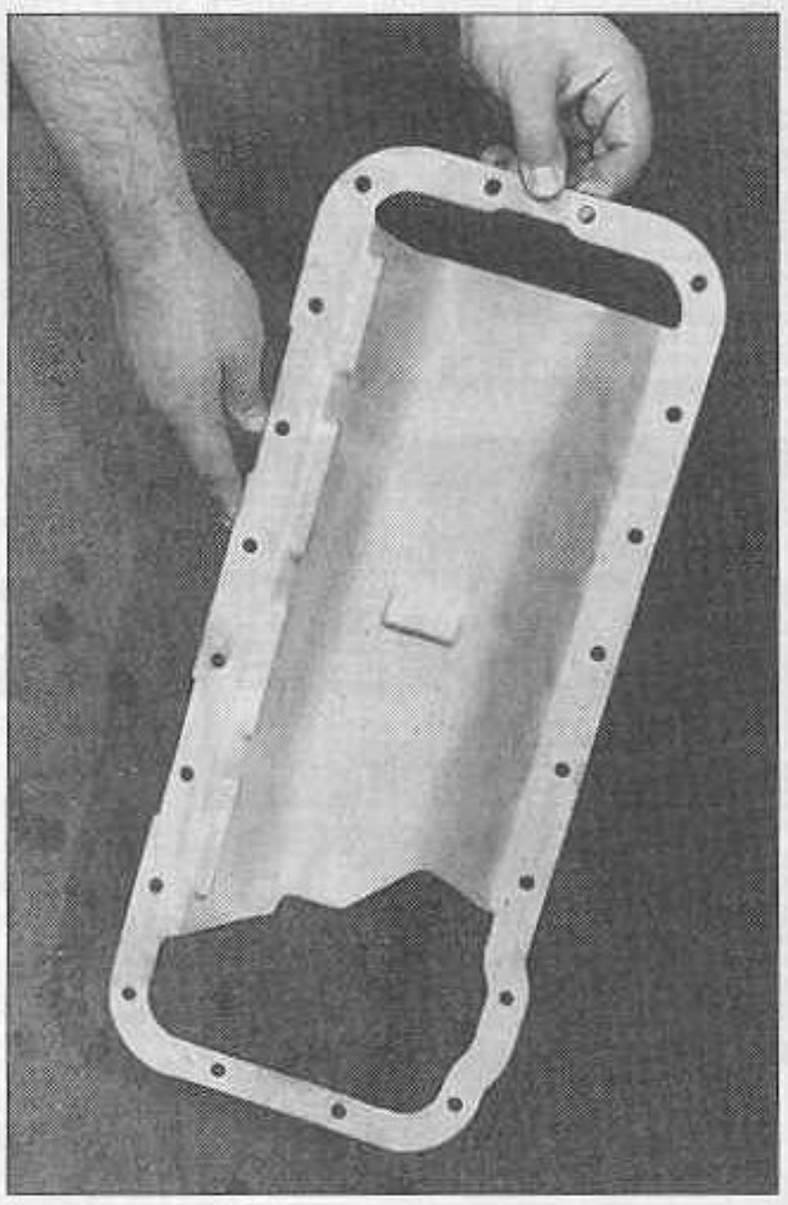
FE OILING SYSTEM SECRETS

Steps To Upgrading Your 390/428 To Legendary 427 Status

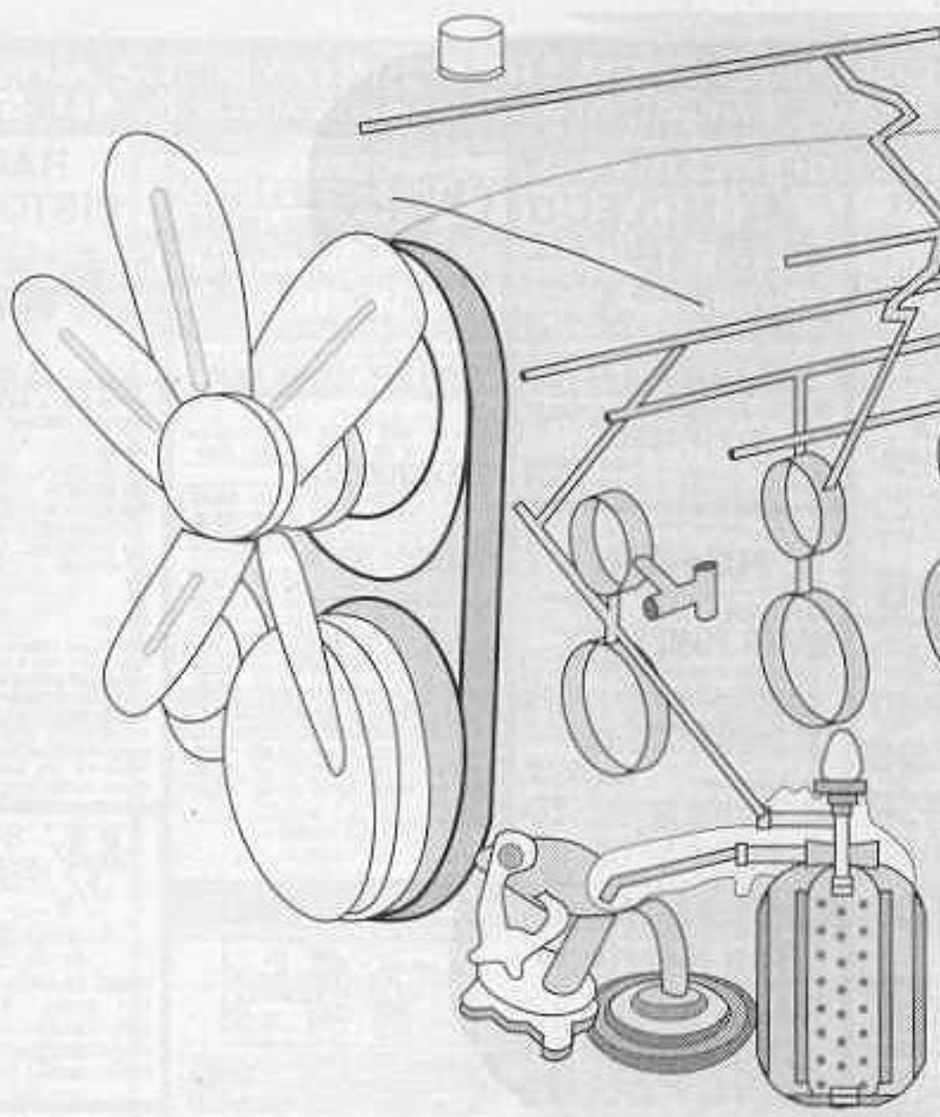
By JERRY PITT

The longevity of any engine is based on its ability to meet the rotating parts demands for lubrication. Without that thin oil film separating moving metal parts, your engine would be scrap. While the 427 is long on durability and power, its sibling 390/428 FE has a list of deficiencies that contribute to reducing its life span. However, with the help of FE guru Ron Miller of Ford Power Parts in Norwalk, California, we have looked at a few of the specific cures to build longevity, power, and reliability back into the 390/428 FEs vocabulary.

But before delving into the how-tos of oiling system modifications, Ron thought it would be proper to offer some etiquette about building any FE engine. Specifically, he points out that there is a myth about the amount of oil pressure needed. While some build for over 100psi, Ron categorically opposes this excessive amount. "At initial start-up that figure is fine." Ron contends, "But if you put too much load on the distributor gear, wear becomes a problem." In addition, on those FE engines equipped with a pressure relief valve (i.e., 406 and 427 top/side oiler), anything over 100psi will result in the diversion of oil back into the pan. However, Ron doesn't recommend low oil pressure since this is the quickest way to spin a bearing. Chevrolets have a very wide bearing surface and fairly small-diameter rod journal and, therefore, they don't need the oil pressure an FE requires. The FE Ford's rod journal is almost ¼-inch larger in diameter, which translates into higher bearing speed and greater amounts of heat. By opening up the clearances and raising the oil pressure, bearing life increases tremendously. Ron recommends a hot running (above



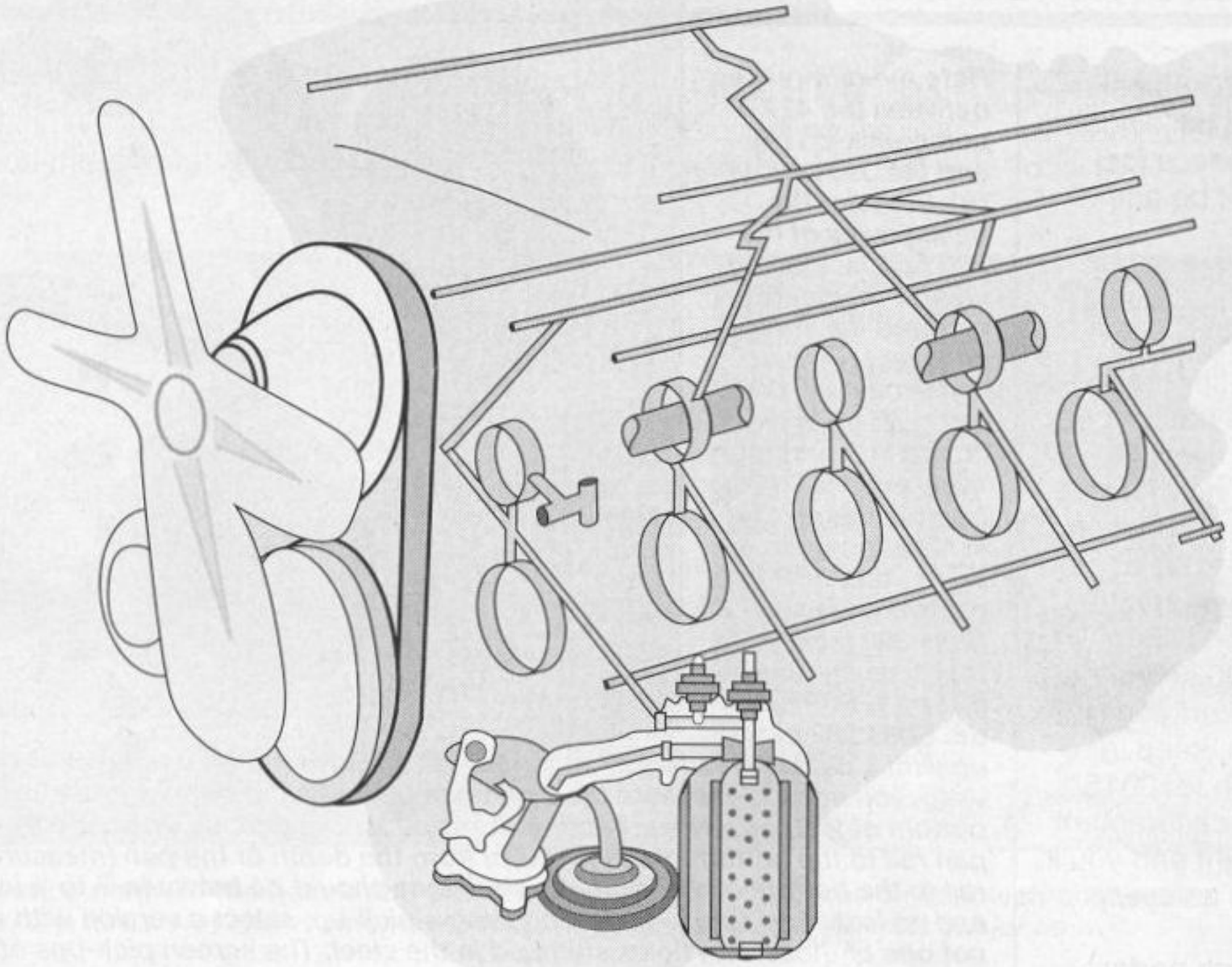
Perhaps the most important improvement you can make to your 390/428 FE engine is the installation of a 427/428SCJ-style windage tray. Dollar for dollar this is the cheapest horsepower you can buy. On engines revving over 6000 rpm, gains from 10 to 15 horsepower can be expected. The windage tray prevents the spinning crank from sucking up oil from the sump, which slows down the crank.



