

Siddhartha Institution of Engineering & Technology

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Campus: Ibrahimpatnam, R.R. Dist., Telangana - 501 506

Department of Mechanical Engineering

Instructional Material on

PRODUCTION TECHNOLOGY
II B Tech – I Semester



Prepared by

Mr. C SUDHAKAR

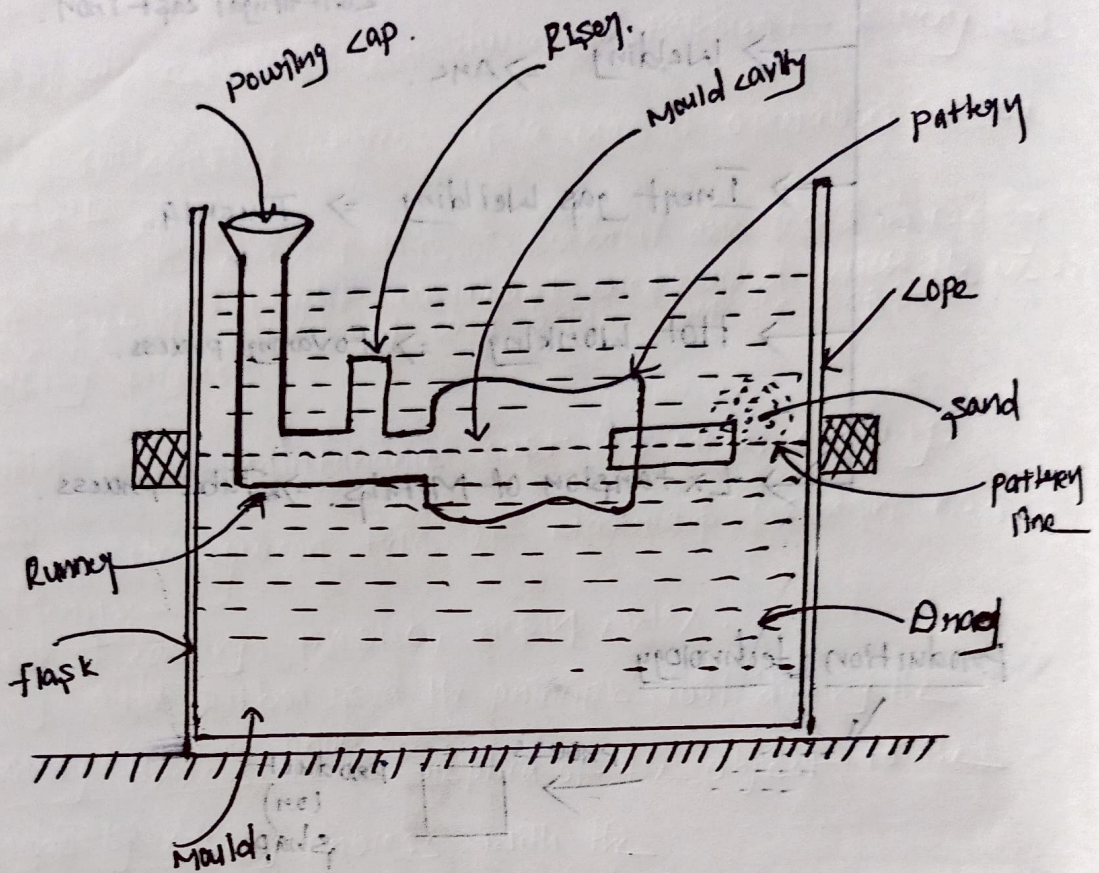
Assistant Professor

Department of Mechanical Engineering

UNIT - I

CASTING

Casting procedure:-



Steps involved in casting process,

- ① Pattern making.
- ② Mold creation.
- ③ Melting & pouring.
- ④ Solidification process.
- ⑤ Ejection & cleaning.

A manufacturing process when liquid material is poured into liquid to solid state the mould solidify into desired shape product and part.

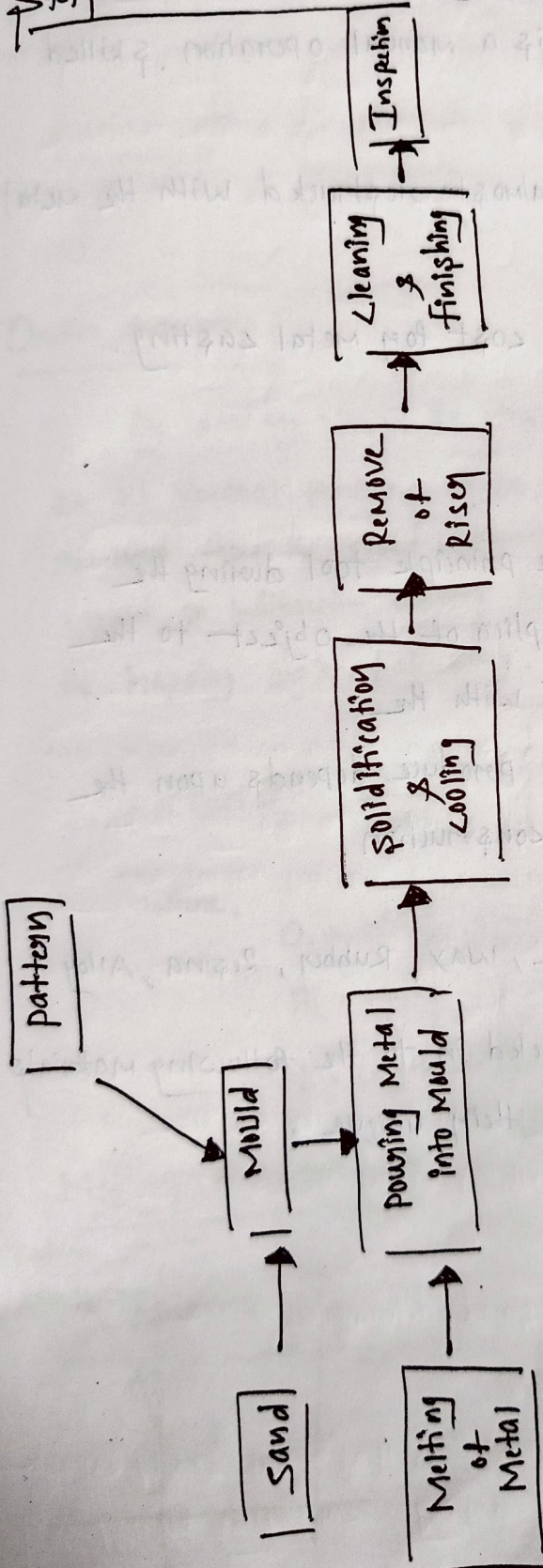
Types of casting:-

The common type of material are used in casting

iron, steel, aluminium and brass for the cast.

* The common type of materials used in non metal casting plastic, resin, wax for the cast.

Steps Involved in casting process:-



* Metal casting process initial investment is very low.

* The Metal casting process initial investment is very low.

* The Metal casting process is a manual operation & skilled doesn't required.

* The size and weight are almost restricted with the metal casting process.

* There is no maintenance cost for metal casting.

Pattern's:-

The pattern is a the principle tool during the casting process to the replica of the object to the made by casting process with the

* The quality of the casting produce depends upon the material of design and construction.

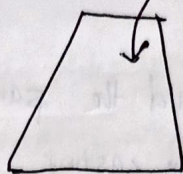
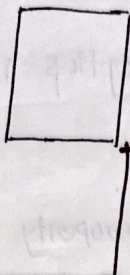
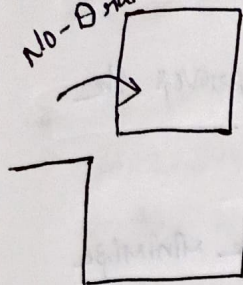
Example:-

Wood, Plastic, Wax, Rubber, Resin, Alloy.

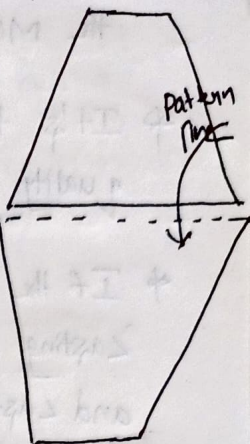
* Pattern can be constructed in to the following materials than each material having their unique:

Draft (on) Taper Allowances :-

No-Draft allowances.



