Design and Fabrication of Pneumatic Sheet Metal Cutting Machine

A project report submitted to the Department of Mechanical Engineering, Sonargaon University in partial fulfillment of the requirement for the degree of Bachelor of Science in Mechanical Engineering.

Submitted by:

Akash Marma Mongsing
ID: BME 1803016144

Md.Asmaul Hossen
ID: BME 1803016121

Md.Tofazzal Hossain
ID: BME 1803016122

Sumon Biswas
ID: BME 1803016143

Mushfiqur Rahman
ID: BME 1803016315

Supervised by:

Minhaz Uddin
Lecturer,
Dept. of Mechanical Engineering,
Sonargaon University of Bangladesh

Department of Mechanical Engineering
Sonargaon University (SU)
Dhaka-1215, Bangladesh

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[Authors]

Akash Marma Mongsing
ID: BME 1803016144

Sumon Biswas
ID: BME 1803016143

Md. Asmaul Hossen
ID: BME 1803016121

Mushfiqur Rahman
ID: BME 1803016315

Md. Tofazzal Hossain
ID: BME 1803016122

Abstract

Pneumatic Sheet Metal Cutting Machine has been used to shear the sheets made of galvanized iron and aluminum of various thicknesses. The pressure and force required for shearing these metal sheets have been listed accordingly. Automation in the process is incorporated by using air compressor solenoid valve-controlled roller feed system. The automation provides provision to enter the number of sheets to be cut and required length of the sheet. The system works by pneumatic means which consists of air compressor, pipe lines, control valves and pneumatic cylinder. The design is particularly suited for the applications where working space is contained. Pneumatic systems are useful when sheet metals are need to be cut in hazardous areas such as oil and gas refineries and in chemical factories. Further it is observed that, the employment of automation system makes the cutting process accurate, time efficient and increases the productivity as compared to conventional non-automated cutting machine. Sheet metal is simply a metal formed into thin and flat pieces. It is one of the fundamental forms used in metal working and can be cut and bent into a variety of different shapes. Countless everyday objects are constructed of the material. There are three primary procedures in Layout. They are Parallel, Radial, and Triangulation. The major aim to our experiment is to study about pneumatic control system, study about double acting cylinder, study about the advantage of pneumatic hand operated valve and study about high-speed blade.

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Chapter I: Introduction

1.1 Introduction

Sheet metal is simply a metal formed into thin and flat pieces. It is one of the fundamental forms used in metal working and can be cut and bent into a variety of different shapes. Countless everyday objects are constructed of the material. Thicknesses can vary significantly, although extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. Sheet metal is available in flat pieces or as a coiled strip.[1] The coils are formed by running a continuous sheet of metal through a roll slitter. The thickness of the sheet metal is called its gauge. Commonly used steel sheet metal ranges from 30 gauge to about 8 gauge. The larger the gauge number, the thinner the metal. Gauge is measured in ferrous (iron based) metals while nonferrous metals such as aluminum or copper are designated differently; i.e., Copper is measured in thickness by ounce. [3] There are many different metals that can be made into sheet metal, such as aluminum, brass, copper, steel, tin, nickel and titanium. For decorative uses, important sheet metals include silver, gold and platinum (platinum sheet metal is also utilized as a catalyst).[4]

Sheet metal also has applications in car bodies, airplane wings, medical tables, roofs for buildings (Architectural) and many other things.[5] Sheet metal of iron and other materials with high magnetic permeability, also known as laminated steel cores. Sheet metal is a metal formed into thin and flat pieces. It is one of the fundamental forms used in metal working and can be cut and bent into variety of different shapes [6]. Sheet metals are available in flat pieces or as a coiled strip. The thickness of the sheet metal is measured in gauge. Commonly used steel sheet metal ranges from 30 gauge to 8 gauge [7]. The larger the gauge number, the thinner the metal. Sheet metals has wide range of applications in car bodies, airplane wings, medical tables, roofs of buildings and many other things. Sheet metal of iron and other materials with high magnetic permeability are known as laminated steel cores [8]. The shearing machine is most important in sheet metal industry. In most of the small-scale industries, hand sheet cutters are used, which requires human effort to cut down the sheets. It can be replaced by a pneumatic cutting machine which can cut the sheet metal at a faster rate and in a convenient way [9]. In shearing operation, the pressure exerted by the punch, causes the plastic deformation of the sheet metal. Since the clearance between the die and punch al adjacent to the cutting edges.

