



Unit 4

Cooling system of IC engine

Functions of the Cooling system



- ❑ Control temperature of hot combustion.
- ❑ Keep engine at its most efficient temperature
- ❑ 2500 degree temps. Could seriously damage engine parts.
- ❑ Provide Heat for passenger Compartment.
- ❑ Cool Trans fluid & Oil

EFFECTS OF OVERHEATING OF THE ENGINE COMPONENTS

- ❑ Evaporation of lubricating oil.
- ❑ Setting up of thermal stresses in the cylinder.
- ❑ Sticking of piston rings in the ring grooves, due to carbonization of the oil.
- ❑ Burning of piston crown.
- ❑ Burning and warping of exhaust valves.
- ❑ Reduction in volumetric efficient i.e. reduced weight of charge retained in the cylinder.

EFFECTS OF EXCESSIVE COOLING



- ❑ Reduction in thermal efficiency.
- ❑ Increased corrosion of engine parts.
- ❑ Reduced mechanical efficiency.
- ❑ Improper vaporization of fuel.

TYPES OF COOLING SYSTEM



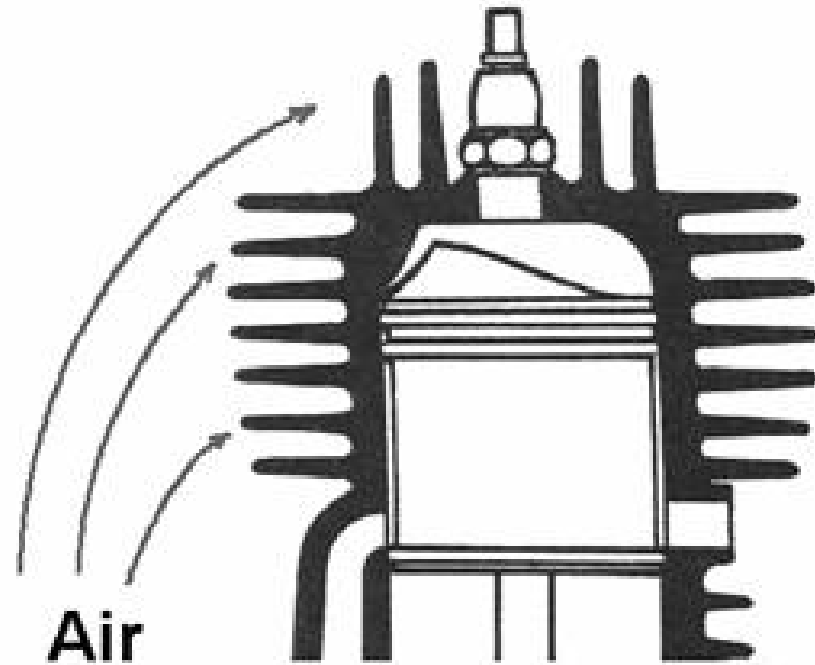
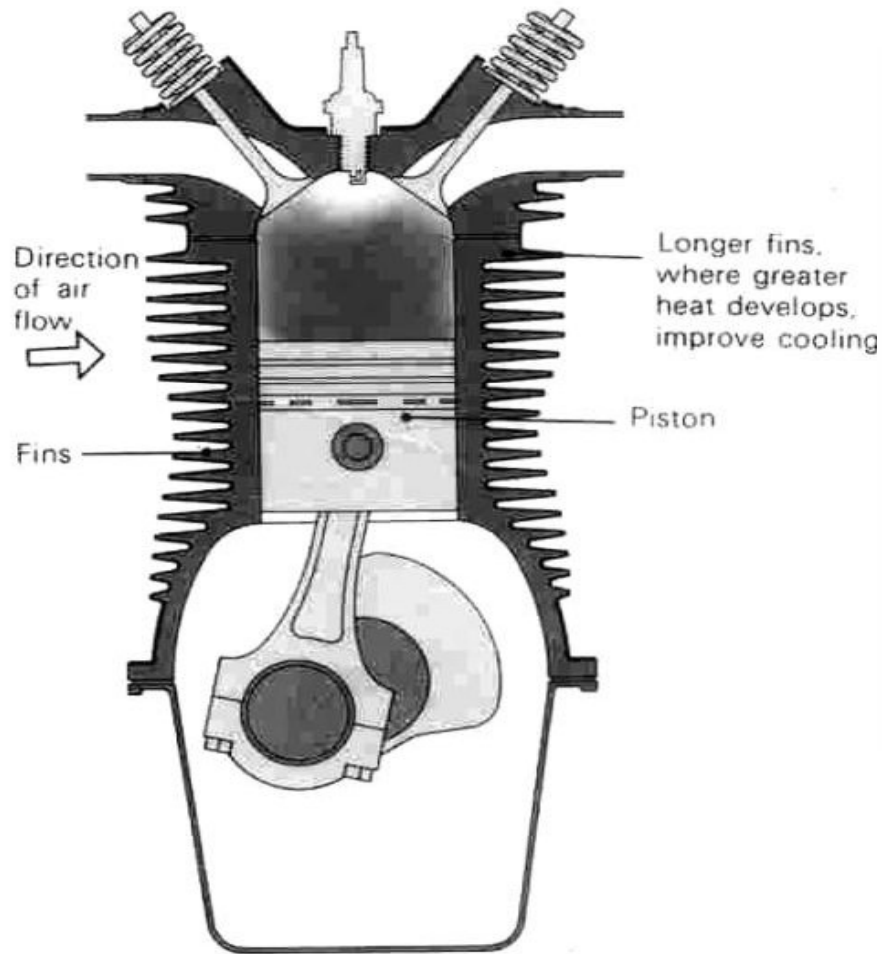
There are two types of cooling systems:

- (i) Air cooling system
- (ii) Water-cooling system

AIR COOLING SYSTEM

- In this type of cooling system, the heat, which is conducted to the outer parts of the engine, is **radiated** and **conducted** away by the **stream of air**, which is obtained from the atmosphere. In order to have efficient cooling by means of air, **providing fins** around the cylinder and cylinder head **increases the contact area**.
- The fins are metallic ridges, which are formed during the casting of the cylinder and cylinder head.
- The amount of heat carried off by the air-cooling depends upon the following factors:
 - The total area of the fin surfaces,
 - The velocity and amount of the cooling air and
 - The temperature of the fins and of the cooling air

