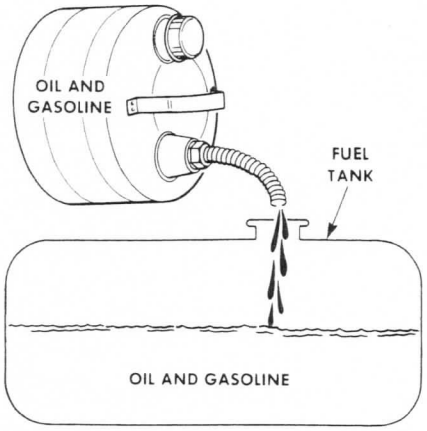


unit 10
lubricating systems

An engine needs oil between its moving parts. The oil keeps the parts from rubbing on each other. When the parts do not rub on each other they do not wear out as quickly. The parts also move more easily, because the oil prevents friction. The oil also helps cool the engine by carrying heat away from hot engine parts, and oil is used to clean or flush dirt off engine parts. Oil on the cylinders helps seal the rings to prevent compressed air from leaking. Getting the oil to the engine parts is called *lubrication.* There are several types of lubricating systems used on small engines. In this unit we will study how these systems work.

LET'S FIND OUT: When you finish reading and studying this unit, you should be able to:

1. **Describe the purpose of lubrication.**
2. **Describe the properties of oil.**
3. **Explain how a two-cycle engine is lubricated.**
4. **Describe the operation of a splash lubrication system.**
5. **Explain the operation of a pressure lubrication system.**

REDUCING FRICTION

If you push a book along a table top you will notice resistance. This is due to the friction between the book and table. The rougher the table and book surfaces, the more friction there is, because the two surfaces tend to lock together. If a weight is placed on the book, you will notice that it takes even more effort to move it across the table. As the amount of pressure between two objects increases, their friction increases. The type of material from which the two objects are made also affects the friction. If the table is made of glass, the book slides across it easily. If it is made of rubber, it is very difficult to push the book across.

Friction is not desirable between engine parts for several reasons. First, power is needed to

overcome friction. The less friction between engine parts, the more usable power an engine can develop. Friction between two objects causes them to heat up and to wear. The fact that friction causes heat may be demonstrated simply by rubbing your hands together rapidly. The heat is caused by the friction between the skin of your two hands.

The purpose of lubrication is to reduce friction on engine parts as much as possible. Friction cannot be eliminated completely, but it can be reduced to a point where long engine life may be expected. Suppose a slippery liquid such as oil is spilled on the table top, Figure 10-1. The book could now be pushed across the table with very little resistance. The friction has been reduced between the book and table. The oil forms a thin layer called a *film* which gets under the book and actually lifts it off the table surface. An oil film is used between engine parts to reduce friction and wear.

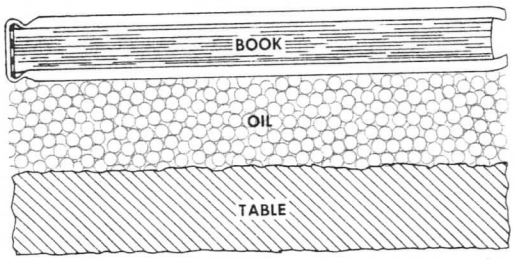


Figure 10-1. Oil reduces the friction between the book and the table.

OIL

Oil is the most common fluid used to provide lubrication. For many years, lubricating oil has been made or refined from crude petroleum pumped from oil wells. Lubricating oil is only one of the many products refined from crude petroleum. Others include gasoline, kerosene and fuel oil. Oil refined from crude petroleum sometimes is called *mineral oil* or *petroleum oil*. Oil also may be made from nonpetroleum sources. This kind of oil is called *synthetic oil*. Oil used in a small engine must have the correct viscosity and service rating for that engine, Figure 10-2.

Figure 10-2. The oil used in an engine must have the correct viscosity and service rating.

