



DESIGN, CAD MODELING & FABRICATION OF AUTOMATIC HAMMERING MACHINE

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Abstract –

This paper discusses about CAD modeling, design and analysis of an automatic hammering machine. Our goal for this paper is to design and fabricate an automatic hammering machine. And for this, we have calculated the maximum torque, impact velocity for hammering, torque force and also shear failure in bolt joint. In our project we are using torque force to perform various manufacturing operations in industries like riveting, upset forging, punching etc. Also time required for operation is less so it is useful in mass production.

In this project we have prepared a solid model of project assembly by using CATIA v5R20 software {Computer aided three dimensional interactive application}. The snapshots of every component are attached in the file in design section. The model consists of motor, shaft, hammer, jigs and fixtures. From this we fabricate a conceptual model of an automatic hammering machine. Automatic portable hammering machine is one of the new techniques proposed in design in order to achieve instant hammering accurate repetition and impacting, fast hammering process. It should be user friendly without any risk and worker manual effort can be used easily automatically. In the past, a labor used a hammer to drive a nail, fit parts, break apart and more. It would be used manually with more effort and man power used in process. But now a day it is possible to make it process easy by invented automatic hammering. There are very clear benefits that the industry sees while using automated systems. These advantages can be very beneficial in the long run. We assure that our products are one of the best and they are long lasting.

Key Words: CATIA v5R20 1, Automatic2, CAD modeling3, impact velocity4, torque force5, shear6, Accurate7

1. INTRODUCTION

This paper is basically worried about the upset outline process and assembling machine of programmed compact hammering machine. Prototype which can be defeated the issue of off base hammering and strange effect of hammering in procedure of manufacturing. A conceivable arrangement of the issue of moderate hammering speed and anomalous hammering by a work is plan a programmed convenient hammering machine given mechanical advances in assembling process technique. The suitability of such an idea was explored as far as delivering reasonable and compacted plan for specialist which can be exchange anyplace of this machine by any laborers. Automatic portable hammering machine can be considered as the backbone of any hammering operation in mass production its principle function is to safely and preciously hammering work like to perform the punching operation, filleting operation, riveting operation and smithy operation

i.e. upset forging etc for all designed operating conditions. This paper describes cad modeling, design and analysis of automatic portable hammering machine. A programmed hammering machine self-working machine going to assume an imperative part in the assembling procedure (hammering process). Hammering machine utilized as a part of the generation of material extending from instruments, to pivots, car frame forming, molding of metal and so forth. The present development identified with metal squeezing machine and forming machine included certain outstanding challenges in regard of to drive nail, fit parts, forge metal and break separated question. The innovation has for its question cure this downside and to empower, by including helper implies, to drive nail, fit parts, manufacture metal and break separated protest the like. Hammering is the most generally utilized in mechanical operation and also development action. Hammering or screws

1.1 SLIDER CRANK MECHANISM

In this prototype model we used slider crank mechanism to convert rotary motion into linear motion. A crank is an arm attached at a right angle to a rotating shaft by which reciprocating motion is imparted to or received from the shaft. It is used to convert circular motion into reciprocating motion, or vice versa. The arm may be a bent portion of the shaft, or a separate arm or disk attached to it. Attached to the end of the crank by a pivot is a rod, usually called a connecting rod (con rod). The end of the rod attached to the crank moves in a circular motion, while the other end is usually constrained to move in a linear sliding motion. The term often refers to a human-powered crank which is used to manually turn an axle, as in a bicycle crank set or a brace and bit drill. In this case a person's arm or leg serves as the connecting rod, applying reciprocating force to the crank. There is usually a bar perpendicular to the other end of the arm, often with a freely rotatable handle or pedal attached.

