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Design and Fabrication of Pneumatic Ramming Machine

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ABSTRACT:

One of the important metals forming processes used in the production of components for diverse industrial purposes is moulding. Accurate casting may be produced in any size and form. The precision of the cast components and the foundry environment are both enhanced by automation in this area. Numerous factors, including as permeability, collapsibility, adhesiveness, etc., have an impact on the efficiency of moulding. Therefore, it is essential to prevent casting faults. The flaws in sand castings appear after a major foundry issue. More than 10% of castings are rejected because of flaws. Despite the use of competent manpower for the ramming process, the packing of moulding sand will not be uniform throughout the moulding box. Therefore, we have decided to build a "PNEUMATIC RAMMER". Pneumatics are used to operate this rammer. The moulding sand will be uniformly distributed within the box by utilising this rammer.

Keywords: Control valves, actuators, and pneumatic systems.

I. INTRODUCTION

The sand is rammed uniformly all over the design using the pneumatic rammer. Even small-scale enterprises can utilise it. An air compressor is necessary in order to run this rammer. Ramming is accomplished via a butt that is fastened to the piston rod's bottom. The piston and therefore the butt are reciprocated by the pressure that builds up inside the cylinder. An operator only needs to move this rammer over the moulding sand to control it. The sand is evenly shoved by the butt at the relocated locations. This rammer cuts down on work and ramming time. The expense is significantly decreased as a result. So foundries are where this machine finds use.

1.1 Problem Statement:

One of the most significant and essential processing phases in the sheet metal industry is the punching or pressing process. If this operation is carried out manually, it lengthens the production process, costs more money, and compromises worker safety. Therefore, automatic punching machines are created in order to increase production and safety. One can have more control over this procedure by automating it. Reducing the lead time for production, cutting costs, and improving worker safety are all desirable outcomes. The goal is to reduce labour effort, increase workplace safety, produce goods in a shorter amount of time at a higher profit, and decrease reliance.

1.2 Scope:

After employing this device, you will benefit from a smooth and straightforward ramming procedure. Additionally, employing our equipment will make ramming less chaotic and less dependent on the availability of workers, which might fluctuate. The procedure will also be cost-effective.

II. LITERATURE SURVEY

1. "Development of a micro-punching machine and study on the influence of vibration machining in micro-EDM" by Ying-Jeng Engin Wu, Shun-Feng Liu, and Gwo-Lianq Chern. (ELSEVIER) . This study outlines the design of a unique micro punching device that can create accurate micro holes. This machine's ability to manufacture the micro-punch and subsequent micro-die in the same apparatus completely eliminates any eccentricity between the two throughout the punching process.
2. "Automatic Punching Machine: A Low-Cost Approach" The proposed work provides details on the design and construction of an automatic punching machine prototype that is PLC-controlled, providing insight into the system's operation and hardware layout. One of the most significant and essential processing phases in the sheet metal industry is the punching or pressing process. One can have more control over this procedure by automating it. The system is controlled using Programmable Logic Controllers. Current hand fed and operated punching and pressing machines can be replaced by this method.

3. The pneumatically operated hole punching machine is the subject of this study. Using the SolidWorks programme, the designing was completed. In order to provide room for future developments, a conclusion is reached and a number of recommendations are offered. This project examines the design of a pneumatic hole punching machine and demonstrates the capacity to create an idea utilising a range of materials. Pneumatic systems transmit electricity using pressurised gases as their name suggests .Air is typically used as the fluid medium in pneumatic systems because it is a cheap, safe, and readily accessible fluid.

2.1 Construction

The machine column, which is fastened to the machine base table, has the pneumatic cylinder fixed to it. The ramming tools are fastened to the pneumatic cylinder piston rod's end. The piston rod of the pneumatic cylinder is where the ramming tool is fastened. The pneumatic energy is used to drive the pneumatic cylinder. A compressor generates the pneumatic power (air), which is then transferred to the pneumatic cylinder via a solenoid valve. The control unit is used to operate the solenoid valves. To move the ramming tool downward, air enters the pneumatic cylinder through port one. The ramming tool will travel higher when the ramming action is completed. While being used, the tool goes upward While the tool is being moved upward, the port number one will release and air will be pushed into port number two. Control unit controls the two directions. The green sand is rammed by the ramming tool as it moves, creating the core that will go within the moulding cavities. The control device assists in stopping the ramming process after the required amount of strokes have been finished.

