INTRODUCTION

The compressor is the main moving component of the vapour-compression system (Figure 2.2). It provides the system with the force to draw the vapour from the evaporator to force it into the condenser by creating a high pressure, and to maintain circulation of the refrigerant.

The compressor's work begins by its creating a low-pressure region on the low side of the system, which allows the low-temperature vapour to flow from the evaporator through the suction line to the compressor.

The function of a compressor is to maintain a pressure difference between the high and low sides of the system. Conditions are created in which the pressure and temperature of the refrigerant in the evaporator are lowered, allowing the refrigerant to boil and absorb heat from the surroundings; and the pressure and temperature of the refrigerant in the condenser are raised, allowing the refrigerant to give up heat at existing temperatures to whatever medium is used to absorb heat.

To transfer heat from the interior of a cabinet or room to the outside, some type of heat carrier must be used.

In a standard mechanical cooling system, heat is removed by evaporating a liquid refrigerant in the evaporator and rejecting that heat in the condenser, and in so doing, changing the vapour back to a liquid.

The compressor is the main moving component of the vapour-compression system. It provides systems with the force to draw the vapour from the evaporator to force it into the condenser by creating a high pressure, and to maintain circulation of the refrigerant.

The compressor's work begins by creating a low-pressure region on the low side of the system, which allows the low-temperature vapour to flow from the evaporator through the suction line to the compressor.

The function of a compressor is to maintain a pressure difference between the high and low sides of a system. Conditions are created in which the pressure and temperature of the refrigerant in the evaporator are lowered, allowing the refrigerant to boil and absorb heat from the surroundings; and the pressure and temperature of the refrigerant in the condenser are raised, allowing the refrigerant to give up heat at existing temperatures to whatever medium is used to absorb heat.

TYPES OF COMPRESSOR

The variety of refrigerants, and the varying size, location and application of systems, are some of the factors which create the need for many types of compressor. Since refrigerant properties differ, one compressor may be required to handle large volumes of vapour at small pressure drops, while another must handle small volumes at large pressure drops.
There are five main types of compressor:
- reciprocating
- rotary
- centrifugal
- screw
- scroll.

The action of the mechanical parts of a compressor determines its classification but, no matter what type of compressor is employed, the effect on the refrigerant is identical.

Operating principles
The basic operating principles of the various types of compressor are as follows.

**Type 1:** In a reciprocating compressor, a piston travels back and forth (reciprocates) within a cylinder.

**Type 2:** In a rotary compressor, an eccentric rotor rotates within a cylinder.

**Type 3:** In a centrifugal compressor, a rotor (or impeller), with many blades rotating in a housing, draws in vapour and discharges it at high velocity by centrifugal force.

**Type 4:** In a screw compressor, the vapour is compressed between two rotating screws in a reciprocating-type compressor, a plunger or

**Type 5:** In a scroll compressor, the vapour is compressed between two identical involute spiral scrolls. One scroll is fixed and the other rotates, compressing the vapour trapped between the lobes or threads.

The reciprocating compressor can be manufactured economically in such a wide range of sizes and designs and operate efficiently over a wide variety of conditions accounts for its popularity.

Reciprocating compressors can be of two types – vertical single-acting and horizontal double-acting. In single-acting compressors, compression of the vapour occurs only on one side of the piston and only once during each revolution of the crankshaft. Double-acting compressors, however, compress the vapour alternately on both sides of the piston so that compression occurs twice during each revolution. Double-acting compressors of the swash plate type are common in vehicle air-conditioning (see Figures 2.3 and 2.15).

The vertical single-acting compressor (Figure 2.4) has been developed to a high level of efficiency and is now used extensively. These compressors differ considerably in design according to their intended duty. Numerous combinations of the following design features are used in order to obtain the desired flexibility:
- number and arrangement of cylinders
- type of piston
- arrangement of valves
- crank and piston speeds
- bore and stroke of piston
- type of crankshaft
- method of lubrication.

The reciprocating compressor is easy to construct, easy to service and has other excellent qualities. Even though its parts can be fitted with relatively wide tolerance, it has a high pumping efficiency.

Operation cycle
The reciprocating compressor basically consists of a cylinder with a piston fitting closely inside. When the piston moves downwards (Figure 2.5), a low pressure is produced above it in the cylinder. The pressure in the suction line forces the suction valve open and vapour enters the cylinder. When the piston moves upwards, the vapour is compressed and, when its pressure is greater than the pressure in the discharge line, the discharge valve is forced open. Flapper or reed valves prevent the vapour from returning to the crankcase.

Reciprocating compressors are by far the most widely used, being employed in all fields of refrigeration. They are especially adaptable for use with refrigerants requiring relatively small displacement and condensing at relatively high pressures. Among the refrigerants used with reciprocating compressors are R22, R134a, R402A, R403A and R717 etc.

Most current compressors can be used with any refrigerant with minor changes such as different-sized valves for each type – and for ammonia the use of steel components (no copper or brass).

Reciprocating compressors are available in sizes varying from 60 W for small domestic up to 150 kW or more. The fact that the
Cylinders

The number of cylinders varies from one to as many as 16. In multi-cylinder compressors, the cylinders may be arranged in-line, radially or at angles to form a ‘V’ or ‘W’ pattern. For two- and three-cylinder compressors, the cylinders are usually arranged in line.

Where four or more cylinders are employed, ‘V’, ‘W’ or radial arrangements are usually used. In-line arrangements have the advantage of requiring only a single valve plate, while ‘V’, ‘W’ and radial arrangements provide better running balance and permit the cylinders to be staggered so that the overall compressor length is shorter (Figure 2.6).

Figure 2.4: Cross-section of open-type reciprocating compressor (MYCOM W Series).

Figure 2.5: Operating cycle of reciprocating compressor.

Figure 2.6: Some piston, cylinder and crankshaft arrangements for two-, four- and eight-cylinder compressors.

More Information

This month’s Skills Workshop has been taken from Australian Refrigeration and Air-Conditioning Volume 1, by Graham Boyle, FAIRAH.

Go to www.airah.org.au/ARAC

PULLOUT

PROUDLY SPONSORED BY DAIKIN

Next month: Summer season contingency planning