Draft (on) Taper allowances.



Draft Allowances :-

By drafting means the taper provide by pattern make on all vertical surfaces of the pattern. So, that it can be removed from the sand without taking any side of the sand. Mould on without snapping by moulders in mould cavity the trapping angle. [calculating].

$$\tan \theta = \frac{D_2 - D_1}{2L} \Rightarrow \theta = \tan^{-1} \left[\frac{D_2 - D_1}{2L} \right]$$

where,

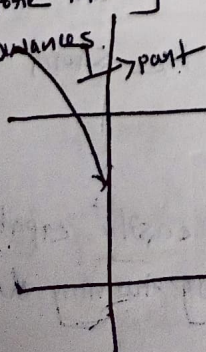
D_1 = Minor diameter.

D_2 = Major diameter.

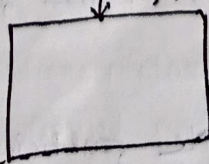
L = length of the specimen.

Machining Allowance :-

Before Machining Allowances.



After Machining Allowances.



During sand casting we use sand as a prepared of the mould.

* It's the mould the sand properties which improves the quality of the casting.

* If the sand of the suitable property is choose minimize casting defects that may produce during the mould preparation and casting.

* Properties of mould sand.

i) Porosity.

ii) Flowability.

iii) Strength.

iv) Adhesiveness.

i) Porosity:-

Some gases get dissolved in a molten metal and when these molten metal starts to solidify these dissolved gases come out of the molten metal and try to escape out of the moulding sand.

ii) Flowability:-

The ability of moulding sand to be have like a fluid when it's pouring the molten metal in mould cavity.

iii) Strength:-

The strength of the sand depends upon the sand properties.

* That should be sufficient so that can easily capable to return it's shape during conveying turning over (or) closing (or) pouring.

iv) Adhesiveness:-

The ability of sand particles get's to stick with another bodies is called "Adhesiveness".

- * The sand should have sufficient Adhesiveness, then it can easily get side of the moulding areas removing of the patterns.

Casting defects:-

The following major defects are in casting one is Gas defects. The Gas defects are evaporated defects (or) porosity defects.

- * A condition existing in a casting caused evaporated Gases, it develops in mould cavity area Blow holes.
- * Blow holes are spherical or elongated cavities present in the casting on the surface (or) inside the casting.
- * Blow holes are it develops porosity.

- * Blow holes porosity occurs due to the displacement of evaporated gases.

Causes of Gas defects:-

i) Metal contain gases:-

The metal contain gases the mould if so harsh, it is high harsh environment.

ii) Shrinkage cavity defects:-

These are caused by liquid shrinkage occurring during the solidification casting.

* The composition properties of the liquid metal is required.

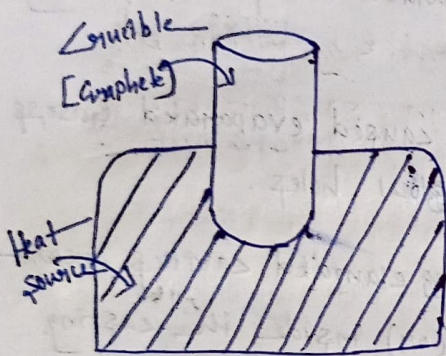
* The for the reason reason is replaced at appropriate placed in mould.

Moulding material defects:-

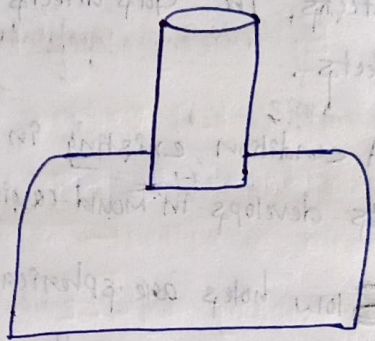
* The moulding defects getting from the moulding sand.

Melting materials:-

Crucible Furnace



Cupola Furnace



* Crucible Furnace are a small capacity chemically used for small melting applications.

* It is suitable for the bath type of boundaries when metal (or) parts required.

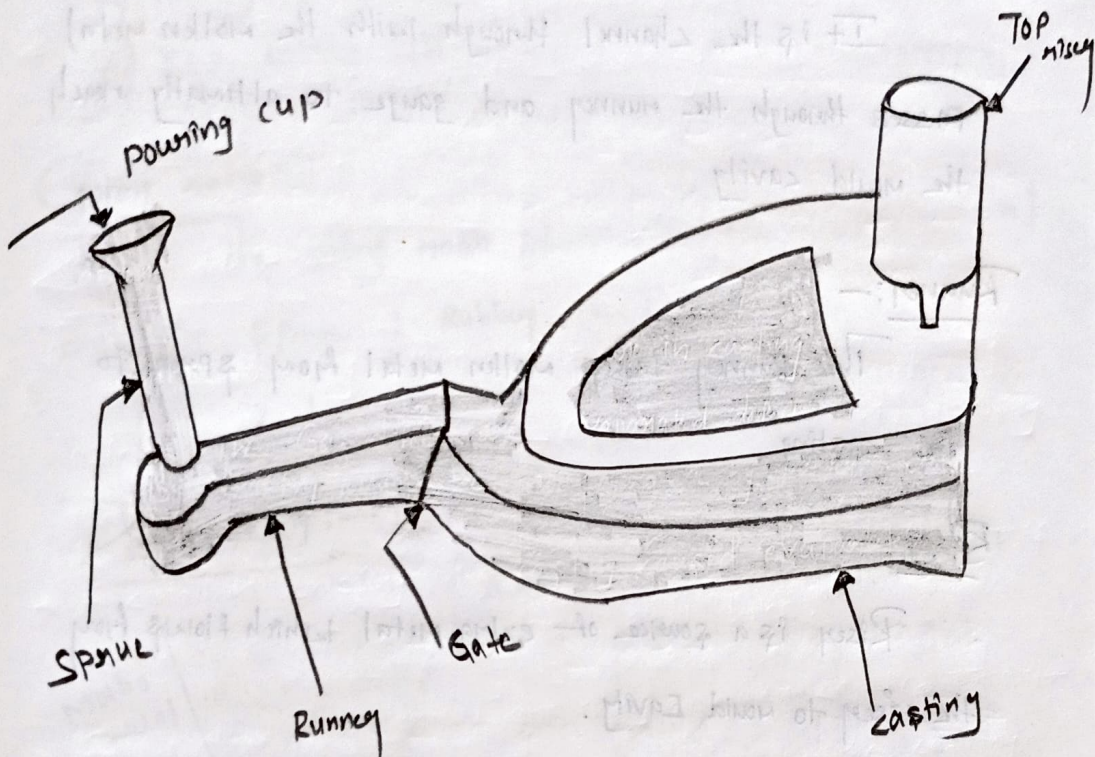
* The metal placed in crucible the crucible is made up of clay (or) graphite.

* The chemical corrosion reactions are avoided by using silicon crucibles.

* The energy applied in directly to the metal by heating crucible

Cope, Gas and electric source.

Gating system



Cast iron [1 : 3 : 2]

Steel [1 : 2 : 2]

Aluminium [1 : 2 : 3]

Gating system in the metal casting used to controlling the flow of molten metal.

- * Gating system refers to all those elements which are connected with the flow of molten metal from mould cavity.
- * The various elements are connected to the gating system that is pouring basin.

sprue, runner, gate, casting, top riser, pouring:

Pouring Basin:

In order to avoid mould erosion, molten metal

is poured into a pouring Basin with acts like a riser very from it's moves smoothly into sprue.

Sprue:-

It is the channel through which the molten metal passes through the runner and gauge to ultimately reach the mould cavity.

Runner:-

The Runner takes molten metal from sprue to the casting.

Riser:-

Riser is a source of extra metal which flows from the riser to mould cavity.

* In the Riser the shrinkage which takes the place in the casting when it starts from the solid metal solidification.

