MORE DUNEROD HORSEPOWER

PROJECT DUNEROD'S "TIRED" VW ENGINE HAS BEEN UPDATED TO A 1600 CC, 70 HP SCREAMER!

By Ed O'Brien

Progress continues on Project Dunerod. The latest improvement is the refreshment and enlargement of our "bug motor."

The progress of our Dunerod continues! With everything else shaping up so well, it finally came time to put some horsepower into it. The engine in the car up to this time had been the stock '66 VW model, displacing 1300 cc and yielding some 50 hp. We turned the car over to the experts at Scat Enterprises in Inglewood, Calif., to accomplish the power boost. Following their every move with a camera, we learned not only what makes the VW engine tick (and how to greatly increase its output) but also several tricks and time savers during the entire operation.

John Caldwell, Scat's ace on VW components, handled the entire operation, answering our many questions and pointing out all critical steps. During our stay at Scat we learned a lot about this relatively simple (but finely engineered) German masterpiece, the Volkswagen engine.

We used a hydraulic lift to get the car off the ground for better access when removing wiring and the upper engine mounting nuts. Actually, it's quite unnecessary, just a little more convenient. Before completely loosening the engine, we had the car back on the ground and supported the engine on a floor jack. Removal is a simple process, but make sure you have disconnected all wires and lines. A little tip here: the rubber cap used to cover the brake bleed fitting will fit snugly over the gas line to prevent all the fuel from draining out of the tank.

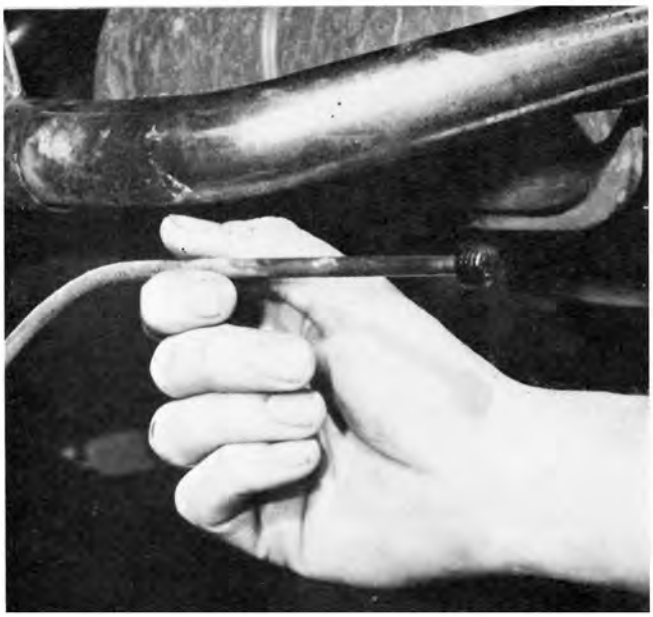
With the engine on the ground, the first disassembly step was to remove the clutch and flywheel. When the actual engine dismantling began, it became obvious just how much these engines are tortured by the sand and dirt in which they are most often used.

We found out that one common problem with engines used extensively in the dirt is in the oil cooling system. When you begin to notice your engine running hotter than normal, the first thing to check would be the oil cooler, located atop the engine under the fan shroud. The fins on this cooler often tend to get clogged with dirt, preventing the passage of air between them. The unit is not hard to clean, but care should be taken not to puncture it.

We also discovered right away where a great deal of our engine's power was being wasted. It's simple to correct the fault, but easy to overlook. Our air filter, plenty big enough to pass sufficient air, looked like it had been dipped in oil and rolled in sand. In other words, our 50 hp engine was being choked down to about 30 hp.

