DESIGN AND FABRICATION OF PNEUMATIC SHEET CUTTER MACHINE

A THESIS IN PARTIAL FULFILMENTS OF
REQUIREMENTS FOR THEAWARD OF THE DEGREE OF

Bachelor of Science in Mechanical Engineering

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ABSTRACT

Pneumatics systems are extensively used in a wide range of industries, factories and manufacturing sector entities. Pneumatics system are noted for their simplicity, reliability, and ease of operation. Also they are suitable for fast and rapid application of force. The purpose of this project is to therefore design a simple, easily operated pneumatic sheet metal cutting and bending machine that is sturdy and strong. A pressure of 8-10 bar is enough for operating the unit. The pressurized air passing through the tubes to the cylinder, forces the piston out whose power through the linkage is transmitted to the punch. The work piece thus got is for required dimensions and the piece can be collected through the land clearance provided in the die. The die used in this is fixed such that the die of required shape can be used according to the requirement. Automation of machine is achieved with the help of pneumatic system. This involves the design of an efficient system which reduces the human effort and help to increase production output. Usually the sheet metal cutting machine is manually hand operated for medium and small scale industries. 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

1.1 Definition of Product Design:

The term product design refers to the effective generation, analysis and development of ideas which leads to a new product to meet the customer requirements. It includes producing a new product or developing the update version of an existing product. The process has several stages such as generation of idea, developing the idea, analyzing the feasibility of the product. Customer demands or requirements is the ultimate driving force while designing a product.

1.2 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.

1.3 Cause of Choosing Pneumatic sheet metal cutting machine

Cutting sheet is one of the main works in any metallic product manufacturing industries. But general sheet metal cutting methods are time consuming and tiresome too. That's why we felt the necessity of a machine which can cut the sheet metal easily. Again, it's maintain cost is very low for design simplicity.

1.4 OBJECTIVES

The objectives of our thesis work are followings-

a) To design a Pneumatic Sheet Cutting Machine.

b) To fabricate a Pneumatic Sheet Cutting Machine.

CHAPTER-II

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 Mausdlay 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, 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 beenconfirmed.

Sharing machines are classified according to the following: -

1) Pneumatic operated
2) Hydraulically operated
3) Rack & Pinion operated
4) Spring operated

CHAPTER-III

3.1 Working Principle (Pneumatic):

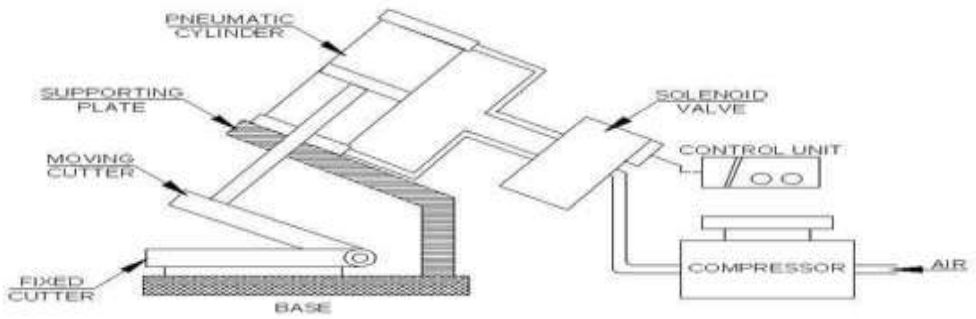

Fig. 3.1 : Pneumatic sheet cutting machine

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.

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.

3.2 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 calledinto used.

Specification:

Piston Type

Capacity Max 8 Bar

Fig: 3.1 Air Compressor

B. Cutting blade: Sheet metal is a metal form by an industrial process into think, 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 form sheet metal.

Specification:

Mild steel flat bar

Length-375mm,

Width-38mm,

Thickness-5mm.

