

MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY



Course Code : Shop 162

Study of Milling Machine

Name : Sadia Tasnim Humana
Roll No : 202318094
Level/Term : 01/01
Course : Shop - 162
Date of exp : 28/5/23
Date of sub : 4/6/23
Group : 02
Signature of Teacher :

Experiment NO:08

Name of the experiment:

Study of milling machine.

Objective:

- ① To introduce with different types of milling machine and milling cutter.
- ② To study and operate milling machine.

Theory:

Milling machine is a machine tool that removes material from a work piece by rotating a cutter and moving it into the material. Milling machines are a very versatile machine tool. Milling machines are capable of machining one or two pieces as well as large volume production runs. The milling machines can produce a variety of surfaces by using a circular cutter with multiple teeth that progressively produce chips as the cutter rotates.

Types of milling machine:

There are two types of milling machines, the vertical and the horizontal milling machine. In the vertical milling machine, the spindle axis is vertically oriented. Milling cutters are held in the spindle and rotate on its axis. The horizontal milling machine spindle axis is horizontal. The knee and column type milling machine is a general type and purpose machine with a full range of speeds and feeds which are controlled either manually or automatically. There are three styles of knee-and-column milling machines:

- a) plain
- b) universal
- c) vertical

Spur gears:

Spur gear is a type of gear that consists of cylindrical teeth that are parallel to the axis of rotation. It is the most common form of gear used in various mechanical machines. This gear works by meshing with another gear. When two spur gears mesh, their teeth engage and transfer rotational motion.

Spur gears are widely used due to their simplicity and cost-effectiveness. Some commonly used materials for spur gears - cast Iron, Brass, Aluminum, Steel, Nylon etc.

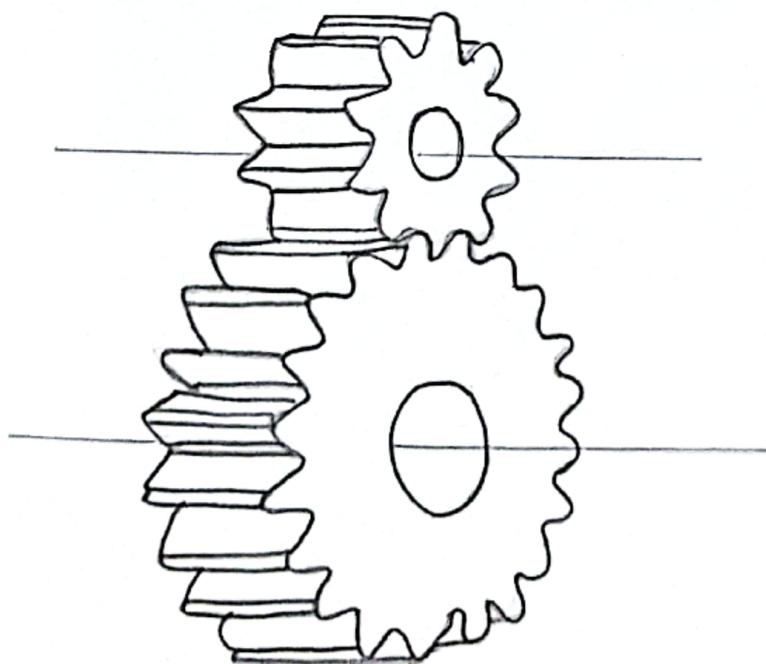


Figure: Spur Gears

Types of milling cutters:

Milling cutters are cutting tools typically used in milling machines or machining centres to perform milling operations. They are available in many types, forms, diameters and widths. Such as -

• Corner Rounding cutter:

It consists of a cylindrical body with a cutting edge on its perimeter that forms a specific radius. It creates rounded corners on various materials.

• Convex formed cutter:

It is a blade that has a convex shape along its cutting edge. It is designed to create smooth rounded cuts on contours on various materials.

• Gear Tooth cutter:

It is a specialized tool used in gear manufacturing process to cut teeth on a gear. It is designed with the specific tooth profile required for the gear being manufactured.

• Single Angle cutter:

It is designed to remove material from a workpiece by rotating the cutter while feeding it into the workpiece at specific angle. The cutting edge of a single angle cutter is ground at a specific angle to create the desired shape or feature.

