ABSTRACT

The objective of this paper is to design and analyse a four-way hacksaw machine, which is used for cutting materials for developments of components like screws, bolts, shafts, etc. This model fulfils the need to cut more material for mass production, as it has an advantage over the traditional hacksaw machine which does material cutting of only one piece at a particular time interval. In this project, we have designed a modernized four-way hacksaw machine which is able to cut four pieces of the same or different material in the same time interval to achieve the overall process with less time than conventional machines. This model implies a conversion of rotary motion of crank to reciprocating motion of four hacksaw blades by double scotch yoke mechanism. This machine can also do cutting of different kinds of materials.

Keywords - Four-Way Hacksaw, Double Scotch Yoke Mechanism, Mass production, etc

1. Introduction

Nowadays, many electrically operated power hacksaws are available which are so precise that they can cut various materials with minimum time. But for industries to achieve the mass production, they have to focus more on high material production rate and minimum consumption of available resources, in order to increase productivity. Hence, we cannot depend on conventional power hacksaw machine (single frame). Using the multi way power hacksaw machine, we can cut four metal bars simultaneously and hence get a high cutting rate and profit. This machine is also helpful for small scale industries because of its compactness, simple working and operating conditions, and improved efficiency.

1.1 Problem Definition

The primary purpose of design and analysis of four-way power hacksaw machines is to facilitate simultaneous cutting of four work pieces. The application of this model is in reducing manual efforts for machining various materials, manufacturing time and cost of operation. This model is obtained by using dual scotch yoke mechanism. We have also done the kinematic analysis of crank wheel, sliding yoke, motor shaft and hacksaw blade.

2. Literature Review

[1] Tanuj Joshi et al [2018] mentioned that standard hacksaw machines may be replaced with programmable twofold hacksaw machines in comparison to standard hacksaw machines, the programmed twofold hacksaw machine provides excellent efficiency in a short period of time. The true advantage of this machine is that labour intercession is minimised to the maximum extent possible. The use of dual Hacksaw machines is widespread in this fast-developing modern era. Time and work are significant components of the continuing process that might be hampered using such programmed devices. The programmable hacksaw machine may be used in any business, such as furniture manufacturing. By adjusting the sharp edge estimate, you may change the size range of workpieces that can be cut with the programmed hacksaw machine. For the time being, the machine cuts with a 12-inch edge.

[2] Avirana et al [2018] claimed that to solve challenges in traditional hacksaw machines, the proposed approach of cross electric hacksaw machines is beneficial and completes all the expectations needed for the mini industries owing to high productivity, ease of operation, and inexpensive pricing. The projected future scope of research effort to enhance the manufacturing rate simply cuts the steel bars. It can endure tremors, there are no jerk dangers, and no special training is necessary to use it. After reading this report, we must understand how the A hacksaw machine will function, as well as the machine's architecture and functioning. We discovered how the theoretical design may be implemented in practice. Another hacksaw machine could only cut a single part at a time, but this machine could cut four pieces at once. This hacksaw machine is less in weight than previous machines. The machine is inexpensive and simple to use, making it suitable for use in a variety of industries. The material utilised, cast iron, has a stronger strength than alloy steels. This project is highly beneficial and simple to install, and the motor utilised will not only function with the assistance of electricity, but also with conventional sources of energy such as solar energy.
[3] Vijay A S [April 2019] evaluated a four-way hacksaw machine which performs less stress-strain concentration on the test piece with a view to modernize the core mechanical mechanism and tool hacksaw by taking forward the vision of industry 4.0. This model works on the principle of Scotch Yoke mechanism along with the reciprocating movement of the blades to perform more effective, cost effective, proficient and impactful mechanism considering the overall ergonomics of the hacksaw mechanism. Moreover, adhering to the DFMA principles, this paper reduces the components as well as minimises the vibrations and jerks by a significant factor. The setup consisted of a frame on which a hacksaw was mounted with the flare cranks on the centre which was operated by the motor. The power supply was made with the help of a transformer and diodes which resulted in the simultaneous motion of the 4 hacksaws. Thus, conventional manufacturing operation is automated to achieve certain objectives such as good product quality, increase efficiency of the plant, reduced production cost, reduced fatigue of failures, reduce material handling and less maintenance. Pressurized gases are used in pneumatic system to transmit and control power the medium used in these systems essentially air. In conclusion the objective of the project was to fabricate a motorized high speed four-way hacksaw mechanism in order to achieve high productivity of workpieces from the vice each time after a piece has been cut.

3. Methodology
3.1 Components
1. **BASE FRAME**
   Base frames are used for supporting mechanical components and equipment’s, also to provide a platform which will be rigid to attach vibration isolators but without allowing excessive differential movement between driving and driven equipment’s and parts. Also, base is used to stabilize the assembly and to reduce unwanted vibration or motion by lowering the centre of gravity of it. The frame we use here can be made of mild steel which can be also case hardened to improve wear resistance.

