CONVERSION OF POWER HACKSAW TO ENGINE OPERATED POWER HACKSAW

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ABSTRACT— In today's era of highly manufacturing field there is always requirement of time and cost saving equipment of metal cutting to increase the productivity. Considering this need we have modified power hacksaw machine to engine operated power hacksaw machine to cut the materials of different sizes and length effectively in short span of time. The aim of this work is to reduce the man power and time in metal cutting by designing the engine operated power hack saw. The engine is provided to vary the speed and torque of saw according to the type of metal to be cut when there is power loss i.e. the engine will work as the secondary power input source to perform the cutting operations. The engine consists of four stage gear box which will vary the speed and torque of the saw. For shifting the gears, clutch and lever arrangement is provided.

KEY WORDS: Power Hacksaw, Cutting Metals, Cooling System, AC Motor, Engine.

INTRODUCTION

Power hacksaws are machines utilized to cut material of various shapes and sizes up to six inches across. They are available in utility, heavy duty, and high production types**.** The power hacksaw's main feature is its reciprocating frame. The frame secures a heavy-duty hacksaw blade who's reciprocating action in combination with a downward force causes the material to be cut. Power hacksaws are used to cut large sizes (sections) of metals such as mild steel, cast iron, aluminium etc. Material having cutting diameters of more than 10/15mm is very hard work with a normal hand-held hacksaw. Therefore, power hacksaws have been developed to carry out the difficult and time-consuming work. To provide variable speed by changing the gears from first to fourth according to the metal to be cut, engine driven power hacksaw machine is developed. Since the power hacksaw has limited speed of cutting operation and needs electricity supply, hence this engine driven power hacksaw machine can be used, which works on engine when there is no electrical energy also it will perform the cutting operations with more speed as compare to power hacksaw. This engine driven power hacksaw consists of a motor, base, frame, engine, pulley, coupling & saw blade.

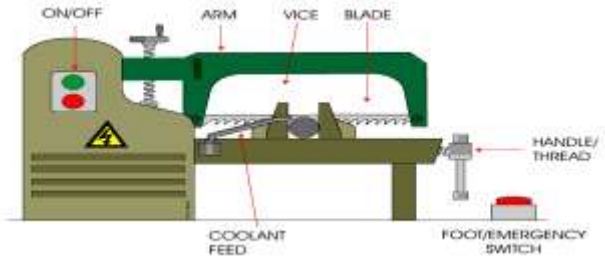

Fig **1- General setup of Power Hacksaw.**

The heavy 'arm' moves backwards and forwards, cutting on the backwards stroke. The metal to be cut is held in a machine vice which is an integral part of the base. Turning the handle tightens or loosens the vice. The vice is very powerful and locks the metal in position.

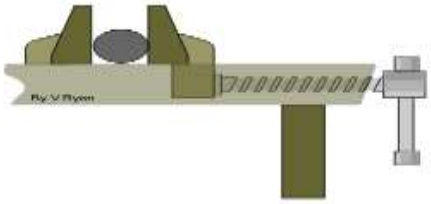

Fig **2- Machine Vice**

When cutting is taking place, the metal and especially the blade heats up quickly. Coolant should be fed onto the blade, cooling it down and lubricating it as it cuts through the metal.

Without the use of coolant, the blade will over heat and break/snap. This can be dangerous as the blade can break with powerful force, shattering.

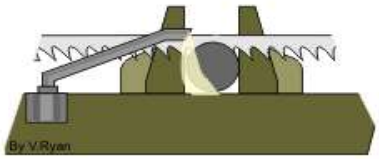

Fig **3- Coolant and Lubrication**

When the metal is placed and fixed in the vice, the blade is lowered onto its top surface. The diagram below shows the 'arm' being lowered with the 'adjusting handle'.

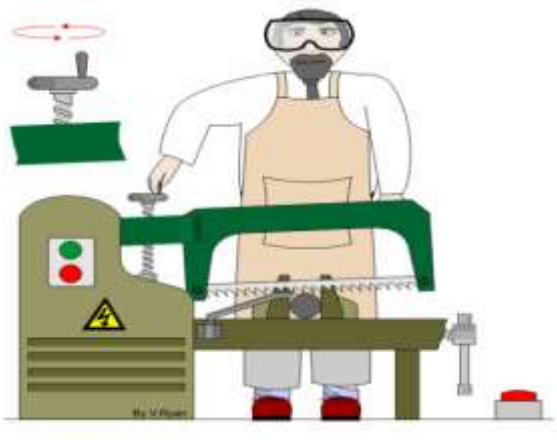

Fig **4- Blade Adjusting Handle**

Blades of power hacksaws are graded according to the material they are made from and the number of teeth per inch. Top quality blades are manufactured from High Speed Steel. Although there are cheaper alternatives such as carbon steel blades.
In general the number of teeth per inch (TPI) range from 14 to 24. The more teeth per inch – the smoother the cut.

