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Design and Fabrication of Penumatic Ramming Machine

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Abstract: *Molding is one of the important metals forming process in manufacturing components for various applications in industry. Casting of any size and shape can be made accurately. Automation in this field helps to improve the foundry environment and accuracy of the cast parts. Efficiency of molding is affected by various parameterslike permeability, collapsibility, adhesiveness etc. So it is a must to avoid defects in casting. The defects occur in sand castings post a great problem in foundry. On account of defects more than 10% castings are rejected. Even though skilled labor is employed for ramming operation, the packing of molding sand will not be even throughout the molding box. So we have selected the idea of fabricating "PNEUMATIC RAMMER". This rammer is operated pneumatically. By using this rammer molding sand will be packed evenly throughout the box.*

Keywords: Pneumatic System, Actuators, Control Valves

I. INTRODUCTION

The pneumatic rammer is used for ramming the sand uniformly around the pattern. It can be used even in small scale industries. To operate this rammer an air compressor is needed. A butt which is attached to the bottom of the piston rod does the operation of ramming. The pressure developed inside the cylinder reciprocates the piston and hence the butt. This rammer is handled by an operator just by moving it over the molding sand. The butt rams the sand at places moved and the sand is uniformly rammed. This rammer reduces the ramming time and labor. Due to this the cost is reduced considerably. So this machine finds application in foundries.

1.1 Problem Statement

Punching or pressing process is one of the most importantand necessary processing steps in sheet metal industry. If this process is done manually, it increases manufacturing lead time, cost and also reduces safetyof the workers. Therefore, to improve the productivity and safety,automatic punching machine is developed. By automating this process one can have a greater control over the process. It is possible to achieve good results in the form of reduced manufacturing lead time, reduced cost and increased safety of the worker. The objective is to reduce labour work, improve work safety, low production cost, less time, high profit & reduce dependency.

1.2 Scope

After using this machine, it will help Labour for easy and simple ramming process. Also the process of ramming by using our machine will become less hectic and will reduce dependency of labour on increasing and decreasing supply of labor. Also the process will be economical.

II. LITERATURE SURVEY

1. "Development of a micro-punching machine and study on the influence of vibration machining in micro- EDM" By, Gwo-Lianq Chern, Ying-Jeng Engin Wu, Shun-Feng Liu. (ELSEVIER) May 2016.
This paper describes the development of a novel micro punching machine that is capable of producing precision micro-holes. A significant feature of this machine is to fabricate the micro-punch and then the micro-die in the same machine, totally eliminating the eccentricity between the punch and the die when punching is proceeded.

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2. "Automatic Punching Machine: A Low-Cost Approach" By, Arun S, Sree Rajendra and Vijayavithal Bongale.The proposed work describes the design and fabrication of prototype of automatic punching machine controlled by PLC and shedding light on the working principle and the hardware structure of the system.Punching or pressing process is one of the most important and necessary processing steps in sheet metal industry. By automating this process one can have a greater control over the process. Programmable Logic Controllers are used for the control of the system. This system can replace existing manual feed and operated punching and pressing machines.

3. "Design of Automatic Pneumatic Hole Punching Machine" By Utkarsha Sharma(IRJET) Dec 2015

This paper deals with pneumatically operated hole punching machine. The designing was done on the SolidWorks software. In the end, the conclusion is made and several suggestions are made to make scope for improvements in future. This project is a study about the designing of pneumatic hole punching machine, which shows the capability to design a concept using variety of components. As the name implies, pneumatic systems use pressurized gases to transmit power. Typically, pneumatic systems use air as the fluid medium, because it is low cost, safe and easily available fluid.

4. "Analysis of lubricant performance in punching and blanking" By M. Moghadam, M. Villa, P. Moreau, A. Dubois, L. Dubar , C.V. Nielsen , N. Bay (Science Direct)

Punching and blanking processes are characterized by severe tribological conditions due to the creation of virgin surfaces, which are highly prone to develop pick-up of workpiece material on the punch surface. Hazardous forming lubricants are, therefore, commonly used in punching and blanking processes for avoidance of wear induced process deviations such as diminished surface quality, reduced dimensional accuracy and reduced tool life.

2.1 Construction

The pneumatic cylinder is fixed on the machine column which is fixed on the machine base table. At the end of the pneumatic cylinder piston rod the ramming tools are fixed. The ramming tool is fixed on the piston rod of the pneumatic cylinder. The pneumatic cylinder is operated through the pneumatic energy. The pneumatic power (air) is produced by a compressor the air is passed to the pneumatic cylinder with the help of the solenoid valve. The solenoid valves are operated through the control unit. The air enters on port one in the pneumatic cylinder to moves the ramming tool in downward direction. After the ramming operation takes places the ramming tool will moves in upward direction. While on the tool moves in upward direction the port one will release and the air will be forced into the port number two. The two directions are controlled by control unit. During the movement the ramming tool ram the green sand to make the core which should be placed on the molding cavities. After the required number of strokes completed the ramming process is stopped by the help of the control unit.

