

Design and Fabrication of Two Step Speed Control of a Cylinder Circuit using Pneumatics

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Abstract : *The main aim of our project is to design and fabrication of pneumatic two step speed control of a cylinder. Initially the flow from the FRL retracts the cylinder when the push button is in its spring offset position. When it is pushed the flow pilots actuate. The air passes through the flow control and shuttle valve. Then the cylinder extends with high speed as the valve allows more air to enter the cylinder. When the piston reaches the position it operates the cam push button and pilot air flow through this and actuate 5/2 pilot operated valve and reaches flow control valve which permits less air. Then the flow through enters the shuttle valve to cylinder and allows the cylinder to extend at relatively low speed. At the end of extension stroke deactivating push button retracts the cylinder. Thus the speed of cylinder is controlled and project can be achieved*

Keywords—*Air Cleaners, Compressors, Fluid flow controls, Machine components, Solenoids.*

I. INTRODUCTION

The term pneumatics is derived from a Greek word ‘pneuma’, which means air. Pneumatics is a branch of technology that deals with the study and application of pressurized gas to effect mechanical motion. The air is mostly used in pneumatic system due to its availability, cheaper in cost, safe, easier maintenance and handling and can be easily exhausted to the atmosphere after its use. Pneumatic system can be applied only to low power applications which is less than 17 bars. The pneumatic system mainly uses compressed air. It is compressed with the help of compressor which increases the pressure of the air and the pressure can be adjusted by using pressure regulator.[1-4]

Air is a mixture of gases

Standard air is a sea level air having a temperature of 20°C, pressure of 1.013bar and a relative humidity of 36%. These are the values used for pneumatic calculations.

The gas in pneumatics absorbs excessive force, whereas the fluid of hydraulics directly transfers force. At the time of power loss we can allow the machines to perform.

The application of pneumatics is almost found in all the industries or fields. Some of the industrial applications are stamping, drilling and hoisting, punching, assembling, clamping, reverting, material handling, logic controlling and hammering.[10,9]

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II. OBJECTIVE OF THE PROJECT

The objective of this project is to design an automatic cylinder reciprocation circuit using pneumatics and to generate a result by using continuous in various applications to do many works mainly to use it in industries for material handling.[15-19]

III. COMPONENTS USED IN PNEUMATICS

Compressor-Compressor is a device which is used to compress the air coming from the atmosphere. The compressor is considered as the air source; supply the required quantity of air

Fluid conditioners-The purpose of fluid conditioners is used to make the compressed air more acceptable medium for the pneumatic system. The important air processing equipments are:

Air filter-To remove contaminants from the air before it reaches the pneumatic components such as valves and actuators

Air regulator-To reduce the air pressure to the desired level for the particular circuit application.

Air lubricator-To ensure proper lubrication for the internal moving parts of the pneumatic components.

Pneumatic silencers-To control the noise caused by a rapidly exhausting air stream flowing into the atmosphere

Control valves-The control valves are used to control air direction, pressure and flow rate. The important control valves used are check valve, shuttle valve, directional control valve and flow control valve.

Pneumatic actuators-The actuator is used to convert the energy of the compressed air into mechanical force or torque to do useful work.

Piping-The pneumatic pipe carries the air from one place to another. If the pipe is not fixed properly the circuit does not work to its full capacity.

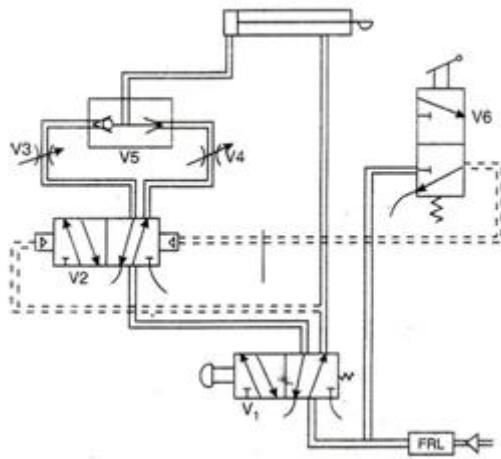


Fig 1
Circuit diagram

Selection of components

The components are selected according to the need of the circuit and easy functioning of the circuit.

