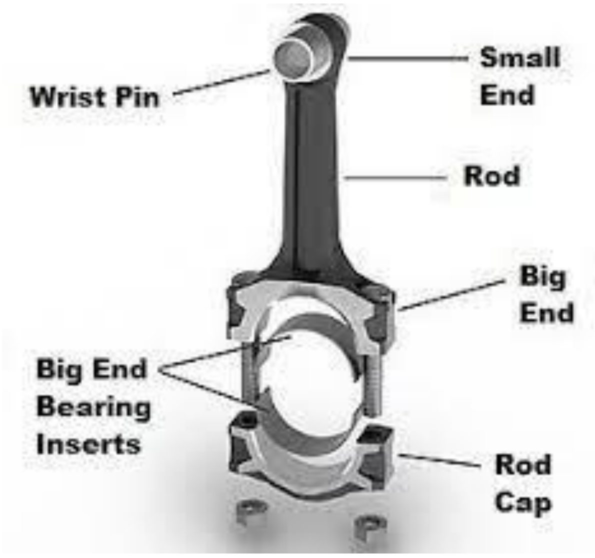
AI 3401 TRACTORS AND ENGINE SYSTEMS

UNIT I NOTES

CONNECTING ROD:

The connecting rod is attached at one end to a crankpin on the crankshaft and at the other end to a piston through a piston pin or wrist pin. The lower part of the connecting rod is split to permit its being clamped around the crankshaft. The split head known as the big end usually incorporates a babbit bearing. A bearing lining. of either steel backed copper lead or steel backed cadmium silver is also used.



The connecting rod must combine great strength with light weight. It must be strong enough to maintain rigidity when carrying the thrust of the piston during the power stroke. At the same time it must be as light as possible so that the centrifugal and inertia loads on the bearings will be no greater than necessary. Usually it is drop forged from alloy steel and is made with an I-beam cross-section.

To provide lubrication of the piston pin, an oil passage hole is often drilled along the entire length of the connecting rod from the crankpin journal bearing to the piston pin bearing. A hole in the big end upper half feeds the oil to the connecting rod oil passage from the oil line drilled in the crankshaft. The oil circulates through the connecting rod oil passage to the piston pin bearing.

Types of Connecting Rod:

In addition to the normal design the following types of connecting rods are also used in some tractors:

(a) Split at an angle: Some engines, viz. Escort 335, have the connecting rod split at an angle to make assembly and disassembly easier and to permit the passage of the rod end through the cylinder bore.

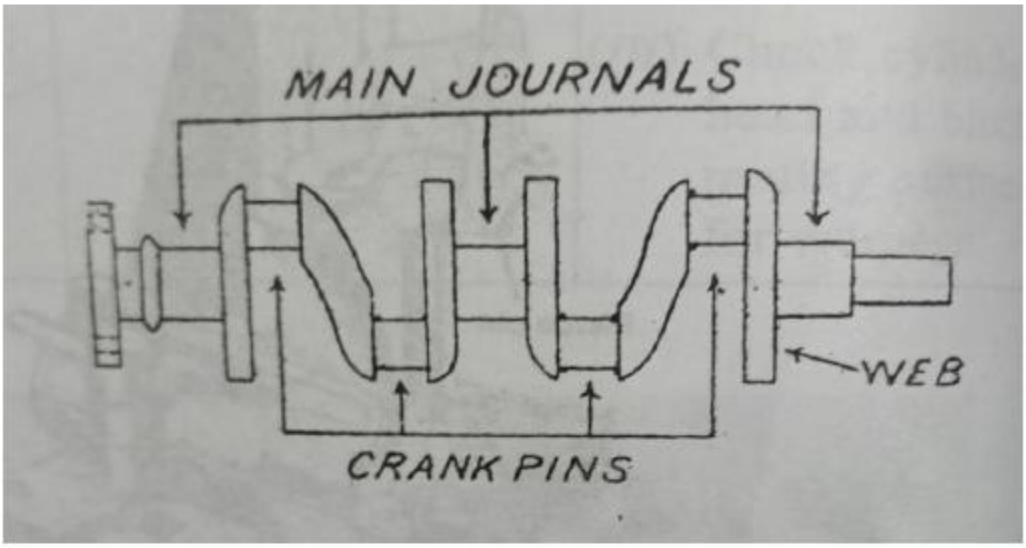
(b) Offset from shank: On some engines, the big end of the connecting rod end bearing is offset to one side of the rod shank. Offset connecting rods are employed on engines where, due to the design of the engine, the cylinders are not exactly centred over the crankpins on the crankshaft.

