Engine Lubrication System

The method of reducing the friction by introducing the substance called lubricant between the mating parts is called **lubrication.**

Objectives

- Reduce friction thus increase efficiency
- Reduce wear and tear of moving parts
- Carry away heat
- Provides sealing action between cylinder and piston rings, thereby it reduce blow by.
- Provide protection against corrosion.
- Lubrication film acts as cushion and reduce vibration
- Carrying away the grit & other deposits and provide cleaning
- Reduce noise

Types of lubricants

- Solid (e.g. Graphite molybdenum, Mica)
- Semi-Solid (e.g. Heavy greases)
- Liquid (e.g. Mineral oils, Vegetable Oils, Animal Oils)

Properties of lubricates

Viscosity

- It is measure of resistance to flow of an oil. It is measured in Saybolt Universal Seconds (SUS).

Viscosity Index

- The variation of viscosity of an oil with change in temperature is measured by viscosity index.
- Smaller the variation of viscosity, higher the VI.
- VI of *Paraffin oil* is 100 (small change) and VI of *Naphthenic oil* VI is 0.

Cloud Point

- The temperature at which the oil starts solidifying is called cloud point.

Pour Point

- It is the temperature just below which oil sample will not flow under certain prescribed conditions.
- Sample is cooled until no movement of the oil occurs for 5 sec after the tube is tilted from the vertical to the horizontal.

Flash Points

- The flash point is defined as the lowest temperature at which an oil will vaporize sufficiently to form a combustible mixture of oil vapour an air above the surface of the oil.
- It is found by heating a quantity of the oil in a special container while passing a flam above the liquid to ignite the vapour. A distinct flash of flame occurs when the flash point temperature is reached.

Fire Points

- Fire point is obtained if the oil is heated further after flash point. Fire point is the temperature at which the oil, it once lit with flame, will burnt steadily at least for 5 seconds.
- Fire point temperature is usually 10^0C higher than flash point temperature.

Oiliness

- The property of an oil to cling to the metal surface by molecular action and then to provide a very thin layer of lubricant under boundary lubrication condition is called the oiliness or lubricity or film strength. .

Carbon residue

- It is the quantity of carbon residue which remains after evaporation of a simple oil under specified conditions.

Detergency

- To prevent the formation of deposits, the engine oil has the property of detergency to clean the deposits.
- It has also the ability of dispersing the particles, preventing them from clotting and to keep then in a finally divided state.

Foaming

- Any violent agitation in the crankcase engine oil to foam. It is because of the presence of air bubbles in the oil. This action accelerates oxidation and reduces the mass flow of oil to the bearing and other moving parts causing insufficient lubrication.

