Fabrication of Pneumatic Metal Sheet Cutting Machine

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Abstract— The main objective of this work is to tell the importance of Pneumatics in our world. So we have proposed a machine which can cut sheets of metal (Aluminium) of different width with the help of Pneumatic. The main objective of this project is to fabricate a machine which can reduce human effort, achieve good surface finish, reduce process time and is cost efficient.

Keywords: Pneumatic Metal Sheet Cutting Machine, Fabrication

I. INTRODUCTION

When it comes to Industry then sheet metal is the most important part of it. This machine should be used for straight cutting machine with wide application, though some other industries also use hand cutter which is operated manually, to use hand sheet cutter man work is required and accuracy is less, so we have developed a machine which can cut pieces of sheet with the help of pneumatics, this increases the accuracy and reduce the man work in operation. Sheet metal operations are generally performed in every mechanical industry, hence this machine is a good alternate to those hand cutters.

In shearing operation, as the upper blade decline downwards upon the metal, the pressure developed and exerted by the blade first causes the plastic deformation of the metal. Since the clearance between the blade and the die is very small, the plastic deformation takes place in a local area and the metal is cut along the cutting edge of blade.

II. LITERATURE REVIEW

Sheet metal shearing is one among the foremost wide applied sheet metal operations. The understanding of the bending mechanics is aimed towards obtaining two forms of data vital for industrial applications. The primary one is that the spring back prediction for die style and shape management. The second is an estimation of the bend force for selection of press capacity, strength analysis and design of dies. Vallance and Matlock (1992) studied the friction behavior of zinc-based coated sheet steels and laboratory scale friction analysis techniques that involve sheet slippery over cylindrical dies. Wenzloff et al (1992) introduced a new check procedure for the bending beneath tension friction check. Mai Huang and Gardeen (1994) bestowed a literature review of the spring back of doubly curved developable sheet metal surfaces and provided a bibliography on the spring back in sheet metal forming. Reviewing the literature, it is found that researchers have been studying the phenomenon of spring back for nearly six decades. There have been diverse efforts to evaluate and/or decrease spring back in the sheet metal forming industry for a long time. Perduijn and Hoogenboom (1995) derived an simple specific bending couple curvature relation for small and larger curvatures and they verified the model with experimental results**.** A simple approach for calculating bendability and spring back in bending based on the normal anisotropic value, strain hardening. exponent and sheet thickness has been presented as delineate elsewhere by Daw Kwei Leu (1997).

You-Min Hang and Daw-Kwei leu (1998) showed the affects of process variables like punch radius, die radius, punch speed, friction coefficient, strain hardening exponent, normal anisotropy on V-die bending process of steel sheet. Sanchez (1999) focused on a systematic analysis of testing equipment as a measurement system of the friction phenomena on sheet metal under plane strain. It describes experimental references in order to optimize the usage of lubricants and sheet metal. Weilong Hu (2000) describes anisotropy hardening models with simple loading conditions that include exponential hardening model, linear hardening model and multi linear hardening model. Samuel (2000) studied the spring back in axisymmetric U-bending processes with a finite element program and discussed the effect of tool geometry and blank holder force on the final shape after spring back.

Aleksy et al (2001) conducted experiments on spring back for dual phase steel and conventional high strength steel for a hat channel section with varying cross sections. They delineate the methodology of experiments and mentioned spring back related results. Livatyali and Altan (2001) presented experimental investigation to determine the effect of die corner radius, punch radius, punch-die clearance, pad force and sheet material on spring back in straight flanging. Leo De Vin (2001) described the problems related to an oversimplification of the air bending process and explained the consequences of applying models, standards or thumb rules. Streppel et al (2001) performed the experiments on air bending that address the required punch displacement and the sheet length correction. Draw bend test for various die radii, friction coefficients and tensile forces was conducted by Cardeen (2002).

