DESIGN AND FABRICATION OF PEDAL POWER HACKSAW

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ABSTRACT *In this Pedal operated hacksaw machine which means operated by human effort which means by pedaling which can be used for industrial applications and Household needs in which no specific input energy or power is needed. The pedaling plays a key role in creating energy which can be further transferred. This project consists of a crank and slider mechanism. In the mechanism pedal is directly connected to the hacksaw through crank and slider mechanism for the processing of cutting the metal sheets and wooden blocks and PVC materials. The objective of the modal is using the conventional mechanical process which plays a vital role. The main aim is to reduce the human effort for cutting various materials such as wooden blocks, steel, PVC etc. By using human effort through pedaling there is transfer of motion and that turns into linearity motion and further process towards cutting action. Importance of this project lies in the very fact that it is green project and helps us to reduce our electricity need. Secondly, this cutter can be used and transferred to our working place easily. Moreover, if we want we can generate electricity with our project by connecting it to dynamo, diode and battery.*

Keywords: *Hacksaw Blade, Crank and Slider Parts, Pedal and Stand Setup Parts.*

INTRODUCTION

PEDAL POWER HACKSAW:

Pedal powered Hacksaw cutting machine is a manually pedal operated system which is mainly used for cutting metals, wood and plastics. The pedal powered hacksaw setup has a simple mechanism operated with chain and sprocket gear arrangement. During pedaling, the wheel rotary motion is converted into the "To and Fro" motion of the cutting tool (Hacksaw). That is the principle of slider crank mechanism. The size and shape is similar to a bicycle, it can be operated by very low power since it requires a very low pedaling power. The means of transmission is through a simplex chain mechanism and thus it transmits power without much loss. The system also uses the flywheel which reduces the fluctuations speed caused by the fluctuations of pedaling and also uniform cutting. The flywheel also serves as energy reservoirs that stores energy when it is excess and release it when there is shortage of energy within the system

Fig. 1.1 PEDAL POWER HACKSAW

An individual can generate four times more power (1/4 HP) by pedaling than by hand-cranking. At the rate of ¼ HP, continuous pedaling can be served for only short periods, approximately 10 minutes. However, pedaling at half this power (1/8 HP) can be sustained for close to 60 minutes but power capability can depend upon age. As a consequence of the brainstorming exercise, it was apparent that the primary function of pedal power one specific product was particularly useful: the bicycle. Many devices can be run right away with mechanical energy.

DESIGN OF PEDAL POWER HACKSAW:

ENGINEERING DRAWING:

The Engineering design process is a methodical series of steps that engineers use in creating functional products and processes. One framing of the engineering design process delineates the following stages: research, conceptualization, feasibility assessment, establishing design requirements, preliminary design, detailed design, production planning and tool design, and production.

DESIGN REQUIREMENTS:

When designing our attachment, the following considerations were taken into account:-

1. The device should be appropriate for local manufacturing competence.
2. The attachment should employ low-cost materials and mechanized methods.
3. It should be accessible and reasonable by low-income groups, and should accomplish their basic need for mechanical power.
4. It should be simple to manufacture, maneuver, maintain and repair.
5. It should be as multi-purpose as possible, on condition that power for various agricultural implements and for small machines used in rural industry.

2D DRAWING:

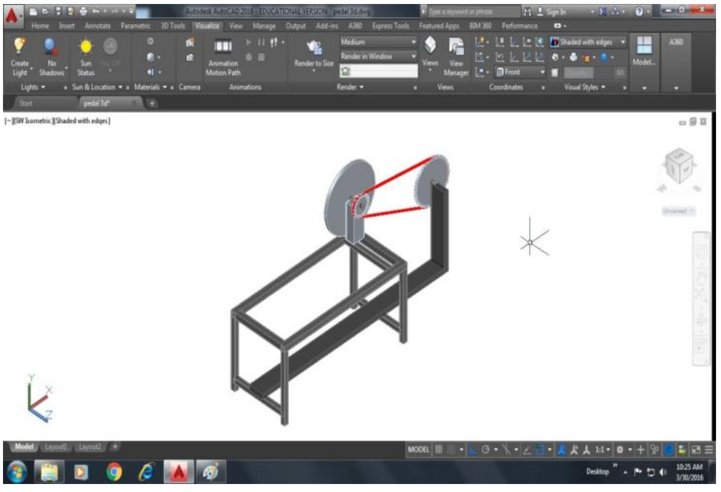
1. A 2D drawing is a drawing that sits in only the X and Y axis. More simply, a 2D drawing is flat and has a width and length but no depth or thickness. There is no shade and shadow and therefore little realism in a 2D drawing.
2. It is a primary thing while starting a 3D modeling we have to draw the 2D profile of that component.
3. To make the 2D profile we have take the dimensions regarding our design and modeled in AUTOCAD 2016 software.
4. By using all these dimensions the 2d profile is drawn which gives us the exact dimensions and profile of pedal power hacksaw.