1.2 Shearing Principle

A punch (or moving blade) is used to push a work piece against the die (or fixed blade), which is fixed. Usually, the clearance between the two is 5 to 40% of the thickness of the material, but dependent on the material. Clearance is defined as the separation between the blades, measured at the point where the cutting action takes place and perpendicular to the direction of blade movement. It affects the finish of the cut (burr) and the machine's power consumption. This causes the material to experience highly localized shear stresses between the punch and die. The material will then fail when the punch has moved 15 to 60% the thickness of the material, because the shear stresses are greater than the shear strength of the material and the remainder of the material is torn.

Two distinct sections can be seen on a sheared work piece, the first part being plastic deformation and the second being fractured. Because of normal inhomogeneities in materials and inconsistencies in clearance between the punch and die, the shearing action does not occur in a uniform manner. The fracture will begin at the weakest point and progress to the next weakest point until the entire work piece has been sheared; this is what causes the rough edge. The rough edge can be reduced if the work piece is clamped from the top with a die cushion.

1.3 Use of shearing machine

A metal shearing machine is used for cutting sheet metal, plate, aluminum and stainless steel to size. Sheet Metal Cutting (Shearing) Cutting processes are those in which a piece of sheet metal is separated by applying a great enough force to cause the material to fail. The most common cutting processes are performed by applying a shearing force and are referred to as shearing processes.

Benefits of Metal Shearing

1. Provides ability to make straight line cuts on flat sheet stock
2. Cleaner cut
3. Straighter edge than traditional torch cutting.

4. Since shearing cuts without forming chips or burning or melting the material, the process works well with most softer metals.
5. Perhaps the biggest advantage of shearing is that it produces minimal or no kerf, with virtually no loss of material which equates to minimize waste.
6. Shearing can be used with virtually any diameter part and is especially cost-effective for high-output operations producing thousands of pieces per hour. However, shearing is not ideal for lengths under 0.750".
7. Can cut relatively small lengths of material at a time because the shearing blades are able to be mounted at an angle. This reduces the overall shearing force needed for each project.

1.4 Objective:

The objectives of this project are:

- To study about Pneumatic Sheet Metal Cutting Machine system.
- To design and construct a Pneumatic Cutting Machine .
- To test the performance of the Pneumatic Cutting Machine.

1.5 Application:

- This system can be used in any workshop.
- It can be used in industrial lab or workshop.
- It can be used in places where metal sheets need to be cut.

1.6 Advantages:

- Metal sheets can be cut very easily
- It is a pneumatic system so can easily cut metal sheet without applying any human force. There is no installation cost.
- It is portable so it is very easy to use.
- The whole system can be controlled with a pneumatic Hand Lever Valve so the metal sheet can be cut properly.

1.7 Disadvantages:

- This is a major drawback that the sheet cannot be cut out of a specific thickness.

Chapter II : Literature Review

2.1 Literature Review:

There are many sheets 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.[1] Joseph Bramah 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.[2] 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 was called the "Father of Industrial Hydraulics" by ASME. [4] 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.[5] 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.[6] It works for simple sheet metal cutting.

In shearing or cutting operation as or blade descends upon the metal, the pressure exerted by the blade first cause the plastic deformation of the metal. Since the clearance between the two blades is very small, the plastic deformation takes place in a localized area and the metal adjacent to the cutting edges of the blade edges becomes highly stressed, which causes the fracture to start on both sides of the sheet as the deformation progresses and the sheet is sheared.[7] In dentistry applications, pneumatic drills are lighter, faster and simpler than an 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.[8] Pneumatic transfer systems are employed in many industries to move powders and pellets.

