CHAPTER FOUR

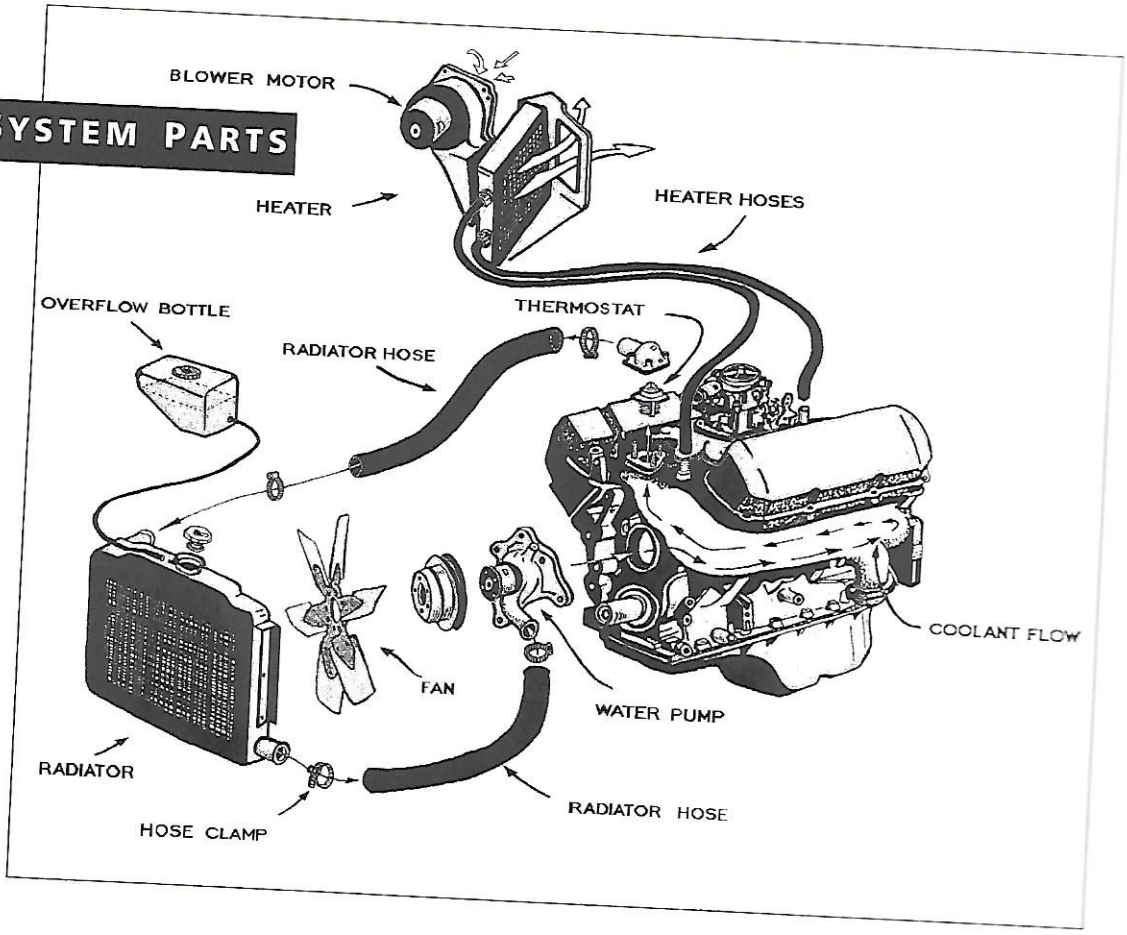
Cooling System

A *cooling system* uses a mixture of water and *antifreeze* to absorb and disperse engine heat. This mixture, called *coolant*, is pushed through a cooling system by a *water pump*. The coolant flows around the outside of the combustion chambers and absorbs heat. The hot coolant then circulates to a *radiator* where excess heat radiates to the outside air.

