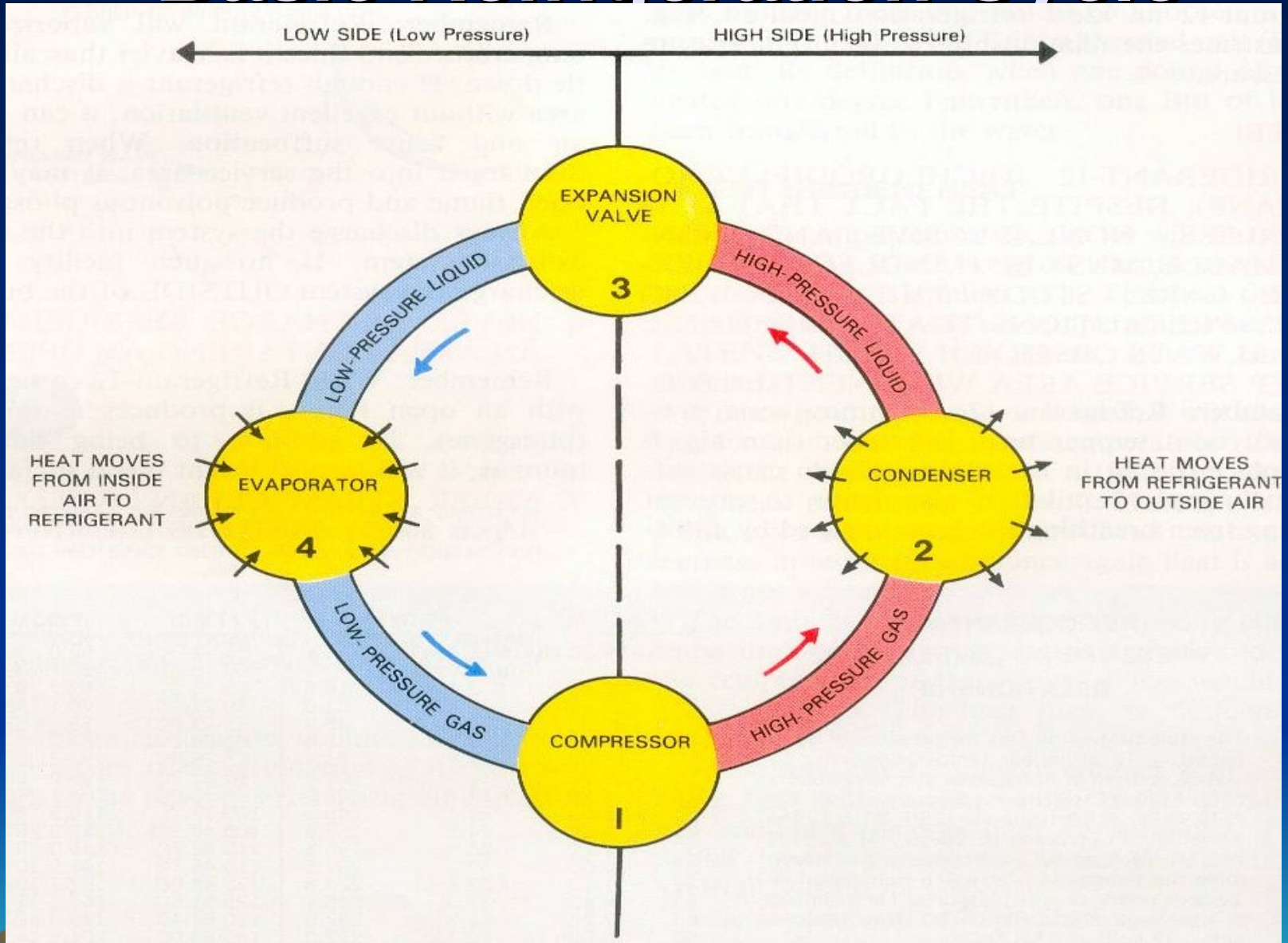
Automotive Air Conditioning

- Cooling

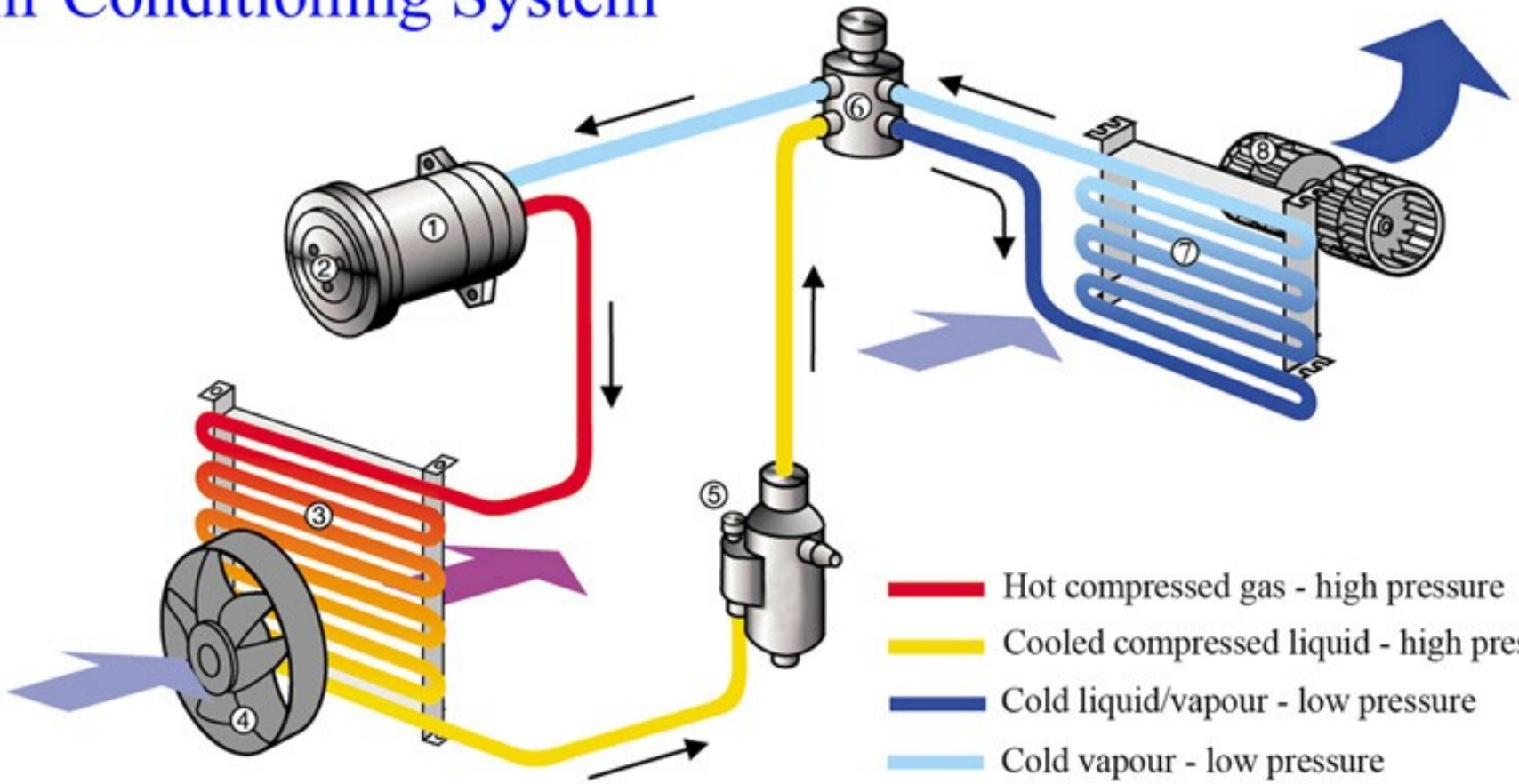
- Heating

Basic Refrigeration Cycle



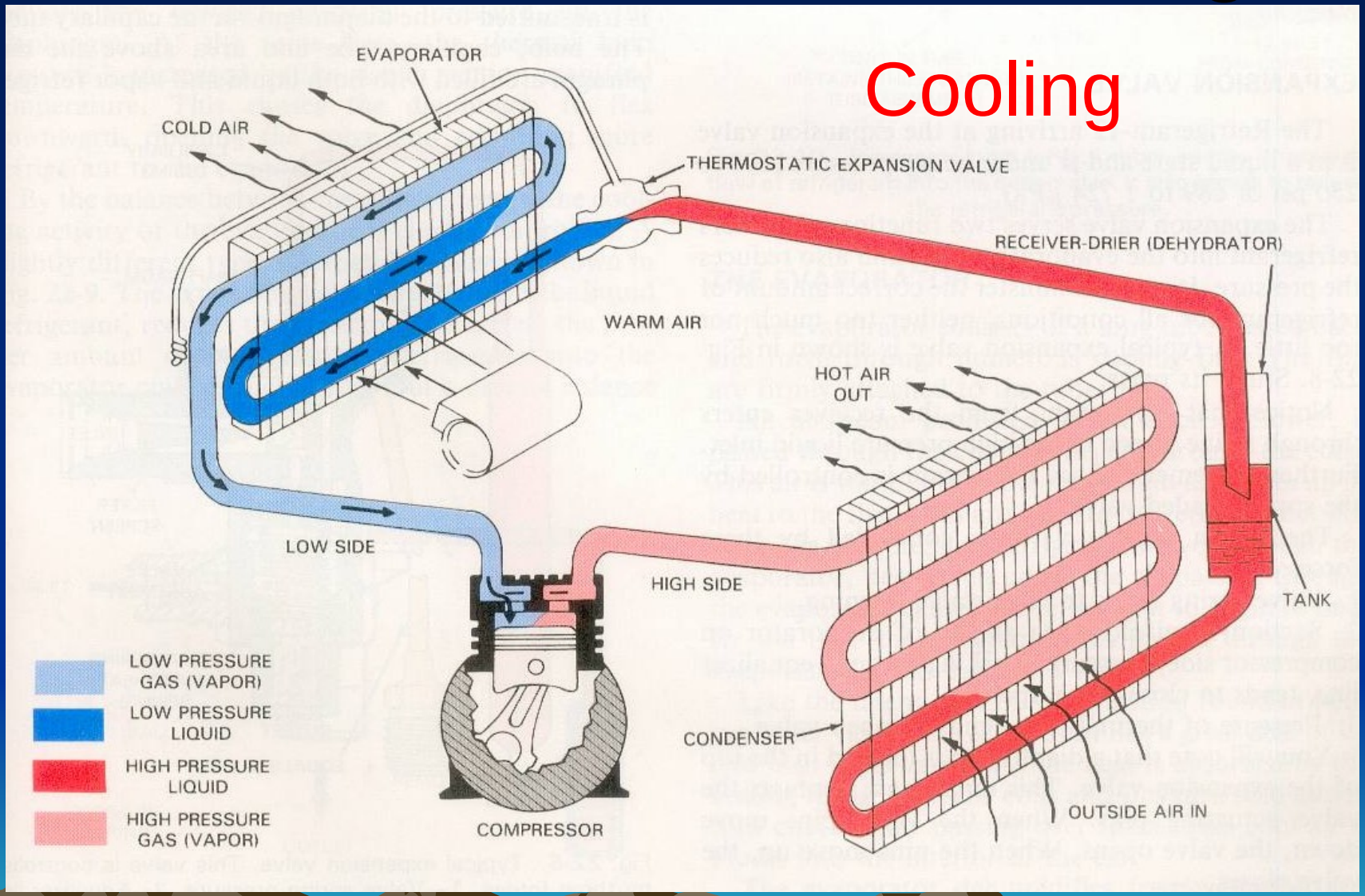
2-4. Schematic illustrating the four basic parts employed in the refrigeration cycle. Note refrigerant flo direction. (Deere & Co.)

Air Conditioning System



1. Compressor
2. Compressor clutch
3. Condenser
4. Condenser fan
5. Receiver/Drier
6. Expansion valve
7. Evaporator
8. Cabin blower motor

Automotive Air Conditioning



Eight Basic Parts are Used for Cooling

Refrigerant:

R134a ($C_2H_2F_4$) that carries heat through system to lower air temperature in vehicle.

Compressor:

pump that pressurizes refrigerant and forces it through system.

Condenser:

cause refrigerant to change from a gaseous state into a liquid state, causing it to give off its stored heat.

Continu…

Flow control device:

usually expansion valve or tube that causes refrigerant pressure and temperature to drop, cooling the evaporator.

Evaporator:

uses cooling action of vaporizing refrigerant to cool air inside car.

Receiver-drier or accumulator:

removes moisture (water) from and stores refrigeration.

Blower:

fan that forces air through evaporator and into passenger compartment.

Continu…

Thermostatic switch:

shuts compressor off when evaporator temperature nears freezing.

