

# Fabrication of pedal powered hacksaw machine

<sup>1</sup>M.Khaja Gulam Hussain, <sup>2</sup>T. John babu

Assistant Professor

<sup>1</sup>Department of Mechanical Engineering

RGM College of Engineering & Technology, Nandyal-518501, A. P., India.

**Abstract:** The pedal powered hacksaw has a very simple mechanism operated with pedal by pedalling the wheel rotary motion is converted into to and fro motion of the cutting tool. The aim of this paper is to cut materials like wood, plastic etc., with less effort and quickly. That is by connecting a hacksaw to the pedal of a cycle and pedalling the pedals the forces are transmitted and get the work done. The size and shape of the pedal power hacksaw setup is similar to the cycle. It is like a cycle added with a bed for the cutting tool. It can be used in the place where electricity is not available. As it required very low pedalling power it is operated at very low power. In this pedal powered hacksaw connected directly to the pedal. While pedalling directly rotary motion of the pedal is converted into to and fro motion of the cutting tool. The end of the cutting tool is placed on the workpiece. By the to and fro motion of the cutting tool action is done on the work piece. In this way by applying force on the pedal of the cycle the cutting tool undergoes to and fro motion and we get the required work done.

**Keywords:** pedal power hacksaw machine, peddle power, bearings, welding, time and cost saving.

## INTRODUCTION:

### Raw materials:

Cast iron is an alloy of iron and carbon, and is popular because of its low cost and ability to make complex structures. The carbon content in cast iron is 3% to 4.5% by weight. Silicon and small amounts of Manganese, Sulphur, and Phosphorus are also present in it. The products of cast iron exhibit reasonable resistance against corrosion. It is neither malleable nor ductile, and it cannot be hardened like steel. It melts at about 2100 °F, and has either a crystalline or a granular fracture. The mechanical properties of cast iron are very much dependent on the morphology of its carbon content. Carbon is present in the form of plates in gray cast iron, whereas, it is incorporated in compound Fe<sub>3</sub>C (cementite) in white cast iron. Nodular cast iron, which show better tensile strength and strain than gray cast iron, carry carbon in the form of sphere shaped graphite particles

### Properties Of Castiron:

**Tensile Strength:** Different varieties of cast iron are used in the construction of machines and structures. Cast iron having a tensile strength of 5 tons per square inch, or less, is of no value for the purpose where strength is required. This type may however be used for balance weights, foundation blocks, or for purposes where weight alone is of consequence. Some varieties of cast iron show a tensile strength as high as 19 tons per square inch, but on an average, the strength is 7 tons per square inch. Addition of vanadium can increase the strength of cast iron.

**High Compressive Strength:** Compressive strength is defined as the ability of a material to withstand forces which attempt to squeeze or compress it. Cast iron shows high compressive strength, which makes it desirable for use in columns and posts of buildings. The compressive strength of gray cast iron can be almost as high as that of some mild steels.

**Low Melting Point:** Its melting temperature ranges from 1140 °C to 1200 °C. Nowadays, many advanced melting, alloying and casting methods are being used, which can bring the new irons formed, in competition with steel.

**Resistance to Deformation:** Cast iron structures show resistance to deformation and provide a rigid frame. However, if one part of the casting after the iron is poured into the moulds, is very thin, and another very thick, the problem of the structure Breakdown becomes prominent. The reason for this is when the thin part cools first and contracts, the thick part which cools down afterward causes stress in the thin part, offering sufficient force to break it.

## NEED FOR MECHANIZATION

Mechanization or mechanization is the process of doing work with machinery. In an early engineering text a machine is defined as follows:

“Every machine is constructed for the purpose of performing certain mechanical operations, each of which supposes the existence of two other things besides the machine in question, namely, a moving power, and an object subject to the operation, which may be termed the work to be done. Machines, in fact, are interposed between the power and the work, for the purpose of adapting the one to the other.” In some fields, mechanization includes the use of hand tools. In modern usage, such as in engineering or economics, mechanization implies machinery more complex than hand tools and would not include simple devices such as an un-

geared horse or donkey mill. Devices that cause speed changes or changes to or from reciprocating to rotary motion, using means such as gears, pulleys or sheaves and belts, shafts, cams and cranks, usually are considered machines. After electrification, when most small machinery was no longer hand powered, mechanization was synonymous with motorized machines

### Levels of mechanization:

For simplification, one can study mechanization as a series of steps. Many students refer to this series as indicating basic-to-advanced forms of mechanical society.

