Manufacturing Machining
Module-3 Notes
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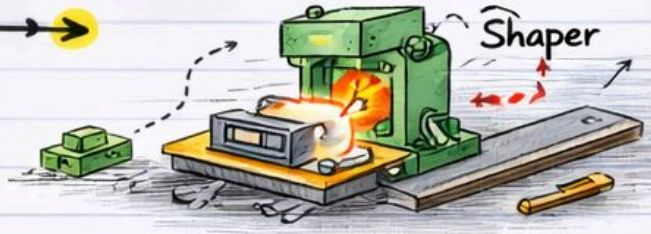
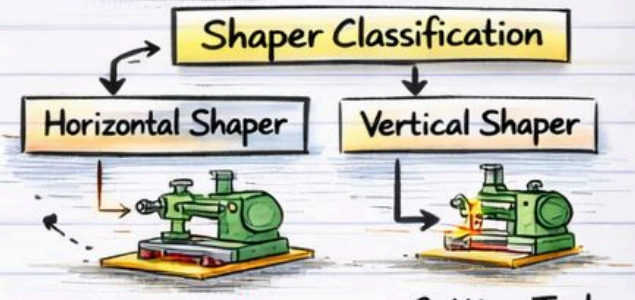
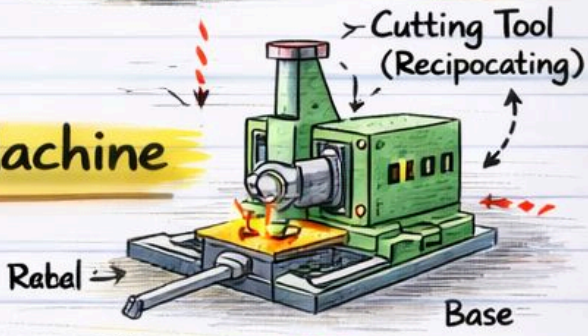
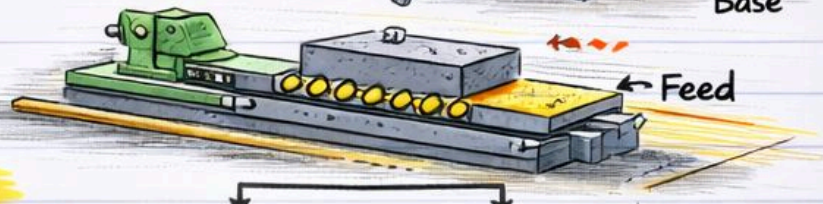
Contents Covered:

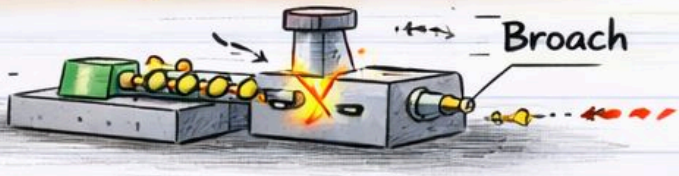
- Shaper
- Shaper Classification
- Working Principle of Slotting Machine.
- Main Parts of Slotting Machine
- Planer
- Planer Types
- Broaching and it's Methods
- Broaching Machines

