engineering proceedings

MDPI

Proceeding Paper

Design and Fabrication of Four-Way Hacksaw †

P. H. J. Venkatesh [1,*], M. Tarun [1,2], R. Rudrabhi Ramu [1] and Bathula Vineela Rathan [1]

[1] Department of Mechanical Engineering, Vignan's Institute of Information Technology (A), Visakhapatnam 530049, AP, India; maruvadatarun@gmail.com (M.T.); ramumittuusha@gmail.com (R.R.R.); vineelarathan16dec@gmail.com (B.V.R.)
[2] Department of Mechanical Engineering, Gayatri Vidya Parishad College of Engineering (A), Visakhapatnam 530048, AP, India
* Correspondence: venky61788@gmail.com
† Presented at the 5th International Conference on Innovative Product Design and Intelligent Manufacturing Systems (IPDIMS 2023), Rourkela, India, 6–7 December 2023.

Abstract: Automatic power hacksaws are made for cutting different materials into different sizes. The main aim of making this machine is to save human effort, space, and time when cutting various materials to increase the amount of work that can be carried out. A special motor turns the hacksaw blade, and the circular motion of the motor is changed into a back-and-forth motion by a crank and a link connected to the saw. Engineers designed this machine using AUTO CAD 23.0 and it can cut materials that are between 10 mm and 14 mm thick. There are sensors on the machine that can detect when the cutting is finished, and a coolant is used during the cutting process.

Keywords: power hacksaw; cutting materials; CAD software; coolant; machine

Citation: Venkatesh, P.H.J.; Tarun, M.; Ramu, R.R.; Rathan, B.V. Design and Fabrication of Four-Way Hacksaw. *Eng. Proc.* **2024**, *66*, 17. https://doi.org/10.3390/engproc2024066017

Academic Editors: B. B. V. L. Deepak, M. V. A. Raju Bahubalendruni, Dayal Parhi, P. C. Jena, Gujjala Raghavendra and Aezeden Mohamed

Published: 8 July 2024

1. Introduction

A hacksaw is a saw with small teeth mainly for cutting metal. It is similar to a circular saw but for woodwork. The blade in most hacksaws is held tight by a C-shaped frame [1,2]. These hacksaws use pins to hold a slim, disposable blade to a handle, which is usually shaped like a pistol. The frames can change to fit different blade sizes. A screw or similar object tightens the thin blade. In hacksaws, like many frame saws, the blade can point towards or away from the user. It can be used by pushing or pulling the handle [3–5]. A hacksaw is a hand tool used for cutting materials like plastic tubes and metal pipes. It has removable blades with sharp teeth. Normally, it consists of a metal frame with a downward-facing blade [6–8]. A handle made of plastic, wood, or metal is usually attached at one end of the frame. The frame's ends have adjustable pegs to hold the blade tight or loose for removal. Each end of the blade has a small hole that fits onto the saw frame's pegs [9].

2. Methodology

The geometry of the proposed hacksaw and its assembly model is presented in Figure 1.

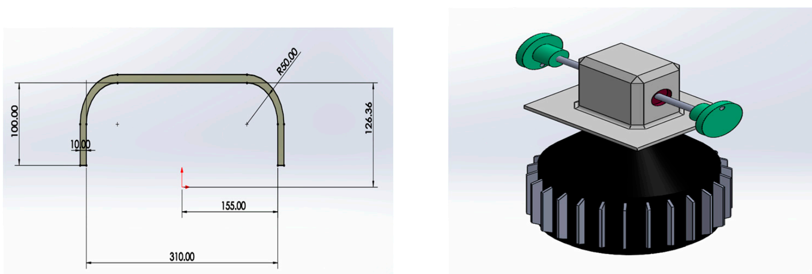

Figure 1. Hack saw frame dimensions and its assembly model [9].

3. Results

3.1. Velocities of Sliders [10–12]

Considering cutting stroke length, L = 30 mm
We know that $L = 2\,r$
Where r = crank radius. Therefore, r = 15 mm
Connecting rod length = 220 mm
For speed, N = 400 rpm
$\dot{\omega}$ = 42 rad/s

3.2. Velocity Diagrams [4,5]

Therefore, the velocity of "p" with respect to "o" Vp = 1.5 m/s
Vap = 0.41 m/s
Vbp = 0.45 m/s
Vcp = 0.43 m/s
Vdp = 0.54 m/s

3.3. Total Force [3]

INERTIA FORCE
F = ma
Where $n = L/r$= 220/15
Therefore, a = 52.95 m/s^2
Now, inertia force is F = ma = 2 × 52.95
F = 105.9 N
F = μN for mild steel (μ = 0.5 to 0.8)
F = 42.32 N

3.4. Cutting Force

Cutting force required
$Fc = Z \times K \times A \times f$
Fc = 300 N

3.5. Total Required Force

F = cutting force + inertia force + friction force
F = 448.22 N

3.6. Initial Torque

Power required
P = ($F \times V$) A + ($F \times V$) B + ($F \times V$) C + ($F \times V$) D
P = 738.07 Nm/s
P = 1 HP
Therefore, torque is required.
T = 17.80 N-m
The results of the above are listed in Table 1.

