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"Design & Fabrication of Sheet Metal Cutting Machine by using Pneumatic Power"

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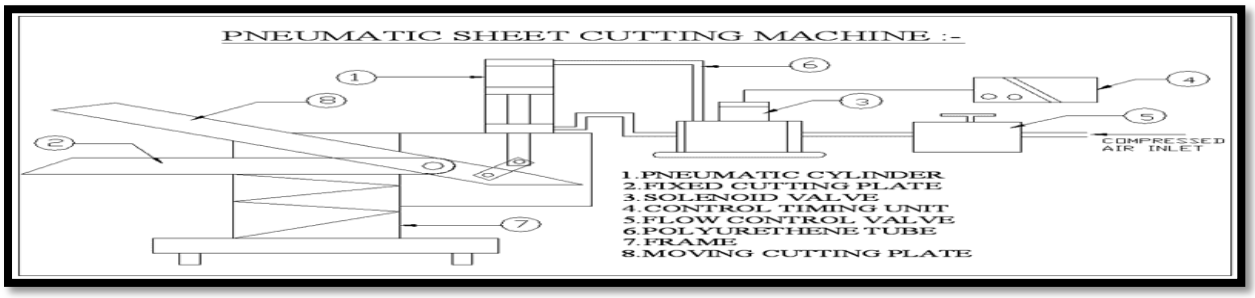
ABSTRACT- *Normally the sheet metal cutting machine is manually hand operated for medium and small scale industries. This paper gives an insight about the automatic sheet metal cutting machine. Any automatic machine aimed for economical use of man. In this paper, pneumatic cylinder is used for cutting in easy way which can be use in small scale industries at lower cost. The sheet metal cutting machine works with the help of pneumatic double acting cylinder. The piston is connected to the moving cutting tool which is used to cut the sheet metal. The cutting process is operated by a direction control valve by using compressor. In manual method sheet metals goes to the scrap sometime because of wrong dimensions, improper cutting etc. Hydraulic machines are also used for sheet metal cutting. The main advantage of pneumatic sheet metal cutting machine is to improve product quality, repetition of work and increasing production rate.*

INTRODUCTION



The production of iron and steel is of great importance for any country's economy. This is because the iron and steel industry directly influences the development of a sustainable society and also it the basis for all other industries. Thus the trend in production and consumption in steel is also viewed as an indicator of the condition of the country's economy. This is the reason why steel is called the "backbone" of a country's economy. Hence by increasing the production of steel, we can help in the growth of our country's economy, but this where the problem arises. A sheet metal cutting or a punching machine is very important to the sheet metal industry and since large scale industries are well established they can afford to equip themselves with hydraulically operated cutting and punching machines that generate a large amount of force and also are easily automated.

LITERATURE REVIEW

1) Automated Pneumatic Sheet Metal Cutting Machine Prajwal Poojary, Nishanth V, Nikhil, Niranjan Karkera, Ganesh Kalagi International Journal of Scientific & Engineering Research Volume 9, Issue 4, April-2018 243.

2) Design and Fabrication of Pneumatic Sheet Metal Cutting and Punching Machine International Journal of Engineering Research & Technology (IJERT) www.ijert.org Vol. 9 Issue 07, July-2020.

3) Fabrication Of A Pneumatic Sheet Metal Cutting Machine, Conference Paper · December 2017.

4) Pneumatic Sheet Cutting Machine- A Review International Journal of Scientific and Technical Advancements This is an industrial era and in order to have better surface finish and obtain a high degree of flexibility in the manufacturing processes in the industries, a lot of work is done on sheet metal.

5) Fabrication of Pneumatic Sheet Metal Cutter International Journal on Emerging Technologies (Special Issue on ICRIET-2016) 7(2): 360-365(2016).