Viscosity describes the thickness or thinness of fluid. A common term for viscosity is *body*. A fluid with a high viscosity is said to have a heavy body. An example of fluid with a high viscosity is the thick lubricant used in some standard transmissions and rear axles. A low-viscosity fluid is one with a light body. The viscosity of fluid determines how freely it flows. Low-viscosity fluids flow very freely. High-viscosity fluids flow sluggishly. Oils used in engines must have a viscosity which allows them to flow freely under cold conditions but which has enough body to provide a coating during times of high temperature.

The Society of Automotive Engineers (SAE) has set up standards for oil viscosity. Thin oil receives a low viscosity number, such as SAE 20, while thicker oil receives a higher number, such as SAE 40 or SAE 50. The viscosity number is stamped on top of the oil can. The operator's manual for the engine usually specifies what viscosity should be used.

Some engines used SAE 30 in the summer and SAE 20, 10 or 5 in the winter. For this reason, oil companies sell what is called a multiple-viscosity oil, such as SAE 10-40. This oil flows freely like SAE 10 when the weather is cold, but protects like SAE 40 when it is hot. An engine operated in different climates needs multiple-viscosity oil. A viscosity rating that has a W after it, such as SAE 20W, means the oil has been tested at 0° F and is rated for cold-temperature operation.

Just as important as viscosity is an engine oil's service rating, printed on the side of the oil can. The service ratings, set up by the American Petroleum Institute (API), are a measure of how well the oil holds up under severe wear-and-tear. If the oil does not do well, it gets a low rating or classification; if it does well, it gets a high one. The categories are SA (lowest) SB, SC, SD, SE (highest).

Small engines may use oil of a lower classification than automobiles. The engine operator's manual usually will specify what service classification should be used. A higher classification can always be substituted but never a lower one.

LUBRICATION SYSTEMS

Premix Lubrication

Most two-stroke engines are lubricated by premix lubrication. Both oil and gasoline go in the fuel tank, as shown in Figure 10-3. Usually they are mixed together in the right amount and then the mixture is poured into the fuel tank.

The oil is a special type of two-stroke-cycle oil, Figure 10-4. It mixes with the gasoline and stays mixed for a long time. The mixture is different for different engines. Some engines use 20 parts of gasoline for each part of oil. Other engines use a 50 to 1 mix. This means 50 parts of gasoline are used with one part of oil. There is always more gasoline than oil in the mixture. It is possible to buy fuel with oil already mixed in. This is called *premix*.

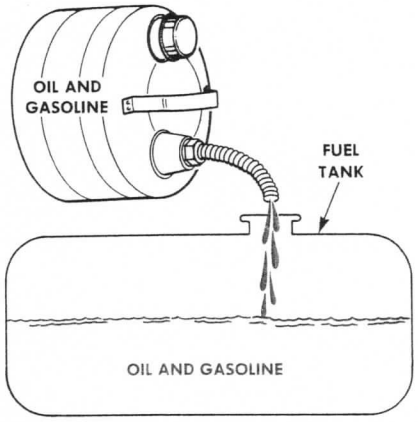


Figure 10-3. Fuel and oil are mixed together in the fuel tank of a two-cycle engine.

Figure 10-4. Two-stroke oil is made to be mixed with gasoline.

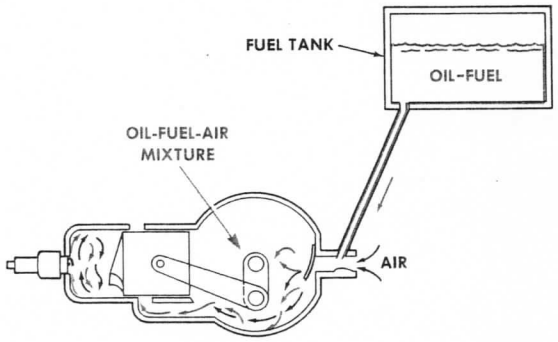


Figure 10-5. A mixture of oil and fuel goes into the crankcase with the air.

