

BABARIA INSTITUTE OF TECHNOLOGY



DESIGNED BY:
HUSAIN Y MALEK.
E. NO:140050119038
ROLL NO:14ME38

GROUP MEMBERS

- Sagar Makvana (140050119035)
- Shyam Makwana (140050119036)
- Yash Makwana (140050119037)
- Husain Malek (140050119038)
- Jasvant Maliwad(140050119039)



TOPIC

Milling Machine



CONTENT:

- Introduction of milling machine
- Principle of milling machine
- Types of milling machine
- Milling machine operation



Milling




Milling machine

Milling: is a metal cutting operation in which the excess material from the work piece is removed by rotating multipoint cutting tool called milling cutter.

A **milling machine** is a machine tool that removes metal as the work is fed against a rotating multipoint cutter. The milling cutter rotates at high speed and it removes metal at a very fast rate with the help of multiple cutting edges.

One or more number of cutters can be mounted simultaneously on the milling machine. This is the reason that a milling machine finds wide application in production work.

Used for machining flat surfaces, contoured surfaces, external and internal threads.

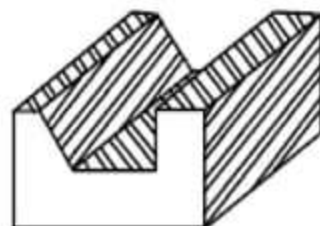
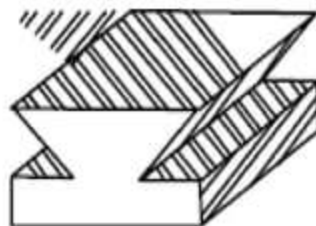
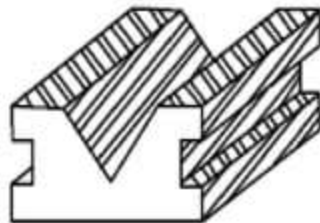
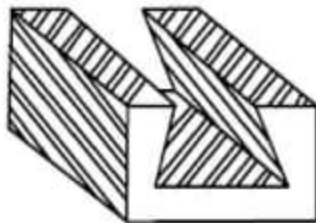
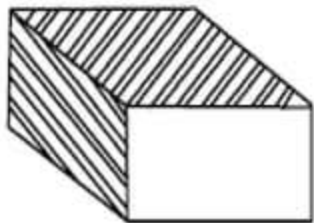


Milling machine

- As the workpiece moves against the cutting edges of milling cutter, metal is removed in form chips
- Machined surface is formed in one or more passes of the work.
- The work to be machined is held in a vice, a rotary table, a three jaw chuck, an index head, in a special fixture or bolted to machine table.
- In many applications, due to its higher production rate and accuracy, milling machine has even replaced shapers and slotters.



Milling machine applications




MILLING METHODS

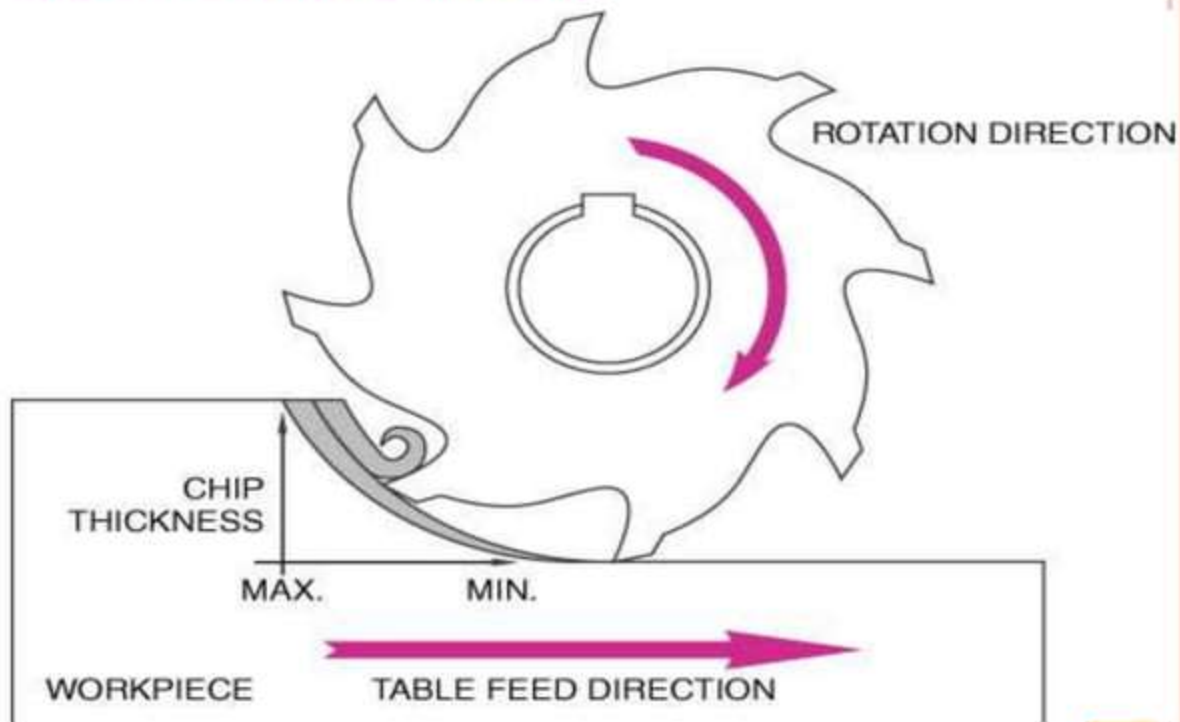
Two basic methods of milling

- 1.Up-milling or conventional milling
- 2.Down-milling or climb milling

1.Up-milling or conventional milling

- Metal is removed by cutter rotating against the direction of travel of the workpiece.
 - Needs stronger holding of the job.
 - Chip thickness is minimum at the start of cut and maximum at the end of the cut.
 - Disadvantage- tendency to lift work from the fixtures and poor surface finish.
- 