Classification based on rating

SAE rating

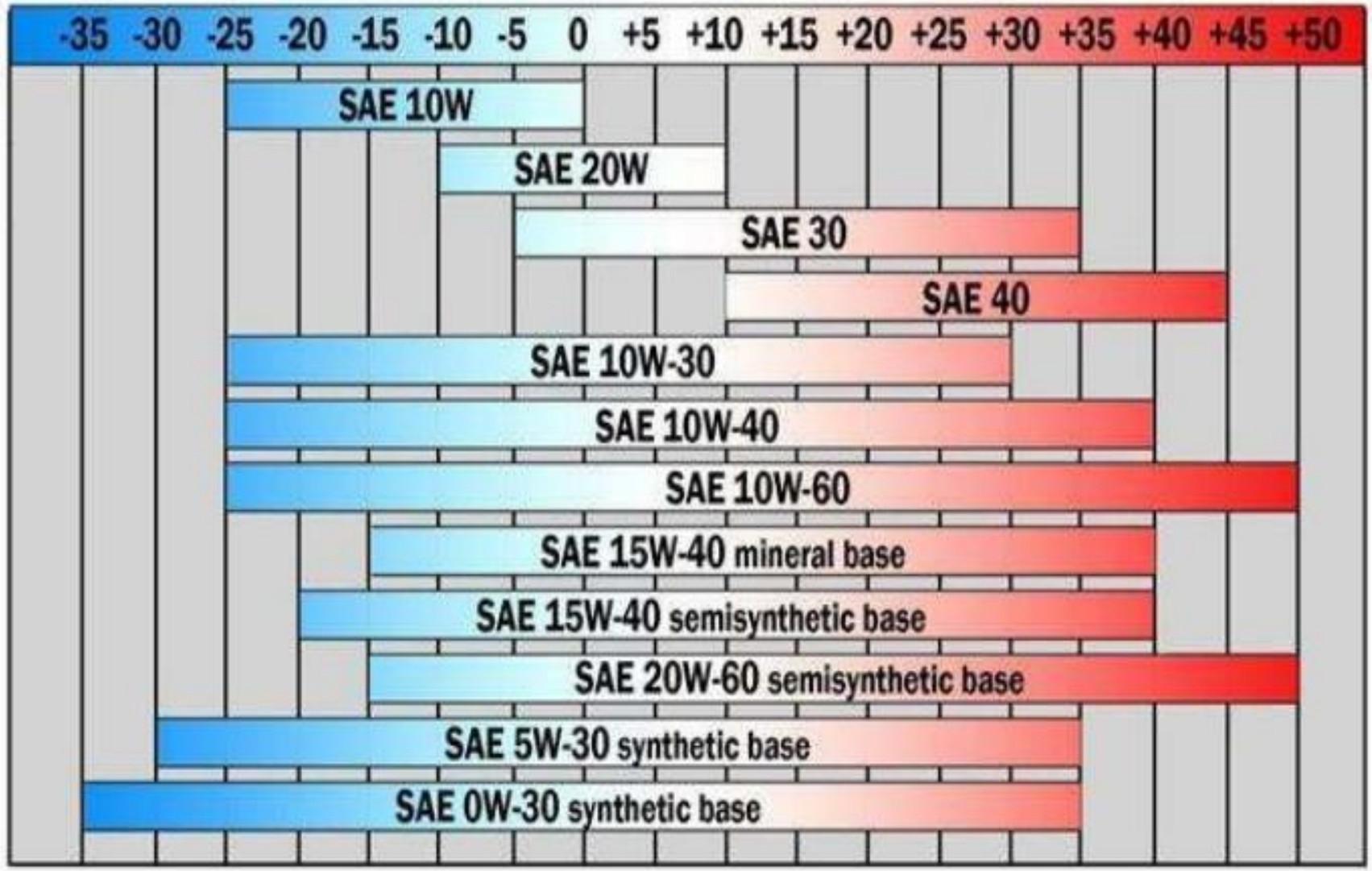
- Society of Automotive Engineers assigned the number for gradation of oil based on their viscosity at -18^{0}C (5W, 10W, 15W) & 99^{0}C (20W, 30W, 40W, 50W).

API Service rating

- American Petroleum Institute classified the oil based on their property into three classes as Regular, Premium and Heavy Duty type based on quality & performance of oil.
- Petrol engine- SA, SB, SC, SD, SE
- Diesel engine- CA, CB, CC, CD, CE
- A,B stands for light duty and naturally aspirated while D,E stands for heavy duty and supercharged.

SAE Grades

For Engine Oils Recommended in Relation with the Outside Temperatures (°C)



Lubrication System Types

- Petroil or mist lubrication (Petrol and Oil Premix)
- Splash
- Pressure Fed or Force Feed

Mist Lubrication system (Petrol)

- Employed in 2 Stroke Petrol engine
- In this system, the petrol and lubricating oil are previously mixed in fuel take from where it is supplied to the carburettor.
- Proportion 2 to 3 %
- It provide lubrication to cylinder, piston, piston rings and connecting rod bearing via the crankcase.
- Also the separate lubrication is provided to those parts of the engines where the mixture of oil and petrol cannot reach or in case it gives unsatisfactory lubrication

Mist Lubrication system (Petrol)

