Pneumatic Auto Feed Punching and Riveting Machine

A.S. Aditya Polapragada[1], K. Sri Varsha[2]

[1]*PG student, Institute of science and technology, University College of engineering, JNTU Kakinada, A.P, INDIA*

[2]*PG student, Department of mechanical engineering, University College of engineering, JNTU Kakinada, A.P, INDIA*

Abstract

The pneumatic system has gained a large amount of importance in last few decades. This importance is due to its accuracy and cost. This convenience in operating the pneumatic system has made us to design and fabricate this unit as our project. This unit, as we hope that it can be operated easily with semi skilled operators.

The pneumatic press tool has an advantage of working in low pressure, that is even a pressure of 6 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. 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

Key words: *Shaping machine, solenoid valve, Pneumatics, lamies equation, design& Drawings*

1. Introduction:

The press is the punching and riveting machine tool designed to punch letter or rivet metal by applying mechanical force or pressure. The metal is punched or riveted to the desired requirement. The presses are exclusively intended for mass production and they represent the fastest and more efficient way to form a metal into a finished punched or riveted product.

Press tools are used to form and cut thin metals. Press tools operation can be simplified to a few simple operations involving a punch a die. There are Nemours types of presses in engineering field, which are used to fulfil the requirements. We are interested to introduce pneumatic system in presses. The main function of pneumatic press is to form or cut thin sheet metals or non metals using pneumatic power. In this project we have used to punching process and riveting process for simple application.

2. General Description:

2.1 Production of Compressed Air

Pneumatic systems operate on a supply of compressed air, which must be made available in sufficient quantity end at a pressure to suit the capacity of the system. When a pneumatic system is being adopted for the time, however it wills indeed the necessary to deal with the question of compressed air supply.

The key part of any facility for supply of compressed air is the compressor. A compressor is a machine that takes in air, gas or vapours at any certain pressure and delivers the air at a high pressure.

Compressor capacity is the actual quantity of air compressed and delivered and the volume expressed is that of the air at intake conditions, namely at atmosphere pressure and normal ambient temperature.

Clean condition of the suction air is one of the factors, which decides the life of the compressors. Warm and moist air will result in Compressors may be classified into two types, namely

1. Positive displacement compressors
2. Turbo compressors.

Positive displacement compressors are most frequently employed for compressed air plants and have proved

highly successful to supply air for pneumatic control application.

The types of positive Compressors are,

a. Reciprocating type compressors
b. Rotary type compressors.

Turbo compressors are employed where large capacity of air is required at low discharge pressures. They cannot attain pressure necessary for pneumatic control applications unless built in multi stage designs are seldom en counted in pneumatic service.

2.2 Principle of Operation of a Press:

Every press has got certain basic units. They are bed frame, sliding ram, drive for the ram and power source.

Base or bed is the lower part of the press frame. A thick plate called bolster plate is placed on the top of the bed. A die is fitted on the top of the bolster plate. The driving mechanism is mounted on the frame. The frame has got guide ways for the sliding movement of the ram. The driving mechanism is connected to the ram. The punch is fitted at the bottom of the ram. The die and punch are correctly aligned. The work piece is in the form of sheet metal. It is fed over the die. When the ram comes down, the punch presses the sheet metal. The required operation is carried out.

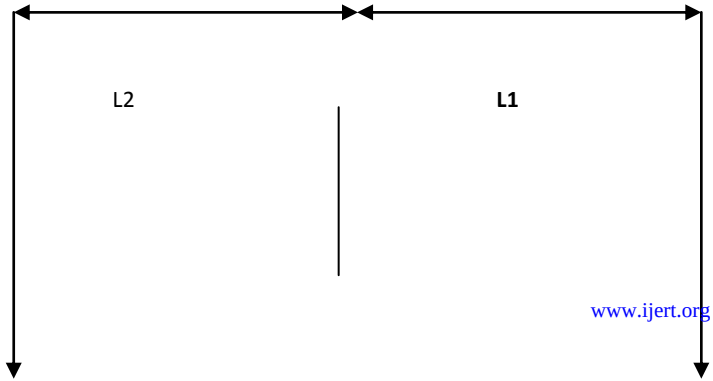
As said earlier the force from the press is used to do a particular operation. This is done by two main parts die and punch.

