DESIGN AND CONSTRUCTION OF PNEUMATIC PRESSING MACHINE

In this book, a thesis report presented to the mechanical engineering department in partial fulfillment of the Bachelor of Science in Mechanical Engineering degree.

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September,2022

APPROVAL

This is to certify that the project on **" Design & Construction of Pneumatic Punching Machine."**By Md. Rakib Ul Islam (ID No: BME 1803016082), Md.Imran Hosen (ID No: BME 1803016136), Md.Shariful Islam(ID No: BME 1803016137), Md. Shafran Ali (ID No: BME 1803016145),Arnob Halder(ID No: BME1803016138) has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of the years of 2022 and has been approved as to its style and contents.

…………………………..

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DECLARATION

We now declare that the work provided in this project is the result of our investigation and research work conducted under the direction of "**Md. Minhaz Uddin"**, Lecturer, Sonargaon University's Department of Mechanical Engineering (SU). We further certify that no element of this project or thesis has been or will be submitted for a degree elsewhere.

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ACKNOWLEDGMENT

First and foremost, we thank Allah, the Almighty, for blessing us with the courage and motivation to fulfill the thesis work. The writers are grateful to **"Md. Minhaz Uddin"** for his frequent and rigorous monitoring, helpful suggestions, and support in completing this project. The authors express their heartfelt gratitude to him for all of this. We are also grateful to all of our SU thesis and project working teams for their assistance in constructing the project. Finally, we'd like to express our gratitude to everyone who helped us finish the thesis in whatever way.

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ABSTRACT

Now a days Pneumatic systems are widely used in a various of sectors, and manufacturing companies. Pneumatic systems are known for their ease of use, reliability, and simplicity. They are also excellent for the application of force in a quick and efficient manner. The goal of this project is to create a solid and reliable pneumatic punching machine that is simple to operate. The pneumatic press tool has the benefit of functioning at low pressure. The piston is forced out by the pressurized air coming via the tubes to the cylinder, and the power is passed to the punch via the linkage.The resulting workpiece has the required dimensions and can be collected using the land clearance supplied in the die. The die used in this is fixed, allowing the die of the desired shape to be utilized as needed. As a result, we can use a variety of punch dies, resulting in a diverse range of products. "Various varieties of punch as a requirement can be obtained in this manner. The operating pressure can be adjusted depending on the work material.

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CHAPTER 1

INTRODUCTION

1.1 Punching

Punching is process in which a punching device is used to shove a tool called a punch through the work piece in order to cut a hole. Frequently, the punch travels through the piece and into a die. During the procedure, a scrap slug from the hole is placed into the die. This slug may be recycled and reused or dumped, depending on the substance pierced. Punching holes in sheet metal in medium to high production numbers is frequently the most cost-effective way. Blanking is the process of creating many usable bits from a sheet of material using a specifically shaped punch. Hot punching is a technique used in forging applications to punch the piece while it is still hot.

Hardened steel or tungsten carbide are commonly used for punch tooling. A die is situated on the opposite side of the workpiece and helps to localize the shearing forces for a cleaner edge by supporting the material around the perimeter of the hole. Because there is a little gap between the punch and the die to prevent the punch from adhering, less force is required to form the hole. The quantity of clearance required is determined by the thickness of the material, thicker materials necessitate more clearance, although clearance is always less than the thickness of the workpiece. The clearance is also affected by the work piece's hardness. After the punch is withdrawn, the punch press drives the punch through the workpiece, producing a hole with a diameter equivalent to the punch, or slightly smaller.

When the type of article in question is suitable for this technique of manufacturing, the pneumatic press contributes significantly to the output of engineering workshops and is vital for the low-cost production of large quantities of comparable articles. A compressed air source is used in a pneumatic press to control piston operation for high pressure to achieve the desired component. The press has a piston that is driven by pressurized air and drives a piston rod to run the press. This pneumatic press is ideal for working with small press tools. to is based on the compressed air principle. A compressor plant, pipelines, control valves, driving members, and auxiliary applications are all included. The air is compressed in an air compressor, and the flow medium is transmitted to the pneumatic system for the compressor plant. It is critical that the pressure drop between compressed air generation and consumption be kept to a minimum. It has been observed that pipeline fittings and joints are primarily responsible for any pressure drop in the pneumatic system.

1.2 Need For Automation

The use of control systems and information technologies to lessen the demand for human labor in the production of goods and services is referred to as automation. Automation is a step beyond mechanization in the realm of industrialization. Automation considerably reduces the need for human sensory and cerebral requirements, whereas mechanization provides human operators with technology to assist them with the physical requirements of work. In both the global economy and everyday life, automation is becoming increasingly significant.

Manufacturing companies typically create hundreds of thousands of products per day, and they rely on automation to fulfill their clients' expectations and meet their deadlines in order to make a profit. Although a thousand workers is very useful, new technologies are more vital in increasing a company's production.

If you have to pick between employing hundreds of people and maintaining machines, you will most likely select the latter because machines are easier to manage than people with various personalities. A single machine may perform the work of hundreds of people, which means you can save a lot of money by using automated equipment to manufacture particular products, reducing the stress on those employees who have attitude issues at work. Though machines are one of the most expensive investments you will make for your company, they will quickly pay for themselves owing to the increased productivity they may give.

All that is required is a small group of persons with sufficient experience in operating such machines. These machines frequently use program logic controllers, which are regarded as the heart and brain of the machine's automation. Learning about program logic controllers has a lot of benefits in terms of maintenance and troubleshooting.

1.3 Benefits of Pneumatics

❶ Pneumatics is an appealing medium for low-cost mechanization, especially for critical and repetitive tasks.
❷ Many factories or facility already has a compressed air system that can provide energy requirements as well as a control system.
❸ The main advantages of pneumatic systems are usually cost-effectiveness and simplicity, with the latter lowering maintenance costs.
❹ It has a lot of advantages in terms of safety.

