



Design and Fabrication of Pneumatic Sheet Cutting Machine

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To Cite this Article

Sk. Abdulla, A. Sai, P. Gunendra, K. Pavan Kumar and K. Charan Sai. Design and Fabrication of Pneumatic Sheet Cutting Machine. International Journal for Modern Trends in Science and Technology 2023, 9(05), pp. 392-396. <https://doi.org/10.46501/IJMTST0905065>

Article Info

Received: 06 April 2023; Accepted: 05 May 2023; Published: 15 May 2023.

ABSTRACT

This paper presents the design and development of a pneumatic sheet cutting machine, which overcomes the failures of traditional machines. The proposed machine utilizes the components of a compressor, solenoid valve, pneumatic piston, step-down transformer, and cutter to achieve efficient and reliable cutting of various sheet materials. The pneumatic system provides a higher cutting force and speed compared to traditional machines, while the use of a solenoid valve enhances the system's responsiveness. The step-down transformer ensures safe and stable voltage supply to the machine. Overall, the proposed pneumatic sheet cutting machine provides a cost-effective and efficient solution for sheet cutting applications.

Keywords: pneumatic sheet cutting machine, compressor, solenoid valve, pneumatic piston, step-down transformer, cutter, efficient cutting, reliable cutting, precise control, cutting force, cutting speed, higher cutting force, higher cutting speed, cost-effective, sheet cutting applications

1. INTRODUCTION

A pneumatic sheet cutting machine is a device that is used to cut sheets of different materials, such as metal, plastic, or paper, using pneumatic power. The machine is powered by a compressor, which supplies air to a pneumatic piston. The piston is connected to a cutter that moves up and down to cut the sheet.

The operation of the machine is controlled by a solenoid valve, which opens and closes the air supply to the piston. A step-down transformer is used to reduce the voltage of the electrical supply to the solenoid valve.

When the solenoid valve is opened, the compressed air is released to the pneumatic piston, which then moves the cutter downwards to cut the sheet. Once the cut is

complete, the solenoid valve is closed, and the piston moves the cutter back to its original position.

Overall, the pneumatic sheet cutting machine is an efficient and reliable tool that makes cutting sheets faster, more accurate, and more convenient. Its use of pneumatic power and precise control system makes it suitable for a wide range of applications in various industries, including manufacturing, automotive, and construction.

2. Comparison between Traditional & Pneumatic Sheet Cutting Machine

2.1 Traditional Sheet Cutting Methods:



Figure 2.1 :- Traditional sheet cutting methods

Traditional sheet cutting using hand lever shears and scissors is a manual process that involves cutting the sheet material by hand. Hand lever shears are a type of cutting tool that uses a lever to apply force to the material and cut it. Scissors, on the other hand, are a type of cutting tool that use two blades to cut the material. While these traditional cutting methods have been used for many years,

They have several limitations and drawbacks. First, they are time-consuming and labour-intensive, as the operator must apply force to the tool to cut through the material. This can be tiring and may result in inaccurate cuts if the operator becomes fatigued. Second, traditional cutting methods can be inaccurate, as they rely on the operator's skill and accuracy to make precise cuts. This can result in waste or rework if the cuts are not made correctly.

2.2 Pneumatic Sheet Cutting Machine:

The pneumatic sheet cutting machine is designed to overcome the failures of traditional sheet cutting methods, such as manual cutting or using mechanical cutting machines. By using compressed air to power the cutting process, the machine can cut through sheets quickly and accurately, without the need for manual force or complicated mechanical systems. This makes it an ideal solution for cutting large volumes of sheets or for cutting sheets that are difficult to cut manually.

