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A Pneumatic Sheet Metal Cutting Machine: Design and Construction

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Abstract:

Pneumatic systems are vital to several organisations and companies in the industrial sector. Pneumatic systems are famous for their simplicity, dependability, and user-friendliness. In addition, they work best when used quickly and with a lot of pressure. A robust and user-friendly pneumatic sheet metal cutting and bending equipment is what this project is all about. A pressure range of 8 to 10 bar is sufficient for the machine to operate. The air pressurised via the tubes forces the piston out of the cylinder. The force from the piston is sent to the punch via the link. The final result is simple to gather and meets all standards thanks to the integrated land removal. You are free to use whatever die shape you choose since the die is permanently attached. Because of this, we are able to use many various types of punch dies to make a broad variety of items. This way, you may modify your punches according to your requirements. Depending on the task's material, you may adjust the operating pressure.

KEYWORDS

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

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INTRODUCTION

A firm may be started by anybody, but it all begins with an idea. No business, no matter how long it has been around, can survive without a constant supply of innovative, high-quality ideas. A firm's ability to remain successful depends on its ability to consistently generate new ideas. Without these, the company would eventually go out of business. Any new product, method of reducing production costs, or answer to problems with industrial labour originates in the human mind. Most people's ideas originate in their subconscious, and because they aren't aware of the exact mental steps that resulted in the "idea," they are unable to consistently generate profitable concepts. Fortunately, there are tried-and-true ways of thinking creatively that, when used correctly, may genuinely allow one to produce a flood of excellent ideas whenever they choose. One technique that aids with creativity is brainstorming, which is perhaps the most well-known in the American corporate sector. Pneumatic equipment has several applications in the industrial sector. For the most part Pneumatic devices are often more economical than electric ones and are used in situations that need less force than hydraulic ones. Pure, dry air powers these gadgets. The next step is for the actuator to compress the air and transform it into mechanical motion. What kind of motion is produced is defined by the actuator's design. Pneumatics finds applicability in a wide variety of contexts. When it comes to dental work, pneumatic drills are preferable to electric ones since they are easier to use, lighter, and faster. This is because the compressor, which is situated outside of the drill, is responsible for propelling the air that is used in pneumatic drills, and this air may cause the drill bit to spin at very high rpm. Pneumatic transfer systems are widely used in many sectors to carry pellets and powders.

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

In their 1992 study, Vallance and Matlock examined the friction behaviour of zinc-coated sheet steels using methods for laboratory-scale friction analysis that included sliding the sheets over cylindrical dies. A literature review on doubly curved developable sheet metal surfaces and a bibliography on springback in sheet metal forming were both carried out by Mai Huang and Garden in 1994. A survey of the relevant literature indicates that springback has been researched for about 60 years. The sheet metal forming industry has invested much in research into potential methods to lessen springback. Perduijn and Hoogenboom (1995) built a basic explicit bending pair curvature relation and experimentally validated the model for small and large curvatures. Sanchez primarily focused on conducting a thorough review of testing instruments for the aim of detecting friction phenomena on sheet metal exposed to plane strain (1999). It provides experimental references for the goal of optimising the usage of sheet metal and lubricants. Using a finite element software, Samuel (2000) investigated springback in axisymmetric U-bending operations and found that tool geometry and blank holding force affected the final shape after springback. Aleksy et al. (2001) examined the effects of springback on conventional high strength steel and dual phase steel for hat channel sections with varying cross sections. The results associated with springback and the experimental method were discussed.The variation of spring back in high strength steels was investigated by Carlos Gomes et al. (2005) using theoretical and experimental approaches. Research by DongyeFei and Peter Hodgson (2006) examined the air v bending behaviour of cold rolled transformation induced plasticity (TRIP) steels. A 2007 study by Kim Se Young et al. investigated the impact of process and tool factors on GLARE's spring back, including punch radius, forming temperature, forming load, and punch speed.