The oil-and-fuel mixture goes into the engine's crankcase through the reed valve, as shown in Figure 10-5. The oil in the mixture floats around

in the crankcase as a mist. Some of the oil falls on the engine parts. This is the oil that lubricates. Oil droplets fall on the crankshaft connecting rod, main bearings, piston pin and cylinder walls. Some of the oil also goes with the fuel into the combustion chamber, where the oil is burned along with the fuel.

The main advantage of the premix lubrication system is that it has no moving parts. On the other hand, if the operator forgets to mix oil with the gasoline, the engine will be damaged.

Oil Injection

There is another way to get the fuel and oil mixed together. Many larger two-stroke-cycle motorcycle engines have two tanks. One of the tanks, the fuel tank, holds gasoline. The other, the oil tank, holds oil. A pump is used to pull oil out of the oil tank. The oil moves up an oil line to the intake port and is forced out a small nozzle called a *port injector* into the air-fuel mixture. The oil mist then is carried around the crankcase. It settles on the parts and provides the lubrication. A port injection system is shown in Figure 10-6.

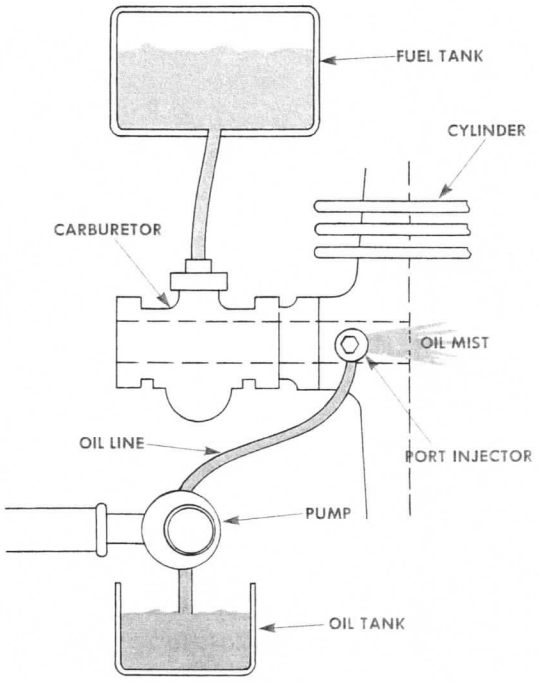


Figure 10-6. Oil is pumped into the port in a port injection system.

Splash Lubrication

Most of the small four-stroke-cycle engines used on lawn equipment use a splash lubrication system. Splash lubrication needs very few parts. Horizontal-crankshaft engines use an oil dipper. The dipper is hooked to the bottom of the connecting rod. An oil dipper is shown in Figure 10-7. When the rod goes around, the dipper goes around. The dipper is used to splash oil on the engine parts.

Vertical-crankshaft engines cannot use a dipper, because the connecting rod is not near the oil. A small gear called a *slinger* is used. The gear rides on the camshaft gear, as shown in Figure 10-8.

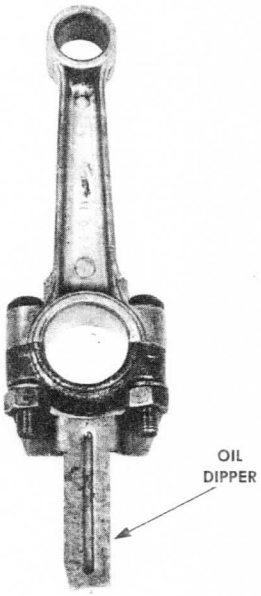


Figure 10-7. Horizontal crankshaft engines use a dipper on the connecting rod.

