2/02/21

Cooling system of IC Engines

Requirement of cooling system.

→ A/c to Kelvin plank statement of second law of thermodynamics some heat must be ejected for producing work in a cycle.

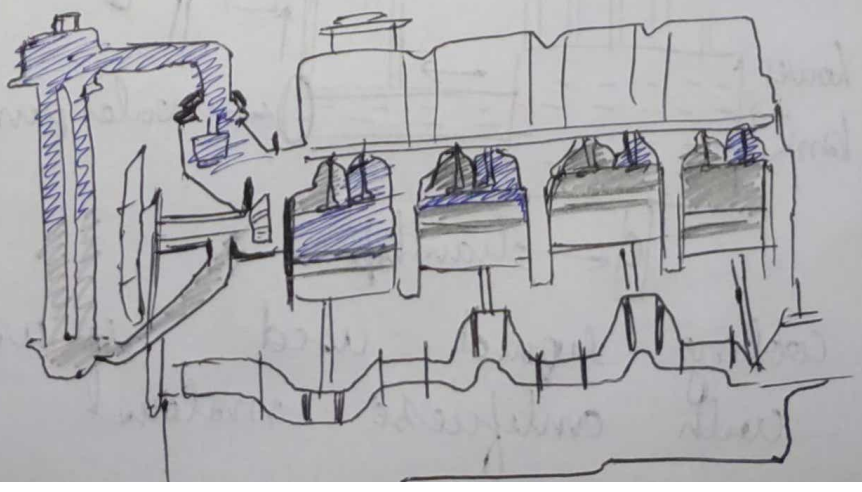
→ Around 25 - 35 % of total heat generated is rejected in an IC engine.

→ If there is no continous removal of heat ejected temp. will increase rapidly

→ Components of IC engines are made of diff. materials which can withstand certain temp only

→ High temp leads to expansion of Piston in the cylinder which may result in seizure of the piston

→ Hence improper cooling will adversely effect the components.



Classification

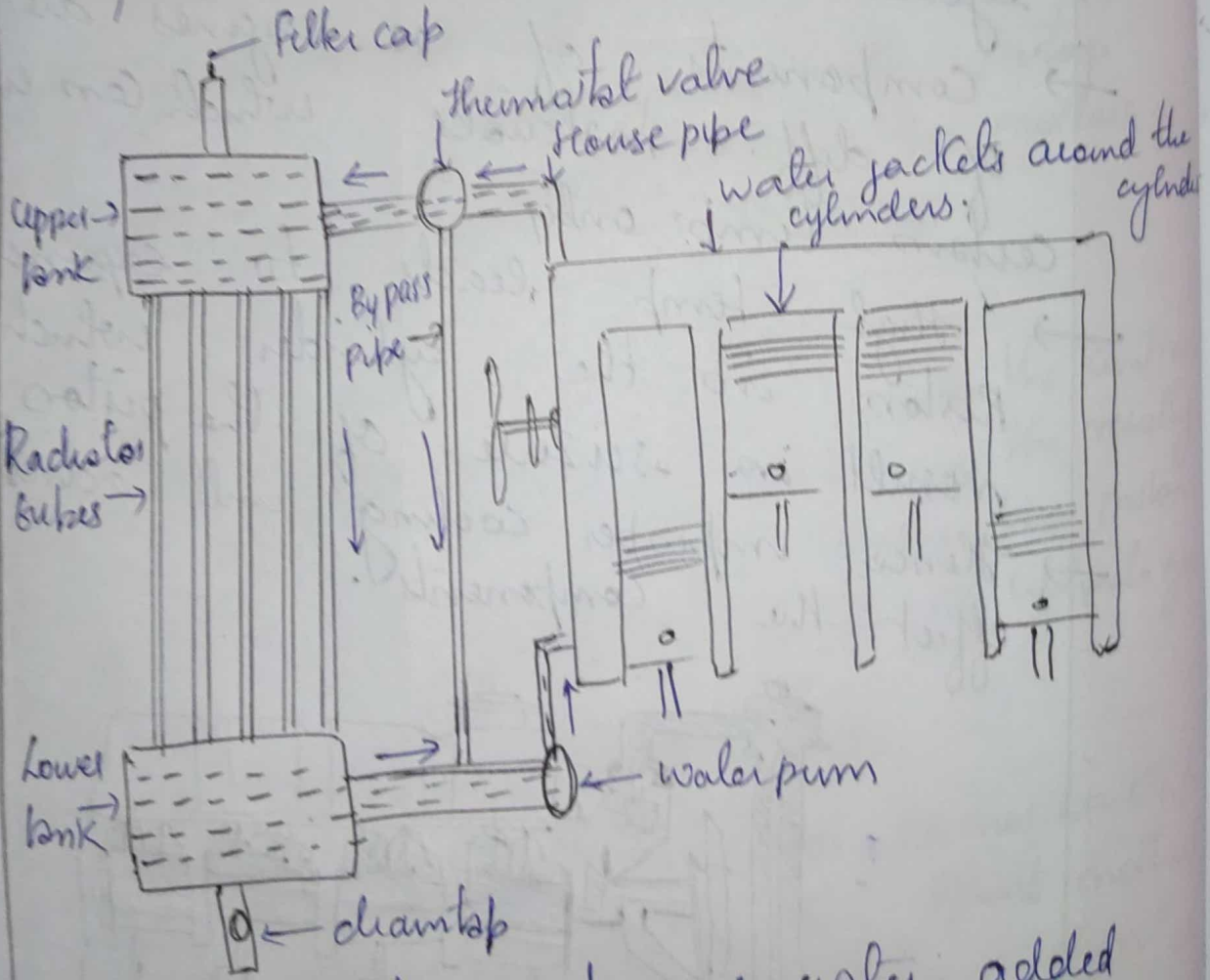
Acc to fluid used for carrying heat cooling sys is classified in 2 →