2.2 Pneumatic Actuators:

Pneumatic actuators are mechanical devices that move a load along a linear route by using compressed air acting on a piston within a cylinder. The operating fluid of a pneumatic actuator is just air, unlike hydraulic alternatives, therefore leaks won't drop and contaminate nearby regions.A moveable piston, intake and exhaust channels, and a cylindrical chamber make up the basic pneumatic cylinder. When gas,such as compressed air, is pushed into the cylinder's bottom, the gas expands and

pushes the moveable piston upward, producing force. Pneumatic cylinders, sometimes referred to as air cylinders, are employed in a broad range of applications and, in some circumstances, outperform hydraulic ones.

2.3 Solenoid Valve:

Reset manually Applications and processes requiring the strictest safety checks before beginning or terminating the process employ solenoid valves. Human involvement is the final check in all such applications before the process is taken into/used auto mode turned off. Depending on the operation, solenoid valves may be needed to prevent the process from beginning automatically in the event of an emergency or vice versa. Manual Reset valves with Latching on Energization are what these valves are known as. Other names for them are No Voltage Release and Free Handle Type Manual Reset.

2.4 Working:

First, we'll place some potatoes in a container for storage and some The flow control valve is supplied by compressed air. The air flow is managed by the flow control valve. It can be adjusted. To ensure that the Solenoid Valve receives the necessary pressurised air, we must move the lever .The solenoid valve serves as a direction control valve in our project. The electronic control timing unit manages this solenoid valve. By altering the electronic unit's timing control, the ramming time may be changed To the pneumatic double acting cylinder goes compressed air. At one end of the pneumatic cylinder, the ram is fixed. The pneumatic cylinder is propelled by compressed air, which causes the piston to descend. simply filling the pneumatic cylinder with air in one direction. The short time delay caused by the solenoid valve causes the air flow to change direction. The direction of the air flow has changed at this point, which causes the piston of the pneumatic cylinder to travel upward. The solenoid valve is in charge of directing the airflow in this direction.

2.5 Design Calculation:

Length and width and height of the machine = 30*30*59cm

Pressure available from the compressor =300psi (20 bar)

Diameter of cylinder = 19mm

Diameter of piston = 6mm

Stroke length = 60mm

Area of piston = $\pi/4*19^2$ = 283.52mm^2

Volume of air exhaust = stroke * area of piston

60*283.59 = 17.01172mm^3

As pressure = F/A

Outstroke force (F) = pressure * area of cylinder

20 * 17.0112

340.39N

Area of piston rod = $\pi/4*6^2$

28.274mm^2

Effective area (A) = piston area – piston rod area

283.52-28.2743 = 255.246mm^2

Instroke force = F*A

20*255.246

=514.92N

As pressure = F/A

The outward force F= P*A

= 20*28.27425

F= 565.488 N

Process Sheet:

a. Cutting

Cutting is the use of an intensely directed force to split or open a physical item into two or more pieces. Knife and saw are typical cutting tools, as well as the scalpel and microtome in science and medicine. But if it has a hardness sufficiently greater than the thing being cut and is applied with enough power, any suitably sharp object may cut. When utilised with enough force, even liquids may be used to cut objects (see water jet cutter).

The material fits our sizing specifications. Power chop saw is the tool used for this process. A power instrument used to quickly and precisely crosscut a work item at a chosen angle is a power chop saw, sometimes referred to as a drop saw. Operations involving framing and moulding cutting are frequent uses. The majority of chop saws are compact and portable, and their typical blade diameters range from eight to twelve inches.

By swiftly and carefully pushing a rotating circular sawblade down onto a work item, the chop saw creates cuts.

In most cases, the work piece is clamped up against a fence, which creates a perfect cutting angle between the blade's plane and the plane of the longest edge of the work piece. This angle is set at 90 degrees in the normal position.The mitre index, which enables the angle of the blade with respect to the fence to be altered, is one of the mitre saw's key distinguishing characteristics. Many mitre saws also have "stops" that enable the mitre index to be rapidly changed to popular angles (such as 15°, 22.5°, 30°, and 45°), even though the majority of mitre saws allow accurate one-degree incremental adjustments to the mitre index. The This procedure will take 50 minutes to complete.

B. Welding:

A construction or artistic method called welding combines materials, often metals or thermoplastics, by melting the components together at a high temperature, letting them to cool, and then fusing them together. Welding is separate from lower temperature metal joining methods that don't melt the base metal, such brazing and soldering.

The base metal is usually melted first, followed by the addition of a filler material to create a pool of molten material (the weld pool), which cools to produce a junction that, depending on the weld configuration (butt, full penetration, fillet, etc.), may be stronger than the base material (parent metal). To create a weld, pressure can be employed alone, in combination with heat, or both. A type of shield is also necessary for welding. to prevent contamination or oxidation of the filler metals or molten metals.