1.CONVENTIONAL MILLING



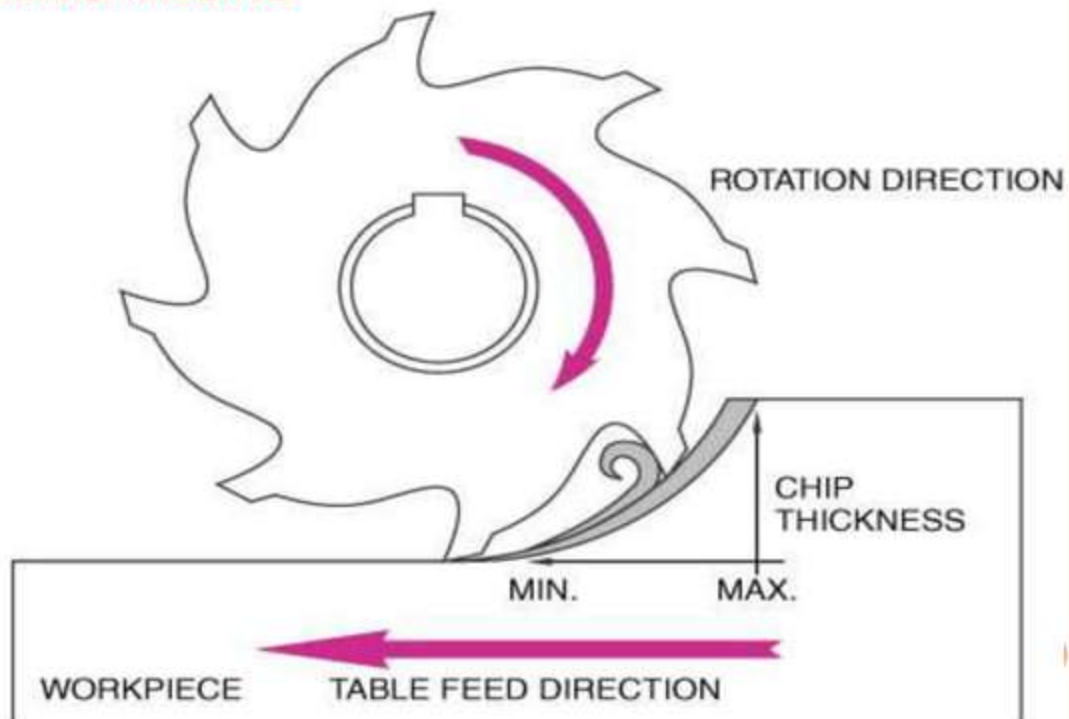
MILLING METHODS

2.down-milling or climb milling

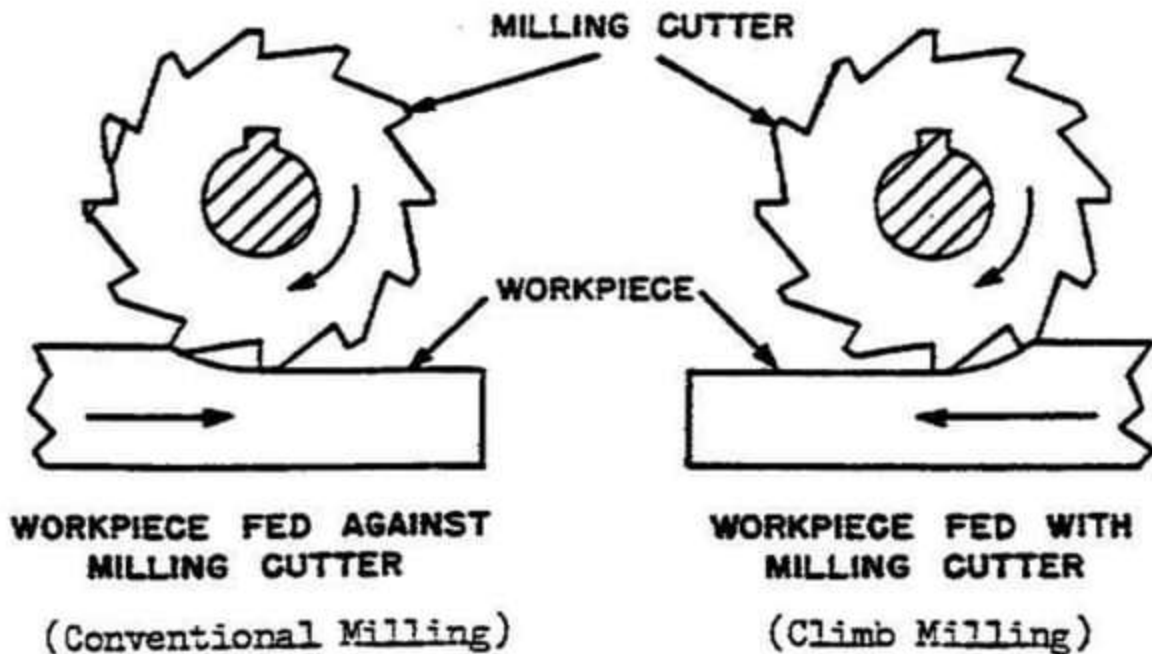
- Metal is removed by cutter rotating in the same direction of travel of the workpiece.
- teeth cut downward instead of upwards.
- Chip thickness is maximum at the start of cut and minimum at the end of cut.
- Less friction involved
- Better surface finish.
- Less power consumption.



