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Design and Fabrication of Automated Hammering Machine

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Abstract : The main goal is to create an automated hammering machine that can do hammering duties without the assistance of a human operator. One is selected since there isn't an automated hammering machine in these enterprises. The adoption of an automated hammering machine will benefit the economy and make operations simple and safe. Additionally, the automated hammering machine will have a bigger impact on the metal sectors. With the aid of a 16V battery, the machine will be able to carry out quick and precise pounding operations. When making the machine, mild steel is utilized. The use of a connecting rod allows a large pulley and shaft to be joined. The rod will move to the side thanks to the rotating shaft. The hammer and connecting rod are joined in a mid-swinging configuration. A bed that can hold the workpiece will be created. For designing the machine, Solid Works is employed. The main goal of the project is to create an automated hammering machine using a 16V battery, pulley, shaft, connecting rod, hammer, and other components to makehammering activities easier. The creation of a body case for the machine may be the subject of future work.

1INTRODUCTION

The foundation of any hammering operation in mass production can be thought of as an automatic hammering device that is portable. The automated hammering machine describes the automated portable hammering machine. Along with its analysis, design, and cad modelling. One of the new methods to achieve immediate hammering, precise repetition, and impacting is the automated hammering machine. In the past, a laborer would use a hammer to shatter or fit components. Manual labour would be less efficient and would require more manpower to break parts. However, modern automatic hammering machines make it feasible to simplify the operation. The use of automated machinery in the construction and industrial sectors has many evident advantages. The foundation of any automated hammering operation in mass productions can be regarded as theautomated hammering machine. The automated hammering device uses a 16V battery to deliver precise, quick,and automated pounding whenever and wherever it is needed. The user only needs to place the work item inside the machine before turning the hammer on. A pulley is hooked to the DC motor, and this pulley is connectedto a larger pulley for effective power transmission that increases torque. The rod creates lateral motion from the rotating shaft. Mild steel was used to manufacture the machine's frame. This is due to its low cost, durability, accessibility, and ease of cutting, joining, and moulding.

1.2 SLIDER CRANK MECHANISM

In a robotic hammering device, rotary motion was translated to linear action via a slider crank mechanism. In order to transfer or receive reciprocating motion to a rotating shaft, a crank is an arm that creates a right angle to the shaft. Circular motion can be changed into reciprocating motion, or vice versa. It is possible for the arm to be a bent portion of the shaft, an extended disc, a disc attached to another item, or both. A connecting rod, which is held to the crank's end by a pivot, is a frequent name for this rod. The end of the rod that is attached to the crank rotates in a circular motion, but the other end is typically just allowed to glide along a straight path. Similar to a bicycle crank set or a brace and bit drill, the word often refers to a human- powered crank that is used to manually turn an axle. In this case, a person's arm or leg rotate sin place of the connecting rod to turn the crank. [1].

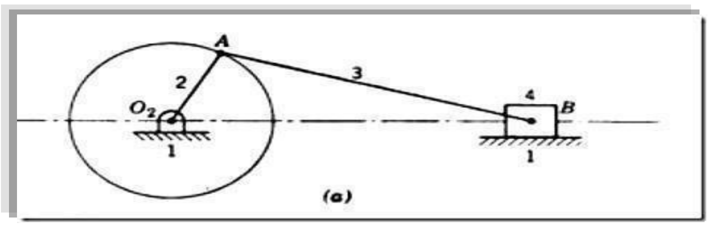


Fig 1: Slider Crank Mechanism

1.3 OBJECTIVE OF THE PROJECT

- Measuring the hammer's torque and impact velocity
- To ascertain the duration needed for the various operations.
- Automation using the least amount of labour.
- Low cost of acquisition and maintenance.
- Time-consuming processes are less effective for mass production

2 LITERATURE REVIEW

The use of automation has grown in importance in industrial operations. In the mechanical engineering fields, hammering is a highly common technique. Hammering is a common tool used in the manufacture and machining of metal components. Hammering is also widely utilized in the woodworking industry. The goal of this project is to build a machine that can effectively perform hammering tasks. The fact that the hammering procedure is manual results in a variety of injuries for the operators. To make matters worse, manual hammering cannot attain the efficiency and accuracy needed for hammering activities.

Although it's a straightforward tool, it will be useful in a variety of procedures. Accuracy is becoming a need for the industry, and the permitted tolerances are now severely constrained. The enhancement of operationsand operator safety are key elements. Take the hammering process that is being used on a sizable metal object, for instance. Manual operations have a greater potential for harm than using the gadget, which carries only minorrisks of injury for the operators. Furthermore, using this tool will enable you to achieve the necessary level of accuracy. If this automated hammering machine is created on a commercial scale and made available to many businesses, it might bring about a significant transformation in those sectors.

