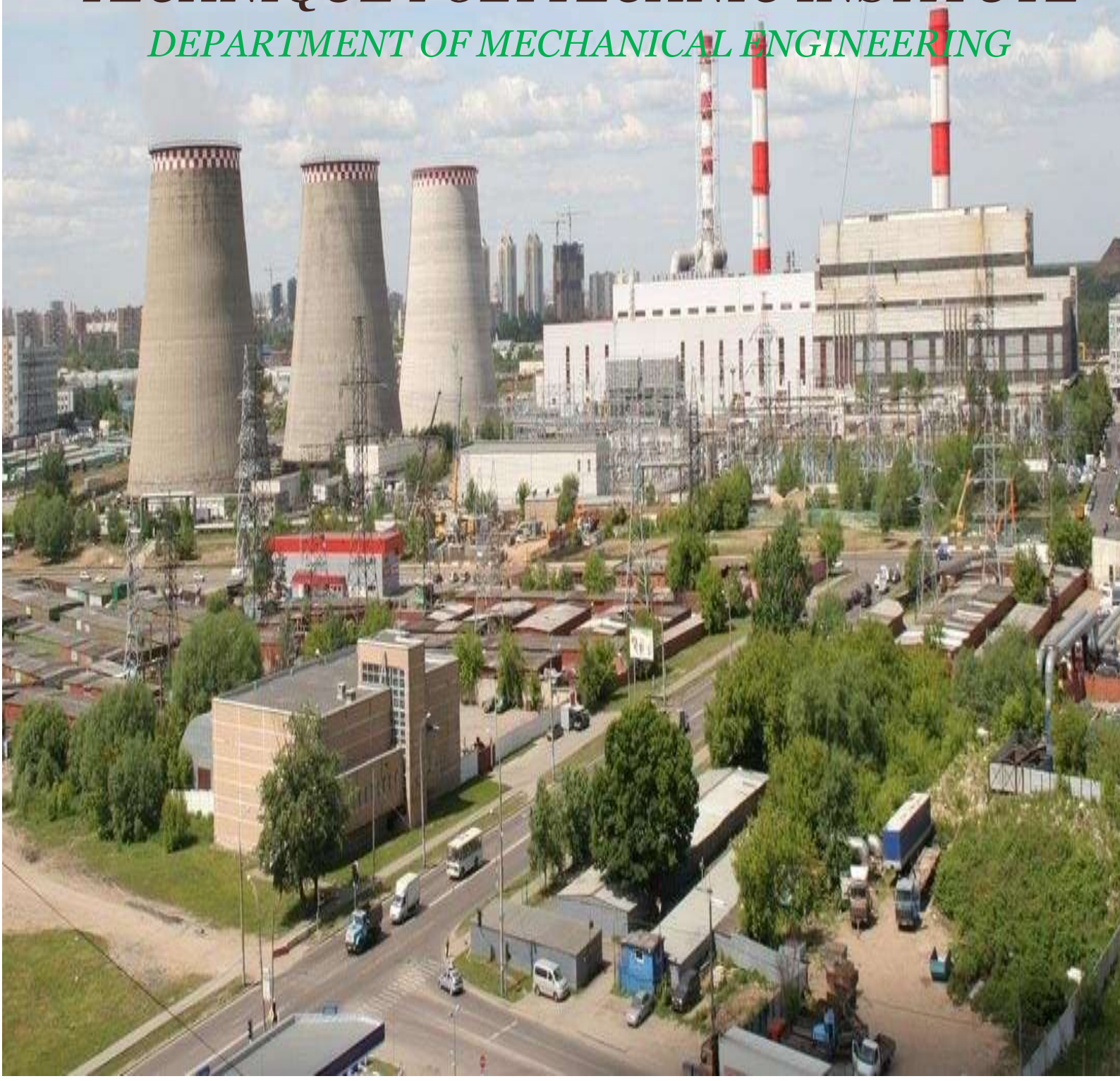
11th Edition

SPECTROMECH 2025

NOVEMBER 2025

TECHNIQUE POLYTECHNIC INSTITUTE

DEPARTMENT OF MECHANICAL ENGINEERING



Vision of the Institution

- To be a premier institute in pursuit of excellence in technical education and skill development committed to serve the society

Mission of the Institution

- To promote excellence in learning, teaching and technology transfer
- To improve the quality of skilled workforce through a structured programmed and professional skills training
- To inspire students to learn and facilitate their overall development with social orientation and values

Vision of the Department

- To be a Centre of excellence in Mechanical Engineering to impart technical & professional skills to cater industrial requirements while considering environmental aspects fulfilling societal obligations

Mission of the Department

- To impart the necessary technical skills among students
- To enhance the interaction with industry
- To produce competitive& employable Diploma Engineers
- To inculcate ethical & professional values among students

Program Educational Objectives (PEOs)

- **Successful career (PEO #1):** To provide students strong foundation of technological fundamentals, necessary to analyze, design, manufacture using modern technological tools to become successful professional in real life world
- **Adaptability with new learning environment (PEO #2):** To build up the aptitude for an understanding of requirement analysis, ability to adopt new working environment and solves complex problem especially in multidisciplinary in nature
- **Keeping pace with developing world (PEO #3):** To provide adequate exposure to promising radical change in technology, training and opportunity to work as teams in cross functions project with effective communication skill and leadership qualities
- **Integration with the society (PEO #4):** To promote student awareness on the life sustained learning by bringing them to their professional principles of practice based on professional ethics of codes so as to achieve the ability to integrate in to the world of practicing professionals for collaborations, mutual support and representing the profession to society.

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Published by
DEPARTMENT OF MECHANICAL ENGINEERING
TECHNIQUE POLYTECHNIC INSTITUTE, HOOGHLY
WEST BENGAL-712102.

FOREWORD

Heartily welcome to our tenth edition of Mechanical Engineering Technical magazine 'SPECTRO MECH' in 2025. We excited to report that the Department of Mechanical Engineering continues to grow to meet our vision of the department which is analyse by Faculty Course Assessment Report (FCAR). Mechanical Engineering is one of the largest enrolled department in the collage with more than 673 under graduate student over the period of 2010-2025 & more than 37 students are already placed at various companies as well as higher studies within the academic session 2024-25. All the initiatives are possible by the efficient contributions of alumni, friends, faculty members and staffs.

I would like to express my appreciation to all the authors of the article in this issue of the Magazine. Our goal is to create quality education for the student of the twenty first century. The success of 'SPECTRO MECH' depends on energetic and joint effort of all stake holders of the Institution. I would appreciate your feedback and any suggestion for improvement.

Soumendra Nath Basu
Advisor (Academic & Administration)
Technique Polytechnic Institute

CONTENT

Battery Operated Grass Cutter

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ABSTRACT

In Agricultural field or in Nursery or even in House hold, growing grass is a commonly found problem. Removal of the grass is also a tedious job involving lot of human efforts. In order to reduce the time and effort in clearing the unwanted grass, the removal of grass need to be mechanised. This machine can be called as grass cutter. Depending on the type of power utilised for the machine, it can be termed differently like solar powered, battery powered electrical and manual etc. In its simple construction a very high speed motor is connected to an end of a holding rod that is hang with a shoulder and held with hand to the free end of this rod a battery pack is attached. Also a solar panel can be attached to charge the batteries there by making the grass cutter run with the help of solar energy. Multi agriculture is the new innovative and effective concept mainly used for agricultural field. The main goal of this project is to design a grass cutting machine for making the cutting operation smooth and with less effort. The main components used in this project are motors, blade, Switch, battery, connecting wires and a robust chassis. The cutter used is sometimes a flexible wire that cuts the grass with high speed rotation. We prefer to go for a solid steel blade as the cutting tool. The switch pad is used to control the cutting machine to ON/OFF the motor containing a grass cutting blade on its shaft. The motors are powered by the battery. The purpose of the project is to design the different components of the grass cutter like electrical motor, battery pack, cutting assembly, base frame and fabricate the same. In the first phase the components will be designed and in the second phase the grass cutter will be assembled.

I. INTRODUCTION:

The aesthetic value of his environment is as important as food and shelter to the modern man. In general, grasses are found to survive in a variety of conditions and thus the need to curtail their growth in order to enhance the beauty of our habit environment. Conventional Grass cutting Machines produces number of unpleasant effects on human as well as environment. Running and maintenance cost of traditional grass cutting machines are high .Looking in to all these problems it was decided to develop a good machine with easy in operation and with low cost. The first actual mower was invented in 1830 by Edwin Beard Budding. Budding was an engineer from England who first discovered the idea of a mower from a cylindrical machine used for cutting in a mill. A lawn is any area of grass; mostly tough grass which is neatly cut like in a private garden or a public park. The mower that he developed was composed of a large roller which provided power to the cutting cylinder using gears. The cutting cylinder contained several blades connected in series around the cylinder. His innovation opened the door for numerous advancements in lawn cutting. An electrical Grass Cutter is more suitable & easy to use than the Grass Cutter with an engine, so we select an electrical Grass Cutter with an electric motor, which will provide the high speed rotation to the blades. Cordless electric Cutters are powered by 12-volt rechargeable batteries. Typically, more batteries mean more run time and/or power. Batteries can be in the interior

of the Grass Cutter or on the outside. If on the outside, the depleted batteries can be quickly swapped with recharged batteries. Cordless Cutters have better.

II. DEFINITION:

A grass cutter is a machine used for cutting grass or lawns. A lawn is any area of grass; mostly tough grass which is neatly cut like in a private garden or a public park. In early years sheep and other animals were used to keep the lawn or yard trimmed. The animals used to gaze the grass however in today's modern time a machine with rotating blades is used for cutting grass of lawns. These machines are called grass cutter and they can be manual (hand-operated) or motor-driven. Some cutter blades may be push forward and some may cut the grass to an even height with spinning of blade. All the mowers have some similar structure which includes a motor, rotating blade, moving around options and grass clippings dispenser. While searching for a lawn mower, please make sure that paying a high price here wouldn't really mean higher quality results. There are other factors to consider.

III. TYPES OF GRASS CUTTER:

There are three types of lawn mower nowadays used in general. They are as fallow:-

1. Walk-Behind Mower
2. Riding Mower
3. Tow-Behind Mower

WALK-BEHIND MOWER

Walk-Behind Mower

Types of Walk-Behind Mower

1. Gas powered grass cutter.
2. Electric grass cutter.
3. Manual grass cutter.

ELECTRIC GRASS CUTTER

The electrical powered mowers are suitable for land under 1/3 acres. They offer similar features to that of gas powered mowers including 3-in-1 feature, push or self-propel, wide cutting etc. but they save you fuel and maintenance cost. Moreover they have relatively quieter operation. These machines are environment- friendly with no carbon emissions. There are corded and cordless electrical mowers available and usually have a motor power between 6-12amp. Cordless mowers operate on battery giving you ease of mowing around. These are most suitable for flat surfaces.