2. CLIMB MILLING



PRINCIPLE OF MILLING



TYPES OF MILLING MACHINE

- The milling machine may be classified in several forms, but the choice of any particular machine is determined primarily by the size of the workpiece.
- According to general design, the distinctive types of milling machines are:
 1. Column and knee type milling machines
 2. Planer milling machine
 3. Fixed-bed type milling machine
 4. Special types of milling machines



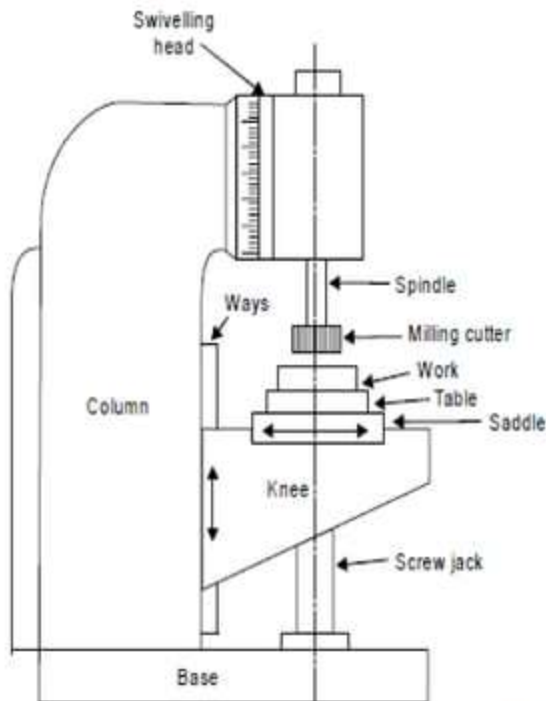
PRINCIPLE PARTS

- Base
- Column
- Knee
- Saddle
- Table
- Spindle



COLUMN AND KNEE TYPE

- It is the most commonly used milling machine used for general shop work.
- The table is mounted on the knee which in turn is mounted on the vertical slides of the main column.
- The knee is vertically adjustable on the column so that the table can be moved up and down to accommodate work of various heights.



CLASSIFIATION OF COLUMN & KNEE TYPE MILLING MACHINE

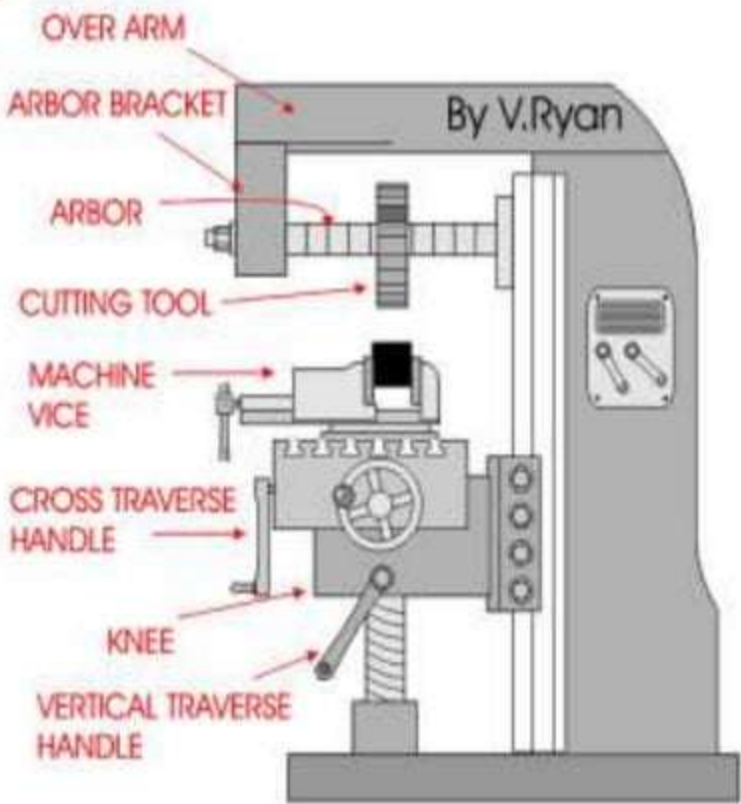
- (a) Hand milling m/c.
- (b) Horizontal milling m/c.
- (c) Universal milling m/c.
- (d) Vertical milling m/c.



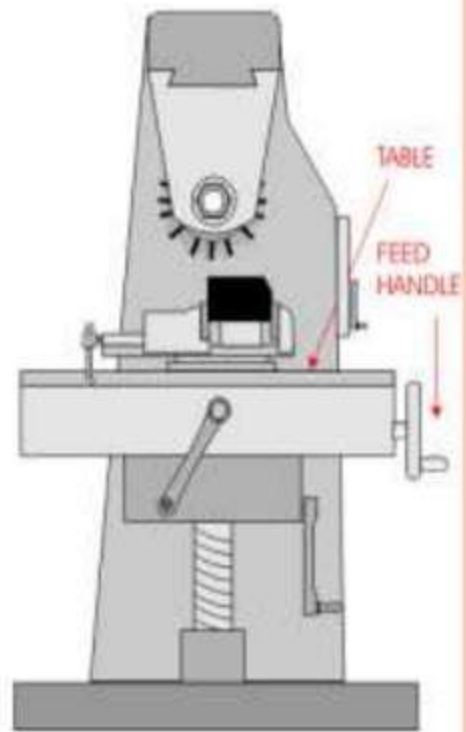
(a) Horizontal Milling machine

- The horizontal milling machine has a spindle that is parallel to the shop floor and an overarm that extends over the workpiece.
- The overarm supports the arbor, which holds the milling cutter.
- On the horizontal mill, the arbor is the component that rotates the milling cutter.