A cooling system has three jobs:

1. Dispersing excess engine heat
2. Quickly heating a cold engine
3. Maintaining the proper engine running temperature

COOLING SYSTEM PARTS

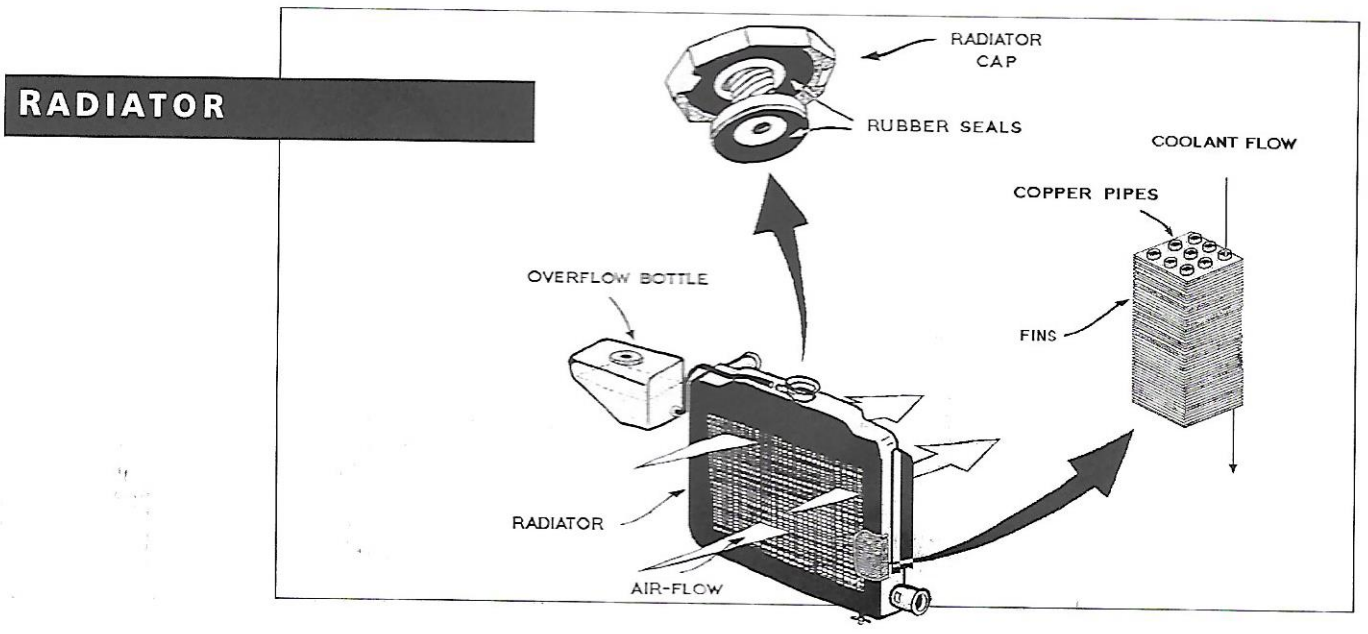


Radiator

A *radiator* efficiently transfers heat from liquid coolant to the surrounding air. Hot coolant enters at the top of a radiator and flows down to the bottom through small copper pipes. Fins attached to the pipes increase the surface area exposed to the air. As air passes over the fins, heat is conducted to the moving air-flow and carried away. By the time coolant gets to the bottom of a radiator, it has cooled enough to absorb another dose of heat.

An engine operates more efficiently at temperatures above the boiling point of water. As an engine heats, coolant expands inside the system, increasing pressure. The greater pressure raises the boiling point of the coolant, allowing an engine to run at the higher temperatures without boiling the coolant. If pressure becomes too great, a spring-loaded pressure release *radiator cap* automatically opens so coolant can escape the system, thus relieving the pressure. This overflow coolant is saved in a *reservoir bottle* or *overflow bottle* located to the side of an engine compartment. As an engine cools, coolant volume in a radiator shrinks, drawing back the overflow coolant. This is how coolant added to a plastic reservoir bottle is returned to a radiator.

Separate radiators may be used to cool transmission fluid, engine oil, freon gas, and turbochargers (*intercooler* radiators). A separate radiator also delivers heat to a passenger compartment and defrosters.



