Engine Lubrication System:-

* Lubrication is essential to reduce friction and wear between the components in an engine.

Requirement of a good Lubricating system:

* To reduce friction and wear between the moving parts and thereby the energy loss and to increase the life of the engine.
* To provide sealing action e.g. the lubricating oil helps the piston rings to maintain effective seal against the high pressure gases in the cylinder.
* To cool the surfaces by carrying away the heat generated in engine components.
* To clean the surfaces by washing away carbon and metal particles.

Main Components of lubricating system:-

* Piston and cylinder * Main crankshaft bearings * crankpin and their bearings * wristpin and their bearings * Valve gear.

Types of Lubricating system:

1. Mist Lubricating system.
2. Wet sump lubricating system.
3. Dry sump lubricating system.

Mist Lubricating system!. (two Stroke Engine) (5)

* This system is used where crankcase lubrication is not suitable.
* In two stroke engine, as the charge is compressed in the crankcase, it is not possible to have the lubricating oil in the sump.
* In such engines, the lubricating oil is mixed with the fuel, the usual ratio being 3% to 6%.

Wet sump Lubrication system!.

* Bottom of the crankcase contains oil pan or sump.
* Lubricating oil is pumped to various components.
* After lubricating these parts, the oil flows back to the sump by gravity.
* It is of three types.

(i) The splash system (ii) The splash and pressure system (iii) The pressure feed system.

Splash System!-

* This system used in light duty engines.

Splash System: This type of lubrication system is used in light duty engines. A schematic diagram of this system is shown in Fig.13.9.

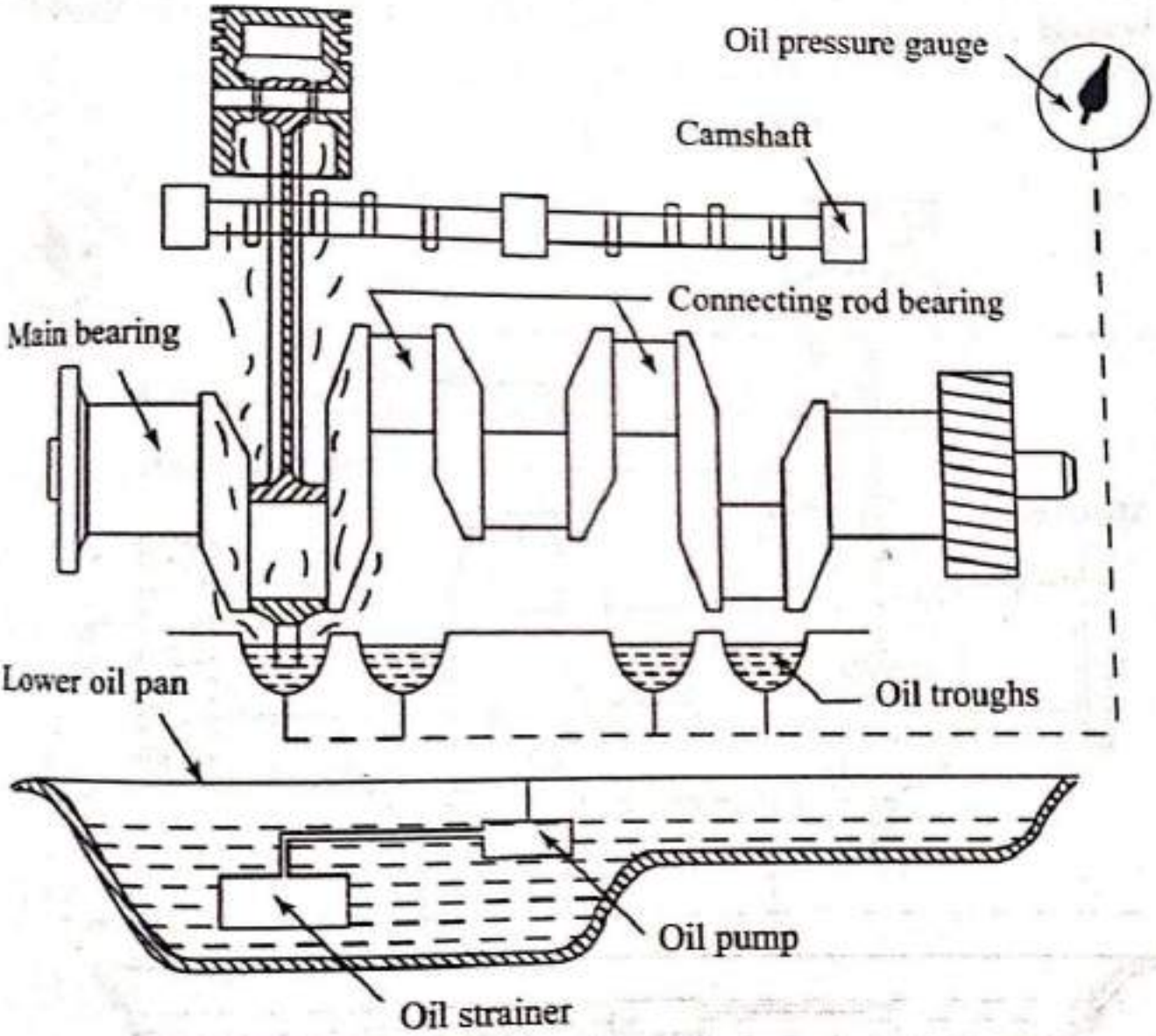

Fig. 13.9 Splash Lubrication System

The lubricating oil is charged into in the bottom of the engine crankcase and maintained at a predetermine level. The oil is drawn by a pump and delivered through a distributing pipe extending the length of the crankcase