1. V1 – Push button
2. V2 – 5/2 pilot operated DC valve
3. V3 – Flow control valve
4. V4- Flow control valve
5. V5 –Shuttle valve
6. V6- Cam operated push button
7. Double acting cylinder
8. FRL unit
9. Compressor
10. Pipes and fittings

IV. DESCRIPTION

The selected components are explained and the use of each component in the circuit and its function and types are described below

Cylinder

Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion..There are different types of cylinders like single acting cylinders, double acting cylinders, Multi-stage telescoping cylinders, through rod air cylinder, rotary air cylinder, rod less air cylinder etc. Here we are using double acting cylinder and the working and functions of double acting cylinder are explained below.

Double Acting Cylinder



Fig 2

Symbol of the double acting cylinder

When the air enters the piston end the piston extends for the extension stroke and when the air enters towards the rod end

the piston retracts. This is the process going in the double acting cylinder. The cylinder we have selected has 40mm diameter and a stroke length of 100 mm and it can give pressure up to 10 bars

Fluid Conditioners

The atmospheric air that is compressed in the compressor is visibly not clean because the atmospheric air contains many contaminants such as smoke, dirt, water vapour etc.this contaminated air may lead to excessive wear and failure of pneumatic components. The system performance and accuracy depends mainly on the supply of clean, dry, and contaminated

free compressed air.therefore the fluid conditioners are used to condition the compressed air before leaving into various pneumatic components.the important fluid conditioners are filters, regulators, lubricators, mufflers and air driers.

In these first three components are the one which we used in our ciruir which is collectively known as FRL(filter, regulator, lubricator)unit or service unit

Air Filter

The function of the filter is to remove contaminations from air before it reaches the pneumatic components such as actuators and valves. The main component of a filter is the filter cartridge, which is mostly made of sintered brass or bronze and other materials. They remove contaminants in the range of 5 to 50 microns. These elements have large ratio of air to filter media and can thus hold a large amount of contamination on the surface without suffering any pressure loss.

Air flow entering the filter is directed downward with a swirling motion that forces the moisture and the heavier particles to fall down. The deflector used in the filter mechanically separates most of the contaminants before they reach the filter element..

FRL(filter, regulator,lubricator) unit

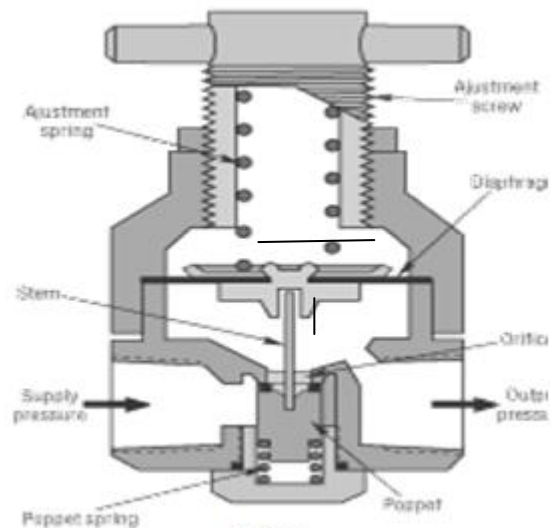


Fig 3 FRL(filter, regulator,lubricator) unit

The combined symbol of the FRL unit is shown below

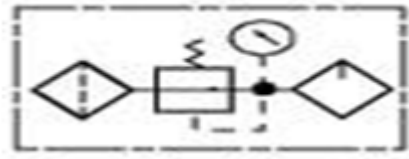


Fig 6 Symbol of the FRL

In most pneumatic system, the compressed air is first filtered and then regulated to the specific pressure and made to pass through a lubricator. Thus the filter, regulator and lubricator are always placed at the inlet side of the circuit they may be installed as a separate unit but most often it is placed as a combined unit. [1],[3],[5]

Air Compressor

A compressor is a device used to compress air from a low inlet pressure (usually atmospheric pressure) to a higher desired pressure level. The pressure of the air is increased by reducing the volume of the air. From this positive displacement compressor is divided into reciprocating and rotary where else dynamic is centrifugal type compressor. However the piston type reciprocating air compressor is used in our circuit. A symbol of compressor is shown in the below diagram.



