

CHAPTER 1

INTRODUCTION TO PNEUMATICS

The term Pneumatic has been derived from the Greek script. 'Pneuma' in Greek means breath or wind. Hence the term pneumatics means the study of air movement or air as a working medium.

The application of pneumatic has its own history. When the energy of air was disposed, it was mainly used to kindle fires. Later spread of awareness made man to use it with fans and blowers and with advancement in technology, at present compressed air is used for driving.

In this world of modern technology, pneumatics is a basic requirement in every industry. One of the reasons for such a widespread use of pneumatics is its flexibility in automation. This is because no other working medium other than compressed air can be used more effectively and economically. Pneumatic deals with the study and application of pressurized gas to produce mechanical motion. The technology of pneumatics deals with the study of behaviour and application of compressed air. Though the science of air was known to man for centuries, it was not much used in industry before the beginning of the second war (1939-44).

During the war, many industries all over western countries started switching over to more and more automatic equipment and machineries. Many of these were the present day concept of automation started provoking man to use compressed in production plants. Today, air operated tools and accessories are a common sight in each and every industry, not only in the technologically advanced countries but even in countries where industrial activities are still at the stage of developing .with the introduction of pneumatics in the manufacturing process, the industry is benefited with a cheaper medium of industrial automation which if judiciously used, may bring down the cost of production to a much lower level .a few decades ago, maximum application of pneumatics was probably in the field of construction where the main source of power for tools like power hammers ,drillers, riveting hammers etc. was compressed air only .today the list is endless. Now compressed air is used in every walk of industries.

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In order to clearly define the areas and fields of applications of pneumatics, it is necessary to mention the advantages and limitations of compressed air at this juncture.

Advantages of pneumatics:

- Air is abundantly available in nature.
- Transportation of compressed air over larger distances through pipelines is easier.
- Economical in storing and retrieving large quantity of air.
- Since air is used, wear and tear of moving parts in mechanism is bare minimum.
- Pneumatic devices present no spark hazards in explosive atmosphere.
- Use of compressed air ensures reliable operations even at extreme temperature.
- Low maintenance cost.
- There is better control over the operation of pneumatic elements.
- These devices provide flexibility, simplicity and versatility in industrial designs.

Limitation of pneumatics:

- Even though air is available abundantly, it requires a means to compress it
- Air requires to be freed from dust and moisture.
- Compressed air should be lubricated for smooth operation.

Application of pneumatics:

1. **Construction:** when it connects to moving dirt or rock for roads, tunnels and dams etc., pneumatically controlled shovels, scrappers, diggers etc, are invariably used.
2. **Agriculture:** paddy transplants, harvesting machines, pneumatically controlled conveyor mechanism.

- 3. Mining:** control of material handling systems in mixers, drilling equipment.
- 4. Paper industry:** In production of paper, pneumatic power devices may be found such as feeders, dryers, vibrators, hydro pumpers and finishing tables.
- 5. Chemical industry:** pneumatically operated remote control valves, feeding materials to mixtures, weighing machine controls, hot air ovens etc.
- 6. Textile:** The striking colours and patterns on clothes are mainly due to the modern automatic textile printers, which use fluid power for speed regulation, plate pressure and colour feed. Pneumatic power is used for the devices like squeezers, beam wrappers, washers, drawing, frames, winders and folders.
- 7. Metal working and machine tools:** controlling the table movements of a milling machine, feeding the cutting tools on an automatic lathe advancing and feeding twist drills, actuating the ram of a branch or clamping the work in chuck these are all routine jobs for fluid power.
- 8. Steel:** To convert steel ingot into fine gleaming sheet or into a reel of enormous pressure is required. Throughout these stages both hot and cold, the control of roll pressure is maintained by fluid power.
- 9. Wood working:** Tracer drawings, copy shapers, slot boring devices, clamping and feeding equipment's.
- 10. Knitting, wool manufacture:** Skein packers, pattern card feeders, gluers and presses, pattern programming by pneumatic program controls, pneumatic wool feeders, and cutters.
- 11. Rope making:** Controls and drivers for binding and knotting machines in manufacture of cord and loop rope.