into splash troughs located under the big end of all the connecting rods. These troughs were provided with overflows and the oil in the troughs are therefore kept at a constant level. A splasher or dipper is provided under each connecting rod cap which dips into the oil in the trough at every revolution of the crankshaft and the oil is splashed all over the interior of the crankcase, into the pistons and onto the exposed portions of the cylinder walls. A hole is drilled through the connecting rod cap through which oil will pass to the bearing surface. Oil pockets are also provided to catch the splashing oil over all the main bearings and also over the camshaft bearings. From the pockets the oil will reach the bearings surface through a drilled hole. The oil dripping from the cylinders is collected in the sump where it is cooled by the air flowing around. The cooled oil is then recirculated.

The Splash and Pressure Lubrication System: This system is shown in Fig.13.10, where the lubricating oil is supplied under pressure to main and camshaft bearings. Oil is also supplied under pressure to pipes which direct a stream of oil against the dippers on the big end of connecting rod bearing cup and thus the crankpin bearings are lubricated by the splash or spray of oil thrown up by the dipper.

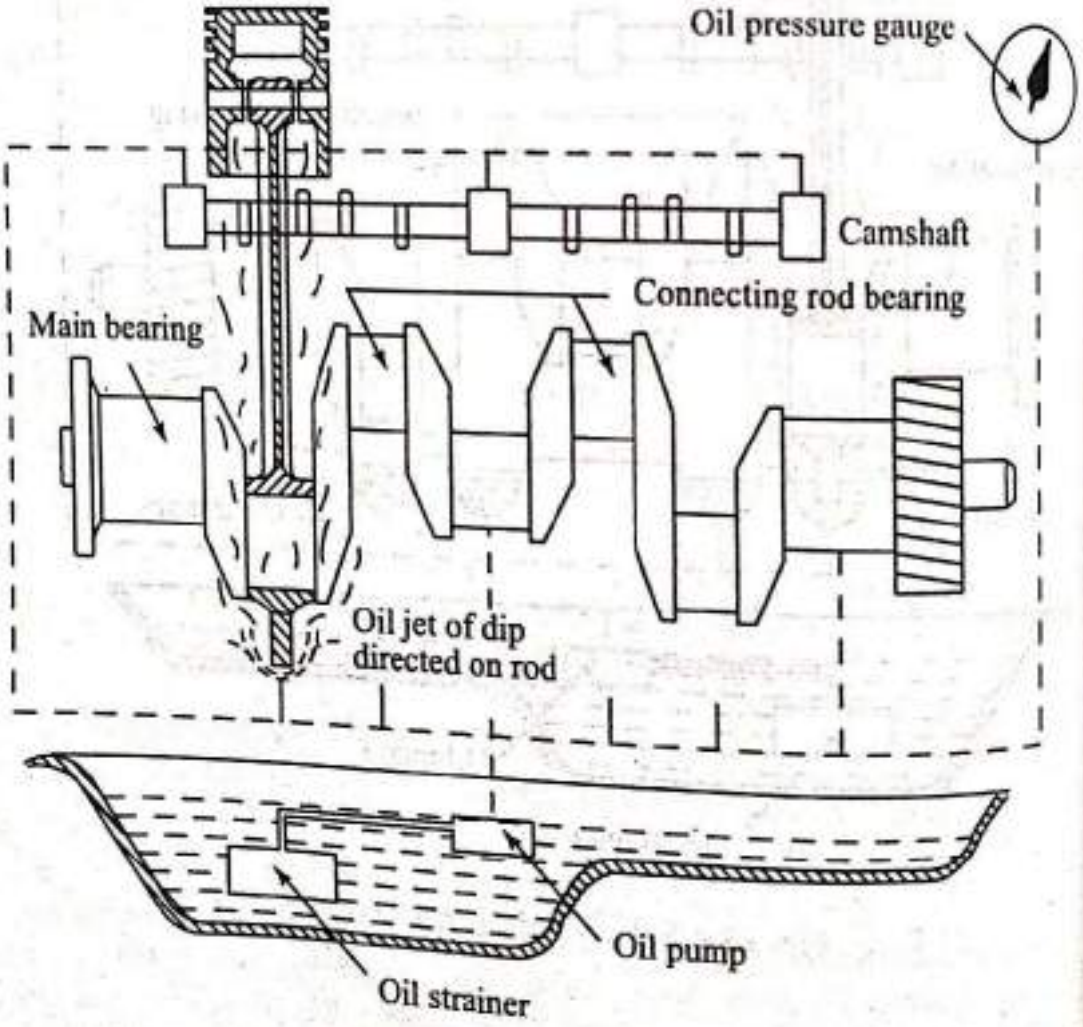

Fig. 13.10 Splash and Pressure Lubrication System

Pressure Feed System: The pressure feed system is illustrated in Fig.13.11 in which oil is drawn in from the sump and forced to all the main bearings of the crankshaft through distributing channels. A pressure relief valve will also be fitted near the delivery point of the pump which opens