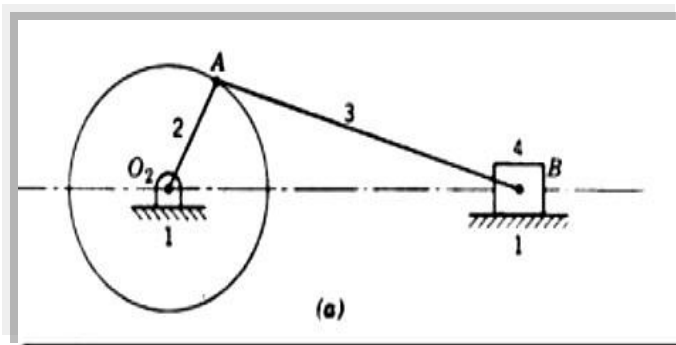


Fig 1: SLIDER CRANK MECHANISM

Many applications require a machine with reciprocating, linear sliding motion of a component. Engines and compressors require a piston to move through a precise distance, called the stroke, as a crank continuously rotates. Other applications such as sewing machines and power hacksaws require a similar, linear, reciprocating motion. A form of the slider-crank mechanism is used in virtually all these applications.

1.2 OBJECTIVES OF PROJECTS

- Determination of impact velocity and torque force of hammer.
- To determine the time required for the various operations.
- Prepare the modelling of project on CATIA V5R20.
- Automation with minimum man power.
- Low initial and operating cost.
- As time required in less useful in mass production.

1.3 ANALYTICAL TECHNIQUES.

Analytical methods can also be used to achieve precise results. Advanced analytical techniques often involve intense mathematical CALCULATION. In addition, the significance of the calculations is often difficult to visualize. The analytical techniques incorporated in this text couple the theories of geometry, CAD Modeling and graphical mechanism analysis. This approach will achieve accurate solutions, yet the CAD modeling of automatic hammering machine graphical theories allow the solutions to be visualized. A significant of automatic hammering machine dedicated to these analytical techniques.

1.4 FEATURES

- Instant Hammering.
- Fast Hammering Process.
- No Manual Effort.
- Portable System.
- Low Initial Cost.
- Low Tooling Cost.
- Accurate Repetition and Impact.
- User Friendly.
- Easy Maintenance.

2. PROJECT METHOD & COMPONENTS

This project has various different design paths to complete our products while meeting the objectives. These means we will have to implement and compare our different design to insure the best product on our set of objectives. These paths have changed as we progressed through our project, and there were few fore seen methods that we expand upon in the design section.

The basic design for automatic hammering machine is to have motor fixed on stand, and then motor shaft is inserted in center hole of the disc. Disc is connected to the hammer rod with the link rod when we supply the dc current to the dc motor by using adapter then the motor shaft start rotating further transmit the spinning motion to the disc by using shaft the first decision is to create an impact force for the respective operation this will help to determine product affordability.

A more efficient yet expensive design would be to have battery instead of adapter. There is bound to be various obstacles and design method to be implemented as projected progresses and will be observed and recorded as they occur.

2.2 COMPONENT



Fig 2: PROTOTYPE MODEL AUTOMATIC HAMMERING MACHINE

2.1.1 DC MOTOR

A DC motor is any of a class of rotational electrical machines that converts coordinate current electrical vitality. A DC wiper gear motor is used which having 30 rpm speed and runs on 96 watt power and transmits 30.55 N-M maximum torque

2.1.1 HAMMER

In this project we have used hammer having weight 1.5kg for various operations such as punching, upset forging, riveting, etc. these types of manufacturing operations in manufacturing industries.

2.1.2 DISC

A disc is a wheel on a hub or shaft that is intended to help development and alter of course of a rigid link or belt. The disc having eccentric holes in which bolts are fitted to connect linkages.

2.1.3 MOTOR DRIVE SHAFT



Fig 3: PROTOTYPE AUTOMATIC HAMMERING MACHINE

A drive shaft or Cardin shaft is a mechanical part to transmit torque and revolution, typically used to associate different segments of a drive prepare that can't be associated straightforwardly as a result of separation or the need to take into account relative development between them. The shaft is connected to eccentric disc and is transfers rotational motion from motor to hammer rod.