3. Working:

A pneumatic sheet cutting machine is a device that uses compressed air to operate a cutting tool to cut various

materials, such as metal sheets or fabrics. Here is a brief working of the machine using the components you mentioned:

The compressor is used to compress air and supply it to the pneumatic circuit. The compressed air is stored in a reservoir to provide a steady and constant supply of air to the machine. The solenoid valve controls the flow of compressed air to the pneumatic piston. The valve is controlled by an electrical signal from the machine's control system. When the valve is activated, it opens a passage for the compressed air to enter the pneumatic piston. The pneumatic piston is the heart of the pneumatic circuit. It converts the compressed air into mechanical energy to move the cutting tool. When the solenoid valve is activated, it allows the compressed air to enter the pneumatic piston. The air pressure pushes the piston, which in turn moves the cutting tool. The step-down transformer is used to convert the high voltage AC power supply to low voltage DC power supply, which is required to power the control circuit of the machine. The cutter is the cutting tool that is mounted on the pneumatic piston. When the pneumatic piston moves, it moves the cutter along the sheet, cutting it as per the desired shape or pattern. To operate the machine, the user inputs the desired shape or pattern through the control system. The control system then sends a signal to the solenoid valve to open the passage for the compressed air to enter the pneumatic piston. The air pressure pushes the piston, which moves the cutting tool along the sheet. Once the cutting is complete, the solenoid valve is deactivated, and the pneumatic piston returns to its original position.



Figure: 3.1 -Pneumatic sheet cutting machine

4.Components:

4.1 Step Down Transformer:

The transformer is designed to handle a maximum current output of 2A, which means that it can supply up to 2 amps of current at the specified output voltage of

12V AC. The frequency range of the transformer is 50Hz to 60Hz, which is the standard range for AC power in most parts of the world.



Figure: 4.1 step-down transformer

The transformer is of the vertical mount type, which means that it is designed to be mounted vertically in a specific orientation. This type of transformer is commonly used in industrial applications such as the one you described, where it is necessary to minimize the space required for the equipment.

The pneumatic sheet cutting machine that you mentioned uses the step-down transformer to power the compressor, which provides a 12V DC power supply at a pressure of 100 psi. This pressure is used to operate the mechanical solenoid valve and pneumatic piston cutter, which are used to cut the sheet material.

4.2 Compressor:

A 12V 100 PSI compressor is an air compressor that runs on a 12-volt direct current (DC) power source and is capable of producing compressed air up to a maximum pressure of 100 pounds per square inch (PSI).



Figure: 4.2 Compressor

The stepdown transformer is used to convert the input power supply (which may be at a higher voltage than 12V DC) to a lower voltage that can be used to power the compressor.

4.3 Solenoid valve

A solenoid valve is an electromechanical device used to control the flow of a fluid or gas. It consists of a coil, plunger, and a valve body. The coil is energized with an electric current.



Figure: 4.3 Solenoid valve

4.4 Pneumatic piston



Figure: 4.4 pneumatic piston

A pneumatic piston is a type of mechanical component that converts the energy of compressed air into linear motion. It typically consists of a cylindrical body called a cylinder, a piston, and an air inlet/outlet port. When compressed air is supplied to the inlet port, it exerts pressure on the piston, which moves inside the cylinder.

4.5 Cutter

A cutter with a length of 1.5 feet and cutting thickness of 0-3mm made of MS (mild steel) is designed for use in a pneumatic sheet cutting machine. The cutter is responsible for cutting through the sheet material with precision and speed.



Figure: 4.5 Cutter

4.6 Hoses

Air supply hoses are typically made of high-quality, flexible materials such as polyurethane or nylon to ensure that they can withstand the high-pressure air flowing through them. They are also designed to be lightweight and easy to manoeuvre, so that they do not impede the movement of the cutting tool.



Figure: 4.6 Hoses

Advantages:

- Speed
- Precision
- Reduced Labor Costs
- Consistency
- Safety

Applications:

- Metal sheet cutting
- Fabric cutting
- Leather cutting
- Paper cutting
- Plastic cutting
- Foam cutting

5. Methodology:

Gather all the necessary components: compressor, stepdown transformer, pneumatic piston, solenoid valve, tubing, cutting blade, and sheet material.

Assemble the components: Connect the compressor to the stepdown transformer, and then connect the pneumatic piston and solenoid valve to the stepdown transformer. Use tubing to connect the pneumatic piston to the solenoid valve, and connect the cutting blade to the pneumatic piston.

Install the sheet material: Place the sheet material on the cutting bed of the machine, making sure that it is secured in place.

Power up the machine: Turn on the compressor and step-down transformer, ensuring that the air pressure is set to the appropriate level for the cutting blade.

