Design and Development of 4-Way Hacksaw Machine with Shaper Attachment

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Abstract— Many industrial application where round bar or square bar are required to be operated on a different machine to make machine components such as the shaft, bolts, screws etc. and also in wooden industries to cut the wooden piece for a different domestic application. This needs more and more number of pieces to be cut for mass production of the components. To achieve this goal we design and develop 4-way hacksaw machine which is able to cut 4 pieces (may be of same or different materials) simultaneously with a very less time consumption. Also, this model deals with modification and development of shaper machine. In conventional shaping machine, the cutting action is performed but the tool only in forward direction and return stroke is idle. This attachment is developed for to get cutting in return stroke as well as cutting in forward stroke. This attachment is also increased productivity and help in many industries due to its reliability, efficiency, compact in size and compatibility. So, the objective of this project is to save manpower and time for cutting metal and shaping in order to achieve high productivity.

Key words: Square Rod, Hacksaw-Blade, Shaper Tool, Motor, Belt, Gear Box, Bevel Gear, Vice

I. INTRODUCTION

For cutting and shaping of different materials with a higher rating, improvement in accuracy and efficiency because of minimization in an idle time of the machine, the cutting time for conventional hacksaw machine and shaper machine is relatively more. Therefore, productivity is less. So our effort is to reduce the cutting time and increase productivity. In this machine, we are using scotch yoke mechanism and with the help of this mechanism, the limitations of conventional hacksaw machines are minimized. This machine can be helpful in many small-scale industries as it operates in four different directions simultaneously. Hence, rapidness and quick working are most important. For achieving this, we are using a worm and wear gear mechanism to transmit power at a right angle to run scotch yoke mechanism.

A. *Objectives*

- To develop two machining process is made in one machine with the help of scotch yoke mechanism.
- We can operate four hacksaws and four shaper tool simultaneously.
- To reduce the human effort and provide safety to the operator.
- To reduce time consumption, floor area, man power and increase productivity.

B. *Statement of the problem*

There are many industrial where round bar or square bar are required to make machine components such as shaft, bolts, screws etc. and also in wooden industries to cut the wooden piece for the different domestic application. To achieve this goal we design and develop 4-way hacksaw machine which is able to cut four pieces. Also, this model deals with modification and development of shaper machine. In conventional shaping machine, the cutting action is performed but the tool only in forward direction and return stroke is idle. This attachment is developed for to get cutting in return stroke as well as cutting in forward stroke. This increased productivity and help in many industries due to its reliability, efficiency, compact in size and compatibility.

II. DESIGN METHODOLOGY

4-Way hacksaw with shaper is a mechanical device which gives multi-operation task as a single mechanism with less effort. Single driver gear with four driven members are operated via single power output. Scotch-yoke mechanism is operated for cutting operation done with less effort and also it provides enough reverse stroke power. Here power during the reverse stroke can be utilized as shaper attachment compound with that besides arm. The operation takes place with the best comfort with a mechanism and dual operations.

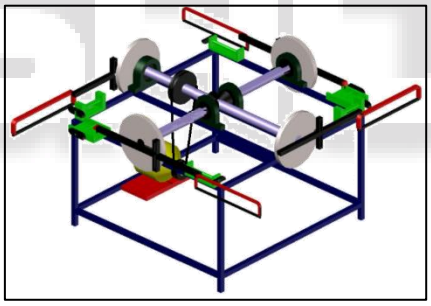

Fig. 1: 4-way Hacksaw Machine with Shaper Attachment

A. *The design of hacksaw blade*

Consider hacksaw blade under axial load. So due to axial load hacksaw blade will bend.

Axial force (p),

Maximum permissible deflection (e),

With the help of a maximum permissible deflection, we can find the critical load.

1) *Assumption*

Length of blade l=400 mm

As per standard,

72 teeth

TPI (teeth per inch) =5

Width=32 mm

Thickness=6 mm

a) Moment of inertia for blade,

$$I_{min}=bd^3/12 \quad (1)$$

Where b=32 mm, d=6 mm

$$I_{min}=576\ mm^4$$

b) Cross sectional area of blade,

$$A=b*d \quad (2)$$

$A=192\ mm^2$

c) Sectional modulus,

$Z=I_{min}/d/2$ (3)

$Z=576/3$

$Z=192mm^3$

d) Radius of gyration

$K^2=I/A$ (4)

$K=3\ mm^2$

2) For high carbon steel blade

– Data available for HCS,
– Stress, σ_1= 160 MPa & σ_2= 609.114 MPa
– Strain, ε_1 = 0.00612, & ε_2 = 0.0142
– Modulus of elasticity(E) =

$\sigma_2 - \sigma_1 / \varepsilon_2 - \varepsilon_1$ (5)

E=609.11-160 / 0.0142-0.00612

$E=55.58*10^3$ MPa

a) Euler's eq^n for critical load,

$P_c=n\prod 2EI_{min}$ (6)