Mechanization is described as the use of mechanical power to substitute manual labor. Pneumatic is an appealing medium for low-cost mechanization, especially for repetitive activities in sequence. Many companies and facilities already have a compressed air system that can supply the power or energy requirements as well as the control system, while pneumatic control systems are normally more cost-effective and can be applied to various kinds of power. The main benefits of an entirely pneumatic system are usually cost and simplicity, with the latter lowering maintenance costs. It can also provide significant benefits in terms of security.

1.4 COMPRESSED AIR

Pneumatic systems rely on compressed air, which must be available in sufficient quantity and at a pressure that matches the system's capability. When a pneumatic system is installed, although it is being utilized for the first time, it will be required to address the issue of compressed air supply.

The reciprocating compressor is an important feature of any compressed air supply plant. A compressor is a device that takes in air or gas at a specific pressure and then delivers it at high pressure.
The capacity of a compressor is the amount of compressed and delivered air, and the volume expressed is the volume of air at intake circumstances, such as atmospheric pressure and normal

ambient temperature. One of the elements that determine the life of a compressor is the cleanliness of the suction air. Suction air that is warm and moist will cause more condensate to form in the compressed air. The compressor can be divided into two categories.

❶ Positive displacement compressor
❷Turbo compressor

Positive displacement compressors are commonly used in compressed air plants and have shown to be very effective in providing air for pneumatic control applications. Positive compressors are classified as follows:

❶ Reciprocating type compressor
❷ Rotary type compressor

When a high volume of air is required at low discharge pressures, turbo compressors are used. They are rarely encountered in pneumatic service because they cannot achieve the pressure required for pneumatic control applications unless designed in multistage designs.

CHAPTER 2
LITERATURE REVIEW

This chapter will go over all you need to know about this project, including die design, piercing punches, pneumatics, and tolerances. Using this information, the project's elements will be presented to provide a better understanding of the title, objective, problem statement, and project scope. A book, journal, patent, conference paper, research paper, or website can all be used as sources.

2.1 Introduction

PNEUMATICS

Pneumatics is a discipline of fluid pv systems that studies and applies the use of pressurized gas to control mechanical motion. In industry, pneumatic systems are widely employed, as factories are frequently piped with compressed air or other compressed inert gases. This is due to the fact that a centrally Bloated and electrically powered pressurized that powers cylinders and other pneumatic equipment via lever-actuated valves can typically supply.

motive power in a way that is less expensive, safer, more versatile, and more reliable than a large number of electric motors and actuators Compressed air is used in pneumatic systems in stationary installations such as factories because ambient air may be compressed to provide a long-term supply. Moisture is normally removed from the air, and a tiny amount of oil is supplied at the compressor to prevent corrosion and lubricate mechanical components.

2.2 Reliability

❶ Pneumatic systems are known for their extended service lives and low maintenance requirements.

❷ The equipment is less likely to be damaged by stress since gas is compressible.

❸ Pneumatics uses gas to absorb excessive force, whereas hydraulics uses fluid to transfer force directly.

2.3 Storage

❶ When compressed gas is stored, it can be used to power machines when electric power is lost.

2.4 Safety

❶ Machine controlling is so easy, fewer accidents is happened.

❷ When compared to hydraulic oil, there's a very little risk of fire.

❸ Overload-protected machinery can be designed.

2.5 Advantages

❶ The control valve, which reliably applies a specified load with minimal effort, is the most notable advantage of the pneumatic system.

❷ Various materials, ranging from thin foils to metal sheets, can be punctured to create desired shapes.

❸ It can be tweaked to any degree to achieve the desired result.

❹ Its output can be put to good use in the vast mechanical area.

❺ Depending on the pressing effort required, several cylinder systems can be activated.

❻ This pneumatic system can be utilized to load press rolls in modern payer facilities.

❼ Mechanical and hydraulic presses have more complicated constructions.

❽ Pneumatic presses are less expensive than hydraulic and mechanical presses.

❾ It does not necessitate the use of current-carrying cables.

❿ Operating this system does not necessitate any additional skills.

➊➊ The functioning is quite fluid, and we can get more output with less work in this system.

➊➋ This technique can be used to punch marks in industrial materials like as a company's name, address, or product number.

2.6 Limitations

➊ Riveting is not possible with hard or thick materials.

➋ Even a small amount of leakage might cause power loss.

➌ Frictional losses will occur as a result of the couplings.

➍ The amount of moving parts will necessitate additional maintenance.

➎ The length of the stroke is fixed.

CHAPTER 3
METHODOLOGY

3.1 Objective

The major goal of this project is to develop and manufacture a simple and portable punching machine that eliminates the need for expert labor. Because this project is entirely automated, we also want to boost the production rate of industries by lowering machining time.

