



Design and Fabrication of Pneumatic Sheet Cutting Machine

A thesis report submitted to the Department of Mechanical Engineering, Sonargaon University (SU), in partial fulfillment of the requirement for the Degree of Bachelor of Science in Mechanical Engineering.

Submitted by

<u>Name</u>	<u>ID</u>
Md. Reza Hossain	BME-1402003108
Mohammad Kamal	BME-1403004311
Md. Jakir Ahmed	BME-1503007168
Md, Eusuf Abdullah	BME-1501005357

Supervised by

Md. Rakibul Alam
Lecturer,
Department of Mechanical Engineering
Sonargaon University (SU)

January, 2020

Letter of Transmittal

January, 2020

To

Md. Rakibul Alam

Department of Mechanical Engineering
Sonargaon University (SU).

Subject: Submission of Project Report.

Dear Sir,

We are pleased to submit the project report on “Design and Fabrication of Pneumatic sheet cutting machine”. It was a great pleasure to work on such an important topic. The project has been done as per instruction of your supervision and according to the requirements of the Sonargaon University (SU).

We expect that the concerned authority will accept the project we will remain happy to further explanation that you may feel necessary in this regard.

Thanking You,

Sincerely yours.

.....
Md. Reza Hossain
ID: BME-1402003108

.....
Mohammad Kamal
ID: BME-1403004311

.....
Md. Jakir Ahmed
ID: BME-1503007168

.....
Md. Eusuf Abdullah
ID: BME- 1501005357

DECLARATION

We do hereby deeply declare that, the work presented here in this project report has been carried out by used and has not been previously submitted to any University.

We hereby ensure that the works has been prevented here does not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligation.

.....
Md. Reza Hossain
ID: BME-1402003108

.....
Mohammad Kamal
ID: BME-1403004311

.....
Md. Jakir Ahmed
ID: BME-1503007168

.....
Md. Eusuf Abdullah
ID: BME- 1501005357

CERTIFICATE

This is to certify that the project report on “Design and Fabrication Pneumatic Sheet Cutting Machine”. It is the bona fide record of project work done by Md. Reza Hossain (BME-1402003108), Mohammad Kamal (BME-1403004311), Md. Jakir Ahmed (BME-1503007168), Md. Eusuf Abdullah (BME- 1501005357), for partial fulfillment of the requirement for the degree of Bachelor of Science in Mechanical Engineering from Sonargaon University (SU).

This report has been carried out under my guidance and is record of benefice work carried out successfully.

I wish them every success in the future.

Faculty Guide

Supervised By

.....
Md. Rakibul Alam

Lecturer

Department of Mechanical Engineering

Sonargaon University (SU).

ACKNOWLEDGEMENT

This thesis is accomplished under the supervision of **Md. Rakibul Alam, Lecturer, Department of Mechanical Engineering**, Sonargaon University (SU). It is great pleasure to acknowledge our profound gratitude and respect to our supervisor for this consistent guidance, encouragement, helpful suggestion, constructive criticism and endless patience through the progress of this work. The successful completion of this thesis would not have been possible without his persistent motivation and continuous guidance.

The authors are also grateful to Associate Professor **Md. Mostofa Hossain, Head of the Department of Mechanical Engineering** and all respect teachers of the Mechanical Engineering Department for their co-operation and significant help for completing the thesis work successfully.

Thanking you all,

Authors

.....
Md. Reza Hossain
ID: BME-1402003108

.....
Mohammad Kamal
ID: BME-1403004311

.....
Md. Jakir Ahmed
ID: BME-1503007168

.....
Md. Eusuf Abdullah
ID: BME- 1501005357

ABSTRACT

Usually the sheet metal cutting machine is manually hand operated for medium and small scale industries. This paper gives an insight about the pneumatic sheet metal cutting machine. Any pneumatic machine aimed for economical use of man. In this paper, pneumatic cylinder is used for cutting is easy way which can be used in small scale industries at lower cost. The sheet metal cutting machine works with help of pneumatic double acting cylinder. The piston is connected to the moving cutting blade which his used to cut metal. This sheet cutting machine can cut sheet maximum 1 mm thickness with shearing blades which length is 375 mm and width 38 mm at a pneumatic pressure of 3 bar and its material is mild steel. The design and fabrication of pneumatic sheet cutting machine is totally economical in human effort and useful in small and medium sheet metal industries.

