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MiscRes: Magazine Articles

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"Go With the Flow", How Oil Circulates Through Your Engine

FOR YOUR INFO

GO WITH THE FLOW

How Oil Circulates Through Your Engine

Text and photos by John W. Frank

Those of you who have owned a two-stroke bike, outboard boat engine, or even a lawn mower know how simple it is to run and feed one of these engines. All the motor's lubrication needs were satisfied when you poured the correct amount of oil and gasoline into a fuel can and then shook the tank to mix it. The mixture was then poured into the engine's fuel tank. The engine was lubricated by the oil/fuel/air mixture as it passed through the engine on its way to be burned. But it's not that simple for a four-stroke engine like the one in your Sportster.

All four-stroke engines must have a means of circulating lubricating oil to all the various moving parts. There are two methods to accomplish this. The first is a wet sump system. This is the method most automobile engines use. With this system, the engine's oil supply is kept in the engine's crankcase, or oil pan. That's why whenever you add oil to your car's engine, you put it into the engine's valve cover where it can drain down into the oil pan. The second method is a dry sump system. With this system, the engine's oil supply is kept in an oil tank when it's not circulating in the engine. When everything is working correctly, a dry sump system has very little oil in the crankcase. Both Sportsters and Big Twins use a dry sump lubricating system.

With that in mind, let's follow the oil as it travels through a typical Evo Sportster engine. The accompanying two oil system schematics (compliments of the Harley-Davidson Motor Company) will help as we go along. Starting at the oil tank, gravity helps oil flow from the tank to the oil

pump. This pump is mounted on the engine and has two separate sections: a feed section and a return or "scavenge" section. The gears in both sections are driven by a gear on the right



Oil is forced through the engine by the feed side of the oil pump (Evo pump shown here).

flywheel's pinion shaft. The oil from the tank goes to the feed section of the oil pump. Oil is forced out of the pump's feed section and passed through the oil filter. And if your bike is so equipped, the oil goes through the oil cooler and then returns to the engine.

The oil is then forced through passageways in the right engine case and cam cover at which point the passageway divides. Some of the oil travels into a hole in the pinion gear, through a passage in the right flywheel, and then travels up another passageway into the engine's crankpin. There are three little holes in the crankpin that allow the oil to pass into the bearings of the

two connecting rods. (Though there are only two connecting rods, there are three bearings. This is because one rod has a forked end, thus two bearings.) The oil from the crankpin and connecting rods then drops into the crankcase's sump. The oil that took the other passageway travels up to the tappet guides and the hydraulic lifters.

Here's where the Harley-Davidson engineers and stylists worked some of their magic with the Evo models. Ironhead Sportsters use external feed lines to carry oil up to the rocker boxes and heads. On an Evo, oil is forced through the engine's hollow pushrods into the rocker boxes. That's why there are no external lines on Evos. But no matter how it gets there, oil is sprayed into the rocker boxes and upper half of the cylinder heads to lubricate the rocker arms and other moving parts found in this section of the engine.

Once its job is done, there are two routes for the oil to take on its way back down into the engine's crankcase. The oil that pools around the valve springs can flow down through drain holes in the heads and cylinders and then drop into the crankcase. Oil that collects in the cylinder heads by the pushrods flows down the pushrod tubes, through holes in the tappet blocks, and down into the camshaft area also called the gearcase. The gearcase and crankcase are interconnected so oil can flow between from the gearcase to the crankcase sump.

Though the oil doesn't stay in the crankcase sump — remember, this is a dry sump engine — it does one more task before moving on. The sump's oil is splash-fed to the cylinder walls, pistons, and flywheel components. This splash of oil also lubricates the piston pin by way of a small hole at



If you cut a spin-on oil filter open, this is what you'll see. This material catches dirt and other debris but allows oil to pass through it.



These three holes in the crankpin feed oil to the three connecting rod bearings.

