"AUTOMATIC MOTORIZED HACKSAW MACHINE WITH ADJUSTABLE FIXTURE"

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Abstract: This paper discuss about the 3D Modelling, design and analysis of Automatic Motorized Hacksaw Machine with Adjustable Fixture. Our goal for this paper is to design and fabricate an Automatic Motorized Hacksaw Machine with Adjustable Fixture. For this we calculate the Cutting force, cutting velocity and such a tests like tensile test, wear test, Cutting performance, Hardness test, etc. In our project, we are focusing in making Adjustable fixture to produce maximum 45 degree cut and use for the less time consuming to change the component frequently. This is our concept for evolution in hacksaw machines future.

In this project we have prepared solid model of project solid model of project assembly by using SOLID EDGE ST9, SOLIDWORKS software. The snapshot of every component are attached in the file in design section. The model consist of Motor, Chain, Gears, Shaft, Bearing, Link mechanism, connecting road, crank shaft, hacksaw, Blade HSS, Fixture. From this we fabricate conceptual model of Automatic Motorized Hacksaw Machine with Adjustable Fixture. Adjustable Fixture if one of the new technique proposed in design in order to archive accurate angle to cut with adjustable fixture and get friendly cutting process. It should be user friendly without any risk and worker manual Effort can be used easily automatically. In conventional machine of Hacksaw is time consuming process but from this attachment we can save production time, from this attachment we can use in also lathe machine with suitable fitting. 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

Index Terms - SOLIDWORK[1], SOLIDEDGE[2], Adjustable Fixture[3], Force[4], Velocity[5], Test[5].

I. INTRODUCTION

This paper is basically worried about the upset outline process and assembling machine of Automatic Motorized Hacksaw Machine with Adjustable Fixture. Prototype which can be defeated the issue of adjustable fixture and cutting effect of hacksaw in procedure of manufacturing. A conceivable arrangement of the issue of moderate cutting angle at various plate and various undetermined shapes of cutting. 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 labourers.

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 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.

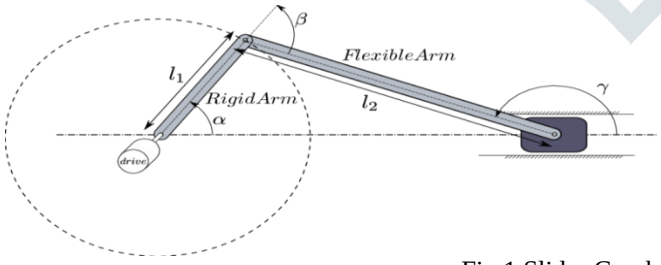


Fig.1 Slider Crank Mechanism

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

- To determine of cutting velocity and cutting forces.
- To determine time required for the various operations.
- Prepare the modelling of project on Solid edge and solid works an analysis in ANSYS.
- Automation with less men power.
- Low initial and operating cost.
- Time required in less useful in mass production.