RIDING GRASS CUTTER

As opposed to walk-behind grass cutters, the riding lawn mowers have a seat to ride on for cutting. It includes various controls that enable you to cut your lawn while being seated on this mower. These are suitable for larger lawns and are often termed as small farm tractor. These machines have powerful engines and cutting decks as compared to push cutters.

Riding Grass Cutter

TWO-BEHIND MOWER

Two -behind cutters are used for much larger areas, like massive fields, and are used much more in agriculture and road sides. Tractors or powerful vehicles must tow these devices. Most are mechanical, much like some of the first grass cutters ever invented. They use the rotation and energy from being pulled over ground to rotate and cut grass, sod or whatever needs to be cut.

Two-Behind Mower

IV. PARTS OF GRASS CUTTER:

The main parts of a Grass Cutter are:-

1. B**lade–**It Consist of 2 to 3 blades that are attached to a rotating shaft. The blades rotate, creating a cutting motion.
2. **Body frame -** The main structural frame of the Cutter onto which the other parts of the Cutter are mounted.
3. **Wheels -** These help propel the Cutter in action. Generally Grass Cutter have four wheels.
4. **Push Handle -** The "power source" of a manually operated Cutter. This is a sturdy handle that is connected to the frame, wheels and blade chamber.
5. **Motor -** The power source of a Grass Cutter that is powered by Battery & We are using AC motor.
6. **Bag -** The bag is used to carry grass clippings.
7. **Battery –** It Provides Power source to the motor.

V. OPERATING PRINCIPLE:

Electrical energy of the battery is converted to mechanical energy through a set of blades designed to achieve cutting operation. The electric circuit ensures power transfer from the battery to

run the D.C. motor, whilst the alternator utilizes the mechanical power to continuously recharge the battery while in operation. The cutting blades tap power from the D.C. motor. When the power switch is on, the electrical energy from the battery powers the motor which in turn actuates both the blades and the alternator shafts. The rotating motion of the alternator shaft generates current to recharge the battery, thereby compensating for the battery discharge. The rotating blades continuously cut the grass as the mower is propelled forward and the cut grass is channelled to the collection box/bag attached at the rear of the machine. Height of cut is adjusted by means of the link mechanism via the lift rod.

VI. ANALYSIS OF POWER SUPPLY:

THEORY

The shearing force of most annual and perennial grasses found on most lawns is usually between 9.2N ~ 11.51N. Force required by cutting blade to shear the grass is given by;

$F = T/R$ - - - - - - - - - - - (1)

Where, T = Shaft torque R = Radius of cutting blade

But shaft torque is given by; $T = P/2\pi N$ - - - - - - - - - - (2)

Where P = Power developed by shaft T = Torque required and N = Shaft speed in Rev/min.

MOTOR

The power source of a grass cutter that is powered by electric. The electric motors for grass cutters are typically 24V, 1¼hp (932.5 W) DC motor. The benefits of the electric motors are that they run very quietly and they do not take up too much space on the cutter chassis. For smooth grass cutting, a motor power of not less than 628.3W (0.84hp) having a rotational speed of not less than 3,000 rev/min and producing Sheer Force of about 10.5N is recommended. However, due to non-availability of wide range of DC motors in the market, a 1¼ HP (932.5 W) having a rotational speed of 2,500 rev/min was used. Though this gives a sufficient torque with a high cutting force, using an average blade radius of 210 mm, the speed is still not sufficient enough for easy grass cutting. Hence a speed multiplication pulley system is used.

D.C.Motor

Battery

BATTERY

For this project, batteries will be needed to provide 12V to the electric motors in order to run these systems. Features:-

Voltage – 12V, 100amp

Weight- 1.05 Kg

Height – 210 mm

VII. ASSEMBLY OF GRASS CUTTER:

Component	Specification
Mild steel rods	To make frame of grass cutter
Blades	Taper shaped Blade 300mm
4 wheels	8" Rubber wheels
4 Iron roller	7" per roller
AC Motor	700 watt

VIII. ADVANTAGE AND DISADVANTAGE:

ADVANTAGES

1. It is easy to use, because it is cordless.
2. With Battery powered grass Cutter, there is no more messy oil & smelly gasoline.
3. Now we are safety with no pollutants emitted.
4. There are also no air filters & spark plugs to bother it.
5. The cost of electricity to recharge the battery is minimal compared to the high cost of gasoline, oil, air filters, & sparkplugs.

DISADVANTAGES

1. It is Costly, An electric Cutter is more expensive.
2. The eventual disposal of worn-out batteries is problematic & the motors in cordless Cutter tend to be less powerful than gasoline motors of the same total weight (including batteries).
3. Recharging of Grass Cutter batteries can take from 8 to 16 hours with only an hour of operation. We need to replace the batteries after so many hours of operation.
4. As a result of incorrect use, fluid can leak from the rechargeable battery. Avoid contact with the fluid.

IX. CONCLUSION:

Easiest operation is obtained by the control unit in the "LAWN MOWER". The comparative gain that can be accomplished because of the utilization of motor in control unit.This will reduce the labor required to cut the grass.This project "GRASS CUTTER" is designed with the hope that it is very much economical and helpfull to many agricultural areas. This project helped us to know the periodic steps in completing a project work. Thus we have completed the project successfully.

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"If a cluttered desk is a sign of a cluttered mind, of what, then, is an empty desk a sign?" – Albert Einstein

CENTRE LATHE

PARTHIB DARI
DME 3rd Semester

Abstract:
The centre lathe machine is one of the most significant inventions in the history of mechanical engineering. It is primarily used for shaping metal, wood, or plastic by removing material through a cutting process. The lathe machine performs several operations such as turning, facing, threading, drilling, boring, and knurling. This paper explores the construction, working principle, types, operations, applications, and importance of the central lathe machine in modern engineering and manufacturing industries.

1. Introduction:

Among all the machine tools used in workshops, the central lathe machine stands as the foundation of mechanical machining. It is often referred to as the 'Mother of all machines' because it has given rise to other machine tools like milling, drilling, and grinding machines.

A lathe machine operates by rotating the workpiece against a stationary cutting tool. It can produce cylindrical, conical, or even complex shapes with great accuracy. The central lathe or engine lathe is widely used in tool rooms, repair shops, and educational workshops for basic machining operations.

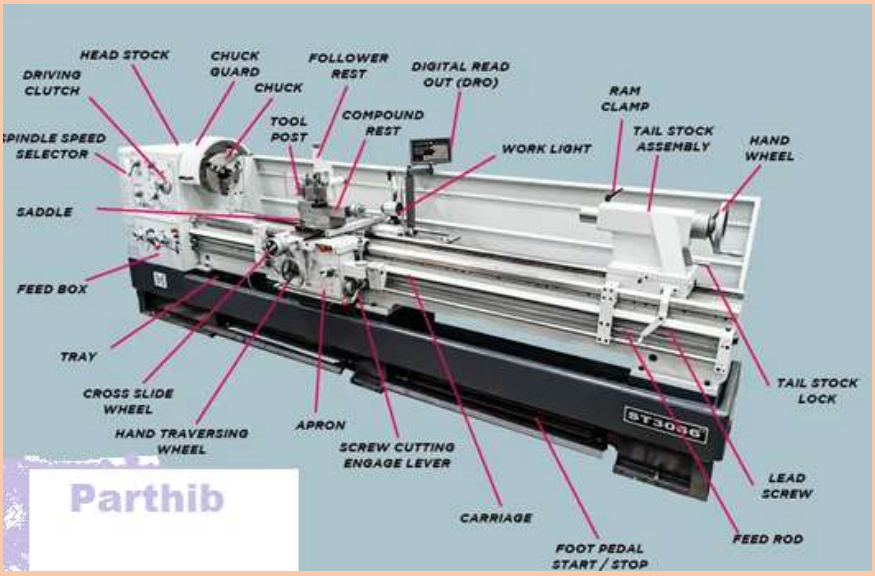
With advancements in automation, CNC (Computer Numerical Control) lathes have evolved from traditional central lathes, yet the basic working principles remain the same — making the study of the central lathe vital for every mechanical engineer.

2. Main Parts of a Central Lathe Machine:

Bed: The bed is the main supporting structure of the lathe machine. It is made of cast iron to resist vibration and wear. All other parts are mounted on the bed.

Headstock: Located on the left side of the bed, the headstock houses the spindle, gear box, and motor drive. It is responsible for rotating the work piece at the required speed.

Tailstock: Mounted on the right side of the bed, the tailstock supports the free end of the work piece and can hold tools such as drills or reamers.
Carriage: The carriage moves the cutting tool along the length of the work piece. It consists of the saddle, cross-slide, compound rest, tool post, and apron.
Lead Screw and Feed Rod: Used for automatic feed and thread cutting operations, ensuring accurate tool movement.
Chuck: A chuck is used to hold and rotate the work piece firmly. The most common type is the three-jaw self-centering chuck.



Suggested Diagram: A labeled diagram showing Bed, Headstock, Tailstock, Carriage, Lead Screw, Chuck, and Tool Post.

3. Working Principle:

The working principle of the lathe is based on rotary motion. The work piece is clamped in the chuck and rotated at a desired speed. A single-point cutting tool is then fed either parallel or perpendicular to the axis of rotation. The tool removes material in the form of small chips to achieve the desired size and shape.
Formula for Cutting Speed: $V = (\pi DN) / 1000$, where V = Cutting speed (m/min), D = Diameter of work piece (mm), N = Spindle speed (rpm).

4. Common Lathe Operations:

Turning: Reducing the diameter of a work piece.
Facing: Making the end surface flat and smooth.
Drilling: Creating holes using drill bits.
Thread Cutting: Producing external or internal threads.
Knurling: Creating a rough surface for better grip.
Taper Turning: Producing conical shapes.

5. Applications:
- Manufacturing of shafts, bolts, nuts, and pins.
- Tool room and maintenance workshops.
- Automobile and aerospace industries.
- Educational training for mechanical students.
- Precision machining of cylindrical components.

6. Advantages:
- Simple construction and operation.
- Capable of producing accurate and smooth surfaces.
- Versatile for multiple machining operations.
- Easy maintenance and repair.
- Cost-effective compared to CNC machines.

7. Safety Precautions:
- Always wear safety goggles and proper clothing.
- Ensure the workpiece is securely clamped.
- Do not touch rotating parts while the machine is running.
- Keep cutting tools sharp and properly adjusted.
- Stop the machine before making any adjustments.

8. Conclusion:

The central lathe machine has remained an essential component of the manufacturing world for centuries. Even in the era of automation and CNC technology, its fundamental role in shaping materials and training engineers remains unchanged. Understanding its working and mastering its operations lays the foundation for every aspiring mechanical engineer.

The central lathe truly symbolizes the heart of mechanical workshops — precise, reliable, and timeless.

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"Develop success from failures. Discouragement and failure are two of the surest stepping stones to success."

