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Design, Construction and Performance Test of a Pedal Operated Hacksaw Machine

Md. Mostafizur Rahman Komol[1], Md. Monem Nawaz[2], Amit Kumer Podder[3], Md. Tanvir Khan[4]
[1,2,3,4] Khulna University of Engineering & Technology, Khulna-9203, Bangladesh.
E-mail: komolmostafizur@gmail.com

Abstract

This research paper represents an advanced hacksaw machine that is operated manually by pedal cycling to eases human labor in cutting vegetables, wood, plastic and other basic light materials by increasing mechanical advantage and reducing the requisite effort. Here, the hacksaw machine performs in cutting objects with its sharp and replaceable hacksaw blade. With strong crankshaft mechanism and revolving chain and sprocket operation, this system is made more durable and efficient. A sitting place is affiliated to ensure comfort and longevity of operation without exhaust. In this device, the frame is designed to grab the wood piece properly while vibrating. Moreover, the tray in the frame collects sawdust and wheels make the device locomotive. Besides, device parts are made individually that can be separated while necessary so that it becomes easily portable. Converting the rotating cycling force to the reciprocal sliding blade force is the fundamental principle behind the proposed system. The system performance is measured and results are found satisfactory for real time application.

Keywords: Hacksaw machine, Pedal, Sprocket, Slab, Wheels.

1. Introduction

Pedal power is the exchange of vitality from a human source using a foot pedal and wrench framework. This technique is most generally used for transportation for many years. Pedal controlled machines resurged in the 1970s, together with the bike. Since the further improvement of stationary pedal-controlled machines had been stopped for over 5 decades, there was a considerable measure of work ahead keeping in mind the end goal to modernize the innovation [1-2]. A few people and associations took some attempts with another age of pedal power machines. Although their endeavors did not result in monetarily accessible machines, a lot of advances were achieved. The utilizations of pedal power were stretched out to incorporate relatively every conceivable machine. Besides, a few innovators plan and manufacture widespread pedal power units that could be utilized to drive an extensive variety of apparatuses and machines [3]. This undertaking comprises of a wrench and slider component. In the instrument, the pedal is straightforwardly associated with the hacksaw through wrench and slider components for the preparing of cutting the wooden squares, metal bars and PVC materials [4].–The significance of this venture lies in the plain truth that it is a green undertaking and encourages us to lessen our power required. Also, it can be utilized to produce power by associating it to dynamo, diode, and battery [5-7]. Pedal power empowers a man to drive gadgets at an indistinguishable rate from that accomplished by hand wrenching, yet with far less exertion and weariness. Pedal power likewise lets one drive gadgets at a quicker rate than previously (e.g., winnower), or control gadgets that require excessively for hand-wrenching (e.g., thresher). Bikes can be adjusted to drive such gadgets; however, the net outcome is wasteful. It is less expensive in starting and support expenses to utilize a legitimately planned and built [8-9].

In this research work, a pedal-operated hacksaw machine is designed and constructed utilizing the pedal power for cutting applications. Vibration is generated while cutting wood due to the massive cutting force of the blade. Therefore, it is necessary to hold the wood piece tightly while cutting due to avoid the unexpected movement from the exact location. In the proposed device, the frame is designed to grab the wood piece properly. Besides, multiple blade arrangement makes the device more effective. Moreover, a tray is attached to the frame so that the sawdust can be collected and used. It also makes the device environment-friendly by reducing pollution or dirt. To reduce the metal cost as well as the weight of the device, the roller attached to the blade is made hollow. Wheels are attached to the frame to make the device locomotive. Moreover, each part of the device is made individually that can be separated while necessary so that it becomes easily portable. These features make the device more flexible than traditional saw machines in which heavy wood piece needs to carry to the saw machine.

2. Design of the system

The rule of pedal power hacksaw is to convert the rotating motion of the paddle into reciprocating motion and cut materials such as metals and plastics with the assistance of a metal cutting bar. It is a pedal worked framework. Appropriate cutting edge choice is critical. Four tooth edges are reasonable for cutting huge areas or promptly machined metals. Six tooth edges are reasonable for cutting harder amalgams and various cutting. Ten and fourteen tooth edges are reasonable fundamentally on light obligation machines where work is constrained to little areas requiring moderate or light feed weight. The three tooth shapers had been utilized in the design. Sharp edges are made in two chiefs composes, adaptable back and all hard. The computer-aided design (CAD) of the main body pedal operated hacksaw is shown in Fig. 1. The description of the overall design of the proposed design is delineated below.