• Double Angle cutter:

It is used in machine operations to produce grooves, slots or other features with a specific angle. It has a cylindrical body with two cutting edges at opposite ends.

• Concave Formed cutter:

It is designed with a cutting edge that follows the curvature of the desired shape, allowing precise and controlled cuts on materials. It comes in various forms depending on the application.



Figure: Corner Rounded Cutter



Figure: Convex Formed Cutter

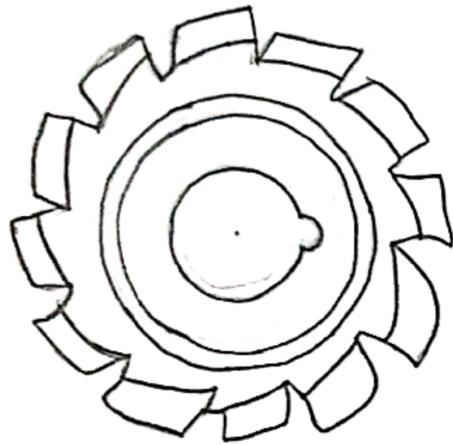


Figure: Gear Tooth Cutter



Figure: Single Angle cutter

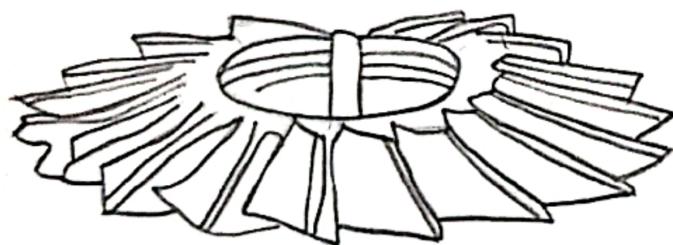


Figure: Double Angle Cutter



Figure: Concave Formed CUTTER

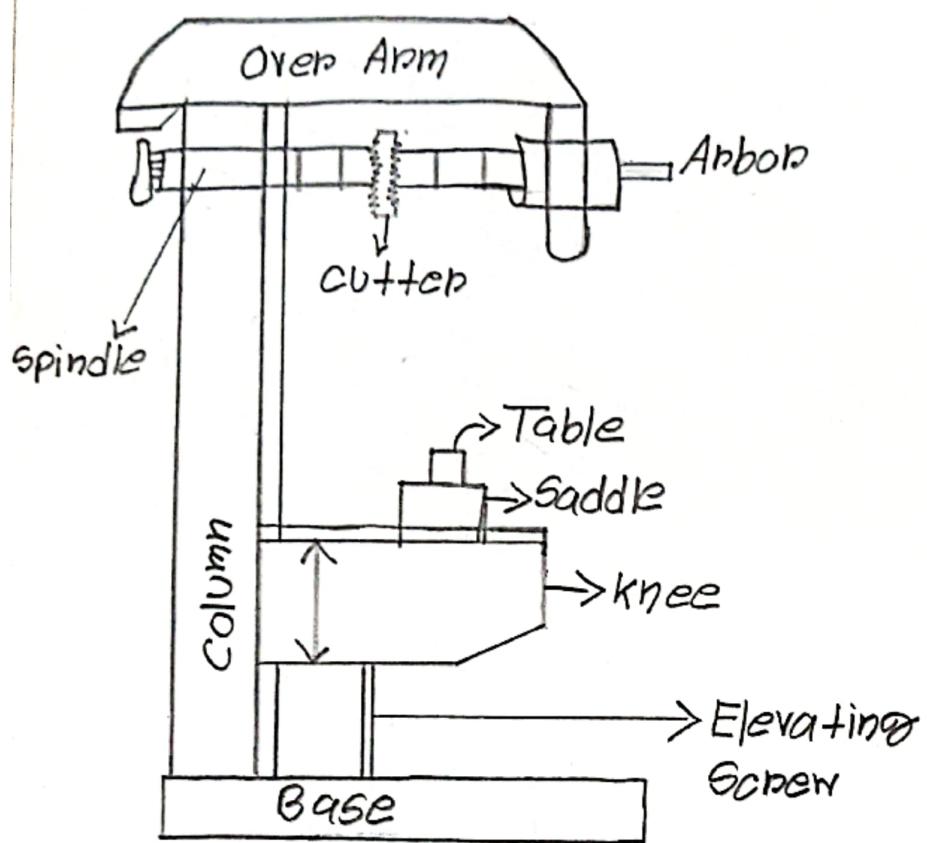


Figure: Milling machine

Parts of milling machine:

Milling machine consists of following major parts-

- | | |
|----------|--------------------|
| ① Base | ⑥ Over-arm |
| ② knee | ⑦ Spindle or Arbor |
| ③ column | ⑧ Arbor Support |
| ④ Saddle | ⑨ Ram |
| ⑤ Table | ⑩ Milling head |

① Base:

It is the segment upon which the whole machine sections are mounted. It is kind of foundation of the machine.