Fig-3.2 Mild steel cutting Blade

C. **Pneumatic Cylinder:** Double acting cylinder are equipped with to working ports- on the piston size add the other on the road side, to achieve forward motion of the cylinder, compress air is admitted on the piston side and road side is connected to exhaust, during return motion supply air admitted at the road 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-3.3 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 passageas directed by a signal from a controller this enables the direct control of flow rate and the consequential control of process quantities suchp 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-3.4 Direction control valve

CHAPTER-IV

DESIGN

Base Frame:

Mild steel square boxlength-450mm, width-375mm, high-300mm and thickness-25mm

Shearing blade:

Mild steel flat bar length-375mm, width-38mm and thickness-6mm

Air cylinder:

Double acting pneumatic cylinder, model: MAL16x75-CA and pressure capacity 0.1-1MPa

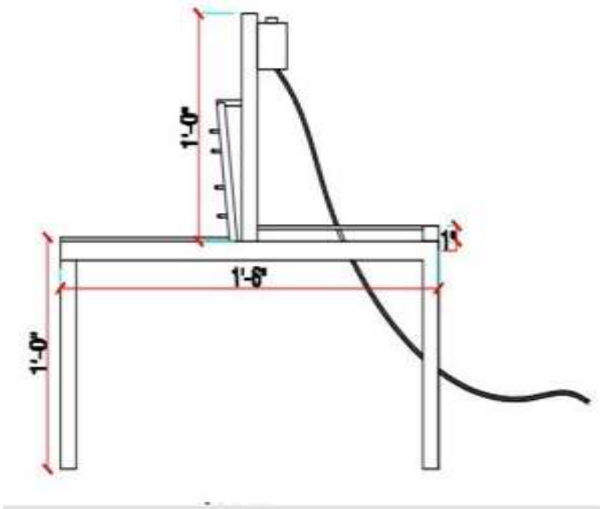

Fig-4.1.1. Pneumatic cutting machine side view

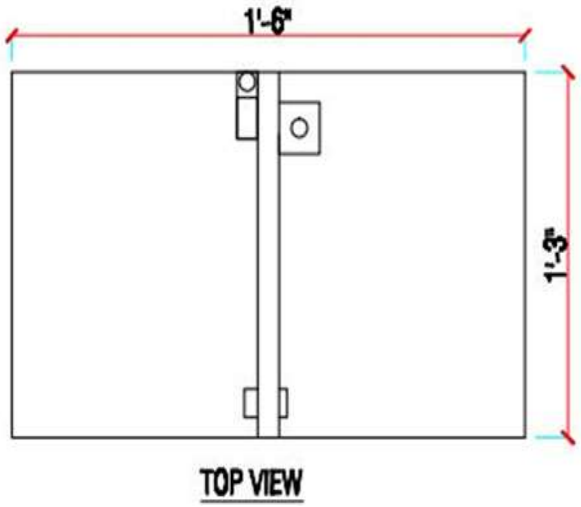

Fig-4.1.2. Pneumatic cutting machine top view

Control valve:

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

Thread screw:

Thread screw length-32mm, dia-2mm

Nut-bolts Adjusting and fixing length-38mm, 25mm,20mm, size-M8

Push switch:

Push switch for controlling the machineON and OFF.

Pneumatic pipe:

Compressed air transmission energy.

Air Compressor Maximum 8 bar.

