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Machine for Cutting Pneumatic Sheet Metal: Design and Construction

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Abstract:

In the industrial sector, pneumatic systems are essential to a wide variety of businesses and groups. The simplicity, reliability, and ease of use of pneumatic systems are well-known. Furthermore, they are effective when applied with a rapid and forceful force. The purpose of this project is to design and build a pneumatic sheet metal cutting and bending machine that is both strong and easy to use. The machine can function with a pressure range of 8 to 10 bar. The piston is forced out of the cylinder by the pressured air that flows through the tubes. The connection transfers the piston's force to the punch. With the included land clearing, the finished product is easy to collect and conforms to all requirements. Because the die is permanently connected, you may use whatever shape die you choose. This allows us to create a wide range of products utilising different kinds of punch dies. In this manner, you may tailor your punches to your specific need. It is possible to change the operating pressure according to the material of the task.

KEYWORDS

Pneumatic System, Direction Control Valve, Compressor, Sheet Cutter, Bending Punch & Die.

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INTRODUCTION

Anyone may start a company, but it all starts with a single person coming up with a concept. Even a well-established company needs a steady stream of high-quality ideas to keep going strong. Any company that can't keep coming up with fresh ideas will ultimately go out of business since it can't make enough money or grow enough to be profitable. The human intellect is the origin of all innovation, whether it's a new product, a way to cut production costs, or a solution to issues with industrial labour. The majority of individuals come up with their ideas subconsciously, and because they don't know what mental processes led to the creation of the "idea," they can't just keep coming up with lucrative ideas. Thankfully, there are tried-and-true methods of creative thinking that, when used properly, may really let one generate a deluge of first-rate ideas whenever they want. Brainstorming is one method that helps with creativity and is perhaps the most popular in the American business world. There are a lot of industrial uses for pneumatic equipment. In most cases Pneumatic devices are often used in applications that need less force than hydraulic ones, and they are usually more cost-effective than electric ones. These devices are powered by clean, dry air. After that, the air is compressed and turned into mechanical motion by means of the actuator. The design of the actuator determines the sort of motion that is generated. Many different applications make use of pneumatics.
Pneumatic drills have the advantage over electric drills in dentistry due to their less weight, quicker speed, and simplicity. This is due to the fact that the compressor, the primary mover of the pneumatic drill, is located outside of the drill, and the pumped air may spin the drill bit at exceptionally high rpm. Many industries use pneumatic transfer systems for the transportation of powders and pellets.

Reasons for atomizing the industrial activity include:

- increasing the output pace
- reducing the effort required by humans
- With the goals of enhancing industrial efficiency
- decreasing workload, and shortening production time

I. LITERATUREREVIEW

The friction behaviour of zinc-based coated sheet steels and laboratory scale friction analysis methodologies involving sheet sliding over cylindrical dies were investigated by Vallance and Matlock (1992). In 1994, Mai Huang and Garden compiled a bibliography on springback in sheet metal forming and conducted a literature study on doubly curved developable sheet metal surfaces. According to a literature review, springback has been the subject of study for about 60 years. Many people in the sheet metal forming business have spent a lot of time trying to figure out how to reduce springback. For both small and large curvatures, Perduijn and Hoogenboom (1995) constructed a simple explicit bending pair curvature relation and experimentally confirmed the model. A comprehensive evaluation of testing apparatuses for the purpose of measuring friction phenomena on sheet metal subjected to plane strain was the primary emphasis of Sanchez (1999). For the purpose of optimising the use of lubricants and sheet metal, it gives experimental references. The impact of tool geometry and blank holding force on the final form following springback was studied by Samuel (2000), who used a finite element programme to investigate the springback in axisymmetric U-bending operations. For hat channel sections with different cross sections, Aleksy et al. (2001) tested springback for conventional high strength steel and dual phase steel. They spoke about the outcomes linked to springback and the experimental approach.Using both experimental and computational methods, Carlos Gomes et al. (2005) studied the fluctuation of spring back in high strength steels. The air v

bending behaviour of cold rolled transformation induced plasticity (TRIP) steels was studied by DongyeFei and Peter Hodgson (2006). (Kim Se Young et al., 2007) looked into how various process and tool factors, such as punch speed, forming load, forming temperature, and punch radius, affect GLARE's spring back.

