Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 04, pp.14423-14426, April, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

CLUTCH OPERATED GEAR DRIVEN POWER HACK SAW

[1]Shivesh Dwivedi, *[,2]Rahul N. Dabhade and [3]Vishal S. Dabhade

[1]Mechanical Engineering, Maharana Pratap Engineering College Kanpur, Uttar Pradesh, India
[2,3]Mechanical Engineering, Sandip Institute of Tech. & Research Centre, Nashik, Maharastra, India

ARTICLE INFO

Article History:
Received 19th January, 2015
Received in revised form
25th February, 2015
Accepted 08th March, 2015
Published online 28th April, 2015

Key words:

Metal Cutting,
Clutch,
Gearbox,
Ac Motor,
Power Hack Saw.

ABSTRACT

In today's era of highly developing manufacturing field, there is always requirement of time and cost saving equipment for metal working. Considering this need, we have developed this clutch operated gear driven power hack saw to cut the metal effectively in short span of time. The time required for previous power hack saw to cut the material having large thickness was very much also for all metal workers & the manual labor involved in cutting operation, it is tedious when a great deal of cutting has to be done on large metal sections. The aim of present work is to reduce time in metal cutting by designing the gearbox equipped clutch operated power hack saw. The four stage gearbox is provided to vary the speed and torque of saw according to type of metal to be cut. To shift the gear a clutch arrangement is provided.

INTRODUCTION

This clutch operated gear driven hacksaw consist of a motor, base, frame, vice, gear arrangement & saw blade. The hacksaw machine is a machine tool designed out to cut material to a desired length. It functions by drawing a blade containing cutting teeth through the work piece. This hacksaw machine is faster and easier than hand sawing and is used to produce an accurate &metered cut on the work piece. Power hacksaws are used to cut large sizes or sections of metals such as mild steel. It is very difficult to cut the material having diameter more than 10 mm by hand sawing (en.wiksipedia.org/wiki/Hacksaw). Therefore this clutch operated gear driven power hacksaws have been developed to carry out the difficult and time consuming work of metal cutting. The blade or saw moves backwards and forwards, cutting the metal or work piece. The metal to be cut is held in a machine vice. The vice can be tightens or loosens by turning the handle. It is also used to cut the hard materials like aluminum and steel etc.

Blade

Blades are available in standardized lengths, usually 25 to 30 mm for a standard hand hacksaw (www.technologystudent.com/equip1/phcksw.htm).

Corresponding author: Rahul N. Dabhade,
Mechanical Engineering, Sandip Institute of Tech. & Research Centre, Nashik, Maharastra, India.

Powered hacksaws blades are available in wide range of sizes. The pitch of the teeth can be vary from fourteen to thirty-two teeth per inch (TPI) for a hand blade, with as few as three tpi for a large power hacksaw blade. The blade chosen is based on the thickness of the material to be cut, with a minimum of three teeth in the material. The more commonly used blades are-

Inch Blade

- The most commonly used blade is the 300 mm length. Hacksaw blades are provided with two holes near the ends for mounting them in the saw frame.
- Hole to Hole: 300 mm
- Overall blade length: 315 mm (not tightly controlled)
- Mounting Hole diameter: 3.5 to 4 mm (not tightly controlled)
- Blade Width: 11 to 13 mm (not tightly controlled)
- Blade Thickness: 0.5 to 0.70 mm

The 10 Inch Blade

- This is also fairly common and all the above dimensions apply except for the following:
- Hole to Hole: 250 mm
- Overall blade length: 265 mm (not tightly controlled)

Soft materials require a coarser blade to provide adequate spaces between the teeth for removal of chips. Hard material requires a finer blade to distribute the cutting pressure equally to a greater number of teeth, reducing wear of the blade. At least three to four teeth must be in contact with the work piece at all times or the blade will snag on the work piece and break teeth from the blade. Therefore, a blade must be selected with sufficient pitch so that 3 or more teeth will be in contact with the work piece.

Tooth Forms

The different types of tooth forms used are Precision (regular), claw (hook), buttress. The precision formed tooth type is most generally used in saw to cut metals. This tooth is having 0º rake angle &30º back clearance (Theory of machine Book, R.S. Khurmi). The claw (hook) have Positive rake on cutting face & Faster. The buttress tooth have tooth angles same as precision teeth. & used on thick work sections.

Fig. 1.Hacksaw Tooth Forms

Construction and Working

The simple slider crank and quick return mechanism is used in this machine as shown in Fig 2 below.