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CHAPTER-1

INTRODUCTION

- **Historical background:**

The sheet cutting machine is the heart of sheet metal industries. In some industries, hand sheet cutter is used which is operated manually. In these machine, we are using pneumatic cylinder for sheet metal cutting. These machine should be easy to operate and maintain also. Hence, we are introducing a pneumatic sheet metal cutting machine which will reduce manufacturing cost and minimize industrial labor problems which is the biggest headache for human. The main objective of our project is to perform job holding operation effectively with less human efforts by using a machine with the pneumatic power. This will also reduce the time required for metal cutting. By using these machine we can increase the production rate and automatically the industry will be in profitable. Automation plays an important role in mass production. Automation can be achieved through pneumatic from. The main advantage of pneumatic system is economically cheap and easy to handle.

- **Objective:**

The objective of this project is

- To a design a Pneumatic Sheet Cutting Machine.
- To fabricate a Pneumatic Sheet Cutting Machine

CHAPTER-2

LITERATURE REVIEW

There are many sheet metal cutting processes. Laser sheet metal cutting process is one of them. Many researchers have investigated experimentally the effect of various process parameters on the different quality characteristics in the laser cutting of different categories of materials. Rajaram have found the influence of laser power and feed rate (cutting speed) on the kerf width in the laser cutting of 1.27 mm thick 4130 steel.

Joseph Bramah [1] patented the hydraulic press in 1795. While working at Bramah, Henry Maudslay suggested a cup leather packing. Because it produced superior results, the hydraulic press eventually displaced the steam hammer from metal forging. Hydraulic power was used extensively in Bessemer steel production. Hydraulic power was also used for elevators, to operate canal locks and rotating sections of bridges. Some of these systems remained in use well into the twentieth century.

Harry franklin [2] was called the "Father of Industrial Hydraulics" by ASME. Pneumatics was first documented by Hero of Alexandria in 60 A.D, but the concept had existed before then. Pneumatic devices are used in many industrial applications. Generally appropriate for applications involving less force than hydraulic applications, and typically less expensive than electric applications, most pneumatic devices are designed to use clean dry air as an energy source. A pneumatic system is a system that uses compressed air to transmit and control energy. In the big industries sheet metal cutting machines are very much important to cut the sheet metal as a large amount. As a simple pneumatic sheet metal cutting machine could not afford much in these big industries. It works for simple sheet metal cutting.

Pan Ling Steel et al [3], The portable type provides a portable pneumatic cutting machine and a bearing to the technical field of pneumatic cutting machine. State and a normal cutting machines is generally not provided with a handle so that operation and carrying are inconvenient. The portable pneumatic cutting machine loads a machine

body, a cutting slice is constituted on an output shaft of the head of the machine body, a high pressure airflow air inlet connecting port is formed in the tail side of the machine body, a trigger compliance, and reliability to humans. However, the system using pneumatic actuators is complicated in general with a compressor, control valves, and air tubes. Solving a lot of control wires to control valves. The purpose of this research is simplifying pneumatic system having many degrees of freedom. For this purpose we have proposed a new method of multiplex pneumatic transmission for the multi pneumatic servo system. The pneumatic valve for this system consists of two vibrators and springs. The working principle of the valve is based on vibrator resonance caused by multiplex pneumatic vibration. This valve works as an ON/OFF valve without electric wire but works just through one air supply line. This pneumatic system using the valve realizes independent control of valves with only air tubes. It is effective for the pneumatic system having many degrees of freedom. The basic working has been confirmed.

