TOPIC #9 SMALL ENGINES (2-cycle and 4 -cycle)

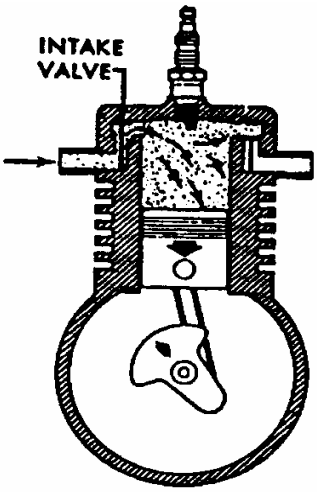
TYPES OF SMALL ENGINES

The Fire Department has several different tools that are powered by gasoline engines. There are two different types of engines used to power this equipment. The two cycle and four cycle types. The small two-cycle gasoline engine differs in many ways from the four-cycle engine. The four-cycle engine takes four strokes of the piston to go through one cycle from power stroke to the next power stroke. It has valves, valve lifters, valve springs, a camshaft drive gear in addition to the flywheel, piston, crankshaft and the connecting rod. The two-cycle engine takes only two strokes of the piston to go through one cycle from power stroke to the next power stroke. It has no camshaft, valve springs or valve lifters and, in most cases, its piston acts as a slide valve. The four-cycle engine uses its crankcase as a lubricating oil storage sump. Lubricating oil is splashed up from the storage sump onto the connecting rod and the cylinder walls, utilizing a splasher paddle in the crankcase. The two-cycle engine uses its crankcase as a fuel mixture transfer pump and lubrication is taken care of by mixing oil with the gasoline.

The easiest way to understand how a two-cycle engine operates is by comparing its cycle of strokes with the strokes of a four stroke engine. Originally both engines were known as two-stroke cycle and four-stroke cycle engines. But time and the human inclination to shorten names have dropped the word “stroke” and now we have two-cycle and four-cycle engines. But the word “stroke” is the key to the way both engines operate.

FOUR-CYCLE OPERATION

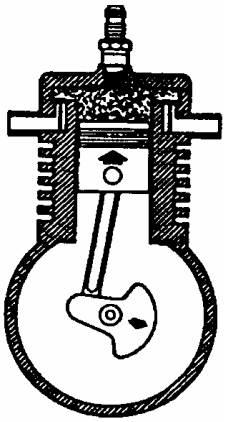
The intake stroke of the four-cycle engine begins with the intake valve open and the piston at the top of the combustion chamber. As the piston moves towards the crankshaft on the downward stroke, the fuel charge is pushed, by atmospheric pressure, into the combustion chamber.



Intake Stroke

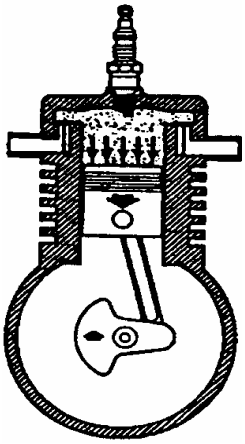
Compression Stroke

At the bottom of the first stroke, the intake valve closes, trap the fuel charge in the combustion chamber. The second or upward stroke of the piston compresses the fuel charge. Just before the piston reaches the top of the stroke, the spark plug fires the fuel charge. The fuel charge "burns" rather than "explodes" and the burning spreads across the combustion chamber so that the increasing pressure of hot burned gases is ready to drive the piston downward as the piston comes past top dead center.



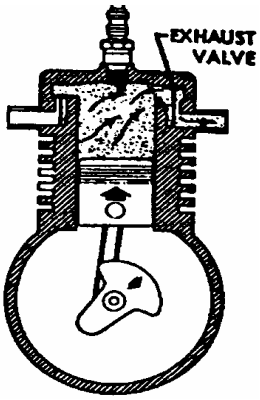
Power Stroke

The third stroke of the piston is the power stroke. During this stroke the fuel continues to burn and the expanding heated gases shove the piston down.