1) water / liquid cooling
2) Air cooling.

Water liquid / cooling System.

In this method the engine cylinder walls and heads are provided with cooling jackets through which cooling liquid is circulated.

Exam fig



cooling liquid used is water added with antifreeze material like ethylene glycol.

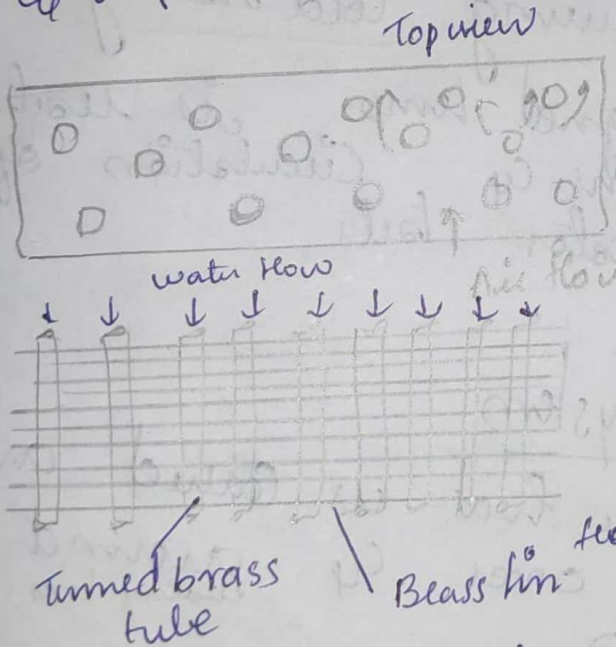
- Major components of liquid cooling system are
  1) Radiator
  2) Pump
  3) Fan
  4) Thermostat.

upper → lower
↳ hot → cold.

Radiator

- consist of a no. of tubes for passage of water connected b/w upper (hot) & lower (cold).
- tanks.

function – to provide sufficient area to increase the heat transfer b/w coolant & air



- No. of thin sheets (fins) are used to further enhance the heat transfer.

- Radiator tubes & fins are made of brass

Pump

→ function → circulation of coolant
→ Centrifugal type is used mostly.
→ The power for the crank shaft through belt & pulley during the pump driven from arrangement

Fan

- Fan is fitted behind the radiator.
- Fan induce a flow of air through radiator block
- Fan is driven by a V belt from engine crank shaft.
- Blades of fan are made of metal, nylon plastic etc.