2.2 Pneumatic Actuators

Pneumatic actuators are mechanical devices that use compressed air acting on a piston inside a cylinder to move a load along a linear path. Unlike their hydraulic alternatives, the operating fluid in a pneumatic actuator is simply air, so leakage doesn't drip and contaminate surrounding areas.

The basic pneumatic cylinder consists of a cylindrical chamber with a movable piston and intake and exhaust channels. When compressed air or other gas is pumped into the bottom of the cylinder, the gas expands, pushing the movable piston upwards and generating force. Pneumatic cylinders, also known as air cylinders, have advantages over hydraulics in some cases and are used in a wide variety of applications.

2.3 Solenoid Valve

Manual Reset Solenoid Valves are used in applications and processes demanding utmost safety checks before starting / stopping the process. In all such application, human intervention is the final check before the process is taken into/ taken

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off the auto mode. Based on the nature of the process, the solenoid valves are required to stop the process from starting automatically in case of an emergency or vice versa.

These valves are called Manual Reset valves with Latching on Energization. They are also referred to as No voltage Release or Free handle type Manual reset.

2.4 Working

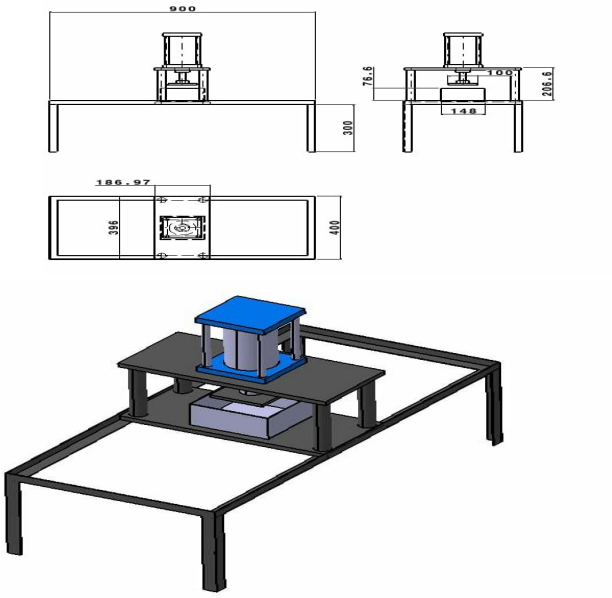
Firstly, we store some potatoes in pan and will put some The compressed air goes to the flow control valve. The flow control valve is used to control the flow of air. It is adjustable one. We have to adjust the lever, so that the required pressurized air goes to the Solenoid Valve.

In our project, the solenoid valve is used as a direction control valve. This solenoid valve is controlled by the electronic control timing unit. The ramming time is varied by adjusting the timing control of the electronic unit.

The compressed air goes to the pneumatic double acting cylinder. The ram is fixed at one end of the pneumatic cylinder. The compressed air pushes the pneumatic cylinder, so that the piston moves downward by giving air supply in one direction of pneumatic cylinder.

The solenoid valve is changing the air flow in the opposite direction by the small time delay. In this time the pneumatic cylinder piston moves upward due to changing of the air flow direction. This air flow direction is controlled by the solenoid valve.

2.5 CAD Drawing



2.6 Design Calculation

Selecting Cylinder:

25 mm diameter and 100 mm stroke. Our input given pressure is 0.4 bar.

Diameter of piston rod is 8 mm.

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Solution-
Area of piston π/4*25^2 490.873 mm^2
Volume of air exhaust = stroke *area of piston
100*π/4*25^2
49087.385 mm^3
As pressure = F/A
Outstroke force (F) = pressure *Area of cylinder
= 0.4bar *490.873m^3
= 196.349 N
Piston rod area A1 π/4*d^2
π/4*8^2
50.20 mm^2
Effective area = piston area- piston rod area
= 490.873 -50.20
= 440.673 mm^2
In-stroke force = P*A
=0.4*440.673
=176.2692 N

2.7 Process Sheet

A. Cutting

Cutting is the separation or opening of a physical object, into two or more portions, through the application of an acutely directed force. Implements commonly used for cutting are the knife and saw, or in medicine and science the scalpel and microtome. However, any sufficiently sharp object is capable of cutting if it has a hardness sufficiently larger than the object being cut, and if it is applied with sufficient force. Even liquids can be used to cut things when applied with sufficient force (see water jet cutter).

The material as our required size. The machine used for this operation is power chop saw. A power chop saw, also known as a drop saw, is a power tool used to make a quick, accurate crosscut in a work piece at a selected angle. Common uses include framing operations and the cutting of moulding. Most chop saws are relatively small and portable, with common blade sizes ranging from eight to twelve inches.

The chop saw makes cuts by pulling a spinning circular sawblade down onto a work piece in a short, controlled motion. The work piece is typically held against a fence, which provides a precise cutting angle between the plane of the blade and the plane of the longest work piece edge. In standard position, this angle is fixed at 90°.