Chapter III : Methodology

3.1 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 shearing 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 Pneumatic Transmission of Energy:

The reason for using pneumatics, or any other type of energy transmission on a machine, is to perform work. The accomplishment of work requires the application of kinetic energy to a resisting object resulting in the object moving through a distance. In a pneumatic system, energy is stored in a potential state under the form of compressed air. Working energy (kinetic energy and pressure) results in a pneumatic system when the compressed air is allowed to expand. For example, a tank is charged to 100 psi with compressed air. When the valve at the tank outlet is opened, the air inside the tank expands until the pressure inside the tank equals the atmospheric pressure. Air expansion takes the form of airflow. A positive displacement compressor basically consists of a movable member inside a housing. The compressor has a piston for a movable member. The piston is connected to a crankshaft, which is in turn connected to a prime mover (electric motor, internal combustion engine). At inlet and outlet ports, valves allow air to enter and exit the chamber.

3.3 Control of Pneumatic Energy:

Working energy transmitted pneumatically must be directed and under complete control at all times. If not under control, useful work will not be done and machinery or machine operators might be harmed. One of the advantages of transmitting energy pneumatically is that energy can be controlled relatively easily by using valves.

3.4 Control Of Pressure:

Pressure in a pneumatic system must be controlled at two points - after the compressor and after the air receiver tank. Control of pressure is required after the compressor as a safety

for the system. Control of pressure after an air receiver tank is necessary so that an actuator receives a steady pressure source without wasting energy.

3.5 Control Of Pressure After A Compressor:

In a pneumatic system, energy delivered by a compressor is not generally used immediately, but is stored as potential energy in air receiver tank in the form of compressed air. In most instances, a compressor is designed into a system so that it operates intermittently. A compressor is a device that usually delivers compressed air to a receiver tank until high pressure is reached, then it is shut down. When air pressure in the tank decreases, the compressor cuts in and recharges the tank. Intermittent compressor operation in this manner is a power saving benefit for the system. A common way of sensing tank pressure and controlling actuation and de-actuation of relatively small (2-15 HP) compressors, is with a pressure switch.

3.6 Operation:

The most common cutting processes are performed by applying a shear force, and are therefore sometimes referred to as shearing processes. Cutting processes are those in which a piece of sheet metal is separated by applying a great enough force to cause the material to fail .When a great enough shearing force is applied, the shear stress in the material will exceed the ultimate shear strength and the material will fail and separate at the cut location. This shearing force is applied by two tools, one above and one below the sheet. Whether these tools are a punch and die or upper and lower blades, the tool above the sheet delivers a quick downward blow to the sheet metal that rests over the lower tool. A small clearance is present between the edges of the upper and lower tools, which facilitates the fracture of the material. The effects of shearing on the material change as the cut progresses and are visible on the edge of the sheared material. When the punch or blade impacts the sheet, the clearance between the tools allows the sheet to plastically deform and "rollover" the edge. As the tool penetrates the sheet further, the shearing results in a vertical burnished zone of material, finally, the shear stress is too great and the material fractures at an angle with a small burr formed at the edge. The height of these portions of the cut depends on several factors, including the sharpness of the tools and the clearance between the tools.

3.7 Flow Chart

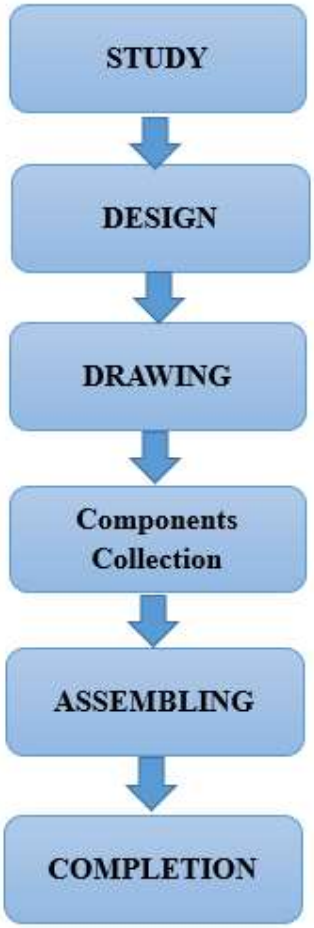

Figure 3.1: Flow Chart of this project

Chapter IV : Design & Construction

4.0 Experimental Data:

Sheet Metal Material	ALLUMINIUM
Thickness	**.8**mm
Length of cut	**203.2**mm
Max. SHEAR STRENGTH OF ALLUMINIUM	**30** $\frac{N}{mm2}$

