LECTURE NOTES

ON

PRODUCTION TECHNOLOGY

PREPARED BY

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Production Technology

Production technology refers to all measures and facilities for the industrial production of goods that transfers scientific knowledge in to technological controlable and economically usable production system.

UNIT-I
Metal Forming process

Metal forming is a process where materials are subjected to plastic deformation to obtained the required size; shape and change in physical appearance.

The processes are used in metal forming generally drawing, forging, rolling, bending, extruding.

Extrusion:-

Extrusion is a metal forming process in which metal or work piece is forced to flow through a die to reduce its cross-section or convert it in to desire shape.

This process is extensively used in pipes and steel rod manufacturing. The force used to extrude the work piece is compressive in nature.

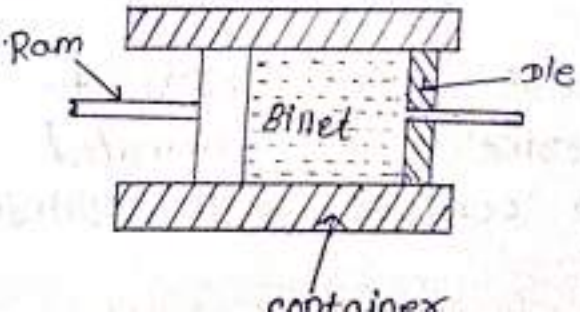
Types of Extrusion

Extrusion process can classified in to following types:-

According to the direction of flow of metal this process is ~~are~~ classified in two types.

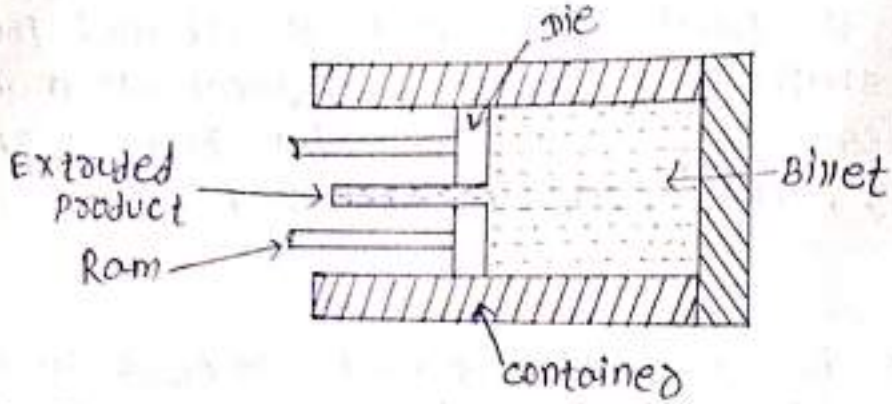
(i) Direct extrusion
(ii) Indirect extrusion

(1) Direct extrusion:-



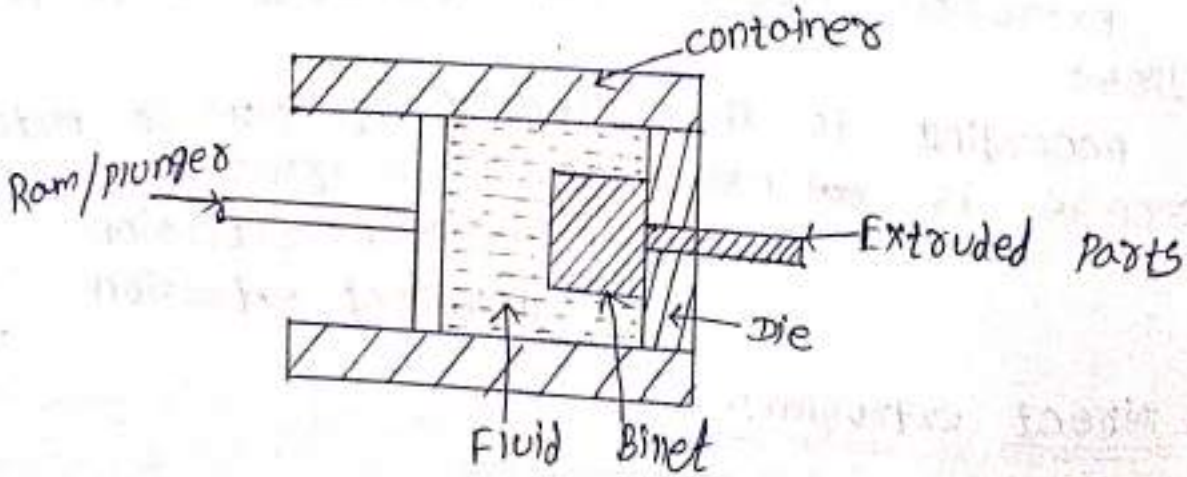
In this type of extrusion process metal is forced to flow in direction of feed of punch. The punch or Ram moves towards die during extrusion and the liquid metals or billets move out in the direction of pressure of ram. This process requires higher force due to higher friction between billet and container.

(b) Indirect extrusion :-



In this process metal flows towards opposite direction of plunger or ram movement. The die is fitted on opposite side of punch movement and the metal is allowed to flow through angular space between punch and container.

© Hydrostatic extrusion :-



This process uses fluid to apply pressure on billet, the friction is eliminated because the billet is neither contact with cylinder nor plunger.

There is a fluid provided in between the billet and the plunger. The plunger applies force on fluid which is further applied on billet. The pressure transmitting fluids common use for hydrostatic extrusion are glicerin, ethyle glicer, castrol oil with 10% alcohol and isopaintain.

④ According to the working temperature extrusion is two types. (i) Hot extrusion
(ii) cold extrusion

(i) Hot extrusion :-

If the extrusion process takes place above recrystallization temperature which is about 50% to 60% of its melting temperature, this process is known as hot extrusion process.

(ii) cold extrusion :-

If the extrusion process takes place below recrystallization temperature or room temperature that process is known as cold extrusion process.

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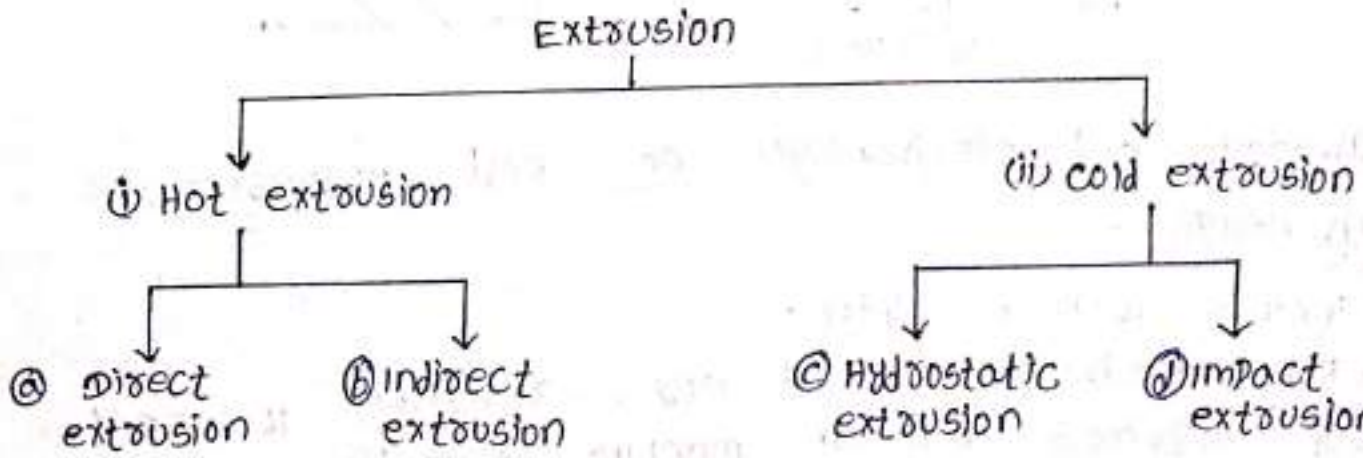
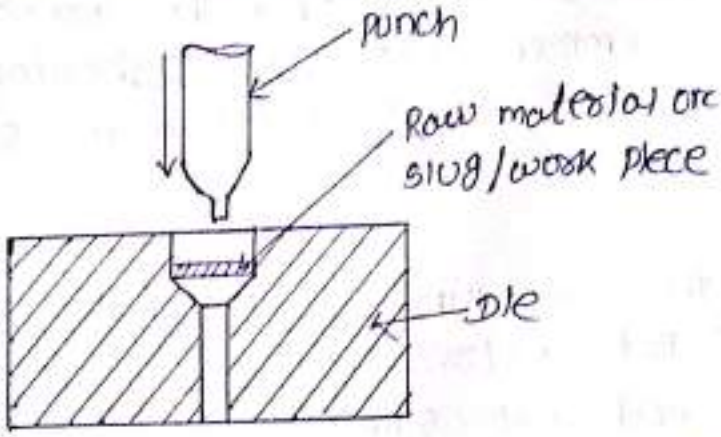
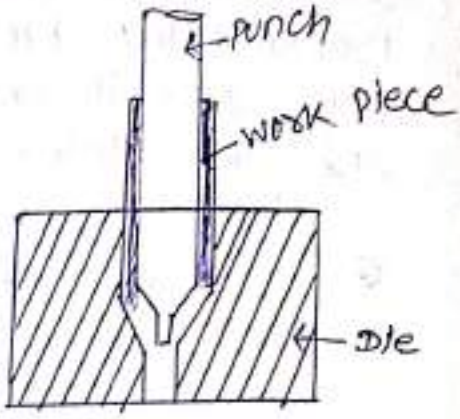


Recrystallization :-

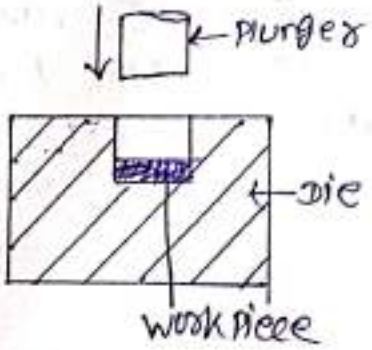
Recrystallization is a procedure for purifying an impure compound in a solvent.

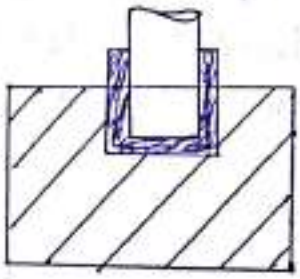
⑦ Impact extrusion





The impact extrusion is perform using a punch and a die as shown in figure. The material is placed in the die and punch is struck from top with high pressure and speed, and the metal will flow up and fall cup shape over the punch which is remove later.





⑧ Advantage and disadvantage of cold extrusion :-

Advantage :-

(i) include surface finish.
(ii) High production rates and relatively low cost.
(iii) It requires minimum machine operations.
(iv) Improved mechanical properties.
(v) No oxidation at metal surface.

Disadvantage :-

(i) Higher force required
(ii) Lubrication is required

Advantages and disadvantages of hot extrusion process:-

Advantage:-

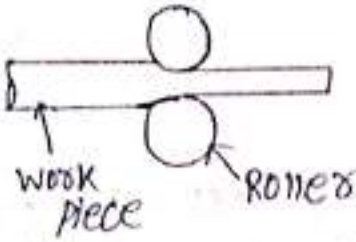
(i) Low force required compair to cold working process.
(ii) Easy to work in hot working process / extrusion process
(iii) The product is free from stain hardening.

disadvantages:-

(i) Low surface finish due to scale convention from extruded parts.
(ii) Increase die wears.
(iii) High maintainance required.

Rolling

Rolling is the process of compressing the metal by passing in between the two or more revolving rolles or cylinders as the result the area of cross-section gets reduced and length is increases.



Rolling is normally a hot working process where heated metal is passed between two rolls, rotating in the opposite directions and the gap between the rollers is some what less than ~~the~~ thickness of metal and entrance. Thus the rolled will squeze the work piece and reduces the area of cross section and also increases the length.

Types of Rolling

There are two types of rolling.

(i) Hot rolling
(ii) Cold rolling
(iii) Thread rolling
(iv) Ring rolling.

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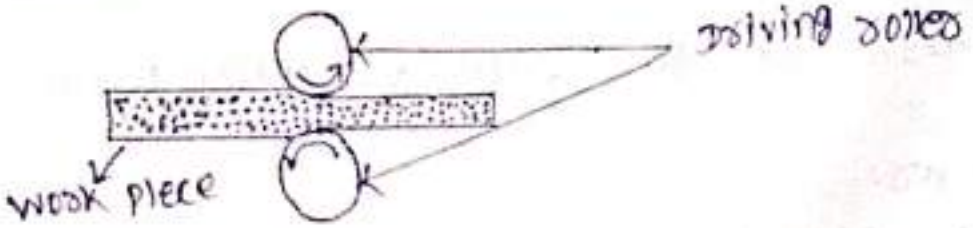
(i) Hot Rolling :-

The rolling process in which metal passed between the roller is heated above its recrystalization temperature, then the process is called hot rolling process.



