



BITS Pilani
Pilani Campus

Automotive Vehicles AEL ZC441

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Lecture 1 - Recap

- Introduction to Automobile
- Development of Automobile (1769 to 2005)
- General Classification (Type I & II)
- Basic Structure &
- Components of Automobile (Basic Structure, Power Plant, Transmission System, Auxiliaries, Controls, Superstructure)

Lecture 2 - Recap



- Chassis & Body
- Classification
- Conventional Construction
- Sub frames
- Frameless Constructions
- Classifications of Body

Lecture 3 - Recap



- Cylinder Block and crank case
- Cylinder Head
- Sump or oil pan
- Intake and Exhaust Manifolds
- Gaskets
- Cylinder Liners
- Piston
- Piston Rings
- Connecting Rods
- Piston Pins
- Crankshaft
- Main bearings
- Valves and Valve actuating mechanisms
- Mufflers

Lecture 4 - Recap



- Need of Cooling system
- Variation of Gas temperature
- Theory of Engine heat transfer and co-relation
- Parameters affecting Heat transfer
- Air cooled Systems

Lecture 5 - Recap



- Water Cooling system
- Types of Water cooling
- Components of Water Cooling system
- Other coolants & Anti-freeze solutions
- Intelligent cooling system

Today's Topic



Lect No.	Learning Objectives	Topics to be covered	Reference to Text
1	An introduction to automobiles	Overview of the course and evaluation scheme Development of automobiles, General classification, Basic structure and components of automobile	1TB1,1TB2
2	The chassis Construction and Body	Classification, Conventional construction, Sub frames, Frame less constructions, Classification of body, Numerical problems on chassis member bending.	11TB1, 1 TB2
3	Reciprocating Engine Construction and basics	Constructional details, Calculation of displacement velocity and acceleration of piston and connecting rod, Working of 2and 4 stroke engines. Numerical problems on the above topics	3TB1
4	Cooling systems	Need. Variation of gas temperature. Piston temperature distribution. Theory of engine heat transfer and correlation. Parameters affecting engine heat transfer. Air-cooled systems.	8TB1, 12RBa
5	Cooling systems	Types of water-cooling systems. Radiators. Fans. Correlation for the power required for engine cooling. Numerical problems on the above topics	8TB1, 12RBa
6	Lubrication systems	Causes of engine friction. Function of lubrication. Mechanism of lubrication. Journal bearing lubrication.	7TB1, 11RBa
	Lubrication systems	Types of lubrication systems. Lubrication of engine components.	7TB1, 11RBa
7	Clutch	Definition of clutch, requirements, classification, principle of working of friction clutches, Driving system and Plate clutch (uniform pressure and uniform wear).	14TB1, 3TB2



Automotive Vehicles

Lecture 6

Lubrication System

- Causes of engine friction
- Function of lubrication
- Mechanism of lubrication
- Journal bearing lubrication
- Lubrication system types
- Lubrication of Engine systems

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Lubrication System – Causes of Engine Friction



- When two metallic surfaces move over each other under direct contact
- Due to irregularities on the two surfaces interlocking each other
- Viscous or Fluid lubrication : oil interposed between two surfaces not in actual physical contact
- Boundary Lubrication : Application of Grease over the boundaries - Piston rings & Valve train
- Hydrodynamic Lubrication : Engine bearings and Pistons
- Elasto hydrodynamic Lubrication : at High loads with hydro carbon oils – Engine valve and Piston rings

Lubrication System – Function of Lubrication



- To reduce friction of moving parts to its minimum value so that power loss is minimized
- To reduce wear of the moving parts as far as possible
- To provide cooling effect : Takes heat from hot moving parts during circulation and delivers it to the surrounding air through crank case
- To provide cushioning effect : Good cushion against Shocks in the Engine
- To provide cleaning action : Dissolves many impurities and purified by filtration
- To provide sealing action : Maintain an effective seal against high pressure gases in the cylinder

Lubrication System – Requirements of Lubricants



1. Viscosity (Resistance of the lubricating oil to flow)
2. Physical Stability (Stable at low and higher temperature)
3. Chemical Stability (Chemically stable – Resistance to oxide formation)
4. Resistance against corrosion (Should not have any tendency to corrode the pipeline, crank case and other engine parts)
5. Pour point (Minimum temp. at which oil will pour)
6. Flash point (avoid flashing of oil vapors)
7. Cleanliness (lack of impurities)
8. Resistance against extreme pressure

Lubrication System – Types of Lubricants



1. Animal oils (From Animal fat)
 - Not suitable for automotive engine lubrication
 - Oxidized easily
2. Vegetable Oils (From fruits, seeds, plants)
 - Oxidized easily
 - Castor oil : High viscosity and High strength
3. Mineral Oils (Derived from petroleum)
 - Greater chemical stability
 - Less tendency to form emulsions
 - More plentiful and cheaper
4. Synthetic Lubricants
 - High viscosity index
 - Less oil consumption
 - Increased fuel economy
5. Greases (Suspensions of metallic soaps)
6. Sodium Lubricants
 - Graphite
 - Stable at high temperature and low co-efficient of friction
 - Fill the pores of the metal and makes it friction free

Lubrication System - Rating



Viscosity Rating :

- SAE classified lubricating oils according to Viscosity and Service
- Eg. Of Ratings : 0W, 5W, 20W,10,15,20,30,40....