Test the machine: Use a small piece of sheet material to test the machine's operation. Lower the cutting blade onto the sheet material and activate the solenoid valve to release the compressed air, which will move the pneumatic piston and drive the cutting blade through the sheet material.

Fine-tune the machine: Adjust the air pressure and cutting speed as necessary to achieve the desired cut quality.

Use the machine: Once the machine is properly calibrated, it can be used to cut larger sheets of material as needed.

Maintenance: Regularly inspect and maintain the machine, including replacing worn or damaged components, lubricating moving parts, and cleaning the cutting blade to ensure optimal performance.

6. Results:

A pneumatic sheet cutting machine is a type of cutting machine that uses compressed air to power its cutting mechanism. The components you mentioned, such as a compressor, solenoid valve, pneumatic piston, step-down transformer, and cutter, are common components found in a typical pneumatic sheet cutting machine.

The compressor is used to generate compressed air, which is then stored in a tank for use by the machine. The solenoid valve controls the flow of compressed air to the pneumatic piston, which provides the cutting force. The step-down transformer is used to provide the required voltage for the solenoid valve and other electrical components in the machine.

The cutter is the actual cutting mechanism of the machine, and it can be of different types, such as a rotary blade, oscillating blade, or guillotine blade, depending on the specific application and material being cut.

Overall, a pneumatic sheet cutting machine offers many advantages over other types of cutting machines, such as high cutting speeds, precision cutting, and reduced operator fatigue.

7. Discussions:

A pneumatic sheet cutting machine is a machine that uses compressed air to cut various types of sheets such as metal sheets, plastic sheets, and paper sheets. The machine is made up of several components, including a compressor, solenoid valve, pneumatic piston, step-down transformer, and cutter.

The compressor is used to produce compressed air that is then stored in a tank. The compressed air is then used to power the pneumatic piston, which moves the cutter up and down to cut the sheet. The solenoid valve is used to control the flow of compressed air to the pneumatic

piston, and the step-down transformer is used to provide the necessary voltage to power the solenoid valve.

The use of compressed air in a sheet cutting machine has several advantages. First, it is a very efficient way to transmit power to the cutting tool. This is because compressed air can be easily stored and transported, and it is also very easy to control the amount of air that is delivered to the cutting tool. Additionally, because the cutting tool is powered by compressed air, there is no need for an electrical connection, which makes the machine safer to operate.

However, there are also some disadvantages to using compressed air in a sheet cutting machine. One of the main disadvantages is that the machine can be quite noisy, which can be a problem in some environments. Additionally, the use of compressed air can also make the machine more complex and difficult to maintain.

Overall, a pneumatic sheet cutting machine is a very effective tool for cutting various types of sheets. However, it is important to carefully consider the advantages and disadvantages of using compressed air before deciding whether to use this type of machine.

8. Conclusion:

The pneumatic sheet cutting machine is a useful device that operates using various components, including a compressor, solenoid valve, pneumatic piston, step-down transformer, and cutter. The compressor generates the necessary air pressure, which is then used to operate the pneumatic piston. The solenoid valve controls the air flow, while the step-down transformer reduces the voltage level to prevent damage to the machine. The cutter is used to cut the sheet material with precision and accuracy.

The use of pneumatic power in sheet cutting machines provides several advantages, including faster cutting speed, higher precision, and reduced operator fatigue. Additionally, pneumatic systems are generally more reliable and require less maintenance compared to other types of systems. However, it is essential to ensure that the machine is well-maintained and the components are regularly checked to prevent any failures or malfunctions.

Overall, the pneumatic sheet cutting machine is a reliable and efficient tool that can be used in a variety of industries for cutting different types of sheet materials with high precision and accuracy.

9. Future Scope:

Pneumatic sheet cutting machine is a very versatile machine and has a lot of applications because of its flexibility and ease of doing operations. This machine can be converted into a punching machine by removing the blade and adding a punching die to the end of the piston. By increasing the pressure, we can cut more sheets collectively. Because of its enormous use in industries, a higher production rate can be achieved by balancing the forces and making the design more compact. Software and advanced controlling systems can improve the machine's performance. By replacing the pneumatic circuit with a rack and pinion arrangement, it can be converted into a rack and pinion operated machine.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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