ILLUSTRATIONS: JANET TABOR

THE CENTER OILER

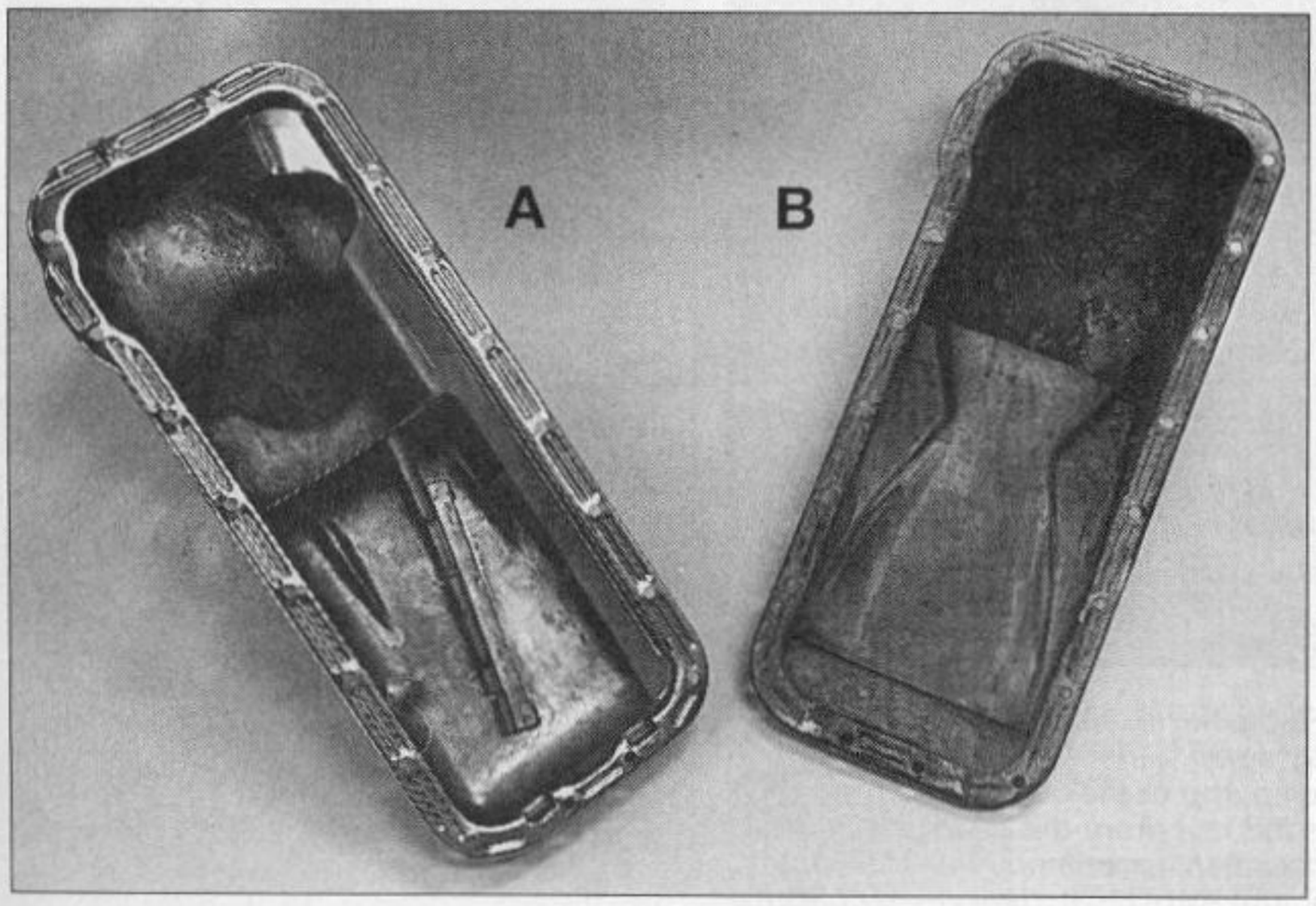
The conventional FE engine oiling system features a main oil gallery that runs down the center of the block to lubricate the cam and crank journals. The "center oiler" (also referred to as a "top oiler") features grooves *in the block* in the cam journals to carry oil to the galleries for oiling the rocker-arm shafts. Galleries that run parallel to the center gallery are only found in hydraulic lifter application. The center oiler design is the most common FE engine block.

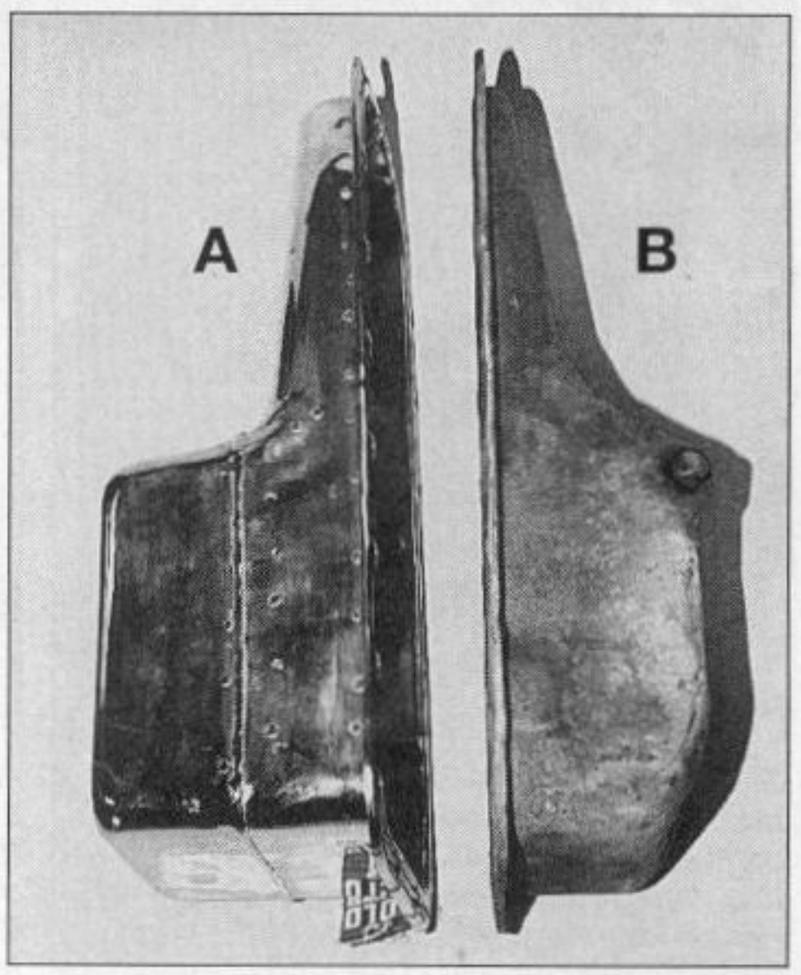


THE SIDE OILER

The side oiler features a main oil gallery that runs down the driver's side of the engine block. The block *is not grooved* in the second and fourth cam journals. Thus, the camshaft must be grooved to carry oil to the rocker-arm shafts. The '68-and-later hydraulic cam 427 is a similar design, except that it has galleries that lubricate the lifter bores, so it can be used with a hydraulic, solid, or roller cam. All pre-1968 blocks are solid lifter only and cannot be used with hydraulic cams. If your 427 block has "66-427" cast on the rear, this does not mean it was made in 1966. All '66-and-later blocks including 427 service blocks cast after 1968 have this cast on the block.

Why was the side oiler oiling system invented? According to John Vermeersch of Total Performance in Mt. Clemens, Michigan, it was made for the GT-40 big-block cars so oil pressure could be monitored and externally adjusted by tightening or loosening. Does it work better than the top oiler block? Actually, not. Bearing life is the same for both a blueprinted top oiler and a side oiler block.





Increasing the oil capacity should be one of the first improvements made to your 390/428 FE. The production-style 427 oil pan (A) two baffles have been added here, has a capacity of 7 quarts. It is the hot setup over the standard 5 quart oil pan (B). Besides the larger capacity, additional baffling keeps oil around the oil pump pick-up that prevents oil starvation. Ford Power Parts has a limited supply of the 427 pans in stock and they sell in the $200 price range. Another consideration is that while the 427 pan is larger, it does not sacrifice nearly as much ground clearance as some of the aftermarket 8- or 9-quart oil pans. Low-profile road-race-style oil pans with swinging trap doors are very popular, work great, and are available from manufacturers such as Canton Oil Pans.