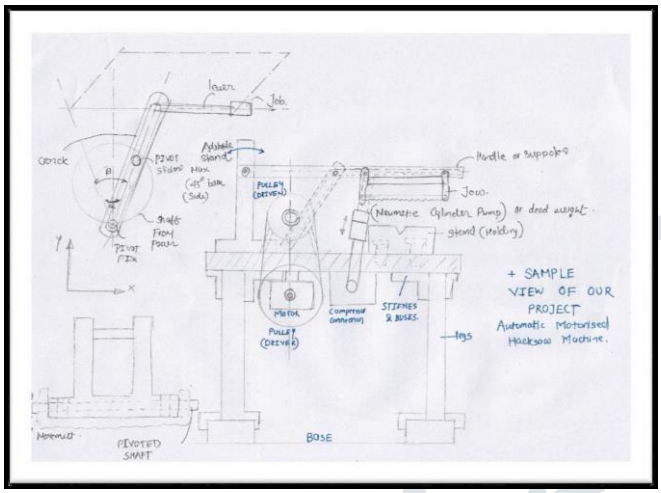
II. PROJECT METHOD & COMPONENTS

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

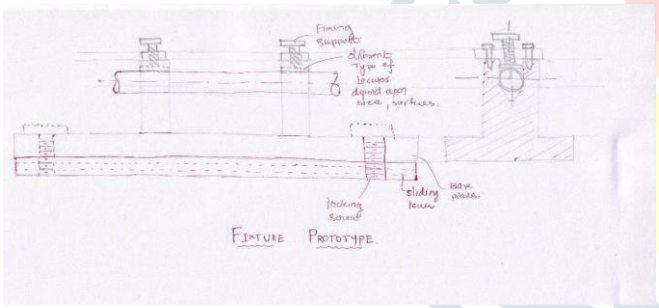
The basic design for automated hacksaw machine is have motor fixed on the base of fabricated table and motor shaft in insert in driving pulley to the driven pulley for power transmission with chain drive. Driven pulley is attached to the counter shaft with roller bearings. This counter shaft one end pivoted with rocker arm, with this rocker arm attached connecting road help of pivot joint, connecting road attached with hacksaw assembly. Hacksaw assembly attached on linear horizontal circular bar at cantilever support. Main function of attachment of adjustable fixture on base of fabricated body.

Schematic Diagram

- Fig.2 Basic Hacksaw Machine



- Fig.3 Adjustable Fixture



2.1 Components

1. DC motor
2. Chain drive with driven and driving pulley
3. Hacksaw
4. Adjustable fixture
5. Motor drive shaft

Fig.4 Automatic Motorized Hacksaw Machine with Adjustable Fixture

2.1.1 DC Motor

A DC motor is any of a class of rotational electrical machines that believers coordinate current electrical vitality. A DC wiper gear motor is used which having 70 rpm speed and runs on 96 watt power and transmits 13.09 N-M maximum torque.

2.1.2 Hacksaw

In the project we have used hacksaw blade to cutting a MS bimetallic material with High carbon steel of manufacturing operation in manufacturing industries.

2.1.3 Chain drive with driven and driving pulley

This is drive chain drive mechanism where the two gears are attached at same parallel to drive a motion.

2.1.4 Adjustable fixture

Adjustable fixture is our main concept to develop an adjustable cutting at various angles so that archive a moderate and finished cutting product.

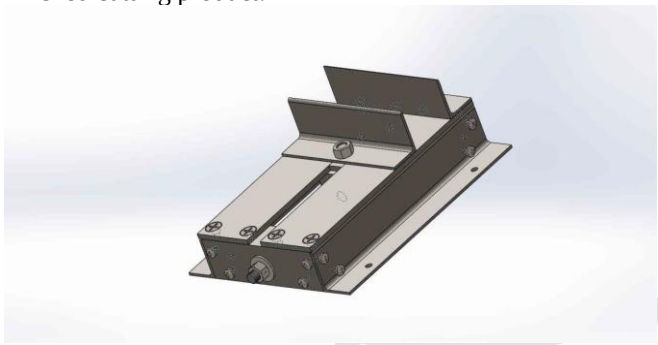


Fig.5 Adjustable fixture

2.1.5 Motor Drive Shaft

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 chain drive mechanism to the link to give linear motion to the hacksaw.

- The most reliable design of Automatic Motorized Hacksaw Machine with Adjustable Fixture are described below along with their specification in order to show the different existing approaches to the small and portable Automatic Motorized Hacksaw Machine with Adjustable Fixture concept. These data could be useful when performing the initial sizing in the design stage of Automatic Motorized Hacksaw Machine with Adjustable Fixture.
  - Length- 1270mm
  - Width- 600mm
  - Height- 240mm
  - Motor- 12V, 70 RPM, DC Motor.
  - Driving and Driven Pulley- 85mm
  - Shaft length- 320mm
  - Connecting Rod- 340cm
- Material Cast Iron
- Distance between to pulley 200mm