CHAPTER-3

DESIGN AND CONSTRUCTION

3.1 Drawings:

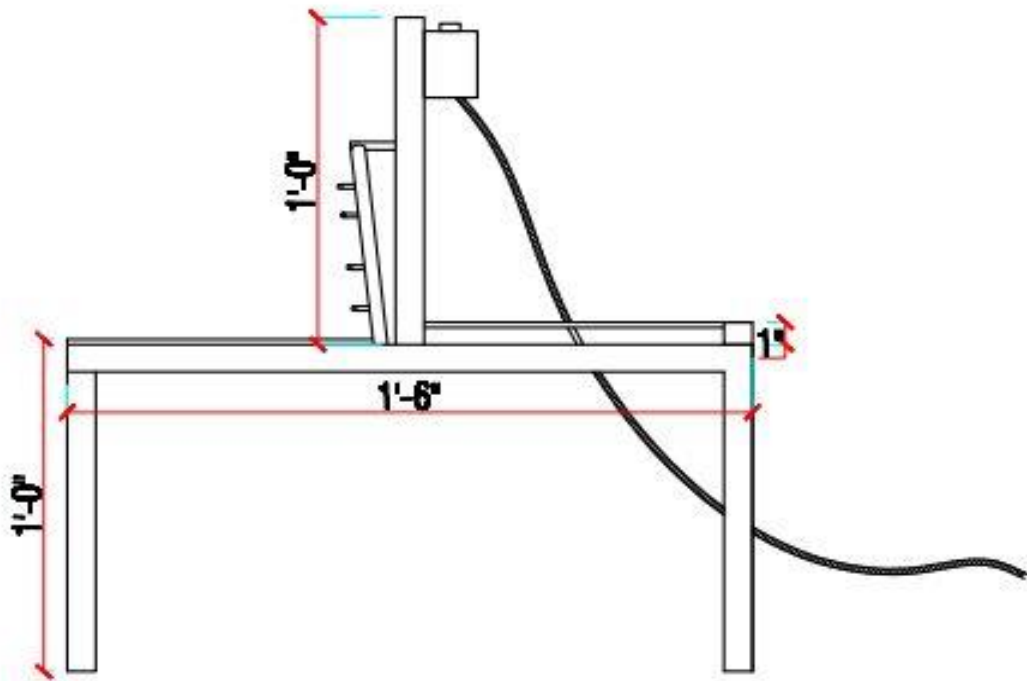


Fig-3.1.1 Pneumatic cutting machine side view

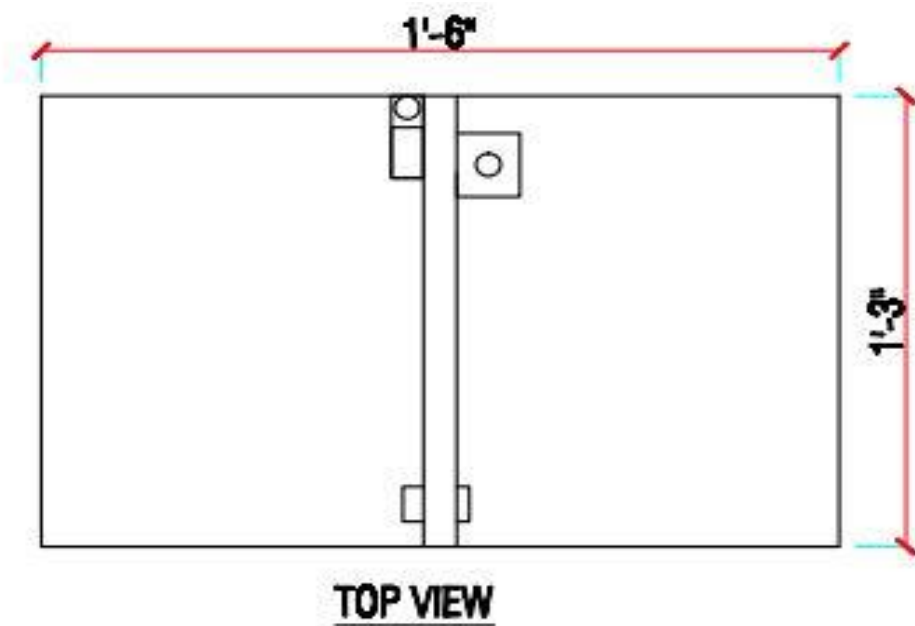