Creating and building a monitoring device to test machine-aided hammer forging. The automatic hammering machine can certainly benefit from it. In the work, a machine hammer forging technique that is almost identical to hammering was conceived and manufactured. In the machine hammer forging process, the metal is heated in a furnace, hammered in a press, and then cooled using cooling equipment. [2]

2.1 TYPES OF POWER HAMMER

Helve hammer

When the size of the stock is frequently changing, helve hammers work effectively for general engineering jobs. A horizontal hardwood shelf with pieces at one end and a hammer at the other makes up their construction. A mobile eccentric raises the hammer, which strikes when it lands. Various models come from 5kg to 200 kg in size.

Trip Hammer

A toggle connection that is rotated by a shaft at the top of trip hammers' rams allows them to reciprocate vertically. Trip hammers are available in sizes from 5 kg to 200 kilograms. For small sizes, the stroke rates for helve and trip hammers are 400 to 175 per minute.

Lever-Spring Hammer

They are hammers that are mechanically propelled and have a lifting force that is essentially constant and hardly changing. It only gets bigger as the operation speed goes up and has more strokes per minute as a result. An elastic rod and a rocking lever work together to move the ram. In order to create an elastic drive, the rocking lever is made of a leaf spring. Small forgings made in huge quantities can be drawn out and flattened with their help. Their flaw is that they frequently break springs from vibrations while in use. Rams weighing 30 to 250 kg are used to construct spring hammers. There are between 200 and 40 strokes each minute.

Pneumatic Hammer

Compressor and ram cylinders are the two cylinders that make up the hammer. Before delivering the compressed air to the ram cylinder, the piston of the compressor cylinder compresses the air. This activates the piston, which works with the ram to attack the target. Because of the crank drive, which is powered by a motor through a reducing gear, the compression piston can reciprocate. The spinning valves with ports that allow air to alternately enter the ram cylinder below and above the piston serve as the air distribution system between the two cylinders. In consequence, the ram is lifted and lowered.

Hydraulic hammer

Oil was used in place of air in these hammers. In comparison to hydraulic hammers, which are more expensive, pneumatic hammers are more affordable. In high force applications, hydraulic hammers are used. These have less noise

Power hammers

However, there are a number of inescapable downsides to employing the power hammers and formers currently available. The bulk of power hammers and formers that are currently on the market are expensive, frequently costing in the tens of thousands of dollars, making them unaffordable for all but the biggest metalworking enterprises. The power hammers and formers that are now available on the market have a propensity to be large and take up a lot of space, making them inappropriate for small- scale operations. Furthermore, the power hammers and formers that are currently available to give the necessary operational clearance, it could be necessary to use accurate, custom-machined die sets that might not be compatible with other equipment. The ability to run contemporary power hammers and formers with linkage drives is finally a possibility. Incorrect die setups and clearances have the potential to seriously harm the machines if not maintained.

2.2 RECENT RESEARCH OF POWER HAMMER

The now disclosed power hammer assembly offers users the advantages of power machinery for metal forming while being less expensive and taking up less room than existing power hammer systems. In general, the power hammer assembly of the present invention offers three-dimensional shaping capabilities that are used in the manufacture of distinctive metal goods, such as, for example, distinctive motorcycles and cars.

3 PROBLEM DEFINITION

The most popular industrial and building activity is hammering. It takes a lot of time and effort to hammer screws, metal sheets, pieces, etc. Therefore, a system that allows for entirely automatic hammering is an automated hammering system. This enables precise, quick, and automatic pounding wherever and wherever itis required. A machine that automates the hammering process can be used to reduce the danger of injury when hammering.

4 METHODOLOGIES

An automatic hammering machine's fundamental construction involves mounting the motor on a platform and inserting the motor shaft into the disc's center hole. To determine the cost of the product, the first alternative is to create an impact force for the relevant operation. The link rod serves as the connection between the disc and the hammer rod. The motor shaft beginsrotating when the dc motor receives dc current from a 16 V battery, which then transfers the spinning action to the disc via the shaft.

Instead of an adopter, a battery would be a more effective but more expensive design. Lot of challenges and design approaches will be put into practice as expected advances, and they willbe monitored and noted as they arise.

5 COMPONENTS

- **DC Motor**

Fig 2: DC Motor

Any member of the group of rotating electrical equipment known as DC motors controls the flow of current electrical energy. 96 watts of power and 30.55 N-M of maximum torque are transmitted via a DC wiper gear motor with a speed of 30 rpm.

