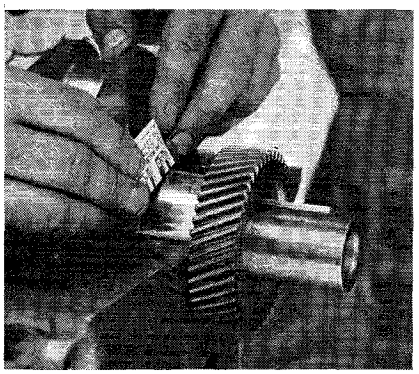
2. The thrust main must be seated by prying the crank back and forth, and then prying forward on the crank with another pry going back on the cap.

3. After the thrust cap and bearing are seated, you must still exert a force forward on the crank as you torque down the fifth main cap.

4. There's little danger of nicking even such a long cam as this one in installation, because on the Ford 6 you can reach through the block and guide the cam through by hand.

5. TRW fine-toothed steel gears are used on both the crank and cam and lined up with the dots together. Use Loctite on the retaining bolts on the cam thrust plate (arrows).

6. Giant craters in the tops of the TRW forged pistons keep compression down to 8.3:1, suitable for a blown engine. Rods are stock Ford 300.



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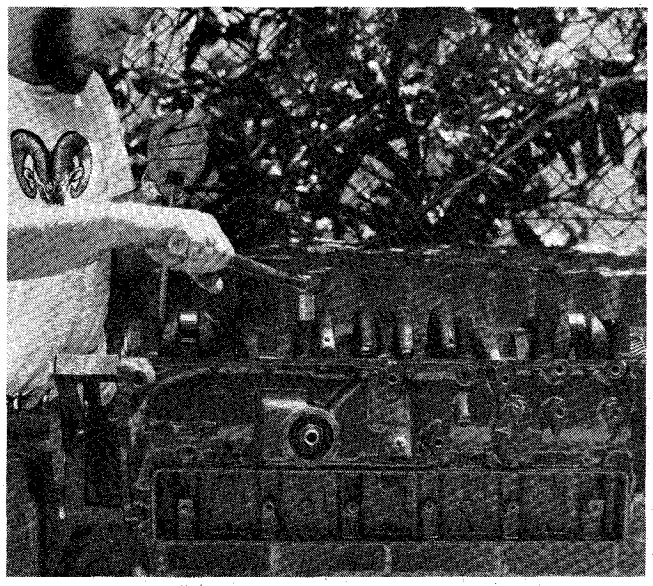
strously long (compared to a forked-8) engine as having a "short" block, but once it's installed in the roadster and the back two cylinders are swallowed up by the aluminum firewall, it looks less like an Allison. Evans Speed Equipment honed our six holes on the Sunnen Cylinder-King, and final bore finish was obtained with a Brush Research Flex-Hone. Larry Atherton of A&W Performance Products, Santa Fe Springs, Calif., did our Flex-Honing. This finishing is noted for promoting quick ring seating, and this is especially important for our engine because propane engines don't have the usual grit and dirt of a gas engine in them to help "lap in" the rings. A smaller size Flex-Hone was also used to hone the newly installed cam bearings, so there was a good, oil-retentive surface for the cam to ride on.

The 300-in. heavy-duty engine has a beautiful forged-steel crank, which is plenty stout enough for racing and turbocharged applications, especially when it's supported by the seven main bearings. The crank (part #C5TZ-6303-D) is the secret to making a regular 240 engine a stormer, as it's just a drop-in. You do have to use the 300 rods though, unless you want to order special pistons. If you use the early 240 rods (C5AZ-6200-A) with .9121-in. wrist pin, you can have special pistons made up with a high pin location to prevent piston rock in the bore. Do *not* use the later 240 rod, which has a larger .9752-in. wrist pin and an oil squirt hole on the big end, as it is weaker. We used the 300 rods and a set of off-the-shelf TRW forged pistons made for a 300. They carry TRW part #L2219F, and are perfect for a turbo motor because of their low (8.4:1) compression ratio. The 240-300 has a 4-in. bore like many popular V-8's, so pistons and rings are pretty easy to find for it. The TRW pistons take standard 5/64-in. and 3/16-in. rings, so we selected a set of Speed-Pro's gapable moly rings. They're called gapable because they're .005-in. oversize so that you can file the ends to achieve the end-gap you want. Since we wanted a good tight cylinder seal in our turbocharged motor, we gapped ours at .014-in.

