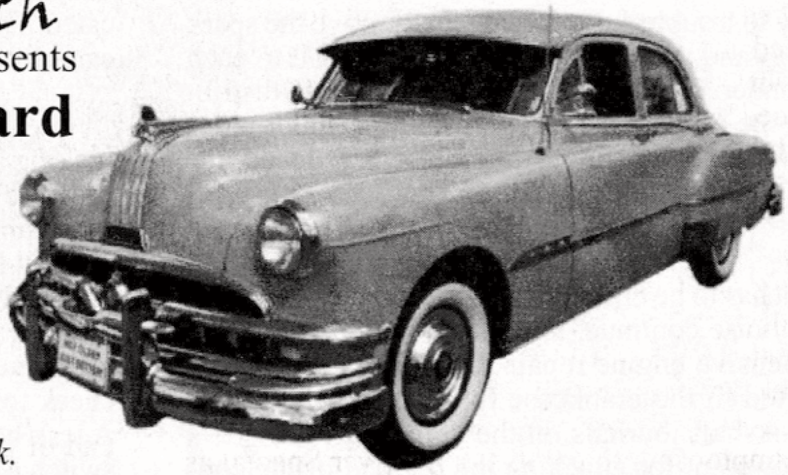
Orest Lazarowich
Presents

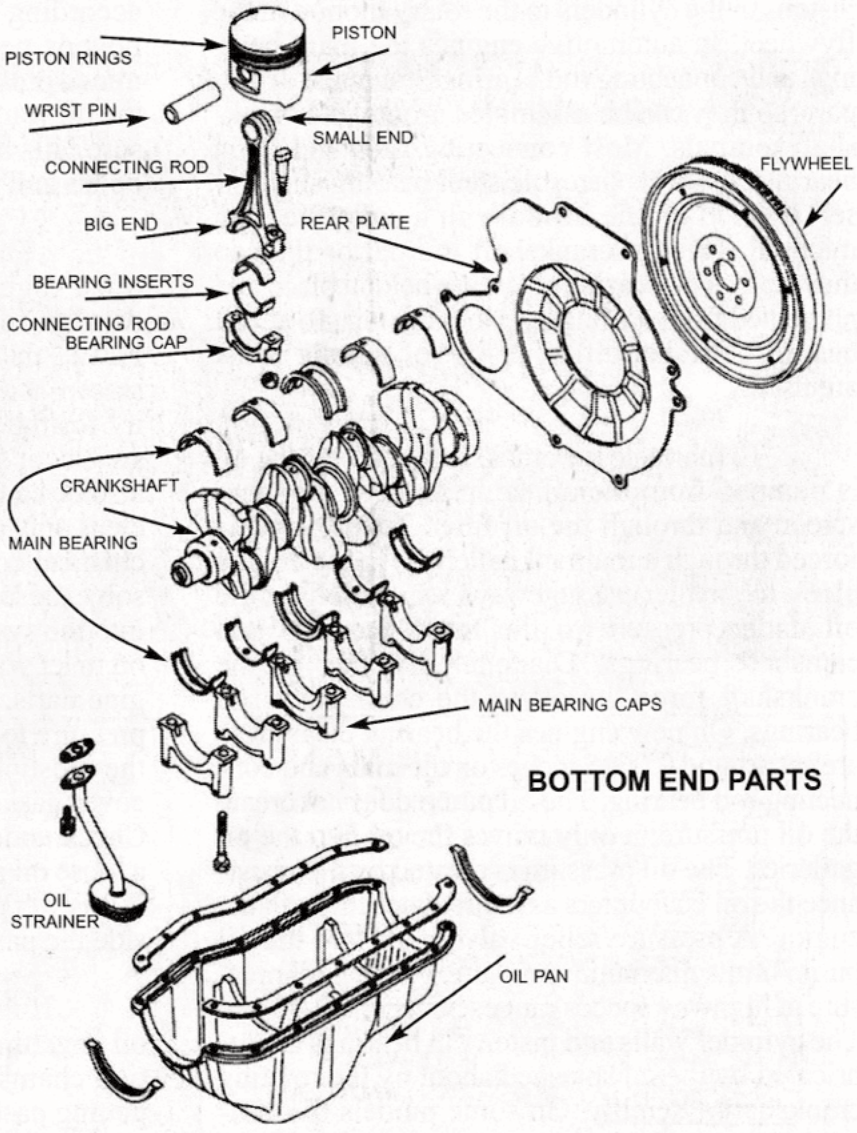
Looking Backward
but
Moving Forward

A Continuing Series focused on the Repair and Restoration of your old Car and Truck.



Bottom End Noise

The bottom end parts include the engine block, crankshaft, pulley/harmonic balancer, connecting rods, pistons, rings and wrist pin, connecting rod bearings, main bearings and their caps, and the flywheel/flexplate and/or nuts and bolts that hold everything together. Use a mechanic's stethoscope to pinpoint where the noise is coming from. Two types of noise are very common and easily identified: noise at the piston and noise at the crankshaft. If you hear a hollow, muffled noise for a few minutes during a cold start up and the noise disappears when the engine warms up, this should not cause any problems. If the noise continues after the engine reaches operating temperature, there can be excessive piston clearance (piston slap) between the pistons and the cylinders caused by worn pistons and/or worn cylinder walls. A metallic double knock noise at idle can be caused by a worn or loose piston pin, worn upper connecting rod bushing or lack of lubrication to the piston pin. Piston ring noise is most common during acceleration and can be caused by worn piston ring grooves, low ring tension or broken piston



BOTTOM END PARTS

rings. A dry/wet compression test is the easiest way to troubleshoot this noise. Remove the spark plugs and add a tablespoon of engine oil to each cylinder. Crank the engine a few times to distribute the oil past the rings. Install the spark plugs and start the engine. If the noise is reduced, the problem is at the piston ring area.

Any noise coming from the crankshaft area has to be checked out immediately. If you let the noise continue, the end result will be a very expensive engine repair. The crankshaft is supported in the crankcase by main bearings. The crankshaft journals on the crankshaft provide a pivot point for attaching the big end of the connecting rod to the crankshaft. In this way the crankshaft changes the up and down motion of the pistons in the cylinders to the rotary motion of the flywheel. In automotive engines the main bearings and connecting rod bearings are made of two parts so they can be assembled around the crankshaft journals. Most connecting rods and main bearings use a replaceable steel bearing shell insert layered on the inside with a softer bearing material than the crankshaft journal or the cap they sit in. The bearing shells are held in place and prevented from turning by a locking lug. To adjust bearing clearance different sizes of bearing shells are used.