—Dale Carnegie

Cooling Tower of Thermal Power Plant

BRISTI DAS
DME 5th Semester

Abstract:
This writing provides the classification, working principle and applications of cooling towers in various industries. It covers the fundamental principles of heat transfer, types of cooling towers, and factors influencing their performance. The report also discusses the importance of cooling towers in industrial processes, their environmental impact, and strategies for optimizing their efficiency. Key findings and recommendations are presented to enhance the understanding and operation of cooling towers in industrial settings.

Introduction:
Cooling towers are essential components in various industrial processes, particularly in power generation, chemical manufacturing, and HVAC systems. They facilitate heat rejection from water to the atmosphere, enabling efficient cooling and temperature control. With growing industrial demands and environmental concerns, optimizing cooling tower performance has become crucial. This project report explores the design, operation, and applications of cooling towers, highlighting their significance, challenges, and potential improvements in industrial settings.

Types of Cooling Towers:
1. Natural Draft Cooling Towers: Use natural airflow for cooling.
2. Mechanical Draft Cooling Towers: Use fans to force or induce airflow.
3. Crossflow Cooling Towers: Air flows horizontally across the falling water.
4. Counterflow Cooling Towers: Air flows upward, counter to the falling water.

Mechanical Draft Thermal Power Plant Cooling tower

Components:

1. Fill Material: Increases water surface area for efficient heat transfer.
2. Drift Eliminators: Reduce water loss due to drift.
3. Fans: Used in mechanical draft towers to move air.
4. Water Distribution System: Distributes water evenly over the fill.

Working Principle:

1. Heat Transfer: Water is cooled through evaporation and convection.
2. Water Circulation: Hot water is pumped to the tower and distributed over the fill.
3. Airflow: Air passes through the tower, absorbing heat from the water.

Applications:

1. Power Plants: Cooling systems for condensers.
2. Industrial Processes: Cooling for machinery and processes.
3. HVAC Systems: Cooling for large buildings.

Challenges and Considerations:

1. Water Consumption: Evaporation and drift lead to water loss.
2. Maintenance: Regular maintenance is crucial for efficient operation.
3. Environmental Impact: Impact on local ecosystems and water resources.

Improvements and Future Directions:

1. Water Conservation: Implementing water-saving technologies.
2. Energy Efficiency: Optimizing fan and pump operations.
3. Sustainability: Using eco-friendly materials and designs.

Working Principle:

The cooling towers are heat exchangers as well their functioning follows the principle of the heat exchange between gases and liquids, so the water that enters at a temperature will modify it after having met the gas (that can be water vapor), reaching the exit with a lower temperature.

The exchange happens thanks to the use of fans, that push the air towards the water, even though this can happen even without fans, in the bigger cooling towers, which can exploit the water evaporation thus saving energy, but the physical conformation of the towers will have to allow it: this means that they will have to be vertical so that gases and liquids can meet following their natural directions.

To be able to work properly, cooling towers need the air not to be saturated in water vapor, for example, they can have some difficulties in a rainy day, because the air is saturated, hence the exchange between gas and liquids is not possible.

Everything goes around the state of the air, which the drier it is the more it can exchange heat with the water, thus making it lose temperature; the cooling towers are an example of the exploiting of the physics law in the products used in industry. To reach the aim, just like many others in fact: just think, for example, of the heaters, that use the heat exchange from inside the pipe towards the outside.

The cold water, in fact, gets hot at the base and when it reaches the temperature it goes up, just like the water boiling in a pot: it gets hot at the basis, near the fire, it goes up, it cools and goes down again, circulating again like this as long as the fire burns.

Conclusion:

Cooling towers play a vital role in various industrial processes, facilitating efficient heat rejection and temperature control. This project report has highlighted the different types of cooling towers, their components, working principles, and applications. While challenges such as water consumption and environmental impact exist, advancements in technology and sustainable practices can mitigate these

issues. By optimizing design and operation, industries can enhance the performance and efficiency of cooling towers, contributing to more sustainable and environmentally friendly operations.

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"Nothing in life is to be feared, it is only to be understood"

Marie Curie's

CNC Milling

SUBRATA PARAMANIK

DME 5th Semester

1. Abstract:

CNC (Computer Numerical Control) milling is a modern machining process used to produce precise and complex components by removing material from a work piece using rotary cutters. The process is controlled by computer programs that follow coded instructions, ensuring accuracy, repeatability, and high efficiency in manufacturing industries.

2. **Introduction: Z**NC milling is an advanced form of machining that uses a computer to control the movement of the cutting tool and work piece. The machine operates on multiple axes (commonly 3, 4, or 5 axes) to perform operations such as drilling, slotting, and contouring. It replaces manual milling by automating tool paths through pre-programmed CAD/CAM software, making it essential for modern engineering production.

3. **Working :**

The working of a CNC milling machine involves the following steps:

A) Design Preparation:

The part is first designed using CAD (Computer-Aided Design) software.

B) Program Generation:

The design is converted into CNC codes (G-code and M-code) using CAM (Computer-Aided Manufacturing) software.

C) Machine Setup:

The work piece is clamped on the machine table, and the cutting tool is mounted on the spindle.

D) Machining Operation:

The computer controls the movement of the tool along X, Y, and Z axes according to the program. The rotating tool cuts and shapes the material precisely.

E) Finishing and Inspection:

After machining, the component is cleaned, measured, and inspected for accuracy.

4. Applications :

- Manufacturing of automotive and aerospace components
- Production of precision molds and dies
- Fabrication of machine parts and tools
- Engraving and prototype development
- Production of electronic housings and mechanical components

5. Advantages :

- High precision and accuracy in machining
- Consistent quality and repeatability of parts
- Reduced human error and labor cost
- Capability to machine complex shapes and contours
- Faster production rate and minimal setup time

6. Disadvantages :

- High initial investment cost
- Requires skilled programmers and operators
- Maintenance and repair costs are high
- Limited flexibility without reprogramming
- Power consumption is relatively high

7. **Conclusion:** CNC milling has revolutionized modern manufacturing by providing superior precision, speed, and automation compared to conventional machining. Although it involves higher costs, its benefits in terms of accuracy, productivity, and versatility make it an indispensable process in today's industrial world.

"Research is to see what everybody else has seen, and to think what nobody else has thought."

----------Henri Poincare

DRILLING MACHINE

SOUVICK DAS
DME 5th Semester

❖ **Introduction :**

Drilling machine is one of the most important machine tools in a workshop. It was designed to produce a cylindrical hole of required diameter and depth on metal work pieces. Though holes can be made by different machine tools in a shop, drilling machine is designed specifically to perform the operation of drilling and similar operations. Drilling can be done easily at a low cost in a shorter period of time in a drilling machine.

Drilling can be called as the operation of producing a cylindrical hole of required diameter and depth by removing metal by the rotating edges of a drill. The cutting tool known as drill is fitted into the spindle of the drilling machine. A mark of indentation is made at the required location with a centre punch. The rotating drill is pressed at the location and is fed into the work. The hole can be made upto a required depth.

❖ **Construction of a drilling machine**

The basic parts of a drilling machine are a base, column, drill head and spindle. The base made of cast iron may rest on a bench, pedestal or floor depending upon the design. Larger and heavy duty machines are grounded on the floor. The column is mounted vertically upon the base. It is accurately machined and the table can be moved up and down on it. The drill spindle, an electric motor and the mechanism meant for driving the spindle at different speeds are mounted on the top of the column. Power is transmitted from the electric motor to the spindle through a flat belt or a 'V' belt.

❖ **Types of drilling machines**

Drilling machines are manufactured in different types and sizes according to the type of operation, amount of feed, depth of cut, spindle speeds, method of spindle movement and the required accuracy.

The different types of drilling machines are:

1. Portable drilling machine (or) Hand drilling machine
2. Sensitive drilling machine (or) Bench drilling machine
3. Upright drilling machine
4. Radial drilling machine
5. Gang drilling machine
6. Multiple spindle drilling machine
7. Deep hole drilling machine

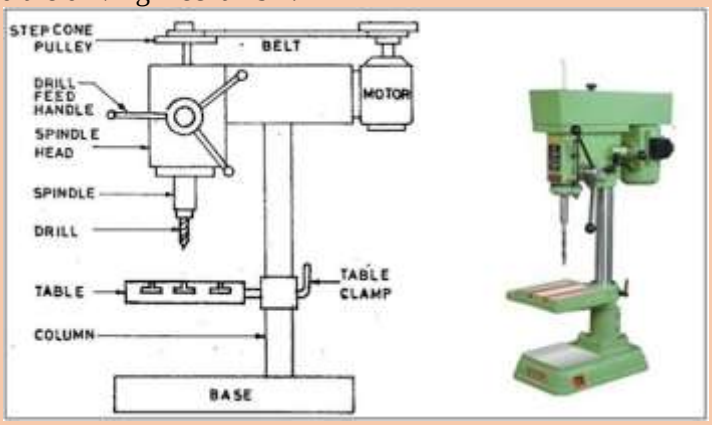
➢ **Portable drilling machine**

Portable drilling machine can be carried and used anywhere in the workshop. It is used for drilling holes on workpieces in any position, which is not possible in a standard drilling machine. The entire drilling mechanism is compact and small in size and so can be carried anywhere. This type of machine is widely adapted for automobile built-up work. The motor is generally universal type. These machines can accommodate drills from 12mm to 18 mm diameter. Portable drilling machines are operated at higher speeds.

➢ **Sensitive drilling machine**

It is designed for drilling small holes at high speeds in light jobs. High speed and hand feed are necessary for drilling small holes. The base of the machine is mounted either on a bench or on the floor by means of bolts and nuts. It can handle drills upto 15.5mm of diameter. The drill is fed into the work purely by hand. The operator can sense the progress of the drill into the work because of hand feed. The machine

is named so because of this reason. A sensitive drilling machine consists of a base, column, table, spindle, drill head and the driving mechanism.



- **Base**

The base is made of cast iron and so can withstand vibrations. It may be mounted on a bench or on the floor. It supports all the other parts of the machine on it.

- **Column**

The column stands vertically on the base at one end. It supports the work table and the drill head. The drill head has drill spindle and the driving motor on either side of the column.

- **Table**

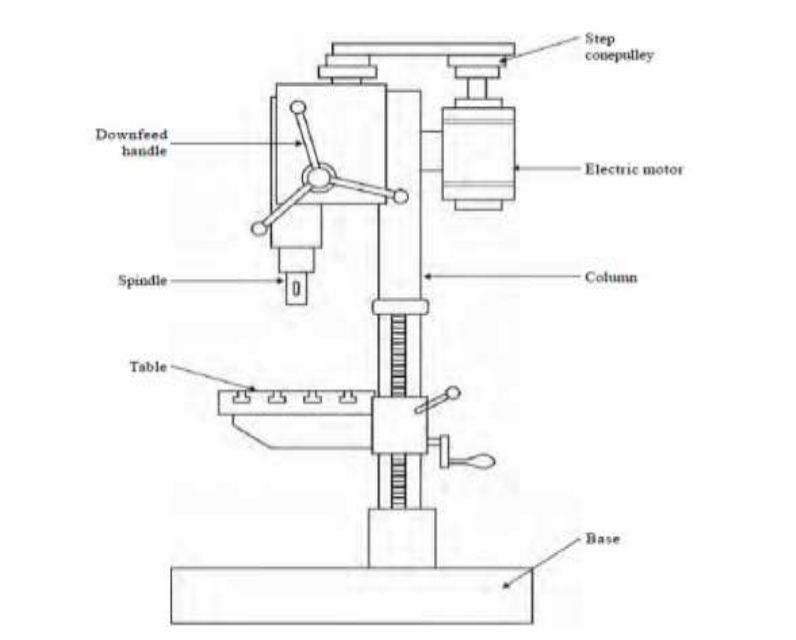
The table is mounted on the vertical column and can be adjusted up and down on it. The table has 'T'-slots on it for holding the workpieces or to hold any other work holding device. The table can be adjusted vertically to accommodate workpieces of different heights and can be clamped at the required position.