1. hand/muscle power
2. hand-tools
3. powered hand-tools, e.g. electric-controlled
4. powered tools, single functioned, fixed cycle
5. powered tools, multi-functioned, program controlled
6. powered tools, remote-controlled
7. powered tools, activated by work-piece (e.g.: coin phone)
8. measurement
9. selected signalling control, e.g. hydro power control
10. performance recording
11. machine action altered through measurement
12. segregation/rejection according to measurement
13. selection of appropriate action cycle
14. correcting performance after operation
15. correcting performance during operation

### WORKING PRINCIPLE

1. Working medium adopted is mechanical power.
2. The machine works without the help of electricity.
3. The rotary motion of the pedalling operation performed to our required on the cutting job.
4. The work piece is clamped on the work table using suitable clamp devices like clamp.
5. After clamping by pedalling the rotary motion of the pedal is converted into to and fro motion of the cutting tool and cutting operation takes place on the work piece.
6. After machining work piece is removed and cleaned.

### COMPONENTS AND DESCRIPTION:

#### Hacksaw:

A hacksaw is a fine tooth hand saw with a blade held under tension in a frame, used for cutting materials such as metal or plastics. Hand held hacksaw consist of a metal arch with a handle, usually a piston grip, with pins for attaching a narrow disposable blade.



**Fig: Hacksaw frames**

A screw or other mechanism is used to the thin blade under tension. The blade can be mounted with the teeth facing toward or away from the handle, resulting in cutting action on either push or pull stroke. On the push stroke, the arch will flex slightly decreasing the tension on the blade, often resulting in an increased density of the blade to buckle and crack. Cutting on the pull stroke increases the blade tension and will result in greater control of the cut and longer blade life.

#### Blades:

Blades are available in standardized lengths, usually 10 or 12 inches for a standard hand hacksaw. "Junior" hacksaws are typically 150mm long. Powered hacksaws may use large blades in a range of sizes, or small machines may use the same hand blades. The pitch of the teeth can be anywhere from fourteen to thirty-two teeth per inch (tips) for a hand blade, with as few as three tips for a large power hacksaw blade. The blade chosen is based on the thickness of the material being cut, with a minimum of three teeth in the material. As hacksaw teeth are so small, they are set in a "wave" set. As for other saws they are set from side to side to provide a kerf or clearance when sawing, but the set of a hacksaw changes gradually from tooth to tooth in a smooth curve, rather than alternate teeth set left and right. Hacksaw blades are normally quite brittle, so care needs to be taken to prevent brittle fracture of the blade. Early blades were of carbon steel, now termed 'low alloy' blades, and were relatively soft and flexible. They avoided breakage, but also wore out rapidly. Except where cost is a particular concern, this type is now obsolete. 'Low alloy' blades are still the only type available for the junior hacksaw, which limits the usefulness of this otherwise popular saw.



**Fig :Types of blades**

For several decades now, hacksaw blades have used high speed steel for their teeth, giving greatly improved cutting and tooth life. These blades were first available in the 'All-hard' form which cut accurately but were extremely brittle. This limited their practical use to benchwork on a work piece that was firmly clamped in a vice. A softer form of high speed steel blade was also available, which wore well and resisted breakage, but was less stiff and so less accurate for precise sawing. Since the 1980s, bi-metal blades have been used to give the advantages of both forms, without risk of breakage. A strip of high speed steel along the tooth edge is electron beam welded to a softer spine. As the price of these has dropped to be comparable with the older blades, their use is now almost universal.

#### **Variants:**

A panel hacksaw (no longer commonly available) eliminated the frame, so that the saw could cut into panels of sheet metal without the length of cut being restricted by the frame.

Junior hacksaws are the small variant, while larger mechanical hacksaws are used to cut working pieces from bulk metal.

A power hacksaw (or electric hacksaw) is a type of hacksaw that is powered either by its own electric motor or connected to a stationary engine. Most power hacksaws are stationary machines but some portable models do exist; the latter (with frames) have been displaced to some extent by reciprocating saws such as the Sawzall, which accept blades with hacksaw teeth. Stationary models usually have a mechanism to lift up the saw blade on the return stroke and some have a coolant pump to prevent the saw blade from overheating.