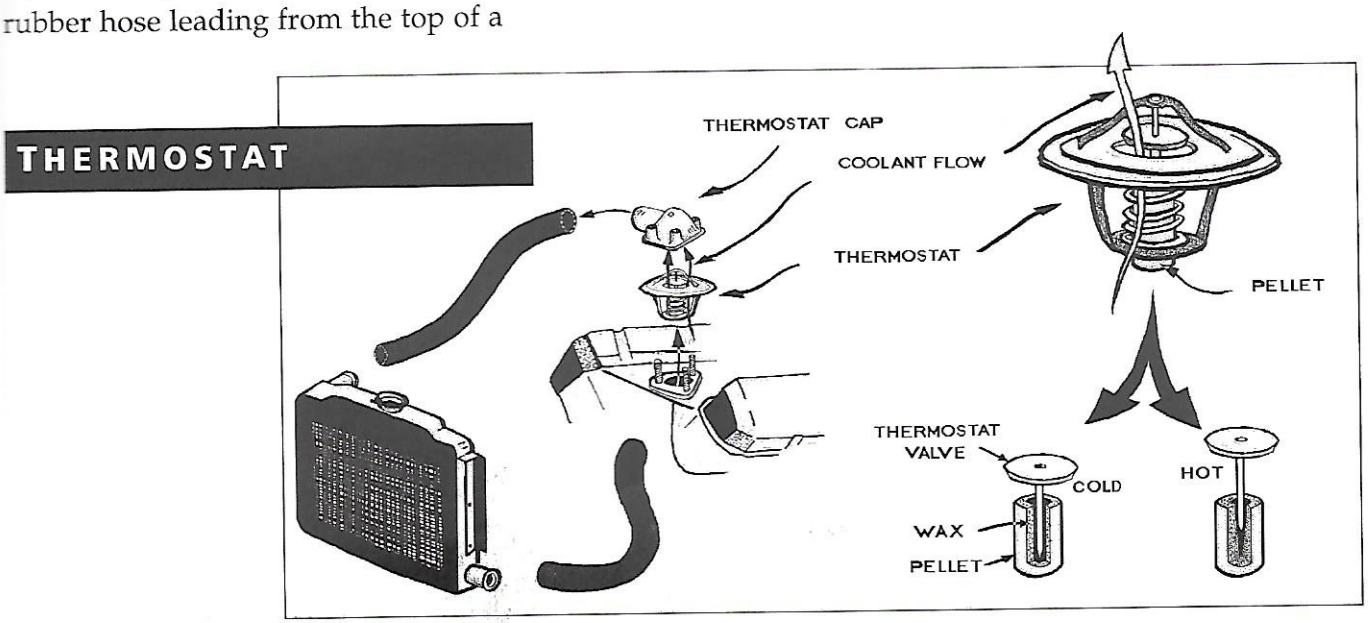
Thermostat

A *thermostat* maintains a steady engine temperature by regulating the amount of coolant flowing through a system. If an engine is cold, a thermostat blocks coolant flow, allowing an engine to heat-up quickly. As an engine warms, a thermostat automatically opens to allow the coolant to circulate. When proper engine temperature is reached, a thermostat maintains that temperature by slightly opening or closing to compensate for engine load, vehicle speed, and outside air temperature. A balance is thus maintained between coolant flow and proper engine temperature.

A thermostat is usually located on the top of an engine, often inside a rounded metal cover cap. A *thermostat cap* is usually at the end of the large rubber hose leading from the top of a radiator to an engine. This radiator hose almost always attaches directly to the metal cap that houses a thermostat.

Modern thermostats use a metal pellet containing a special wax that rapidly expands and contracts with changing coolant temperature. When temperature increases, the wax expands inside the pellet and pushes out a rod and *thermostat valve*, opening the thermostat and increasing the coolant flow.