Thermostat

→ Thermostat is fitted b/w coolant passage of cylinder head & upper tank of radiator.

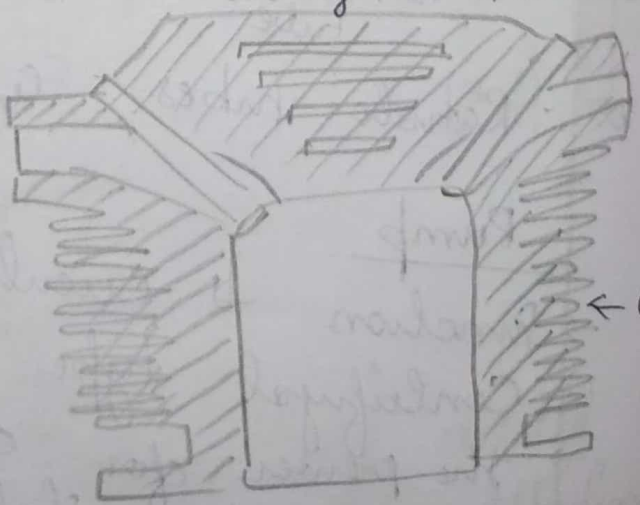
→ function → is to restrict the circulation of coolant during Cold starting → starting after many days

→ when the designed temp is reached the thermostat opens & circulation of water to the radiator starts

Air cooling System

→ In this the heat is carried away by the air flowing over & around the cylinder (used in bikes)

→ fins are cast on the cylinder head to provide the additional surface area



Air cooling sys. is mainly applied in motor bikes, aircraft engine etc where limitation of weight exist.

Applications of fins - Increase area.

* Computer processor
* transformers

Comparison

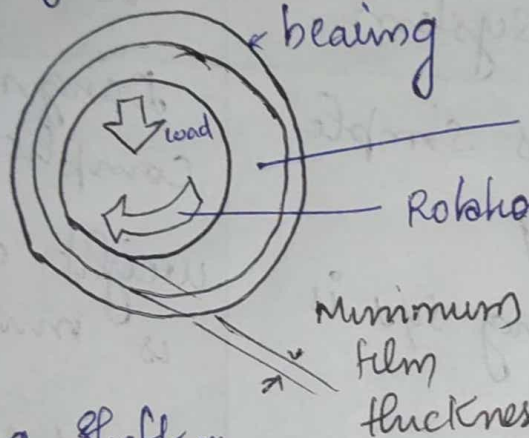
Air cooling system	water cooling system
Design of sys is simple and less costly	Design of sys is complicated & more costly
weight of cooling sys is very less.	weight of cooling sys is much more
Installation & maintenance are very easy	Installation & maintenance are difficult
There is no danger of leakage or freezing of the coolant	There is a danger of leakage or freezing of the coolant
As the rate of heat transfer is low not suitable for large engines & multicylinder engines	Due to high rate of heat transfer this can be employed for multicylinder engine & large engines

Lubrication System of IC Engines

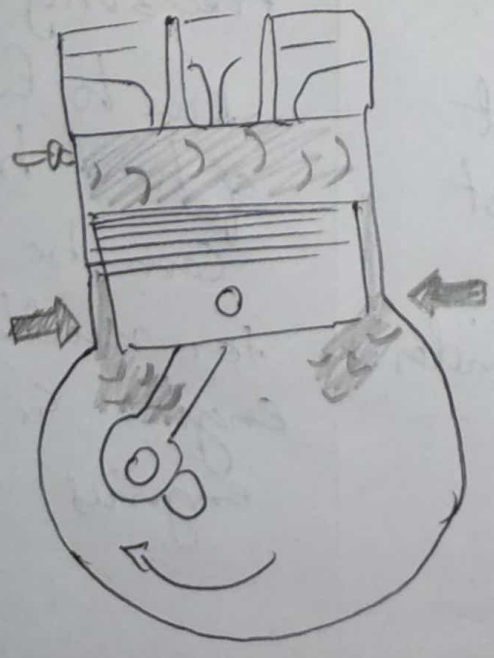
Purpose of lubrication System.

→ In an IC engine almost all machine parts have relative motion and rub against each other

→ Lubrication reduce friction by creating a thin film b/w the moving parts



→ oil helps form gastight seal b/w piston rings & cylinder walls & reduces blow by.



