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DESIGN & FABRICATION OF PORTABLE MOTORIZED POWER HACKSAW MACHINE

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ABSTRACT

As we know that in large manufacturing industries, the cutting operation is very required for raw material, for this purpose they use conventional hacksaw machine for cutting operation. In that type of machine single piece can cut at a time by using an electric motor. Also, one labor utilizes for same. So it is time-consuming and comparatively costly. Therefore we have manufactured a four-way hack-saw machine which is used for cutting job simultaneously, this four-way hack-saw machine uses single motor four cutting job at the same time while in conventional hack-saw machine single motor is used for cutting one job only. Conversion of rotary motion of dc motor into reciprocating motion is obtained by using the eccentric cam. By making such type of machine, cutting operation time as well as labor working time can be reduced. Since such a hack-saw machine gives more productivity than a conventional cutting hack-saw machine, it can be used in manufacturing industries where automation is required. It can be also used in industries where labor availability is less. In this present work, we manufactured a model of four-way hacksaw machine, so we use light duty of structural parts and crank mechanism, the capacity of the electric motor is also very low. But in future, if we want to use such type of machine in industry, we can manufacture it by using heavy duty of body structure and all other required parts.

KEYWORDS: Power hacksaw machine, dc motor, wheel, welding, time and cost saving.

1. INTRODUCTION

Raw materials: Cast iron is an alloy of iron and carbon, and is popular because of its low cost and ability to make complex structures. The carbon content in cast iron is 3% to 4.5% by weight. Silicon and small amounts of Manganese, Sulphur, and Phosphorus are also present in it. The products of cast iron exhibit reasonable resistance against corrosion. It is neither malleable nor ductile, and it cannot be hardened like steel. It melts at about 2100 ºF, and has either a crystalline or a granular fracture. The mechanical properties of cast iron are very much dependent on the morphology of its carbon content. Carbon is present in the form of plates in gray cast iron, whereas, it is incorporated in compound Fe3C (cementite) in white cast iron. Nodular cast iron, which show better tensile strength and strain than gray cast iron, carry carbon in the form of sphere shaped graphite particles

Properties Of Cast iron: Tensile Strength: Different varieties of cast iron are used in the construction of machines and High Compressive Strength: Compressive strength is defined as the ability of a material to withstand forces which attempt to squeeze or compress it. Cast iron shows high compressive strength, which makes it desirable for use in columns and posts of buildings. The compressive strength of gray cast iron can be almost as high as that of some mild steels. Low Melting Point: Its melting temperature ranges from 1140 ºC to 1200 ºC. Nowadays, many advanced melting, alloying and casting methods are being used, which can bring the new irons formed, in competition with steel.

Resistance to Deformation: Cast iron structures show resistance to deformation and provide a rigid frame. However, if one part of the casting after the iron is poured into the moulds, is very thin, and another very thick, the problem of the structure Breakdown becomes prominent. The reason for this is when the thin part cools first and contracts, the thick part which cools down afterward causes stress in the thin part, offering sufficient force to break it.

ISSN: 2277-9655
Impact Factor: 5.164
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2. LITERATURE REVIEW

- "Material selection and testing of hacksaw blade based on mechanical properties" stated that the appropriate saw blade must be selected for better operation and fine cutting by selecting a number of teeth per inch.
- There are four types of blades based on material namely High Carbon steel, Alloy Steel, Bi-metallic strip and High-speed steel blades. Out of these four the best suitable for cutting hard materials like a Mild steel bar and Aluminum is a Bi-metallic blade on the basis of Properties of materials, Wear resistance and Cutting performance.
- "Theoretical Analysis of Multi-Way Power Hacksaw Machine" proposes the model of multi-way hacksaw machine which is able to cut four pieces simultaneously without any jerk and minimum vibrations.
- "Design and Fabrication of Automated Hacksaw Machine" (April 2014) gives an idea about the various components required for fabrication of the proposed model. These components will help to get smooth working condition and future automation of different mechanical actions as well as linkages.
- The vast review of literature will help to understand the concepts, theorems and different factors affecting the performance of the machine. R. S. Khurmi, J. K. Gupta in their book "Theory of machines" (Velocities in mechanisms) helps to find Velocity diagrams of slider crank mechanism.

