

# CRANK BASED PORTABLE RAMMING MACHINE BY USING ELECTRICALLY OPERATED RAM FOR SAND MOULDING

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**Abstract:** The basic aim of 'Portable Ramming Machine by Using Electrically Operated Ram for Sand Molding' project is to achieve ramming operation with reduced human effort. In this context, we are in the process of designing & fabrication of Portable ramming machine which is operated by means of crank. The crank is the machine elements driven by the pulleys, which in turn are driven by the electric motor. The principle components of machine are hammer, crank, pulley, belt, shaft, bearings, bushes, motor and supporting structure. In the ramming machine, the crank serves the purpose of lifting the hammer and it also drops it from considerable height to impart the energy required for ramming. As a result hammer exerts very high potential energy under gravity over the sand mould to achieve required hardness. The Ram is used for ramming the sand uniformly around the pattern. It can be used even in small scale industries. To operate this Ram an Electric motor is needed. This Ram 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 Ram reduces the ramming time and labor. Due to this the cost is reduced considerably. So this machine finds application in foundries for small units.

**Key Words:** Portable machine, Rammer, sand casting.

## I. INTRODUCTION

Most of the ram used for sand molding are pneumatically, hydraulically operated. Many more researchers found the best suitable way for ramming operation. In this case instead of using above stated method we are using 'Portable Ramming Machine by Using Electrically Operated Ram for Sand Molding'. The project is aims to achieve ramming operation with reduced human effort. In this process of designing & fabrication of Portable ramming machine which is operated by means of crank. The crank is the machine elements driven by the pulleys, which in turn are driven by the electric motor.

## II. LITERATURE REVIEW

**Pneumatically Actuating Ram** Kaveriappa M B, Kaushik N D, Amanyu R N, Harikrishnan A, Milton P Mathew, RamizMuhammed suggest Casting is a manufacturing process where usually a hollow cavity of the required shape called mould is poured with liquid material and then allowed to solidify. Usually the hollow cavities are made inside a cope and drag arrangement where it is filled with sand. This sand has to be packed compactly to get the required shape of cavity. To enable this compatibility a piece of equipment is used in foundry i.e. a Sand Ram. A conventional Sand Ram used to have a calibrated sliding weight actuated cam, which used to be actuated manually on to the required specimen, but this method was not satisfactory when it comes to mass production with large mould. Hence several experimentation have been going on to improve the quality and reduce time used for ramming process, where pneumatically actuated Ram is one type of idea where the Ram is completely actuated with the help of pneumatic controls and the time used for ramming is also reduced to an effective duration Electric Motor Efficiency Buschart (1979) presents the results of a motor-efficiency study conducted on a project that required nine medium-voltage motors and discusses motor-efficiency economics, motor-design parameters that affect efficiency, motor application factors relevant to efficiency, and efficiency of 26 testing to be adopted. Hasuike (1983) describes 12 variable elements which affect the improvement of efficiency. With the objective to discuss the factors which determine the efficiency and rating of

poly-phase AC induction motors, Umans (1989) discusses the loss mechanisms and their relation to the performance and design characteristics of the motor. Bonnett (1980) has discussed in detail the various design considerations affecting motor efficiency i.e. amount of copper wire in the slots, stator slot size, length of coil extension, lamination steel length, rotor bar size, rotor bar conductivity, bearing selection, increased air gap etc. Bonnett (1993) updates users on the opportunities available to achieve higher performance levels. He summarizes the actions that can be taken by those who specify and design electric motors to improve the efficiency. Numerous actions taken by those who specify the motor requirements that have far-reaching effects on the motor-efficiency like System Voltage, Operating Voltage, Motor Size and Loading, Motor Speed, Load Shedding, Adjustable-Frequency Drives applied to Centrifugal Pumps and Fans etc. have also been discussed. Bonnett (1994) updates users on the relationship and trade-offs between efficiency and power factor.

### III. PRODUCT DETAILS

#### 1. Moulding Machines

A moulding machine consists of a large number of inter-connected mechanisms which transmits and guides various motions in order to prepare the mould. According to the method in which the sand is compacted around the pattern to make a mould. The moulding machines are classified as Jolt machine, Squeeze machine, Jolt & Squeeze machine and Sand linger.

