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Design and Fabrication of 2-Way Hacksaw Machine using Scotch Yoke Mechanism

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ABSTRACT: This work focuses on the conceptualization and implementation of a Two-Way Hacksaw, a versatile cutting tool designed to overcome the limitations of traditional hacksaws. The system is engineered for bidirectional cutting, eliminating the need for manual repositioning of the work piece. The design integrates precision components and a robust frame to ensure durability and reliability in diverse metalworking applications. Driven by an electric motor, the hacksaw incorporates a mechanism that facilitates smooth transitions between forward and reverse cutting motions. The bidirectional functionality is achieved through a thoughtful combination of mechanical components, optimizing cutting efficiency and reducing operational time.

The study includes a comprehensive analysis of the system's kinematics and dynamics, with a focus on stroke length, cutting speed, and overall energy efficiency. Experimental validation demonstrates the practical feasibility of the Two-Way Hacksaw, showcasing its potential to significantly enhance productivity in metal cutting processes.

KEYWORDS: Scotch Yoke mechanism, Two-Way Hacksaw, Bidirectional cutting.

I. INTRODUCTION

In the realm of metalworking, the humble hacksaw has long stood as a stalwart companion in the arsenal of tools, providing a versatile means of cutting through various materials with precision and efficiency. However, as industries evolve and demands for increased productivity rise, the limitations of the traditional hacksaw become increasingly apparent. The unidirectional cutting motion inherent in these tools necessitates manual repositioning of the work piece, introducing inefficiencies and time constraints that hinder optimal workflow. In response to this inherent limitation, the integration of a Two-Way Hacksaw utilizing a Scotch Yoke mechanism emerges as a transformative innovation in the landscape of metal cutting machinery. This novel approach seeks to revolutionize the conventional hacksaw's functionality by introducing bidirectional cutting capabilities, thereby eliminating the need for manual repositioning during operations.

The Scotch Yoke mechanism, renowned for its simplicity and efficiency in converting rotary motion into reciprocating motion, serves as the cornerstone of this cutting-edge design. Unlike traditional hacksaws that move in a single direction, the Two-Way Hacksaw harnesses the power of the Scotch Yoke to facilitate seamless back-and-forth motion of the cutting blade. This innovative mechanism not only streamlines the cutting process but also opens up new possibilities for enhanced precision, efficiency, and versatility in metalworking applications. As we embark on a journey to explore the intricacies of this Two-Way Hacksaw with a Scotch Yoke mechanism, it is crucial to understand the driving force behind this design evolution. The bidirectional cutting capability is not merely a cosmetic enhancement but a strategic response to the evolving needs of modern manufacturing. The manual repositioning required in traditional hacksaws introduces a bottleneck in the workflow, limiting the pace at which materials can be processed and impeding overall efficiency.

Transitioning between forward and reverse cutting motions, all made possible by the precision and reliability of the Scotch Yoke mechanism. This introduction sets the stage for a deeper exploration into the intricate design considerations, kinematic analyses, and practical implications of this innovative metal cutting tool. In the subsequent sections, we will delve into the detailed design parameters that govern the functionality of the Two-Way Hacksaw. We will explore the intricacies of the Scotch Yoke mechanism, understanding how it translates rotary motion into the reciprocating motion required for bidirectional cutting. Moreover, a comprehensive analysis of the kinematics and

dynamics of this mechanism will shed light on the theoretical underpinnings of the Two-Way Hacksaw's operation. Safety considerations and ergonomic design principles will also be addressed, ensuring that the Two-Way Hacksaw not only enhances productivity but also aligns with industry standards for user safety and comfort. In essence, the introduction of a Two-Way Hacksaw with a Scotch Yoke mechanism represents a paradigm shift in metal cutting technology. It not only aims to address the limitations of traditional hacksaws but also heralds a new era of efficiency, precision, and adaptability in metalworking processes.

II. RELATED WORK

Wilson et al, studied the vast literature to understand the concepts which effect the performance of the machine The concept of two-way hacksaw cutting machine mainly carried out for production-based industries. Khan; expressed that Industries are essentially implied for generation of valuable merchandise and enterprises at low creation cost, Machinery cost and low stock cost. Information about built up a model of a machine reach would be fit for performing diverse task all the while, and it ought to be monetarily productive. These machines can be utilized as a part of remote spots where power is customary. It is planned as a versatile one which can be utilized for cutting in different spots. It can be utilized for working on materials like thin metals, wood. A solitary stage vertical electric engine unbendingly set at the focal point of metallic establishment gave. Linxu et al.; research about 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. It consists of pedal powered machine setup which has a simple mechanism operate with chain and sprocket arrangement. Chaudhary; learned about the chain is put on the teeth of the hagggle. The pole is mounted on platform direction. To begin with mechanical linkage is evacuated by expelling nut and screws and v belt drive boring connection. It is realized that regular power hacksaw machine can be supplanted with robotized control Hacksaw machine.