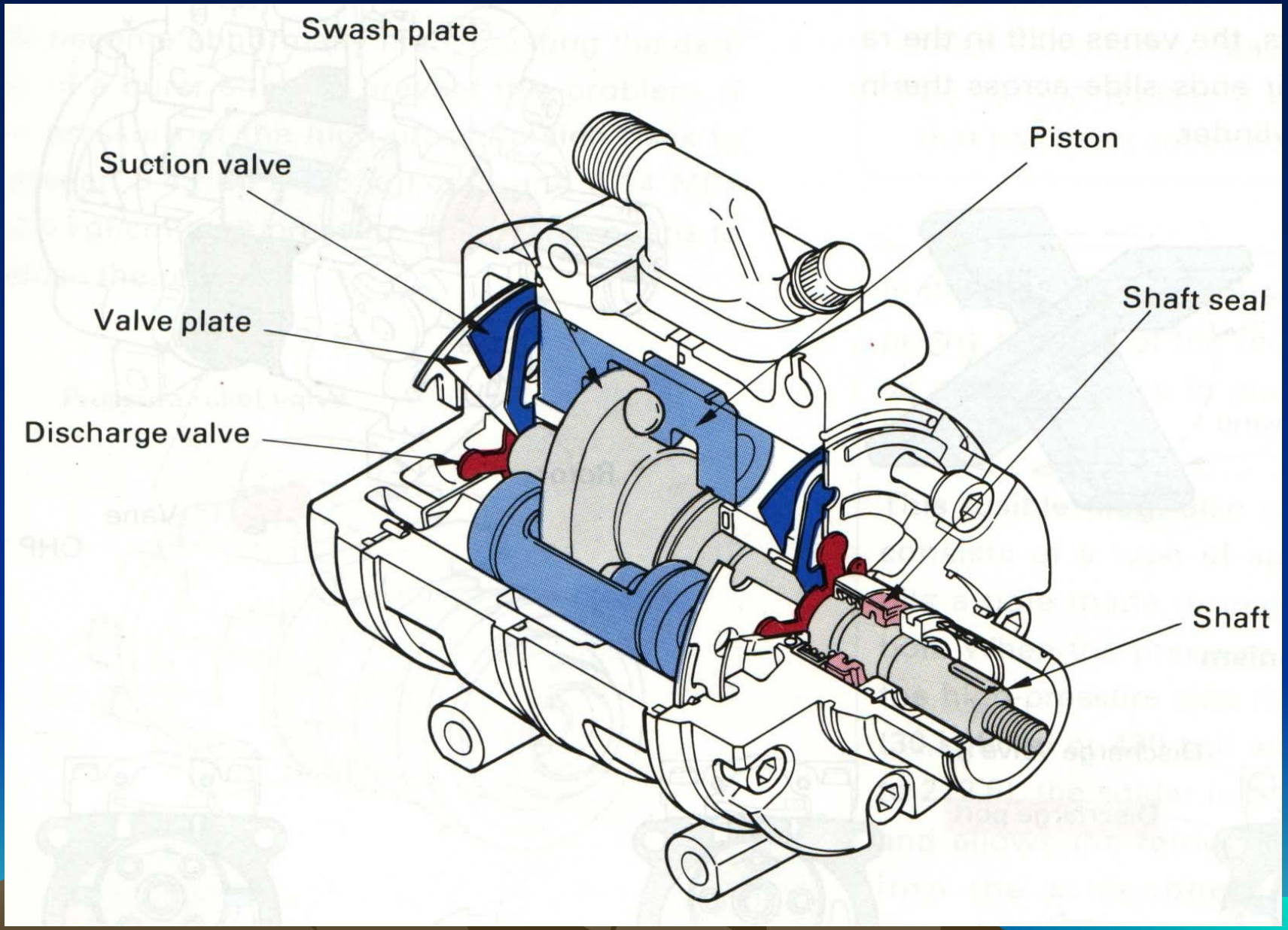
Types of Compressor

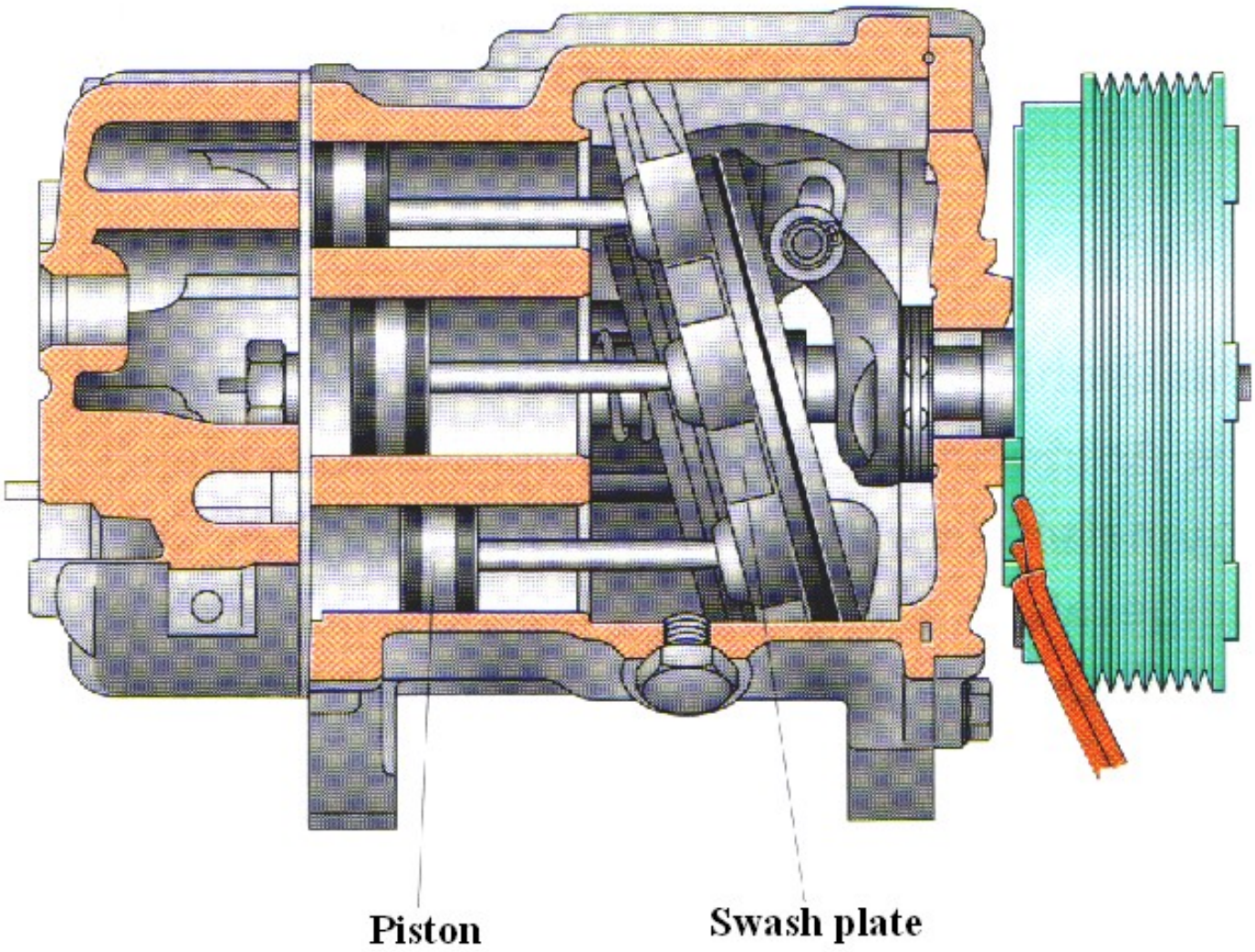
- Crank (in-line or v-type), compressor
- Axial (swash plate), compressor
- Radial, type compressor
- Rotary vane compressor
- Scroll compressor

Swash Plate

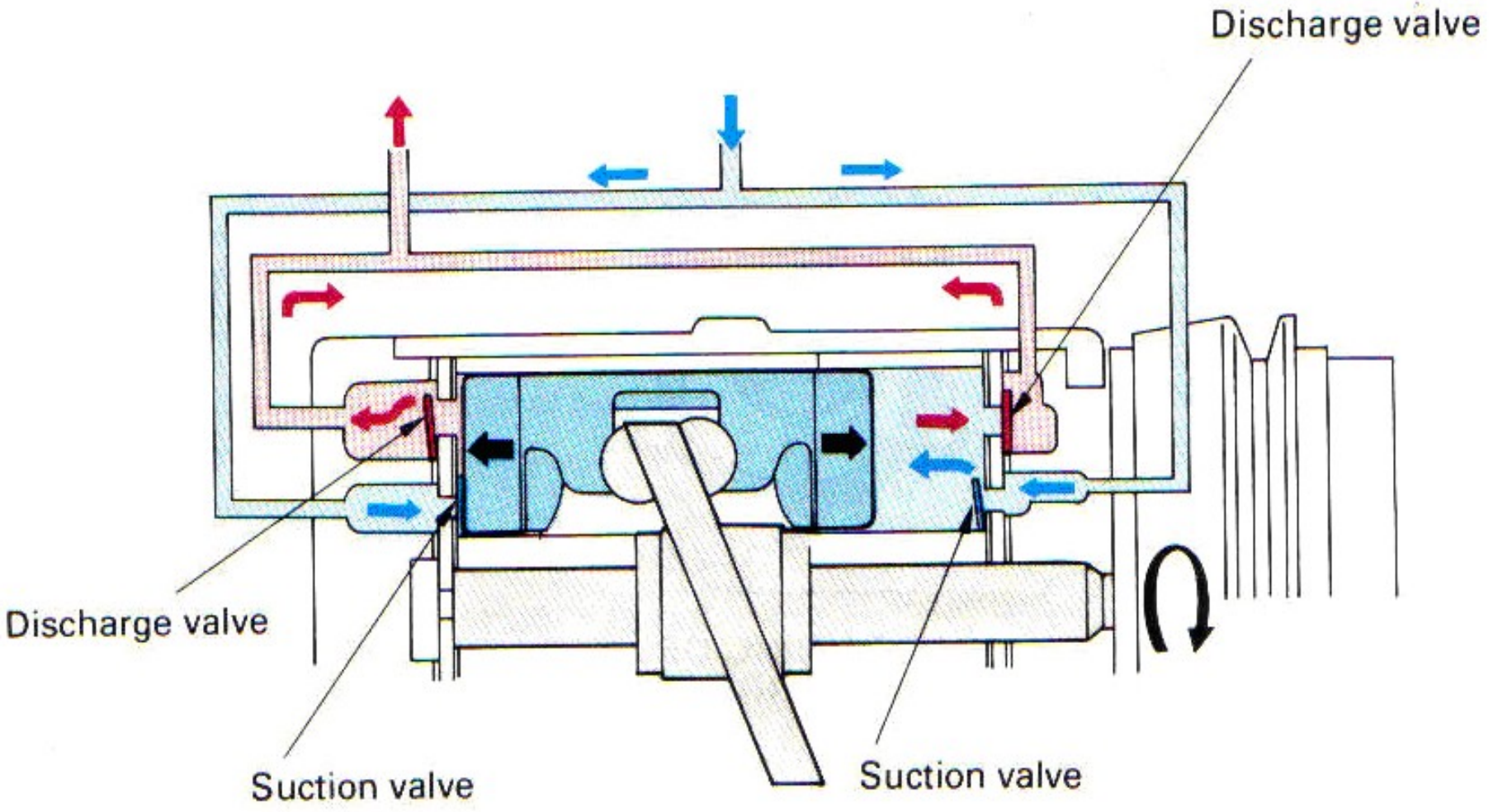
- A number of paired pistons are set on the swash plate at an interval of 120^0 for six cylinder and 72^0 for 10 cylinder.
- In this design the piston is (double acting).

Swash Plate


Swash plate
Suction valve
Valve plate
Discharge valve
Piston
Shaft seal
Shaft


Piston
Swash plate

Swash Plate..

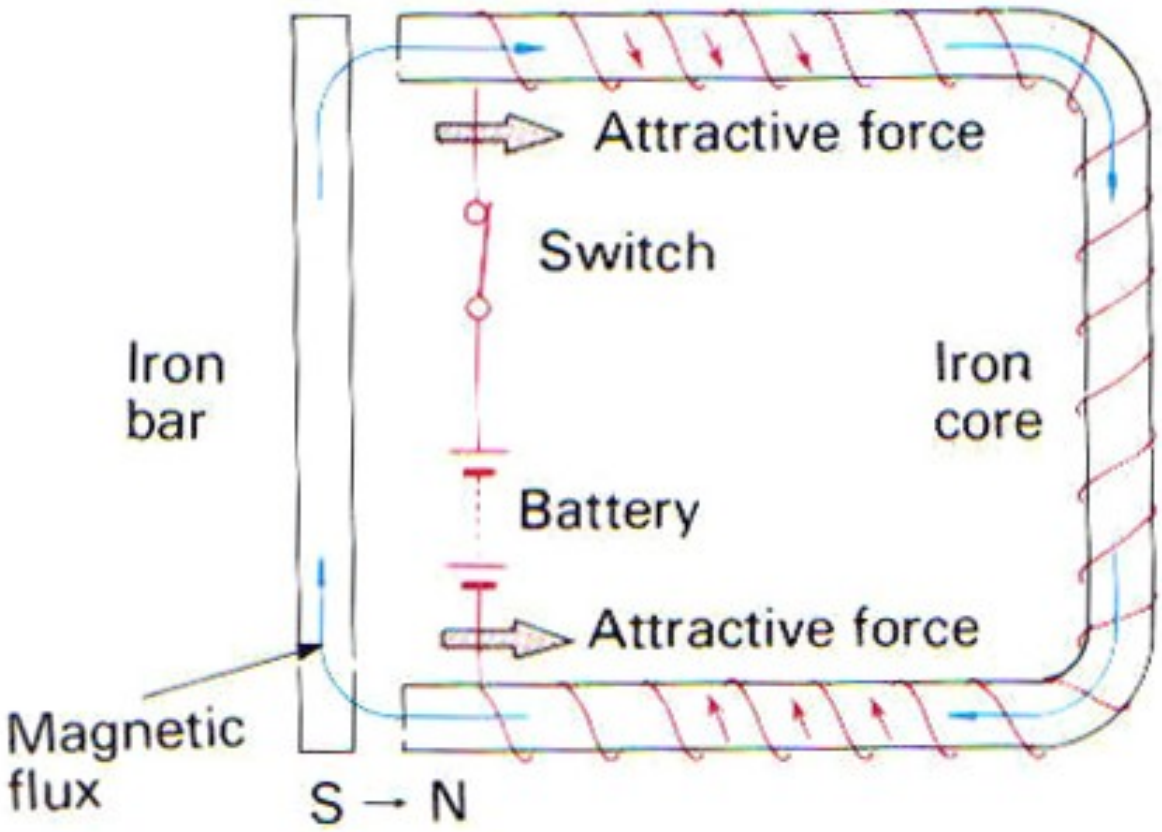

Discharge valve
Discharge valve
Suction valve
Suction valve

Magnetic Clutch

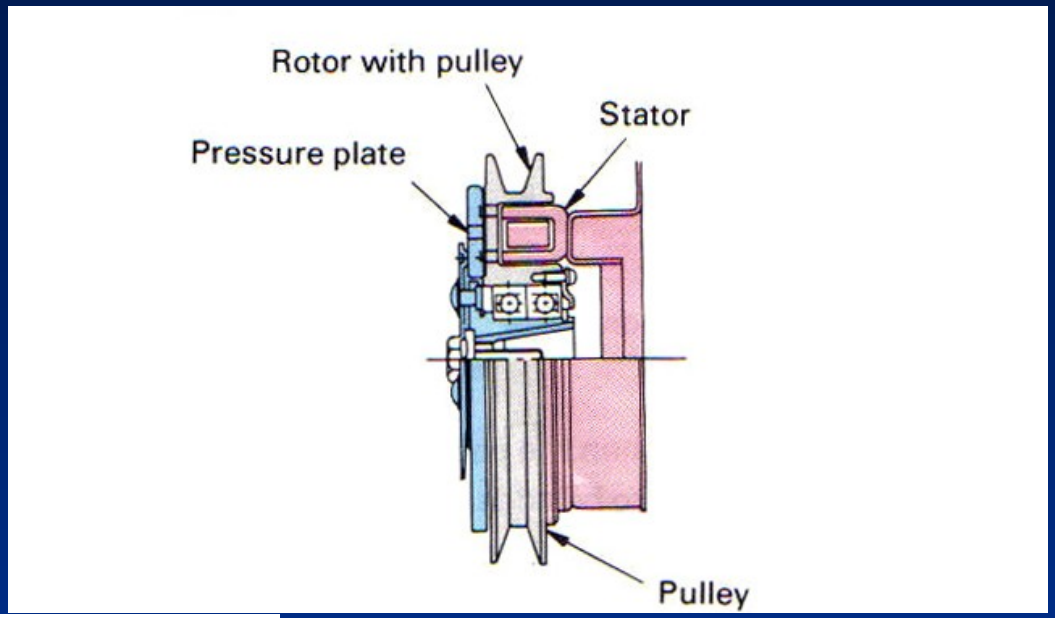
- Is used to engage and disengage the compressor from the engine.

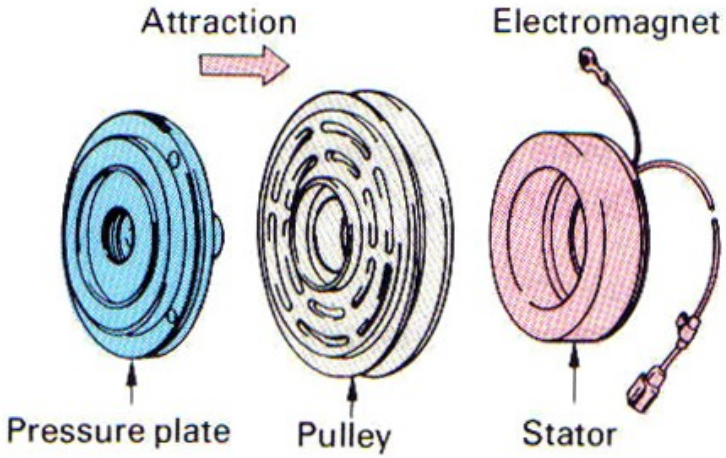
- There are two types of magnetic clutches
  - Stationary field clutch
  - Rotating field clutch

Clutch..


Attractive force
Switch
Iron bar
Iron core
Battery
Attractive force
Magnetic flux
S → N

Clutch..


