

ENGINE COMPONENTS

Tractors use internal combustion engines, which are basically heat converters. To make the engine an efficient heat converter, it is to be maintained as per recommendations of the manufacturers. No matter how good the engine construction is, its efficiency depends upon the ability and skill in operating and maintaining it. Thus to give it an intelligent care and attention, the components of the engine and their construction along with functions must be clearly understood.

3.1 ENGINE TYPES

Engine may be defined as a mechanical device that converts the chemical energy of a fuel (wood, coal, petrol, diesel, etc.) into mechanical energy by combustion. Engines may be classified on different bases.

- i. Ignition Place: External or internal combustion engines
- ii. Fuel used: Petrol, diesel or gas engines
- iii. No. of strokes: 2-stroke or 4-stroke engines
- iv. Fuel Ignition method: Spark ignition (petrol) or Compression ignition (diesel) engines

3.2 ENGINE PARTS

The engine components may be grouped as follows.

- 3.2.1 Power Chain: To receive, exert and transmit power such as piston, connecting rod, crankshaft and flywheel
- 3.2.2 Stationary Parts: To constraints and support moving parts such as cylinder, cylinder head and crankcase.
- 3.2.3 Auxiliary Parts and Accessories: To time the operating systems, supply and ignite fuel, lubricate and cool surfaces and start engine.
- 3.2.4 Chesi: Body or frame to support engine and other transmission components
- 3.2.5 Transmission System: To reduce engine speed and transmit power to wheels and power-take-off (PTO) shaft such as gearbox, differential and final drive gears.
- 3.2.6 Miscellaneous Parts: To control the movement of tractor and attached implements such as steering, brakes, clutch, three point linkage and hydraulic control.

3.3 DESCRIPTION OF ENGINE PARTS

3.3.1 Cylinder (Cylinder Block)

A barrel shaped component, which provides space for the ignition of fuel houses piston, connecting rod and cylinder sleeve or liner. Hollow spaces or water jackets are provided in the cylinder walls for the circulation of cooling water. In air-cooled engines, fins are also provided on the outer surface of the cylinder for better air circulation and dissipation of heat. Removable cylinder liner is provided inside the cylinder to facilitate cheaper over-hauling of engine. By maintaining a specified cylinder diameter, helps to prevent gas leakage down to crankcase along the cylinder walls. The material used for liners is alloy iron containing manganese, silicon, nickel and chromium. The liners of Massey Ferguson tractors, now a day, are crosshatched at 45° called as honing to retain lubricating oil for better working. The cylinder liners are of two types i.e. dry type and wet type. When the outer surface of the liner is in contact with the cooling water, it is called wet type otherwise it is dry type. Several cylinders when casted together form a cylinder block and are used in medium to heavy duty engines. The material used for cylinder block is mostly gray cast iron. In case of light and air-cooled engines, aluminum alloy is used because of its lighter weight and greater thermal conductivity. Figure 3.1 illustrates different parts of the engine.