AIR COOLING SYSTEM



Cooling fins are used to increase the surface area exposed to the airstream

Advantages of Air Cooled Engines

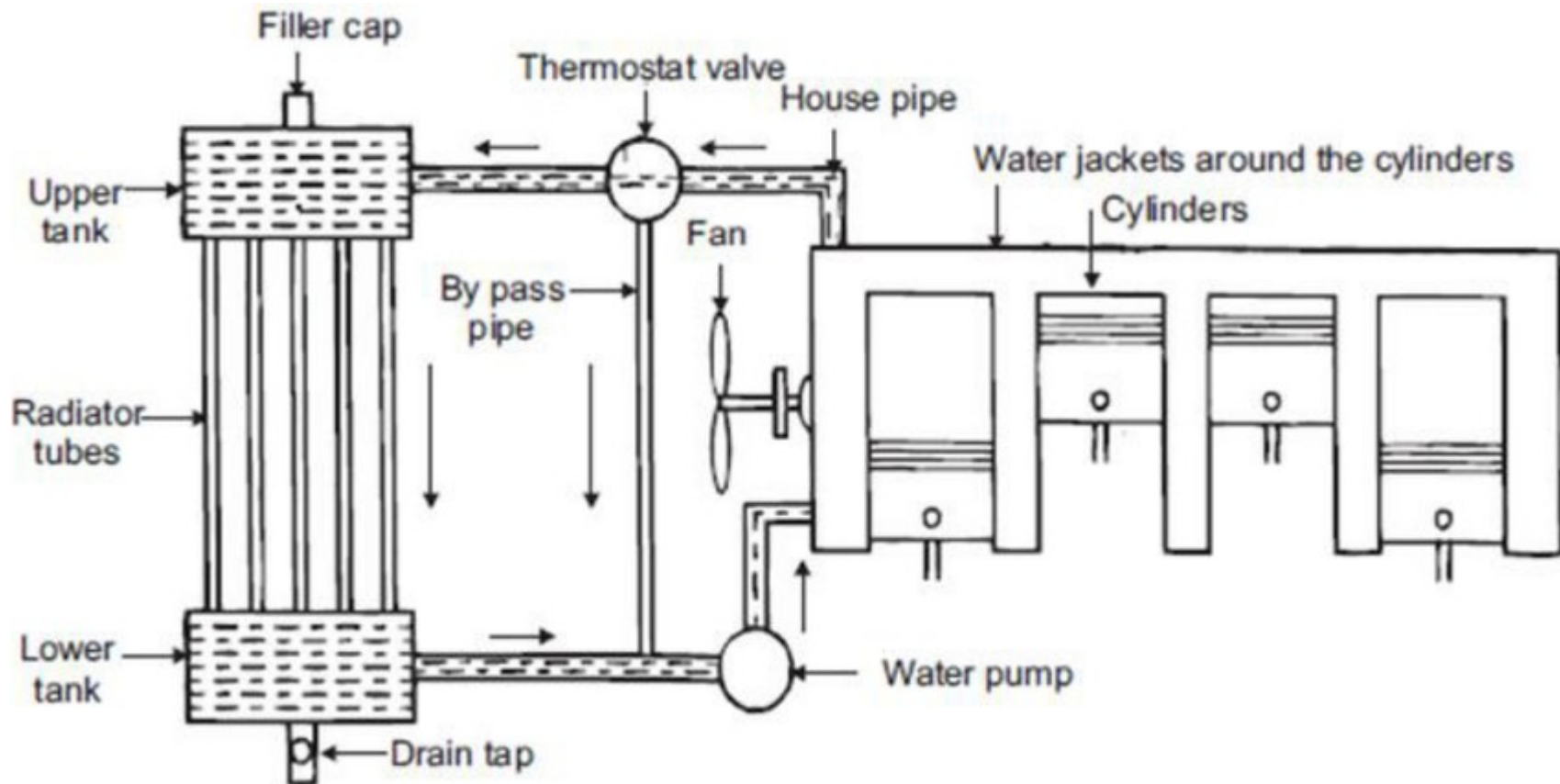


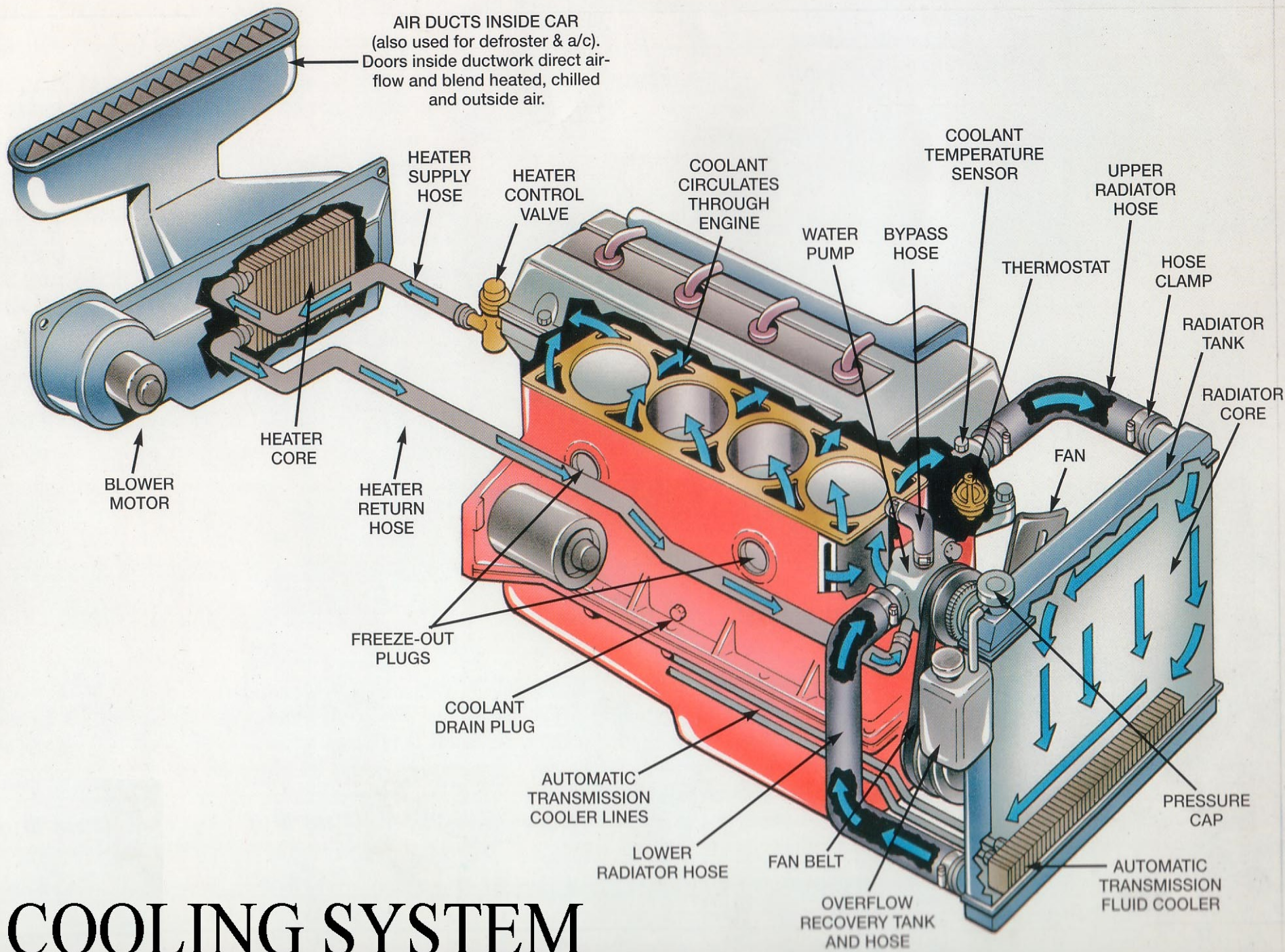
1. The air-cooled engine is **simple in design**.
2. It is **lighter in weight** than water-cooled engines due to the absence of water jackets, radiator, circulating pump and the weight of the cooling water.
3. It is **cheaper** to manufacture.
4. It needs **less maintenance**.
5. This system of cooling is particularly advantageous where there are **extreme climatic conditions** in the arctic or where there is scarcity of water as in deserts.
6. No risk of **damage from frost**, such as cracking of cylinder jackets or radiator water tubes.