Table 1. Values [9].

S.no	Type of Force	Values
1	Velocity of sliders	$\dot{\omega}$ = 42 rad/s
2	Friction	42.32 N
3	Inertia force	105.9 N
4	Cutting force	300 N
5	Total required force	448.22 N
6	Torque required	17.80 N-M

4. Conclusions

A reduced cutting time per unit of work piece translates to a decreased machine idle time, thereby enhancing efficiency and reliability. To address issues encountered with conventional hacksaw machines, such as their inefficiency, complexity, and costliness, a novel solution is proposed: the four-way hacksaw machine. This innovative model proves invaluable in mini-industries by fulfilling all operational requirements while bolstering production and simplifying metal bar cutting. Notably, it can withstand vibrations, eliminates jerking hazards, and demands no specialized training for operation. Its primary advantage lies in minimizing labor intervention to the utmost extent.

Author Contributions: P.H.J.V., M.T., R.R.R. and B.V.R. contributed equally to this manuscript. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all informants involved in the study.

Data Availability Statement: The original contributions presented in the study are included in the article: further inquiries can be directed to the corresponding author.

Conflicts of Interest: The author declares no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. Chaudhary Pravinkumar, K. Volunteers in Technical Assistance. In *Understanding Pedal Power*; Technical Paper 51; VITA: Arlington, VA, USA, 1986; ISBN 0-86619268-9.
2. Bahaley, S.G.; Awate, D.A.U.; Saharkar, S.V. Performance Analysis of Pedal Powered Multipurpose Machine. *Int. J. Eng. Res. Technol.* **2012**, *1*, 2278-0181.
3. Ambade, R.; Sartabe, A.; Arekar, M.; Khachane, V.; Gawali, P. Design & Fabrication of human powered multi-purpose Machine. *Int. J. Adv. Technol. Eng. Sci.* **2015**, *3*, 293–297.
4. Subash, R.; Meenakshi, C.; Samuel Jayakaran, K.; Venkateswaran, C.; Sasidharan, R. Fabrication of pedal powered hacksaw using dual chain drive. *Int. J. Eng. Technol.* **2014**, *3*, 220–223. [CrossRef]
5. Domazet, Z.; Luksa, F.; Susnjar, M. Failure analysis of rolling mill stand coupling. *Eng. Fail. Anal.* **2014**, *46*, 208–218. [CrossRef]
6. Sreejith, K. Experimental investigation of pedal driven hacksaw. *Res. Inventory Int. J. Eng. Sci.* **2014**, *4*, 1–5.
7. Kshirsagar Prashant, R.; Rathod Nayan, J.; Rahate Prashant, P.; Halaye Prashant, P. Theoretical Analysis of Multi-way Electricity Hacksaw system. *Int. J. Res. Advent Technol.* **2015**, *3*, 37–40.
8. Boyer, H.E. *Metals Handbook 10-Failure Analysis and Prevention*, 8th ed.; American Society for Metals: Metals Park, OH, USA, 1975; pp. 1–10.
9. Anand, R.; Khomesh; Kumar, S.; Verma, A. Theoretical Analysis of Four way Hacksaw Blade Machine. *Int. J. Adv. Res. Innov. Ideas Educ.* **2016**, *2*, 1104–1107.
10. Francis, D.K.; Deang, J.; Florea, R.S.; Gaston, D.R.; Lee, N.; Nouranian, S.; Permann, C.J.; Rudd, J.; Seely, D.; Whittington, W.R.; et al. Characterization and failure analysis of a polymeric clamp hanger component. *Eng. Fail. Anal.* **2012**, *26*, 230–239. [CrossRef]
11. Chavez, J.C.; Valencia, J.A.; Jaramillo, G.A.; Coronado, J.J.; Rodriguez, S.A. Failure analysis of a pelton Impeller. *Eng. Fail. Anal.* **2015**, *48*, 297–307. [CrossRef]
12. Patel, N.R.; Vasanwala, M.A.; Jani, B.B.; Rathwa, M.D.; Thakkar, R.A. Material selection and testing of hacksaw blade based on mechanical properties. *Int. J. Innov. Res. Sci. Eng. Technol.* **2013**, *2*, 2043–2052.