Manufacturing Process

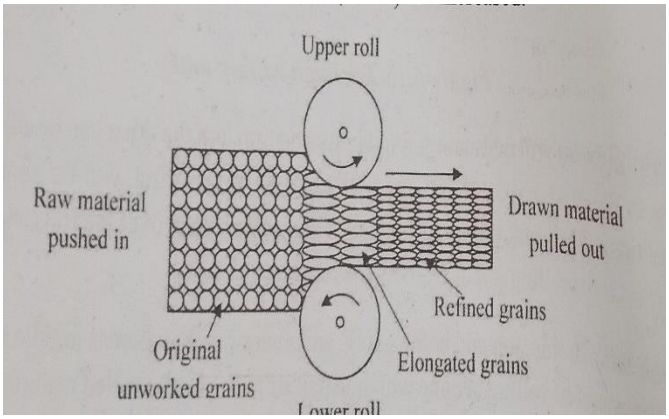
Manufacturing processes are those processes by which raw materials are converted into final products.

Manufacturing processes can be classified as follows.

- **Shaping process: -** Process in which the shape and size of the metal is changed without the removal of the material Eg :- Casting, Forging , Rolling etc
- **Machining process:-** Process in which the shape and size of the metal is changed by removing the material from the work piece Eg :- Turning Drilling, Milling etc.
- **Joining Process:-** Processes in which two or more parts are joined to8gether for getting desired product. Eg :- Welding ,soldering etc
- **Finishing Process:-** Process by which the required surface finish or protective coating is provided to the part . Eg:- Electroplating , Galvanizing etc.
- **Property Changing Process :-** Process in which certain properties of a part are changed so as to make it suitable for a particular application Eg:- Hardening Annealing etc.

Rolling :-

- Process of plastically deformation metal by passing it between rolls
- Cylinder rolls are used to reduce the cross-sectional area of a bar or plate with a corresponding increase in the length
- Process of rolling basically consists of passing metal between two rolls rotating in opposite direction at the same speed



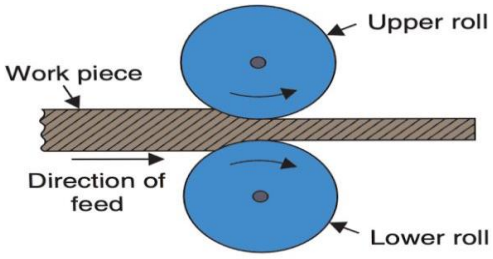
- There are two types of rolling processes
    1. **Hot Rolling :-** Process in which metal is fed to the rolls after being heated above the recrystallization temperature .
    2. **Cold Rolling :-** Process in which metal is fed to the rolls after being heated below the recrystallization temperature .

- **Types of Rolling Mills :-**
    1. Two high mill
    2. Three high mill

3. Four high mill
4. Cluster mill
5. Tandom mill / Continuous mill

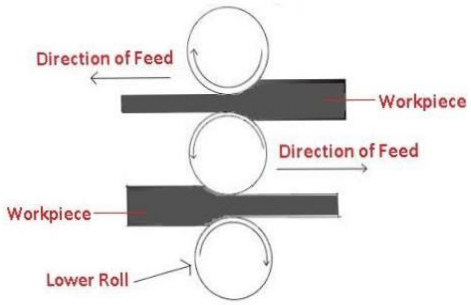
1. **Two high mill :-**

- Two rolls are used
- Lower roll will be fixed
- Upper roll can be moved to adjust the space between the rolls
- Both the rolls rotate at the same speed but in opposite direction.



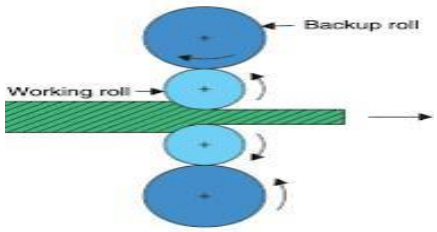
2.Three high mill :-

- Three rolls positioned one over another
- Upper and lower rolls rotate in the same direction
- Middle roll rotates in the opposite direction
- Mile roll is fixed
- Upper and lower rolls are moved to adjust the roll gap.



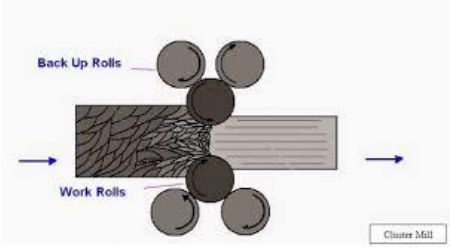
3.Four high mill :-

- Four rolls
- Two rolls are working rolls and the other two are backup rolls
- Back Up tools preventing the deflect8on of the working rolls



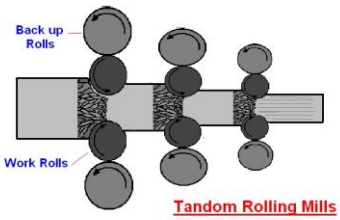
4.Cluster mill :-

- Used for rolling very thin sheet or foils.
- It consists of a pair of working rolls of very small diameter, supported by a number of back up tools on either side.