Power hacksaws are not as commonly used in the metalworking industries as they once were. Band saws and cold saws have mostly displaced them. While stationary electric hacksaws are not very common, they are still produced. Power hacksaws of the type powered by stationary engines and line shafts, like other line-shaft-powered machines, are now rare; museums and antique-tool hobbyists still preserve a few of them.

#### **Tool bit:**

A tool bit is a non-rotary cutting tool used in metal lathes, shapers, and planers. Such cutters are also often referred to by the set-phrase name of single-point cutting tool, as distinguished from other cutting tools such as a saw or water jet cutter. The cutting edge is ground to suit a particular machining operation and may be resharpened or reshaped as needed. The ground tool bit is held rigidly by a tool holder while it is cutting.

#### **Bearing:**

Bearing is a machine element that constrains relative motion and reduces friction between moving parts to only the desired motion. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Many bearings also facilitate the desired motion as much as possible, such as by minimizing friction. 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.

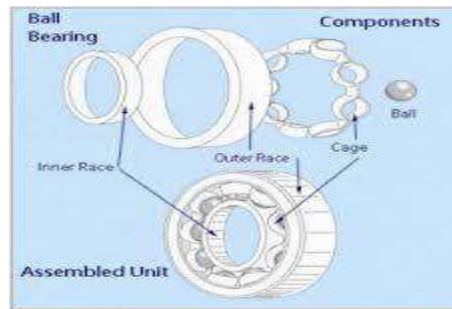
The term "bearing" is derived from the verb "to bear" "a bearing being a machine element that allows one part to bear (i.e., to support) another. The simplest bearings are bearing surfaces, cut or formed into a part, with varying degrees of control over the form, size, roughness and location of the surface. Other bearings are separate devices installed into a machine or machine part. The most sophisticated bearings for the most demanding applications are very precise devices; their manufacture requires some of the highest standards of current technology.

#### **Types of bearings:**

There are many kinds of bearings. Some of them are:

##### **Ball bearing:**

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races



**Fig : Ball bearing**

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

#### **Roller bearing:**

A rolling-element bearing, also known as a rolling bearing,] is a bearing which carries a load by placing rolling elements (such as balls or rollers) between two bearing rings. The relative motion of the pieces causes the round elements to roll with very little rolling resistance and with little sliding

A rolling element rotary bearing uses a shaft in a much larger hole, and cylinders called "rollers" tightly fill the space between the shaft and hole. As the shaft turns, each roller acts as the logs in the above example. However, since the bearing is round, the rollers never fall out from under the load.



**Fig: Roller bearing**

Rolling-element bearings have the advantage of a good trade off between cost, size, weight, carrying capacity, durability, accuracy, friction, and so on. Other bearing designs are often better on one specific attribute, but worse in most other attributes, although fluid bearing can sometimes simultaneously outperform on carrying capacity, durability, accuracy, friction, rotation rate and sometimes cost. Only plain bearings are used as widely as rolling-element bearings.

#### **Maintenance and lubrication:**

Many bearings require periodic maintenance to prevent premature failure, but many others require little maintenance. The latter include various kinds of fluid and magnetic bearings, as well as rolling-element bearings that are described with terms including sealed bearing and sealed for life. These contain seals to keep the dirt out and the grease in. They work successfully in many applications, providing maintenance-free operation. Some applications cannot use them effectively.

Many bearings in high-cycle industrial operations need periodic lubrication and cleaning, and many require occasional adjustment, such as pre-load adjustment, to minimise the effects of wear.

Bearing life is often much better when the bearing is kept clean and well lubricated. However, many applications make good maintenance difficult. For example, bearings in the conveyor of a rock crusher are exposed continually to hard abrasive particles. Cleaning is of little use, because cleaning is expensive yet the bearing is contaminated again as soon as the conveyor resumes operation. Thus, a good maintenance program might lubricate the bearings frequently but not include any disassembly for cleaning. The frequent lubrication, by its nature, provides a limited kind of cleaning action, by displacing older (grit-filled) oil or grease with a fresh charge, which itself collects grit before being displaced by the next cycle.

#### **Packing:**

Some bearings use a thick grease for lubrication, which is pushed into the gaps between the bearing surfaces, also known as packing. The grease is held in place by a plastic, leather, or rubber gasket (also called a gland) that covers the inside and outside edges of the bearing race to keep the grease from escaping.