→ Lubrication oil clean the engine by picking up metal particles and carbon and bearings - them back down to the pan

→ When heavy loads are imposed on the bearings, the lubrication oil helps to cushion the load and absorb shock.

→ Circulation of lubrication oil helps to remove some amount of heat from the engine.

* Viscosity

→ It is a measure of oil resistance to flow

→ Viscosity changes a/c to temp.

→ If the oil is too thin (has very low viscosity) it will be forced out from b/w the moving parts, resulting in rapid wear.

→ If the oil is too thick (has very high viscosity) it will flow very slowly to engine parts, esp. when the engine & the oil are cold, resulting in rapid wear.

→ Viscosity index is the measure of how much the viscosity of an oil changes with temp.

→ Viscosity no. is set by SAE (Society of Automotive Engineers).

Types of Lubrication System

1) Mist Lubrication
2) Wet sump Lubrication
   a) • Splash
   b) • pressure feed
   c) • combined Splash & pressure feed
3) Dry Sump Lubrication

Mist Lubrication

→ Mainly used in 2 Stroke engine where crankcase lubrication is not possible.

→ 3 to 6 % Lubrication oil is mixed with fuel & is inducted through Carburetor

→ fuel is vaporized & lubrication oil in the form of mist goes to cylinder & other components

→ Advantage of mist lubrication is its Simplicity & cost

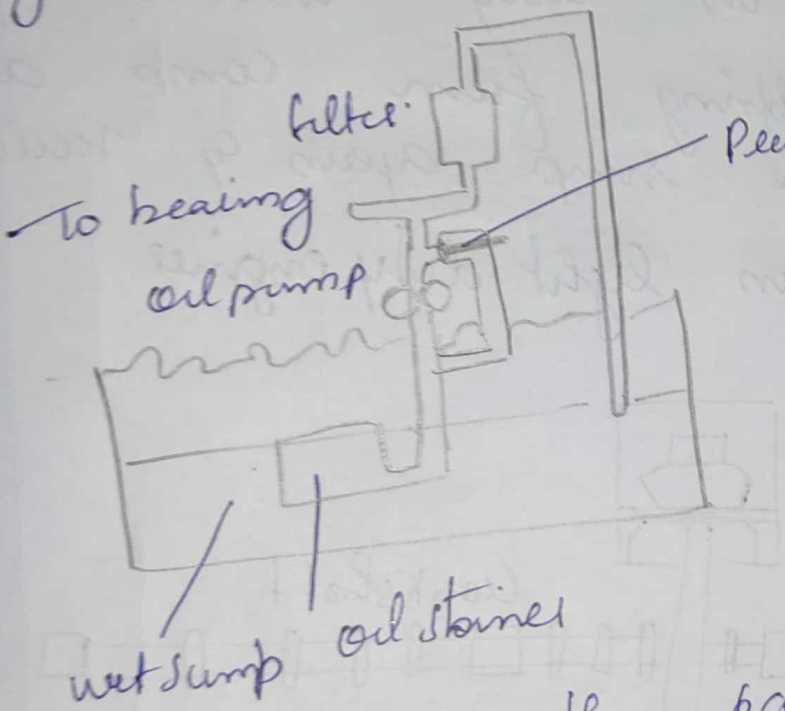
→ But it cause heavy smoke due to burning of lubricating oil

→ Another important limitation is during closed thottle operation, like

vehicle moving down hill, engine will suffer from insufficient lubrication

Wet Sump Lubrication

Here the bottom of the crankcase contains an oil sump from which the lubricating oil is pumped to engine components



→ After lubricating the parts oil flows back to sump by gravity
→ Again it is recirculated
→ 3 types of wet sump lubrications are available
- Splash lubrication
- pressure fed lubrication
- Combined lubrication. Splash & pressure feed

