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# Design and Fabrication of Pneumatic Sheet Bending Machine

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**ABSTRACT:** Use of aluminium is increased now days in many industries like automobile, packaging, medical etc. The reason behind this is that the aluminium made things are quite easier to manufacture, handle and reliable to use. So, the aluminium goods manufacturing industries are striving hard to produce good quality products at large scale and cheaper cost. Hydraulically operated machines are too costlier for small scale and medium scale industries. This paper deals with pneumatically operated cutting and bending machine. The bending machine is one of the most important machine tools in sheet metal work shop. It is primarily designed for bending. The bend has been made with the help of punch which exerts large force on the work clamped on the die. Normally the sheet metal bending machine is manually hand operated one for medium and small-scale industries. Automation in the modern world is inevitable. Any automatic machine aimed at the economical use of man, machine, and material worth the most. In our project is solenoid valve and control timing unit are used for automation. The sheet metal cutting machine works with the help of pneumatic double acting cylinder. The piston is connected to the moving cutting tool. It is used to cut the small size of the sheet metal. The machine is portable in size, so easily transportable.

**KEYWORDS:** Pneumatic, Automation, feeding mechanism, microcontroller.

## I. INTRODUCTION

This machine makes bending a single operator work whereas 2 operators are needed for all manual bending processes. The machine makes use of a pneumatic control valve to operate the machine. The user may use the valve using his/her thumb to control a joystick. Bending is a manufacturing process that produces a V- shape, U-shape, or channel shape along a straight axis in ductile materials, most commonly sheet metal. Commonly used equipment include box and pan brakes, brake presses, and other specialized machine presses. bending machine is most important in sheet metal industry. This machine should be used for straight cutting machine with wide application. But in some industry hand sheet cutter and hand bender are used. For that machine to operate the human effort are required. The machine should be simple to operate and easy to maintain, hence we tried out to develop the Pneumatic Shearing and Bending Machine. In shearing operation as the punch descends upon the metal, the pressure exerted by the punch first cause the deformation of the metal. Since the clearance between the punch and the die is very small, the plastic deformation takes place in a localized area and the metal adjacent to the cutting edges. In bending operation, the bend has been made with the help of punch which exerts large force on the work clamped on the die. The bending machine is designed in such a way that, it works automatically.

### Metal Sheet Bending Machine

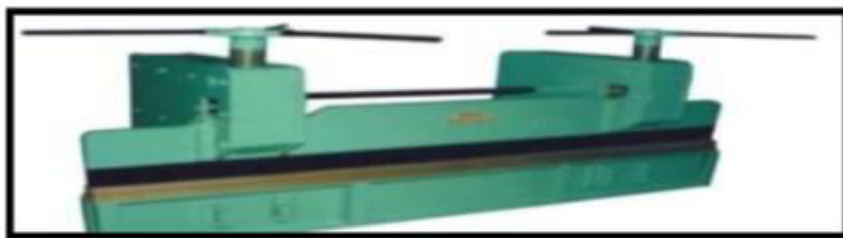


Fig. 1. Metal sheet bending machine

The sheet bending machine is mainly selected for the purpose of creating a bend inside the metal sheets. The metal pieces are initially fixed on the clamping device which is known to hold them during the complete operating process. The nature of this bending machine is found due to an unknown fact which is that they are manufactured by using a very high-grade raw material. A sheet folding machine is referred to as an instrument which is used to bend the objects at any particular angle. This profile of bending machine is referred to as a pipe bending machine as it is used mainly with an aim to bend the pipe objects. Mainly this type of machine is found suitable to be used whenever it comes to any bending objects like a pipe, tube, etc. The profile bending machines are the ones which are used due to their highly accurate quality and is preferred amongst most of the users.

### Hydraulic Press Brake Machine

All the technically superior and perfectly engineered instruments are found to consume less electricity and are even found having minimum maintenance. Mostly due to the rear cylinders, the system is responsible for consuming lower pressure along with the compact cylinders. The machines with these types of superior quality are found having power to fight against fatigue failure and the machines have a capacity of better rigidity as well as load carrying capacity.



Fig. 2 Hydraulic press break machine

These are the tools which are mostly found including features like accuracy, high speed, minimum wear and tear etc. The tougher will be the hydraulic brake the more it will last hydraulic. These are found to be simple to operate and are even noise and vibration free. There are many models of such machines available in the market, which are specifically designed to set the requirements of the client.

### CNC Press Brake Machine

A CNC press brake is referred to as a 3-axis machine which is found to be accurate, automatic & has fast back gauge. This is known to be one of the perfect tool which is used for fulfilling the precise bending requirement. These are the ones which are known to be highly user-friendly and are found offering cost-effective solutions as per the requirement of the various industries. Each section of the machine is found to be ready in order to provide the best support while operating. These machineries are specially designed in order to fit all the precise bending requirement at a very low investment comparatively.



Fig. 3 CNC Press break machine

### Plate Rolling Machine

There are various types of plate rolling machines about which one should definitely know, in order to select the best for their usage. Scroll down to learn more:



Fig. 4 Plate Rolling Machines

## II. REVIEW OF LITERATURE

**Vallance and Matlock (1992)** studied the friction behavior of zinc-based coated sheet steels and laboratory scale friction analysis techniques that involve sheet sliding over cylindrical dies. Also introduced a new test procedure for the bending under tension friction test.