Following are the advantages of moulding machine:

- Time required to make the mould is greatly reduced, this reduces the overall cost.
- The labour productivity is greatly increased owing to the mechanisation of labour's operation of sand ramming & pattern remover.
- More accurate castings are produced.
- High quality of product is maintained.

#### 2. Types of machine

##### 2.1 Jolt machine:

In the Jolt molding machine the pattern & the flask are mounted on the mould plate and the flask filled with the sand. The entire assembly is raised a small amount and then dropped against a fixed stop. The compacting of sand is achieved by the decelerating force acting on it. About 20-50 drops are needed to compact the sand and average machine operates about 200 strokes/min. The drawback of this machine is that the density of the sand in the mould is that the density of the sand in the mould is not uniform it is greatest in the layer next to the pattern i.e. lowest near the top of the mould.



Fig.1 Jolt Machine

##### 2.2 Squeezing machine

These machines are operated by compressed air or hydraulic fluid with a pressure from 5 to 7 Bar. The principle on which it operates is as shown in the fig. The pattern on which it operates is as shown in the fig. The pattern plate with a pattern is clamped on work table. Flask is placed on the frame of the machine and is with sand from a hopper. The squeeze head is brought against the top of the head and lift. Mechanism switches on.



Fig.2 Squeezing Machine

### 2.3 Conventional Ramming Machine

The cam is actuated by a user by rotating the handle, causing a cam to lift the weight and let it fall freely on the frame attached to the ram head. This produces a standard compacting action to a pre-measured amount of sand. Variety of standard specimen for Green Sand and Silicate based (CO<sub>2</sub>) sand are prepared using a sand Ram along with accessories. The sand Ram machine can be used to measure compatibility of prepared sand by filling the specimen tube with prepared sand so that it is level with the top of the tube.

The tube is then placed under the ram head in the shallow cup and rammed three times. Compatibility in percentage is then calculated from the resultant height of the sand inside the specimen tube.

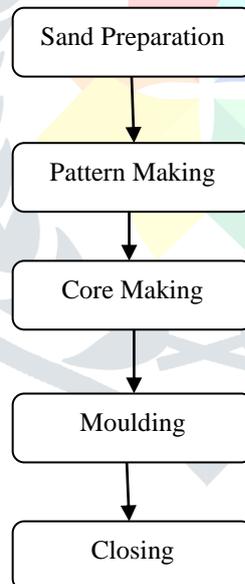


Fig.3 Flow Chart of Conventional Ramming

### 2.4 Automatic Pneumatic Ramming Machine

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.

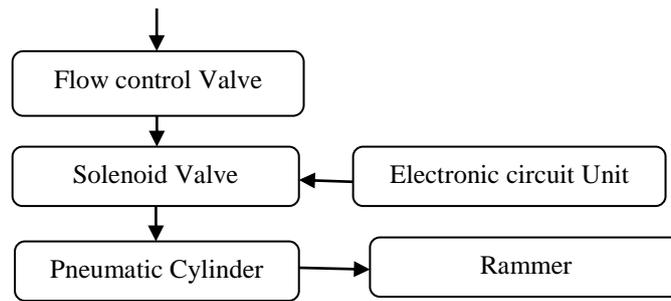


Fig.4 Flow Chart of Pneumatic Ramming

#### IV. METHODOLOGY

##### Construction details of Portable Ramming Machine

##### 4.1 Frame Support

- Frame is the supporting structure of the project.
- Frame hold all the parts used for the project.
- Frame is made of bars joined together by welding.
- It also has wheels attached to its bottom which are used to make it portable.
- The material used is cast iron.



Fig.6 Machine Frame

##### 4.2 HAMMER (RAM)–

- Hammer is the name given to the working ram.
- Its operation is to transfer the rotating mechanical energy to kinetic energy with impact to the sand present at the base.
- Its construction is a rectangular ram connected to steel rod.
- This steel rod is connected to the rotating crank.
- Material used is Cast Iron.