Fig. 2. Construction of Clutch Operated Gear Driven Power Hack Saw

This is the actual setup of the clutch operated hacksaw. The motor with power more than one horse power is selected for this hacksaw machine depending upon the material to be cut out. The electric supply is given to motor. The motor is connected to four stage spur gear box with sufficient reduction ratio. The lubrication is required for efficient working of machine for cutting metal. The clutch is provided for engagement and disengagement of gear (Theory of machine Book, R.S. Khurmi). According to the material to be cut the proper gear is shifted. The speed of hacksaw will increase with shifting gear from first to fourth gear. The motion from these gear is further given to saw blade by using slider crank and quick return mechanism as shown in following working setup.Motor equipped gear driven hacksaw is an important device for the automatic cutting of long rods, bars etc. with accurately and less time consuming. Feed pressure is increased for softer materials and decreased for harder ones. The proper speedis selected by shifting a lever on the gearbox (Experimental Investigation of Pedal Driven Hacksaw, 2014). The speed can be vary from first gear to forth gear & the gear can be directly shifted by clutch. The speed selection is made with the machine in the off position. The feed mechanism regulates the amount of downward pressure the blade applies on the material during the forward stroke. A moderate feed pressure is utilized for mild steels. Excessive feed pressure will cause the blade to jam into the material, possibly causing it to break.

Sawing Operation

The procedure for the cutting operations is given below.

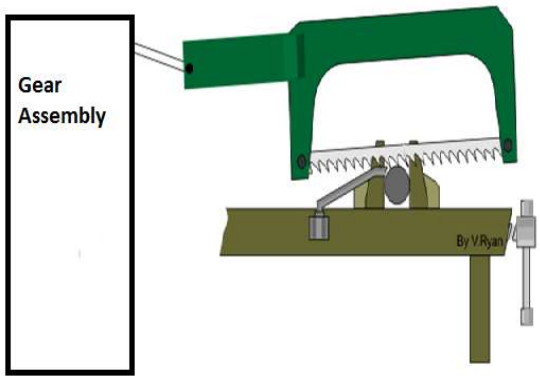

Fig. 3. SawingOperation

- Check the level of the work piece or metal bar to be cut and adjust the table, if necessary, to suit the angle of the cut.
- Use the proper blade and speed for each cutting operation. This ensures not only the fastest and most accurate work but also longer saw life.
- Before starting the machine, adjust the height of the upper band guide so that it will clear the work from 7 to 20 mm. The closer the guide is expected to the work, the greater the accuracy.
- When starting a cut, feed the work to the saw gradually. After the saw has started the kerf, increase the feed slowly to the recommended pressure. Do not make a sudden change in feed pressure because it may cause the band to break.

- Be sure the saw band and guides are properly lubricated.
- Use lubricants and cutting coolants.

Steps for Procedure

- Mount the work to be cut inside the vice.
- Lower the frame so that the blade is about 2-3 mm from touching the material.
- The measurement of work-piececut is marked on work piece.
- Tighten the vice. If this bolt is over tighten, the vice will not securely fasten.
- Recheck measurement.
- If multiple parts of the same size are to be cut, set the work stop to the desired length.
- The gap must be provided between the stop and the work piece to prevent damage to the blade.
- Select the proper speed and feed.
- Turn machine on.
- With a new blade, never start on a previously started location as this will cause the new blade to bind and break.
- Verify that coolant is directed to area of blade contact to ensure cooling and chip wash.
- The different materials can be cut with different speed by changing gears with the help of clutch.

Gear Arrangement

Our main purpose is to vary the speed as per the material to be cut. We need to employ a gear assembly with clutch to reduce the speed when required (Design and Fabrication of Automated Hacksaw Machine, 2014). It consist of four gears with clutch with the gear ratio of 1:3.5

The used components are-

(1) A 1.5hp, 3φ electric motor
(2) A clutch and gear box
(3) A camshaft and blade

Design and calculation for the torque and speed of power driven hacksaw with gear arrangement

We know that,
1hp = 746 watt
So that,
1.5hp = 746*1.5 =1120 watt

P = 1120 watt

And as per standard values, on no load condition, the maximum speed of motor is about-
N_{max} = 1500rpm
N_{min} = 1000rpm

Now,

$$P = \frac{2\pi NT}{60}$$

$$1120 = \frac{2\pi * \text{Nmax} * \text{Tmin}}{60}$$

T_{min} = 7.002 kN-mm

And

$$T_{max} = \frac{P*60}{2\pi \text{Nmin}} = \frac{1.5*746*60}{2\pi*1000}$$

T_{max} = 10.50 kN-mm

Diameter of primary gear (N) = 40 mm
Diameter of clutch gear = 100mm
Max. Speed of clutch gear $p = Np/Nmax$ = 40/100
Np = 600rpm
Min. Speed of clutch gear (Nq),
$Nq/Nmin$= 40/100
Nq = 400 rpm
$Navg$= 400+600/2 = 500rpm
Here we are using a constant mesh gear box, which consist of four gears. As per the standard values, the gear box has 1: 3.5 gear ratio at its maximum rpm.