when the pressure in the system attains a predetermined value. An oil hole is drilled in the crankshaft from the centre of each crankpin to the centre of an adjacent main journal, through which oil can pass from the main bearings to the crankpin bearing. From the crankpin it reaches piston pin bearing through a hole drilled in the connecting rod. The cylinder walls, tappet rollers, piston and piston rings are lubricated by oil spray from around the piston pins and the main and connecting rod bearings. The basic components of the wet sump lubrication systems are (i) pump (ii) strainer (iii) pressure regulator (iv) filter (v) breather.

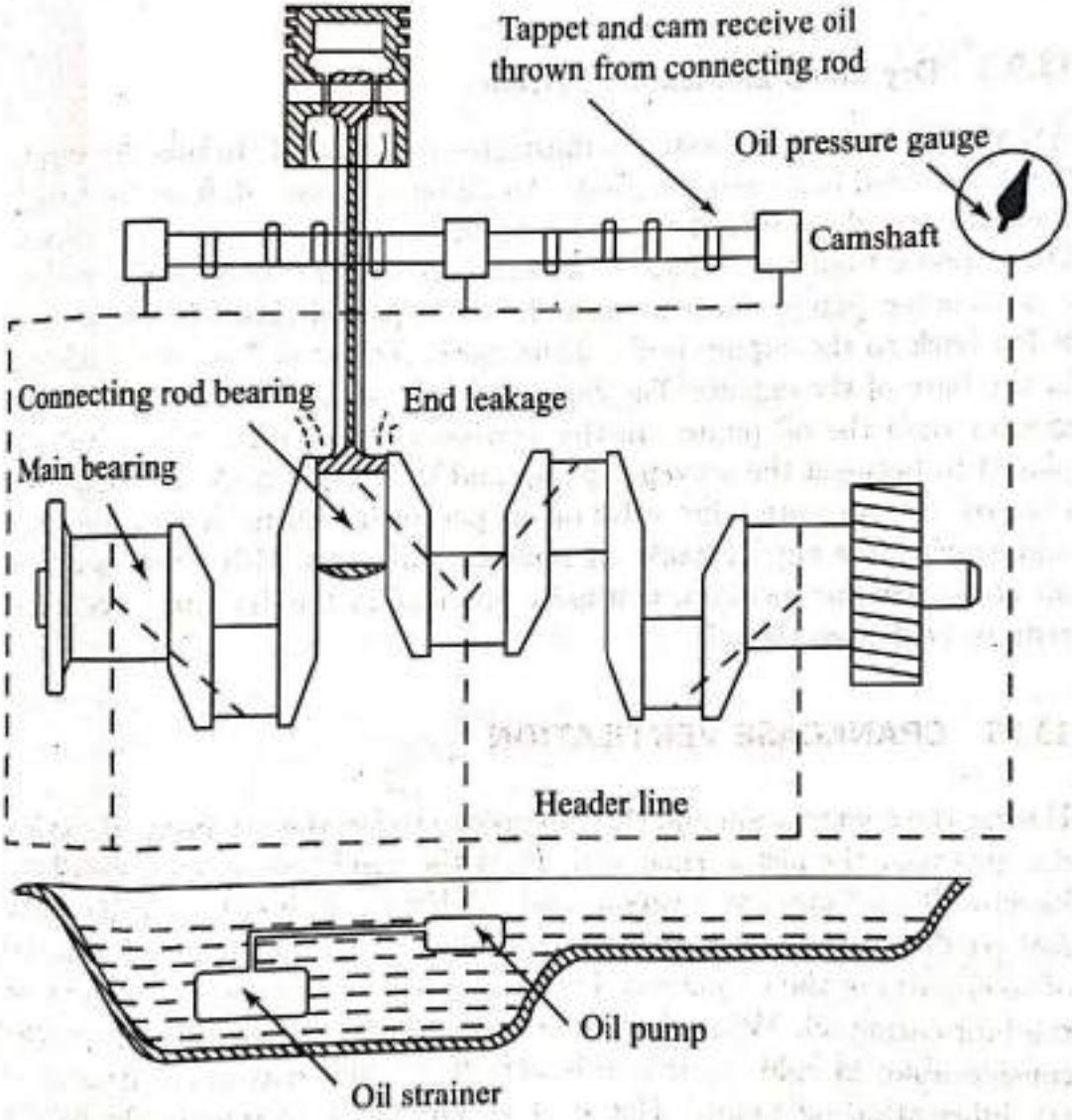

Fig. 13.11 Pressure Feed Lubrication System

A typical wet sump and its components are shown in Fig.13.12. Oil is drawn from the sump by a gear or rotor type of oil pump through an oil strainer. The strainer is a fine mesh screen which prevents foreign particles

8.19 Dry Sump Lubrication System :

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Difference between wet sump and dry sump lubrication systems :

- Dry sump system is similar to wet sump method except that in this case the lubricating oil is maintained in a separate tank kept behind the radiator.
- The oil is kept cool because of air blast thrown on the radiator.
- The oil from the tank is supplied by the oil pump under a pressure of 3 - 8 bar to various parts of the engine through a distributor header covering the entire cylinder block.
- Since the temperature rise of lubricating oil in case of dry sump method is less than the wet sump method due to cooling, this system permits the use of thinner oil compared to wet sump method.