FE OILING SYSTEMS SECRETS

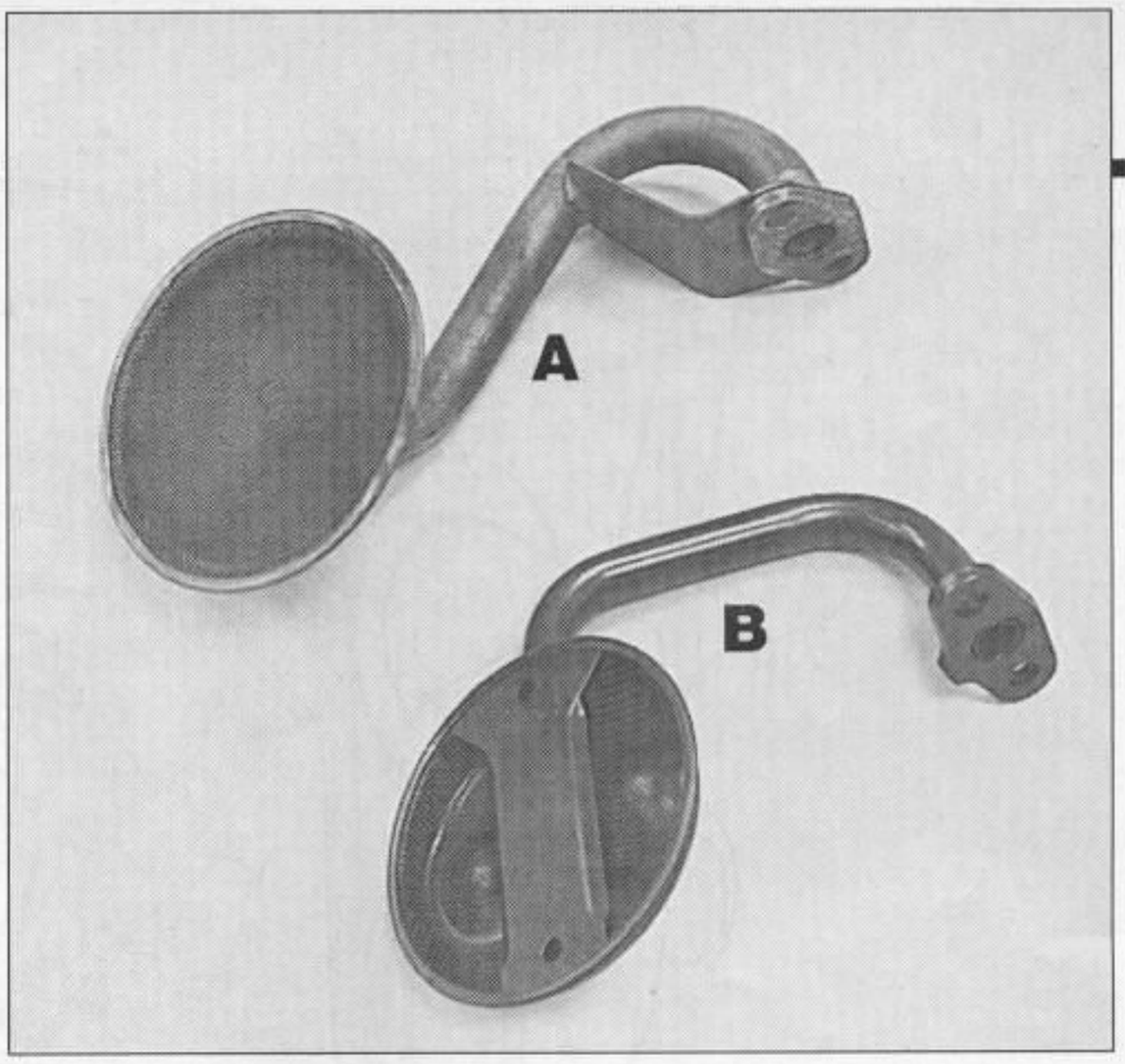
2000rpm) oil pressure of 70-85 psi.

As for the particulars in building the engine, often the factory specs for bearing clearances will not be adequate for the street.

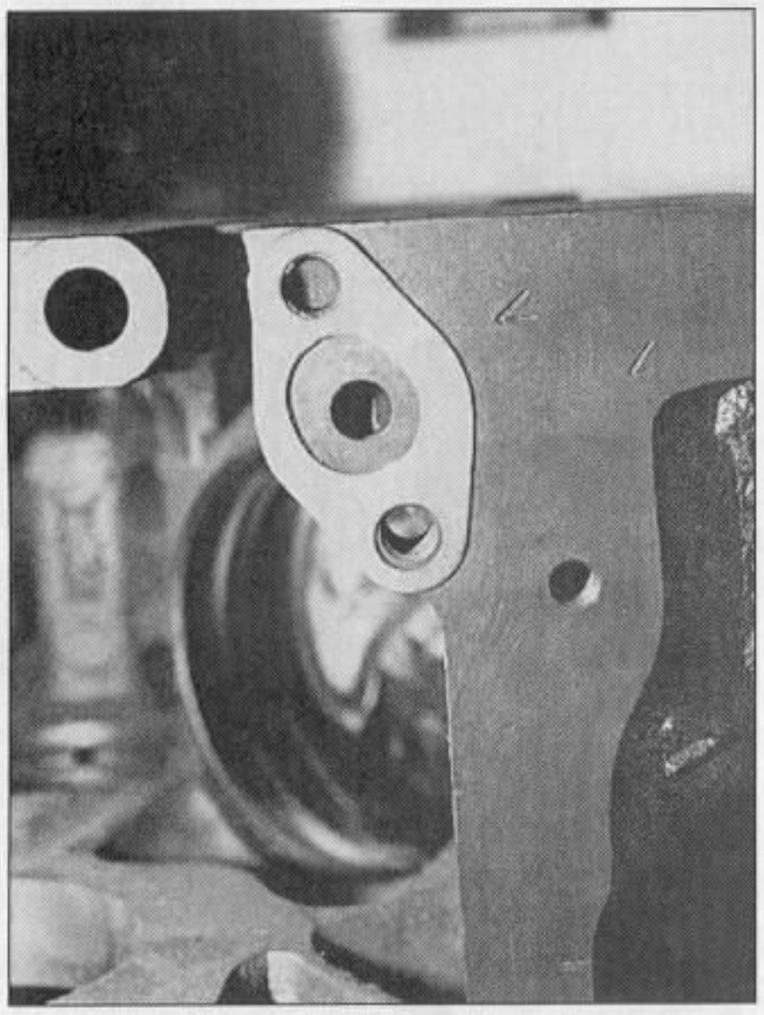
The bearing books will tell you a factory high and a factory low. When the folks at FPP do their machine work, they always stay under the factory low to ensure that the bearing clearances will not be too tight. Factory specs often allow no more than .0025 inch to a mere .0005 inch of clearance. The result can be a spun bearing, so rather than adhere to these tight measurements, Ron insists on clearances of .0025 inch to a generous .003 inch. Before you claim that's way too much, keep in mind that's only .0012 inch to .0015 inch per side. Hold that measurement in a micrometer up to a light and you'll realize that's not as much as everybody makes it out to be.

If your application is high performance, then plan to use a high-pressure blueprinted pump and open up those clearances to .0030 inch to .0035 inch to ensure adequate oiling above 6000 rpm. If you don't specify exact numbers to your crank grinder, he will normally grind within the factory tolerances. To achieve .0030- to .0035-inch clearance, tell your machinist to grind the mains .0005 inch under factory low and grind the rods .001 inch under factory low.

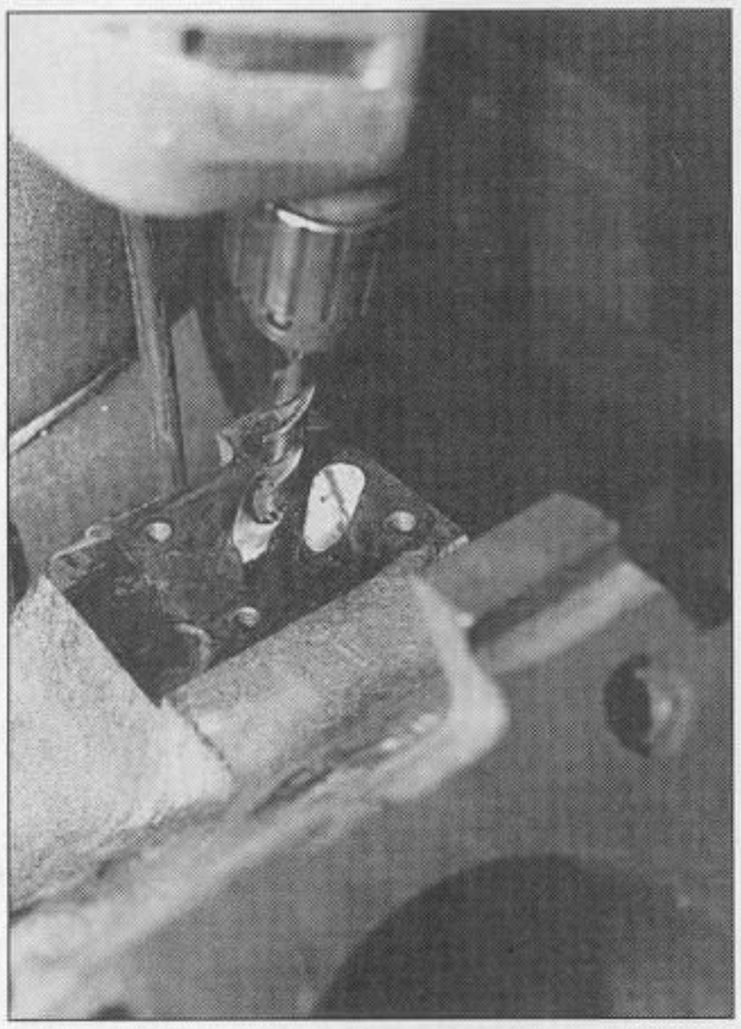
As is the case for any engine, the amount of prep work you do will translate to additional reliability and durability. Of course, if the blueprinting portion of this procedure seems a bit



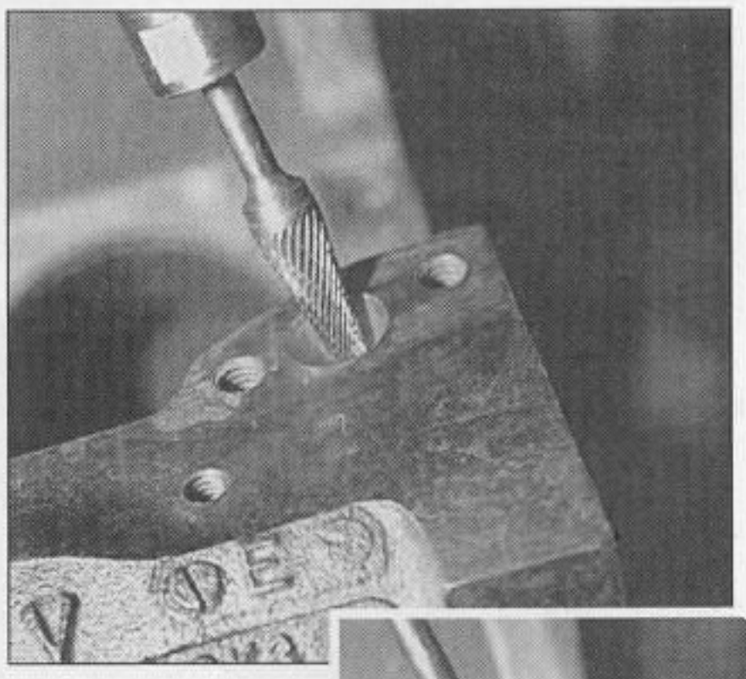
Note the differences between the 427 oil pump pick-up (A) and the 390 pick-up (B). Some of the deficiencies of the 390 part include a smaller inside diameter and the sharp angles of the tube. Unfortunately, the 427 pick-up is difficult to find and relatively expensive (approximately $40 to $50). Another option that FPP suggests is the use of a Boss 302 pick-up that's similar to the 427 part. FPP sells the Boss 302 pick-up with a custom-made gasket for only $19.95. No matter what pick-up or pan is used, you need to measure the clearance between the bottom of the pick-up and the bottom of the pan. By subtracting the depth of the pick-up (measure from the block pan rail to the bottom of the pick-up) from the depth of the pan (measure from the pan rail to the bottom of the pan), the clearance should be between 3/8 to 1/2 inch, no more and no less. And finally, when choosing a pick-up, select a version with a screen and not one of those with holes stamped in the steel. The screen pick-ups offer better filtration and better overall flow.

