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Design and Development of Pneumatic Punching Machine

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Abstract: *A pneumatic punching machine is always a better choice than a hydraulic punching machine to produce similar products if it is suited for the method. It is comparatively more economical for production of large quantities of products as it uses compressed air rather than some hydraulic fluid which is rather expensive. A pneumatic punching machine uses compressed air to generate high pressure to be applied on the piston. A solenoid valve controls the directional flow of air into and out of the cylinder. Polyurethane tubes are used for pressure transmission from the pneumatic cylinder to the punch assembly. The high-pressure air fed to the punch, forces it on the material and as the punch descends upon the sheet, the pressure exerted by the punch first cause the plastic deformation of the sheet.*

Key Words: Compressed Air, Economical, Solenoid Valve, Polyurethane tubes, Pneumatic Cylinder

1. INTRODUCTION

Pneumatics, from the Greek (pneumatikos, 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 had existed before then. Pneumatic products represent a multi-billion 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 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. 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 powered by air motors to preclude the need for electric motors deep in the mine where explosive gases may be present. Pneumatic cylinders are generally less expensive than hydraulic cylinders of similar size and capacity.

1.1 OBJECTIVE OF PROJECT

To design and develop such a pneumatic punching machine which uses compressed air to generate high pressure to be applied on piston and this high-pressure air fed to punch, forces it on the material. And thus punching operation is performed.

2. LITERATURE SURVEY

Girish Gharat et all (1): This project has met its objective to produce a C-Frame Pneumatic Press and its function is

limited to V-Bending and Punching. We designed a pneumatic press which costs less than that available in the market. We are very good at what we have done and had fun doing it. Our pneumatic press is useful to do metal forming operations and as it is a 2 tonne capacity press.

Anand Kumar Singh et all (2): Pneumatic system is better than hydraulic system and mechanical system in terms of maintenance, cost, accuracy, Productivity. Based on calculation project model work on max 42 bar punching force

K.K.Alaneme et all (3): The failure of punch die materials used in the production of cable trays has been investigated. The analysis show that the short service life of the indigenous die component is due to incorrect heat-treatment which did not remove the cold-worked structure in built in the material during production, thus resulting in inferior toughness and/or fatigue resistance .It was equally identified that occasional misalignment of the mould upper die teeth and lower die plate due to over exertion of the machine contributes to failure of the die material.

Shridhar D. R. et all (4): In this paper design and control method of sheet metal punching machine is explained. By using Programmable Logic Controllers as the controller of the whole system, good and easy control over the system can be achieved. Manufacturing lead time of the system is reduced by developing automatic feeding mechanism, worker safety is increased by reducing the human participation in the process and the problem of angular misalignment of sheets is also reduced.

3. EXPERIMENTAL SETUP

1. COMPRESSOR: A compressor is a machine that compresses air or another type of gas from a low inlet pressure (usually atmospheric) to a higher desired pressure level. This is accomplished by reducing the volume of the gas. Air compressors are generally positive displacement units.

Fig3.1. Air Compressor

2. Pneumatic Cylinder: The cylinders convert the energy of the compressed air into linear motion which extend or retract the piston rod.

Fig3.2. Pneumatic Cylinder

Selected pneumatic cylinder is listed below-:

Type of Cylinder	Bore Diameter	Stroke Length
uble Acting Cylinder	50 mm	100 mm

3. Direction Control Valve: Direction control valve is used to give proper direction to the working fluid for extension and retraction of the piston in cylinder. Fig.3.1 shows direction control valve selected and Fig.3.2 shows mechanism of operation.

Fig3.3. 5/2 hand lever operated DCV

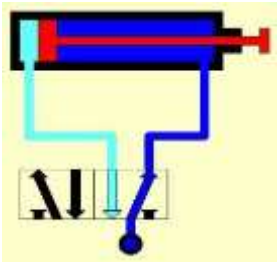

Fig3.4. Mechanism of 5/2 DCV

4. Polyurethene tubes: Polyurethene tubes are used for transmission of pneumatic fluid i.e. compressed air. Polyurethene combines the best properties of both plastic and rubber. It offers abrasion and tear resistance, high tensile and elongation values, and low compression set.

Fig3.5. Polyurethene Tube

5. Bed and Frame: Frame is the structure used for supporting pneumatic cylinder and Bed is the structure used for handling the material to be punched.

For bed

Material	Length(cm)	Width(cm)	Height(cm)
Mild Steel	60	60	95

For frame

Material	Length(cm)	Width(cm)	Height(cm)
Mild Steel	20	20	35

6. Punch and Die: The sheet metal used is called strip or stock. The punch which is held in the punch holder is bolted to the press ram while die is bolted on the press table. During the working stroke, the punch penetrates the strip, and on the return stroke of the press ram the strip is lifted with the punch, but it is removed from the punch by the stripper plate. The stop pin is a gage and it sets the advance of the strip stock within the punch and die. The strip stock is butted against the back stop acting as a datum location for the center of the blank.