II. SHEETMETAL:

Essentially, sheet metal is just metal that has been thinly and flattened into pieces. It is versatile enough to be bent and carved into many forms, making it an essential element in metalworking. You may find this substance in a myriad of commonplace items. Different thicknesses denote different materials; for example, tiny portions are called foil or leaf, whereas large pieces are called plate if they are thicker than 6 mm (0.25 in). Flat sheets or coiled strips are the two most common forms of sheet metal. A roll slitter is used to create the coils by feeding a continuous metal sheet through it. The gauge describes the thickness of the metal sheet. Steel sheet metal is typically between 8 and 30 gauges thick. The metal's thickness is proportional to its gauge number. Metals that aren't iron based, like aluminium or copper, have various names; for example, the thickness of copper is measured in ounces, whereas ferrous metals are measured in gauge. Sheet metal may be formed from a wide variety of metals, including aluminium, brass, copper, steel, tin, nickel, and titanium, among many others. Silver, gold, and platinum are essential sheet metals for ornamental purposes; platinum is also used as a catalyst.Among the numerous additional uses for sheet metal are in the construction of automobile bodywork, aircraft wings, hospital tables, and architectural roofs. Laminated steel cores, which consist of iron sheet metal and other materials with high magnetic permeability, find use in electric machines and transformers. Plate armour was a major usage of sheet metal in the past, and it still has numerous ornamental purposes now, one of which is in horse equipment. The practice of hammering panel seams during the installation of tin roofing gives sheet metal workers another nickname: 'Tin Bashers' (or 'Tin Knockers'). Layout primarily employs three procedures:

1. Parallel,

2. Radial

3. Using many sources of information

SheetMetalCutting

Cutting is the process of separating a sheet of metal by use of an applied force sufficient to break the material. Some people call the most frequent cutting techniques "shearing" because they use a shear force to accomplish the cutting. If the shear force is strong enough, the material will fail and split at the spot where the cut was made because its shear stress is higher than its ultimate shear strength. Above and below the sheet, two tools apply this shearing force. Punch and die sets or upper and lower blades work in the same way: the tool above the sheet quickly presses down on the sheet metal that is resting on the lower tool. The material is more easily fractured due to the little gap that exists between the top and lower tool edges. Many variables, including the particular shearing technique, the material, and the sheet thickness, determine the amount of this clearance, which is usually between 2% and 10% of the material thickness. As the cut continues, the sheared material's effects become more apparent near the cutting edge. The sheet is able to "rollover" the edge when the punch or blade hits it because of the space between the instruments, which causes plastic deformation. Shearing creates a vertical burnished zone of material as the tool continues to penetrate the sheet; at some point, the shear force becomes too strong, and the material breaks at an angle, leaving a little burr at the edge. The tools' sharpness and the space between them are two of numerous variables that determine how high these sections of the cut will be.

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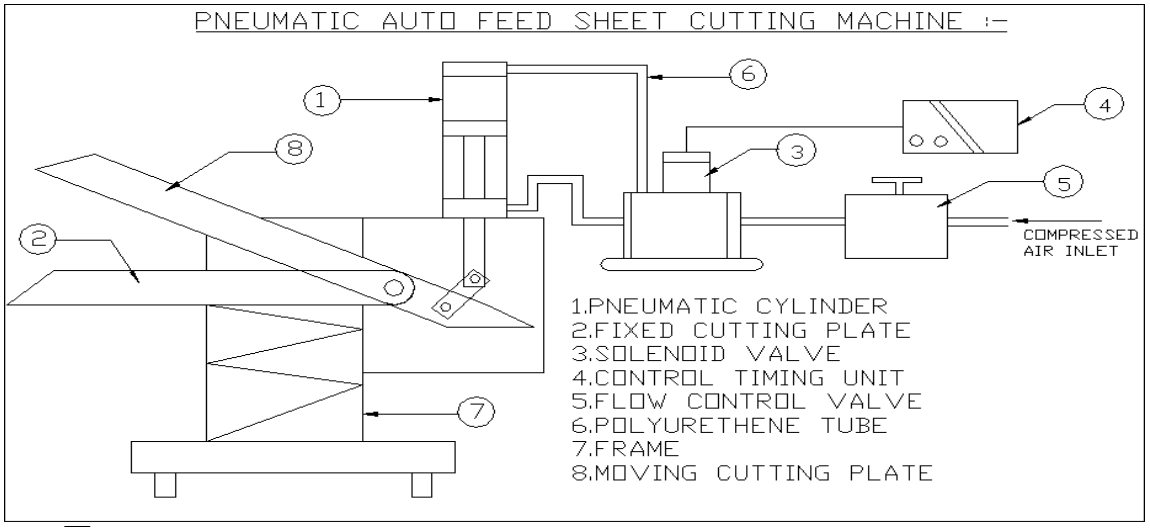
Vol 18, Issue 1, 2024

