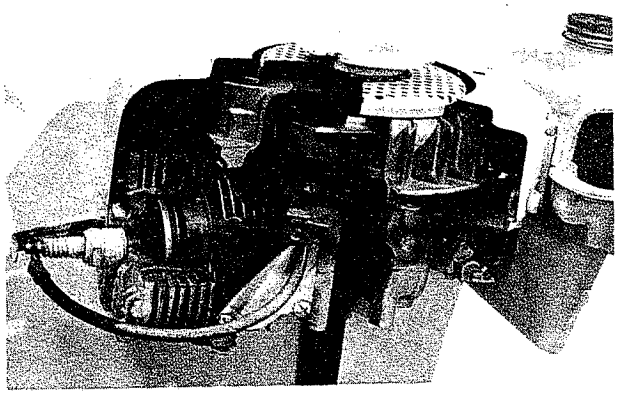
unit 6

fundamentals of the two-stroke-cycle engine



Not all engines we use work on the four-stroke cycle. Many small engines used for mopeds, motorcycles, chainsaws, boats and snowmobiles develop power in just two strokes of the piston. Such an engine is called a two-stroke-cycle engine. Often we shorten the name and just call this engine a two-stroke or a two-cycle. Remember that a stroke is a movement of the piston from one end of the cylinder to the other. A cycle is an action that is repeated over and over. In this unit we will study the operation of the two-stroke engine.

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

1. **Describe the basic parts of a two-stroke-cycle engine.**
2. **Explain how a two-stroke-cycle engine works to develop power.**
3. **Describe how a two-stroke-cycle engine differs from a four-stroke-cycle engine.**
4. **Describe the operation of a reed valve.**
5. **Name the component parts of a two-stroke-cycle engine.**

BASIC PARTS

The basic parts of a two-stroke-cycle engine are the same as those in the four-stroke-cycle with one exception: there is no valve train in a two-cycle engine. There is a cylinder and a combustion chamber. A piston in the cylinder is connected to a crankshaft by a connecting rod. A flywheel is mounted to the crankshaft.

The basic parts of a two-stroke-cycle are shown in Figure 6-1. There are two holes or ports in the cylinder. One, called the *exhaust port,* lets the burned air-fuel mixture out. The other, called the *intake port,* lets the fresh air and fuel in.

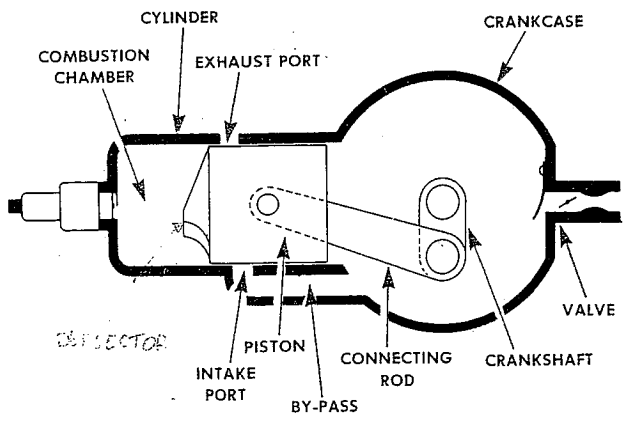


Figure 6-1. Basic parts of a two-stroke engine. (Tecumseh Products Co.)

The intake port opens into a passageway to the crankcase. This passageway may be called a bypass or transfer port. The crankcase is a box or housing that holds and protects the crankshaft. A valve in the crankcase lets in air and fuel.

HOW IT WORKS

The two-cycle engine has to do in two strokes what is done by the four-cycle engine in four strokes. When the piston moves up in the cylinder, the space below the piston gets bigger. The result is a vacuum in the crankcase. An air and fuel mixture is pulled into the crankcase through the valve, as shown in Figure 6-2. At the same time, the piston covers the intake and exhaust ports. Air and fuel above the piston are trapped. The piston squeezes or compresses the mixture in the combustion chamber, as shown in Figure 6-3.

Near the top of the piston's upward stroke we introduce a spark to start the mixture burning. The burning causes an explosion, just as it did in the four-stroke cycle. The expanding gases force the piston down. The piston gives its power to the crankshaft, as shown in Figure 6-4.

As the piston moves down, the crankcase area becomes smaller and the air and fuel mixture in the crankcase is squeezed. The mixture would like to escape, but the valve is closed. The mixture gets squeezed more and more tightly in the crankcase.