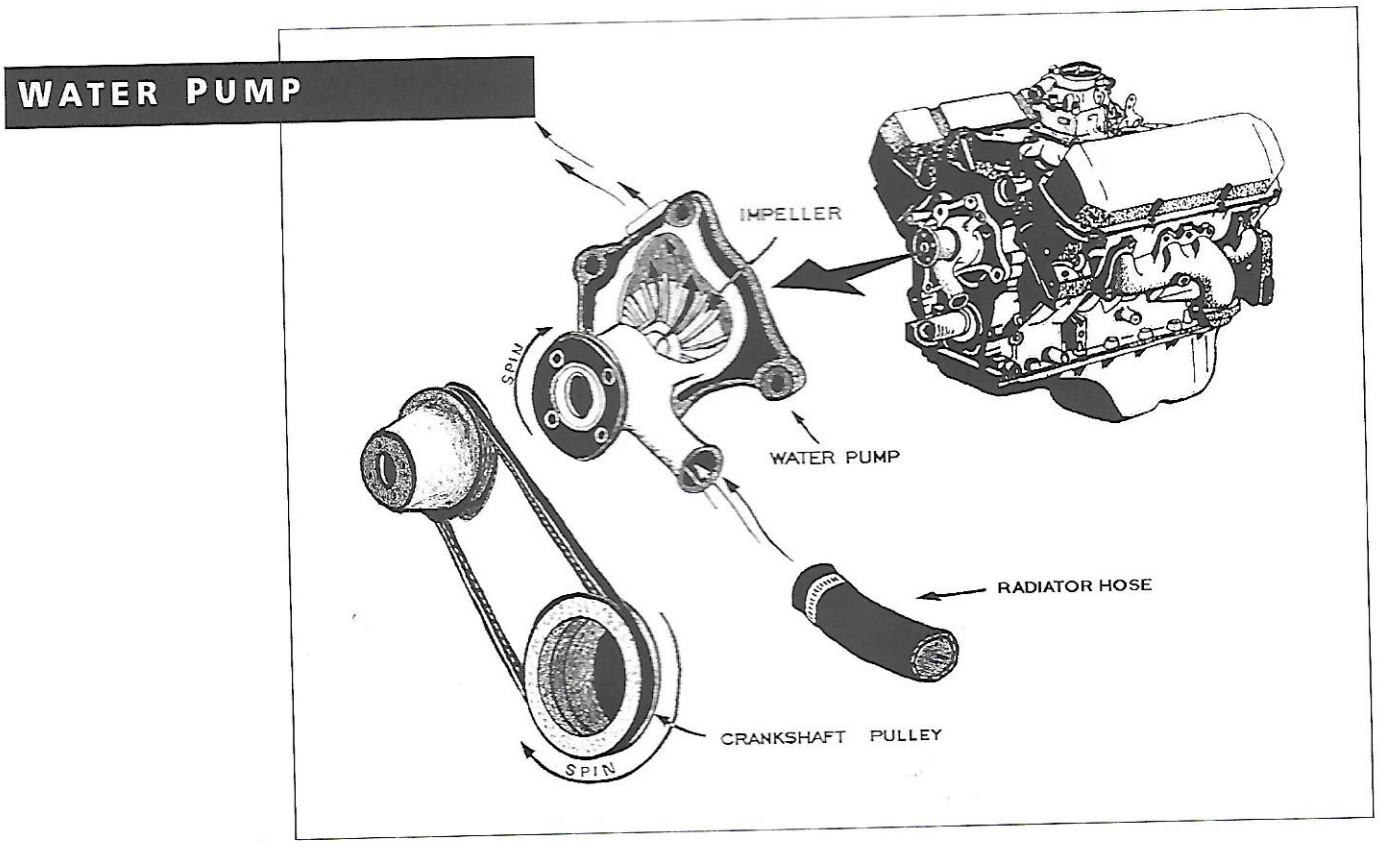
Although part of a cooling system, a thermostat actually heats an engine by closing off the coolant flow. Without this warm-up feature an engine might never reach its proper operating temperature, especially on cold days, thus disabling the heater and defroster when needed most.