→ The surface finish is not well. Because formation of scale on the surface of the work piece. Close tolerance on dimensions can't be achived due to thermal expanation and shrinkage of metal.

Application :-

It is widely used for ferrous and nonferrous Metals.

(ii) Cold Rolling :-

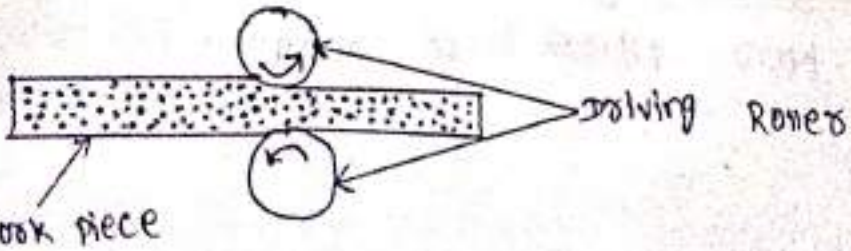
It is a type of rolling process in which Metal passed in between the rollers as a temperature below recrystalization temperature.

→ Sheets can be made with better surface finish

→ The hardness yield strength, tensile strength of the material increases.

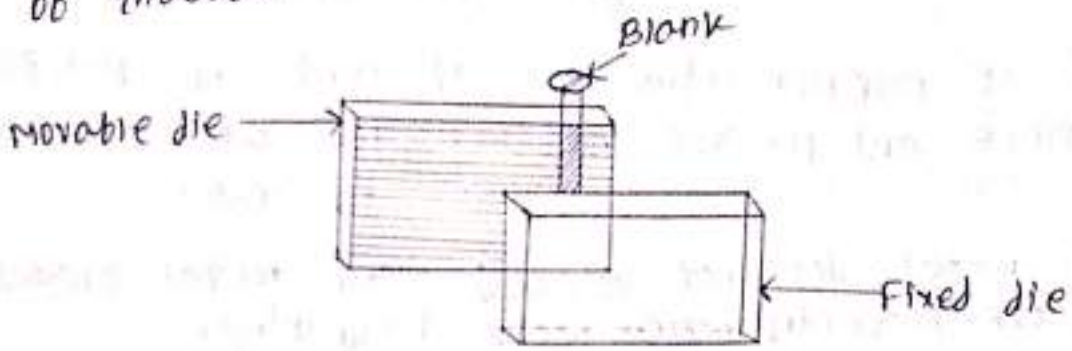
→ Ductility decreases.

→ It is widely used for nonferrous metals and alloys.



(iii) Thread cutting rolling :-

It is a cold forming operation in which threads are formed by rolling a blank in between hardened die. That causes the metal to flow radially desired shape. This process mostly used for the production of threads.

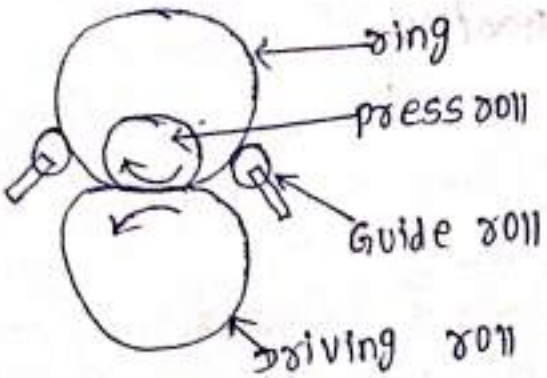


→ Threads are formed by dies on the surface of work-piece by penetrating action of the dies. This process is used for making wood screw, machine screw, sheet metal screw.

→ In this process lubrication is also important for good surface finish to minimize defect.

(iv) Ring rolling :-

In this rolling process one roll is passed through the hole of a thick walled ring and second roller presses on it from the outside. In this process the thickness of the ring is reduced and its diameter will increase when the roll squeezes and rotates.



(*) Difference between hot rolling and cold rolling.

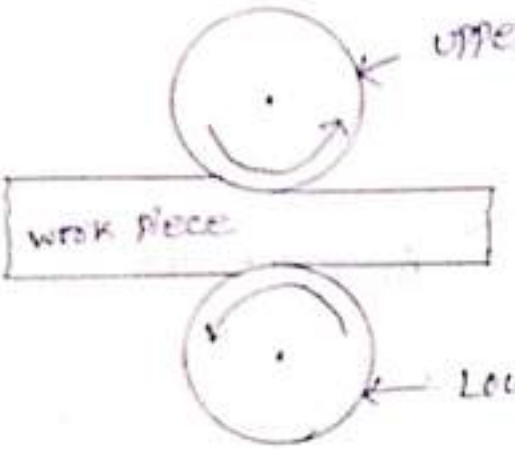
Hot rolling	Cold rolling
(i) Metal is heated above the recrystallization temperature and is fede to the rolls.	(i) In cold rolling operation metal is heated below the recrystallization temperature and then fede to the rolls.
(ii) Coefficient of friction between the work piece and the roll is high.	(ii) Coefficient of friction between the work piece and the roll is less.
(iii) Hot rolled metal does not show a work hardening effect.	(iii) Cold rolled metal shows work hardening.
(iv) Closed dimensional tolerance can not be archived	(iv) Closed dimensional tolerance with better surface finish can be achived.
(v) Roller radius is large.	(v) Roller radius is smaller.
(vi) Poor surface finish due to scale on it.	(vi) Smooth and oxide free surface can be obtained.
(vii) Heavy reduction in cross-sectional area is possible in hot rolling.	(vii) Heavy reduction in cross-sectional area is not possible in cold rolling.
(ix) Due to high friction coefficient, shearing of metal can take place.	(ix) Due to low friction coefficient shearing of metal does not take place.
(x) It is difficult to carry out theoritical ~~pass~~ experiment as for each pass, the yield stress varies with temperature.	(x) It is easy to carry out theoritical experiment.

Types of Rolling Mills

Rolling mills are classified in to following types according to their arrangements :-

(i) Two high rolling mills
(ii) Three high rolling mills
(iii) Four high rolling mills
(iv) Clusted rolling mills
(v) Planetary rolling mills
(vi) Two high reversible rolling mills.

(i) Two high rolling mill

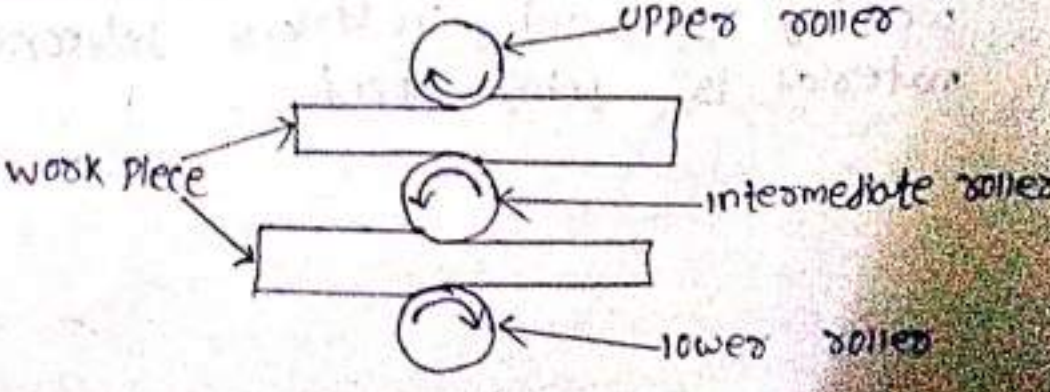


It contains two heavy rolls fixed one over the other and the rollers are supported in bearing houses which are fixed in the frame.

→ The vertical gap between the roller is adjustable and the rollers rotates in opposite directions and are driven by electrical motors.

→ The direction of rotation of roller can not be changed, therefore the workpiece has to fed in to the rollers from one direction only.

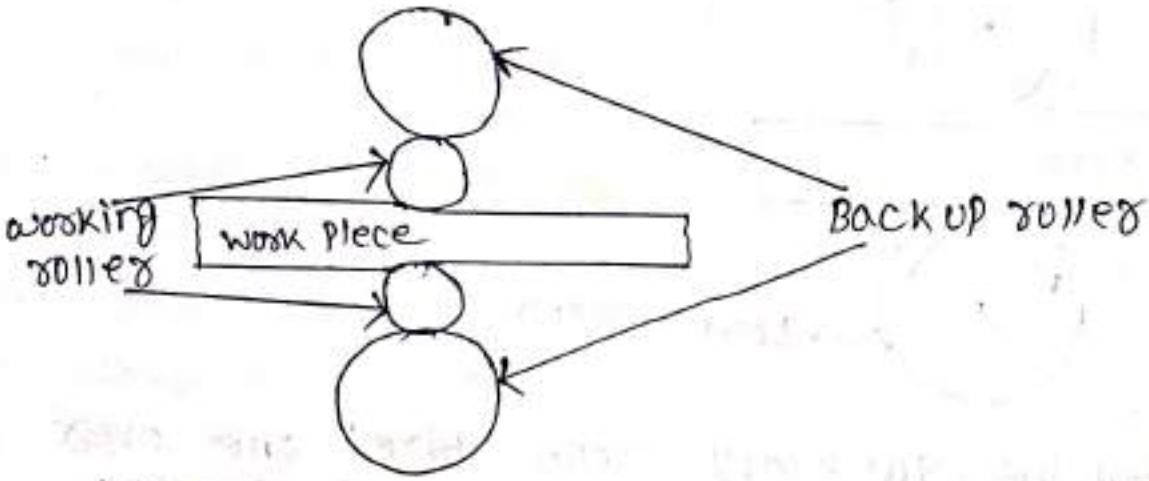
(ii) Three high rolling mill



A three high rolling mill upper and intermediate roller rotates in the opposite direction and also lower and intermediate roller rotates in opposite direction. But upper and lower roller rotates in same direction and rollers are fixed the bearings. This type of rolling mills used to give to continuous passes to the metal.

→ The advantages of this mill is that work piece can be fed in one direction between the first and second rolls and the return pass can be provided between the second and third rolls.

(iii) Four high rolling mills



Backup roll :- Back roll is a roll that supports working roll for the purpose of avoiding deflection of the working roll and affecting the yield and quality of the plate and strip rolling mill.

The mill has four no. rolls from which two smaller diameters and remaining two larger rollers and the larger diameter roll are called back up roll and the smaller diameter roll are called working rolls. Back up roll holds the working roll and restricts deflection when the material is being rolled.

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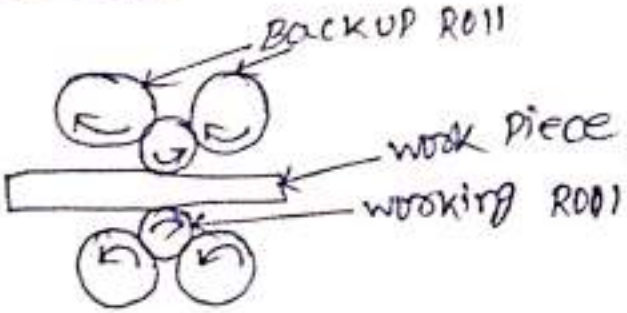
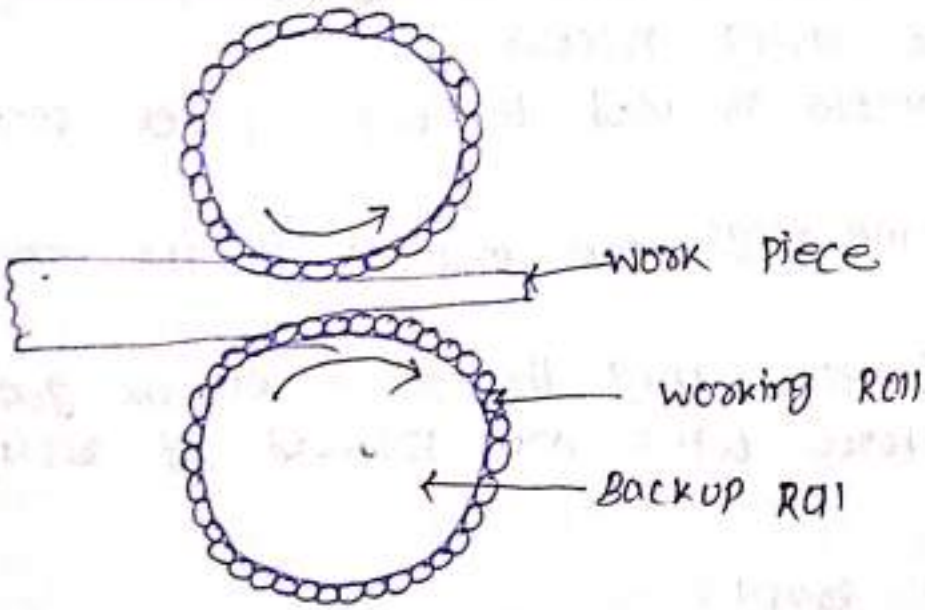
(iv) Cluster rolling mill



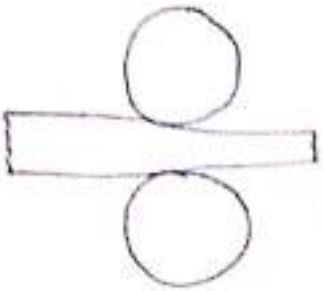
The cluster rolling mill consist of two working roll and four or more back up rolls. The no of back up rolls or supporting roll required depending upon the types of workpiece required for the working rolls. cluster mill is generally used in cold rolling operations.