Zafer Tekiner (2004) examined the springback of sheet metals with various thicknesses and properties in bending dies. Carlos Gomes et al (2005) investigated the variation of spring back in high strength steels based on experimental and numerical analysis. Ihab Ragai et al (2005) discussed the effect of sheet anisotropy on the spring back of stainless steel 410 draw bend specimens and lubrication. Ozgur Tekaslan et al (2006) carried out the experiment to determine spring back of steel sheet with Vshaped die. Dongye Fei and Peter Hodgson (2006) investigated the spring back behavior of cold rolled transformation induced plasticity (TRIP) steels in air vbending process.

In shearing or cutting operation as or blade falls downwards upon the metal, the pressure produced 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.

A. Types of shearing Machine:

1) Pneumatically operated 2) Hydraulically operated 3) Rack and pinion operated 4) Spring operated.
Detailed representation of all the types is as follows.

1) Pneumatically operated:

Here the improvement 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 stimulate 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 comparably 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 mechanics of spring-operated machine is alike to the rack and pinion operated machine but differs from it in construction. The lowering and the raising of the heating handle are carried out manually and it needs too much pressure for its working and also there is possibility of having vandalism to the work piece if not handled carefully.

III. PROPOSED TOOLS

Pneumatic metal shearing machine is fabricated with the help of following tools:

A. Air Compressor:

Air compressor is a device, which converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy; accumulate in pressurized air (i.e., compressed air). An air compressor pushes more and more air into a storage tank, increasing the pressure. When tank pressure reach its upper limit the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy stored in the compressed air can be used for a various types of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor switches on again and re-pressurizes the tank. The most common types of air compressors are: electric or gas/diesel powered compressors. The power of a compressor is measured in HP (Horsepower) and CFM (cubic feet of air per minute). The gallon size of the tank tells you how much compressed air "in reserve" is available. Gas/diesel powered compressors are extensively used in remote areas with problematic access to electricity. They cause noise and require ventilation for exhaust gases. Electric powered compressors are used in manufacturing, workshops and garages with permanent gain to electricity. Common workshop/garage compressors are 110-120 Volt or 230-240 Volt. Compressor tank shapes are: "pancake", "twin tank", "horizontal", and "vertical". Depending on a size and purpose compressors can be stationary or portable.

Fig. 1: Air Compressor

B. Solenoid Valve:

The directional valve is one of the vital part of a pneumatic gas system. Generally known as DCV, we use this valve to control the direction of airflow in the pneumatic system. The directional valve does this by altering the position of its internal portable parts. This valve was selected for speedy working and to reduce the man effort and for the modification of the machine into automatic machine by means of using a solenoid valve. A solenoid is an electrical device that transforms electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn intervene the valve mechanism. Solenoids may be push type or pull type. The push type solenoid is one in which the plunger is pressed when the solenoid is energized electrically. The pull type solenoid is one in 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 acknowledged when called upon to make repairs, to do service work or to situate them.

Fig. 2: Solenoid Valve

C. DC Motor:

A stepper motor is an electromechanical device which converts discrete electrical pulse into discrete mechanical motion. The shaft or spindle of a stepper motor rotate at equal angle of increment called steps when electrical command pulses are involve to it in the proper sequence. The sequence of the applied pulse is directly related to of

rotation of motor shaft and its speed directly related to the frequency of input pulses and total radiation at a stretch is directly related to the number of input pulse applied. Stepper motors with steps of 12, 24, 72, 144, 180 and 200 per revolution are accessible resulting in angle of the shaft increments of 30°, 15°, 5°, 25°, 2° and 1.8° per step. Special micro-stepping circuitry is sometimes provided to allow many more steps per revolution and these circuitry offer 10,000steps per revolution or even more.

D. Parameters of DC Motor

• Length: 80mm • Torque: 1.5kg.cm • Shaft Diameter: 6mm • Weight: 130.00g • Supply Voltage: 12V • Speed = 3.5 RPM.