② knee:

It supports the milling head, which is connected to the sliding saddle. The saddle, in turn, rides on the knee. It is supported and adjusted by the elevating screw.

③ column:

The column rests on the base and also it has a coolant reservoir and a pump to provide coolant in machine operations.

④ Saddle:

The saddle supports the table. It is supported and guided by the accurately machined surfaces of the knee.

⑤ Table:

The table holds the workpiece. It rests on the dovetailed guides of the saddle. They are used to align the job on the fixture, which holds the job.

⑥ Over-arm:

The over-arm is mounted on the top of the column and is guided in perfect alignment by the machined dovetailed surfaces. It supports the arbor and is adjustable.

⑦ Spindle:

It is a shaft mounted on bearings supported by the column. It holds and drives the various cutting tools.

⑧ Arbor Support:

It supports and helps the arbor to function.

⑨ Ram:

The ram is a movable overhanging arm on a vertical milling machine. It is mounted on top of the column.

⑩ Milling head:

It holds and rotates the cutting tool of the milling machine on specific or even custom-built centers of machining.

Uses of Milling Machines:

Milling machines can be used for making:

① Flat surfaces

② External and internal threads

③ Drilling

④ Gear cutting

Milling Methods: There are two basic milling methods -

① Up milling: In up milling, the feed direction of the cutting tools is opposite to the rotation. The chip thickness starts at zero and increases towards the end of the cut.

② Down milling: In down milling, the cutting tool is fed with the direction of rotation. Here the chip thickness will decrease from the start of cut, gradually reaching zero at the end of cut.

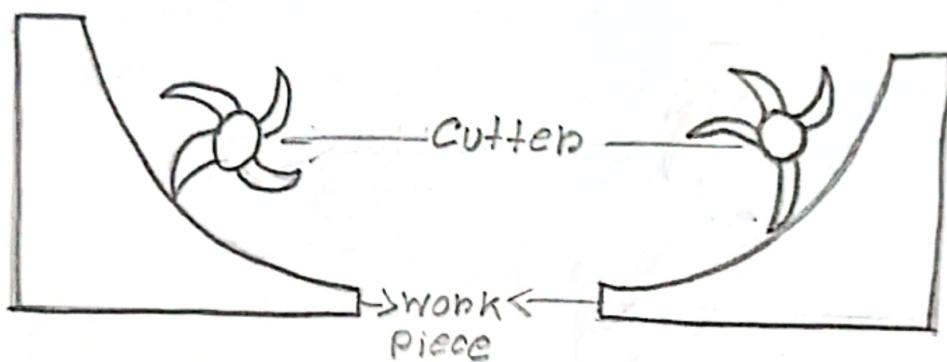


Figure: UP Milling

Figure: Down Milling

Milling machine operations:

① Plain Milling:

Plain milling is a process in which the plain, horizontal or flat surfaces are produced which are parallel to the axis of the rotation of the cutter. A peripheral milling cutter is used for performing the plain milling operation.

② Face milling:

Face milling is a machining process in which the milling cutting is placed by perpendicular to the workpiece.

③ End milling:

An end milling process consists of a cylindrical cutter that has multiple cutting edges on both its periphery and its tip, permitting end cutting and peripheral cutting.

④ Straddle milling:

The straddle milling is the operation of producing a flat vertical surface on both sides of a workpiece by using two side milling cutters mounted on the same arbor.

⑤ Slot milling:

It is a type of milling operation in which a rotating cutting tool is used to remove material from a workpiece by moving it in and out of a slot.

⑥ Side milling:

It is the operation of producing a flat vertical surface on the side of a workpiece by using a side milling cutter.

⑦ Angular milling:

It is a process to produce angular ends.

