A Mini Project Report

On

FABRICATION OF BEAM ENGINE MECHANISM POWERED BY MINI CIRCULAR SAW MACHINE

Submitted to

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

In Partial fulfillment of the Requirement for the Award of the degree of

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In

MECHANICAL ENGINEERING

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CERTIFICATE

This is to certify that the project report entitled **"FABRICATION OF BEAM ENGINE MECHANISM MINI POWERED BY CIRCULAR SAW"** submitted by **B.SHIVA KUMAR,** bearing H.T No: **195U5A0305, CH.SRUJITHA,** bearing H.T No: **195U5A0306, D.SRINIVAS RAO,** bearing H.T No: **195U5A0309, N.LAVANYA ,** bearing H.T No: **195U5A0326, V.KIRAN KUMAR,** bearing H.T No: **195U5A0344,** in partial fulfillment for the Degree of Bachelor of Technology in **MECHANICAL ENGINEERING** to **Jawaharlal Nehru Technological University** is a report of bonafide work carried out by him under my guidance and supervision.

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I would like to thank my project guide **Mr.K.KIRAN KUMAR (Ph.D), Assistant Professor,** for his excellent guidance, support and distinguished supervision which allowed me to complete this work.

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DECLARATION

I hereby declare that the project entitled **"FABRICATION OF BEAM ENGINE MECHANISM MINI POWERED BY CIRCULAR SAW"** submitted in partial fulfillment for the Degree of Bachelor of Technology in Mechanical Engineering to Jawaharlal Nehru Technological University is an authentic work and has not been submitted to any other university/institute for the award of any degree.

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ABSTRACT

A beam engine mechanism is one where that use an overhead beam to create motion. In these a beam engine mechanism based assembly in order to achieve hack saw cutting motion using a circular cutting disc. This system uses a motorized disc to drive a connector which is in turn connected to an overhead beam. The overhead beam has a connecting rod in turn connected to a mini hacksaw blade. When the motorized disc below is turned on the connecting arm starts reciprocating the overhead beam. This beam now heals achieve a back and forth cutting motion as required by the hacksaw blade.

In this project a small bed in order to rest the work piece to achieve desired cutting. Hence study the fabrication of mini hacksaw using beam engine mechanism.

CONTENTS

Chapter 1

INTRODUCTION

1.1 Beam Engine Mechanism

A beam engine mechanism is one where we use an overhead beam to create motion. Here we use a beam engine motion based assembly in order to achieve hack saw cutting motion using a circular cutting disc. Our system uses a motorized disc to drive a connector which is intern connected to an overhead beam. The overhead bean has a connecting rod in turn connected to a mini hacksaw blade. When the motorized disc below is turned on the connecting arm starts reciprocating the overhead beam.

This beam now heals achieve a back and forth cutting motion as required by the hacksaw blade.We construct a small bed in order to rest the work piece to achieve desired cutting. Thus we study the design and fabrication of mini hacksaw using beam engine mechanism.

In this project, the output of a Beam Engine is used to drive a reciprocating saw to cut timber. Here, instead of the rotating fly wheel, it is intended to have a rotating reciprocating saw. This rotating reciprocating saw is used to cut timber. Reciprocating saws driven with electric power. But in places where electricity is scarce, or absent, it is difficult to operate these Equipments. But since the Beam Engine powered saw runs on fuel, it can be operated even in places where electricity is totally absent. A beam engine is a design of stationary steam engine.

A stationary engine is an engine whose framework does not move. Usually, a stationary engine is used not to propel a vehicle but to drive a piece of immobile equipment such as a pump or power tools.

Piston is mounted vertically, and the piston rod does not connect directly to the connecting rod, but instead to a rocker or beam above both the piston and flywheel. The beam is pivoted in the middle, with the cylinder on one side and the flywheel, which incorporates the crank, on the other. The connecting rod connects to the opposite end of the beam to the piston rod, and then to the flywheel.

1.2 METHODOLOGY

1.2.1 ROTATIVE BEAM ENGINES

In a rotated beam engine, the piston is mounted vertically, and the piston rod drives the beam as before. A connecting rod from the other end of the beam, rather than driving a pump rod now drives a flywheel.

Early Watt engines used Watt's patent sun and planet gear, rather than a simple crank, as use of the latter was protected by a patent owned by James Pickard. Once the patent had expired, the simple crank was employed universally. Once rotary motion had been achieved a drive belt could be attached beside the flywheel. This transmitted the power to other drive shafts and from these other belts could then be attached to power a variety of static machinery e.g. threshing, grinding or milling machines. Here the oscillatory motion of the saw blade is achieved by the rotary motion of the driving wheel this mechanism called as a Beam Engine Mechanism.

1.3 WORKING PRINCIPLE

There is a motor attached for working of beam engine powered circular sawing machine. When the wheel attached to the motor rotates, it imparts a oscillating motion to the rocker arms. For this oscillating motion connecting rods are attached as a link. This oscillating motion of the rocker arm is converted into rotary motion by the crankshaft.

The crankshaft, which is connected to the circular saw. These all attachments makes the circular saw to rotate. This rotary motion of the circular wood saw is used to saw timber or wood blocks. There is a small table attachment for supporting the wooden block. The wooden block is placed on the table and pushed towards the rotating wood saw, which results in the sawing action. There is a provision for up down (vertical movement for the wooden block as a adjustment). It has a spring attached below the base. On the rear side of the base there are the bolts for adjusting the height of the base.

Chapter 2

2. LETRECHER SURVEY

1. Tanuj Joshi et al [2018] stated that ordinary hacksaw machine can be supplanted with programmed twofold hacksaw machine. Programmed twofold hacksaw machine gives high efficiency in brief era in examination with the regular hacksaw machines. The real favourable position of this machine is that intercession of work is diminished to greatest level. In this fast- developing modern time, the utilization of twofold Hacksaw machine is wide. Time and work assume a noteworthy part underway process this can be overwhelmed by utilizing this sort of programmed machines. The programmed hacksaw machine can be made utilization of at any of the ventures like furniture enterprises. The scope of size of work-pieces that can be cut utilizing the programmed hacksaw machine can be shifted by changing the sharp edge estimate. Right now, the machine utilizes 12-inch edge for cutting.

2. Avirana et al [2018] stated that to overcome problems in conventional hacksaw machines, due to high efficiency, easy to operate and affordable price the proposed model of multi-way power hacksaw the machine is helpful and completes all the expectations needed for the mini-industries. Future scope of proposed research work to increase the production rate cuts the metal bars easily. It can withstand the vibrations, no hazards from a jerk, no special training required to operate it. After studying this report, we have to know that how the A hacksaw machine will work and knowing the construction and how mechanism work in the machine. We learnt how the theoretical design is possible in practise. Another hacksaw machine is only cut one part at one time but this machine cut the four parts at a time, this hacksaw machine has lighter weight compared to another machine. The cost of the machine is less and easy to operate so it affordable for all industry. The material cast iron which is used will give the high strength than alloy steels. This project is very much useful and easy to install by the user and also the motor used will not only operate with the help of electricity but also through conventional source of energy like solar energy.