WATER COOLING SYSTEM

- In the present day, liquid cooling is widely used due to the resistance to heat transfer from the cylinder wall to a liquid in contact with it is low.
- When the velocities of the liquid are fairly high, this resistance is very low.
- Due to this, the film heat transfer coefficients are high. Also **heat transfer is greater**.
- The most commonly used substances for cooling is water.
- Other liquids are ethylene glycol or Preston or glycerin.
- These have boiling points much higher than water, But they have **corrosive effects** on engine parts.
- In liquid cooled engines, water jackets are provided to circulate coolant.

WATER COOLING SYSTEM





COOLING SYSTEM

Merits and Demerits of Liquid cooling system

Merits

- ❑ Uniform cooling of cylinder, head and valves.
- ❑ Specific fuel consumption improves.
- ❑ Engine can be provided in front or rear.
- ❑ Less engine noise than air cooled engine.
- ❑ Higher thermal efficiency.

Demerits

- ❑ Depends on supply of coolant.
- ❑ Water pump takes power from engine.
- ❑ If system fails, severe damage will occur to engine.
- ❑ Costly
- ❑ Periodic Maintenance required.
- ❑ Increases weight of vehicle.

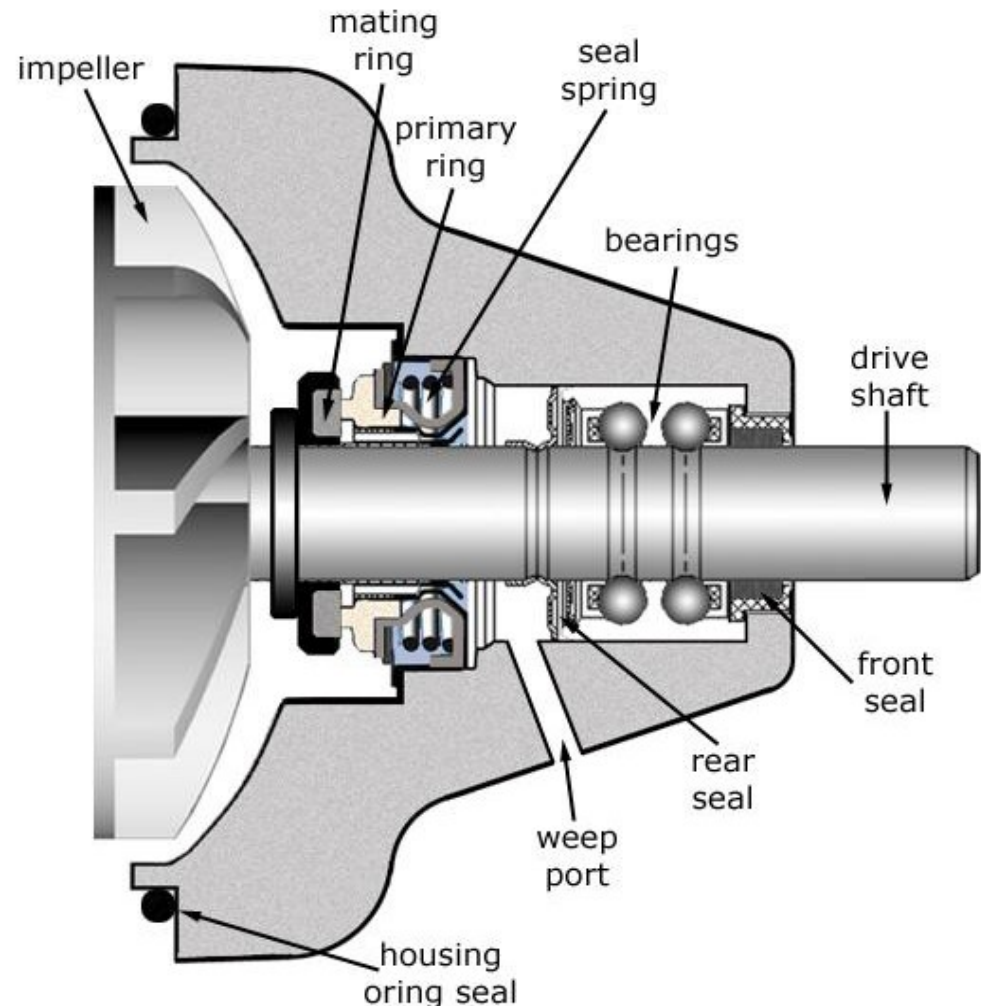
Parts of Liquid(Water) Cooling System



- (i) Water Pump
- (ii) Fan
- (iii) Radiator and Pressure Cap
- (iv) Fan Belt
- (v) Water Jacket
- (vi) Thermostat Valve
- (vii) Temperature Gauge
- (viii) Hose Pipes

Water Pump

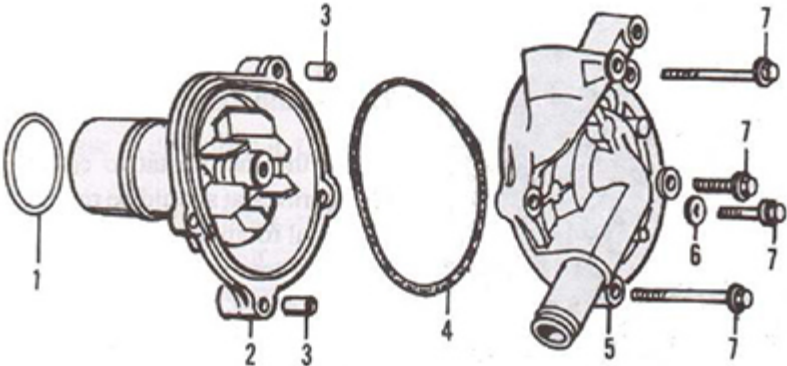
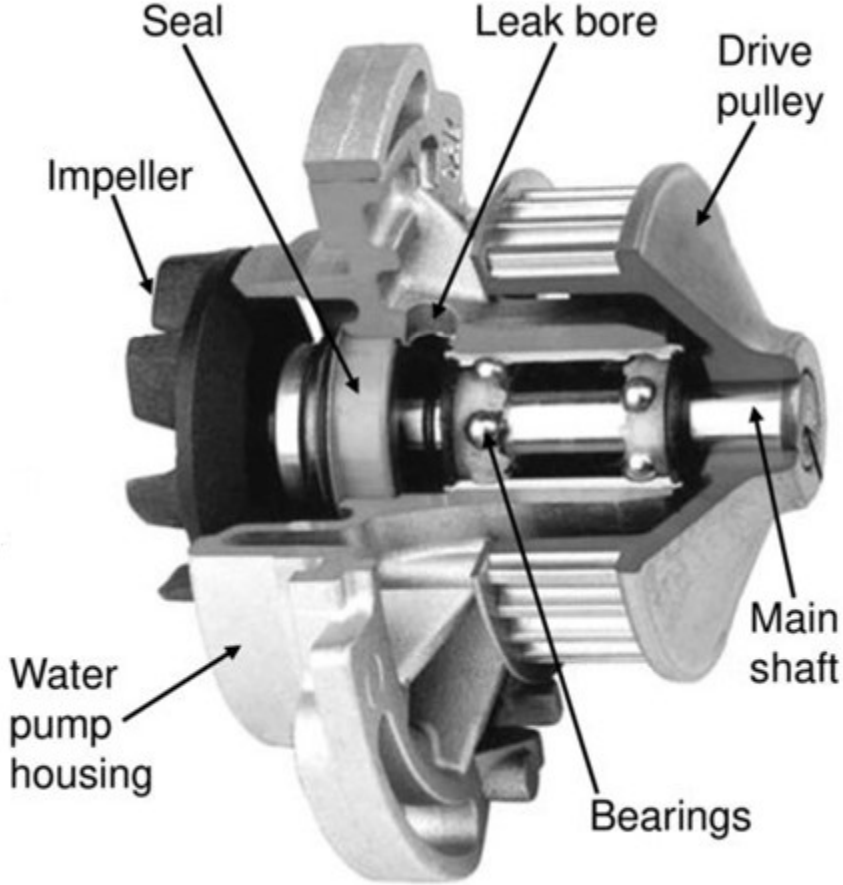
- Centrifugal type pump.
- Mounted at the front of the cylinder block.
- This type of pump consists of the following parts:
 - (i) Body or casing,
 - (ii) Impeller (rotor),
 - (iii) Shaft
 - (iv) Bearings, or bush,
 - (v) Water pump seal
 - (vi) Pulley