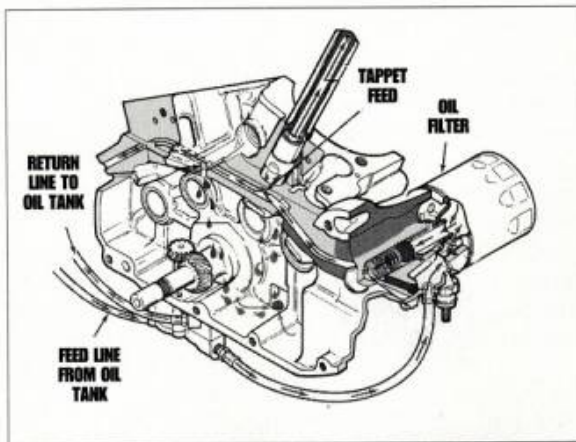


Ironhead Sportsters used external oil lines to get oil up to the heads. Evos have hollow pushrods which do the same job.

the top of each connecting rod. Oil from the crankcase sump is then picked up by the scavenge section of the oil pump and fed back to the oil tank to start the trip again.

The crankcase breather is part of the lubrication system even though oil doesn't ordinarily flow through it. Crankcase fumes need to go where they won't harm

the engine or the environment. Blow-by past the piston rings and the downward movement of the pistons tends to pressurize the crankcase. Fumes on Ironheads just vent out of the tube on the cam cover by the generator to the atmosphere. Fumes on four-speed Evolution Sportsters travel up a hose from a fitting near the oil filter mount to the air filter backplate and are burned in the engine. Five-speed Sportsters use hollow bolts to vent the fumes into the air filter (to be burned) via passages from the heads. That's



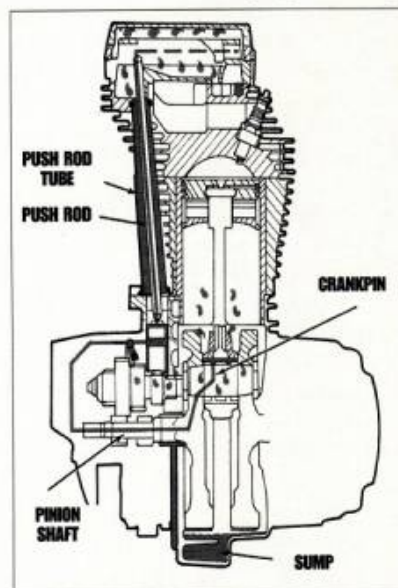
This illustration from the 1993 and 1994 XLH service manual, courtesy of Harley-Davidson, shows how oil circulates through the oil pump, oil filter, and gearcase.

why five-speed Sportsters don't have that black rubber hose leading up to the air filter.

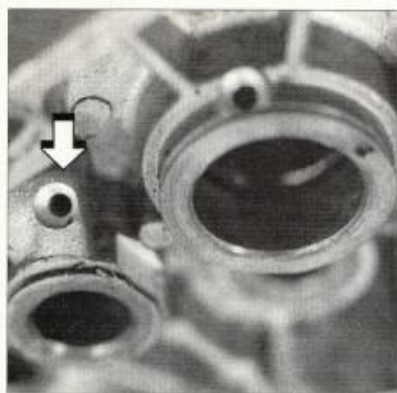
In a rather large nutshell, that's how the lubricating system in a Sportster engine works. What can a Sportster owner do to keep everything working the way it should? Check the oil frequently. The owner's manual for your bike specifies the correct way to position the bike when checking the oil level. Change the oil regularly and use an oil blended for use in motorcycles. Oils meant for use in cars, trucks, airplanes, or boats have different additives and may not provide optimum protection for a motorcycle engine. How often should you change oil? Some riders change oil by the calendar; some change oil at specific mileage intervals. Every 5000 miles is what's recommended by The Motor Company. Better yet, change the oil every 2500 miles. Can a rider who only travels 1000 miles a year get by with changing his oil every five years? No way! Low mileage riders should change their oil every autumn before putting the bike in storage for the winter.

Another part of the oil system's routine maintenance consists of changing the oil filter with each oil change. There are two things to be aware of when changing the oil filter. First, use a filter designed for your Sportster. Some automotive filters will fit and may cost a few bucks less, but it's a gamble. The bypass valve in an automotive filter won't open if the filter becomes clogged. This is because Sportster oil pumps don't create enough pressure to open the valve. Second, pre-fill the oil filter with as much oil as possible without spilling any when you install it on your bike. Failure to fill the filter with oil before installation will starve the engine for oil until the filter fills up. Remember, the filter is between the feed side of the oil pump and the engine.