The most reliable design of automatic hammering machine are described below along with their specification in order to show the different existing approaches to the small and portable automatic hammering concept. These data could be useful when performing the initial sizing in the design stage of automatic hammering machine project. Following are 13 designs for initial data collection:

- Total weight =6 kg.
- Hammer weight = 1.5 kg.
- Hammer length =460mm.
- Hammer stroke height = 186 mm.
- Width = 355 mm.
- Height = 450 mm.
- Length = 580 mm.
- Disc thickness = 1 mm.
- Battery (supply voltage) =12v and 7 Ampere.

- Motor = DENSO INDIA LTD (SR05950-4772), 30RPM, 12V. DC motor.
- Diameter of pulley =250 mm.
- Length of link rod = 200mm.
- Typical operation = Common Riveting for 2 mm rivet.
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3. Design of Hammering Machine

3.1. Calculations

A) To calculate maximum torque by motor

Motor rating, Given Data:- N = 30 RPM

$$I = 8 \text{ A}$$

$$V = 12 \text{ v}$$

Power Transmitted by Motor,

$$P = V \times I$$

$$= 12 \times 8$$

$$P = 96 \text{ W}$$

$$P = 2 \pi NT/60$$

$$96 = 2\pi 30 \times T$$

$$60$$

$$T = 30.55 \text{ N-m}$$

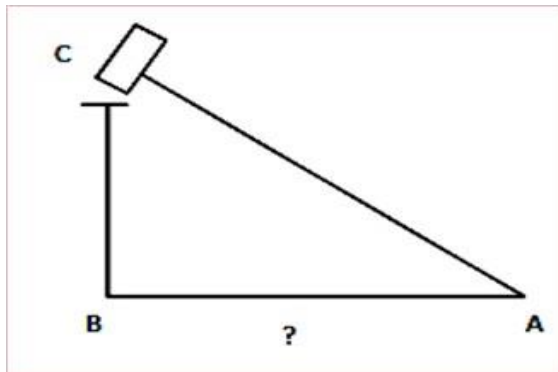


Fig 4: FREE BODY DIAGRAM

To find the distance of BA

,By Pythagoras theorem

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

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

$$(AB) = 391.14 \text{ mm}$$

A) To find torque force transmitted we have two cases CASE 1: When Hammer Moves Downward.

Given:

$$(BC) = h = 153 \text{ mm} = 0.153 \text{ m}$$

$$\text{Maximum torque} = 30.55 \text{ N-m}$$

$$= 30.55 \times 10^3 \text{ N-mm}$$

$$\text{Length of hammer rod} = 420 \text{ mm}$$

$$= 0.42 \text{ m}$$

$$\text{Torque Force} = \underline{T_{\max}} \times \text{Length of hammer rod}$$

$$T_f = \underline{30.55} \times 0.42$$

$T_f = 83.86 \text{ N-m.}$

CASE 2: WHEN HAMMER GOES UPWARD, TORQUEFORCE WILL BE DECREASED

$$T_f = \frac{T_{\max} \times [\text{Length of hammer}]}{h} - \text{Weight of hammer}$$

$$T_f = \frac{T_{\max} \times [0.42]}{0.153} - 14.71$$

$$T_f = 69.15 \text{ N-m}$$

A) TO FIND IMPACT VELOCITY OF HAMMER, Given:-

$$H = 153 \text{ mm} = 0.153 \text{ m}$$

$$T \text{ (time required for one revolution of Disc)} = 2 \text{ sec. So,}$$

$$V = h \times T$$

$$V = 0.15 \times 2$$

$$V = 0.306 \text{ m/sec}$$

So the impact velocity of hammer is 0.306 m/sec.

