Design and Fabrication of Semi Automatic Electric Powered Four Way Hacksaw Machine

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Abstract- *There are many industrial applications where round bar or square bars are required to be operated on different machines to make machine components such as Shafts, Bolts, Screws etc. This needs more and more number of pieces to be cut for mass production of those components. To achieve this goal the Multi-way power hacksaw machine is developed. This paper proposes the model of multi-way hacksaw machine which is able to cut four pieces simultaneously without any jerk and minimum vibrations. The model implies conversion of rotary motion into the reciprocating motion for proper working of hacksaw. This model overcomes the limitations of conventional hacksaw machines which can cut single piece at a time. It is able to cut metal bars of different materials at same time and will be helpful in many industries due its compatibility, reliability and efficiency.*

I. INTRODUCTION

In present condition many electrically operated power hacksaw machines of different companies with different specifications are available for the use in shop floor. These machines are so precise that they can cut metal bars with minimum time made up of different materials but they have one and major disadvantage that those are able to cut single piece of bar at a time. For industries to achieve the mass production, it is necessary to cut metal bars with high rate. So it is impossible to depend upon conventional single frame power hacksaw machines and need the improvement in technology and design of such machines. With the help of this multi-way power hacksaw machine the four metal bars can be cut simultaneously to get high speed cutting rate and to achieve mass production for maximum profit in related companies. As this machine overcomes all the limitations and drawbacks of conventional hacksaw machines, it is also helpful for small scale industries due to its simple working and operating conditions along with its compatibility, efficiency and affordable price.

II. PROJECT IDEATION

Current scenario of industry focuses on the high production rate with less consumption of resources. To achieve this we need to minimize idle time and machine time per unit. The multi-way power hacksaw improves those factors by reducing time per unit to increase the production.

2.1. Problem Definition

To cut different metal bar pieces with high rate and accuracy to minimize an idle time.

2.1.1 Present method and problems associated

In present situation electrical as well as hydraulic Operated machines are used but the output from them is not satisfactory as it has low cutting rate.

2.2. List of components with materials

Following are the important parts of hacksaw machines.

S. no.		Material	Attributes
1	Motor	-	1 hp, 1440 rpm
2	components	MS	Square hollow pipe (1.6'' x 1.6'')
3	Connection rod	MS	300 mm
4	Crank	MS	62.5 mm
5	Shafts	E 34	25 mm & 50 mm
6	Pulley	CI	300 mm
7	Belt	Rubber on fabric	v- belt (A 48)
8	Bevel gear set	Steel C40	Pinion – 9 teeth, 50 mm Crown – 13 teeth, 115 mm
9	Pedestal bearing	High C- Cr steel	25 mm
10	Ball bearing	High C- Cr steel	50 mm
11	Vice	CI	60 mm
12	Hacksaw frame	MS	-
13	Blade	Bi – metallic	28 mm
14	Guide way	MS	300 mm
15	Bush	Rubber	Diameter-22 mm

III. REVIEW OF LITERATURE

The vast review of literature will help to understand the concepts, theorems and different factors affecting the performance of 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.[06] Prof. Nitinchandra R. Patel, Ravi Thakkar, Miteshkumar Rathwa in his research paper "Material selection and testing of hacksaw

blade based on mechanical properties" stated that the appropiate saw blade must be selected for better operation and fine cutting by selecting number of teeth per inch.[02] There are four types of blades based on material namely High Carbon steel, Alloy Steel, Bi-metallic strip and High speed steel blades.[10] Out of these four the best suitable for cutting hard materials like Mild steel bar and Aluminium is Bi-metallic blade on the basis of Properties of materials, Wear resistance and Cutting performance. D.V.Sabarinanda, V.Siddhartha, T.Mohanraj in their paper "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. O.Cakir, A. Yardimen, T. Ozben in the paper "Selection of cutting fluids in machining processes" gives directions about selection of proper cutting fluids . The suitable cutting fluid is required to select for the purpose of cooling, to avoid friction and making smooth operation and removal of burr.

