# Design of 4 Way Automated Multiple Hacksaw Machine

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**Abstract: In this work develop a four-way automated hacksaw machine which can be used to increase productivity. The aim of this project is to develop a machine capable of carrying out uniform cutting operations on various materials like metal, PVC, wood. We also want to show the difference between a traditional hacksaw, manual hacksaw and multiple hacksaws. In this study, convert the rotational motion of the crank to a reciprocating motion by using Scotch Yoke Mechanism. Hacksaw machine operate on 4 hacksaws at the same given time and increase output. Machine also have significantly less vibrations and jerks. This machine worked on electricity so there will be less losses comparatively to traditional hacksaw machines. Because of its ability of cutting various materials, increasing productivity with less labor many industries will be interested in this machine. So, to achieve these goals we are developing a "4- way automated multiple hacksaw machine".**

***Keywords — Hacksaw machine, 4-wayOperation, Design, Scotch Yoke Mechanism, Material, Productivity.***

## I. INTRODUCTION

A hacksaw is a saw with thin teeth, originally and primarily design to a cut metal. Most hacksaws are hand saws with a C-shaped walking frame which keeps a blade tensioned. These hacksaws have a handle, typically a gun handle, with pins to secure a narrow disposable blade. The frames can also be adjusted for blades in different sizes. In hacksaw, like most frame saws, the blade can be mounted with the teeth oriented towards or away from the handle, resulting in cutting action on either the push or pull stroke. In normal operation, by cutting vertically downwards with work held in a bench vice, hacksaw blades are oriented forward. There are four types of blades based: High Carbon steel, Alloy Steel, Bimetallic strip and High-speed steel blades. Among these four the best suited for cutting Bi-metallic hard materials blade based on material properties, Wear resistance and Cutting performance [4]. In today's world, almost everything is automated, even hacksaws were automated by inventing power hacksaw. In industries there is need for high production so power hacksaw is used for cutting operations. A power hacksaw (or electric hacksaw) is a type of hacksaw that is powered either by its own electric motor or connected to a stationary engine. Most power hacksaws are stationary machines but some portable models do exist. Stationary models usually have a mechanism to lift up the saw blade on the return stroke and some have a coolant pump to prevent the saw blade from overheating. But now in the current scenario we need more than just automation, we need to save time and save money. So, to help in this cause a need for 4-way automated multiple hacksaw is felt. It overcomes all the limitations and disadvantages of conventional hacksaw machines, it is also useful for small industries due to its simple working and operating conditions as well as its compatibility, efficiency and affordable price. It overcomes the limitations of conventional hacksaw that can cut one piece at a time. It can cut metal bars from different materials at the same time and will be useful in many areas thanks to its compatibility, reliability and efficiency[1]. In a regular conventional hacksaw machine, we encounter issues like power loss, hydraulic leakage, our project will overcome those issues. The machine has the ability of cutting 4 materials at same time of different and same material. We have selected this project to increase the production rate in industries while decreasing cost. Automated hacksaw machines give high productivity as compared to traditional hacksaw machines. In this current industrial scenario of rapid use of power hacksaw machine is wide, time and labor play an important role in production [2]. Industries mainly are looking for machine with low cost, low maintenance and high productivity. It can also be used in remote areas with regular electricity. It is much portable than a regular power hacksaw machine and much cheap [3]. In Mechanical Workshop/Technical institute, the designer still faces difficulties in choosing the perfect hacksaw blade material for the trainee use along with trainees to prevent accidents

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and reduce blade failure rates [5]. The aim of the project is the development of a hacksaw which can perform cutting operations uniformly and with less effort. They have also pointed the difference between conventional and fourway hacksaw machine [6].