(v) planetary rolling mill



In this type of rolling mill no. of three rolls are provided over the periphery of large back up roll and which is mostly suitable for large reduction in area in single pass of the work piece.

(vi) Two high reversable rolling mill



In this type of rolling mill the rolles have capacity to rotate in both directions depending upon the requirments.

Application of Rolling mill

→ Rolling is used to reduce cross-section of large section work piece.
→ Thread parts, bolds, screws etc. which have mass prod is made by the rolling process.
→ The rolling process is used to make plates, steel sheet etc.
→ Bearing, turbine rings are produced by the use of rollings.
→ Rolling is used to cutting the gears on the gear blan operations.
→ Rods, simless hollow tubes are produced by rolling

Advantage of Rolling

- It is suitable for mass production.
- It is fast and less time consuming. manufacturing proc
- Different shapes can be formed easily.
- It has high efficiency.
- It has very close tolerance.

Disadvantages of Rolling

- Higher cost of equipments.
- After operation it requires secondary operation for finising.

» It is suitable for large scale production only.

UNIT-2

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WELDING

2.1 Welding is a process of joining two similar or disimilar metals by fusion (application of heat) with or without the application of pressure and with or without use of filler metal.

Weldability:-

weldability of a metal is the ability of the metal is which two similar or disimilar metal are join by fusion with or without the application of pressure and with or without the use of filler metal.

Fusion:-

It is the procedure of liquefying or melting by the application of heat.

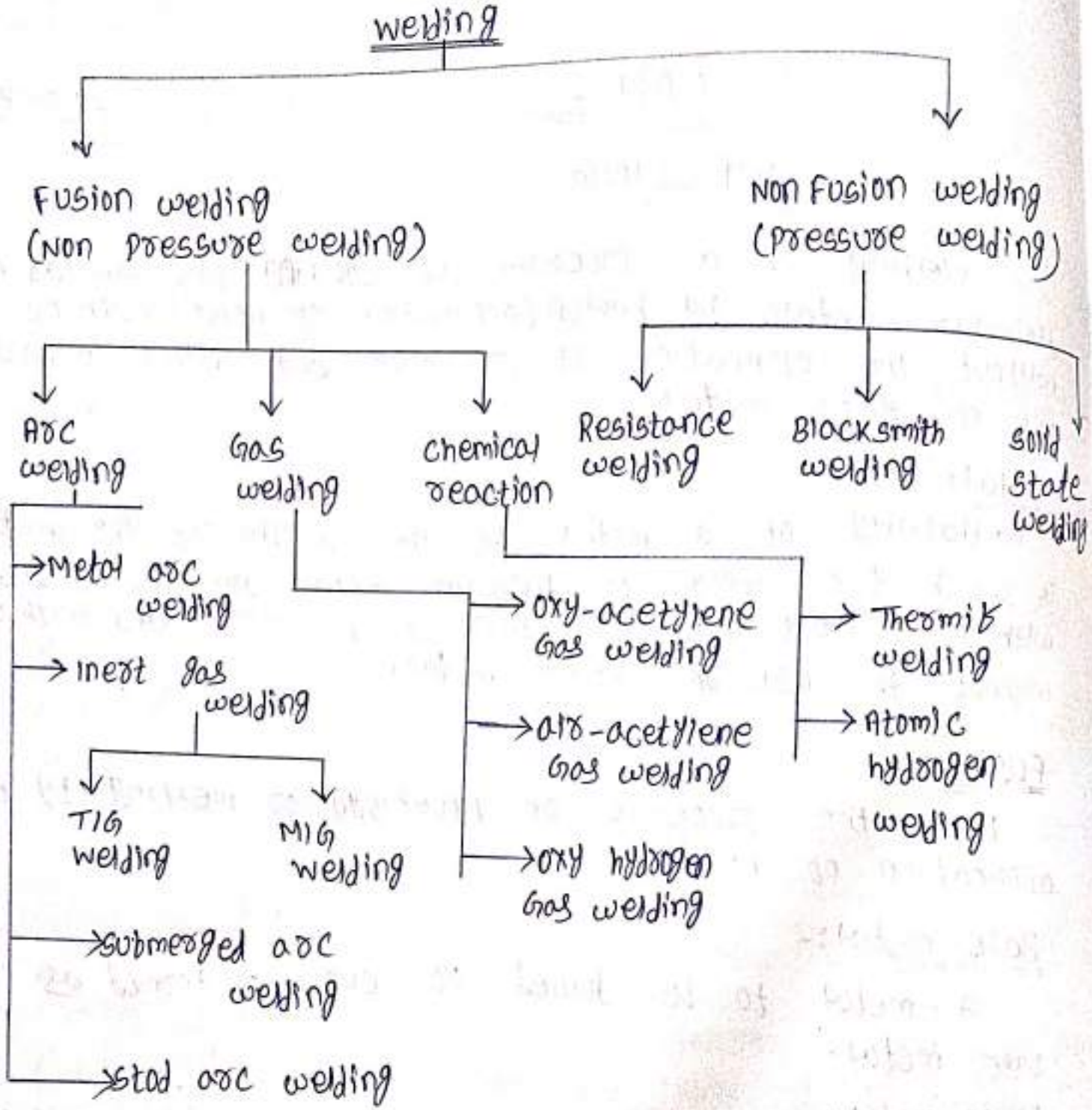
Base metal:-

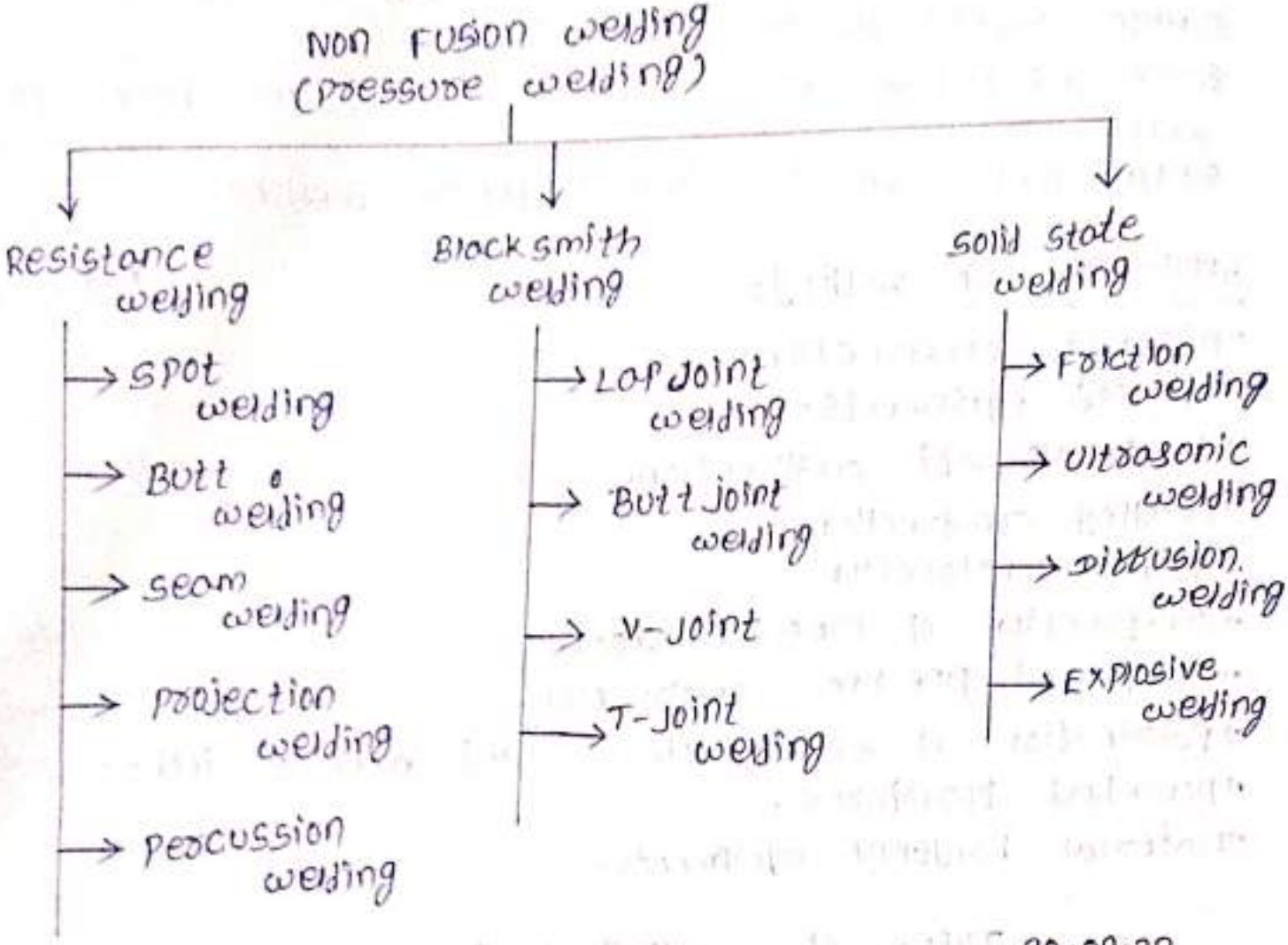
A metal to be joined or cut is termed as base metal.

Filler metal:-

It is the metal (in the form of wire or rod) added to suplement the molten metal pool to make a good and strong joint.

Classification of welding


Welding
Fusion welding
(Non pressure welding)
Non Fusion welding
(pressure welding)
ARC welding
Gas welding
Chemical reaction
Resistance welding
Blacksmith welding
Solid State welding
Metal arc welding
Inert gas welding
TIG welding
MIG welding
Submerged arc welding
Stud arc welding
oxy-acetylene Gas welding
air-acetylene Gas welding
oxy hydrogen Gas welding
Thermit welding
Atomic hydrogen welding



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Advantages of welding

- A good weld is as strong as the base metal. A large number of metals or alloys can be joined by welding.
- Repair by welding is very easy.
- Welding can be easily mechanized.
- Generally general welding equipment is not very costly.
- Total joining cost is less in case of welding joint.

Disadvantages of welding

- welding produces the harmful radiation, fumes and a spatter.
- A skill welder is required.

vessel

- ⊙ welding heat produces metalurgical changes.
- ⊙ initial cost of equipments and set up is high.
- ⊙ More safety devices are required.
- ⊙ Jigs and fixtures are required to hold the parts to weld.
- ⊙ Edge preparation is required before welding.

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Application of welding:-

- » Automobile construction.
- » Railroad equipments.
- » sheep, aircraft construction.
- » Building construction.
- » Bridge construction.
- » construction of pressure vessel.
- » piping and pipe lines construction.
- » Fabrication of zigs, Fixtures and machine tools.
- » Household furnitures.
- » Material handeling equipments.

Types of welding joints

① Lap Joint
② Butt Joint
③ Edge Joint
④ T - Joint
⑤ corner Joint

There are Five basic types of joints commonly used in fusion welding. (i) Lap joint
(ii) Butt Joint
(iii) corner joint
(iv) Edge joint
(v) T Joint

(i) Lap Joint

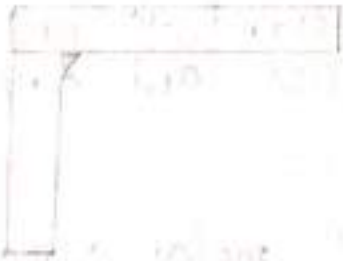
The lap joint is obtained by overlapping the plates and then welding the edge of the plates.

(ii) Butt Joint

Butt joint is obtained by welding the ends of edges of the plates.

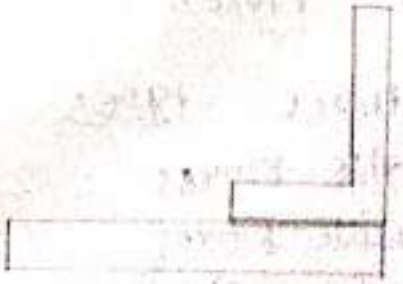
(iii) Corner Joint

It is obtained by ~~the~~ joining the edges of the two plates whose surface area at an angel of approximate 90° to each other.