Specification and calculations for gearbox

At Gear No.1

Diameter of primary shaft's first gear, (D_{11}) = 30 mm
Diameter of main shaft's first gear, (D_1) = 90 mm
Speed at first gear = N_1

$N_1/N_{avg} = D11/D1$

N_1 = 167 rpm
After losses consider
N'_1= 130 rpm

At Gear No.2

Diameter of primary shaft's second gear, (D_{22}) =40mm
Diameter of main shaft's second gear, (D_1) =75mm
Speed at second gear = N_2
$N_2/ Navg.$ =40/75
N_2 = 267rpm
After losses considering
N'_2 = 230rpm

At Gear No.3

Diameter of primary shaft's third gear, (D_{33})=50mm
Diameter of main shaft's third gear, (D_3)=64mm
Speed at second gear = N_3
$N_3/ Navg.$ =50/64
N_3 =390rpm
After losses considering
N'_3 = 340rpm

At Gear No.4

Diameter of primary shaft's fourth gear,($D44$)=40mm
Diameter of main shaft's fourth gear, ($D3$)=42mm
Speed at second gear = $N4$

$N4/\ Navg.$ =40/42
$N4$=476rpm
After losses considering
$N'4$ = 440rpm

The standard values of speed/stroke per minute for the various materials are-

- Aluminium - 65 stroke per minute
- Cast iron – 45 stroke per minute
- High Speed Steel – 30 stroke per minute

Cutting speed for different material

- For aluminum we will choose 3rd gear where speed is 340 rpm and torque 31 kN-mm.
- For low carbon steel we will choose 2nd gear where speed is 230 rpm and torque 45.67 kN-mm.
- For mild steel we will choose 1st gear where speed is 130 rpm and torque 80.80 kN-mm.

Type of cutting operation

Straight Cutting

- Change band guides as necessary. Select and install the proper band for the job and adjust the band guides.
- Place the work piece on the table of the machine and centre the work in the work jaw.
- Allow the saw to cut the metal bar which is straight cut.

Angular Cutting

- Make angular loose the vice and move it to desired angle to the desired angle of the cut.

Safetyprecautions

Some safety precautions that must be taken are as follow,

- Keep hands away from the saw blade of the hack sawing machine or band sawing machine when in operation.
- Ensure the power supply is disconnected prior to removal or installation of saw blades.
- Use a meter guide attachment, Keep fingers well clear of the blade at all times.
- When removing and installing band saw blades, handle the blades carefully.
- A large springy blade can be dangerous if the operator does not exercise caution.

Cooling

When cutting is taking place, the metal and especially the blade heats up quickly. Hence there is requirement of coolant While cutting operation. Coolant should be fed onto the blade. Without the use of coolant the blade will over heat and break.

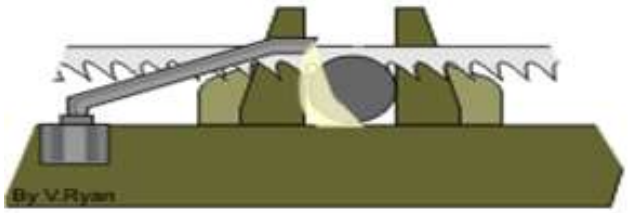

Fig. 4.Use of Coolant

Advantages

It capable of rotating the solid jaw up to 45 degrees so that angular cuts may be provided. Power hacksaws are better suited for cutting aluminium, brass, and mild steels. Inexpensive device with less component&less time consumption in cutting the task according to cutting material.

Limitations

Without electricity hack saw can't be operated& at high rpm tooth wear rate is high.

Disadvantages

It is bulky. It takes large space & Operation is noisy.

RESULTS AND DISCUSSION

After conducting number of experiments and analyzing this clutch operated gear driven power hack saw, it is came to know that it require very less time to cut different material. The cutting speed can be simply increased by pressing the clutch and just shifting the gear. It is also very efficient when great deal of cutting has to be done on large metal sections.

REFERANCES

Design and Fabrication of Automated Hacksaw Machine, *International Journal of Innovative Research in Science, Engineering and Technology*, Volume 3, special issue2, April 2014
en.wiksipedia.org/wiki/Hacksaw
Experimental Investigation of Pedal Driven Hacksaw, International Journal of Engineering And ScienceVol.4, Issue 7(July2014), PP 01-05Issn (e): 2278-4721,
http://www.academia.edu/8827328/Multi_Drive_Hacksaw
http://www.longwood.edu/assets/chemphys/ch6.pdf
Machine Design – R.S. Khurmi
Notes of Dr. R M Hingley (MIT University, U.S.A.)
Theory of machine – S.S. Rattan
Theory of machine- R.S. Khurmi
www.technologystudent.com/equip1/phcksw.htm

****