3D MODELING:

In 3D computer graphics, 3D modeling (or modeling) is the process of developing a mathematical representation of any three-dimensional surface of an object via specialized software. The product is called a 3D model. It can be displayed as a two-dimensional image through a process called 3D rendering or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices.

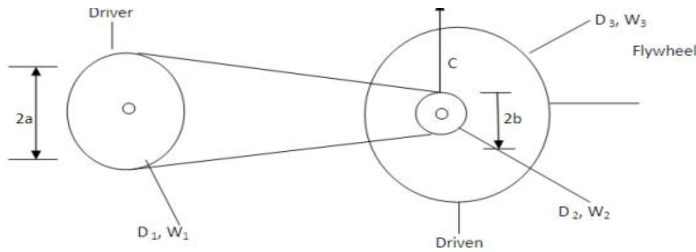
Models may be created automatically or manually. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting 3D models represent a physical body using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc. Being a collection of data (points and other information), 3D models can be created by hand, algorithmically (procedural modeling), or scanned.

The basic 3D modeling software's that are used in the design process by AUTOCAD 2016

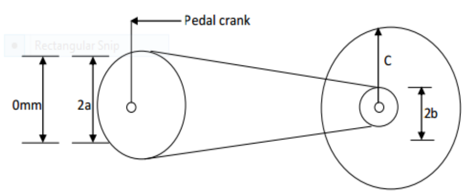


ISOMETRIC VIEW

CALCULATIONS:



The block diagram representation of speed ratio of the system.
W2= W3
The ideal Mechanical Advantage (IMA) = D Driven /D Driver
⇒ IMA = D Driven/ DDriver = WIN /WOUT
Where: D Driven = Diameter of crank= D2
D Driver = Diameter of driver sprocket = D1= WIN = Input rotational velocity of wheel = W1
WOUT= Output rotational velocity of wheel = W2
And, IMATotal= IMA1
Also IMATotal = WIN/ WOUT
So, using the datas below:
Sprocket 1, Driver(D1) = 76mm
Sprocket 2, Driven(D2) = 190mm
Flywheel Diameter (D3) = 304mm
No. of Teeth of D1 = TN1=39
No. of Teeth of D2 = TN2 = 53
IMA1 = D1/D2 = 76/190= 0.4 = IMA TOAL
So, using NIN = 120 RPM (Faruk Yildiz, 2009)
⇒WIN = 2πNin/60 = 2x3.142x150/60 = 15.7rad/s
IMA Total = WIN /Wout ⇒
Wout = Win/ IMA Total 15.7/ 0.4 = 39.25 rad/s Wout = 39.25rad/s .
The output rotational speed of the flywheel = 39.25 rad/s ⇒
The power output, P =FC X V
Where FC = centrifugal force on the flywheel.
and V = Linear Velocity but V = Wout x r; where r = radius of flywheel.
So, using the weight of an average man say 60-75kg and 15kg mass of flywheel
But flywheel radius =(D3/ 2X100) meters = (304/ 2X100) m
= 0.152m
= 152m
⇒V = 39.25X 0.15 = 5.89M/S and
FC = mrw^2 =3x0.155 x (39.25) ^2 = 716.3N = 0.716KN:.
The power, P = FC x V = 716.3x5.89
= 4154.5W
The Torque, T = FC x V = 716.3 x 0.155
= 107.4Nm
= 0.10KN



Velocity Ratio:
V.R = effort distance/ load distance = length of crank pedal /hacksaw cutting stoke
= 100mm/ radius of flywheel = 100/152 = 0.65
V.R = 0.65 which is less than 1

Efficiency of the Machine:
Efficiency = M.A = IMA /V.R x 100% Where I.M.A = Ideal Mechanical Advantage
= 0.4 (as calculate earlier)
Efficiency = 0.4/0.65 x 100%
= 76.9%

MATERIALS USED

MILD STEEL FOR FRAME:

"Mild steel" refers to low carbon steel; typically the AISI grades 1005 through 1025, which are usually used for structural applications. With too little carbon content to through harden, it is weldable, which expands the possible applications.

Fig 4.1 MILD STEEL RODS

Mild steel also known as plain-carbon steel, is now the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications. Low-carbon steel contains approximately 0.05–0.25% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing. These mild steel rods are used for preparing frame in this pedal power hacksaw.