- **Drill head**

Drill head is mounted on the top side of the column. The drill spindle and the driving motor are connected by means of a V-belt and cone pulleys. The motion is transmitted to the spindle from the motor by the belt. The pinion attached to the handle meshes with the rack on the sleeve of the spindle for providing the drill the required down feed. There is no power feed arrangement in this machine. The spindle rotates at a speed ranging from 50 to 2000 r.p.m.

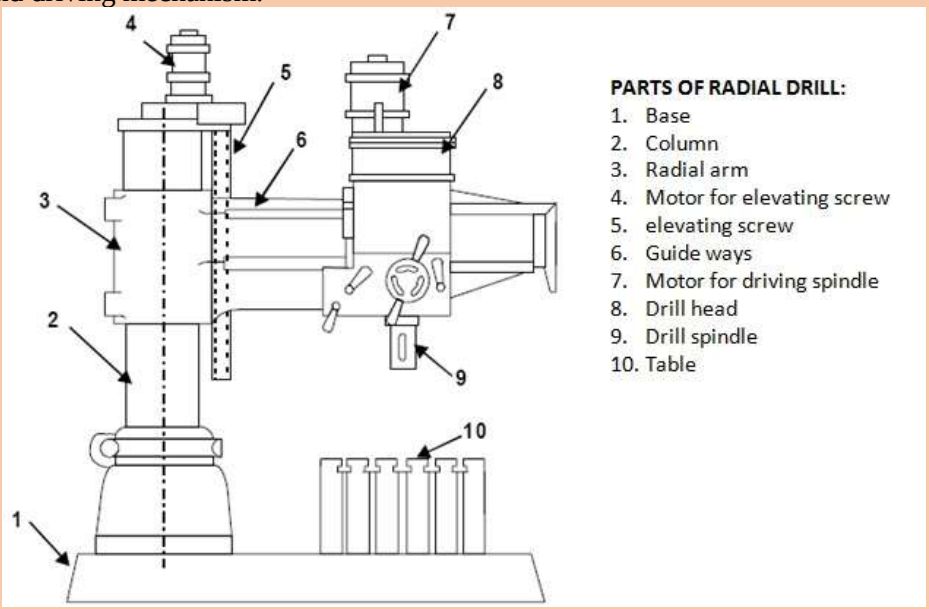
➢ **Upright drilling machine**

The upright drilling machine is designed for handling medium sized workpieces. Though it looks like a sensitive drilling machine, it is larger and heavier than a sensitive drilling machine. Holes of diameter upto 50mm can be made with this type of machine. Besides, it is supplied with power feed arrangement. For drilling different types of work, the machine is provided with a number of spindle speeds and feed.



- **Radial drilling machine**

The radial drilling machine is intended for drilling on medium to large and heavy workpieces. It has a heavy round column mounted on a large base. The column supports a radial arm, which can be raised or lowered to enable the table to accommodate workpieces of different heights. The arm, which has the drill head on it, can be swung around to any position. The drill head can be made to slide on the radial arm. The machine is named so because of this reason. It consists of parts like base, column, radial arm, drill head and driving mechanism.



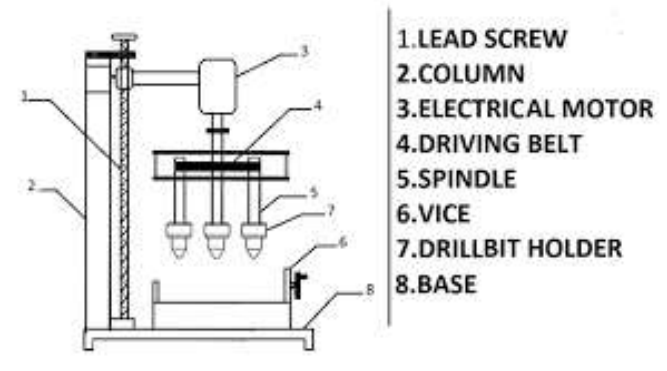
- **Gang drilling machine**

Gang drilling machine has a long common table and a base. Four to six drill heads are placed side by side. The drill heads have separate driving motors. This machine is used for production work. A series

of operations like drilling, reaming, counter boring and tapping may be performed on the work by simply shifting the work from one position to the other on the work table. Each spindle is set with different tools for different operations.

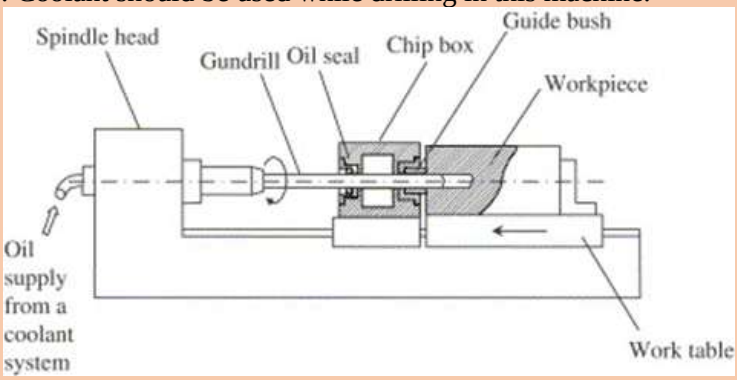
- **Multiple spindle drilling machine**

This machine is used for drilling a number of holes in a workpiece simultaneously and for reproducing the same pattern of holes in a number of identical pieces. A multiple spindle drilling machine also has several spindles. A single motor using a set of gears drives all the spindles. All the spindles holding the drills are fed into the work at the same time. The distances between the spindles can be altered according to the locations where holes are to be drilled. Drill jigs are used to guide the drills.



- **Deep hole drilling machine**

A special machine and drills are required to drill deeper holes in barrels of gun, spindles and connecting rods. The machine designed for this purpose is known as deep hole drilling machine. High cutting speeds and less feed are necessary to drill deep holes. A non rotating drill is fed slowly into the rotating work at high speeds. Coolant should be used while drilling in this machine.



- **Size of a drilling machine (Specification)**

Drilling machines are specified according to their type.
To specify the machine completely the following factors are considered:
1. The maximum diameter of the drill that it can handle
2. The size of the largest work piece that can be centred under the spindle
3. Distance between the face of the column and the axis of the spindle
4. Diameter of the table
5. Maximum travel of the spindle
6. Numbers and range of spindle speeds and feeds available
7. Morse taper number of the drill spindle

8. Floor space required
9. Weight of the machine
10. Power input is also needed to specify the machine completely.

❖ **CONCLUSION:**

Drilling machines are essential tools for creating precise holes in a wide range of materials, playing a critical role in industries from manufacturing and construction to aerospace. While their core function is to use a rotating drill bit, the efficiency, accuracy, and versatility of modern machines are enhanced by technological advancements like CNC controls. Therefore, selecting the right type of drilling machine for a specific task is crucial for maximizing productivity and quality, with the future pointing towards even more automated and "smart" systems.

"If you don't like the road you're walking, start paving another one."

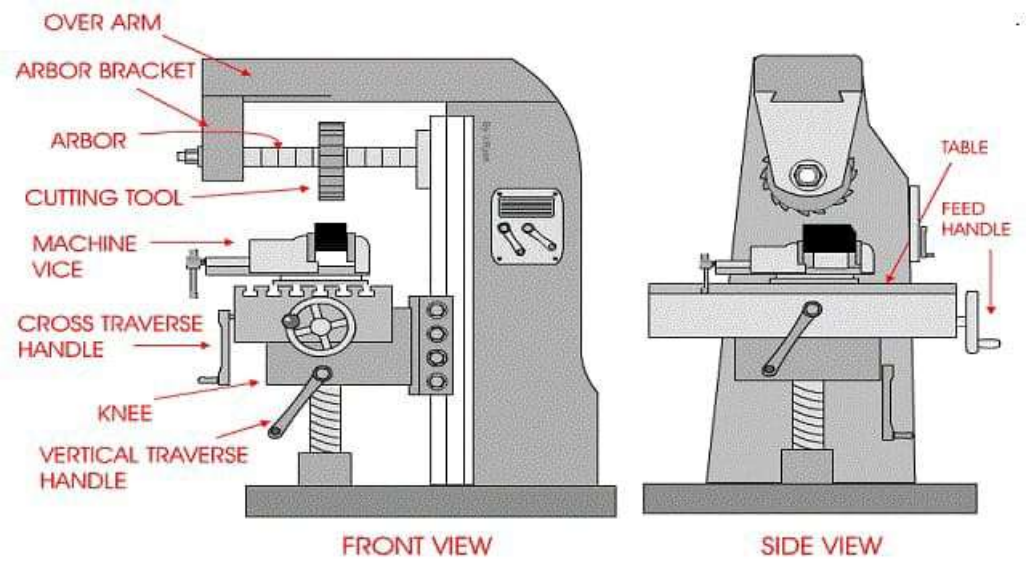
—Dolly Parton

MILLING MACHINE

KUNTAL DAS
DME 5TH Semester

Introduction

Milling is a process of removing metal by feeding the work against a rotating multipoint cutter. The machine tool intended for this purpose is known as milling machine. Milling machine is used for achieving flat surfaces, contoured surfaces, surfaces of revolution, external and internal threads, and helical surfaces of various cross-sections. The surface obtained by this machine tool is superior in quality and more accurate and precise.



❖ **Types of milling machine**

The milling machines are classified according to the general design of the machine.