## II. METHODOLOGY

Our project consists of a framework on which the hacksaw blades will be installed. The blades will be located at all 4 sides of the frame. There is a motor fitted in the center of the frame, which will be powered by regular domestic supply of 240V DC. The motor will have a disc on its top which will be connected to the connecting rods. The connecting rods will be connected to the slider mechanism on which the hacksaw blades will be mounted. The slider will have a dead weight on its end to keep pressure on the blade to help in cutting operation. The bench vice for fixing the work piece will be mounted a support extended from the frame as shown in Fig.1

The DC motor is rigidly placed at the center of the metal frame. The motor speed can be varied as required by the personnel. The motor rotates the disc attached to it in a circular way. The disc has a point through which the connecting rods are connected on it with help of nut and bolt. This allows us to be able to choose if we want to use all 4 hacksaw blades or any no. of blades required. The connecting rods are connected to the slider; these sliders have hacksaw blades attached to them. The rotating disc moves the connecting rod which makes the slides move in reciprocating way. The slider has a dead weight attached to it so that there is a downward force acting on the hacksaw blade to have ease in cutting operation. The vice on which the work piece is to be loaded is fixed on a support which is attached to the main frame.

The Fig.1 shows the rough design of the hacksaw machine to be made. The overall dimension of the total project will be around 1.5 x 1.5 x 0.6 m. The connecting rod connecting the motor and hacksaw can also be removed, so that we can only use the number of hacksaw needed at that moment.

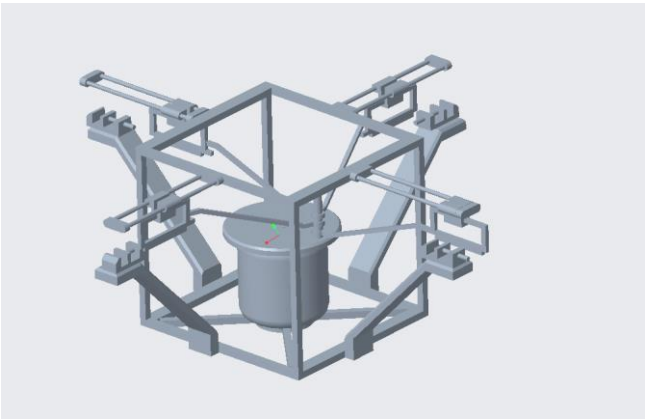

Fig. 1. 3-D model of 4-way automated multiple hacksaw machine

Following are the components used in our 4-way automated multiple hacksaw machine

Table 3.1 – List of components

| Sr. NO. | Component | Material/Details |
|---|---|---|
| 1 | Frame | Mild Steel |
| 2 | 4 Hacksaw Blades | Bi-metallic |
| 3 | Electric Motor | DC motor |
| 4 | Four Guide Ways/ Sliders | Mild Steeel |
| 5 | Disc | Mild Steel |
| 6 | Connecting Rods | Mild Steel |
| 7 | Bushes | Rubber |
| 8 | Vice | Mild Steel |
| 9 | Power supply | 240V |

The Scotch yoke mechanism that is also known as slotted link mechanism, is known to convert the linear movement of a slider into rotating movement or vice versa. In this project the scotch yoke mechanism is used to convert the rotary motion from the disc connected to the rotor to connecting rod, to reciprocating motion of the slider to which the hacksaw blades are attached as shown in Fig 2.