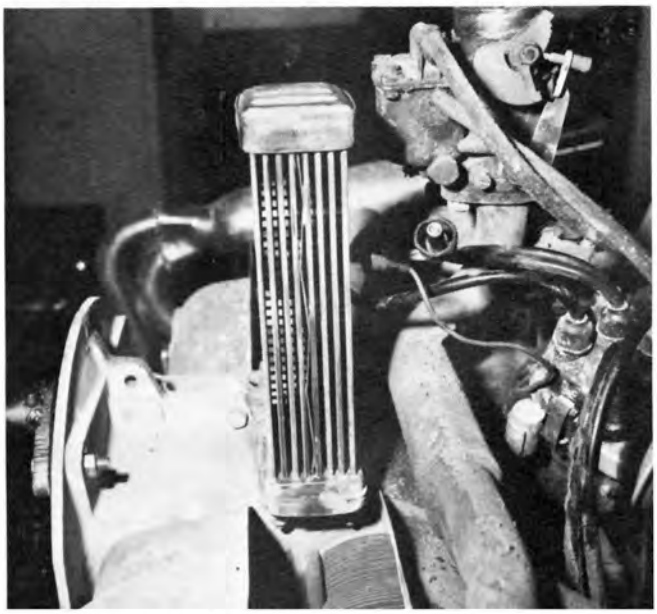
During these initial disassembly steps, it's a good idea to open the crankcase drainplug. This is especially helpful if you're working with an engine stand and can just leave the plug open allowing the oil to drain entirely while you take off parts.

Removal of the carburetor, exhaust system, distributor and intake manifold is quite simple and, though you'll need metric wrenches, practically every nut and bolt on the engine can be handled with two sizes. You'll be able to strip the engine pretty bare, including removal of the barrel covers, oil pump cover and oil screen before you'll need any type of puller. It's best, though not entirely necessary, to



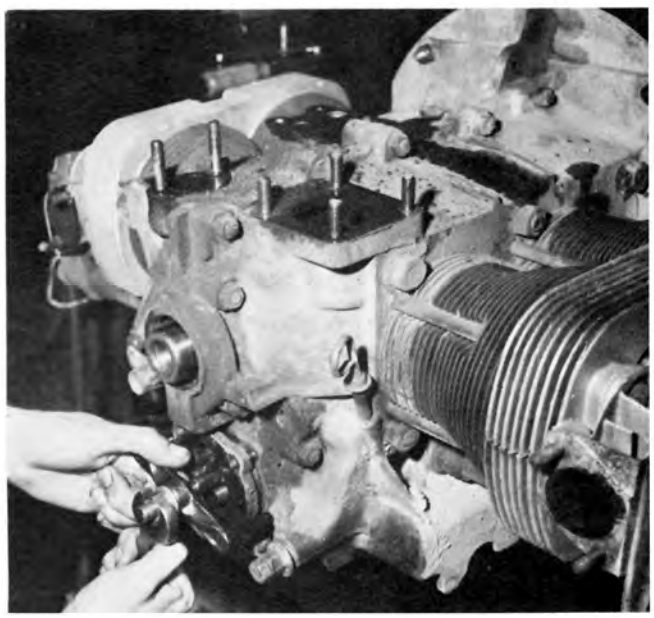
A time saver: the rubber cap on the brake bleed fittings will fit snugly over the gas line to seal it after disconnection.

For engine removal, a floor jack is handy, but two people can easily lift the aluminum VW powerplant out of the car.



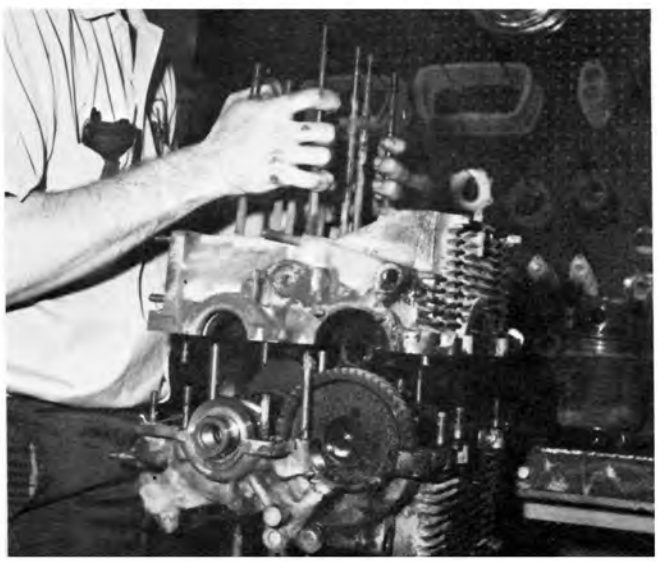
Under the main fan shrouding is the oil cooler. This will often cause an overheating due to a dirt buildup. This is the first place to check whenever overheating is a problem.