Fig-3.1.2 Pneumatic cutting machine top view

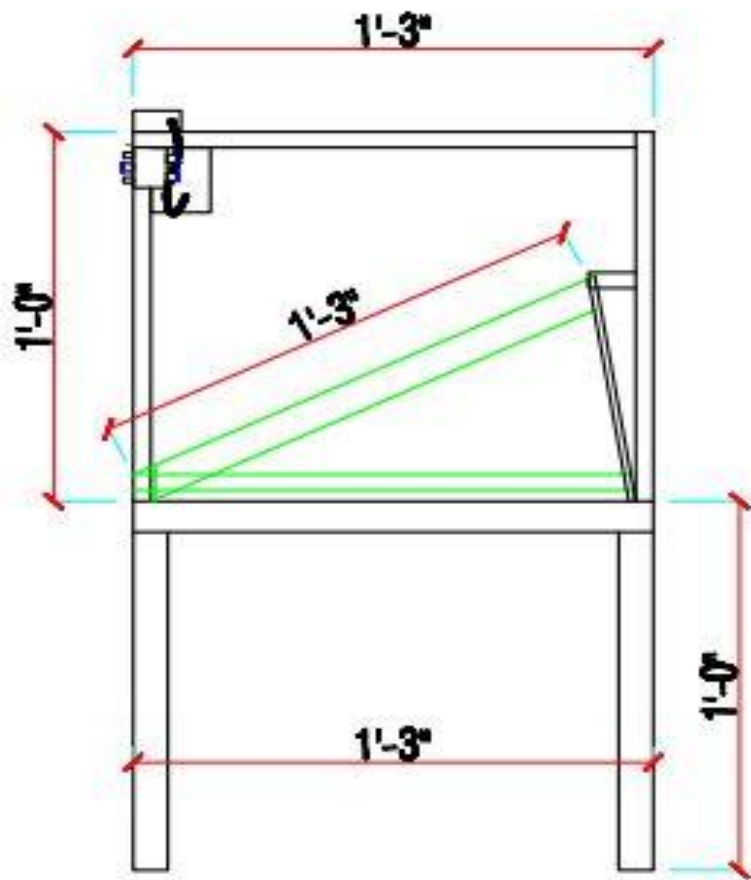


Fig-3.1.3 Pneumatic cutting machine side view

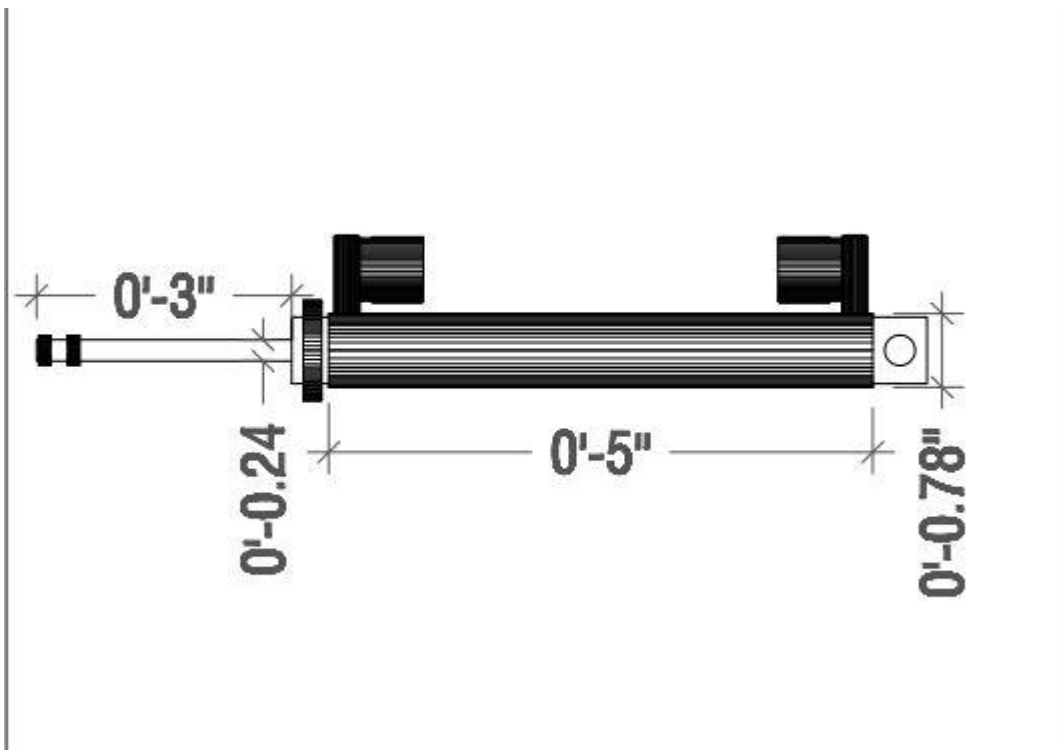


Fig-3.1.4 Pneumatic cylinder side view