3. Sibabrata Mahanoy et al [2017] stated that to overcome problems in conventional hacksaw machines, due to high efficiency, easy to operate and affordable price the proposed model of multi-way power hacksaw machine is helpful and completes all the expectations Volume 03,

No. 04 Apr 2017 Page 6 needed in the mini industries. Future scope of proposed research work to increase the production rate cuts the metal bars easily. It can withstand the vibrations, no hazards from jerk, no special training required to operate it. After studying this report, we have known that how the 4-way hacksaw machine will work, and knowing the construction and how mechanism works in the machine. We learnt how the theoretical design is possible in practical. Other hacksaw machine is only cut one part at one time but this machine cut the four part at a time, this hacksaw machine has lighter weight compare to another machine. The cost of machine is less and easy to operate so it affordable for all industry.

4. Raj Rut raj et al [2017] stated that conventional hacksaw machine can be replaced with automatic power hacksaw machine. Automatic power hacksaw machine gives high productivity in short time period in comparison with the conventional hacksaw machines. The major advantage of this machine is that intervention of labour is reduced to maximum level. In this rapid emerging industrial era, the use of power Hacksaw machine is wide. Time and labour plays a major role in production process this can be overcome by using this type of automatic machines. The automatic hacksaw machine can be made use of at any of the industries like pump manufacturing industries that involve bulk amount of shafts that have to be cut frequently. The range of size of work-pieces that can be cut using the automatic hacksaw machine can be varied by changing the blade size. Currently, the machine uses 10 inch blade for cutting.

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The survey of the literature regarding the Power hacksaw machines are listed below: Rakesh Ambade (1) In this paper presented a "Design and Fabrication of human powered multi-purpose Machine" which does not require electricity for several operations like culting, grinding etc. This is a human powered machine runs on chain drive mainly with human effects. But if you wanted to operate this machine by electric power this machine can also does that. It has some special attachment so use both human power as well as electric power. The design is ideal for use in the developing world because it doesn't require electricity and can be built using metal base, chain, pulley, rubber belt, grinding wheel, saw, bearing, foot pedal (for operated by human) electric motor, chain socket.

Nitinchandra R. Patel (2) in this research paper presented a "Material selection and Testing of hacksaw blade based on mechanical properties" stated that the appropriate saw blade must be selected for better operation and fine cutting by selecting a number of teeth per inch. There are four types of blades based on material namely High Carbon steel, Alloy Steel, Bi-metallic strip and High-speed steel blades. Out of these four the best suitable for cutting hard materials like a Mild steel bar and Aluminum etc. Here, it is found out that the testing of mechanical properties such as Hardness, Wear resistance, Tensile strength, Permissible deflection of blade.

S.G.Bahaley (3) In this paper presented a "Designed and Fabrication of a pedal powered multipurpose machine". It is a human powered machine which is developed for lifting the water to a height 10 meter and generates 14 Volt, 4 ampere of electricity in most effective way. Power required for pedaling is well below the capacity of an average healthy human being. The system is also useful for the work out purpose because pedaling will act as a health exercise and also doing a useful work.

Sahu Samirkumar Satishkumar (4) In this paper presented a "Fabrication of two-way pedal powered hacksaw machine" which can be used for industrial applications for cutting of wooden block, metal bar and pipe. The machine works on the principle of slider crank mechanism. In this machine pedal is connected to the crank which is connected directly to the hacksaw frame by connecting rod from both the side and the power is supplied to the hacksaw frame by means of chain.The main objective behind this machine to reduce both cutting time and energy, it also available in affordable cost. The pedal power two-way hacksaw machine, which runs on human power, works on the principle of the conversion of rotational motion to oscillatory motion

Chapter 3

FABRICATION

3.1 MAJOR COMPONENTS AND MATERIAL USED

The Beam Engine Powered Circular Sawing Machine consists of the following components to fulfill the requirements of complete operation of the machine.

1. Saw Blade

   The saw blade is used for timber cutting.Easily available in the market.

Fig 3.1 Saw blade

2. Rocker arm.

   Material used for rocker arm is mild steel. Which is laser cut of 2mm sheet.

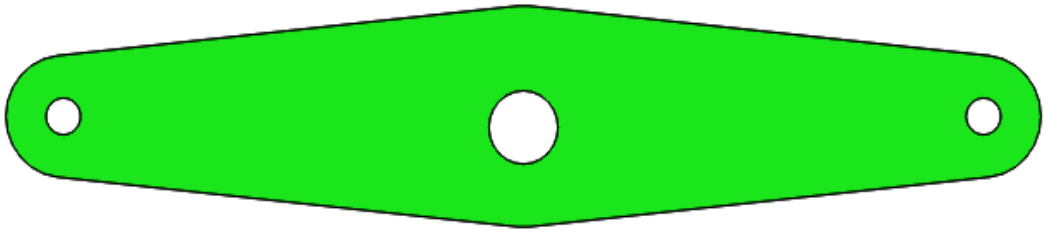

Fig 3.2 Rocker arm

3. Connecting link

   Material used for connecting link is mild steel. Which is laser cut of 2mm sheet.

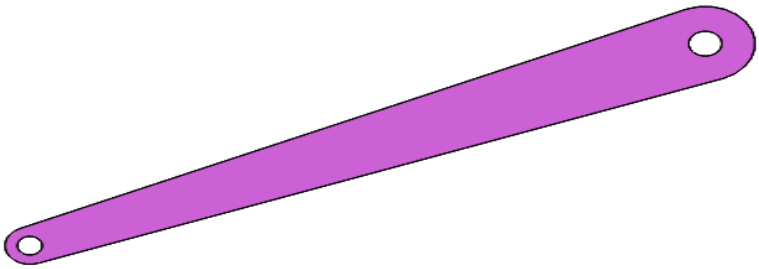

Fig 3.3 Connecting link

4. Crankshaft

   Material used for crankshaft is mild steel. Which is laser cut of 2mm sheet.

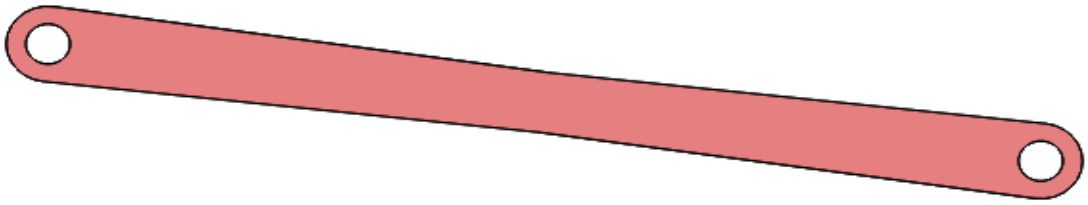

Fig 3.4 Crankshaft

5. Base with Spring Attachment

   Material used for base is mild steel. Which is laser cut of 2mm sheet. Spring is attached to the bottom for the vertical adjustment.