To lubricate the crankshaft bearings the oil is pumped from the oil sump through a pickup screen and through the oil filter. Then the oil is forced through a main oil gallery(s) in the engine block to smaller passageways which deliver the oil under pressure to the main bearings and camshaft bearings. Diagonal drillings in the crankshaft force the oil to the connecting rod bearings. On new engines the bearing clearances are set around 0.0015 inches on the main and connecting rod bearing. The oil pump does not create the oil pressure; it only moves the oil into the oil galleries. The oil pressure is created by the resistance the oil encounters as it circulates through the engine. A pressure relief valve built into the oil pump limits maximum pressure. Normal oil pressure at highway speeds ranges between 30-45 psi. The cylinder walls and piston pin bearings are lubricated by the oil splashed about by the rotating crankshaft assembly. On some models the connecting rod is drilled and the piston pin is lubricated. On some engines an oil squirt hole lubricates the thrust side of the piston.

If the engine is at idle speed and NOT making any unusual noises but you notice the oil pressure gauge reading is very low and does not move up when the engine is accelerated or the engine oil light is flickering or stays on, turn off the engine. Raise the hood, and check for any sign of an oil leak at the filter or oil pressure line, if the oil gauge is mechanical. If the gauge is electrical, check for a leak at the oil sender switch (sensor). A leak here will cause the oil light to flicker. The switch is operated by a movable diaphragm fitted with a hair spring whose position is determined by the pressure applied to it. This pressure varies according to engine type and can be 3.5 - 11 pounds per square inch (psi). When the determined pressure is applied, the switch is closed and the oil warning light goes off. When the oil pressure falls below the determined value the switch opens and the oil warning light goes on.