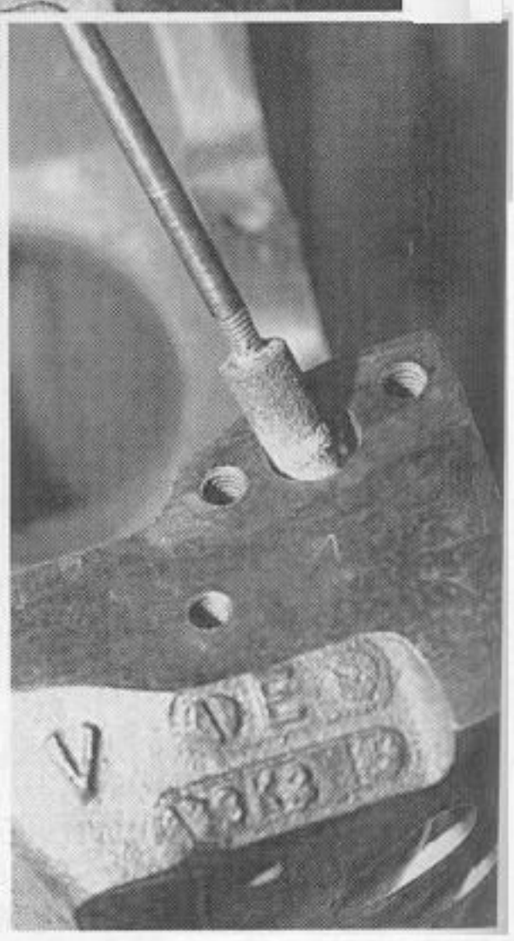


Simply placing the FPP oil pump-to-block gasket displays the insufficient diameter of this orifice. By increasing this diameter, pressure and volume remain constant through the rpm range and rod and main bearing life is increased tremendously. Another note regarding this gasket: it can only be installed one way to line up the oil pump to the oil filter-to-oil pump passage.



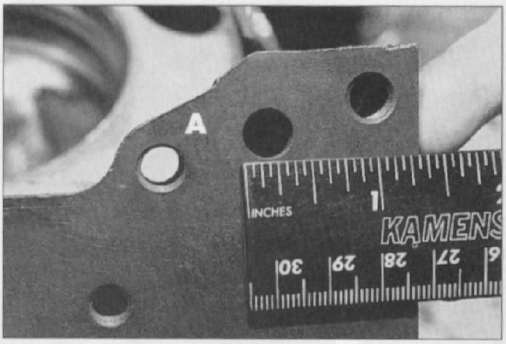
All FE blocks (except 406 and 427) have a very small 3/8-inch-diameter hole from the oil pump to the oil filter adapter. FPP drills this out (from the adapter side) to 7/16 in 1/64-inch increments. Starting with 25/64 inch, move up to 13/32, then 27/64, and finally 7/16 inch. Use a heavy-duty 1/2-inch chuck drill and be careful at the end of drilling to prevent the drill bit from chipping or breaking a piece of the block where the oil pump mounts.

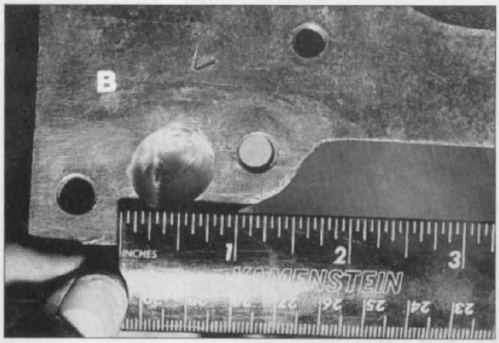




After using the FPP gasket to scribe the orifice, use the carbide bit to increase the size and use the cartridge roll to polish and remove all excess burrs.

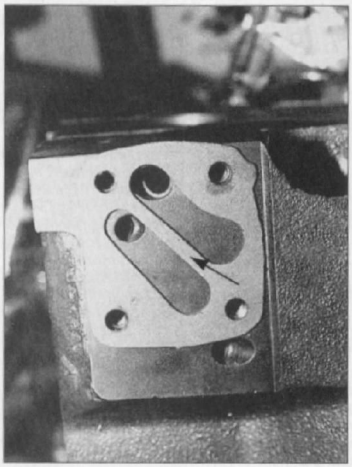
overwhelming or you don't have the necessary tools to accomplish the job handily, Ron and the folks at Ford Power Parts are more than willing to handle it for you. Blueprinting the oiling system (not including additional parts) costs approximately $100 for all FE blocks except 427s, which are only $75.

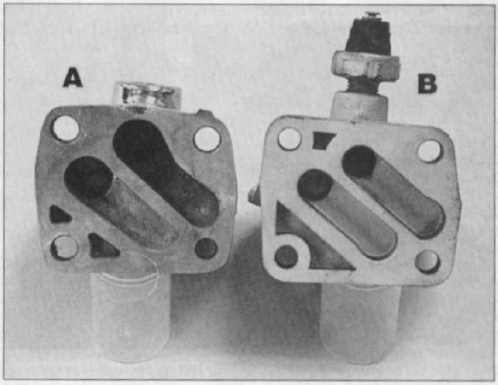




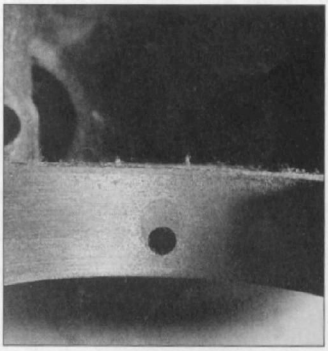
Look at the difference between the before and after pictures. The idea is for the oil to flow throughout the entire block without any obstructions or sharp turns. Not only is volume increased by doing this, but the oil is cooler as well.

The external filter housing on all FE engines is another area where oil flow can be substantially increased. Use the custom-made FPP gasket to scribe the opening, and make sure you maintain adequate material between the inlet and outlet (arrow).

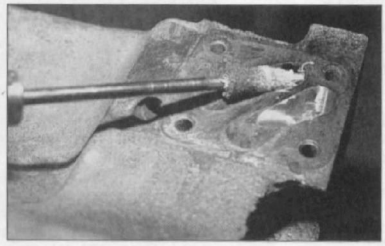




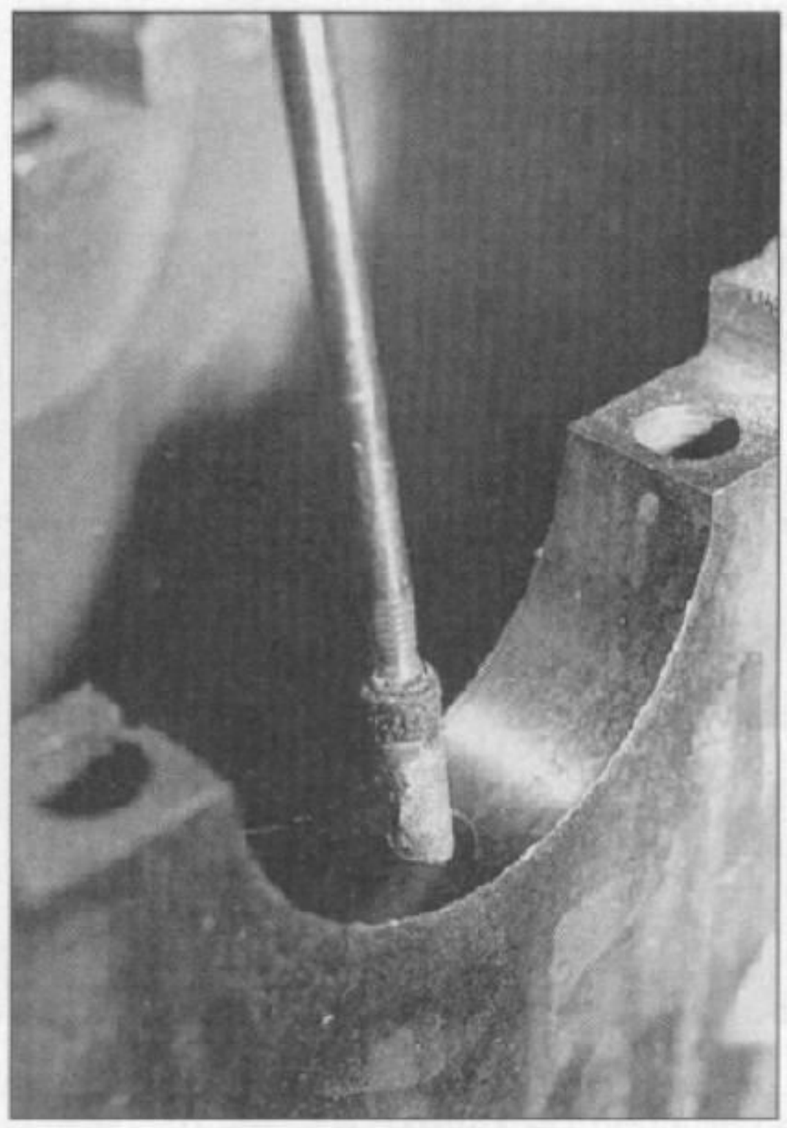
Before modifying the block adjacent to the oil filter adapter, take a look at your adapter. The aluminum flared unit (A) is found on '68-and-later FEs. The non-flared, aluminum housing (B) is pre-'68; note its smaller diameter orifices.