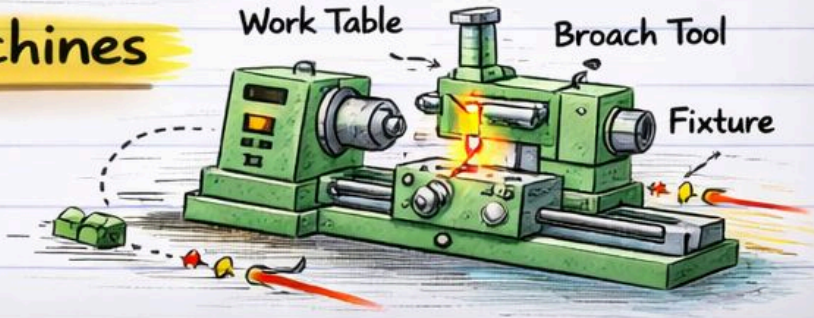








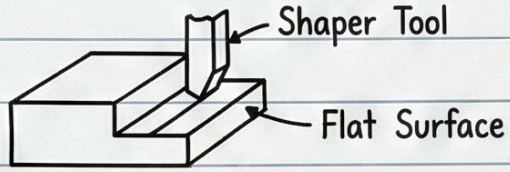




Shaper

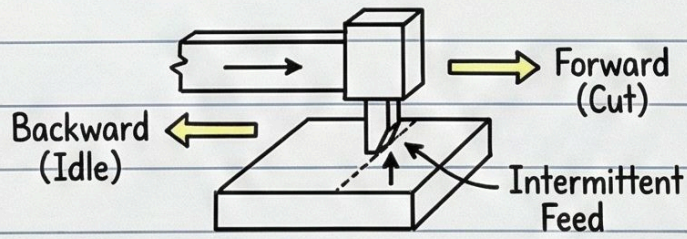
1. What is a Shaper?

- A machining process for producing flat surfaces and slots.
- Uses a horizontally reciprocating single point tool.
- The machine is called a shaper.
- It is versatile: can produce horizontal, vertical, inclined, and combined surfaces.
- Used for small flat surfaces, keyways in hubs (gears, wheels, pulleys), or splines in shafts.



2. Principles of a Shaper:

- A single-point tool is held in the tool post of a reciprocating ram.
- Forward stroke: The cutting stroke with low speed.
- Backward stroke: The idle stroke, has quicker speed.
- The length of stroke can be adjusted.
- Feed is applied to the workpiece in increments at the end of the return stroke.



3. Types of Operations (as shown in Fig. 4.25):

- Horizontal surface
- Vertical surface
- Inclined surface

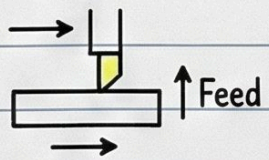


Fig. 4.25(a)

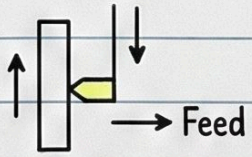


Fig. 4.25(b)

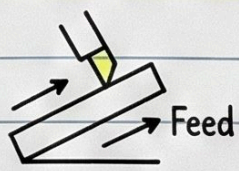


Fig. 4.25(c)

Shaper Classification: Mechanism for Reciprocating Motion of Ram

1. Mechanism for Reciprocating Motion of Ram

(a) Crank shaper:

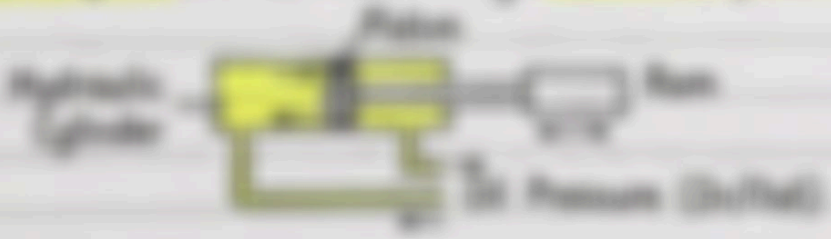
- Electric motor drives a large 'bull gear' and its circular motion is converted into reciprocating motion of the ram by a crank mechanism.
- The single-point tool is mounted on the ram and workpiece is clamped in position on an adjustable table.
- This is most common type of shaper.

(b) General shaper:

- The electric motor drives a train of gears. The pinion driven by gear train drives a rack directly below the ram.
- The ram has reciprocating motion due to rack and pinion operation.

(c) Hydraulic shaper:

- The ram is connected at the end of piston of a hydraulic cylinder which is moved to and fro by oil pressure.
- The ram speed is controlled by amount of oil pumped.