Finally, the piston goes far enough down the cylinder to uncover the exhaust port. The burned mixture goes out of the cylinder through the exhaust port, as shown in Figure 6-5. When the piston reaches the bottom of its stroke, it uncovers the intake port. Air and fuel trapped in the

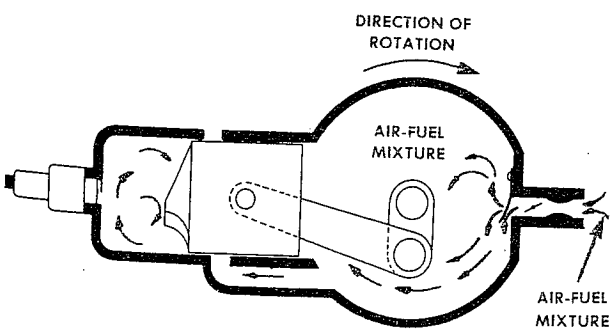


Figure 6-2. The piston moves up, pulling the mixture into the crankcase. (Tecumseh Products Co.)

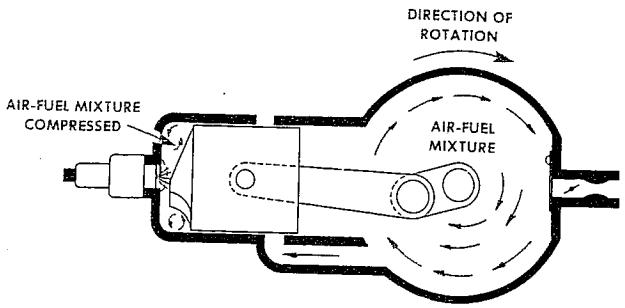


Figure 6-3. The piston squeezes the mixture in the combustion chamber. (Tecumseh Products Co.)

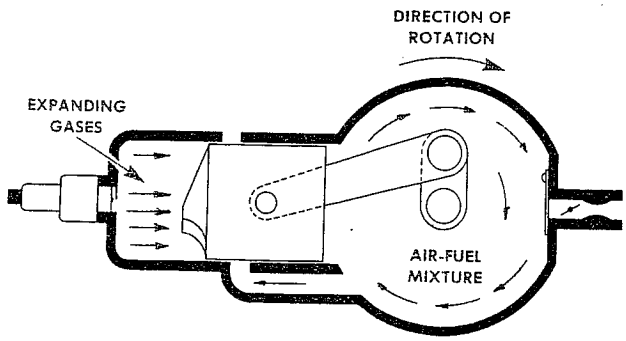


Figure 6-4. The mixture is burned, pushing the piston down. (Tecumseh Products Co.)

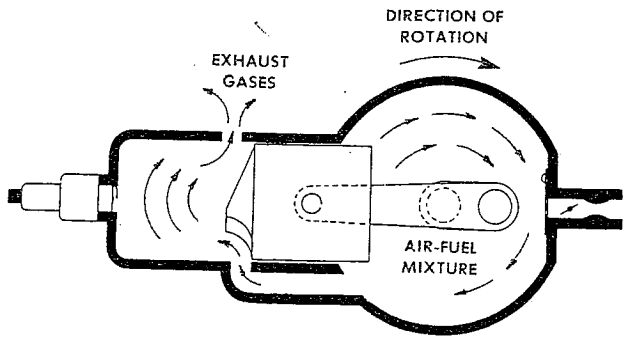


Figure 6-5. As the piston uncovers the ports, burned gases escape and a new mixture gets in. (Tecumseh Products Co.)

crankcase flow through the bypass or transfer port and into the cylinder. The piston moves back up, trapping the mixture, and the cycle starts all over again.

The two-stroke-cycle engine develops power in two strokes. On one stroke the piston compresses the mixture. On the second stroke it is pushed down the cylinder. The crankshaft turns one complete turn or revolution during these two strokes.

TWO-STROKE-CYCLE ENGINE PARTS

A cutaway view of a two-stroke-cycle engine is shown in Figure 6-6. The two-stroke engine has many parts which are similar to the four-stroke cycle. It does not, of course, have any valve train. In this section we will study the parts which are different from the four-stroke-cycle engine.