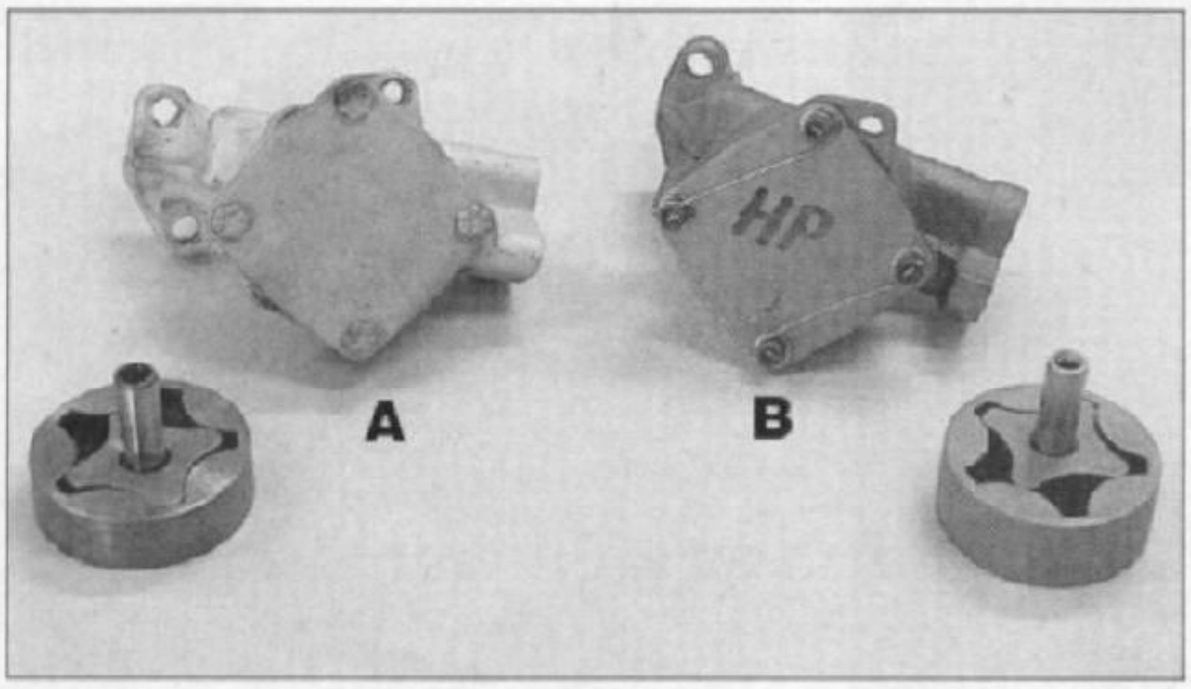
Polish the two openings using a cartridge roll until smooth. After this area is done, inspect the block for any sharp edges and/or burrs. Deburring the block is important to eliminate the chance of particles breaking off and getting into the oiling system. Should a customer request this process, FPP can do this work, but it is not included in its oiling system blueprinting machine work.



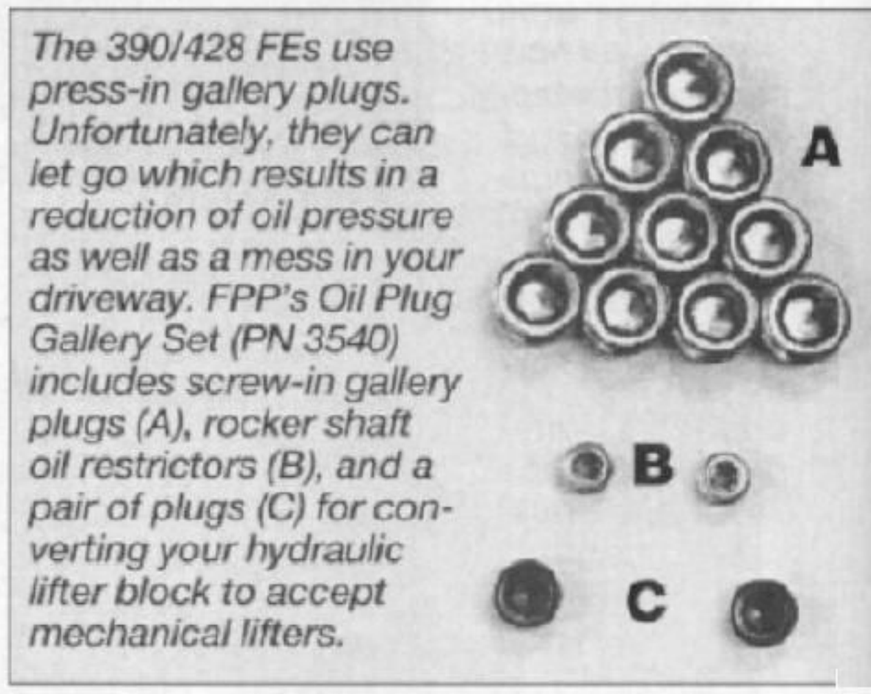
One of the most significant problems with FE engines is the mismatch of the crankshaft saddle oiling hole and the hole in the main journal bearings. Note the darker ring adjacent to the orifice. Only 50% of the orifice was open to the crankshaft due to the bearing mismatch. This is the No. 1 journal in an FE. The problem most often exists with the 1, 2, and 4 main journal saddle holes.



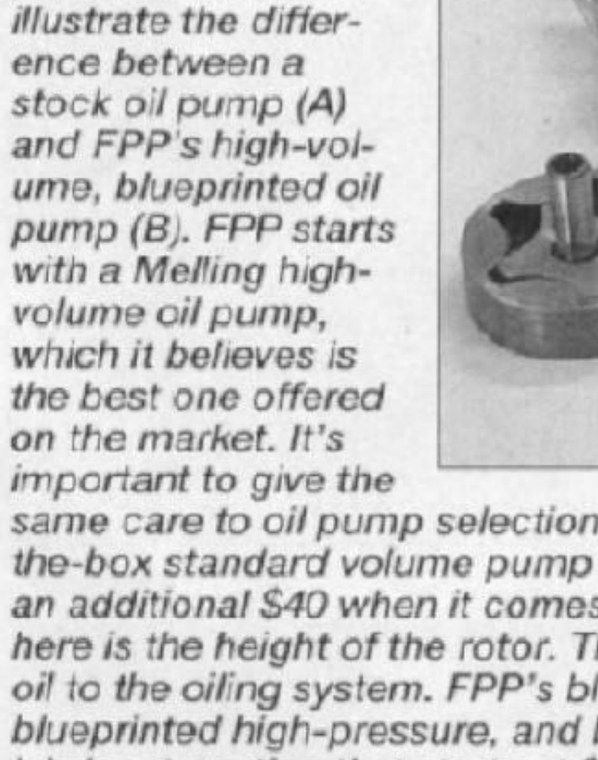
To remedy the saddle hole problem, begin by scribing the saddle bearing feed hole. Once completed, use your carbide-tipped die to enlarge the hole to the appropriate diameter. Once adequately sized, polish with a cartridge roll. When all five holes are done, take a piece of wet-or-dry 400-grit sandpaper and deburr the sharp edges completely. Any burrs left in the main saddles can cause main bearing problems. The 406 and 427 blocks have main oil holes that almost match the bearing holes, but even they need a little help.



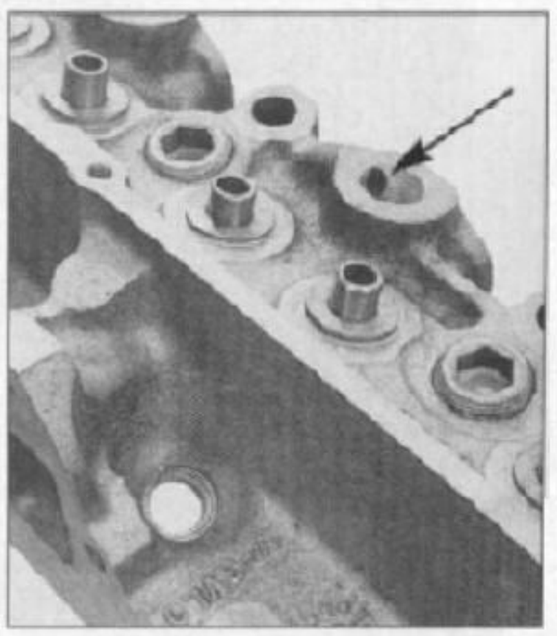
An entire article could be done on oil pump selection and modification for an FE. Here we want to illustrate the difference between a stock oil pump (A) and FPP's high-volume, blueprinted oil pump (B). FPP starts with a Melling high-volume oil pump, which it believes is the best one offered on the market. It's important to give the same care to oil pump selection as you did to any other engine part. A $19.95 out-of-the-box standard volume pump may be sufficient for your low-buck engine, but what's an additional $40 when it comes to getting the best. The basic difference displayed here is the height of the rotor. The larger rotor in the high-volume pump moves more oil to the oiling system. FPP's blueprinted pump comes in four varieties, blueprinted, blueprinted high-pressure, and both versions with a G&L friction-reducing dry-film lubricant coating that starts at $54.95. Even if you think your selection is fine, take the four cover bolts off and look for metal chips, excessively sharp edges, and flat, true cover-to-housing surfaces.