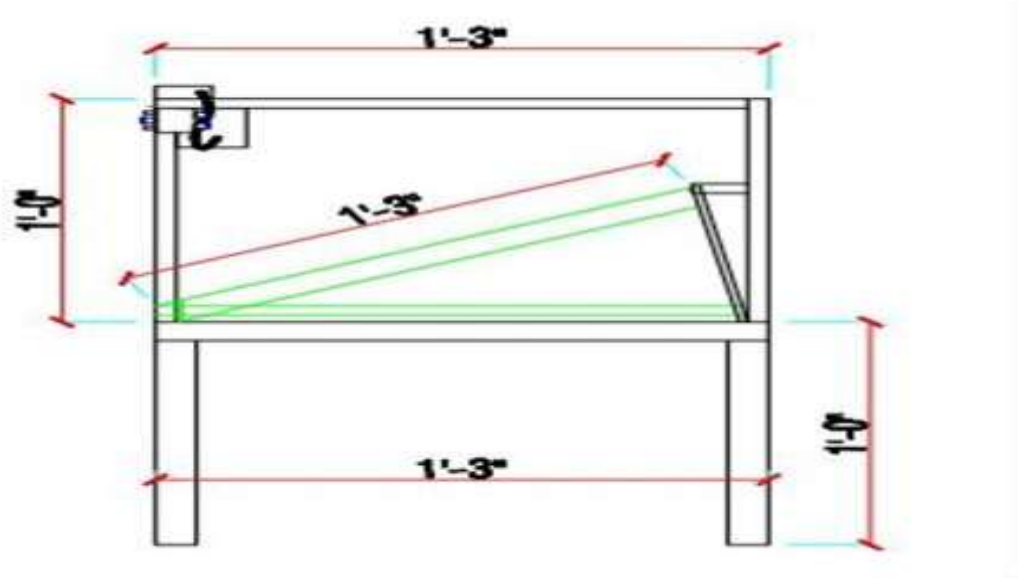

Fig-4.1.3. Pneumatic cutting machine side vie

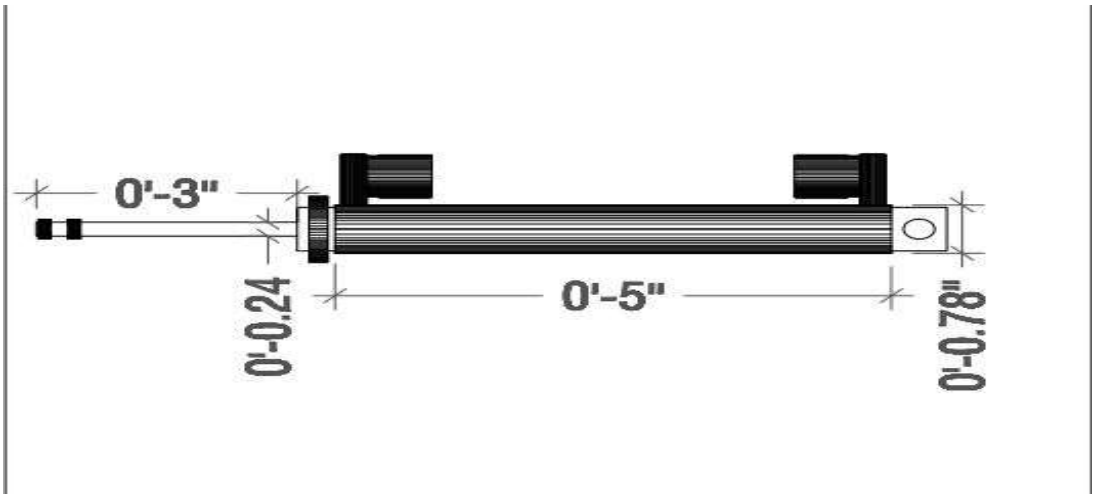

Fig-4.1.4. Pneumatic cylinder side view

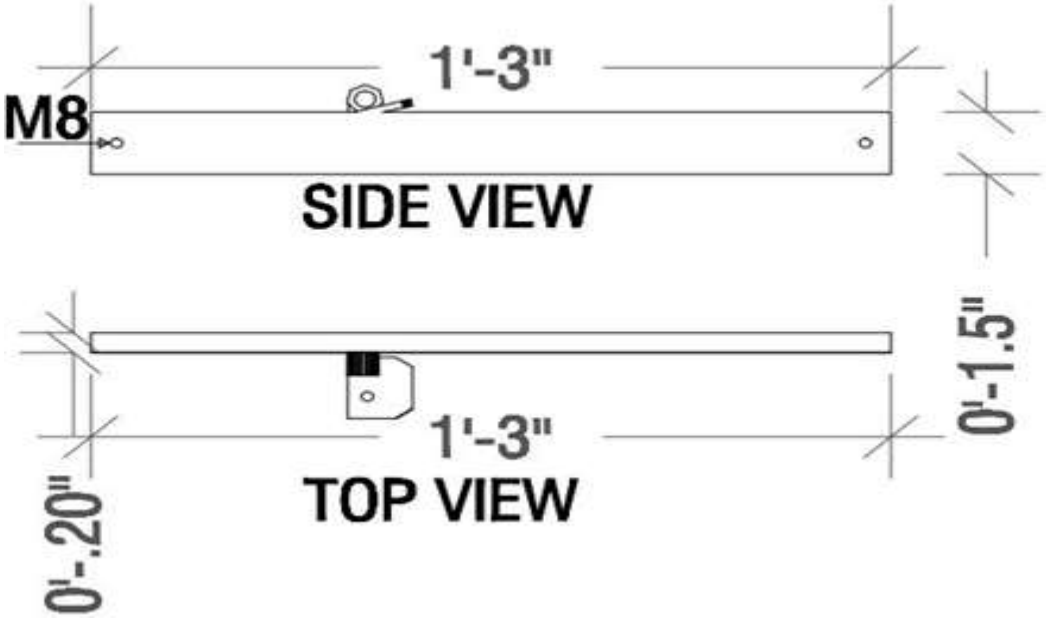

Fig-4.1.5. Pneumatic cutting blade side view and top view

CHAPTER-V

CONSTRUCTION

- **3D Drawing**

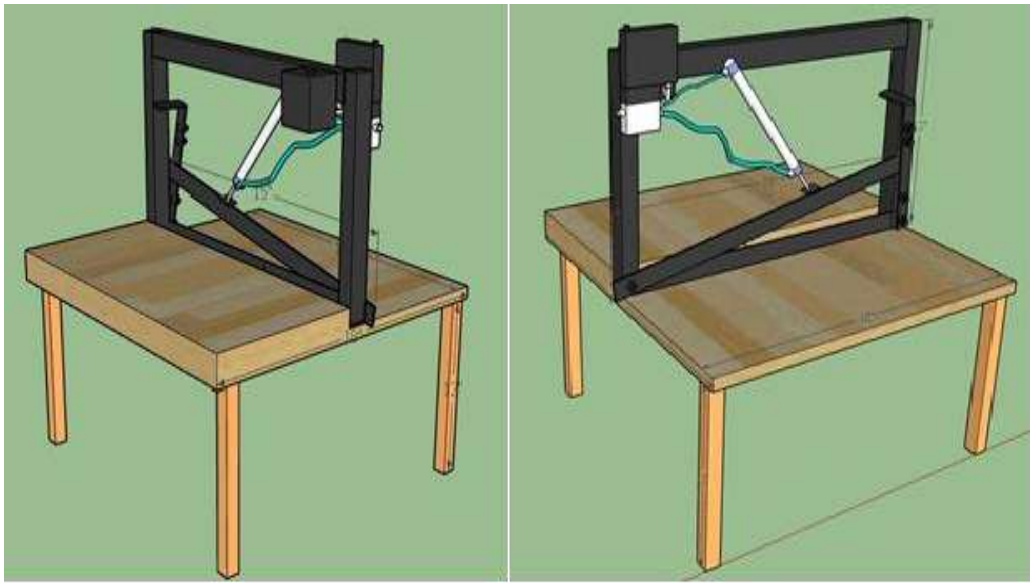

Fig-5.1 Pneumatic sheet cutting machine 3D design.

- Actual Prototype Output Figure

Fig-5.2 Pneumatic cutting machine figure (Actual figure)

5.1. Introduction:

The formation of any business begins with someone producing the initial idea for the project. The continued success of an established business depends upon the number and quality of the ideas fed into it. Without a continual flow of new ideas, a business cannot function profitably or expand successfully and must, therefore eventually fade into total obscurity. Ideas for a new business project, a new product, a means of reducing manufacturing costs or for solving industrial labor problems, begin in the human mind. Most people conceive their ideas unconsciously, and because they are unaware of the mental mechanics that caused the 'idea' to be produced, they cannot repeat the ideation process to produce further profitable ideas at will. Fortunately, there are available established creative techniques which, when used correctly, do enable a person to produce a large number of first-class ideas at will. One such creative technique, and probably the most widely used in American industry, is 'brainstorming'.

5.2. Prior Concepts:

Pneumatics, from the Greek (pneumatic, coming from the wind) is the use of pressurized gases to do work in science and technology. Pneumatics was first documented by Hero of Alexandria in 60 A.D., but the concept has existed before then. A pneumatic product represents a multibillion dollar industry today. 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. The actuators then convert that compressed air into mechanical motion. The type of motion produced depends on the design of the actuator. Pneumatic is employed in a variety of settings. In dentistry applications, pneumatic drills and lighters, faster and simpler than a electric drill of the same power rating (because the prime mover, the compressor, is separate from the drill and pumped air is capable of rotating the drill bit at extremely high rpm).pneumatic

transfer system are employed in many industries to move powders and pellets. Pneumatic tubes can carry objects over distances. Pneumatic devices are also used where electric motors cannot be used for safety reasons, such as mining applications where rock drills are powdered by air motors to preclude the need for electric motors depends in the mine where explosive gases may be present.

Table 5.1: 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 pneumaticcylinder, model: MAL16x75-CA and pressure capacity 0.1-1MPa.	01 no.
4.	Control valve	Operating voltage 220Ac-6.0VA, voltagerange 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-225mmand thickness-3mm.	02 nos.
8.	Push switch	Push switch for controlling the machineON and OFF.	01 no.
9.	Pneumatic pipe	Compressed air transmission energy.	03 nos.
10	Air Compressor	Maximum 8 bar	01 no.