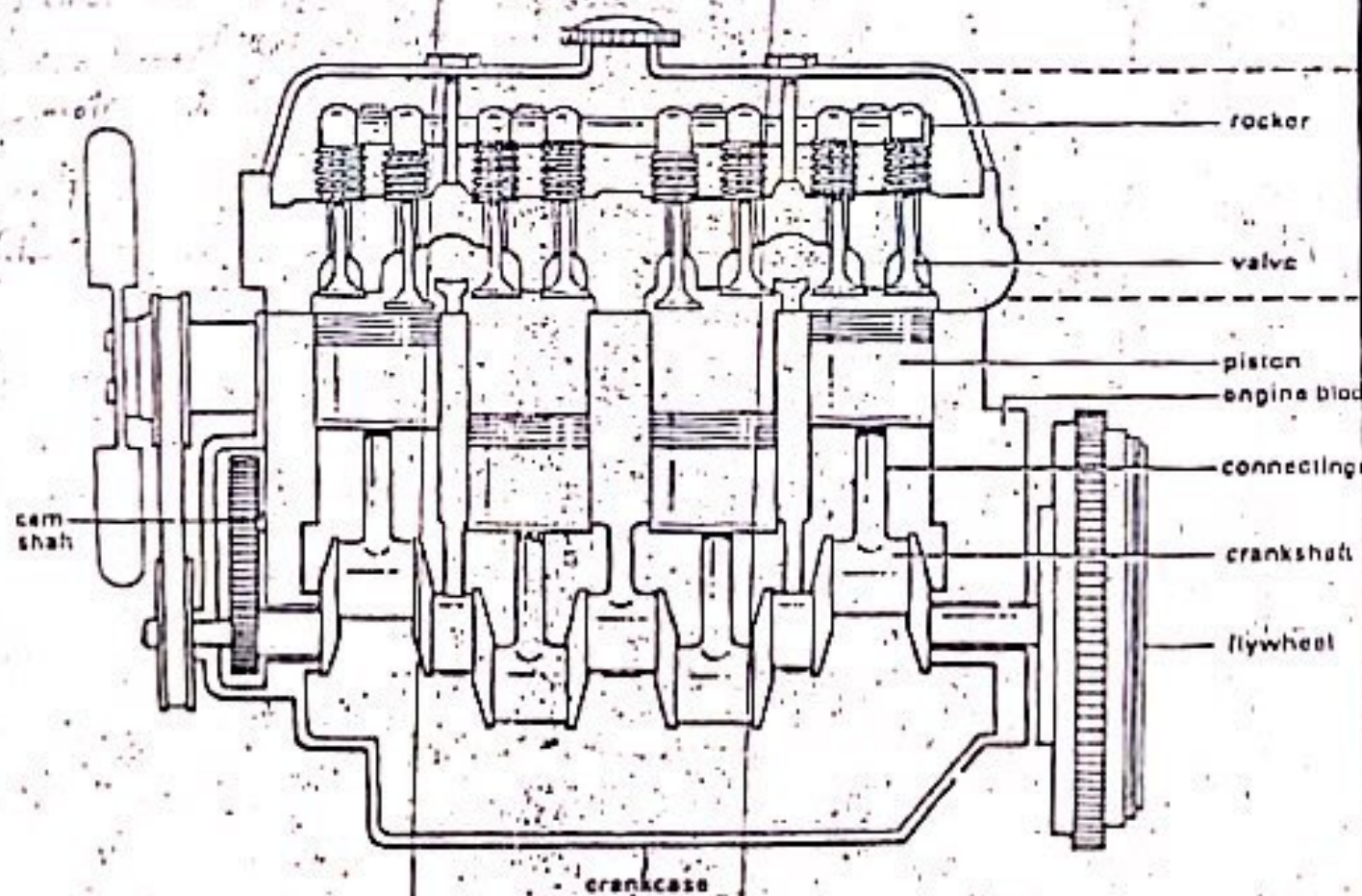


Figure 3.1 Cylinder block along with other engine components.

3.3.8 Flywheel:

It is a heavy wheel attached at one end of the crankshaft. The end usually referred to as rear end and the other as front end of the crankshaft. The of the flywheel are to store energy during power stroke and then distribute to idle strokes. It thus maintains a uniform speed of the engine by overcoming the variation in to idle strokes. Flywheel is usually mounted on the rear end of the crankshaft in engine. It has a ring gear for self-starting pinion and serves as one of the pressure for the clutch plate. Engine timings are frequently marked on the flywheel. The flywheel is usually made of cast iron.

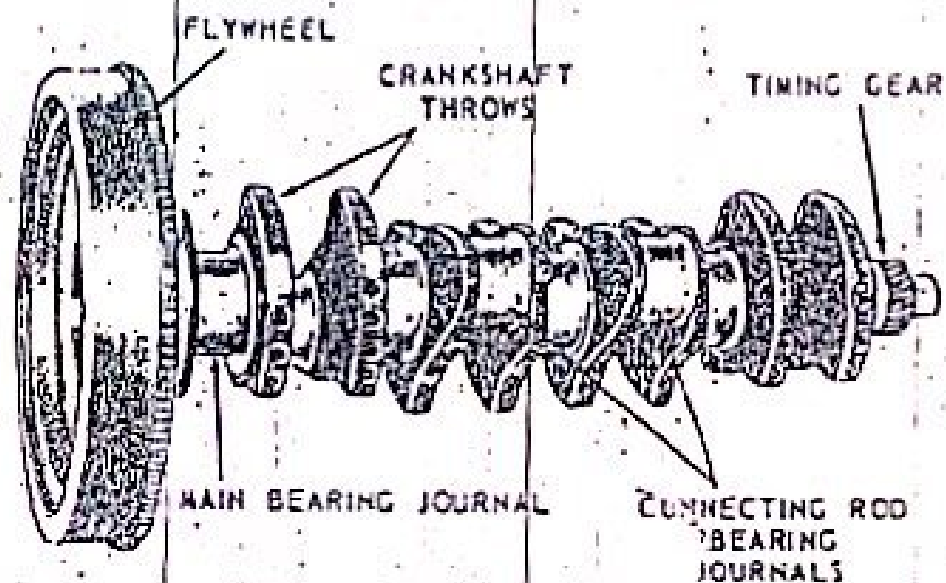


Figure 3.4 Crankshaft along with flywheel

3.4 ✓ ENGINE TERMINOLOGIES

Some important terms related to the operations of an internal combustion engine are explained with the help of Fig. 3.2

Bore (d): The diameter of the cylinder is referred to as engine bore.