Advantages of Hydraulic Shaper:

(i) The cutting speed and force of ram drive remain constant throughout.
(ii) There is great flexibility of speed and feed control.
(iii) There is no shock.
(iv) There is slowing down of motion when cutting tool is overloaded. There is prevention of tool breakage.
(v) The machine operates smoothly without noise.

Shaper Classification: Position and Travel of Ram

2. Position and Travel of Ram

(a) Horizontal shaping machine:
- The ram with cutting tool reciprocals in a horizontal plane.
- These shapers are used to produce flat surfaces.

(b) Vertical shaping machine:
- The ram holding the cutting tool reciprocals in a vertical plane.
- These may be crank driven, rack driven, screw driven or hydraulically driven.
- The work table has cross, longitudinal and rotary movement.
- Used for machining:
  (i) Internal surfaces
  (ii) Keyways, slots and grooves
  (iii) Large internal and external gears may be machined using rotating table and indexing mechanism.
  (iv) Keyjections are special vertical shapes to machine internal keyways.

(c) Travelling head shaping machine:
- The travelling ram with the tool reciprocates as well as moves crosswise to give required feed.
- The ram reciprocates and supplies the feeding movement.
- This is very useful for heavy and complex workpieces which are difficult to be clamped to the table of a standard shaper.

Shapes Classification : Design of Work Table

3. Design of Work Table

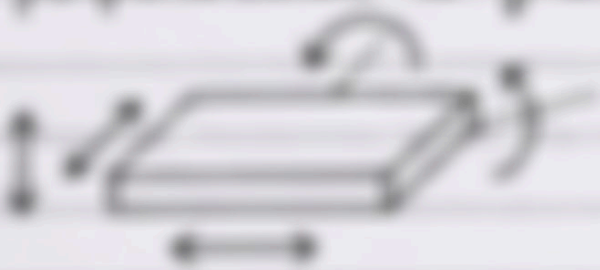
(a) **Standard Shapes** (or plain shapes) :

- The standard shapes or plain shapes has work table with two movements, i.e., vertical and horizontal to give feed.

(b) **Universal Shapes** :

- This shapes is used in a tool room for machining different types of work.
- The table has the following movements :

(i) Horizontal movement
(ii) Vertical movement
(iii) Table can be swivelled about an axis parallel to ram stroke.
(iv) The table can be tilted about a horizontal axis perpendicular to feed axis.



Shape Classification: Cutting Tools

Based on the Direction of the Cutting Tools

1. Push Type Shape

- The cut [illegible] away from the [illegible] while cutting the workpiece.
- The cutting action takes place during the [illegible] stroke.

- This is the most common type of shape.

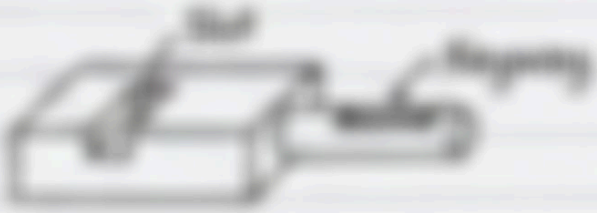
2. Pull in Head Type Shape

- The cut [illegible] towards the [illegible] while cutting.
- The cutting action takes place during the [illegible] stroke.

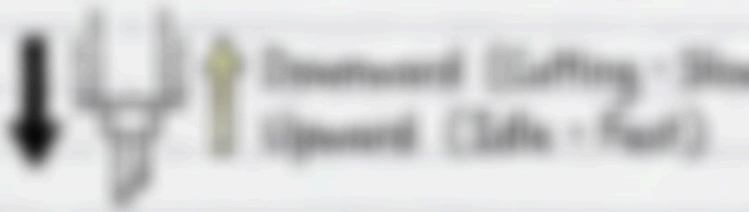
- This type is [illegible]