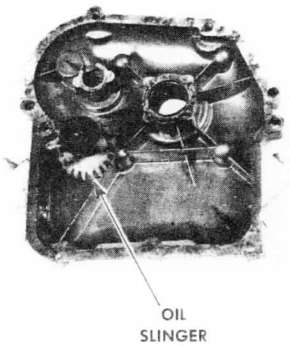


Figure 10-8. Vertical crankshaft engines use an oil slinger driven by the camshaft.

When the camshaft turns, the slinger turns. The small paddles on the slinger dip into the oil. The oil is splashed on the engine parts.

The engine's crankcase is partly filled with oil, as shown in Figure 10-9. As the engine runs, the crankshaft and connecting rod turn around and around. The oil dipper on the connecting rod dips into the oil, Figure 10-10, and splashes the oil upward.

Some of the oil is splashed on the cylinder. It is carried upward by the piston and rings. This provides lubrication between the piston and cylinder wall.

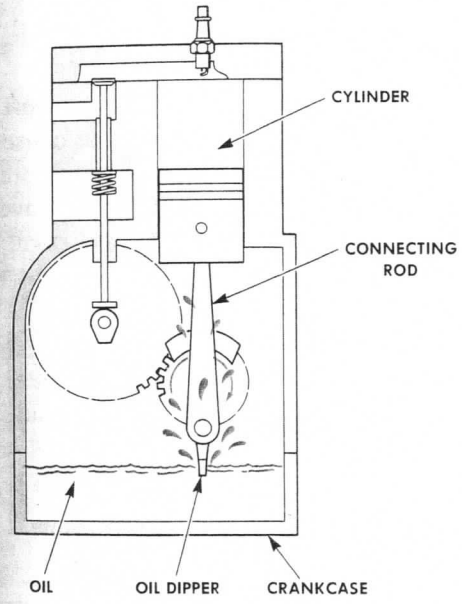


Figure 10-9. The oil dipper splashes the oil up on the engine parts.

Figure 10-10. A dipper going into the oil.

The oil that is splashed up by the dipper falls back down and into holes in some of the engine parts designed to catch it. There is an oil hole in the connecting rod, as shown in Figure 10-11. Oil runs into this hole. The hole leads into the area where the rod is attached to the crankshaft. Oil gets between the connecting rod and crankshaft.

There are also holes or passages in each of the main bearings. Oil runs into the main bearing

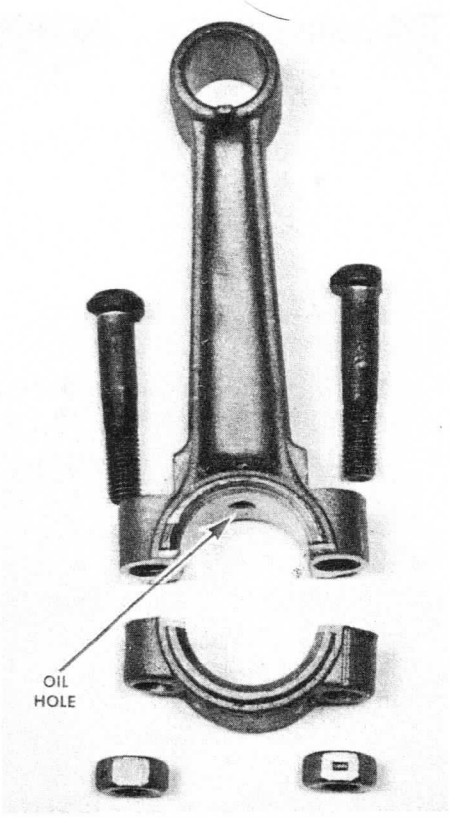
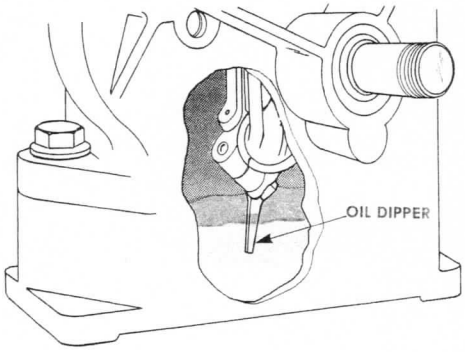


Figure 10-11. An oil hole in the side of the connecting rod lets oil get between the rod and crankshaft.



