Lecture 3: PRINCIPLES AND OPERATIONS OF 4-STROKE AND 2-STROKE ENGINES

3.1 Principles of operation

An engine is a device, which converts the energy in a fuel into heat and the heat into mechanical energy. For field operations, the energy is made available to the implements for work through the tractor. Thus, the tractor is the main source of power in agriculture.

Agricultural tractors are equipped with either 2 or 4 stroke cycle engines. The events in an ICE are air intake, compression of mixture of fuel and air, combustion and expansion, and exhaust.

3.2 Four stroke cycle engine

In a four stroke cycle engine, all the events taking place inside the cylinder are completed in four strokes of the piston. This engine has got valves for controlling the inlet of charge and outlet of exhaust gases. The opening and closing of the valve is controlled by cams, fitted on camshaft. The camshaft is driven by crankshaft with the help of suitable gears or chains. The camshaft runs at half the speed of the crankshaft.

The sequence of operations for a 4 stroke cycle petrol engine is as shown below:

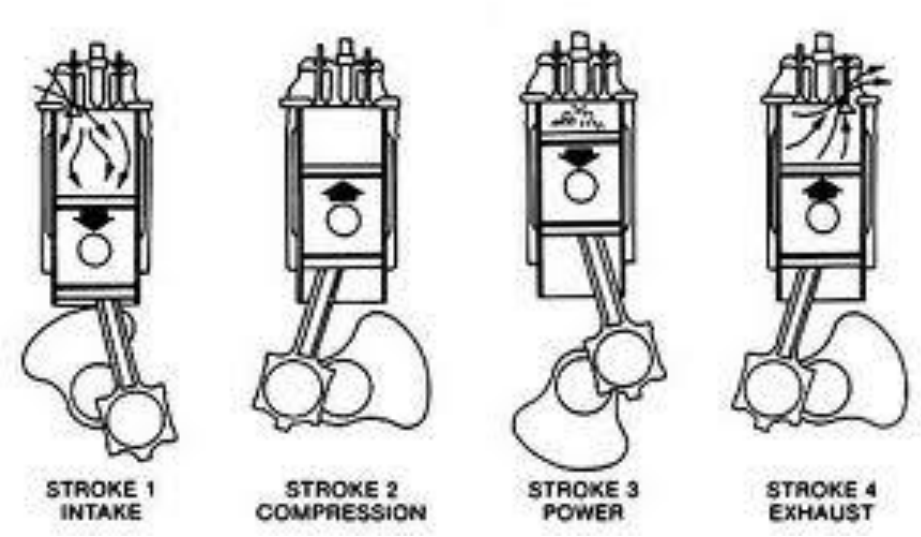


Fig. 3.1 Sequence of events in a 4 stroke cycle petrol engine

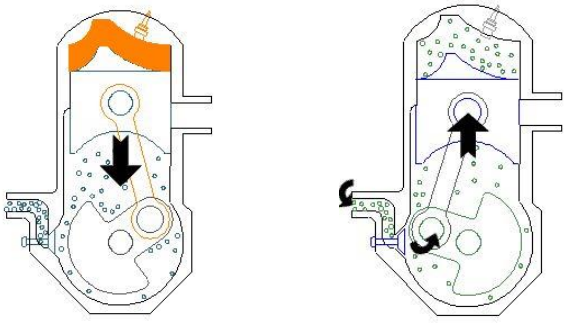
1. Intake stroke – the piston moves down, intake valve opens while exhaust valve remain closed. Fuel – air mixture from the carburetor is forced into the cylinder because of the vacuum created by the piston.

2. Compression stroke – the piston moves up, intake valve closes and fuel – air mixture is compressed. At the top of its motion, mixture is high temperature and pressure.
3. Power stroke – the compressed mixture is ignited by the spark plug, creating a high pressure which pushes the piston down, releasing power. Both valves are closed.

4. Exhaust stroke – the piston moves up, intake valve closed, exhaust valve opens and burned gases are pushed away. When this is finished the cycle repeats.

3.3 Operation of 2- stroke engine

A 2-stroke engine is an internal combustion engine that employs both the crankcase and the cylinder to achieve all cycles. It complete the process cycle (suction, compression, power and exhaust) in one revolution of the crankshaft compared to twice that number for a 4 –stroke engine. This is accomplished by using the beginning of the compression stroke and the end of the combustion stroke to perform simultaneously the intake and exhaust functions. There is no valve in this type of engine. Gas movement takes place through holes called ports in the cylinder.



The piston starts at a lower position such that the intake port and exhaust port are opened, fuel mixture is forced in and at the same time exhaust gases are driven

away. The piston moves up and blocks the intake and exhaust ports, thus the fuel – air mixture is compressed. Ignition occurs and power is produced as the piston moves down. On its downward motion the air intake port is opened and the cycle repeats.

The functions of the valves of a 4 – stroke engine are performed by ports that are opened and closed by the motion the pistons, greatly reducing the number of moving parts. Gasoline (spark ignition) types are particularly useful in lightweight applications. Since the 2 – stroke engine fires on every revolution of the crankshaft, a 2 –stroke engine is usually more powerful than a 4 – stroke of equivalent size. This, coupled with their lighter, simpler construction, makes the 2 –stroke engine popular in chainsaws, line trimmers, outboard motors, snowmobiles, jet- skis, light motorcycles, and model airplanes.

Unfortunately, most 2 stroke engines are inefficient and terrible polluters due to the amount of unspent fuel that escapes through the exhaust port.

3.4 Comparison between 4 stroke and 2 stroke engines

S/No	Particulars	4 stroke engine	2 stroke
1	No of power stroke	One stroke for every 2 revolutions of crankshaft	One stroke for every 1 revolution of crankshaft.
2	Power for the same cylinder volume	Small	Large (about 1.5 times of 4 stroke)
3.	Valve mechanism	Present	Ports instead of valve
4.	Construction & cost	Complicated, expensive	Simple, cheap
5.	Fuel consumption	Little	High (about 15% more)
6.	Removal of exhaust gases	Easy	Difficult
7.	Durability	Good	Poor
8.	Stability of operation	High	Low
9.	Changeability of rpm	High (with large flywheel)	Low (with small flywheel)
10.	Lubrication	Equipped with an independent lubricating oil circuit	Using fuel, mixed with lubricating oil
11.	Oil consumption	Little	Much
12.	Carbon deposit inside cylinder	Not so much	Much because of mixed fuel
13.	Noise	Suction & exhaust is noiseless but other working is noisy	Suction & exhaust is noisy but other working is noiseless
14.	Air tightness of crankcase	Unnecessary	Must be sealed
15.	Cooling	Normal	Chances of over heating
16.	Self-weight and size	Heavy & large	Light & small