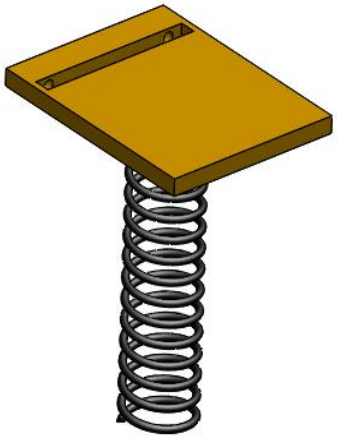

Fig 3.5 Base with spring attachment

3.2 SCHEMATIC DIAGRAM OF BEAM ENGINE POWERED CIRCULAR SAWING MACHINE

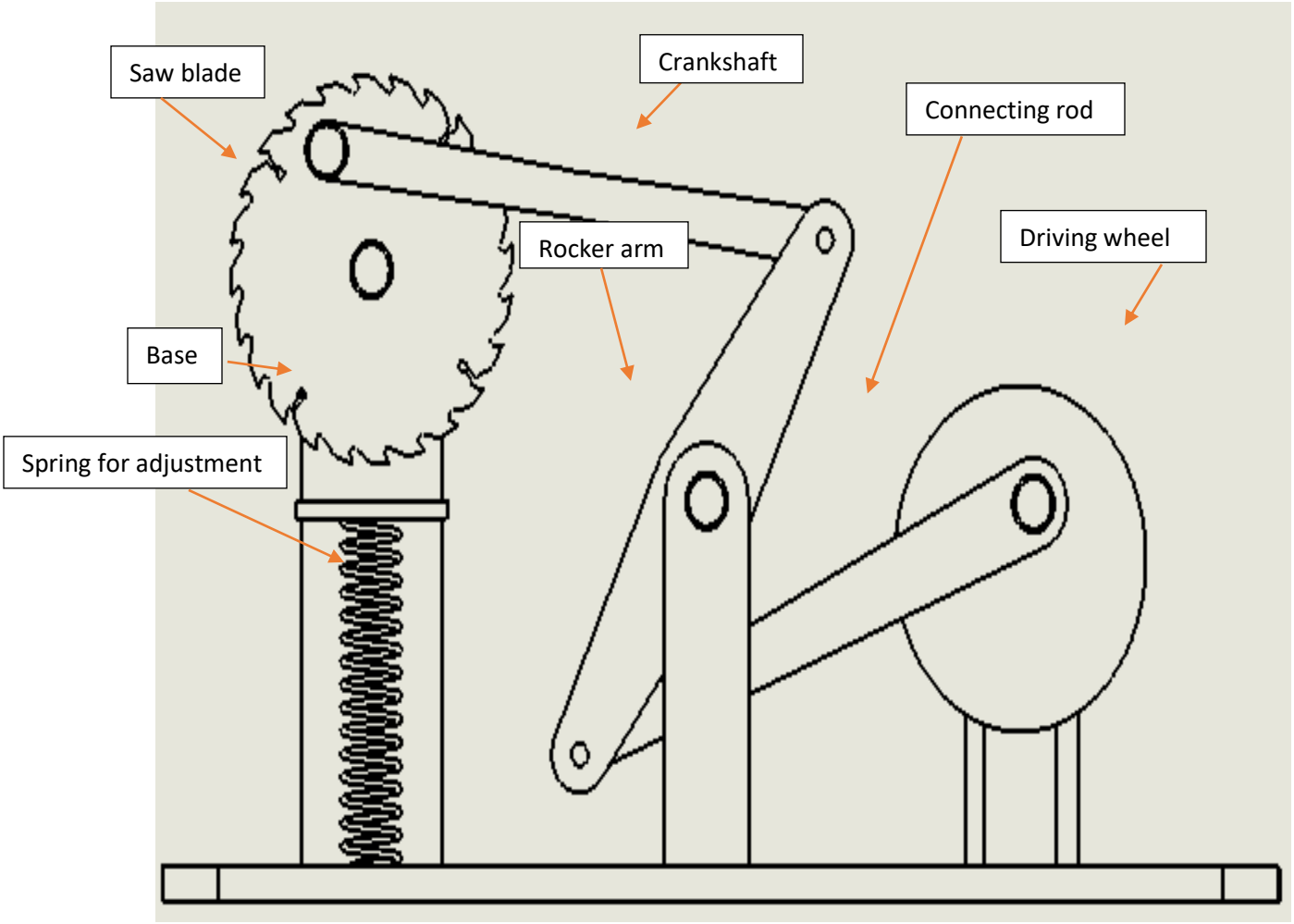

Fig3.6 3D CAD MODELS USING SOLIDWORKS

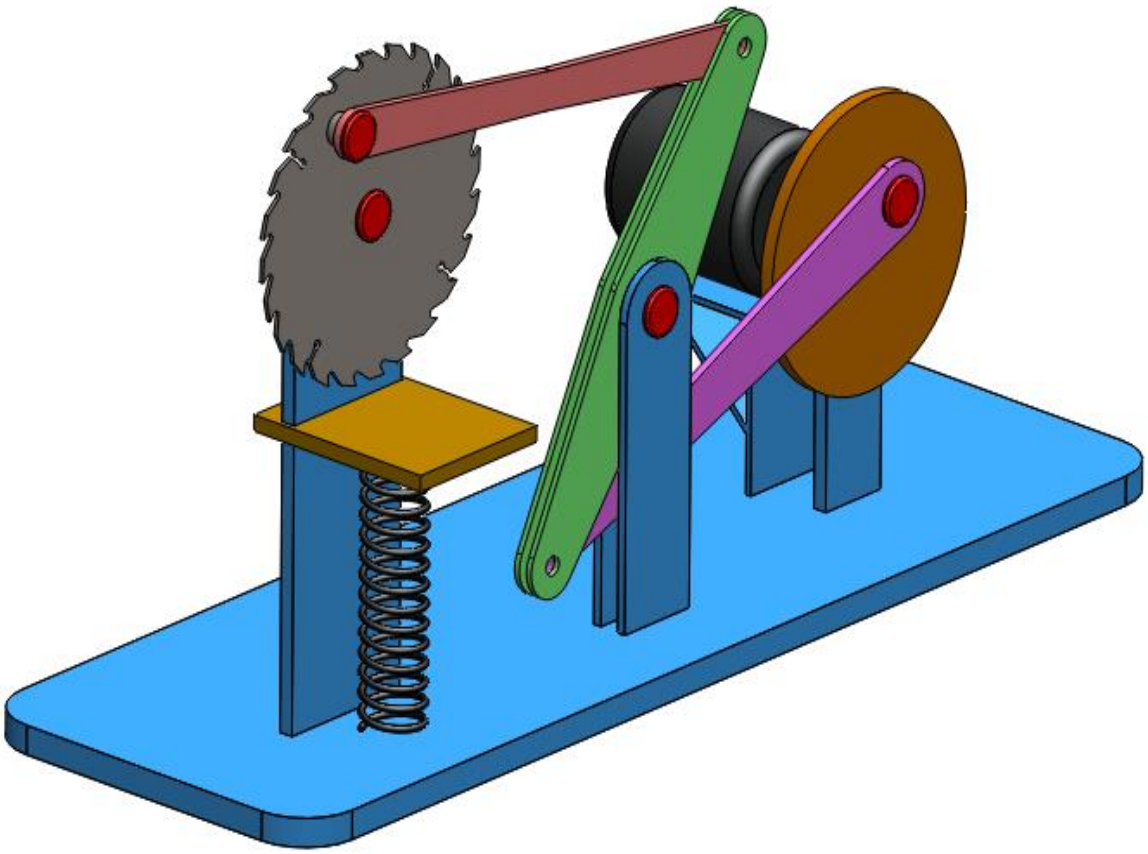

Fig 3.7 Isometric view

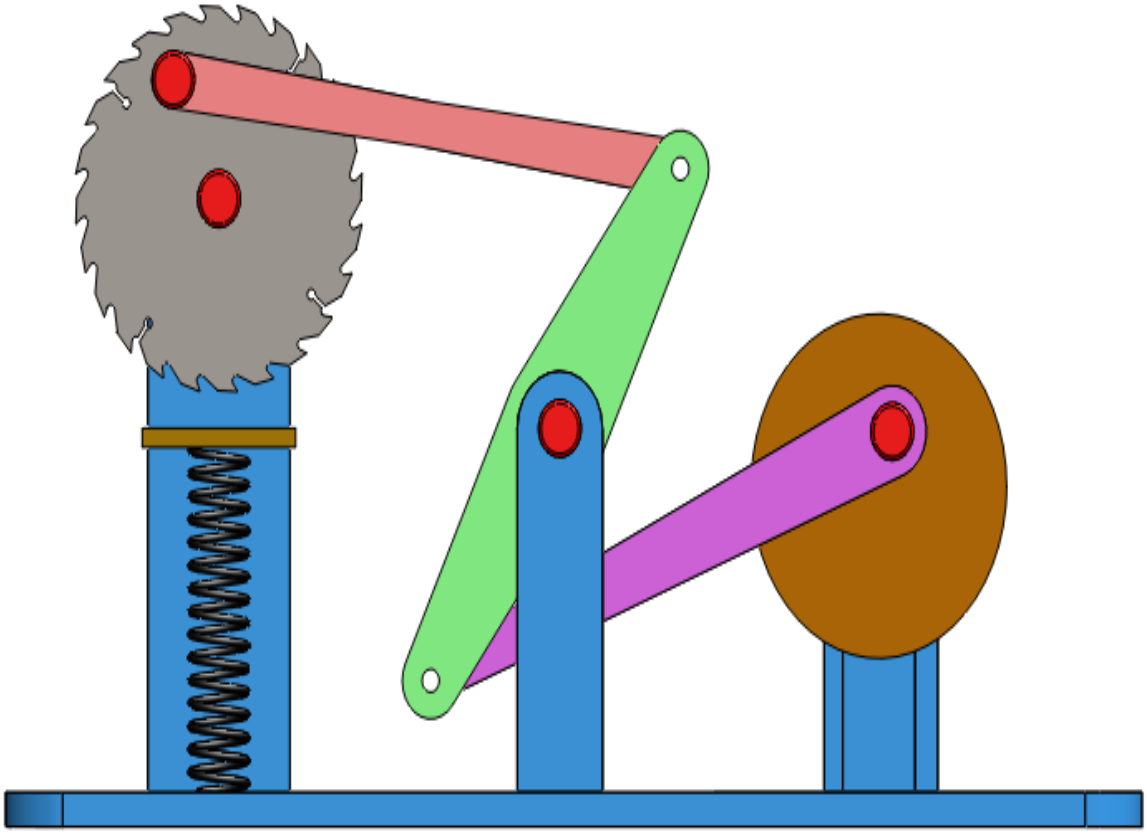

Fig 3.8 Front view

3.3 Fabrication model construction

In a reciprocating beam engine machine materials are shaped which makes it more advantageous than usual beam engine. Reciprocating Beam engine machine helps industries to achieve high production rate at a minimal amount of time and cost. Reciprocating Beam engine machine reduces the production cost as well as the time. In this project a reciprocating beam engine machine is designed with the help of quick return mechanism, the rotary motion of the motor is converted into linear motion of the tool which shapes the material mounted on the vice. The quick return mechanism converts rotary motion into reciprocating motion, but unlike the crank and slider the forward reciprocating motion is at slower rate than the return stroke. DC motor is connected with the mechanism with the help of chain and sprocket. Whole mechanism is built on rugged metal frame.