Exhaust Stroke

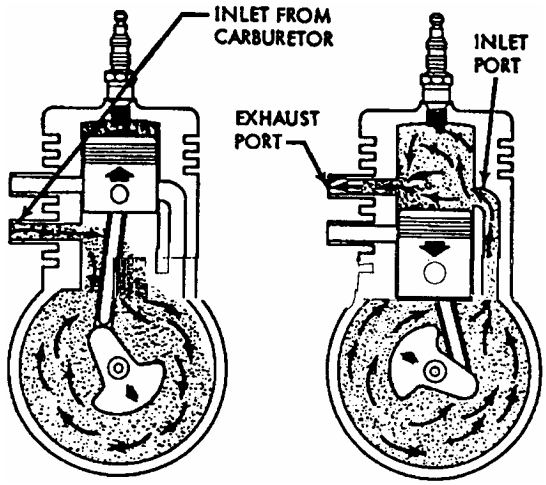
At the bottom of the third stroke, the exhaust valve opens and, as the pi its fourth stroke, the burned gases are pushed out of the combustion chamber. At the top of the fourth stroke, the exhaust valve closes, the inlet valve opens, and the piston is ready to begin a new four-stroke cycle.



TWO-CYCLE OPERATION

The two-cycle engine has to do, in two strokes, what is done by the four-cycle engine in four strokes. In addition, it has to charge the crankcase with the air-fuel mixture so that the mixture can be pumped into the combustion chamber. This means that the charging of the crankcase, compression of the fuel charge, and ignition must occur on the upward stroke and exhaust of the burned gases and intake of the fresh fuel charge on the downward stroke. The picture shows how this is possible through the use of three openings or ports: two ports opening into the combustion chamber and one opening into the crankcase from the carburetor.

The upward stroke of the piston creates a vacuum in the crankcase and the air-fuel mixture is drawn in from the carburetor. At the same time, the piston seals off the inlet and exhaust ports and compresses the fuel charge, which was forced in from the crankcase, in the combustion chamber. Near the top of the upward stroke, the spark fires the fuel charge. The burning spreads in the same manner as in the four-cycle engine and shoves the piston downward. The descending piston seals off the entrance to the crankcase from the carburetor and begins to build up pressure in the crankcase. As the piston continues downward, the exhaust port is uncovered and the burned gases are allowed to escape from the combustion chamber. Near the bottom of the downward stroke, the inlet port is uncovered by the piston and the compressed air-fuel mixture in the crankcase rushes into the combustion chamber. While some of the fuel charge usually escapes through the exhaust port, most small engine manufactures shape the top of the piston to act as a barrier which creates a whirling turbulence. Engines take advantage of this turbulence, that is, the imparting of a whirling motion to the in flowing fuel charge, to assist in clearing the combustion chamber of almost all of the burned gases, while limiting the escape of the fresh fuel charge to a minimum. At this point the process begins again.



LUBRICATION

In the four-cycle engine, oil is poured directly into the crankcase and must be kept at "full" level. The oil is splashed up from the crankcase onto the connecting rod, the journal and the walls of the cylinder, which insures proper lubrication of the moving parts and reduces the heat build-up in the engine.
An engine that is operated without oil will seize and will not operate again. The Honda 4-cycle engines that are found on CFD generators have a Low Oil feature that will prevent starting or stop operation if the oil level is low or becomes low during operation.

In the two-cycle engine, the crankcase acts as a transfer pump for the air-fuel mixture, so no oil can be poured directly into the crankcase. Lubrication of the engine depends on the addition of oil to the gasoline. When the mixture passes through the carburetor, the gasoline becomes highly vaporized by the stream of air, while the oil is broken down into tiny droplets which lubricate all the surfaces with which they come in contact. Some oil remains in the crankcase but the greater quantity passes through the combustion chamber, where it is burned, and out the exhaust port. As in the four-cycle engine, it is necessary that the proper lubrication take place. Without it, the engine will heat up, seize and never operate again.

Be certain that the four cycle engine is full of oil. CHECK IT EACH MORNING AND ADD THE PROPER AMOUNT IF NECESSARY.

GAS / FUEL MIX

Gasoline, just like any other substance, goes bad over time. Gasoline/oil mix should not be kept for longer than 90 days un-stabilized or 6 months stabilized. The most common cause of small engine starting and/or operating problems are associated with bad gas or gas/oil mix.

When filling a gas can or mixing new gas/fuel mix, you must start with an empty can. Don't mix new gas with the old gas. If you don't start with a new batch every time and leave residue in the can, your 50:1 ratio will be off, thus affecting the operation of the equipment.

The Stihl 2-cycle motors found on the CFD chain saws and circular saws use a 50:1 gas/oil mix. **BE CERTAIN THAT THE FUEL IS MIXED WITH 2-CYCLE OIL TO A 50:1 RATIO FOR THE TWO CYCLE ENGINE. NEVER OPERATE A TWO-CYCLE ENGINE WITH STRAIGHT GAS!**