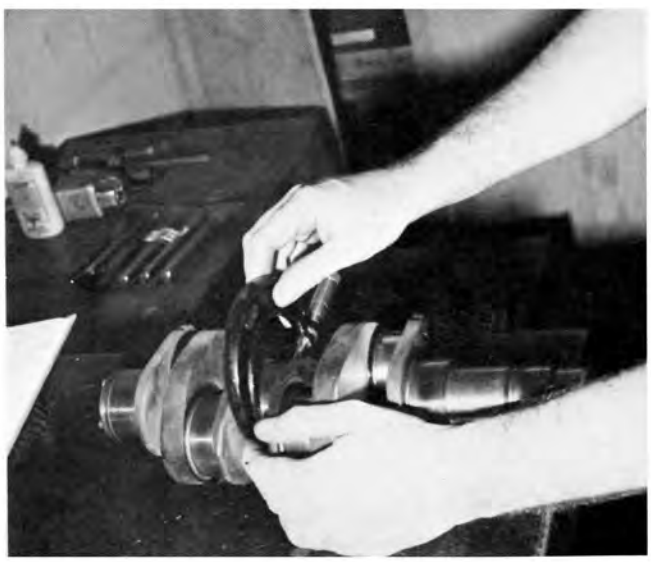
With everything removed and the bolts loosened, Dunerod's case was split and the inner workings of the German masterpiece were revealed.



Though disassembly can be handled almost entirely with two sizes of metric wrenches, special VW puller is required to remove the oil pump.

First indications of our engine's good condition came when a micrometer check and a check for straightness showed our crank to be in near new condition.





use a puller on the generator belt drive wheel to remove it from the end of the crankshaft. Then, to get the oil pump out, a puller must be used.

Back to the wrenches; the rocker arms, pushrods, heads and chambers (cylinders) were next to come off. We were now to the final steps. The case could be split at this point, but it is suggested that the pistons be removed first to prevent any damage. After loosening all the nuts holding the two halves together, and tapping around the edges to break the seal, our engine case was split and we got our first look inside that famous "bug motor."

Something important to remember when splitting the case is that, even though it may be hard to separate, never try to pry. If you must pry at all, do so with caution. This is a metal-to-metal contact, with gasket sealer, but no gasket. If you pry, you could either bend or gouge the case and will surely create an oil leak.

We're now inside the engine, and from this point it is vital to check for markings and keep everything in order. After removing the crank from our engine, John carefully marked the connecting rods with the numbers one through four before removing them. Had we been retaining our stock cam he'd have kept the pushrods and lifters in order also. Since only the center main bearing is a split insert, the others mount to the crank and come out with it. Remaining in the case are dowel pins which locate the bearings. These should be removed before cleaning since they come out easily and could be lost.

Here's where some machine shop work comes in. A hydraulic press was used to remove the cam drive and distributor drive gears from the crank. It's necessary to get these off to remove the second main bearing. Before removing this main bearing, it's a good idea to observe the locater hole in it. This hole, which lines up with one of the dowel pins in the case, is to the rear of center in the bearing, that is to say, nearer the flywheel end of the crank. Also, if you lay the crank down with the connecting rods in the position they would be in the engine, you'll see small raised marks in the casting. To get the rods on right, make sure these marks all show before you install the rods. The marks are only on one side of the rod.

Our crankshaft was thoroughly checked and found to show almost no wear. It was also checked for straightness and was okay here also. Then John used an emory cloth crankshaft polisher to micro polish all bearing surfaces. The crank, now ready for reassembly, was put aside, and the camshaft became our objective.

We sought a little vitality in this department also, and it was decided our stock cam would be replaced with one of Scat's performance grinds. Tom Lieb, founder of Scat, suggested we use his model C-40. This would give us a lift of .320-inch, with a 282-degree duration. At his suggestion, our cam went by the wayside, and our cam drive gear was mated with a C-40. Our stock lifters, pushrods and rockers were to be retained, but the valve springs and retainers were replaced. Spring pressure was increased from 73 psi to 105 psi with a set of Scat springs and the corresponding heavy duty retainers.

We had decided upon minor head modifications, so for the machine work required, we turned the heads over to George Beavis. Before the head work, John thoroughly disassembled and cleaned the heads, using a sand blasting process to remove everything and produce a semi-polished surface. The cleaned heads were carefully checked for faults or cracks.