Fig:3.9 frame cutting pipes

Fig:3.10 single pipes

Fig:3.11 pipes cutting

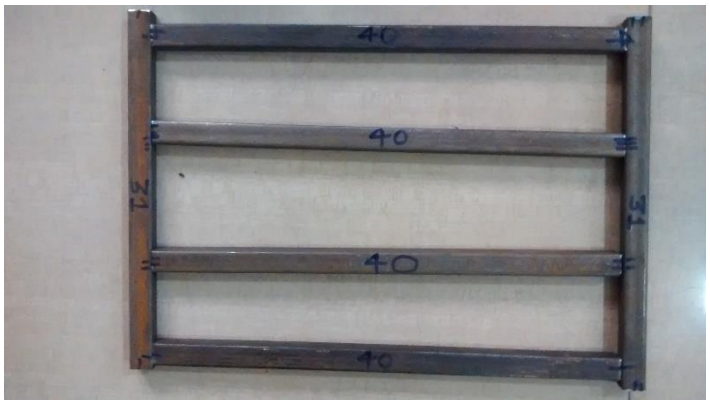

Fig: 3.12 welding pipes

Fig:3.13 table welding frame

Fig:3.14 Components

Fig:3.1Blade

5

Fig:3.16 motor bush

Fig:3.17 fly wheel

Fig:3.18 fly wheel

Fig:3.19 hub

Fig:3.20Wiper moor

Fig: 3. 21 dc gear motor (wiper motor)

- Different Types of DC Motor
- Difference Between AC and DC Motor
- Speed Control of DC Motor
- Applications of Dc motor

3.4 Construction of DC Motor

Before understanding the working of DC motor first, we have to know about their construction. There are two main parts of the DC motor.

- Armature
- Stator

3.4.1 Working Principle of DC Motor

A DC motor is an electrical machine which converts electrical energy into mechanical energy. The basic working principle of the DC motor is that whenever a current carrying conductor places in the magnetic field, it experiences a mechanical force.

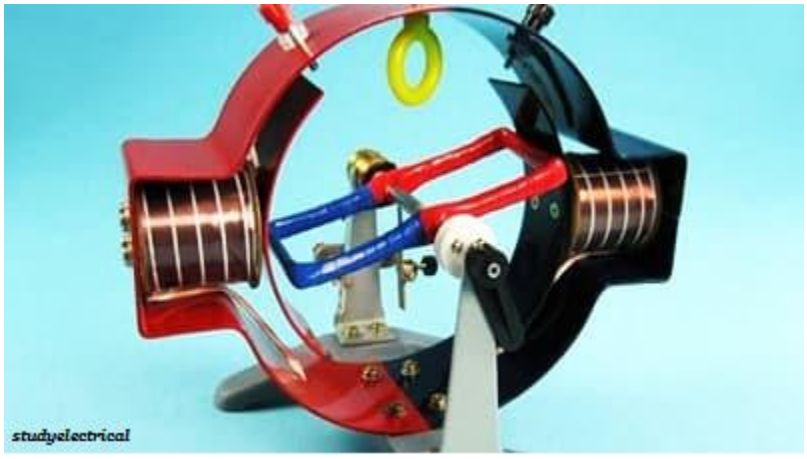

Fig: 3.22 Fleming's left-hand rule and its magnitude decide the direction of this force.