CAST IRON FOR FLYWHEEL:

Cast iron is a group of iron-carbon alloys with carbon content greater than 2%. Carbon (C) and silicon (Si) are the main alloying elements, with the amount ranging from 2.1–4 wt% and 1–3 wt%, respectively.

Fig 4.2 FLYWHEEL OF CAST IRON

Cast iron tends to be brittle, except for malleable cast irons. With its relatively low melting point, good fluidity, castability, excellent machinability, resistance to deformation and wear resistance, cast irons have become an engineering material with a wide range of applications and are used in pipes machines and automotive ,industry parts, such as cylinder heads (declining usage), cylinder blocks and gearbox cases. It is resistant to destruction and weakening by oxidation (rust).

STAINLESS STEEL FOR BOLTS AND NUTS:

Stainless steel does not readily corrode, rust or stain with water as ordinary steel does. However, it is not fully stain-proof in low-oxygen, high-salinity, or poor air-circulation environments. There are different grades and surface finishes of stainless steel to suit the environment the alloy must endure. Stainless steel is used where both the properties of steel and corrosion resistance are required.

Fig 4.3 STAINLESS STEEL OF BOLTS AND NUTS

WORKING PRINCIPLE:

CONSTRUCTION AND WORKING

The cycle frame is fixed with the base mild steel by the process of welding The chain sprocket is connected to the cycle frame and it is connected to the pedals. The one end of the chain is connected to the big sprocket and the other end is connected to the small sprocket which is held in a chain hub. The other end of the hub is fixed with the flywheel .From the other end of the hub it is connected to the sprocket and other end is connected to which is held with the circular rod and bearing setup. The circular rod is inserted into the bearing and is welded with the sprocket at one end and with rotating disc at the other end. The connecting rod is connected to the rotating disc at one end and to the hacksaw at the other end

Fig 5.1 CONSTRUCTION AND WORKING OF PEDAL POWER HACKSAW

CRANK AND SLIDER MECHANISM:

The Slider-crank mechanism is used to transform rotational motion into translational motion by means of a rotating driving beam, a connection rod and a sliding body. In the present example, a flexible body is used for the connection rod. The sliding mass is not allowed to rotate and three revolute joints are used to connect the bodies. While each body has six degrees of freedom in space, the kinematical conditions lead to one degree of freedom for the whole system.

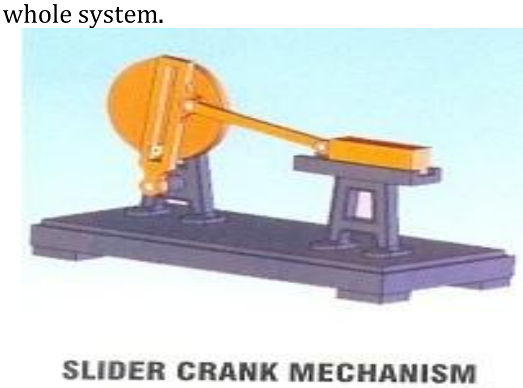


Fig 5.2 CRANK AND SLIDER MECHANISM

A slider crank mechanism converts circular motion of the crank into linear motion of the slider. In order for the crank to rotate fully the condition L> R+E must be satisfied where R is the crank length is the length of the link connecting crank and slider and E is the offset of slider . A slider crank is a RRRP type of mechanism i.e. It has three revolute joints and 1 prismatic joint. The total distance covered by the slider between its two extreme positions is called the path length.

The four-bar mechanism has some special configurations created by making one or more links infinite in length. The slider-crank (or crank and slider) mechanism shown below is a four-bar linkage with the slider replacing an infinitely long output link.

CUTTING RATE:

Figure 6.1 gives the variation of number of strokes with rpm of PDH. It is observed that the number of strokes increases uniformly with the pedal rpm. The variation in the obtained plot is due to errors in observation and due to power transmission losses.

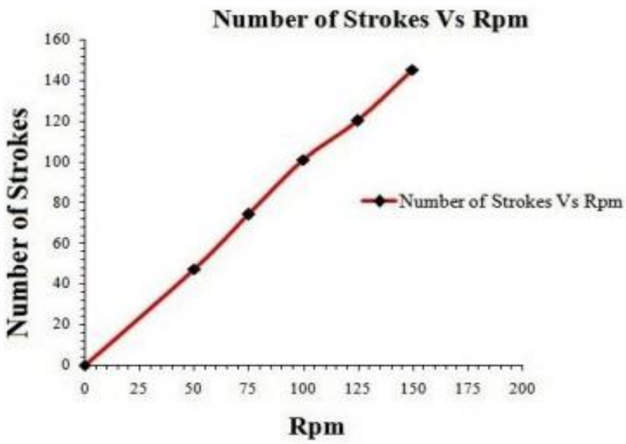


Fig 6.1 Variation of Number of Strokes with Rpm .