Final preparation of the lower-end pieces included a balance job at Automotive Balancing Service in South Gate. Because a 6-cylinder engine's crank doesn't have its throws 90° to each other like a V-8's, true dynamic balancing can't be performed. But, as Alan Welch of Automotive Balancing explained, you can do a better job than the factory does. Because the long crankshaft can flex a little in the middle even with seven main bearings, Ak recommends that the 300HD front dampener (05TZ-6312-K) be used because its extra weight on the front helps dampen crank vibrations better. All inline engines have inherent vibration, but ours will be pretty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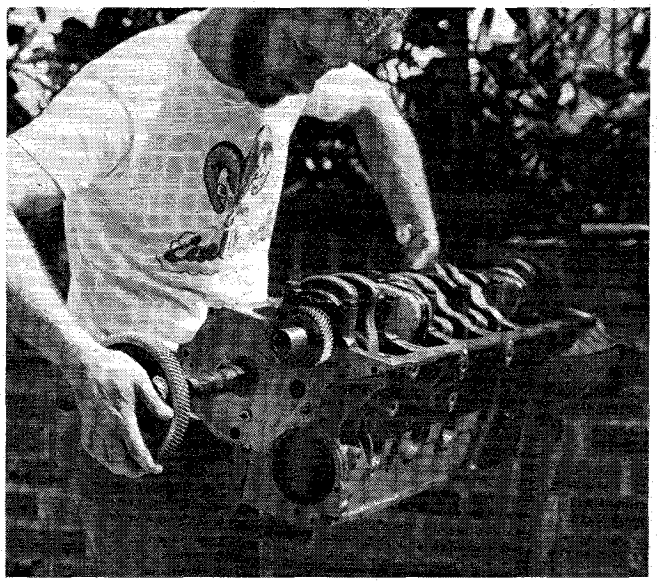
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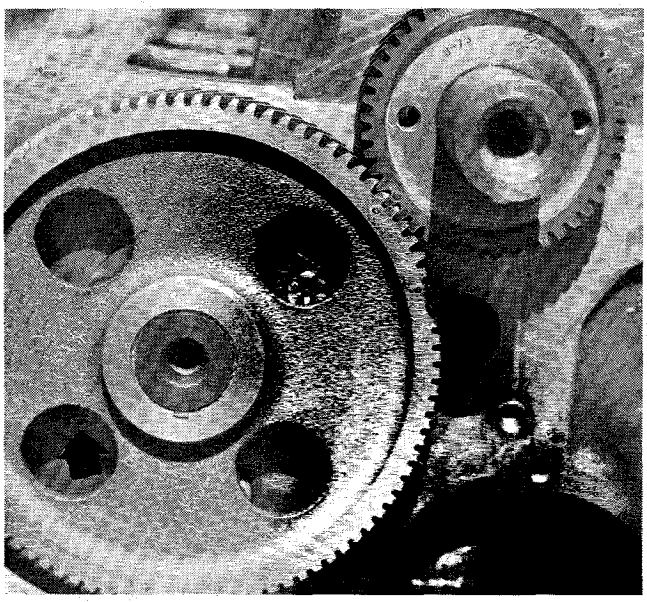
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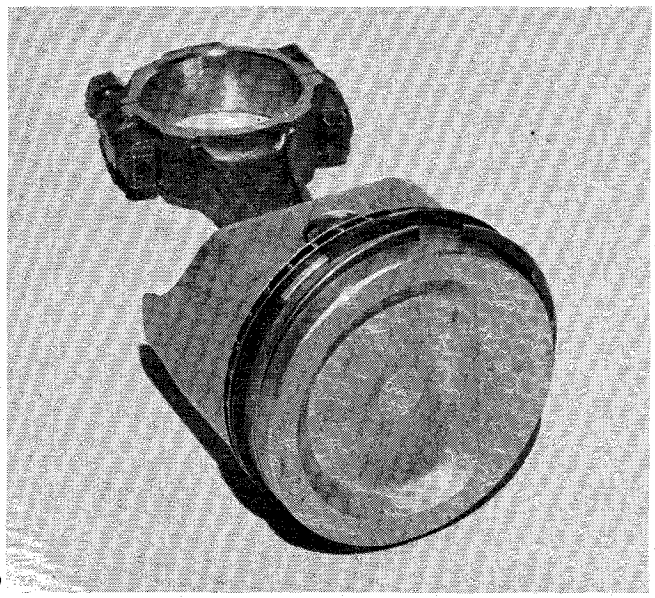
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smooth due to the balancing and running on propane. Naturally, the rods, pistons, and flywheel were all balanced, too. Alan then put our heavy crank in the lathe and polished all the bearing journals with a super-worn sanding belt for good oil flow.