3.4.2 Fleming's Left Hand Rule:

If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other, and first finger represents the direction of the magnetic field, the second finger

represents the direction of the current, and then the thumb represents the direction of the force experienced by the current carrying conductor.

Fig: 3. 23 dc motor

F = BIL Newton

Where,

B = magnetic flux density,

I = current and

L = length of the conductor within the magnetic field.

When armature winding is connected to a DC supply, an electric current sets up in the winding. Permanent magnets or field winding (electromagnetism) provides the magnetic field. In this case, current carrying armature conductors experience a force due to the magnetic field, according to the principle stated above.

The Commutator is made segmented to achieve unidirectional torque. Otherwise the direction of force would have reversed every time when the direction of movement of the conductor is reversed in the magnetic field. This is how a DC motor works!

3.4.3 Back- EMF of DC motor

According to the fundamental law of nature, no energy conversion is possible until there is something to oppose the conversion. In case of generators, magnetic drag provides this opposition, but in the case of dc motors, there is back emf. Presence of the back emf makes a dc motor ‘self-regulating’.

When the armature of a motor is rotating, the conductors are also cutting the magnetic flux lines and hence according to the Faraday's law of electromagnetic induction an emf induces in the armature conductors.

The direction of this induced emf is such that it opposes the armature current (I_a). The circuit diagram below illustrates the direction of the back emf and armature current.

3.4.4 Significance of Back-EMF

Magnitude of back emf is directly proportional to speed of the motor. Consider the load on a dc motor is suddenly reduced. In this case, required torque will be small as compared to the current torque. Speed of the motor will start increasing due to the excess torque. Hence, being proportional to the speed, magnitude of the back emf will also increase. With increasing back emf armature current will start decreasing. Torque being proportional to the armature current, it will also decrease until it becomes sufficient for the load. Thus, speed of the motor will regulate.

On the other hand, if a dc motor is suddenly loaded, the load will cause decrease in the speed. Due to decrease in speed, back emf will also decrease which allows more armature current. Due to increase in armature current the torque will increase to fulfill the load requirement.

A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into the mechanical rotation.

3.4.5 Definition of DC motor

A DC motor is defined as a class of electrical motors that convert direct current electrical energy into mechanical energy.

From the above definition, we can conclude that any electric motor that is operated using direct current or DC is called a DC motor. In the next few sections, we will understand the DC motor construction and how a DC motor converts the supplied DC electrical energy into mechanical energy.

3.4.6 DC Motor Diagram

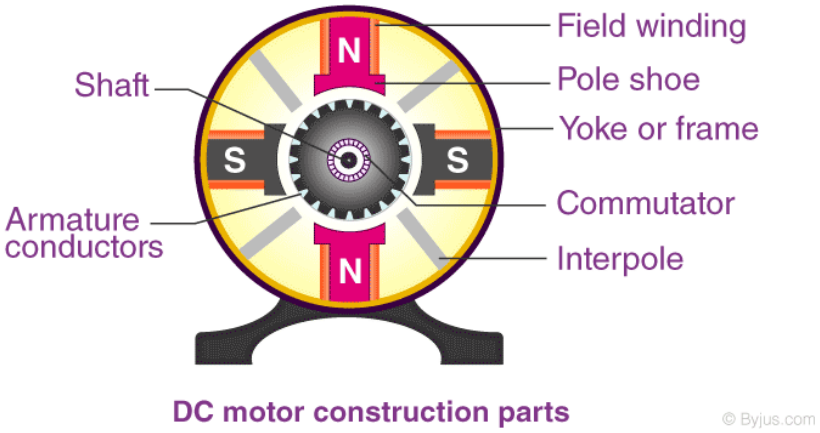

Fig: 3.24Motor Diagram

3.5 Different Parts of a DC motor

A DC motor is composed of the following main parts:

3.5.1 Armature or Rotor

The armature of a DC motor is a cylinder of magnetic laminations that are insulated from one another. The armature is perpendicular to the axis of the cylinder. The armature is a rotating part that rotates on its axis and is separated from the field coil by an air gap.

3.5.2 Field Coil or Stator

A field coil of a DC motor is a non-moving part on which winding is wound to produce a magnetic field. This electro-magnet has a cylindrical cavity between its poles.

3.5.3 Commutator and Brushes

The commutator of a DC motor is a cylindrical structure that is made of copper segments stacked together but insulated from each other using mica. The primary function of a commutator is to supply electrical current to the armature winding.

3.5.4 Brushes

The brushes of a DC motor are made with graphite and carbon structure. These brushes conduct electric current from the external circuit to the rotating commutator. Hence, we come to understand that the commutator and the brush unit is concerned with transmitting the power from the static electrical circuit to the mechanically rotating region or the rotor.

A magnetic field arises in the air gap when the field coil of the DC motor is energized.The created magnetic field is in the direction of the radii of the armature. The magnetic field enters the armature from the North pole side of the field coil and “exits” the armature from the South pole side of the field coil.

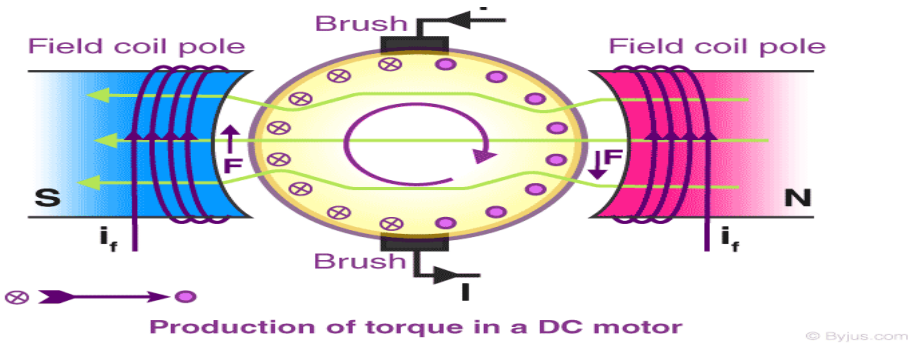

Fig: 3.25 conductors located

The conductors located on the other pole are subjected to a force of the same intensity but in the opposite direction. These two opposing forces create a torque that causes the motor armature to rotate.