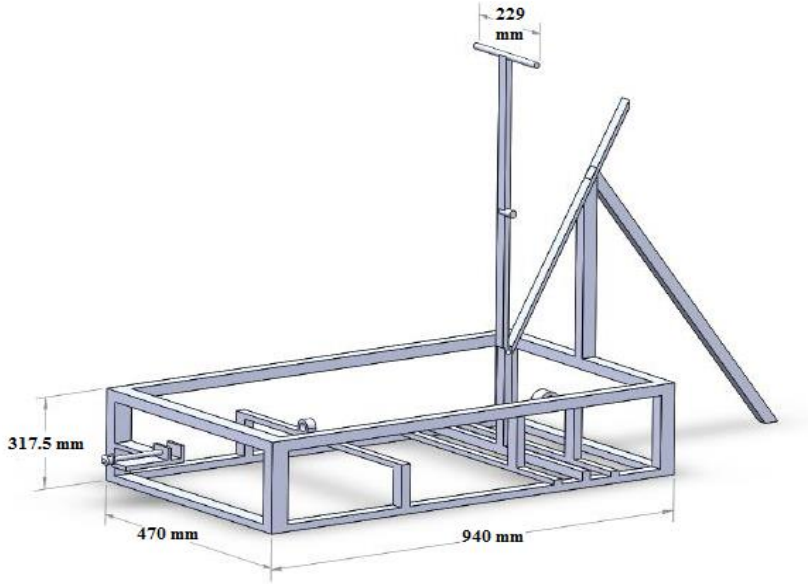

Fig. 1: CAD design of the main body.

2.1 Mounting a power hacksaw blade

The cutting edge must be mounted to cut on the power (back) stroke. The cutting edge should likewise lie superbly level against the mounting plates. For long life and exact slices are to be accomplished, the cutting edge must be appropriately tensioned. Numerous strategies have been created for legitimately mounting and tensioning sharp edges. Tooth design decides the productivity of a sharp edge in different materials. The standard tooth sharp edge design is most appropriate for cutting most ferrous metals. A skip tooth sharp edge design is favored for cutting aluminum, magnesium, copper, and delicate brasses. The snare tooth sharp edge design likewise is suggested for most nonferrous metallic materials. For maximum productivity, the cutting edge must be introduced deliberately. A band saw blade is mounted on the pedal operated hacksaw machine. Substantial cowhide gloves are added to secure hands while arranging a band saw a sharp edge. The CAD design of the roller and shaft is shown in Fig. 2.

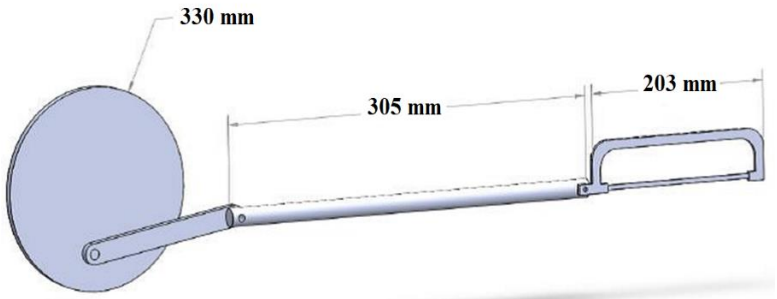

Fig. 2: CAD design of roller and shaft.

2.2 Chain sprocket system

The chain and sprocket system is designed to convert the motion to the hacksaw blade from the rotating paddle as shown in Fig. 3. A conventional bicycle chain sprocket is used for the ease of construction.

2.3 Sprocket control system

The speed of the saw machine can be manually controlled by the variable set of the sprocket. The chain sprocket ratio can be changed and the speed of the machine can be controlled. The speed can be controlled by the sprocket ratio R, which is calculated by

$$R=\frac{N_{small}}{N_{large}}=\frac{S_{small}}{S_{large}} \quad (1)$$

Where, N_{small} and N_{large} presents the number of teeth on small and large sprocket, respectively and S_{small} and S_{large} represents the speed of the small and large sprocket, respectively. The diameter, pitch, teeth number length etc. of small and large sprocket systems is shown in Table 1.