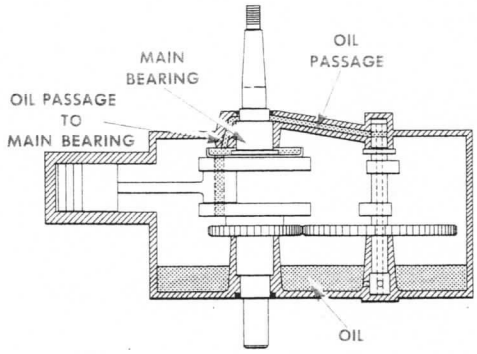


Figure 10-12. Oil runs down through holes and into the main bearings. (Kohler)

holes, as shown in Figure 10-12. The oil gets between the main bearings and the crankshaft.

Pressure Lubrication

Some small engines use pressure lubrication. Pressure lubrication uses a pump to force oil into engine parts. Pressure lubrication works better than splash lubrication. Oil is forced into parts such as the connecting rod and main bearings.

Oil Pump. The oil pump is the most important part used for pressure lubrication. The oil pump makes oil flow to the engine parts. Small engines are a barrel oil pump like the one shown in Figure 10-13. The pump is made in two parts. The larger part is called the *body*. A smaller part, called a *plunger*, fits inside.

The pump works much like a piston and cylinder. In principle, when the plunger moves out of the body, it creates a vacuum. This movement is called an *intake stroke*. When the plunger moves into the body, it is called a *compression stroke*. The pump pulls in oil on the intake stroke and then pushes oil into engine parts on the compression stroke. The two strokes of a pump are shown in Figure 10-14.

The pump body has a large hole in it. This hole

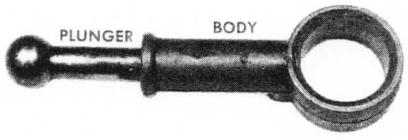


Figure 10-13. A barrel pump has a body and plunger.

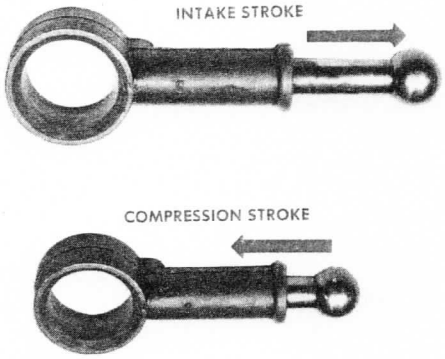


Figure 10-14. The pump pulls oil in on the intake stroke and forces it into engine parts on the compression stroke.

is drilled off-center. This off-center hole fits around the engine's camshaft. The plunger is mounted so that it does not move.

When the engine is running, the camshaft goes around and around. The offset hole causes the body to move up and down. The pump plunger cannot move. The body slides in and out over the plunger. As the pump has an intake stroke, oil is pulled into it. When it has a compression stroke, oil is forced into engine parts.

Oil Flow. Oil holes are used to get the oil into the engine parts. The pump pulls oil out of the crankcase on the intake stroke. Oil is pushed out of the pump on its compression stroke. The oil leaves the pump through an oil hole, as shown in Figure 10-15.

