

INNOVATION OF SHEET METAL CUTTING MACHINE

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Abstract—Pneumatics are used in industries for a wide variety of uses, including blanking, piercing and pressing. There are many different types of presses. The most popular are pneumatic presses and hydraulic presses. These two models of presses are very similar in function. But pneumatic presses are more preferable than hydraulic presses. The greatest advantage of Pneumatic presses is their speed. Pneumatic presses are 10 times faster than hydraulic presses and they can perform many jobs faster and more efficiently. They can also be stopped at any time by opening the valves to release the air. Pneumatic presses are extremely flexible, that they can be placed in a factory in any required position, even upside down.

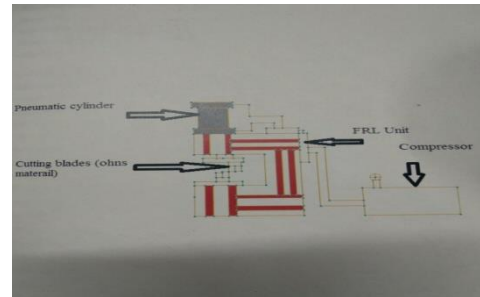
Keywords: Pneumatic, hydraulic presses, flexible.

I. INTRODUCTION

Cutting processes are those in which a piece of sheet metal is separated by applying a great enough force to cause the material to fail. The most common cutting processes are performed by applying a shear force, and are therefore sometimes referred to as shearing processes. When a great enough shearing force is applied, the shear stress in the material will exceed the ultimate shear strength and the material will fail and separate at the cut location. This shearing force is applied by two tools, one above and one below the sheet. Whether these tools are a punch and die or upper and lower blades, the tool above the sheet delivers a quick downward blow to the sheet metal that rests over the lower tool. A small clearance is present between the edges of the upper and lower tools, which facilitates the fracture of the material. The size of this clearance is typically 2-10% of the material thickness and depends upon several factors, such as the specific shearing process, material, and sheet thickness. The effects of shearing on the material change as the cut progresses and are visible on the edge of the sheared material. When the punch or blade impacts the sheet, the clearance between the tools allows the sheet to plastically deform and “rollover” the edge. Finally, the shear stress is too great and the material fractures at an angle with a small burr formed at the edge. The height of these portions of the cut depends on several factors, including the sharpness of the tools and the clearance between the tools.

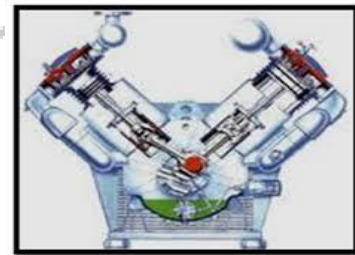
II. METHODOLOGY

3.1 Construction:

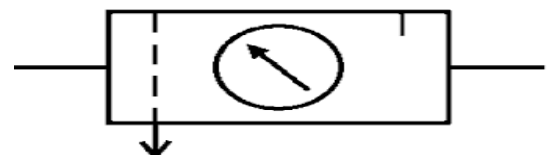


3.1.1 Compressor:

A compressor is a mechanical device that increases the pressure of the gas (air) by reducing its volume. The compressor is similar to the pump both increases the pressure of the fluid and transport it through the pipe. As gases are compressible the compressors reduces the volume of the gas. Liquids are relatively incompressible, while some can be compressed, the main action of the pump is to pressurize and transport the liquids. Compressor is a device which uses surrounding air as the fluid medium and compresses it to a high pressure. In this we are using two stage compressor with tank. The tank under it is used to store the pressurised air.

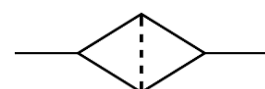


3.1.2 FRL Unit:



Air leaving the compressor is hot dirty and wet which can damage and shorten the life of downstream equipments such as valves and cylinders. Before air can be used it needs to be filtered regulated and lubricated. It consist of three parts that is FILTER, REGULATOR and LUBRICATOR.

A. FILTER:



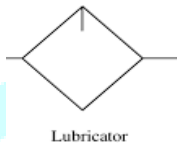
Air line filters remove contaminants from pneumatic systems preventing damage to the equipment and reducing the production losses due to contaminant related downtime. Selecting the proper size of filter for any application should be done by determining the maximum allowable pressure drop. There are three types of filters general purpose coalescing (oil removal) and vapour removal. General purpose are used to remove water and particles. Coalscing to remove oil and vapour removal to remove oil vapour and odor.