Fig.7 Ram

### 4.3 Electric Motor -

- The electric motor here is the heart of the whole operation.
- The electrical energy is converted into mechanical energy and then it is passed to crank mechanism.
- The work required to be carried out by human in the conventional ramming is replaced by the electric motor.
- The electric motor used in this place is 3-phase AC
- The reasons behind selecting this particular motor are:-  
Speed and Torque characteristics of this motor satisfy our requirements.  
Also the small size if this motor makes portable so we have employed this motor in our project



Fig.8 Electric Motor

### 4.4 Belt

- The belt is the main element in the force transfer mechanism. It takes energy from Prime mover and transfer to pulleys.
- Belts used in the project are Eco drive b45 and b36 models.
- These are V-Type belts with good transmission properties.
- These are antistatic as well as Heat and Oil Resistant.



Fig.9 Drive Belts

### 4.5 Pulley with crank wheel

- The pulley is the 'force and motion transfer' mechanism.
- It takes its rotary motion from electric motor and helps transfer it to the crank.
- The material used for the pulleys is Cast Iron.



Fig.10 Pulley with Crank Wheel



Fig.11 Pulleys with shaft housed in bearings

#### 4.6 Crank Wheel and Connecting Rod

- The crank is metal strip, drilled with holes to be attached to the ram.
- It's used to transfer rotating motion to the Ram.
- The material used here is same – Mild steel



Fig.12 Crank Wheel

## V. Working Principle

When the electric motor situated at lower casing starts, the vertically connected pulley also starts rotating with the help of belt attached to the motor output and pulley. So motor transmits power to the pulley by means of pulley belt drive. After this as we used compound pulley systems in which the pulley (A) and pulley (B) are located on the same shaft as the result the pulley (B) starts rotating as the shaft rotates due to pulley (A). These shafts are firmly fixed with bearing provided for smooth operation. Onwards the pulley (B) transmit the power to pulley (C), again similarly by means of belt drive. The Pulley (A) and the pulley (C) are of the same size. Pulley (B) is considerably small in size as mostly seen in compound drive systems. As the pulley (C) is also

mounted on the shaft of same diameter of previous one, with the help of bearing and on the same shaft the crank wheel is attached at the end. This results in power transmission from pulley (C) to the shaft and from shaft to the crank wheel.

The crank rod attached to the crank wheel is used operate the Ram plate on sand mould to achieve required hardness. As the crank wheel rotates either clockwise or anticlockwise the total 360 degree rotation completes one full travel of crank rod from top to bottom and bottom to top. As much more power delivered we will get more ramming force for moulding.

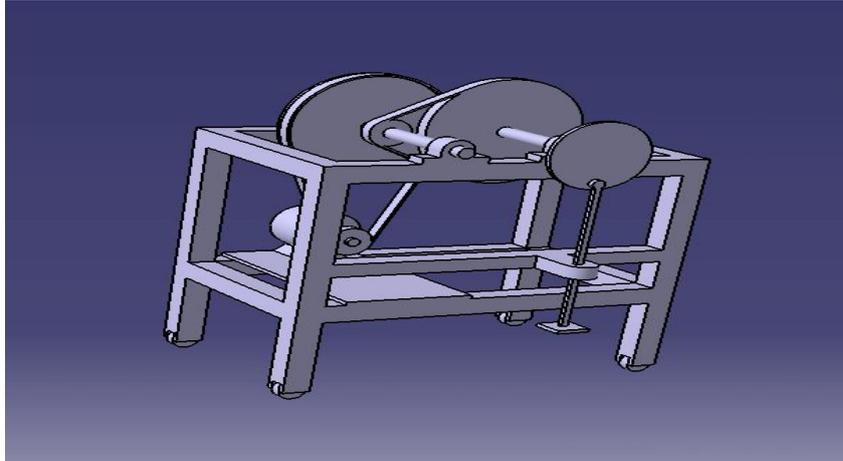


Fig.13 Cad drawing of ramming machine

## VI. Conclusion

- We successfully performed ramming operation on a portable unit with the help of electrically operated Ram.
- We reduced size of the ramming machine required for smaller moulds, which otherwise were carried out on large, heavy duty machines. These large machines have high initial, operating and maintenance cost.
- We implemented the use of Electric Mechanism over Hydraulic and Pneumatic mechanisms.

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