Modifications involved an increase of .338-inch in the diameter of the combustion chamber, necessary to fit the new cylinder barrels we were installing. In making the cut, George went deep enough into the chamber to show a slight cut around the edges of the top surface. He explained that by doing this he could check to make sure the heads were not warped, which is not too uncommon since the heads are aluminum. After cutting for the new barrels, George milled .030-inch from each head to increase our compression to 8½-to-1. Had we decided to install Scat's larger 88mm barrels, it would have been necessary to make a cut in the case openings as well as in the heads, but in our case this wasn't necessary.

With the head machine work completed, John Caldwell did a stock valve job on our heads, and we were ready to begin the reassembly process. Our engine, though one of the smaller variety of VW units, had shown little sign of wear. For this reason, most of Scat's endeavors would be aimed at improvement rather than repairing to bring the engine back to normal. It was at this point that both Caldwell and Tom Lieb said they felt that the results of this work on our engine would be most gratifying.

With everything gathered in the engine room at Scat, it was interesting to take inventory and determine just which of our engine's components were being replaced. The biggest objects, of course, were the barrels. We swapped our 1300's for four 1600's and the pistons to correspond. Then the cam was set aside in favor of Scat's C-40. Scat has a longer oil pressure relief valve which we installed for a 30 per cent oil pressure increase. Replacing the stock carburetor was a Zenith 32NDIX, increasing venturi area from 28mm to 56mm, improving horsepower by 15 per cent. A newly designed Scat manifold was selected to replace ours and improve carburetion further. A Bosch 031 single point distributor was to replace our stocker. A new flywheel and a heavy-duty diaphragm clutch were to be installed and, of course, all new bearings and gaskets were necessary. Everything was now ready, and the critical reassembly began.

The initial assembly step was to insert the main bearing locator dowel pins into the engine case. According to the experts, it's best at this time to set the bearings in place properly, and to scribe them on the outside surface so you can check to see they are correctly installed with the crank. The main bearings will feel loose on the crank, but this is normal since they crush when the case halves are torqued. It's important when assembling the crank to insure that the dowel pin locator holes in both the bearings that mount on either side of the timing gears are to the rear. If you discover them on wrong after installing the gears, you'll have to press the gears off again and change the bearings. On the other hand, if you don't discover the error, the bearings (and probably the crank) will either never work or will have a life that could be measured in minutes and seconds.

Our connecting rods (lined up with numbers and marks all showing and right) were then attached. John was very careful to apply good engine assembly oil to the bearing surfaces as he attached each rod. After torquing the rods to 36 ft.-lbs., John replaced the assembly into the engine, carefully checking the scribe marks on all main bearings.

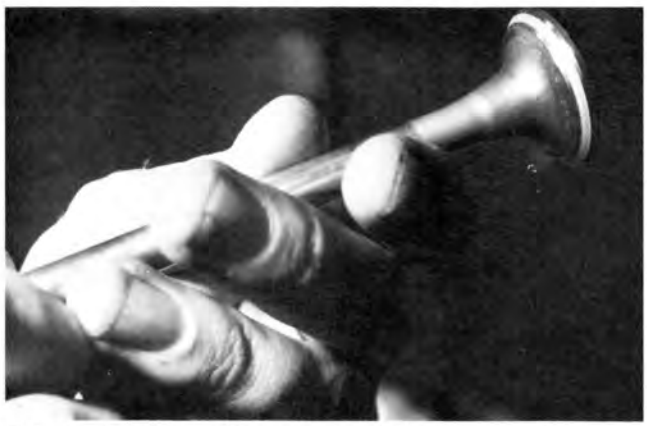
The lifters (camfollowers) went in next, and once again a liberal application of lubricant was used. After installing and lubricating the cam bearings, John put our new cam in its place. To line up the cam, check the front side of the timing gears on the crank and the cam. There's a double mark on the crank and a single one on the cam. Line the cam mark up between the crank marks. When the cam is in, apply gasket sealer around the edges of the cam plug and mount it in the hole (half on each half of case) behind the cam. The cam bearings should already be in the half of the case which has been set aside until now, as should be half of the one split main bearing. Four lifters should also be in that other half.

Before connecting the two case halves, carefully apply gasket sealer all around the edges. (It wouldn't hurt to apply a thin coating to each.) To make the mating of the halves easier, whether using an engine stand or not, it's best to tip each on its side. This prevents the lifters from falling out. With our engine (on a stand) John tipped the half he'd been working with, then stuck his hands through the barrel holes in the other half. Reaching out with his hands, he took hold of the rods that were meant for that half of the engine and matched the two case halves. Before going any further, John put all the bolts and nuts connecting the case halves in their places and tightened them. There are six large nuts on the case which are torqued to 22 ft.-lbs., and 13 small ones which, together with two bolt/nut combinations, are torqued to 14 ft.-lbs.