Indexing:

There are mainly five types of Indexing. Two of them are:

① Direct Indexing:

In this type of indexing, there is a plate of 24 holes which is placed vertically with the rotary table. By this method, we cannot make more than 24 equal teeth in gear. Here the formula is $\frac{24}{N}$, where N is the number of teeth.

② Simple Indexing:

In this indexing, where the crank plate takes a full turn than the spun gear turns only one teeth. When

crank plate will turns then the spur gear will take a turn. Here the formula is $\frac{10}{N}$.

Precaution:

- ① Safety gears should be worn.
- ② Tidy dress, apron must be worn and wrist watch and finger rings must be removed before starting the job.
- ③ The tools must be fastened properly before starting the machine.

Discussion:



Assignment:

① Both lathe and milling machine are common types of machining equipment used in manufacturing and metalworking process. A lathe uses a single-point cutting tool, which means it has only one cutting edge. On the other hand, milling machines use multi-point cutting tools, typically with multiple teeth, allowing for higher material removal rates. Lathes primarily rotate the workpiece while cutting and they are suitable for symmetrical shapes, while milling machines involve the movement of both the workpiece and cutting tool, allowing for more complex operation and versatile machining capabilities.

② In a horizontal milling machine the spindle is horizontally oriented. It typically has three main motions-

③ X-Axis motion: It allows the workpiece to move left and right relative to the milling cutter. This is controlled by the table feed handwheel.

④ Y-Axis motion: This is the vertical motion along the width of the table. It enables the workpiece to move up and down relative to the milling cutter.

⑤ Z-Axis motion: It is the vertical motion of the spindle. It controls the depth of cuts or the vertical position of a milling cutter.

⑥ There are two types of milling machine available.

① The vertical milling machine

② The horizontal milling machine

⑦ The principle parts of the plain knee and column milling machines are-

① Base

⑤ Knee

⑨ Arbor

② Column

⑥ Over-hanging arm

③ Table

⑦ Front base

④ Saddle

⑧ Spindle

⑩ There are five types of Indexing-

① Direct

③ Angular

⑤ Simple

② Compound

④ Differential

6) A milling machine attachment refers to a tool that is designed to be used with a milling machine.

Some common milling machine attachments include-

- ① Rotary Table
- ② Dividing Head
- ③ Boring Head
- ④ Slitting attachment
- ⑤ Grinding attachment
- ⑥ Digital Readout System

7) The rotary attachment is a device used in various machines, allowing the machine to engrave, cut or process cylindrical or irregularly shaped objects with precision. It enables the machines to work on three-dimensional objects.

8) Up milling: When the feed direction of the cutting tool is opposite to its rotation, it is called up milling.

Down milling: When the cutting tool is fed with the direction of rotation, then it is called down milling.

MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY



Course Code : Shop -162

Study of Milling Machine

Name : Rubaiya Naher
Roll No : 202318085
Level/Term : S-01, T-01
Course : Shop-162
Date of exp : 28/05/23
Date of sub : 4/6/23
Group : 02
Signature of Teacher :

Experiment No: 08

Name of the Experiment: Study of milling machine.

Objectives:

- (i) To introduce with different types of milling machine and milling cutter.
- (ii) To study and operate milling machine.

Theory:

The milling machine is the cutting operation that removes metal by feeding the work against a rotating, cutter having single or multiple cutting edges. Flat or curved surfaces of many shapes can be machined by milling with good finish and accuracy. A milling machine may also be used for drilling, slotting, making a circular profile and gear cutting by having suitable attachments. Milling machines are a very versatile machine tool. Milling machines are capable of machining one or two pieces as well as large volume production items. The milling machines

Can produce a variety of surfaces by using a circular cutter with multiple teeth that progressively produce chips as the cutter rotates.

Types of milling machines:

There are two major types of milling machines, the vertical milling machine and the horizontal milling machine. As their names imply, a vertical milling machine spindle is vertical and the horizontal milling machine spindle axis is horizontal. The knee and column type milling machine, five types of movement can be found. The longitudinal traverse hand wheel moves the worktable to the left and right, the cross traverse hand wheel moves the worktable in and out. The vertical column moves the knee, saddle up and down. The swivel plate gives the angular movement and spindle gives the rotary movement.