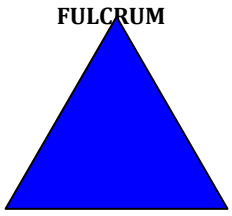
2.3Mechanical Advantage

Mechanical advantage can be defined as the ratio or the load lifted to the power or the effort applied in the system to overcome the load successfully.

Principle of Levellers

The points A and B through which the load and effort is applied are known as load and effort point respectively. F is the fulcrum about which the lever is capable of turning. The perpendicular distance between the load point and the fulcrum is known as the load arm. The perpendicular distance between the effort point and the fulcrum is called as effort arm.





Taking moments about the fulcrum points,

W * L1 = P * L2

The ratio of effort arm to parallel arm L2/L1 is called as leverage

The displacement of effort to the displacement of load is called as the Displacement Ratio. To obtain great leverage compound levers may be used. In a compound lever, the leverage is the product of leverages of various levers.

3. COMPONENTS AND DESCRIPTION:

3.1 PNEUMATIC CONTROL COMPONENTS

Selection of Pneumatics

Mechanization is broadly defined as the replacement of manual effort by mechanical power. Pneumatics is an attractive medium for low cost mechanization particularly for sequential or repetitive operations. Many factories and plants already have a compressed air system, which is capable of providing both the power or energy requirements and the control system (although equally pneumatic control systems may be economic and can be advantageously applied to other forms of power).

The main advantages of an all-pneumatic system are usually economy and simplicity, the latter reducing maintenance to a low level. It can also have outstanding advantages in terms of safety.

The pneumatic punching and riveting machine consists of the following components to fulfil the requirements of complete operation of the machine.

i. Pneumatic cylinder
ii. Solenoid valve
iii. Flow control value
iv. Connectors and
v. Hoses

3.2 Solenoid valve:

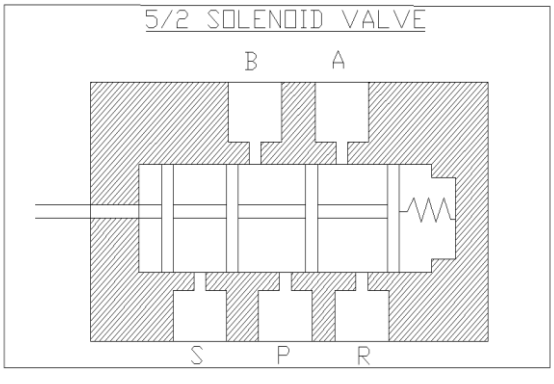
5/2 Double Acting Solenoid Valve:

The directional valve is one of the important parts of a pneumatic system. Commonly known as DCV, this valve is used to control the direction of air flow in the pneumatic system. The directional valve does this by changing the position of its internal movable parts.

This valve was selected for speedy operation and to reduce the manual effort and also for the modification of the machine into automatic machine by means of using a solenoid valve.

A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn operates the valve mechanism. Solenoids may be push type or pull type. The push type solenoid is one in which the plunger is pushed when the solenoid is energized electrically.

The pull type solenoid is one is which the plunger is pulled when the solenoid is energized. The name of the parts of the solenoid should be learned so that they can be recognized when called upon to make repairs, to do service work or to install them.



Technical Data

Size	:	¼”
Pressure	:	0 to 10 kg / cm2
Media	:	Air

3.3 Working of 5/2 Solenoid Valve

The solenoid valve has 5 openings. This ensure easy exhausting of 5/2 valve. The spool of the 5/2 valve slide inside the main bore according to spool position; the ports get connected and disconnected. The working principle is as follows. It is used to flow the air from compressor to the single acting cylinder.