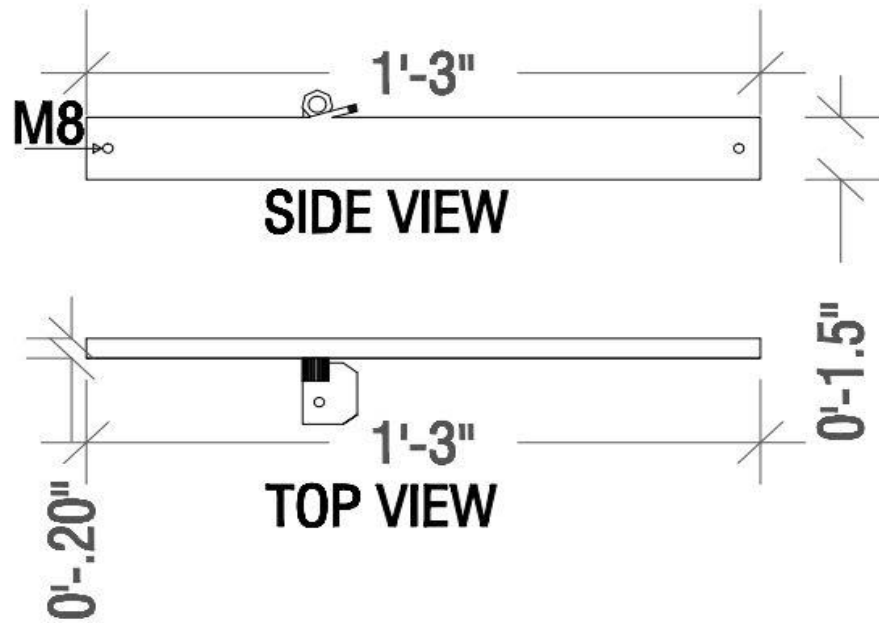


Fig-3.1.5 Pneumatic cutting blade side view and top view

- 3D Drawing

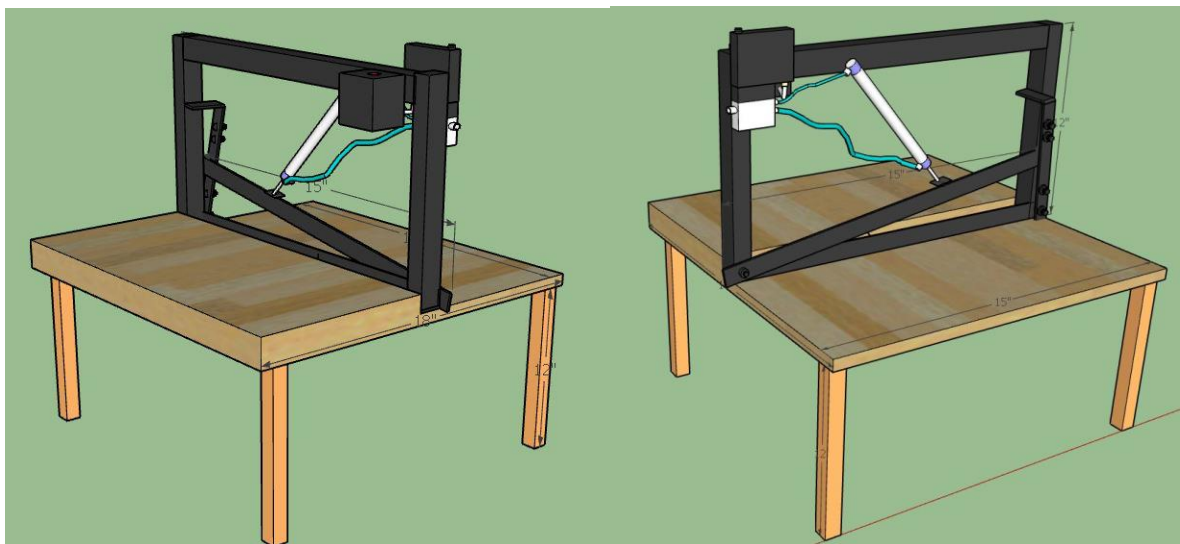


Fig-3.1.6 Pneumatic sheet cutting machine 3D design.