ASSEMBLY

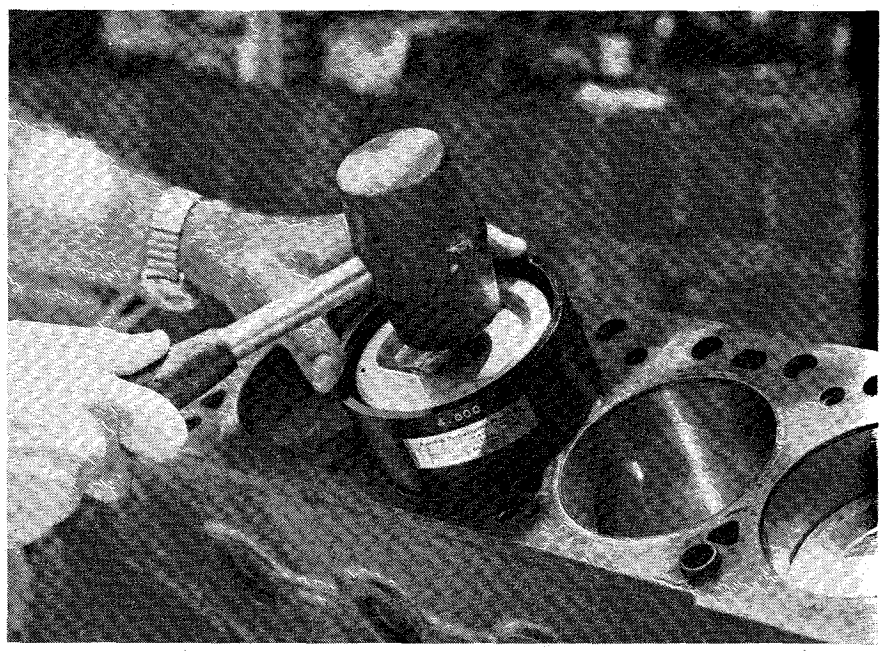
With the block "cleaned and machined," we could at last attach it to our engine stand at home and start assembly. The roadster had been a labor of love for 3 years and seeing progress on the powerplant was not without some personal excitement. We lubed up the bottom halves of the TRW bearing set, laid them into the block, and gathered our strength to slowly and gently lower the heavy forged-steel crank to its new home. Being more or less of a backyard operation, we didn't have expensive micrometers or calipers, so bearing clearances were measured with good ol' Plastigauge, and they all worked out to .0015-in. to .002-in.

Next to go into the block was our Iskenderian cam. Isky has worked closely with Ak Miller, Jack Lufkin and others on turbocharged engines and pretty much has a cam philosophy worked out for turbo motors. The best grind for our street 6 turned out to be their 260° hydraulic with .417-in. lift. Going by the catalog, this grind is available only for the smaller Falcon 6 and not the 240-300 engine, but they ground one up for our engine on a 240 blank. This was heavily lubed and slipped into the block, being careful to get the crank and cam gears meshed at the timing marks. The big Ford 6's come with gear-drive cams right from the factory, but the cam gear is one of those pressed-fiber types. Since we were using the heavier-than-stock spring pressure of Isky's Silicon-Chrome inner and outer valve springs, we took no chances on the fiber gear stripping its teeth and used a set of TRW steel gears (part #'s 2752 and 2753). Other Isky parts in the valve train were anti-pump-up hydraulic lifters, chrome-moly pushrods and aluminum spring retainers.

For fitting the pistons and rods into the block, we used a tapered-bore ring compressor from A&W Performance Products; having assembled other engines before with the usual Allen-screw-tightened sheetmetal ring compressors, we'd have to say that the tapered-bore type makes the job a lot easier. Machined out of a billet of aluminum on a gradual inside taper down to the bore size, there's no chance of breaking rings with this type of compressor and the job can also be done quicker. Most of the top engine builders use them and we can see why; they're a worthwhile luxury even if you only use it once. The Plastigauge was brought out again to check all the rod-bearing clearances once all the pistons were down in their new homes, and the front cover and crank dampener were installed, since the front cover must go on before the oil pan can be bolted up tight.

Since Ak had told us that a turbocharged propane engine should run as cold as you can make it, we felt additional oil capacity was good insurance. With a saber saw we cut off the sump portion of the oil pan, and cut a 2-in. strip of sheetmetal long enough to go around the pan. After a sheetmetal shop rolled some stiffening ribs in it for us, Curt Hamilton welded the strip around the cut portion of the oil pan, and then welded the sump of the pan back onto the strip, so that we wound up with the sump being 2 ins. lower and holding three or four more quarts of oil. The pickup for the oil pump was likewise extended 2 ins., and the pan was cadmium irradiated, which is a very inexpensive plating process ($4 for our pan) that prevents rust and makes our homemade pan look like the gold products of Milodon or Aviaid.

With the bottom-end torqued down and buttoned up, we turned our attention topside. Head gasket leakage with the high cylinder pressures of a turbocharged engine are always a problem, so Ak suggested cutting the head for O-rings. Machinist Jon Meyer set the head up on the Bridgeport mill and proceeded to cut a groove around each combustion chamber. .040-in. wide and .035-in. deep. The grooves were cut so that they fell right in the middle of the small steel section of the head gasket, and 17-gauge copper wire was tapped into