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III. DESIGN OF MACHINE

3.1 Calculation

a) To calculate maximum torque by motor

Motor rating,
Data:-
N = 70 RPM
V = 12v
I = 8 A

Power transmitted by motor,

$P = V \times I$
$P = 96\ watt$
$p = \frac{2\pi NT}{60}$
$96 = \frac{2\times\pi\times70\times T}{60}$
$T = 13.09$ Nm

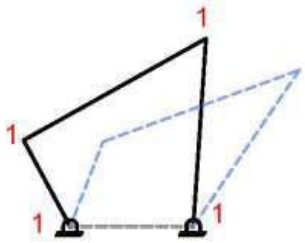
b) To calculate maximum torque by motor

We use a Crank-Rocker mechanism for the Power Hacksaw. Grumbler's equation. This equation is used to find the Degrees of freedom of a mechanism.
N= Number of Links (including ground link).

P = Number of Joints (pivot connections between links).

- Each link has 3 degrees of freedom.
- Each pivot subtracts 2 degrees of freedom.

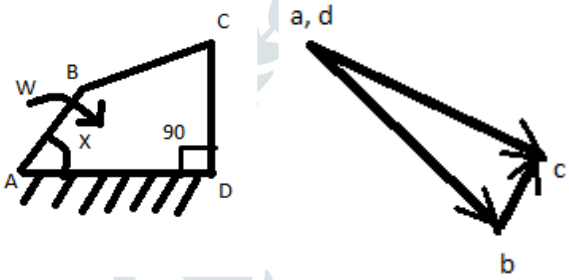
DOF = 3(N-1) - 2P



N=4, P=4 $DOF = 3(4-1) - 8 = 1$

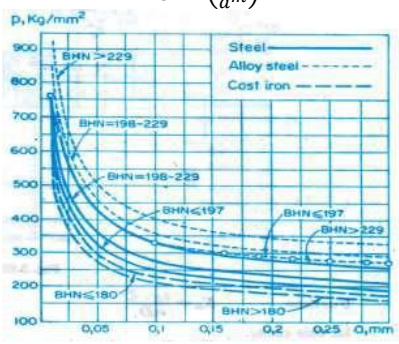
c) Velocity Analysis

- Optimum speed for cutting from the motor for cutting mild steel = 70 Rpm.
- Speed of the crank w= 7.85 rad/sec v= 0.746 m/sec.
  Using Graphical method velocity of the rocker arm where the frame is pivoted = 0.355 m/sec.
  Consider for the position shown below
  AB = 90 mm, AD = 335mm, BC = 295mm, CD = 190mm
  From the above velocity diagram dc = 500mm,
  We know that 'dc' and 'de' are in the same ratio of lengths DC and DE Therefore $^{de}/_{135} = {}^{500}/_{190}$, then we get de = 355.26 mm/sec.
  Hence 'de' = Velocity of the pivoted point of frame on the Rocker = 0.355 m/sec.



d) Force Calculation

From the modified second law of cutting force,
$Fz=(po \div am)\times A$
Now,
$A=a \times (\Sigma zb)$
Where, a = rise per tooth
$\Sigma zb=b \times Zc$
Where, Zc= Number of cutting teeth
b = width of teeth in 'mm'
The value of $K_s = \left(\frac{P_o}{a^m}\right)$ is show following figure, Where force to be evaluated,



$$F_z = K_s \times a \times (\Sigma^z b)$$

The force F_z can be expressed in Granovsky's form derived from First Law of Cutting Force, then

$$F_z = C_z \times s^u \times (\Sigma b) \times K_H \times K_y \times K_a \times K_w \times K_c$$

The values of constants **C_z, U and V** can be determined from the Table 3.1 and the values of **K_H, K_γ, K, K_w** and **K_c** Can be determined from the following tables,

Here, C_z = 202; u = 0.85; v = 1.00

$\boldsymbol{K_H = 1}$; $\boldsymbol{K_y = 1}$; $\boldsymbol{K_a = 1, K_w = 1\ and\ K_c = 1.33}$

Feed, S = 0.35526 m/sec = 5.921 x 10^{-3} m/min

(From cutting speed obtained in Velocity Analysis)