FRONT VIEW



SIDE VIEW

ACTUAL HORIZONTAL MILLING MACHINE



ARBORS

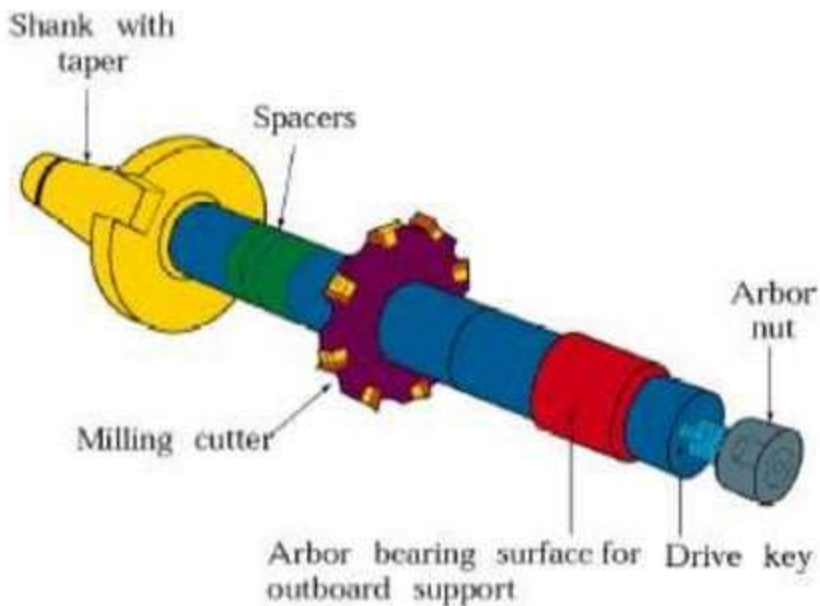


Fig : Mounting a milling cutter on an arbor for use on a horizontal milling machine.

(B) VERTICAL MILLING MACHINE

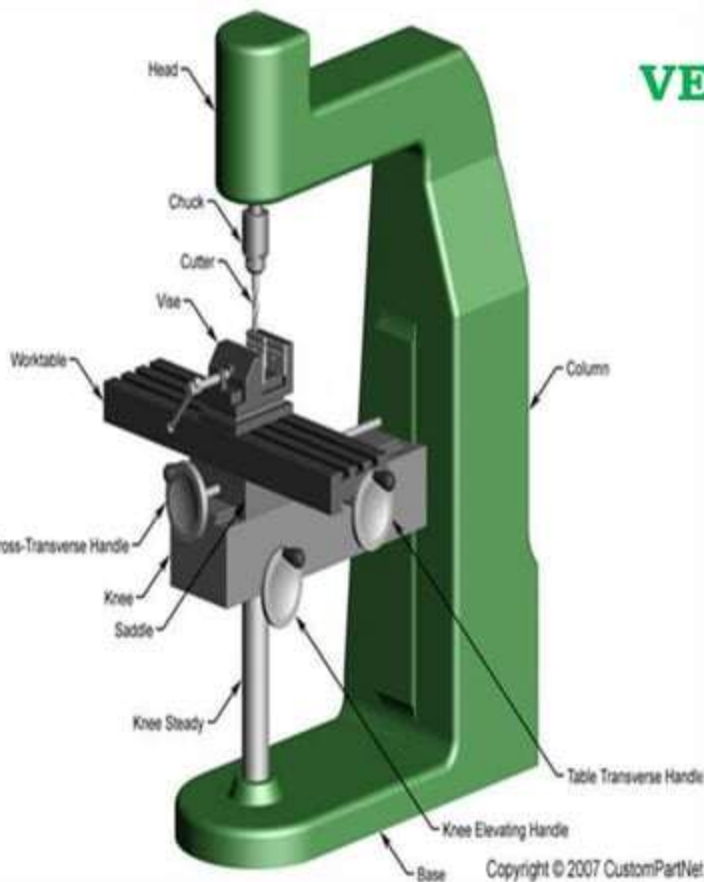
- Spindle is vertical or perpendicular to the work table.
- It has all the movements of the table for proper setting and feeding the work.
- Spindle head may be swiveled at an angle, permitting the milling cutter mounted on the spindle to work on angular surfaces.
- In some machines, spindle can also be adjusted up or down relative to the work.
- Adopted for machining grooves, slots and flat surfaces.



VERTICAL MILLING MACHINE

MAJOR PARTS :

1. BASE
2. COLUMN
3. SPINDLE
4. SPINDLE HEAD
5. KNEE
6. SADDLE
7. WORKTABLE



DIFFERENCES BETWEEN HORIZONTAL & VERTICAL MILLING MACHINES

SL. NO.	HORIZONTAL MILLING MACHINE	VERTICAL MILLING MACHINE
01	Spindle is horizontal & parallel to the worktable.	Spindle is vertical & perpendicular to the worktable.
02	Cutter cannot be moved up & down.	Cutter can be moved up & down.
03	Cutter is mounted on the arbor.	Cutter is directly mounted on the spindle.
04	Spindle cannot be tilted.	Spindle can be tilted for angular cutting.
05	Operations such as plain milling, gear cutting, form milling, straddle milling, gang milling etc., can be performed.	Operations such as slot milling, T-slot milling, angular milling, flat milling etc., can be performed and also drilling, boring and reaming can be carried out.


(C) UNIVERSAL MILLING MACHINE

Difference from plain horizontal machine is addition of table swivel housing Permits table to be swiveled 45° in either direction in a horizontal plane

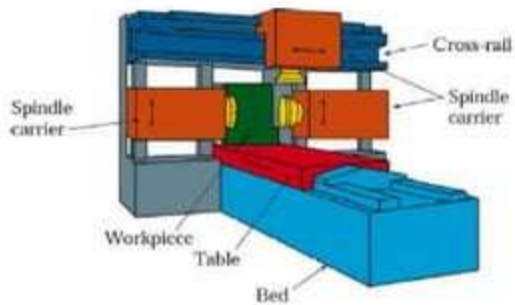
Used for milling of helical grooves in twist drills, milling cutters, and gears



2. Fixed-bed type milling machine

- Comparatively large, heavy and rigid and differ from column and knee type milling machines.
 - Table is directly mounted on fixed bed.
 - No provision is provided for cross or vertical adjustment of the table.
 - The cutter mounted on the spindle head may be moved vertically on the column and the spindle may be adjusted horizontally to provide cross adjustment.
 - Three types
 1. Simplex
 2. duplex
 3. triplex
- 

FIXED BED MILLING MACHINE



3. PLANER MILLING MACHINE

- Looks like double column planer machine.
- Milling heads mounted in various planes, vertical heads on the cross-rail and horizontal heads at the sides (on column)
- This arrangement enables it to machine a workpiece on several sides simultaneously
- Used for producing long straight surfaces on large and heavy machine parts.