Top Dead Center (TDC): The extreme position of the piston when moving towards the cylinder head.

Bottom Dead Center (BDC): The extreme position of the piston when moving towards the crankcase.

Stroke (L): It is the distance covered by the piston when moving from TDC to BDC and vice versa.

Piston Displacement (PD): The volume swept or displaced by the piston in one stroke.

Cylinder Head

Nearly all engines and particularly water-cooled engines have a removable cylinder head. The head may be either separate piece and removable or it may be an integral part of the cylinder. It houses valves, rocker arm, inlet and exhaust main-folds, spark-plug (in petrol engines), injector (in diesel engines), combustion chamber and water circulation passages which match to those of in cylinder walls. A copper-asbestos gasket is provided as a seal between the cylinder and cylinder head. The material used for cylinder head is mostly cast iron but the heads of small engines are made of aluminum alloys arranged with fins at their faces for air-cooling.

3.3.3 Crankcase and Oil Pan

At the bottom of the cylinder or cylinder block there is crankcase, which supports and encloses the crankshaft, camshaft and lubricating oil. It is also used for mounting on it the oil pump, oil filter, generator, self-starter and ignition parts. The lower portion of the crankcase is commonly called as the oil pan. This pan is securely bolted to the block and the joints sealed with suitable gaskets. Oil pan serves as a reservoir for the storage, cooling and ventilation of lubricating oil. A drain plug is provided at its bottom to drain the oil when desired. The material used for crankcase is mostly cast iron because it is cheap and more rigid than aluminum and its alloys.

3.3.4 Piston

A cylindrical plug which moves to and fro in the cylinder under the pressure of combustion gases and transmit power to the connecting rod. A trunk piston is closed from top and open from bottom with length greater than its dia is mostly used in I.C. engines. The diameter of piston is slightly smaller than that of cylinder bore. The space between cylinder wall and the piston is called piston clearance. The purposes of the clearance are to avoid seizing of the piston in the cylinder and provide an oil film between the piston and cylinder walls. The material used for piston is generally aluminum alloy because of its lighter weight and excellent heat conduction. In some engines the pistons made of cast iron and cast steel are also used.

3.3.4.1 Parts of Piston

Head: closed end of the piston is called piston head.

Piston Crown: The portion of piston wall from head to piston pin.

Piston skirt: The portion of piston wall from piston pin down to the bottom (open) end of piston.

Piston pin bosses: These are heavy extensions casted with the piston for supporting the piston pin

3.3.4.2 Piston Rings :-

Two types of rings are used on each piston i. e. compression rings and oil rings. The piston is arranged with 2 to 3 compression rings at the top and one to two oil rings at the bottom end of the piston. Compression rings help to; (i) air tight the combustion chamber (ii) dissipate heat to cylinder walls and (iii) scrap out carbon deposits. The oil ring is used to lubricate piston and cylinder walls and sweep lubricating oil down to oil

sump. The piston rings when worn out can be replaced easily and cheaply replacing the whole piston. A piston ring clearance of 0.002 to 0.003 inch per cylinder diameter is provided to allow for expansion of rings, as they get hot. The ring clearance is the space between two ends of the ring when it is in the cylinder. The material of the rings is grained alloy cast iron, which has excellent heat, wear resistant elastic qualities.

3.3.5 Piston Pin or Gudgeon Pin or Wrist Pin

A case hardened alloy steel pin used to connect the piston with small connecting rod is called piston pin. To reduce the weight of the pin it is made of I section. The pin may be stationary (fixed with piston), oscillating (fixed with connecting rod) or fully floating type (free to rotate both in piston and connecting rod). The piston is held in place by means of snap rings at each end of the piston.