Fig 3.7
Single fixed displacement



Fig 3.8
Single, variable displacement

V. WORKING

The compressor takes the atmospheric air and compresses it to a particular pressure, in this circuit we use a pressure upto 6 bar. Then the compressed air is stored in air tank. The FRL unit is connected to the air tank and the air enters in to the unit after impurities filtered process, then the air is regulated for a particular pressure and the air is lubricated.

The compressed air passes through the 2/2 directional control valve operated by push pull button. When the button is pushed the circuit becomes active and when the button is released means the circuit deactivates.

The input power for the dc valve and FRL unit is given from the frl unit. Then the output from the limit switches are connected to the pilot for operating the 4/2 dc valve. The

actuation of limit switches causes the cylinder forward and backward motion.

Initially the cylinder retracts in the offset position due to the flow of air from the FRL unit.. The air passes through the flow control V3 and shuttle valve V5 and will extends the cylinder at a high speed as the flow control valve V3 allows more air to enters the cylinder. When the piston reaches the position at which the cam operated push button V6. The cam operated push button V6 is placed carefully as we are using a piston of 100 mm stroke length it should be placed as if it should press the roller fully. The pilot air through the cam operated push button V6 actuates direction control valve V4 to shift and now the air passes through the other flow control V3 valve which permits less air. The flow through flow control valve V4 enters through the shuttle valve V5 to the cylinder and allows the cylinder to extend at relatively low speed. At the end of the extension stroke deactivating push button v1 retracts the cylinder.Thus the speed of extension of cylinder can be varied in its intermittent position to achieve the required function

Application Of The Circuit

The application of pneumatic system are almost found in all the industries and field. So many applications like stamping, punching, assembling etc. The automatic cylinder reciprocation circuit finds its main application in material handling which is used to relocate the material which cant be handleed by the employee.the explanation is given below[2],[4],[6]

Extension

When first workpiece on the transfer table contacts and depresses roller of oilot valve on the left side, the air flows to pilot chamber of 4/2 dc valve shifting its position to the right mode. When the dc valve is shifted to the right flow path configuration, the compressed air flows to the blind end which makes the cylinder to extend. The speed is controlled by flow control valve through which air is exhausted from rod end now the workpiece moves from the transfer table to the grqavity conveyor.

Retraction

As the piston approaches its end of the cylinder stroke, the roller operated pilot control valve in right is depressed and air flows to the pilot controlled 4/2 dc valve sghifting its position to left mode the air flows to the rod end of the cylinder and the cylinder retracts . the speed is controlled by flow control valve through which air is being exhausted from the blind end.

Now the second workpiece es fed in and the next cycle automatically starts. Thus the sequence continous and the cylinder reciprocates continously with the help of the operators help.

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Table 1:cost estimation

TABLE I COST ESTIMATION			
S.NO	COMPONENTS	QUANTITY	COST
1	Double acting cylinder	1	1600
2	FRL Unit	1	1000
3	Shuttle valve	1	300
4	Pilot pressure operated 4/2 valve	1	750
5	Flow control valve	2	500
6	Push button	1	800
7	Roller operated pilot control valve	1	600
8	Pipes and fittings	As per required	1000
9	Carpentry	-	700
10	Paint	-	300
	Total		7550

Double Acting Cylinder



Flow Control Valve



Roller Operated Pilot Control Valve



SNAP SHOTS



FRL unit



Pressure Controlled 4/2 Valve



VI. CONCLUSION

Our project is to design and fabricate a pneumatic quick exhaust circuit. The designed circuit meets various demands both domestically and also used for industrial applications like mass productions, time varying operation and quality circuit. The cost estimated to be acceptable and can be implemented in various applications through the engineering field.

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