5. SPECIAL-TYPE MACHINES

Designed for individual milling operations

Used for only one particular type of job

Completely automatic Employed when hundreds or thousands of similar pieces are to be machined

➤ Tracer mills (Profiling milling machines):

- Also called duplicators
 - Designed to reproduce an irregular part geometry that can be created on an template
 - In two dimensions- *tracer*
 - In three dimensions- *duplicator*
- 

SPECIAL-TYPE MACHINES

- **CNC milling machines:**
- - Cutter path controlled by numerical data
- - Suited to profile, pocket, surface contouring.



MILLING OPERATIONS

- ❖ Plain or slab milling
- ❖ Face milling
- ❖ End milling
- ❖ Side milling
- ❖ Slot milling
- ❖ Angular milling
- ❖ Form milling
- ❖ Straddle milling

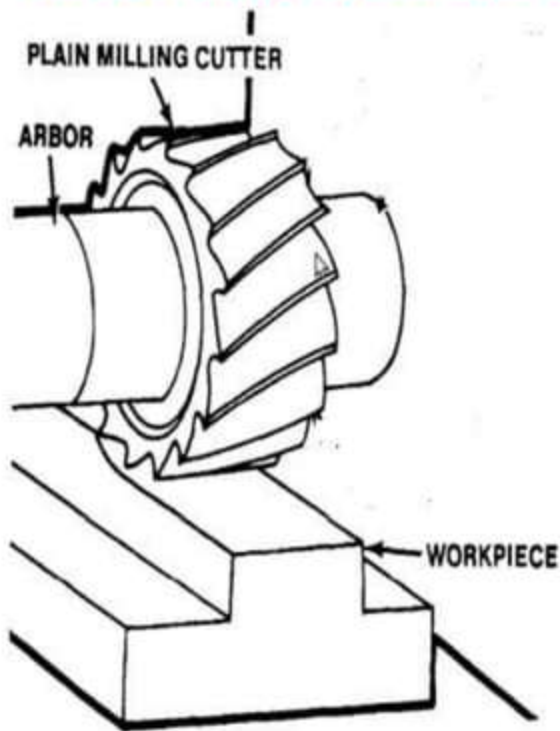


MILLING OPERATIONS

- ❖ Slitting or saw milling
- ❖ Gear cutting
- ❖ Key way milling
- ❖ String milling
- ❖ Profile milling
- ❖ Thread milling
- ❖ Helical milling
- ❖ Cam milling



PLAIN/SURFACE/ SLAB MILLING



Plain Milling:

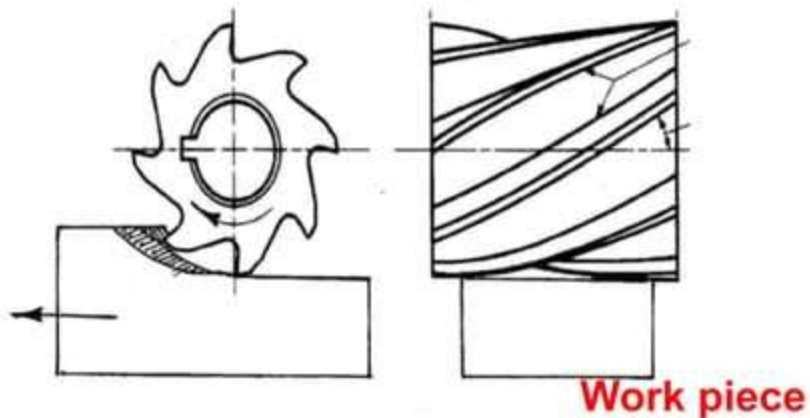
Process to get the flat surface on the work piece in which the cutter axis and work piece axis are parallel. The primary motion is the rotation of the cutter. The feed is imparted to the work piece.

Cutter: Plain milling cutter.

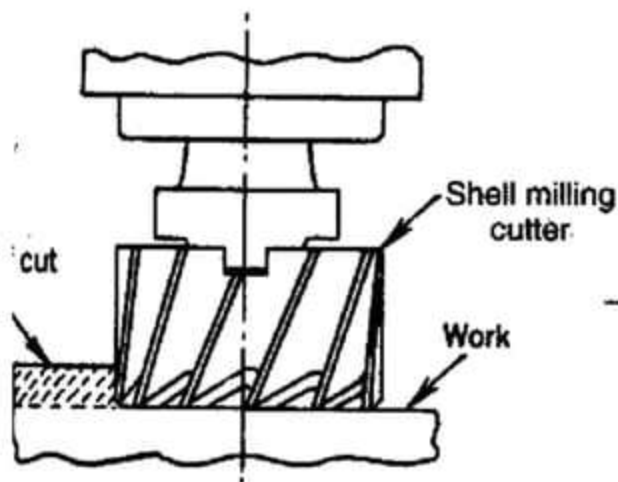
Machine: Horizontal Milling m/c.

PLAIN/SURFACE/ SLAB MILLING

Plain mill
cutter



FACE MILLING



Face Milling:

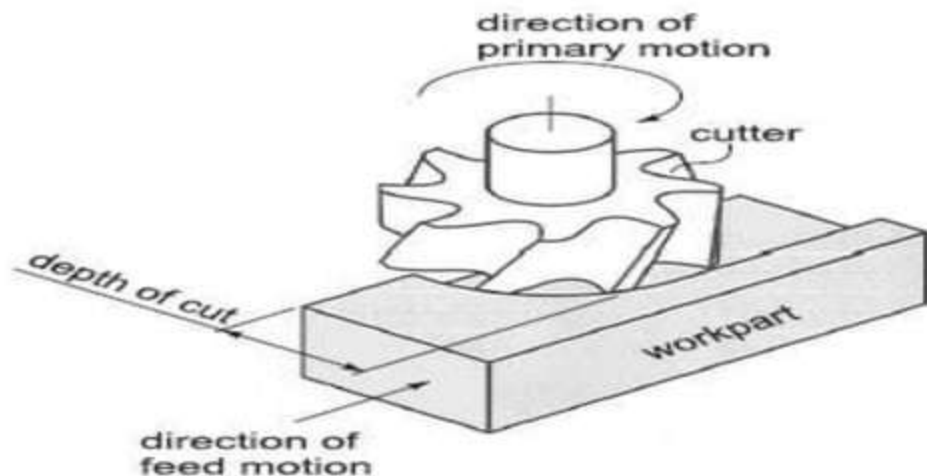
Operation carried out for producing a flat surface, which is perpendicular to the axis of rotating cutter.