- Actual Prototype Output Figure



Fig-3.1.7 Pneumatic cutting machine figure (Actual figure)

3.2 Construction:

Table 3.2.1 Materials technical specification.

SL	Name	Technical specification	Quantity
1.	Base frame	Mild steel square box length-450mm, width-375mm, high-300mm and thickness-25mm.	01 no.
2.	Shearing blade	Mild steel flat bar length-375mm, width-38mm and thickness-6mm.	02 nos.
3.	Air cylinder	Double acting pneumatic cylinder, model: MAL16x75-CA and pressure capacity 0.1-1MPa.	01 no.
4.	Control valve	Operating voltage 220Ac-6.0VA, voltage range AC187V-253V, 50/60Hz.	01 no.
5.	Thread screw	Thread screw length-32mm, dia-2mm.	06 nos.
6.	Nut-bolts	Adjusting and fixing length-38mm, 25mm, 20mm, size-M8	06 nos.

7.	Base wood	Base wood length-375mm, width-225mm and thickness-3mm.	02 nos.
8.	Push switch	Push switch for controlling the machine ON and OFF.	01 no.
9.	Pneumatic pipe	Compressed air transmission energy.	03 nos.
10	Air Compressor	Maximum 8 bar	01 no.

CHAPTER-4

METHODOLOGY

The main goal of project studies is to study about pneumatic control system. Then, to study about double acting cylinder. Then, to study about the advantage of pneumatic hand operated valve. Then, to study about high speed blade. Then, to design & fabrication pneumatic sheet metal cutting machine. Then, collecting the proper components. Then, machining them. Then, assembling the all components to a proper shape. Finally, Completion the process to make a proper pneumatic sheet metal cutting machine.

4.1 Name of components description with figure:

A. Air Compressor: Air compressor is a device that convert power (using and electric motor, diesel or gasoline engine etc.) into potential energy stored pressurize air (that is, compress air), by one of several method and air compressor force more and more air into storage tank, increasing the pressure, when tank pressure reaches is upper limit the air compressor shuts of the compress air, then, held in the tank until called into used.

Specification:

Piston Type

Capacity Max 8 Bar



Fig.4.1.A-Air Compressor

B. Cutting blade: Sheet metal is a metal form by an industrial process into thin, flat pieces it is one of the fundamental forms used in metal working and it can be cut and bend every day object are fabricated from sheet metal.

Specification:

Mild steel flat bar

Length-375mm,

Width-38mm

Thickness-5mm.



Fig-4.1.B Mild steel cutting Blade

C. Pneumatic Cylinder:

Double acting cylinder are equipped with two working ports- on the piston side and the other on the rod side, to achieve forward motion of the cylinder, compressed air is admitted on the piston side and rod side is connected to exhaust, during return motion supply air admitted at the rod side while the piston side volume is connected to the exhaust, force is exhausted by the piston both during forward and return motion of cylinder.

Specification:

Model: MAL16x75-CA

Pressure capacity 0.1-1MPa.



Fig-4.1.C Pneumatic cylinder

D. Direction control valve:

A Control Valves are used to reduce the rate of flow in a section of a pneumatic circuit, resulting in a slower actuator speed. Unlike a Needle Valve, a Flow Control Valve regulates air flow in only one direction, allowing free flow in the opposite direction. A control valve is a valve used to control fluid flow by varying the size of the flow passage as directed by a signal from a controller this enables the direct control of flow rate and the consequential control of process quantities such as pressure, temperature, and liquid level. Air control valves are fundamental components of any pneumatic system. Selecting the right air control valves to regulate system pressure, direction of flow, and rate of flow is crucial when designing fluid power circuitry. If the pneumatic valve is too big for your application, you will be wasting air and money.