Table 1. Dimensions of the small and large sprocket system

Small Sprocket diameter = 139.902 mm	Entre distance: 774.24 mm maximum
Large Sprocket diameter = 539.709 mm	Sprocket: single strand, No. 12 B, 19.05 mm pitch
Pitch: No. 12B, 19.05 mm	Small: 23 teeth
Length: 140 pitches=2667 mm	Large: 89 teeth

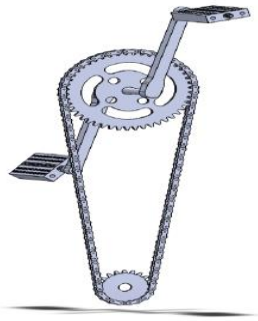

Fig. 3: Solid work design of chain sprocket system

2.4 Pedal arrangements

A couple of pedals are connected to the stand set up in which the power will be created physically. A run of the mill bicycle plan is utilized. Pedals, as a rule, comprise of an axle direction that strings into the finish of the wrench and a body, on which the footstools are appended, that is allowed to pivot on concerning the shaft. Stands are acquainted with immobilizing the device. Different parts utilized are settled into this game plan. The stand get together is separated into two sections; the rectangular base edge and one triangular upright backings. The base edge and triangular help had been joint by welding. The base casing is 3' 1" long and the tallness is 1' 2.5" and the "of the base casing is 1' 0.5".

2.5 Crank and slider mechanism

The pedal-driven hacksaw (PDH) is chipping away at the slider-crank mechanism [7]. This instrument is utilized to change over the rotating movement of the wrench into the responding movement of the hacksaw. The lengths of the wrench and interfacing poles are made utilizing experimentation strategy. The vertical development of the hacksaw will be guided by to press poles. The vertical development will go about as a sustaining unit. The wrench shaft is 1 foot long.

2.6 Metal slab

It is utilized to manage the control of the hacksaw edge which is utilized to cut the metal. Metal sections were fitted on the hacksaw edge to guarantee weight on the protest be cut and direct development of the cutting edge. A brace, with 360^0 revolution, is settled to hold the metal pieces while cutting and to enable them to be cut in any shape and point.

2.7 Seat

A seat is intended to help the bum and back of the riders ordinarily in the semi-leaned back position. In this design, the wooden seat had been utilized. The stature of the seat from the floor is 3' 2" and the seat is made of wood. The overall CAD design of the proposed pedal operated hacksaw machine using the above-mentioned equipment is shown in Fig. 4.

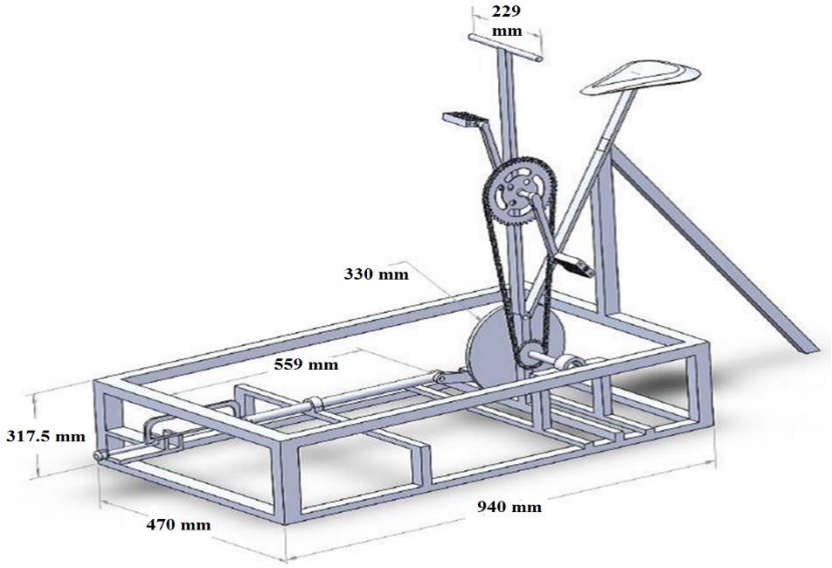

Fig. 4: Overall CAD design of pedal power hacksaw machine

3. Construction of the system

The pictorial view of the constructed main body of the pedal power hacksaw machine is shown in Fig. 5. For the construction of the proposed system, several parts of the system like frame, cutter, roller, shaft, and handle are to be constructed. The brief description of the several parts of the system is delineated below.

3.1 Frame

Cast press is utilized for the construction of the frame. Cast press is a general term connected to a wide assortment of iron-carbon silicon composites in the mix with a few different components. The constituent's content of cast press in percentage is given in Table 2. Their carbon content provides some fluid eutectic arrangement to cement. The base carbon content is subsequently, around 2% while the reasonable most extreme is around 4.3%. There are various types of cast press such as dark cast press, white cast press, shed cast press pliant cast press, spheroidal cast press inosculated cast iron and composite cast press. Cast press has an assortment of employments for general purposes like machine outline, pulleys, flywheel, couplings, pipe fittings, water mains, soil channels, vehicle chambers and cylinders. Cast press segments are most favored for compressive stacking, as their compressive quality is greatly improved than rigidity.