* Without riser the parts of casting will have shrinkage defects, surface defects and internal strength losses.

Purpose of Riser:-

* To remove the Gasses.

* Over flowing pouring Material.

* To provide the pouring.

Gating system:-

The Gating system the open through the with the molten metal enters to the mould cavity.

Types of gating system:-

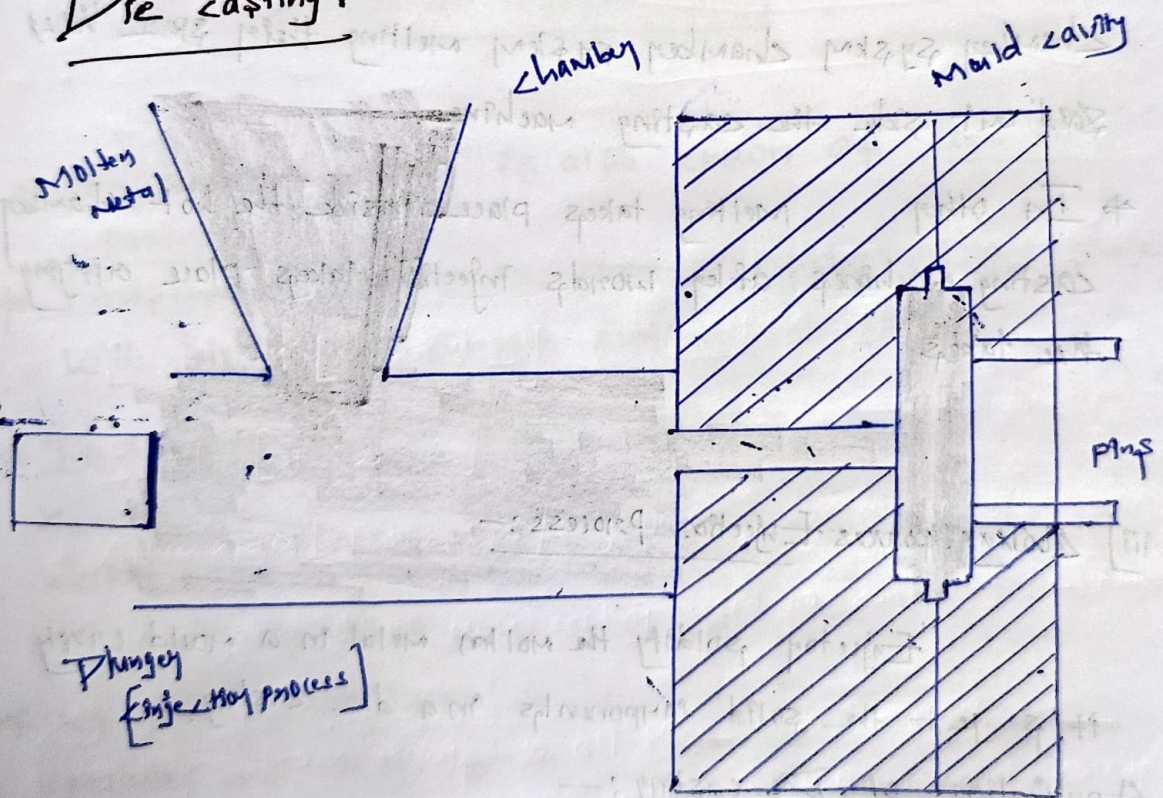
- i) Top gating system.
- ii) Bottom gating system.
- iii) Parting line gating system.
- iv) SLP gating system.

Gating ratio:-

The gating ratio identification of cross sectional area of Sprue : Runner : Ingate

1 : 2 : 1

Die casting:-



Die casting is a metal casting process that is utilise reusable moulds to create a part.

Components of Die casting:-

1. Die.
2. plunger
3. pins

A metal casting process the force into a mould cavity under high pressure to create complex (or) disform.

Steps involved die-casting:-

i) Mould preparation:-

A single cavity moulds are the simplest type of the die mould having one cavity and capable of providing one part per cycle.

ii) Injection process:-

Injection depends on whether it is a hot (or) cold chamber system. In chamber system melting takes place inside the casting machine.

* In other casting machines after moulds injection takes place applying the takes

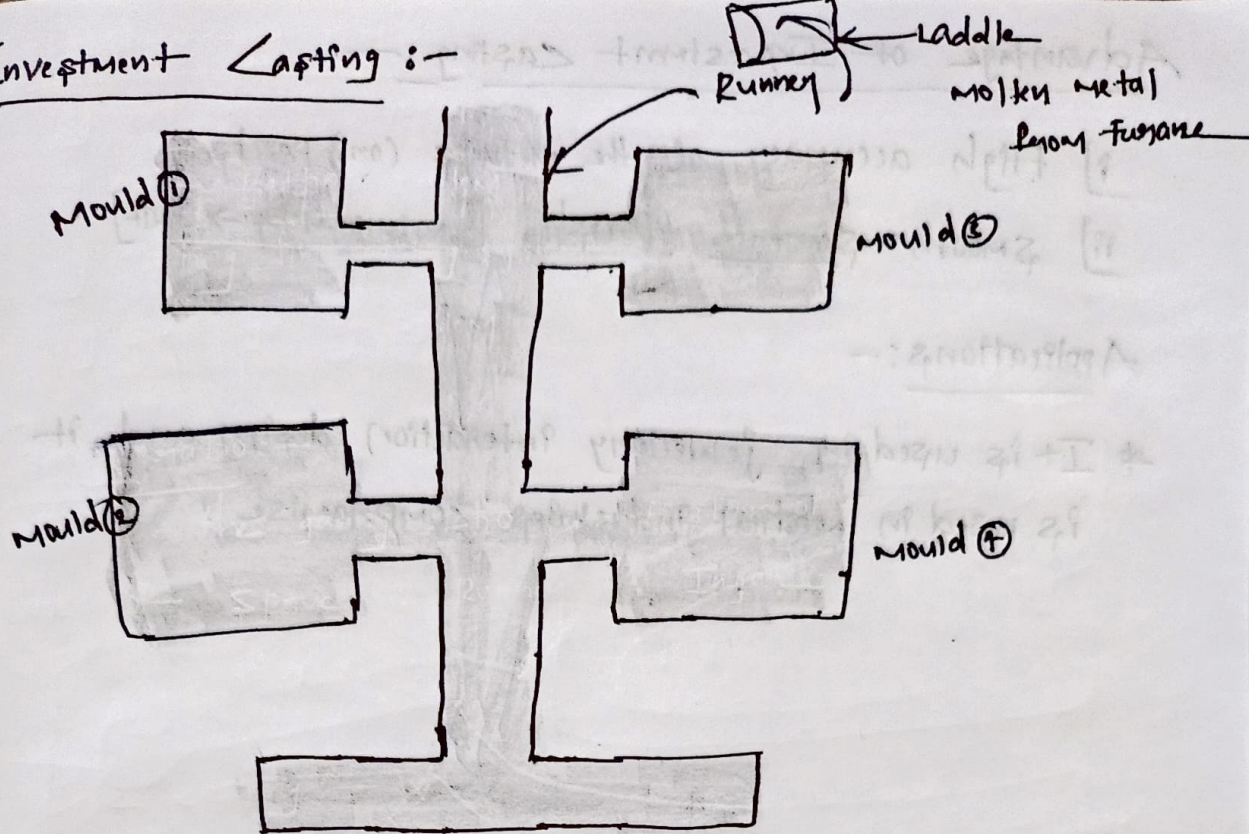
iii) Cooling process Injection process:-

Injector solidify the molten metal in a mould cavity it's get the solid components in a die casting.

Applications of Die casting:-

* Engine cylinder, Engine head, Automobile, Aerospace Industries.

Investment Casting :-



- * Investment casting is also known as Low weight pattern.
- * Investment casting the process creates complex shapes with highly and smooth surface finished.
- * It involves creating a wax patterns coating with ceramic cell melting out the wax and then pouring a molten metal through out the runner it create a mould in the part.
- * Generally Investment casting used in low weight material and less strength, Aluminium, copper then Bronze.