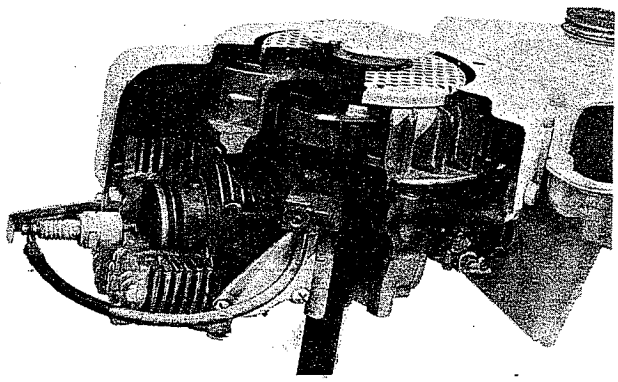


Figure 6-6. Cutaway of a two-stroke-cycle engine.

Reed Valve

A valve is used to let the mixture into the crankcase when the piston moves up the cylinder. The valve must close when the piston moves down, so the mixture can be trapped and squeezed. Many small engines use a type of valve called a *reed valve*. The reed valve is a thin piece of metal. It works much like a hinge. When there is a vacuum in the crankcase, the reed valve is pulled

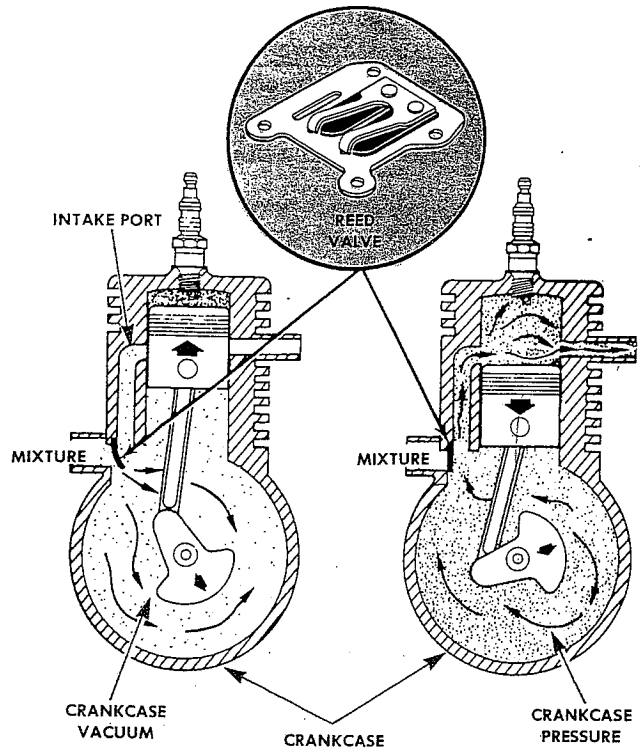


Figure 6-7. A reed valve is opened by crankcase vacuum and closed by crankcase pressure. (McCulloch Corp.)

open, as shown in Figure 6-7, *left*. This allows the mixture to enter the crankcase.

When the piston moves down, the area of the crankcase gets smaller. Pressure starts to build up in the crankcase. The pressure pushes the hinged valve closed, as shown in Figure 6-7, *right*, and the mixture is trapped in the crankcase.

There are many types of reed valves. The valves are attached to a metal part called a *reed plate*. A reed valve is shown in Figure 6-8.

Crankcase and Main Bearings

The crankcase for a two-stroke engine is shown in Figure 6-9. The crankcase houses and supports the crankshaft. The crankcase is also the area into which the air-fuel mixture enters when the piston moves up. A mount for the reed valve may be attached to the crankcase.

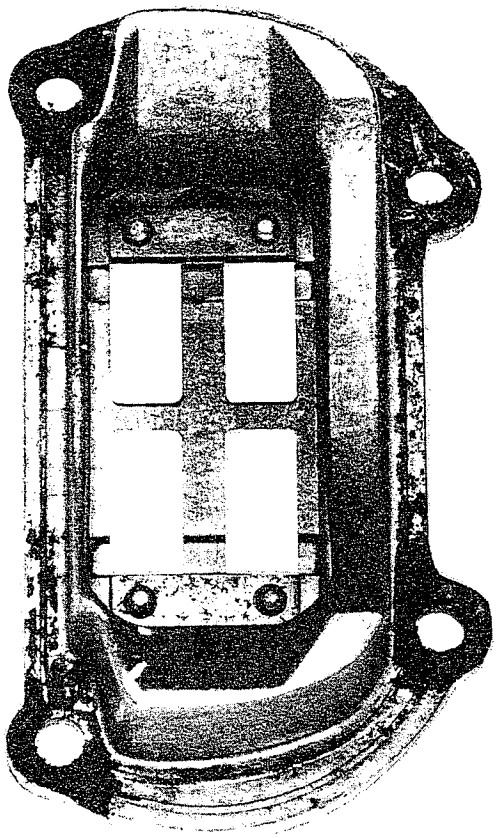


Figure 6-8. A reed plate with four reed valves.