B. Regulator:



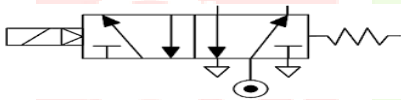
Pressure regulators reduce and control the fluid pressure in compressed air system. Regulators are also frequently referred to as PVRs (pressure reducing valves). Optimally a pressure regulator maintains a constant output pressure regardless of variations in input pressure is influenced to some degree by variations in primary and flow.

C. Lubricator:



Most air tools cylinders valves air motors and other air driven equipments require lubrication to extend their useful life. The use of an airline lubricator solves the problem of too much or too little lubrication that arise with coventional lubrications methods such as grease gun or oil.

3.1.2 Solenoid Valve: (5/2)



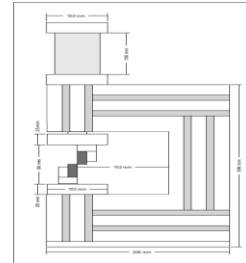
A solenoid valve is an electromechanically operated valve. The valves controlled by an electric current through a solenoid in the case of two ports valve the flow is switched on or off in the case of three port valve the out flow is switched between the two outlet ports.

3.1.3 Pneumatic Cylinder:



Pneumatic cylinder(s) (sometimes known as air cylinders) are mechanical devices which use the power of compressed air or gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders something forces a piston to move in the desired direction.

3.1.4 MAIN MACHINE FRAME:



The main machine frame is made up of Ms Material. The outer portion of the main frame is given a reinforcement to withstand higher pressures.

3.1.5 Photoelectric Sensors:



A photoelectric sensor, or photo eye, is equipment used to discover the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver. They are largely used in industrial manufacturing.

3.1.6 Timer:



A timer is a type of relay that carries out opening or closing of a contact after the elapsing of a predetermined time interval upon receiving the signal. This is a timer in which the time control can be realized easily by a simple setting.

3.1.7 Cutting Blades:

It is made up of OHNS material (oil hardened steel). The main advantage of the blade is it is sharp from all four sides and life of one side is approx one year

III. WORKING

- The basic principle working of our project is shearing of material by air pressure.
- The compressor compresses the air from the surrounding and passes to the solenoid valve through the FRL unit.
- The air gets filtered all dust and moisture particles is removed and is sent to the pneumatic cylinder.
- The pressure of the air is controlled by the regulator.
- The solenoid valve is the main controlling element which sends the air to the upper port or lower port of the pneumatic cylinder.
- When the the solenoid valve sends the pressurised air to the upper port the pressure is applied to the piston in the cylinder to move down and we get the cutting or shearing operation at the metal.
- The cutting blades are connected to the piston through a long shaft.
- After the cutting or shearing operation the solenoid valve sends the pressurised air to the lower port which gives return stroke.
- And finally the shearing of metal is done.

- The timer is use to adjust the speed of the blade and the photoelectric sensors are used for safety purpose.
- That whenever anything interrupts in between operation the sensors get activated and the operation is stopped to prevent any accident.

IV. ADVANTAGES

- Wide availability of air.
- Compressibility of air.
- Easy transportability of compressed air in pressure vessels, containers and in long pipes.
- Fire proof characteristics of the medium
- Simple construction of pneumatic elements and easy handling.
- High degree of controllability of pressure, speed and force

V. DISADVANTAGES

- This step is accurate and efficient, so that the successive stages of the manufacturing process can be performed properly.
- Holds the work piece in the correct positions it is easier in the case of sheet cutting, with respect to mechanical shearing.
- Short obtained by laser cutting are extremely accurate and does not take long. Rather, the cutting process and material is easily reached in less time than traditional scissors.
- As the section with the help of the shearing is produced, there is no direct contact of the work piece with a cutting tool, for which the risk of contaminating material.

VI. CALCULATIONS

- Force applied while advancing = $3.53 \times 10^3 \text{N/mm}^2$.
- Force applied while retracting = $3.39 \times 10^3 \text{N/mm}^2$.
- Clearance between two cutting blades = 20 microns.
- Upper jaw or blade angle = 4 degree.
- Maximum sheet thickness can be cut = 3.5 mm.

VII. SAFETY PRECAUTIONS

- Sheet metal can cause serious cuts. Handle it with care. Wear steel reinforced gloves whenever feasible.
- Treat ever cut immediately, no matter how minor.
- Remove all burrs from the metal sheet before attempting to work on it further.
- Use a brush to clean the work area. NEVER brush metal with your hands.
- Use tools that are sharp.
- Keep your hands clear squaring shears of the blade

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