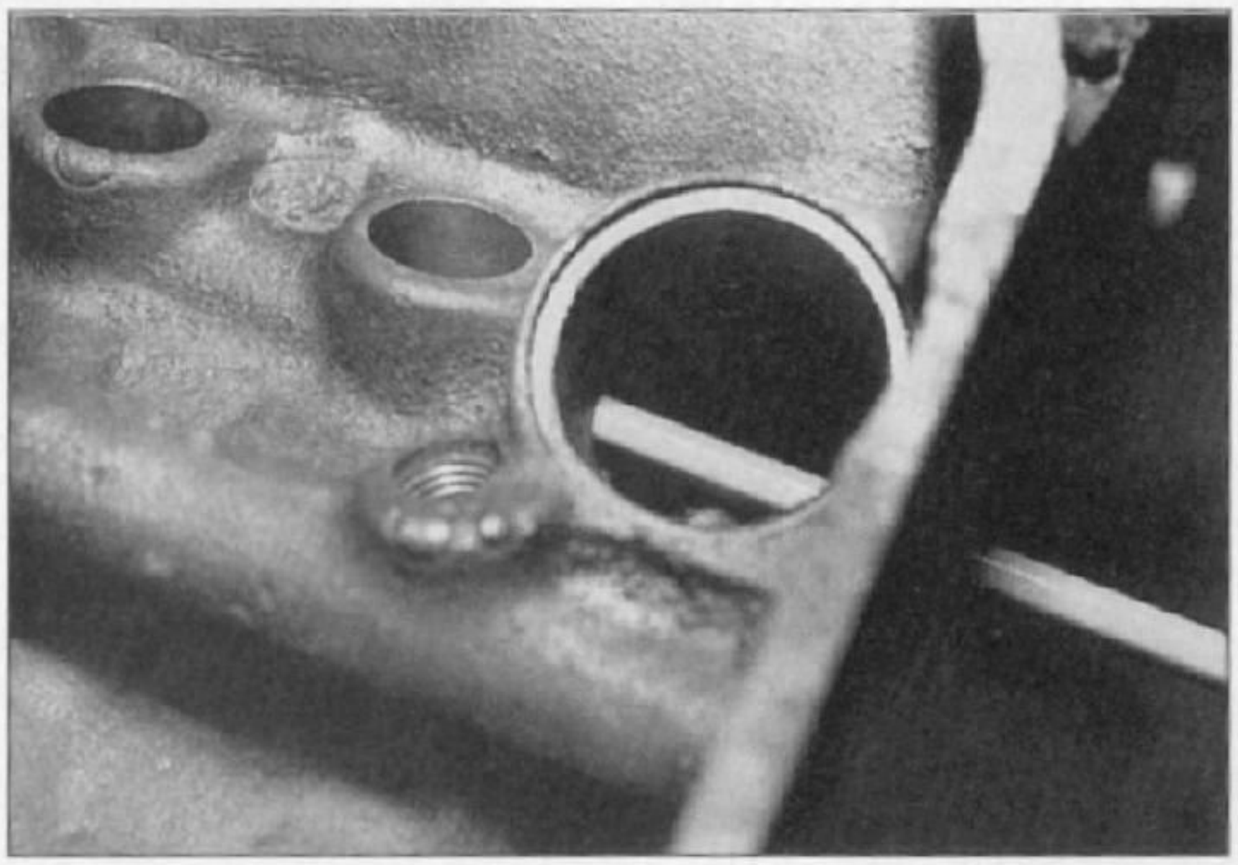
The 390/428 FEs use press-in gallery plugs. Unfortunately, they can let go which results in a reduction of oil pressure as well as a mess in your driveway. FPP's Oil Plug Gallery Set (PN 3540) includes screw-in gallery plugs (A), rocker shaft oil restrictors (B), and a pair of plugs (C) for converting your hydraulic lifter block to accept mechanical lifters.



Another very important point is the oil pump driveshaft. Don't even think about using the old one again even if it's a stock 360/390 rebuild. FPP manufactures a heavy-duty chrome moly shaft (PN 1303) for $19.95 with a lifetime warranty against breakage. The broken and twisted shafts are actual parts that were removed from FE engines. If your oil pump drive breaks, bearings, rods and the crankshaft can be seconds away from being destroyed. If your oil pump picks up any foreign material that locks it up, the stock drive will twist and break. With an FPP drive, the distributor roll pin will shear, causing the engine to immediately shut off, thus preventing damage.

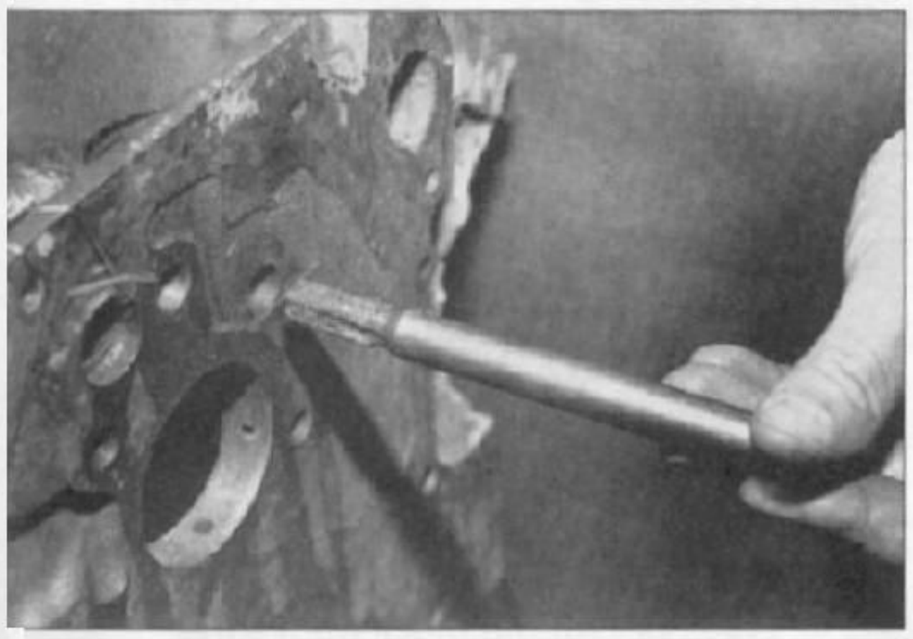


The oil feed hole (arrow) on each stock cylinder head for oiling the rocker shaft is too large. The rocker shaft oil restrictors reduce the diameter of that orifice from 5/16 inch (.312) to .090 inch. The big valve FE heads (427 Medium Riser, High Riser, and Tunnel Port) have a smaller passage of .250 inch. The result is less oil to the top end and more oil to the crank. Does .090 inch seem too small to feed an entire rocker assembly? With the oil hot, remove one valve cover and rev the engine to 4000rpm and watch the amount of oil on the top end. For drag-race-only FEs, builders often restrict this orifice to only .060 inch.

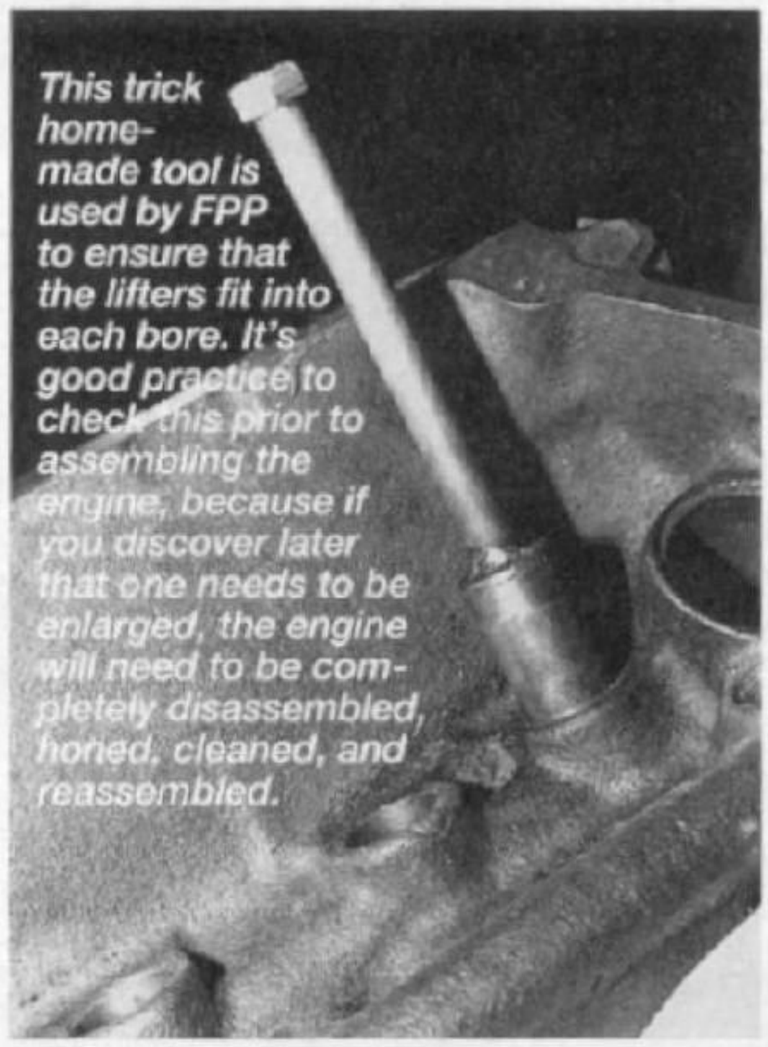


Peering through the distributor guide, the driver's side gallery orifice is easily viewed. Ron points out that forgetting to install this particular plug is a regular problem for many engine builders who are not familiar with FEs.

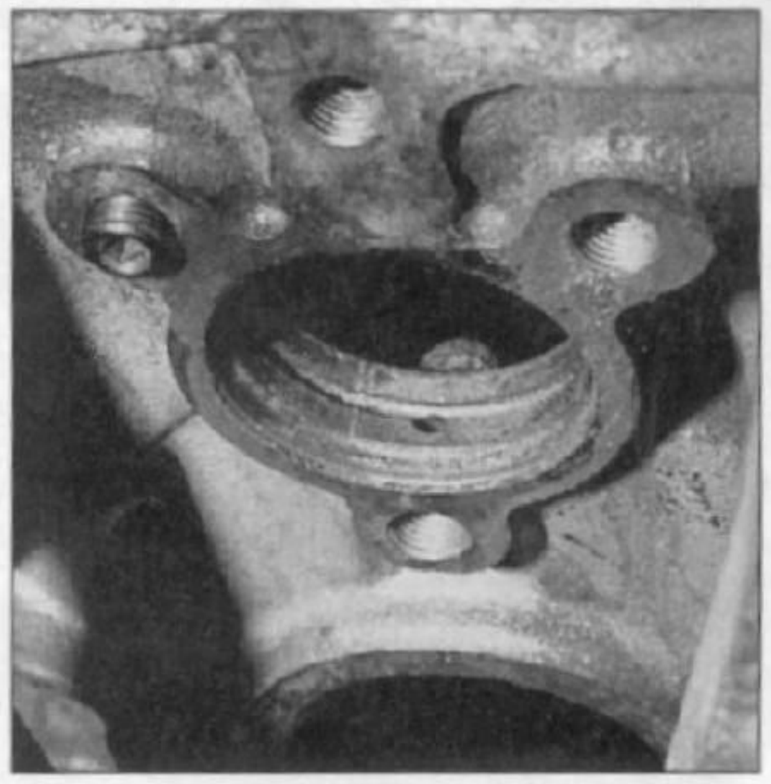
The internal gallery press-in plugs are replaced with screw-in ¼-inch NPT plugs. Never install oil gallery plugs dry. Using liquid Teflon® works as both thread lubricant and also a sealer to prevent leaks.



Due to its location, the front gallery plug on the driver's side of the block requires an expensive, long ¼-inch NPT tap. Don't forget to use a reamer first, otherwise there's a good chance of breaking that expensive tap.