4. Working of system

The compressed air from the compressor at the pressure of 8 to 10 bar is passed through a pipe connected to the hand lever operated valve with one input. The hand lever operated valve has two outputs pressure below the piston is more than the pressure above the piston. So these move the piston rod from BDC to TDC. This force acting is passed on to punch which also moves downwards. The punch is guided by a punch guide who is fixed such that the punch is clearly guided to the die. The materials are in between the punch and die. So as the punch comes down the materials are sheared to the required profile and one input. The air entering into the input goes out through two outputs. When the hand lever valve is pressed, due to the high air pressure at the BDC of the piston, the air of the punch and the blank is moved downwards through the die clearance. When the piston is at the extreme point of the stroke length, the exhaust valve is opened and the air is exhausted through it and when hand lever operated valve is release the pressurized air come in at the TDC of the piston and it pushes the piston from

TDC to BDC. So the one side of the air is pulled downwards and the other side is lifted upwards. So the punch is therefore pulled upwards from the die. Now the piston reaches the BDC of the required stroke length. Now the material is fed and the next stroke of the piston is made ready.

5. Assembly

Fig.5 Assembly of Project

6. Simulation

Automation Studio is a circuit design, simulation and project documentation software for fluid power systems and electrical projects conceived by Famic Technologies Inc.. It is used for CAD, maintenance and training purposes. Mainly used by engineers, trainers and service and maintenance personnel.

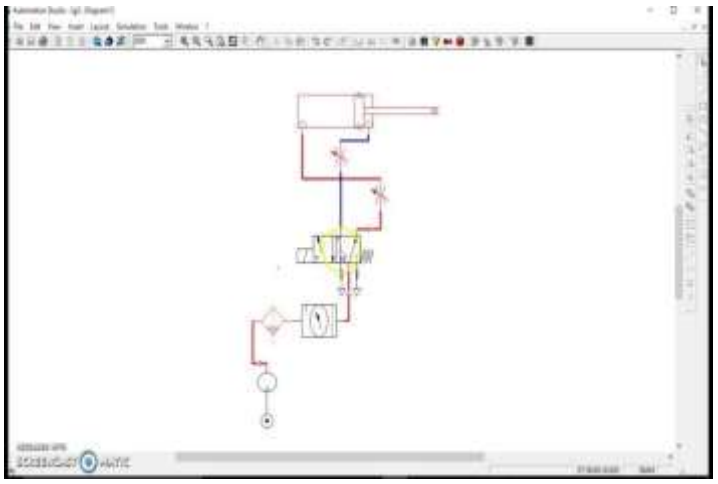

Fig. 6.1 Extension of Cylinder

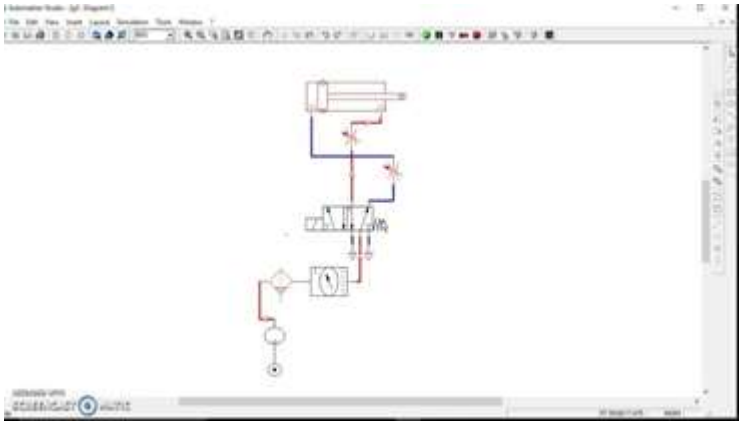

Fig. 6.2 Retraction of Cylinder

Conclusions: This project has met its objective to produce a hole by pneumatic force. We are very good at what we have done and had fun doing it. We can do simple operations like punching, which is very useful and helpful to do small works at our college. We chose a simple c-frame machine which occupies less space which any one can operate.

We tested our project by punching the sheet metal. As our project is based on manufacturing of pneumatic punching further modifications can be done and increase its applications.

Future Extension:

We contemplate the following future features which can be incorporated into this project:-

1) Automation of pneumatic punching machine

2) Accident avoiding systems by adding LDR sensors

3) Improvements in pneumatic machine by adding components like timers, silencers, etc.

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