Engine Cooling System

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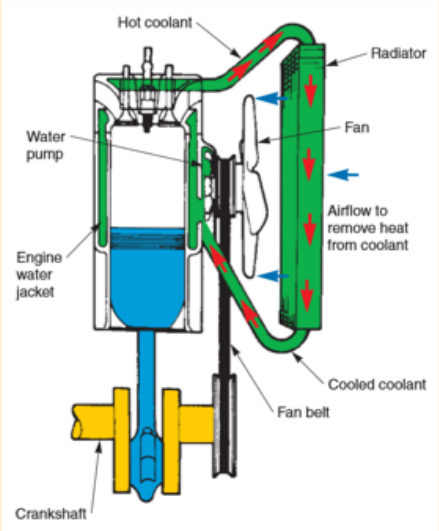
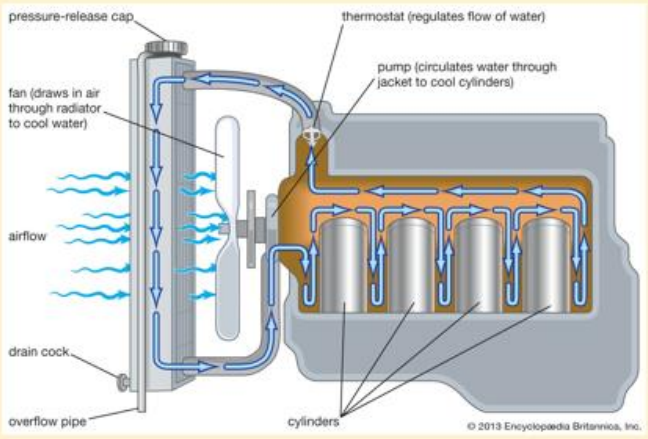
The Cooling System

- The temperature of combustion could reach 2500°C.
- Part of combustion heat (30~35%) should be removed from the engine by the cooling system to avoid parts deformation.
- Engine fast worm-up is needed at cold-starts.
- The engine must run at constant operational temperature.



Heat Transfer

- Water circulate throughout the cooling system by natural convection. Hot water in the engine move upwards and replaced by cold water from the radiator.
- A water pump is installed to speed-up the circulation process.
- A thermostatic valve is installed to control engine temperature at different operational conditions.



The Radiator

- The radiator is a heat exchanger.
- Hot water enters the radiator at the top then flows downwards trough high conductive pipes.
- The cooling of the down flowing water increases its density which enhances the circulation process.
- Air at ambient temperature carries away the heat as it flows through the radiator pipes and fins.
- Air is forced to flow through the radiator by a fan which is either mechanically or electrically driven.

The Mechanically driven Cooling Fan

- The fan is installed on the water pump shaft therefore, they're both are driven by the crankshaft through sheeves and V-type belts.
- The speed of the fan varies with engine temperature by a special silicon clutch.
- The higher the engine temperature the higher the fan speed.

The Electric Fan

- The fan is driven by an electric motor.
- The speed of the motor is directly proportional to engine temperature.
- A temperature sensor is fitted on the hot water line. A signal actuates a controller to increase the electric current to the motor.

The Radiator Cap

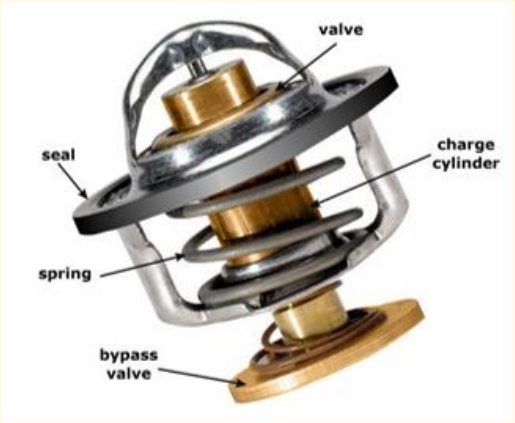
- The cap prevents water spillage from the radiator.
- It also maintain the pressure in the radiator to a specified level to avoid boiling.
- During hot weathers as the pressure exceeds the limits, the cap comprises a thermostatic valve that reliefs the pressure by releasing some water to a side container.
- This water returns back-to the radiator as the engine cools down.

The Water Pump

- It is a vane type pump.
- The pump is driven by the crankshaft through sheeves and V-type belts.
- The higher the speed of the engine the higher the pump discharge.
- In some designs the cooling fan is bolted to water pump flange.
- A water seal between water pump shaft and casing prevent any water leakage.

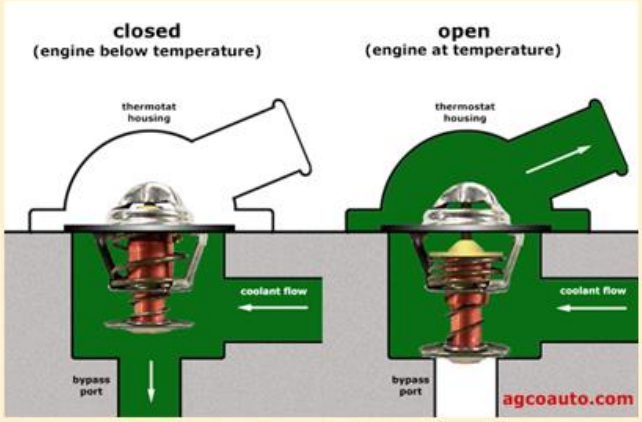
Coolant Temperature Control Thermostat

- The thermostat controls the temperature of the cooling water by controlling the flow direction.
- It comprises a piston and a cylinder that contain a temperature sensitive fluid.
- On the cylinder there are two valves acting against each other.
- The setting temperature is written on the valve such as 75°C or 90°C.



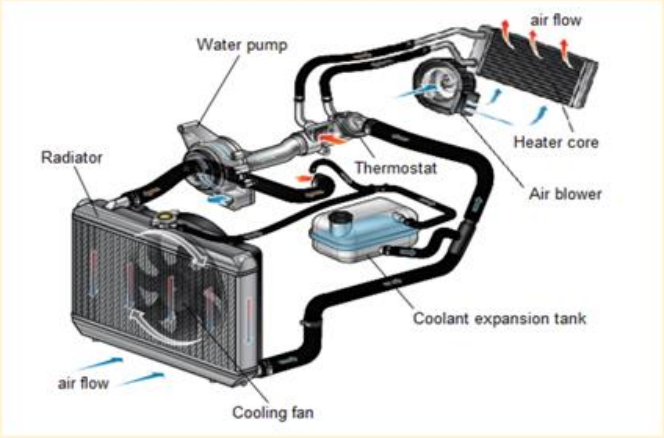
The Function of Thermostat

- One valve controls the way to the radiator, while the 2nd controls the bypass.
- As one valve is completely closed the other one is fully open.
- When the coolant temperature is low, the thermostat closes the way to the radiator therefore the coolant circulates in the engine and vice versa.



Cooling System and Cabin Heating

- During the winter season, part of the engine heat is recovered for heating the cabin.
- A second radiator and air blower are installed in the dashboard to warm-up the cabin.
- A 2nd manually set thermostat controls the cabin temperature.



Air Cooled Engines

- Heat is transferred from the cylinders by natural or forced convection.
- A big air blower is used to cool down the cylinders.
- No radiators and water jackets are needed.
- The efficiency of cooling is enhanced by the fins around the cylinders and cylinder heads.