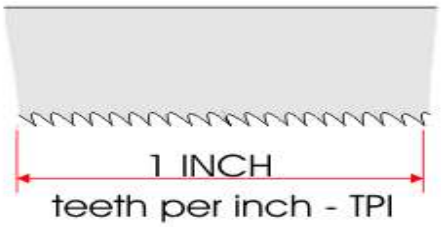

Fig **5- Blade Terminology**

Power hacksaws have electric motors that power the blade through a pulley system. Some have ratchet systems. The pulley system shown below shows how rotary power is transferred from the motor and changed to reciprocating motion, allow the blade to cut through the material.

Most power hacksaws have two pulley wheels. If the belt is placed on the smaller pulley wheel the speed of cut will be fast. Changing the belt so that it runs around the larger pulley wheel will reduce the speed.

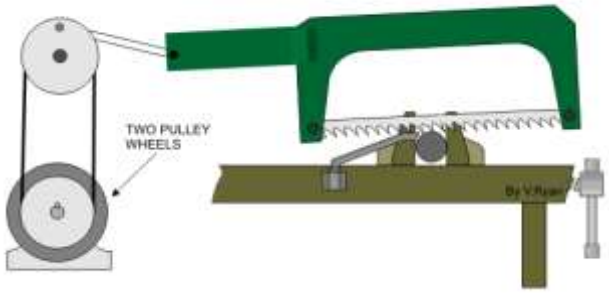

Fig **6- Pulley Arrangement for Power Hacksaw**

OBJECTIVE

To provide alternative for industries aiming towards reducing human effort and improvement in material handling system by implementing automation.
To perform the cutting operations at the places where there is no electrical energy.
To develop the alternative source of input i.e. fuel to increase the efficiency of the machine.
Sustainable and practical automation solutions for the future industrial environment.
To provide variable speed by changing the gears from first to fourth according to the metal to be cut while running on engine.

EXPERIMENTAL SET UP

WORK MATERIAL

Power Hacksaw Machine:

Power hacksaws are used to cut large sizes (sections) of metals such as mild steel, cast iron, aluminium etc. having cutting diameters of more than 10/15mm is very hard work with a normal hand-held hacksaw. Therefore, power hacksaws have been developed to carry out the difficult and time-consuming work.
Power hacksaws have electric motors that power the blade through a pulley system. Some have ratchet systems. The pulley system shown below shows how rotary power is transferred from the motor and changed to reciprocating motion, allow the blade to cut through the material.

Fig **7- Power Hacksaw Machine**

- Power consumption = 1 HP.
- RPM of the motor = 1480 rpm.
- Cutting Angle = 0 to 45 deg.
- Blade size in mm =315*13*0.7.
- Number of strokes = 95-105/m.

Engine:

Motorcycle engines are typically two-stroke or four-stroke internal combustion engines, a motorcycle engine drives the rear wheel, power being sent to the driven wheel by belt, chain or shaft. Most engines have a gearbox with up to six ratios. Reverse gear is occasionally found on heavy tourers, The rider changes gears on most motorcycles using a foot-pedal and manual clutch, but early models had hand-levers. More recently, some have automatic or semi-automatic gearboxes.

Fig **8- Engine (Pulsar-150 Classic)**

- Single cylinder, 4 strokes, air cooled
- Bore (mm) X Stroke (mm) 57 X 56.4
- Displacement (cc) 143.9
- Fueling "Carburetor
- Max. Power (Ps @ rpm) 12.00 @ 8500
- Max. Torque (NM @ rpm) 10.80 @ 7500
- Starting Kick / Kick + Self

A. C. Motor:

An electrical motor is such an electromechanical device which converts electrical energy into a mechanical energy. This Motor consists of two major parts:

Stator of Motors

In stator of motor, the three-phase winding is arranged in such a manner in the slots that they produce a rotating magnetic field when three-phase AC supply is given to them.

Rotor of Motor

Rotor of three phase induction motor consists of cylindrical laminated core with parallel slots that can carry conductors. The conductors are heavy copper or aluminium bars which fit in each slot, and they are short-circuited by the end rings. The slots are not exactly made parallel to the axis of the shaft but are slotted a little skewed because this arrangement reduces magnetic humming noise and can avoid stalling of the motor.

Fig **9- A. C. Motor**

- Number of phase– Three phase.
- Speed- 1480 rpm.
- Voltage- 415 V.
- Hp/Kw- 1hp/ 0.746kw.

Belt and Pulley:

Fig **10- Belt and Pulley**

Belt:

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel.
V-Belts are friction-based power or torque transmitters. The power is transmitted from one pulley to the other by means of the friction between the belt and pulley.
Class-B.
Power transmission capacity- 0.5kw to 6kw.

Pulley:

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt.

- Class- B.
- Grooves- 1.
- Pulley Diameter- 2 inch.
- Bore- 20 mm.

COUPLING:

A coupling is a device used to connect two shafts together at their ends for transmitting power. Couplings do not normally allow disconnection of shafts during operation, however there are torque limiting couplings which can slip or disconnect when some torque limit is exceeded. The primary purpose of couplings is to join two pieces of rotating equipment while permitting some degree of misalignment.