Working Principle of Slotting Machine

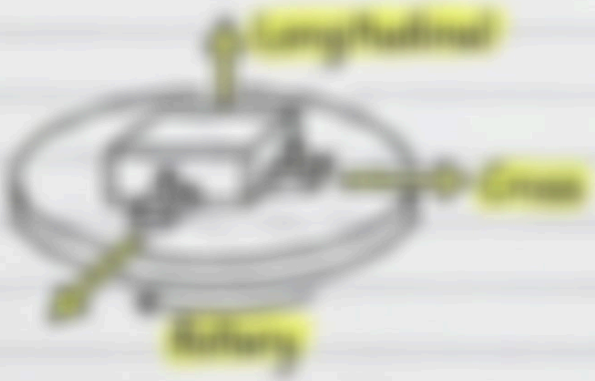
1. **What is Slotting?**
   - A machining operation to **produce slots, grooves or keyways**.
   - The *slotting machine (or slotter)* is a **single-point vertically reciprocating machine**.



2. **The Cutting Stroke:**
   - The tool performs the **cutting operation** during the **downward stroke**.
   - The **upward stroke** is the **idle stroke**.
   - The *idle stroke* is **faster** than the **working stroke**.



3. **Work Holding & Feed:**
   - The work is *fixed on a* **horizontal rotary table**.
   - Feeds *can be*:
     - **Longitudinal feed**
     - **Cross feed**
     - **Rotary feed** in a **horizontal plane** about the **axis of the table**.



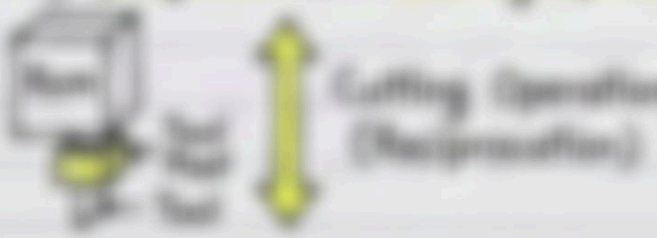
Main Parts of a Slotting Machine

1. **Base:**
   - It is a heavy casting to support all parts of the slotter such as column, table and saddle.
   - The saddle can slide horizontally in the slide ways at the top of the base.

2. **Column:**
   - It supported on the base and accommodates complete driving mechanism.
   - The front end of column has ways for the ram to reciprocate vertically.

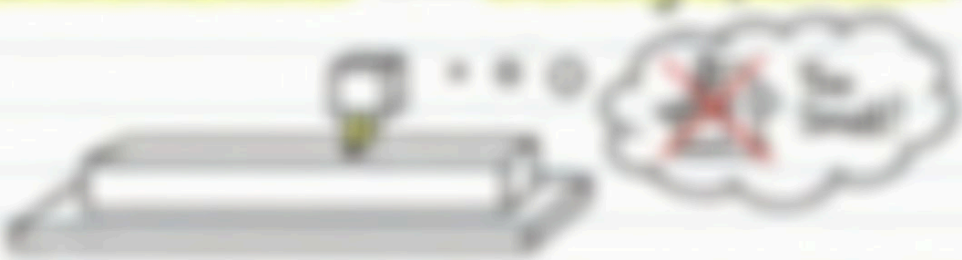
3. **Table and Saddle Assembly:**
   - A rotary table on the carriage which is mounted on saddle.
   - The table can be rotated on base plate.
   - The latter can be fed longitudinally parallel to the face of column.

4. **Ram and Tool-head Assembly:**
   - The ram is mounted on the face of the column.
   - A tool post is fitted at the lower end of ram.
   - Ram and tool assembly performs the cutting operation.