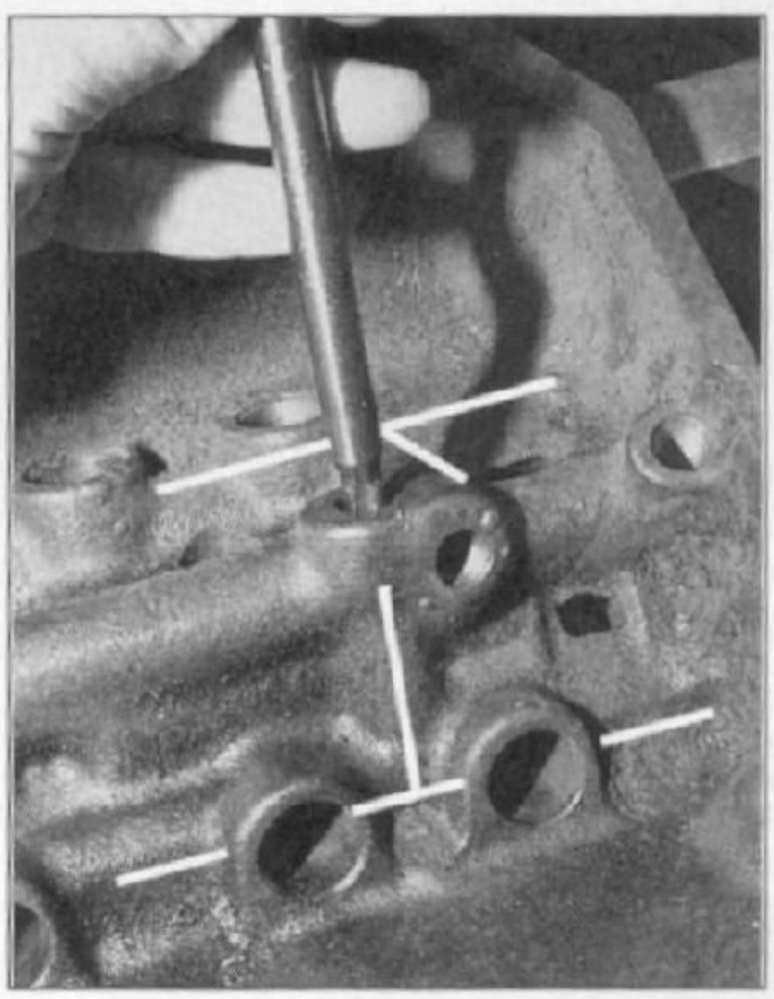
This trick home-made tool is used by FPP to ensure that the lifters fit into each bore. It's good practice to check this prior to assembling the engine, because if you discover later that one needs to be enlarged, the engine will need to be completely disassembled, honed, cleaned, and reassembled.



The same goes for the orifices at the rear of the block. If the plugs stick out a little when tight, make sure your block plate has four holes drilled in it. If not, either drill the holes in the block plate or tap the ¼-inch NPT plugs deeper to ensure they fit flush.

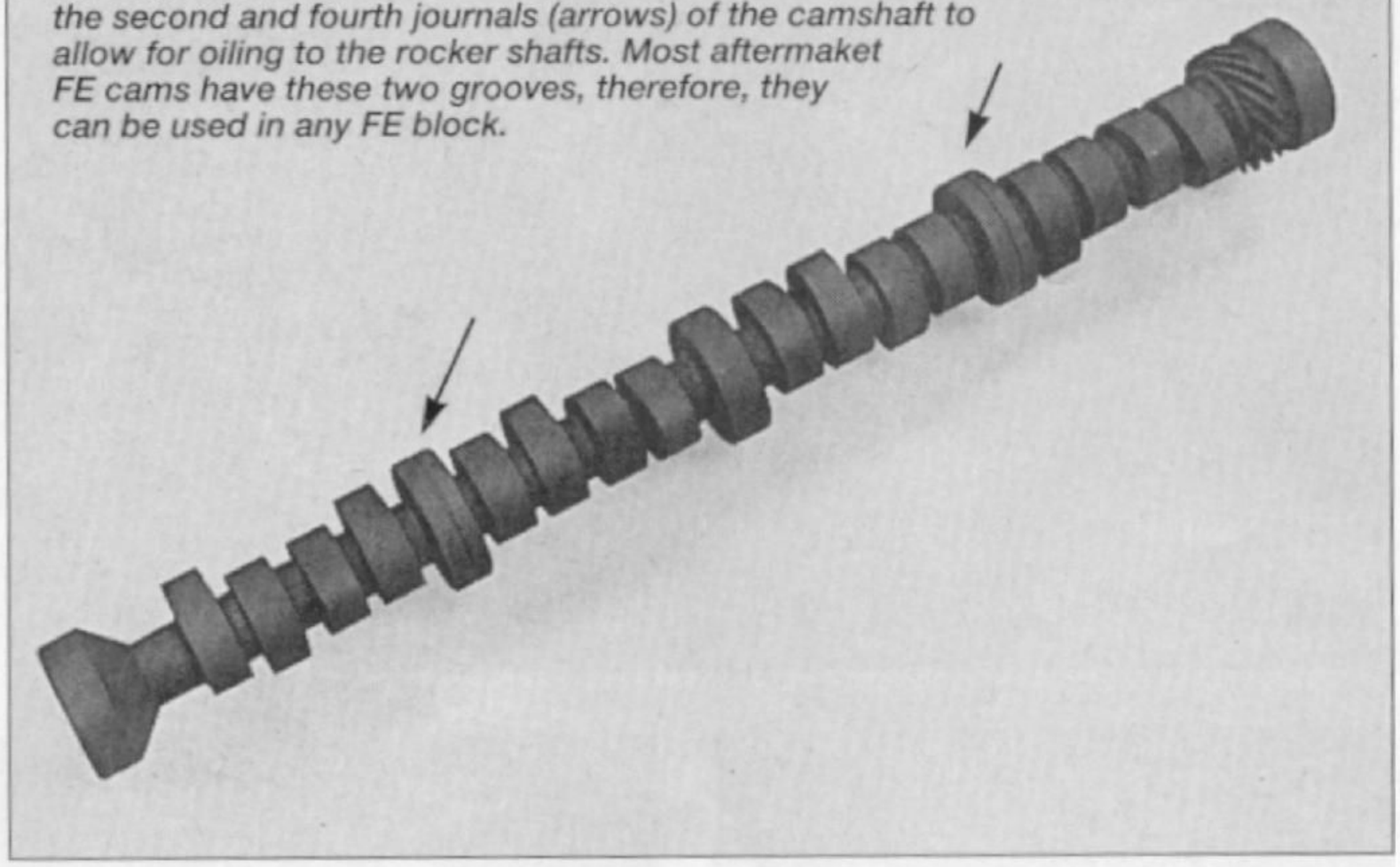
Once the front gallery plug orifice is threaded, it is a good practice to ball hone the lifter bore to ensure that no burrs are protruding into the lifter bore. Check the other 15 lifter bores to ensure that a lightly oiled lifter slides easily in and out of each bore.

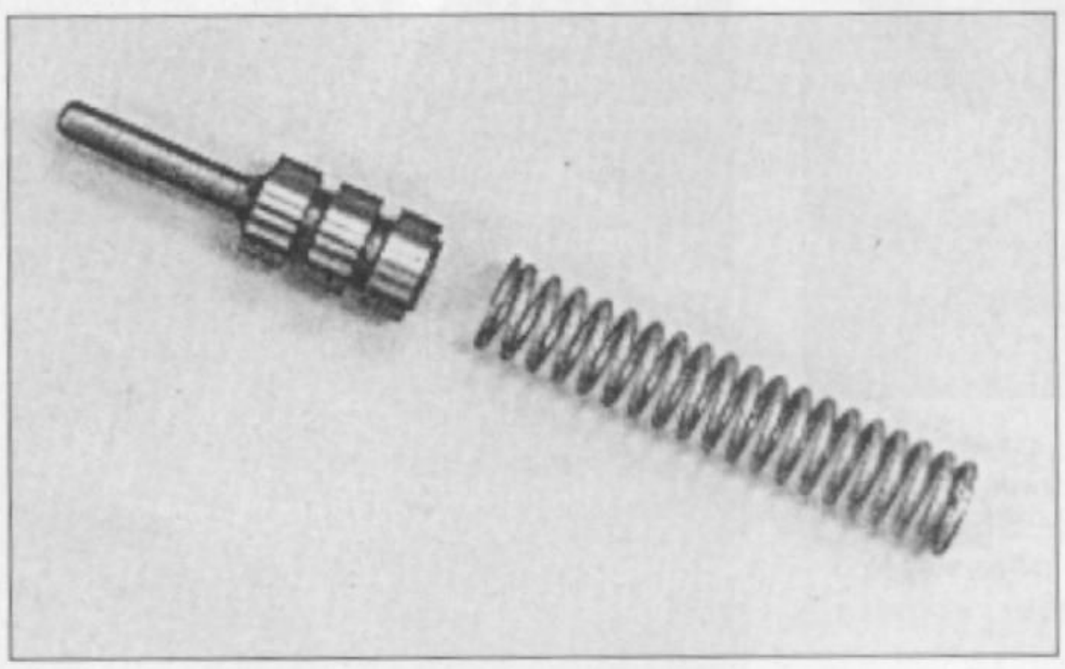
Often, many FE owners wish to block off the lifter bore oiling gallery to convert to mechanical lifters. To do this, FPP offers the correct plugs, but the feed hole must be plugged. This particular photograph illustrates the route the oil takes to oil the lifter bores. Even if you currently have no plans to install mechanical lifters, it is a good practice to go ahead and tap the threads to prevent complete disassembly should you decide further down the road to make this change. If there is an overhanging lip protruding from this small passage, use a 7/16-inch drill to take an even amount of material off of the top of the orifice. This small passage is already the correct size for tapping with an ⅛-inch NPT tap. The trick is to tap this hole until the tap bottoms out.