CHAPTER-VI

EXPERIMENT RESULT

6.1. Sheet metal cutting fo rce:

Cutting force = $L \times S \times Tmax = 25 \times 0.511 \times 20 = 255.5$ N

Stripping force=10%-20% of cutting force

L = 25mm Length of

periphery to be cut in

S= 0.511mm Sheet

thickness in mm

$Tmax$ = Shear

strength in

N/mm^2

$Tmax$ = 80%

of tensile

strength

After putting corresponding values according to the equation we can get that aggregatedcutting force of our
Pneumatic Sheet Metal Cutting Machine was F=10080 N.

6.2. Results:

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

Law

Shear Stress $_{Steel} = 4.0 \times 10^8 N/m^2$
S = Shear Stress/ Shear Strain =F/A// DealtaX/h
Shear Stress =F/A
F =(Shear stress)A

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

CHAPTER-VII

DISCUSSION

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.

7.1.A. Advantages:

To reduce human efforts to increase production rate To increase efficiency of industry To reduce the work load To reduce time The pneumatic is more efficient in the technical field. Quick response is achieved. Easy maintenance and repair. Low investing cost. Continuous operation is possible without stopping. Compact size and less floor space is used. All movements are pneumatically operated. Optional solution of operation is Electrical control Panel. Ragged construction to suit in highly acidic Atmosphere & high temperature. All pneumatic actuators are S.S. to suit corrosive Atmosphere. Air is available everywhere Can be stored easily Clean and non – pollutant Transportable over long distances High speed operation Relatively low cost to produce Largely insensitive to temperature Technology can be easily learned.

7.1.B. Disadvantages:

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

7.1.C. Applications:

- This is very useful for small scale industries
- This machine is used to cut roller sheet metal
- All industrial application.
- Car body
- Air planes way
- Medical tables
- Roof for buildings
- Sheet metal of iron and others material with high magnetic permeability also known as laminated sheet cores, has application in transformers and electric machine FOR Paper cutting
- For sheet cutting
- For stamping operating

7.2. Additional development (Cutting oil box set up):

When the pneumatic sheet cutting machine will cut the sheet continuously that`s the cutting blade and metal getting hot as a result the cutting blade can be broken & the sheet can be hampered.

7.2.A. Advantages of key points of using cutting oil:

1) Heating removal
2) Keep work piece at a stable temperature and reduce thermal distortion
3) Lubrication
4) Reduce cutting force and power consumption
5) Enable optimum cutting speed
6) Surface finish
7) Corrosion resistant
8) Chip breaking
9) Chip removal
10) Ensure the safety of the operator and environment upon disposal

7.2.B. Essential Elements:

1) High pressure pump
2) Nozzle
3) Oil tank
4) Control circuit
5) Pneumatic pipe
6) Solenoid valve

7.3. How to setup the lubricating system:

Firstly, we have to keep oil that`s why need an oil tank. Beside oil tank have a pump (distance2 to 3 feet). From the pump we setup a pipe that`s connected with solenoid valve. It`s perform to control the lubricating flow. Then from the solenoid by a pneumatic pipe connect with nozzle. Finally to control all the system have control circuit.

7.4. High pressure pump:

Professional pump users have a variety of pump technologies available for a wide varietyof industries and uses. Learn more about the different types of pumps, their functions, differences and applications. Whether for ash disposal, autoclave feeding, spray drying, dosing, extraction, descaling, cooling, industrial cleaning of surfaces and components or for many other uses - at SPA you will find the right pump for your application thanks to the wide range of pumps from different pump manufacturers. If you still don't know which pump is suitable, you can already determine your suitable pump technology. We will gladly connect you with the rightmanufacturer of the SPA.

7.4.A. The pump can be uses as:

- Transfer / feeding pumps
- circulation pumps
- booster pumps
- high-pressure pumps

- high-temperature pumps
- hygienic pumps (for food & pharmacy)
- laboratory pumps
- dosage pumps
- mixing pumps

and many more to give just a few examples.