3.6 Types of DC motor

DC motors have a wide range of applications ranging from electric shavers to automobiles. They are classified into different types based on the field winding connections to the armature as:

- Self Excited DC Motor
- Separately Excited DC Motor

3.6.1 Self Excited DC Motor

In self-excited DC motors, the field winding is connected either in series or parallel to the armature winding. Based on this, the self-excited DC motor can further be classified as:

- Shunt wound DC motor
- Series wound DC motor
- Compound wound DC motor

3.6.2 Shunt wound DC motor

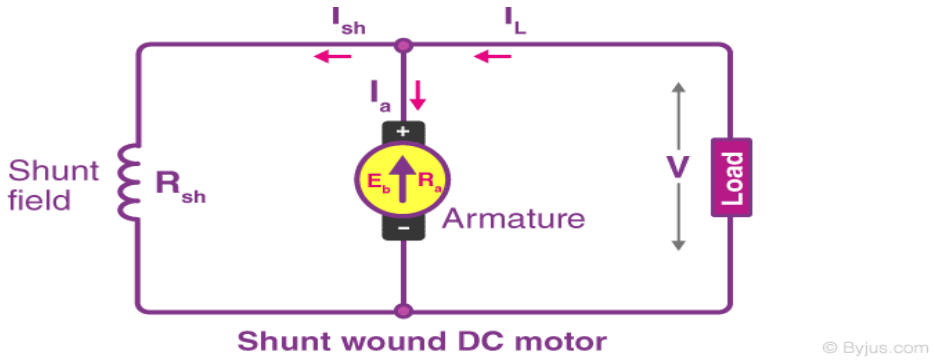

Fig: 3.26 shunt wound motor

In a shunt wound motor, the field winding is connected parallel to the armature as shown in the figure.

3.6.3 Series wound DC motor

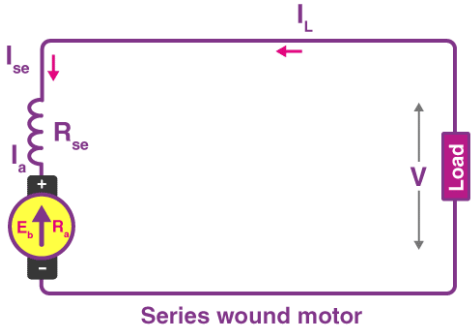

Fig: 3.27 In a series wound DC motor

In a series wound DC motor, the field winding is connected in series with the armature winding as shown in the figure.

3.6.4 Compound wound DC motor

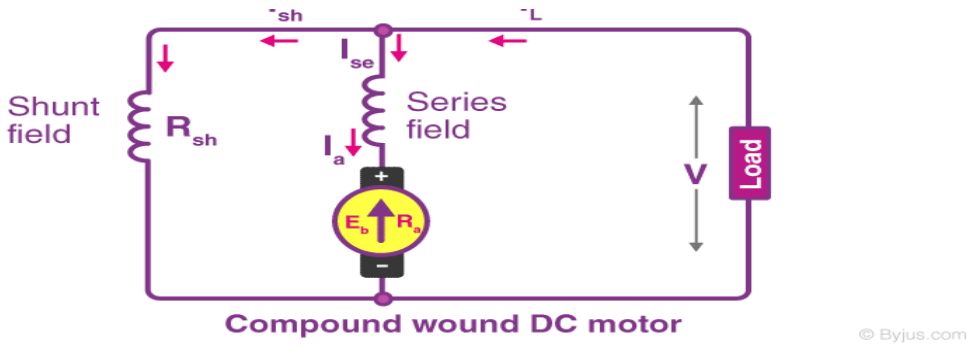

Fig: 3.28 DC motors having both shunt and series field

DC motors having both shunt and series field winding is known as a Compound DC motor, as shown in the figure. The compound motor is further divided into:

- Cumulative Compound Motor
- Differential Compound Motor

In a cumulative compound motor, the magnetic flux produced by both the windings is in the same direction. In a differential compound motor, the flux produced by the series field windings is opposite to the flux produced by the shunt field winding.

3.6.5 Separately Excited DC Motor

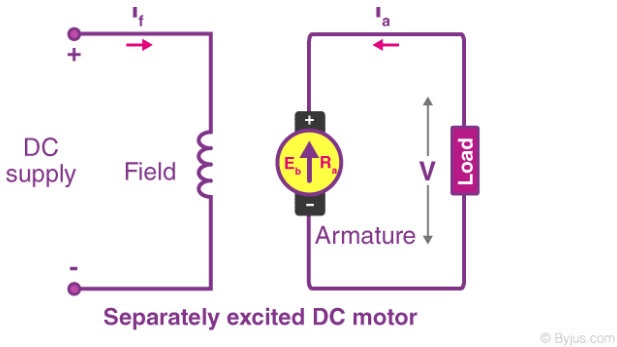

Fig: 3.29 In a separately excited DC motor

In a separately excited DC motor, the field coils are energised from an external source of DC supply as shown in the figure.

3.7 Brushed dc motor vs brushless dc motor

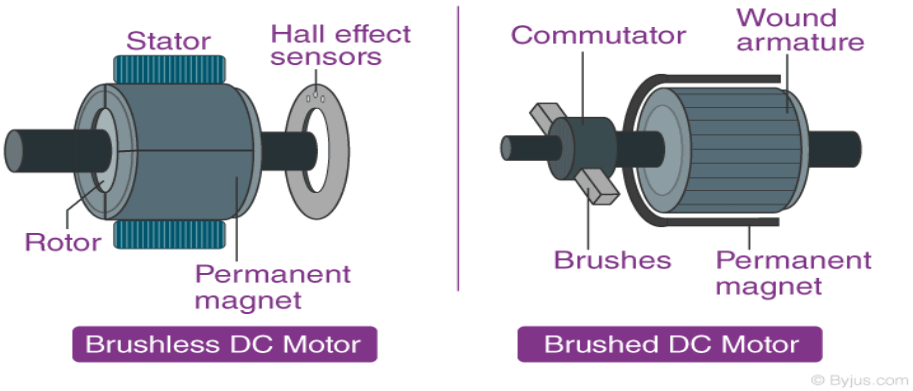

fig:3.30 A brushless DC motor

A brushless DC motor, also known as synchronous DC motor, unlike brushed DC motors, do not have a commutator. The commutator in a brushless DC motor is replaced by an electronic servomechanism that can detect and adjust the angle of the rotor.

A brushed DC motor features a commutator that reverses the current every half cycle and creates single direction torque. While brushed DC motors remain popular, many have been phased out for more efficient brushless models in recent years.

3.8 Applications of DC Motor

The applications of different types of DC motors are listed below:

3.8.1 Shunt DC Motors

Because of the fairly constant speed and medium starting torque of shunt DC motors, they are used in the following applications:

1. Centrifugal and reciprocating pumps
2. Lathe machines
3. Blowers and Fans

4. Drilling machines
5. Milling machines
6. Machine tools

3.8.2 Series DC Motors

Because of the high starting torque and variable speed of series DC motors, they are used in the following applications:

- Conveyors
- Hoists, Elevators
- Cranes
- Electric Locomotives

3.8.3 Cumulative Compound DC motors

Because of the high starting torque of cumulative compound DC motors, they are used in the following applications:

- Shears
- Heavy Planers
- Rolling mills
- Elevators

3.9 Fabricating welding works

Fig: 3.31 Fabrication making

Many people use fabricating and welding as interchangeable verb but that's not quite the case. In its most basic sense fabrication is the process of creating a project out of metal, and welding can be a singular operation during that process.

Simply put, welding joins together two pieces of metal, glass, or thermoplastics with similar melting points and compositions using fusion. Fabrication is the evolutionary process of creating a metal product, from layout and design to formation and finishing. However, in this ever-evolving industry, it's likely that many welders can fabricate, and it's more likely that fabricators can weld.