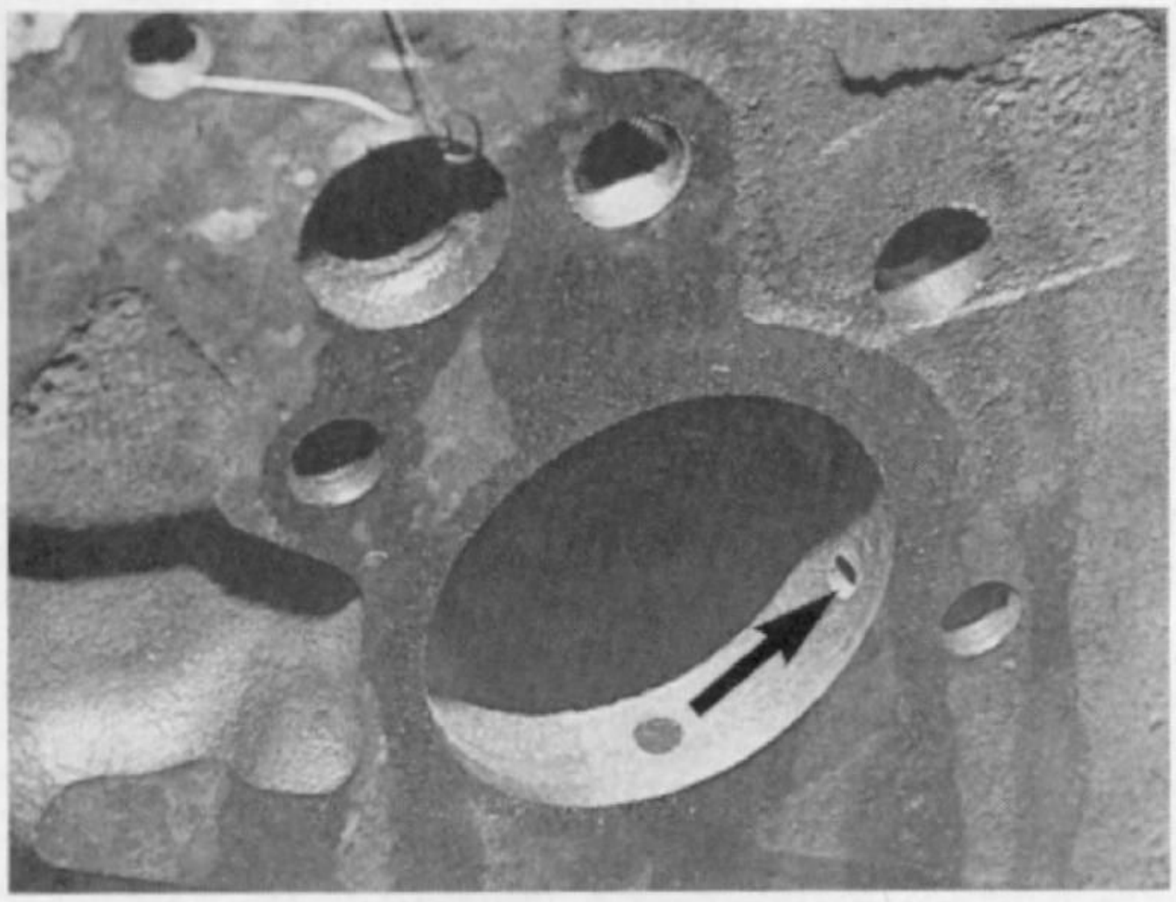
A quick way to determine whether an engine has mechanical lifters is to check if the two lifter bore galleries (arrows) have been drilled. This particular 427 top-oiler block obviously has mechanical lifters. If the two lifter passages are drilled, then it could be either a hydraulic or a solid cam block. Another very important point to notice in this photo is the cam plug. Note that the correct installation actually appears as if the plug is in backwards. As for installing the cam plug, it must be installed prior to putting the block on the engine stand. When installing, use Permatex No. 1 on the plug and also around the seam once it is in. After the cam plug is securely installed, the cam can go in.

The difference is that 427 side-oiler blocks need grooves in the second and fourth journals (arrows) of the camshaft to allow for oiling to the rocker shafts. Most aftermaket FE cams have these two grooves, therefore, they can be used in any FE block.

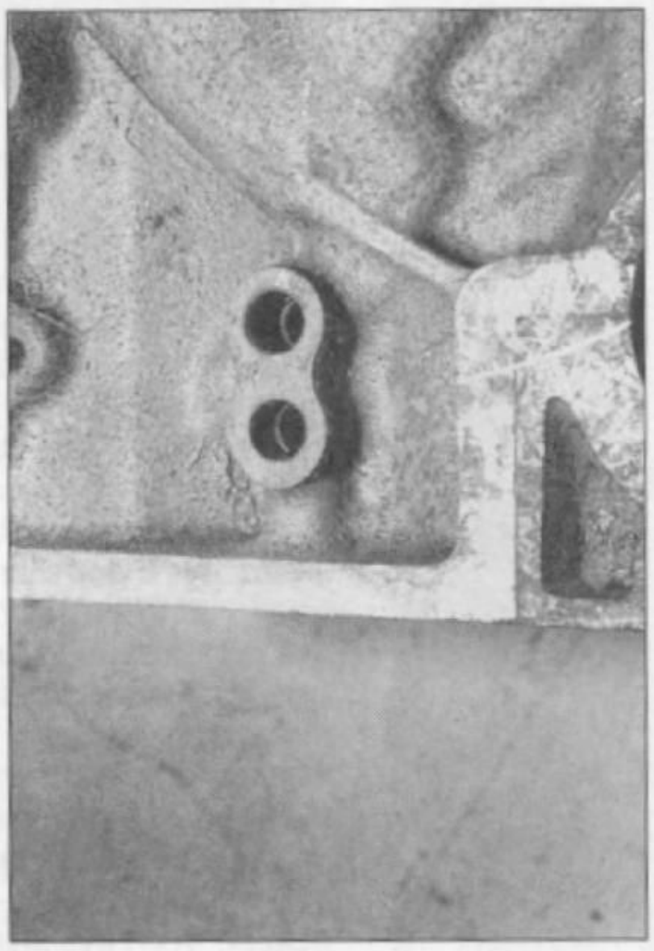




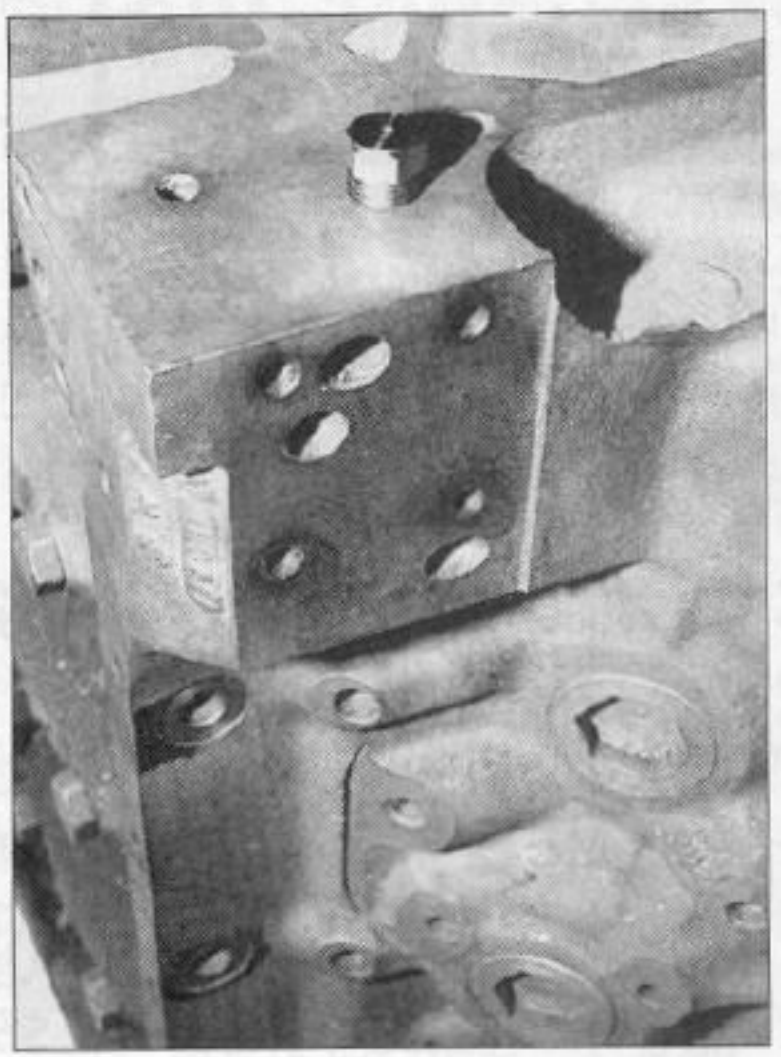
All 406 and 427 blocks utilize a pressure relief valve that opens at approximately 100 psi to create a bypass that redirects oil back into the pan. All 406 and top-oiler 427s have this valve located at the rear of the block above the rear cam plug. All 427 side-oilers have this valve at the rear-lower-left-hand corner of the block. The plunger is the same for both top- and side-oilers, however the relief springs are different for each. FPP makes an exact reproduction plunger that sells for $11.95 and a reproduction stainless steel spring for the side-oiler is priced at $3.95. With a .230-inch spacer (a small nut works well), the side-oiler spring will work in the top-oiler block. However, FPP plans on making a top oiler stainless steel spring in the near future. Upon installation, make sure that you put the spring in the block first then the plunger (with the tip facing out) followed by installing the plug. Make sure the relief valve assembly goes in the lower hole, and definitely don't mix up these two plugs since they have different thread styles.



All FE's feature oil feed holes (arrow) for oiling the cam bearings and distributor gear while a small notch in the front of the No.1 cam bearing oils the timing chain. Cam bearings should be installed after all machine work and grinding is done and the block has been thoroughly cleaned. Ron recommends using one-piece non-crimped cam bearings that have been treated with G&L Dry Film Lubricant. Clearance and alignment also needs to be checked prior to assembling.



FE OILING SYSTEMS SECRETS



Never available separately from Ford, FPP is now offering an exact reproduction of this uniquely threaded special plug that goes at the front of the side oiler passage. In the past, if you didn't have this plug, a used original one would cost from $20 to $40—and that's if you could find one! FPP sells a reproduction of this plug for only $11.95.

FUTURE FEs?

While we've heard lots of information about a new 427 side oiler block to come from Ford Motorsport, we thought that if you read most of this story, you would be interested in such an offering. In any event, accompanying this sidebar is a coupon we'd like you to return to us regarding this rumored offering. Again, like in our SVO 351W story, we will pass this information on to Ford SVO.

SOURCES

Canton Racing Products
Dept. MF
9 Tipping Drive
Branford, CT 06405
(203) 481-8324

Ford Power Parts
Dept. MF
14504 S. Carmenita
Unit C
Norwalk, CA 90650
(310) 921-5300
Hours: Noon-7 p.m. Tuesday-Friday,
10 a.m.-4 p.m. Saturday (Pacific Time)

G&L Coatings
Dept. MF
Box 178
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Harbinger, NC 27941
(919) 480-0905