RESULT

Thus for riveting of 2mm rivet calculated the impact velocity is 0.306 m/sec with a torque force of 83.86 N-m is sufficient and it is calculated successfully. [4]

B) TO CALCULATE SHEAR STRESS IN BOLTED JOINT

We have bolted joints so there is torsional shear stress in joints,

We have,

$$T = 30.55 \text{ N-m.}$$

d = Diameter of bolt 10 mm. J = polar moment of inertia.

$$J = \frac{\pi}{64} \times (0.1)^4$$

$$J = 4.90 \times 10^{-6} \text{ m}^4$$

$$\frac{T}{J} = \frac{\tau}{r}$$

$$\frac{30.55}{4.90} = \frac{\tau}{0.05}$$

$$\tau = \frac{30.55 \times 0.05}{4.90} \dots \dots \dots r = \frac{d}{2} = 0.05 \text{ mm}$$

$$\tau = 311.73 \times 10^3 \text{ N/m}^2$$

RESULT

As the standard permissible value of shear stress for M10 bolt is $396.8 \times 10^3 \text{ N/mm}^2$ and the calculated value of shear stresses is $311.73 \times 10^3 \text{ N/m}^2$ so Therefore the value of shear stress is less than permissible shear stress the design is safe. [4]

4) COMPUTER AIDED MODELLING

4.1 INTRODUCTION

CAD modelling is used by many designers to create elaborate computerized model of objects. CAD is computer-aided design. Engineers, architects, and even stands artists utilize computers to assist their design projects. Computers allow them to in visualize their designs and confront problems before they have expended any of the resources necessary to put them into physical form CAD modelling takes many different forms depending on the type of project. Some models are simple two dimensional representations of various views of an object. Others are elaborate three- dimensional cross-sections that show every detail in great depth. It is an important industrial art involved in automotive, aerospace, prosthetic, and artistic designs. The use of CAD modelling is massively widespread; anything from chairs to rockets can be designed with the aid of computer programs. CAD modelling has had a profound effect on the process's development. First, a general idea must be made to solve a specific problem. Next, CAD modelling is used to work out the specifics of the model's design.

4.2 TYPE OF CAD MODELING

4.2.1 WIREFRAME MODELS

Wireframe systems were developed in the early 1960s to automate design drafting of the early 3 CAD Systems used wireframe models. The very first systems were only 2D and the user had to construct a model point by point and line by line. A wireframe model is represented by tables defining edges and points. The start point and the end point of each edge are stored in the edge table. An edge may be a line or a curve. The coordinates of each point are stored in the point table. This representation is natural for a designer who is familiar with mechanical drawing" since is the lines and curves in a drawing which define 3D shape a wireframe it simply in a computer as a data structure. The storage space is Del stored very is l and the access time very short.

4.2.2 SURFACE MODELS

Surface models a surface model is represented by tables of edges and points, as is a wireframe model, but additional to wireframe. A surface model is represented by tables of faces. The face table stores information on which edges are attached to each face, In most conventional CAD systems for free-form surfaces, surface models have been used as internal representations. However, a surface model is a set of faces, and as such can be ambiguous when determining the volume of an object. Surface models play an important role in industry, because they give an accurate description of the surface of an object. An example of a very simple surface models shown in Figure.

4.2.3 SOLID MODELS

Because there is no ambiguity in using a solid s 3D object, the importance of using solid modelling has been widely recognized. Solid models can support a wide range of activities, like interference check computation of volume and surface area, finite element analysis etc. In general, most solid modelling systems have adopted either constructive solid geometry (CSG) or boundary representation (B-Rep) as representations of solid Solids. Solid models may be divided in three basic classes as follows:

1. Decomposition models represent a solid as a collection of simple object from a fixed collection of primitive object types, combined with a single gluing operation;
2. Constructive models represent a solid as a combination of primitive solids each of the primitives is represented as an instance of a primitive solid type. Different types of constructive modelling representations are half pace representation and CSG;

Boundary models represent a solid in terms of its boundary. The boundary of a solid is a surface that is usually represented as a collection of faces. Faces again, are often represented as a bounded region of the surfaces. B-Rep represents a solid boundary as a "skin" around the object. Following showing the 3D solid models of various components of project by using modelling software CATIA V5R20