Force Application:

Force required to cut the sheet = L*****t*Tmax

For sheet of 0.5 mm thickness,

Force required=203.2*.8*30=4876.8N

This is the force required to cut the sheet metal, however the initial force required to cut the sheet is more and it is 140-150% than we calculated.

Therefore, max force required to cut the sheet =525-562.5N

Now we have chosen 12volt DC Air Compressor that develop a pressure 10.34bar (150psi)

Designing of a cylinder

Since the max force required to cut the sheet= 562.5N

And pressure applied by 12volt compressor = 10.34 bar

Therefore,

Force applied by the cylinder,

$F= \left(\frac{\pi}{4}\right) * d^2 * p$

$526.5= \left(\frac{\pi}{4}\right) * d^2 * (\frac{10.34}{10})$

→d=26.3mm

4.1 System Drawing

Automatic cutting machines are made to cut many types of metal. Here pneumatic cylinder is used to increase and decrease the pressure of the blade through the handle controller. That's way we get good efficiency. This machine is very easy to use and it works very effectively and accurately. A relevant picture is added below –

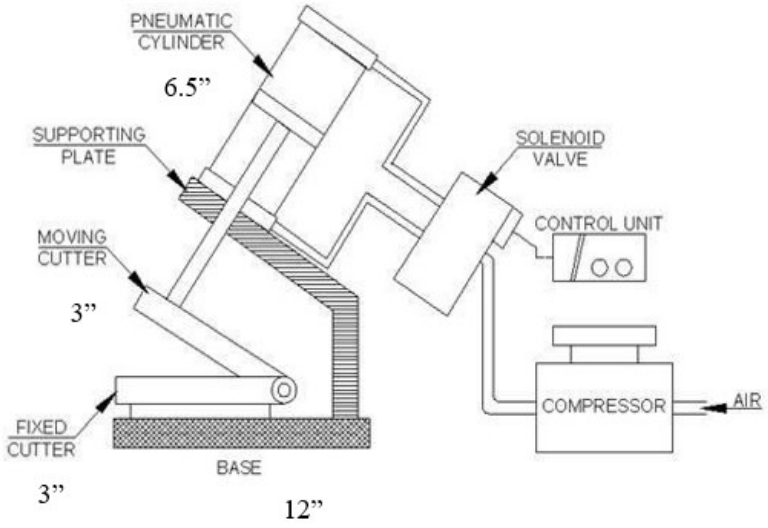

Figure 4.1: Diagram of Pneumatic Sheet Metal Cutting Machine

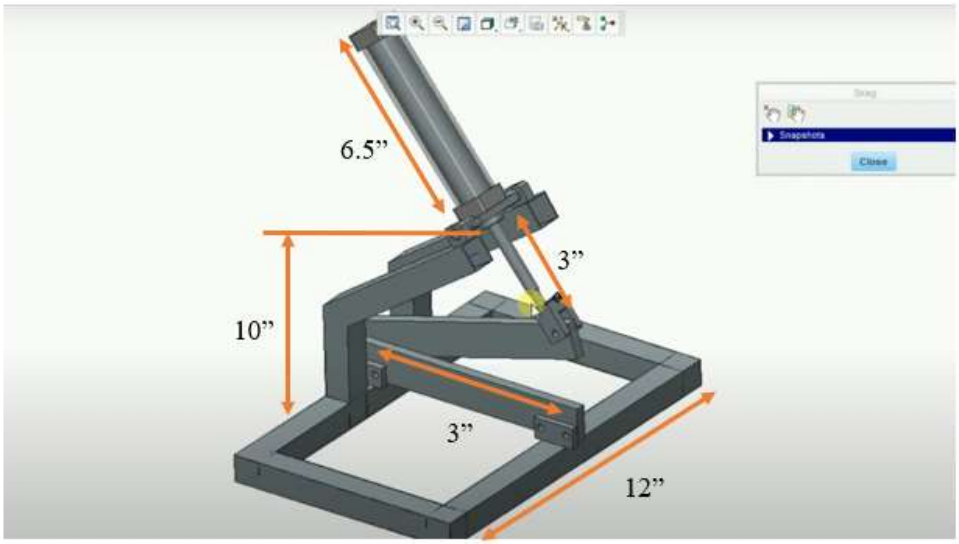

Figure 4.2: 3D drawing of Pneumatic Sheet Metal Cutting Machine

4.2 Required Components:

The common components of this pneumatic sheet metal cutting machine are double acting cylinder pneumatic hand operated valve and high-speed steel blade, air pipe etc.Double-Acting Cylinder

1. Hand Lever Air Valve
2. Air Compressor
3. SMPS
4. Pneumatic Air Regulator Valve
5. Blade
6. Air Cylinder
7. MS Steel Box
8. Nut Bolt

4.3 Construction:

The Pneumatic Sheet Metal Cutting Machine is supported by a table includes with support arms to hold the sheet. The table also includes the two-way directional control valve. The two-way directional control valve is also known as solenoid control valve. We used two way directional control valve that is connected with the compressor by air pipe. The compressor has a piston for a movable member. The piston is connected to a crankshaft, which is in turn connected to a prime mover. At inlet and outlet ports, valves allow air to enter and exit the chamber. When the compressor is switched ON, the compressed air is flow to inlet of the pneumatic cylinder. The sheet is placed between the upper and the lower blade. The lower blade remains stationary while the upper blade is forced downward. The upper blade is slightly offset from the lower blade, approximately 5 – 10% of the sheet thickness. Also the upper blade is usually angled so that the cut progresses from one end to the other, thus reducing the required force. When the pneumatic hand operated solenoid valve is moved forward, the piston starts moving in the forward direction. The upper blade which are then forced against the sheet, cutting the material. When the pneumatic hand operated lever is moved backward, the upper blade will come to the original position (i.e., the upper blade will move upwards).After the material is cut, adjust the pneumatic hand operated solenoid valve to the mid position (i.e., normal position) and then the compressor is switched off.

Figure 4.3: Installation of Pneumatic Cylinder

Figure 4.4: Installation of Pneumatic Cylinder

Figure 4.5: Project Basement and Air Cylinder

Figure 4.6: After Setup pneumatic cylinder with hardware

4.4 Complete Project Prototype Image :

Figure 4.7: Complete Project

Figure 4.8: Complete Project

4.5 Hand Lever Air Valve:

Hand Lever Valves are used to operate Pneumatic Cylinders. In the absence of electrical supply, manually operated valves such as Hand Lever Valves are used. The functioning is the same, however, the solenoid coil is replaced by a hand lever, which controls the movement of the spool inside the valve, thereby allowing the air to pass.