7.4.B. The pumps are available as / with:

- horizontal / vertical
- single-staged / multi-staged
- sealed / sealless / hermetically
- self priming
- immersed
- API 674
- API 675
- API 676
- API 685
- ISO 2858
- ISO 5199
- ISO 15783
- EN 22858
- ATEX / Ex proofment (zone 1 & 2)
- standardized pumps / norm pumps
- special / individual designed pumps

7.4.C. Available materials for the pump casings or components:

- metal
- stainless steel
- chronium-nickel steel

- bronze
- duplex
- titan
- hastelloy
- /gray cast iron
- ceramics
- PP
- PFA
- PVC
- PVDF
- PEEK
- PTFE
- UHMW-PE
- synthetic coal

7.5. The following engines are possible:

- Electric motor
- diesel motor
- hydraulic motor
- pressed air
- magnetic drive
- special / individual drives

Nozzle:

A gas jet, fluid jet, or hydro jet is a nozzle intended to eject gas or fluid in a coherent stream intoa surrounding medium. Gas jets are commonly found in gas stoves, ovens, or barbecues. Gas jets were commonly used for light before the development of electric light. Other types of fluid jets are found in carburetors, where smooth calibrated orifices are used to regulate the flow of fuel into an engine, and in Jacuzzis or spas.

Another specialized jet is the laminar jet. This is a water jet that contains devices to smooth outthe pressure and flow, and gives laminar flow, as its name suggests. This gives better results forfountains.

The foam jet is another type of jet which uses foam instead of a gas or fluid.

Nozzles used for feeding hot blast into a blast furnace or forge are called tubers.

Jet nozzles are also used in large rooms where the distribution of air via ceiling diffusers is notpossible or not practical. Diffusers that uses jet nozzles are called jet diffuser where it will be arranged in the side wall areas in order to distribute air. When the temperature difference between the supply air and the room air changes, the supply air stream is deflected upwards, tosupply warm air, or downwards, to supply cold air.

7.6. Pneumatic Pipe:

Pneumatic tubes (or capsule pipelines; also known as pneumatic tube transport or PTT) are systems that propel cylindrical containers through networks of tubes by compressed air or by
partial vacuum. They are used for transporting solid objects, as opposed to conventional pipelines, which transport fluids. Pneumatic tube networks gained acceptance in the late 19th and early 20th centuries for offices that needed to transport small, urgent packages (such as mail, paperwork, or money) over relatively short distances (within a building or, at most, within a city). Some installations grew to great complexity, but were mostly superseded. In some settings, such as hospitals, they remain widespread and have been further extended and developed in the 21st century.
A small number of pneumatic transportation systems were also built for larger cargo, to compete with more standard train and subway systems. However, these never gained popularity.

Historical Uses:

Pneumatic transportation was invented by William Murdoch around 1799. The Victorians were the first to use *capsule pipelines* to transmit telegrams, to nearby buildings from telegraph stations. The system is known as pneumatic dispatch. In 1854 Josiah Latimer Clark was issued a patent "for conveying letters or parcels between places by the pressure of air and vacuum." In 1853 he installed a 220-yard (200 m) pneumatic system between the London Stock Exchange in Threadneedle Street, London, and the offices of the Electric Telegraph Company in Lothbury. The Electric Telegraph Company used the system to acquire stock prices and other financial information to pass to subscribers of their service over their telegraph wires. The advantage of the pneumatic system was that without it the company would have had to employ runners to carry messages between the two buildings, or else employ trained telegraph operators within the Stock Exchange. In the mid-1860s, the

company installed similar systems to local stock exchanges in Liverpool, Birmingham, and Manchester. After the telegraphs were nationalised in Britain, the pneumatic system continued to be expanded under Post Office Telegraphs. By 1880 there were over 21 miles of tube in London. A tube was laid between the Aberdeen fish market office and the head post office to facilitate the rapid sale of a very perishable commodity. While they are commonly used for small parcels and documents–including as cash carriers at banks or supermarkets–they were originally proposed in the early 19th century for transport of heavy freight. It was once envisaged that networks of these massive tubes might beused to transport people.

Current Uses:

The technology is still used on a smaller scale. While its use for communicating information has been superseded, pneumatic tubes are widely used for transporting small objects, where convenience and speed in a local environment are important. In the United States, drive-up banks often use pneumatic tubes to transport cash and documents between cars and tellers. Many hospitals have a computer-controlled pneumatic tube system to deliver drugs, documents and specimens to and from laboratories and nurses' stations.[2] Many factories use them to deliver parts quickly across large campuses. Many larger stores use systems.

to securely transport excess cash from checkout stands to back offices, and to send change back to cashiers. They are used in casinos and love hotels. NASA's original Mission Control Center had pneumatic tubes connecting controller consoles with staff Pneumatic tube systems are used in science, to transport samples during neutron activation analysis. Samples must be moved from the nuclear reactor core, in which they are bombarded with neutrons, to the instrument that records the resulting radiation. As some of the radioactive isotopes in the sample can have very short half-lives, speed is important. These systems may be automated, with a magazine of sample tubes that are moved into the reactor core in turn for a predetermined time,

before being moved to the instrument station and finally to a container for storage and disposal.