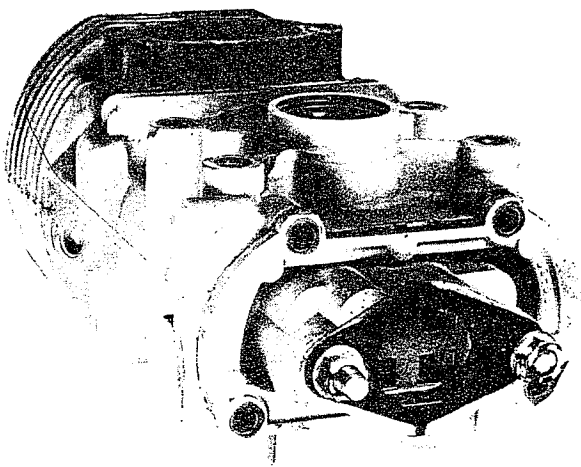


Figure 6-9. Crankcase for a two-stroke-cycle engine.

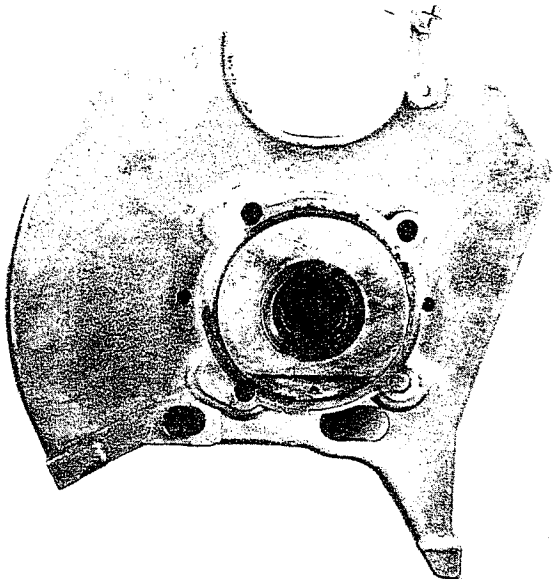


Figure 6-10. Ball or needle bearings may be used for two-stroke main bearings.

The crankcase provides the support for the main bearings. Two-stroke engines often use *ball* or *needle* bearings for main bearings, as shown in Figure 6-10. Ball and needle bearings allow the engine to run at a higher speed.

Cylinder and Block

Two-stroke cylinders generally are made from aluminum with a cast-iron liner. The aluminum makes the engine light in weight and helps get rid of heat quickly. The cast-iron liner provides a good bearing surface for the piston rings.

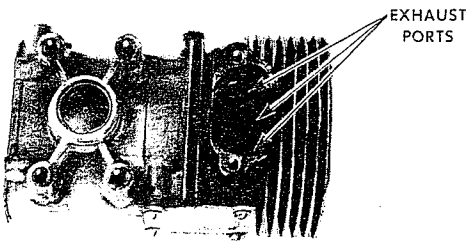


Figure 6-11. Two-stroke cylinders have ports for intake and exhaust gases.

The main difference between a two- and four-stroke cylinder are the intake and exhaust ports. The two-stroke has holes or slots cut directly into the cylinder as shown in Figure 6-11. These are uncovered by the piston to allow air and fuel in and burned gases out.

Cylinder Head

Some two-stroke engines have a removable cylinder head just like a four-stroke engine. The cylinder head is attached with bolts or screws. A gasket fits between the cylinder and cylinder head to form a seal. The cylinder head forms the combustion chamber.

Some two-stroke engines do not have a removable cylinder head. The head and combustion chamber are cast as one piece with the cylinder. This makes the engine lighter and eliminates any problems from leaking cylinder head gaskets. A one-piece cylinder and cylinder head is shown in Figure 6-12.