3.9.1 Tools

The process requires different more specific instruments including are as follows

- Abrasives
- Adjustable wrench
- Benders
- Chipping hammers
- Consumable electrodes
- Cylinders with custom carts
- Electrode holders
- Hand file
- Soapstone
- Tungsten inert gas (TIG) consumables
- Vice and vice grips
- Welding clamps

As for the similarities, both careers require cleaning supplies for disinfecting the metal. Experts use a wire brush and organic solvent, like acetone or a mild alkaline solution, or a citrus-based degreaser without but oxyethanol (A chemical compound that can cause breathing and liver problems) to scrub away any grease, oily deposits, and germs.

To clean the facility after a hard day's work, welders and fabricators use normal mops and sweepers. For industry-specific cleaning techniques, these trade professionals often use surface protection films, floor finishes and coatings, and electro-cleaners.

3.9.2 Processes

Because welding is a metal forming technique, it goes hand-in-hand with sheet metal fabrication, and each trade uses similar processes, like assembling and bending, to get the final product. To clarify, there are different ways to weld, including oxyacetylene, TIG (The most common form in fabrication shops) and gas metal arc (GMAW) welding.

3.9.3 Safety Precautions

Because this industry can be more dangerous than others due to working with hot metal and heavy machinery, every welder and sheet metal fabricator should be aware of the safety guidelines in their respective shops. To help prevent injury, each tradesperson should own or be provided (at least) the following:

- Fume extraction equipment
- Protective, flame-resistant pants
- A sturdy, fitted, flame-resistant jacket
- Coveralls or leather apron
- Heavy, non-slip working boots or steel toe boots
- Thick leather working gloves
- An auto-darkening helmet with the proper visor
- Safety goggles
- Hearing protection
- Respirator or dust mask

To help create a safe work environment, each trade's shop should have strict equipment storage policies (whether handheld or automatic), and every apprentice must be trained before using machinery on their own. Also, all tools should be thoroughly and regularly inspected for any damage.

3.10 Drilling Machine:

It is a machine which is used to drill the holes on the components or workpiece with the help of drill bits.

The drill bits are also called as Multi-point cutting tools which can have their rapid impact on the Material Removal Rate (MRR) i.e. a single-point cutting tool (like the one used in a lathe machine) can remove the material slowly whereas, a multi-point cutting tool removes the material at a faster rate and thereby increases MRR

3.10.1 Line Diagram of Drilling Machine:

The line diagram of Drilling machine is shown below.

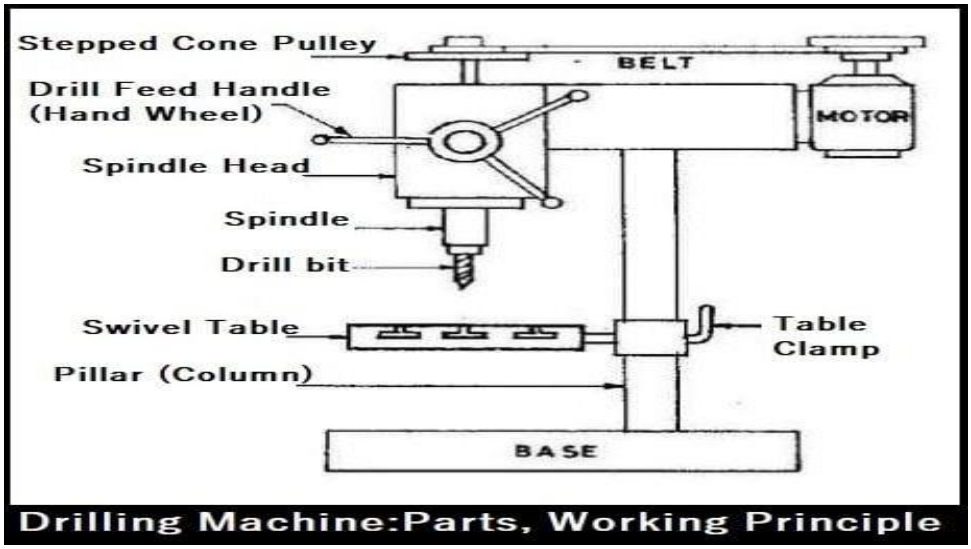

Fig: 3.32 The line diagram of Drilling machine

3.10.2Parts of Drilling Machine:

The parts of Drilling Machine are as follows.

- Base
- Vertical Column
- Swivel Table
- Power Transmission system (Stepped Cone Pulley)
- Drill Feed Handle (Hand Wheel)
- Chuck
- Table Clamp
- Drill bit
- Spindle

- **Base:**

The base is made up of Cast Iron which has the capability of high compressive strength, good wear resistance, and good absorbing capability (i.e. absorb the vibrations induced during working condition) and for these reasons, it acts as a base to the drilling machine.

- **Vertical Column:**

It is exactly placed at the center of the base which can act as a support for rotating the Swivel table and holding the power transmission system.

- **Swivel Table:**

It is attached to the column which can hold the machine vice in the grips and thereby, the work piece is fixed in the machine vice to carry out the drilling operation.

The Swivel table can move up and down by means of rotational motion and can be locked to the column by means of locking nut.

- **Power Transmission system:**

It consists of motor, stepped pulley, V-belt, and the Spindle. The power transmission is explained in the working of the drilling machine.

- **Drill Feed Handle:**

By the rotation of hand-wheel, the spindle moves up and down in the vertical direction in order to give the necessary amount of feed to the work.

Here, the rotational motion is converted into linear motion by means of a Rack and Pinion mechanism which was explained below

- **Chuck:**

It is used to hold the work piece. Generally, 3 jaw chuck is used for holding circular components and 4 jaw chuck is used for holding rectangular components.

- **Table Clamp:**

It is used to lock the swivel table at the desired location.

- **Spindle:**

It is used to hold the drill bit along with jaws.

- **Drill bit:**

It is the major part of this machine and is used to remove the material in the form of holes from the surface of the work piece.

3.10.3 Working Principle of Drilling Machine:

When the power is given to the motor, the spindle rotates, and thereby the stepped pulley attached to it also rotates. On the other end, one more stepped pulley is attached and that is inverted to increase or decrease the speed of the rotational motion.

Now, a V-belt is placed in between the stepped pulleys so as to drive the power transmission. Here a V-belt is used instead of a flat belt, in order to increase the power efficiency.

Now the drill bit also rotates which was placed in the chuck and which was in connection with the spindle. As the Pulleys rotates, the spindle also rotates which can rotate the drill bit.

Now, by the rotation of hand-wheel, the spindle moves up and down in the vertical direction in order to give the necessary amount of feed to the work and this drill bit is used to make the holes on the component placed in the machine vice.

Drive Mechanism of Drilling Machine:

This drive mechanism is based on Rack and Pinion Mechanism.

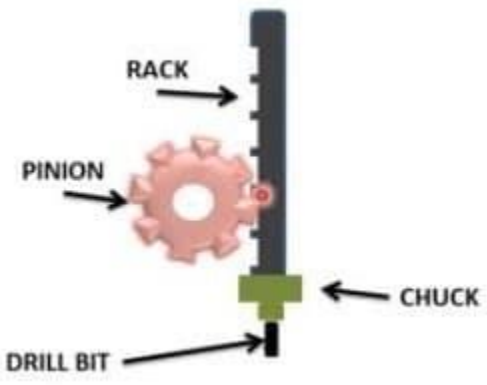

Fig: 3.33 Rack and pinion mechanism in drilling machine

When the hand-wheel is rotated, it is converting the rotational motion to the linear motion by means of rack and pinion.