3.2 Line Diagram

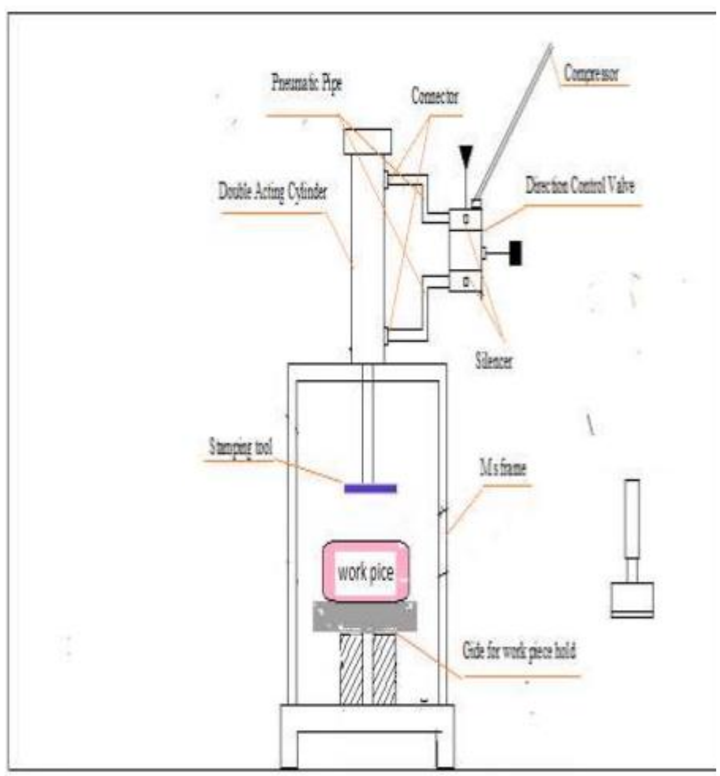


Fig 3.2 : Line Diagram of Pneumatic Punching Machine

3.3 Working Principle

The flow control valve receives the compressed air. The air flow is controlled by the flow control valve. It is one that can be adjusted. The lever must be adjusted so that the required pressurized air reaches the Solenoid Valve.

The solenoid valve is employed as a direction control valve in our project.

The pneumatic double-acting cylinder receives the compressed air. At one end of the pneumatic cylinder, the ram is fixed. By providing air supply in one direction, compressed air pushes the pneumatic cylinder downward, causing the piston to travel downward. Due to the slight time delay, the solenoid valve changes the air flow in the opposite direction. Due to the change in air flow direction, the pneumatic cylinder piston swings upward at this time. The solenoid valve controls the direction of air flow.

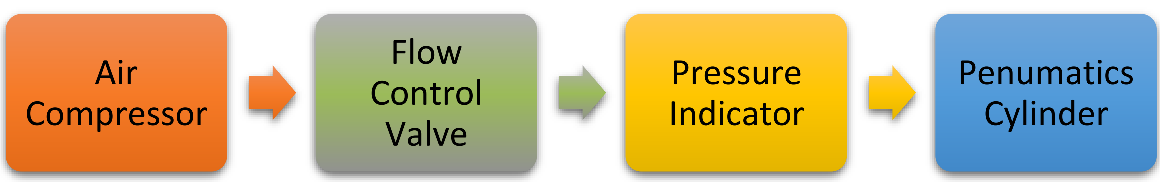


Fig 3.3 : Working Procedure

3.4 List of The Components We Used

❶ Pneumatics Cylinder.

❷ Solenoid Valve.

❸ Pressure Indicator.

❹ Connecting Tube.

❺ Connector.

❻ Nuts & Bolt’s.

❼ Metal Frame

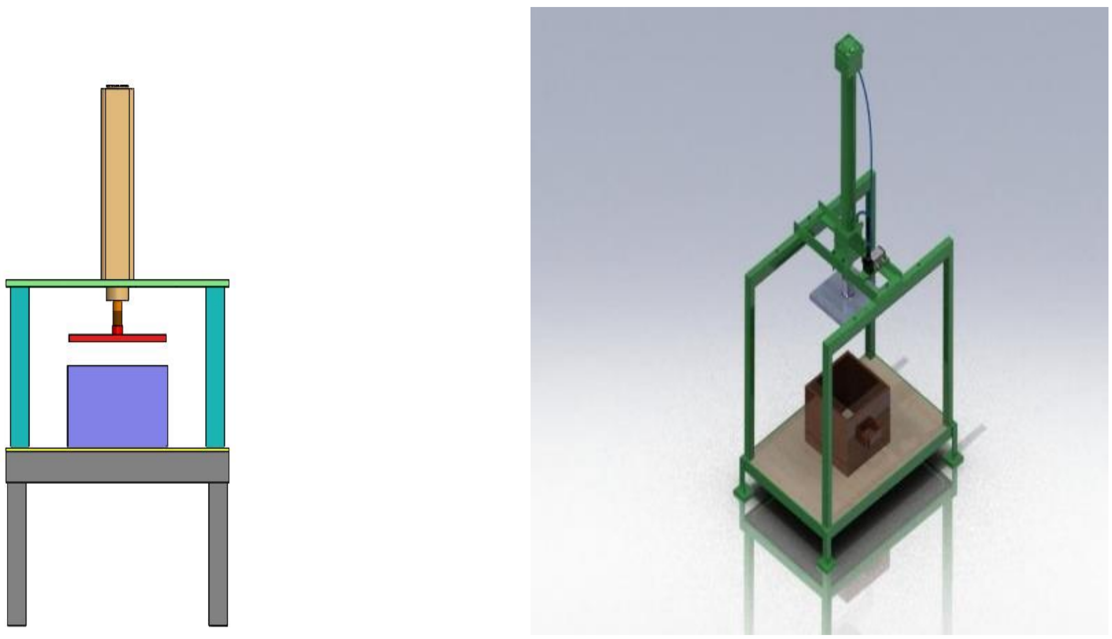


Fig 3.4 : 3D Diagram of Pneumatics Punching Machine

3.5 Structure & Innovation

The goal of the design is to build a strategy to meet a specific demand or to remedy a problem. If the strategy leads to the construction of physical reality, the product must be functional, safe, dependable, competitive, useable, manufacturable, and marketable. The following is an example of a design imperative:

❶ Create a different solution.

❷ Simulate and anticipate the performance of each alternative using analysis and testing. Retain satisfactory alternatives and eliminate bad ones.

❸ Choose the most satisfactory approximation to optimality that you can find.

❹ Put the plan into action.

3.6 Considerations in Design

The strength required of an element in a system can sometimes be a deciding factor in the geometry and dimension of the element. In this case, we can state that strength is a crucial design concern. When we say "design consideration," we're talking to a feature that influences the design of an element or, in certain cases, the entire system. Usually In a specific design context, several of these qualities are taken into account, including
strength/stress, distortions/deflection, /stiffness, Wear, corrosion, safety, stability, utility, Cost, Processing, Weight, Life, noise, Shape, Control, Thermal properties, /surface.