Water Pump



WATER PUMP

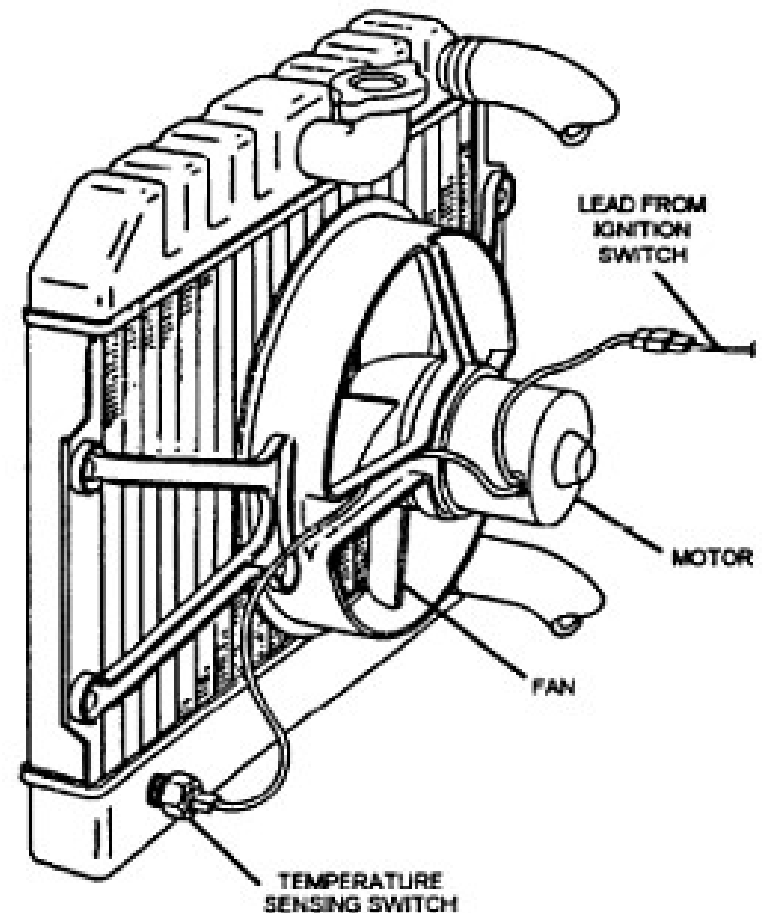


- 1. O-ring
- 2. Water pump assembly
- 3. Locating dowel
- 4. O-ring

- 5. Water pump cover
- 6. Sealing washer
- 7. Bolt

Cooling Fan

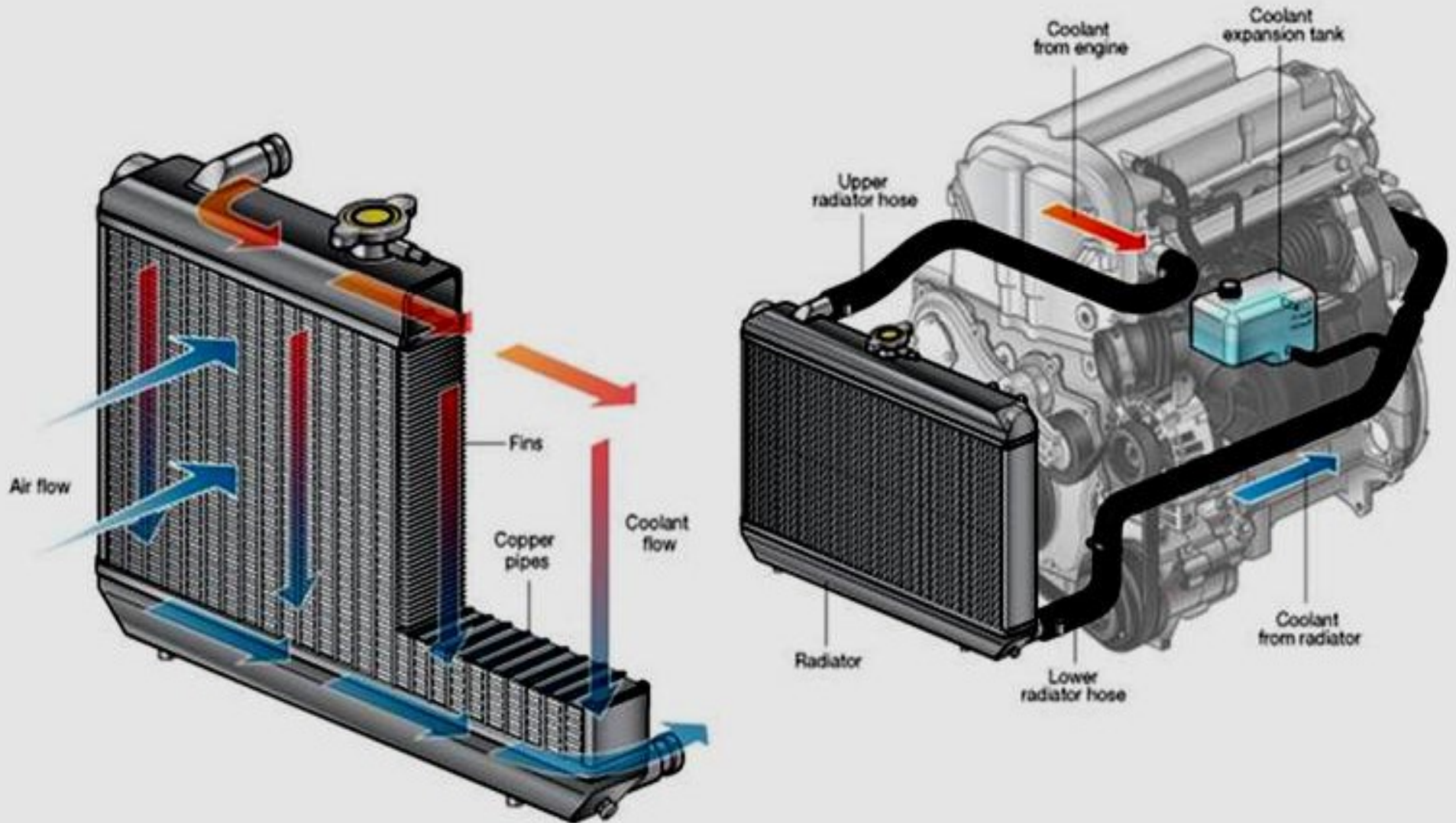
- The fan is mounted on radiator frame. It serves two purposes in the cooling system of an engine.
 - (a) It draws atmospheric air through the radiator and thus increases the efficiency of the radiator in cooling hot water.
 - (b) It throws fresh air over the outer surface of the engine, which takes away the heat conducted by the engine parts and thus increases the efficiency of the entire cooling system.