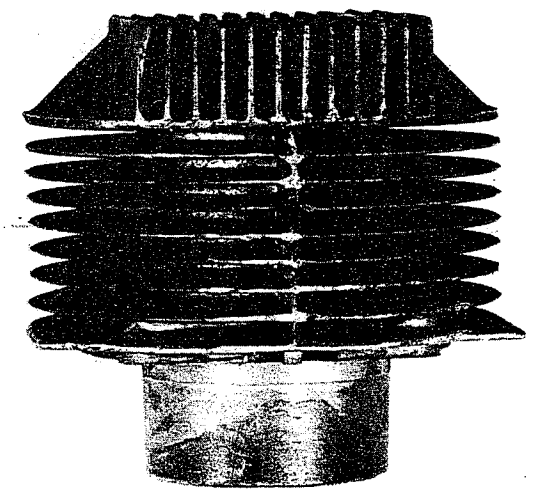


Figure 6-12. A one-piece cylinder and cylinder head is common in two-stroke engines.

Crankshaft

The two-stroke-cycle crankshaft has the same job as the crankshaft in a four-stroke-cycle engine. It changes the up-and-down movement of the piston to round-and-round movement. The two-cycle crankshaft, shown in Figure 6-13, has the same parts as a four-stroke crankshaft.

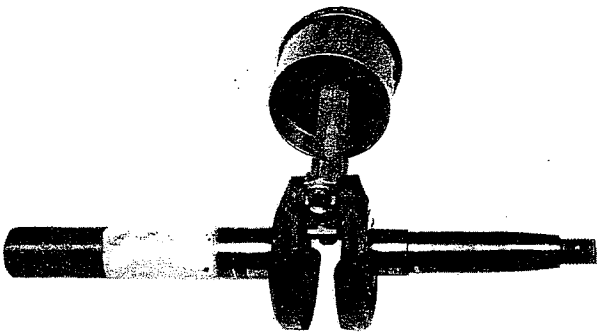


Figure 6-13. A two-stroke-cycle engine crankshaft.

Piston

The pistons used in two-stroke engines are very different from those used in four-stroke engines. The top of the piston often has a high dome or deflector, as shown in Figure 6-14. The deflector prevents the burned gases from mixing with the fresh charge of air and fuel. When the piston uncovers the intake and exhaust ports, the deflector acts as a wall to help prevent the two gases from mixing.

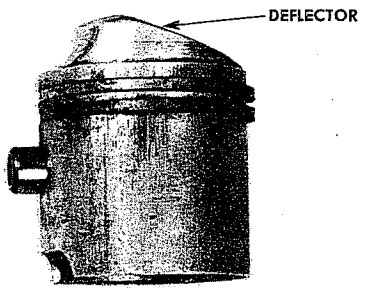


Figure 6-14. A piston with a deflector, or contoured top, helps prevent mixing of intake and exhaust gases.

The ring area of the piston is also different from that of a four-cycle piston. There are often only two ring grooves. Sometimes, the ring grooves have a pin or stop mounted in them, as shown in Figure 6-15. This prevents the piston

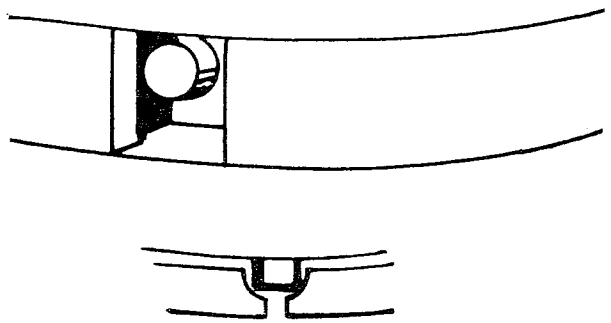


Figure 6-15. A stop pin in the ring groove prevents the ring from rotating.

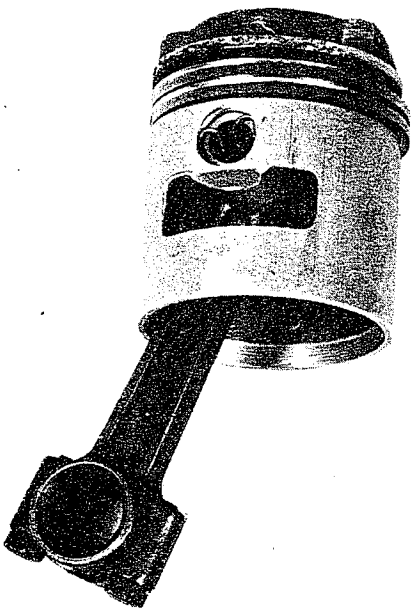


Figure 6-16. Some pistons have holes or slots in the skirts for mixture flow.

ring from rotating around the ring groove. The ends of the ring must not be allowed to rotate around into the port area. If they do, the ends of the ring could catch in the ports and the ring could break.