Service Rating :

- According to service conditions
- Eg. SA,SB, SC..... SM
- SA : Mildest conditions

Lubrication System – Testing of Lubricants



Physical Tests :

1. Viscosity Test
2. Flash and Fire point Test
3. Loss due to evaporation
4. Cold or Pour point Test
5. Specific gravity Test

Chemical Tests :

1. Acid value Test
2. Saponification Value Test
3. Insoluble residue Test
4. Moisture and Emulsification Test

Lubrication System – Testing of Lubricants



Viscosity Test – Determination of Viscosity level

Flash Point Test – Minimum temperature at which it gives off vapor so as to form an explosive mixture with air.

Fire point Test – Oil is heated to certain temperature above which it starts to burn continuously

Loss due to Evaporation – When the lubricants are subjected to high temperature, they are liable to vaporize to a certain extent

Cold or Pour point test – at which lubricant ceases to flow

Specific Gravity Test – Value of Specific gravity

Acid Value Test – Acid value of an oil is the number of milligrams of KOH required to neutralize one gram of the oil

Saponification Value Test – Number of milligrams of KOH required to saponify one gram of the oil

Insoluble Residue Test - To test the presence of insoluble

Moisture and Emulsification Test – When lubricating oil mixes thoroughly with water, Mixture of the two is called as Emulsion

Lubrication System – Lubrication conditions and Losses



1. Stationery Vehicle
2. Short distance journeys
3. Traffic jams
4. Highway travel

Oil losses :

- Combustion
- Loss through leakage
- Loss through crankcase ventilation
- Loss due to excessive vehicle speed

Lubrication System – Parts require Lubrication



1. Main crankshaft bearings
2. Big end bearings
3. Gudgeon pin bearings
4. Piston rings and cylinder walls
5. Timing Gears
6. Camshaft and Camshaft bearings
7. Valve Mechanism
8. Electrical equipment

Lubrication System - Types



1. Petroil System
2. Splash System
3. Pressure System
4. Dry sump System
5. Pre-Lubrication System

Lubrication System - Types



Petrol System :

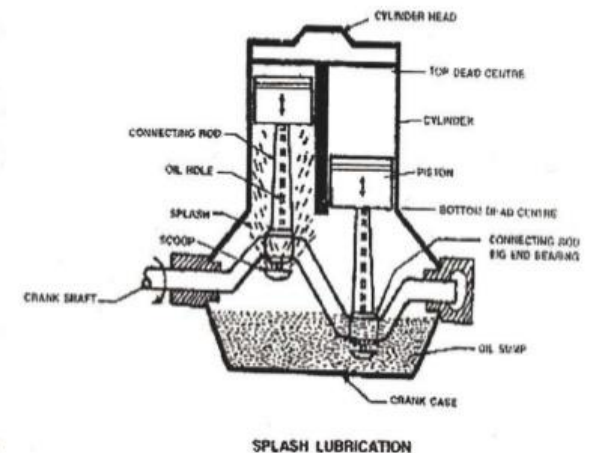
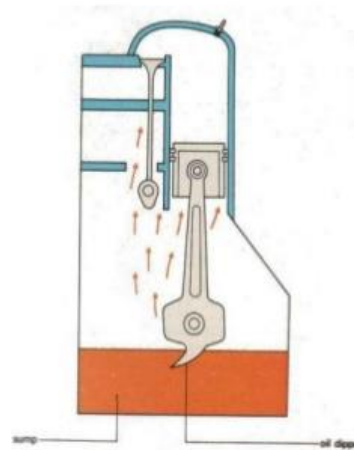
- Used in small two stroke engines Eg. Scooter or Motor cycle
- Simplest of all Engine lubrication system
- Lubricating oil mixes with Petrol (2 to 3%)
- Lesser than above causes damage and insufficient lubrication
- More than above causes excessive carbon deposits and give dark smoke
- Requirement of lubricating oil is to mix with petrol and burn without leaving residue.