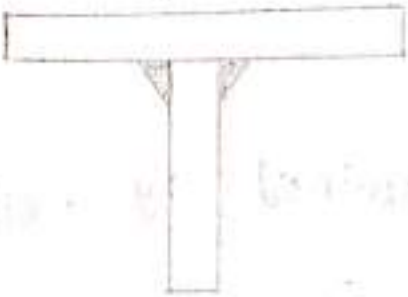
(iv) Edge Joint

The edge joint is obtained by joining two parallel plates and it is economical for the plates having thickness less than 6mm.



(v) T-Joint

The joint is obtained by joining two plates at rightangle to whose surface area approxmately equal to each other and this joint is suitable up to 3mm. thickness



2.2

FLUX:-

Flux is a mixture of various minerals, chemicals, and alloying materials that primarily protect the molten weld metal from contamination by the oxygen and nytrogen and other contaminats in the atmosphere. The addition of certain chemicals and alloys helps to improve mechanical properties and controls arc stability.

Function of Flux:-

- It reduce oxidation in the metal surface.
- It produces slags after reaction with oxygen which prevents almospheric contaminants.
- It improves strength of the metal.
- It provides arc stability to the weld.
- produce smooth weld contour.

Types of Fluxes

There are three types of fluxes used in welding process.

(i) oxide fluxes
(ii) Halide fluxes
(iii) oxide Halide fluxes

(i) oxide Fluxes

- $MnO - SiO_2$
- $FeO - MnO - SiO_2$
- $CaO - TiO_2 - SiO_2$

→ It is suitable for low carbon or low alloy steel.

(ii) Halide Fluxes

- $CaF_2 - NaF_2$
- $CaF_2 - BaCl_2 - NaF$
- $KCl - NaCl - Na_3AlF_6$

→ It is suitable for aluminium & titanium.

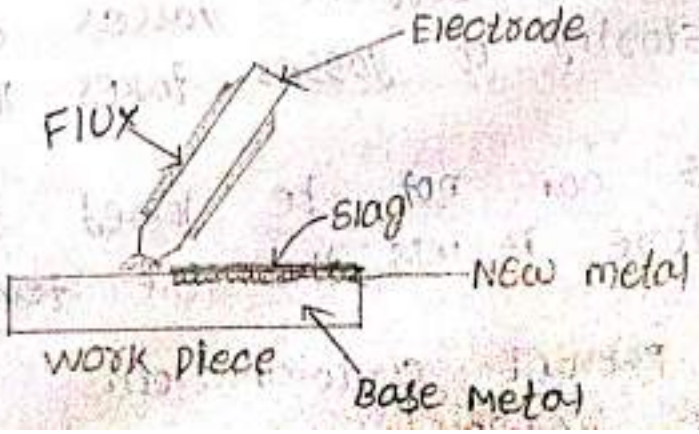
(iii) oxide Halide Fluxes

- $CaF_2 - CaO - Al_2O_3$
- $CaF_2 - CaO - SiO_2$
- $CaF_2 - CaO - MgO - Al_2O_3$

→ It is suitable for high alloy steel.

Use of Fluxes :-

- It is used in submerged arc welding
- shielded metal arc welding
- Flux cored arc welding
- To improve strength of weld. Alloys used are Nickel, chromium, vanadium etc



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Fusion welding

In fusion welding the material around the joint is melted in both the parts to be joined. If necessary a molten filler metal is added.

Gas welding

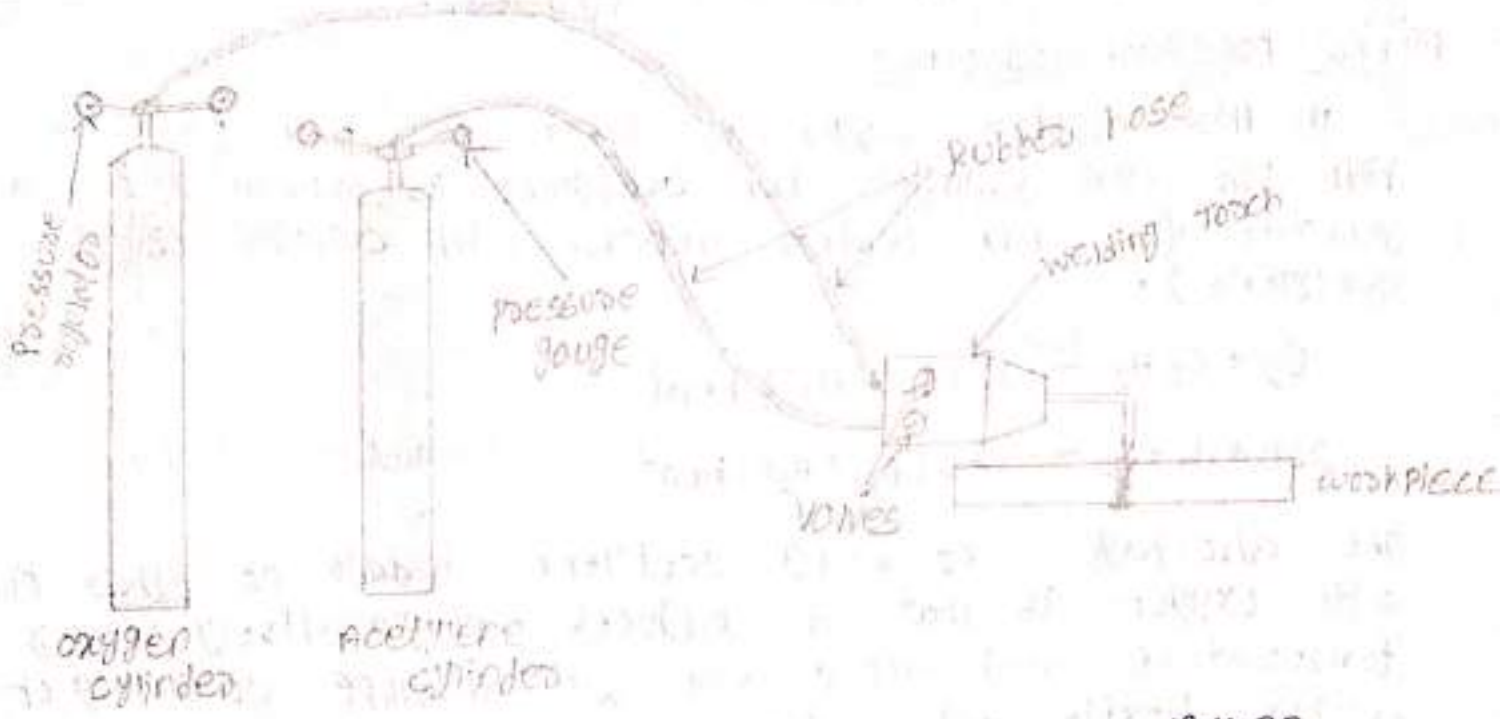
It is a method of fusion welding in which a flame produced by the combustion of gasses is employed to heat and melt the parent metal and filler rod of a joint.

- Advantages of gas welding:-
  - It is portable and can be moved almost everywhere for repair or fabrication work.
  - The oxy-acetylene flame can be easily controllable and extensively used for sheet metal fabrication work.
  - The cost and maintance of gas welding equipments is low.
  - The rate of heating and coning is relatively low which is advantage on some cases.
  - Good weld quality
  - The oxy-acetylene torch is versatile. It can be used for brazing, bronze welding, soldering, heat treatment, metal cutting, metal cleaning etc.

- Disadvantages of gas welding:-
  - Gas compared to arc welding it takes considerably longer time for the metal to heat up.
  - use of oxygen and acetylene gasses are expensive.
  - Handeling and storing of gasses takes lot of safety precautions.
  - Heavy sections can not be joined economically.
  - Flame temperature is less than the temperature of the arc.
  - Difficult to prevent contamination.
  - Skilled operator required.

2.3

oxy-acetylene welding



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The oxy-acetylene welding process can be used for welding almost all metals and alloys used in engineering practices.

The principle of oxy-acetylene welding is the ignition of oxygen and acetylene gasses, mixed in a hose pipe fitted with a nozzle of suitable diameter. oxygen is stored in a cylinder which is painted in black colour and acetylene is stored in a cylinder painted maroon colour. The flame is applied to the edge of the joint and a filler metal is used if it applicable. which is there by melted and run in to joint.

When the acetylene is burned in an atmospheric oxygen and intensely hot flame with a temperature about 3300°c is produced and the melting point of steel is approximately 3300°c the metal is fused very rapidly at the point of which the flame is applied.

Two NRV (Non-Return valve) is used to prevent the back flow of acetylene and oxygen to the cylinder.

There are two systems of oxygen acetylene welding
(1) High pressure system
(2) Low pressure system

(i) High pressure system:-
In this method both oxygen and acetylene are derived for use from high pressure cylinders.

(ii) Low pressure system:-
In this system oxygen is taken as usual from a high pressure cylinder but acetylene is generated from a generator (in which water reacts with carbide forms acetylene).

$$O_2 + C_2H_2 \xrightarrow{heat} 2CO + H_2 + heat$$

$$2CO + H_2 + O_2 \longrightarrow 2CO_2 + H_2O + heat$$

The advantages of using acetylene instade of other fuels with oxygen is that it produces comparatively higher temperature and also an inert gass inveiop consisting of carbon dioxide and water vapour which prevents the molten metal from oxidation.

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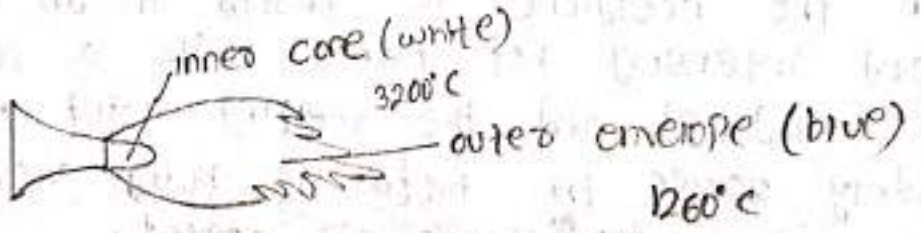
2.4 Types of Gas welding flames

① Neutral flame / Natural flame.
② oxidizing flame.
③ carburizing flame / reducing flame.

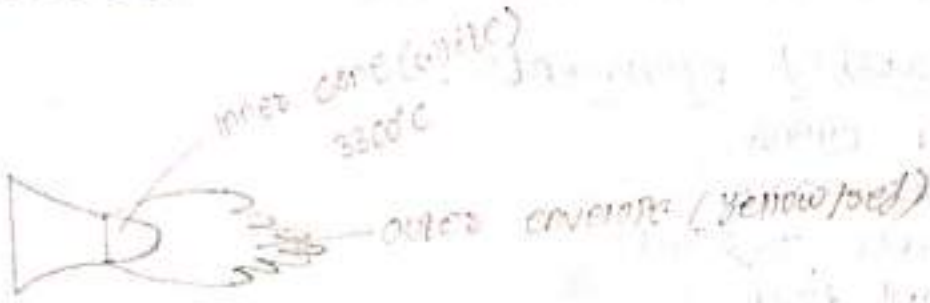
① Neutral flame



→ A neutral flame is produced when equal amount of oxygen is mixed with equal amout of acetylene The flame has nicely define inner cone (white in colour)

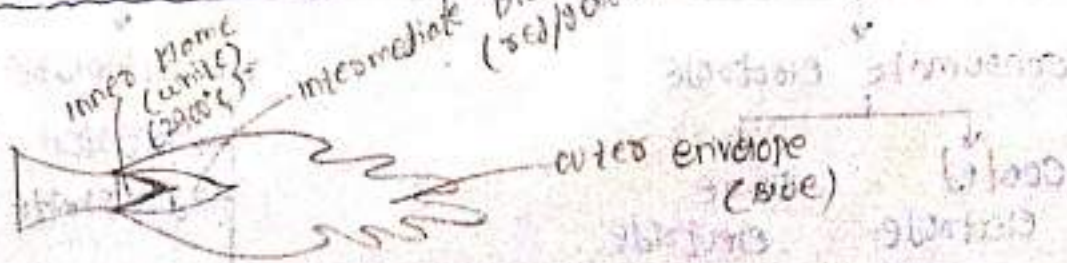
and is surrounded by outer envelope which is blue in colour than the inner cone.
→ The temperature of inner cone nearly 3200°C and outer envelope is about 1260°C.
→ The inner cone indicating that combustion is completed than outer envelope.
→ It is called Neutral because it will not oxidize or carburise the metal.
→ It is used for welding of copper, cast iron, mild steel, stainless steel, Aluminium.