Specification:

Operating voltage 220Ac-6.0VA,
voltage range AC187V-253V, 50/60Hz.

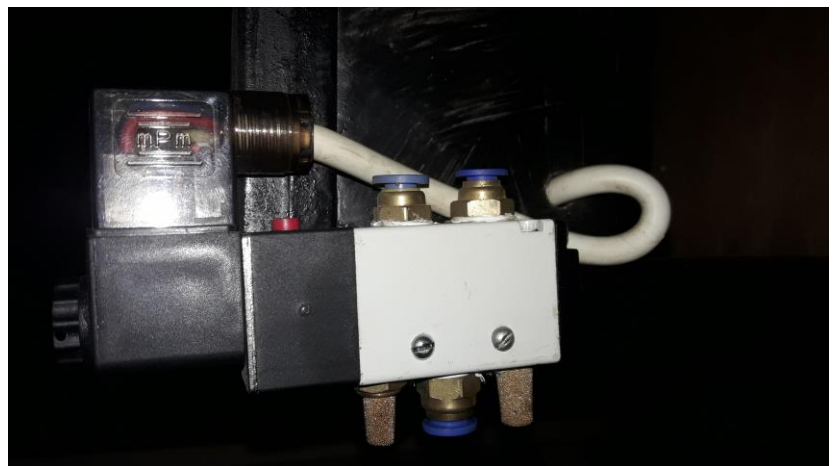


Fig-4.1.D- Direction control valve

4.2 Methodology:

The main goal of project studies is to study about pneumatic control system. Then, to study about double acting cylinder. Then, to study about the advantage of pneumatic hand operated valve. Then, to study about high speed blade. Then, to design & fabrication pneumatic sheet metal cutting machine. Then, collecting the proper components. Then, machining them. Then, assembling the all components to a proper

shape. Finally, Completion the process to make a proper pneumatic sheet cutting machine metal.

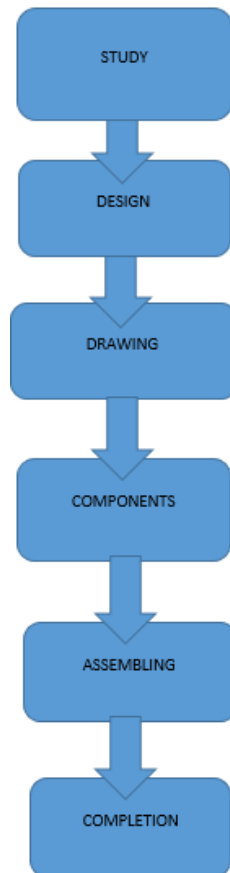


Fig 1: Flowchart for fabrication of sheet metal cutting machine.

4.3 Working Principle (Pneumatic):

The sheet metal cutting machine work with the help of pneumatic double acting cylinder. The piston is connected to moving cutting tool which is used to cut small size of the sheet metal. The machine is portable so it is easy to transportable, the compress air form the compressor is used to force medium for this operation. There is pneumatic double acting cylinder control valve flow air. With the help of direction control valve to perform cutting operation. The controlled air from the flow control valve enter in cylinder and piston rod moves forward and force exert on cutting tool and cutting

stroke are obtained. Then at next position, air enter other side and piston rod moves backward so that the releasing stroke is obtain the speed of cutting and releasing stroke is varied back by the time control unit circuit.