5.Tandom Mills:-

- Series of rolling mills are placed one after another.
- Different reduction takes place at each stand, the strip will be moving at different



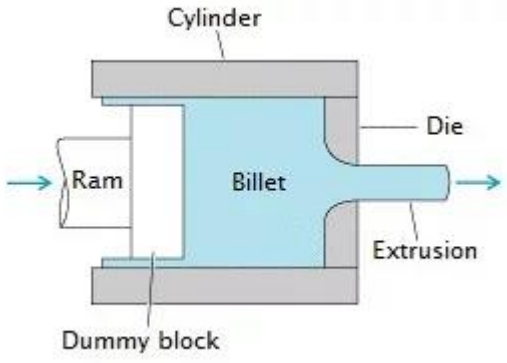
Tandom Rolling Mills

EXTRUSION

- Processes of forcing a metal enclose in a container to flow through the opening of a die
- Metal is subjected to plastic deformation
- Metal undergoes reduction and elongation during extrusion.
- Used for manufacturing rods, tubes, circular, rectangular, hexagonal and other shapes both in hollow and solid form.
- There are two types of extrusion processes.
- **Hot Extrusion: -** Process in which extrusion is carried out above the recrystallization temperature
- **Cold Extrusion: -** Process in which extrusion is carried below the recrystallization temperature.

Forward or direct extrusion

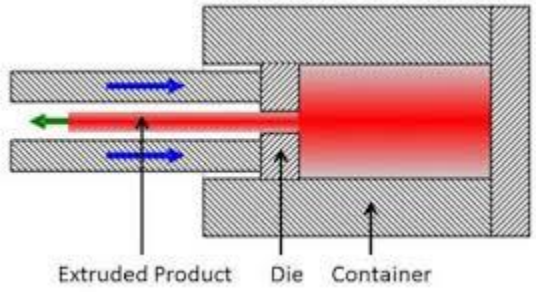
- The flow of metal through the die is in the same direction as the movement of Ram.
- As the RAM move forward pressure develop and metal plastically deformation
- As the chamber is closed on all sides with a heat material is squeezed through the die - opening as an elongated strip.



Backward or indirect extrusion

- Flow of metal through the die is in the opposite direction as the movement of Ram

- Hot billet (work piece) is used
- Ram used is hollow
- Billet remains stationery while die is pushed into the billet by the hollow ram



FORGING :-

- ❖ Forging is the process in which metals or alloys are deformed to the required shape by applying continuous compressive force from a hammer.
- ❖ Ther are two of forging processes,
- ❖ HOT FORGING:- Process in which forging is carried out above the recrystallisation temperature.
- ❖ COLD FORGING:- Process in which forging is carried out below the recrystallisation temperature.

Type of Forging:-

- ❖ Hand Forging
- ❖ Drop Forging
- ❖ Press Forging

HAND FORGING :-

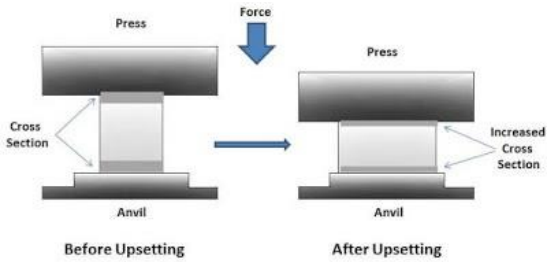
- ❖ Traditional forging operation carried out by black smith in a section of workshop call smithy
- ❖ Hand tools are used for forging (eg :- hammer, Chisel...)
- ❖ Not suitable for mass production

FORGING OPERATIONS:-

- ❖ Upsetting
- ❖ Drawing Down
- ❖ Setting Down
- ❖ Bending
- ❖ Forge Welding

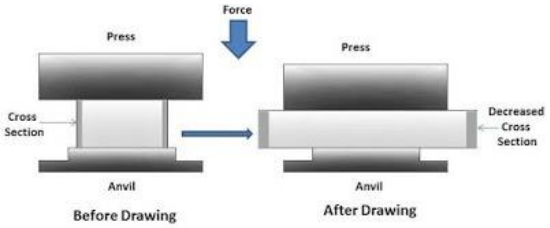
❖ Upsetting

- ❖ It is a processes of increasing the cross- sectional area of a bar at any desired location with the reduction in length
- ❖ The portion to be upset is heated and then hammered.



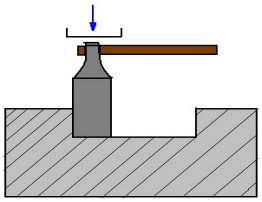
❖ Drawing Down :-

- ❖ It is the process of reducing the cross-section of a bar by inceasing its length.



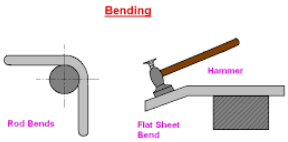
❖ Setting Down:-

- ❖ It is the Local thinning down operation using a set of hammers.



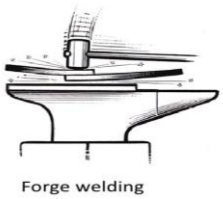
❖ Bending:-

- ❖ Bending is an operation by which bars are bent to form ring, hooks etc.



❖ Forge Welding: -

- ❖ Joining two metallic surface.
- ❖ Surface to be joined are heated to a temperature of about 1000 C
- ❖ Metal surface are joined by applying pressure at the mating surface