Water Pump

A *water pump* circulates coolant through a cooling system with an internal paddle wheel or *impeller*. The impeller is turned by a *fan belt*, or *drive belt*, connected to the crankshaft pulley. The faster a crankshaft turns, the faster coolant circulates.

Water pumps are at the front of an engine where they can conveniently use a drive belt from a crankshaft pulley. The same drive belt, sometimes called a *serpentine belt*, often spins other accessories, such as an alternator, power steering pump, smog control pump, air conditioning compressor, or cooling fan.



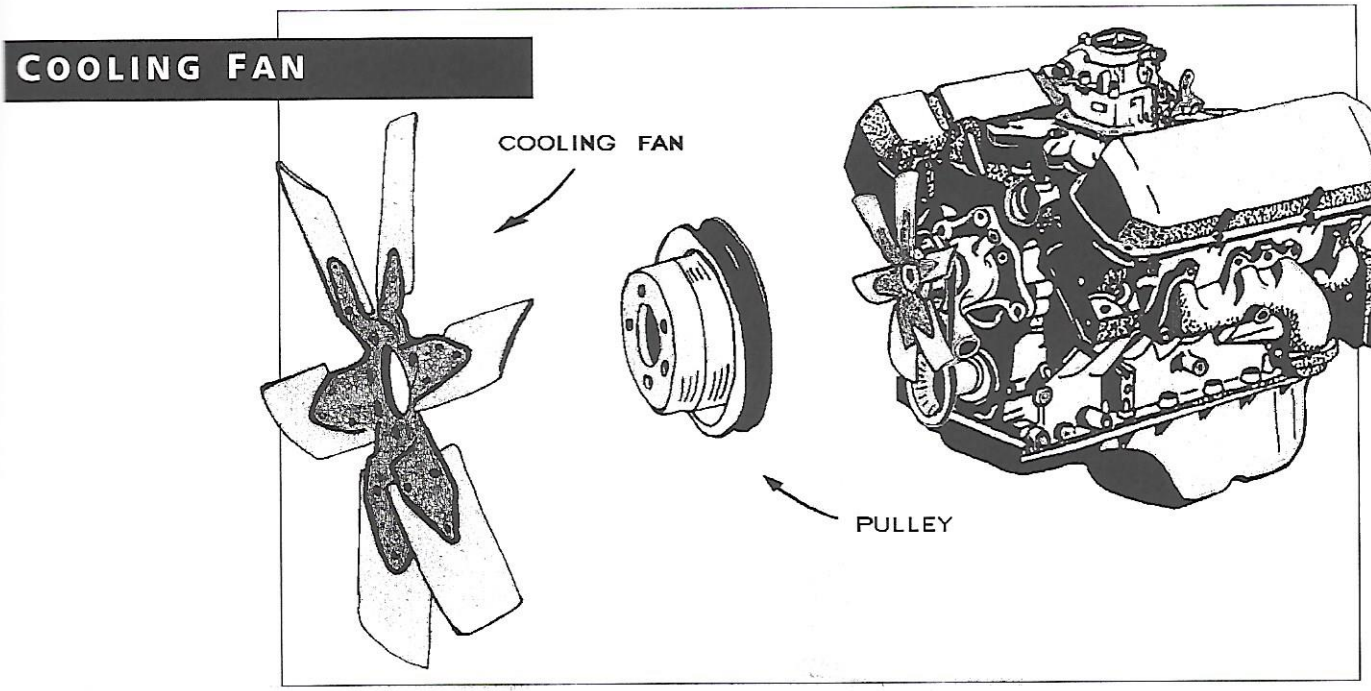
Cooling Fan

A *cooling fan* creates an air flow when a car is stopped or moving slowly. Air must flow over the fins in a radiator to carry away enough heat to cool an engine. Fans rotate either by a fan belt from a crankshaft or a small electric motor.

A *thermal fan* engages only when coolant temperature is too high; most of the time a thermal fan is disengaged and not moving. This saves energy and reduces engine noise.

With a forward-facing engine, a cooling fan attaches to a water pump at the front of an engine, directly behind the radiator. With an engine facing forward, a fan and water pump are easily powered by the drive belt from the crankcase pulley.