3.7 Material Selection Procedure

In every material selection dilemma, the first step is to define the product's requirements. The engineer should generate a clear picture of all the characteristics required for this item to successfully execute its intended function without any prior knowledge of the material or technique of production.

There are three key areas where these requirements will fail:

❶ Geometry or shape considerations

❷ Property is required.

❸ Concerns about manufacturing

3.8 Complete Project Picture

CHAPTER 4

PNEUMATICS CONTROLLING COMPONENTS

4.1 Pneumatic Cylinder

Pneumatic equipment is divided into two categories: cylinders and valves. Cylinders and valves are the pneumatic system's muscles, as they are used to move, hold, and lift objects. They're even capable of controlling other pneumatic components. Compressed air powers cylinders, which convert the compressed air's stored energy into linear motion.

Fig 4.1: Pneumatics Cylinder

Linear motion is defined as movement in a straight path, such as an apple falling from a tree or a sliding door closing. Arrows like the ones below can be used to symbolize linear motion.

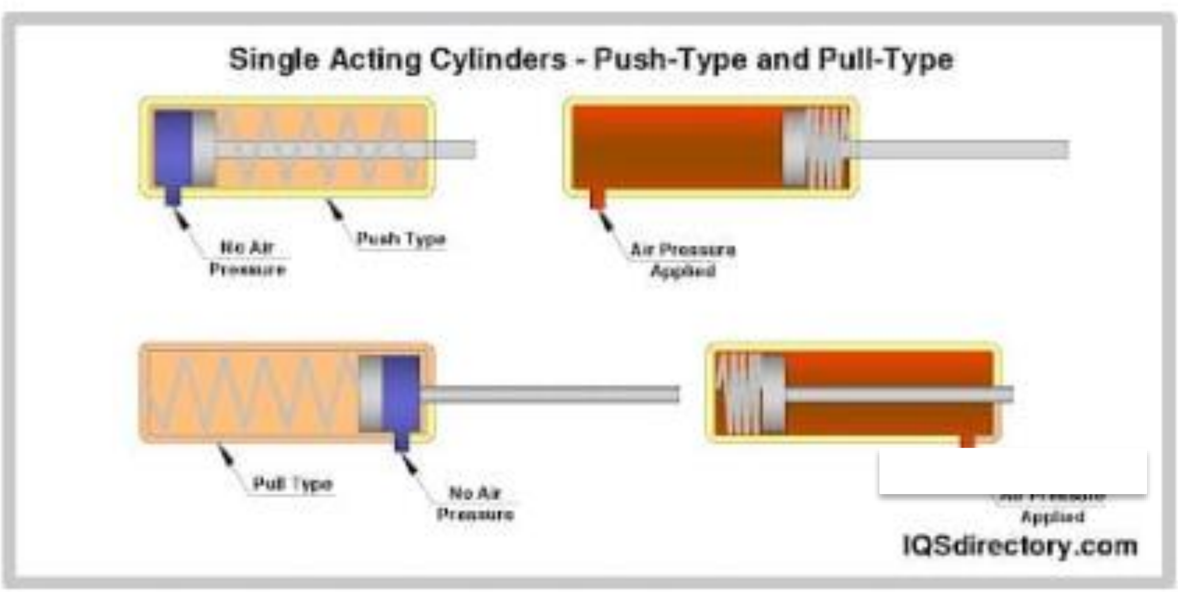
We'll be using two different types of cylinders:

❶ Single-acting Pneumatic Cylinder.

❷ Double-acting Pneumatic Cylinder.

4.2 Single Acting Pneumatic Cylinder

A spring is inserted around the piston rod in single-acting pneumatic cylinders to aid in the retraction of the piston and rod assembly. Only one side of the chamber is filled with compressed air, which enters through one of the cylinder caps. While compressing or stretching the spring, the piston and rod assembly move linearly and extend in one direction. When the piston rod reaches its maximum thrust, the spring, together with the piston and rod assembly, returns to its original position. One of the caps has a vent opening that lets air out. If there is a loss of pressure or power, the piston will simply return to its original position.