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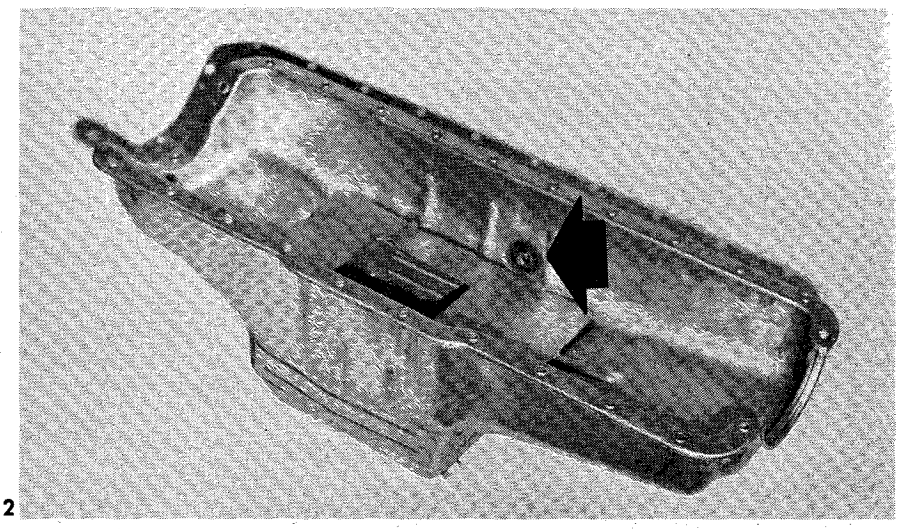

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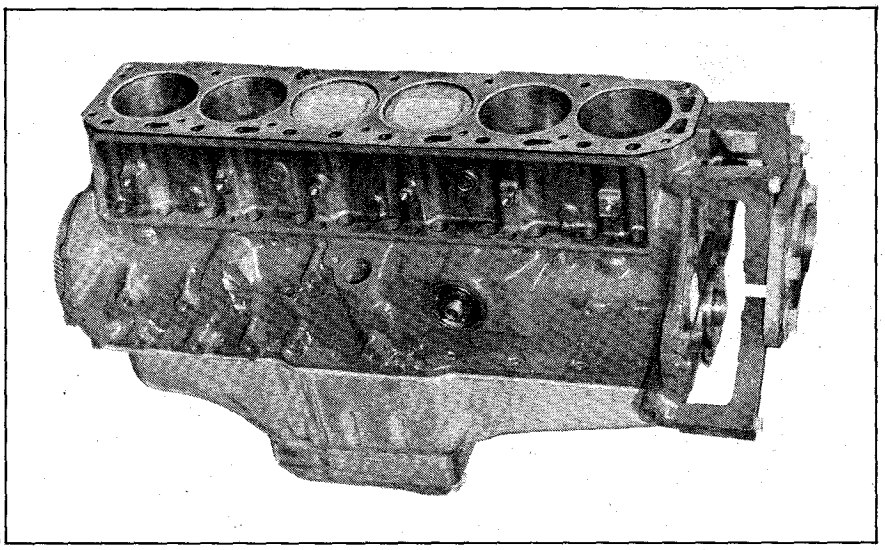
the grooves. The rest of the head was left completely stock except for Isky valve stem seals and a valve job, because, as Ak says, "When you're supercharging an engine, most of the usual engine trickery and nitpicking is unnecessary."

PLUMBING IT

The intake and exhaust systems are perhaps the most interesting aspects of this otherwise relatively stock 6-banger. It would seem trick to have a super set of tubing headers for any hot rod engine, but in the case of turbochargers, they aren't the way to go. Since the turbine operates on exhaust gases, the hotter these gases are the faster the turbine spins and the more boost you get. Simple. Tubing headers cool off the exhaust gases as they come out of the engine



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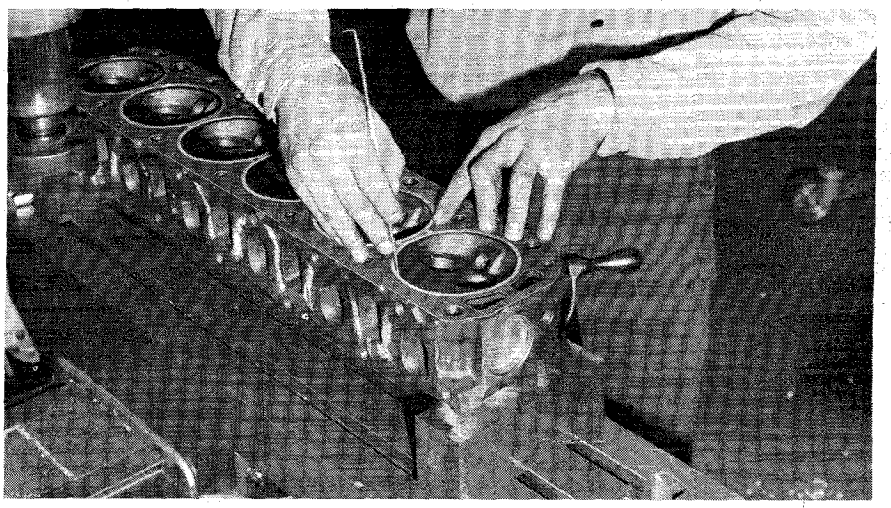