III. CONSTRUCTION

A pneumatic double-acting cylinder powers the sheet metal bending and cutting machine. The cutting tool, which is in constant motion, is linked to the piston. Its tiny size makes it ideal for cutting and bending sheet metal. The machine is compact and lightweight, making it simple to move about. The process relies on the force medium, which is the compressed air produced by the compressor. The timer unit, flow control valves, solenoid valves, and pneumatic double-acting cylinders are all part of the system. The solenoid valve receives regulated airflow from the flow control valve. All of the air passes via solenoid valves at precisely the right intervals. This is a 5/2 solenoid valve. At one setting, air is pushed into the cylinder by the piston, causing the cutting stroke to be achieved. In the next position, air is introduced into the opposite side of the cylinder, which forces the piston to return, resulting in the release stroke. A circuit in the timer control unit allows the operator to adjust the cutting and releasing stroke speeds.The process relies on the force medium, which is the compressed air produced by the compressor. Timer units, solenoid valves, flow control valves, and pneumatic double-acting cylinders are all part of the setup.The flow control valve is reached via the arm that extends from the compressor. The solenoid valve receives regulated airflow from the flow control valve. All of the air passes via solenoid valves at precisely the right intervals. This is a 5/2 solenoid valve. The cutting stroke is achieved when air enters the cylinder and presses on the piston in one position. In the next position, air is introduced into the opposite side of the cylinder, which forces the piston to return, resulting in the release stroke. A circuit in the timer control unit allows the operator to adjust the cutting and releasing stroke speeds.



Requirementof Component-

- PneumaticCylinder
- FixedCuttingPlatt
- SolenoidValve&ControlTimingUnit
- Polyurethanetube
- Frame
- MovingCuttingPlate

ConstructionandMeasurement ofAirEngineCylinder-

- TotalLengthofCylinder=150mm
- BoreofCylinder =30mm
- StrokeLength =125mm
- Piston Rod Diameter=10mm

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ConstructionalandMeasurementofMovingCutter-

- LengthofMovingCutter=380mm
- WidthofMovingCutter=25mm
- ThicknessofMovingCutter=3mm
- Material Used =CastIron

Constructional measurement of Fixed Cutter-

- Length =300mm
- Width = 25mm
- Material Used= Cast Iron

ConstructionalMeasurementofAircompressor-

- Voltage = 12vi/p
- Maximumpressure=7kg/cm^2
- Displacement = 35L/min
- SttrokeLength =80mm
- Boreofcompressor(D)=60mm
- Swept volume =Π/4 D^2 L

BatteryusedforI/PtoTheCompressor =12volts&2.5Hz Constructional

Measurement of Basel Frame-

- Length=550mm
- Width = 350mm
- Height = 160mm

ConstructionalMeasurementofPolyurethane-

- DiameterofTube=10mm
- Thickness=1mm
- Quantity = 3

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Vol 18, Issue 1, 2024

IV. COSTANALYSIS

- Pneumatic Cylinder =1350Rs
- Fixed&MovingCutter =20Rs
- PneumaticPolyurethaneTube=40Rs
- Air Compressor =3000Rs
- Battery(a)12 volt =1300Rs
- 9 volt =25Rs
- SolenoidValve =1400Rs
- Frame =63Rs

TotalCost =5798Rs

V. APPLICATION

Sheet metal, paper, and small-scale companies may all benefit from this machine's cutting capabilities.

VI. ADVANTAGE

Quick reaction, ease of construction, and greater efficiency in the technical sector are all benefits of pneumatic systems.

Simple to fix and keep in good condition

• The unit is more affordable than competing machines

• It eliminates the risk of fire caused by overloading

• Its operating costs are lower than competing machines

• It cuts quicker than competing machines since air is used as the operating medium

• It can function continuously without stopping

VII. DISADVANTAGE

•Compressed air makes a lot of noise when it works, thus a suppressor can be useful. • It is not possible to get high torque.• This device does not have a particularly high load carrying apability.below 50 Newtons

VIII. FUTURESCOPE

Given that, as we age, we naturally want ever-increasing forms of luxury. Aesthetic and economic considerations drive man's incessant pursuit of ever-more-modified techniques. More and more opportunities arise as a result. But as Diploma Engineers, we can think and plan forward. But because of limited resources and time, we could only consider and include the following changes in the report for the future: 1. Swapping out the air compressor and pneumatic cylinder setup for a gear oil pump makes it hydraulically powered.

2. By swapping out the pneumatic circuit with a rack and pinion arrangement—consisting of square threaded screws and nuts—it may be converted to either a spring and lever or rack and pinion operation.

3. In areas with limited power, an internal combustion engine (ICE) compressor takes the role of an electric motor. Thus, there are a plethora of potential adjustments we might do to thrive in the face of such immense global competition.

IX. CONCLUSION

In order to maximise the efficiency of the "Pneumatic cutting machine," a device used in production cells to cut die blades for punching die, we devised a branch-and-bound strategy that is complemented by fast and effective bounds. Because of the need for robust interaction among the many components, the study's focus on control architecture design was crucial. We are aware that there are restrictions that prevent our "Pneumatic cutting machine" from being immediately deployed on the manufacturing floor. However, we will address the system's shortcomings and make it applicable to many sectors. For that reason, we consider the initiative a success.

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