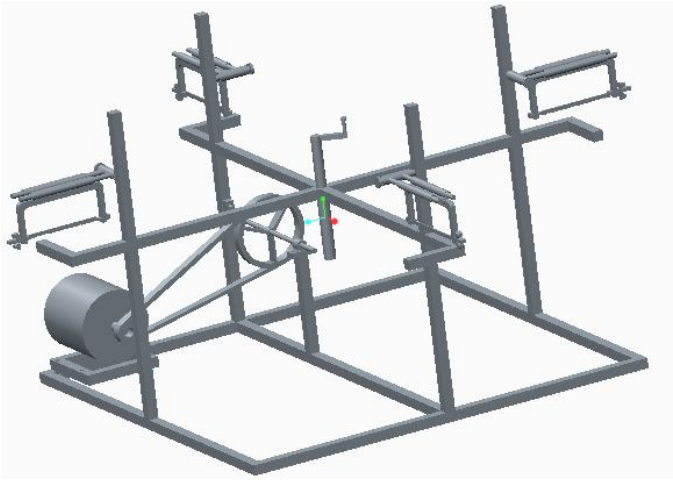
3.1. Conventional Hacksaw Machine

All the conventional power hacksaw machines contain main four components are Base, Frame, Vise and Speed change mechanism etc. The conventional machine contains complex design and working. The processes like frame reciprocation, lifting up of frame after cutting stroke etc.

IV. PROPOSED METHODOLOGY

This project consists of single phase vertical electric motor rigidly placed at the center of metallic foundation provided. The shaft of motor rotates at 90-100 rpm with the power 2HP. The circular disc is mounted on the shaft of motor with the help of key and key slot arrangement. The eccentric point on the plane of disc is provided such that the desired cutting stroke is achieved (around 4-5 inches). One end of each connecting rod is pivoted at this eccentric point by the use of suitable bearing. Another end of each rod is connected to the hacksaw blade fame with the help of universal joint to get vertical and horizontal Degree of Freedom of rotation for the proper cutting operation. The hacksaw frame slides on the guide ways provided. When 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 vise. The automatic feeding of coolant is provided to reduce heat generated due to friction which also avoids the jerk.

IV. CAD MODEL OF MACHINE



VI. DESIGN CALCULATIONS

6.1 Torque Calculations:

From Velocity Diagram,

Considering cutting stroke length 5inches = 125mm
(Value taken by referring hacksaw manufacturer's catalogue)

As we know L = 2r ; where r =crank radius
Therefore r = 2.5inches = 62.5mm
The length of connecting rod = 300mm
Speed= N = 90rpm (as per catalogue)
So angular velocity $\omega = 2\pi N/60 = 9.424$ rad/sec
Here OP = crank radius
OA = OB = OC = OD = connecting rods

$\omega_{po} = 9.42$ rad/sec
since op = 0.0625m
so velocity of p wrt o

vpo= vp= 9.42 × 0.0625 = 0.588m/sec

From velocity diagram, we get velocities of slider
vap= 4.4cm/sec = 0.44m/sec
vbp= 4.1cm/sec = 0.41m/sec
vcp= 4.4cm/sec = 0.44m/sec
vdp =4.1cm/sec = 0.41m/sec

Required Torque

We know forces at A, B, C,D
FA = FB = FC = FB = 500 N

Power output = to x ω_{po}
= to x 9.42 rad/sec

Power input = (FA X VA) + (FB X VB)
+ (FC X VC) + (FD X VD)

= (500 × 0.44) + (500 × 0.41) + (500 × 0.44) + (500 × 0.41)
= 850 Nm /sec

Neglecting losses power input is equal to power output
so,
to x 9.42 = 850 Nm/sec

Available Torque

$P = 2\pi NT / 60$
Where N = 120 rpm
P = 1 hp = 746 watt
T = 158.30 N− m

VII. FURTHER SUGGESTED WORK AND CONCLUSION

7.1 Future work

- The maximum size of Round or Square bar can be increased by increasing the motor power and dimensions of different parts.
- Automatic feeding mechanism for material can be introduced by using limit switches or sensors.
- Automatic lifting up mechanism for frame when cutting operation is finished to introduce next portion of bar for cutting.

7.2 Conclusion

As per the above discussion we concluded that to overcome problems in conventional hacksaw machines, due to high efficiency, easy to operate and affordable price the proposed model of multi-way power hacksaw machine is helpful and completes all the expectations needed in the mini industries. Future scope of proposed research work to increase the production rate, cuts the metal bars easily. It can withstand the vibrations, no hazards from jerk, no special training required to operate it.

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