# FABRICATION OF PNEUMATIC STOCK-STILLING MACHINE

[1]Rahul Kumar [2]Venkata Sai Mohan, [3]Srikanth, [4]Sneha Kumar, [5]Jagadeeswara rao
[1]Assistant Professor, [2345]U G Scholar
[1]Mechanical Engineering,
[1] Godavari Institute Of Engineering and Technology, Rajahmundry, Andhra Pradesh

***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 or 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 enable 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. This project work deals with the design of pneumatically controlled three axis punching machine to carry out piercing operation on thin sheets (1-2 mm) of different material (like aluminium and plastic). Reduction in punching force requirement being the main aim of this project work is obtained by modification in punch tool design i.e. by provision of shear on punch face. Subsequently it results in reduction in amount of punching force requirement.

***IndexTerms - pneumatic, pressurized air, stock stilling***

## I. INTRODUCTION

A pneumatic stock stilling machine can be thought of as a large flexible mechanical structure that is moved by some sort of control system. The control system takes its input from a human operator and translates this command into the motion of actuators, which move the mechanical structure. The high performance and highly powerful, Pneumatic riveting machine vice with the capacity for high volumes of punching has done. Punching is a operation of producing permanent impression over a job, it historical day it is done by hammering, where nowadays it is done pneumatic machine with accessories.
One form of inefficiency in current systems is due to the link between the flows of the two ports of the cylinder. This is because most valves use a single spool to control the flow in both ports. Because of this link, it is impossible to set the pressure levels in the two sides of the cylinder independently.
Therefore, the outlet side will develop a backpressure, which acts in opposition to the direction of travel, which increases the pressure required on the inlet side to maintain motion. Since the force generated by the actuator is proportional to the pressure difference between the two sides, the actual pressures in the cylinder don't affect the action of the cylinder.

## 1. PNEUMATICS

Pneumatics is that branch of technology, which deals with the study and application of use of pressurized air to affect mechanical motion.
The compressed air is used as the working medium, normally at a pressure of 6-8bars (also can be extended up to 15bar) and a maximum force up to 50KN can be obtained .Stock-stilling is used extensively in industry as well as in many everyday applications. It has many distinct advantages in terms of energy consumption, cost and safety. Stock-stilling power is used in industry, where factory machines are commonly plumbed for compressed air (other compressed inert gases can also be used). Pneumatics also has applications in dentistry, construction, mining, and other areas

### 1.2 Applications of Stock-Stilling:

- Used in small scale industries.
- It can be used as machine with fixed mounting and as a portable machine because it is flexible to move.
- For performing the operations in huge numbers which cannot be done in ordinary machines, Since it's portable.

### Literature Review:

**A.S. Aditya Polapragada & K. Sri Varsha** et al. stated that, Pneumatic systems used in industry are commonly powered by compressed air or compressed inert gases. A centrally located and electrically powered compressor powers cylinders, air motors, and other pneumatic devices.
A pneumatic system controlled through manual or automatic solenoid valves is selected when it provides a lower cost, more flexible, or safer alternative to electric motors and actuators.

**Mr. Utkarsh Sharma** et al. stated that, Hydraulically operated machines are expensive and their maintenance cost is high, which makes the manufacturing of aluminum goods a challenge for small scale industries. This paper deals with pneumatically operated hole punching machine. The automatic pneumatic hole punching machine is designed using various components.
The components are pneumatic cylinder, pressure regulator, solenoid valve, solar panel, compressor. The application of solar panel is to charge the battery that runs the compressor. The pneumatic cylinder is used to obtain the ramming action to punch holes, and the compressor provides the compressed air to the cylinder due to which the movement of piston cylinder takes place.

**Asst. Prof .P. S. Baravkar & Prof. D.P.Sonawane** et al. stated that, The successful implementation of any manufacturing sector is largely depend upon the quality & its productivity. In traditional machining process for performing the different operation a separate machine required which becomes a time consuming also the inaccuracy in productivity due to involvement of human error which affects to productivity cannot be get improved at faster rate .
The main purpose of this paper to develop special purpose machine for riveting machine which leads to improve the quality and productivity by minimizing the time period by using hydraulic. In this process two or more operation can be performed simultaneously due to this cost of a material reduces.

**Prof . Ajay Mahawadiwar** et al. stated that, Pneumatic systems are extensively used in a wide range of industries and factories and manufacturing sector entities. Stock-stilling system are noted for their simplicity, reliability, and ease of operation. Also they are suitable for fast and rapid application of force.
The purpose of this project is to therefore design a simple, easily operated pneumatic sheet metal cutting and bending machine that is sturdy and strong. A pressure of 8-10 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.