Important components of a pneumatic system are:

a) Air filters: These are used to filter out the contaminants from the air.

b) Compressor: Compressed air is generated by using air compressors. Air compressors are either diesel or electrically operated. Based on the requirement of compressed air, suitable capacity compressors may be used.

c) Air cooler: During compression operation, air temperature increases. Therefore coolers are used to reduce the temperature of the compressed air.

d) Dryer: The water vapor or moisture in the air is separated from the air by using a dryer.

e) Control Valves: Control valves are used to regulate, control and monitor for control of direction flow, pressure etc.

f) Air Actuator: Air cylinders and motors are used to obtain the required movements of mechanical elements of pneumatic system.

g) Electric Motor: Transforms electrical energy into mechanical energy. It is used to drive the compressor.

h) Receiver tank*:* The compressed air coming from the compressor is stored in the air receiver

COMPONENT USED

A. Pneumatic Cylinder

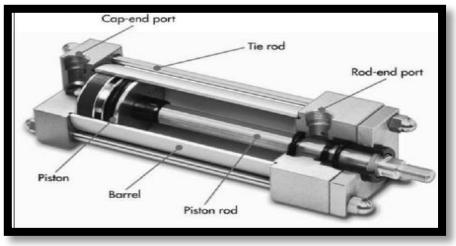


Fig. D-A Cylinder

Fig. Actual D A cylinder

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion.In pneumatic cyinder a compressed air is used as working fluid and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts or space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

B. Direction Control Valve

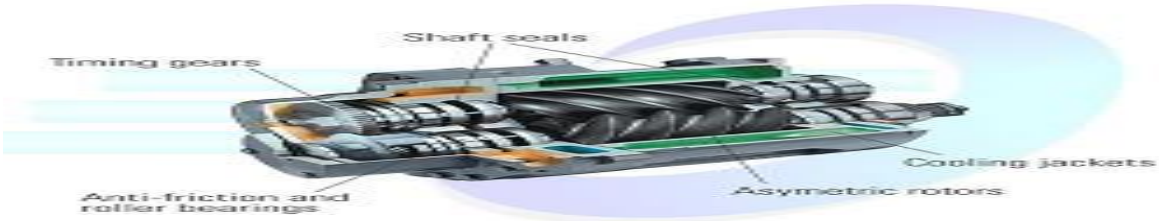
The direction of air flow can be controlled in the pneumatic system by making use of direction valve. It is also called as DCV. It consists of a solenoid which is used for the conversion of electrical energy into straight line motion as well as force. It can be of two types i.e. pushing type of pull type. A plunger is pushed in push type solenoid where as in pull type; plunger is energized

when the plunger is pulled inwards. A cylinder is fitted with a spool inside it which can be controlled electrically or mechanically. To ease the operation, we have used the electrically controlled DCV.

C. Pneumatic Compressor

Positive-displacement compressors work by forcing air into a chamber whose volume is decreased to compress the air. Common types of positive displacement compressors are Piston-type air compressors use this principle by pumping air into an air chamber through the use of the constant motion of pistons. They use one-way valves to guide air into a cylinder chamber, where the air is compressed.

D. Rotary Screw Compressor



Rotary screw compressor makes use if the positive displacement compression. This is done by correctly arranging the two helical screws so that the volume of the chamber is decreased by turning the screws.

E. Polyurethane Tube

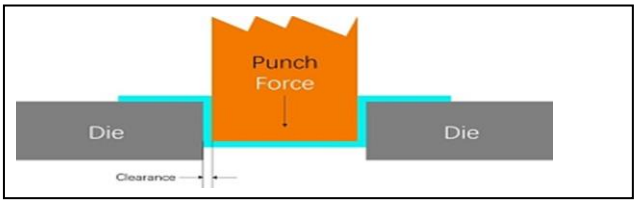
It is used to pass substances which can flow through it. It can be used for various applications. The hollow pipes are generally stiffer than solid pipes. It generally consists of a nominal diameter and schedule that defines the thickness.

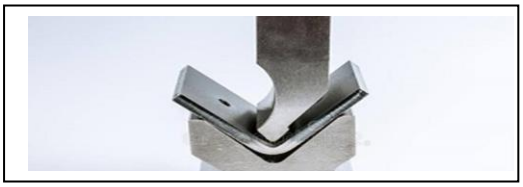
F. Cutting Blade

It is one of the main components which cut the metallic sheets. Generally it is made of high carbon steel because there is huge resistance in the metallic sheets which are to be sheared. It is used to cut the sheets of metal of varying sizes; generally thickness may vary from 1 mm to 5mm. A compressor of size nearly 8-14 Kg/cm2 is enough to cut down the sheet having thickness up to 5 mm A Pneumatic sheet cutter has to be designed and developed. In order to reduce human effort in manual operated machine our machine should ensure automatic operation finer cutting. In addition to that the product should be

small in size so that it is easier to carry the product from one place to another.