This is an added advantage over wet sump method since the thinner oils reduce the viscous friction loads on the engine.

Working of dry sump system :

- The general arrangement of dry-sump lubrication system is shown in Fig. 8.19.1.
- In this system the oil contained in the sump is drawn by the pump through the strainer. This oil after passing through a filter is supplied to supply tank kept outside the cylinder block.

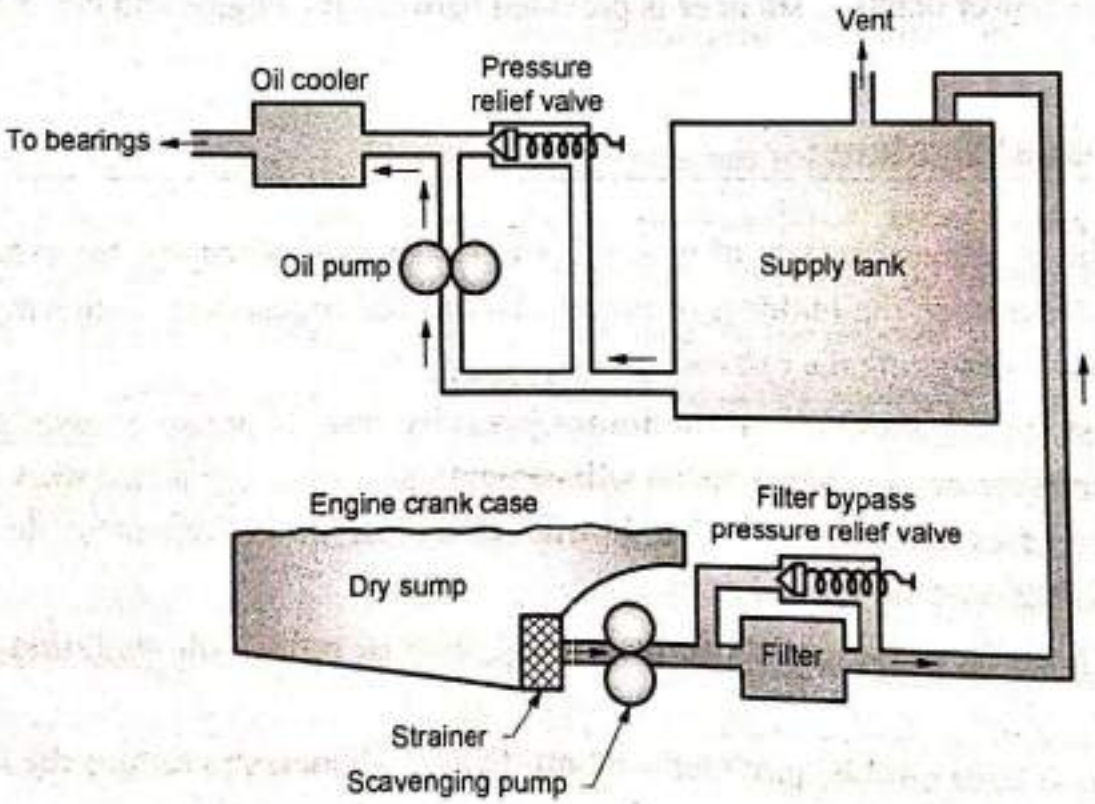


Fig. 8.19.1 : Dry sump lubrication system

- The function of the filter is to remove from oil the abrasive particles upto 10 to 15 microns that causes the wear of working surfaces and also to prevent sludge deposits to the bearings.

Engine Cooling System:

Why is it required?

* I.C. Engine can transform about 25% to 35% of chemical energy in the fuel into mechanical energy.
* 25% to 35%, → lost to cooling medium,
* Remainder dissipated through exhaust and lubrication oil.

Requirement of an efficient cooling system:

* It should be capable of removing about 30% of heat generated in Combustion Chamber while maintaining the optimum temprature of the engine
* It should remove the heat at a faster rate when engine is hot. However during the starting of the engine the cooling should be minimum

Types of cooling system:

(i) Liquid or indirect cooling system.
(ii) Air or direct cooling system

Liquid cooling system:

* This type of cooling is employed for medium and large sized engines in automobiles.
* The system consist of water jackets enclosing the cylinder and cylinder head.
* The water jacket is connected to the heat exchanger and it flows back to the water Jacket