Steps involved in Investment casting:-

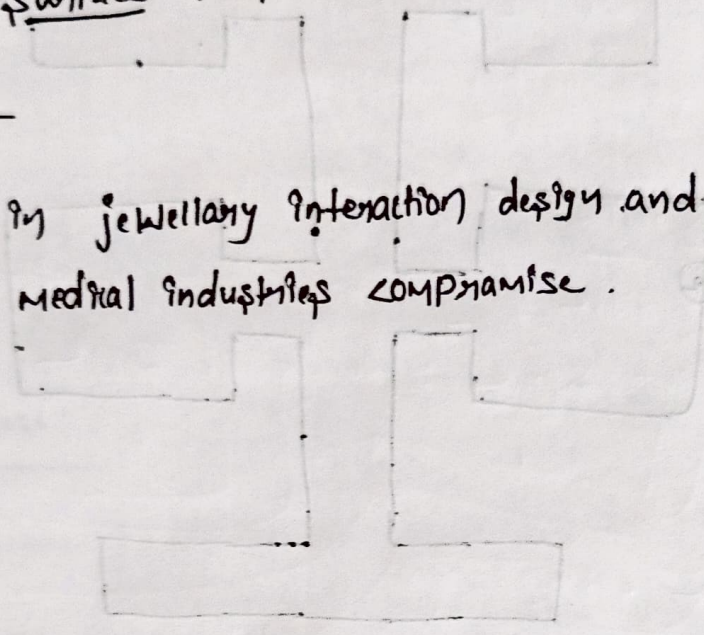
- i) pattern creation.
- ii) Self foundation.
- iii) Dewatering.
- iv) Casting.
- v) finishing.

Advantage of Investment Casting:-

- i) High accuracy of the metal/ (an) parts.
- ii) Smooth surface finish. [micro metry $\rightarrow$ unit]

Applications:-

* It is used in jewellery interaction design and it is used in medical industries compromise.



LIT - II

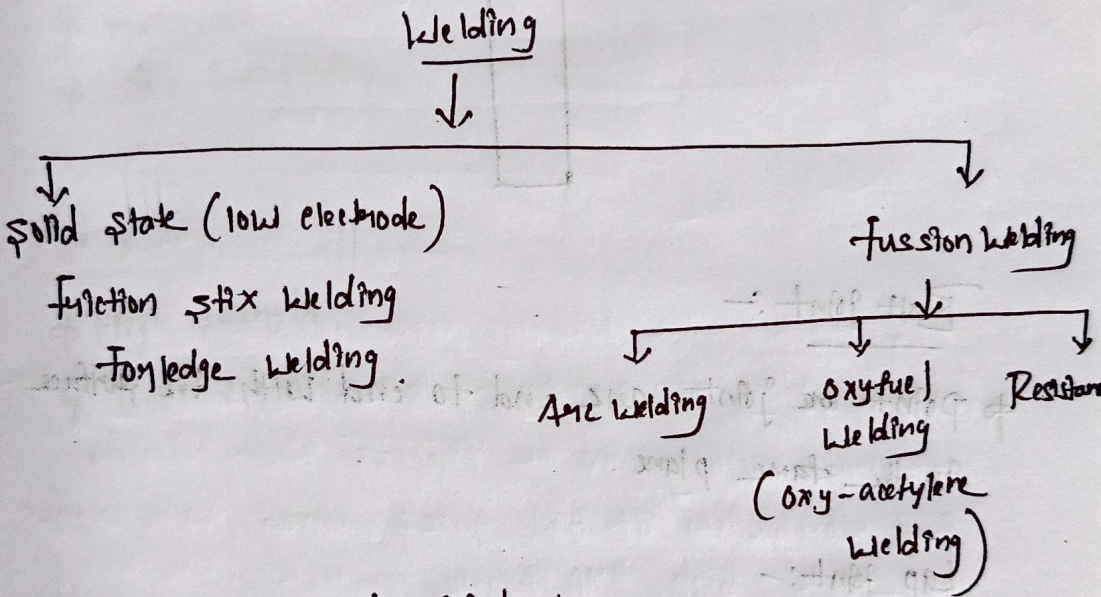
WELDING

WELDING

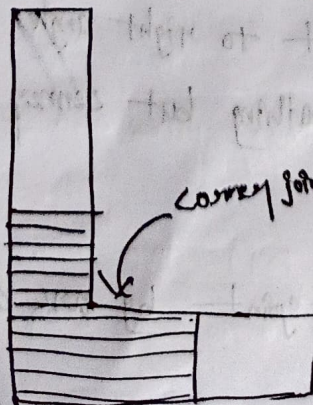
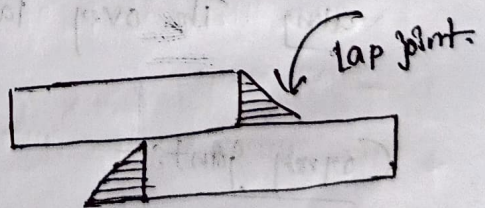
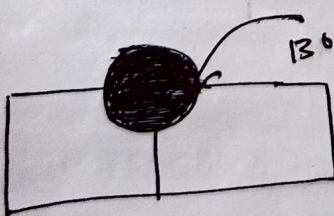
* Joining of one or more material by using heat source is called 'Welding'.

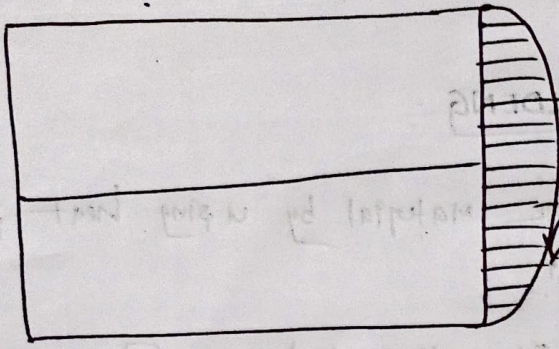
* Welding is a fabrication technique. The process joining material as usual metal by melting. The part together and allowing. Then to cool as a fusion.

The following classification.

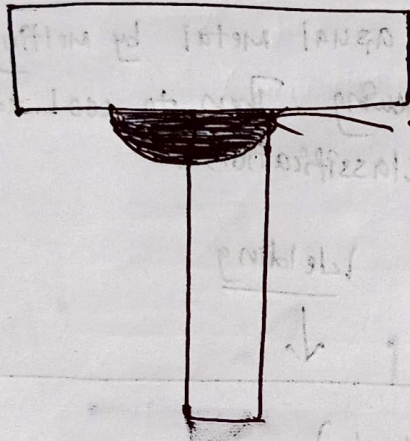


Welding joints :-





Edge joint.



Tee joint.

Butt joint :-

Two parts are joint end to end with the surface in the same plane.

Lap joint :-

Two parts are over lapping each other and are welding along. The over lapping area.

Corner joint :-

Two parts are joint to right angle from the corner. The process is called corner joint.

Edge joint :-

The parts are joint by their edges of an area.

for carry thin layer join together nothing edge joint.

Tee joint:-

• The parts are placed perpendicular to other formation of Tee shape is known as Tee joint.

Application:-

Welding joint use for an applications for different,

- Automobiles.
- Automoto.
- Any industries.