Mounting the pistons to their

George Beavis cut .338-inch from the head combustion chamber's diameter to fit our new larger barrels.

With the machine work complete, John reground our valves and valve seats and did a stock-type valve job.



This is the way a VW valve should look for stock or near stock use. Unlike a racing valve job, the seat is not right on the edge of the valve where better performance and shorter life exists.

Our stock 73 psi valve springs were replaced with 105 psi units from Scat, complete with heavy duty retainers.

When replacing main bearings on the crank, the dowel pin locater holes go towards the engine's rear.

To mount the rods right, lay the crank down and insert the rods in order, making sure this little mark faces upward.

Small dowel pins in the case match with holes to the rear of center in each main bearing to locate the bearing.

No gasket is used between the case halves, so a coating of gasket sealer is applied for a tight seal.

connecting rods was the next step. A word of caution here: since you're installing pistons with the rings in place, you'll have to be careful. When tapping the wrist pin through the holes in the rod and piston, keep the rod straight. If you let it drop to one side or the other, the piston will be resting on the studs used to mount the heads, and you could easily break a ring. One more word of caution involves the wrist pin keeper. This spring clip, when being inserted into the piston with needle nose pliers, could spring loose and go through the piston hole. The result would be a clip inside the sealed engine case. A rag in the hole, or a hand shielding the hole could be very gratifying preventive maintenance.

Unlike the conventional engine where the pistons slip into the cylinders through the top, the cylinders (barrels) on the VW engine are mounted over the pistons. For this part of the operation, a piston ring compressor that can be opened and pulled off to one side must be used.

John began our barrel installation by first checking for free ring movement on the pistons, then lubricating the rings and positioning the end gaps. When inserting the barrels, the cooling fins with flattened sides go to the inside. The barrels won't go on any other way. There is also a thin gasket that goes onto the barrel and ends up between the base of the barrel and the edge of the case.

After inserting the barrels, there is a small piece of shrouding that should be clipped on under the barrels. It goes between the barrels on each side and, if you go much beyond the barrel installation before clipping these pieces on, the job becomes quite difficult. These clip-on pieces are quite necessary to insure a good flow of cooling air around the bare fins.

The way John handled the installation of the heads seemed to be the easiest way. He balanced one head on top of the studs that go through it, then placed the pushrod tubes on the holes in the engine case. He then carefully lowered the head into position, making sure the tubes were lined up straight. No sealer was used between the barrels and the heads. He put the six nuts onto the head studs to hold the one head in place, then repeated this action on the other side.

When both heads were on, he torqued the nuts to 25 ft.-lbs., being sure to accomplish this in progressive steps so as to prevent the heads from warping. Also, while tightening, he checked to make sure the pushrod tubes were in properly.

The rest of the valve components were installed next, with the pushrods going in place first. Our pushrods were all cleaned and checked, but since John did a valve job on our engine, they were not kept in order. He first put four of them in one side, then put the shaft and rocker arms onto the studs that hold them. Two nuts used to hold the rocker shaft were then installed and torqued to 25 ft.-lbs. After this was done on the other side, the engine was turned upside down and the oil screen was put back into the hole in the case bottom. This screen mounts over the holes used to hold a cover and a gasket goes both between the screen and the case and between the screen and the cover. Gasket sealer was also used in this area for a tight oil seal. This cover is subjected to some pressure since the oil drain plug is on it, so the sealer is a good idea.

Turning the engine upright again, John began installing the final pieces of our engine. The fuel pump was first, and it was our stock unit. Unless the pump is disassembled (ours wasn't) there are three main components and two gaskets to install. There's a plastic spacer called a guide block that mounts over the pump hold-down studs. Under and over this are thin gaskets. A pushrod goes through the block, then the pump mounts over this. Turning the engine to a point that lowers the fuel pump pushrod makes installation of the pump much easier. The pump pushrod is installed with the point down. The oil filler tube/generator bracket combination goes on next, with a gasket separating it from the engine case.