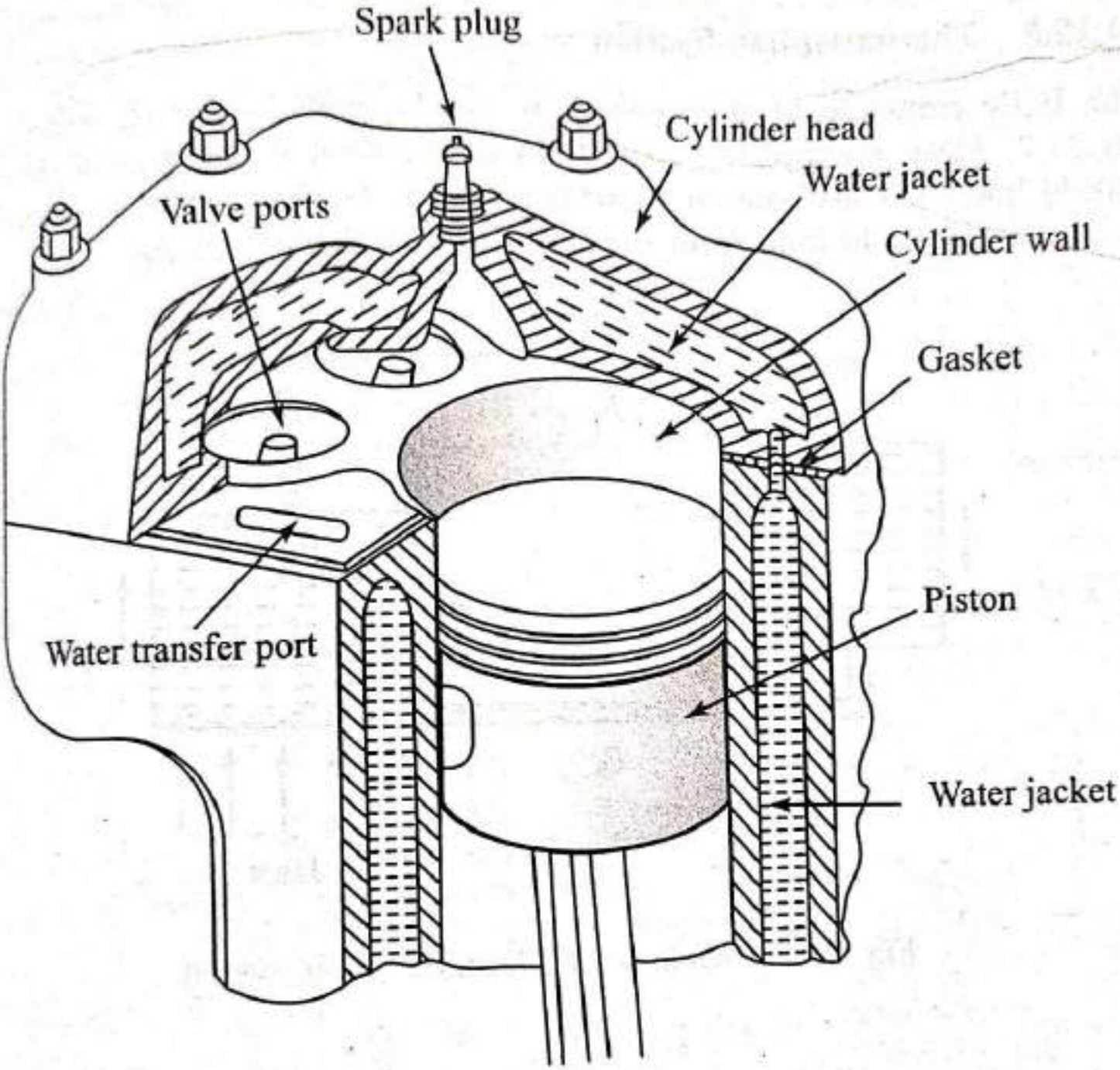


Fig. 14.6 Cooling Water Passages

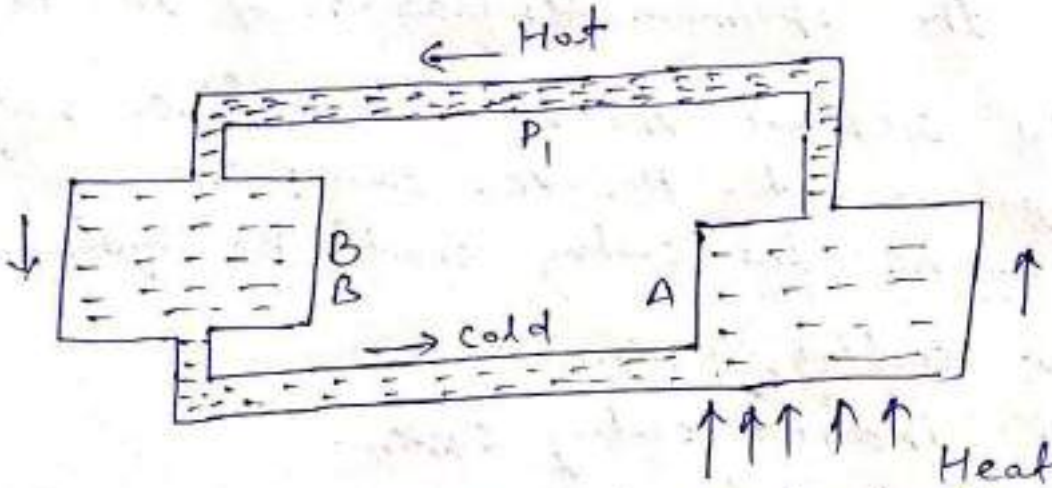
Types of water cooling system:

(i) Direct or non return system
(ii) Thermo syphon system
(iii) forced circulation cooling system
(iv) Evaporative cooling system

Direct or Non return cooling system:

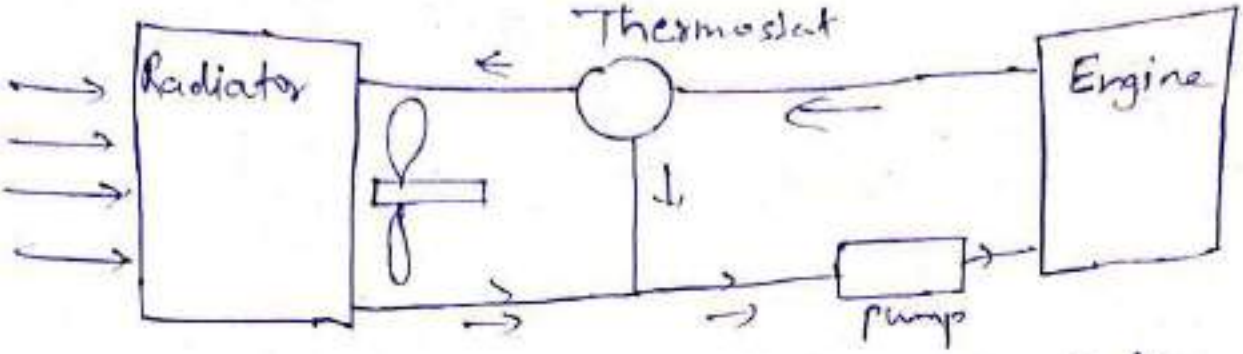
* This system is useful for large installations where plenty of water is available.
* The water is not recirculated but it is drained out.

Thermosyphon System:



* The system is so designed that the water may circulate naturally because of convection current.
* for engine application tank A represents the cylinder jacket while tank B represents a radiator and water acts as a circulating fluid.
* Cylinder jackets, water jackets are located at a lower level than the radiator.

forced circulation cooling system!



* The principle behind the forced circulation can be explained by the above block diagram.
* The water or coolant is circulated through Jackets around the parts of the engine to be cooled and kept in motion by a centrifugal pump which is driven by engine..
* A thermostat is used to control the water temperature required for cooling.

① Evaporative cooling:-

* This type of cooling system is used for industrial engine applications.
* The cooling water in this system is allowed to be heated upto 100°c with formation of steam.
* In this engine cooling is done because of evaporation of water in the cylinder jackets into steam.
* the advantage is taken from the high latent heat of vaporization of water by allowing it to evaporate in the cylinder jacket..

* The steam formed in the cooling circuit is flashed off to a separate heat exchanger where it is condensed. The same condensate is sent to the cooling system as make up water