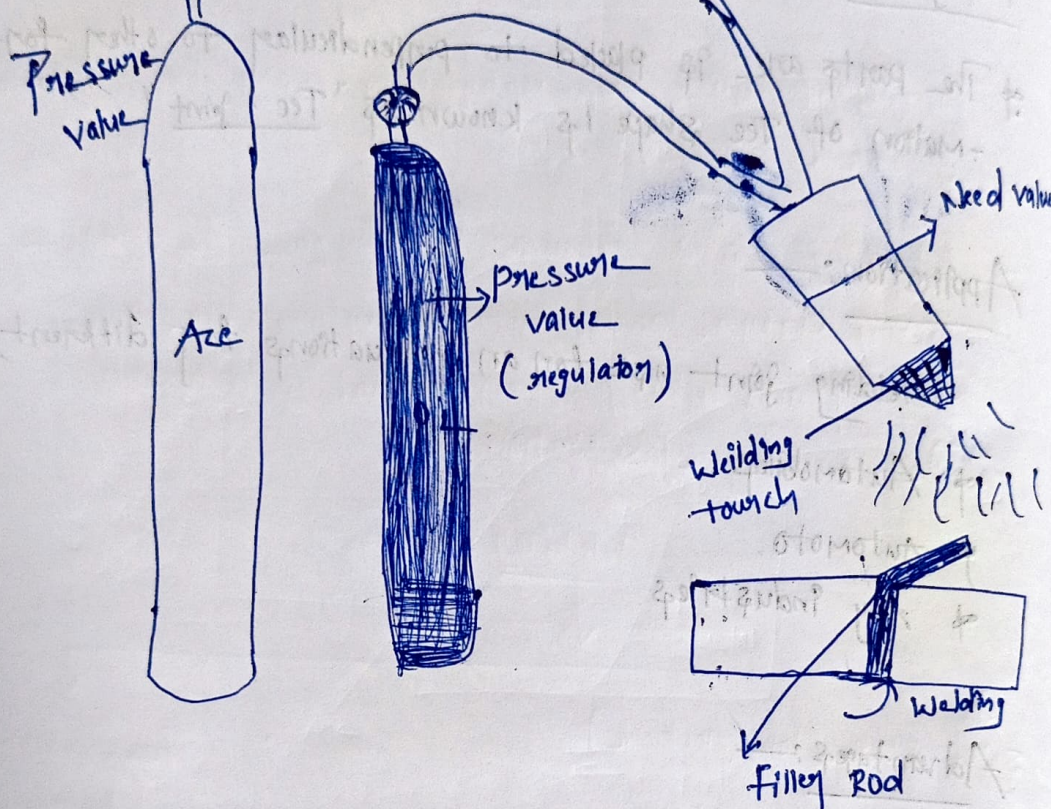
Advantages:-

• High strength.

• Cost effective & very low.

Gas Welding - (oxy fuel welding) :-

(oxyacetylene welding)



- ✦ Gas welding or an oxy fuel welding (or) Acetylene welding is a process that involves that combustion of fuel gases mixed with oxygen to create high temp flame.
- ✦ The flame is used to use the flame used to melt the edges of the metal pieces with joint filling rods.
- ✦ The process is performed to without gas cutting.

Construction:-

- Joining of beam pipe and structure of elements
- (or) fabrication.
- ✦ L-shaped metal (or) And funnels due to it is pressure and control the over heat.

Equipments in :-

→ Oxygen Welding Cylinder :-

It supply O_2 for combustion,

→ Acetylene Cylinder :-

Supply the fuel gas

⇒ pressure regulator (on) pressure wall.

⇒ It's a containing the flow of gas's.

Need value :-

⇒ Need value.

⇒ It is containing the combustion fuel and oxygen.

⇒ It is also develops different kind of flames.

Welding torch :-

⇒ Mixing the gas's and direct flames to the work piece.

Applications :-

→ For repairing the defect system other metal compounds.

Advantages of gas welding :-

→ Gas welding can be Acetue without electric city.

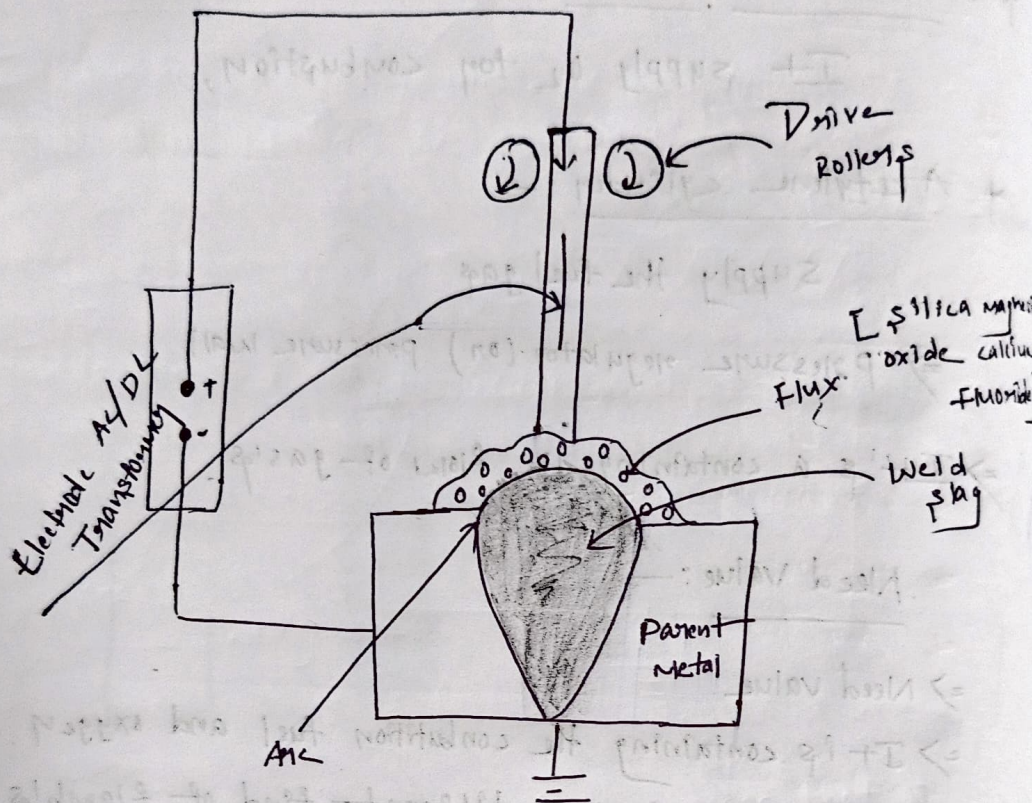
→ Gas welding can be use's different material of weld.

Disadvantages of Gas welding :-

→ It involves flammable gas's with can be process with cannot handle the proper way.

→ The maximum temperature method is lower than of some electric welding method.

Submerged Arc Welding :-



Submerged Arc welding is used for the production of long continuous welding. In case the core of electrode is 1.525mm thickness in the form of continuous wire is used for the work.

- ✦ The Arc is struck b/w the electrode wire and work piece under the arc made up of silicon and other elements.
- ✦ Flux is fed powder form at the electrode. The flux is made of the arc metal's productivity welding coating and slag.
- ✦ The slag is essentially decomposed from the fused weld. The flux is recovered and reused.
- ✦ The rate of cooling on the weld metal is slow and also protect from the atmosphere while cooling.

* The principles of submerged arc welding automatic feeding device in a dip electrode and base metal.

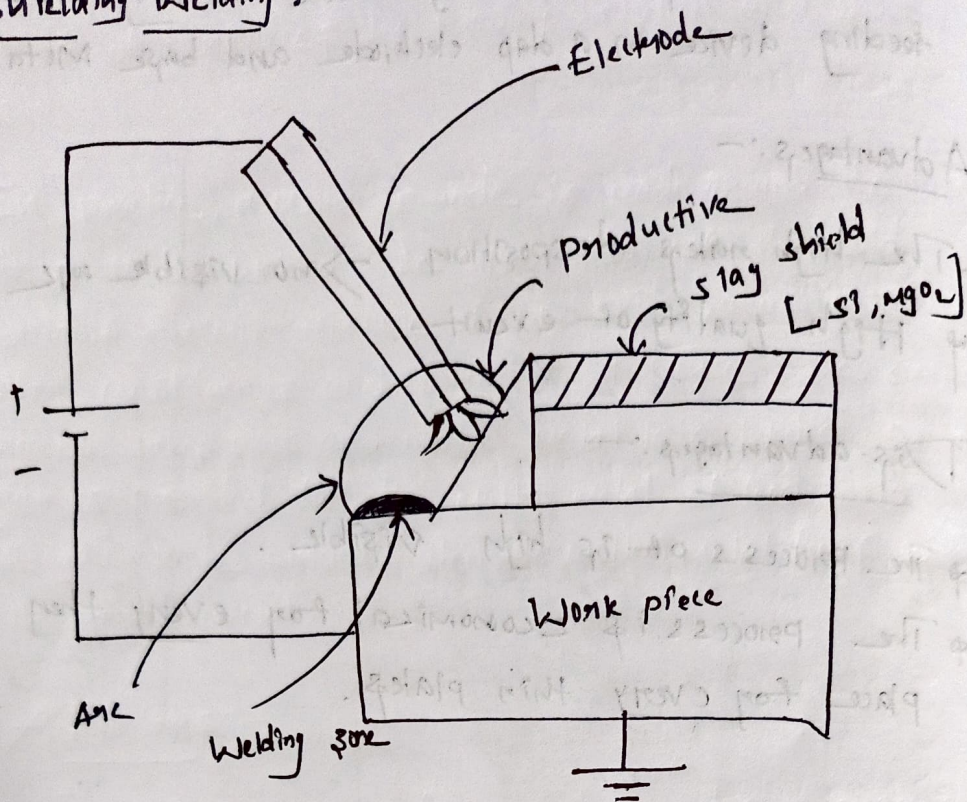
Advantages:-

- * The high rates deposition $\rightarrow$ no visible arc
- * High quality of exert.