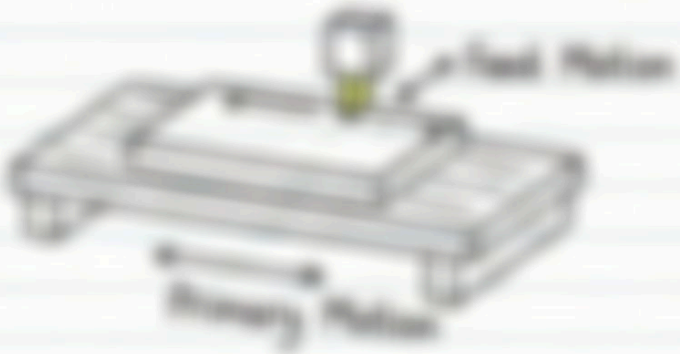


Planer : Principle of Operation

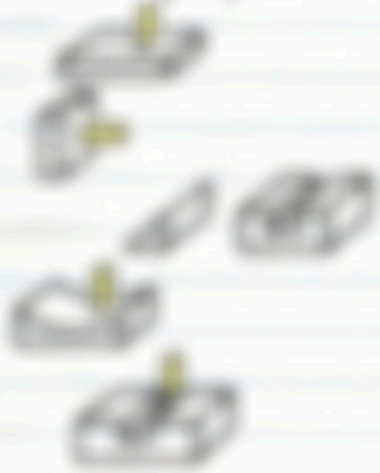
1. Why use a Planer?
   - Used for generating flat surfaces on very large parts.
   - A shaping machine is not suitable for this due to limitations on the stroke and overhang of the ram.



2. The Core Principle:
   - The linear primary motion is given to the workpiece, which is mounted on a reciprocating table.
   - The table is fed at right angles to the primary motion.



3. Common Operations:
   - The following are common operations performed:
     1. Horizontal surfaces
     2. Vertical surfaces
     3. Angles and dovetails
     4. Curved surfaces
     5. Slots and grooves



Types: Double Housing and Open Side Planer

1. Double Housing Planer
   - This is the *standard planer most widely used* in industry.
   - Two columns (housings) are supported on the bed, *one on each side of* the table.
   - It has *four tool heads*: *two on the cross rail and one on each housing*.

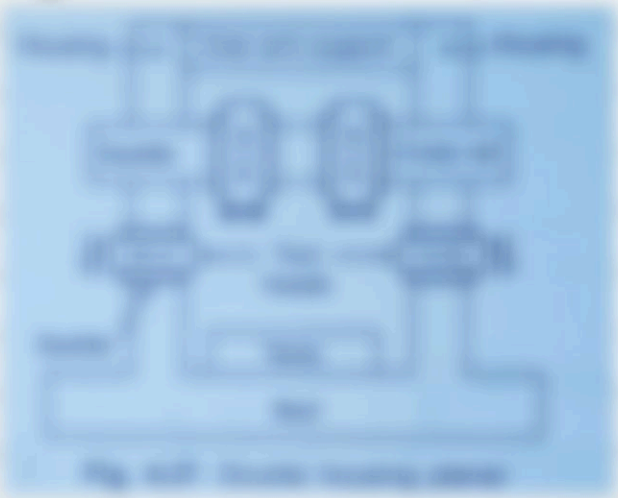


Fig. 4.17 Double housing planer

2. Open Side Planer
   - Used to machine *long and wide parts which overhang the table* from the *open side*.
   - Has only *one housing or column* supported on the bed.
   - Features a *cantilever type cross rail* suspended from the column.
   - Typically has *three tool heads*: *two on the cross rail and one on the column*.