1. Column and knee type
   a) Plain milling machine
   b) Universal milling machine
   c) Omniversal milling machine
   d) Vertical milling machine
2. Table type milling machine
3. Planer type milling machine
4. Special type milling machine

Column and knee type milling machine

The column of a column and knee type milling machine is mounted vertically upon the base. Knee is mounted on the accurately machined guide ways of the column. It is designed to move up And down accurately. Saddle and table are mounted on the knee. There are different types of column and knee type machines.

a) Plain milling machine

It is rigid and sturdy. Heavy work pieces are mounted and machined on the machine. The work mounted on the table is moved vertically, longitudinally and crosswise against the rotating cutter. The table cannot be rotated. It is also called as horizontal milling machine because the cutter rotates in horizontal plane.

b) Universal milling machine

The table of a universal milling machine can be swiveled by 45º on either side and so helical milling works can be performed. It is named so because it can be adapted for a very wide range of milling operations. Various milling attachments like index head, vertical milling head, slot milling head and rotary table can be mounted. It can machine drills, reamers, gears, milling cutters with a very high degree of accuracy and so it finds an important place in a workshop.

c) Omniversal milling machine

In addition to the table movements obtained in a universal milling machine, the knee can be tilted to a required angle. It is useful for machining helical grooves, reamer and bevel gears. It is mostly used in tool room work.

d) Vertical milling machine

A spindle of a vertical milling machine is positioned at right angles to the table. The cutter is moved vertically or at an angle by swivelling the vertical head of the machine. The machine is adapted for machining slots and flat surfaces by moving the table. By mounting end mills and face milling cutters on the spindle, vertical milling and internal milling are performed.

- **Main Parts of Column and knee type milling machine**

Base

It is made of cast iron and supports all the other parts of the machine tool. A vertical column is mounted upon the base. In some machines, the base serves as a reservoir for cutting fluid.

Column

It is mounted upon the base and is box shaped. It houses the mechanism for providing drive for the spindle. The front vertical face of the column is machined accurately to form dovetail guide ways for the knee to move up and down. The top of the column holds an overhanging arm.

Knee

It slides up and down on the guide ways of the column. An elevating screw mounted on the base obtains this movement. Saddle is mounted upon the knee and moves in a cross direction.

Saddle

It is mounted on the guide ways of the knee and moves towards or away from the face of the column. This movement can be obtained either by power or by hand. The top of the saddle has guide ways for the table movement.

Table

The table is moved longitudinally either by power or manually on the guide ways of the saddle. The trip dogs placed on it control the movement of the table. The table of a universal milling machine can be swiveled horizontally to perform helical works. The top surface of the table has got 'T' – slots on which the work pieces or other work holding devices are mounted.

Spindle

It is located in the upper part of the column. It receives power from the motor through belt, gears and clutches. The front end of the spindle has got a taper hole into which the cutters are held with different cutter holding devices.

Overhanging arm

It supports the arbor from the top of the column. The arbor is supported by the bearing fitted within the arbor support. It is also useful while using some special attachments.

Front brace

It is an extra support fitted between the knee and the overhanging arm. It is slotted to allow the knee to be adjusted vertically.

Arbor

It supports the different types of cutters used in the machine. It is drawn into the taper hole of the spindle by a draw bolt. One or more cutters are mounted on the arbour by placing spacing collars between them.

The arbor is supported by an arbor support. The arbor is provided with a Morse taper or self-releasing taper.

Vertical milling machine

It is very similar to a horizontal milling machine in construction as it has the same parts of base, column, knee, saddle and table. The spindle of the machine is positioned vertically. The cutters are mounted on the spindle. The spindle is rotated by the power obtained from the mechanism placed inside the column. Angular surfaces are machined by swiveling the spindle head.

- **Size of a milling machine**

The size of a milling machine is specified as follows

1. The size of the table (length and width), 2. The maximum lengths of longitudinal, cross and vertical travel of the table. 3. Number of spindle speeds, number of feeds. 4. Spindle nose taper. 5. Power required. 6. Net weight of the machine. 7. The floor space required. 8. Type of the machine

- **Milling Operation - Peripheral milling**

The machining is performed by the cutting edges on the periphery of the milling cutter.

It is classified under two headings

1. up milling 2. Down milling

Up milling

In this method, the work piece mounted on the table is fed against the direction of rotation of the milling cutter. The cutting force is minimum during the beginning of the cut and maximum at the end of cut. The thickness of chip is more at the end of the cut. As the cutting force is directed upwards, it tends to lift the work piece from the fixtures. A difficulty is felt in pouring coolant on the cutting edge. Due to these reasons the quality of the surface obtained by this method is wavy. This processes being safer is commonly used and sometimes called conventional milling.

Down milling

The work piece mounted on the table is moved in the same direction as that of the rotation of the milling cutter. The cutting force is maximum at the beginning and minimum at the end of cut. The chip thickness is more at the beginning of the cut. The work piece is not disturbed because of the bite of the cutter on the work. The coolant directly reaches to the cutting point. So the quality of surface finish obtained is high. Because of the backlash error between the feed screw of the table and the nut, vibration is setup on the work piece.

- **Cutter holding devices**

Depending on the design of the cutter, there are several methods of supporting milling cutters on the machine spindle.

Arbor

Milling cutters with central holes are mounted and keyed on a shaft called arbor. There are here different types of arbor namely Pilot end arbor, ‘A’ type arbor and stub arbor.

Collet

It is a form of sleeve bushing used to hold arbors or cutters having a smaller shank than the spindle taper. Collets are connected to the spindle by a draw bolt and the rotary motion is transmitted to the cutters.

Adapters

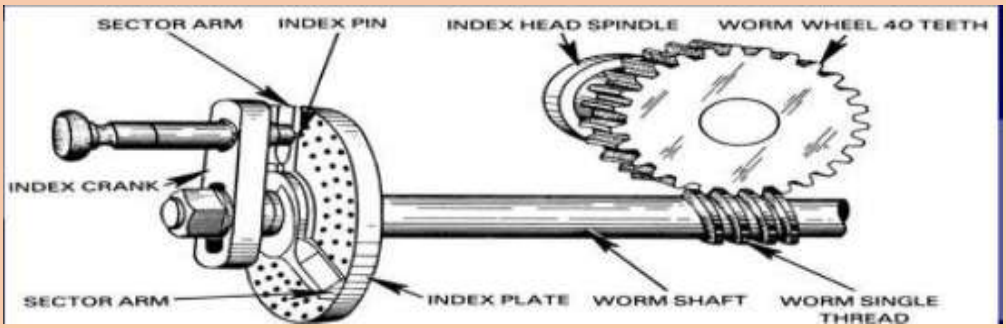
Milling cutters having shanks are generally mounted on adapters. The outside taper of the adapter conforms to the taper hole of the spindle. The shank of the cutter fits into the taper hole of the adapter.

Screwed arbor

The small cutters having threaded holes at the center are held by screwed arbors. It has a threaded nose at one end and a taper shank at the other end. The shank of the arbour is mounted on the spindle.

Indexing head

Indexing is the method of dividing the periphery of a piece of work into any number of equal Parts. The attachment used for performing indexing is known as indexing head. The indexing Operation can be adapted for cutting gears, ratchet wheels, keyways, fluted drills, taps and Reamers. The indexing head serves as an attachment for holding and indexing the work in doing The above tasks.



- **There are three different types of indexing heads namely:**

1. Plain or simple dividing head, 2. Universal dividing head, 3. Optical dividing head.

Working principle of dividing head:

When the crank is rotated with help of a handle through the required number of holes in the index plate, the work is rotated to required amount. This is possible because of the worm and worm wheel mechanism. A gear train is arranged between the main spindle and the driven shaft when indexing is done by differential indexing method. The work is rotated as usual when the handle is rotated. At the same time, the index plate is also made to rotate a small amount through the gear train. When indexing is by this differential indexing method, the index plate is released from the lock pin.

- **Conclusion**

Milling machines are versatile and essential tools in modern manufacturing, offering precision and efficiency in various machining operations. With their ability to perform a wide range of tasks, from simple cutting and drilling to complex 3D machining, milling machines have become indispensable in industries such as aerospace, automotive, and precision engineering.

"The only source of knowledge is experience,"

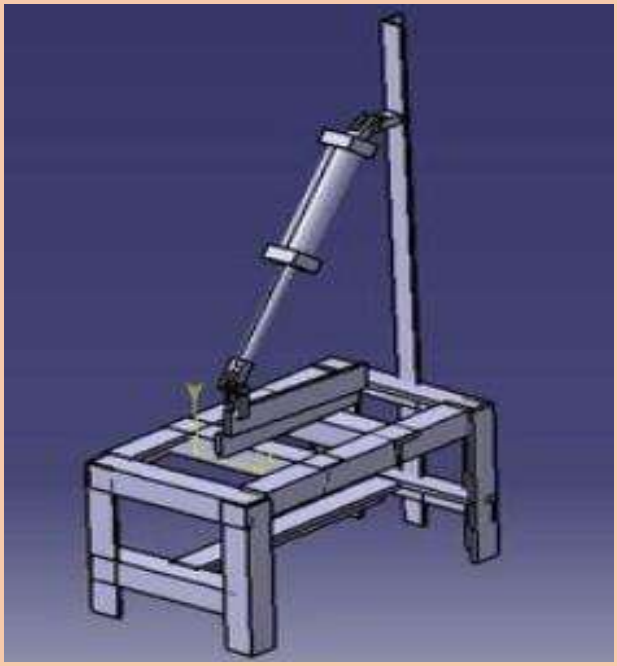
-------Albert Einstein.

PNEUMATIC SHEET CUTTER MACHINE

SWAPNIL GUPTA
DME 5th Semester

Introduction: -

In today's industries, speed, accuracy and productivity plays a major role in every manufacturing operation. Cutting of sheet materials like metal, plastic or paper manually takes a lot of time and also leads to less accuracy and operator tiredness. To solve these issues, the Pneumatic Sheet Cutter Machine came into picture. It uses compressed air for cutting sheets in a quick and efficient way. The main idea behind this machine is to reduce manual work and improve cutting quality with simple working principle.



Working Principle: -

The pneumatic sheet cutter works on the basic idea of converting compressed air energy into mechanical motion. The system mainly includes air compressor, pneumatic cylinder, solenoid valve, cutting blade and a control unit. When the compressed air is supplied into the cylinder, the piston moves forward and pushes the cutting blade with force. This force is enough to cut or shear the sheet placed under it.
The machine can be operated manually or automatically depending on the design. In automatic types, sensors and control systems like PLCs are used to control timing and movement. This makes the operation faster and more safe compared to manual cutting.

Construction and Components: -

1. **Frame: - The** frame acts as the main support for all other components. It is usually made from mild steel which gives strength and reduces vibration during operation.
2. **Pneumatic Cylinder: - It** is the heart of the machine. The cylinder converts air pressure into mechanical motion to drive the cutting blade. The stroke length depends on the sheet thickness.

3. **Cutting Blade: - The** blade is made of hardened steel withstand wear and give accurate cuts. It can be straight or circular type depending on the sheet material.
4. **Air Compressor: - It** supplies the compressed air, generally between 6 to 10 bar pressures, which is used for the cylinder.
5. **Solenoid Valve: - This** valve controls the air flow direction. It is operated either manually or automatically by using an electrical switch or sensor.
6. **Control Unit: - It** manages all the operations and ensures safety. In modern designs, a simple microcontroller circuit is used for better control.

Advantages: -

There are many advantages of using a pneumatic sheet cutter machine as compared to traditional mechanical or manual cutters:

(i) **High Efficiency: -** The machine performs cutting operations very quickly and repeatedly without errors.

(ii) **Less Human Effort: - It** reduces the physical work of the operator and increases comfort.