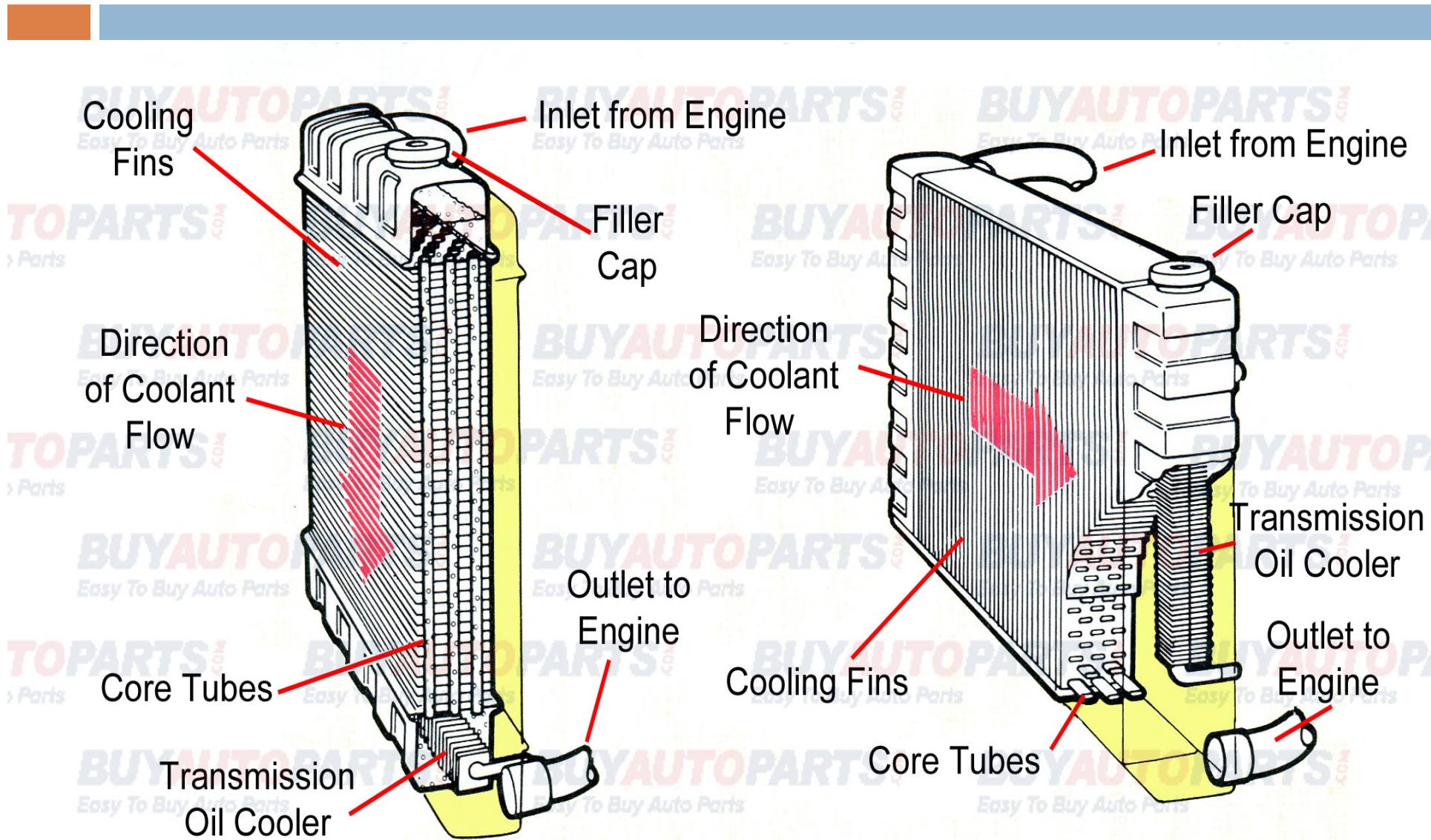
Radiator

- The purpose of the radiator is to cool down the water received from the engine. The radiator consists of three main parts: (i) upper tank, (ii) lower tank and (iii) tubes.
- Hot water from the upper tank, which comes from the engine, flows downwards through the tubes. The heat contained in the hot water is conducted to the copper fins provided around the tubes.
- An overflow pipe, connected to the upper tank, permits excess water or steam to escape.
- There are three types of radiators: (i) Gilled tube radiator, (ii) tubular radiator and (iii) Honey Comb or Cellular radiator