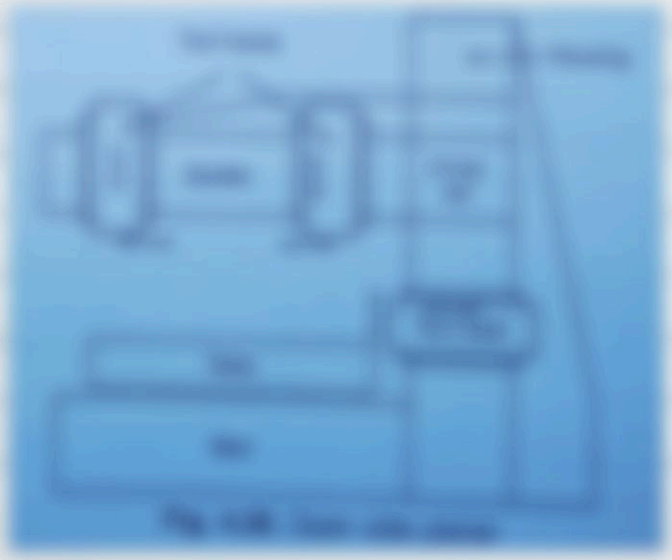
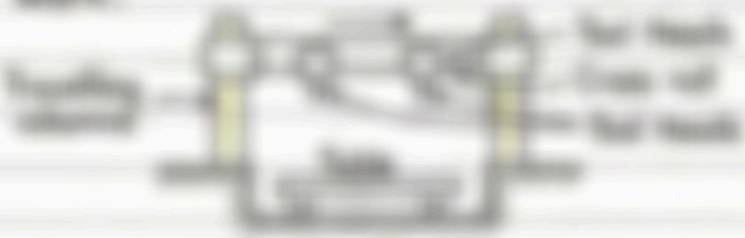


Fig. 4.18 Open side planer

Pit, Plate and Divided Table Planer

3. Pit Planer

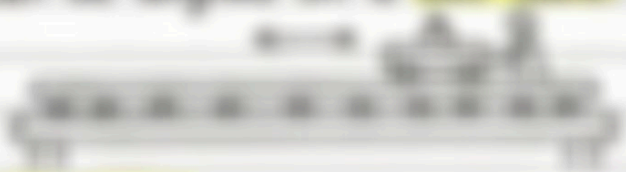
- Designed to machine very long works such as aluminium billets and aeroplane parts.
- The work is clamped on a stationary table.
- The work table is placed in a pit.
- The tool heads, cross rails and housings move along the ways past the work.



Based on Fig. 4.29

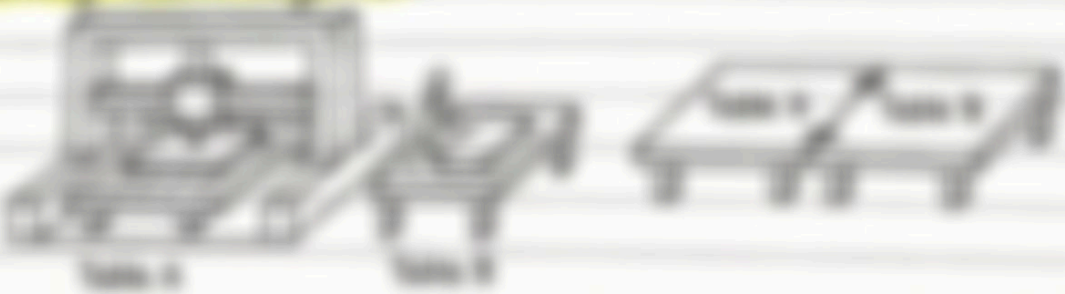
4. Plate Planer

- A specialized machine to plane the edges eg. steel plates upto 30 cm thickness.
- Edges may be machined square or bevelled.
- Main applications: armour plates, plates eg ships, plates eg pressure vessels.
- The work is held stationary and the tool and operator move to and fro along the work.
- The work can be aligned on a ball table.



5. Divided Table Planer

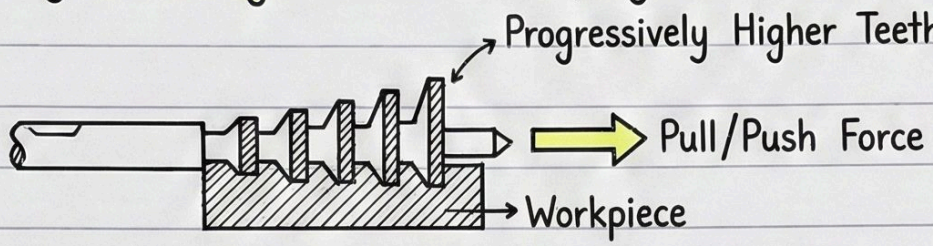
- Standard planer provided with divided table to save work setting time.
- One part eg table is taken out for setting the work while other table is in the machine which already set work is planed.
- For very large parts, both the tables can be used when required by bolting them together.