Bearings may also be packed with other materials. Historically, the wheels on railroad cars used sleeve bearings packed with *waste* or loose scraps of cotton or wool fibbers soaked in oil, and then later used solid pads of cotton.

### **FABRICATION :**

#### **Fabrication of machine:**

Metal fabrication is the building of metal structures by cutting, bending, and assembling processes:

Cutting is done by sawing, shearing, or chiselling (all with manual and powered variants); torching with hand-held torches (such as oxy-fuel torches or plasma torches); and via numerical control (CNC) cutters (using a laser, mill bits, torch, or water jet).

Bending is done by hammering (manual or powered) or via press brakes and similar tools. Modern metal fabricators utilize press brakes to either coin or air-bend metal sheet into form. CNC-controlled backgauges utilize hard stops to position cut parts in order to place bend lines in the correct position. Off-line programming software now makes programming the CNC-controlled press brakes seamless and very efficient.



Assembling (joining of the pieces) is done by welding, binding with adhesives, riveting, threaded fasteners, or even yet more bending in the form of a crimped seam. Structural steel and sheet metal are the usual starting materials for fabrication, along with the welding wire, flux, and fasteners that will join the cut pieces. As with other manufacturing processes, both human labor and automation are commonly used. The product resulting from fabrication may be called a fabrication. Shops that specialize in this type of metal work are called fab shops. The end products of other common types of metalworking, such as machining, metal stamping, forging, and casting, may be similar in shape and function, but those processes are not classified as fabrication.

There are few types of fabrication methods done on the machine.

They are:

1. Cutting 2. Drilling 3. Machining 4. Welding 5. Cleaning 6. Assembly

## MACHINING OPERATIONS

### Cutting:

The raw material has to be cut to size. This is done with a variety of tools.

The most common way to cut material is by Shearing (metalworking); Special band saws designed for cutting metal have hardened blades and a feed mechanism for even cutting. Abrasive cut-off saws, also known as chop saws, are similar to miter saws but with a steel cutting abrasive disk. Cutting torches can cut very large sections of steel with little effort.



Fig: Cutting machine

### Drilling:

Drilling is used to produce holes in the objects. In this project plates requires holes for making assembly. These holes are done by vertical type drilling machine.



Fig : Drilling machine

### Machining:

Machining is a trade, in and of it, although Fab shops will generally entail a limited machining capability including; metal lathes, mills, magnetic based drills along with other portable metal working tools.

### Welding:

Welding is the main focus of steel fabrication. The formed and machined parts will be assembled and tack welded into place then re-checked for accuracy. A fixture may be used to locate parts for welding if multiple elements have been ordered. The welder then completes welding per the engineering drawings, if welding is detailed or per his own judgment if no welding details are provided.



Fig : Welding machine

Special precautions may be needed to prevent warping of the weldment due to heat. These may include re-designing the weldment to use less weld, welding in a staggered fashion, using a stout fixture, covering the weldment in sand during cooling, and straightening operations after welding. Straightening of warped steel weldments is done with an Oxy-acetylene torch and is somewhat of an art. Heat is selectively applied to the steel in a slow, linear sweep. The steel will have a net contraction, upon cooling, in the direction of the sweep. A highly skilled welder can remove significant warpage using this technique.



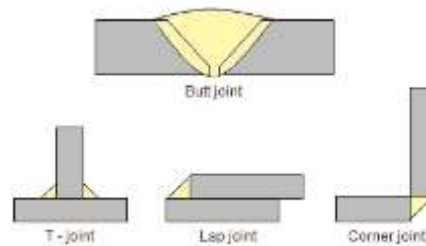
**Fig: Welding process**

Steel weldments are occasionally annealed in a low temperature oven to relieve residual stresses. Such weldments, particularly those employed for engine blocks, may be line-bored after heat treatment.