It is observed that the cutting depth increases with the pedal rpm. Experimental result shows cutting depth of about 17 mm can be obtained can be obtained in one cycle of strokes for around 100rpm. The variation in the obtained plot is due to errors in observation and due to power transmission losses.

FUTURE SCOPE:

Following all types of operation can be carried out by the proper pedal attachment as per the requirement. Here are some operations.

Fig 7.1 CORN SHELLING

Fig 7.2 WATER PUMPING FROM A SHALLOW WELL

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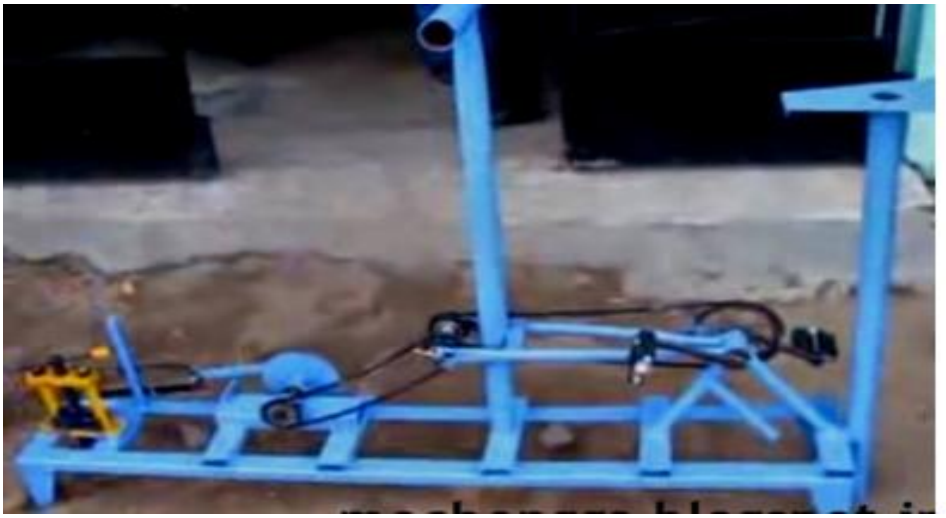

Fig 7.3 PEDAL OPERATED DUAL CHAIN HACKSAW

RESULTS AND DISCUSSIONS:

Design and fabrication of pedal power hack saw is completed**.** This project can be applicable to cut small round, square bars. Application is depended on the selection of hacksaw blade as well as RPM required. This is used to cut metal sheets, wooden blocks and PVC pipes. This can also be machined at small scale industries and at workshops. This plays a key role in excising purpose also which gives mental relief .So this project can be used in workshops, seminars for the cutting of various processes. According to the productivity it can also be used in small scale industries for cutting of thin sheet of metals since its cost is relatively accessible.

COST ESTIMATION:

S.No	NAME OF COMPONENT	COST(INR)
1.	PEDAL AND SPROCKET(2)	500
2	FLYWHEEL	500
3.	FRAME SET (2)	300
4.	NUTS AND BOLTS	300
5	HACKSAW	200
6.	HACKSAW BLADE	20
7.	SUARE RODS(S)	350
8.	SUARE RODS (B)	500
9.	CHAIN AND HUB PARTS	250
10.	CONNECTING ROD	200
11.	HOLDING VICE	300
12	ELECTRODES	60
	TOTAL	4500

CONCLUSION

Thus the pedal powered hacksaw machine is designed tested successfully. The output is verified by cutting the metal pipes, plastics in the hacksaw by pedaling action. The following advantages were seen such as it is more convenient and easier. It is more eco-friendly. Power is not required

Thus a low cost and simple design pedal operated hacksaw machine is fabricated. This machine reduces the human effort and hence we don't need two persons to cut the wooden logs. This simple design of conventional design which can enhance day today 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 we can do any operation as per our requirement without the use of electricity. So we can save the electrical power.

Pedal power hacksaw can be used in distant places where electricity is not accessible. It is designed as a transportable one which can be used for cutting in various places. The ply wood can be cut devoid of any peripheral energy like fuel or current. Since PDH uses no electric power and fuel, this is very economical and best. PDH can be used for light duty cutting process of plywood. It is also effective for the human health. Pedal driven hack saw helps to obtain less effort uniform cutting. The results specify that the PDH had given better, accurate and faster cuts when evaluate with hand hacksaw at different rpm.

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