Check the oil level on the oil dipstick. Most engines will burn some oil in between the regular oil changes. If the reading is close to FULL, the problem can be a plugged oil pickup screen, worn/broken oil pump, wrong oil viscosity for the time of the year, defective oil sender switch, or a burned out bulb. Low oil pressure can also be caused by a plugged oil filter. If this vehicle is only driven occasionally, and is in good mechanical condition, a filter and oil change might solve the low pressure problem. This bulb is wired into the system so it goes on when the ignition is on to let you know the bulb is okay. When the engine starts, the light goes off indicating there is oil pressure to the engine. If the oil level reading on the dipstick is low, check for leaks at the valve cover gaskets, oil pan gaskets and oil pan seals. Check under the engine for a damaged oil pan or a loose oil plug. Check the bottom of the pan, and if it is wet or leaking, it is possible a rust spot inside the pan has rusted through.

If there is no evidence of an oil leak, the oil is getting past the rings and into the combustion chamber. On I-head engines the oil can be getting past the valve seals and valve guides and

into the combustion chamber. If you cannot trace any oil leaks, check for a defective PCV valve. To this point all you have going for you is the lack of engine noise at the crankshaft. The low oil pressure reading or a flickering oil pressure warning light is a sign that the engine is operating at low oil pressure. Refer back to the dry/wet compression test. The first sign that an engine is burning oil is the blue exhaust smoke out the tailpipe. As the engine parts wear, oil consumption increases. Worn crankshaft bearings throw more oil onto the cylinder walls. Worn cylinder walls prevent normal ring control because the rings cannot change shape as they move up and down in the cylinder. As the crankshaft bearing clearances increase due to engine wear, the oil pressure gauge will indicate lower readings. Check the mileage. Most engines up to the late 1970s will develop an oil consumption problem somewhere around the 60,000 mile mark.

If this is a low mileage engine and you do some troubleshooting now, it is possible to repair the engine at a reasonable cost if the bearing shells are not damaged. If you keep driving, you will begin to hear noises starting with the hydraulic lifters, if so equipped. They are starved for oil and are drawing in air. Continue driving and you will hear a light rapping noise coming from the crankshaft area which can be caused by a worn connecting rod bearing. On acceleration this noise will turn into a rattle, and if you continue driving, the chances of breaking a connecting rod and damaging the engine are one hundred percent. Shut the engine down, and be prepared for a very expensive repair, if the engine block is damaged.

Checking Engine Oil Pressure

This test will determine the wear of the engine's crankshaft main bearings and crankshaft bearings. You will need a manual mechanical oil pressure gauge. The shop manual calls this a 'master' gauge but any regular oil gauge calibrated in pounds and attached to the oil gallery by a flexible hose can be used. Raise the hood. Cover the left fender with a fender cover. Locate the oil sender switch on the engine block, and disconnect the electrical connection. Remove the oil sender switch. With the mechanical dash gauge disconnect the oil line at the oil gallery. Connect the 'master' gauge to the oil sender location or to the oil gallery. You may have to use an adapter fitting to connect the flex line. Check the owner's manual for engine speed and pressure reading. Make sure the oil in the oil pan is up to the FULL level. With the transmission in neutral and the parking brake on, start the engine. If there is NO reading on the gauge in the first few seconds, STOP the engine immediately. The oil is getting past the worn crankshaft bearings or the oil pump is worn. If there is an oil pressure reading, bring the engine up to operating temperature. Normal oil pressure (e.g. 327 Chevy block at idle speed a steady needle reading of 35 psi) as you speed up the engine should increase. Pressure of less than 10 psi at idle indicates worn bearings. Correct oil viscosity is important to oil pressure in hot and cold weather. Most engine manufacturers recommend 5W-30 for year round driving.