2. **HACKSAW FRAME**
   A hacksaw is a fine-toothed saw, originally and mainly made for cutting metal. Adjust the hacksaw frame such that the end post and handle post are slightly more apart than the length of blade. This is done by putting pressure on the end post until the frame releases from notch and can be moved. Set forward and rear blade holders such that pins are perpendicular to the frame. Place the blade onto the forward and rear pins so teeth are facing away from the handle.

3. **HACKSAW BLADE**
   The saw blade is one of the most important components of a hacksaw. Saws are characterized by some things like their material, tooth form, teeth set, tooth spacing and size. The geometry of the teeth is singular to that of the single point tools, that means all teeth’s structure will be the same in one tool. The straight tooth form is suitable for finer pitches whereas the undercut face tooth forms are used for coarser pitches. Undercut tooth form is better from a design point of view, because the cutting edges are backed up by more metal. It is very difficult to have this tooth form if teeth are very small in size.

4. **CRANK WHEEL**
   In this project, a small pin is attached perpendicular to the plane of the disc. When the disc is rotated with the use of a motor by connecting it with the pulley drive, it will rotate with a particular angular velocity because it has a difference in distance between the centres of the disc and pin.

5. **ELECTRIC MOTOR**
   An electric motor is an electrical machine that converts electrical energy into mechanical energy. And it will be connected to the pulley via belt drive which further will be connected to the scotch yoke mechanism.

6. **YOKE FRAME:**
   The term scotch yoke continues to be used when the slot in the yoke is shorter than the diameter of the circle made by the crank pin. For example, the side rods of a locomotive may have scotch yokes to permit vertical motion of intermediate driving axles.

7. **VISE**
   A vise is also known as a metalworking vise and it is used to clamp metal instead of wood. It is used for holding the metal when filing or cutting. Most often cast iron is used to make it but sometimes it is also made of cast steel or malleable cast iron. The jaws are often separate and replaceable, usually engraved with serrated or diamond teeth. Soft jaw covers made of aluminium, copper, wood (for woodworking) or plastic may be used to protect delicate work. The jaw opening of a metalworking vise is almost always the same size as the jaw width, if not bigger.
3.2 Block Diagram

![Block Diagram of total assembly](image)

Fig.2 Block Diagram of total assembly

3.3 Scotch Yoke Mechanism

The scotch yoke mechanism is built with iron bars. Here the crank is made with some length and the yoke is additionally made by utilizing a similar material. It is noticed that the base length of the yoke has to be two-fold the length of the crank. The crank and yoke are associated with a rod. Iron bars are welded to the two sides of the yoke to get the responding movement. The yoke with the iron bars is fixed on the main frame with the assistance of c clamp. Now the crank is welded to the end of the shaft. Presently the stick on the crank is associated with the yoke. This mechanism is utilized for changing over turning movement into reciprocating movement. Iron bars are welded to the two sides of the yoke to get the responding movement. The yoke with the iron bars is fixed on the base frame with the assistance of a square pipe that is somewhat greater than that of the iron bars. Presently the crank is associated through a slotted link mechanism. Presently the pin on the crank is associated with the yoke.

4. Working

The basic and main objective of our project is to design a motor-powered high speed four-way hacksaw machine. Another objective of this work is to modify the conventional hacksaw machine so that we can achieve high productivity rates. In this machine the operator has need not to measure actual length of workpiece which is to be cut and to load and unload the workpiece from the vice each time after the workpiece has been cut. Basically, this particular machine is built with the four hacksaw blades such that all the blades are operated at the same time with the help of an electric motor and a scotch yoke mechanism. The purpose of the scotch yoke mechanism is to convert the rotary motion into reciprocating motion.

So, the concept of scotch yoke mechanism is used to convert the rotary motion of the motor into the reciprocating motion of the hacksaw blades. In this mechanism the all-hacksaw blades are connected in such a way that when we start the motor, all the hacksaw blades can receive power from the motor and then they can cut material according to the requirement.

5. Results

5.1 Results

![Acceleration of crank wheel](image)

Fig.5 Acceleration of crank wheel
5. Conclusion

After completing the project, conclude that our project is simple in construction and compact in size for use. Manufacturing of machines is easy, and the cost of the machine is less. We can cut four work pieces in a single time and by a single person. It will be a very successful method of cutting pieces in large scale by small labour cost. Four-way hacksaw is helpful to overcome the problems of conventional hacksaws with high efficiency and it's easy to operate. By increasing the motor power and dimensions of eccentric cam the size of material to be cut can be increased. The proposed machine will aim at the limitations of single piece cutting of material at an instant of time by introducing four ways cutting of material simultaneously. It is so compact that it will occupy less space, cost effective so usable in mini and large industries. As in cutting it will take less time of cutting per unit of work piece, so machine idle time is also reduced which also results in improved efficiency, reliability. Also, the machine works on minimizing vibrations and jerks produced during cutting operation.

We have developed the multi way hacksaw machine which is working in satisfactory conditions and optimum performance and also performed the motion analysis for the same.

7. References

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