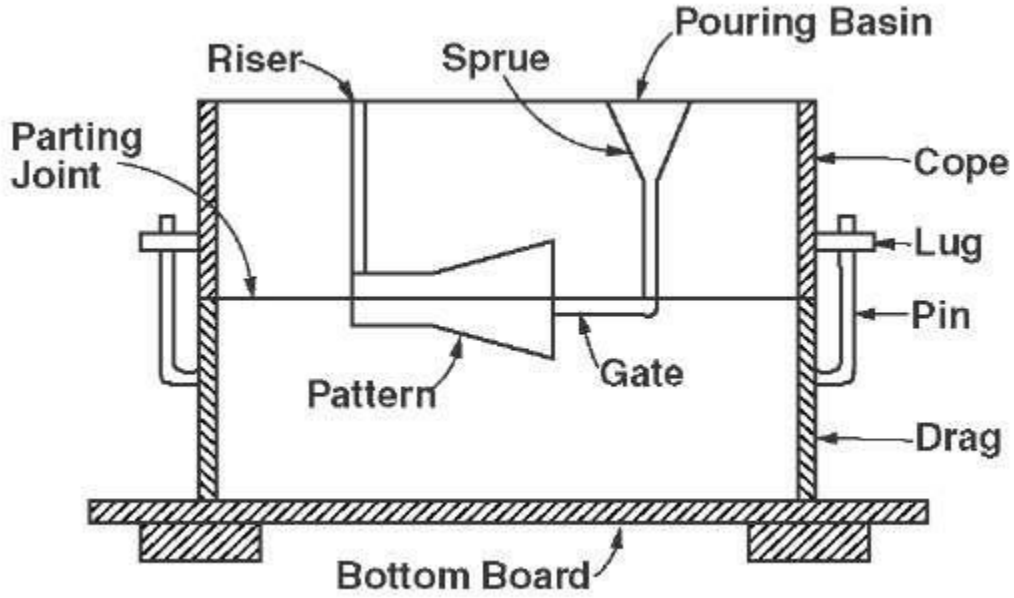


SAND CASTING

- It is a manufacturing process in which molten metal is poured in a Mould or cavity and allowed to solidify.
- Molten metal on solidification gets the shape of the mould
- In sand casting, sand is used as the mould materials
- The place where casting is carried out is known as foundries.
- Basic Moulding material includes silica sand with binder and additives.

PORPERTIES OF MOULDING SAND

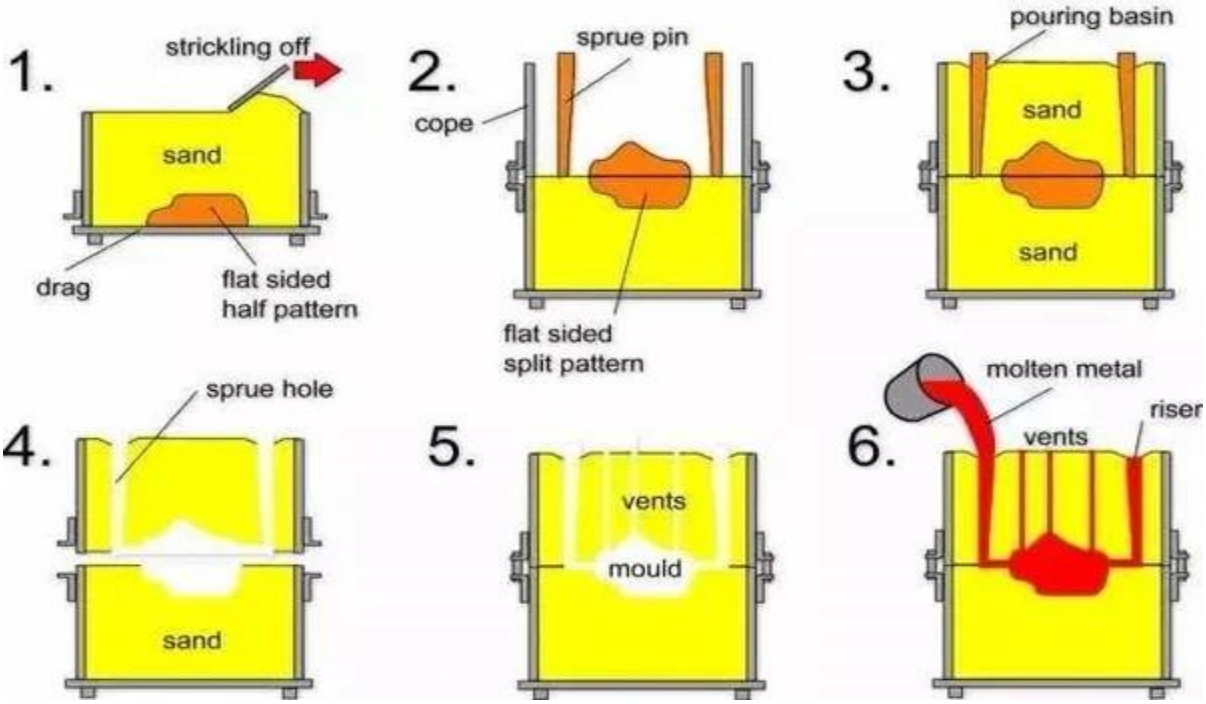
- **Refractoriness :-** Ability to withstand high temperature
- **Chemical Inertness :-** Sand should not chemically react with the metal
- **Permeability :-** Sand should allow gases and vapours liberated during casting to escape through it.
- **Cohesiveness :-** Sand should have enough cohesiveness to bind each other.
- **Collapsibility :-** Sand should be collapsible to remove the product after casting
- **Cost :-** Sand should be cheap and easily available.



- Flask :_ It is the box contains the mould cavity
- Drag :- lower part of the flask
- Cpoe :- Upper part of the flask.
- Pouring Basin :- Top of the mould for pouring the molten metal at the required rate into the mould cavity.
- Sprue :- Vertical passage made through the cope for connecting pouring basin with the gate.
- Runner :- For connecting the sprue and gate.

- Gates :- Passage for connecting the base of the runner with the mould cavity.
- Riser :- Passage made in the cope to permit molten metal to rise up after filling the mould cavity.