## METHODS AND CALCULATIONS

### Analytical methods and calculations:

**Rating of compressor (kg/cm $^2$):**

1 kg/cm$^2$ = 0.9806 bar
4 bar = 3.924 kg/cm$^2$, 5 bar = 4.905 kg/cm$^2$
6 bar = 5.886 kg/cm$^2$, 7 bar = 6.867 kg/cm$^2$

**Pneumatic cylinder specifications:**
Stroke length : 125mm bore diameter: 40mm
Piston rod diameter: 15mm

**Thrust force by the cylinder:**
$A = \pi d^2/4$
$Ft = P*A$
At 4 bar =502.65N, 5 bar= 628.32 N
6 bar= 753.98 N, 7 bar=879.65 N

**Allowable Shear stress (τ)(for ductile material mild steel of variable thickness):**
**(τ) =** $Ft/\pi d^1 t$ ($d^1$=diameter of the rivet=2mm)
At 4 bar= 79.99 N/mm$^2$ (t=thickness of work piece=1 mm)
= 39.99 N/mm$^2$ (t=2 mm)
= 26.66 N/mm$^2$ (t=3 mm)
At 5 bar= 100 N/mm$^2$ (t=1 mm)
= 50 N/mm$^2$ (t=2 mm)
= 33.33 N/mm$^2$ (t=3 mm)
At 6 bar= 119.9 N/mm$^2$ (t=1 mm)
=54.9 N/mm$^2$ (t=2 mm)
=29.9 N/mm$^2$ (t=3 mm)

**Yield stress (Failure):**
**(τ) =** $Ft/\pi dt$
At 7 bar= 140 N/mm$^2$ (t=1 mm)
=70 N/mm$^2$ (t=2 mm)
=46.6 N/mm$^2$ (t= 3mm)

**Factor of safety :**
FOS = **τ**yield/ **τ**allowable

At 4 bar, FOS = 1.75
5 bar, FOS =1.4
6 bar, FOS =1.32
(FOS)Avg =1.49

**ALLOWABLE SHEAR STRESS BY THE RIVET AND WORK PIECe**

| Pressure (bar) | 4 | | | 5 | | | 6 | | |
|---|---|---|---|---|---|---|---|---|---|
| Cylinder bore diameter (D) mm | 40 | | | 40 | | | 40 | | |
| Stroke length (l) mm | 125 | | | 125 | | | 125 | | |
| Piston rod diameter(d)mm | 15 | | | 15 | | | 15 | | |
| Thrust force(F) N | 502.65 | | | 628.32 | | | 753.98 | | |
| Thickness(t) mm | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| Allowable shear stress (N/mm²) | 79.99 | 39.99 | 26.66 | 100 | 50 | 33.33 | 199.9 | 54.9 | 29.9 |

**FAILURE OF WORK PIECE**

| Pressure (bar) | 7 | | |
|---|---|---|---|
| Thrust force(F) N | 879.65 | | |
| Thickness | 1 | 2 | 3 |
| Failure shear stress (N/mm²) | 140 | 70 | 46.6 |

**OVERALL FACTOR OF SAFETY**

| Pressure (bar) | 7 | | |
|---|---|---|---|
| FOS | 1.75 | 1.4 | 1.32 |
| FOS(Average) | 1.49 | | |

**EXPERIMENT:**

**Components**

- Pneumatic cylinder
- Solenoid valve
- Flow control valve
- Polyurethene Tubes
- Rivet
- Frame

**WORKING**

The compressed air from the compressor at the pressure of 4 to 7 bar 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.
This moves the piston rod upwards which further moves up the effort arm, pivoted by control unit. This force acting is passed on to punch which also moves downwards. The punch is guided by a punch guide which 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 descends down, the material is 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.

**RESULT AND CONCLUSIONS:**

Pneumatically operated riveting machine is suitable for small scale and medium size industries. Based on the shear provided on the punch face the punching force reduction of 25% to 60% thereby increasing tool life and reducing tool machining cost. Therefore with this force reduction we are able to easily punch sheets of thickness upto 1-3 mm for mild steel sheet by taking pressure of 4-6 bar allows an average allowable shear stress 60 $N/mm^2$ with factor of safety 1.49.
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.

**FUTURE SCOPE:**

In this machine, compressed air is used to move the punch tool for carrying out punching operation. After the completion of the cycle the air moves out through the out port of Solenoid valve. This air is released to the atmosphere. In future the mechanism can be developed to use this air again for the working of cylinder.
In this machine the return stroke of the punch tool can be stored in the flywheel which helps the further forward stroke. Finally reduces the input of the machine. In future this mechanism can be developed to store the return stroke energy by using the flywheel.

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