III. METHODOLOGY

In contemporary metalworking and manufacturing processes, the conventional unidirectional hacksaw poses inherent limitations, requiring manual repositioning of the work piece for bidirectional cutting. This manual intervention significantly hampers operational efficiency, leading to increased processing time and reduced overall productivity. To address this challenge, there is a critical need for an innovative Two-Way Hacksaw that utilizes a Scotch Yoke mechanism, enabling seamless bidirectional cutting without the need for manual adjustments

1. Power Supply: Represents the electrical power source for the system.
2. Motor and Controller: Includes the electric motor responsible for generating rotary motion and its controller. The controller may consist of an on/off switch and speed control components if needed.
3. Scotch Yoke Mechanism: Core of the system, illustrating the components:
4. Motor Shaft: Connected to the motor.
5. Slider: Moves back and forth in a linear motion.
6. Yoke: Converts rotary motion into reciprocating motion.
7. Connecting Rod: Connects the yoke to the hacksaw blade.
8. Hacksaw Blade: Represents the cutting element driven by the Scotch yoke mechanism.
9. Frame/Chassis: Physical structure holding all components together.
10. Lubrication System: Represents the application of lubricants and greases to ensure smooth operation.
11. Safety Features: May include emergency stop buttons, protective covers, and other safety mechanisms.
12. Output (Cutting Action): Represents the result of the system's operation, which is the reciprocating motion of the hacksaw blade for cutting.

IV. DESIGN CALCULATIONS

CALCULATION

LINEAR SPEED:

$$V=2 \times D/T \quad \text{---1}$$

$$T=60/N \quad \text{---2}$$

Combine 1 & 2

D=Stroke length

T=Time taken for one complete cycle

$$V=2 \times D \times N / 60$$

$$N=60 \times V / 2 \times D$$

Suppose stroke length =100mm

Linear speed $v=200\text{mm/s}$

$$N=60 \times 200 / 2 \times 100$$

$$N=60 \text{ rpm}$$

TORQUE CALCULATION

Power = Torque \times Angular velocity

Torque = Power/Angular velocity

$$\text{Power} = 84 \text{ W}$$

Angular velocity = Speed $\times 2\pi$

$$= 60 \times 2 \times 3.14$$

$$= 376.80$$

$$\text{Torque} = 84 / 376.80, \text{ Torque} = 0.229 \text{ N-m}$$

V. 2-D AND 3-D MODELS

2D CAD Model

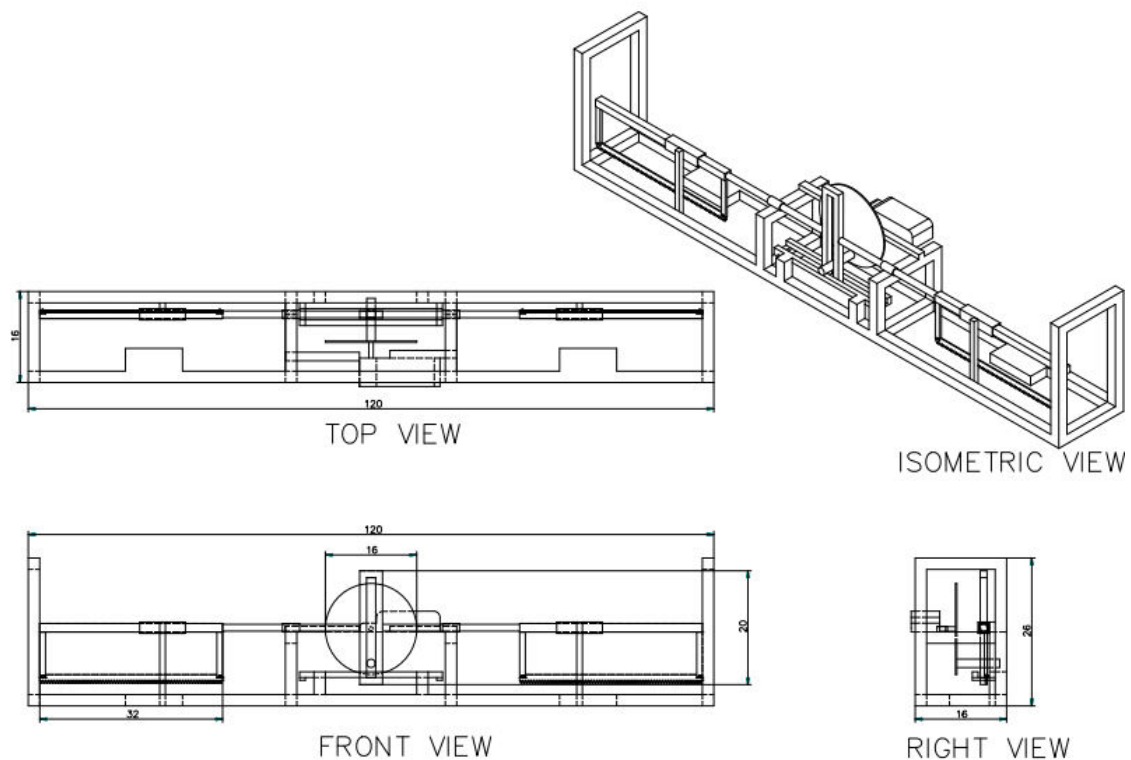


Fig. 1. 2D Cad Model of Complete Assembly

3D CAD Models

3D CAD MODEL OF PARTS

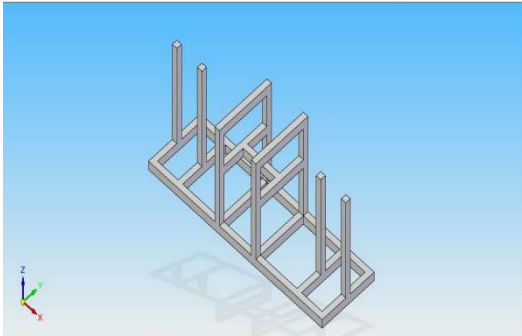


Fig.2. Base Frame

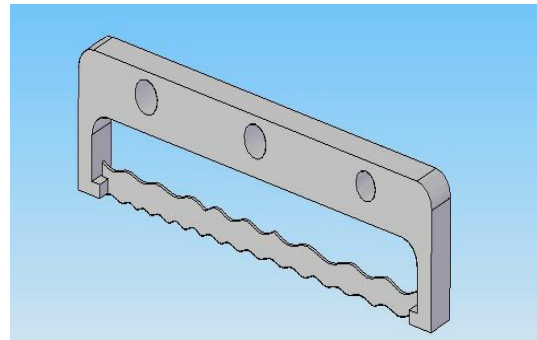


Fig.3. Hack Saw with frame

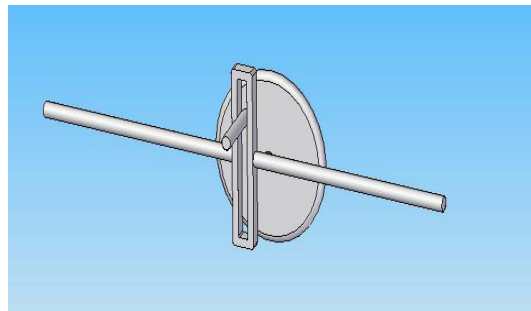


Fig.4.Scotch Yoke Mechanism

3D CAD MODEL OF COMPLETE ASSEMBLY

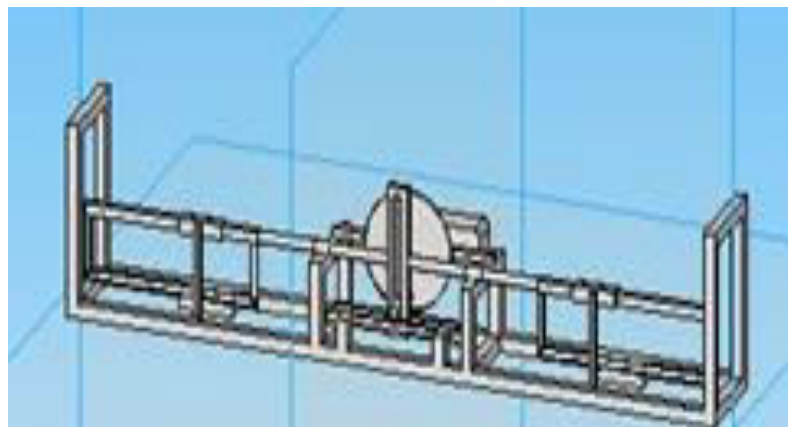


Fig.5. 3-D CAD model of Complete Assembly of Two Way Hack saw machine

VI. FABRICATION & TESTING

Base Frame: Cut mild steel to desired lengths for top, bottom, and sides. Assemble the rectangular frame by joining corners securely by welding .Ensure corners are square for stability and strength. Predrill holes for mounting

components such as the yoke mechanism and crankshaft. Add reinforcement if necessary for extra stability. Mount components securely using screws or bolts. Test movement of the Scotch yoke mechanism to ensure smooth operation. Sand rough edges and apply finish for a polished appearance and protection.