A primary distinguishing feature of the mitre saw is the mitre index that allows the angle of the blade to be changed relative to the fence. While most mitre saws enable precise one-degree incremental changes to the mitre index, many also provide "stops" that allow the miter index to be quickly set to common angles (such as 15°, 22.5°, 30°, and 45°). The

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time required for this operation is 50 minutes.

B. Welding

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool causing fusion. Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal.

In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that, based on weld configuration (butt, full penetration, fillet, etc.), can be stronger than the base material (parent metal). Pressure may also be used in conjunction with heat, or by itself, to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

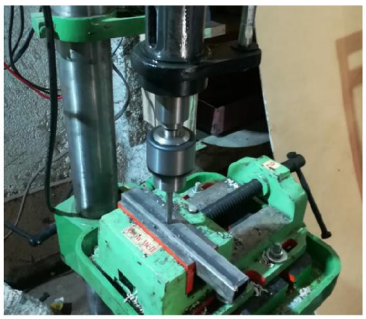
Square pipes of different lengths to make frame. The machine used for this operation is electric arc welding. Electrical arc welding is the procedure used to join two metal parts, taking advantage of the heat developed by the electric arc that forms between an electrode (metal filler) and the material to be welded. The welding arc may be powered by an alternating current generator machine (welder). This welding machine is basically a single-phase static transformer Suitable for melting RUTILE (sliding) acid electrodes. Alkaline electrodes may also be melted by alternating current if the secondary open-circuit voltage is greater than 70 V.

The welding current is continuously regulated (magnetic dispersion) by turning the hand wheel on the outside of the machine, which makes it possible to select the current value, indicated on a special graded scale, with the utmost precision.

C. Drilling

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips (swarf) from the hole as it is drilled.

In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside the hole (top-hammer drill) or within the hole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills. In rare cases, specially-shaped bits are used to cut holes of non- circular cross-section; a square cross-section is possible.



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Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

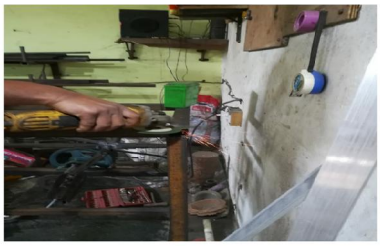
Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion and crack propagation at the stressed surface. A finish operation may be done to avoid these detrimental conditions.

For fluted drill bits, any chips are removed via the flutes. Chips may form long spirals or small flakes, depending on the material, and process parameters. The type of chips formed can be an indicator of the machinability of the material, with long chips suggesting good material machinability.

D. Finishing

Finishing is a broad range of industrial processes that alter the surface of a manufactured item to achieve a certain property. Finishing processes may be employed to: improve appearance, adhesion or wettability, solder ability, corrosion resistance, tarnish resistance, chemical resistance, wear resistance, hardness, modify electrical conductivity, remove burrs and other surface flaws, and control the surface friction. In limited cases some of these techniques can be used to restore original dimensions to salvage or repair an item. An unfinished surface is often called mill finish.

The edges with grinder using grinding wheel. The machine used for this operation is hand grinder. An angle grinder, also known as a side grinder or disc grinder, is a handheld power tool used for cutting, grinding and polishing. Angle grinders can be powered by an electric motor, petrol engine or compressed air. The motor drives a geared head at a right-angle on which is mounted an abrasive disc or a thinner cut-off disc, either of which can be replaced when worn. Angle grinders typically have an adjustable guard and a side-handle for two-handed operation. Certain angle grinders, depending on their speed range, can be used as sanders, employing a sanding disc with a backing pad or disc. The backing system is typically made of hard plastic, phenolic resin, or medium-hard rubber depending on the amount of flexibility desired. The time required for this operation is 20 minutes.



E. Polishing

Polishing is the process of creating a smooth and shiny surface by rubbing it or using a chemical action, leaving a surface with a significant specular reflection (still limited by the index of refraction of the material according to the Fresnel equations.) In some materials (such as metals, glasses, black or transparent stones), polishing is also able to reduce diffuse reflection to minimal values. When an unpolished surface is magnified thousands of times, it usually looks like mountains and valleys. By repeated abrasion, those "mountains" are worn down until they are flat or just small "hills." The process of polishing with abrasives starts with coarse ones and graduates to fine ones.

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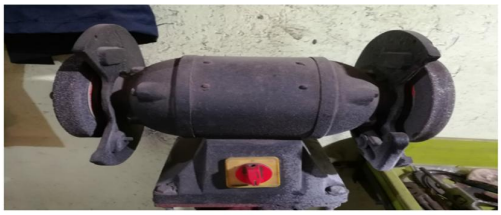

III. CONCLUSION

Uniform ramming of sand is obtained by this rammer. The time consumption for ramming is reduced considerably. It eliminates more labour for ramming operation and hence the labour cost is reduced. Skilled labour is not required to operate this machine. Transportation of this machine is easy. Maintenance is also easy, The reduction of production time and elimination of more labour for ramming operation reduce production cost, thereby the economy is greatly achieved.

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