Rotor with pulley
Stator
Pressure plate
Pulley


Attraction
Electromagnet
Pressure plate
Pulley
Stator

Clutch…

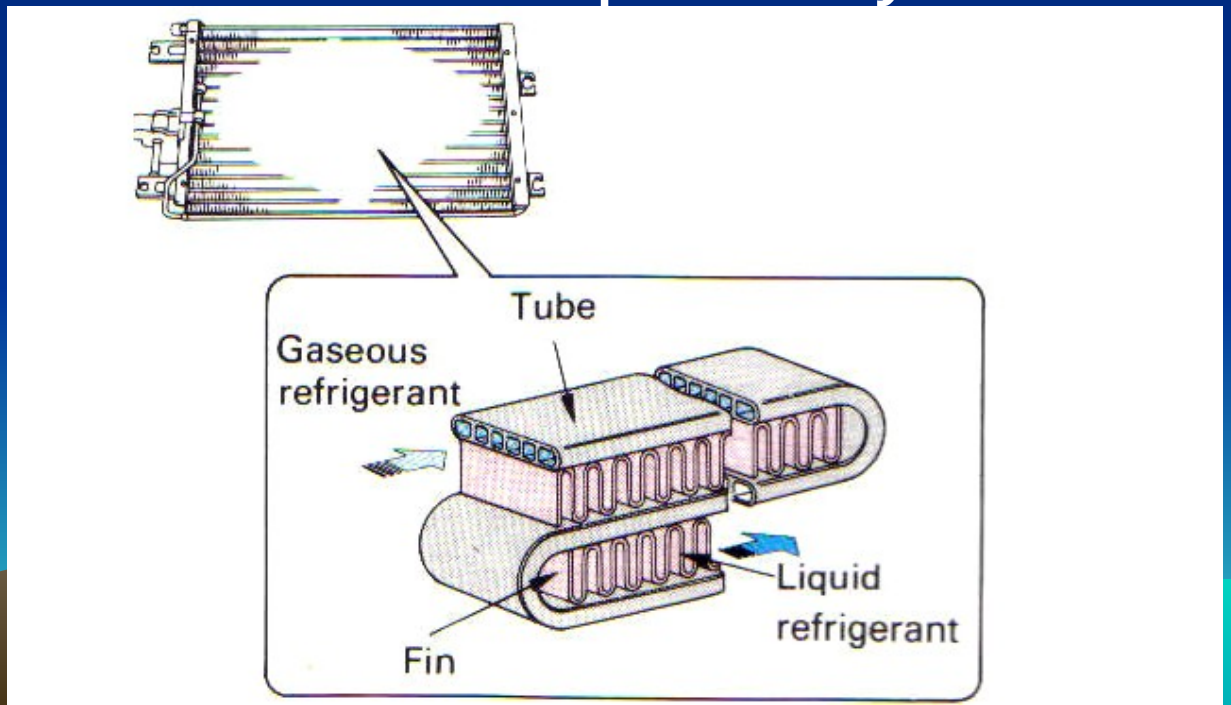
Stationary field clutch

- Main components are: stator, rotor with pulley, pressure plate.
- Stator is fixed on the compressor housing
- Pressure plate is attached to compressor shaft.

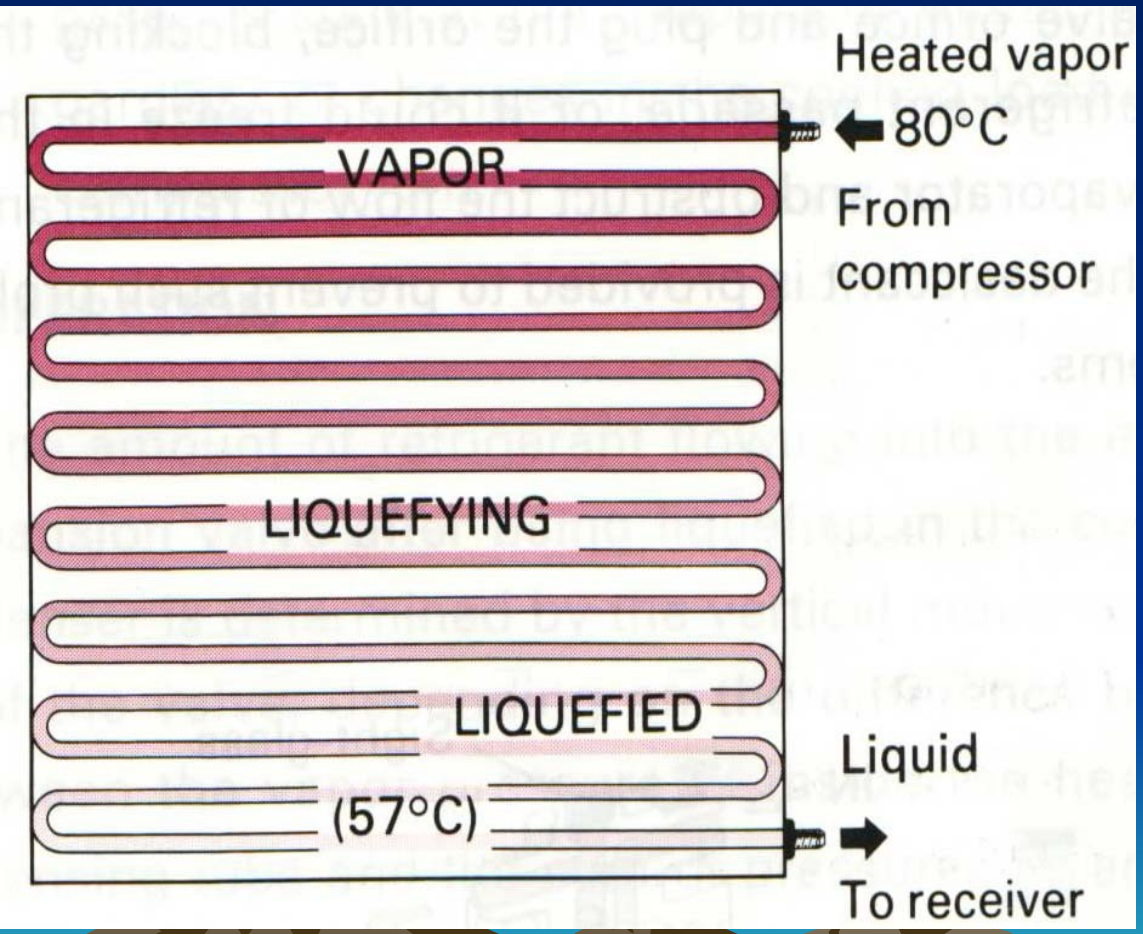
Rotating field clutch ?

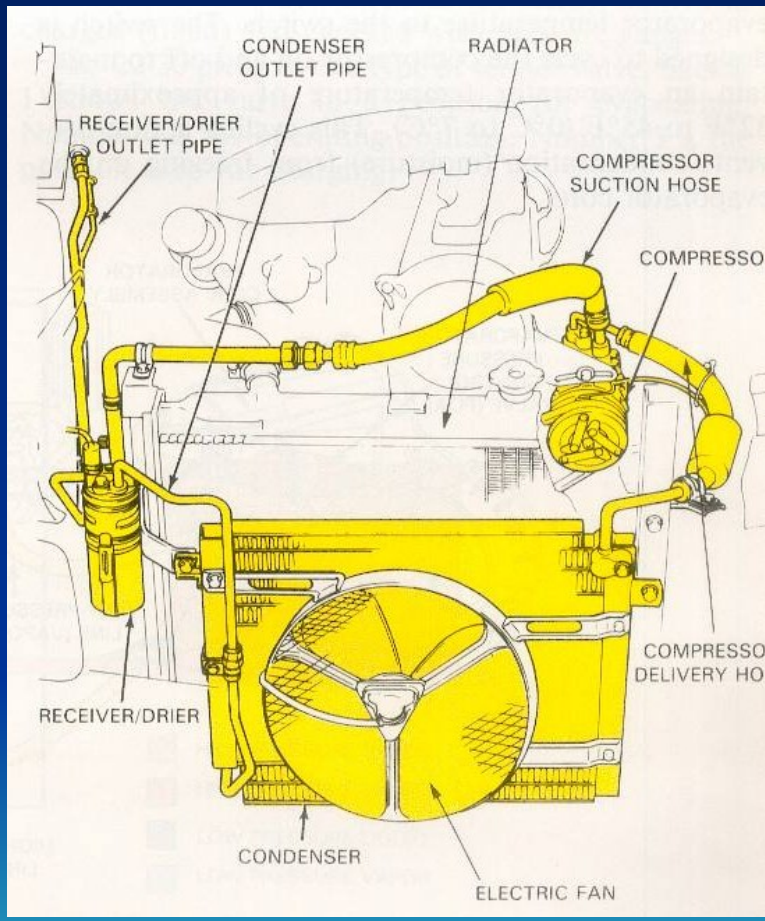
Condenser

- Is a kind of heat exchanger like radiator
- Changes high T_o refrigerant gas to liquid
- The heat given off by the refrigerant is the sum of heat absorbed at the evaporator and the heat of the work required by the compressor



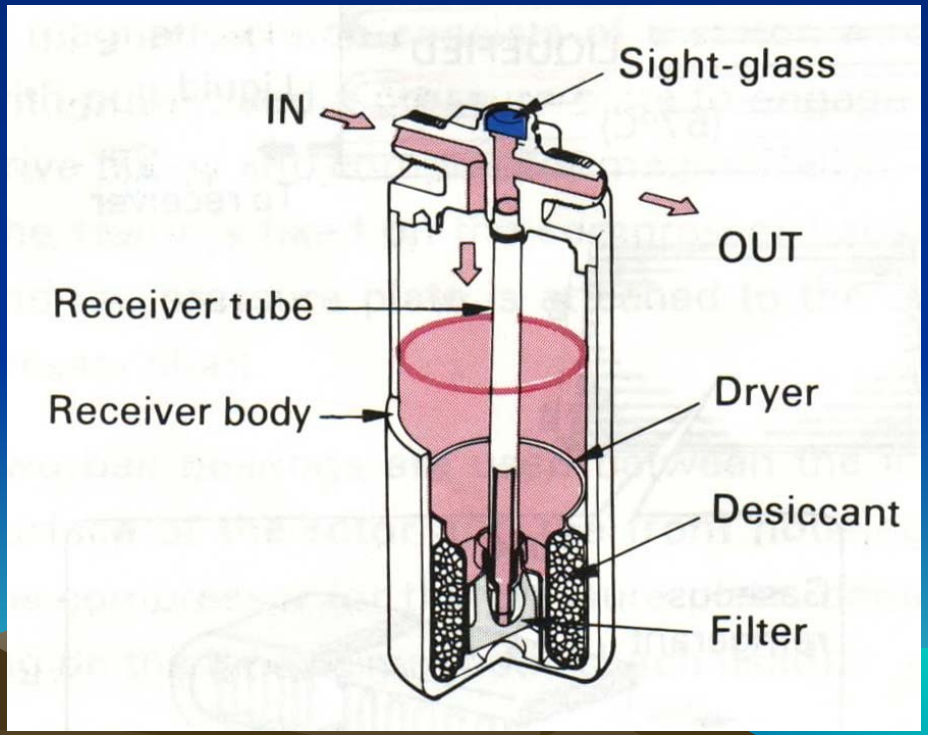
Condenser


Heated vapor
80°C
From compressor
VAPOR
LIQUEFYING
LIQUEFIED
(57°C)
Liquid
To receiver


CONDENSER OUTLET PIPE
RADIATOR
RECEIVER/DRIER OUTLET PIPE
COMPRESSOR SUCTION HOSE
COMPRESSO
COMPRESSO DELIVERY HO
RECEIVER/DRIER
CONDENSER
ELECTRIC FAN

Receive-drier

- Is a metal tank used to store extra refrigerant and remove moisture from the system by means of a special desiccant (drying agent or silica gel).



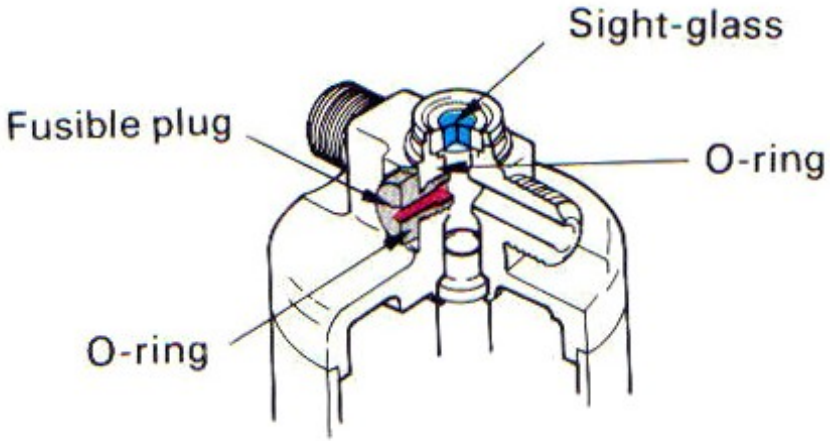
Receive-drier..