② Oxidizing flame



→ After the neutral flame if supply of oxygen is further increased the result will be an oxidizing flame.
→ The inner cone is more pointed and outer flame envelope is much shorter than neutral flame.
→ The inner cone is white in colour and outer envelope is yellowish or reddish in colour.
→ It burns with a loud noise.
→ The temperature of inner cone is about 3300°C because excess of oxygen completes combustion.
→ This flame is harmful for steels, because it oxidizes the steel.
→ It is used for welding of copper and brass based alloys.

③ Carburizing flame



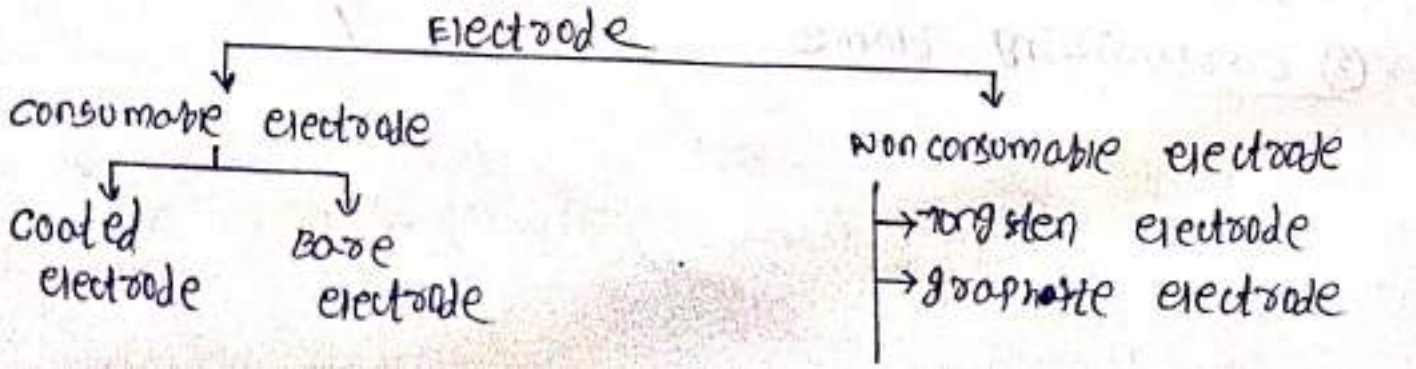
→If the volume of acetylene is supplied to the neutral flame is increased or oxygen supplied to the flame is reduced, the resulting flame will be reducing or carburizing flame.
→Carburizing flame contains unburned carbon and after solidification of the weld the surface appeared to be very hard and brittle. Because lot of carbon will be present in the flame.
→It does not produce any sound.
→Metals which absorb carbon should not be used for welding in reducing flame.
→It is used for welding of low alloy steel rod, high carbon steel and cast irons.

* Gas welding equipments :-

- Oxygen cylinder
- Cylinder valve
- Pressure regulator
- Welding torch
- Hose pipe
- Acetylene cylinder
- Goggles (to protect eye from radiation)
- Gloves and sleeves
- Spark lighter
- Chipping hammer
- Wire brush
- Filler rod (It is a types of material used for supply of additional material to the weld pool during welding).
- Electrode (It is a type of filler metal used in welding).
- Pressure gauge.

* Electrode :-

There are two types of Electrode.



27.10.22

Definition

It is a fusion welding process in which two or more work piece join together by using heat produced from an electric arc welding machine.

* Working Principle of Arc welding machine

In arc welding arc is generated between the electrode and work piece when connected to the electric supply which may be DC or AC. When these two pools are brought together and separated from a small distance nearly (0.8 to 3mm) then the current started to flow throug a path of ionized particles called plasma and an electric arc is formed. Heat is generated as the ions strikes the cathode nearly 70% heat is liberated at positive terminals and 30% heat is produced at negative terminals.

various arc welding processes are :-

(i) carbon arc welding

(ii) Metal arc welding

(iii) TIG welding (Tongsten inert gas)

(iv) MIG welding (Metal inert gas)

(v) submerged arc welding

(vi) plasma arc welding

* Applications of Arc welding

→ used for fabrication work and repairs.

→ used in sheet building, pipe lines, bridge construction, tanks, boilers etc.

→ Domestic repairs and making of doors, gates.

* Advantages

→ Most efficient method to join metals
→ Lowest cost joining method
→ Joins all commercial metal

* Disadvantages or limitation

→ Manually applied there for high labour cost.
→ Need high energy. which causes danger.
→ Not convinient for disassembling.
→ Defects are hard to detect joints.

* Arc welding equipments

→ A welding machine or generator or transformer (AC).
→ Two cables come for work other for electrode.
→ Electrode holder.
→ Electrode
→ Gloves
→ Wire brush
→ Chipping hammer.
→ Goggles
→ Tong
→ Face shield

* Electrode :-

Electrode is a rod used for providing heat input in arc welding. It is of two types.

(i) consumable electrode
(ii) Nonconsumable electrode

(i) Consumable electrode :- consumable electrodes are made up of various materials depending upon the chemical composition of the metals to be weld. it may be made up of steel, cast iron, copper, brash, bronze and Aluminium.

→ A consumable electrode used in welding can be either bare or coated.
→ The coated electrode mostly used for manual arc welding process.

→ since the electrode continuosly melt it also asked as filler rod. to provide filler metal in to the joint. Thus the function of providing filler metal and heat are both built in a single electrode.

→ once the arc is initiated, the electrode is continuously consomed and hence the electrode should be move continuously towards the workpiece to materialy constant welding.

(ii) Non consumable electrode :-

→ It is also possible to use Non consumable electroons made up of carbon, graphite or tungsten.

→ The carbon and graphite electrodes are used only DC welding where as tungsten electrodes are used for both AC and DC welding.

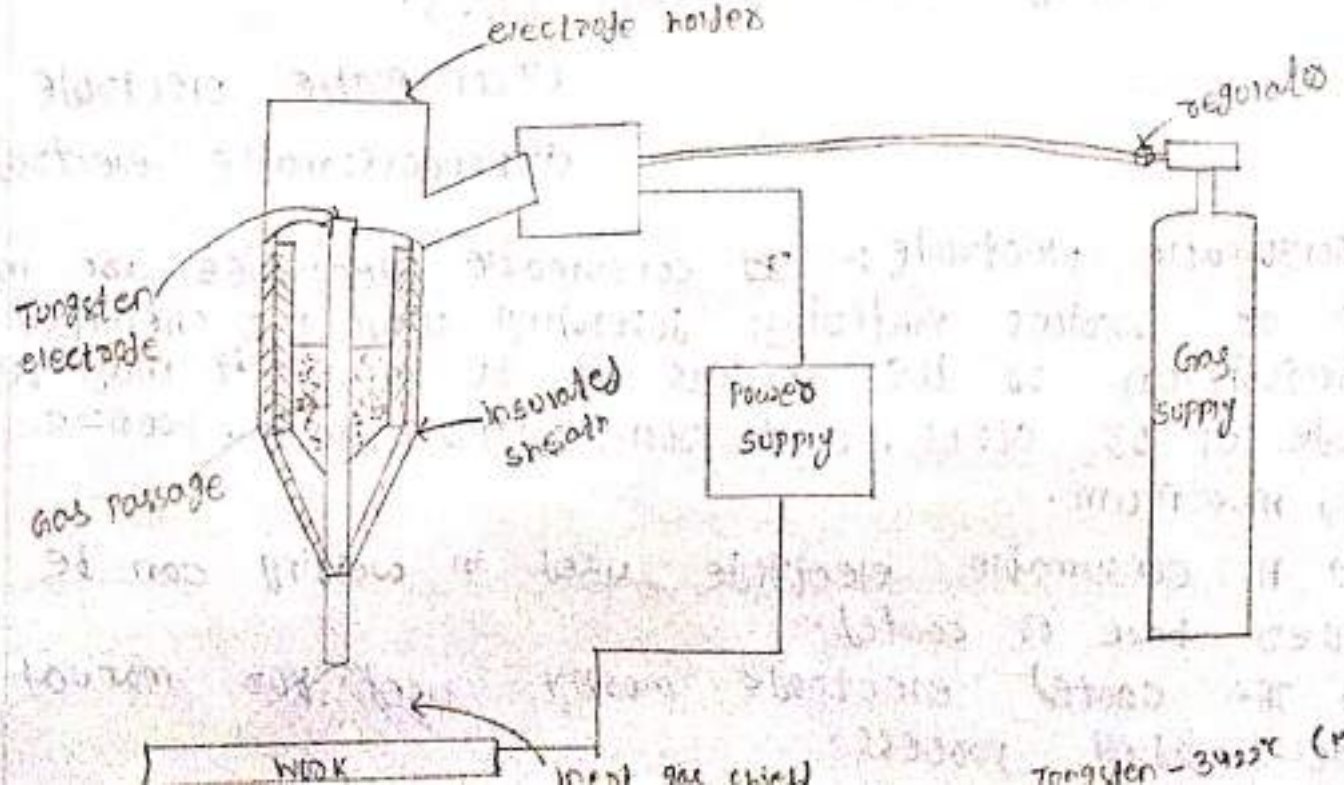
→ The filler metal required has to be deposited through a separate filler rod.

* Function of Coating

The coatings provide inert gasses such as :- carbon dioxide which shields the molten metal pool and protect it from atmospheric oxygen, hydrogen and nitrogen to reduce contamination of the weld metal.

2.9

TIG welding



28.10.22

Tungsten inert gas welding or gas tungsten arc welding is an inert gas shielded arc welding process that uses a nonconsumable electrode.

A typical TIG welding set up is shown in figure which consists of a welding torch at the center of which a tungsten electrode is present. The inert gas is supplied to the welding zone through the annular path surrounding the tungsten electrode to effectively displace.

Intense heat of electric arc produced between a nonconsumable tungsten electrode and the material to be welded. The shielding gas is obtained from an inert gas (helium, argon).

The shielding gas displaces the air surrounding the arc and weld pool. It prevents the contamination of the weld metal with oxygen and nitrogen present in the air.

A filler metal is separately used and a manually fed in to the weld pool.

The smaller weld torch may not be provided with any cooling device for the electrodes but larger one provided with circulating cooling water.

TIG welding process can be used for joining of a no. of materials ~~the~~ such as Aluminium, Magnesium, stainless steel etc. Both AC and DC are used in TIG welding. Where AC enables good penetration and less surface oxidation and the electrode should be held at an angle of 60°-80° with the workpiece and the filler metal at 15°-20° with the workpiece.

* Advantages of TIG welding

→ It also used for welding disimilar metals, hard facing and the surfacing of metals.

* Disadvantages of TIG welding

→ The process is slow in operation.
→ All joints require proper cleaning before welding as the inert gas does not provide fluxing action. (cleaning action).
→ The cost of the process is high.
→ skilled man power required.