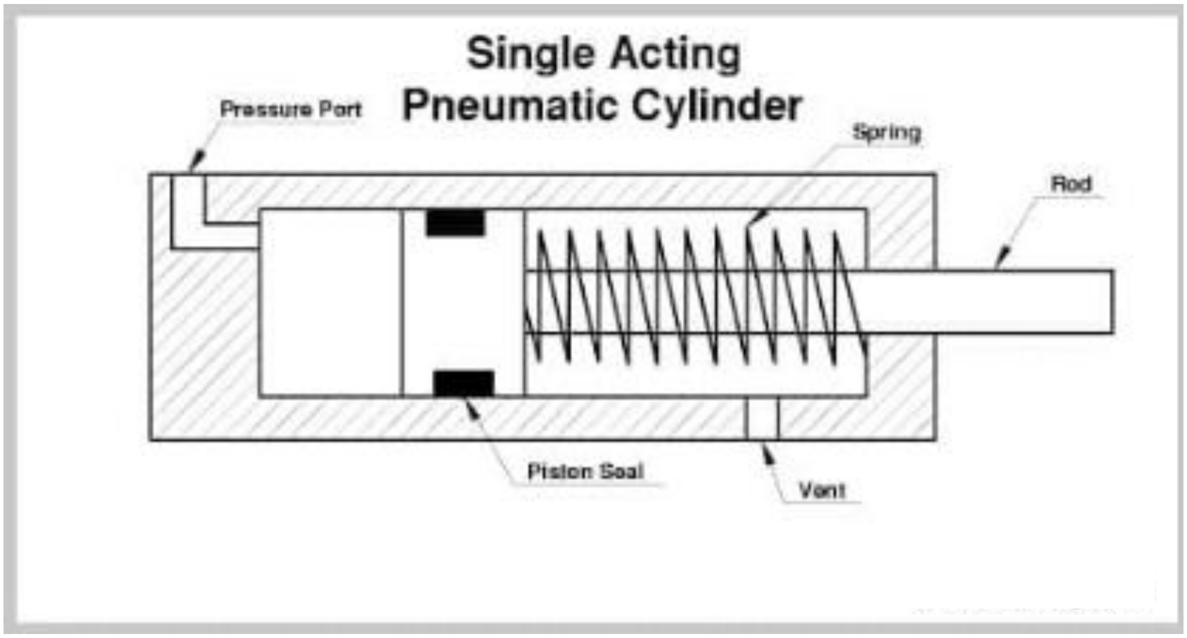


Fig 4.2: Single Acting Pneumatics Cylinder

single-acting Pneumatics cylinder can be either a push or a pull kind. The piston rod is pushed out of the cylinder by pressurized air in a push-type cylinder (out stroke or extension). The piston rod is pulled within the cylinder by pressurized air in a pull-type cylinder (in-stroke or retraction).

The retraction mechanism is accomplished by an external force or gravity in less frequent varieties of single-acting cylinders.

Single-acting cylinders have a simple design and are less expensive because they use less air. Clamping, punching, and positioning are all examples of applications where force is applied in a single direction. Pumps and rams also contain them. However, because to the opposing spring force, the output force is limited. The stroke length is limited by the spring's size. With repeated use of the spring, piston strokes become inconsistent.

4.3 Double Acting Pneumatics Cylinder

Compressed air can be introduced on both sides of the piston in double-acting cylinders. With less internal pressure, the piston and rod assembly will shift to the side of the chamber. As a result, both extension and retraction strokes can be performed by the piston and rod combination. By delivering compressed air on the other side of the cylinder, the piston and rod assembly returns to its previous position.

Because the area on the side of the piston near the rear-end cap is greater, the extension force of double-acting cylinders is greater than the retraction force. This is only true if the amount of pressured air on both sides of the piston is equal. Furthermore, because the rod reduces the effective volume, the retraction speed is faster than the extension speed, allowing the chamber to be filled with compressed air faster.

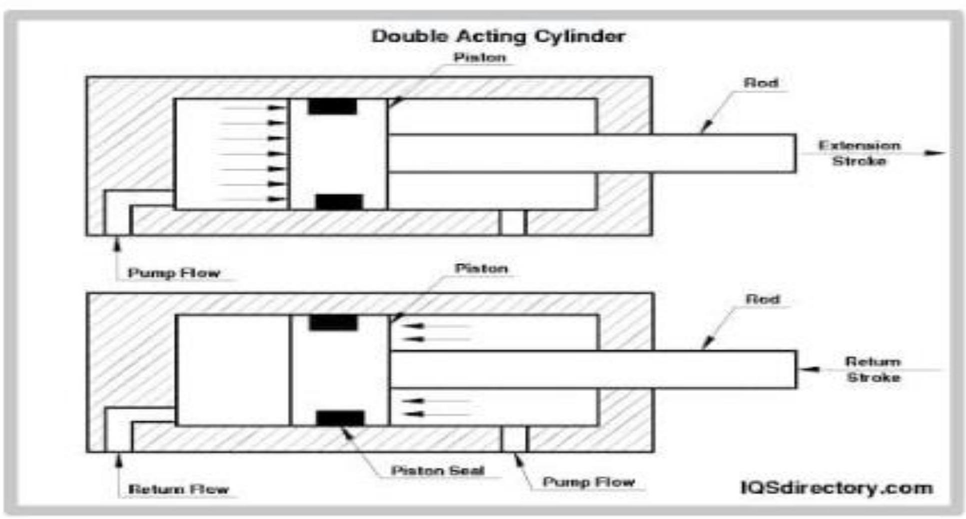


Fig 4.3: Double Acting Pneumatics Cylinder Block Diagram

Double-acting cylinders are handy for opening and closing gates and valves. They're employed in applications that require a lot of speed and force. They have longer stroked and a stronger and more consistent output force. As a result, they require a more robust cushioning system. Because the piston and rod combination is moved by compressed air in both directions, it moves faster and more precisely. Double-acting cylinders, on the other hand, use more compressed air and are more expensive. In the event of a sudden pressure or power loss, the location of the piston cannot be identified.

4.4 Pneumatics Cylinder Piston

A piston is a cylindrical element with a specific length that reciprocates inside a cylinder. The piston is connected to the top of the piston rod and has a diameter somewhat less than the cylinder bore diameter. It is a crucial component that transfers pressure energy into mechanical power. The piston is furnished with a ring that is proportioned well and is made of reasonably soft rubber, allowing for good sealing and low friction at the operating pressure. The aim of a piston is to provide a way of transmitting the pressure of air inside the cylinder to the oil cylinder piston.

In most cases, a piston is constructed by of :

❶ Light and medium work in aluminum alloy.

❷ Bronze, or brass.