#### **Types of weld joints:**

The American Welding Society defines a joint as “the manner in which materials fit together.” There are five basic types of weld joints:

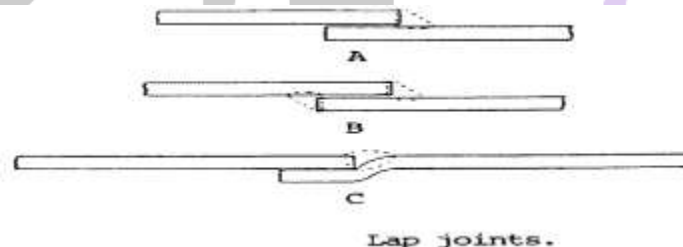
Butt joint. T-joint. Lap joint. Corner joint. And Edge joint



**Fig: Weld Joints**

#### **Lap joint:**

Lap joints can be used in wood, plastic, or metal. A half lap joint or a halving joint is a technique of joining two pieces of material together by overlapping them. A lap may be a full lap or half lap. In a full lap, no material is removed from either of the members to be joined, resulting in a joint which is the combined thickness of the two members. In a half lap joint, material is removed from



**Fig :Lap joints**

each of the members so that the resulting joint is the thickness of the thickest member. Most commonly in half lap joints, the members are of the same thickness and half the thickness of each is removed

#### **Butt joint:**

A butt joint is a joinery technique in which two members are joined by simply butting them together. The butt joint is the simplest joint to make since it merely involves cutting the members to the appropriate length and butting them together. It is also the weakest because unless some form of reinforcement is used (see below) it relies upon glue alone to hold it together. Because the orientations



**Fig: Butt joint**

of the members usually present only end grain to long grain gluing surface, the resulting joint is inherently weak.

#### **Tee joints:**

Tee joints are used when one part must be joined to the center of another part forming a “T”. Like the other types of weld, there are several ways that this joint can be prepared and welded, each with their own benefits and disadvantages. Most methods of welding tee joints involve welding the two joints between the parts, with either a high or low energy density beam. Like the other weld types,

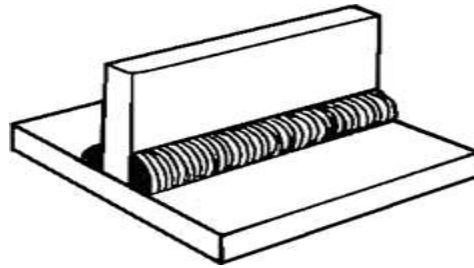


Fig : Tee joint

**Corner joint:**

Corner joints are used to join two members located approximately at right angles to each other in the form of an L. The fillet weld corner joint is used in the construction of boxes, box frames, and similar fabrications. The closed corner joint is used on lighter sheets when high strength is not required at the joint. In making the joint by oxyacetylene welding, the overlapping edge is melted down and little or no filler metal is added. When the closed joint is used for heavy

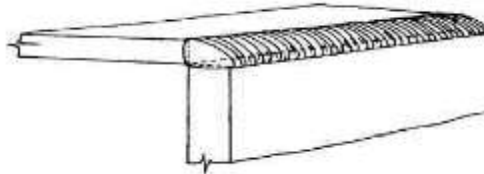


Fig : Corner joint

sections, the lapped plate is V-bevelled or U-grooved to permit penetration to the root of the joint. The open corner joint is used on heavier sheets and plates. The two edges are melted down, and filler metal is added to fill up the corner. Corner joints on heavy plates are welded from both sides.

**Edge joint:**

Edge jointing or just jointing is the process of making the edge of a wooden board straight and true in preparation for subsequent operations, often ultimately leading to joining two or more components together. Traditionally, jointing was performed using a jointer plane. Modern techniques include the use of a jointer machine, a hand held router and straight edge, or a table-mounted router.

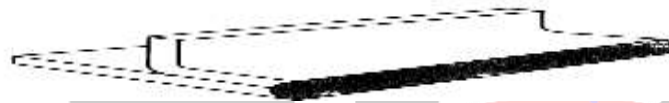


Fig : Edge joint

**Cleaning:**

It is the operation to clean all the machined parts without burrs, dust and chip formals. So that the parts are brightened and good looking.

**Assembly:**

After the weldment has cooled it is generally sand blasted, primed and painted. Any additional manufacturing specified by the customer is then completed. The finished product is then inspected and shipped

**PEDAL POWERED HACKSAW MACHINE:**

Fig : pedal powered Hacksaw machine

**APPLICATIONS**

1. In a furniture making industry at production it is widely used
2. It can perform cutting operation in various kinds of industries.
3. This machine can be applied in carpentry and plumbing works also.

**Advantages:**

1. Pedal powered hacksaw can be used for light duty cutting operations of plywood.
2. Pedal powered hacksaw can be used in remote places where electricity is not available.
3. It is designed as a portable one which can be used for cutting in various places.