If the oil pressure readings check out, but the oil warning light was flickering during idle or the oil sender switch is leaking, replace it. Clean the area around the switch. On some models you can use a deep socket and a ratchet to remove the oil sender unit. On others, use an open end wrench. Remove the switch, and take it to the parts store and replace it with a correct new unit. Wrap Teflon tape around the threads of the new sender and replace it in the block. Tighten securely. Clean the connector on the wire, and then connect it to the switch. If there is a rubber boot over the switch to keep dirt away, push it over the switch. Turn the ignition key on, and the oil warning light should be on. Start the engine, and the light should go off when the oil pressure is reached.

Mechanical Oil gauge

If this vehicle uses a mechanical gauge and the reading on the 'master' gauge does not match, or come close to, the reading on the dash gauge, examine the connecting copper or plastic line for any sign of an oil leak. There should be a rubber grommet

around the line where it passes through the firewall to the oil gauge. If there is no grommet, look for an oil leak down the firewall and a crack in the line. Check the connections at both the oil gauge and the oil gallery for leaks. Check the oil gauge for any sign of a leak at the gauge itself. If the gauge leaks, the solder joint inside the gauge may have a crack in it. Remove the connecting line and wrap a rag around one end and force air under pressure through the other. This should clear the tube of any oil blockage. Use air pressure and recheck the line for any leaks. Install the connecting line, tighten the fittings, but do not over tighten or cross thread them. Start the engine, and check the oil pressure reading. If the reading does not match the 'master' gauge reading or the instrument panel gauge leaks, remove the gauge from the instrument panel.

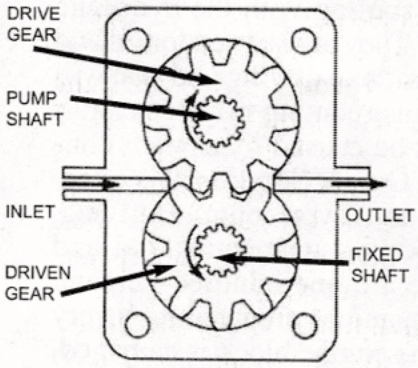
The mechanical oil gauge is a pressure expansion type of gauge. The indicator uses a hollow bourdon (curved) tube that is fastened at one end and free at the other. The oil pressure is applied to the curved tube through an oil line from the engine oil gallery. As the pressure increases, it causes the tube to flex and straighten out. This movement is transmitted to a needle by a linkage from the end of the tube. The needle moves across the face of the dial and registers the amount of oil pressure. If the gauge is not providing an accurate oil pressure reading, replace the gauge. If this is an older gauge and you cannot find an exact replacement, it is possible the linkage inside is gummed up causing an inaccurate oil pressure reading.*

To examine the linkage you first have to remove the bezel that holds the glass in place against the rim of the outer cup. Use a small screwdriver, and pry the edge of the bent over bezel up a little bit at a time. Repeat this procedure two or three times until you can remove the bezel and the glass. Do not damage the bezel because it has to be rolled back in place on assembly. Remove the fasteners that hold the cup to the gauge. Handle the gauge carefully, and use a magnifying glass to examine the regulating system. Spray the linkages with WD40, and with low air pressure, blow the parts clean. If the needle does not line up with the zero mark on the face of the gauge, very carefully bend the bourdon tube until it does. Do not apply excess pressure or you may break the solder joint. Use a 'lick' of Lubriplate on the linkages. Do not use WD40. Wipe the face plate and glass with a lint free cloth. Assemble the gauge, and roll the bezel back in place using a smooth rod around the circumference of the cup. Do this a bit at a time until the bezel and glass are tight to the cup. Regulate the air pressure at the compressor and test the gauge at ten pound air pressure increments using a rubber tipped nozzle at the inlet port. If the gauge tests okay, replace it in the instrument panel. Connect the gauge, and start the engine. If oil pressures meet those of the 'master' gauge, you have repaired the oil gauge. If the pressures are not accurate, replace the gauge.