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II. SHEETMETAL:

Metal that has been rolled or stamped into thin sheets is, in essence, sheet metal. It is a crucial component in metalworking because to its malleability, which allows it to be shaped and cut into various shapes. This material is present in a wide variety of everyday products. Thicker pieces are referred to as plates if they are thicker than 6 mm (0.25 in), whilst thinner bits are termed foil or leaves. The two most typical shapes for sheet metal are flat sheets and coiled strips. To make the coils, a continuous metal sheet is fed through a roll slitter. The metal sheet's thickness is indicated by the gauge. Thicknesses of 8 to 30 gauges characterise standard steel sheet metal. The gauge number is a direct correlation to the thickness of the metal. In contrast to ferrous metals, which are measured in gauge, non-iron based metals like as aluminium and copper are known by a variety of names. As an example, the thickness of copper is often measured in ounces. Countless metals may be worked into sheet metal, including but not limited to: aluminium, brass, copper, steel, tin, nickel, and titanium. Sheet metals such as silver, gold, and platinum are essential for decorative reasons; platinum is also used as a catalyst.Sheet metal has many other applications, such as in the manufacturing of automotive bodywork, aeroplane wings, medical table tops and building roofing. Electric machines and transformers use laminated steel cores, which are composed of iron sheet metal and other materials with high magnetic permeability. Sheet metal has many decorative uses now, including in horse equipment, but in the past it was mostly used for plate armour. 'Tin Bashers' (or 'Tin Knockers') is another moniker for sheet metal workers who often hammer panel gaps while installing tin roofing. Three main processes are used in layout:

1. Parallel,

2. Radial

3. Using many sources of information

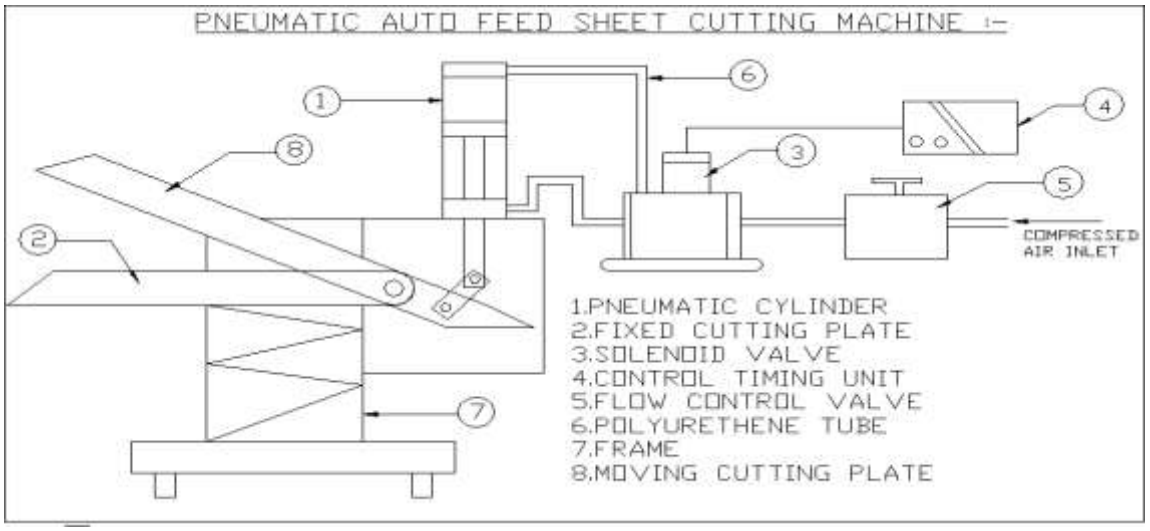
Sheet Metal Cutting

III. Cutting involves applying enough force to split a metal sheet, which separates the metal into its component parts. The most common methods of cutting are often referred to as "shearing" due to the fact that they use a shear force to achieve the cutting. Because the shear stress exceeds the ultimate shear strength, the material will break and split at the cut site if the shear force is sufficiently severe. Two tools, one above and one below the sheet, provide the shearing force. Whether you're using an upper and lower blade set or a punch and die set, the basic principle is the same: the tool above the sheet forces the sheet metal down onto the lower tool with rapid pressure. Due to the little space between the upper and lower tool edges, the material is more prone to cracking. This clearance typically ranges from two percent to ten percent of the material thickness, while it may be as much as twenty percent depending of the material, the shearing process, and the sheet thickness. Near the cutting edge, the impacts of the sheared material become more apparent as the cut progresses. The sheet might "rollover" the edge when struck by a punch or blade due to the plastic deformation caused by the gap between the instruments. If the tool keeps penetrating the sheet at a constant shear rate, the material will eventually break at an angle, leaving a little burr at the edge, creating a vertical burnished zone. The height of these parts of the cut is dependent on a number of factors, including the sharpness of the tools and the distance between them.

IV. CONSTRUCTION

The sheet metal bending and cutting machine is powered by a pneumatic double-acting cylinder. A connection connects the piston to the cutting tool, which is always in motion. Cutting and bending sheet metal is a breeze with its little size. The machine is easy to transport due to its small size and low weight. Force medium, or compressed air produced by the compressor, is essential to the process. Pneumatic double-acting cylinders, flow control valves, solenoid valves, and the timer unit are all components of the system. The solenoid valve is connected to the flow control valve, which regulates the airflow. Solenoid valves ensure that all air goes through at exactly the correct intervals. Solenoid valve type 5/2. When the dial is turned to its cutting stroke position, the piston forces air into the cylinder. The following position initiates the release stroke by forcing the piston to return once air is delivered to the opposite side of the cylinder. The operator may modify the cutting and releasing stroke rates using a circuit in the

timer control unit.Force medium, or compressed air produced by the compressor, is essential to the process. The configuration includes timer units, flow control valves, solenoid valves, and pneumatic double-acting cylinders.An arm extends from the compressor, which allows access to the flow control valve. The solenoid valve is connected to the flow control valve, which regulates the airflow. Solenoid valves ensure that all air goes through at exactly the correct intervals. Solenoid valve type 5/2. When air is pushed onto the piston in one position by the cylinder's intake, the cutting stroke is accomplished. The following position initiates the release stroke by forcing the piston to return once air is delivered to the opposite side of the cylinder. The operator may modify the cutting and releasing stroke rates using a circuit in the timer control unit.



Requirementof Component-

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

ConstructionandMeasurement ofAirEngineCylinder-

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

ConstructionalandMeasurementofMovingCutter-

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

Constructional measurement of Fixed Cutter-

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- 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

V. 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

VI. APPLICATION

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

VII. 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

VIII. 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

IX. FUTURESCOPE

Since it is only human to want more and more opulence as we get older. Aesthetic and economic factors always motivate man to seek for ever-more-improved methods. The outcome is an increase in the number of opportunities. On the other hand, we have the ability to plan forward as Diploma Engineers. Unfortunately, we were only able to think about and include the following potential revisions into the report due to time and resource constraints: 1. It may be converted to a hydraulic system by replacing the air compressor and pneumatic cylinders with a gear oil pump.

2. It may be changed to work with either a spring and lever or a rack and pinion system by replacing the pneumatic circuit with a rack and pinion arrangement, which is made of square threaded screws and nuts. 3. A compressor from an internal combustion engine (ICE) acts as an electric motor in places where electricity is scarce. In light of this enormous global rivalry, there are a myriad of possible modifications that

we may do.

X. CONCLUSION

Our goal was to find the optimal configuration of the "Pneumatic cutting machine," a tool used in production cells for punching die blades, by combining a branch-and-bound technique with quick and effective bounds. The study's emphasis on control architecture design was vital due to the need for strong interaction among the many components. We are cognisant of the fact that our "Pneumatic cutting machine" cannot be promptly installed on the production floor due to certain limitations. But we'll fix the system's flaws and make it work in a variety of fields. That is why we think the effort was fruitful.

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