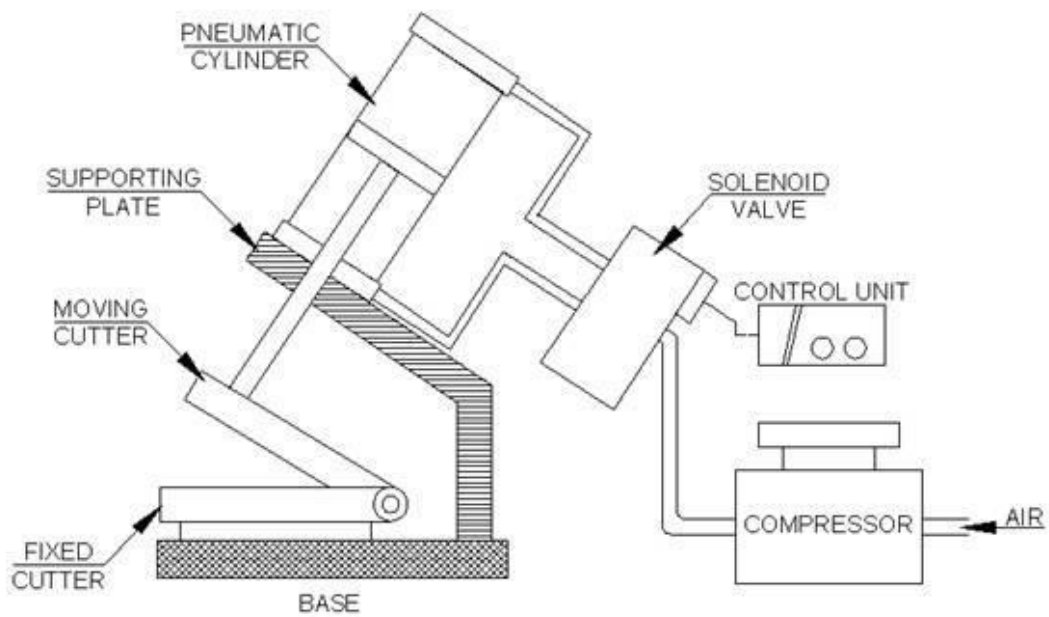


Fig: Pneumatic sheet cutting machine

A. Advantages:

- To reduce human efforts
- To increase production rate
- To increase efficiency of industry
- To reduce the work load
- To reduce time etc.

B. Disadvantages:

- While working the compressed air produces noise therefore a silencer may be used
- High torque cannot be obtained and
- Load carrying capacity of this unit is not very high etc.

C. Applications:

- This is very useful for small scale industries
- This machine is used to cut roller sheet metal
- All industrial applications etc.

4.4 Mathematical Calculation:

A. Sheet metal cutting force:

$$\text{Cutting force} = L \times S \times T_{max} = 25 \times 0.511 \times 20 = 255.5 \text{ N}$$

Stripping force = 10%-20% of cutting force

$L = 25$ Length of periphery to be cut in mm

$S = 0.511$ Sheet thickness in mm

T_{max} = Shear strength in N/mm^2

T_{max} = 80% of tensile strength

After putting corresponding values according to the equation we can get that aggregated cutting force of our

Pneumatic Sheet Metal Cutting Machine was $F = 10080 \text{ N}$.

CHAPTER-5

RESULTS AND CONCLUSION

5.1 Results:

The metal strips made of galvanized iron and aluminum with different thickness has been shared by the pneumatic cutting machine add various pressures.

Table: 5. 1: Force reading for different sheets.

Materials used	Thickness (mm)	Applied pressure (bar)	Force (N)
Galvanized iron sheet metal	0.511	2.5	255.5
	1	3.0	500

5.2 Conclusion:

The design and fabrication of pneumatic sheet metal cutting machine is totally economical in human effort and useful in improvement of cost factory, show and work place layout and design of plant and equipment. We know that pneumatic sheet metal cutting machines are very chip as compare to hydraulic sheet metal cutting machine. The range of cutting thickness can be increases by installing high pressure cylinder and harder blade. The small sheet metal cutting industry cannot afford the expensive hydraulic cutting machine so that we use pneumatic sheet metal cutting machine.

5.3 Future Scope:

- It can be made hydraulically power operated by installing the gear oil pump at the place of air compressor and pneumatic air arrangement.
- It can be made as rack and pinion operated or spring and lever operated, by replacing

pneumatic circuit by rack and pinion arrangement by the square threaded screw and nut arrangement.

- The place where there is scarcity of the electricity the electric motor operate compressor is replace by an IC engine install compressor.
- In this machine, compress air is use to move the cutting tool for carrying our cutting operation. After the completion of the cycle the air moves out through the outward of control valve, this air is release to the atmosphere. In future the mechanism can be develop to use this air again for the working of cylinder.

Thus in future there are many modifications, which we can make to survive the huge global work of computation.

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