Safety devices in the receiver /drier

-fusible (melt bolt), 2,942kpa and 95-100^{0}c

-sight glass

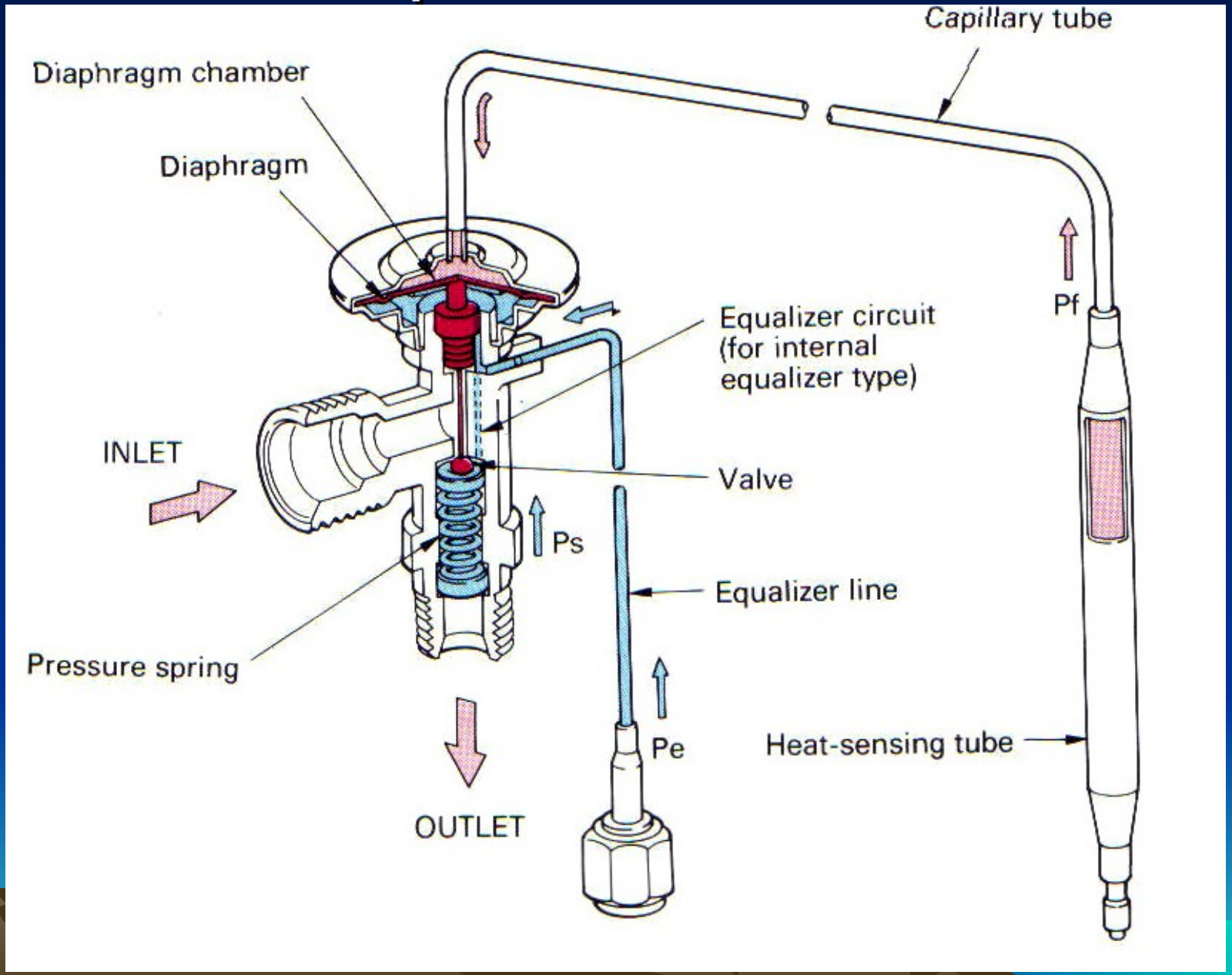
-high and low pressure switch



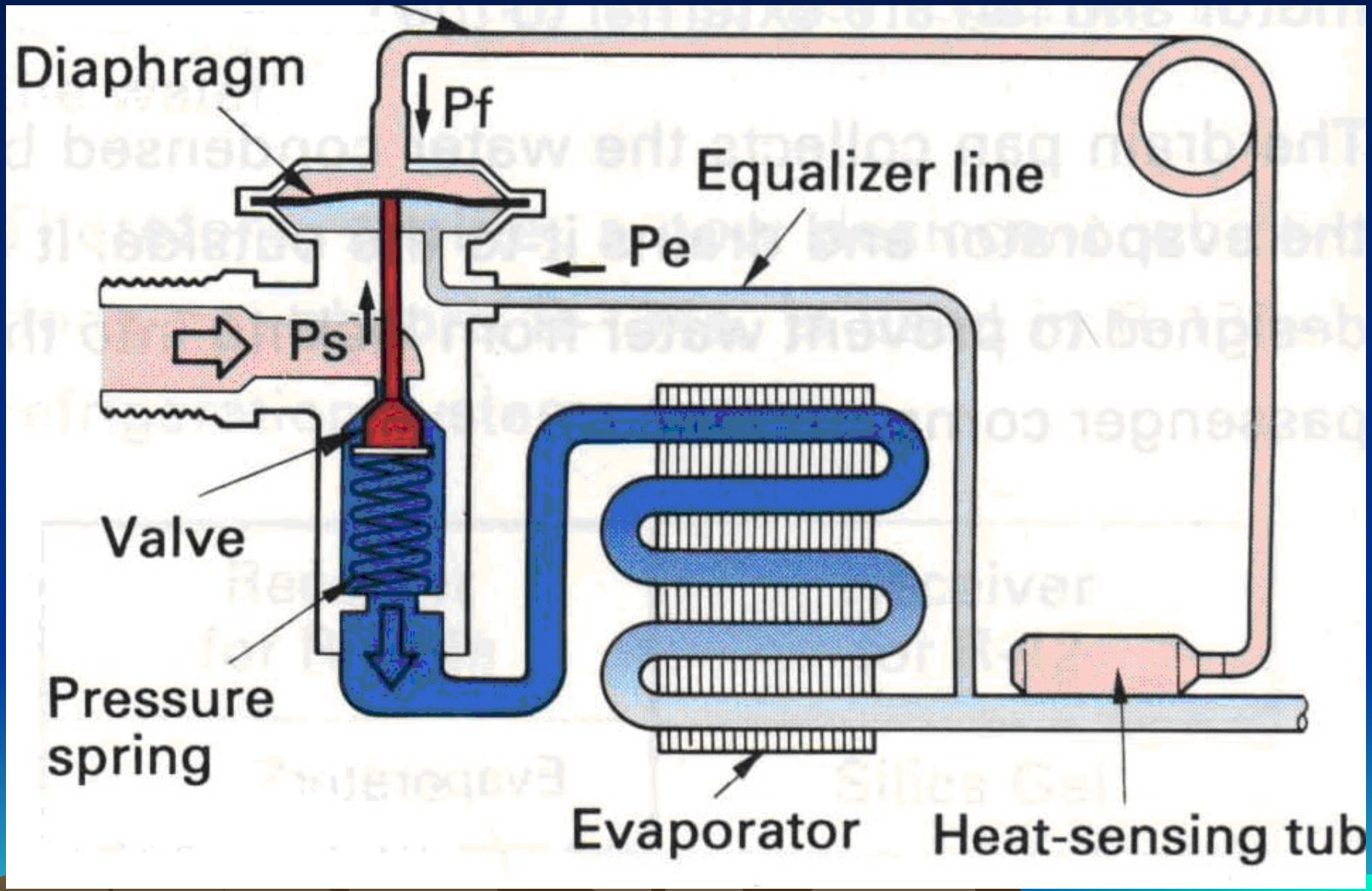
Expansion valve

- Is located between receiver/drier and evaporator.
- Two types of expansion valve
  - -Constant pressure expansion valve
  - -Thermal expansion valve
    - -Internally equalizer
    - -Externally equalizer
- Has two functions
  - Lowers the pressure and T_o of refrigerant.
  - Controls the cooling load

Expansion valve



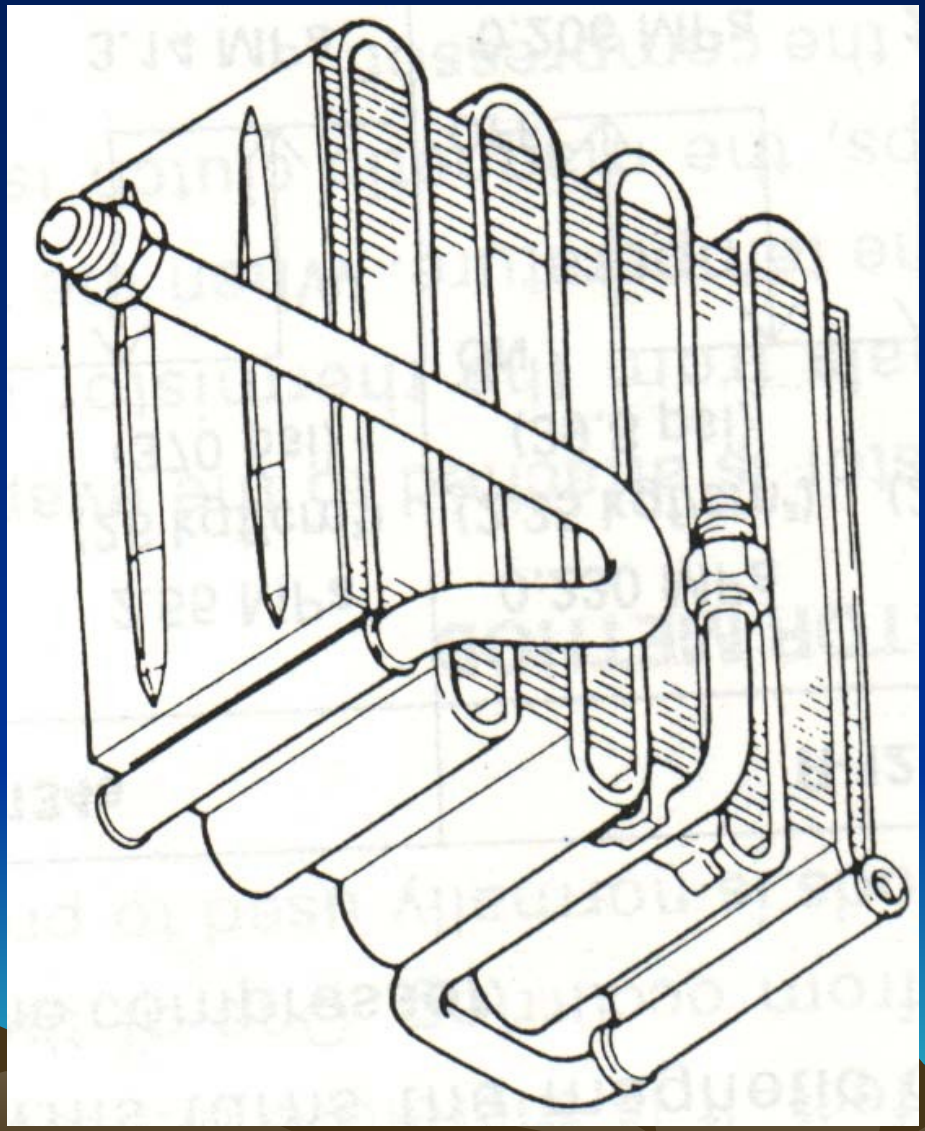
Externally Equalizer



Evaporator

- Located inside the driver compartment
- It serves as heat absorption component
- Its ideal To is 0^{o}c (32^{o}f)
- Has two functions
  - To remove heat from the inside of your vehicle
  - To dehumidify the incoming air

Evaporator



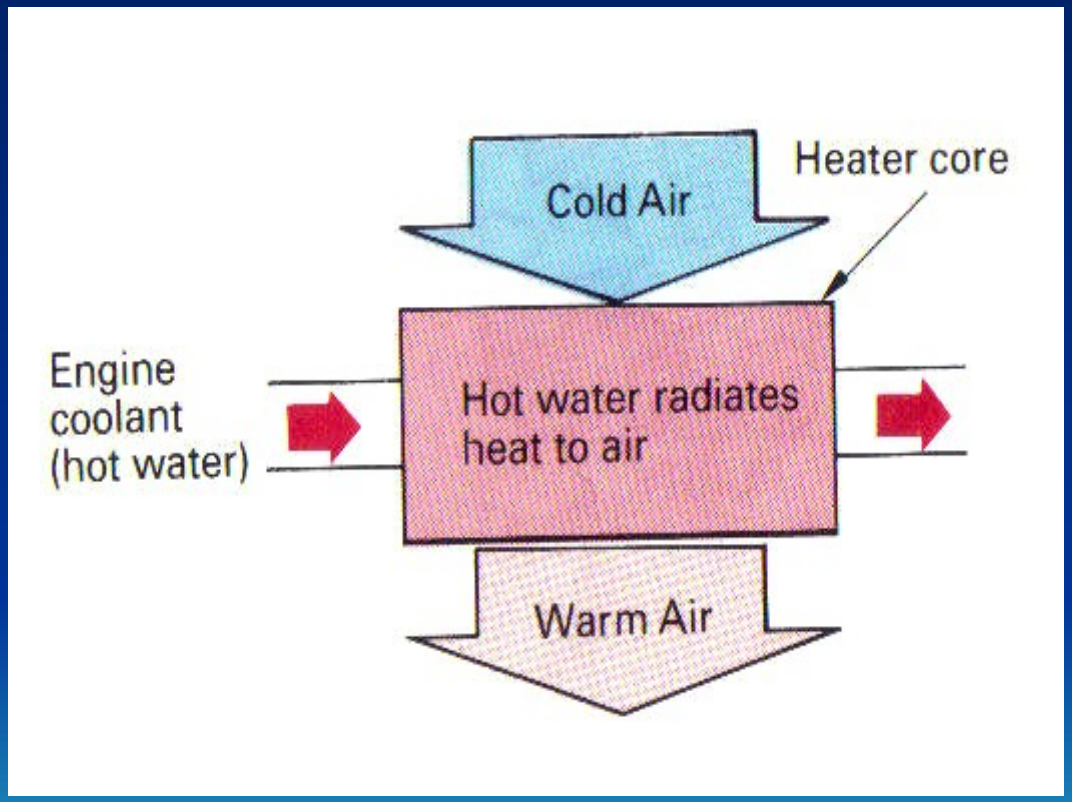
Refrigerant oil

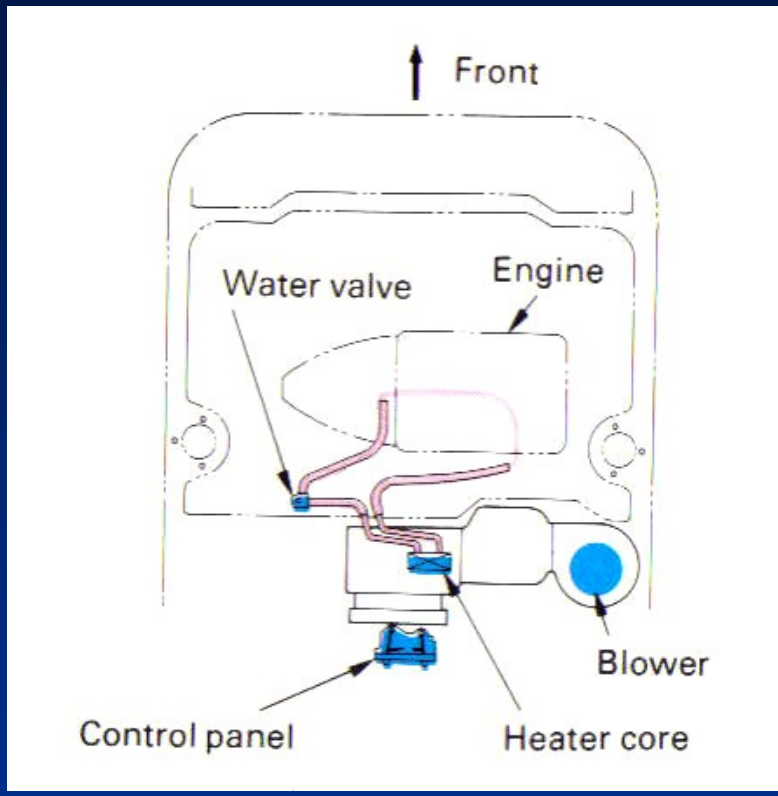
- In order to function properly, an A/C system requires the appropriate type and amount of oil.
- Mineral oil is the lubricant used for all R-12 systems.
- R-134a systems use synthetic oils such as PAG (polyalkylene glycol) and POE (polyolester).

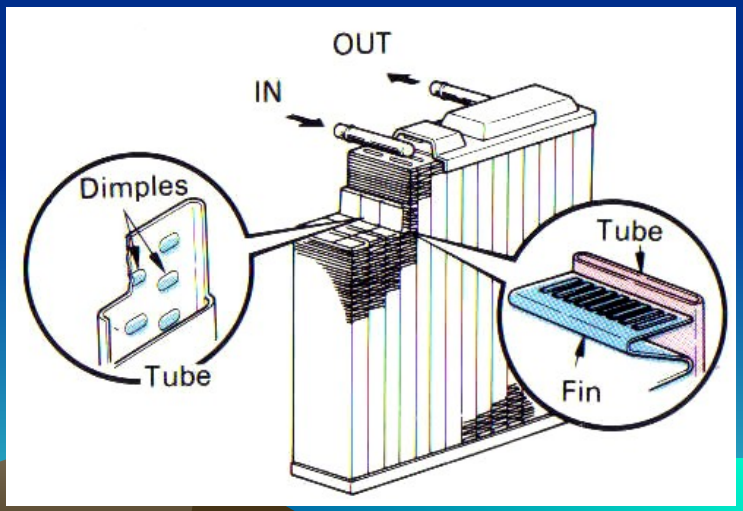
Heating

- Is a device that heats the air inside the vehicle
- Types of heater
  - Hot water heater (widely used)
  - Combustion heater
  - Exhaust heater

Heater

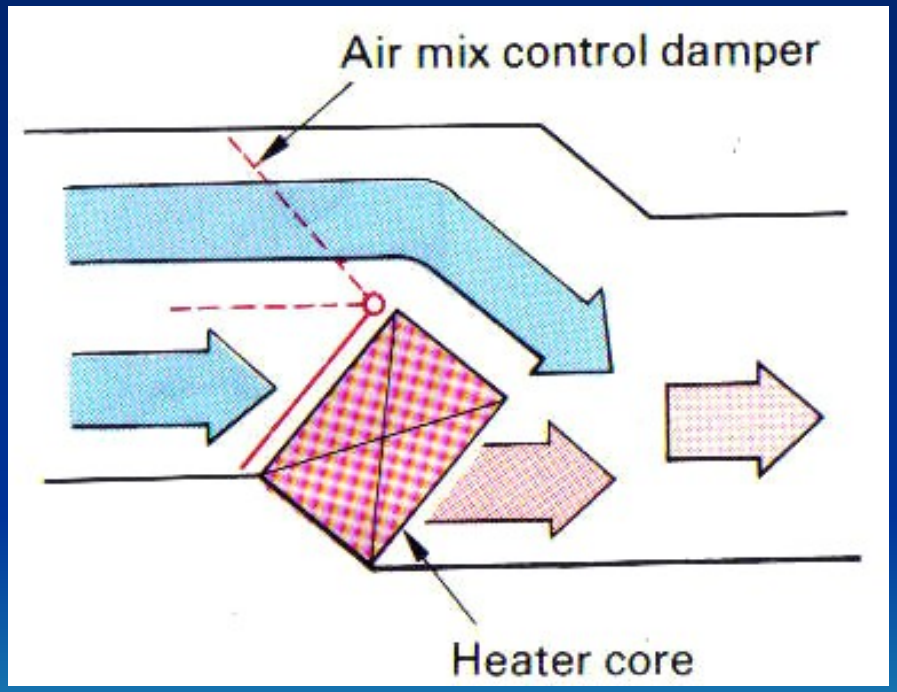

Cold Air
Heater core
Engine
coolant
(hot water)
Hot water radiates
heat to air
Warm Air