The installation of a distributor was relatively simple, but a few steps must be followed. One difficult thing is the insertion of two steel washers that go under the distributor gear drive. It's best to put these into the engine rather than try to keep them on the gear drive. Some lubrication will help keep them in place until the drive is in. The gear drive itself is slotted, and the unit is installed with the slot (it's off center) towards the engine front. A coil spring then goes inside the counterbore in the gear drive, and the distributor is installed. Make sure the drive lip on the distributor lines up with the drive slot. It's also important to have the engine turned to number one cylinder firing position (check timing mark) during this operation; with the distributor in place, set the timing and then tighten the hold down bracket. Incidentally, our ignition runs 29 degrees total advance.

With the installation of the shrouding around the barrels, then the oil cooler, we were nearly ready to run. Installing the oil cooler is very basic, but there are two rubber grommets that must go on the mounting studs between the cooler and the engine.

John had taken the main shroud apart to clean it, the coil and the generator. These were replaced and the shroud was ready to remount. To prevent clearance problems with the generator, the intake manifold was installed first. This was a new type from Scat, complete with a good chrome job. The shroud assembly was installed next, and at last we could see that what had been a mass of parts in a shop now resembled once again the air cooled VW engine we brought in.

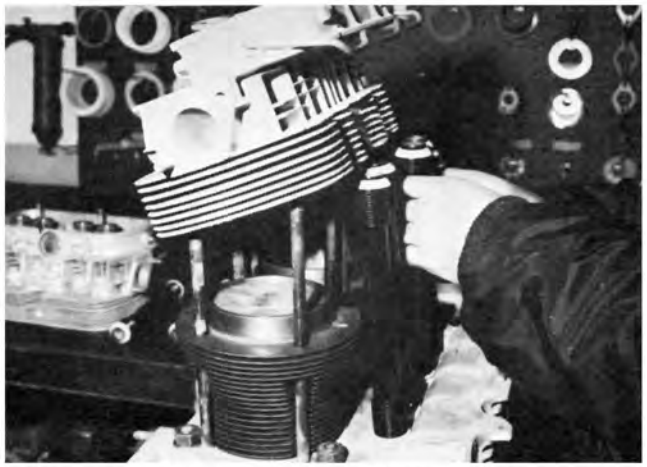
Our Zenith two-barrel carburetor went on next, completing the engine's stay on a stand. It next went to the floor where a fitting was made for new clutch components.

The flywheel was first. We retained a stock unit here, but installation was very interesting. Three steel washers go between the engine and the flywheel (not two–or four–but three). With these washers in place, the flywheel must be installed and checked for end play. A tolerance of between .004 and .008 is acceptable, with a spot right in the middle of this being most desirable. If you can't get the right end play, the size (not the number) of

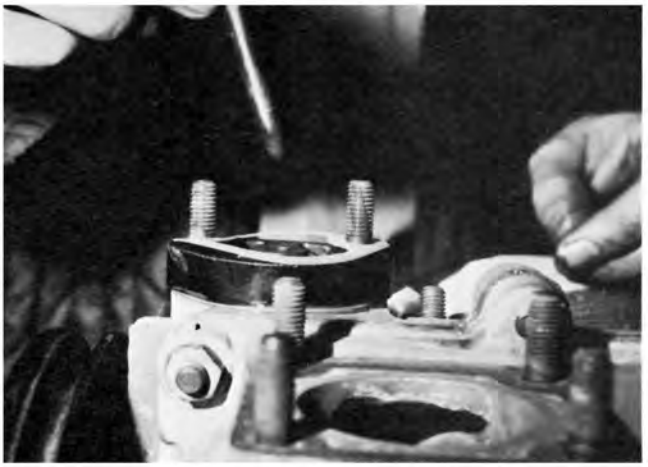
continued on page 75

Torque the 13 small nuts and the two nut/bolt combinations to 14 ft.-lbs. and the six large nuts to 22 ft.-lbs.

Our 1300 cc barrels were replaced by 1600 cc models. A ring compressor that can be slid off the side of the piston must be used for installing the barrels on these engines.



With the engine on its side, the pushrod tubes were balanced in place and our cylinder head carefully mounted.



This fuel pump pushrod, inserted through a plastic guide block, must go into the engine pointed end first.