Where l=400 mm, n=1(because fixed on both side)

P_c=1396.95 N.

b) Bending moment,

(M) =Fc*Z (7)

For HCS material, Fc=300 MPa

$P_c*e_{max} = F_c*Z$ (8)

$1396.95*e_{max} = 300*192$

E_{max}=4.123mm

B. Dimension of scotch yoke mechanism: Stroke length of hacksaw, L=152.4mm

By referring hacksaw mfg. catalogue,

L=2r; where r= radius

Therefore, R=76.2mm

Diameter of scotch disc, D=152.4mm

Connecting rod length, L_r=300mm

Thickness of disc, T_s=0.022D to 0.033D=4mm

Inner diameter of yoke pin, $d_{ip}=2T_s$, dip=2x4=8mm

Outer diameter of yoke pin, $d_{op}=2.5T_s$ to $3T_s$=2.5x4 to 3x4=12mm

Length of yoke, L_y=D=152.4mm

Angular velocity of scotch disc,

$\omega=2\prod N/60$ (9)

Where N=speed of connecting rod=1400rpm

ω= 2x3.14x1400)/60

ω=146.33 rad/s

III. REVIEW

This attachment is developed for to get cutting in return stroke as well as cutting in forward stroke. This increase productivity and help in many industries due to its reliability, efficiency, compact in size and compatibility. Therefore this paper concentrates on the review of modelled and analyzed mechanical component.

D.V.Sabariananda, V.Siddhartha, B.Sushil Krishnana, T. Mohanraj [1] The objective of this work is to automate the conventional power hacksaw machine in order to achieve high productivity of work-pieces than the power hacksaw machine using Microcontroller. The operator need not measure the length of the work-piece that is to be cut and to load and unload the work-piece from the chuck each time after a piece has been cut. . A pneumatic cylinder is used for holding the work-piece when cutting operation is done. An AC motor is used to bring about the reciprocating motion required for cutting the work-pieces. There is a self-weight attached with the reciprocating mechanism to provide the necessary downward force required for penetration of hacksaw blade into the work-piece.

R. Praveen Kumar, G. Navaneetha Krishnan, V. Venkadesh and N.Premkumar [2] develop a dual side water pumping system using scotch yoke mechanism. The reciprocating motion of the plunger is utilized for the pumping action. The plunger is reciprocated with the help of a cam plate. By this action, the water is pumped with very high pressure and to various heads. This can be utilized for various applications like lubrication in machines and water pumping in the agriculture field.

Avilasha B G, Dr. Ramakrishna D S [3] measurement of the load acting on machines and structures is important from many considerations. When the load or forces are to be measured, a load cell is to be placed in the load path. The load measurement involves identification of the critical component in the load path. While the process of load measurement is not straightforward in the case where the known load is cannot be applied, inverse FEM is to be adopted for the case where applied load is not known. Once the critical component in the load path is identified, electrical resistance strain gauges are mounted in an appropriate fashion to get maximum output for an applied load. The finite element analysis done for hacksaw machine with proper boundary conditions and the strain data are taken for series of loads and then these values are compared with the experimental strain value and the unknown load was estimated.

Prof. Dipak Patil1, Swapnil Raut2, Shrikant Jadhav, Gaurav Kulkarni, Pankaj Shinde[4] changes in conventional hacksaw machine into multiday hacksaw machine. This machine is able to cut multiple elements at a time with different strength. Due to an optimization we take it to improving quality and its performance in optimum sources.

T. Mohanraj, V. Siddhartha[5] using Scotch Yoke Mechanism. we can operate four hack saws at the same time.

H G Chothani, B B Kuchhadiya, J R Solanki[6] researchers for proper material selection. The selection of an optimal material for an engineering design from among two or more Alternative materials on the basis of two or more attributes is a multiple attribute decision making (MADM) problem. Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit the use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

IV. CONCLUSION

From critical literature review it is concluded that there is, we are concluded that to overcome problems in conventional hacksaw and shaper machines due to high efficiency, easy to operate and less price the proposed model of '4-way hacksaw machine with shaper attachment' is helpful and complete all the expectations needed in small industries as it overcomes limitations of conventional hacksaw machine.

ACKNOWLEDGMENT

It is a privilege for me to have been associated with Prof. Swapnkumar S. Sonara, Asst. Prof. Mechanical Engineering Department, NTC vadodara, during this paperwork. I have been greatly benefited by his valuable suggestions and ideas. It is with great pleasure. I express my deep sense of gratitude to him for his valuable guidance and constant encouragement throughout this workThe preferred spelling of the word "acknowledgment" in America is without an "e" after the "g." Avoid the stilted expression "one of us (R. B. G.) Thanks." Instead, try "R. B. G. thanks". Put sponsor acknowledgments in the unnumbered footnote on the first page.

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