Figure 4.9: Hand Lever Air Valve

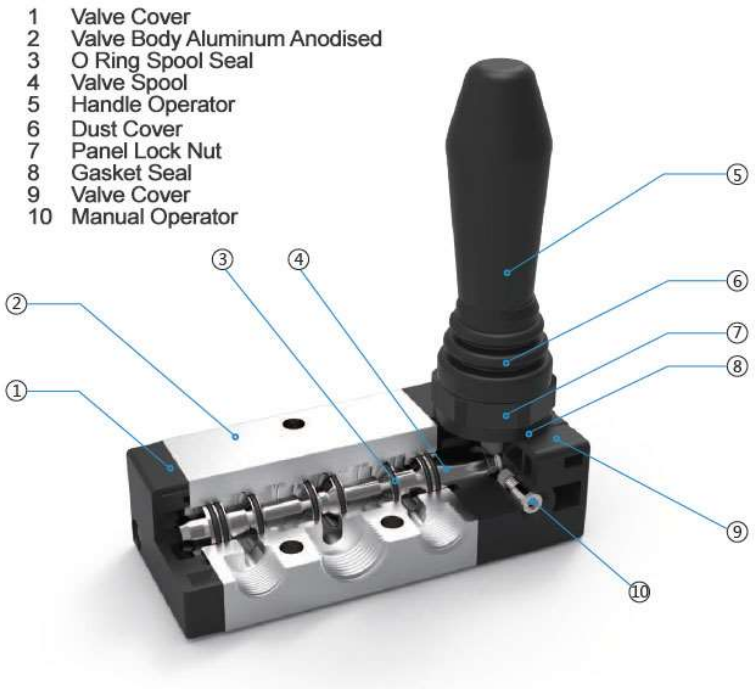

Figure 4.10: Hand Lever Air Valve

4.6 Air Compressor

Portable Mini Air Compressor is a breeze with this DC 12V air compressor! This lightweight mini compressor is small, compact and portable for easy storage in most vehicle types. It can inflate car and motorcycle tires and more.

1. Voltage: DC 12V
2. Amperage: 10 Amp
3. Air Volume: 35 L/Min
4. PSI: 100-140 PSI

Figure 4.11: Portable 12V Mini Air Compressor

Portable Mini Air Compressor Machine – DC 12V:

Heavy Duty Portable Mini Air Compressor is a small version of air compressor. They have a small electric motor that compresses the air in a small attached cylinder tank. This type of ultra-portable compressor can be plugged into a 12V car system for on-the-go repairs or inflation.

Sporting enthusiasts, drivers, campers, and bike riders can find an almost unlimited amount of use for a Heavy Duty Portable Mini Air Compressor. They can inflate bike tires, inflatable boats, or even car tires if you have a flat while driving. Because they can be powered through a cigarette lighter in your vehicle, they are incredibly versatile and a lifesaver in some instances.

Features of Mini Air Compressor:

1. 100 PSI mini compressor and fast inflation of tires, rafts and sports equipment.
2. Little handy unit, great for outdoor sports, camping and much more.
3. Easy-to-read pressure gauge and easy to use:
4. Beautiful design, easy to carry.
5. Flexible air hose with tire valve locking system.
6. Fitted with fused cigarette lighter plug and 3m of cable.
7. The barometer can measure and display the pressure accurately.
8. Aeration time: The tire can achieve normal pressure in 2 or 3 minutes.
9. Maximum inflatable pressure can be up to 100PSI (it is 30PSI to 40PSI for general tire).

Specifications:

1. Material: Metal, Plastic
2. Color: Black & Silver
3. Voltage: DC 12V
4. Amperage: 10 Amp
5. Air Volume: 35 L/Min
6. PSI: 100-140 PSI
7. Continuous working time: 15minutes
8. Power Cord Length: 1 meter
9. Size: 14 x 16 x 8.5 cm / 5.51 x 6.3 x 3.3 Inch
10. Package Weight: 1250g

4.7 SMPS (Switch Mode Power Supply):

A switched-mode power supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state.

Switching power supplies have high efficiency and are widely used in a variety of electronic equipment, including computers and other sensitive equipment requiring stable and efficient power supply.

A switched-mode power supply is also known as a switch-mode power supply or switching-mode power supply.

Figure 4.12: SMPS (Switch Mode Power Supply)

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.

Figure 4.13 SMPS (Switch Mode Power Supply)

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

12V 20A Industrial SMPS Power Supply – 60W – DC Metal Power Supply – Good Quality – Non-Waterproof with Aluminum casing.