① Power / s 16.75
② Power / s
③ Combustion
④ Crankshaft
⑤ F
⑥ F
⑦ F
⑧ F
⑨ F

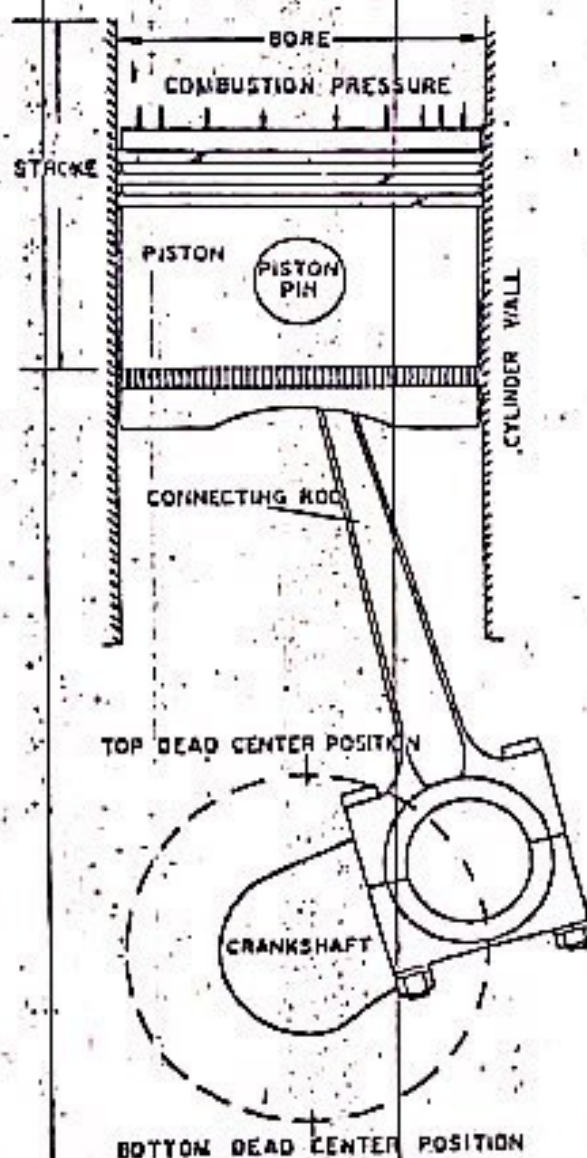


Figure 3.2. Piston in a cylinder along with a connecting rod

3.3.6 Connecting Rod

It is an element that provides connection between piston and the crankshaft. It is made of forged steel or duralumin. It is made in I-section to reduce its weight and vibration. The purpose of connecting rod is to transmit reciprocating motion of the piston to the crankshaft, which converts this motion into rotary motion. The end of the connecting rod fasten to piston pin is called small end and the other is called big end which is connected to the crankshaft. The big end has split bearing held together by 2 or 4 bolts.

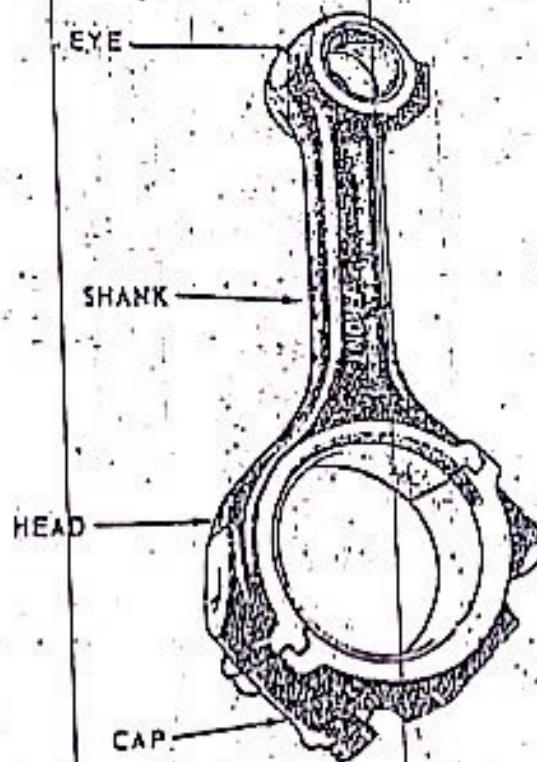


Figure 3.3 Connecting rod showing different parts.

3.3.7 Crankshaft.

It is a zigzag shaft in the engine. It converts the reciprocating motion of the piston into rotary motion. It is the heaviest shaft in the engine. The main parts of the crankshaft are crank pin, main journals, balance weights, webs and flywheel flange. It also contains oil passages for lubrication as shown in figure 3.4. The material used for the crankshaft is generally copper-chromium iron with high carbon content and some silicon. The journals of the crankshaft rest in the main and big-end (crank) bearings. The size of the crankshaft, the no. of main bearings and the arrangements of cranks are dependent upon the type, size and speed of the engine. Crankshafts are equipped with counter weights through out their length to provide complete balance and to reduce vibration. Crankshaft has a gear and pulley at its front end to operate camshaft and water pump, respectively.

The number of main bearings of crankshaft varies even the engines having the same number of cylinders. A six-cylinder engine may have 3, 4, 5 or 7 main bearings.