Front
Water valve
Engine
Blower
Control panel
Heater core

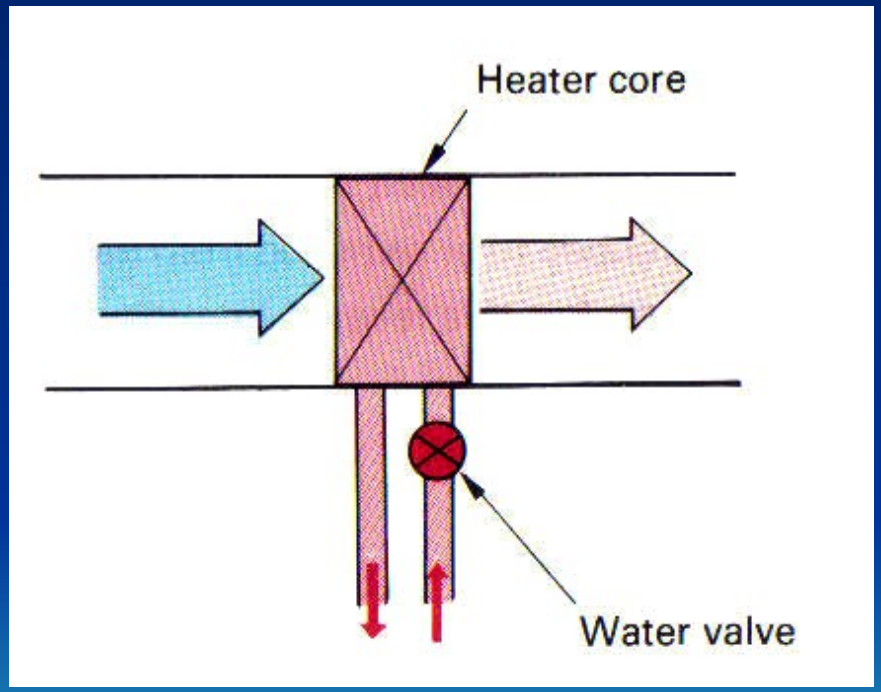

OUT
IN
Dimples
Tube
Tube
Fin

Types

Air mix type

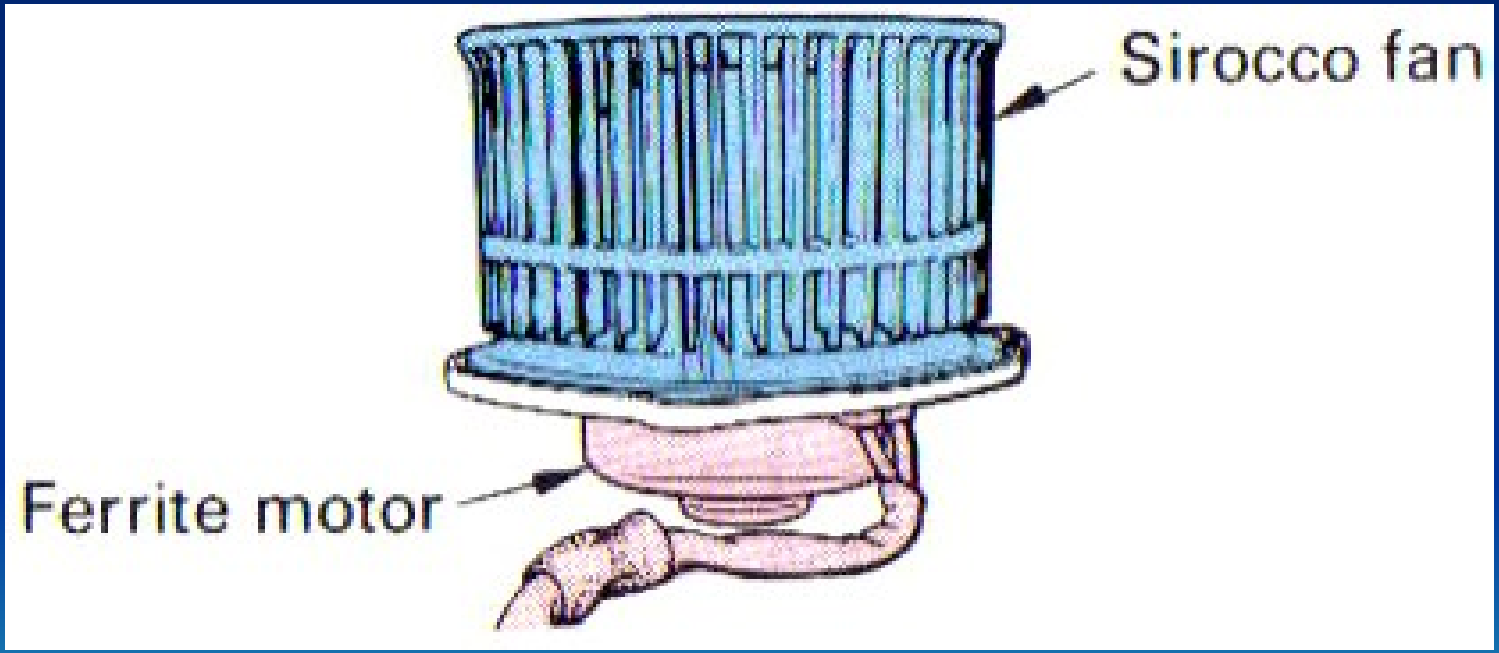


Water flow control type

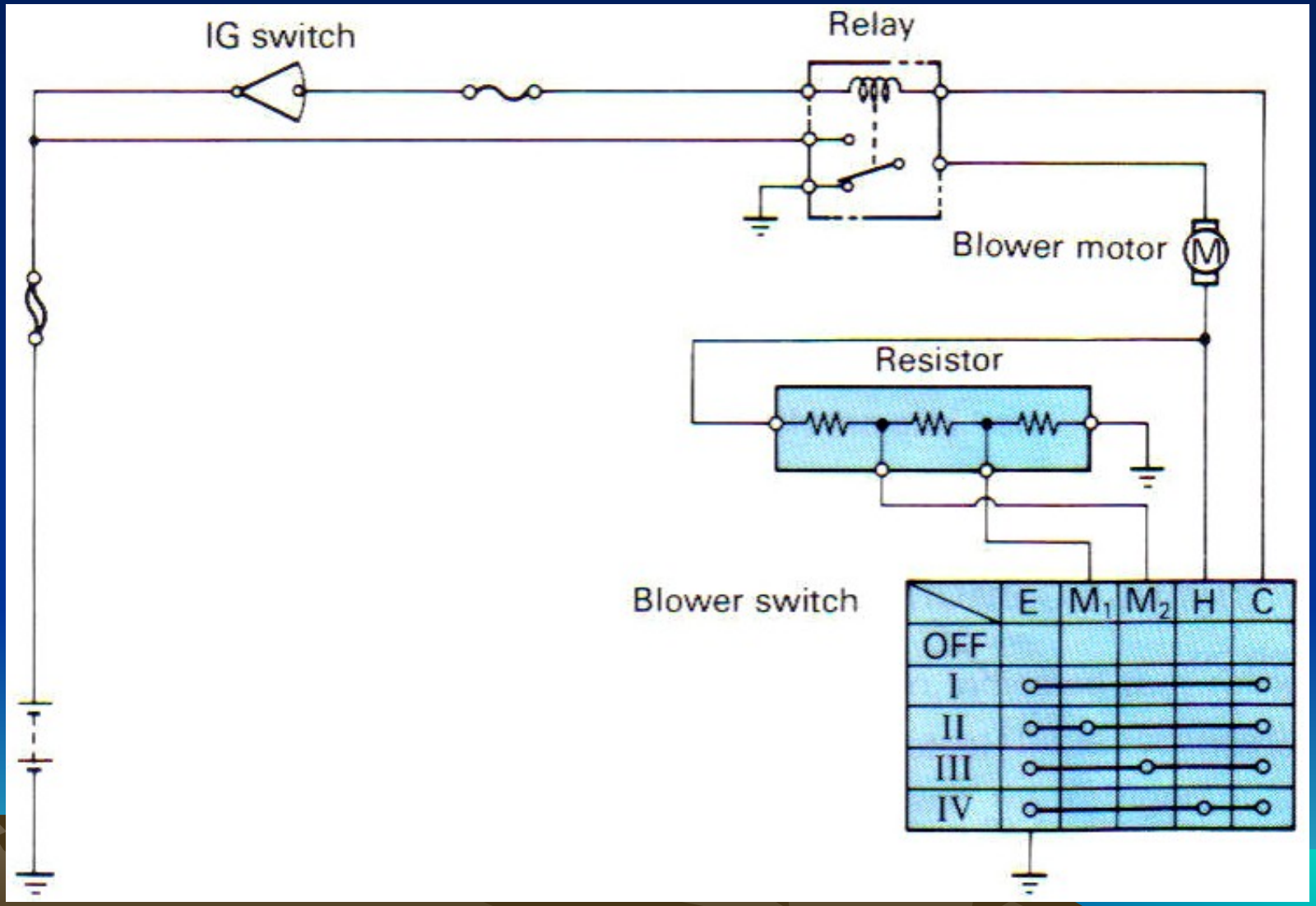


Blower

- It consists of a motor and fan



Blower control Circuit

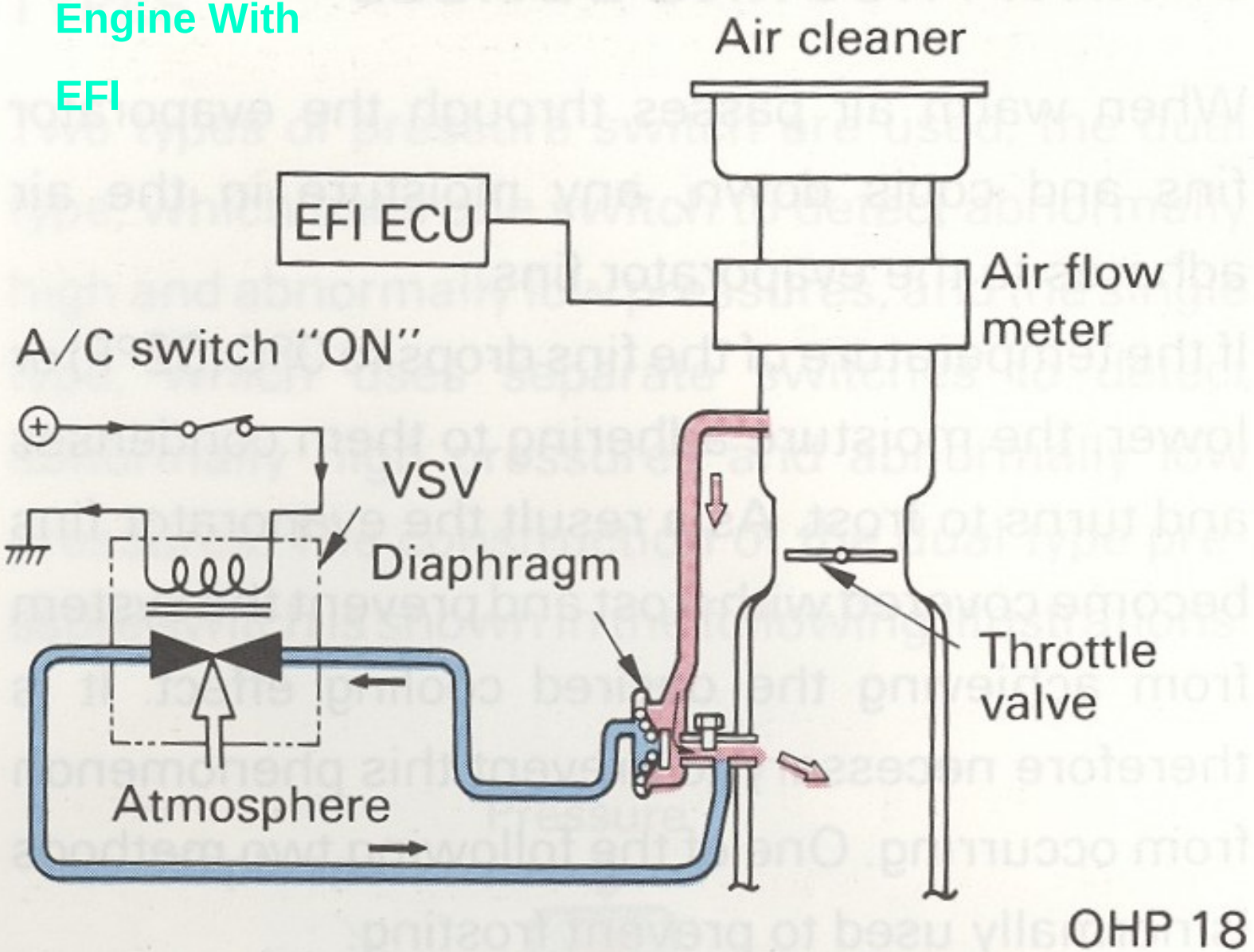


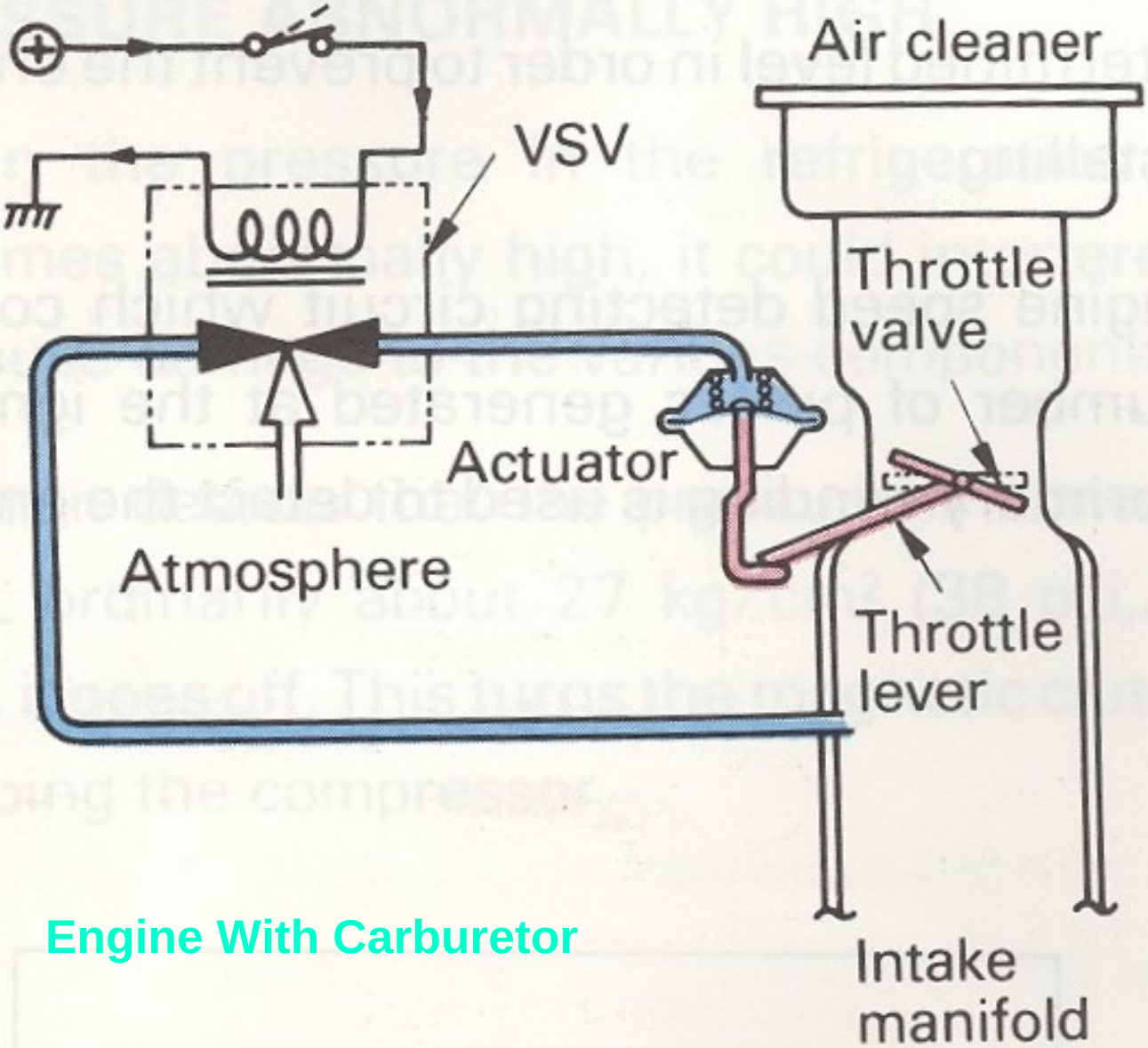
Idle up device

- When driving in heavy city traffic or standing still, where the engine is running at idle or nearly idle speed range, the engine out put is small so that operating the compressor under this condition will place excessive load on the engine, with possibilities of overheating or stalling.