SAND MOULDING PRCEDURE :-



- Place the drag pattern on the bottom board.
- Sprinkle the facing sand carefully all around the pattern so that pattern doesn't stick with moulding sand.
- Fill the drag with loose moulding sand
- Ram the sand uniformly around the pattern
- Strike off the excess sand
- Sprinkle parting sand over the top of the drag and roll over the drag
- Place the cope pattern on the drag pattern.
- Place the cope over drag.
- Sprinkle parting sand over the top of the drag and roll over the drag
- Place sprue and riser pins.
- Fill the cope with sand and ram
- Strike off the excess sand from the top of the cope
- Remove the sprue and riser pins.
- Sprinkle parting sand over the top surface of the cope
- Roll over the cope and remove both drag and cope patterns.

- Cut gate connecting the sprue basin with mould cavity.
- Close the mould by inverting cope over drag.

WELDING

Welding is the process of joining similar or dissimilar metals by the application of heat, with or without the application of pressure and with or with the addition of filler materials.

Welding can be classified into two types

Fusion Welding: - No pressure is involved but a very high temperature is produced in or near the joint. The metal at the joint is heated to the molten state and allowed to solidify. A filler material may be used during the welding process

Eg:- Oxy- acetylene welding, Carbon arc welding etc

Plastic Welding: - Metals to be joined are to be heated to the plastic state and then forced together by external pressure without the addition of filler material.

Eg:- Forge welding, Resistance welding etc.

Depending upon the type of heat production welding processes are classified as

1) Electrical Resistance Welding
   a) Spot Welding
   b) Butt welding
   c) Flash Welding
   d) Seam welding
2) Arc Welding
3) Gas Welding
4) Thermit Welding

1) <u>Electrical Resistance Welding</u>

→ Work Pieces are held together

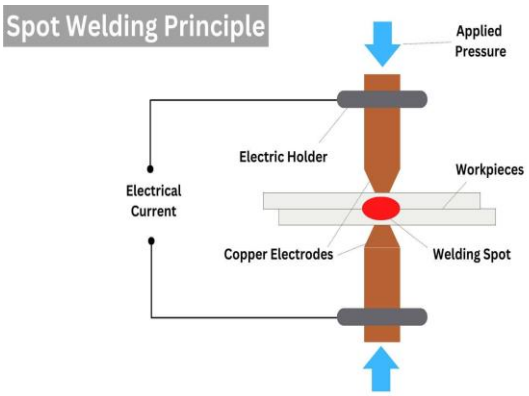
→ A strong electric current is passed through them

→ The high resistances at the point of contact raises the temperature at the junction.

→ The mechanical pressure applied at this moment completes the weld.

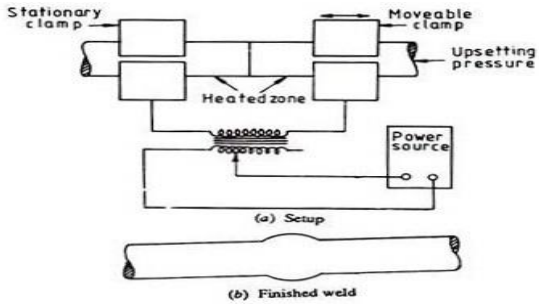
a) **Spot Welding :-**

- Used for making lap welds on the thin sheet
- The sheets are held between the metal electrodes
- The secondary current from the transformer has passed.
- Contact spot temperature is raised to welding temperature
- pressure is applied by electrodes itself
- Used for welding most of the ferrous and non-ferrous alloys



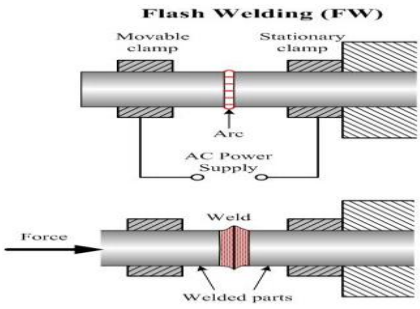
b) **Butt Welding :-**

- Work piece of the same cross section is held in suitable clamp
- The current is passed- contacting surface
- Mechanical pressure is applied.



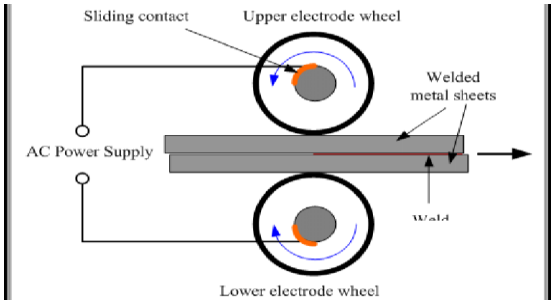
c) **<u>Flash Welding :-</u>**

- Ends of the work pieces are held together
- The current is passed sudden separation of the ends by a short distance produces an arc resulting very high heat.
- Immediately the current is cut off- then apply pressure.



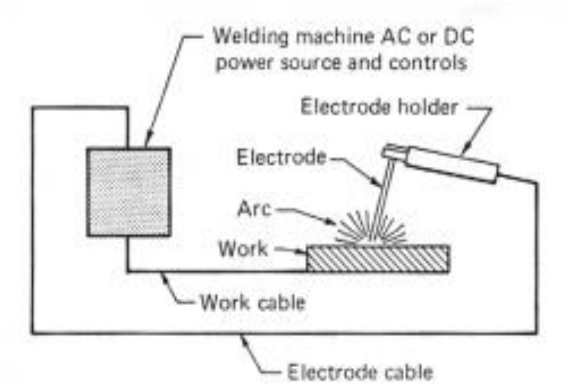
d) <u>Seam Welding :-</u>

- Similar to spot welding
- Overlap and make a leak proof joint
- Rotating wheels are electrodes
- Current is passed from wheel to wheel through the work pieces heat is produced
- Pressure is applied
- Weld is formed



ARC WELDING

- The welding in which the electric arc is produced to give heat for the purpose of joining two surfaces is called electric arc welding.
- The Arc is like a flame of intense heat that is generated as the electrical current passes through a highly resistant air gap
- It is a fusion welding process.