The setup consists of Rack(has fine grooves), Pinion, Chuck and the Drill bit. The drill bit has placed in the chuck and the chuck is connected to rack and when the hand-wheel rotates, the Pinion is inserted in the grooves of Rack [shown in the below fig.] and thereby the rotational motion is converted to linear motion and as this mechanism is running by means of Rack and Pinion called as Rack and Pinion mechanism.

3.10.4 Types of Drilling Machines:

Below is the list of drilling machines which are used in the industries for the production of the materials.

- Radial drilling machine
- Upright drilling machine
- Multiple Spindle drilling machine
- Deep hole drilling machine
- Sensitive drilling machine
- Portable drilling machine
- Gang drilling machine

The explanation of above types of drilling machines are as follows.

- Radial Drilling Machine:

A radial drilling machine is used to drill holes in the components but it is quite different from the general drilling machine. The radial drilling machine has an arm that can rotate in the given radius.

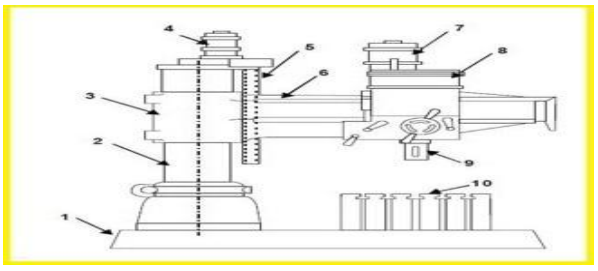

Fig: 3.34 Radial Drilling Machine

If the component is large and if it is not able to hold on the worktable, then the component has to be placed on the ground and by rotating radial arm, the operation is to be performed.

- Upright Drilling Machine:

It is used to drill holes of Medium size in the components. It is heavier and bigger than the Sensitive drilling machine.

Fig: 3.35 Upright drilling machine

A large number of spindle speed and feed can be accessible for various types of works.

The Upright Drilling machine can have a drilling capacity range of 75mm diameter drills.

- Multiple Spindle Drilling Machine:

As the name indicates, these drilling machines have multiple spindles that are away from each other.

Fig: 3.36 Multiple Spindle Drilling Machine

This machine is used, when you want to drill a large number of holes on a single workpiece or making holes on individual workpieces.

By this operation, the production will be at a higher rate.

- Deep Hole Drilling Machine:

These types of drilling machines are designed to drill deep holes in various components of automobiles such as connecting rods, Aircraft Landing Gear, Inside Bore of Hydraulic Cylinder, Fuel Injector Bodies, Oilfield Exploration Equipment, etc.

Fig: 3.37 Deep hole drilling Machine

It has to make sure that the coolant has to be added during the removal of material from the components.

- Sensitive Drilling Machine:

Here in the case of a Sensitive drilling machine, when the operator gives the feeding of the tool into the work piece, it allows the operator to 'feel' or 'sense' the cutting action of work piece tool and that's the reason, it is called as Sensitive Drilling Machine

It is also called a Bench Drilling machine which was explained at the beginning of the article.

- Portable Drilling Machine:

The portable drilling machine works in the similar way of bench drilling machine, but the difference is, the portable drilling machine can be taken to the different workplaces along with you and that's the reason it is called as portable drilling machine.

Whereas, the bench drilling machine can do various operations but it can stand at one place and it is not movable with respect to the workplaces.

- Gang Drilling Machine:

As the name indicates that it has a gang of drill heads with individual motors attached to the vertical column and does multiple operations at a time.

It generally consists of 4-6 drill heads which are placed side by side which can do various operations like drilling, boring, reaming, tapping, etc.

Either you want to create a small hole or large, the multiple spindles does the operation.

3.10.5 Drilling Machine Operations:

The operations of drilling machine are as follows.

- Drilling
- Boring
- Reaming
- Tapping
- Spot facing
- Honing
- Counter boring
- Counter Sinking

- **Drilling Operation:**

Fig: 3.38 Drilling

The operation of making holes on the surface of the work piece by the use of drill bit is called Drilling Operation.

- **Boring Operation:**

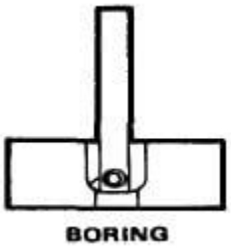

Fig: 3.39 Boring

The operation of enlarging an existing hole is called the Boring Operation. The existing hole was created by the drilling operation.

- **Reaming Operation:**

The operation of sizing and finishing an existing hole with the help of a reamer is called Reaming Operation.

Fig: 3.40 Reaming

Reamer is a multipoint cutting tool having several cutting edges to finish the surface.

- **Tapping Operation:**

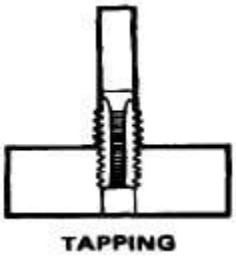

Fig: 3.41 Tapping

It is the operation of creating internal threads by means of a cutting tool called Tap and the operation is called Tapping Operation.

- **Spot Facing Operation:**

This is an operation of removing the chips from the surface of the hole such that proper seating of bolts takes place and this removal can be done through end mill cutter using a drilling machine.

- **Honing Operation:**

In this operation, the tool will rotate and reciprocate about its axis for producing very smooth holes.

This honing operation is mainly used for finishing the holes in the IC Engine cylinder.

- **Counter boring Operation:**

Fig: 3.42 Counter boring

The Counter boring operation is used to enlarge a particular portion of the hole.

- **Counter sinking Operation:**

The Counter sinking operation is used to enlarge the end of the hole to give it a conical shape for a shorter distance.

Fig: 3.43 Counter sinking

3.11 Advantages of Drilling Machine:

- It requires less labor.
- High precision and accuracy will be maintained by the operator in Bench Drilling Machine whereas, in the case of Automatic drilling machine, high accuracy is maintained by the machine itself.

- It is a lower cost machine.
- More efficient building space.
- Easy construction and operation.

- Less maintenance is enough.
- Effective working principle.

3.12 Disadvantages of Drilling Machine:

- It’s totally manually operated.
- Time consuming as compared to electrical power hacksaw.
- Without human effort it’s not operated.
- Not fit for heavy production

3.13 APPLICATIONS OF BEAM ENGINE POWERED HACKSAW:

1. It is used in small scale industries and in large scale industries.
2. It is useful when materials need to be cut in hazardous areas such as oil & gas refineries, chemical factories or oil rigs as well as dusty and wet environments where electric tools are not effective.
3. It is valuable tools in production environments such as pallet repair, shipbuilding or fiberglass workshops, because they will last longer than electric tools

Chapter 4

CONCLUSION

The aim of this project is to implement the beam engine mechanism for the sawing operation and to show that this type of machine tool is an option for wood working industry in remote places. This saw, which can run either on electricity or battery can be used in places where electricity is sparse or absent. Further improvements include using reduction gears, to vary the speed of the circular saw.

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