12. Foot –wear industry: Forming and stamping units, presses, cutters, and elevators press devices, heel and sole shapers, turning units, sole gluing presses, mould closing units on vulcanising machines for rubber shoes.

13. Dairy products: Bottling and other filling units, package assemblers and sealing units.

14. Transportation: Rail bound vehicle break systems, sliding door operation on street cars and rail coachers, grit spreader controls, interlocking of emergency brakes, crossing gate controls and actuators, entrance gate controls, road making equipment

1.1 A Typical pneumatic system

Figure illustrates a pneumatic system that uses compressed air. Air from the atmosphere flows into the inlet of the air compressor where the pressure of the air is increased to a predetermined value. Air compressor is driven by either an electric motor or an IC engine. A relief valve at the discharge end of the compressor is used to avoid dangerously high pressures. Filter is used to remove the dirt in the air. Purpose of lubricator is to add some oil and lubricate the sliding surfaces such as piston. Direction control valves are provided to control the direction of the air in the system. The compressed air acts on the systems to develop a force the piston rod for moving a device or a load thus create the some useful energy.

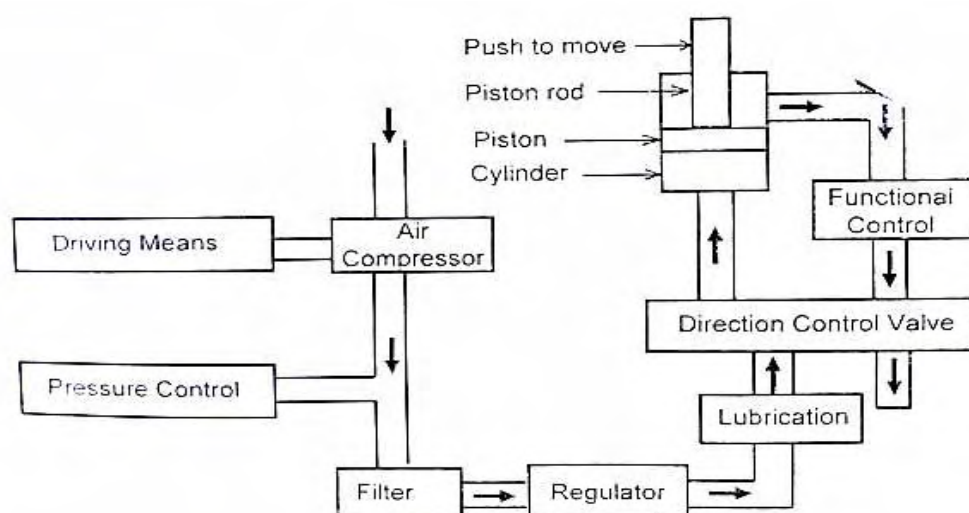


Fig.1 A typical pneumatic system

1.2 Introduction to Pneumatic Auto Loader

Pneumatic auto loader is basically an automatic pick and place device. It uses compressed air as the driving force. Hence it is named as pneumatic auto loader. It is used to pick and place the objectives with flat surfaces.

Here suction cup grips the objects due to vacuum created at it by the vacuum generator. The object is lifted up and turned through desired angles to place at the predefined place.

Pneumatic deals with the study and application of pressurized gas to produce mechanical motion. Pneumatic system used extensively in industry is commonly powered by compressed air or compressed inert gases. A pneumatic system controlled manually or automatic solenoid valves of lower cost, more flexible are safer alternative to an electric motors and actuators. Autoloader is a self-loader device that automatically loads cartridge using a robotic mechanism. Pneumatic autoloader is designed for transferring of finished or semi-finished sheet or plate type component in process industries as well as automobile industries. This type autoloader moves the component in longitudinal, vertical, and circular movement or combination of such movements. For irregular or symmetrical shape components are held on a component holder through vacuum type/ finger type gripper. This type of loader reduces the cycle time, having less fatigue, more accuracy,

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cost effectiveness and reduces the labour cost, while increasing productivity by freeing up operator time from mundane task to perform more complex jobs.