Changing your bike's oil and filter yourself? Make sure you locate the correct drain hose or plug. No, I'm not kidding. Over the years, I've heard horror stories about people draining



This illustration, also courtesy of The Motor Company, shows oil flow through the pinion shaft to the connecting rod bearings and to the top end.

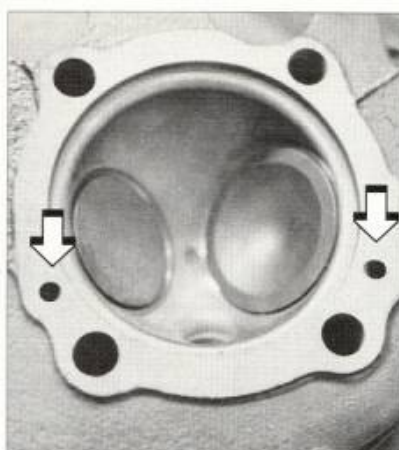


Cam bearings are lubricated through these holes above each bearing.

the transmission lubricant instead of engine oil. Not surprisingly, the transmission later went into meltdown.

After changing the oil, start the engine to check for leaks. Also, make sure oil is returning to the oil tank. Do this by pulling the dipstick from the oil tank and looking inside. You should see oil flowing back to the tank. If you don't see oil flowing, stop the engine and find out what's wrong.

Your engine's lubricating oil also



These two holes in each head allow oil to drain down into the crankcase (Ironhead shown).

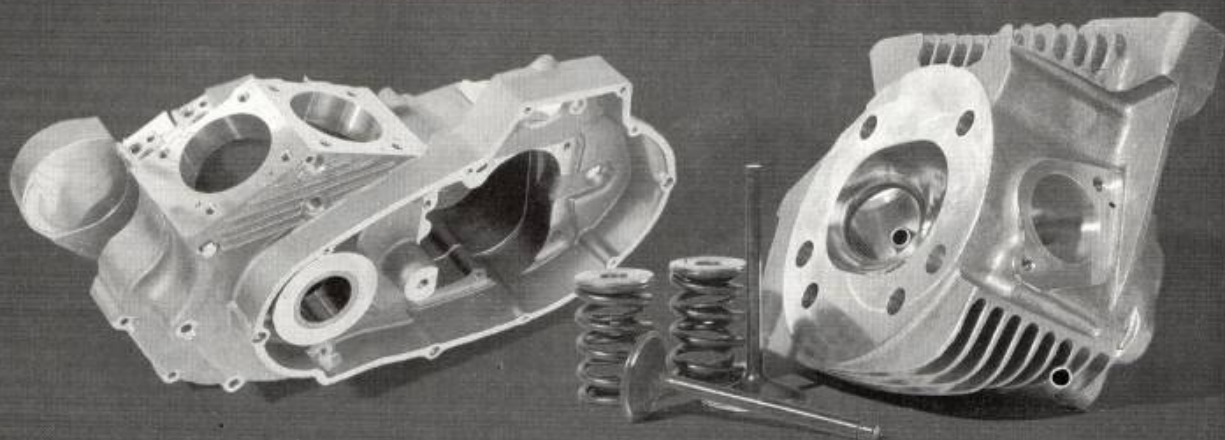
cools the parts it comes in contact with. Does that mean you should buy an oil cooler? It depends on how hot your engine is running and why. One of my riding acquaintances noticed his bike was running hot. Did he check for dragging brakes, a slipping clutch, improper carburetor jetting, incorrect ignition timing, or any other prob-

lems that could cause overheating? Nope, he just went out and bought an oil cooler. He should have determined why the engine was running hot because the original problem is still there. The simplest way to find out if the oil is too hot is with a dipstick temperature gauge. These gadgets are available from the Harley parts and accessories catalog or from various aftermarket sources. The temperature gauge is part of a dipstick, which replaces the stock dipstick in your bike's oil tank. How hot is too hot? If the oil temperature consistently goes over about 210 degrees F, and there are not other correctable factors causing it, get an oil cooler installed on the bike.

Besides lubricating and cooling the engine's components, oil also cleans the parts it comes in contact with, seals the tiny gap between piston rings and cylinder walls, and clings to parts to provide a corrosion inhibiting coating when the engine isn't running.

As you can see, the oil in your engine does many things to extend the life of your engine. If you want to learn more about how the lubrication system in your bike works, read the service manual for your bike. It's just that simple. ■

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