Cutter: Face milling cutter.

Machine: Vertical Milling Machine

FACE MILLING

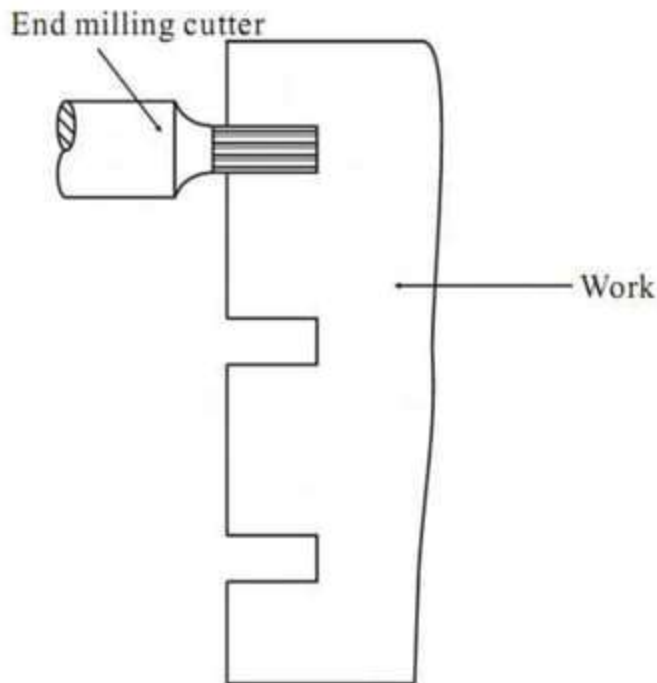
MANUFACTURING TECHNOLOGY



Partial face milling operation. The face-milling cutter machines only one side of the workpiece.



END MILLING



End Milling:

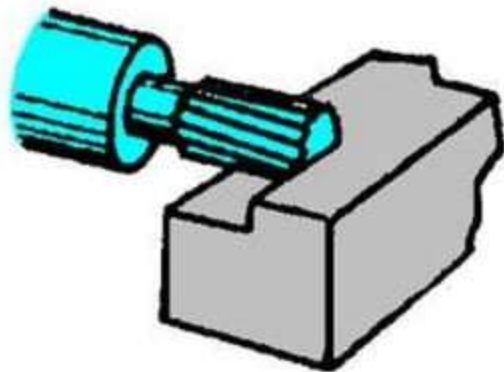
Operation performed for producing flat surfaces, key slots, grooves or finishing the edges of the work piece.

Cutter: End milling cutter.

Machine: Vertical Milling Machine



SIDE MILLING



SIDE MILLING : Operation performed for producing flat surfaces, slots, grooves or finishing the edges of the work piece.

Cutter: End milling cutter.