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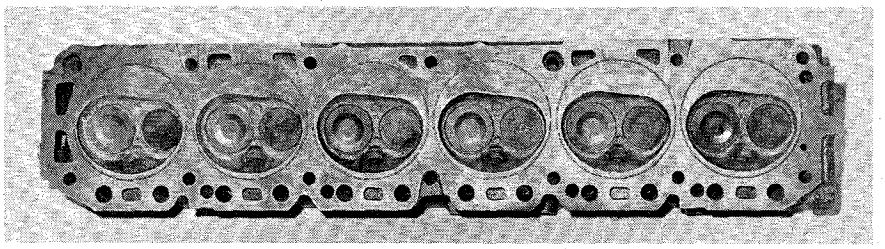

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1. Making the job of ring compressing a great deal easier here is an A&W tapered-bore ring compressor. It works so well, it's no wonder that racing pros all use this type.

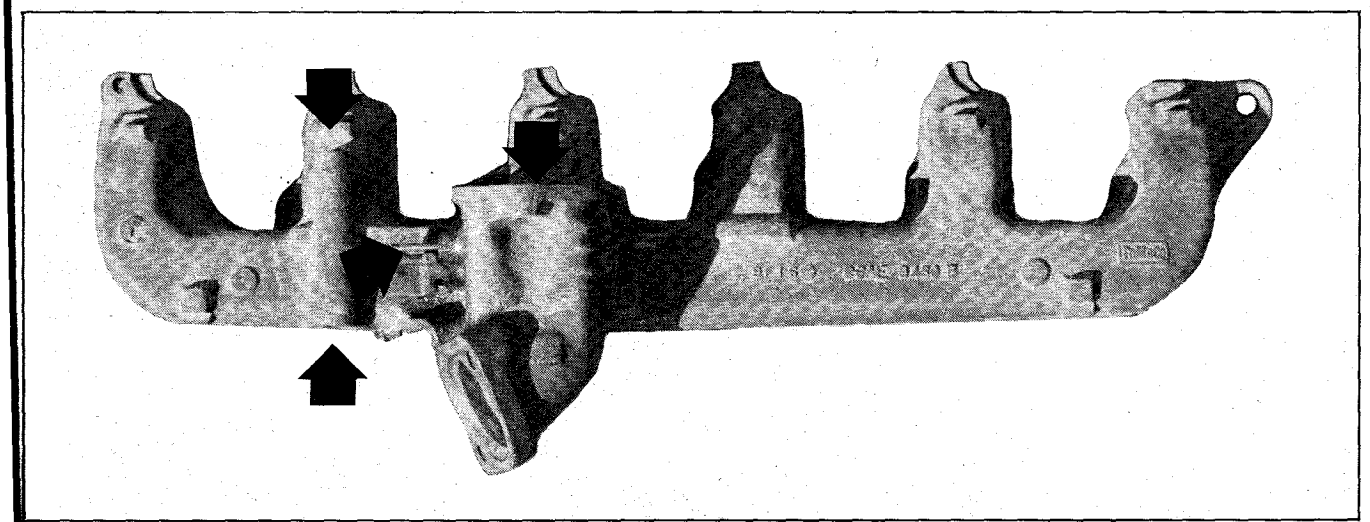
2. We dropped the sump on the pan 2 ins. and added a windage tray. Welded-in tube is for the oil return line from the turbocharger. Cadmium plating makes the pan look like a professional product, yet it's just about as cheap as a can of paint.

3. Once the bottom-end was buttoned up, our "long-short" block was ready to accept the head and be lowered into the waiting '32 chassis.

4. Jon Meyer, machinist at the Ak Miller Enterprises shop, used our head gasket to scribe a line where he would cut the head for O-rings.

5. Here's the truck cylinder head just before installation. The seats and valves were ground to 45° and 17-gauge copper wire was tapped into the .035-in.-deep O-ring grooves for a tight seal on the pressurized 6.

6. Both intake and exhaust manifold must be reworked to run with a turbo. The 240 exhaust manifold needed to be welded up at these points.