Advantages

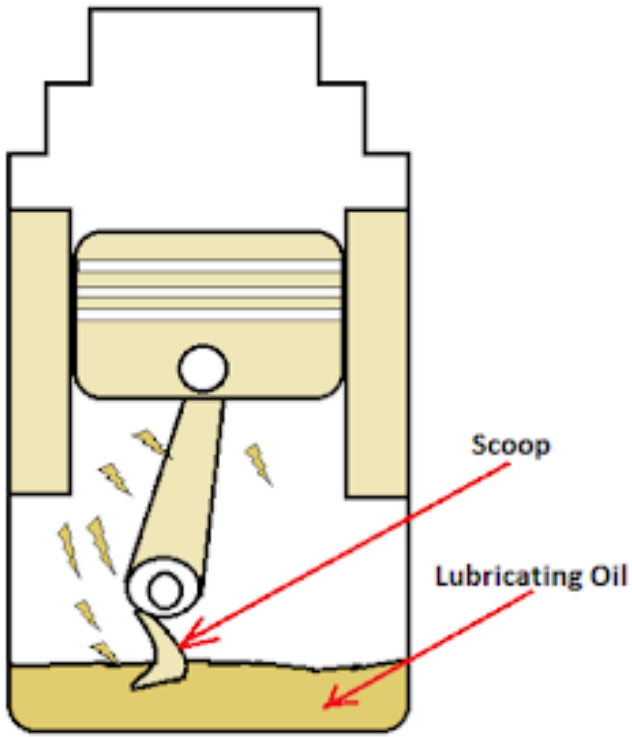
- Economical and cheap
- No oil pump, filter and oil carrying pipe needed
- Quantity of oil is automatically regulated with load and speed
- Probability of lubrication failure are the least

Mist Lubrication system (Petrol)

Disadvantages

- Carbon deposits and burning of oil film
- Fouling of sparkplug, increases maintenance cost.
- Oil consumption is high, rather the engine is usually over oiled