Table 2. Constituent content of cast press in percentage

Carbon - - 2 to 4%	Manganese - 0.2 to 1%	Sulfur - - 0.04 to 0.15%
Silicon - - 0.5 to 3%	Phosphorus - 0.05 to 0.8%	Iron 91%

Fig. 5. Main body of pedal operated hacksaw machine

Fig. 6. Roller Disk

3.2 Shaft

The shaft is made of sheet steel. Its carbon content is 0.05 to 0.25%. Steel with a carbon content between 0.05 to 0.10% is utilized as sheet strips, tubing, and wire makes and so forth. Steels with the carbon content between 0.10 to 0.20% are utilized for bolts, screws, and parts to be callous. Sheets can be delivered hot moving and by the chilly moving procedure. Hot moving sheets have a superior surface wrap up. Again, the chilly moving sheet likewise allows the moving of slenderer check material than hot rolling.

3.3 Rollers

The rollers are made via carbon steel as shown in Fig. 6. It contains carbon up to 83% and past this, it drops rapidly. Rigidity in wrinkles increases with the expansion in carbon content. To this amalgam is added as a deoxidizer to evacuate or limit the hints of oxygen.

3.4 Cutter

The cutter is made of carbon steel as shown in Fig. 7. The choice of the best possible device steel relies upon the application and operation of it. Water solidifying tool steel contains 0.70~1.30% carbon. They provide great durability, magnificent machinability and low cost. Sometimes cobalt is added to enhance the cutting quality in harshness activities. These hold significant hardness at a red heart where the temperature may ascend to 540℃.

3.5 Handle

The handle is made by mild steel (as shown in Fig. 8) that would be safe enough to create forces during cutting operation. It helps the operator to perform the operation properly by grabbing the device. It also ensures comfort operation.

Fig. 7. Hacksaw Cutter

Fig. 8. Handle

4. Methodology and Performance Test

The pedal operated hacksaw machine comprises a pedal that rotates the crank and slider which is an oscillating instrument. The power is transmitted to the crank and slider component. This is utilized to turn the crank plate; the circle which is having a stretched out pole is associated with the sliding bit of the hacksaw straightforwardly by means of a linkage. The hacksaw is gone through the guide courses by methods for keeping up the cutting pivot. As the client worked the pedal, the hacksaw cuts the different materials consequently with less power. The deadweight is for compressive power while the client operated the foot pedal. The performance of the proposed hacksaw machine is tested by involving it for the cutting of different pipes and woodblock. Two different types of pipe-like cast iron pipe and PVC pipe are utilized here to test the performance of the proposed hacksaw machine. The cast-iron pipes having a 30 mm diameter are cut by the proposed machine and the performance of it is shown in Table 3. Again, PVC pipes of 30 mm diameter are cut by the proposed hacksaw machine and the performance of it is shown in Table 4. For both cases, the proposed hacksaw machine performs satisfactorily. Again, the performance of it is further tested by cutting a woodblock having a diameter of 50 mm and the performance of it is shown in Table 5. In all the cases, the proposed pedal operated hacksaw machine performs satisfactorily.

Table 3. Performance on cast iron pipes (30mm diameter)

Serial No.	R.P.M	Time (min)	Depth of cut (mm)
01	30	2	06

02	40	2	08
03	50	2	11

Table 4. Performance on PVC pipes (30mm diameter)

Serial No.	R.P.M	Time (min)	Depth of cut (mm)
01	25	2	14
02	35	2	17
03	45	2	21

Table 5. Performance on Wood block (50mm diameter)

Serial No.	R.P.M	Time (min)	Depth of cut (mm)
01	30	2	17
02	40	2	23
03	50	2	28

5. Conclusion

The proposed pedal operated hacksaw machine is believed to be useful in all industries. For practical applications, this is fabricated for light-duty operation. This machine reduces the human effort and hence does not need two persons to cut the wooden logs. This simple design of conventional design can enhance day to day household needs and daily day to day purposes and it can be also used in for industrial applications during power shut down scenarios. By using this method any operation as per our requirement can be done without the use of electricity. Therefore, electrical power can also be saved. This system acts as a healthy and fresh cutting system for both labor and the object.

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