$F_z = C_z \times s^u \times (\Sigma b) \times K_H \times K_y \times K_a \times K_w \times K_c$

Required Cutting Force,

$F_z = 170.609\ kg$

$F_z = 1673.67\ N$

IV. Model And Analysis

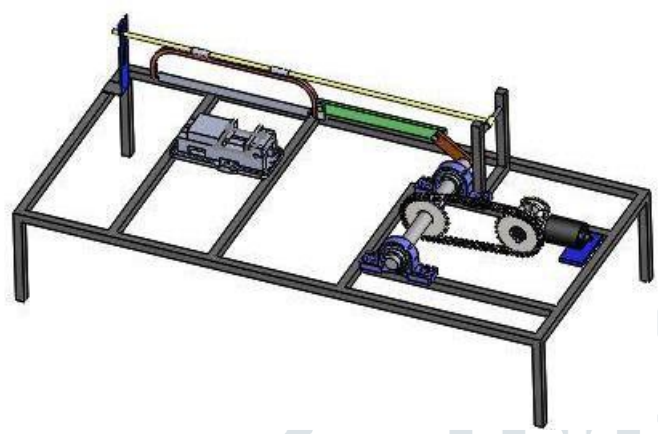
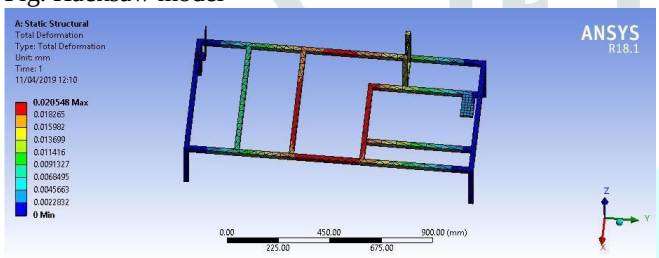


Fig. Hacksaw model



Fig, Analysis Of Base

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V. Result Discussion

Hardness Test:

➢ High speed steel blade and alloy steel blade having hardness of order of 65 HRC is higher than other materials. Hence, HSS is the best as far as the hardness of tooth is concerned. So, for cutting harder work piece like mild steel etc., best option is to employ HSS material blade.

Cutting Performance:

➢ HSS blades cut both ferrous as well as non-ferrous materials with minimum cutting time.

Wear Test:

➢ so, for cutting ferrous materials HSS and Bi-metallic blades are best in wear consideration also for cutting non-ferrous materials either high carbon steel or alloy steel is good as far as the wear is concerned.

Tensile Test

➢ HSS blades are superior as far as the tensile strength is concerned.

Performance under Buckling

➢ HSS having maximum deflection of the order of 30 mm. So, HSS blades are better under buckling than others.

Hardness	Best
Tensile Strength	Better
Response under Buckling	Best
Cutting Performance (M.S., Al , Br)	Good
Wear Resistance	Good

VI. ADVANTAGES AND DISADVANTAGES AND APPLICATIONS.

5.1 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.

5.2 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.

5.3 APPLICATION

- To perform the cutting operation.
- To perform cutting at angle with adjustable fixture
- To perform fast cutting operation etc.

VII. CONCLUSION

It is known that conventional hacksaw machine can be replaced with automatic power hacksaw machine with adjustable fixture. Automatic power hacksaw machine gives high productivity in short time period in comparison with the conventional hacksaw machines. The major advantage of this machine is that intervention of labor is reduced to maximum level and take flexibility in the cutting. In this rapid emerging industrial era, 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 automatic machines. The automatic 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 automatic hacksaw machine can be varied by changing the blade size. Currently, the machine uses 12 inch blade for cutting. Extra feature is fixture adjustable.

VIII. FUTURE SCOPE

- To achieve more flexibility.
- The machine can be fully automated by using Microcontroller
- The operator need to only enter the two input namely the number of pieces to be cut and the length of each piece that is required to be cut.
- Machine will automatically feed the given length of work-piece and start to cut till the given number of work-pieces will be cut.

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