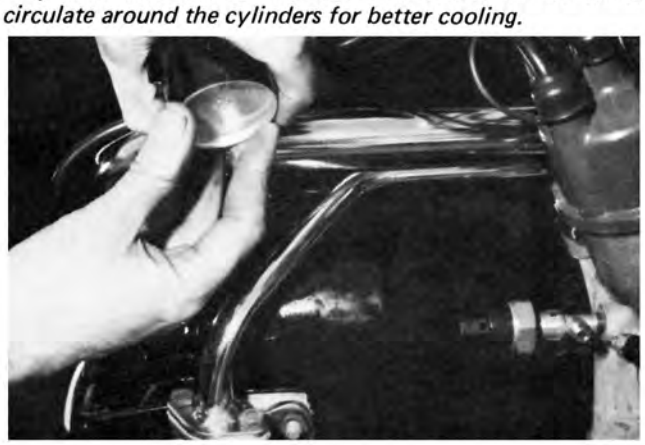
The slot on the top side of the distributor drive gear must be towards the front or pulley end of the engine when installed.

A new longer oil pressure check valve (right) was installed into the Dunerod for a 30 per cent cooling increase.

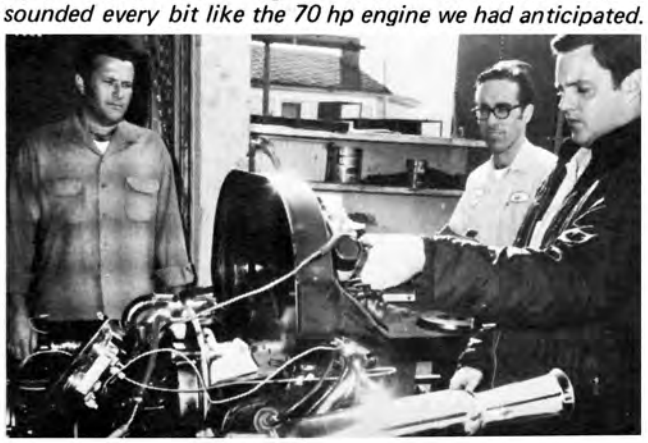
Crankshaft end play is tolerable between .004 and .008. Ours was just right at .005.

A new heavy-duty Scat diaphragm clutch was installed to handle our refurbished powerplant. The first clutch engagement showed the benefit of this larger unit.

Aluminum plugs were inserted into the heater ducts where they exit from the fan shroud. This causes all the air to circulate around the cylinders for better cooling.



Scat's Dale Lingard, Tom Lieb and John Caldwell (left to right) watched as our engine was fired for the first time. It sounded every bit like the 70 hp engine we had anticipated.



VW ENGINES

continued from page 30

washers must be changed. When the proper end play is achieved, remove the flywheel again, insert the rear main engine seal and replace the flywheel, tightening the bolt to 230 ft.-lbs. Then our Scat heavy-duty clutch assembly went on and was tightened, completing the job except for re-installation of the engine into the car.

To make checkout easier, our engine was tested on an engine stand before going into the car. With an oil pressure indicator and easy engine access, John could easily pinpoint any problems and tune our engine to perfection. The only thing he found and changed was the carburetor jetting. With this leaned down some, using .135 primaries and .220 air correctors, the engine sounded very strong. We might have been able to get a slight further boost with a different type exhaust header system, but we decided to polish and retain what we had been running.

The engine was once again mated to the transmission in Project Dunerod, and the wiring and lines were connected. It finally became time for the big thrill we had been awaiting, and the true test of our project: a road test.

What a test it was! The combination of a new, larger clutch, plus all the added horsepower (now between 65 and 70) produced an exciting ride, even on the street. Everything seemed to check out perfectly. John accelerated hard one time, then instantly disengaged the clutch and shut the engine off to check a spark plug. It showed the fuel mixture to be nearly perfect, and this along with the general performance of the engine proved very satisfying to him and to us. John recommended ethyl gasoline but assured us it wasn't essential.

It was fortunate in one way that we did take a test ride, since we encountered one problem. A plastic line running from the engine oil pressure fitting to the dash gauge touched the header pipe and was burned through. Some engine oil was lost, but a check after the short test revealed this and the problem was quickly discovered and solved. However, had we not taken the test run, the results could have been tragic. This pointed out to us graphically what the mechanic had said about checking carefully to make sure everything was in order after installing the engine.

Back at Scat, John rechecked the setting of the valves. He had set them while the engine was on the test stand. At first he set them with .008-inch lash, but he decided this made the engine too noisy, and closed them to .004-inch. This proved just right for power and noise.

And so, Project Dunerod, one of the most fun undertakings at PHR, is now nearer completion. It is now Scat powered!