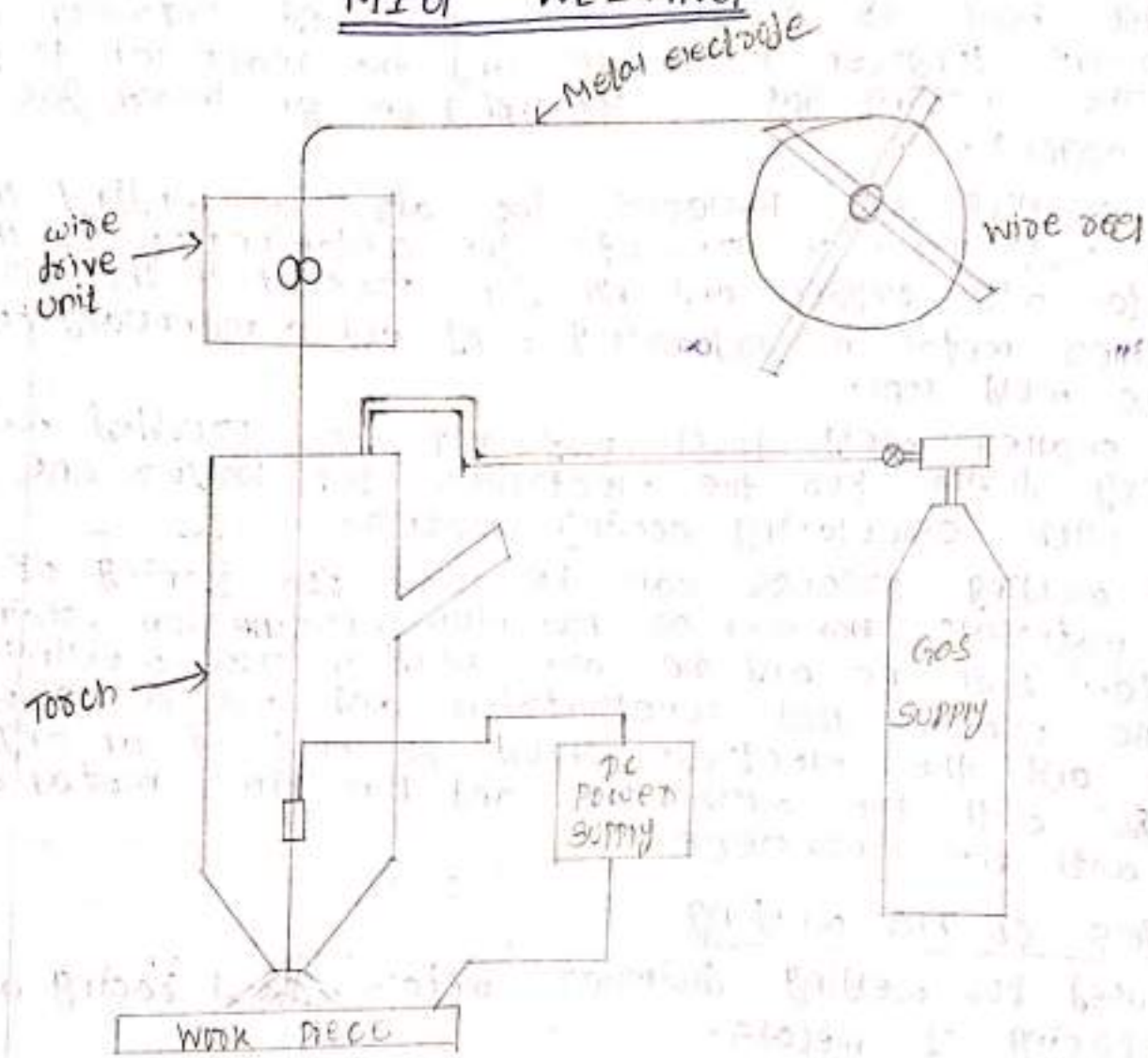
* Application of TIG welding

→ used for welding of all metals and alloys of various thickness.

→ Extensively used for welding aluminium, stainless steel and titanium.

→ Employed for fabrication of missiles, air craft, rockets.

MIG WELDING



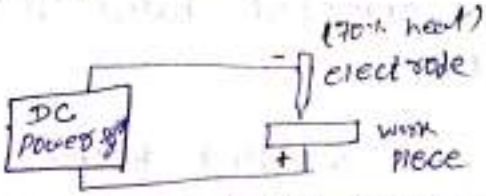
31.10.22

Metal inert gas welding (MIG) is a type of inert gas welding that utilizes a consumable electrode and tungsten gas for providing shielding zone.

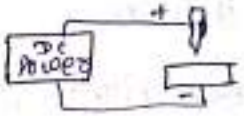
The typical setup of the gas metal arc welding or MIG welding is shown in figure. The consumable electrode is in the form of wire reel which is fed at a constant rate through the feed rollers.

→ The welding torch is connected to the gas supply cylinders which provides the necessary inert gas. The electrode and the workpiece are connected to the welding power supply.
→ The power supply are always of the constant voltage but current from the welding machine is changed by the rate of the feeding of the electrode wire.
→ The combination of bare electrode wire and shielding gasses eliminates the slag covering on the weld bead.
→ Usually DC with reverse polarity is used in MIG welding. AC is not used in this method.

NOTE



Straigh polarity
Non-consumable electrode (30% heat)



(electrode more melt)
Reverse polarity (used for thin sheet)
consumable electrode

Advantages of MIG :-
→ Flux is not required hence no slag formation.
→ High welding speed.
→ Weld all metals including aluminium and stainless steel.
→ It provides higher deposition rate.

Disadvantages of MIG :-
→ Equipment cost is high.
→ Not suitable for outdoor work.
→ As the strong wind may break the shielding gasses.

Applications :-
→ Used for welding carbon and alloy steels, stainless steel copper and Aluminium alloys.
→ MIG welding has been widely used in air craft and automobile industries.

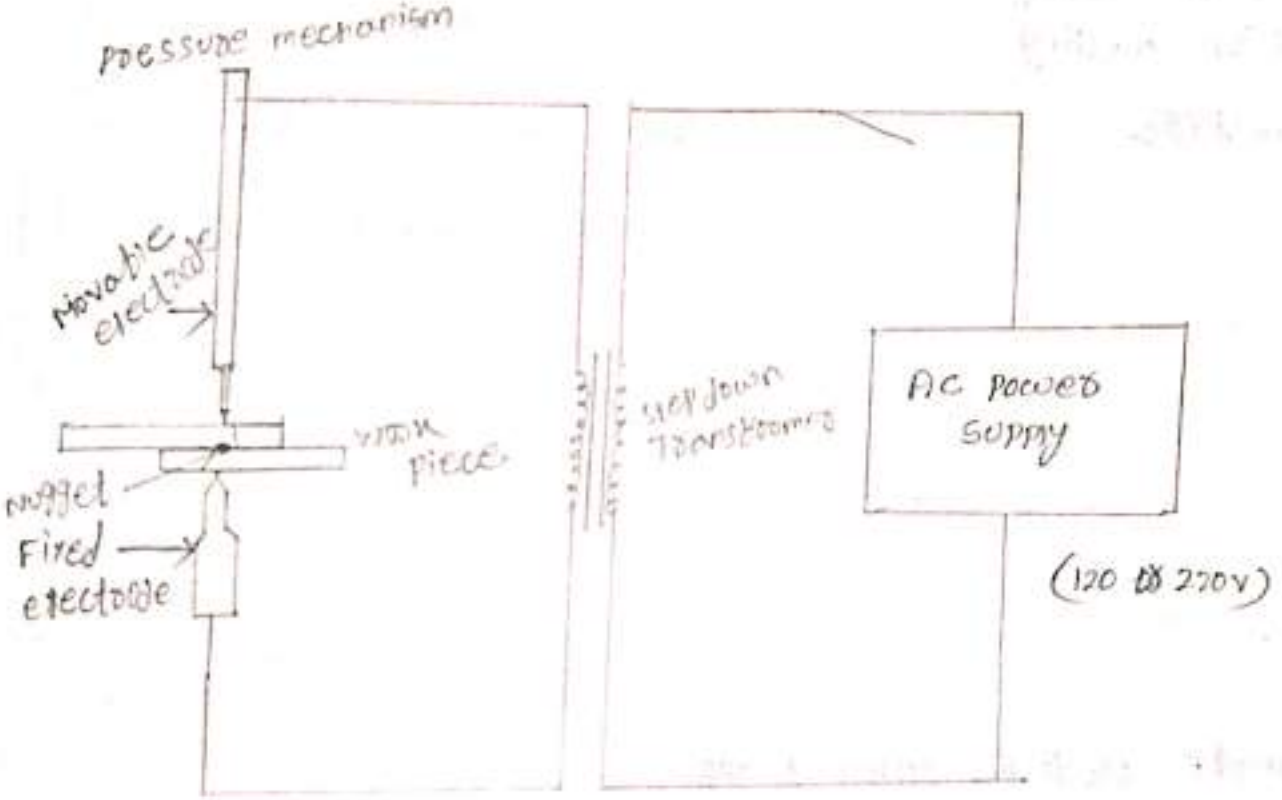
3.11.22

* Difference between TIG and MIG.

TIG	MIG
(i) Tungsten inert gas welding utilises non consumable electrode.	(i) Metal inert gas welding utilises consumable electrode.
(ii) In TIG welding if required a filler metal is supplied additionaly by feeding a small diameter filler rod in to the arc.	(ii) The electrode it self melts down to supply necessary filler metal required to fill the gap between the ~~necessary~~ base metal
(iii) Electrode is always made up of tungsten with other alloying elements like thorium.	(iii) composition of electrode metal selected based on parent metals.
(iv) In TIG welding ~~com~~ filler metal comes in the form of small diameter (1-3mm) and short length (60-180mm) rod.	(iv) In MIG welding filler comes in the form of a small diameter and very long wire wound in a pool.
(v) TIG welding is commonly carried out either in AC or DCEN (straight) polarity to increase electrode life.	(v) MIG welding is commonly carried out DCEP polarity or reverse polarity to increase filler deposition rate.
(vi) Filler deposition rate is low. In this sence it is not very productive.	(vi) Filler deposition rate is very high so the process is highly productive.
(vii) TIG welding is mostly free from spatter.	(vii) MIG welding usually produces spatter. this causes loss of costly filler metal.
(viii) It can easy produce defect-free reliable joint with good appearance.	(viii) Quality and appearance of weld are not very good.
(ix) Used for welding of all metals and alloys of various thickness.	(ix) It is used for welding of carbon and alloy steel, stainless steel, copper and Aluminium alloys of lower thickness.

Resistance welding

Registance welding is a welding process in which welding heat is obtained from the registance of the workpiece to the flow of electric current and with the application of pressure.



Principle of resistance welding :-

In resistance welding a low voltage (4 to 12 V) and very high current (10000 to 50000 A) is passed through the joint for a very short time and this high Ampere current produces heat at the joint.

The heat generated in resistance welding can be expressed as :- $H = I^2Rt$

where H = heat generated to the joint

I = Electric current passed through the joint

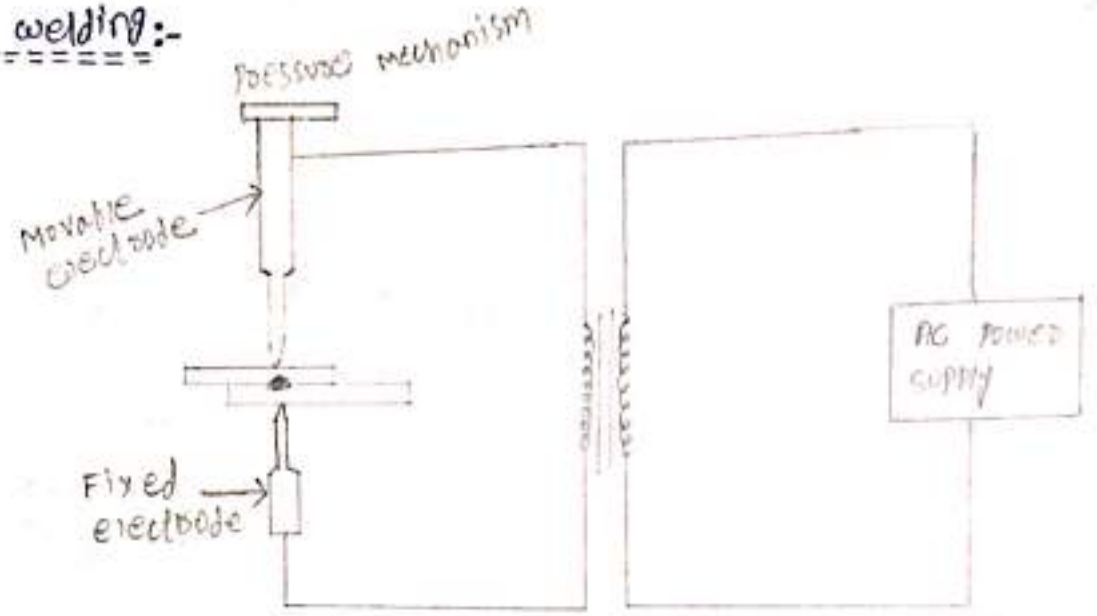
R = Resistance at the joint.

t = time of flow of current.

Types of resistance welding :-

(i) Spot welding
(ii) Seam welding
(iii) Projection welding
(iv) Flash butt welding
(v) Percussion welding

(i) Spot welding :-



Nonconsumable electrode - copper & alloy.

Spot welding is a resistance welding process in which overlapping sheets are joined by fusion at one or more spots by the heat and pressure is applied by the electrodes one above and other below the workpiece. The heat is generated because of the resistance to the flow of electric current through work piece

Working procedure

→ First job or work piece should be clean and free from the grease, dirt, paint, scale, oxide etc.
→ Electrode tips should be clean.
→ The welding set up is shown in the figure in which a high electric current or low voltage pass through the electrode and the work piece to be joined.
→ As the current passes through a small area where the work piece are in contact is heated and spot weld takes place

due to the resistance provided by the workpiece to the flow of electric current.

→ After the welding takes place the welding current is cut off. Extra electrode force is then applied or the original force is prolonged to hold the metals until to get colldown and gain strength.