With a transverse-mounted engine, the engine, crankshaft pulley, and drive belts all face sideways. A fan mounted to the front of this engine arrangement would face sideways and not help the air-flow. So a cooling fan, still mounted behind a radiator, is used, powered by a remote electric motor, switched on and off by signals from a temperature sensor.

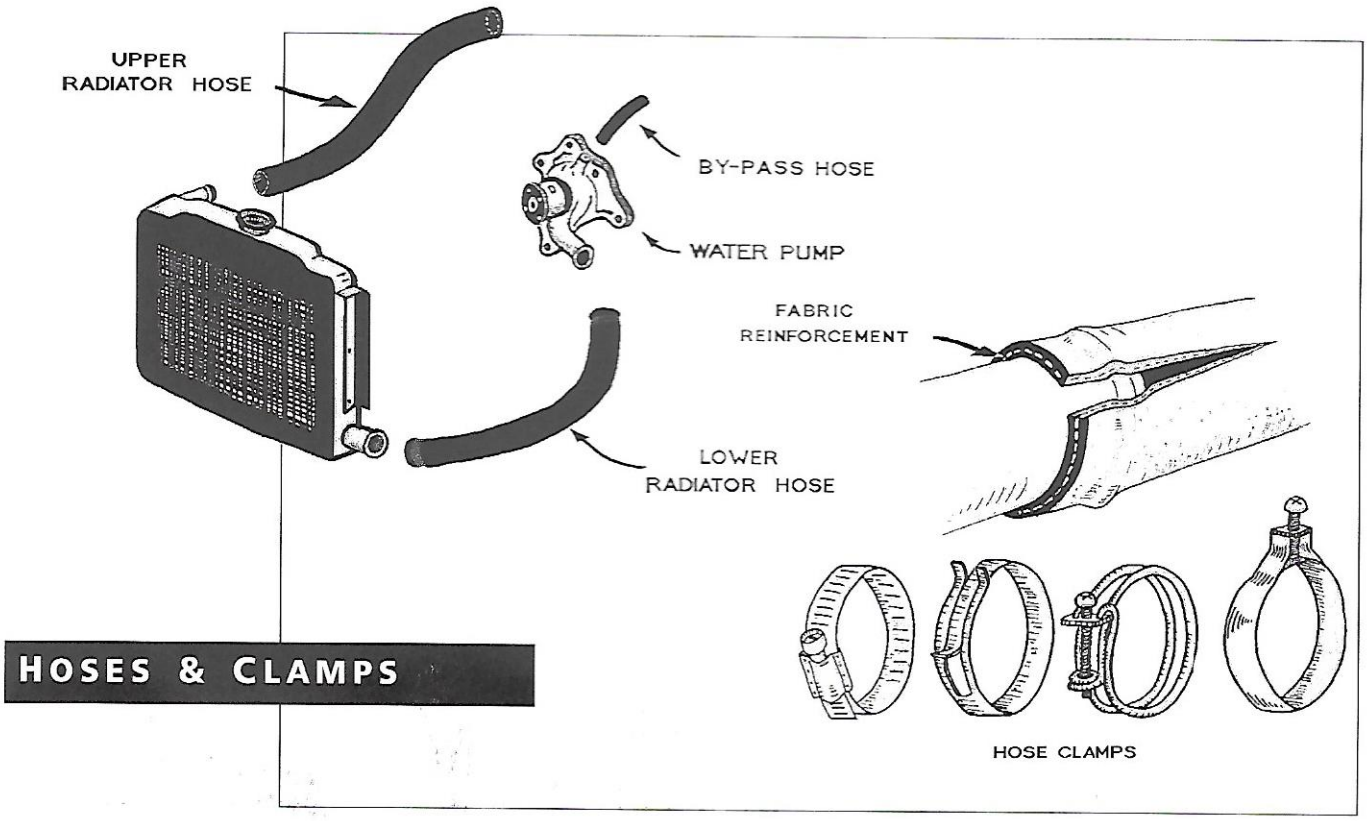


Hoses

Two radiator *hoses* carry coolant between a radiator and an engine. These thick rubber hoses have layers of fabric reinforcement molded into them. Some have metal springs inside to prevent kinking and collapsing. An upper radiator hose connects to the top of a radiator and delivers hot coolant from an engine to a radiator. A lower radiator hose, connects to the bottom of a radiator and delivers coolant to a water pump. Smaller hoses, the *heater hoses*, carry coolant to a separate *heater* radiator in the passenger compartment.