Some two-stroke pistons have holes or slots in the skirt area, Figure 6-16. These slots or holes line up with passages in the cylinder and crankcase when the engine is running. When they are lined up, the air-fuel mixture may be routed through the piston. We will see later how an engine like this works.

Piston Rings

The piston rings in a two-stroke engine are necessary to prevent compression pressure from leaking out of the combustion chamber area. Oil control is not as important in this engine as it is in a four-stroke. We will see why when we study the operation of the lubrication system in a later chapter. The two-stroke engine generally uses just two rings, both compression rings, Figure 6-17.

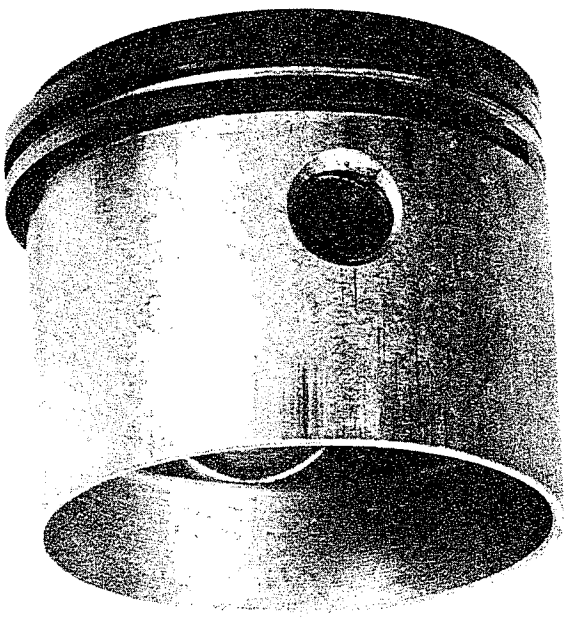


Figure 6-17. A two-stroke engine uses two compression sealing rings.

Connecting Rod and Piston Pin

The connecting rod and piston pin are similar in design to those used in a four-stroke engine. The connecting rods, Figure 6-18, often are made of cast iron or steel to provide needed strength and to permit the use of needle bearings. Needle

bearings often are used in both ends of the connecting rod. They allow for high-speed operation and can be lubricated easily. The piston pin usually is held in the piston with two lock rings similar to those used in the four-stroke engine.

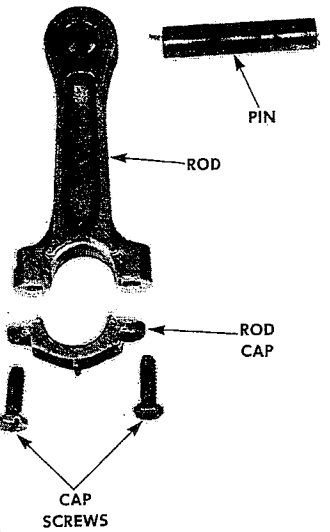


Figure 6-18. A connecting rod used in a two-stroke engine.

Loop-Scavenged Two-Stroke Engines

As mentioned earlier some two-stroke engine pistons have holes or slots in the skirt area. Such pistons are used in machines described as loop-scavenged engines. A loop scavenged engine works just like the two-stroke engine described earlier. The only difference is that the air-fuel mixture travels or loops through the holes in the pistons.

The operation of a loop-scavenged engine is shown in Figure 6-19. The piston is constructed with large bores in the piston skirt. When the piston is at the bottom of its stroke, these bores line up with passages in the cylinder. The fuel-air mixture, compressed slightly during the power stroke of the piston, passes through the bores and mixes with the fuel-air mixture at two sides of the cylinder. This eliminates the need for the conventional piston with a deflector. The loop-scavenged type of engine produces a somewhat greater horsepower per unit weight by more completely removing the exhaust gases at the end of the power stroke.