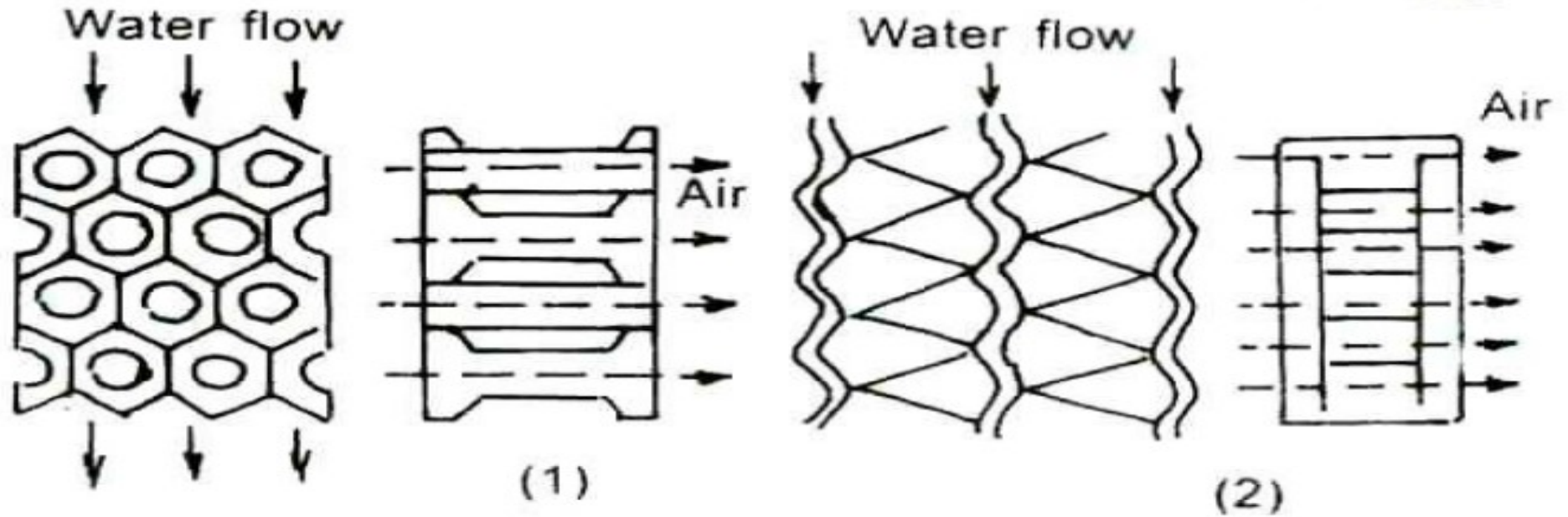
Radiator



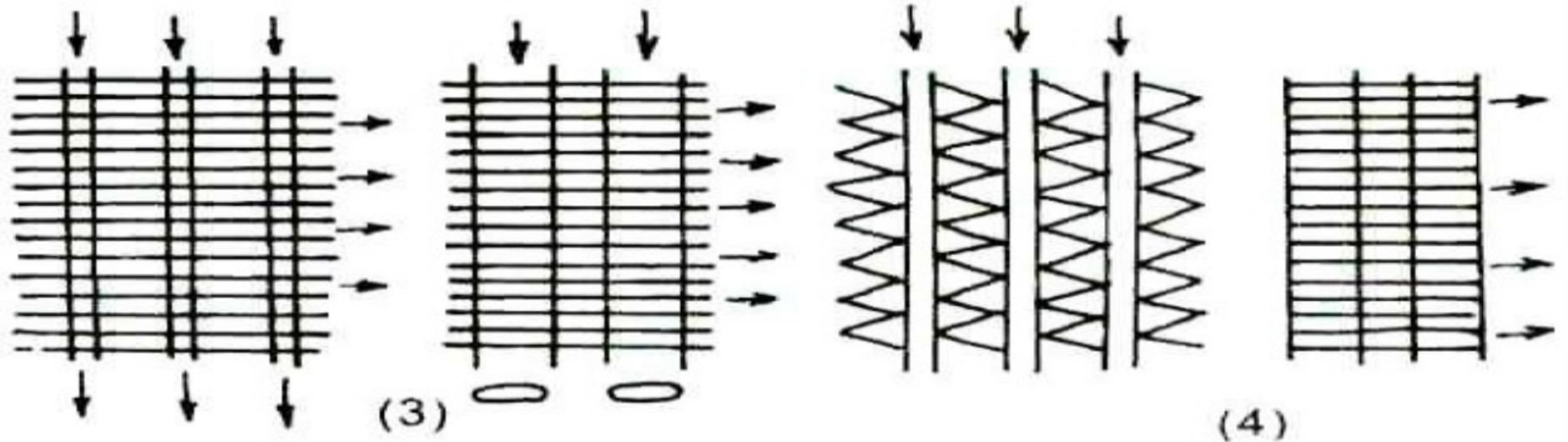
Radiator



Different types of radiator cores

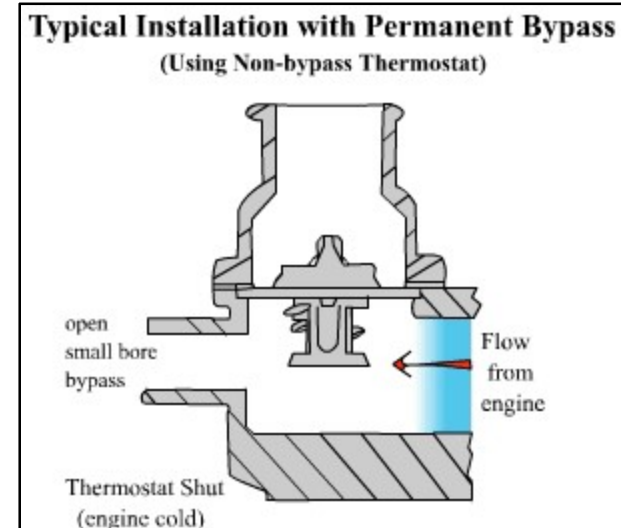


Different types of radiator core



Thermostat Valve

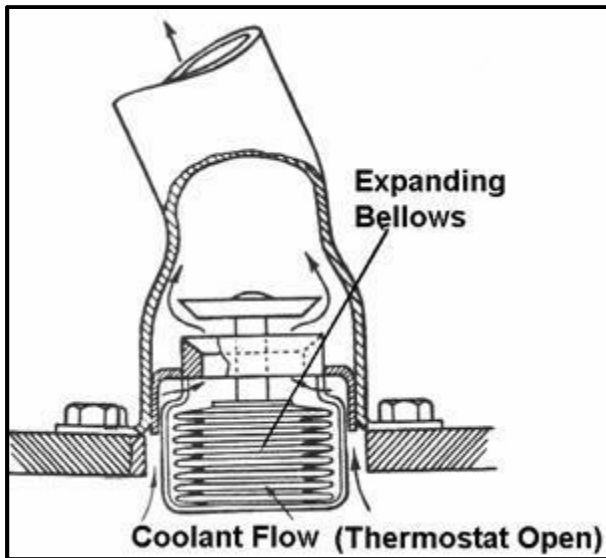
- It is **check valve** which opens and closes with the effect of temperature.
- It is fitted in the water outlet of the engine to allow engine to **warm-up**.
- During the warm-up period, the thermostat is closed and the water pump circulates the water only throughout the cylinder block and cylinder head.
- When the normal operating temperature is reached, the thermostat valve opens and **allows hot water** to flow towards the **radiator**.
- Standard thermostats are designed to start opening at 70° to 75°C and they fully open at 82°C.
- High temperature thermostats, with permanent anti-freeze solutions (**Prestine, Zerex, etc.**), **start opening at 80° C to 90°C and fully open at 92°C.**



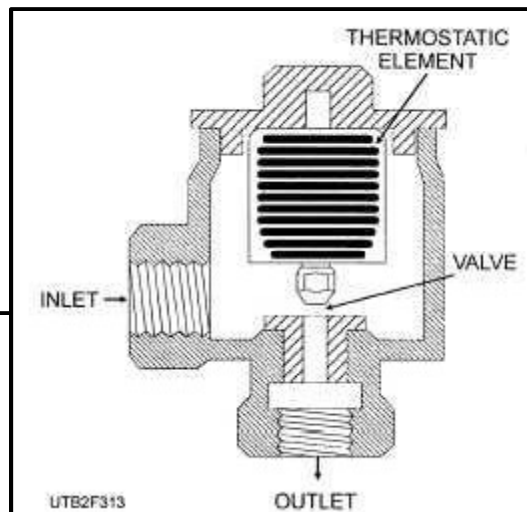
Types of Thermostat

There are three types of thermostats:

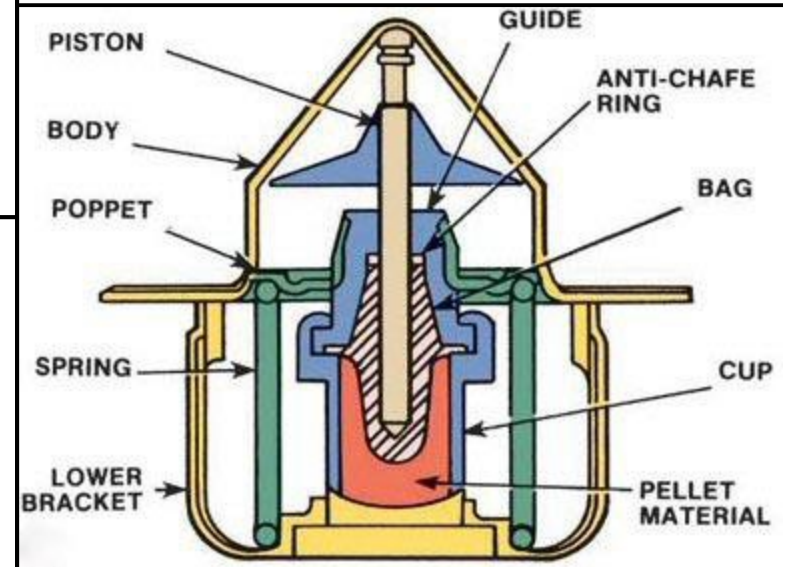
- (i) Bellow Type,
- (ii) Bimetallic Type
- (iii) Pellet Type.