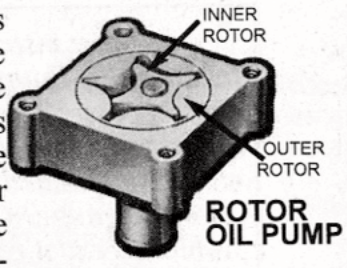
Oil Pumps

The oil pump does wear over time because it draws oil directly from the oil pan sump. If the oil is not changed regularly, it becomes contaminated and increases oil pump wear. As the pump wears the oil flow is reduced. Generally, in a stock engine, the crankshaft bearings wear out before the pump. There are two types of oil pumps in use: the gear type and the rotor type. Both are driven by a shaft with a gear at its end that meshes with a gear on the camshaft and drives the oil pump at half engine speed. The gear type pump depends upon a pair of meshing gears enclosed in a housing. As the gears rotate and unmesh a partial low pressure area is created. Atmospheric pressure on the oil in the oil pan forces the oil to enter through the oil pickup tube and screen and fill the spaces between the gear teeth. The oil is then carried around between the housing and the gear teeth. As the teeth mesh again, the oil is forced out of the space between the teeth and through the pump outlet to the oil galleries.

GEAR DRIVEN OIL PUMP



The rotor pump uses an inner and outer rotor. The inner rotor is attached to the oil pump driveshaft which is mounted off-center in the housing. The inner rotor drives the outer rotor. As the two units turn the spaces between the inner and outer rotors are first filled with oil. After a one-half revolution the lobes of the inner rotor move into the spaces of the outer rotor, forcing the oil out of the spaces, through the pump outlet and to the oil galleries in the engine block. Both of these pumps are mounted on the bottom of the engine inside the oil pan. There is a third style of pump called the internal pump which is mounted inside the front engine cover and driven by the crankshaft. It generates more oil flow and pressure. It is often used on overhead cam engines. There are two types of engines where the oil pump is not located inside the oil pan.



ROTOR OIL PUMP

The oil pump on the VW Beetle is located at the front of the engine and is driven by the camshaft. The pump can be removed with the engine in place. If the engine is in good mechanical condition and the oil level is good but the oil light flickers during driving, check the pressure relief valve first and then the oil sender switch. If the oil relief valve is located under the crankcase, use a screwdriver to remove the flat-headed bolt that holds the spring and valve in place. The spring will fall out. If the valve is stuck, use a screwdriver to work the valve loose. Clean the inside of the bore. Clean the valve and the spring. Check the spring length against specs, and replace the spring, if the coils are etched. Replace the valve in the bore; it must slide freely. Fit the spring and the bolt with the gasket. Tighten the bolt as tight as you can. Start the engine. If the warning light is off, the oil pressure is okay. If the warning light continues to flicker, check the oil sender switch. To check the oil pump, remove the oil pump cover plate, and measure the gears and oil pump housing for wear. If the wear is above the prescribed limits, the oil pump must be replaced. You will need a specially built puller to remove the old pump. Follow the service manual procedures.

The oil pump on Chrysler-Desoto-Dodge-Plymouth 6 and 8 cylinder flatheads can be removed without removing the engine oil pan. The pump is driven by a gear on the camshaft. Engine oil pressure at normal temperature is from 30-45 psi at speeds above 30 miles per hour. If pressure is low and the engine is mechanically sound with no oil leaks, check the oil pump for wear. Remove the distributor cap and rotate the engine until the rotor is in firing position for number 1 cylinder. Keep the crankshaft in this position while the pump is off the engine. Remove the oil pump attaching screws, and remove the pump. Note the position of the drive slot on the oil pump driveshaft when you pull the oil pump out. It must be in this same position when the pump is installed so it engages with the distributor shaft. On early models it is necessary to tilt the engine so the pump will clear the frame side member.