4. The ply wood can be cut without any external energy like fuel or current.
5. Since Pedal powered hacksaw uses no electric power and fuel, this is very cheap and best.
6. Pedal powered hacksaw saw helps to obtain less effort uniform cutting.
7. There are fewer losses in power transmission by using pedal powered hacksaw
8. As pedalling is done by human it is good exercise and is good to health.

**Limitations:**

1. Leads to physical stress
2. High thick wood cannot be cut
3. More amount of human efforts is required.

**COST ESTIMATION:**

S.NO	NAME OF THE PART	MATERIAL	QUANTITY	AMOUNT
1	Square pipe	Cast iron	35 feet	550
2	Hacksaw Frame	Cast iron	1	150
3	Hacksaw Blade	Stainless steel	1	10
4	Cup Bearings	Cast iron	1	450
5	Bearing Shaft	Cast iron	1	200
6	Pedal Rod	Stainless steel	2	160
7	Pedals	Wood	2	100

Table : cost estimation

TOTAL COST: R S 1620/-

**RESULTS****For cast iron pipes:**

Performance of Pedal powered hacksaw for light duty cutting operations on cast iron pipes

S.NO	R.P.M	TIME(min)	DEPTH OF CUT(mm)
1	30	2	11
2	40	2	13
3	50	2	16

Table : performance on cast iron pipes

**For pvc pipes:**

Performance of Pedal powered hacksaw for light duty cutting operations on pvc pipes

S.NO	R.P.M	TIME(min)	DEPTH OF CUT(mm)
1	30	2	14
2	40	2	18
3	50	2	22

Table : performance on pvc pipes

**For wood block:**

Performance of Pedal powered hacksaw for light duty cutting operations on wood block

S.NO	R.P.M	TIME(min)	DEPTH OF CUT(mm)
1	30	2	17
2	40	2	22
3	50	2	28

Table : performance on wood block

**CONCLUSION:**

Thus this paper work might be useful in all industries. For practical applications this is fabricated for light duty operation. Its height, weight, and other mechanical designs may not be suitable for any other operation or work on hardened materials. We are proud that we have completed the work with the limited time successfully. The pedal powered hacksaw works with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making use of available facilities.



Thus we have developed a pedal powered hacksaw which helps to achieve simple cycling mechanism. The applications of the machine are comparatively wide with respect to cost of the machine.

## REFERENCES

- [1]. David Gordon Wilson "UNDERSTANDING PEDAL POWER" ISBN: 0-86619-268-9 [C] 1986, Volunteers in Technical Assistance" Technical paper 51 VITA 1600 Wilson Boulevard USA.
- [2]. Zoeb khan , " Design and Fabrication of Human Powered Wood Cutting machine" ,International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169 Volume: 3 Issue: 2 072– 074.
- [3] Chaudhary Pravinkumar k, "Understanding pedal power" ISBN: 0-86619268-9 [C] 1986, Volunteers in Technical Assistance" Technical paper 51 VITA 1600 Wilson Boulevard USA.
- [4]. Linxu, Weinan Bai, Jingyu Ru, Qiang Li, "Design and Implementation of the Reciprocating Pedal Powered Electricity Generating Device", Advanced Materials Research (Vol.282-283 (2011) pp 735-738 .
- [5] S.G.Bahale, Dr.A.U.Awate, S.V.Saharkar, "Performance Analysis of Pedal Powered Multipurpose Machine", International Journal of Engineering Research and Development (IJERD) (Vol.1, Issue.5, e-ISSN:2278-0181) (2012)
- [6] Kshirsagar Prashant R, "Theoretical Analysis of Multi-Way Power Hacksaw Machine" , International Journal of Research in Advent Technology, Vol.3, No.4, April 2015 E-ISSN: 2321-9637
- [7] Sreejith K. , "Experimental Investigation of Pedal Driven Hacksaw", Research Inventy: International Journal of Engineering And Science Vol.4, Issue 7 (July 2014), PP 01-05 Issn (e): 2278-4721, Issn (p):2319-6483
- [8] Dharwa Chaitanya Kirtikumar, " designed and developed a multipurpose machine which does not require electricity for several operations like cutting, grinding", International Journal for Technological Research in Engineering (Vol.1, Issue.1, ISSN:2347-4718) (2013).