- Input Voltage: AC 100 – 264V 50 / 60Hz
- Output Voltage: 12V DC, 0-20A
- Output voltage: Adjustment Range: ±20%
- Protections: Overload / Over Voltage / Short Circuit
- Auto-Recovery After Protection
- Universal AC input / Full range
- 100% Full Load Burn-in Test
- Cooling by Free Air Convection
- High Quality and High Performance
- LED power supply with a metal body for hidden installation for LED lighting
- Design with Built-in EMI Filter, improve signal precision.
- Certifications: CE & RoHs
- No Minimum Load.
- Compact Size Light Weight.
- High Efficiency, Reliability & low energy consumption
- Category – Switch Mode Power Adaptor (SMPS)

4.8 Pneumatic Air Regulator Valve

Figure 4.14: Pneumatic Air Regulator Valve

The air pressure regulator is also known as pressure-reducing valves. It maintains a constant output pressure regardless of variations in input pressure or output flow. In pneumatic instrumentation systems, instrument air is required to power valve actuators and other instruments like transmitters, controllers, control valves etc.

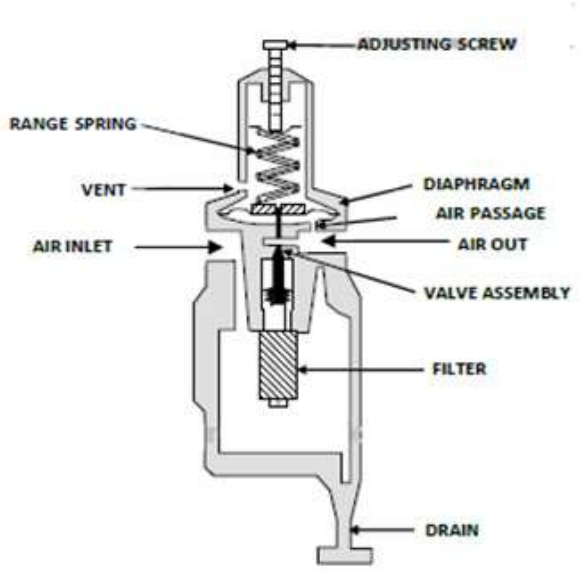

Figure 4.15: Construction of Pneumatic Air Regulator Valve

The figure shown above is fisher air regulator. As the pressure rises, it pushes the diaphragm closing the inlet valve and preventing the instrument air from entering regulator. As the air is drawn out through the outlet side, the pressure inside the regulator falls.

The working principle of the air pressure regulator

- The main air supply which is connected to the air inlet port passes through the filtering chamber.
- The filter removes the dirt particles from the air which may block nozzles etc. The air then goes into the valve assembly.
- The valve assembly is moved by the range spring pressing on the diaphragm.
- The range spring holds the valve assembly until the output pressure is high enough to lift the diaphragm. At this point the small spring in the valve assembly closes the valve.
- The air now passes through a hole at the center of the diaphragm and out of the vent. This is how the pressure is balanced across the diaphragm.
- When the output pressure becomes more than the pressure set by the range spring, the air will go out through the vent. When the outlet pressure becomes less, the valve assembly opens up to reach the set pressure. This pressure will exit the regulator through the outlet air port.
- If the outlet pressure is below the pressure set by the range spring the valve assembly will stay open until the set pressure is reached.

4.9 Blade:

Specification:

- Metal: Steel metal with Heat Treatment.
- length: 8Inch
- Thickness: 8mm
- Wide:1.5 Inch

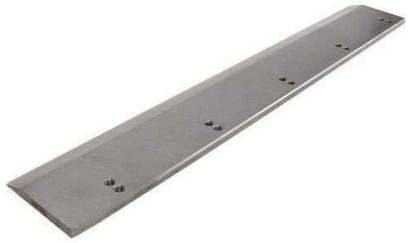

Figure 4.16: Sheet Metal Cutting Blade

4.10 Air Cylinder:

Pneumatic actuators enable considerable forces to be produced from relatively small pressure changes. Pneumatic energy is desirable for main engine controls because it can quickly respond in starting and stopping as the power source does not need to be stored in reserve for operation. Moreover, pneumatic actuators are cheaper, and often more powerful than other actuators. These forces are often used with valves to move diaphragms to affect the flow of air through the valve.

The advantage of pneumatic actuators consists exactly in the high level of force available in a relatively small volume. While the main drawback of the technology consists in the need for a compressed air network composed of several components such as compressors, reservoirs, filters, dryers, air treatment subsystems, valves, tubes, etc. which makes the technology energy inefficient with energy losses that can sum up to 95% .