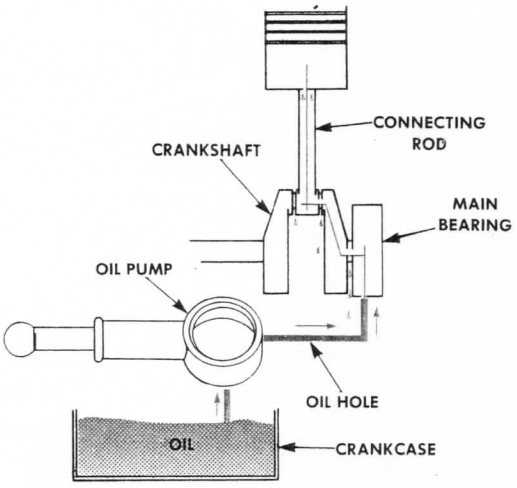


Figure 10-15. The pump forces oil into the engine parts.

The oil goes through a hole into the main bearings. Here it gets between the main bearing and crankshaft. This gives the main bearings their lubrication.

There is another hole drilled in the crankshaft. This hole lets oil flow from the main bearing to the connecting rod bearing. Oil can get between the crankshaft and the connecting rod.

Some engines have a hole that goes up the middle of the connecting rod. Oil can flow up this hole. This oil flows in between the connecting rod and piston pin.

When the engine is running, oil leaks out between the crankshaft and connecting rod. This oil is thrown off the moving crankshaft. Some of this oil is thrown up on the cylinder wall. This is how the cylinders get lubricated.

Dry Sump Lubrication

Some motorcycles use a dry sump lubrication system. This system uses a pump to force oil through the engine parts and a pump to return the oil to the oil tank. The parts of a dry sump system are shown in Figure 10-16. The oil tank usually is located above the engine. Oil flows by gravity into the high-pressure pump. The pump forces oil through the engine parts for lubrication. The lubricating oil runs down into the bottom of the engine. The area where the oil is collected is called a *sump*. A scavenger pump pulls the oil out of the sump and returns it to the oil tank. Since there is never very much oil in the sump, the system is called a *dry sump*. The advantage of this system is that more oil is available for the engine in the tank than could be stored in the engine itself.

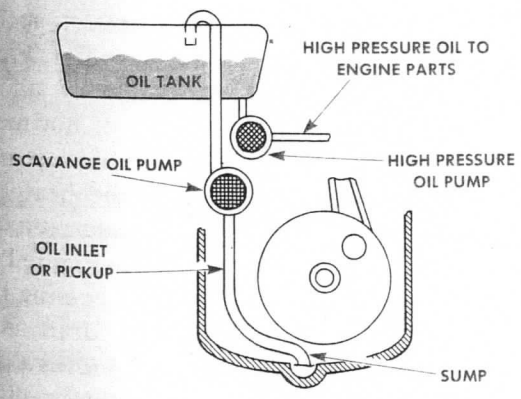


Figure 10-16. A dry sump lubricating system.

NEW TERMS

dry sump lubrication: A lubrication system that uses a scavenger pump to pull oil out of the engine into an oil tank.

friction: Resistance to motion between two parts that causes wear and heat.

lubrication: Reducing friction in an engine as much as possible by providing oil between moving parts.

oil: A fluid used for lubrication.

premix lubrication: Oil and gasoline mixed together for lubrication.

pressure lubrication: A system that uses a pump to force oil into engine parts.

service classification: A rating system for engine oil based on the type of service it is used in.

splash lubrication: A system in which oil is splashed on engine parts for lubrication.

viscosity: The thickness or thinness of the oil.

SELF CHECK

1. Why is friction bad in an engine?
2. Describe how oil can reduce friction.
3. How can you find out the viscosity of an oil?
4. How can you find out the service rating of an oil?
5. Describe how a premix lubrication system works.
6. What is oil injection?
7. Explain how a splash lubrication system works.
8. Explain how a pressure lubrication system works.
9. What is the purpose of the oil pump in a pressure lubrication system?
10. Why does a dry sump lubrication system need two pumps?

DISCUSSION TOPICS AND ACTIVITIES

1. Look up the correct oil viscosity and service classification for a small engine.
2. Use a cutaway model to trace the oil flow in a pressure lubrication system.