Machine: Horizontal Milling Machine



SLOT MILLING

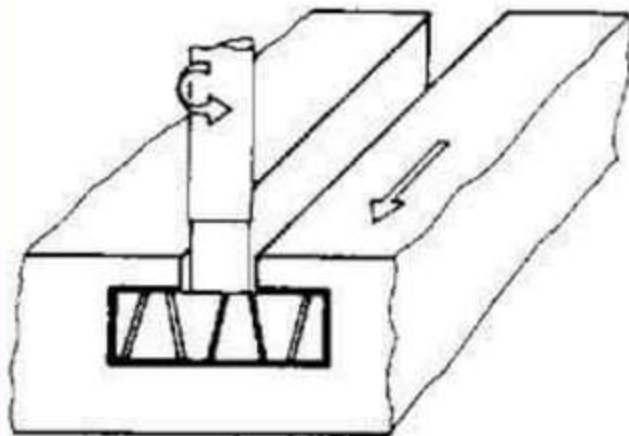


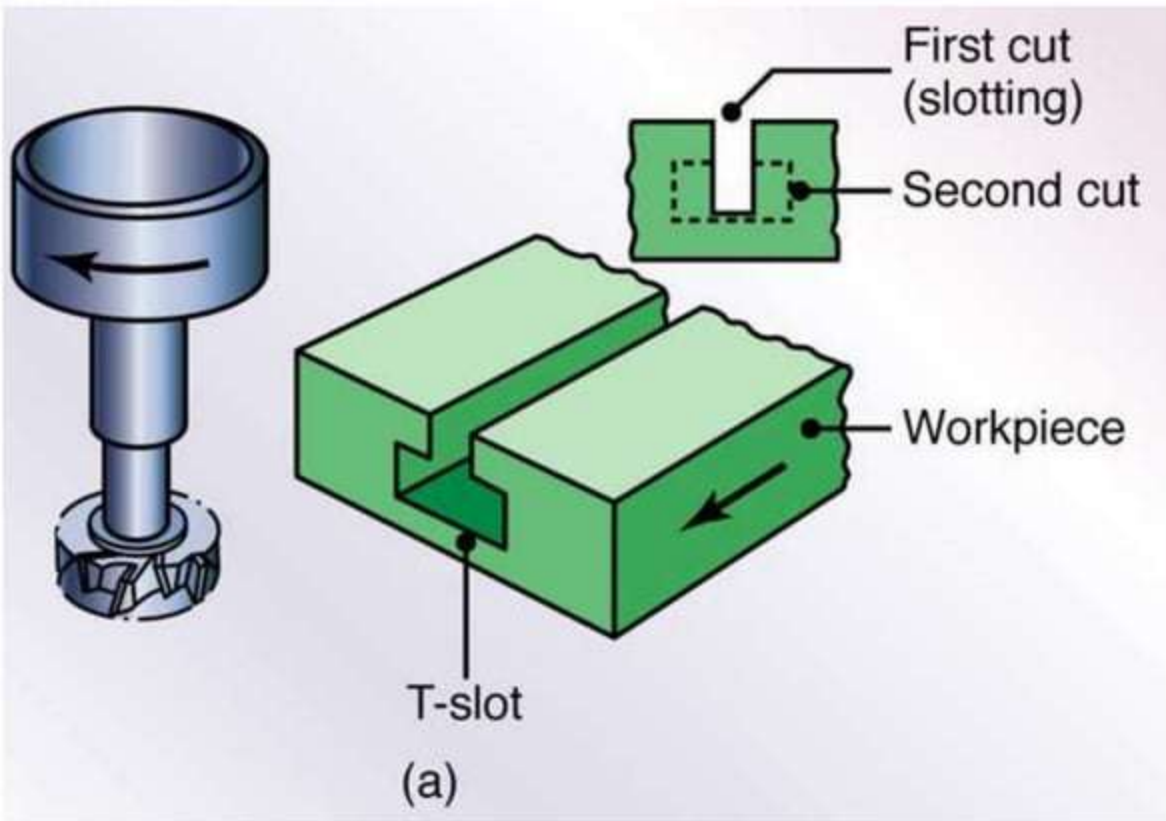
FIG. T-SLOT MILLING

Slot Milling:

Operation of producing slots like T-slots, plain slots etc.,

Cutter: End milling cutter, T-slot cutter, side milling cutter

Machine: Vertical Milling Machine



ANGULAR MILLING

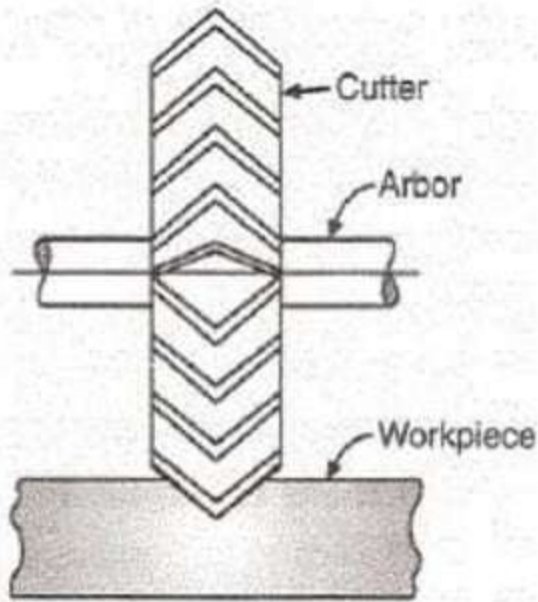


FIG. ANGULAR MILLING

Angular Milling:

Operation of producing all types of angular cuts like V-notches and grooves, serrations and angular surfaces.

Cutter: Double angle cutter.

Machine: Horizontal Milling Machine

FORM MILLING

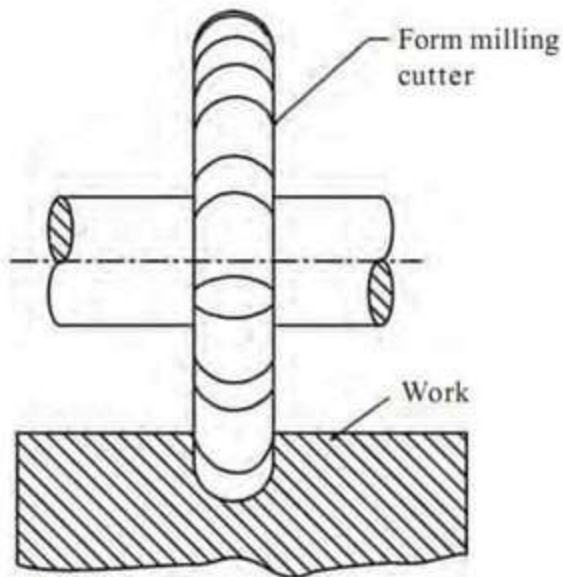


FIG. FORM MILLING

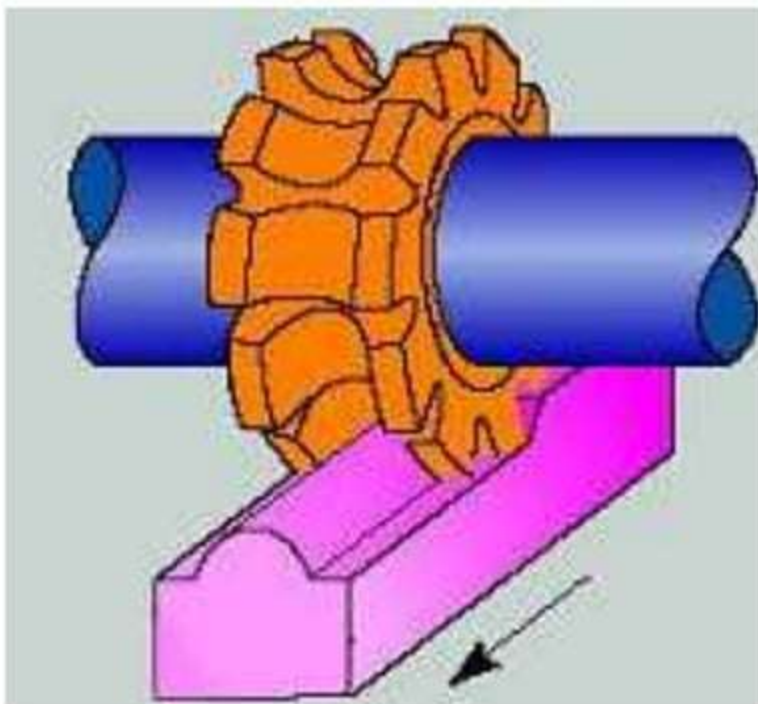
Form Milling:

Operation of producing all types of angular cuts like V-notches and grooves, serrations and angular surfaces.