4.1 CAD DRAWINGS OF HAMMERING MACHINE

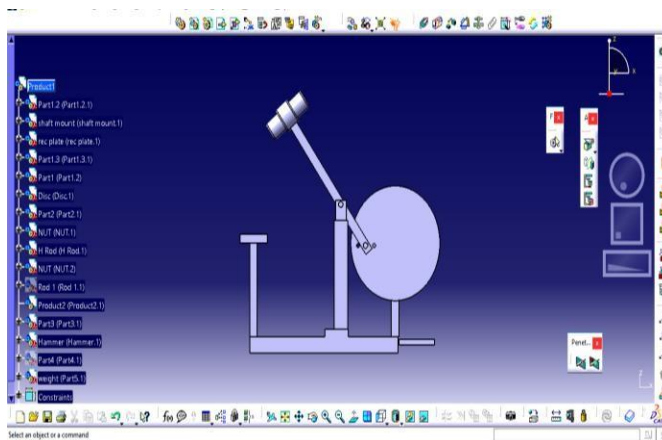


FIG 5: 3D VIEW OF AUTOMATIC HAMMERING MACHINE

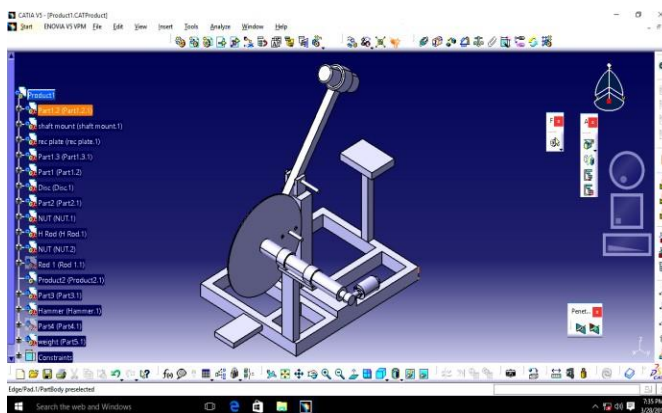


FIG 6: SIDE VIEW OF AUTOMATIC HAMMERING MACHINE

ADVANTAGES AND DISADVANTAGES AND APPLICATIONS.

ADVANTAGES

Available in wide variety of sizes.

Maintain good control and required force.

Low cost.

Save man power.

Saves time.

Time delay can be achieved easily.

Mass production.

DISADVANTAGES

This mechanism is only suitable for few operations.

As torque force required is more there is difficult to find the motor to achieve the required torque.

Having little wear.

APPLICATION

To perform smithy operation i.e. upset forging.

To perform the punching operation.

To perform filleting operation as torque force produce is sufficient for the operation.

To perform riveting operation etc.

5. CONCLUSIONS

We have successfully calculated the torque force of the motor. For the design the impact velocity and torque force for riveting of 2 mm rivet is calculated accurately. The entire modelling of the project is done with the help of CATIA V5R20. In this addition to this. The project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding. Planning, Perching, assembling and machining while doing this feel that the project work is good solution to bridge the gates project work. We between institutions and industries. We are proud that we have completed the work with limited time successfully Automatic hammering machine is working with satisfactory condition. We have done to our ability and skill making ma work.

5. FUTURE SCOPE

The concept of an automatic hammering machine in this paper has been shown to have a place in the actual market and to fill a need demanded by potential customer. IN this paper, the concept of automatic hammering machine prototype will have to fulfill the basic design requirement, let us add the proposed concept will a few more lines about our impression project work. Help in production line where many workers are used for the material handling purpose it also reduce the cost and threshing time requirement of more number of worker will completely eliminated as only two workers can carried out the be complete operation. The project objective originally is to reduce human efforts in manufacturing industries. The in future the complete stress analysis of the project model could be done. This analysis could be done by us. Moreover, for the automatic hammering machine to achieve fully success in the future, many collateral improvement must be done in terms of systems (autopilot technology, for instant) and time delay management (pedal operated control will be required) and some modification can will be done in this project

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