

Experiment No: 5

Title:-To study the working and construction details of Double Acting Simple Steam Engine

Apparatus: - Demonstration model and charts of steam engine

Theory:

The steam engine operates on the principle of first law of thermodynamics i.e. heat and work are mutually convertible.

In all steam engine, steam is the working substance. The heat energy of steam is converted into mechanical work by the to and fro (reciprocating) motion of the piston inside the cylinder. They are also known as external combustion engines as the combustion of the fuel takes place outside the engine cylinder i.e. in the boiler

The expansion of steam is carried out in a single cylinder and after that steam is exhausted to atmosphere or condenser. In single acting steam engine, steam is supplied only on one side of the cylinder where as in double acting steam engine, steam is supplied on both sides of the piston alternately i.e. one after the other. Engine works on modified Rankine Cycle.

Construction:

The main parts of the steam engine are-

Frame or cylinder block: It is heavy metal part generally made up of cast Iron. It supports all the stationary and moving parts and holds them in proper position. Generally it rests on foundations to avoid vibrations etc.

Cylinder: It is hollow thick vessel made of east iron. The piston moves to and fro inside the cylinder due to steam pressure. Both ends of the cylinder are closed and made steam tight. If the steam engines are of small capacities, the cylinder is made as an integral part of the frame or block.

Piston: It is a cylindrical solid disc, moving to and fro in the cylinder due to steam pressure. Its main function is to convert heat energy of steam into mechanical work. The grooves are provided on the periphery of the piston to support piston rings. The purpose of the piston rings is to prevent the leakage of steam from one side of the piston to other side i. e. to prevent blow by.

Steam chest: It is an integral part of the cylinder. It is used to preserve steam and supplies to the cylinder with the movement of the D-Slide valve and opening of the ports.

"D'= Slide valve: It is situated inside steam chest and it also moves to and fro in a simple



harmonic motion to supply steam to cylinder and also to exhaust steam from the cylinder to atmosphere/Condenser.

Inlet and exhaust ports: These are the passages provided in the body of the cylinder to supply steam to cylinder and also to exhaust steam from cylinder after the work is over.

Piston rod: It is heavy rod usually circular in section connects piston to one side and connecting rod on other side and guided by crosshead. Its main function is to transfer reciprocating motion of the piston with support of crosshead to connecting rod.

Crosshead: It is a link between piston rod and connecting rod. Its function is to guide motion of the piston rod and to prevent it from bending.

Connecting Rod: Connecting rods is usually made of forged steel. The one end is connected to the piston rod and the other end with the crank. Its main function is to convert reciprocating motion of the piston and piston rod into rotary motion of the crank

Crankshaft: It is the main part or shaft of the steam engine and connected with crank. It works on lever principles and produces rotary motion to the crankshaft. The crankshaft is supported on main bearings, which helps to rotate crankshaft freely.

Eccentric: It is in the form of circular disc and made of cast iron. It is fitted with the crankshaft. The function of the eccentric is to provide reciprocating motion to the eccentric rod.