Types of milling cutters:

Milling cutters are cutting tools typically used in milling machines or machining centres to perform milling operations. They are available in many types, forms, diameters and widths. Such as -

• Corner Rounding Cutters:

It consists of a cylindrical body with a cutting edge on its Perimeter that forms a specific radius. It creates rounded corners on various materials.

• Convex formed Cutters:

It is a blade that has a convex shape along its cutting edge. It is designed to create smooth rounded cuts or contours on various materials.

• Gear Tooth cutters:

It is a specialized tool used in gear manufacturing process to cut teeth on a gear. It is designed with specific tooth

Profile required for the gear being manufactured.

• Single-Angle cutter:

It is designed to remove material from a workpiece by rotating the cutter while feeding it into the workpiece at specific angle. The cutting edge of a single angle cutter is ground at a specific angle to create the desired shape or feature.

Double-Angle cutter:

It is used in machine operations to produce grooves, slots or other features with a specific angle. It has a cylindrical body with two cutting edges at opposite ends.

Concave Formed cutter:

It is designed with a cutting edge that follows the curvature of the desired shape, allowing precise and controlled cuts on materials.

It comes in various forms depending on the application.

Types of milling cutters:

A milling cutter is a multiple point cutting tool that is used on a milling machine. There are many available in many types forms, diameters and widths.

Parts of milling machine:

Milling machine consists of following major parts:

- ① Base
- ② Knee
- ③ Column
- ④ Saddle
- ⑤ Table
- ⑥ Over-arm
- ⑦ Spindle or Arbor
- ⑧ Arbor support
- ⑨ Ram
- ⑩ Milling head

① Base:

This milling machine part is the foundation of a milling machine that carries the weight of the machine and moves it to the ground. It is the segment upon which the whole machine sections are mounted. It is end of foundation of the machine.

② Knee: The knee is a cast iron that supports the saddle and table as its enclosed all gear mechanism. It is attached to the column in a dovetail way. The knee is design to be adjust by a vertical positioning screw.

③ Column: The column is vertically mounted on the base as its supports the knee, table, etc. It also works as housing for all the other driving members. This column is a hollow member that contains driving gears and sometimes motor for the spindle and the spindle and the table.

④ Saddle: This machine part is located between the table and the knee as its serve as an intermediate part between them. This move transversely to the face of column which is to provide motion in horizontal direction to the workpiece. It is also made of cast iron.

Table:

The Table is situated over the knee in order to hold the workpiece during the process. It is made of cast iron and has slot Cut on it. This provides vertical motion by moving the knee up and down and provides horizontal motion by the Feed screw provided by the saddle.

⑥) Over-arms: The milling machine component is used to fastened arbor support. It may consist of one or two cylindrical bars that slide through the holes in the bars. It is also made with cast iron.

⑦) Spindle: The spindle is the part of the machine which holds the tool in place, this spindle offers tooling motion and drive for arbors, cutters and attachment used on the machine.

⑧) Arbor supports: The arbor serves as an extension part of the spindle in a horizontal mill machine. It is fitted to the spindle

whenever it's needed. The arbor holds the tool and moves it in the current direction. This arbor support is used only in the horizontal types of milling machines and it's clamped anywhere on the overarm.

⑨ Ram: The milling machine part can move transversely on the column by a hand lever. One end of the arm is attached to the column and the other ends on the milling head.

⑩ Milling head: The milling head is the upper part of a vertical mill machine. It consists of spindle, driving and other controlling mechanisms.

