Design & Fabrication of Pneumatic Sheet Metal Shearing Machine

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***Abstract*- Pneumatics systems are extensively used in a wide range of industries and factories and manufacturing sector. Pneumatic systems used in industry are commonly powered by compressed air or compressed inert gases. A centrally located and electrically powered compressors powers cylinders, air motors and other pneumatic A pneumatic system controlled through manual or automatic solenoid valve is selected when it provides a lower cost, more flexible, or safer alternative to electric motors and actuators. The purpose of this project is to therefore design a simple, easily operated pneumatic sheet metal cutting machine that is steady, cheap and strong. The pressurized air passing through the tubes to the cylinder, forces the piston to reciprocate and supply power through the linkage 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. This enables us to use different type punch dies resulting in a wide range of products. Different types of punch as requirement can be thus got. According to the work material the operating pressure can be varied.**

INTRODUCTION

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 actuator then converts that compressed air into mechanical motion. The type of motion produced depends on the design of the actuator. Pneumatics is employed in a variety of settings. 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. Pneumatic transfer systems are employed in many industries to move powders and pellets. A 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. 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 gauges to about 8 gauges. 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 Once. 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.)

Sheet metal also has applications in car bodies, airplane wings, medical tables, roofs for buildings (Architectural) and many other things. Sheet metal of iron and other materials with high magnetic permeability, also known as laminated steel cores, has applications in transformers and electric machines. Historically, an important use of sheet metal was in plate armor worn by cavalry, and sheet metal continues to have many decorative uses, including in horse tack. Sheet metal workers are also

known as "Tin Bashers",("Tin Knockers") which is derived from the hammering of panel seams when installing tin roofs.

Machine Parts:
Double acting pneumatic cylinder
Shearing blades
Relief valve
Pressure valve
Metallic frames
Connecting pipes

LITERATURE SURVEY

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.

Types of shearing machine

1) Pneumatically operated: Here the advancement of the header is carried out in the upward and the downward direction using the pneumatic double acting piston and cylinder unit arrangement along with the foot operated direction control valve. In this type of machine high pressure air is used as the working fluid for the transfer of power and the motion.
2) Hydraulically operated: Here the lowering and raising of the header is carried over using the hydraulic piston and cylinder arrangement. To actuate the piston and cylinder, the oil is allowed to enter the cylinder from front or the back side of the piston. But the oil is comparatively costlier and its leakage may cause so many problems.
3) Rack and pinion operated: Here the lowering and the raising of the header are carried out manually using the rack and pinion arrangement. In this case the required pressure is applied manually using direct hand pressure on the rack using pinion and lever arrangement. Since the machine is robust and requires large pressure, hence it is not suitable.
4) Spring operated: The working of spring operated machine is similar to the rack and pinion operated machine but differs from it in construction. Here the lowering and the raising of the heating handle are carried out manually and it requires too much pressure for its operation and also there is possibility of having damage to the work piece if not handled carefully.

SPECIFICATION

Pneumatic Cylinder Quantity: 1
Total Length: 375mm
Bore: 40mm Stroke: 200mm
Piston Rod Diameter: 20mm
Max Working Pressure: 8 bar
Weight: 3kg
DC Valve Quantity: 1
Operation: Manual Type: Hand Lever, Detent Type
Number of Ports: 5
Number of Positions: 3
Construction: Sliding spool type.
Pneumatic Pipe Quantity: 3000mm
Diameter: 8mm
Thickness: 1mm
Fork End Nut Quantity: 2
Length: 16mm
Size: M16
Double Acting Cylinders. Double-acting cylinder (DAC) uses the force of air to move in both extraction and retraction strokes

WORKING PRINCIPLE

From the manifold a separate supply for the machine is taken out and given to initially the air-compressor is started and allowed the receiver tank air pressure to reach up to 8 bar. The supply air is then passed to the manifold ON-OFF switch; so as to operate the machine at will without interrupting the running of compressor. Then the pipe carries compressed air first to machines