Bellow type thermostat



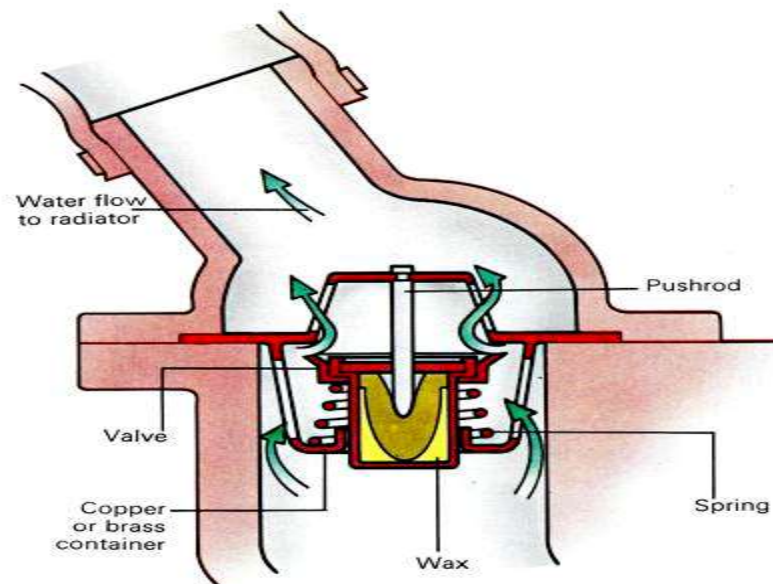
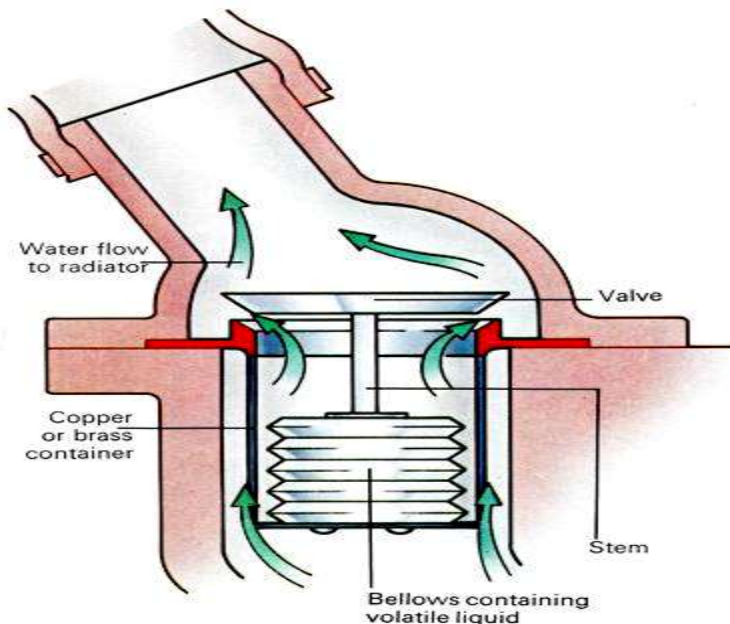
Bimetallic type thermostat



Pellet type thermostat

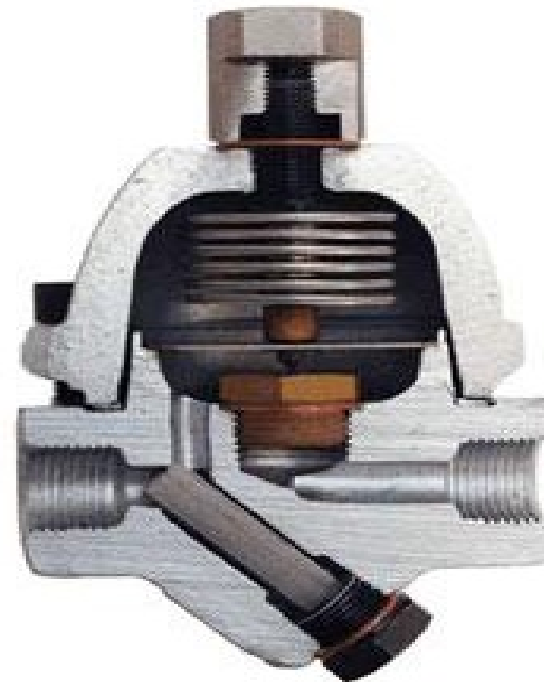
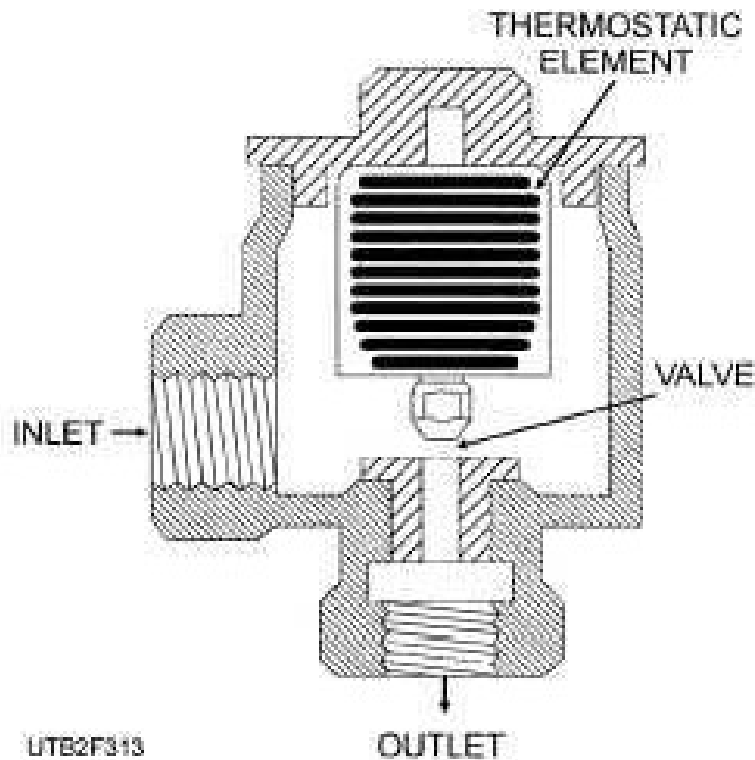
Bellow type valve

- Flexible bellows are filled with **alcohol** or **ether**. When the bellows is heated, the liquid vaporizes, creating enough pressure to expand the bellows. When the unit is cooled, the gas condenses. The pressure reduces and the bellows collapse to close the valve.