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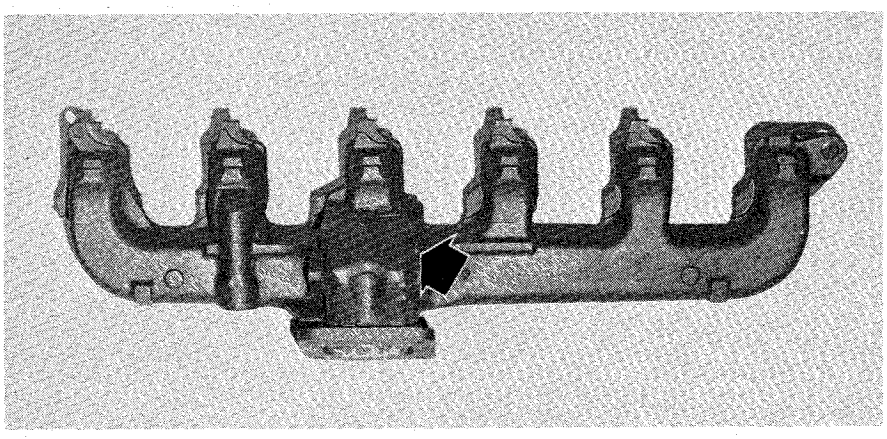
because of their greater heat dissipation—so even for looks they're not worth it. The stock cast-iron exhaust manifold retains the heat, operating the turbo more efficiently. In our case, the stock outlet on the exhaust manifold was cut off and Ak arc-welded on a 4-bolt flange plate to bolt the turbo's exhaust housing to. If you plan on building such a setup yourself, remember that special cast-iron welding rod must be used.

For other turbocharged big Ford 6's that Ak has built, the intake manifold was fabricated from steel tubing in a log-manifold fashion similar to those U-fab kits that Crower used to sell back in the '50's (remember when Garlits' car ran eight carburetors instead of a blower?). In our case, we wanted something distinctive, as the car and its engine would come under a lot of scrutiny at rod runs and on the street. So, instead of steel, we made one from aluminum. An old Offenhauser 6-cylinder 4-bbl. manifold that Ak had was too wide to fit under the narrow '32 hood, but the straight sections of the port runners were cut off and milled so they could be heliarced to a length of 3-in. diameter aluminum tubing. The ends of the tube were capped and welded, two bosses were welded on for the propane carburetors, and the flange surfaces were milled for flatness. For a gasoline-powered engine, it isn't a good idea to blow through the carburetors because they have to be pressurized, which creates a number of problems. And if you mount them out in front of the turbo and suck through them, you need to provide some hot water under the carburetor to keep it from icing up and not vaporizing the fuel. With the basic simplicity of propane carburetors, you can blow through them with no problems whatsoever.

With the turbocharger bolted to the exhaust manifold and two Impco 100-A carburetors on the intake manifold, it remained only to plumb the air from the turbo up to the intake. Within the 2-in. diameter aluminum tubing going from the turbo to the carburetors, Ed Cantrell of Hamilton Automotive heliarced an Impco boost limiter. This is something jointly developed by Ak and the Impco people as a kind of "poor man's waste gate." The boost limiter is a housing with a spring-loaded piston in it that works like a pop-off valve. If you want to change the amount of boost going into your engine, you simply change your 6-lb. spring for a 10-lb. spring.

The final steps, once the usual necessities like a radiator and wiring were installed, were concerned with the rest of the fuel system. From our 32-gal. Manchester steel tank in the rumbleseat, a fat pressure line runs forward to the engine compartment and attaches to an Impco VFF30, which is a combination fuel filter and locking device. Operated by engine vacuum, it shuts off the gas pressure whenever the engine isn't running so that you don't lose propane through bleed-off at any gaskets in your system. The propane is under pressure, so without the shutoff it would be like leaving your gas engine's fuel pump on all the time. The fuel-lock connects directly to an Impco Model E converter, which vaporizes the liquid propane. Hot water hoses from the engine go through the converter to complete vaporization. The final leg of the propane's journey through the roadster is leaving the converter and entering the simple propane carburetors to be mixed with air and burned, quite cleanly, in our 6-holer.

Unfortunately, we can't tell you much more about the engine until the rest of the car is finished, much as we'd like to startle you with incredible drag strip times, Bonneville speeds, cruising ranges, and squeaky-clean emissions reports. We do think it's going to be a clean-air car that goes fast, but our aspiration is for a car that can run well under 13 secs. in the quarter, do at least 150 mph at Bonneville, and have exhaust that won't even register on Highway Patrol analyzers. This sounds like a lot to ask from any engine, but we've worked this out dozens of times. Ak has built a number of cars using turbos and propane, and all of them have come out clean on the tailpipe end. He's also run a Deuce highboy at Bonneville with a 350-hp engine and gone 165 mph, and we hope that with water-and-alcohol injection and



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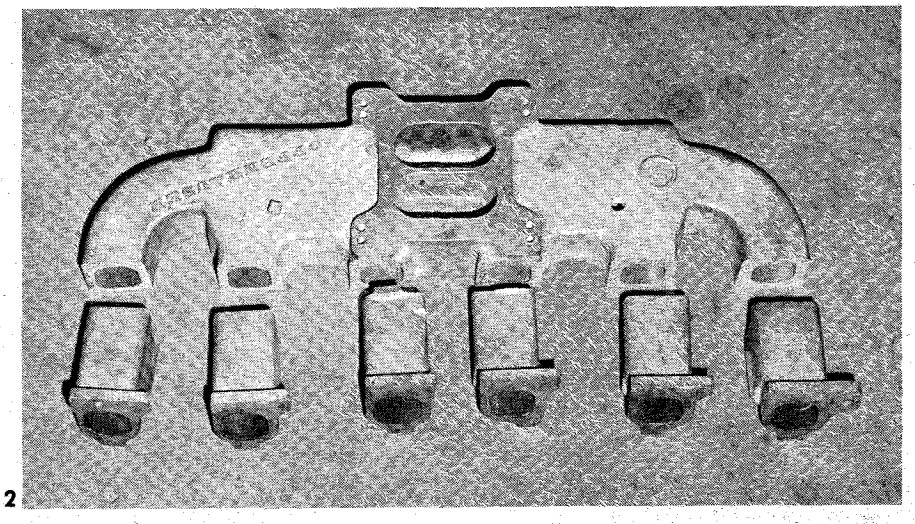