- **Hammer**

In the industrial sectors, hammers weighing 1.5 kg are used for a variety of activities such as punching, upsetforging, riveting, etc.

- **Disc**

An unyielding link or belt can develop and be guided in the right direction with the help of a wheel that is mounted on a hub or shaft. eccentric holes on a disc that are used to insert linkage connection nuts.

- **Motor Drive Shaft**

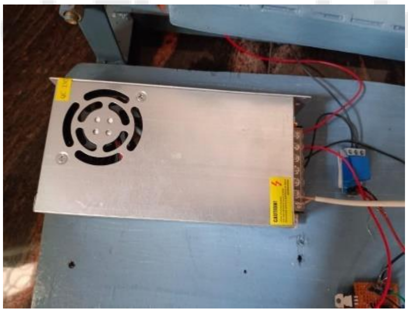


Fig 3: Motor Drive Shaft

Drive shafts, also referred to as Cardin shafts, are mechanical parts that convey torque and revolution. Various drive preparation segments that cannot be connected directly because of their separation or the need to take intoaccount relative development between them are frequently connected using this method. Rotational motion from the motor is transferred to the hammer rod through the shaft, which is coupled to the eccentric disc.

- **Sensor**

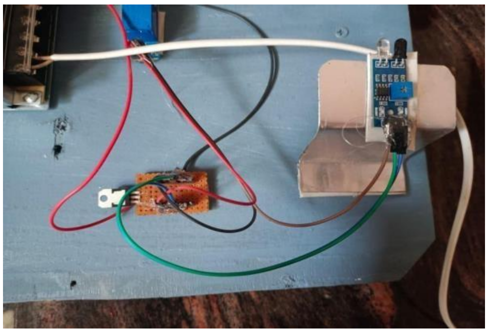


Fig 4: Sensor

A sensor is a device that picks up input from the outside world and reacts to it. Sensors can enhance people's security and safety. In this automated hammering machine, a sensor is utilized to detect motion and begin the pounding operation.

5 FINAL MODEL OF AUTOMATED HAMMERING MACHINE

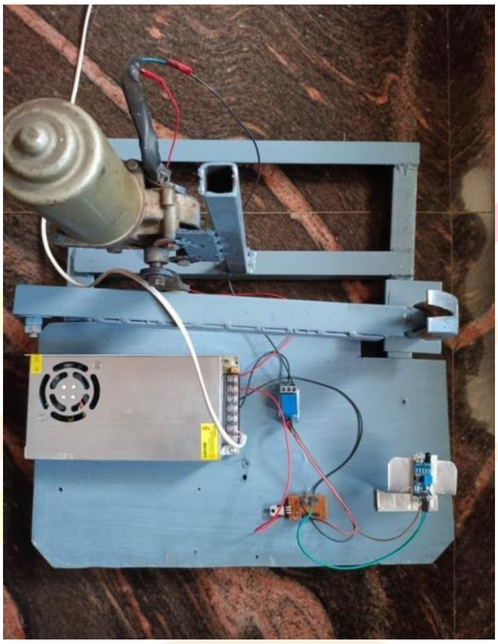


Fig 5: Final Model of Automated Hammering Machine

A tool that uses an automated system to help it run automatically is called an automated hammering machine. The motor powers the automated system, which generates rotary motion that is subsequently sent to the shaft and eventually automates the motion of the hammer. The motor's input could be a battery supply.

6 CALCULATIONS

To calculate maximum torque by motor:

Motor rating,

Given Data: -

N = 30 RPM

V = 12v

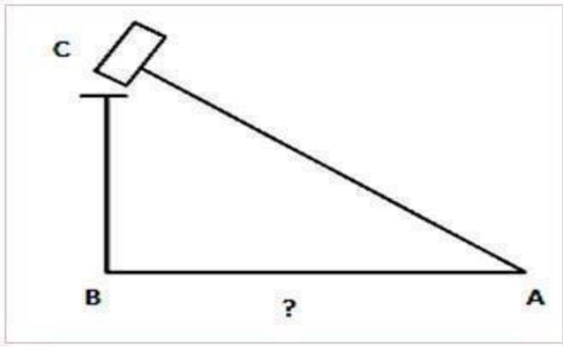
I = 8 A

Power Transmitted by Motor $P = V \times I$

$= 12 \times 8$

$P = 2\pi NT$

Distance of rod BA



To find the distance of BA, By Pythagoras theorem

$(AB)^2 + (BC)^2 = (CA)^2$

$(AB)^2 + (153)^2 = (420)^2$

$(AB) = 391.14$ mm.