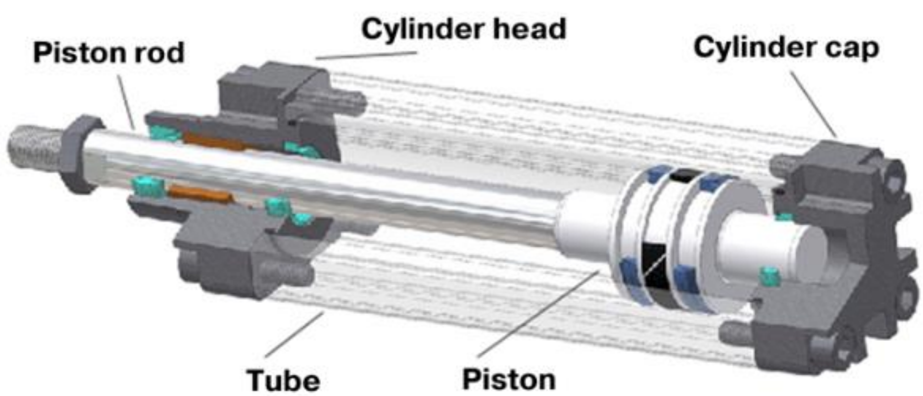


Fig 4.4 (a): Pneumatics Cylinder Piston Block Diagram

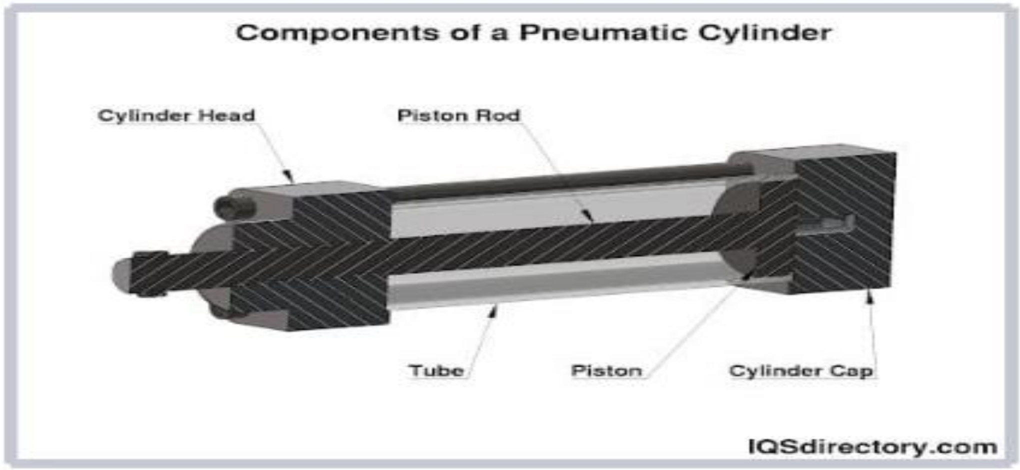


Fig 4.4 (b): Pneumatics Cylinder Components

The piston is double-acting type. The piston moves forward when the high-pressure air is turned from the right side of the cylinder. The piston moves backward when high pressure acts on the piston from the left side of the cylinder. The piston should be as strong and rigid as possible. The efficiency and economy of the machine primarily depend on the working of the piston. It must operate in the cylinder with a minimum of friction and should be able to withstand the high compressor force developed in the cylinder and also the shock load during operation.

The piston should have the following characteristics:

❶ The piston does not make a lot of noise while it moves.

❷ It should be free of friction.

❸ It should be able to resist a lot of pressure

4.5 Pneumatics Cylinder Piston Rod.

The cross-section of the piston rod is round. It connects the piston of one cylinder to the piston of the other. The piston rod is constructed of mild steel that has been polished and honed. To keep the rod seals from wearing out, the outer rod surface must have a high polish. Mechanical fastening connects the piston rod to the piston. If necessary, the piston and piston rod can be separated. The bottom of the piston is attached to one end of the piston rod.

Fig 4.5: Pneumatic Cylinder Piston Rod

The coupling connects the other end of the piston rod to the other piston rod. The piston rod transmits the working force from the piston to the oil cylinder. The piston rod is made to resist a lot of compressions. It should not bend and should be able to sustain shock loads from the grinding force. The piston moves inside the cylinder's bottom cover plate, where the rod seal is fastened. While the rod reciprocates through the cylinder, the sealing mechanisms prevent air loss from the bottom.

4.6 Pneumatics Cylinder Cover Plates

To get the applied pressure from the compressor and act on the pinion, the cylinder should be enclosed. The cover plates on both ends of the cylinder so seal the cylinder, preventing air leakage. On the top cover plate, there is an intake port, and on the bottom cover plate, there are outlet ports. There is also a hole drilled for the piston to travel through. The cylinder cover plate shields the cylinder from dust and other particles while maintaining the same compressor pressure. The piston must be held in both of its extreme positions by the flange. During the return stroke, the piston strikes the top plate, and at the end of the forward stroke, it strikes the bottom plate. As a result, the cover plates must be able to sustain the load.

Fig 4.6: Pneumatic Cylinder Cover Plates

4.7 Directional Control Valve

In pneumatic systems, directional control valves are used to guide or halt pressurized air or oil flow to their appliances. They are the most common components in pneumatic systems, and they can be used to control a cylinder, a larger industrial valve, or air tools, for example. The valves can have two or more ports and perform a variety of roles in the circuit. A symbol can be used to indicate the function and behavior of the valve. However, the valve's construction is not explained by the symbol. Manual or solenoid actuation are two options for controlling directional control valves.