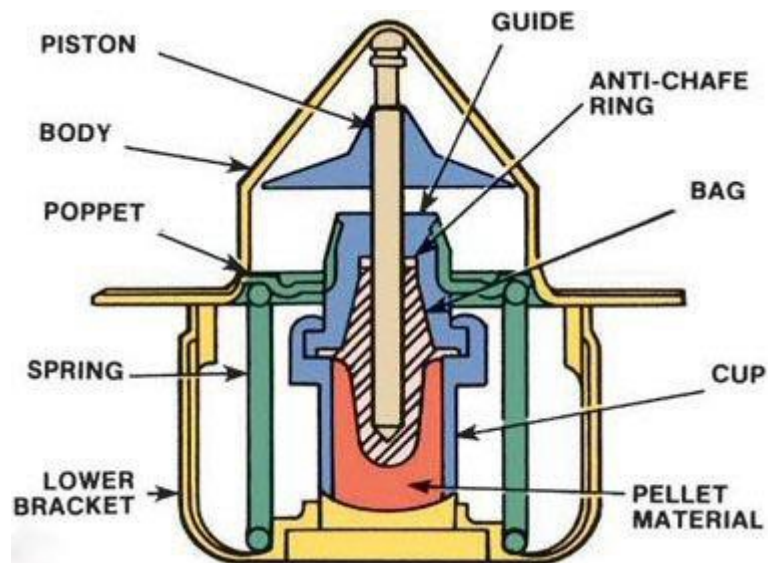
Bimetallic type Thermostat valve

This consists of a bimetallic strip. The unequal expansion of two metallic strips causes the valve to open and allows the water to flow in the radiator.

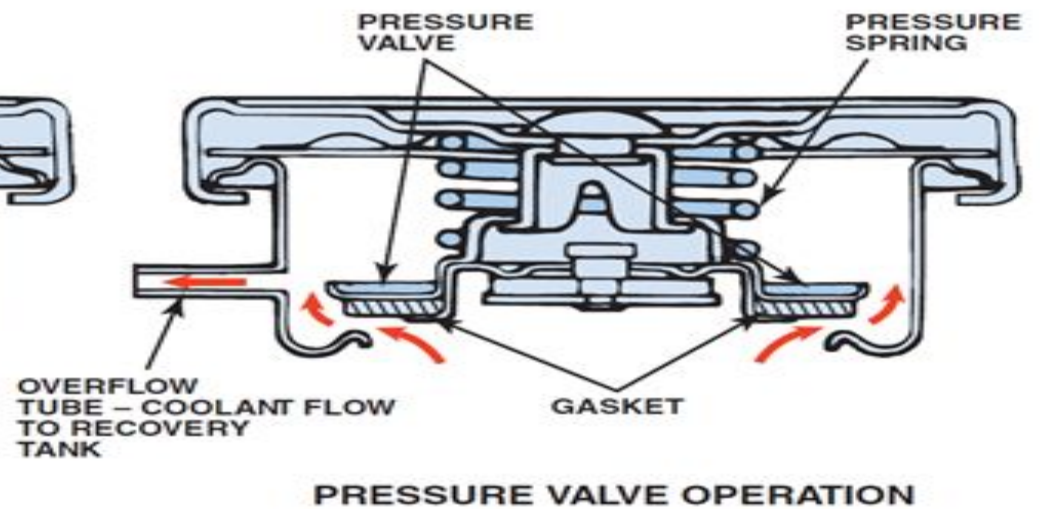
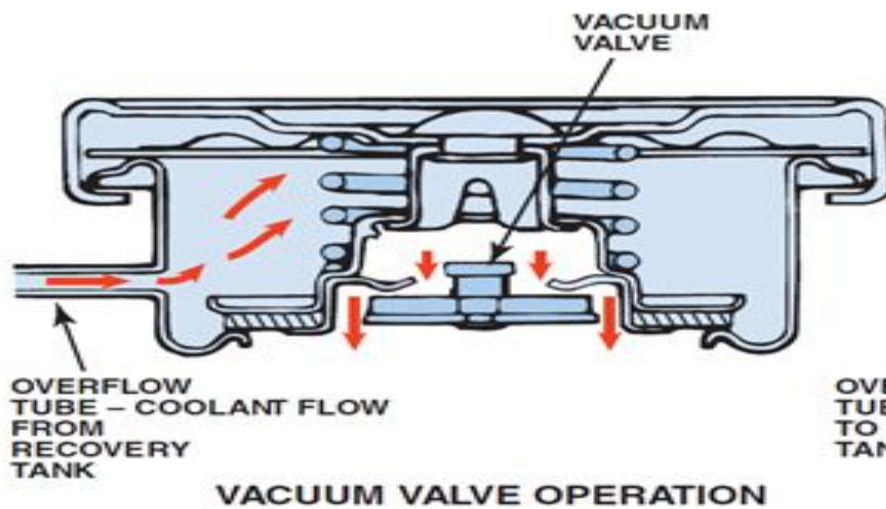
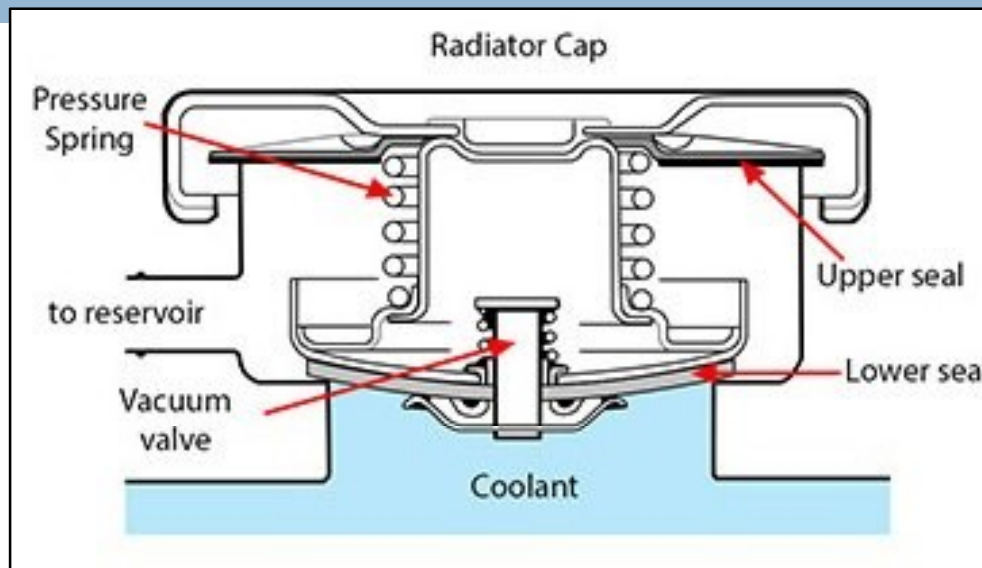


Pellet type Thermostat valve

A copper impregnated wax pellet expands when heated and contracts when cooled. The pellet is connected to the valve through a piston, such that on expansion of the pellet, it opens the valve. A coil spring closes the valve when the pellet contracts.



Pressure Cap



Important questions

1. List out effects of overheating of the engine components
2. Draw layout of liquid cooling system.
3. Explain working of water cooling system.
4. Difference between air cooling and water cooling system.
5. Advantages and disadvantages of water cooling system over air cooling system.
6. List out types of thermostat valves.
7. Explain working of thermostat valve.



Thank you