Figure 4.17: Pneumatic Air Cylinder

Specifications:

- Manufacturer: Festo
- Model: DNU-80-50-PPV-A
  - Type of Operation: Double Acting
  - Piston Diameter: 80mm
  - Stroke: 50mm
  - Pneumatic Connection: G3/8
  - Operating Pressure Range (Bar) 0-12

Pneumatic System Work:

A **Pneumatic actuator** mainly consists of a piston or a diaphragm which develops the motive power. It keeps the air in the upper portion of the cylinder, allowing air pressure to force the diaphragm or piston to move the valve stem or rotate the valve control element.

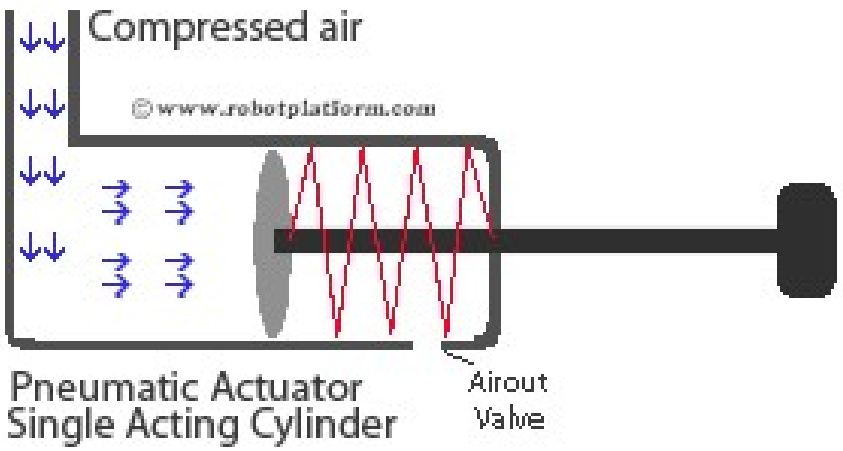

Figure 4.18: Pneumatic working System

Chapter V : Result & Discussion

5.1 Results

We have written our commands using the Arduino IDE and the following things can happen:

- At first , when we connect it to power cable then it will able to work.
- Hand liver is move the blade position.
- Forward and Backward force is control the blade movement and metal is cut by the blade.

5.2 Discussion:

It is observed that the pneumatic cutting is very cheap as compared to hydraulic cutting machine. The range of the cutting thickness can be increased by using high pressure compressor and more hardened blades. This machine is advantageous to small sheet metal cutting industries as they cannot afford the expensive hydraulic cutting machine. Further with the employment of automation, it provides provision to enter the number of sheets to be cut and required length of the sheet. Hence human effort is reduced with increase in accuracy in operation.

5.3 Future Scope:

- The model can be improved to cut many heavy sheets.
- We can add a monitoring-based control to automate control.
- With this system sensor IoT technology can be added as a smarter device and when monitoring and controlling will be easier.

Chapter VI : Conclusion

6.1 Conclusion:

Pneumatic systems are used in controlling train doors, automatic production lines, and Mechanical clamps. The sheet metal cutting process is a main part of the all industries. Normally the sheet metal cutting machine is manually hand operated one for medium and small scale industries. The sheet metal cutting machine works with the help of pneumatic double acting cylinder. The piston is connected to the moving cutting tool. Sheet metal cutting machine can be used to cut the sheet metal of minimum thickness without manual hard work. This machine can also be installed in the lab for the experiment and demonstration to engineering students. In this project I have tried my best to fabricate a pneumatic sheet metal cutting machine which can cut the sheet metal in small pieces.

6.2 Recommendation

Pneumatic Sheet metal cutting machine is very cheap as compared to hydraulic cutting machine or laser cutting machine. The range of the cutting thickness can be increased by arranging a high pressure compressor and installing more hardened blades. This machine is advantageous to small sheet metal cutting industries as they cannot afford the expensive machine. Pneumatic sheet metal cutting machine can be used in various industries or workshops.

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