Coolant must continuously circulate to prevent the creation of hot water pockets inside an engine block. For this reason a small *by-pass hose* creates a trickle flow of coolant through an engine, even when a thermostat has "closed" the coolant flow.

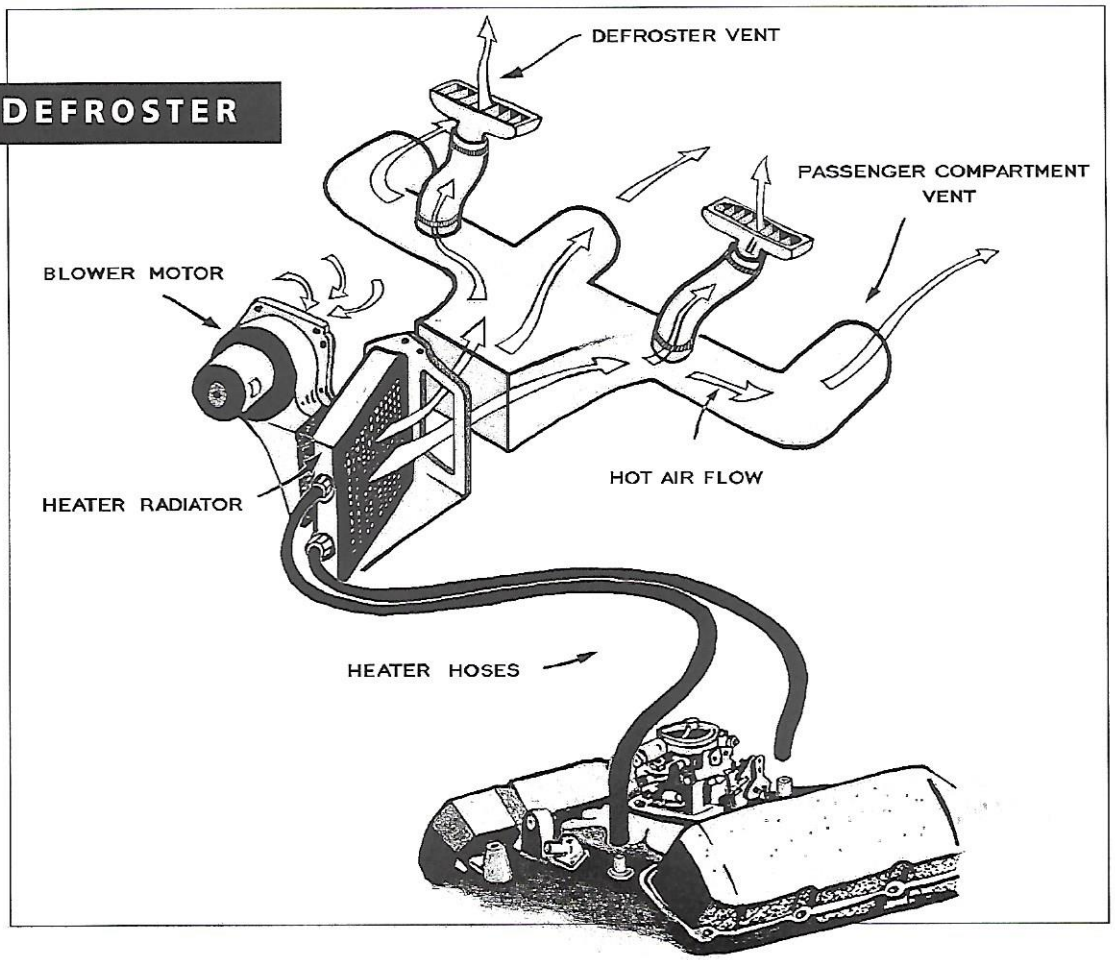
Many other hoses are used in cars, including fuel lines, oil cooler, transmission fluid, vacuum, emissions, freon, and brake fluid hoses. A variety of *hose clamps* are used to secure these hoses.