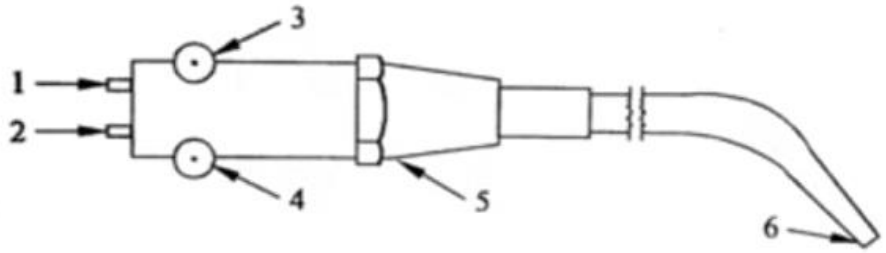
- An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form a electric arc between the electrode and the metals to be joined
- Arc welding is a process that melts and joins metals by heating them with an arc established between a sticklike covered electrode and the metals.
- The core wire conducts the electric current to the arc and provides filler metals for the joint.
- The electrode holder is essentially a metal clamp with an electrically insulated outside shell for the welder to hold safely.
- The heat of the arc melts the core wire and the flux covering on the electrode tip into metal droplets
- Molten metal in the weld pool solidifiers into the weld
- As the weld is laid, the flux coating of the electrode disintegrates giving off vapor that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

ADVANTAGES

- Simple welding equipment's
- Portable
- Inexpensive power sources
- Welders use standard domestic current
- Process is fast and reliable
- Short learning curve

GAS WELDING

Also called
Oxy- fuel Welding
Oxyacetylene Welding
Oxy- Welding
Required heat for fusion is obtained by combusting of a fuel gas



- Heat is used to melt the work piece and filler metal rod (welding rod).

- Several gas mixers are used for producing the flame -Oxygen and acetylene is mostly used as it produces very high temperature as 32000°C
- Blow pipes (Welding torches) are used for mixing and leading the term gases for combustion.
- Mixer (Mixing Chamber) – to mix the gases and to stop any flame travelling back through the touch tip

- Acetylene gases are obtained by mixing calcium Carbide with water.

$$CaC2 + 2H2O = Ca(OH)2 + C2H2$$

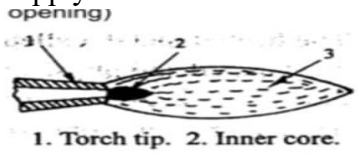
- The combustion of acetylene with oxygen at the tip of the torch takes place in two stages.

$$C2H2 + O2 = 2CO + H2 \text{ (At close to the tip opening)}$$

$$4CO + 2H2 + 3O2 = 4CO2 + 2H2O$$

- The first reaction gives a brilliant white cone flame.

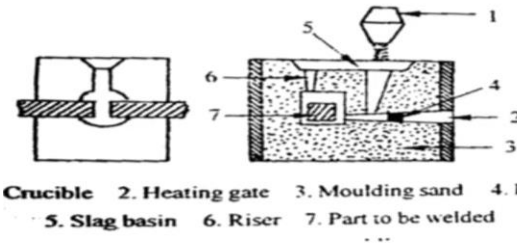
- Secondary reaction in the largest blue flame which surrounds the inner cone. The flame can be adjusted by regulating the oxygen and acetylene supply.



1. Torch tip. 2. Inner core.
3. Outer core

THERMIT WELDING

- The required heat for fusion is obtained by exothermal chemical reaction.
- The gap between the end of the work piece is filled with wax which becomes the pattern for the weld



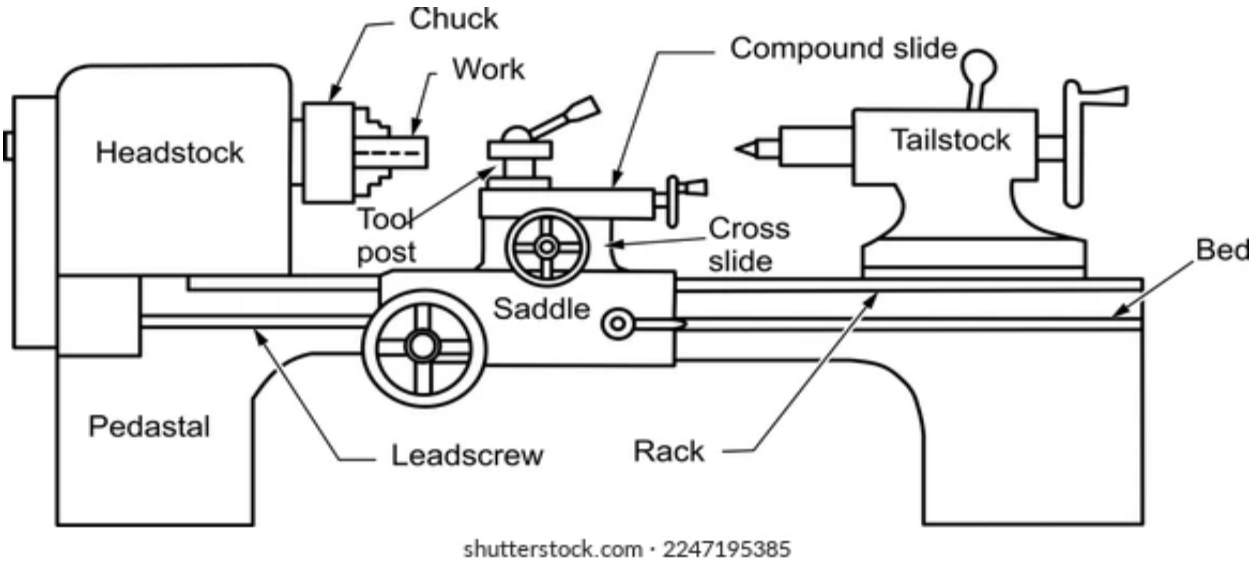
- Moulding sand is packed around this – with riser and gates
- A preheating flame is used to melt and burn out the wax - to dry the mold and to bring the end of the workplace to the red heat.
- The heating gate is plugged in.
- A mixture of powdered aluminum and iron oxide is placed inside the crucible - mixture is ignited – result highly purified I am and Aluminum oxide slag (floats on top of cruisible)
- The temperature of molten and is used is above 3500 degrees Celsius
- The bottom plug of the crucible is removed molten iron flow into the Mould
- Example joining rails, large pipe etc.