- During long duration of no load due to almost closed throttle valve, engine mating parts may not get adequate lubricating oil.

Splash Lubrication System :-



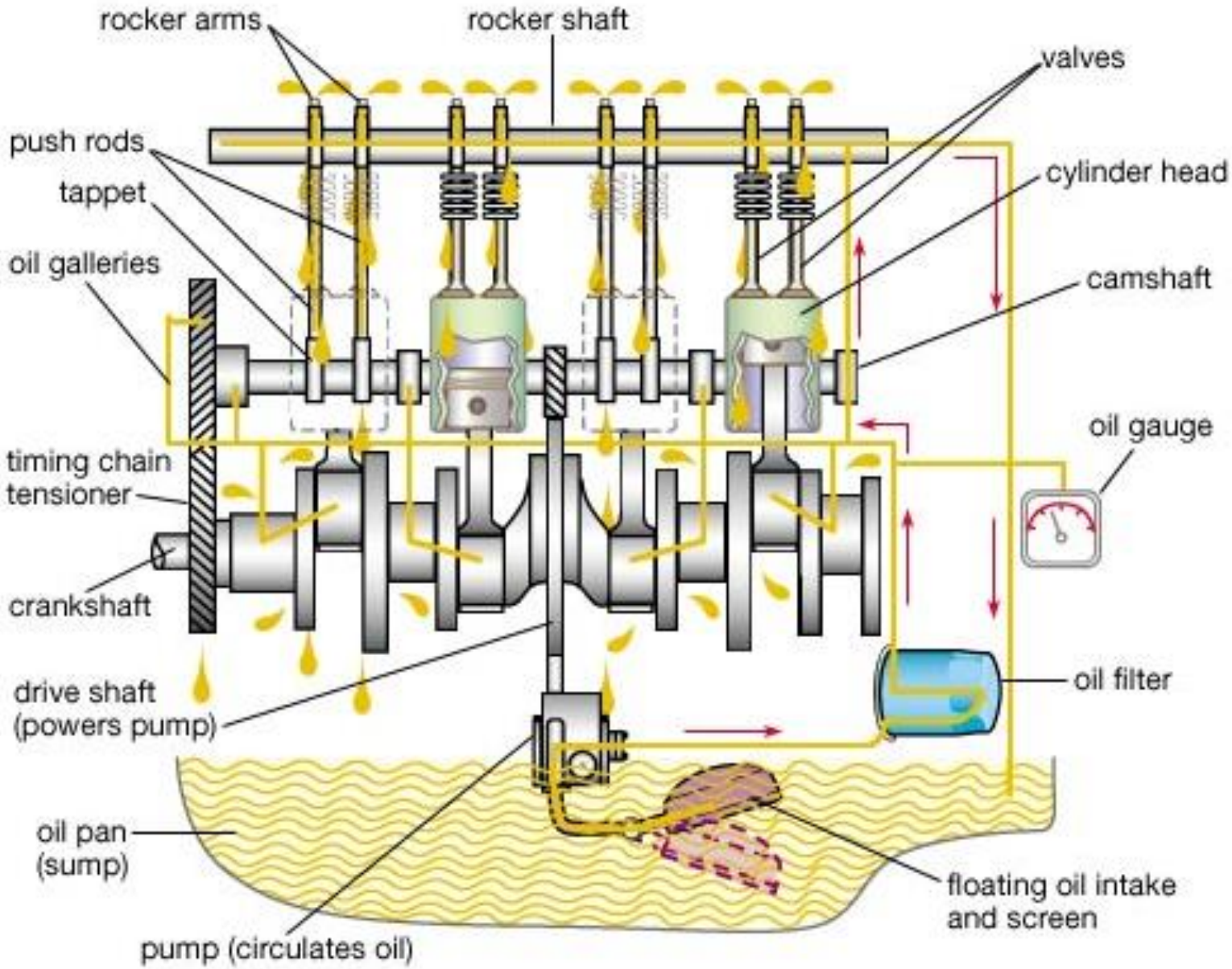
› In this system a scoop is fitted at the bottom of connecting rod and every revolution of camshaft, scoop is dipped in the oil and filled with oil and then splashed the oil on engine component.