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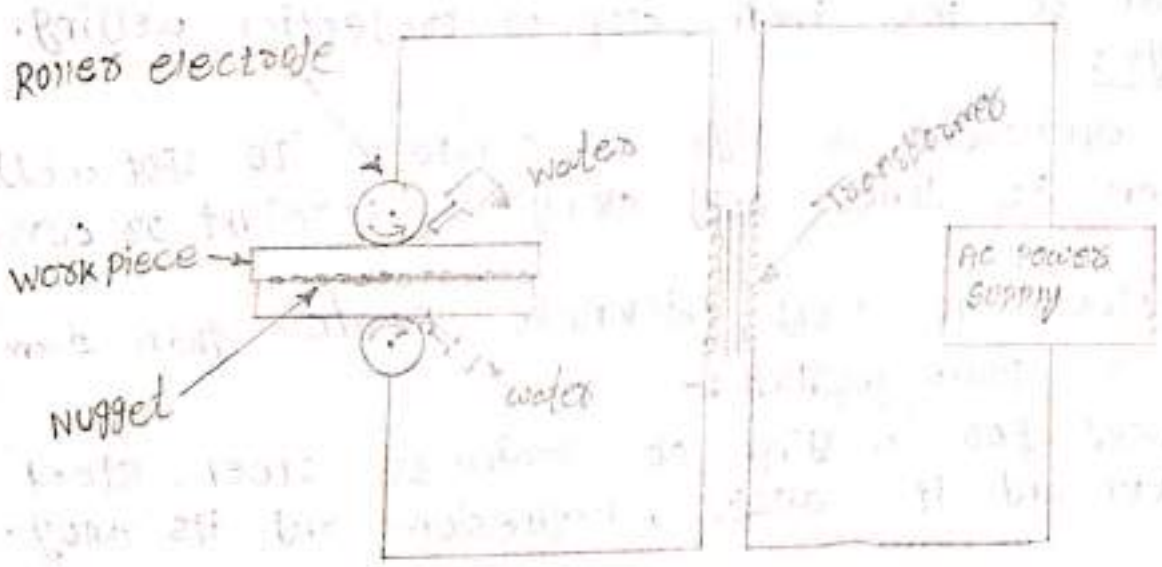
* Advantages :-
  - → Low cost
  - → Less skilled workers can perform the welding
  - → Higher productivity.
  - → No edge preparation is required.

* Application :-
  - → welding of low carbon steel; stainless steel, high carbon steel, Nickel, alloys.
  - → used for welding automobiles, aircraft industry, household furnitures, containers.

(iii) Seam welding :-



Seam welding is a resistance welding process in which overlapping sheets are joined by fusion due to rotating circulating electrodes. Fusion takes place because of heat which is generated from the resistance to electric current flow through work piece which are held together under pressure by electrodes.

Principle of operation

The workpiece to be seam welded are cleaned and to be overlapped and placed between two circular electrodes which hold the workpiece together by the pressure of electrode device and the current supply is provided from a AC step down transformer which are connected to two roller electrode, which are placed on two side of the workpiece. A high current low voltage is passed between the two electrodes through the workpiece and heat is generated between the two workpiece due to the resistance offered by the two workpiece to the flow of electric current.

Heat generated $\Rightarrow H = I^2Rt$

A coolant and water is applied to conserv the electrodes and cool the workpiece for rapid process.

Advantages :-

- It can produce gastite and liquidtite joint.
- overlap can be less than spot or projection welding.

Disadvantage:-

- Cost of equipment is high as compare to spot welding.
- welding can be done only along a straight or curved line.
- It is difficult to weld thickness greater than 5mm.

Application of seam welding :-

It is used for welding of stainless steel, steel alloys, Nickel and it's alloys, magnesium and its alloy.

(iii) projection welding

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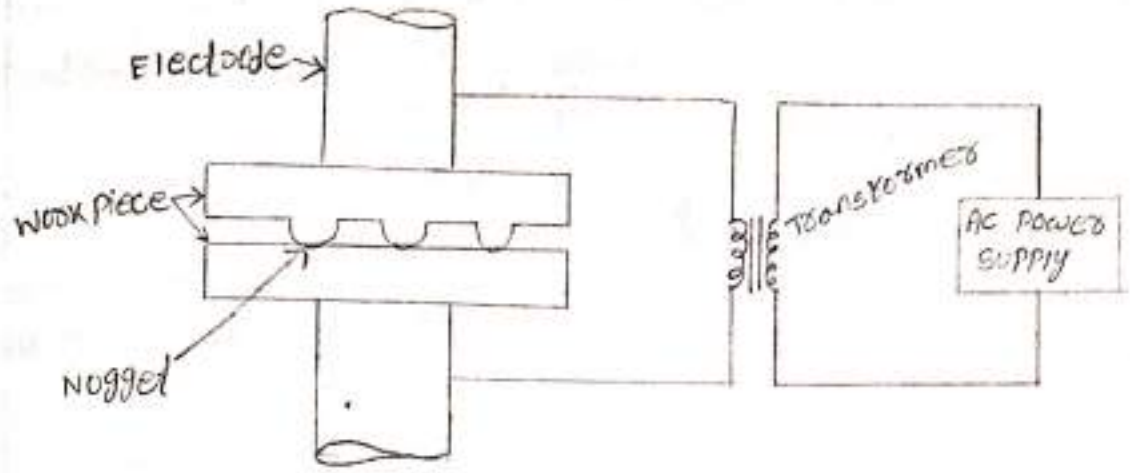
It is another advancement of spot welding where one of the sheets to be joined is provided with a number of projection to help localise the contact at a predetermined spot. Thus the surface of the workpiece are in contact with each other only at the projection.



projections are made in one of the sheet which are placed between the electrode and when electric current is supplied from the transformer passed between the electrode through the workpiece. when switch is on current passes through the projections and heats up these projections due to the resistance flow of electric current and melted the projections for the joint. During welding the electrodes are passed together to complete the weld by passing upper electrode downward. Due projection welding can be done at several point simultaneously.

Advantages :-

- It is possible to weld more the one spot at given time.
- proper heat balance can be easily obtained.
- projections are to be made in thicker plate or the plate having high electrical conductivity.
- Life of electrode is much longer than the life of electrode in spot welding.

Disadvantages :-

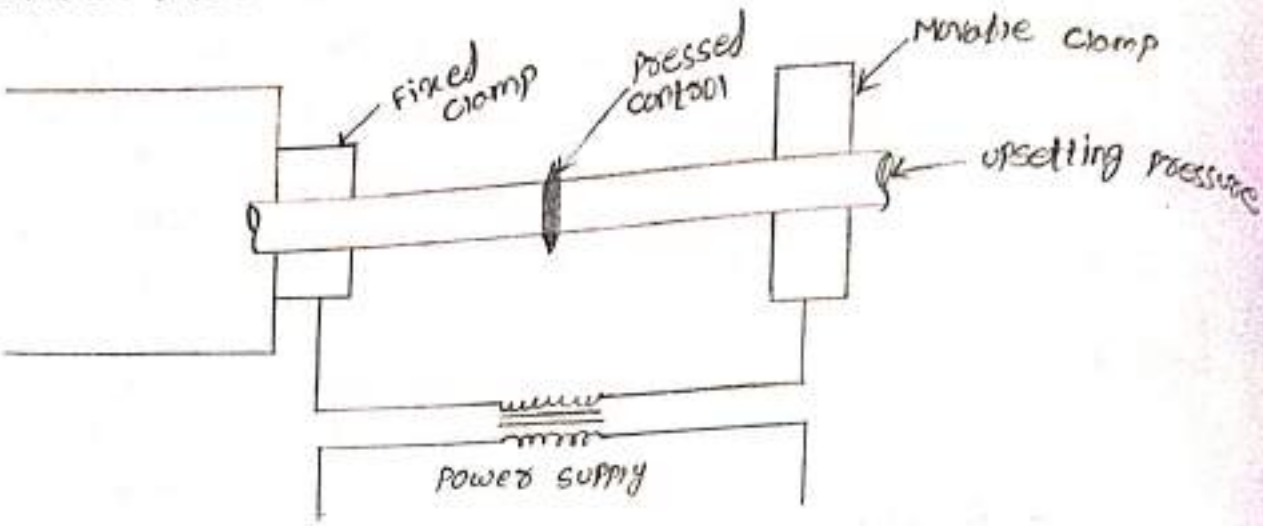
- Making of projections is an extra operation.
- All projection should be of same height.
- Metals which can not support the weld can be satisfactory.

Applications :-

- small , nuts etc. can be welded to large components
- It is used for welding of refrigerator consider of ware.
- welding of stainless steel, titanium alloy etc.
- ~~used for producing butt joint in pipes, tubes, rods etc.~~

10.11.22

(iv) Flash butt welding



Flash welding is similar to upset welding except that heat required for melting is obtained by means of an arc generated between the two workpiece.

one workpiece to be joined is clamped in moving platten and other is mounted on fixed platten. When electric current is supplied from a transformer to the workpiece to be joined and produces flashing between the two workpiece which heats up the metal - desirable melting temperature and pressure is applied from the movable platten to produce the joint between two workpiece.

After welding current is cut off and when welded joints has reached desirable temperature, after that the workpieces are unlocked.

Advantages :-

- It consumes less welding current than upset butt welding process.
- Flash welding offers strength factors up to 100 %.
- preparation of weld surface is not required.
- The process is ~~chip~~ Cheap.
- It is a faster process.

Disadvantages :-

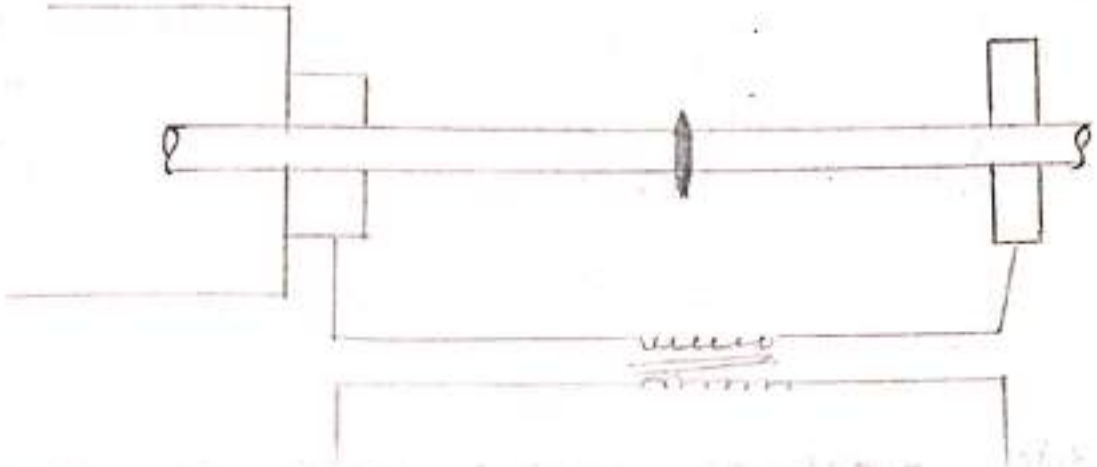
- The shape of the workpiece should be similar which not is always possible..
- Chances of the fire hazards.
- Flashes make causes eye problem.

Applications :-

- It is used for welding of bars, rods, tubes.

(iv) Butt welding (upset welding)

It is a type of welding in which joints are obtained when two rods or bars are joint due to the heat generated from the resistance of electric current when they are connected in face to face and by the application of pressure.



One workpiece to be joined is clamped in stationary damping block and other is clamped in moving clamping block and two workpiece one brought together by pressure a heavy current is passed through the workpiece from the power supply. due to which heat is generated because of resistance to the flow of electric current.

When welding temperature has been reached, the pressure is applied to the workpiece which is connected to the moving clamp that forms joint between the two workpiece and after welding current is cut off, force is released when the welding joint has reached desired temperature. (Normal temperature)

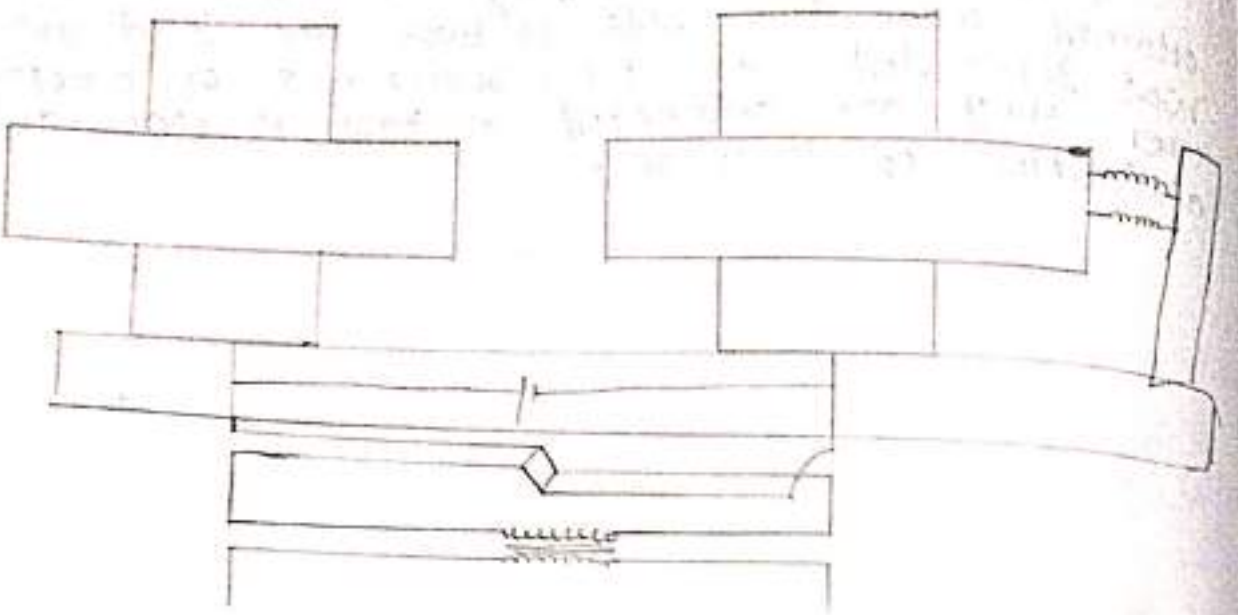
Application :-

i) used in ware drawing industries.

ii) Used for producing butt joint in pipes, tubes, rods. etc.