MACHINE TOOL

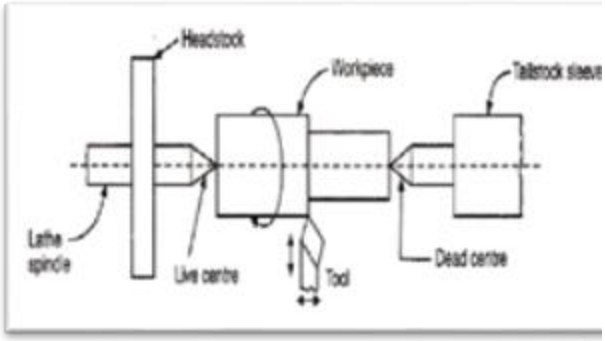
- **A** machine, which performs the material removal operation with tools to produce desired shape and size of the workpiece is known as machine tool.
- Types of Machin Tool
  1. Lathe
  2. Drilling Machine
  3. Milling Machine
  4. CNC Machine.

LATHE

- Lathe is a machine, which removes the metal from a piece of work to the required shape and size
- A lathe operates on the principle of a rotating workpieces, which rotes about its own axis, causing the workpiece to be formed to the desired shape.



- If the tool moves perpendicular to the axis it produces a plane surface.
- If the tool moves parallel to workpiece cylindrical surface is formed.
- If the tool moves inclined o the axis it produces a taper surface and is called taper turning.



1) **BED :-**
   - It is the base of the lathe
   - All the other functional components are mounted on bed
   - Bed is made up of cast iron
   - It gives the strength and rigidity to lathe
   - Guideways are provided on the top surface of the bed for the movement of tailstock and carriage.

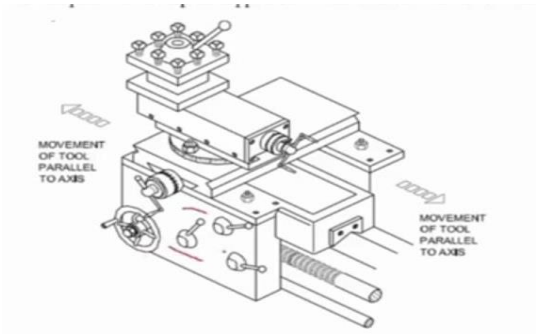
2) **HEADSTOCK**
   - Headstock is permanently fixed on the left side of the machine
   - Head stock houses the gearbox which helps to rotate the spindle at various speeds.
   - Work holding devices such as chucks, faceplate etc, are fixed to spindle.

3) **TAILSTOCK**
   - Tailstock is provided on the right side of the lathe
   - Tailstock can be damped at desired location
   - Tailstock help on support the other end of workpiece
   - Tailstock can also be used for various operation like drilling etc

4) **CARRIAGE**
   - Carriage consists of several parts which helps to support and control the movement of cutting tools.

Saddle :-

- It is the base of the carriage
- It moves along the guide ways



Cross Slide :-

- It is mounted on the saddle.
- Cross slides can move perpendicular to the center line of the lathe.

Compound Rest :-

- It is mounted on top of the cross slide
- Compound rest can be rotated about the saddle, which makes positioning of the cutting tool at the desired angle.

Tool post :-

- Cutting tool can be firmly held on the tool post
- Tool post is mounted on compound rest.

Apron :-

- Apron is fixed below the saddle.
- It contains gears and levers for controlling the motion of carriage

5) LATHE CENTER :-

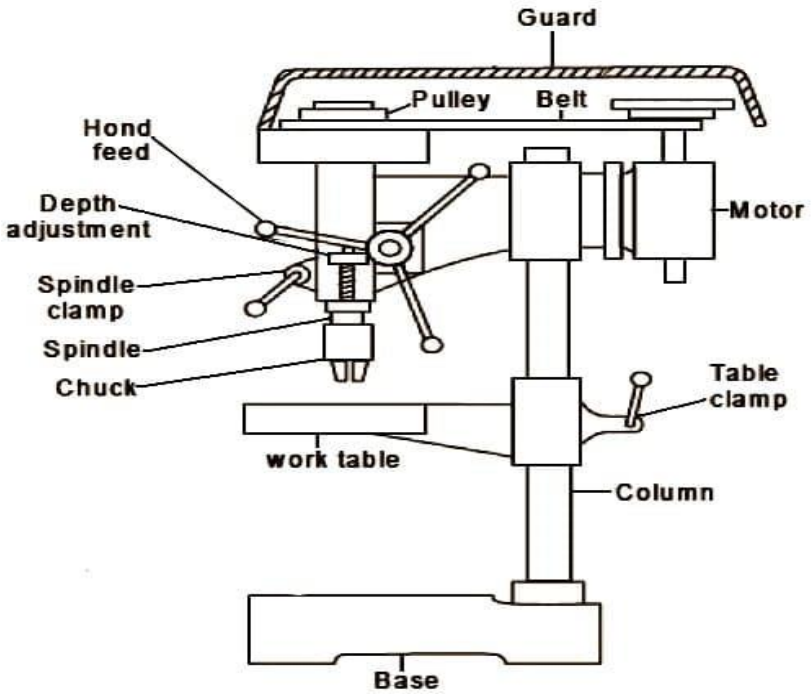
- The most common method of holding the job in a lathe is between the two centers known as live center and dead center.