› It is one of the cheapest method of engine lubrication system which is generally used in small 4- stroke engine.

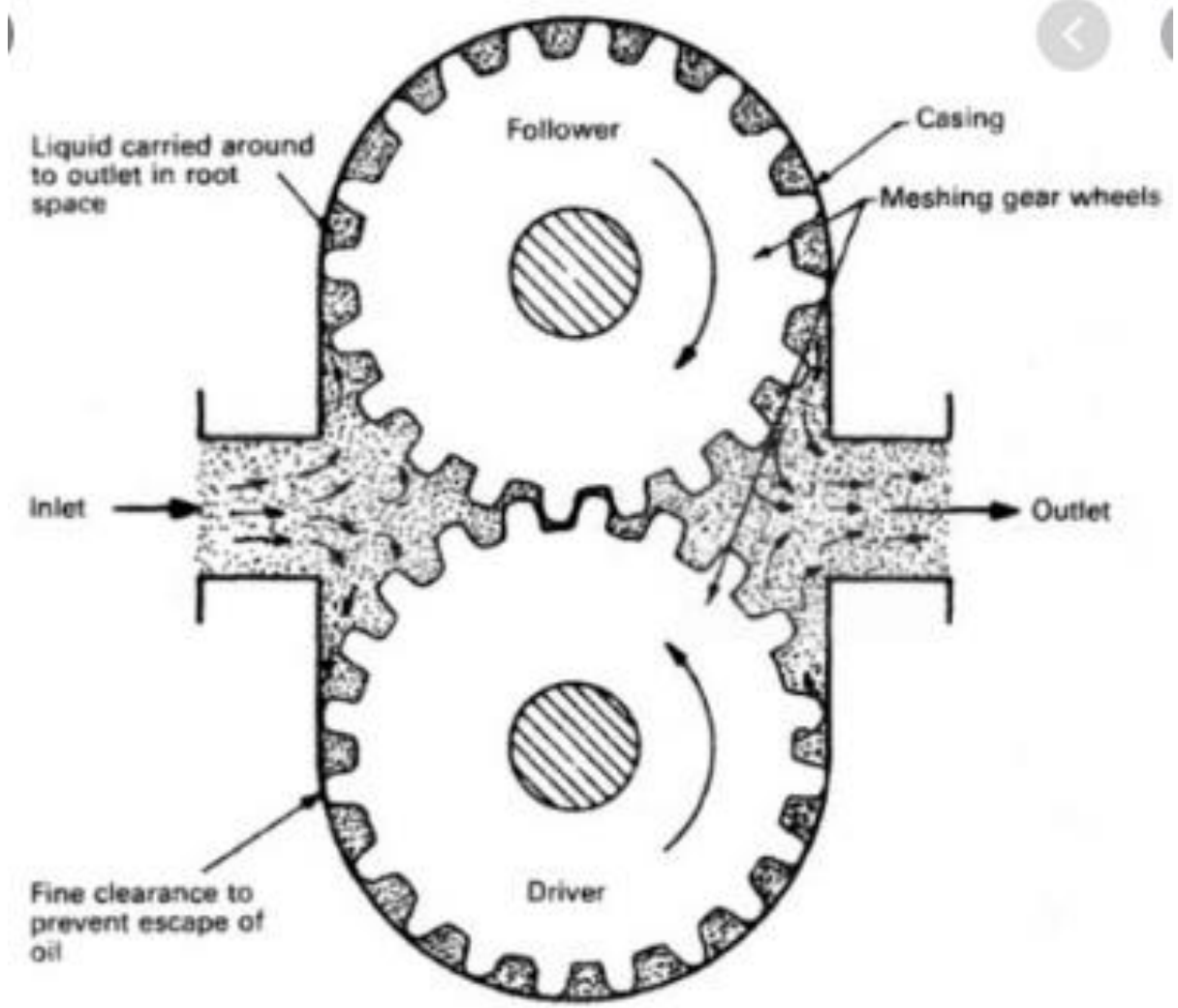
FORCED FEED SYSTEM

In this system, the oil is pumped directly lo the crankshaft, connecting rod, piston pin, timing gears and camshaft of the engine through suitable paths of oil. Usually the oil first enters the main gallery, which may be a pipe or a channel in the crankcase casting. From this pipe, it goes to each of the main bearings through holes. From main bearings, it goes to big end bearings of connecting rod through drilled holes in the crankshaft. From there, it goes to lubricate the walls, pistons and rings. There is separate oil gallery to lubricate timing gears. Lubricating oil pump is a positive displacement pump, usually gear type or vane' type. The oil also goes to valve stem and rocker arm shaft under pressure through an oil gallery.

The excess oil comes back from the cylinder head to the crankcase. The pump discharges oil into oil pipes, oil galleries or ducts, leading different parts of the engine. This system is commonly used on high speed multi-cylinder engine in tractors, trucks and automobiles.


rocker arms
rocker shaft
valves
push rods
tappet
cylinder head
oil galleries
camshaft
oil gauge
timing chain tensioner
crankshaft
drive shaft (powers pump)
oil filter
oil pan (sump)
floating oil intake and screen
pump (circulates oil)

Oil pump: Oil pump is usually a gear type pump, used to force oil into the oil pipe. The pump is driven by the camshaft of t engine. The lower end of the pump extends down into the crankcase which is covered with a screen to check foreign particles. A portion of the oil forced to the oil filter and the remaining oil goes to lubricate various par of the engine. An oil pressure gauge fitted in the line, indicates the oil pressure in the lubricating system. About 3 kg/sq cm (45 psi) pressure is developed in the lubrication system of a tractor engine, [f the oil pressure gauge indicates no pressure in the line, there is some defect in the system which must be checked immediately. Lubricating oil pump is a positive displacement pump.