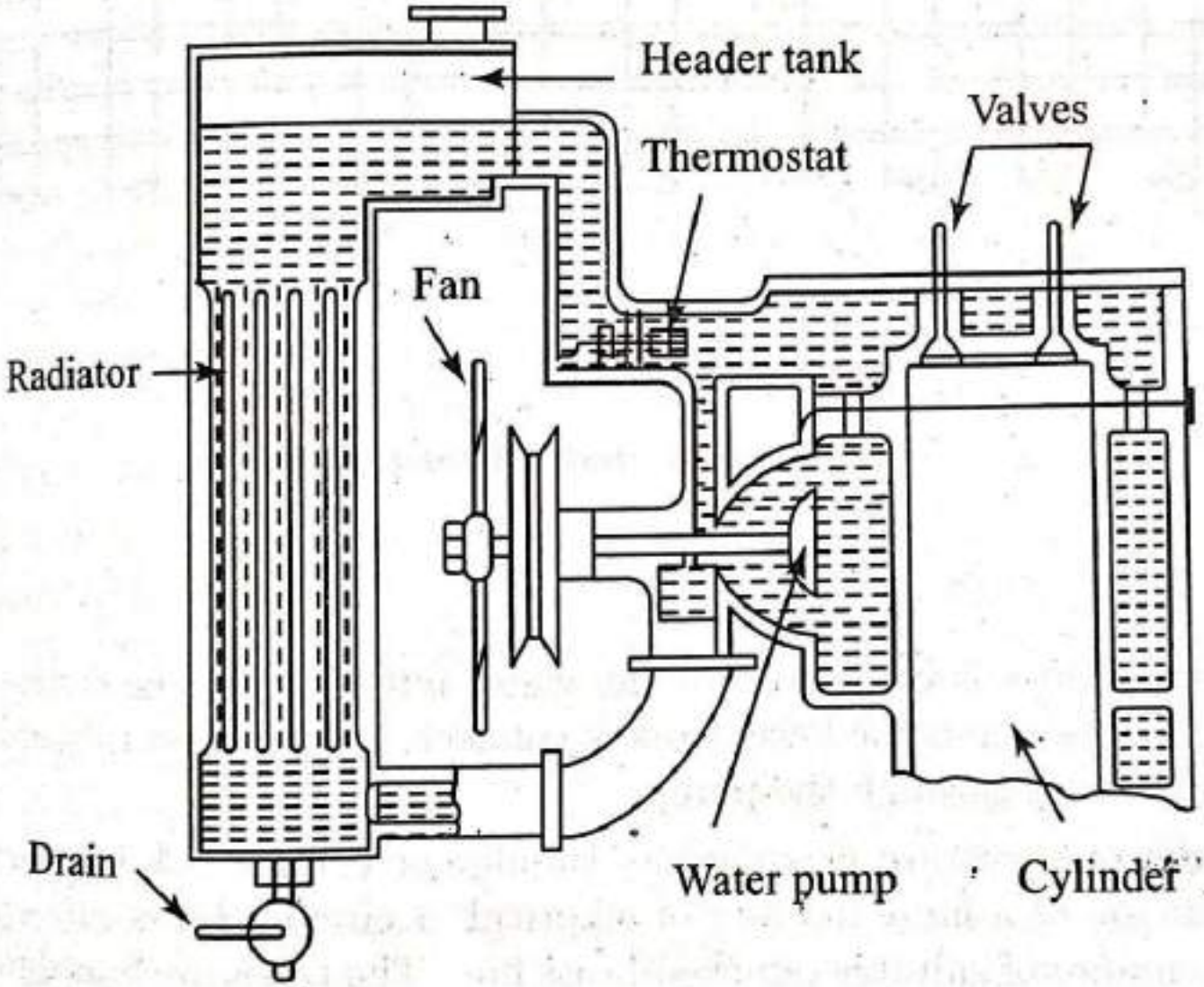


Fig. 14.9 Cooling of an Automobile

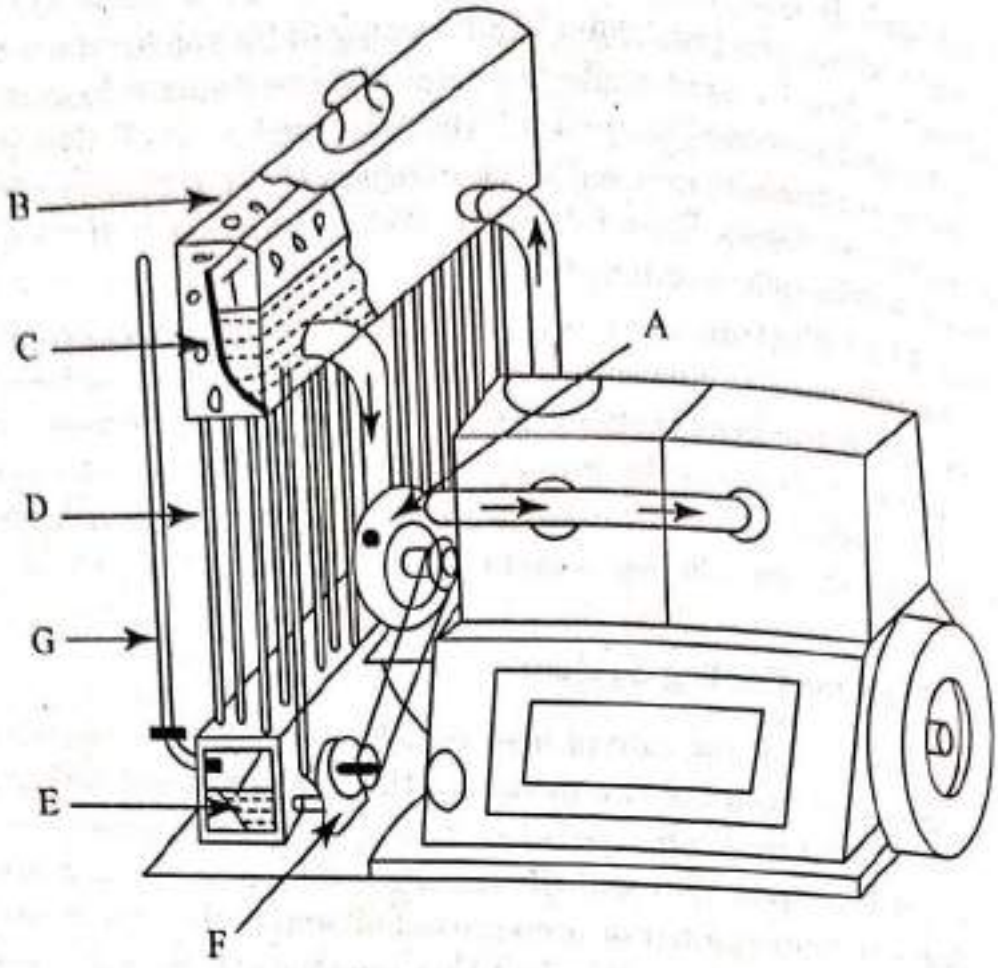


Fig. 14.13 Evaporative Cooling with Air-Cooled Condenser

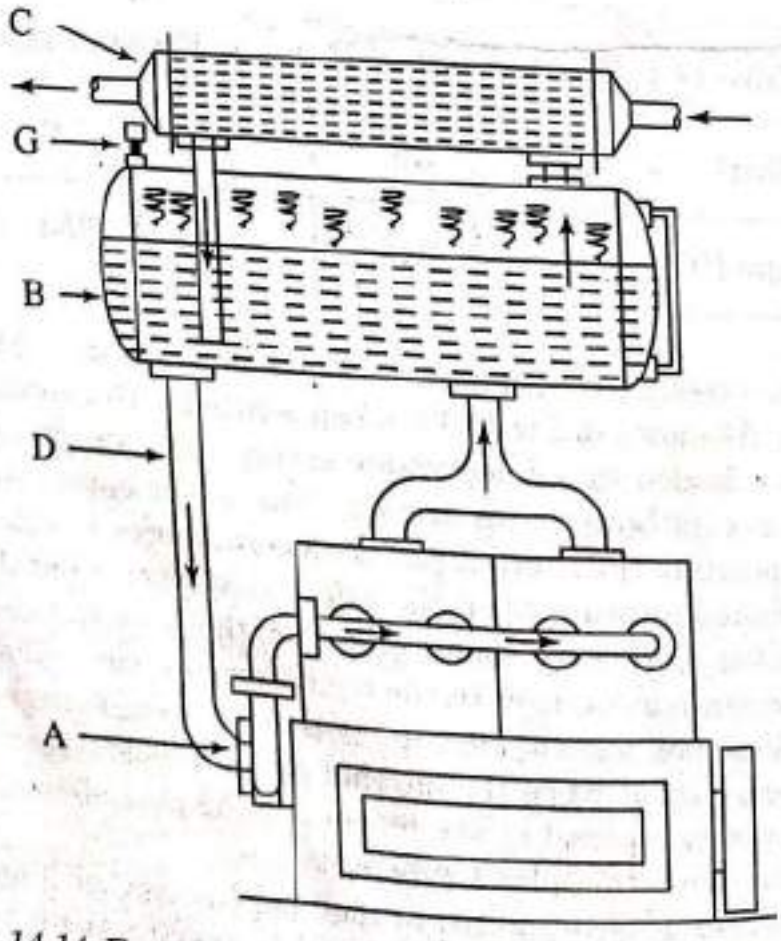


Fig. 14.14 Evaporative Cooling with Water-Cooled Condenser

Supercharging:

* Supercharging is a process of admitting densed charge into the engine cylinder compared to the charge which is admitted during the regular suction stroke i.e. in a naturally arpirated engine.

* This makes more oxygen available for combustion than the conventional method of drawing fresh air charge into the cylinder:

* Consequently, more air and fuel per cycle will be forced into the cylinder, and this can be effectively burnt during the combustion process to raise the power output to a higher value