3. PROPOSED METHODOLOGY

This project consists of single phase vertical electric motor rigidly placed at the centre of metallic foundation provided. The shaft of gearbox rotates at 80- 90 rpm with the motor power 1 HP. The circular disc is mounted on the shaft of the motor with the help of key and key slot arrangement. The eccentric point on the plane of the disc is provided such that the desired cutting stroke is achieved. One end of each connecting rod is pivoted at this eccentric point by the use of the suitable bearing. Another end of each rod is connected to the hacksaw blade fame with the help of a universal joint to get vertical and horizontal Degree of Freedom of rotation for the proper cutting operation. The hacksaw frame slides on the guideways provided. When the motor is ON and disc starts rotating, due to the reciprocating motion of hacksaw frame the metal rod is cut which is firmly fixed in a vice.

4. DESIGN CALCULATIONS

Velocity Calculations:
Considering cutting stroke length = 125 mm As we know l = 2r;
where r = crank radius
Therefore r = 62.5 mm
The length of connecting rod = 300 mm
Speed= 80 rpm
So angular velocity $\omega = 2\pi N/60 = 9.067$ rad/sec
Here OP= crank radius
OA = OB = OC = OD = connecting rod Velocity of point p is $V_p = OP \times \omega$ $V_p = 0.0625 \times 9.067$ $V_p = 0.567$ m/sec
(Scale 0.567 m/sec = 50mm)
we get velocities of slider
Vap = 44 mm = 0.499 m/sec
Vbp = 41 mm = 0.465 m/sec
Vcp = 44 mm = 0.499 m/sec
Vdp = 41 mm = 0.465 m/sec
Torque calculations: We know forces at A, B, C, D
FA = FB = FC = FD = 300 N
Power output = T X ω
Power input = (FA X VA) + (FB X VB) + (FC X VC) + (FD X VD)

ISSN: 2277-9655
Impact Factor: 5.164
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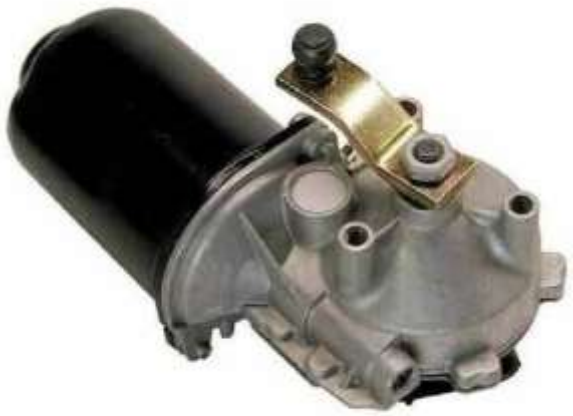
Power input = (300 X 0.499) + (300 X 0.465) + (300 X 0.499) + (300 X 0.465)
Power input = 578.4 Nm/sec
Neglecting losses power input is equal to power output
So, 578.4 = T X ω T = 63.79 Nm
Available Torque
P = 2πNTA/60
Where, N = 80 rpm, P = 1 HP = 746 watt, TA= 89.1 Nm
DC Motor

A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. We use 12 volt dc motor and its running speed is 30 rpm.