Until it closed in early 2011, a McDonald's in Edina, Minnesota claimed to be the "World's Only Pneumatic Air Drive-Thru," sending food from their strip-mall location to a drive-through in the middleof a parking lot.

Technology editor Quentin Hardy notes that renewed interest in transmission of data by pneumatic tube accompanies discussions of digital network security, and he cites research into London's forgotten pneumatic network. Related applications include fish cannons which use mechanisms very similar to pneumatic tubesystems.

Pneumatic pipe

Solenoid valve:

A solenoid valve is an electromechanically-operated valve. Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control. The mechanism varies from linear action, plunger-type actuators to pivoted-armature actuators and rocker actuators. The valve can use a two-port design to regulate a flow or use a three or more port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high-reliability, long service life, good medium compatibility of thematerials used, low control power and compact design.

Operation:

There are many valve design variations. Ordinary valves can have many ports and fluid paths. A 2- way valve, for example, has 2 ports; if the valve is open, then the two ports are connected and fluid may flow between the ports; if the valve is closed, then ports are isolated. If the valve is open when the solenoid is not energized, then the valve is termed normally open (N.O.). Similarly, if the valve is closed when the solenoid is not energized, then the valve is termed normally closed.[1] There are also 3-way and more complicated designs.[2] A 3-way valve has 3 ports; it connects one port to either of the two other ports (typically a supply port and an exhaust port).

Solenoid valves are also characterized by how they operate. A small solenoid can generate a limited force. If that force is sufficient to open and close the valve, then a direct acting solenoid valve is possible. An approximate relationship between the required solenoid force *Fs*, the fluid pressure *P*, and the orifice area *A* for a direct acting solenoid valve is:[3]

Where *d* is the orifice diameter. A typical solenoid force might be 15 N (3.4 lb_f). An application might be a low pressure (e.g., 10 psi (69 kPa)) gas with a small orifice diameter (e.g., $3/8$ in (9.5 mm) for an orifice area of 0.11 in^2 (7.1×10^{-5} m^2) and approximate force of 1.1 lbf (4.9 N)).

When high pressures and large orifices are encountered, then high forces are required. To generate those forces, an internally piloted solenoid valve design may be possible.[1] In such a design, the line pressure is used to generate the high valve forces; a small solenoid controls

how the line pressure is used. Internally piloted valves are used in dishwashers and irrigation systems where the fluid is water, the pressure might be 80 psi (550 kPa) and the orifice diametermight be ¾ in (19 mm).

In some solenoid valves the solenoid acts directly on the main valve. Others use a small, complete solenoid valve, known as a pilot, to actuate a larger valve. While the second type is actually a solenoid valve combined with a pneumatically actuated valve, they are sold and packaged as a single unit referred to as a solenoid valve. Piloted valves require much less power to control, but they are noticeably slower. Piloted solenoids usually need full power at all times to open and stay open, where a direct acting solenoid may only need full power for a shortperiod of time to open it, and only low power to hold it.

A direct acting solenoid valve typically operates in 5 to 10 milliseconds. The operation time of a piloted valve depends on its size; typical values are 15 to 150 milliseconds.

Power consumption and supply requirements of the solenoid vary with application, being primarily determined by fluid pressure and line diameter. For example, a popular 3/4" 150 psi sprinkler valve, intended for 24 VAC (50 - 60 Hz) residential systems, has a momentary inrush of

7.2 VA, and a holding power requirement of 4.6 VA. Comparatively, an industrial 1/2" 10000 psivalve, intended for 12, 24, or 120 VAC systems in high pressure fluid and cryogenic applications, has an inrush of 300 VA and a holding power of 22 VA. Neither valve lists a minimum pressure required to remain closed in the un-powered state.

Components:

Solenoid valve designs have many variations and challenges.