ADVANTAGES OF PNEUMATIC AUTOLOADER

- Air is working medium, which is abundantly available in nature
- Labor fatigue is reduced.
- Minimum maintenance is required.
- Loading and unloading operation is quick which reduces handling time.

LIMITATIONS OF PNEUMATIC AUTOLOADER

- Uneven surface cannot be gripped.
- Components with holes cannot be gripped.
- The surfaces to be gripped must be clean.

1.3 5/2 Direction Control Valve:

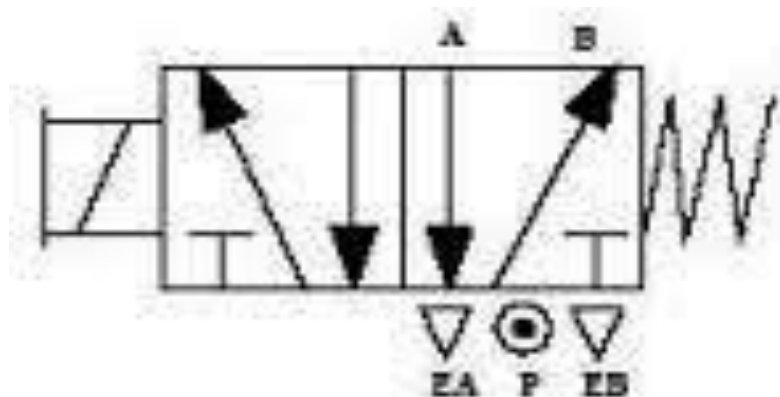


Fig.2 5/2 2D view of Direction Control Valves

A valve is a device that regulates the flow of fluid (gasses, liquids, fluidized solids, or slurries) by opening and closing or partially obstructing passage ways A 5/2 way directional valve from the name itself has 5 ports equally spaced and 2 flow positions. It can be use to isolate and simultaneously bypass a passage way for the fluid which for example should retract or extend a double acting cylinder. There are variety of

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ways to have this valve actuated. A solenoid valve is commonly used, a lever can be manually twist or pinch to actuate the valve, an internal or external hydraulic or pneumatic pilot to move the shaft inside, sometimes with a spring return on the other end so it will go back to its original position when pressure is gone, or a combination of any of the mention above.

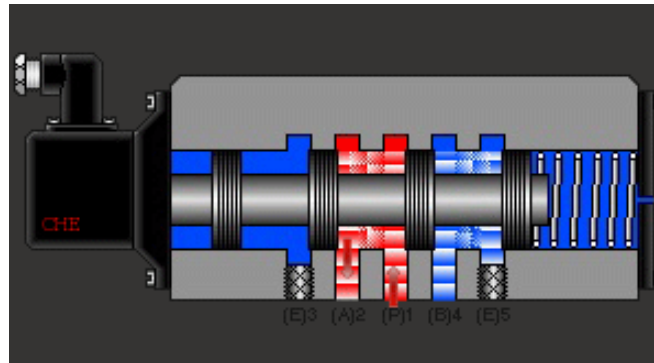


Fig.3 5/2 3D view of direction control valves

In the Illustration given, a single solenoid is used and a spring return is installed in the other end. The inlet pressure is connected to (P)1. (A)2 could possibly be connected to one end of the double acting cylinder where the piston will retract while (B)4 is connected to the other end that will make the piston extend. The normal position when the solenoid is de-energized is that the piston rod is blocking (B)4 and pressure coming from (P)1 passes through (A)2 that will make the cylinder normally retracted. When the solenoid is energized, the rod blocks (A) 2 and pressure from (P) 1 passes through (B) 4 and will extend the cylinder. And when the solenoid is de-energized, the rod bounces back to its original position because of the spring return. (E) 3 and (E) 5 is condemned or used as exhaust.