Dis-advantages:-

- * The process of is high visible.
- * The process is economical for every thin plate.

Shielding Welding :-



Shield welding is a welded process that is nothing but shielded metal (or) weld. The shield welding that covers protective material over the slag material protect from environment's effects.

✦ A electric arc formed betw the fluxes or coated electrodes consumable and the work piece.

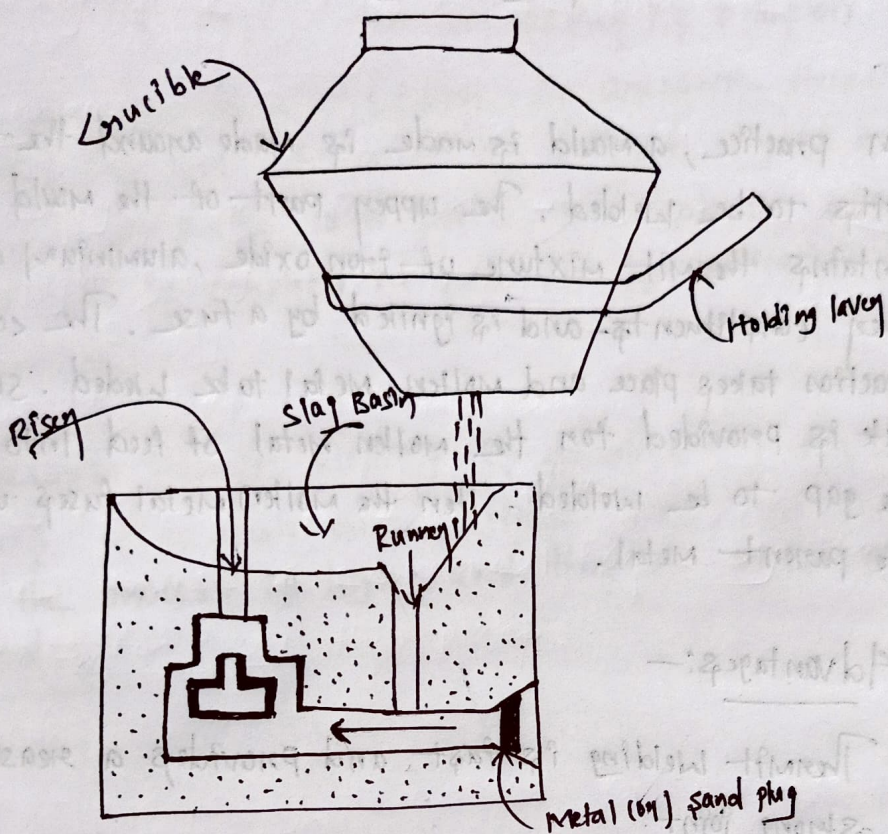
Shielding :-

The flux with in the wire produce shielding gasses and slag protect the weld on it can be combined with and external shielding gasses.

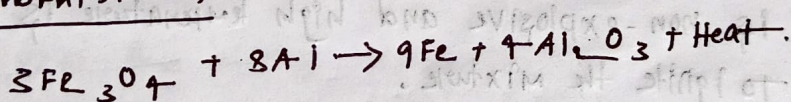
Applications :-

This is semi automatic process it is used in constructional pipe joints.

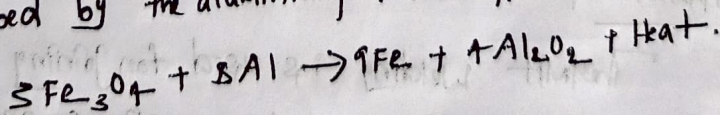
Thermit welding :-



Exothermal reaction :-



Thermit welding is based on exothermic reaction in which heat is generated. If a mixture of iron oxide and aluminium powder is ignited, then the two materials would react exothermically. Once started, the reaction is rapid and continuous until all the oxygen from iron oxide is absorbed by the aluminium. The typical reaction is,



Thermit reaction is non-explosive and completed in 1 minute irrespective of quantity involved, and temperature reached is of the order of 3000°C . In the process a large amount of heat is liberated to melt both the iron and aluminium oxide to a very fluid state. Due to different in densities, slag floats on the top with the molten steel settling

below. The hot molten steel is cast into a mould, welding the ends of workpieces by flowing between and around them.

* In practice, a mould is made is made around the two parts to be welded. The upper part of the mould contains thermite mixture of iron oxide, aluminium and other constituents and is ignited by a fuse. The complete reaction takes place and molten metal to be welded. Suitable gate is provided for the molten metal to feed into the gap to be welded. Then the molten metal fuses with the parent metal.

Advantages:-

- * Thermite welding is fast and provides a reasonably strong joint.
- * The process is considered safe because thermite reaction is non-explosive and high temperature is required to ignite the mixture.

Disadvantages:-

- * Process is complex due to preparation of mould.
- * Not economical for thin sections.

Applications:-

Thermite welding is used for joining thick sections and repairing of large castings and steel structures. It is particularly suitable for joining rails at site and to weld large fractured crank shafts. It is also used for welding pipes.

Pressure thermit welding:-

The process described so far is a fusion i.e., non-pressure thermit welding; In pressure thermit welding, the heat of reaction is utilised only to heat the ends of parts to be joined to a plastic state, and weld is completed in solid state by application of pressure.

* Pressure thermit welding is suitable only for work pieces with small cross-sectional area; Also the cost of the process is high, and therefore it is rarely used. y.

~~Pressure thermit welding~~

UNIT - III

INERT GAS WELDING

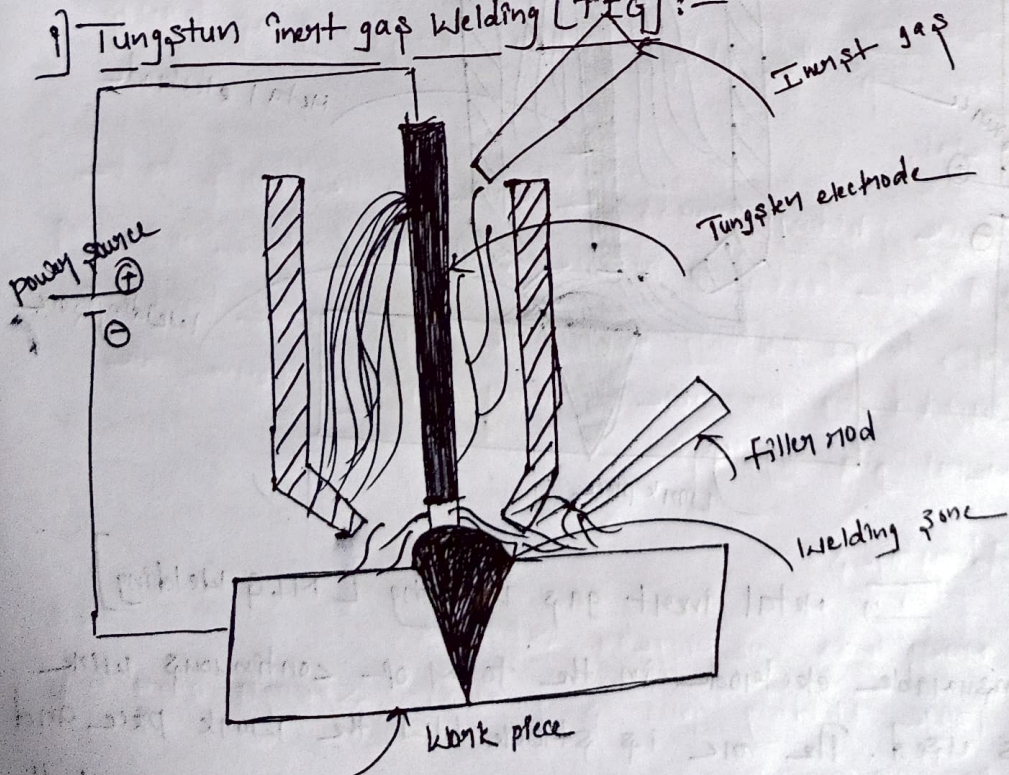
INERT Gas Welding.

