



Design and Fabrication of “Pneumatic Cylinder Operated Sheet Metal Cutting Machine”

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ABSTRACT

The goal of this project is to create a pneumatically operated machine that cuts sheet metal parts without the need for human intervention. The operating medium is compressed air. The blades of the machine are moved by pressurized air to cut the sheet of metal. The project was inspired by a manual sheet metal shearing machine at our college's workshop. Sheet metal is put between the machine's two shearing blades, and the lever is pushed down to move the upper movable blade and cut the workpiece. However, a considerable amount of force is necessary in that machine to manufacture a tire for a worker who works on it continuously for mass production in a big-scale company; thus, pneumatic machines should be chosen to reduce human efforts. As a result, we chose this topic for our project since we want to do some machine development. We hope that a good idea will arise and that we will be able to apply it to a variety of companies in the area, enhancing our practical knowledge, teamwork skills, and leadership abilities.

Keywords: Cutter, Cutting Force, Shear on material, Bending Force, Pneumatic System, IC Timer Circuit, Solenoid Valve, Compressor, etc.

1. Introduction

In the sheet metal business, the shearing and bending machines are the most significant. This machine is best suited for straight cutting with a wide range of applications. However, in some industries, hand sheet cutters and benders are still employed. Human effort is necessary for that machine to function. We attempted to build the Pneumatic Shearing and Bending Machine since it should be simple to run and maintain. When the punch descends upon the metal during a shearing process, the pressure exerted by the punch causes the metal to deform plastically first. The plastic deformation occurs in a restricted area and the metal next to the cutting edges because the gap between the punch and the die is so narrow. The bend is made with the help of a punch that exerts a lot of force on the work clamped on the die during the bending process. The bending machine is set up in such a way that it operates on its own. The machine is built by taking into account several elements in order to increase efficiency and reduce cycle time while providing high-quality output. With the use of a pneumatic system, the machine can be automated. This entails the creation of a productive system that decreases human effort while also increasing output. Pneumatic system, pneumatic component, shearing die, and bending die are also included. When a blade descends upon metal in a shearing or cutting operation, the pressure imparted by the blade causes the metal to deform plastically first. The plastic deformation occurs in a localized area because to the small space between the two blades, and the metal next to the cutting edges of the blade edges becomes severely strained, causing fracture to begin on both sides of the sheet as the deformation develops and the sheet is sheared.

2. Types of Cutting Machine

A. Pneumatically operated:-

- The header is advanced in both the upward and downward directions using a pneumatic double acting piston and cylinder unit arrangement, as well as a foot actuated direction control valve. For the transfer of power and motion in this sort of machine, high-pressure air is used as the working fluid.

B. Hydraulically operated:-

In this case, the header is lowered and raised utilizing a hydraulic piston and cylinder mechanism. Oil is permitted to enter the cylinder from either the front or back side of the piston to activate the piston and cylinder. However, oil is more expensive, and its leaking might generate a slew of issues.

C. Rack and pinion operated:-

In this case, the lowering and rising of the header is done manually using a rack and pinion system. The requisite pressure is delivered manually in this scenario by applying direct hand pressure to the rack via a pinion and lever configuration. The machine is not suited because it is robust and demands a lot of pressure

D. Spring operated:-

The operating of a spring operated machine is similar to that of a rack and pinion machine, but the construction differs. The lowering and rising of the heating handle is done manually here, and it requires too much pressure to operate. There is also a risk of harm to the work piece if it is not handled carefully.

3.Literature survey

Any business starts with someone coming up with the initial concept for the enterprise. The quantity and quality of ideas put into an established business determines its long-term success. A firm cannot operate profitably or flourish successfully without a constant influx of fresh ideas, and will eventually fade into oblivion. The human mind is where new business ideas, cost-cutting strategies, and solutions to industrial labor issues all originate. Most people get their ideas unconsciously, and because they are uninformed of the mental mechanics that led to the creation of the 'concept,' they are unable to repeat the idealization process to generate more profitable ideas on demand. Fortunately, there are well-established creative approaches that, when properly applied, allow a person to generate a big number of excellent ideas on demand. Brainstorming is one such creative approach, and it is arguably the most extensively employed in American industry. Pneumatic devices are more commonly employed in industrial applications than hydraulic devices, and they are typically less expensive than electric devices.

4.Design Procedure

- ✓ Identification of needs and requirement
- ✓ Collect required information
- ✓ Concept designing
- ✓ Material Selection and bought out
- ✓ Part design and Fabrication drawing
- ✓ Assembly and Production
- ✓ Quality and Inspections

5.Fabrication

Raw Material Used- Mild steel bars for the base frame, 35C8 material for the shearing blades, cylinder fittings such as the fork end, base plates, and support links, angle section for blade fitting, connecting link, and blade link

Machines And Tools Used Cutting Machine, Hacksaw Cutting Machine, Sensitive Drilling Machine, Horizontal Milling Machine, And Electric Arc Welding Machine. Potable Grinder. Hand Grinder, Surface Grinding Machine, Tap & Tap Holder.