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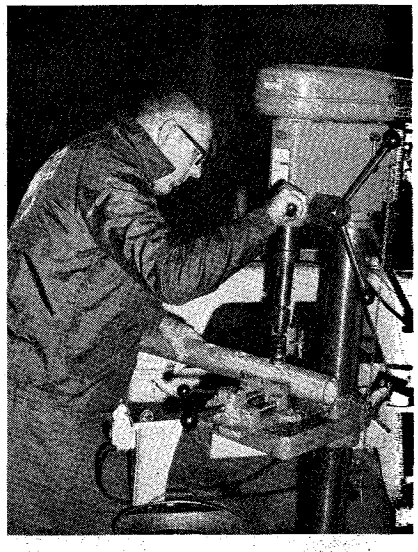

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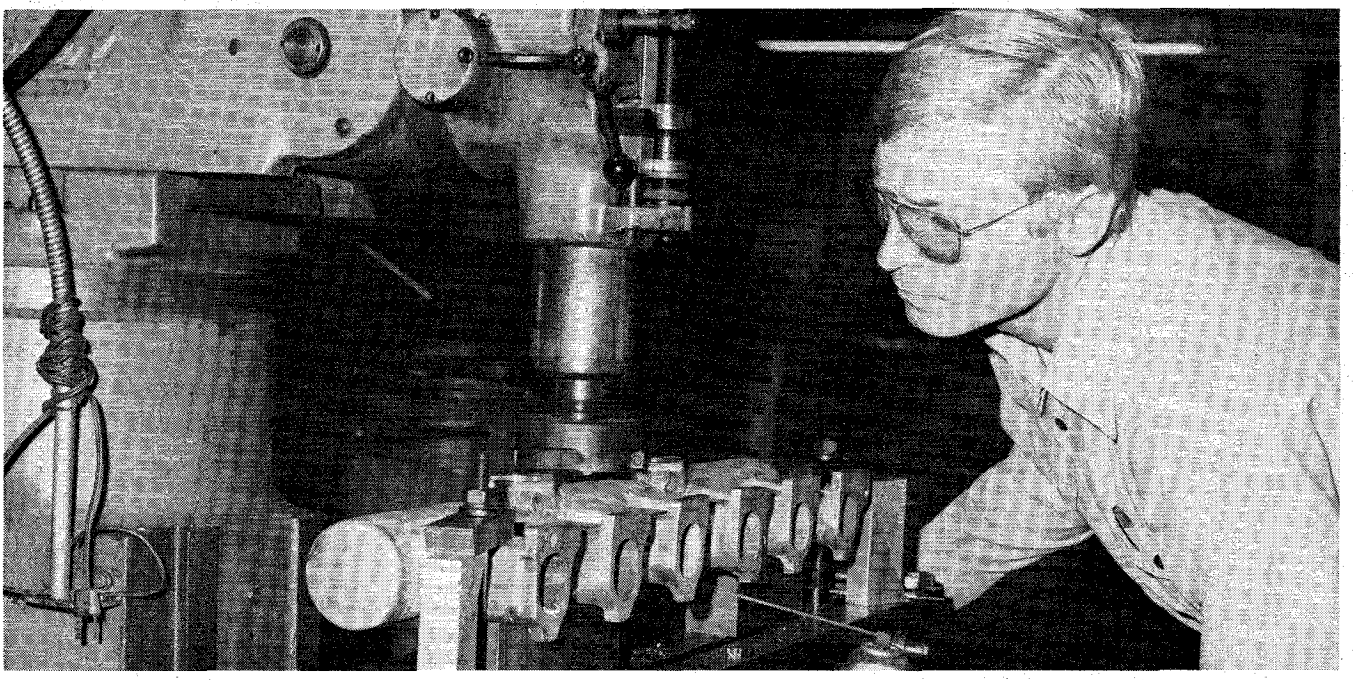


4

1. Finished manifold shows where it had to be cut (arrow) to clear our fabricated intake manifold. Ak arc-welded on flange for the turbo.