Common components of a solenoid valve:-

Solenoid subassembly Retaining clip (a.k.a. coil clip)

Solenoid coil (with magnetic return path)
Core tube (a.k.a. armature tube, plunger tube, solenoid valve tube, sleeve, guide assembly)Plugnut (a.k.a. fixed core)
Shading coil (a.k.a. shading ring) Core spring (a.k.a. counter spring)
Core (a.k.a. plunger, armature)Core tube–bonnet seal
Bonnet (a.k.a. cover) Bonnet–diaphragm–body sealHanger spring
Backup washerDiaphragm Bleed hole Disk
Valve bodySeat

The core or plunger is the magnetic component that moves when the solenoid is energized. The core is coaxial with the solenoid. The core's movement will make or break the seals that controlthe movement of the fluid. When the coil is not energized, springs will hold the core in its normal position.

The plugnut is also coaxial.

The core tube contains and guides the core. It also retains the plugnut and may seal the fluid. To optimize the movement of the core, the core tube needs to be nonmagnetic. If the core tube weremagnetic, then it would offer a shunt path for the field lines.[10] In some designs, the core tube is an enclosed metal shell produced by deep drawing. Such a design simplifies the sealing problems because the fluid cannot escape from the enclosure, but the design also increases the magnetic path resistance because the magnetic path must traverse the thickness of the core tube twice: once near the plugnut and once near the core. In some other designs, the core tube is not closed but rather an open tube that slips over one end of the plugnut. To retain the plugnut, the tube might be crimped to the plugnut. An O-ring seal between the tube and the plugnut will prevent the fluid from escaping.

The solenoid coil consists of many turns of copper wire that surround the core tube and inducethe movement of the core. The coil is often encapsulated in epoxy. The coil also has an iron frame that provides a low magnetic path resistance.

Materials:

The valve body must be compatible with the fluid; common materials are brass, stainless steel,aluminum, and plastic.
The seals must be compatible with the fluid.

To simplify the sealing issues, the plugnut, core, springs, shading ring, and other components are often exposed to the fluid, so they must be compatible as well. The requirements present some special problems. The core tube needs to be non-magnetic to pass the solenoid's field through to the plugnut and the core. The plugnut and core need a material with good magnetic properties such as iron, but iron is prone to corrosion. Stainless steels can be used because they come in both magnetic and non-magnetic varieties. For example, a solenoid valve might use 304 stainless steel for the body, 305 stainless steel for the core tube, 302 stainless steel for the springs, and 430F stainless steel (a magnetic stainless steel for the core and plugnut.

Types:

Many variations are possible on the basic, one-way, one-solenoid valve described above:

one- or two-solenoid valves;

direct current or
alternating current
powered;different
number of ways and
positions;

Common uses:

Solenoid valves are used in fluid power pneumatic and hydraulic systems,

to control cylinders, fluid power motors or larger industrial valves. Automatic irrigation sprinkler systems also use solenoid valves with an automatic controller. Domestic washing machines and dishwashers use solenoid valves to control water entry into the machine. They are also often used in paintball gun triggers to actuate the CO2 hammer valve. Solenoid valves are usually referred to simply as "solenoids."

Solenoid valves can be used for a wide array of industrial applications, including general on-off control, calibration and test stands, pilot plant control loops, process control systems, and various original equipment manufacturer applications.

Fig: Solenoid Valve

A solenoid valve is an electromechanically-operated valve.

Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control. The mechanism varies from linear action, plunger-type actuators to pivoted-armature actuators and rocker actuators. The valve can use a two-port designto regulate a flow or use a three or more

port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high-reliability, long service life, good medium compatibility of thematerials used, low control power and compact design.

CONCLUSSION:

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, designing drawing, purchasing, computing and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution industries. We are proud that we have completed the work with the limited time successfully. The machine is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work. The chief advantage of our system is that, it cutting speed is varied. The fast operation is done by the timer unit. This project is a low cost automation project.

❖ 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 leaver operated, by replacing
  Pneumatic circuit by rack and pinion arrangement by the square threaded screw and nutarrangement.
- The place where there is scarcity of the electricity the electric motor operate compressoris 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. he ' Pneumatic Riveting Machine market' report, recently added by Market Study Report, LLC, examines the industry in terms of the global expanse, highlighting the present & future growth potential of each region as well as consolidated statistics. The study also presents a precise summary of the competitive milieu, key developments, and application landscape of the Pneumatic Riveting Machine market based on the impact of the financial and non-financial facades of the industry. The Pneumatic Riveting Machine market research report offers significant information related to the key growth drivers, challenges & limitations, and various opportunities thatwill define the business scenario in the upcoming years.

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