IC 555 TIMERS

The IC SE / NE 555 monolithic circuit is a highly stable controller capable of producing accurate time delays or oscillations. Additional terminals are provided for triggering or resetting if desired. In the timing operations, the time is precisely controlled by one external resistor and a capacitor, by the operation as an oscillator, the free running frequency and the duty cycle are both accurately contributed with the external RC constants.

SPECIFICATION

Supply Voltage (Vcc)	=	4.5 to 15V
Supply Current (Vcc=5V/2)	=	3 to 6mA
Supply Current (Vcc=25V/2)	=	10 to 15mA
Output Current	=	200mA (maximum)
Power dissipation	=	600mw

Operating temperature

4. DESIGN AND DRAWING:

4.1 DESIGN CALCULATIONS

WORKING PRESSURE: 8 bar to 10 bars

Operating Force = Pressure x Cylinder area

F = (8 x 100) x (3.14/4) (D * D)

Where, D is the diameter of the cylinder in mm.

Operating force= 6 x 9.81 x 104 x 0.785 x 0.057 x 0.057

OPERATING FORCE = 1501.96 N

YIELD STRESS OF THE WORK MATERIAL FROM DATA BOOK FOR ASTHETIC FIBRE = 40 N/mm²

Cutting Force = Yield stress x Shearing area

Yield stress = Fy

Shearing area = (3.14 x d x t)

Factor of safety is to be decided based upon the operating force and cutting force.

CUTTING FORCE REQUIRED FOR THE WORK MATERIAL

CUTTING FORCE FOR ASTHETIC FIBRE =
40 x 117.74 = 1256 N

MECHANICAL ADVANTAGE

W x L1 = P x L2

W/p = Mechanical Advantage = L2/L1 = Leverage, L2 / L1 is 2:1

Hence applied force is doubled due to the leverage. Operating force is greater than cutting force,

Hence the design is safe and the material is cut.

5. UNIT DESCRIPTION (CONSTRUCTION):

5.1 CYLINDER

An (pneumatic) air cylinder is an operative device in which the state input energy of compressed air; (i.e.) pneumatic power is converted into mechanical output power, by reducing the pressure of the air to that of the atmosphere. The bore of the cylinder has very smooth finishing reduces friction and losses. There are to angle plates welded to the cylinder as fitting means.

DOUBLE ACTING CYLINDER

A double acting cylinder is employed in a control system with a full pneumatic cushioning and it is essential when the cylinders itself is required heavy masses. The normal escape of air is out by 'cushioning piston'.

5.2. PUNCH AND DIE

Die and punch are known as 'press tools'. Die is the lower part of press tool. It is clamped on the bolster plate of the press. It remains stationary during the operation. The die has a cavity to receive the punch. The cavity may be with clearance or without clearance.

Punch is the upper part of the press tool. It is attached to the lower end of the ram of the press. It sheds with the ram during the operation and is forced into the die cavity. Die and punch must be in prefect alignment for proper operation.

Die and punches are always used together. Dies are classified according to either the type of construction or operation to be performed. High speed steel, satellite or cemented carbide is the materials used for making dies and punches. The die materials selected depend on the type of production, operation, sheet metal thickness and accuracy.

5.3 FULCRUM LOAD AND EFFORT ARM

A lever is a mechanical devices used to lift heavy loads by application of a small effort. It is a rigid rod or bar, which turns about a fixed point called fulcrum. A lever may be straight or curved. Lever works on the same principle as that of principle of moments.

The load W is applied to the point A and hence the point A is known as load point and point B is effort point. The point F is fulcrum. The perpendicular distance (L1) between the load point A is load arm and L2 between is known as effort arm.

