

Pneumatic Components & Circuits and their demonstration using Models/Fluidsim P Software and Work exercises, Brake system in Machines (KE Valve).

AIR COMPRESSOR: Compressor is a machine which converts air at atmospheric pressure into high pressure by changing its volume. There are two types of compressor.

- 1). Reciprocating Compressor.
- 2). Rotary compressor.

Compressor can be driven by an electric motor or by a diesel/ petrol engine, which serves as a prime mover to the pneumatic power unit.

Reciprocating compressor:- A reciprocating compressor can be single or multiple piston compressors. The more the number of piston in a compressor, the more powerful a compressor is. The multi piston cylinder block of a compressor has crank shaft having same number of crank connection has the number of piston and cylinder in it. The crank shaft is connected to the prime mover. With each cylinder, there are two ports known as inlet and exhaust port depending on their functions. The compressor unit is provided with a sump for storing the oil in it for lubricating and cooling of various components of compressor assembly.

When the crank shaft of compressor rotates and the piston of air compressor takes an inward stroke, atmospheric pressure being higher than the pressure in the compressor cylinder, the flow of air takes place through the inlet port when the crank rotates further and piston moves forward stroke, the inlet valve closes and exhaust port opens thus sending the compressed air to the system/ air container (air tank). The compressor reduces the volume of air thereby increasing its pressure.

If the compressor is a multi stage, one piston sends compressed air to another cylinder and thus to tank. The capacity of a compressor is depending upon the number of cylinder in it. The term single or multistage depends upon the no. of stages or steps that a reciprocating compressor uses to compress air to its final pressure. Single stage compressors are more economical for a pressure below 100 psi but for higher operating pressure multistage compressors are more beneficial.

The capacity of a compressor is defined as volume of air displaced per minute. In FPS (Foot pound system) is denoted by CFM (Cubic ft min) and in M.K.S is LPM (Liter per min).

COOLING COIL:-

As the compressed air has get its temperature risen due to compression, the temperature has to be brought down. This is done by cooling coil which is a helical copper tube by which the cooling coil comes in contact with atmospheric air and therefore the compressed air inside the cooling coil cools down.

PRESSURE VALVES:

Pressure control valves are elements which predominantly influence the pressure or are controlled by the magnitude of the pressure. They are divided into the three groups:

1. Pressure regulating valve
2. Pressure limiting valve
3. Pressure sequence valve

PRESSURE REGULATING VALVE:

The role of this valve is to maintain constant pressure even with fluctuating supply. The input pressure must be greater than the required output pressure.

PRESSURE LIMITING VALVE:

The pressure limiting valves are used mainly as safety valves (pressure relief valves). They prevent the maximum permissible pressure in a system from being exceeded. If the maximum pressure has been reached at the valve inlet, the valve outlet is opened and the excess air pressure exhausts to atmosphere. The valve remains open until it is closed by the built-in spring after reaching the preset system pressure.

PRESSURE SEQUENCE VALVE:

The principle on which this valve acts is the same as for the pressure limiting valve. If the pressure exceeds that set on the spring, the valve opens.

AIR DRYER:-

Condensate (water) enters into the air network through the air intake of the compressor. The accumulation of condensate depends largely on the relative air humidity. The relative air humidity is dependent on the air temperature & the weather condition. The service life of pneumatic system is considerably reduced if excessive moisture is carried through the air system to the components. Therefore it is important to fit the necessary air drying equipment to reduce the moisture content to a level which suits the application & the components used.

Drying of the compressed air is achieved by leading the air flow from compressor through a desiccant granulate (Means of adsorption). The granules are of reticulate molecular structure, thus achieving an active surface being large enough to absorb the moisture out of the air. The drying agent is a granular material (gel) consisting almost of silicon dioxide.

WATER SEPERATOR:

The presence of moisture results in the following types of after effects on the pneumatic components and the system is badly affected.

1. Rusting & corrosion.
2. Formation of emulsion.
3. Reduction in lubricating property of oil.
4. Choking of small orifices, valves and system.