All the Arc welding process the arc is shielded from the surroundings & take to obtaining joint. The Gas shielded arc welding is over from the out-formic process by cover welded zone with a blanket of Gas.

* Argon, Hydrogen, helium and carbon dioxide.

* Argon (or) helium gases the weld metal protected from the atmosphere with non consumable electrode (or) consumable electrode.

* The following classification the inert gas welding is as follows that is i) Tungsten inert gas welding [TIG].
ii) Metal inert gas welding [MIG].

i) Tungsten inert gas welding [TIG] :-

2] The tungsten inert gas welding [TIG welding] is an improvement of manual metal arc welding it uses non consumable electrode and the arc is struck b/w electrode and work. The arc and weld zone is shielded by argon or helium gas and the weld metal is protected from the atmosphere thus TIG welding can be carried out without using flux material.

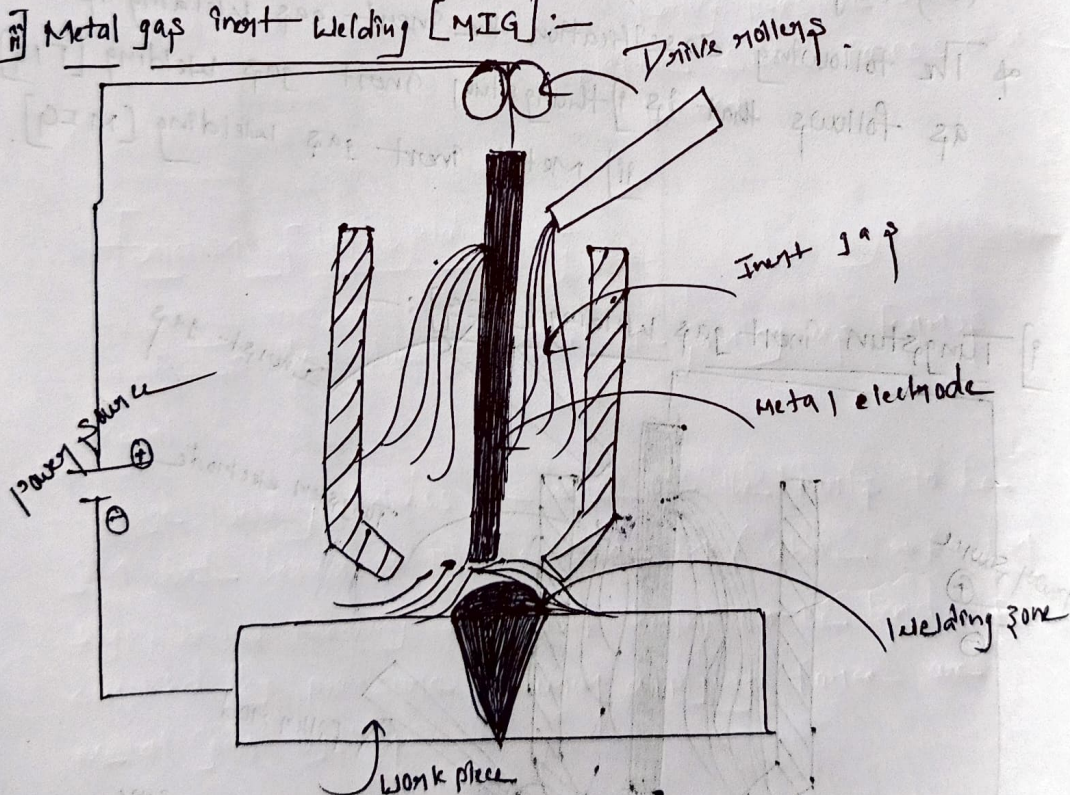
Advantages:-

* No flux is used, and no cleaning of the joint is required after the weld is made.

Disadvantages:-

* All joints require proper cleaning before welding as the inert gas does not provide fluxing (cleaning) action.

3] Metal gas inert welding [MIG]:-



In metal inert gas welding [MIG welding]

consumable electrode in the form of continuous wire is used. The arc is struck b/w the work piece and the wire acts as electrode and filler material, and the

arc and weld pool are shielded by inert gas. Depending upon the wax material. The shielding gas may be argon, helium and carbon dioxide.

* The principle of MIG [Metal inert gas] welding is illustrated in fig. This process of also be referred as gas metal arc welding [GMAW]. In this case, the bare metal electrode consumable electrodes in the form of continuous wire is led through welding torch [Gun] with the help of electrode is "work" piece are connected to electrical supply. The gas from the cylinder is supplied through nozzle to form a protection shield around the weld area. Welding argon is generally used for non-ferrous metals, but helium is preferred for copper. Ferrous metals the carbon dioxide or mixture of argon and CO_2 gas is used as shielding.

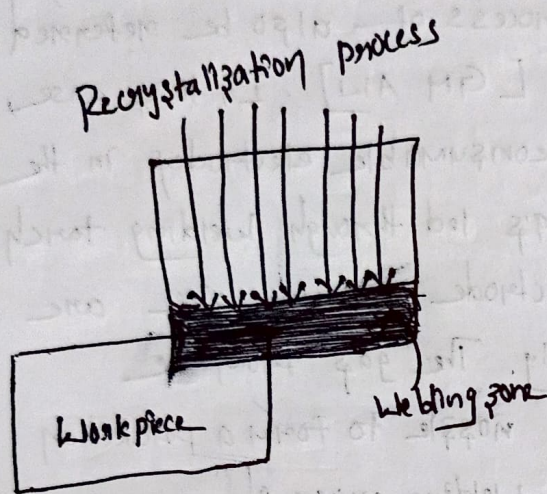
Advantages:-

- * Process is very rapid than TIG and other welding due to continuous feeding.
- * Deep penetration of weld and produced is of better quality.
- * The use of bare electrode and shielding gases eliminate the slag on the weld bead and thus ideal process for multi welding passes on the same joint.
- * Welding can be done in all positions.

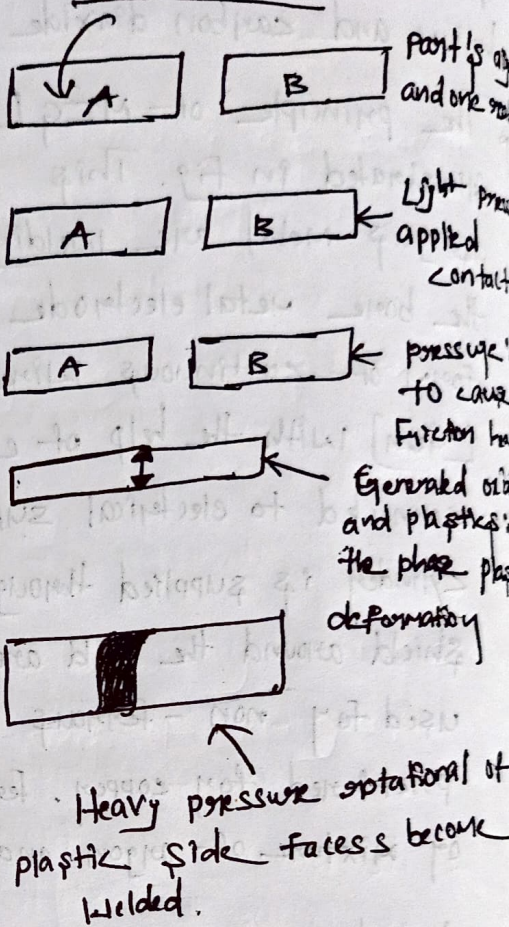
Disadvantages:-

- * Equipment cost is high.
- * Not suitable for outdoor work as the strong wind may break the shield.