Fig. 3: D.C Motor

E. Battery:

To work the 12 volt dc compressor the battery needs to operate this compressor is of 12 volt. For stable, non-mobile applications, Rechargeable lead acid batteries provide a good power-to-weight ratio. They also have high surge current capability and are well suited for driving DC motors for applications such as pumps that usually prefer high inrush currents. Photovoltaic technology combined with rechargeable lead acid batteries is a good solution. When two different metal plates are immersed in acid they create a voltage. This voltage is created by the concentrating negative ions on the negative plates and positive ions on the positive plates. As batteries discharge the acid is changed to water and the lead plates are changed into lead sulfate. When both plates are turned to lead sulfate the battery is discharged or dead. One battery cell produce 2.1 volts and 6 cells are used in 12v battery to produce 12.6 volts.

IV. Working Principle

The sheet metal cutting machine operates with the help of pneumatic double acting cylinder. The piston is attached to the moving cutting tool. It is used to cut and bend the small size of the sheet metal. The machine is portable in size, so easy transportable.

The compressed air from the compressor is used as the force medium for this operation. There are pneumatic double acting cylinders solenoid valves, flow control valve and the timer unit is used. The arm from the compressor move into the flow control valve. The controlled air from the flow control valve move into the solenoid valve. The function of solenoid valves all of air correct time interval. The 5/2 solenoid valve is used.

In one position air moves into the cylinder and pushes the piston so that the cutting stroke is obtained. The next position air enters to the other side of cylinder and pushes the piston return back, so that the releasing stroke is obtained. The speed of the cutting and releasing stroke is altered by the timer control unit circuit. Next the identical procedure repeats to bending machine operation.

V. Working Model of Pneumatic Sheet Metal Shearing Machine

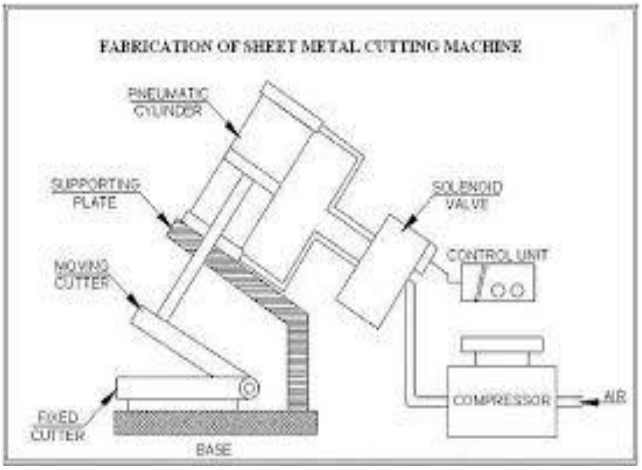

Fig. 4: Diagrammatic view of machine

Fig. 5: Working model of machine

VI. Merits

- The pneumatic is more efficient in the technical field.
- Quick response is achieved
- Simple in construction
- Easy maintenance and repair
- Cost of unit is very less

VII. Demerits

- Silencer must be used while compressing the air
- Excess torque cannot be obtained
- Less load carrying capacity.

VIII. Applications

- This machine is very convenient for small scale industries
- These machines used to cut the roller sheet metal
- All industrial application can be done.

IX. CONCLUSION

Pneumatic shearing machine is more economical as compared to hydraulic one. Higher pressure compressor can be employed for amplifying the range of cutting thickness. As far as small sheet metal cutting units are concerned, this device founds to be of greater benefit as it reduces the dependency on the expensive hydraulic shearing machine.

X. FUTURE SCOPE

1) It can be made rack and pinion operated or spring and lever operated, by restoring the pneumatic circuit by rack and the pinion arrangement by the square threaded screw and nut arrangement.
2) The place where there is scarcity of the electricity the electric motor operate compressor is replaced by an I.C. Engine installed compressor.
3) In this machine, compressed air is used to move the cutting tool for carrying out cutting operation. After the completion of the cycle the air rushes 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.

Hence in future there are so many improvement, which we can make to outlive the huge global world of competition.

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