- For this reason an idle-up device is used to forcibly raise up the idling speed and permit the cooler to operate if air conditioning is desired when driving in heavy traffic or when standing still.

Engine With EFI



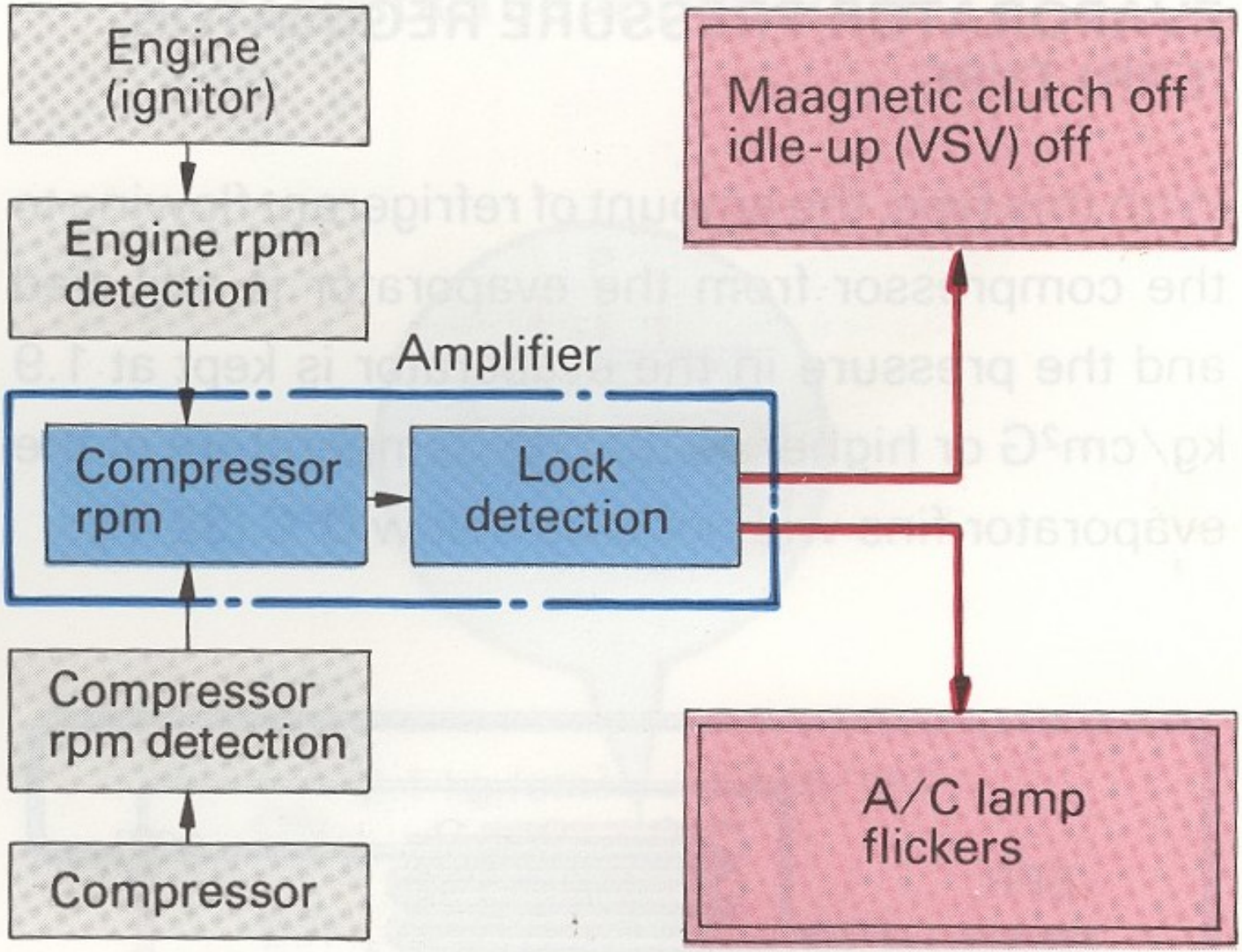


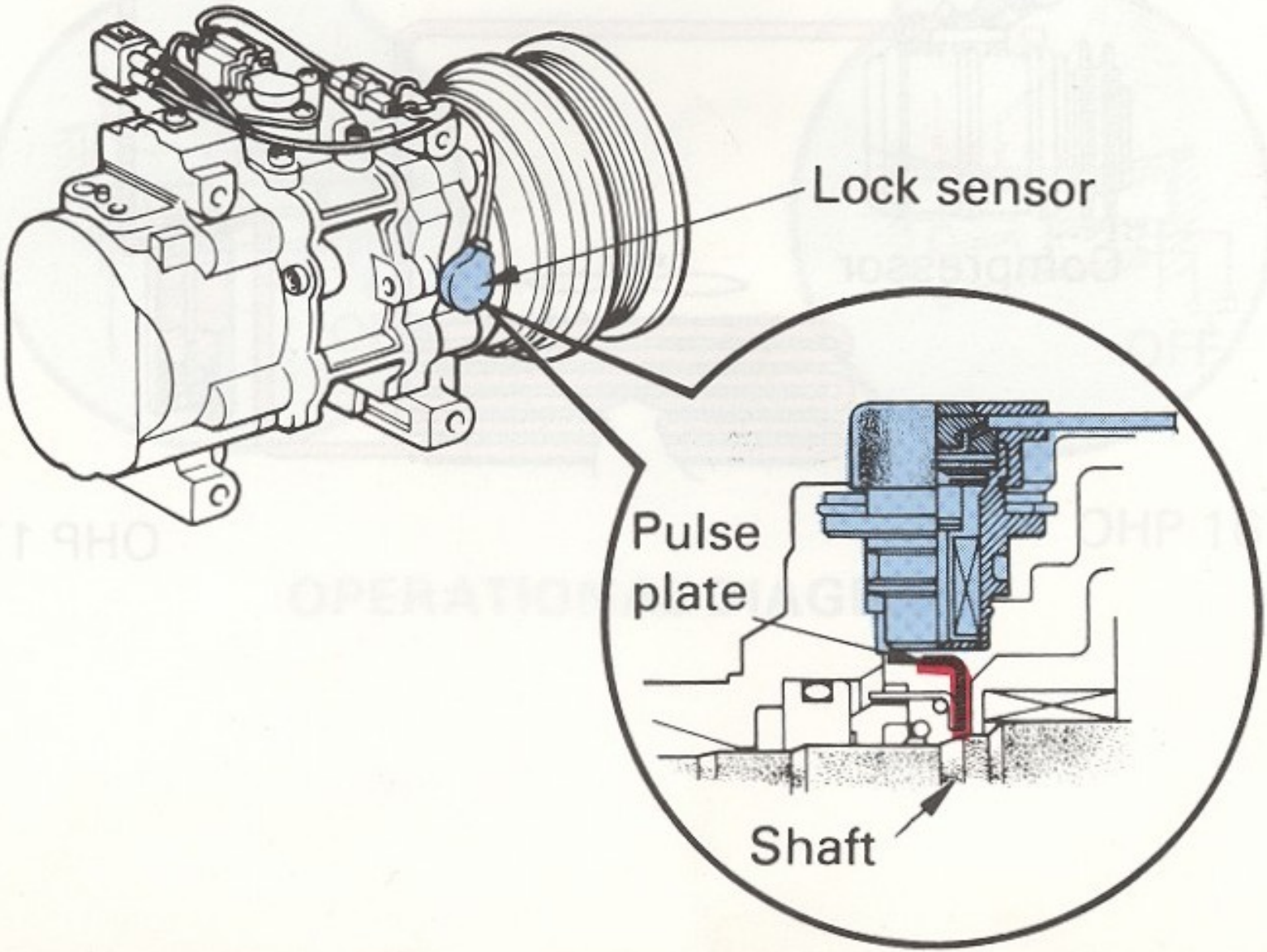
Engine With Carburetor

OHP 18

Compressor Belt Protection System

- Should the compressor lock due to failure, this safety turns off the magnetic clutch and idle-up VSV to prevent belt breakage and also cause the air conditioner switch lamp to blink to inform the driver of the occurrence of cooler trouble.


Engine (ignitor)
Engine rpm detection
Amplifier
Compressor rpm
Lock detection
Compressor rpm detection
Compressor
Maagnetic clutch off idle-up (VSV) off
A/C lamp flickers


Lock sensor
Pulse plate
Shaft

Automatic Air Conditioning System

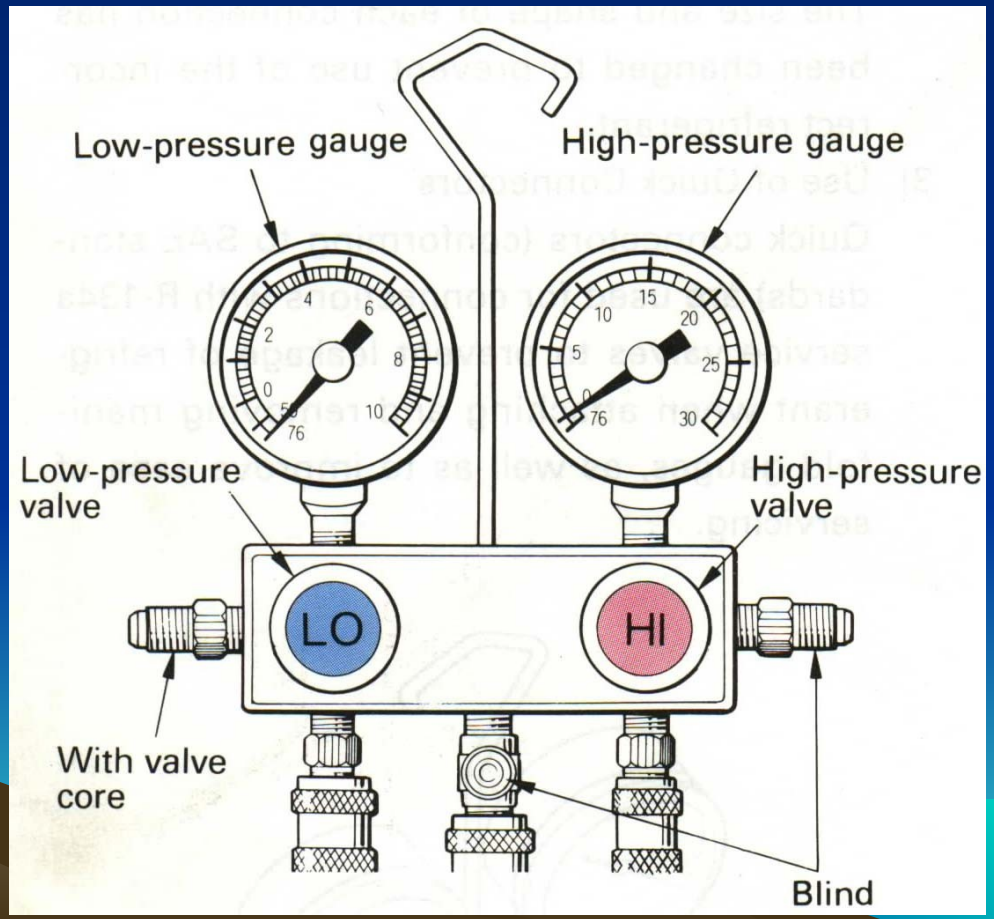
Read about

- Automatic air conditioning
- Servicing and repair of air condition

Service

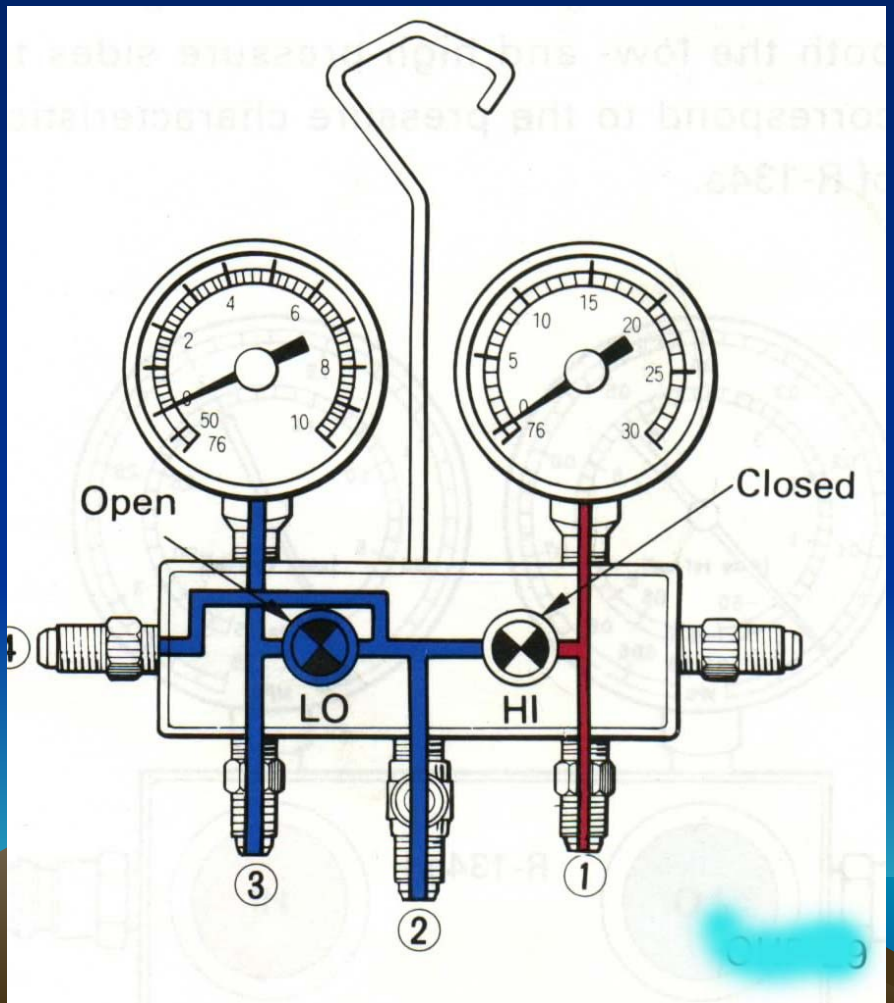
Manifold gauge

Is used for evacuating, charging and, for troubleshooting



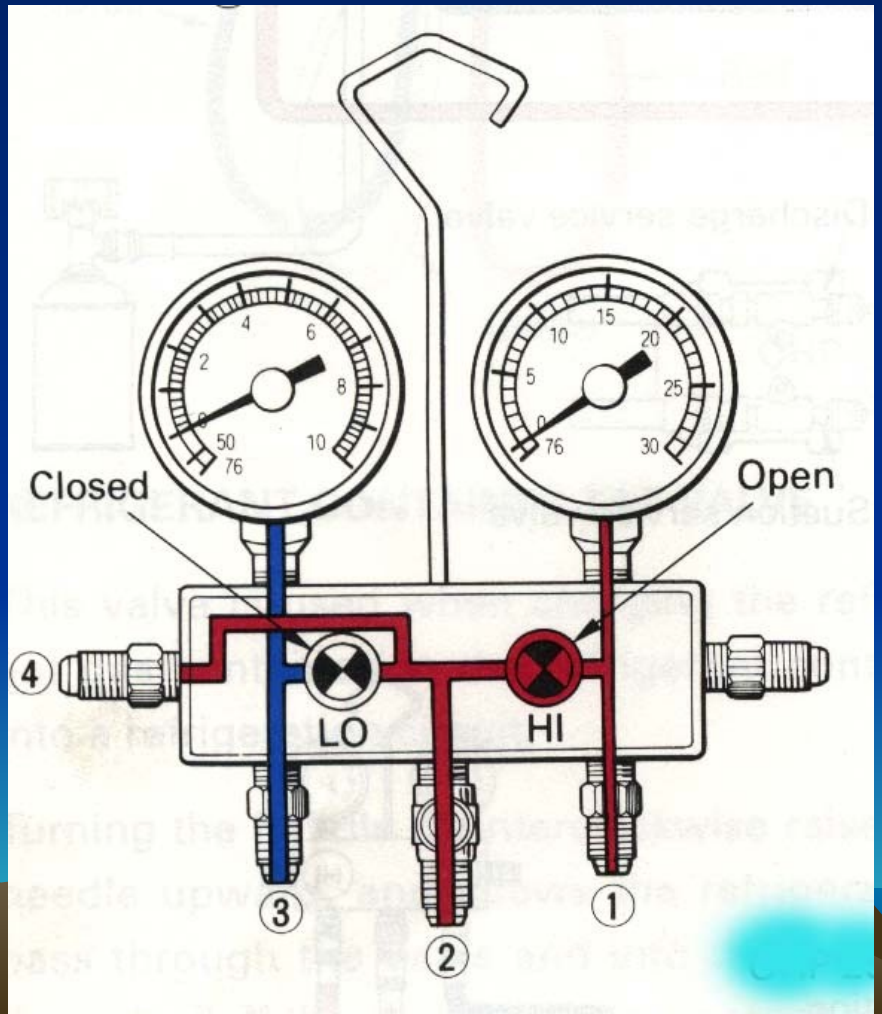
Manifold gauge

- When low-pressure valve (LO) is open and high pressure valve (HI) is closed.