(iii) **Good Accuracy: - The** blade movement is smooth which gives neat and clean cuts every time.

(iv) **Low Maintenance: - As** pneumatic systems have less moving parts, the wear and tear is very less.

(v) **Better Safety: - There** is no risk of electric shock or spark, making it safe for industrial use.

Applications: -

This machine finds its applications in various industries such as:

(a) **Metal fabrication workshops: -** for cutting aluminium, copper and thin steel sheets.

(b) **Plastic and packaging industries: -** for trimming plastic sheets and films.

(c) **Paper industries: -** for fast cutting of large paper rolls.

(d) **Automobile and aerospace industries: -** where accurate sheet cutting is required for components.

Conclusion: -

The Pneumatic Sheet Cutter Machine is a simple but very effective machine for modern workshops. It combines mechanical design with pneumatic power to achieve high performance. The machine not only saves time but also improves the quality of cutting. Due to its low cost, easy maintenance and reliability, it is suitable for small and medium scale industries. In the coming years, such pneumatic systems will become more common as industries move towards automation and better efficiency.

"The good thing about science is that it's true whether or not you believe in it,"

----------Neil deGrasse Tyson.

UTM Machine

SUPRATIK GHOSH
DME 5th Semester

Abstract:
The tensile test always delivers an in-depth understanding of true stress-strain relationship. However, it is not easy for the researchers to understand and evaluate the tensile properties of micro-specimens. This paper presents a research work aiming at the design and manufacturing of a small universal test machine (UTM) for measuring the mechanical properties of the miniaturized samples. The newly developed machine is sensitive to small loads and permits to obtain the stress-strain curves for thin materials. This portable UTM consists of a stepper motor, a load cell, a linear variable differential transformer (LVDT), a load cell amplifier and a data acquisition system. Copper based small and thin (50 μm) tensile test samples were tested on this machine at room temperature, and the calculated results were compared with the test results derived from a commercial UTM (METEX - 1 kN) to justify the validation of the developed apparatus. The obtained mechanical properties are in good agreement with the values obtained from a commercial UTM. To confirm the possibility of in-situ micro-observation, the surface roughness analysis has been conducted on the developed apparatus for pure copper foils under 3D laser-confocal microscope. Finally, it is concluded that this kind of testing apparatus could be manufactured within a manageable budget.

Introduction:
A Universal Testing Machine (UTM) is a versatile mechanical testing equipment used to determine the mechanical properties of materials under various types of loads, such as tensile, compressive, and flexural forces. The UTM plays a crucial role in material testing and quality control across industries, including construction, aerospace, automotive, and manufacturing. A universal testing machine (UTM), also known as a universal tester, universal tensile machine, materials testing machine, materials test frame, is used to test the tensile strength (pulling) and compressive strength (pushing), flexural strength, bending, shear, hardness, and torsion testing, providing valuable data for designing and ensuring the quality of materials. An earlier name for a tensile testing machine is a tonometer. The "universal" part of the name reflects that it can perform many standard tests application on materials, components, and structures (in other words, that it is versatile).

Electromechanical and Hydraulic Testing System

An electromechanical UTM utilizes an electric motor to apply a controlled force, while a hydraulic UTM uses hydraulic systems for force application. Electromechanical UTMs are favoured for their precision, speed, and ease of use, making them suitable for a wide range of applications, including tensile, compression, and flexural testing.

On the other hand, hydraulic UTMs are capable of generating higher forces and are often used for testing high-strength materials such as metals and alloys, where extreme force applications are required. Both types of UTMs play critical roles in various industries including aerospace, automotive,

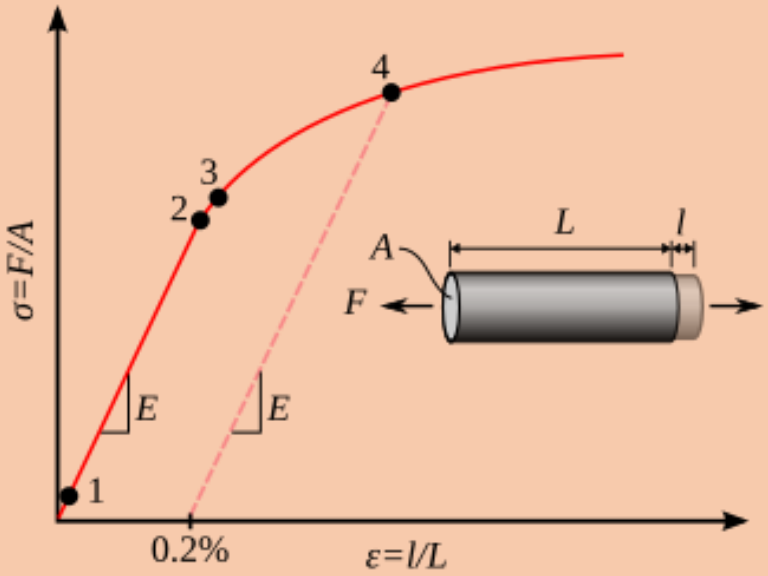
construction, and materials science, enabling engineers and researchers to accurately assess the mechanical properties of materials for design, quality control, and research purposes.

Components:

Several variations are in use. Common components include:

Load frame - Usually consisting of two strong supports for the machine. Some small machines have a single support. Load cell - A force transducer or other means of measuring the load is required. Periodic calibration is usually required by governing regulations or quality system.

Cross head - A movable cross head (crosshead) is controlled to move up or down. Usually this is at a constant speed: sometimes called a constant rate of extension (CRE) machine. Some machines can program the crosshead speed or conduct cyclical testing, testing at constant force, testing at constant deformation, etc. Electromechanical, servo-hydraulic, linear drive, and resonance drive are used. Means of measuring extension or deformation - Many tests require a measure of the response of the test specimen to the movement of the cross head. Extensometers are sometimes used. Control Panel and Software Device - Providing the test result with parameters set by the user for data acquisition and analysis. Some older machines have dial or digital displays and chart recorders. Many newer machines have a computer interface for analysis and printing. Conditioning - Many tests require controlled conditioning (temperature, humidity, pressure, etc.). The machine can be in a controlled room or a special environmental chamber can be placed around the test specimen for the test. Test fixtures, specimen holding jaws, and related sample making equipment are called for in many test methods.



Stress–strain curve showing typical yield behavior for nonferrous alloys (stress, shown as a function of strain): True elastic limit, Proportionality limit, Elastic limit, Offset yield strength.

t

The set-up and usage are detailed in a test method, often published by a standards organization. This specifies the sample preparation, fixturing, gauge length (the length which is under study or observation), analysis, etc. The specimen is placed in the machine between the grips and an extensometer if required can automatically record the change in gauge length during the test. If an extensometer is not fitted, the machine itself can record the d e systems including any slipping of the specimen in the grips. Once the machine is started it begins to apply an increasing load on specimen. Throughout the tests the control system and its associated software record the load and extension or compression of the specimen.

Conclusion: The Universal Testing Machine (UTM) machining project provided valuable insights into the mechanical properties of materials and the principles of material testing. Through the experiment, we were able to accurately determine critical parameters such as tensile strength, yield strength, elongation, and modulus of elasticity. These properties are essential in evaluating a material's suitability for various engineering applications. The use of the UTM enabled precise control and measurement of the applied load and the corresponding deformation, thereby ensuring accurate and reliable results. The practical exposure to handling the UTM also enhanced our understanding of stress-strain behavior, failure modes, and the importance of standardized testing procedures.

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"Be less curious about people and more curious about ideas"

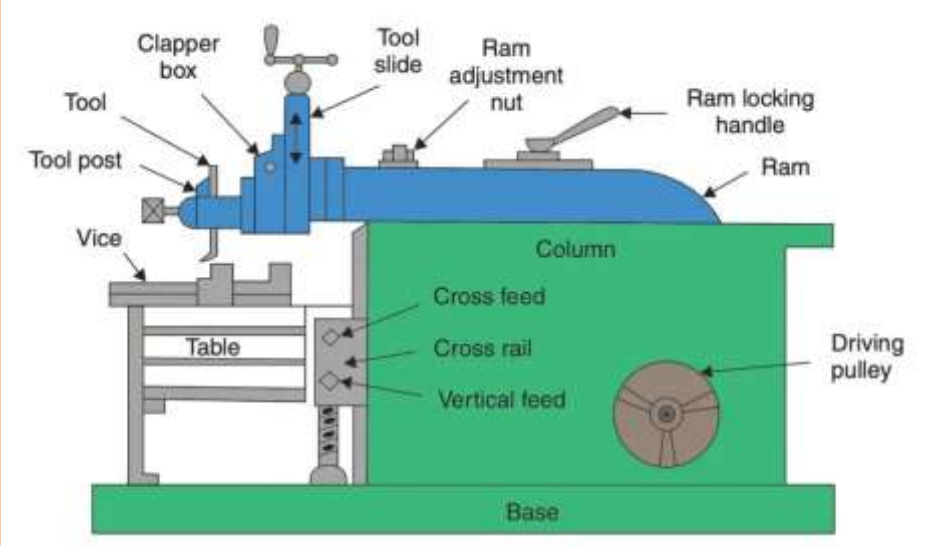
---------- Marie Curie

SHAPING MACHINE

SABUJ DAS
DME 5th Semester

❖ INTRODUCTION :

A shaping machine, or shaper, is a machine tool used in metalworking to create flat surfaces, grooves, and angular planes on a workpiece through a linear, reciprocating motion of a single-point cutting tool. The tool is mounted on a ram that moves back and forth, cutting the material during the forward stroke while a quick-return mechanism makes the return stroke faster and non-cutting. Shaping machines are versatile for creating precision surfaces, slots, keyways, and complex contours for low-volume production.



❖ Classification of shaping machines :

➢ **Based on the driving mechanism :**

- **Crank type:** Uses a crank and bull gear mechanism to convert rotary motion into the reciprocating motion of the ram. It is a very common type, suitable for general-purpose use.
- **Geared type:** Employs a rack and pinion system, with the ram reciprocating due to the movement of a rack driven by a spur gear.
- **Hydraulic type:** Uses high-pressure oil to provide a smooth, quiet reciprocating motion to the ram, with constant cutting force throughout the stroke.

➢ **Based on the position and travel of the ram :**

- **Horizontal type:** The ram moves horizontally, ideal for creating flat surfaces, keyways, and grooves.
- **Vertical type:** The ram reciprocates in a vertical plane, useful for machining internal slots, keyways, and contoured surfaces.
- **Traveling-head type:** The ram can be fed diagonally, while the workpiece remains stationary, which is helpful for very large or awkwardly shaped parts.

➢ **Based on the table design :**

- **Standard type**: The table has only horizontal and vertical movement to provide the feed.

- **Universal type**: In addition to horizontal and vertical movements, the table can be swiveled and tilted to an inclined axis, making it suitable for toolroom work and angled surfaces.