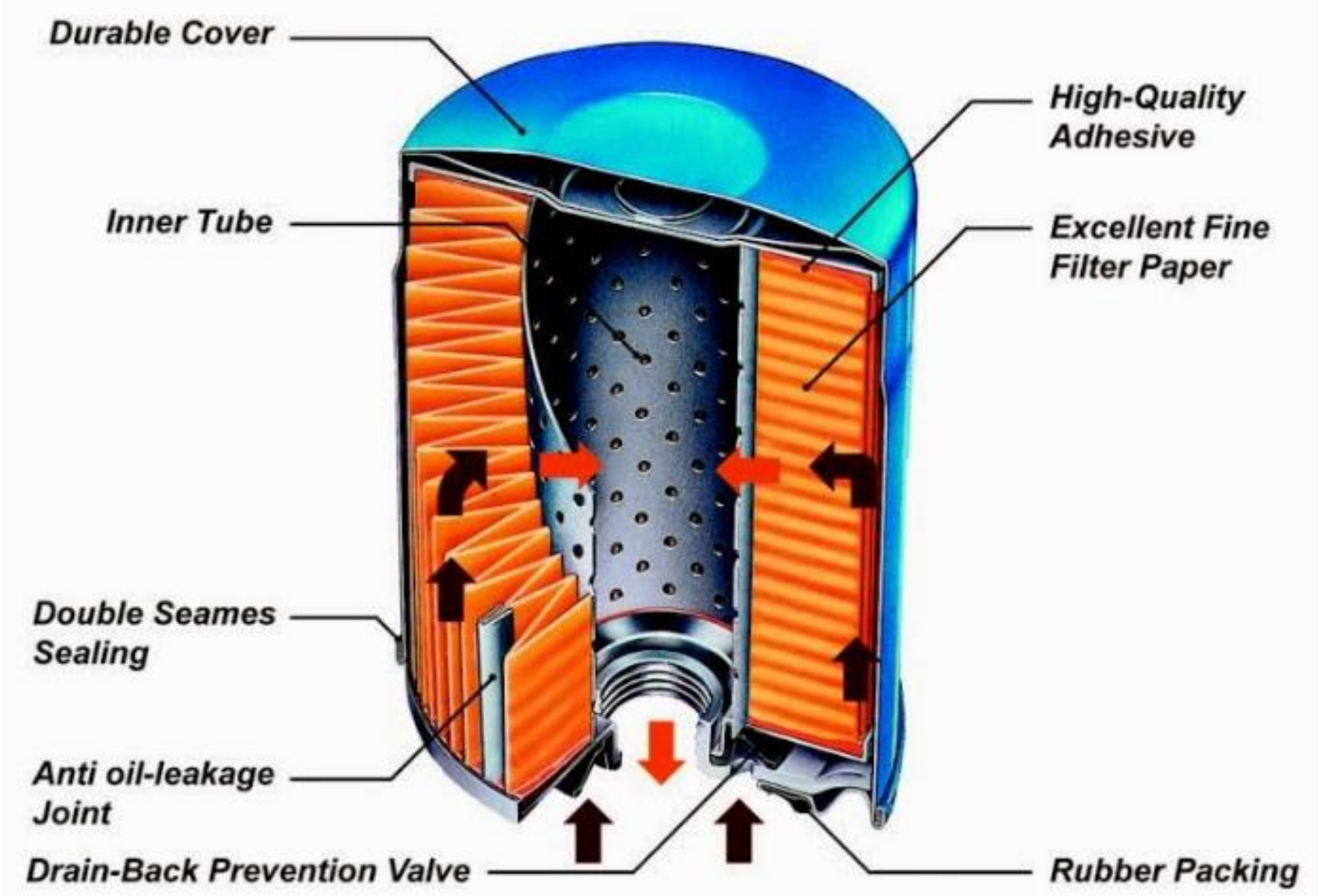


Simple gear pump

OIL FILTER: Lubricating oil in an engine becomes contaminated with various materials such as dirt, metal particles and carbon. Oil filler removes the dirty elements of the oil in an effective way. It is a type of strainer using cloth, paper, felt, wire screen or similar elements. Some oil filter can be cleaned by washing, but in general old filters are replaced by new filters at specified interval of time prescribed by manufacturers. Wearing of parts, oil consumption and operating cost of an engine can be considerably reduced by proper maintenance of oil filters. Oil filters are of two types: (i) Full-flow filter and (ii) By-pass filler.

(i) Full flow filter: In this filter the entire quantity of oil is forced to circulate through it before it enters the engine. A spring loaded valve is usually fitted in the filter as a protection device against oil starvation in case of filter getting clogged. Filter element consists of felt, cloth, paper and plastic. All these elements are replaceable and should be changed after the recommended period.

(ii) By pass filter: In this type of filter, the supply lines are from the pump and are connected to permit only a part of the oil. Through the filter the balance oil reaches directly to the engine parts. Over a period of operation, all the oil in the crankcase passes through the filter.


Durable Cover
High-Quality Adhesive
Inner Tube
Excellent Fine Filter Paper
Double Seames Sealing
Anti oil-leakage Joint
Drain-Back Prevention Valve
Rubber Packing

.5 Crankcase Ventilation

- The pressure inside the combustion chamber is high, so small amount of gases escapes through gap between piston ring and cylinder and enter into the crankcase.
- These gases can dilute and contaminate the engine oil, caused corrosion to critical parts and contribute to sludge built up.
- At high speed, blowing gases increase crankcase pressure that cause oil leakage from sealed engine surfaces and consume some expansion work.
- The crankcase ventilation system removes these blow by gases from crankcase and reduces the pressure of crankcase.