Heater & Defroster

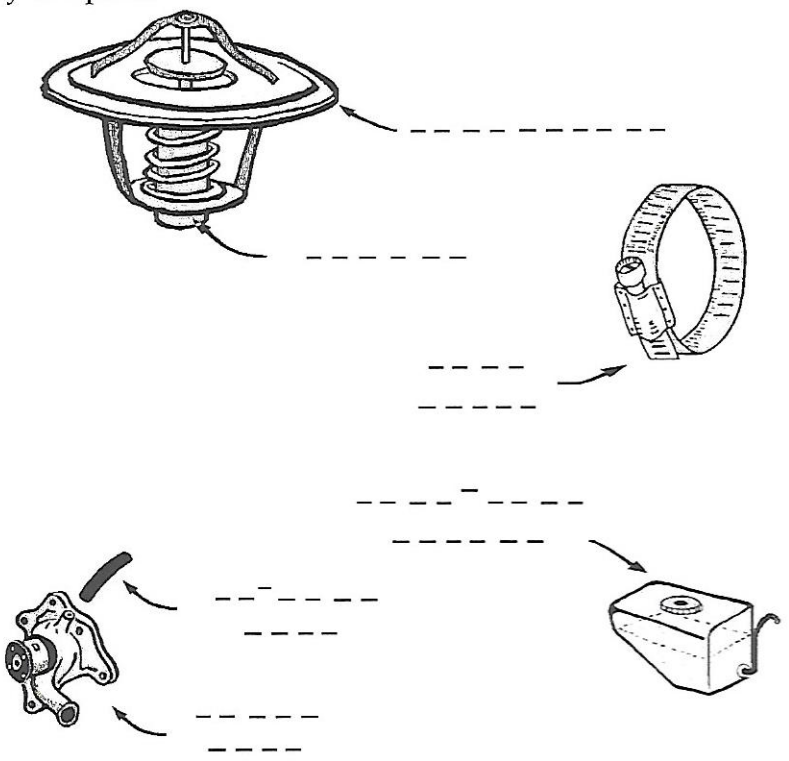
A car heater uses excess heat from a cooling system to warm a passenger compartment. Heater hoses carry hot coolant to and from a small radiator under the dashboard. An electric fan, or *blower*, blows air over the hot radiator fins, carrying warm air through ducts and vents and into a passenger compartment. The amount of heat is governed by the speed of the fan and the amount of coolant flow. A heating system and *air conditioning* system usually share the same duct and vent system and the same blower fan and motor.

The hot air from a heater can also be directed to the inside of a windshield to *defrost* a windshield. A small electric heating wire is often built into the glass of a rear window to act as an electric defroster.



COOLING SYSTEM TEST

Identify the parts:



1. A thermostat helps to heat a cold engine. (T) (F) *(p. 45)*
2. A cooling fan supplements the _____ through a radiator. *(p. 47)*
3. An internal "paddle wheel" inside a pump is called an _____. *(p. 46)*
4. As an engine warms, coolant_____, increasing pressure in the system. *(p. 44)*
5. Water is mixed with _____ to make coolant. *(p. 43)*
6. Only_____hoses carry coolant to and from a radiator. *(p. 48)*
7. Increased pressure raises the boiling point of coolant. (T) (F) *(p. 44)*
8. A _____ hose creates a trickle flow of coolant through the system. *(p. 48)*
9. A car heater takes heat from the cooling system. (T) (F). *(p. 49)*
10. If a car heater only blows cool air. What does this suggest? *(p. 45)* _____ _____
11. A car overheats but there is plenty of coolant. What does this suggest?_____ _____