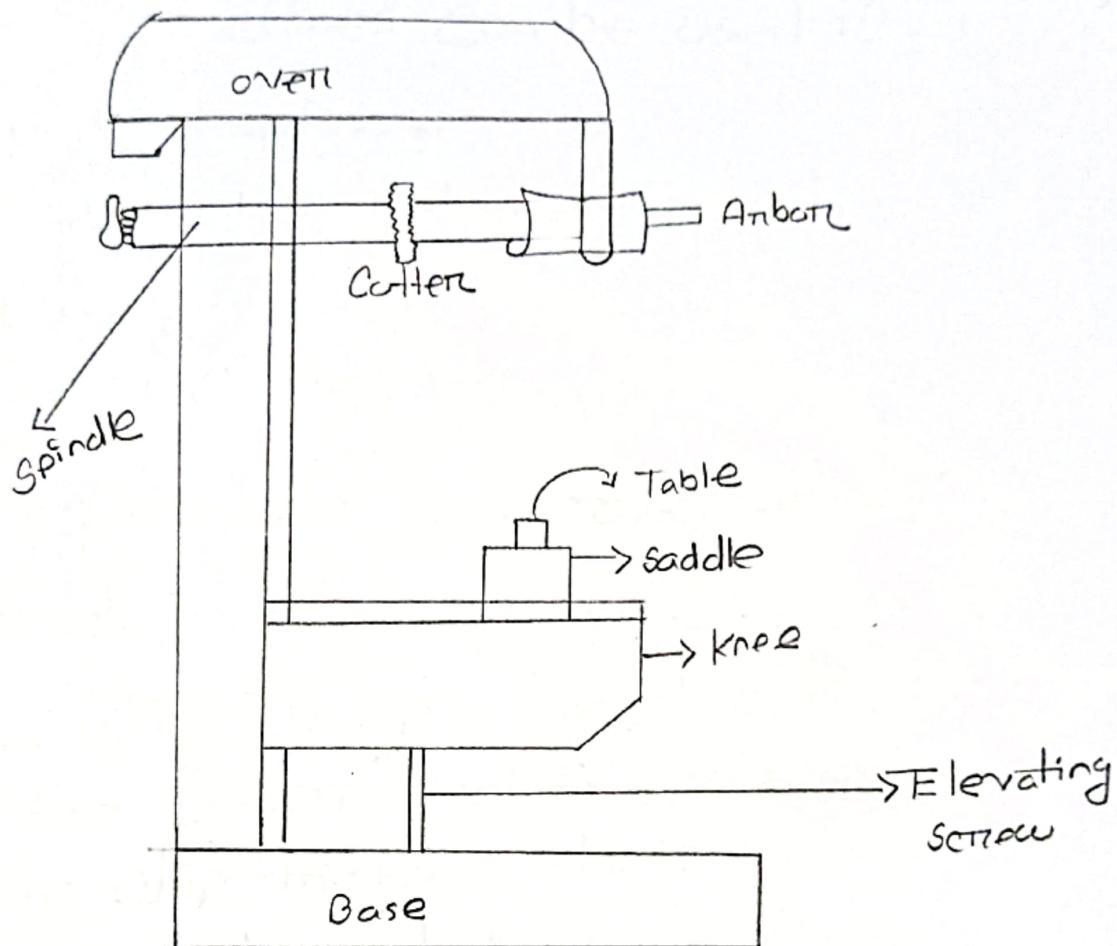


Figure-01 Milling machine

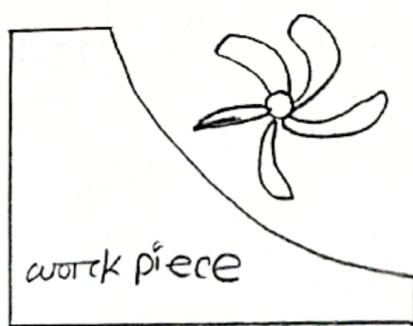
Uses of Milling Machine:

Milling machines can be used for making:

- ① Flat surfaces
- ② External and internal threads
- ③ Drilling
- ④ Gear cutting.

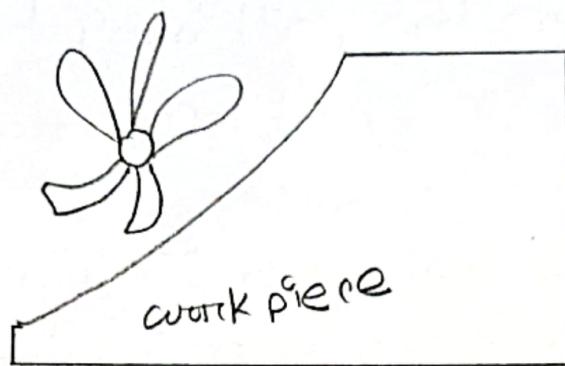
Milling methods: There are two basic milling methods.

1. Up milling: In up milling, the feed direction of the cutter is opposite to its rotation. The chip thickness starts at zero and increases toward the end of the cut.



- ② Down milling: In down milling, the cutting tool is fed with the direction of rotation. Here the chip thickness decreases.

from the start of cut, gradually reaching zero at the end of cut.