LATHE OPERATION:-

TURNING	To remove material from the outside diameter of a workpiece to obtain a finished surface
FACING	To produce a flat surface at the end of the workpieces for making face grooves
BORING	To enlarge a hole or cylindrical cavity made by a previous process or to produce circular internal grooves.
DRILLING	To produce a hole on the work piece
REAMING	To finishing the drilled hole
THREADIJNG	To produce external & internal threads on the work piece
KNURLING	To produce a regularly shaped roughness on the workpiece

DRILLING MACHINE

- Drilling is a metal cutting process carried out by a rotating cutting tool to make circular holes in solid materials.
- Tools which make holes are called drill bit or twist drill.
- The machine which used for drilling operation are called drilling machine



PARTS OF DRILLING MACHINE:-

- **BASE: -**
  - It is the bottom most part of the radial drilling machine
  - It is made up of cast iron
  - It also absorbs the vibrations and shocks induced by the machine parts.
- **COLUMN:-**
  - Vertical member of the machine which supports a table
  - The head supporting the motor and spindle is mounted on the top of the column.
- **TABLE:-**
  - Supports the work pieces or other work holding device
  - It can be moved up and down on the column
  - It can be set in various positions in the horizontal plane.
- **Drill Head: -**

- Mounted on the top of the column and supports the spindle head and motor.
- Spindle head houses drill holding and rotating device.
- Hand wheel is provided for upward and downward movement of the spindle,
- Drill chuck is mounted in the spindle for holding the drill.
- Spindle receives power from the motor through belt and pulley system.

OPERATIONS

DRILLING	Operation of producing a circular hole using a drill by removing metal from the workpiece.
REAMING	Operation of finishing and sizing an already existing hole.
BORING	Enlarging already existing holes by means of an adjustable single point tool.
COUNTER BORING	Operation of increasing the diameter of a hole for a certain distance down.
COUNTER SINKING	Operation by which a cone shaped enlargement is made at the end of a hole
TAPING	Operation of cutting internal threads in a drilled hole by means of a tool called tap.

MILLING MACHINE

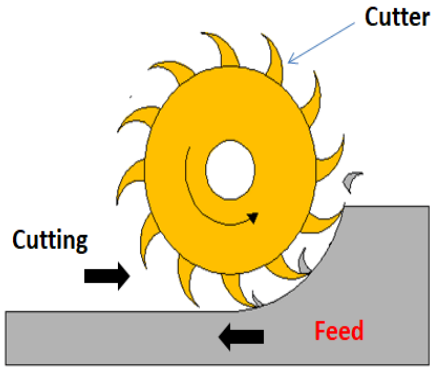
- Milling is the process of removal of metal by feeding the workpieces against a rotating multipoint cutter.
- In the milling machine, the work is clamped rigidly on the table of the machine. The cutter revolves at a high speed on an arbor and the workpiece clamped on the table is fed slowly past the cutter
- As the work advances, the cutter teeth remove material from the work surfaces in the form of small chips to produce the desired shape.

MILLING METHODS

- Based on the direction of cutter motion and workpiece feed milling can be classified into :-
  1. Conventional milling or up milling
  2. Climb milling or down milling

Conventional milling or up milling: -

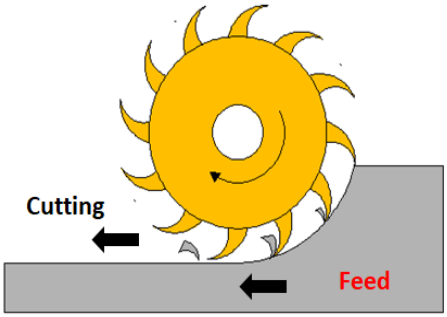
- The workpiece is fed in the opposite direction to that of the rotating cutter.
- Chip thickness varies from minimum at the start of cut to a maximum at the end of cut.
- The load on each cutting edge is gradually increased.
- The disadvantage is that the cutter tends to lift the workpiece from the worktable. While taking heavy cuts, this results in poor surface finish.
- This method is suitable for machining casting and forgings



Up Milling

Climb milling or down milling

- The workpiece is fed in the same direction to that of the rotating cutter.
- Chip thickness varies from maximum at the start of cut to a minimum at the end of cut.
- The cutter forces the work pieces towards the table. This is an advantage for milling of such workpiece which cannot be easily held on the table
- Down milling produces surface of highly quality.
- This method is useful for finishing operations and for small works such as slot cutting, milling grooves etc.