Long and short square pipes to form the frame. Electric arc welding is the tool utilised in this process. By using the heat produced by the electric arc that develops between an electrode (metal filler) and the material to be welded, the process of electrical arc welding is used to unite two metal components. A welding machine (welder) may use an alternating current generator to power the welding arc. In essence, this welding device is a single-phase static transformer. An ideal melting temperature for RUTILE (sliding) acid electrodes. Alternating current can also melt alkaline electrodes if the secondary open-circuit voltage is higher than 70 V.

By rotating the hand wheel on the exterior of the machine, the welding current is constantly controlled (magnetic dispersion), allowing for the most precise selection of the current value, which is shown on a unique graded scale.

4. Drilling

Drilling is a cutting technique that creates circular holes in solid objects using a drill bit. The drill bit is often a multi-pointed, rotating cutting instrument. While rotating at speeds ranging from hundreds to thousands of revolutions per minute, the bit is forced against the workpiece. By pressing the cutting edge firmly against the workpiece, this prevents chips (swarf) from exiting the hole as it is being drilled.

Even though the bit is often spun when drilling through rock, the hole is typically not produced by cutting in a circular manner. Instead, the hole is often created by repeatedly fast slamming a drill bit into the hole. Both inside and outside of the hole (top-hammer drill) can be used to conduct the hammering motion either on top of a hole (top-hammer drill) or inside of a hole (down-the-hole drill, DTH). Drifter drills are drills that are used for horizontal drilling. Rarely, holes with non-circular cross sections are created using specially shaped bits; it is possible to create holes with square cross sections.

The entry side of drilled holes has a sharp edge, whereas the exit side often has burrs (unless they have been removed). Additionally, helical feed marks are frequently seen within the hole.

By generating low residual stresses around the hole opening and a very thin layer of highly strained and disturbed material on the freshly formed surface, drilling may have an impact on the work piece's mechanical characteristics. The work piece is hence more vulnerable to corrosion and fracture growth at the strained surface. These harmful situations can be avoided by performing a completion procedure.

Any chips in fluted drill bits are dislodged by the flutes. Depending on the material and processing conditions, chips might take the form of lengthy spirals or microscopic flakes. Longer chips indicate better material machinability, which may be determined by the sort of chips that are produced.

D. Completion

Finishing is a broad category of industrial operations that modify an object's surface to obtain a certain feature. It is possible to use finishing procedures to enhance a variety of properties, including appearance, adhesion or wettability, solderability, corrosion resistance, tarnish resistance, chemical resistance, wear resistance, hardness, adjust electrical conductivity, remove burrs and other surface imperfections, and regulate surface friction. Some of these procedures can, in some circumstances, be applied to restore an object's original proportions in order to salvage or repair it. Mill finish is a term used to describe an unfinished surface.

Using a grinding wheel, grind the edges. A hand grinder is the tool used for this process. An angle grinder is a portable power tool used for cutting, grinding, and polishing. It is sometimes referred to as a side grinder or disc grinder. Angle grinders can be run on compressed air, a gasoline engine or an electric motor. A thinner cut-off disc or an abrasive disc are attached on the geared head at a right angle and may both be changed when worn. Angle grinders often include a side handle for two-handed use and an adjustable guard. Depending on their speed range, certain angle grinders may also be used as sanders by using a sanding disc with a backing pad or disc. Typically, the backing system is constructed of Depending on the level of flexibility required, options include hard plastic, phenolic resin, or medium-hard rubber. This procedure takes 20 minutes to complete.

E. Polishing:

By rubbing or applying chemical action to a surface, polishing produces a smooth, glossy finish that has a noticeable specular reflection (still constrained by the material's index of refraction, per the Fresnel equations). In some substances (such as metals, glasses, or opaque or dark stones), polishing can also reduce diffuse reflection to extremely low levels. An unpolished surface typically resembles mountains and valleys when magnified hundreds of times. These "mountains" are repeatedly abraded until they are flat or are only little "hills."Starting with coarse abrasives, polishing is done with them before moving on to fine ones.

III. CONCLUSION

This rammer produces uniform sand ramming. The amount of time required for ramming is significantly decreased. More labour is not required for ramming operations, which lowers labour costs. It is not necessary to have skilled workers to run this machine. It is simple to move this machine. Additionally simple to maintain The economy benefits substantially from the decrease of manufacturing time and elimination of extra workers for the ramming process.

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