Ready Purchase Items Used Pneumatic double acting cylinders, flow control valves, pneumatic pipe and pipe fittings, bolts and nuts, anti-rust coat and paint were all used.

Pneumatic parts used- Pneumatic Cylinder, Direction Control Valve (DCV), Pneumatic Pipe, Fork End Nut, Cylinder Base Plate Bolts, Blade Fixing Bolts, Connecting Link Nut and Bolts.

6.Working Principle and Operation

The air-compressor was initially turned on, allowing the receiver tank to create air pressure of up to 8 bar. The supply air is routed through the FRL unit to the manifold, which conditions the air and makes it suitable for industrial usage. A separate supply for the machine is obtained from the manifold and connected to the ON-OFF switch. As a result, the pipe carries compressed air first to the machine and then to the Direction Control Valve, allowing the machine to continue without interruption and the compressor to run smoothly. The pistons are pushed outwardly by compressed air that enters the cylinder through the cap end.

The air that is already present on the rod end side of the cylinder is forced out. When the piston pushes outwards, the force is transferred to the connecting link, which causes the upper blade to descend. The sheet is put between the upper and lower blades before the actuating DC valve. As the upper blade descends, stress is generated in the sheet metal, which exceeds the sheet metal's ultimate shear stress. As a result, the shearing action occurs. The pistons are pushed inwards by pressurized air entering the cylinder through the rod end. The air that was already in the cylinder on the cap end side is pushed out. In the case of large parts, the sheet metal is either reinserted for further cutting, or the little chopped bits are removed and the next sheet is inserted to cut.

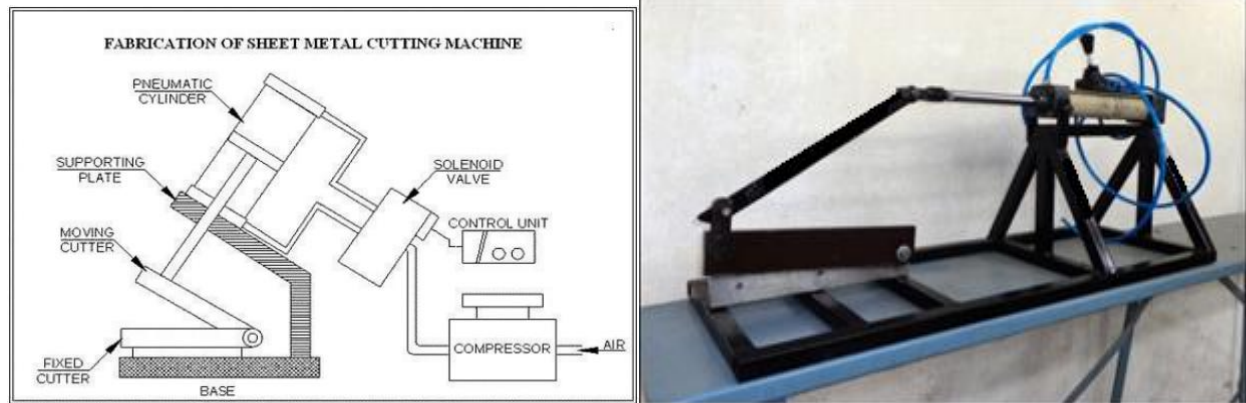


Fig.4 - (a) Working Principle

(b) Actual Fabricated Model

7. Advantages

Although hydraulics have some advantages over pneumatics, pneumatic-powered equipment is more appropriate in some applications, notably in industries where factory units are plumbed for compressed air. Furthermore, to avoid corrosive effects, oil or lubricants are used to lessen friction effects. Most machines employ compressed air, and in some cases pressurized carbon dioxide, to make the cutting process easier. Cutting operation is carried out quickly. It is possible to cut without bending.

8. Future scope

Man is constantly attempting to develop new techniques while maintaining an aesthetic appearance and economic consideration. As a result, there is always a lot of room for growth in the future. I've only considered and included the following prospective modifications in the report: By inserting a gear oil pump in place of the air compressor and pneumatic cylinder setup, it can be rendered hydraulically powered. By replacing the pneumatic circuit with a rack and pinion arrangement and a square threaded screw and nut configuration, it can be made rack and pinion or spring and lever operated. Where there is a lack of electricity, an I.C. Engine fitted compressor replaces the electric motor operated compressor.

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