Cutter: Double angle cutter.

Machine: Horizontal Milling Machine

FORM MILLING



STRADDLE MILLING

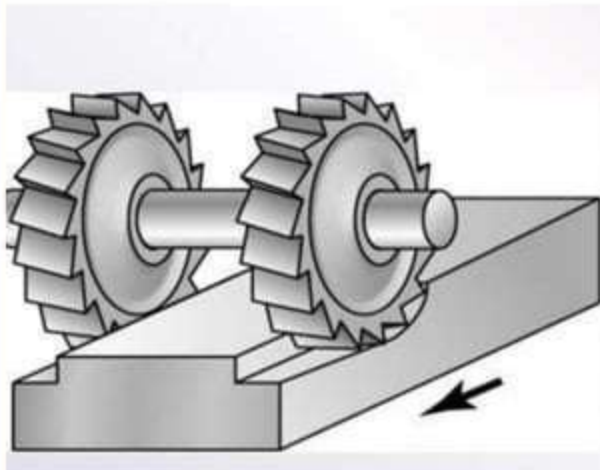


FIG. STRADDLE MILLING

Straddle Milling:

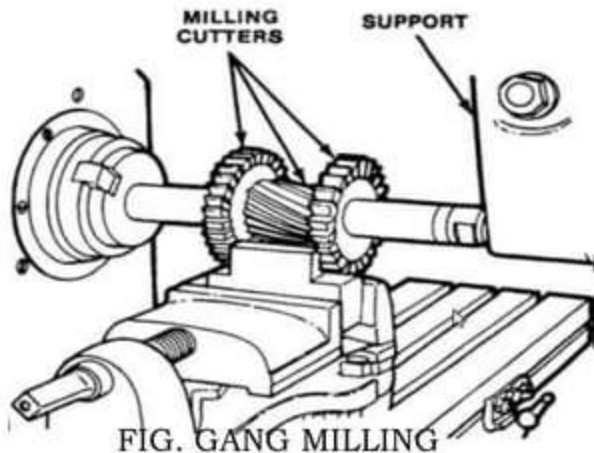
Operation of machining two parallel surfaces simultaneously on a work piece.

Cutter: 2 or more side & face milling cutters

Machine: Horizontal Milling Machine



GANG MILLING



Gang Milling:

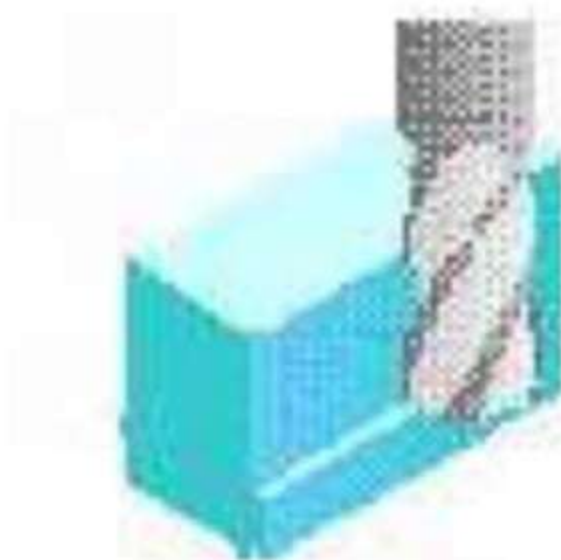
Process to get different profiles on the work piece simultaneously with two or more cutters at one stretch.

Cutter: Different cutters as required.

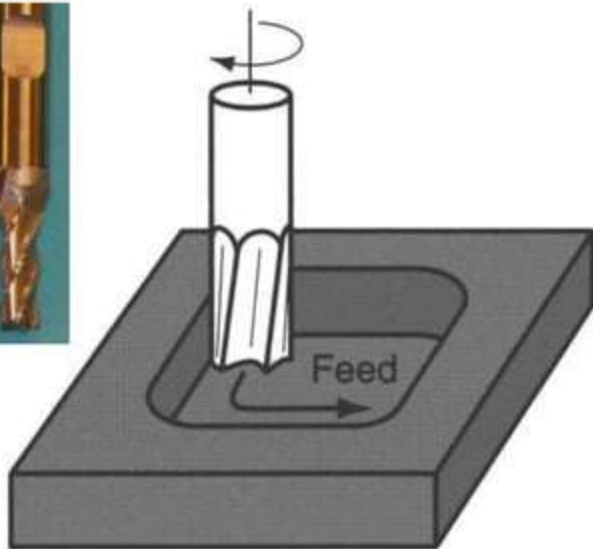
Machine: Horizontal Milling Machine

Profile milling

- Outside periphery of flat part is cut.
- Conventional end mill is used to cut the outside or inside periphery of a flat part.



Pocket Milling

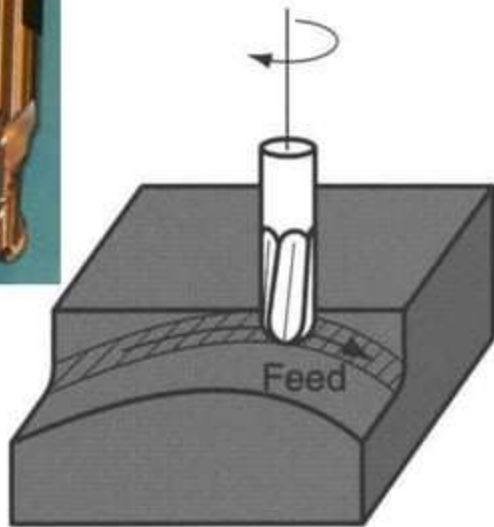


(e)

Another form
of end milling
used to mill
shallow
pockets into
flat parts



SURFACE CONTOURING



(f)

Ball - nose cutter is fed back and forth across the work along a curvilinear path at close intervals to create a three dimensional surface.



THANK YOU