.5 Crankcase Ventilation

Closed PCV system

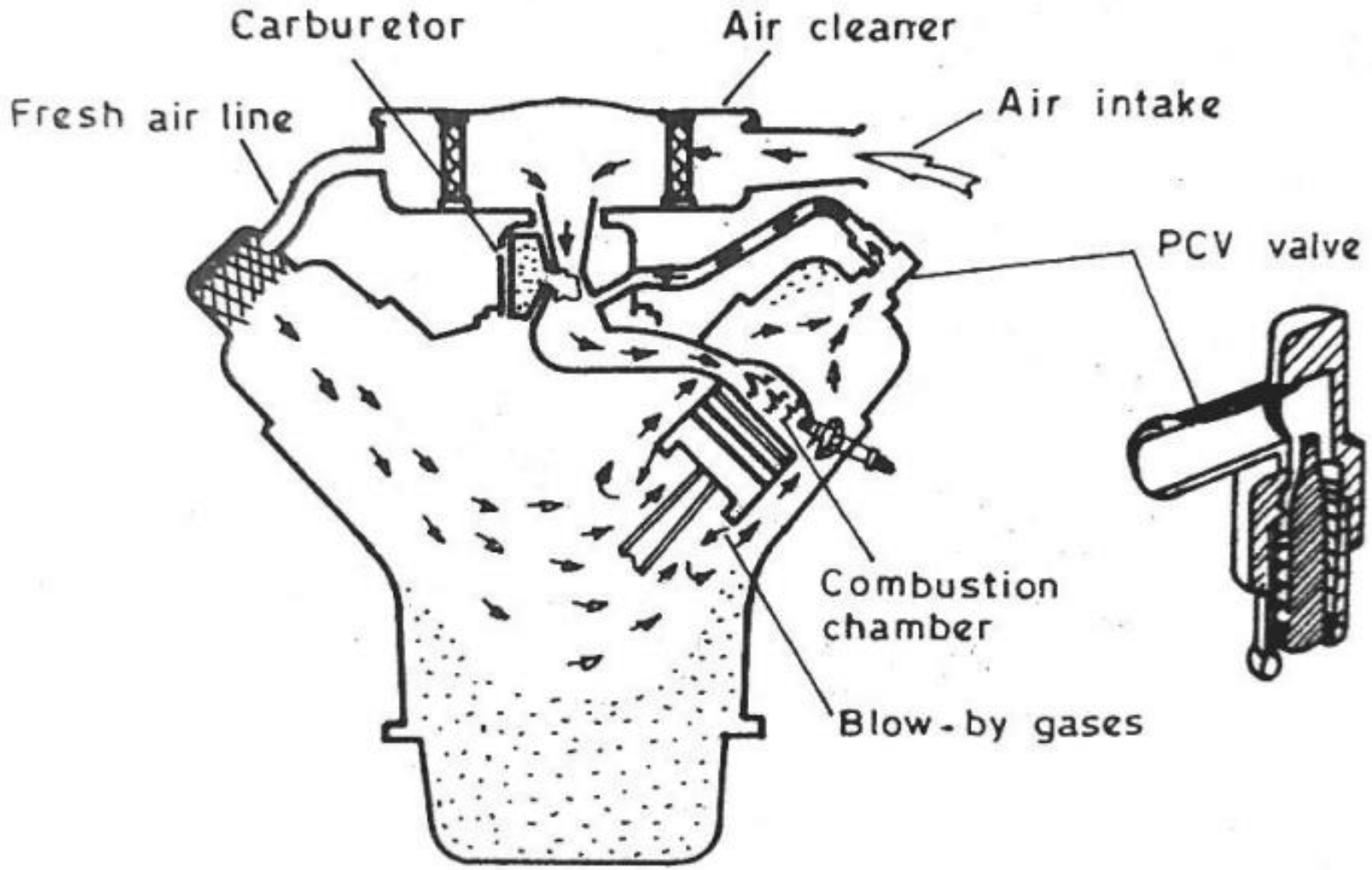
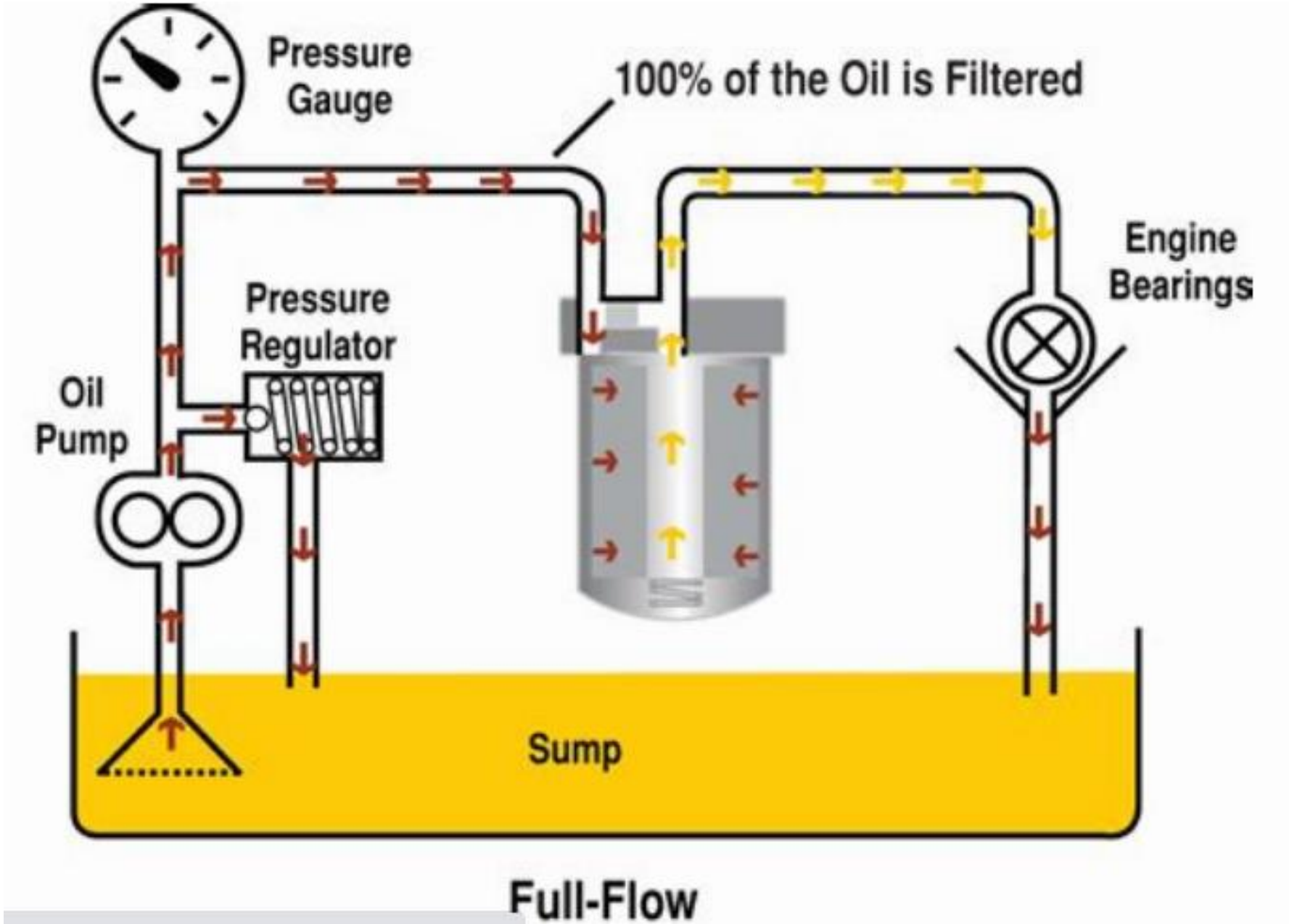


Fig. Closed crankcase ventilation system.

.5 Crankcase Ventilation

- The breather inlet was relocated inside the air cleaner housing, so if pressure backed up, it would overflow into the air cleaner and get sucked down the carburettor.
- No vapour would escape into the atmosphere.
- PCV valve is used to regulate blow by flow back into the intake manifold.
- During idle, blow by is low so PCV valve pintle provide small vacuum passage and allow low blow by flow to the combustion chamber.
- During high speed, blow by is high so PCV valve pintle allows maximum flow to the combustion chamber.
- When engine is shut off, spring tension closed the valve completely and provide safety against accidental fire.


Pressure Gauge
100% of the Oil is Filtered
Engine Bearings
Pressure Regulator
Oil Pump
Sump

Full-Flow