Inspection and Repair:

Procedure When the connecting rod is removed from the engine, it should be tested for alignment. This is done in a piece of equipment called connecting rod aligner. Bent or twisted rods may be straightened in the aligner with a bent piece of iron. Bent or twisted rods cause rapid bearing of the cylinder, ring, piston and pin wear. This is a result of their tendency to oppose the vertical travel of the pistons in the cylinders.

CRANKSHAFT:

The crankshaft is a one piece casting or forging of heat treated alloy steel that is of considerable mechanical strength. The crankshaft takes the downward thrust of the piston during the power stroke. The pressure exerted by the pistons through the connecting rods against the crankpins on the crankshaft causes the shaft to rotate. The crankshaft generally has drilled oil passages through which oil can flow from the main to the connecting rod bearings.



Crankshaft

In the assembled engine, the front end of the crankshaft carries a gear or sprocket that drives the camshaft. Some automobile engines have the crankshaft fitted with a device known as torsional vibration damper which combats torsional vibration in the crankshaft. As part of the vibration damper, there is a pulley with one or more grooves. A

V-belt fits these grooves and drives the engine fan and water pump. The rear end of the crankshaft carries the flywheel. Its purpose is to smoothen power impulses so that the engine moves smoothly.

Parts of Crankshaft:

The main parts of the crankshaft are:

(a) Main bearing journal: Bearing surfaces for support on main bearings.

(b) Crankpins: Bearing surfaces connected to big end of connecting rods.

(c) Crank arms on throws: Offsets which help provide leverage to rotate the crankshaft.

(d) Counter-weights: Balancing weight opposite the rod journals.

Arrangement of Crankshaft Throws:

There are a number of factors which affect the design of a crankshaft. The arrangement of the crank arms is one of them. The firing order of the engine depends on the arrangement of the arm.

The arrangement of the crankshaft throws affects: (i) the balance of the engine, (ii) vibration from turning of the shaft, (ii) loads on the main bearing and (iv) firing order of the engine.

FIRING ORDER:

The sequence in which the power stroke cylinder occurs is called firing order. The arrangement of the crankpin on the crankshaft and design of the camshaft both determine the firing order.

FIRING INTERVAL:

The interval between successive power strokes in different cylinders is called firing interval (FI) and is determined in a four-stroke engine as follows:

FI= 1 cycle or 2 revolutions of crankshaft (720°)/ No. of cylinders

For a two-stroke engine, the formula for firing interval is:

FI= 360°/ No. of cylinders

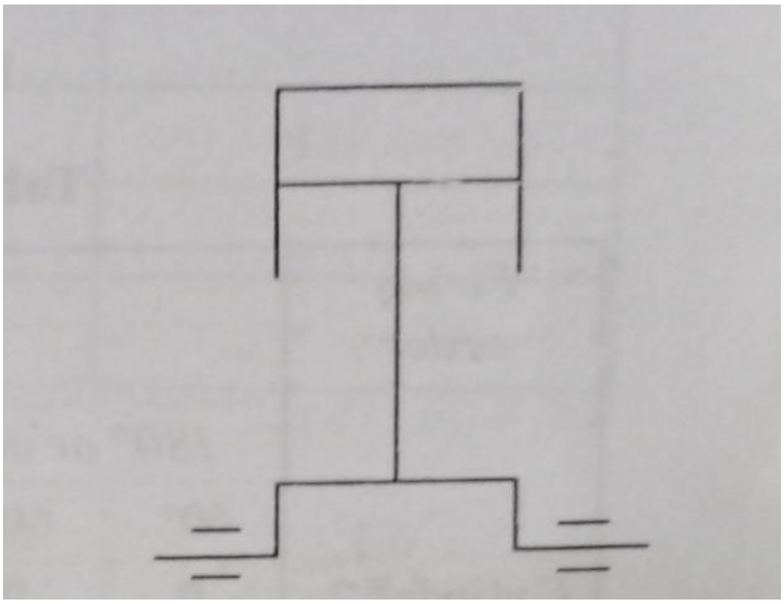
BALANCE AND FIRING ORDER OF ENGINES

For a single cylinder engine, there is one power stroke in two revolutions of the flywheel. The movement of the flywheel, therefore, cannot be smooth and quiet. To compensate for this unevenness in the revolution of the flywheel, it is normally made heavy and large. For a four-cylinder engine, the power impulses are available twice in every revolution of the flywheel, i.e., every time there is a power stroke in one of the cylinders. As a result, the movement of the flywheel is smooth and free from noise.

From the above description it is apparent that the larger the number of cylinders, smoother rotation and lesser the vibration and problems of balancing. The flywheel has to store and release less energy. Therefore, it can be lighter than those used in engines with fewer cylinders.

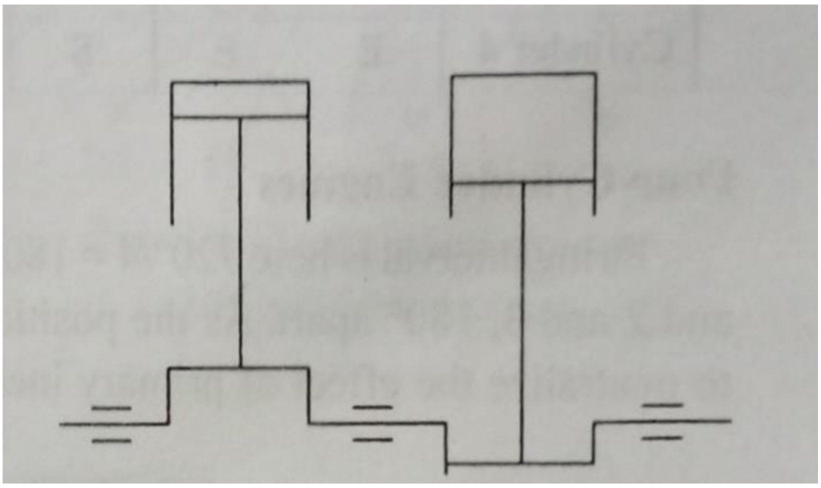
Single-Cylinder Engines:

The reciprocating parts such as the piston and connecting rod are one each in single cylinder engines and there is no provision to counter-balance their weight. Therefore, the mechanical balance in single-cylinder engines is poor. However, by providing counter-weights to the crankshaft and heavy flywheel, single-cylinder engines can be balanced to some extent. However, fluctuations in the speed of the engines will cause vibration even in the best designed single-cylinder engines.



Two-Cylinder Engine:

The crankshaft pins in this case are 180° apart and thus when one piston is going down the other goes up.

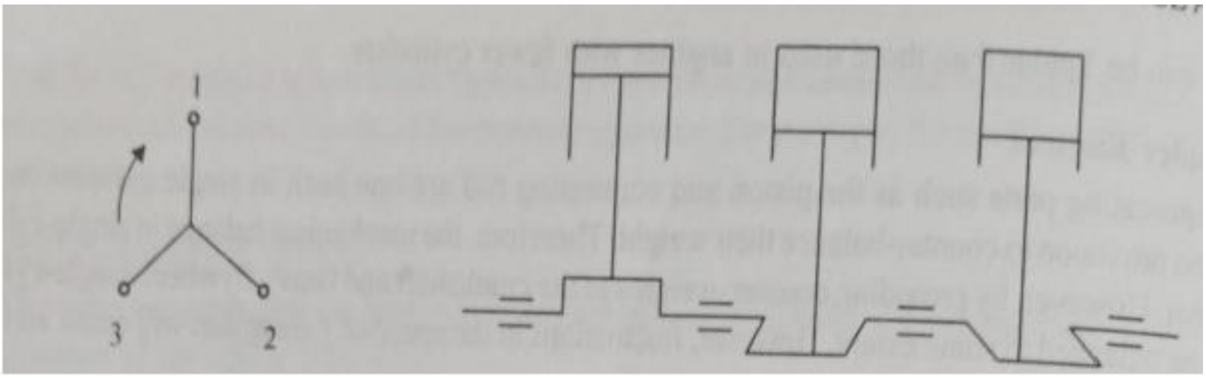


Three-Cylinder Engines:

The firing interval in this case is

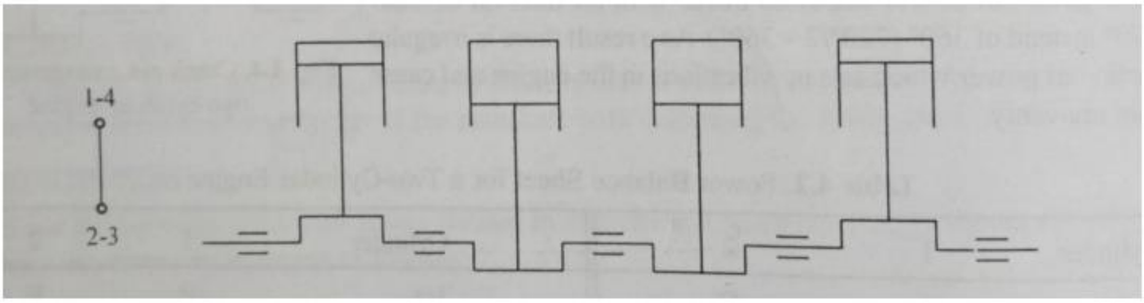
FI= 720°/3= 240

The crankshaft has been designed with crankpins 120° apart.



Four Cylinder Engines:

Firing interval is here 720°/4= 180° and the crankshaft is designed with crankpins 1 and 4 in one direction and 2 and 3, 180° apart. As the position of 1 and 4 is always moving opposite to that of 2 and 3, they tend to neutralize the effect of primary inertia forces.

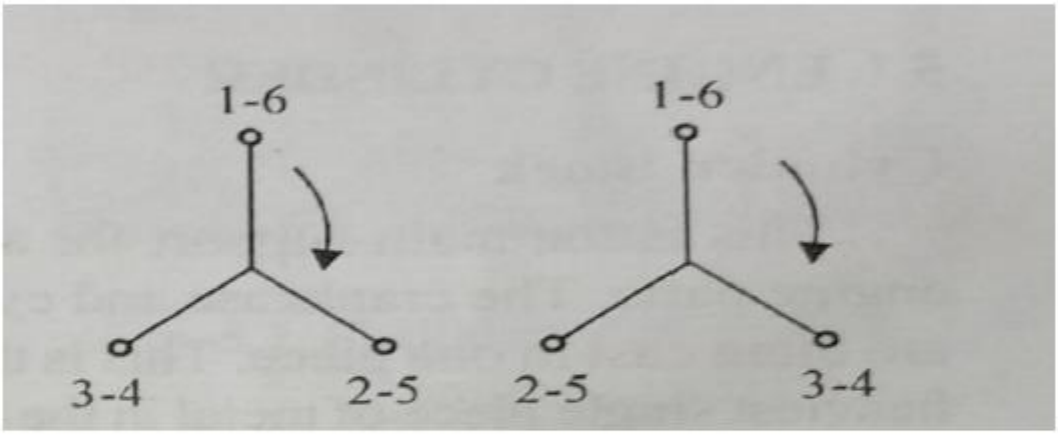


Crank pin arrangement of four cylinder engine

With the arrangement of cams, two types of firing order can be achieved. But the one most commonly used is 1-3-4-2. Hence, the crank revolution is smoother.

Six-Cylinder Engines:

The crankshaft is arranged such that the crankpins 1 and 6,2 and 5, and 3 and 4 are in the same radial plane, 120° apart. The firing interval is 720°/6=120°. i.e., in two revolutions of the crankshaft six power strokes will be available with a firing interval of 120°. In other words, after every 120° there will be a power overlap for 60°. The crankshaft can be arranged in either of the two ways and the firing order will be 1-4-2-6-3-5 and 1-5-3-6-2-4 respectively



Crank pin arrangement of six cylinder engine

The most common firing order in a six-cylinder engine is 1-5-3-6-2-4.