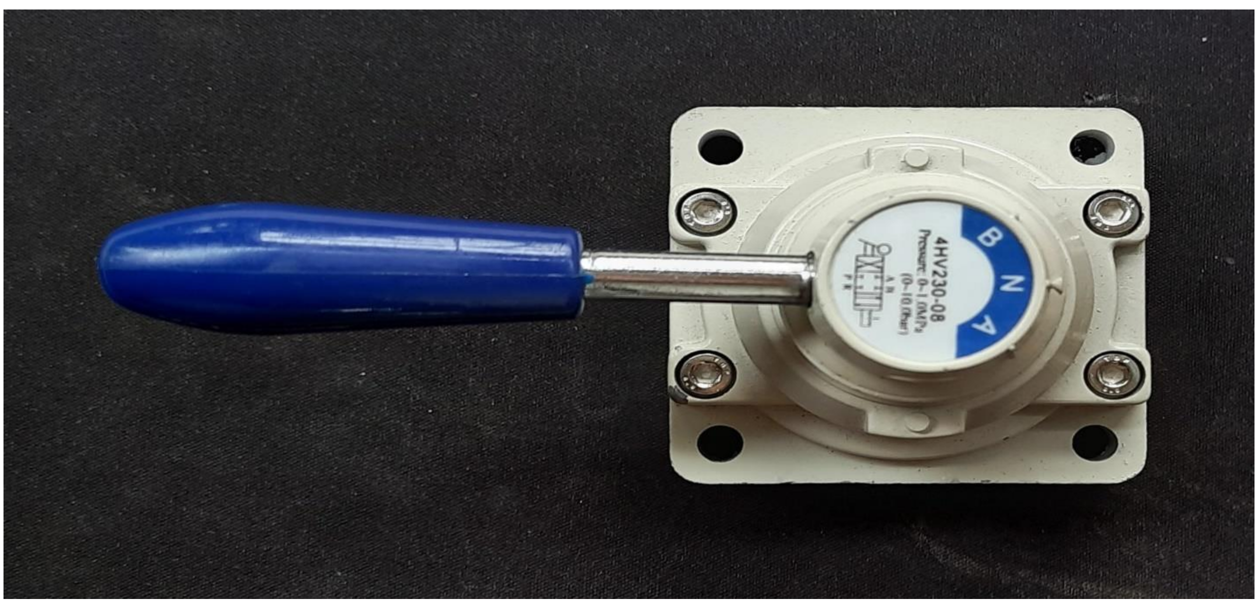


Fig 4.7 : Directional Control Valve

4.8 Working Principle of A Directional Control Valve

There are three openings on the lever-operated valve. This allows the 3/2 valve to be easily exhausted. The 3/2 valve's spool slides inside the main bore according to spool position, connecting and disconnecting the ports. The following is the working principle:

POSITION 1:

The lever is pushed forward, causing air to flow into one side of the cylinder, causing the piston rod to expand.

POSITION 2:

The lever is pushed back, allowing air to flow into the cylinder from the opposite end, causing the piston rod to return to its original position.

4.9 Pipes & Fittings

It allows compressed air to travel from the compressor outlet to the operational valve. The flow rate, pipe diameter, pipe length, and geometry all affect how two distinct pipes connect the operational valve to the working cylinder pressure drop through and airline. For straight pipes of any length, t can be calculated immediately. Even doubling the pipe length will only result in double the pressure drops however a tiny chaining bore size can have a significant impact on pressure drop. Because pressure drop via bends and fittings is particular to the internal geometry involved, it can only be measured by empirical tests. Rigid pipes, on the other hand, are less manipulated through the use of bends with arrangements that require changeable air flow, which can be fluctuating or pulsating. As a result, it is usually focused on practical advice in this scenario.

Fig 4.9: Pipes & Fittings

4.10 Seal's & Pipe Connector

A seal is a vital part of a pneumatic system because it prevents air from leaking through the connection. This project successfully completes the static seal, which is utilized to prevent leaking through a fixed surface. The seal is made of Teflon tape. The qualities of Teflon are as follows:

❶ Withstand the pressure and temperature of the system without being damaged.

❷ Resist abrasion and wear.

❸ Recover from the effects of deformation.

❹Resists the system air's negative effects, such as degradation and shrinkage.

The hoses are connected to the components by connectors.

Fig 4.10: Pipe Connector

4.11 Frame/Structure

Mild steel plate that has been smelted and forged into the required shape.

Fig 4.11: Metal Frame

4.12 Nuts & Bolts

Bolts and nuts are the most appropriate machine components. This pneumatics machine requires five bolts and nuts, which were designed using CATIA software. The screw thread has a 1.5 mm pitch. They are as follows:

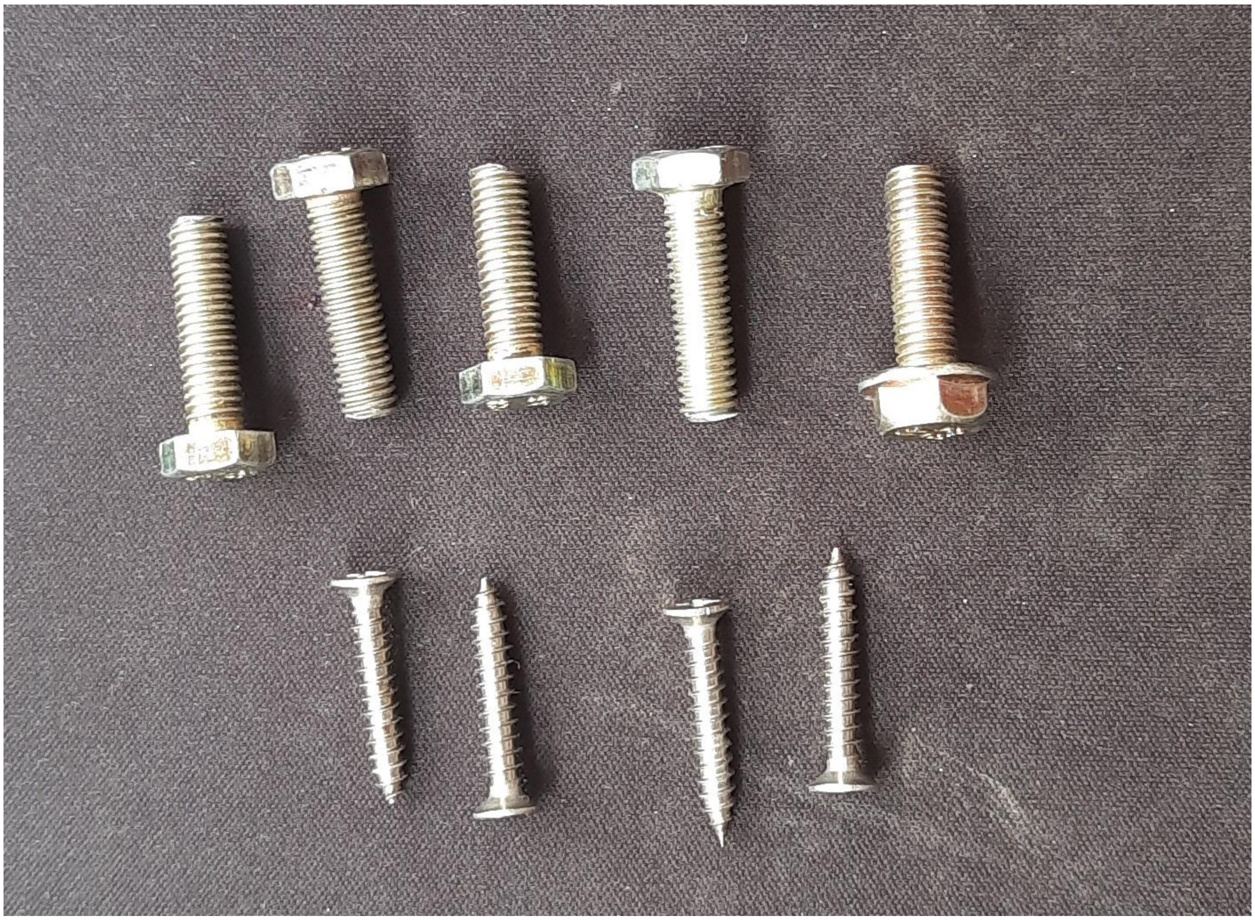


Fig 4.12: Nuts & Bolts

4.13 Air Compressor Machine

A mechanical device that takes in air (or other gas) at a lower or atmospheric pressure and compresses it to deliver the gas at a greater pressure is known as an air compressor.

To compress the air, the air compressor requires power (Or any other gas). The air compressor consumes energy and uses it to compress air or gas, resulting in high-pressure delivery.

The temperature of the air or gas rises dramatically throughout the compression process, necessitating gas cooling, especially when the compression is quite large.

Fig 4.13: Air Compressor Machine

CHAPTER 5

WORKING PROCESS

5.1 Working

❶ The pneumatic cylinder is used as punching equipment in this project.

❷ The force medium for this process is compressed air from the compressor.

❸ In one position, air enters the cylinder at the top and pulls the piston down, completing the punching.

❹ In the next position, air enters the bottom of the cylinder and forces the piston back to its original position, resulting in the return stroke.

CHAPTER 6

USED MATERIALS AND ITS SPECIFICATIONS

To fully meet the machine's requirements for complete operation, the pneumatic cutting and grinding machine is made up of the following components.

❶ Pneumatics Cylinder (Double Acting).

❷ Solenoid Valve.

❸ Pressure Indicator.

❹ Connecting Tube.

❺ Connector.

❻ Nuts & Bolt’s.

❼ Metal Frame.

6.1 Double Acting Pneumatic Cylinder

Stroke Length	40 mm
Quantity	01
Seals	Nitride Elastomer
End Cones	Cast Iron
Piston	EN-8
Media	Air
Max pressure	145 Psi (1.0 MPa , 10.2 Kgf/cm^2).
Temperature	0-80 °C

6.2 Flow Control Valve / Air Solenoid Valve

Size of the Solenoid valve	62 *62 mm
Maximum Pressure Range	(0 -1.0 MPa)
Quantity	01

6.3 Pressure Indicator

Size	5.1 x 4.7 x 2.3 inches (13 x 11.9 x 5.8 cm)
Pressure	0 -200 Psi
Media	Air
Quantity	01

6.4 pipes

Maximum Pressure	10×10^5 N/m²
Outside diameter	8 mm.
Inside diameter	: 5.5 mm

6.5 Connectors

Maximum working Pressure	10×10^5 N/m²
Temperature Range	0 -100 ° C
Material	Brass

CHAPTER 7

RESULT & DISCUSSION

7.1 Specification

Maximum Pressure = 10.2 kg/cm² (1 kg/cm² = 0.9812 Bar)

=(10.2*0.9812) Bar.

= 10.00824 Bar.

Piston Diameter = 20 mm.

= 0.02 m.

Piston Rod Diameter = 10 mm.

= 0.01 m.

(These Values are taken from the Pneumatic Cylinder's user manual)

7.2 Area Calculation

Area of Piston = $(3.1416 \times 0.02^2) / 4$

= $0.000314\ m^2$

Area of Piston Rod = $(3.1416 \times 0.01^2) / 4$

= $0.0000785\ m^2$

7.3 Pressure Estimation

Double-acting cylinder thrust in forward stroke:

From Equation, F $= \frac{\pi}{4} \times D^2 \times$ P

$$F = \left(\frac{3.1416}{4}\right) \times 0.02^2 \times (10 \times 10^5)$$

$$= 314.16 \text{ N.}$$

Double-acting cylinder thrust in return stroke :

From Equation, F $= \frac{\pi}{4} \times (D - d)^2 \times P$

$$F = \left(\frac{3.1416}{4}\right) \times (0.02 - 0.01)^2 \times (10 \times 10^5)$$

$$= 78.54 \text{ N}$$

→The greatest force exerted by our cylinder, according to our calculations, is 392 N.

7.4 Theoretical Air Consumption

$$\textbf{C = [} \frac{\pi}{4} \times D^2 \times (P + 1) \times \text{L] / 1000}$$

$$\text{C = } \textbf{[} \frac{\pi}{4} \times 2^2 \times (10 + 1) \times 4 \text{] / 1000}$$

$$= 0.1382304 \text{ Liters.}$$

So, the Air Consumption is 0.1382304 Liters.

Where,

P = Pressure in Bar

D = Diameter of Bore in cm

L = Length of stroke in cm

C= Air Consumption

CONCLUSION

In the sphere of small-scale companies and automobile maintenance shops, the project we completed was impressive. It is extremely convenient for workers to be able to perform many operations on a single piece of equipment. The cost of the concern has also been decreased as a result of this endeavor. The project was created to complete the entire requirement task, which was also provided.

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