G. New Invention





This machine can be use as punching machine also by replace of cutting blades with die and punch so that this machine work as punching machine to formation of L shapes of sheetmetal.

Fig. Actual Pneumatic Cutter

CONSTRUCTION

Raw Material Used
1. Mild Steel bars for base frame.
2. 35C8 material for shearing blades.
3. Cylinder fittings like fork end, base plates, support links.
4. Angle section for blade fitting.
5. Connecting link.
6. Blade link.

Ready Items Used-
1. Pneumatic double acting cylinder.
2. Direction & flow control valves.
3. Pneumatic pipe & pipe fittings.
4. Bolts & nuts.
5. Antirust coat & paint.

Machines & Tools Used-
1. Cutting Machine.
2. Hacksaw Cutting Machine.
3. Sensitive Drilling Machine.
4. Horizontal Milling Machine.
5. Electric Arc Welding Machine.
6. Table Grinder.
7. Hand Grinder.
8. Surface Grinding Machine.
9. Tap & Tap Holder.

SPECIFICATION

1. Pneumatic Cylinder-
Quantity: 1
Total Length: 375mm
Bore: 40mm
Stroke: 200mm
Piston Rod Diameter: 20mm
Max Working Pressure: 8 bar
Weight: 3kg

2. DC Valve-
Quantity: 1
Operation: Manual
Type: Hand Lever, Detent Type
Number of Ports: 5
Number of Positions: 3
Construction: Sliding spool type

3. Pneumatic Pipe-
Quantity: 3000mm
Diameter: 8mm
Thickness: 1mm

4. Fork End Nut-
Quantity: 2
Length: 16mm
Size: M16

5. Cylinder Base Plate Bolts-
Quantity: 4 Length: 32mm
Size: M6

6. Blade Fixing Bolts-
Quantity: 3 Length: 25mm Size: M10

CALCULATION

- The maximum pressure applied in the cylinder (P) = 10 bar
- Daimeter of the cylinder bore (D) = 40 mm
- Area of the cylinder (A) = ($\pi \times D2$) /4
- Area (A) = ($\pi \times 402$)/4 = 0.0012564 m2
- Therefore, Force acting on the sheet (F) = P×A
- Force (F) = (10×105) × (0.001256) = 1256.4 N

Designing of a cylinder

- Since the max force required to cut the sheet = 562.5 N
- And pressure applied by 12 volt compressor =10.34 bar
- Therefore,
- Force applied by the cylinder,
- $F = (\pi/4) \times d2 \times p$
- $562.5 = (\pi/4) \times d2 \times (10.34/10)$
- $\rightarrow d = 26.3$ mm

FUTURE SCOPE

1) It can be made hydraulic power operated by installing the gear oil pump at the place of air compressor and pneumatic cylinder arrangement.
2) It can be made rack and pinion operated or spring and lever operated.
3) The place where there is a scarcity of the electricity the electric motor operate compressor is replaced by an IC ENGINE installed compressor.

Thus in future there are so many modifications, which we can make to survive the huge global world of competition.

ADVANTAGES

1. Hydraulics present certain advantages over pneumatics, but in a given application, pneumatic powered equipment is more suitable, particularly in industries where the factory units are plumbed for compressed air.
2. Moreover, to avoid corrosive actions, oil or lubricants are added so that friction effects can be reduced.
3. Compressed air is used in most of the machines and in some cases compressed carbon dioxide, whereas cutting process is become easy.
4. Fast cutting action is carried out.
5. Cutting without bending is achieved.

LIMITATIONS

1. Sheet more than 2 mm thickness cannot cut easily.
2. Compressed air is must.
3. Foundation is required also safety major must be Taken.

APPLICATIONS

1) Car bodies
2) Airplane wings
3) Medical tables
4) Roofs for buildings (Architectural) and many other things

CONCLUSION

1. Thus our concept is complying to the demands of the customer whose use the products as well as those who are new.
2. The latent needs of customers, which they were not able to reciprocate properly is estimated successfully.
3. The individual functions were studied thoroughly and were evaluated by each group member.
4. Further study will involve more analysis about the product and comparison of similar products available in the market..

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