So it is imperative that the moisture from the air is removed to avoid crippling of the system. The first step in process of compressed air after pressure regulation is its filtration or removal of moisture contents which is harmful not only that it may result in rusting but also it may form emulsion with lubricating oil which will block the pneumatic assemblies. The air under pressure enters through inlet of a specially designed water separator having provision for baffle and quite zone. The water droplets are thrown from air stream by virtue of their centrifugal force when they strike the deflector with louvers at the entrance. The water collected at the bottom of quite zone is drained out through the drain tap provided at the bottom or by removing the transparent bowl container.

AIR OILER:

There are certain pneumatic tools and equipments which require lubricated air to reduce wear and corrosion and there are certain other components which do not tolerate oil in the air stream. The importance of lubrication can be well imagined as it not only decreases friction but also prevent corrosion of pneumatic assemblies and simultaneously increases the efficiency. There are two types:

1. OIL FOG LUBRICATOR:

It has a transparent bowl which is filled with oil according to consumption. It has a siphon tube dipping in it which open upon a needle valve. When the air under pressure passes through the venturi section, it is atomized and causes the follow of oil in the form of oil fog (1 drop/10 cu. ft/min) which lubricates the parts through which it passes.

2. CONSTANT DENSITY LUBRICATOR:

It is very simple in construction. A transparent bowl serves as an oil container in which dips the lower end of the siphon pipe having filter attached to its bottom. Air under pressure enters from inlet pore to the container and keeps the oil under constant pressure (regulated by pressure regulator).

D.C. VALVES:

Direction control valves used in pneumatic system are similar to those used in hydraulics. Their primary function is to direct flow of air from one place to another in the system. DC valves are devices which influence the path taken by an air stream. Normally this involves one or all of the following:

- Opening the passage of air and directing it to particular air lines.
- Canceling air signals as required by blocking their passage.
- Relieving the air to atmosphere via an exhaust port.

DC valve is characterized by its number of controlled connections or ways, the number of switching positions and the method of actuation. Designs are categorized as follows:

1. Poppet valves
 - 1.1. Ball seat valve
 - 1.2. Disc seat valve
2. Slide valves
 - 2.1. Longitudinal slide valve (spool valve)
 - 2.2. Longitudinal flat slide valve
 - 2.3. Plate slide valve.

POPPET VALVES:

With poppet valves the connections are opened and closed by means of balls, discs, plates or cones. The valve seats are usually sealed simply using flexible seals. Seat valves have few parts which are subject to wear and hence they have a long service life. They are insensitive to dirt and are robust. The actuating force, however, is relatively high as it is necessary to overcome the force of the built-in reset spring and the air pressure.

SLIDE VALVES:

In slide valves, the individual connections are linked together or closed by means of spools, flat slide or plate slide valves.

KE Valve:

KE valve is the most important functional component of the air brake system and is also sometimes referred to as the heart of the air brake system. The function of the KE valve is to distribute compressed air received from brake pipe to auxiliary reservoir and control reservoir. In addition to this it also senses drop and rise in brake pipe pressure for brake application and release respectively. It is connected to brake pipe through branch pipe. Various other components connected to the distributor valve are auxiliary reservoir, brake cylinders and control reservoir.

AIR RECEIVER/CONTAINER:

Before discussing an air receiver, let us be clear in mind that unlike liquids (which are virtually incompressible) is readily compressible. That is why a large quantity of air can be stored in a comparatively smaller vessel or container. The more the air in a container, the higher is the pressure and stronger should be the container to withstand that pressure.

CYLINDERS:

A pneumatic cylinder converts compressed air pressure into mechanical linear force. When the compressed air enters one of the ports of the cylinder, it transmits movements to the piston and its rods and becomes mechanical force to do some work. The flow rate of the pneumatic power determines the piston speed and output in horse power.

PIPING, HOSES AND FITTINGS:

Piping is an important part of pneumatic system. It is not only to transmit the pneumatic power to various components, but also to keep it clean and free from contaminants. The pipes utilized on the machines should be flexible and strong enough to withstand the working pressure of the system. As a thumb rule, the testing pressure of a pipe should be double that of working pressure and bursting pressure double that of the testing pressure.

The working pneumatic pressure on track machine varies between 6.5 – 7.0 kg/cm²

The inside diameter of pneumatic pipe is 6.3 mm and 12.6 mm are used for general transmission and brake system of the machine.

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- Pneumatic working circuits of different machines are discussed in detail.

- Demonstration of Pneumatic Circuits Using FluidsimP Software & Working Exercises.