Milling and machine operations

① Plain milling: Plane milling is performed to produce a plane, flat, horizontal surface parallel to the axis of rotation of a plain milling cutter. The operation is also known as slab milling.

② Face milling: Face mills are primarily used for milling a face on the surface of a plate or bar. They are predominantly used to cut with the ends of the cutter rather than their sides.

③ End milling: An end milling process consists of a cylindrical cutter that has multiple cutting edges on both its periphery and its tip, permitting end cutting and peripheral cutting.

④ Straddle milling: When two or more parallel vertical surfaces are machined at a single cut, the operation is called straddle milling.

⑤ Slot milling: Slot milling is a type of milling operation in which a rotating cutting tool is used to remove material from a workpiece by moving it in and out of a slot. Slots or grooves can be short or long, closed or open, straight or non-straight, deep or shallow, wide or narrow.

⑥ Side milling: It is the operation of producing a flat vertical on the side of a workplace by using a side milling cutter.

⑦ Angular milling: It is a process to produce angular cuts.

Indexing:

There are mainly five types of indexing. Two of them are:

① Direct Indexing: In this type of indexing, there is a plate of 24 holes which is placed vertically with the rotary table. By this method, we can make more than 24 equal teeth in gear. Clear the formula is $\frac{24}{N}$, where N is the number of teeth.

② Simple Indexing: Simple indexing on a milling machine is passed out through the use also a plain indexing head or universal dividing head. This process of indexing involves the use of a worm, crank, index head, and worm wheel. The worm wheel usually carries 40 teeth, with the worm is single-threaded.

Precautions

1. loose clothing, rings, watches should not be worn.
2. Mount, measure or adjust work should not be attempted until cutter is completely stopped.
3. Lean and next hand should not be attempted on avoiding table.

Discussions

c study

1. ~~1~~ ~~2~~ ~~3~~ ~~4~~ ~~5~~ ~~6~~ ~~7~~ ~~8~~ ~~9~~ ~~10~~ ~~11~~ ~~12~~ ~~13~~ ~~14~~ ~~15~~ ~~16~~ ~~17~~ ~~18~~ ~~19~~ ~~20~~ ~~21~~ ~~22~~ ~~23~~ ~~24~~ ~~25~~ ~~26~~ ~~27~~ ~~28~~ ~~29~~ ~~30~~ ~~31~~ ~~32~~ ~~33~~ ~~34~~ ~~35~~ ~~36~~ ~~37~~ ~~38~~ ~~39~~ ~~40~~ ~~41~~ ~~42~~ ~~43~~ ~~44~~ ~~45~~ ~~46~~ ~~47~~ ~~48~~ ~~49~~ ~~50~~ ~~51~~ ~~52~~ ~~53~~ ~~54~~ ~~55~~ ~~56~~ ~~57~~ ~~58~~ ~~59~~ ~~60~~ ~~61~~ ~~62~~ ~~63~~ ~~64~~ ~~65~~ ~~66~~ ~~67~~ ~~68~~ ~~69~~ ~~70~~ ~~71~~ ~~72~~ ~~73~~ ~~74~~ ~~75~~ ~~76~~ ~~77~~ ~~78~~ ~~79~~ ~~80~~ ~~81~~ ~~82~~ ~~83~~ ~~84~~ ~~85~~ ~~86~~ ~~87~~ ~~88~~ ~~89~~ ~~90~~ ~~91~~ ~~92~~ ~~93~~ ~~94~~ ~~95~~ ~~96~~ ~~97~~ ~~98~~ ~~99~~ ~~100~~

Assignment:

1. Both lathes and milling machines are used to remove material from a workpiece.
2. The machine operates through two types of motion: main motion and Feed auxiliary motion.
3. Milling machines come in various types with a variety of functions based on certain standard specifications.
4. The 8 most important parts of a milling machine.
 - Column and Base
 - Knee
 - Power Feed mechanism.
 - Work Table
 - Ram
 - Overhanging Arm
 - Spindle
 - Arbor Support

5. Two many types of indexing methods

are 1) Primary Indexing 2) Secondary Indexing.

6. A milling head attachment is a special or standard auxiliary device meant to be joined with or fastened to one or several milling machine components.

7. The rotary attachment is a device that plugs into the laser cutter and allows you to engrave or rounded objects.

8. Up milling is a traditional type of process. Down milling is used nowadays for better surface finish.