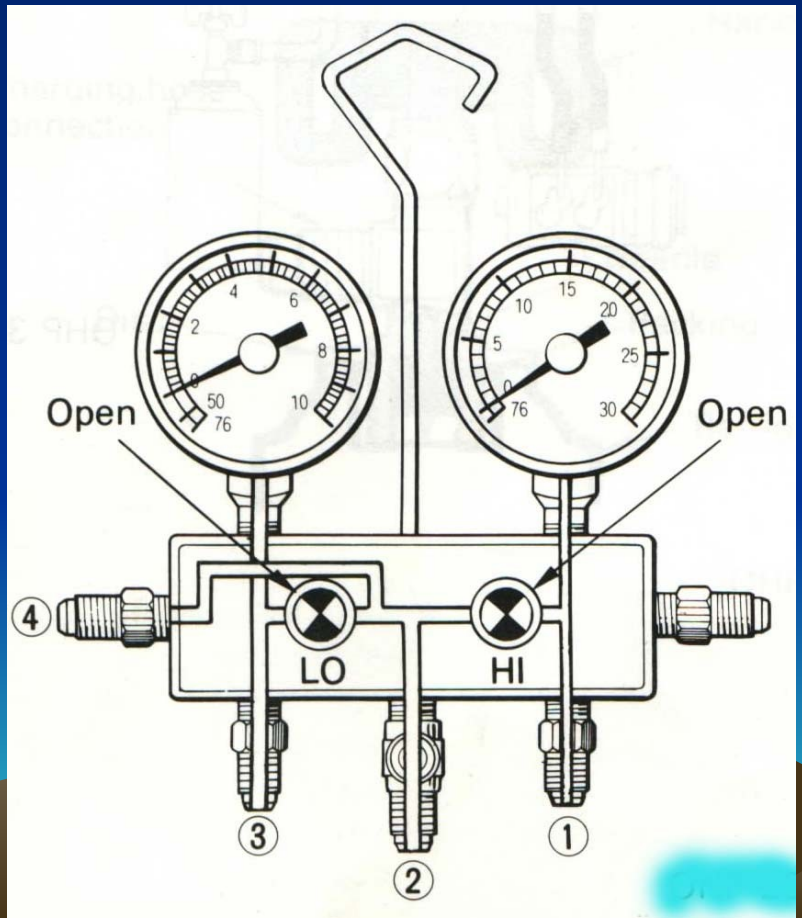
Manifold gauge

- When low-pressure valve (LO) is closed and high-pressure valve (HI) is open



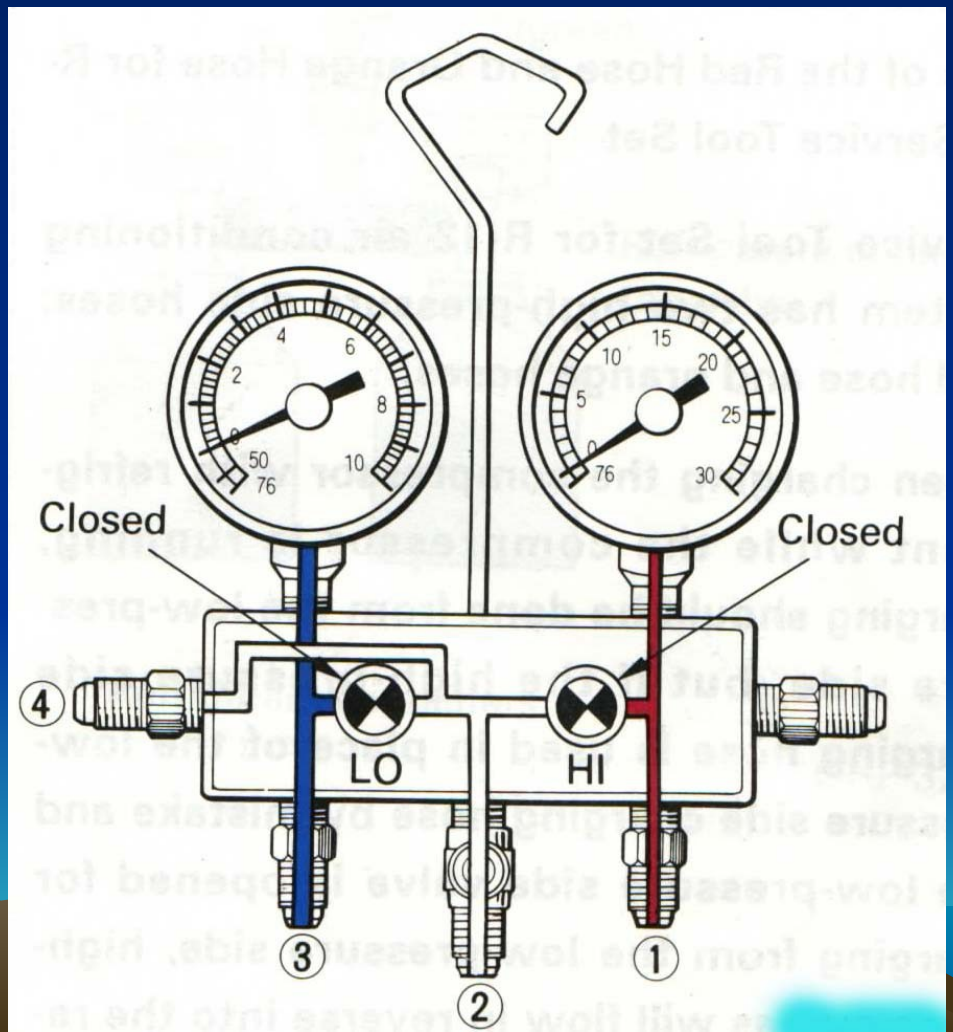
Manifold…

- When both low-pressure valve (LO) and high-pressure valve (HI) are open, all passages are open.



Manifold..

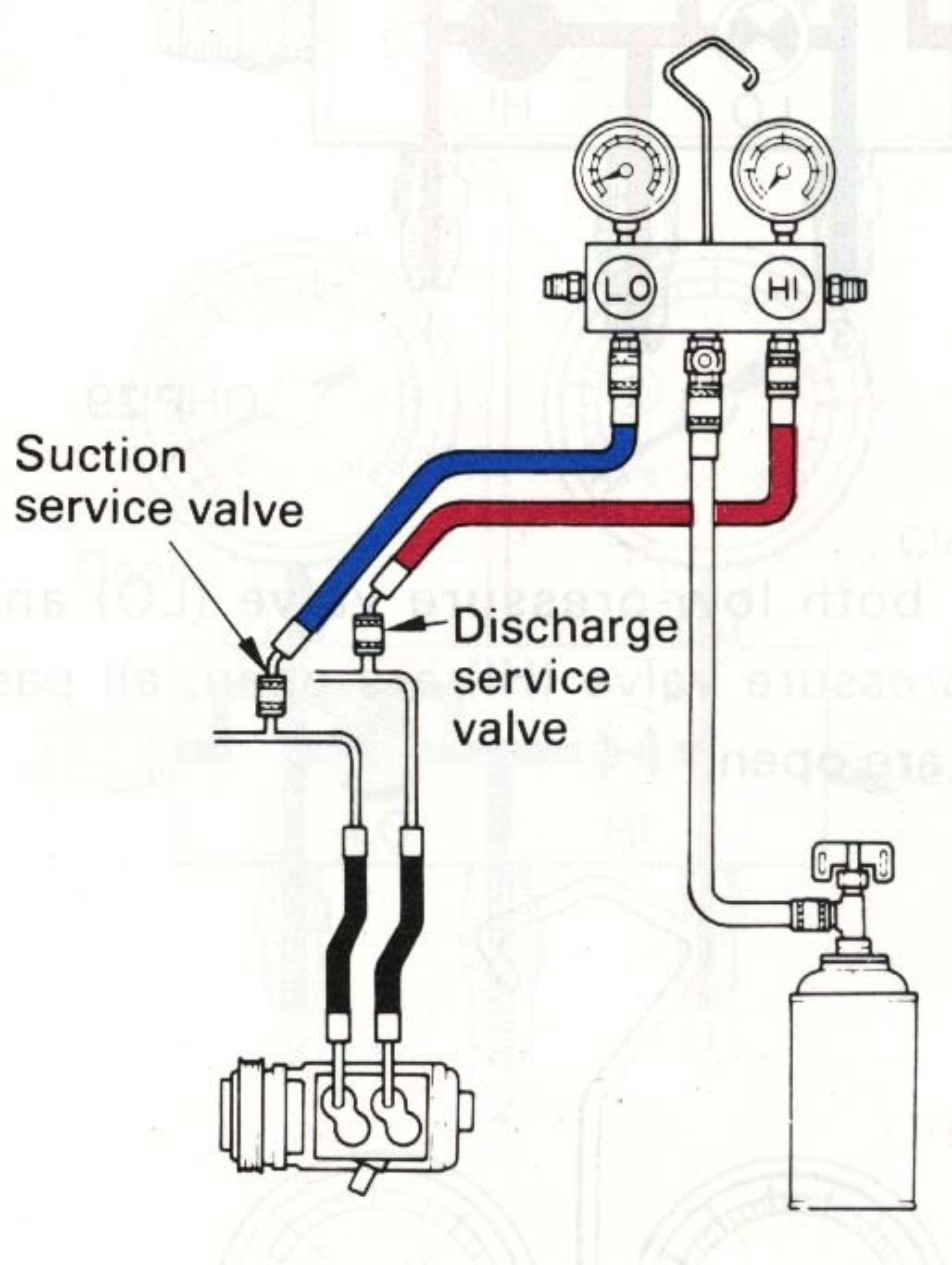
- When both low-pressure valve (LO) and high-pressure valve (HI) are closed.



Refrigerant Charging Hoses

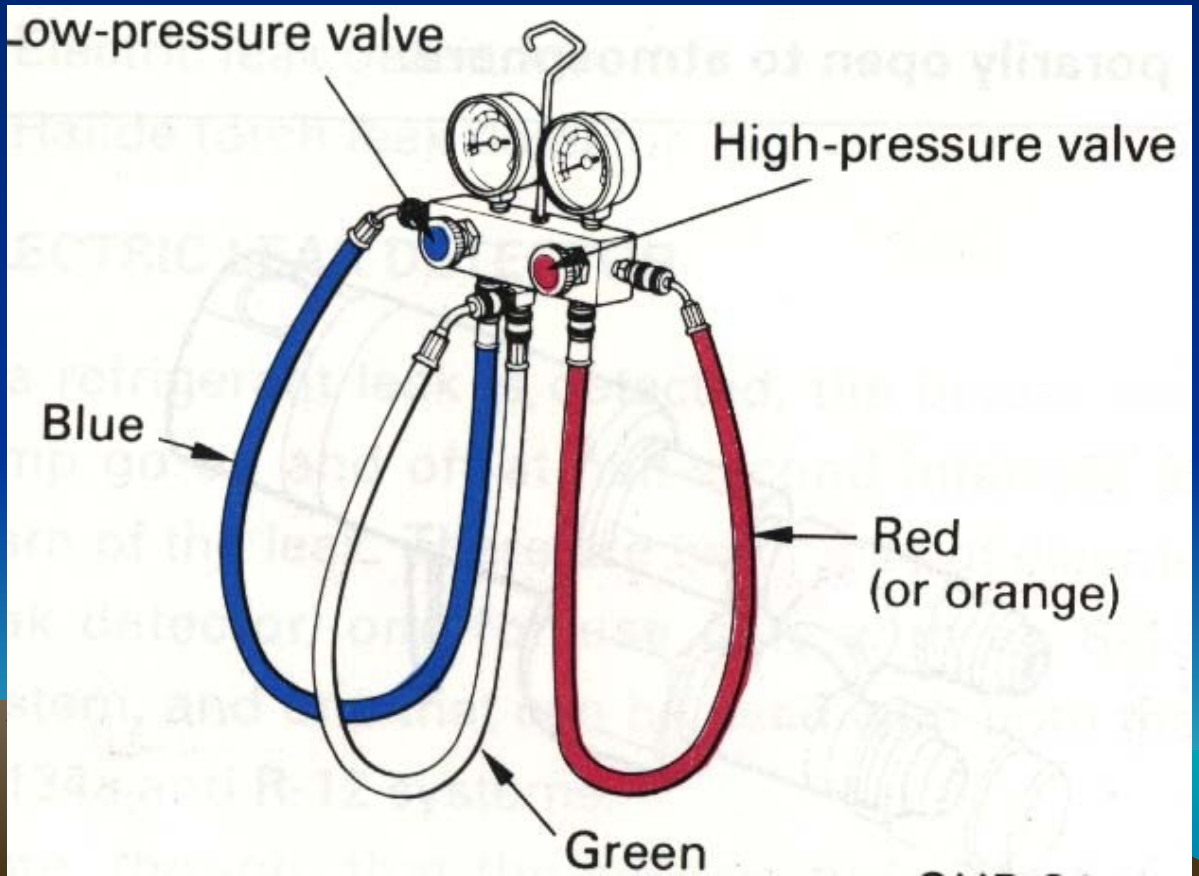
- Hoses are differentiated by color red (orange), green and blue. As a general rule, the blue hose is used at the low-pressure side, the green hose at the charging side, and the red (orange) hose at the high-pressure side.

Refrigerant Charging..



Refrigerant Charging

- When the manifold gauge set is not in use, connect the end of the hose to a spare fitting of the refrigerant charging hose.



Evacuating The System

- Refrigerant has the property of being very insoluble in water.