The ratio of effort arm and load arm is called as leverage. The ratio of load lifted and the effort applied is mechanical advantage.

Taking moments about fulcrum P*L2 =W*L1

5.4 COMPRESSOR

The compressor forms the main part of the pneumatic system by producing the compressed air. Compressor capacity is the actual quantity of air compressed and delivered and the volume expressed is that of the air intake conduction, namely at atmospheric pressure and normal ambient temperature. The clear conduction of the suction air one of the factors which decide the life of a compressor. Compressor is generally classified into two types, namely

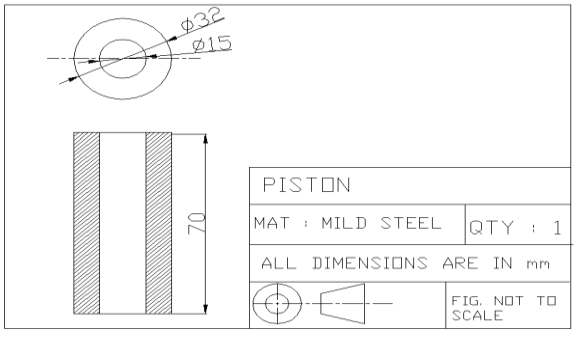
1. Positive displacement compressor
2. Turbo compressor

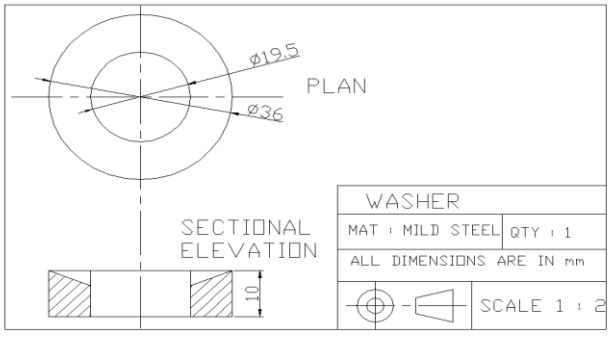
DIRECTION CONTROL VALVES

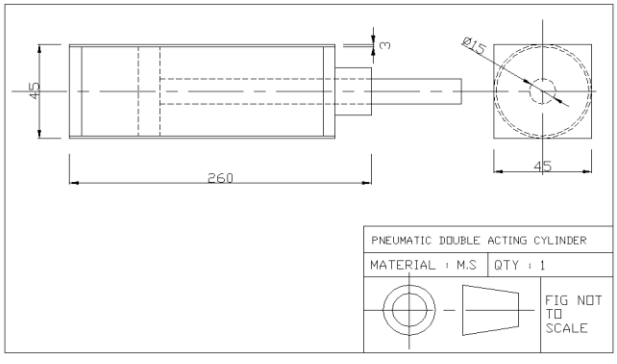
Direction control valves control the way the air passes and used for controlling the commencements, termination and direction of air flow. Depending on the number of paths the air is allowed to pass, directional valves termed two way, three way, and four way or multi way valves.

The different number of rays by means the number of controlled connection of the valve. Inlet connection to the compressed air supplies outlet connections to the air consumer and exhaust connection to the atmosphere.

The solenoid valve is used to control the air flow direction. This is the direction control valve in our project.