Broaching and its Methods

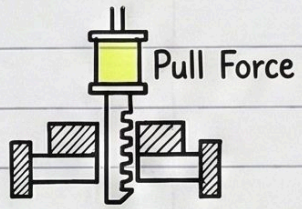
1. What is Broaching?

- A broach is a multi-edged cutting tool that has successively higher cutting edges along its length.
- The tool may be pulled or pushed through the surfaces to be finished.
- The broaching tool moves in a straight path and removes the stock by shearing as in a shaping machine.

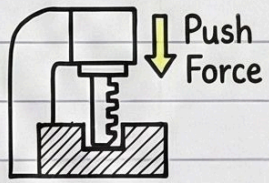


2. Main Broaching Methods:

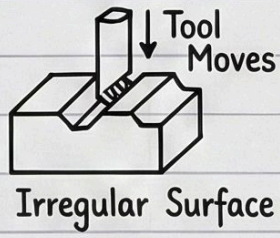
1. Pull broaching: The tool is pulled through a stationary workpiece by hydraulic force. It is used for both internal and surface broaching.



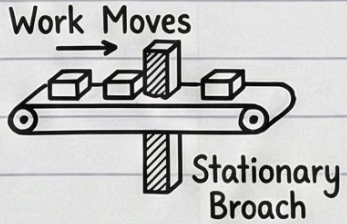
2. Push broaching: The tool is pushed through a stationary workpiece with the help of hydraulic arbor press. It is used mostly for sizing holes and cutting keyways.



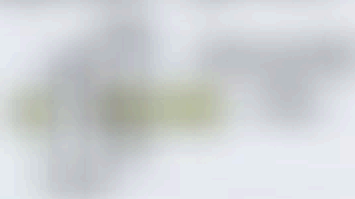
3. Surface broaching: Many irregular and intricate shapes are broached with the help of specially designed broaches. Either workpiece or the broaching tool moves across the other.



4. Continuous broaching: It is used for batch production. The work is moved continuously across a stationary broach in a straight or circular path.



- The broaching machine provides an economical method of machining keyways, splines, irregular shaped internal and external surfaces.



Vertical Broaching Machines

1. Introduction & Main Parts:

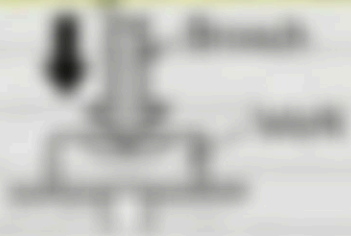
- These machines are used for **multiple operations** and mostly **surface broaching**.
- The broaching tool is attached to a **ram** driven by **hydraulic** or **electro-mechanical mechanism**.
- The main parts are **base**, **column**, **hydraulic cylinder** and a **table**.

2. Methods of Broaching:

There are two methods of broaching on a vertical broaching machine:

(i) Push broaching:

- The broach is **pushed down** across the **stationary work** along a **straight vertical path**.



(ii) Pull broaching:

- The broach is **pulled** across a **stationary work** along a **straight vertical path**.
- The pull type machine may be **pull-up** or **pull-down** machine.

Continuous Broaching Machines

These are **high production machines** where the broaching operation is continuous. The workpiece is mounted over a **stationary broach tool** in the setup, and the cycle repeats without interruption, suitable for **mass production**.

Types of Continuous Broaching Machines

1. **Rotary Type**
   The workpieces are loaded onto a **rotating table** and moved past a stationary broach.

2. **Horizontal Type (Conveyor Driven)**
   The workpieces are loaded onto a **conveyor** that carries them past a stationary broach.

Advantages

- **Very high production** rate.
- **Reduced handling** between cuts.
- Ideal for **large volume manufacturing**.

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