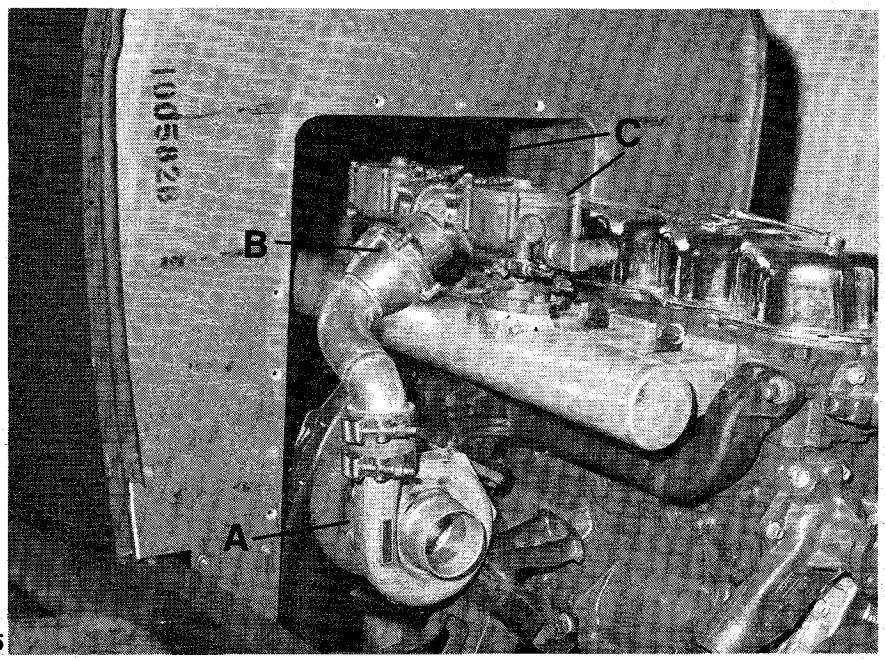
2. A damaged Offy manifold for a big Ford 6 yielded the straight sections of its runners to be part of our new fabricated manifold.

3. Three-inch diameter aluminum tubing was used for the main section of the manifold log. "Big Ak" bored out the ports with a hole saw.

4. After Curt Hamilton heliarced the runners to the log, capped the ends of the tube and added two flanges for the carbs, Jon machined the flange surfaces for flatness.

5. When the exhaust gases drive the turbo (A), it forces air through the boost limiter (B) and into the pair of propane carburetors (C). We plan to run 10 lbs. boost on street to make a possible 350-hp sixer.

6. The 2½-in. exhaust system is by Champion Muffler, Whittier, Calif., uses Corvair turbo muffler. Single pipe at the rear lets everyone know this highboy's got "six appeal!"



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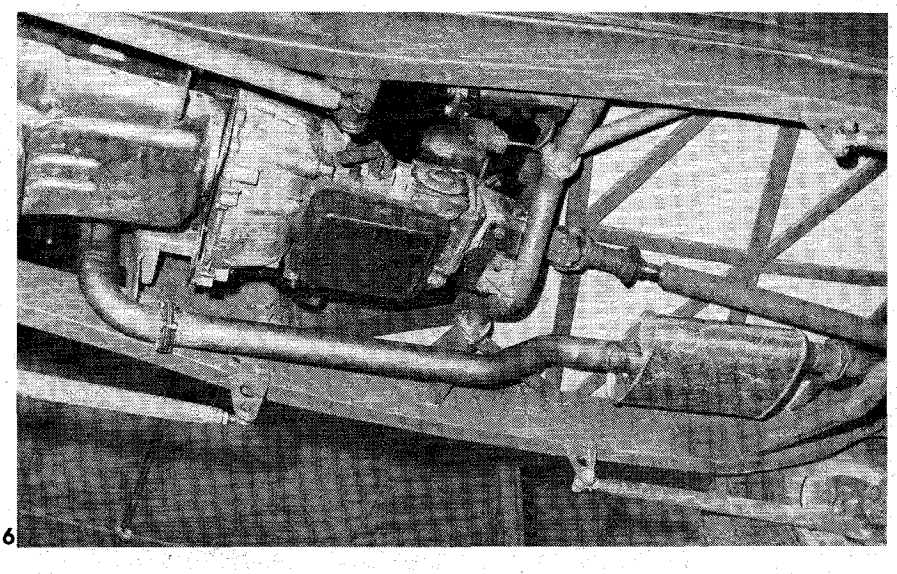

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enough boost, we can get 350 hp out of our 6, too. As for the drag strip performance, remember the car only weighs 2400 lbs., so even times under 12 secs. are possible. It only remains now to do some wiring, hook up some brake lines to the four Corvette discs, hang a fluid cooler on our C-4 automatic transmission and we'll be out on the maiden voyage with the Clean-Air Deuce. You'll be kept posted on the results next year in the pages of *Hot Rod*, but in the meantime, while you're working out your next engine swap or scratch-built street rod, take a tip from us and don't overlook the bulletproof Ford 240-300 6 as a potential fountain of torque for the street.