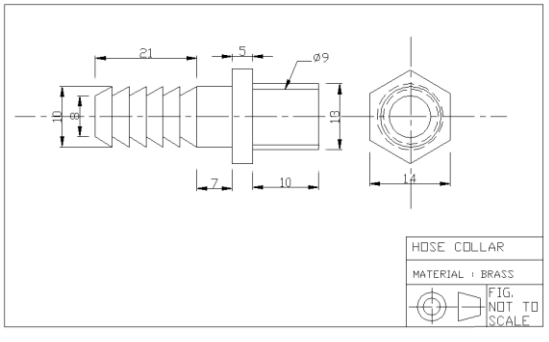


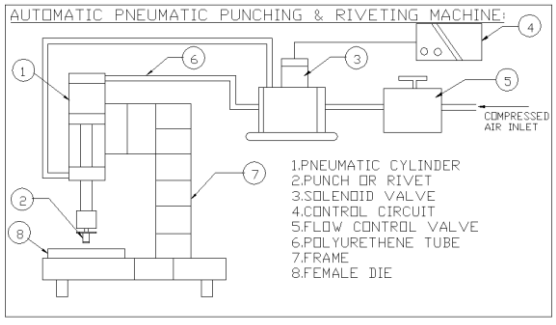


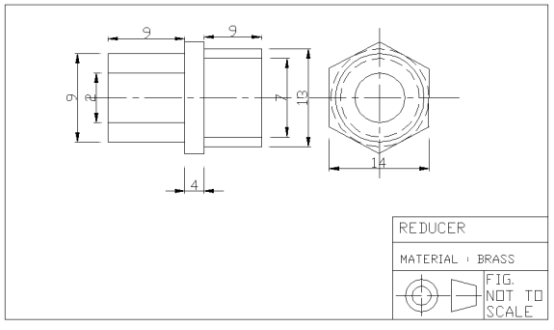
03.	End Plates	M.S.	3
04.	PUNCH(MODEL)	M.S.	1
05.	TOP COVER	M.S.	1
06.	BUSH	M.S.	1
07.	WASHER	M.S.	1
08.	BOTTOM COVER	M.S.	1
09.	STEADY PIN	M.S.	2
10.	PIPE	M.S.	1
11.	BUTT	NYLON	1
12.	SOLENOID VALVE		1
13.	FLOW CONTROL VALVE		1

LIST OF MATERIALS

Sl. No.	PART NAME	MATERIAL	No. OFF
01.	Cylinder	M.S.	1
02.	Piston and piston rod	M.S.	1







5.5 WORKING PRINCIPLE

Compressed air from a compressor is used to press the work by means of the piston and piston rod, cylinder through a lever. The high pressurized air striking against the piston tends to push it upwards. This force is transmitted to a punch by means of a lever by its mechanical advantage. The punch forced downward pierces the work material. This is the main principle of the unit.

WORKING

The compressed air from the compressor at the pressure of 5 to 7bar is passed through a pipe connected to the Solenoid valve with one input. The Solenoid Valve is actuated with Control Timing Unit. The Solenoid valve has two outputs and one input. The air entering into the input goes out through the two outputs when the timing control unit is actuated.

Due to the high air pressure at the bottom of the piston, the air pressure below the piston is more than the pressure above the piston. So these moves the piston rod upwards which move up the effort are, which is pivoted by control unit. 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 of the punch and the blank is moved downwards through the die clearance.

When the piston is at the extreme point of the stock length, the exhaust valve is opened and the air is exhausted through it and the pressurized air come in at the top of the piston and it pushes the piston downwards. 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 bottom point of the required stroke length. Now the material is fed and the next stroke of the piston is made ready.

When the material is correctly positioned then this machine is again actuated automatically. The time duration of the succeeding punching is adjusted with the help of control timing unit.

6. CONCLUSION:

The pneumatic punching and riveting has been successfully completed with fullest satisfaction. We are optimistic based on the revolution, the machine is going to make in the pressing field. This project may be further developed into a unit with an automatic material handling system.

7. BIBLIOGRAPHY:

Production Technology - R.B. Gupta

Manufacturing Process - R.B. Gupta B.K. Gupta

Pneumatic Control - Werner Deepest, Kust Stoll

A Text Book on Machine Design - R.S. Khurmi

Press Working – Shecklos, S.Elanger

PSG Design Data - PSG Mech. Dept

Catalogue of Janatics pneumatic product,

Janatics Private Limited Coimbatore

P.S.G. College of technology, Coimbatore

Design data book – Complied by faculty of mechanical engineering