❖ **Key parts and their functions :**

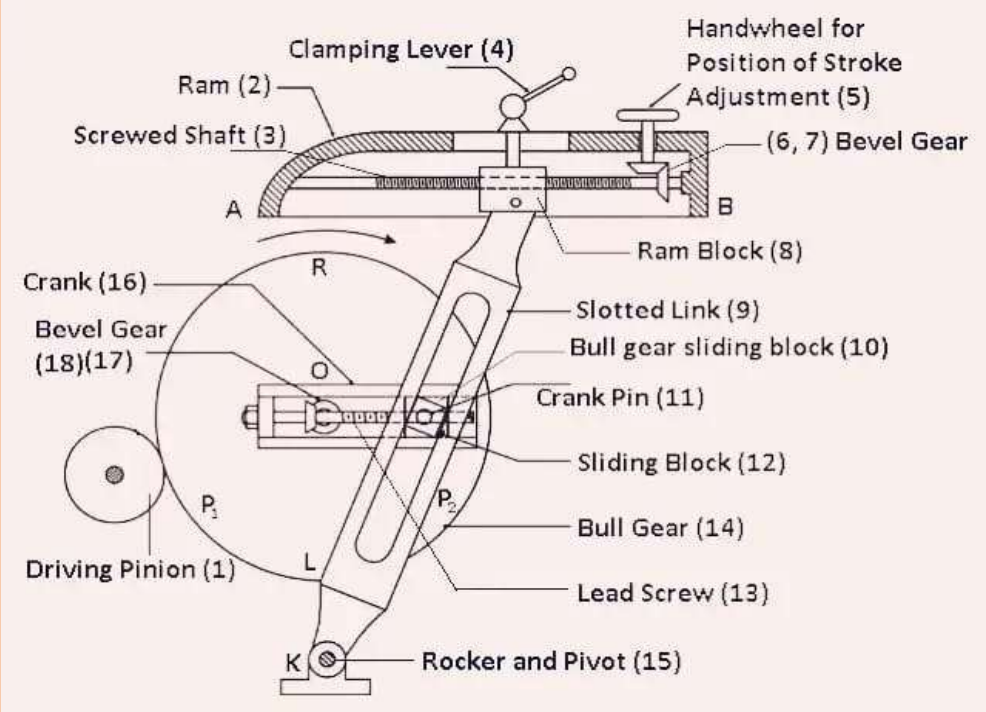
- **Base:** The foundation of the machine, made of cast iron to withstand vibration and support all other parts.
- **Column**: A vertical structure mounted on the base that houses the drive mechanisms and provides guideways for the ram's motion.
- **Cross rail**: A horizontal beam on the front of the column that moves up and down and supports the saddle, which allows the table to move horizontally.
- **Table:** A box-like structure with T-slots for clamping the workpiece. It moves vertically and horizontally to position the work against the cutting tool.
- **Ram:** A component that moves back and forth on the column's guideways. It carries the tool head and performs the reciprocating cutting stroke.
- **Tool head**: Located at the front of the ram, it holds the single-point cutting tool and can be adjusted for depth of cut and angular settings.
- **Cutting tool:** A single-point tool that shaves material from the workpiece during the forward stroke of the ram. A "clapper box" allows the tool to lift slightly on the return stroke to avoid damage.

❖ **QUICK RETURN MECHANISM :**

A shaper's quick return mechanism converts rotary motion into reciprocating motion, with the cutting (forward) stroke taking longer than the faster return stroke to improve efficiency. It typically uses a crank and slotted lever system where a rotating crank pin, connected to a bull gear, slides along a slotted crank plate. This motion is transferred through a connecting rod to the ram, causing it to move slowly during the cutting stroke and quickly back to its starting position for the next cut.

Working principle:

- **Rotary to reciprocating motion**: A motor rotates a driving gear, which in turn rotates the bull gear.
- **Crank and slotted plate**: A crank pin on the bull gear rotates with it. This pin is set in a slot on a movable crank plate.
- **Connecting rod and ram**: The other end of the crank plate is connected to a connecting rod. This rod is connected to the shaper's ram, which holds the cutting tool.
- **Slow cutting stroke**: As the bull gear rotates, the crank pin moves in a circle. The crank plate, driven by the pin, moves through a larger angle during the slow cutting stroke. This results in the connecting rod and ram moving forward at a slower, controlled pace to cut the material.
- **Fast return stroke**: During the return stroke, the crank pin still rotates with the bull gear, but the crank plate moves through a smaller angle. This geometry makes the ram move back to its starting position much faster, reducing idle time and increasing productivity.



❖ **Conclusion :**

Shaping machines are vital in manufacturing, providing precision and efficiency in shaping and machining operations. They offer versatility, accuracy, and productivity, making them essential in various industries, including automotive, aerospace, and construction. With ongoing technological advancements, shaping machines will continue to play a crucial role in producing complex parts and components.

"The whole of science is nothing more than a refinement of everyday thinking".

---------- Albert Einstein

WELDING JOINT

SUBHRADEEP CHHARI,
DME 5th Semester

Abstract
Welding is a fundamental process used to join two or more metal parts permanently by applying heat, pressure, or both. It plays a crucial role in manufacturing, construction, and repair industries due to its strength, durability, and efficiency. Various welding methods such as arc welding, gas welding, MIG, TIG, and resistance welding are employed depending on the material type and application. The process involves melting the base metals, often with the addition of a filler material, to form a strong metallurgical bond. Advances in welding technology have improved precision, automation, and safety, making it an essential technique in modern engineering and fabrication.

Introduction
In this laboratory the type of welding has been carried out is arc welding which a manual process that uses a consumable electrode coated in flux to lay the weld. It is a fusion welding processes which uses an electric arc to produce the heat required for melting the metal. The welder creates an electric arc that melts the base metals and filler metal (consumable) together so that they all fuse into one solid piece of metal. Electric current, in the form of either alternating current or direct current from a welding power supply is used to form an electric arc between the electrode and the metals to be joined. As the weld is laid, the flux coating of the electrode disintegrates giving off vapours that serve as a shielding gas and providing a layer of slag both of which protect the weld area from atmospheric contamination. Arc welding is also known as “stick welding”. It's used an arc welding to weld between a covered electrode and a workpiece. There were shielding obtained from decomposition of the electrode cover. During this working operation the pressure is not used and filler metal is obtained from the electrode. There are many weave pattern technique in welding operation such as circular, “c”, square, "J”, “T”, and straight step pattern. Only the circular and “c” technique has been used on my tasks. Circular pattern is used for at position welds on butt, tee outside corner joints and build up or surfacing applications. “C” pattern good for most at welds but can be used for vertical positions. The arcwelding continues to be used extensively in the construction of steel structures and industrial fabrication. It is popular because it can be used in the field without complicated equipment and gases.

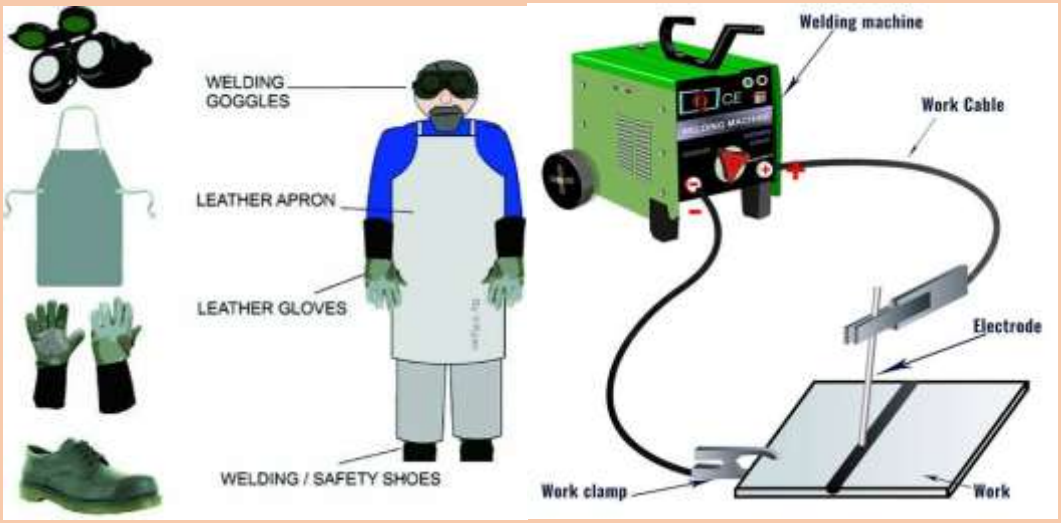
Types of Welding

- Shielded Metal Arc Welding (SMAW) / Stick Welding
- Gas Metal Arc Welding (GMAW) / MIG (Metal Inert Gas) Welding
- Gas Tungsten Arc Welding (GTAW) / TIG (Tungsten Inert Gas) Welding
- Flux Cored Arc Welding (FCAW)
- Submerged Arc Welding (

Safety Precautions

- Wear PPE (Personal Protective Equipment)
- Welding helmet with proper shade filter.
- Flame-resistant gloves and clothing.
- Safety boots and ear protection.
- Ensure proper ventilation: To remove harmful fumes and gases.

- Check equipment regularly: Prevents electrical faults and gas leaks.
- Keep flammable materials away: Maintain a clean, dry workspace.
- Use fire extinguishers: Keep them nearby at all times.
- Training and awareness: Only trained personnel should perform welding.



Welding setup

Welding Process

The working principle of welding is to use heat, pressure, or a combination of both to melt and fuse two pieces of metal together. The most common method, electric arc welding, uses an electric arc between an electrode and the workpiece to generate intense heat, melting the metals to create a strong joint as they cool and solidify. Other methods use a high-temperature flame from burning gases or the heat from electrical resistance.

Welding Joint

Conclusion

Welding is an essential metal joining process used in almost every industry, from construction to automotive and manufacturing. It provides strong, permanent joints between metals and allows the

fabrication of complex structures. By understanding welding principles, components, and safety measures, high-quality welds can be achieved efficiently. Proper training, correct selection of welding methods, and adherence to safety precautions ensure both productivity and protection of workers. In conclusion, welding is a vital and versatile process that plays a key role in modern engineering and industrial development.

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"Everything is theoretically impossible, until it is done."
– Robert A. Heinlein.

MULTI PLATE CLUTCH

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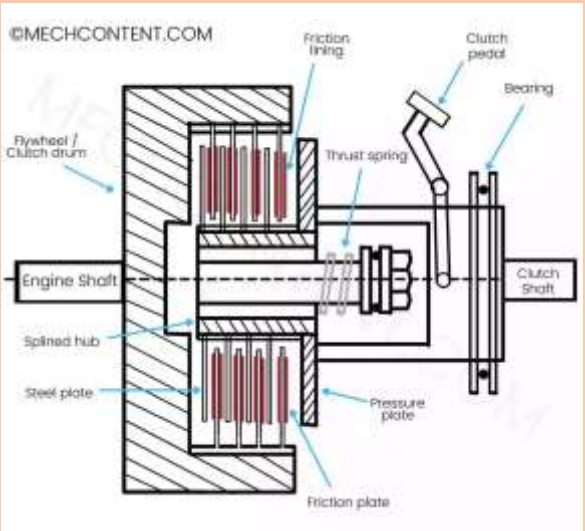
DME 5th Semester

Multi plate Clutch is a one of the Friction type plate clutch. In this clutch, multiple friction plates are used as compared to a single plate clutch. Due to the presence of multiple plates, It has a higher capacity of torque Transmission as Compared to a Single Plate clutch, because Due to the Presence of Multiple Plates, Friction Surface increases.