DC Motor: we have used a 60 rpm motor of torque 0.22 N-m.

Hacksaw Frame: choose a good material for strength and durability. And fabricate it according to the required dimensions and weld it in required area.

Slider: Choose a material with low friction properties to ensure smooth movement. Options include nylon, UHMW (Ultra-High Molecular Weight Polyethylene), or bronze. Design the slider to fit securely within the frame's guide rails while allowing for smooth back-and-forth movement. Typically, a rectangular or cylindrical shape works well for a slider. Ensure it matches the shape and dimensions of the frame's guide rails. Drill holes in the slider for attaching the yoke mechanism or any other components that will interact with it. Ensure these holes are accurately placed for proper alignment. Consider adding lubrication to reduce friction and ensure smooth movement. This can be in the form of grease, oil, or self-lubricating materials. Test the slider's movement within the frame to ensure it moves freely without binding or sticking. Make any necessary adjustments to improve performance.

Blades: Hacksaw Blades are attached to hacksaw frame via a screw the blades are selected according to the hacksaw frame dimension which can fit in properly.

Guideways: Determine the length, width, and thickness of the guideways based on the size of the slider and the intended cutting capacity of the hacksaw. Guideways are typically rectangular or cylindrical in shape to provide a stable track for the slider to move along. Ensure they are designed to match the shape and dimensions of the slider for smooth movement. Drill holes in the guideways for attaching them to the frame securely. Ensure these holes are accurately placed to maintain alignment and stability. Ensure the guideways are mounted parallel to each other and perpendicular to the frame's base to prevent binding or uneven movement of the slider.

Battery: Select a battery with sufficient capacity to power the motor for the desired duration between charges. Consider factors such as the motor's power consumption and the frequency and duration of use.

FABRICATED MODEL



Fig. 6. Fabricated base frame



Fig.7. 2way Hacksaw using scotch yoke Mechanism

VII. RESULTS AND DISCUSSION

1. The project two-way hacksaw using scotch yoke mechanism is effectively cutting the wood and PVC pipes.
2. It is taking nearly 3mins to cut PVC pipe of 1cm dia.
3. It is cutting the materials on both the sides successfully.
4. It is easy to install and operate.
5. It is easily portable so that it can be transported easily where ever required.

VIII. CONCLUSION

The two-way hacksaw utilizing a scotch yoke mechanism represents a cutting-edge solution that overcomes the limitations of traditional hacksaws. Its bidirectional cutting capability, combined careful design considerations, ensures improved efficiency, user-friendly and safety. This project stands as a testament to the continuous pursuit of innovation in metalworking technology with implications for diverse applications across industries. The Scotch yoke mechanism offers a simple yet robust method for converting rotary motion into linear motion, resulting in smooth and precise movement of the hacksaw blade. This translates to enhanced cutting accuracy and reduced vibration, leading to improved cutting performance and longevity of the tool.

Moreover, the two-way functionality of the hacksaw allows for increased productivity and versatility in cutting operations. By enabling both forward and backward strokes, it facilitates efficient cutting of various materials, including metals, plastics, and wood, while also minimizing fatigue for the operator.

REFERENCES

1. Nikhil P Varghese, Asif S, Vishnu Anand, Vishnu Uttam, Vinod G Philips. "Design and Development of Multi-Way Hacksaw Machine", International Journal of Engineering Development and Research (IJEDR), ISSN:2321-9939, Vol.8, Issue 7, pp.5610-5615, July 2020, URL: <http://www.ijedr.org/papers/IJCRT2007627.pdf>
2. Sowmya Dhanalakshmi.C; Madhu P; Hemachandran N; Bharathkumaran G; Harisharvinth LB. "Design and Fabrication of Four-Way Hacksaw Machine – A Design Thinking Approach". International Research Journal on Advanced Science Hub, 2, 7, 2020, 126-130. doi: 10.47392/irjash.2020.76
3. Rakesh Ambade, Amit Sartabe, Meghraj Arekar, Vaibhav Khachane, Prajakta Gawali , "Design & Fabrication Of Human Powered Multi-Purpose Machine", International Journal of Advanced Technology in Engineering and Science, ISSN(Online):2348-7550, Volume No 03, Special Issue No.01, April 2015.
4. R.S.Khurmi, J.K.Gupta, (2012) "Theory Of Machines", Page no. 143-168



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