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# AUTOMATIC PNEUMATIC SAND MOULDING MACHINE

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**Abstract -** Moulding is a crucial process for creating components used in various industries through vital metal forming. Automation can enhance the accuracy of cast parts and improve the foundry environment. However, the moulding process is affected by different factors such as permeability, collapsibility, and adhesiveness, which can lead to casting defects. Sand casting defects can pose a significant challenge in the foundry since manual labor may not guarantee even the packing of moulding sand throughout the box. To address this issue, an automatic pneumatic sand moulding machine was designed and fabricated to mold sand uniformly in small-scale industries. The rammer is operated using an air compressor, and a solenoid valve is used to control the airflow direction. An electronic control timing unit manages the solenoid valve, and the compressed air drives the pneumatic double-acting cylinder, which, in turn, moves the piston downward or upward, depending on the airflow direction.

***Key Words***: Moulding, Ramming, Pneumatic, Machine

## 1. INTRODUCTION

Casting is a manufacturing process that involves pouring a liquid material into a hollow cavity called a mold, which is then allowed to solidify. To create the mold, sand is packed compactly inside a cope and drag arrangement. In foundries, a sand rammer is used to compact the sand and achieve the required shape of the cavity. Traditional sand rammers are operated manually using a calibrated sliding weight-actuated cam, but this method is not suitable for the mass production of large molds. Therefore, several experiments have been conducted to improve the quality and reduce the time required for the ramming process. One such idea is the pneumatically actuated rammer, which is entirely controlled using pneumatic controls, and its ramming time is reduced to an effective duration.

In a pneumatically actuated rammer, compressed air is directed to a direction control valve, which is operated using a solenoid controlled by an electronic controlled timing unit. A double-acting cylinder is used for the ramming operation and is capable of generating a force of 804.3652N for a 32mm diameter and 65mm stroke length. The extending and retracting of the cylinder are controlled using a pneumatic circuit that is actuated by a 5/2-way direction control valve. Additionally, a pneumatic device has been constructed for press-fitting pins into holes. This device uses 3/2-way push button flow control valves that are manually controlled and 5/2-way pilot-operated valves that are used to actuate double-acting cylinders.

## 2. LITERATURE REVIEW

The compressed air is directed to a flow control valve, which is adjustable and used to regulate the airflow. To ensure that the required pressurized air reaches the solenoid valve, the lever must be adjusted. In our project, the solenoid valve serves as a direction control valve and is governed by an electronic timing unit that can vary the ramming time by adjusting the timer 555 IC control. The compressed air is delivered to a pneumatic double-acting cylinder, where the ram is fixed at one end. As the compressed air enters the cylinder, it pushes the piston downward in one direction. The solenoid valve then alters the airflow direction after a small delay, causing the piston to move upward. The solenoid valve is responsible for controlling the direction of airflow.

### SELECTION OF PNEUMATICS

Mechanization refers to the substitution of manual labor with mechanical power. Pneumatic power is a cost-effective means of mechanization, especially for repetitive or sequential tasks. Numerous factories and plants already have a compressed air system that can supply the necessary energy and control system, although pneumatic control systems can be beneficially employed with other forms of power. The primary advantages of an all-pneumatic system are generally cost-effectiveness and ease, with the latter resulting in low maintenance. Additionally, it can provide significant safety benefits.

The purpose of using pneumatics or any other type of energy transmission in a machine is to perform work. To perform work, kinetic energy must be applied to a resisting object resulting in the object moving through a distance. In a pneumatic system, energy is stored in a potential state in the form of compressed air, and working energy results when the compressed air is allowed to expand. Work is completed by imparting kinetic energy to an object that resists motion, causing it to move a certain distance. Compressed air serves as a potential source of energy in pneumatic systems.

### COMPONENTS

- Solenoid valve
- MS frame
- Pneumatic cylinder
- Ramming box
- MS Plate
- Square Pipe
- Electric Controller Circuit

1. Frame: 25 x 25 x 3 mm L angle – Mild Steel
2. Ramming Box Mount Plate and Cylinder Mount Plate: 6mm MS Sheet
3. Ramming Box: 2mm MS Plate
4. Ramming Plate: 3mm MS Plate
5. Pneumatic Cylinder: 32mm Bore 50mm Stroke Double Acting
6. P.U. Pipe: 8 mm OD, 5 mm ID
7. Pneumatic Connectors
8. 5/2 Hand-Operated Hand Lever
9. Fasteners: M6 Nut and Bolts

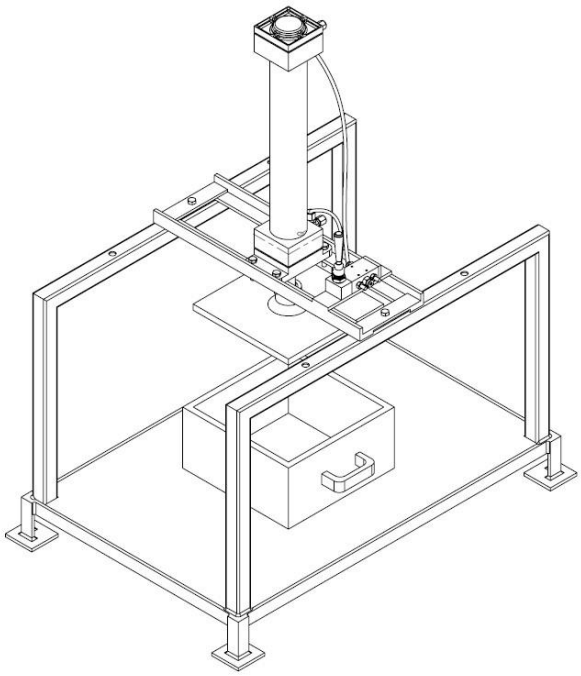

Fig -1

## CALCULATIONS

- Pressure available from the compressor = 10 bars
- Diameter of the piston = 32mm
- Cross-sectional Area of the cylinder = $\pi*32*(32/4) = 804.352mm^2$
- Force = Area * Pressure
- The nature of fit between the cylinder and piston is clearance fit – running fit.
- Tolerance = 32 ±0.02
- Total stroke length = 135 mm
- Working stroke length = 65mm
- The diameter of the piston = 32mm
- The piston force F = P * A
  $= 10^6*804.352*10^{-6}$
  = 804.352 N

## ADVANTAGES

- Its size is small and compact.
- The machine is effortless to operate.
- The construction of the machine is simple.
- It has low maintenance costs and is easy to maintain.
- The operation of this machine is time efficient.
- Various operations can be performed using this machine.
- Operating the machine does not require heavy, strenuous labor.
- The system is portable.

## DISADVANTAGES

- A separate air tank or compressor is necessary.
- This machine is suitable for carrying out small-scale operations.

## 3. CONCLUSIONS

This rammer can be operated by an operator with ease, without causing any discomfort. Specialized skills are not required to operate it, and the operation is quick, saving time and reducing costs. For these reasons, it is widely used in manufacturing industries. Its affordability and ease of handling make it suitable for both large and small-scale industries. Additionally, this rammer produces uniform strength in sand ramming and significantly reduces the time consumption for ramming. The sand rammer achieves even and uniform ramming of sand while considerably reducing the time required for the ramming process. As a result, the need for skilled labor is eliminated, reducing labor costs. Additionally, the machine is easy to transport and maintain, further reducing production costs. The reduction in production time and labor costs results in significant economic benefits.

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