Forge welding



Friction Welding



Friction Stir Welding :-

It's the oldest metal of joining as ferrous metal.

Forge welding process the hence of the parts to be join base heated to plastic state in (above reflow temp, below melting reflow temp) on the bend is completed by pressure hammer applying force on metal join together.

Advantages :-

- Much less residual stress.
- Forge welding join as greatest strength other than fusion welding.

* In Forge welding force material are very less, compare to other process.

* welding time is much longer than other process.

* Forge welding process required by skilled laboury.

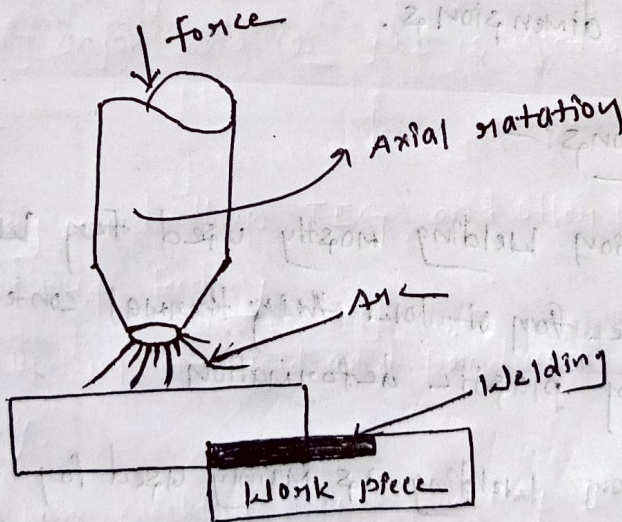
Application:-

* Forge welding used for low carbon steel and white carbon steel.

* In the Forge welding process used for brittle materials like copper, aluminium etc..

* Forge welding is normally in Engineering industry.

Friction welding:-



* Friction welding is depends the heat generated by the friction.

* Friction welding one piece rotate other piece make the contact with primary piece.

* The two pieces closely contact with in maintain axial forces, Rotate force, during rubbing heat is generated.

* The frictional heat causes to attend welding temp

900 to 1000 heat end of the joint.

Advantages:-

- * Friction welding capable of welding a dissimilar (or) like similar materials joint together.
- * Friction welding simple equipment.
- * Friction welding low energy requirements other welding process.

Disadvantages:-

- * The Friction welding is limited welding circular sections are suitable for small sizes of welding upto 150mm dimensions.

Applications:-

Friction welding mostly used for welding steel bars because of low thermal conductive and greater plastic deformation.

- * Friction welding is mainly used for automobiles for welding shapes, walls, tubes and pipes.

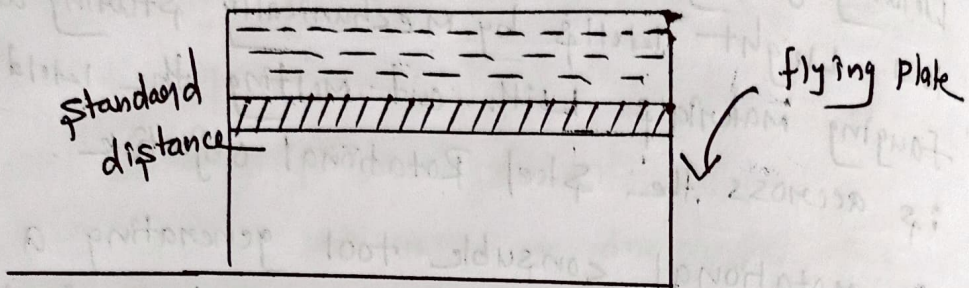
Friction welding :-

- * Friction welding (FSW) it is a solid state of welding joining process that rotate high strength low weight welds by mechanically stirring and forging materials with out melting the welding is across the steel rotational objective.
- * A rotational consumable tool generating a rotational non consumable heat through the friction.
- * The materials sitting below the melting point slow can be fused into continue joint.
- * It's suitable joint of metals are dissimilar metals are particularly suitable aluminium alloys Aerospace and automotive applications.

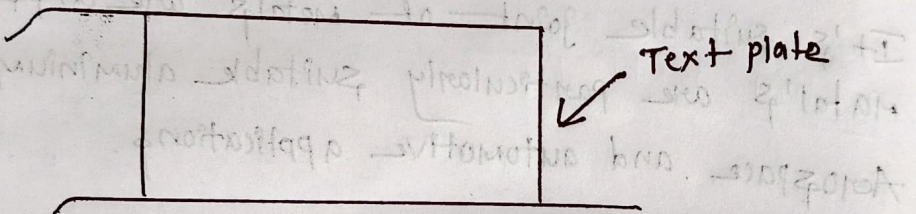
Solid state	Fusion	Other.
Forge Friction * Use can't use fillet rod. * Deformation (plastic). * Time taken process.	ARC welding Submerged arc welding TIG & MIG Gas. Shielding welding. * Use can use fillet rod * Melting.	Thermitt * Thermicaps.

Explosive Welding:-

i) Parallel standard distance

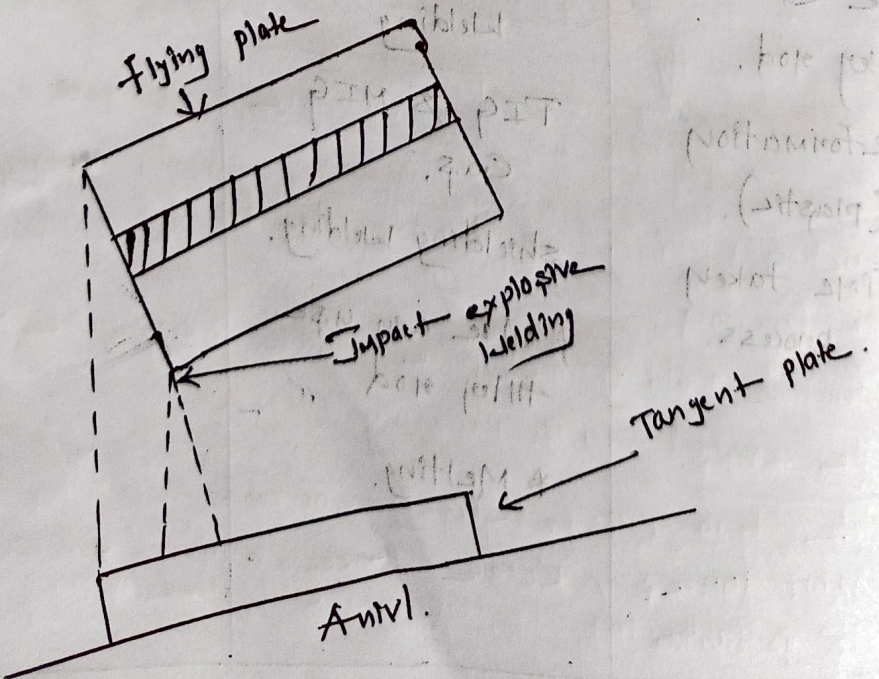


ii) Contact explosive welding



Anvil.

② Angular stand of distance



An explosive used the force and ~~work~~ controlled the explosion effect the weld the two plates ~~are~~ arranged.

- * Tangent plate another one is fly plate the two plates are arranged in the explosive charge.
- * A tangent plate is normally fixed and the fly plate infinite to it source. The fly force impact on tangent plate with on it deformation welded together.
- * The fly plate progressively high velocity.

Advantages:-

- * In process of welding large plate of metal.
- * The welding process joining dissimilar and high melting point of temp constance, Tixeline.

Application:-

- * Welding is used in titanium to steel, aluminium to copper.
- * The Industry explosive welding by included by metallic this breaks, automobiles plastic is industry.