Fig **11- Jaw Coupling**

- Coupling size code- L-075.
- Bore diameter- 22 mm.

- Outside diameter- 45 mm.
- Jaw type- Straight.
- Hub material- Iron.
- Coupling overall length- 54 mm

BEARING:

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole. Lubrication is often used to reduce friction. In the ball bearing and roller bearing, to prevent sliding friction, rolling elements such as rollers or balls with a circular cross-section are located between the races or journals of the bearing assembly.

Bearings played a pivotal role in the nascent Industrial Revolution, allowing the new industrial machinery to operate efficiently.

Fig **12- Bearing**

PROCEDURE:

Fig **13- Actual Setup of Engine Operated Power Hacksaw Machine**

This is the actual setup of the engine operated power hacksaw machine.

The motor with power of one horse power is selected for this hacksaw machine depending upon the material to be cut out.

The arrangement of setup while running on motor is:

power supply to the motor will rotate its shaft.

Further the motion is transmitted to the coupling followed by pulley-1 which transmits the power to the pulley-2.

The rotary motion of the pulley will cause the reciprocating motion to the machine by quick return mechanism.

Hence the cutting operation will take place.

The arrangement of setup while running on engine is:

Running the engine will supply the power to chain and sprocket mechanism which will tend to rotate the shaft connected to it.

This motion will be transmitted to the pulley which is a source to run the machine.

The motion from this setup is further given to saw blade by using slider crank and quick return mechanism.

When we wish to run the machine on engine we'll have to disengage the coupling so that the motion will not be transfer to the motor as it may damage the motor.

4.3- BLOCK DIAGRAM:

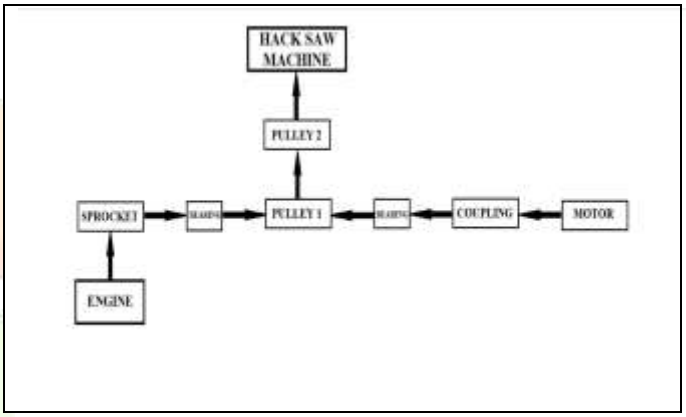

Fig **14- Block Diagram of Engine Operated Power Hacksaw**

EXPERIMENTAL STUDY

COMPARISON OF COMPANY AND ACTUAL ENGINE RPM:

SR. NO	CONTENT	COMPANY RPM	ACTUAL RPM
2	1st Gear	2910 RPM	
3	2nd Gear	4521 RPM	
4	3rd Gear	6159 RPM	
5	4th Gear	7870 RPM	

COMPARISON OF COMPANY AND ACTUAL ENGINE MILEAGE:

1 stroke length of power hacksaw machine = 0.66 mtrs.

COMPANY AVEREGE			ACTAUAL AVEREGE		
KM	STROKES	HOURS	KM	STROKES	HOURS
40	60606	10.10	30	45454	7.58

41	62121	10.35	31	46969	8.08
42	63636	11	32	48484	8.23
43	65151	11.26	33	500000	8.33
44	66666	11.36	34	51515	9
45	68181	11.58	35	53030	9.24

RESULTS AND CONCLUSION

RESULTS:

After analyzing this engine driven power hack saw, we concluded that it requires very less time to cut different material.

It is also very efficient when great deal of cutting must be done on large metal sections.

We can use this machine for cutting of round/square bars, tubes and pipes, construction industries, tool rooms and engineering workshops.

We can run the machine even when there is no electrical power supply.

CONCLUSION:

We conclude that we are going to use Bajaj pulsar engine for our project.

Machine will run on motor when there is power supply.
When there is power loss we can run our machine on engine i.e. on secondary source.

Engine will provide us variable speed for cutting different materials.

It takes motorcycle 40-45 km distance in 1-liter petrol thus calculating the hacksaw one stroke length i.e. 0.66 meters/stroke we can run our machine for approximate 12 hours in same quantity of fuel.

FUTURE SCOPE:

We can replace our 3-phase A.C. Motor with D.C Motor so that we can store and use the reverse current generated by the system while operating on engine.

We can use additional gear box in our setup to run the motor on variable speed.

We can use various sensors around the vice which will be used to measure and display the length to be cut and the cutting depth required.

Also, we can use some additional sensors that will show the time required to cut the material and its cutting speed.

APPLICATIONS:

- Cutting round/ square bars, tubes and pipes.
- Large profiles and solid materials.
- Tool room and engineering workshops.
- Stainless steel cutting, Copper and alloy cutting.
- Engineering Industry, Construction Industry.

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