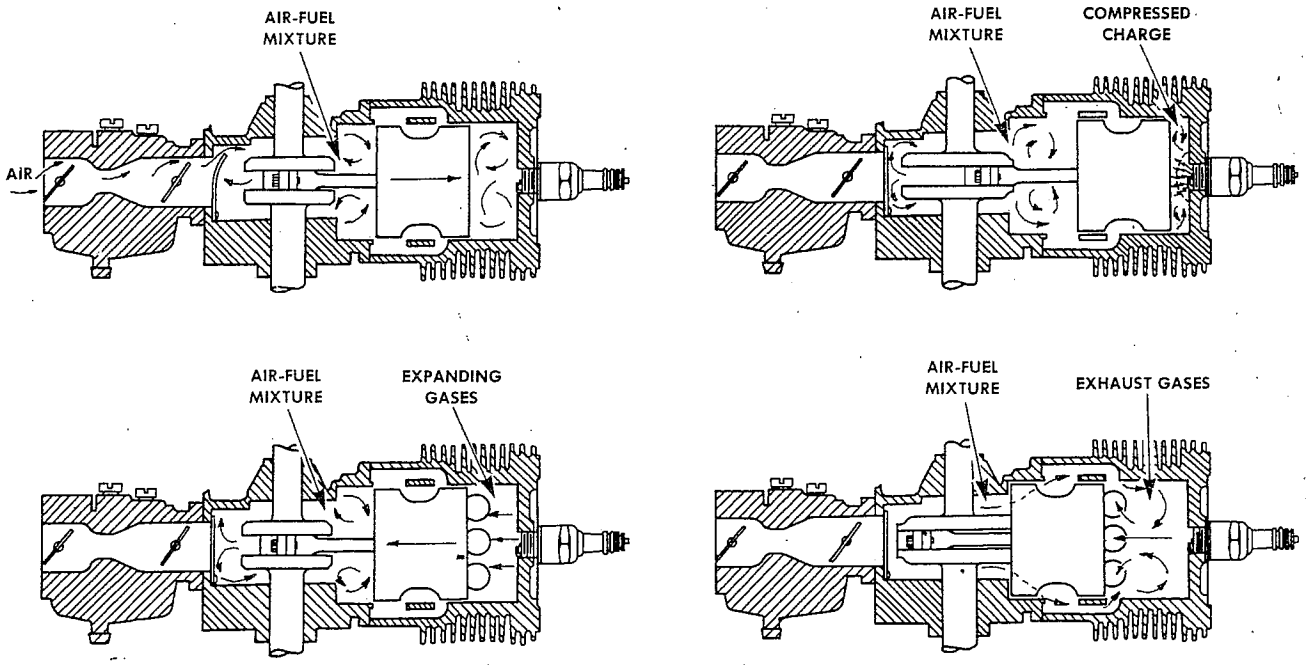


Figure 6-19. Operation of a loop-scavenged two-stroke-cycle engine. (Tecumseh Products Co.)

NEW TERMS

bypass port: Passageway between the crankcase and combustion area in a two-stroke engine

loop-scavenged: A type of two-stroke engine in which the air-fuel mixture loops through bores in the piston skirt.

reed valve: A valve used to control the flow of air-fuel mixture into the crankcase.

rotary valve: A valve attached to the crankshaft that controls the flow of air and fuel into the crankcase.

transfer port: Same as bypass port.

two-stroke-cycle engine: An engine that develops power in two piston strokes or one crankshaft revolution.

SELF CHECK

1. How many strokes does it take to develop power in a two-cycle engine?
2. What is another name for a two-cycle engine?
3. What are the names of the two ports in a two-cycle cylinder?
4. Describe what happens when the piston moves up in a two-cycle engine.
5. Describe what happens when the piston moves down in a two-cycle engine.
6. What is the purpose of the bypass or transfer port?
7. How does the burned mixture get out of the cylinder?
8. How does the fresh mixture get into the cylinder?
9. How does a reed valve work?
10. Why is a liner used in the aluminum cylinder?
11. Why does a two-cycle piston have a deflector?
12. Why does a two-cycle engine not use an oil control ring?
13. Why does a loop-scavenged engine have holes in the piston?

DISCUSSION TOPICS

1. Use a cutaway model to identify the major parts of a two-stroke-cycle engine.
2. Turn the crankshaft of the cutaway model one revolution and explain what happens during each stroke.