Lubrication System - Types



Splash System:

- Employed for Engines of early motor cycle
- Cheapest method of Engine lubrication
- A scoop is made in the lowest part of connecting rod and pumped from oil sump
- When the Engine runs, scoop splashes oil to the cylinder walls when it reaches BDC
- This affects the lubrication of Engine walls, gudgeon pin, main crankshaft bearings , big end bearings etc.



Lubrication System - Types



Pressure System:

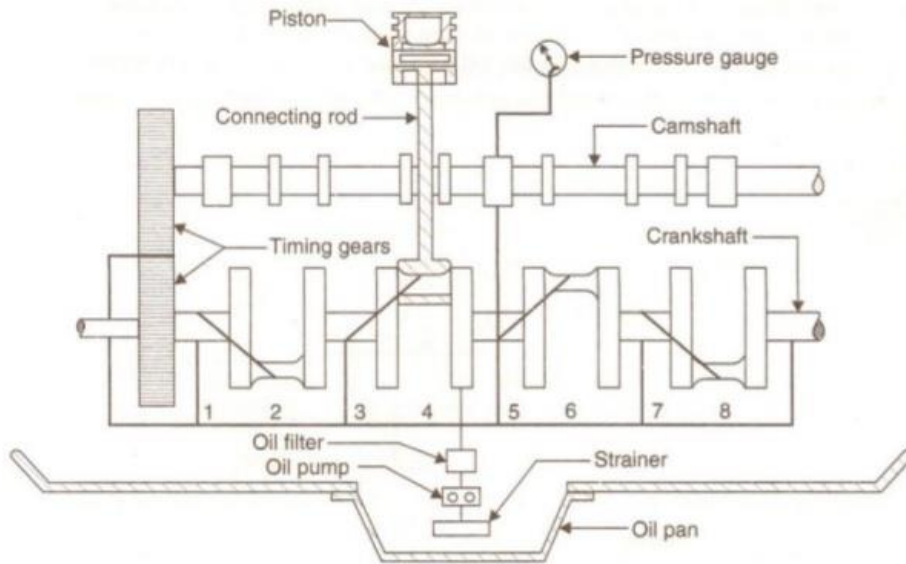
- Used in modern car engines
- Oil pump takes oil from wet sump through strainer and delivers it through a filter to main oil gallery at a pressure of 200 to 400kPa.
- Oil pressure is controlled by Pressure relief valve
- From main gallery, Oil goes through the drilled passages to main bearings from where some of the oil after lubricating the main bearings, connecting rod, Gudgeon pins and falls back to the sump
- Oil falls on cylinder walls back to oil pan and recirculated through lubrication system
- For camshaft and timing gears, Lubricating oil is led through separate oil lines

Lubrication System - Types

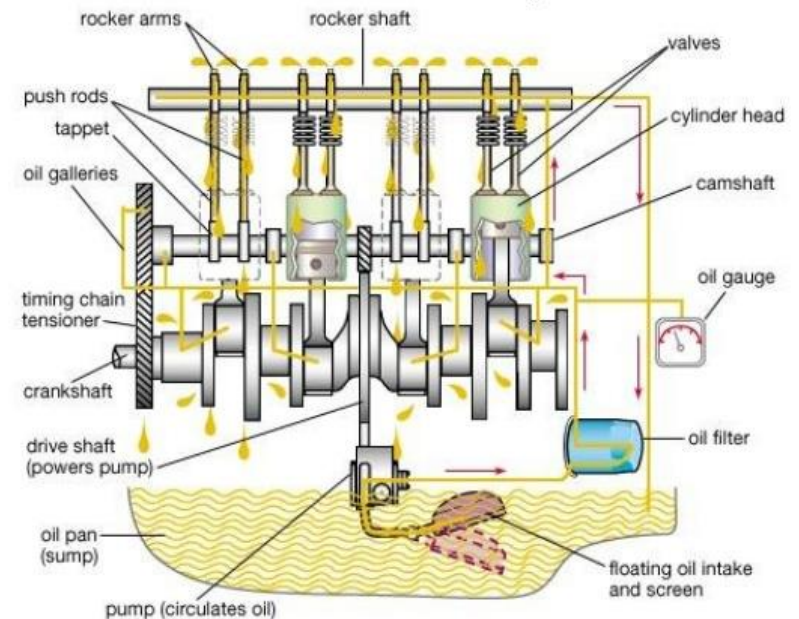


Pressure System:

Pressure Feed System



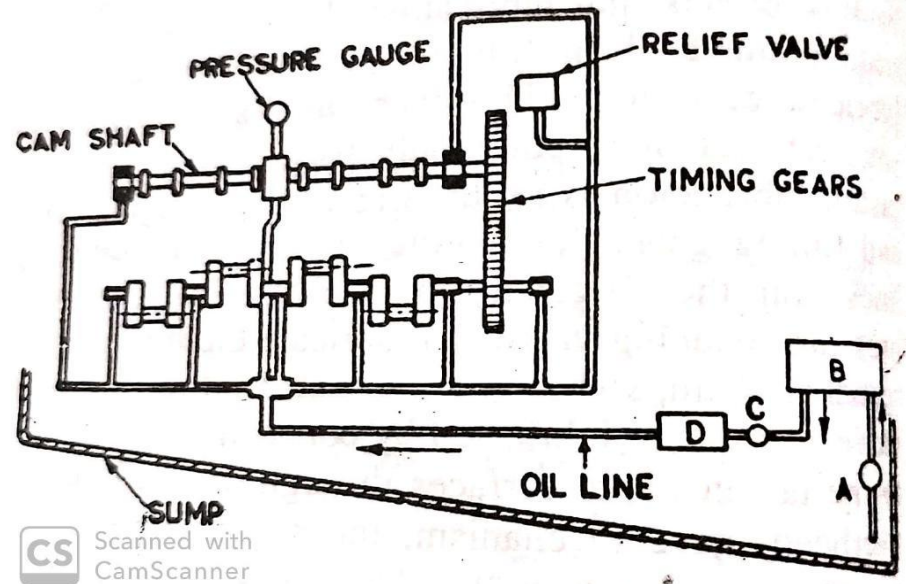
Pressure Feed System



Lubrication System - Types

Dry Sump System:

- It is employed in some racing cars
- And Engine to be operated at steep angles
- Oil pressure is maintained at 400-500kPa.
- Complex and costlier
- Hence not used in common vehicles



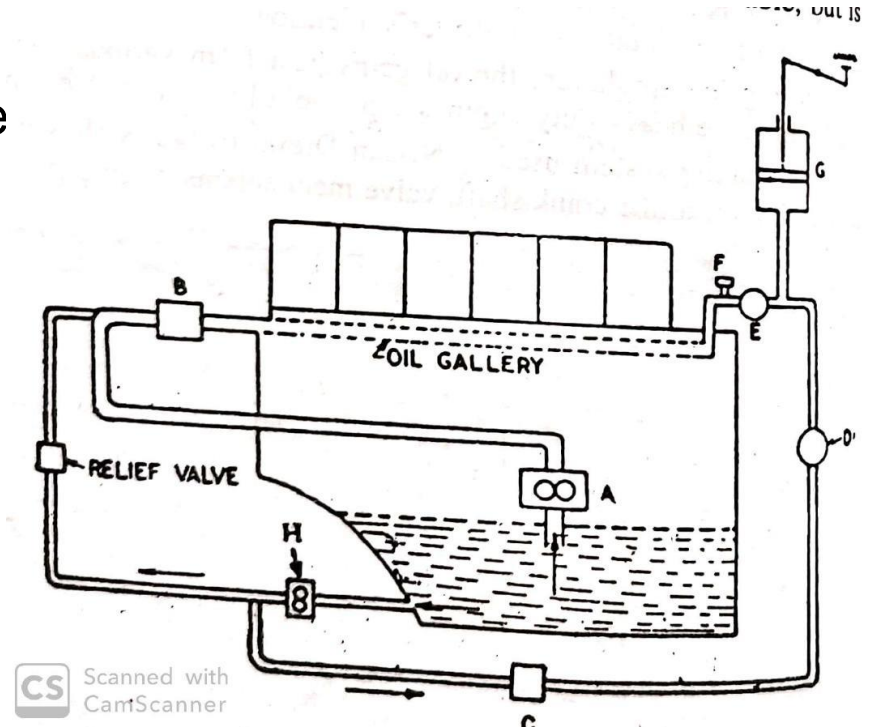
B – Reservoir
C – Pressure pump
D – Filter

Lubrication System - Types



Pre Lubrication System:

- Lubrication before engine starts
- Main oil pump operated by the engine and delivers oil to the oil gallery through Filter.
- Secondary Lubricating pump is provided and operated by Electric Motor
- Oil from Secondary pump is divided into two branches
- One branch to Relief valve and Filter B
- Other branch to Filter C and Non - Return Valve to the fuel control device
- Double safety provided



Lubrication Types – Components



1. Oil Strainer – Remove impurities
2. Oil pumps – Supply oil to various engine parts
 - Gear Pump
 - Crescent type Gear pump
 - Rotor Pump
 - Plunger Pump
 - Vane Pump
3. Oil Filters – Remove Fine impurities
4. Oil Coolers
5. Oil Level indicators
6. Oil Pressure gauges

<https://www.youtube.com/watch?v=mmmcyj53TNic>

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