Application: Racing cars, Marine and automotive engines, Engine working at higher altitude.

Effect of Supercharging:

(1) Higher power output
(2) Greater Induction of charge mass
(3) Better atomization of fuel.
(4) Better mixing of fuel and air.
(5) Better torque characteristics
(6) Quicker acceleration of vehicle.
(7) More complete and smoother combustion.

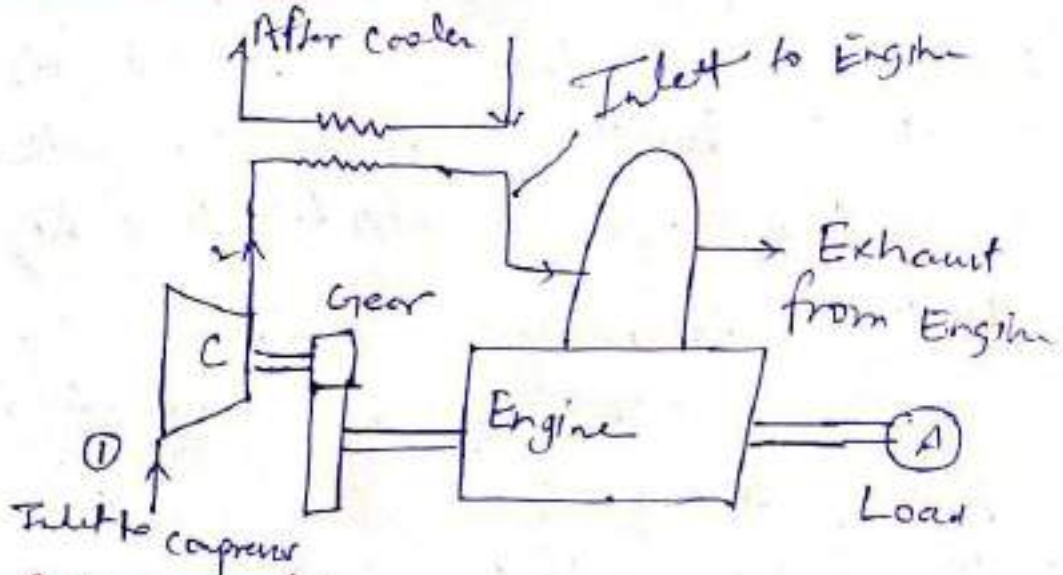
(8) Increased detonation tendency in SI Engine.

(9) Increased mechanical efficiency.

Turbocharging:-

* In turbocharging the supercharger is being driven by a gas turbine which uses the energy in the exhaust gases. There is no mechanical linkage b/w the engine and supercharger while in supercharging the compressor is directly coupled with engine shaft.

Supercharging Arrangement:-



Turbocharger Arrangement:-