The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Figure:1



DC Motor

Adapter
Adapter is an electronic device it converts 240volt of ac into 12volt of dc.They are often used to connect modern devices to a legacy port on an old system. Such adopters may be entirely passive or contain active circuitry

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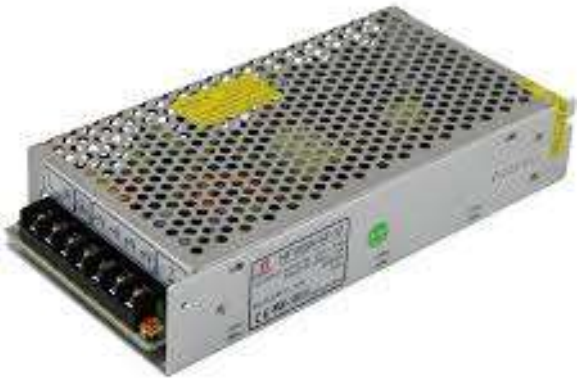

Adapter

Model of Power Hacksaw Machine

5. WORKING OF THE PROJECT

a. Acquiring data from the user

The Automated Hacksaw machine acquires two inputs from such as number of pieces to be cut and length of each piece from the operator through a keypad and an LCD display. The operator may reset the data during any stage before pressing the machine start push button.

b. Sequence of operation

After entering correct data and pressing the start button, the conveyor will feed the work-piece in to the chuck to the required length and gets stopped by the microcontroller. As mentioned earlier, the conveyor motor will get stopped by the microcontroller when the IR sensor has sent the necessary number of pulses to the microcontroller in relation to the user specified length of the work-piece. When the teeth of the rotating disc attached to the conveyor roller pass before the IR sensor, the IR sensor provides a pulse to the controller. The rotation of disc from one tooth to the next teeth means that the corresponding linear movement is one centimeter.

Then the solenoid DCV will make the chuck cylinder to extend and hence hold the work-piece in position and ready for cutting. At the same time, the self-weight gets rested on the work-piece with the blade pressing against the work-piece. Then the AC motor is turned on by the signal from controller, which initiates the cutting process. When a single piece has been cut, a limit switch gets turned on by the self-weight, which makes the microcontroller to start the whole process again until it has finished cutting the quantity of pieces as specified by the operator.

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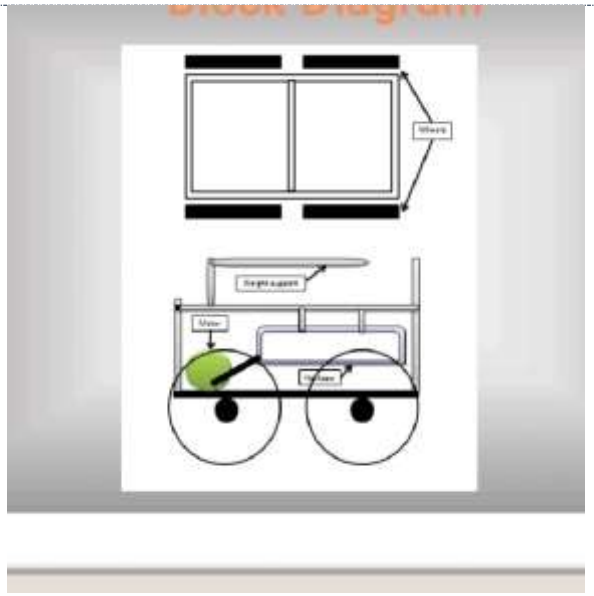

Block Diagram of power Hacksaw Machine

6. CONCLUSION

It is known that conventional power hacksaw machine can be replaced with automated power Hacksaw machine. Automated power hacksaw machine gives high productivity in short time period in comparison with the conventional power hacksaw machines. The major advantage of this machine is intervention of labor is reduced to maximum level. In this rapid emerging industrial section the use of power Hacksaw machine is wide, time and labor plays a major role in production process. This can be overcome by using this type of automated machines.

The automated hacksaw machine can be made use of at any of the industries like pump manufacturing industries that involve bulk amount of shafts that have to be cut frequently. The range of size of work-pieces that can be cut using the automated hacksaw machine can be varied by changing the blade size. Currently, the machine uses 12 inch blade for cutting. An another advancement that can be implemented in automated hacksaw machines is that the user can also get cut work-pieces of different lengths in one cycle itself. This means that the user has to specify the number of workpieces that have to be cut in each of the different length values specified. This will be possible with the help of an advanced microcontroller than AT89C51, which should have high programmable memory.

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