Clean the outside of the pump and remove the pump cover. Measure the clearances between the inner and outer rotors, outer rotor and pump body, pump cover clearance and oil pump driveshaft endplay. Replace the pump, if clearances show excessive wear. Install the pump with the distributor rotor in firing position for number 1 cylinder. To regulate oil pressure on 6 cylinder models, there is a relief valve on the left side of the engine. Different colored springs are used in the relief valve. If the spring has to be changed, the same color spring should be used. On 8 cylinder models the oil pressure relief valve is adjustable by turning in the spring retainer. Refer to the service manual for exact information.

Low Oil Pressure

Do not blame the oil pump for low oil pressure in a high mileage engine. If the 'master' oil gauge indicates low oil pressure, it is probably due to worn crankshaft bearings (mains and connecting rods). If the oil pan has to be removed to check the oil pump, check the bearing clearances at the same time. FIRST, check the service manual to see if the oil pan can be removed with the engine in place. If you can remove the oil pan with the engine in place, think ahead a little bit. This engine is probably going to need a complete

overhaul. That means top and bottom ends. Depending on how much wear there is in the cylinders and the crankshaft, you will need machine shop service. It is not practical, logical or safe to try and remove the crankshaft when the engine is in the vehicle. Remove the engine as an assembly, and then inspect the engine for wear.

Buy a can or two of spray engine degreaser and spray the top of the engine and the oil pan. Let it sit for about 15 minutes. If you are doing this on the driveway, get some cardboard under the engine assembly to make cleanup easier. Attach a spray nozzle to a garden hose and spray the engine from the top down. Now spray the oil pan. Clean away the cardboard, and rinse off the driveway. Push the vehicle into the work area. If you do not have an engine hoist, arrange the vehicle so you can lift the engine out using a rented hoist or a tow truck with an A frame.

S.K.

* *Most instrument gauges, and that includes the Bourbon-type gauges, are extremely delicate and sensitive. Cleaning and adjusting them by the inexperienced mechanic can easily lead to a broken or destroyed gauge. Often, especially on older vehicles, exact replacement gauges are difficult to locate.*

Rather than try to clean or repair a sticky or inoperable gauge, we suggest that you remove the gauge from the instrument panel, pack it well, and send it to Williamson's Instruments (see their ad on this page). Those folks are expert in dealing with all types of gauges, and they will discuss with you just what type of repairs, cleaning or adjustment is recommended.

Editor

Looking Backward *but* **Moving Forward** - by Orest Lazarowich

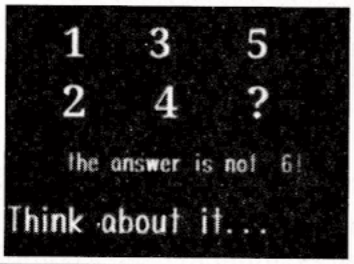
Over the past several months Mr Lazarowich has been dissecting the engine and its components for troubleshooting and repair. Next month he begins a related segment which starts with the removal of the engine.

As a review, the following topics have been covered in the past months:

Pre-1980 Emission Systems - *Skinned Knuckles* magazine, Volume #40, issue 10, October 2016
Automobile Engines, Part I - *Skinned Knuckles* magazine, Volume #40, issue 11, November 2016
Automobile Engines, Part II - *Skinned Knuckles* magazine, Volume #40, issue 12, December 2016
Engine Oil/Coolant Leaks - *Skinned Knuckles* magazine, Volume #41, issue 1, January 2017
Replacing Timing Gears/Chains - *Skinned Knuckles* magazine, Volume #41, issue 2, February 2017
OHV Top End Noise - *Skinned Knuckles* magazine, Volume #41, issue 3, March 2017
Flathead Top End Noises - *Skinned Knuckles* magazine, Volume #41, issue 4, April 2017
Bottom End Noise - *Skinned Knuckles* magazine, Volume #41, issue 5, May 2017

Next Month:
Removing/Replacing an Engine Assembly

Also from Orest....
FIGURE IT OUT:



The answer is on page 41 of this issue, but before turning to the answer, think about it a little....