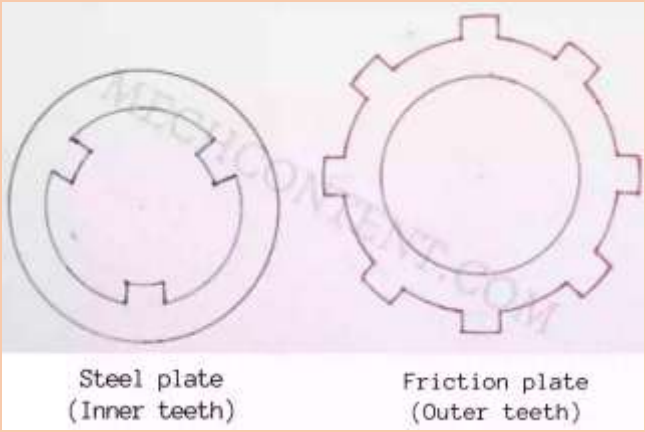


Parts of Multi plate clutch are as follows:-

1] Clutch drum:- Clutch drum is connected to the engine shaft. It rotates continuously as engine shaft rotate.The clutch drum has slots on its circumference so that the externally threaded friction plates can slide into the clutch drum.

2] Splined inner hub:- The hub is connected to the gearbox shaft. It rotates with the speed of the gearbox. The inner hub is splined so that the internally toothed steel plates can slide on it.

3] Clutch pack:- Clutch pack consists of two types of round plates: friction disc and steel plate.



4] Friction disc:- It is also known as friction plate. It has asbestos lining for frictional contact. The friction plates are externally toothed and these plates are mounted into the clutch drum. The friction plates can easily slide into the slots of clutch drum.

5] Steel plate:- These plates are internally toothed and mounted on inner splined hub. This plates are rotates with the speed of the gearbox.

6] Pressure plate:-Pressure plate is generally observed in all types of clutches. The main aim of pressure plate is to apply pressure on to the friction plates so that the friction plates on clutch bucket and steel plates on inner hub are hold firmly together and start to rotate as single unit. The pressure plate is mounted on inner hub with the use of sleeves. The pressure plate can easily move on sleeve for engagement and disengagement. The motion of pressure plate is operated by pedal and thrust spring.

7] Thrust spring:- The aim of the thrust spring is to keep the friction plate and steel plate in firm contact so that they can rotate together. A thrust spring is attached behind of pressure plate.

8] Clutch pedal:- This is the part of the clutch which is operated by the operator for engaging and disengaging the clutch. The aim of the clutch pedal is to operate the movement of the pressure plate hence it helps in the engagement and disengagement of the clutch.

Multi plate clutch construction:- 1) The clutch drum is connected to the engine shaft. 2) Splined inner hub is connected to the gearbox shaft. 3) The externally toothed friction plates are mounted into the slots of the clutch drum and the friction plate can easily slide into the slots of the clutch drum. 4) The internal toothed steel plates are mounted on splined inner hub and can easily slide on it. 5) As shown in figure, the both type of plates are arranged in one by one manner.6) All the plates are pressed together by means of a pressure plate. 7) Thrust spring is mounted behind of pressure plate which pushes the

pressure plate to hold the friction plates together. 8) The pedal is used for movement of pressure plate for engagement and disengagement.

Multi plate clutch working:-

ENGAGEMENT OF CLUTCH: 1) The clutch is generally in engaged condition. 2) The friction plates are mounted into the clutch drum which is further connected to engine shaft. 3) The steel plates are mounted on inner hub which is connected to gearbox shaft. 4) Hence to transmit power from engine shaft to gearbox shaft it is necessary to hold friction plate and steel plate together. This is done by a pressure plate. The pressure plate holds both types of plates together by means of thrust spring. 6) Hence friction plate and steel plates rotate together as a single unit and transfer power from engine to gearbox.

DISENGAGEMENT OF CLUTCH: 1) For Disengagement of clutch, an operator has to press clutch pedal. 2) As we press the clutch pedal, the pressure plate is moved in backward direction. 3) It results in removal of pressure on set of friction plate and steel plate. 4) Now the frictional contact between these two plates is loosen. 5) It breaks the contact between engine shaft and gearbox shaft. 6) This condition is known as disengaged condition. 7) Now if we release the pedal again then the thrust spring again pushes the pressure plate on friction plates which will result in the engagement of the clutch.

Multi plate clutch advantages: - 1) Less effort requires to operate this clutch. 2) It is compact in size hence requires less space. 3) It has high power transmission capacity.

Multi plate clutch disadvantages:- 1) It uses many number of plates hence more heat generates in this type of clutch. 2) Multi plate clutch are heavier in weight.

Multi plate clutch applications: - Motorcycle, Cars, Scooter

CONCLUSION: A multi-plate clutch is an efficient system for high-torque applications due to its ability to transmit greater power through multiple friction surfaces, leading to higher torque capacity. Its multiple, smaller plates allow for a more compact and lighter design, while also improving heat dissipation and offering smoother, faster engagement compared to single-plate clutches. These advantages make it ideal for performance vehicles like motorcycles and racing cars, as well as heavy-duty trucks.

"What you learn from a life in science is the vastness of our ignorance."

– David Eagleman

AUTOMATION IN PRODUCTION ENGINEERING

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1. Introduction to Automation

Production engineering has evolved from manual craftsmanship in the pre-industrial era to mechanized manufacturing during the Industrial Revolution, and later to the highly automated systems of the 20th and 21st centuries. Key milestones include James Watt's steam engine, Eli Whitney's interchangeable parts, Henry Ford's assembly line, and the post-WWII rise of computer-controlled systems. Today, Industry 4.0 integrates cyber-physical systems, IoT, and AI for smart manufacturing. Automation is defined as the use of machines, control systems, and information technologies to minimize human intervention while increasing efficiency, quality, and safety. Its scope includes manufacturing, material handling, quality control, packaging, and predictive maintenance. Types of automation include fixed, programmable, and flexible systems. The main objectives and benefits are enhancing productivity and efficiency. ensuring precision and consistency, reduce costs and waste, improve workplace safety, increase adaptability in production.

2. Fundamentals of Automation Technologies

Automation relies on control systems, feedback mechanisms, and human-machine interfaces. Open-loop systems operate without feedback, while closed-loop systems adjust automatically using real-time data. Three types of Automations are a) Fixed Automation: high-volume, low-flexibility systems (e.g., automotive production lines),b) Programmable Automation: suited for batch production with moderate flexibility, c) Flexible Automation: adapts quickly to product changes, ideal for industries like aerospace. The Key Components are a) Sensors: gather data (temperature, pressure, proximity) b) Actuators: convert signals into movement (electric, hydraulic, pneumatic) c) Controllers: the system's "brain" (PLC, DCS, microcontrollers) The Emerging Trends are Industry 4.0 and IoT connectivity, Collaborative robots (cobots), AI and machine learning for predictive maintenance and quality control. Autonomous mobile robots in logistics and material handling.

3. Role of Automation in Modern Production

Automation drives efficiency, precision, and cost optimization as follows

a) Efficiency: Automated systems operate 24/7, reduce downtime, and eliminate bottlenecks.

b) Precision: Automation minimizes human error through real-time monitoring and automated inspection.

c) Cost Optimization: Savings emerge through reduced labor, material waste, and maintenance costs.

Industry Examples:

a) Automotive: Robots in welding, painting, and assembly increase speed and consistency. b) Electronics: Automated testing and assembly improve quality and reduce defects. c) Pharmaceuticals: Automation ensures precise dosing and sterile packaging. d) Food & Beverage: Robotics enhance hygiene and consistency. e) Aerospace: Precision automation ensures safety and quality in complex components.

4. Tools and Techniques

a) Industrial Robots: Articulated, SCARA, Delta, Cartesian, and Cobots serve in welding, packaging, and assembly. b) PLCs (Programmable Logic Controllers): Rugged computers managing

inputs/outputs. c) CNC Machines: Computer-controlled lathes, mills, and grinders for precision machining. d) AI & Machine Learning: Enable predictive maintenance, advanced quality control, supply chain optimization, and robotic process automation.

Smart Manufacturing and Industry 4.0

a) Smart manufacturing integrates automation with data-driven insights. It emphasizes connectivity, real-time monitoring, customization, and sustainability. **b) Pillars of Industry 4.0**: Cyber-Physical Systems, IoT, Big Data, Cloud Computing, AI/ML, 3D Printing, Advanced Robotics, AR/VR. **c) IoT Applications**: predictive maintenance, energy management, supply chain optimization, and smart factories. **d) Digital Twins & CPS**: Virtual replicas of physical systems for simulation, monitoring, and optimization.

5. Automation and Sustainability

Automation supports eco-friendly practices by reducing energy consumption, minimizing waste, and enabling green manufacturing. a) Energy Efficiency: Smart energy management, VFDs, regenerative braking, and AI-driven optimization. b) Waste Reduction: Precision machining, closed-loop systems, and 3D printing reduce raw material waste. c) Green Practices: Sustainable materials, water conservation, pollution control, and zero-waste goals.

6. Economic Impact

Automation reshapes global economies with both opportunities and challenges. a) Job Market Impact: Creates new roles in robotics and AI but displaces repetitive jobs, increasing the need for retraining. b) Industrial Benefits: Lower costs, higher productivity, improved product quality, faster time-to-market, and global competitiveness. c) Cost-Benefit Analysis: Though upfront investment is high, long-term savings and efficiency provide strong ROI. d) Challenges: High costs, workforce resistance, integration with legacy systems, and cyber security risks.

7. Safety and Risk Management

Automated systems bring mechanical, electrical, operational, and cyber security risks. Key hazards include collisions, electric shocks, software errors, and hacking.

Standards & Regulations: ISO 10218 (robot safety)., ISO 13849 (machinery safety)., IEC 61508 (functional safety), OSHA (U.S. workplace safety), EU Machinery Directive, IEC 62443 (cyber security in automation). Risk Mitigation includes Fail-safes, emergency shutdowns, protective barriers, training, and continuous monitoring.

Conclusion

Automation is a cornerstone of modern production engineering, driving productivity, precision, sustainability, and competitiveness. With Industry 4.0, AI, and IoT, automation extends beyond manufacturing into healthcare, logistics, agriculture, and services. While challenges remain—particularly workforce adaptation, costs, and safety—its long-term benefits are undeniable. The future lies in human-machine collaboration, sustainable practices, and interconnected systems that redefine global industries.

No one can make you feel inferior without your consent."

—Eleanor Roosevelt