Splash lubrication

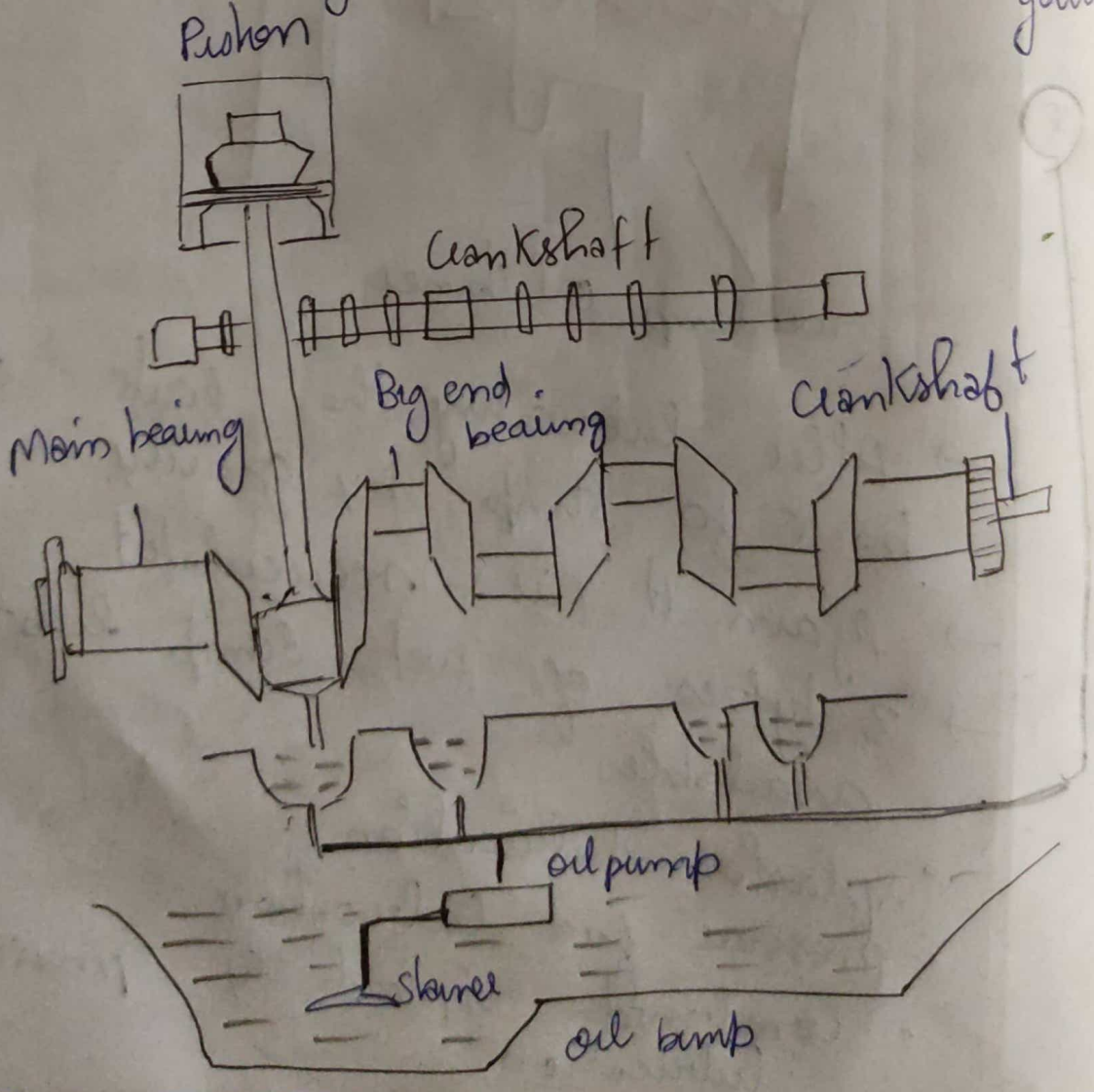
→ Lubricating oil from the crankcase is drawn into oil troughs located under the big end of connecting rods