**Mai Huang and Gardeen (1994)** presented 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 Hoogen boom (1995)** derived a simple explicit 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 described elsewhere by

**Daw Kwei Leu (1997). You-Min Hang and Daw-Kwei leu (1998)** described the effects 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 provides experimental references in order to optimize the usage of lubricants and sheet metal.

**Weilong Hu (2000)** proposed anisotropy hardening models with simple loading conditions that include exponential hardening model, linear hardening model and multi linear hardening model.

**Samuel (2000)** analyzed 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.

**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 behaviour of cold rolled transformation induced plasticity (TRIP) steels in air v bending process.

## III. METHODOLOGY

One of the most common fabrication operations is metal bending. Bending of sheets and rods is done using bending machines mostly manually or using hydraulic pressure. Well, we here develop a small and lightweight machine to bend low thickness metal sheets using pneumatic pressure. This machine makes bending a single operator work whereas 2 operators are needed for all manual bending processes. The machine makes use of a pneumatic control valve to operate

the machine. The user may use the valve using his/her thumb to control a joystick. The valve button when pressed/moved drives pressure through the cylinder thus pressurizing and pushing the tool against the other v tool. This bends the sheet placed in between the tools to be bent as per the required angle. The pneumatic cylinder is mounted on a sturdy supporting frame so that the force does not affect its stability. This ensures sturdy and accurate bends each time using just pneumatic pressure. The base frame and supporting frame give some clearance to the machine for easy sheet insertion and bending.

#### IV. CONSTRUCTION

In our project we used components are pneumatic actuator, solenoid valve, DC motor, Directional control valve, pipe joint, pneumatic compressor etc The pneumatic sheet bending machine includes a table with support arms to hold the sheet, stops or guides to secure the sheet, upper and lower straight-edge blades, a gauging device to precise position the sheet. The table also includes the two-way directional valve. The two-way directional valve is connected to the compressor. The compressor has a piston for a movable member. The piston is connected to a crankshaft, which is in turn connected to a prime mover (electric motor, internal combustion engine) allow air to enter and exit the chamber. When the compressor is switched ON, the compressed air flows to the inlet of the pneumatic cylinder. The sheet is placed between the upper and the lower blade. The lower blade remains stationary while the upper blade is forced.



**Fig. 5 construction of pneumatic sheet metal cutting machine**

The sheet metal bending machine works with the help of pneumatic double acting cylinder. The piston is connected 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 enters to the flow control valve. The controlled air from the flow control valve enters to 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 enters to 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 returns back, so that the releasing stroke is obtained. The speed of the cutting and releasing stroke is varied by the timer control unit circuit. Next the same procedure repeats to bending machine operation.

#### V. WORKING

The pneumatic sheet bending machine includes a table with support arms to hold the sheet, stops or guides to secure the sheet, upper and lower straight-edge blades, a gauging device to precise position the sheet.



**Fig. 6 Working of pneumatic sheet metal cutting machine**

When from the pneumatic cylinder air taken from that with the high velocity air is flowing from the pipes. pneumatic compressor compressed the air with the high pressure and velocity. The DC motor help to provide the power supply. When air is compressed with the high pressure and the compressed pneumatic cylinder and piston go down with the high pressure of air impacted on the sheet and bend the metal sheet as per the die. The metal sheet placed properly in fixture and forming the bending shape as per the required with the help of die. Also in our product used the solenoid valve, when with the high pressure of air coming as per the given specification valve is open and piston go down and impacted on the sheet and bend. After the pressure of air is reduced the piston or cylinder goes up and closed the valve this is work with the help of two directional control valve. The function of solenoid valves all of air correct time interval. The 5/2 solenoid valve is used. In one position air enters to the cylinder and pushes the piston so that the cutting stroke is obtained. The arm from the compressor enters to the flow control valve. This is the process followed continuously for bending the metal sheet. Also in the industry for the mass production it is very useful.

## VI. CONCLUSION

Use of aluminium is increased now days in many industries like automobile, packaging, medical etc. The reason behind this is that the aluminium made things are quite easier to manufacture, handle and reliable to use. So, the aluminium goods manufacturing industries are striving hard to produce good quality products at large scale and cheaper cost. Hydraulically operated machines are too costlier for small scale and medium scale industries. This paper deals with pneumatically operated cutting and bending machine. The bending machine is one of the most important machine tools in sheet metal work shop. It is primarily designed for bending. Now we know that Pneumatic cutting and bending machine is very cheap as compared to hydraulic cutting and bending machine. The range of the cutting and bending thickness can be increased by arranging a high-pressure compressor and installing more hardened blades. This machine is advantageous to small sheet metal cutting and bending industries as they cannot afford the expensive hydraulic cutting and bending machine.

## VII. FUTURE SCOPE

Since old age, man is always trying to gain more and more luxurious. Man is always trying to develop more and more modified techniques by increasing the aesthetic look and economic consideration. Hence there is always more and more scope.

In the report the following future modifications.

It can be made rack and pinion operated or spring and lever operated, by replacing the pneumatic circuit by rack and the pinion arrangement by the square threaded screw and nut arrangement.



The place where there is scarcity of the electricity the electric motor operate compressor is replaced by an I.C. Engine installed compressor.

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 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.

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