- BY applying low pressure (986.583kpa / 740mmhg) it is possible to remove/reduce this moisture. (water boils at 22.5^{o}c)

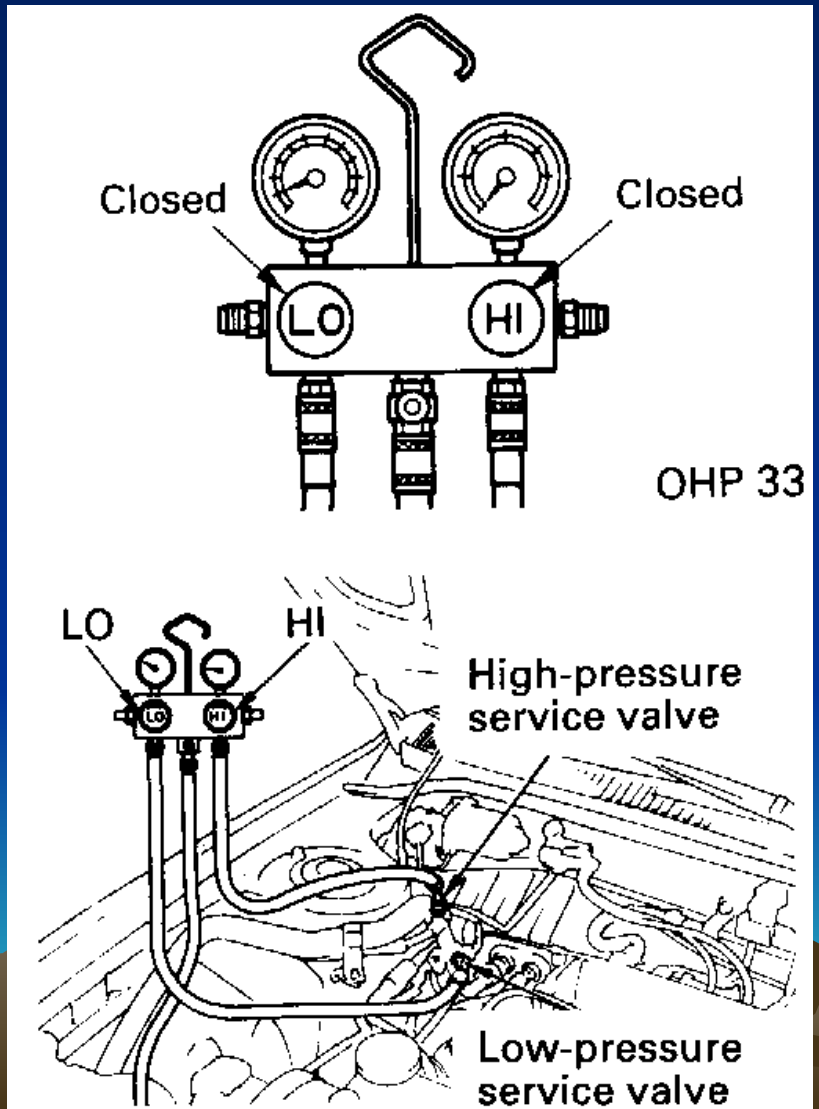
Installation of the Gauge

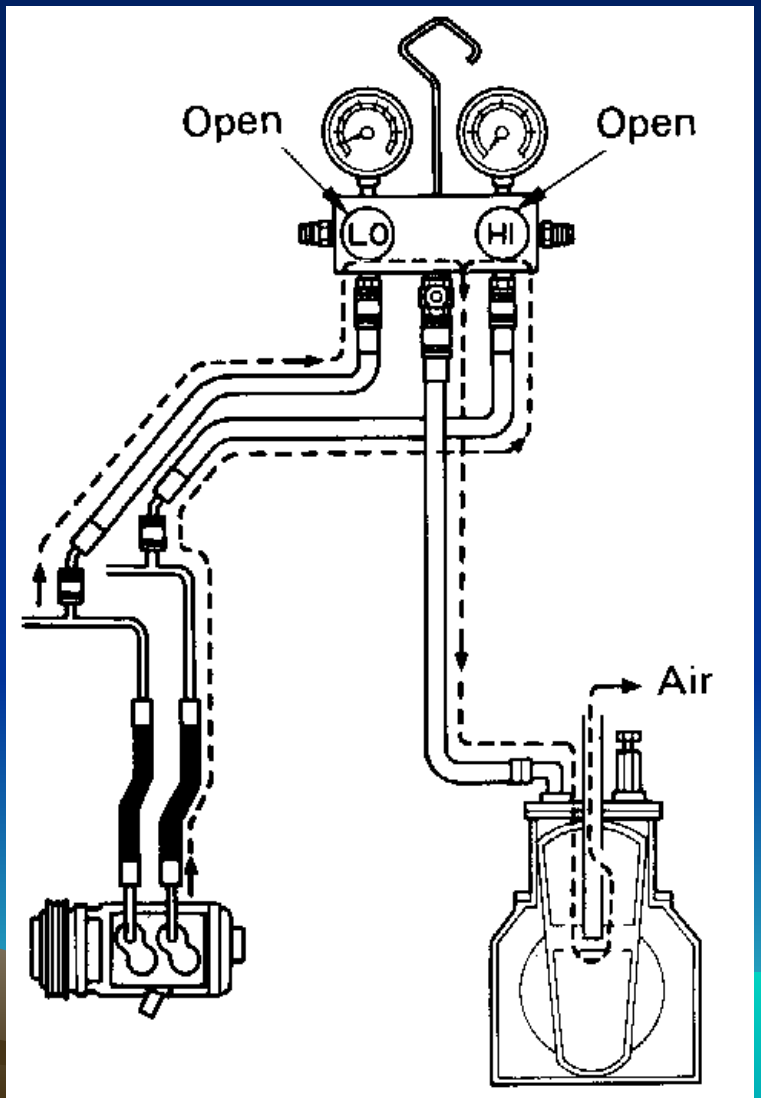
1. Close both the high and low-pressure hand valves of the manifold gauge.
2. Connect the low-pressure hose to the low-pressure service valve and the high-pressure hose to the high-pressure service valve.
3. Tighten the hose nuts by hand, not with pliers.
4. Connect the center hose of the gauge to vacuum pump
5. Open both high and low pressure hand valves and turn on the vacuum pump.
6. After about ten minutes, check that the low-pressure gauge indicates more than 80.8 kPa (600 mmHg; 23.62 in.Hg) of vacuum.

Continued..

7. Continue evacuating the air from the system until the low pressure gauge indicates a vacuum of 100.0kpa(750mmHg; 29.53in Hg).
8. (e) Close both the high and low pressure hand valves and stop the vacuum pump, then leave the system in this condition for five minutes or longer and check that there is no change in the gauge indication.

Continued


Closed
Closed
LO
HI
OHP 33
LO
HI
High-pressure service valve
Low-pressure service valve


Open
Open
LO
HI
Air

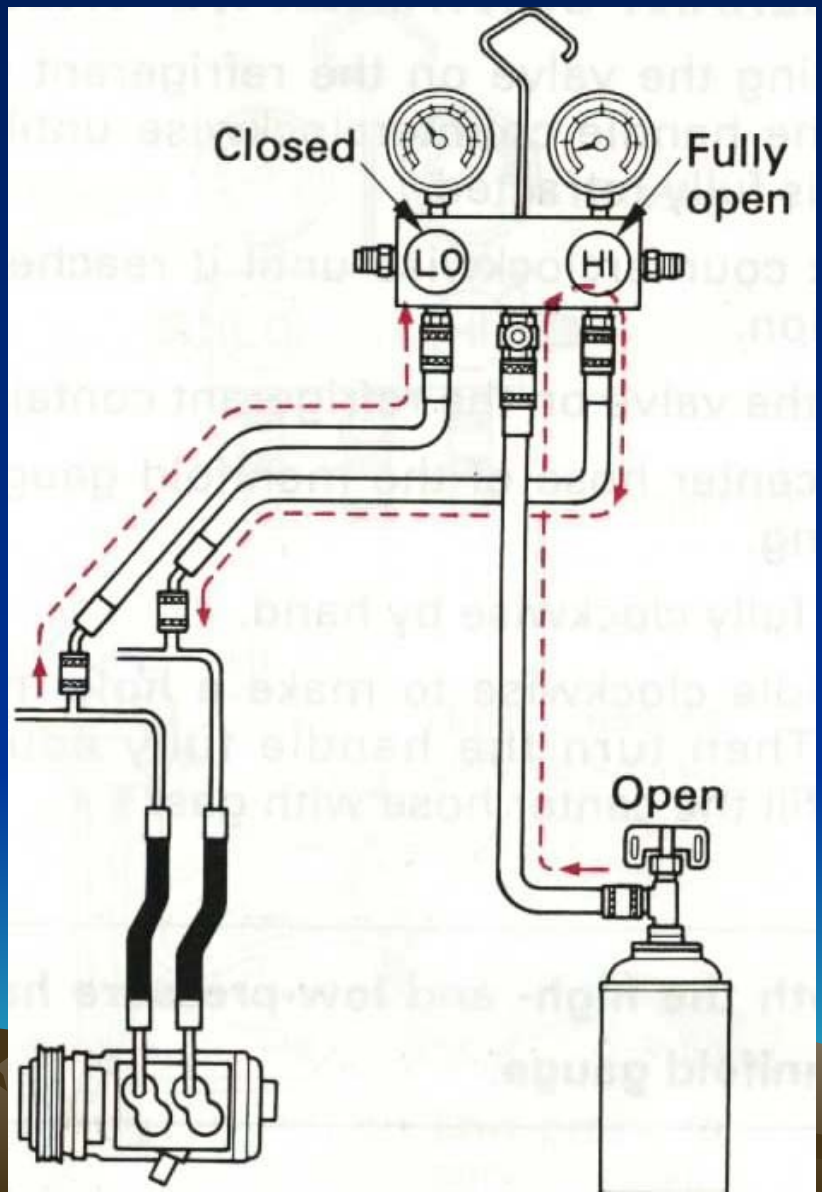
Charging

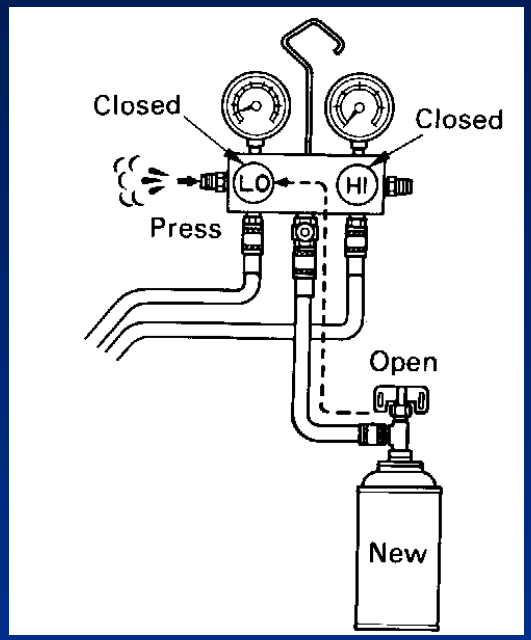
1. Open the high-pressure hand valve all the way.
2. Charge the system with one container of refrigerant, then close the high-pressure hand valve.

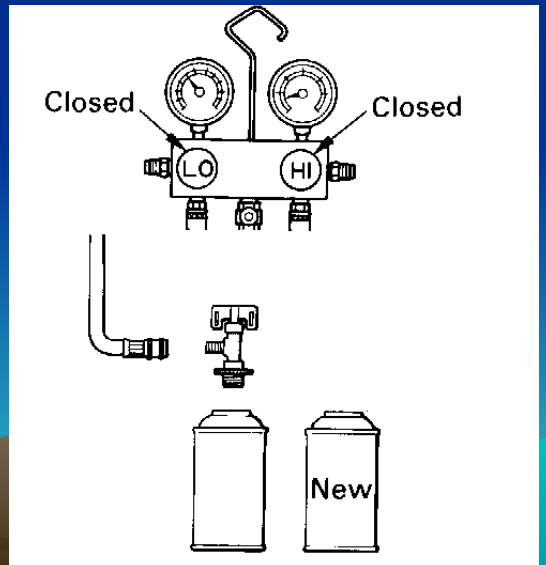
   replace with new container of refrigerant
3. Close both the high and low-pressure hand valves.
4. Remove the container tap valve from the container.
5. Attach the container tap valve to a new refrigerant container as described in step 3.

Never run the engine when charging the system through high-pressure side.

Charging..

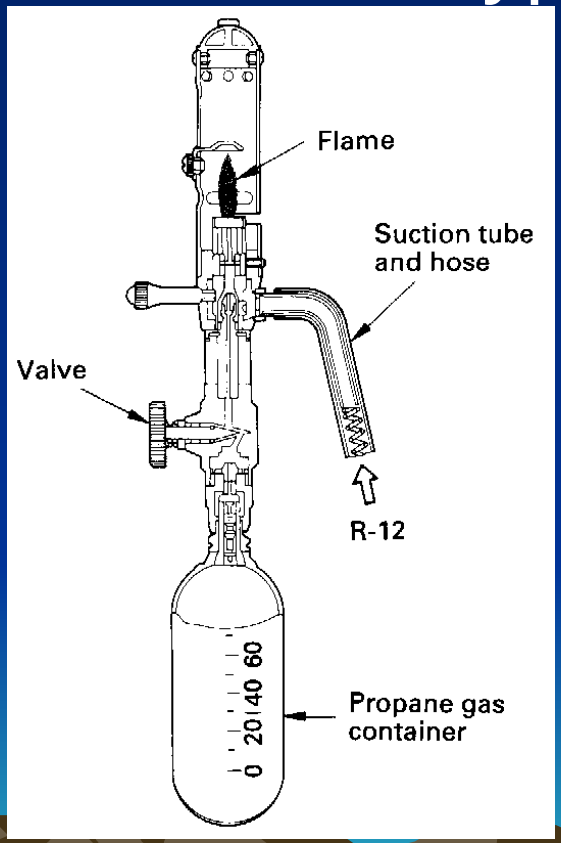

Closed
Fully open
LO
HI
Open


Closed
Closed
LO
HI
Press
Open
New

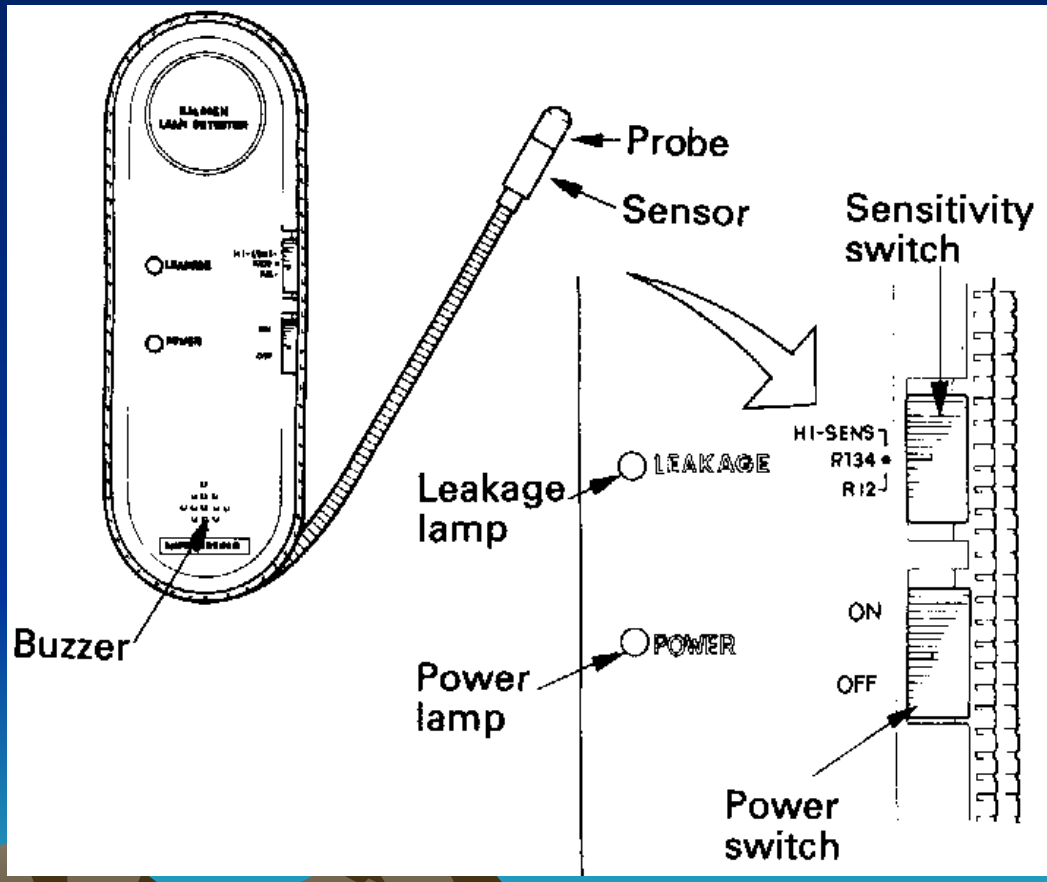

Closed
Closed
LO
HI
New

Leak Detector

- A tester that can detect leakage of refrigerant gas is called leak detector; there are two types:



Halide leak detector



Electric leak detector