B) To find torque force transmitted we have two cases:

Case 1: When Hammer Moves Downward.Given:

(BC) = h = 153 mm = 0.153 mm

Maximum torque = 30.55 N-m

$= 30.55 \times 10^3$ N-mm

Length of hammer rod = 420 mm

= 0.42 m.

Torque Force =Tmax×Length of hammer rod.Tf =

30.55×0.42

0.153.

Tf = 83.86 N-m.

When hammer goes upward, torque force will be decreased.

$$Tf = \frac{Tmax}{h} \times \left[\text{Length of hammer}\right] - \text{Weight of hammer}$$

$$Tf = \frac{Tmax}{0.153} \times \left[0.42\right] - 14.71$$

Tf = 69.15 N-m

C) To Find Impact Velocity of the Hammer

Given: -

H =153 mm = 0.153 m

T (time required for one re revolution of Disc) = 2 sec. So,

$V = h \times T$

$V = 0.15 \times 2$

V = 0.306 m /sec.

Therefore, the hammer's impact velocity is 0.306 meters per second. Therefore, the calculated impact velocityfor riveting a 2 mm rivet is 0.306 m/sec with a torque force of 83.86 N-m is sufficient and it is computed effectively.

7 WORKING PRINCIPLE

The Crank (link 1), which is joined to link 3 at F, maintains the rotation's axis of rotation. Link 3, which is connected at point E, receives the motion generated by link 1's rotation. The connecting rod, which is attached to link 3 at D, receives the motion in a future phase. The connecting rod eventually transmits the motion, following which the Ram Die (link 2) reciprocates along a predetermined path G. For the ram die to be able to move in a straight line, a slot is created at C. There is a connection between the ram die and connecting rod (links 2 and 4). The connecting rod can be oscillated using a crank along a predetermined path (link 5). Machinery for Industrial Process A piece of mild steel is trimmed to the required size using a power hacksaw. After the cutting process is complete, the fillet's edges are smoothed off using a manual grinder. a 6 mm drill was developed after that. Finally, on the bench vice, the filing was finished.

7.1 CONNECTING ROD

With the aid of a power hacksaw, a piece of mild steel is trimmed to the necessary dimensions. The edges are then given a fillet with a hand grinder following the cutting operation. Next, a hole is drilled to the required diameter. Using an end mill cutter, we then follow this process to mill the 65 x 8 x 6 mm slot. Later, to avoid any unfavorable sharp corners, the filing was finished in a bench vice. Power hack saws are used to cut mild steel material to the desired dimensions. For the purposes of facing and turning operations, the material was secured to the chuck of a lathe machine. For a nice surface finish, polishing was done. Sharp corners can be eliminated with chamfers. For the purpose of fixing the slider pin, a hole of the necessary size was drilled into the end of the ram. A slot was carvedinto the rod so that the connecting rod could fit into it and be fastened to the slider pin. To allow the punch to be secured in place with a screw, a hole of the proper size was made in another end of the ram, which was then taped at that end.

7.2 COMPOSITE BUSH

Two different sorts of materials were used to make it: a liner made of gun metal and mild steel, respectively. The outer bush was pressed into the inner one utilizing a press fit because the inner one is composed of gun metal and has undergone the necessary size facing and turning processes. The lathe was used to carry out these operations, and the exterior one is made of mild steel. The column is built out of mild steel that is the required size. First, holes that would be utilized to fix the links to the column were designated. The outside profile was marked, prepared to cut with a gas cutter, and then milled to the appropriate dimensions to remove unnecessarysharp corners and edges. For the bearings, rotating pairs F and A, holes were drilled onthe column. After that, thecolumn's compositebush was welded to it.

8 DETERMINATIONS OF DEGREES OF FREEDOM

The degree of freedom equation can be found using the following formula:

n = 3(υ-1)-2j-h

Where n=Degree of freedom=Number of linkages J = no of lower pairs h = no of higher pairs Links:Fixed link, Crank (link 1), Crank (link 5), Link 3, Connecting Rod, Ram Die

Therefore, number of links = 6

Number of higher pairs =

n = 3(-12j-h)

Therefore, the mechanism has single degree of freedom.

9 FUTURE SCOPE

There are numerous ways to enhance the design of an autonomous hammering machine. The hammer stroke's design is seen from the initial angle. It can be lightened and improved still more. The hammer's strength needs tobe increased in order for it to be employed in the industry for proper hammering activities. Additionally, it is possible to speed up hammering processes by reducing the pause between two blows. The machine's appearance can be improved by adding more to it.

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