→ A dipper is provided under each connecting rod cap

→ Dipper splashes oil all over the interior in every revolution of crankshaft

→ oil dripping from comb. are collected in the sump again & recirculated

→ used in light duty engines

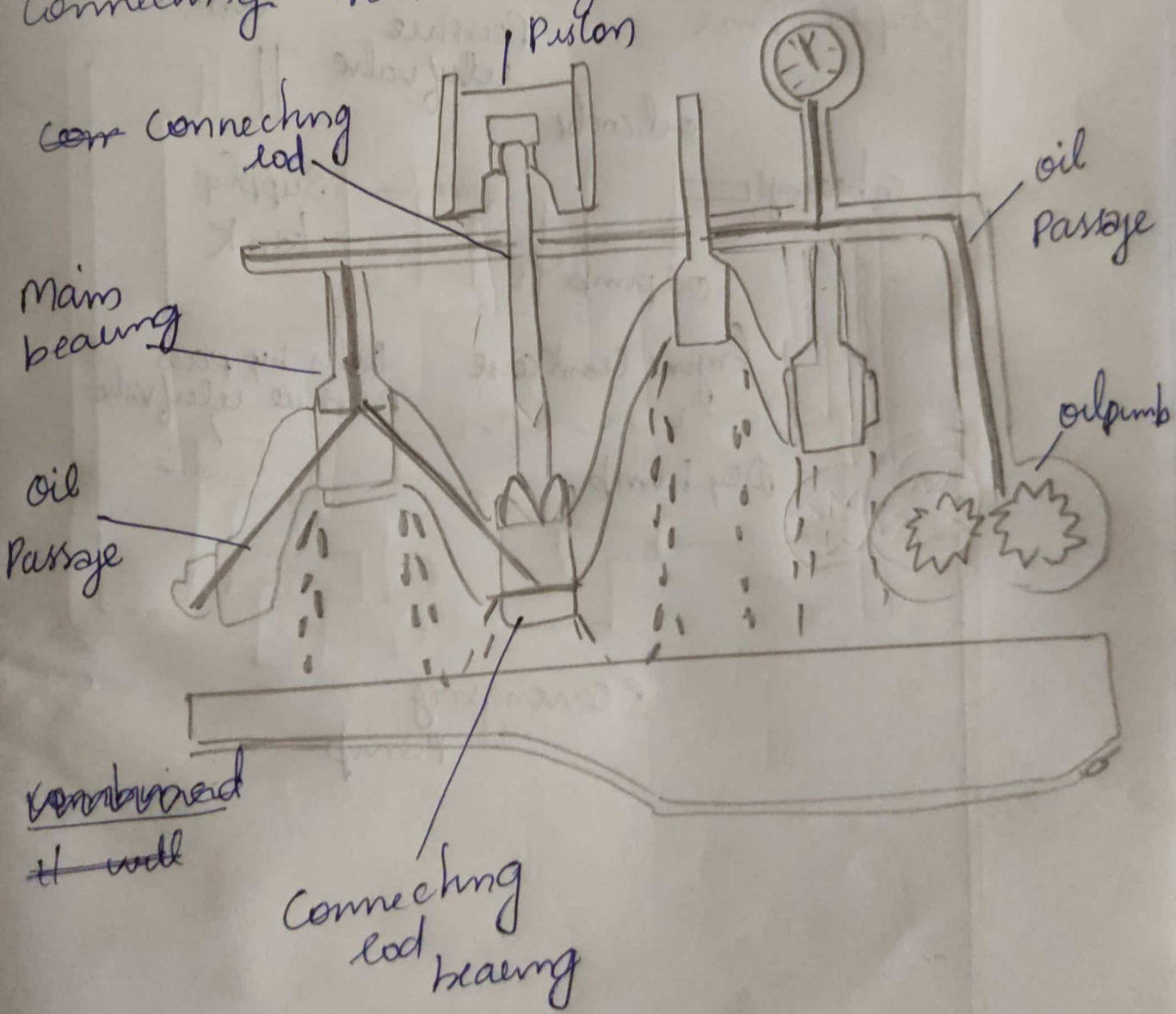


Pressure feed lubrication

→ oil is drawn from the sump and forced to all main bearing of the crankshaft thrugh distributing channels

→ from crank oil reaches the piston through hole drilled in the connecting rod.

→ The cylinder walls, piston and piston rings are lubricated by oil spray from connecting rod bearings



Dry sump lubrication

→ Supply of oil is caused from an external tank

→ oil pump circulates oil from this tank to various bearings

→ oil dipping from cylinders & bearings into the sump is removed by a scavenging pump and fed back to the supply tank