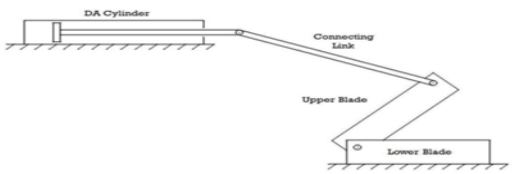

FIG A

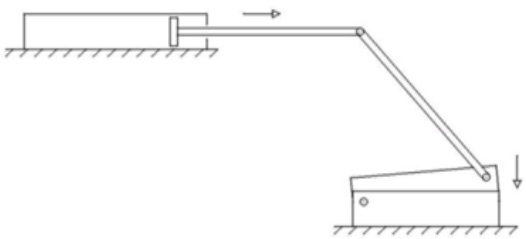

FIG B

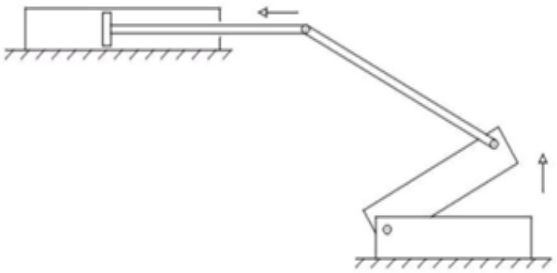

FIG C

Direction Control Valve. At position 'A' shows the non-actuated circuits diagram. At this position the piston is steady and locked. All ports are in closed condition. At position 'B', the DC valve is at left hand position as shown in figure. The cap end port & pressure port get connected to each other and the rod end port gets connected to the exhaust port. The compressed air comes in the cap end of the cylinder and pushes the pistons outwards. The air already present in the rod end side is pushed out of the cylinder.

When the piston moves outwards, the force is transmitted through the connecting link and the upper blade moves downwards. Before the actuating DC valve the sheet is inserted in between the upper & lower blades. As upper blade moves downwards, the stress is generated in the sheet metal and goes beyond ultimate shear stress of sheet metal. And thus the shearing action takes place. Now the DC valve is operated to come at position 'C', as shown in figure. The rod end port & pressure port get connected to each other and the cap end port gets connected to the exhaust port. The compressed air comes in the rod end of the cylinder and pushes the pistons inwards. The air already present in the cap end side is pushed out of the cylinder. The sheet metal is either again inserted for further cutting in case of large pieces; the small cut pieces are removed and the next sheet is inserted to cut.

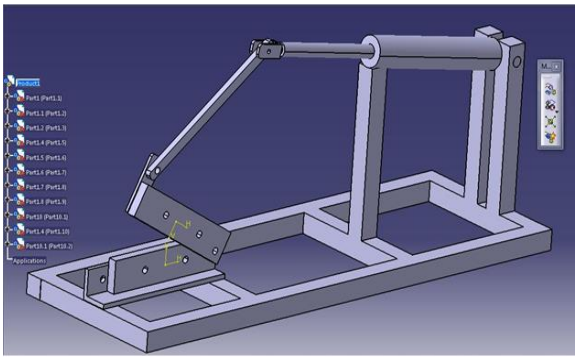

Fig. (1) :- Catia representation of project

CALCULATION

- Since the max force required to cut the sheet=900 N
- And if pressure applied by compressor = 8 bar
- Therefore, Force applied by the cylinder,
  - F = (Pi/4)*d^2*P
  - 900=(Pi/4)*d^2*(8/10)
  - d=37.84 mm
- For safety , we have taken the cylinder of diameter = 40mm
- Force required to cut the Sheet = L*t*τmax
- For sheet of 1mm thickness force required = 20*1*30= 600 N
- 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 = 900 N.
- Now we have chosen DC Air Compressor that develops a pressure of 8 to 14kg/cm2

ADVANTAGES

- 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.

APPLICATIONS

- For paper cutting
- For sheet cutting
- For stamping operating
- For bending operation

The real image of shearing machine

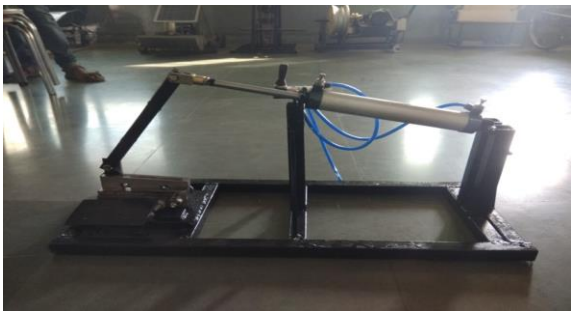

Fig. (2) :- pneumatic sheet metal shearing machine

CONCLUSIONS

Now we know that Pneumatic cutting and bending machine is very cheap as compared to hydraulic cutting and bending machine. The range of the cutting and bending thickness can be increased by arranging a high pressure compressor and installing more hardened blades. This machine is advantageous to small sheet. Metal cutting and bending industries as they cannot afford the expensive hydraulic cutting and bending machine.

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