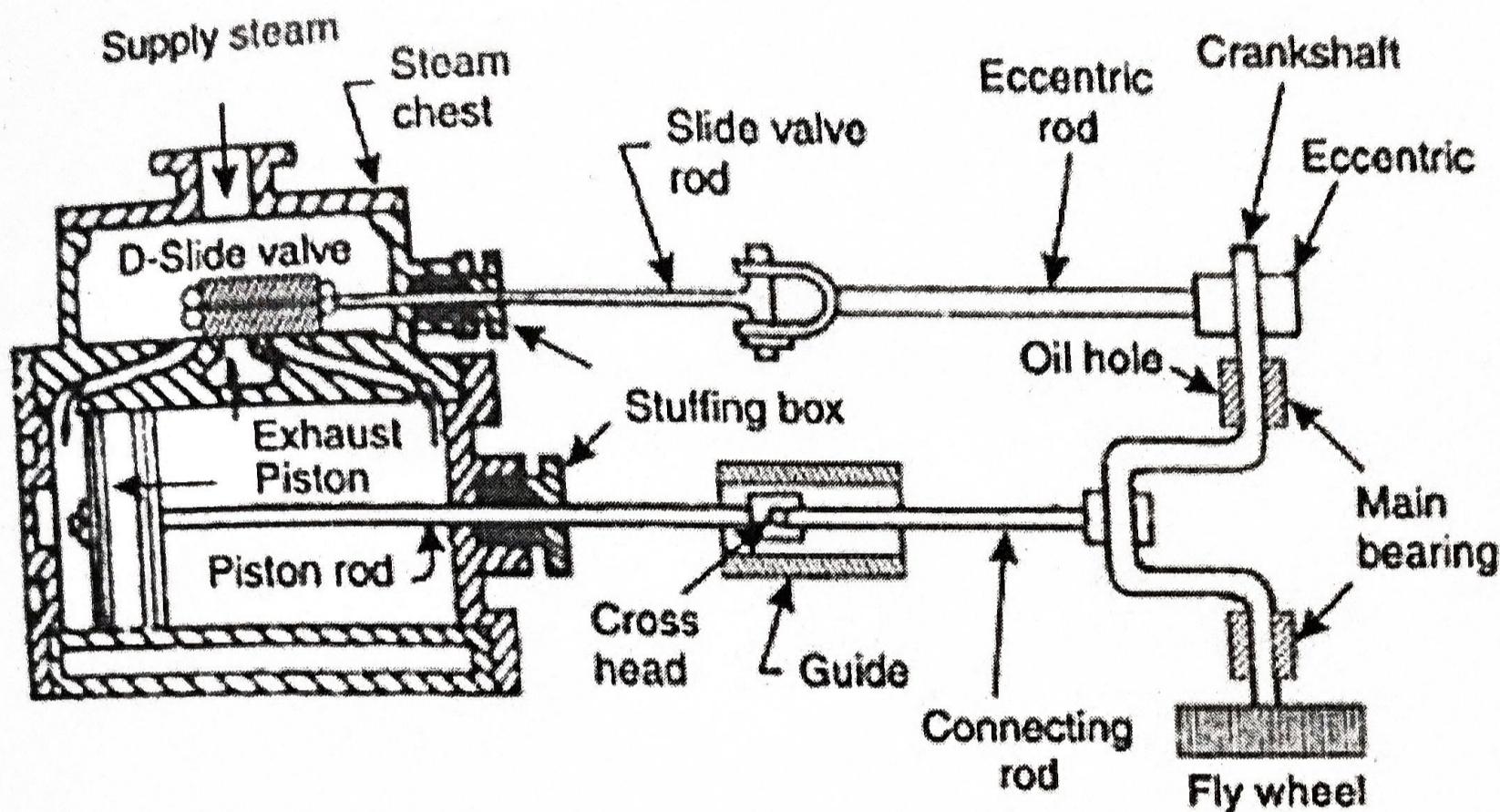
Eccentric rod and valve Rod: The eccentric rod is made of forged steel. The one end is fixed with Eccentric and other end to valve rod. Its function is to convert rotary motion of crankshaft into reciprocating motion (i.e. to and fro motion) to the valve rod. The valve rod connects the eccentric rod and D-Slide valve. Its function is to provide simple harmonic motion to the 'D' slide valve.

Flywheel: It is made of cast Iron and heavy casted wheel, mounted on one end of the crank shaft. Its function is to prevent the fluctuation of engine. It also prevents the jerks to the crankshaft. Crankshaft runs smoothly with flywheel.

Governor: It is a device to keep the engine speed more or less uniform at all varying load conditions. It is obtained either by controlling the quantity of steam flow or controlling the steam pressure to the engine.

Stuffing box: It is filled on crank end side of the steam engine and prevents the leakage of steam from cylinder to atmosphere.

Working



The high pressure steam available from steam boiler is stored in steam chest. The high pressure steam entered into the cylinder from steam chest by opening of port "a" depending upon the position of D-Slide valve. Let port "a" is open; the steam from steam chest rushes to the left side of the piston and forces it to move towards right. During this, the D-slide valve covers the exhaust port and the other side steam port "b". The pressure of steam on left side is greater than right side, the piston moves to the right.

When the piston reaches extreme end i.e. inner dead centre position end of the cylinder or crank end, the "D" slide valve closes the steam port "a" and exhausts port. The port "B" opens and the high pressure steam from steam chest rushes to the right side of the piston.

The piston now moves to the left and the exhaust steam of the left side of the piston goes out through exhaust port, and thus one cycle is completed. Similarly the process or cycle is repeated on right side also performing to deliver work.

In double acting steam engine, the high steam pressure acts alternatively to both sides of the piston and produces nearly double work or double power. In all steam engines, the same ports are used for admitting fresh steam from steam chest and exhausting out steam from the cylinder to atmosphere/ condenser

Applications- steam engines are used where speed is low and small power is required. They are used in locomotives, Ships etc.

Theoretical and actual P-V diagrams without condensing type are drawn (with clearance)