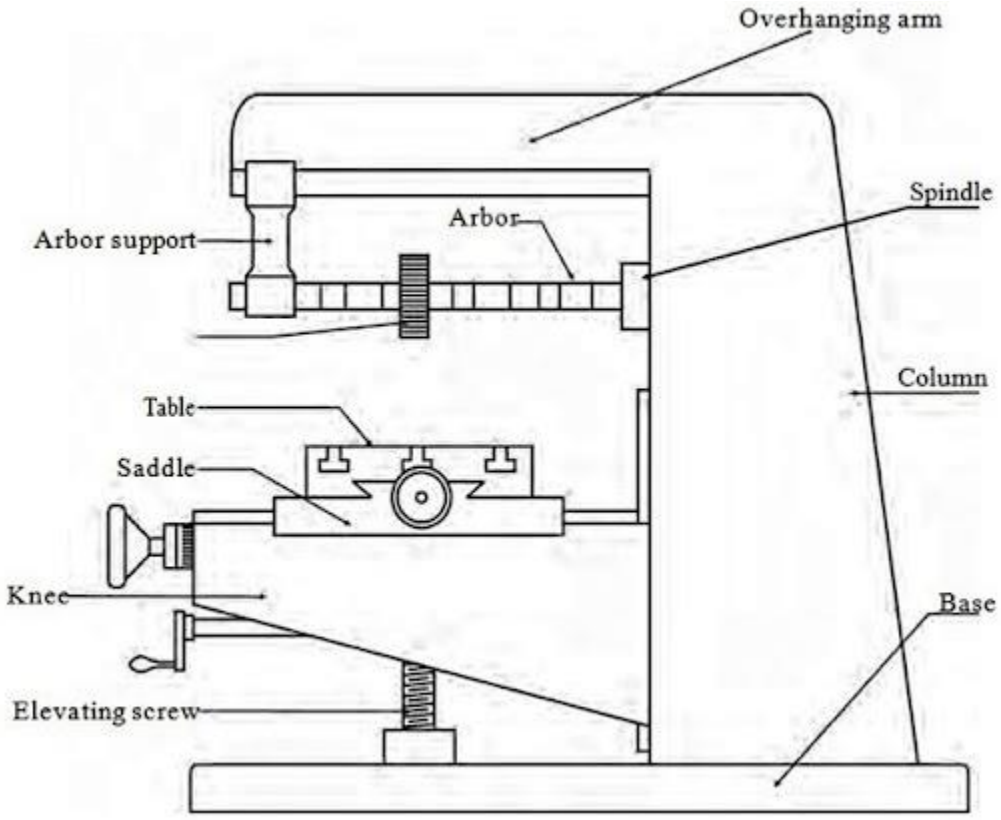


Down Milling

PRINCIPAL PARTS OF MILLING MACHINE

- **BASE :-** It is the foundation for all other parts of the milling machine. It gives the machine the required strength and rigidity.

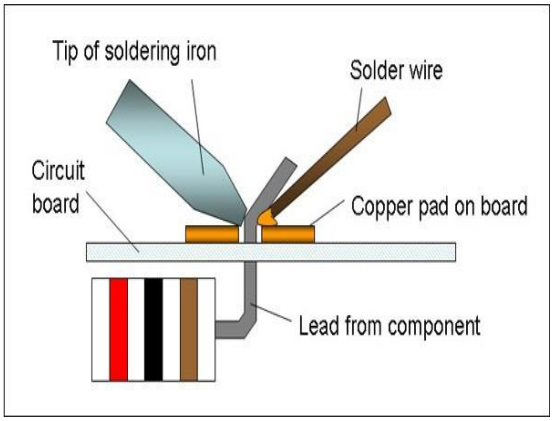
- **COLUMN :-** it is the main supporting frame mounted vertically on the base. The drive mechanism is fixed to it. It supports and guides the knee during its vertical travel.



- **KNEE:-** Knee is a rigid casting that slides up and down on the vertical guide ways of the column. It has horizontal guideways on its top surface. It supports saddle and table. An elevating screw is used for adjusting the height of the knee.
- **ELEVATING SCREW: -**the height of the knee is adjusting by the elevating screw. It also supports the knee.
- **SADDLE:** Saddle supports and carries the table. It can move transversely on the guide ways provided in the knee.
- **TABLE: -** the table rests on the guideways on the saddle and can be moved longitudinally.it supports the workpieces.
- **SPINDLE: -** the spindle obtains power from the motor and transmits it to the arbor. Spindle has tapered sockets for inserting the arbor.
- **ARBOR: -** it is the rod on which cutter is mounted. It is tapered at one end to ft into the spindle. Other end of the arbor is mounted on the arbor support
- **OVER-ARM: - i**t is mounted on the top of the column. It helps to support the arbor

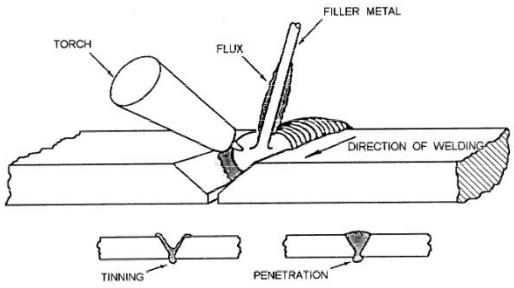
SOLDERING

- Method of joining two or more metal pieces by means of a fusible alloy or metal called solder.
- The melting temp of filler metal is lower than 450°C and lower than the MP of the components to be joined.
- No direct melting of the metals being joined.
- During the process the filler alloy flows between the two closely adjacent surface of the workpiece by capillary action



BRAZING

- Metal pieces are joined by heating the closely placed parts and then filler alloy called spelter applied in the molten state which upon solidification produces the desired joint.
- Melting temperature of filler metal is more than 450°C and lower than the melting temperature of the components to be joined.



- Method of joining two or more metal pieces by means of a fusible alloy or metal called solder.
- The melting temp of filler metal is lower than 450°C and lower than the MP of the components to be joined.
- No direct melting of the metals being joined.
- Brazing gives a much stronger joint compared to soldering.
- During the process the filler alloy flows between the two closely adjacent surface of the workpiece by capillary action.