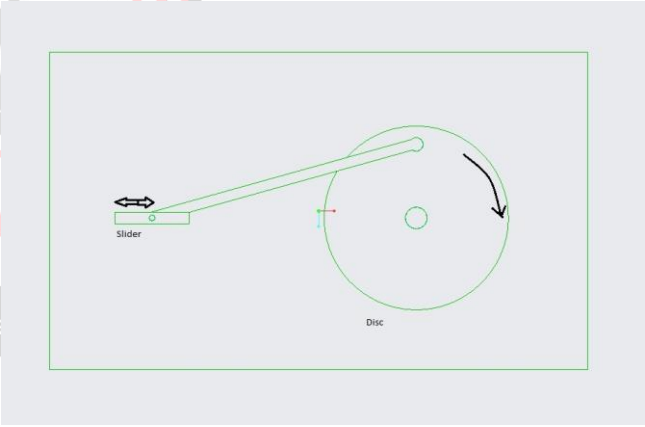


Fig.2 Scotch yoke mechanism

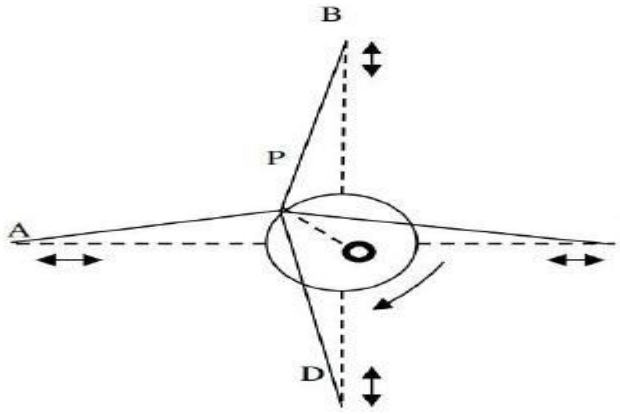


Fig. 3 Top View of Scotch yoke used in this machine

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## III. MATH

A. Equations Used

1) F = τshear x area

Where,

F= Required Force

τshear= Shear Stress

Area = Area on which force is acting

2) ω= 2πN/60

where,

ω = Angular Velocity

N= Rotations Per Minute

3) Vcrank = r×ω

Where,

Vcrank= Velocity of crank

r= radius

ω = Angular Velocity

4) P = F ×Vslider

Where,

P = Power Required for one hacksaw blade

Vslider= Velocity of a slider

5) σb=( M×Y)/Ixx

where,

σb = Stress

M= Moment

Y= Perpendicular Distance

Ixx = moment of inertia about the X-axis of square bar

Iyy = moment of inertia about the Y-axis of square bar

6) $(\sigma b)net=\pm(MY/I)\pm(P/A)$

Where,

(σb)net = Net bending stress

P= Acting Force

A = Area on which force is acting

B. Base Frame Safety Design

M/I= σb/y …….(i)

Bending Moment(M)= Force x Perpendicular distance

= 30 x 9.81 x 600

(M)= 176580 Nmm

I= (b x n^3)/12

= (25 x 25^3)/12

I= 32552.08 mm^4

Y= 25/2= 12.5

Substituting in equation (i),

176580 = σb

32552.08 12.5

σb=67.80 Nmm

∵67.80< 105

Hence, design is safe

C. Square bar Safety Design

M/I= σb/y….(i)

Bending Moment(M)=Force x Perpendicular dist,

=5 x 600 x 9.81

M= 29430 Nmm

I= (b x h^3)/12

= (600 x 25^3)/12

I= 781.25 mm^4

Y= 1.5

Substituting In eq, (i),

29430 = σb

781.25 1.5

σb=56.5 Nmm

∵ 56.5 < 105

Hence, design is safe

D. Disc Safety Design

M/I= σb/Y

M= Force x Perpendicular distance

= 10 x 9.81 x 150

M= 14715 Nmm

I= (M x R^2)/4

= (14715 x 150^2)/4

= 822771.87 mm^4

Y= 300/2= 150

Substituting in eq,

14715 = σb

822771.87 150

σb= 26.6 Nmm

∵26.6<105

Hence, design is safe

## IV. RESULT AND DISCUSSION

The project on 4-way automated multiple hacksaw machine has been fabricated to overcome some of the problems of conventional hacksaw machine. It is highly efficient and easy to operate. This machine will be very helpful and complete the expectations of most industries. To have even better results a good cutting fluid should also be used along so that there is no overheating of cutting tool and work piece, which will ensure that the cutting tool will have a long life than usual. It is much cheap as compared to regular power hacksaw machine and also requires low maintenance. It will help increase productivity of company. Once setup it will also have no power losses and less vibrations. This machine will mainly be much useful to the small- scale industries and workshops.

## V. CONCLUSION

On all the above we can finally conclude that this purposed machine will only aim in helping the industrial world. This project helps to introduce a way in which we

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can complete 4 times work more than a conventional hacksaw machine. It will also produce less vibrations and jerks during cutting operations as compared to regular hacksaw machine.

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