11-11-22

(V) Percussion welding



In this resistance welding heat is obtained from an arc produced by a rapid discharge of stored electric energy. Pressure is applied rapidly during and immediately following the electric discharge.

The electrostatic capacitor or condenser used to store electrical energy.

In this welding process workpiece to be joined is clamped in moving platen. where they brought nearer to each other and an arc is produced by sudden discharge of the condenser and capacitor and rapidly pressure is applied.

Advantages of percussion welding

- Arc temp. is more as compare to flash butt welding.
- Strong joints are produced, can be used for joining different materials.

Disadvantages:-

- The process is limited to butt welding.
- The equipment used for this purpose is quite expensive.
- The equipment must be provided with accurate holding fixture and sensitive timing devices.

Application
- It is used for welding stellite tips tools, silver contact tips to copper, copper to Aluminium.
- It is used in telephone industries.
- It is also used for welding fine wire, leads to filaments in lamps, bulbs.

Welding defects

A defect is a discontinuity which affect a part or a product made to meet minimum applicable specifications. A defect weld is one which contains one or more defects.

Following are the most common defects on welded joints :-
(i) crack
(ii) porosity
(iii) slag inclusion
(iv) spatter
(v) under cut
(vi) incomplete fusion
(vii) incomplete penitration

(i) Crack

Cracking is the most serious defect in welding since it can lead to premature failure particularly in a dinamicaly loaded component.

Causes of cracking
- Poor ductility of base metal.
- First arc travel speed.
- Temp. gradients that caused thermal stresses in weld zone.
- Variation in the composition on the weld zone.
- No preheat of the metals.
- Due to maximum contains of sulpher and carbon in the metal.
- change of polarity.

Remedies

- cooling rate should be reduced.
- use high ductility material.
- It can also prevented by preheating metals, components.

(ii) porosity

14.11.22

Porosity in welding is caused by the presence of gasses which get entrapped during the solidification process. The main gasses that causes porosity are hydrogen, oxygen, nytrogen.

They are generally in the shape of sphere or elongated pockets. Porosity if present in large area, it would reduce the strength of the joint.

Hydrogen is the main cause of porosity in the well pool. oxygen generally reaches the weld pool as oxide of the base metal or filler metal, or in some compounds of fluxes present in the electrode coating.

Remedies or prevent :-

- proper selection of electrode and filler metals.
- improved welding techniques, such as preheating of the weld area or an increase in the rate of heat input.
- proper cleaning and the prevention of contents from entering the weld zone.
- Reduced welding speed, to allow time for gas to escape

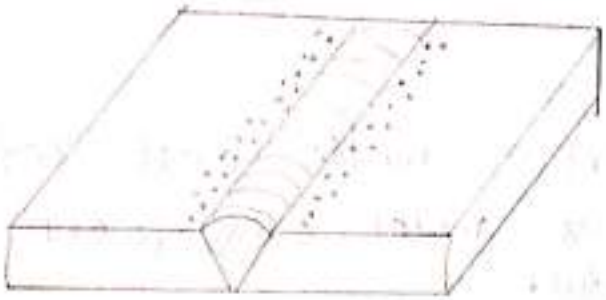
(iii) Slag inclusion

Inclusion may be caused by compounds such as oxides, fluxes and electrode coating material which are trapped in the weld zone.

If shielding is not provided properly the contaminants from atmosphere will contribute to such inclusions.

Remedies:-
- cleaning the weld bead surface before the next layer is deposited by means of a wire brush.
- provide enough shielding gas.

(iv) Spatter



Globules of metal expelled from an electrode and deposited on the surface of the parent metal these are called spatter.

- caused due to high welding current and too low welding speed and arc blow.

Remedies:-
- use proper welding current.
- use fresh electrode.
- proper welding speed.

(v) under cut

It is the melting or burning away the base metal at the toe of the weld as sharpness of the nose.
This is generally attributed to the improper welding technique or excessive welding current.

This is mainly caused by the incorrect manipulation of the electrode while depositing the bead particularly in horizontal and vertical welding.

Remedies :-

- Use proper current.
- Maintain proper arc travel speed.
- proper welding technique.

(vi) Incomplete fusion

Boundries of unfuse metal exist between the weld metal and the base metal or between the adjusting layer of weld metal.

This will be seen as a discontinuty in the weld zone. This may caused due to improper penitration of the joint, wrong design of the joint or incorrect welding technique.

Oxide slag not removed during previous welding.

Other non-metalic substances which prevent the underlying metal from reaching the melting temperature.

Remedies :-

- Keep joint surface clean.
- use adequate welding current.
- Desiag is weld pass.
- place weld pass correctly next to each other.

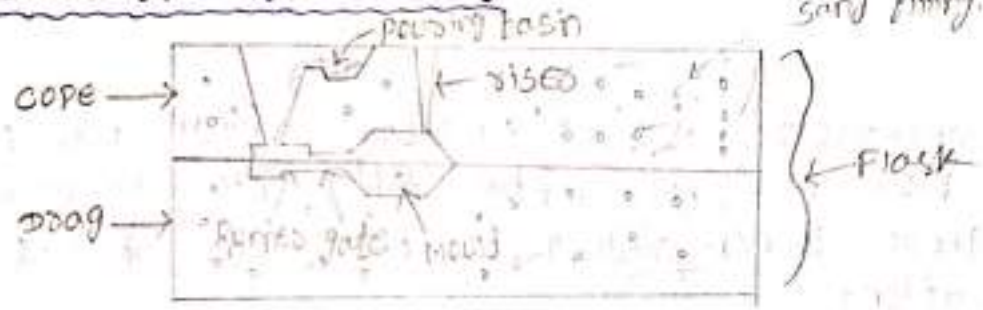
UNIT- 3

casting

casting is one of the earliest method known to human being.

- casting is a process of forming metalic products by pouring molten metal in to mould cavities of the shape to be made and allowing it to solidify, after solidification of molten metal the desired shape of metal object is taken out from mould either by breaking the mold or by taking the mould apart.
- The solidified object is called casting.
- The process is also called foundary.

Terminology of casting



① Flask
② cope
③ Drag
④ pouring basin
⑤ sprue
⑥ Risers
⑦ Mould cavity
⑧ cheek
⑨ pattern
⑩ core

① Flask

Moulding flask is a container which keeps the entire casting component inside it during the casting process.

② Pattern

Pattern is a exact replica of the desired casting which is used to prepare the mould cavity.

It is made up of wood, metal, wax.

③ Cope

The upper part of the flask is called cope.

④ Drag

The lower part of the flask is called drag.

⑤ Cheek

It is the intermediate part of the flask.

⑥ Pouring basin

It is small funnel shaped cavity at the top of the mould in to which the molten metal is poured.

⑦ Sprue

It is the passage through which the molten metal from the pouring basine ; the mould cavity. It is a vertical channel which connects the pouring basine to the runner.

⑧ Riser

Riser is a reservoir of hot molten metal use to facilitate the flow of hot metal back into the mould cavity when there is a reduction of volume of metal due to solidification.

⑨ Mould cavity / mould

Mould is the structure which is made with the help of pattern. That contains cavity of size similar to object being cast.

⑩ Core

It is used for making hollow cavities in the casting.

⑪ Chaplet

Chaplets are used to support cores inside the mould cavity to take care of weight of core and overcome the buoyanci from molten metal.

Types of Pattern

There are different types of pattern are available in casting.

Advantage of casting

- It is cheapest manufacturing process.
- It is very fast
- Intricate shapes can be produce. (difficult shape)
- No wastage of material.
- Suitable for mass production.
- Possible to cast both ferrous and nonferrous material.
- Necessary tools required for casting mould are very simple and inexpensive.

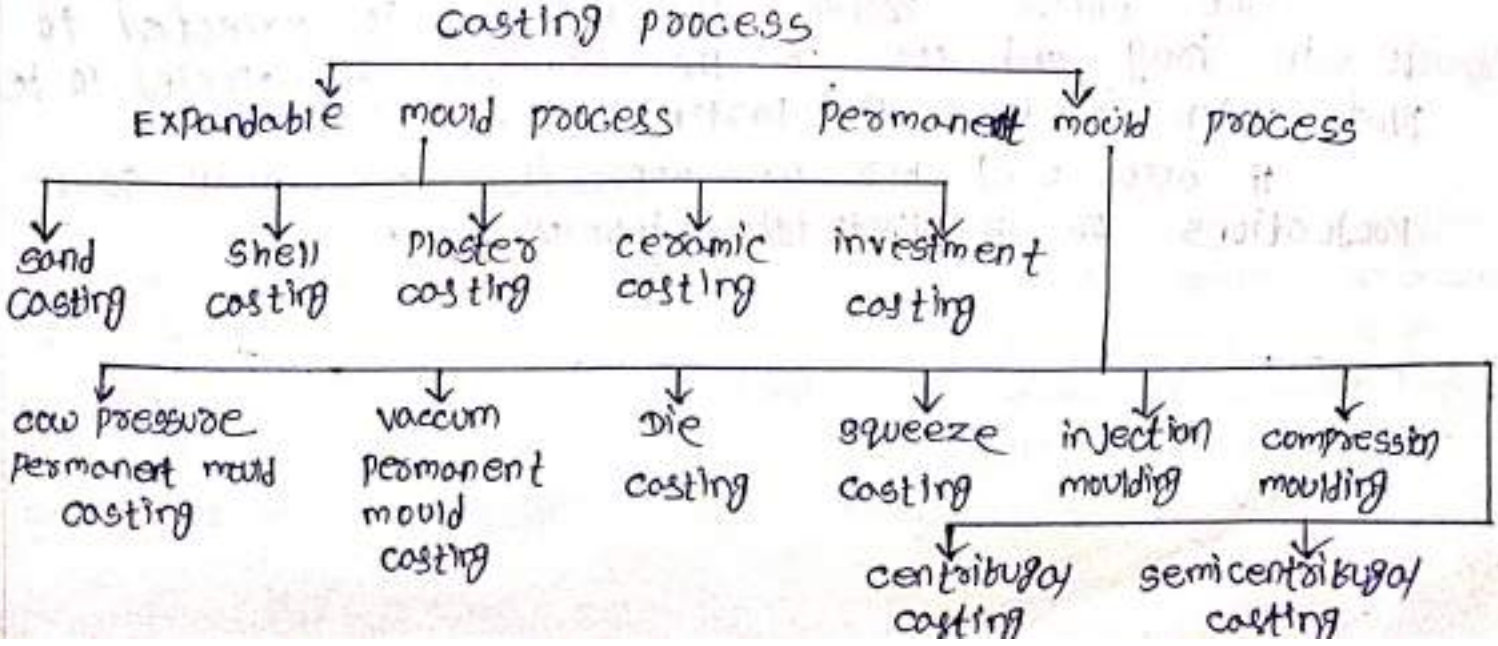
Disadvantages of casting

- Metal casting is a labour intensive process.
- Difficult to remove effects arising out of the moisture present in sand casting.
- Needs a furnesh to melt the metal.

Applications

- It is used for making cylinder blocks; machine tool beds, piston, piston rings, mill rolls, wheel, turbine blades, water supply pipes etc.

Classification of casting process

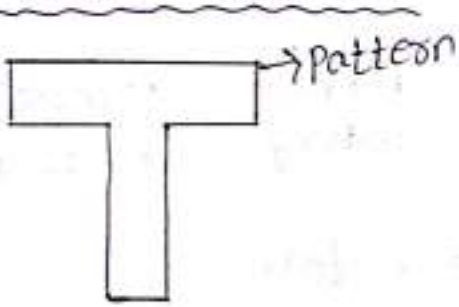


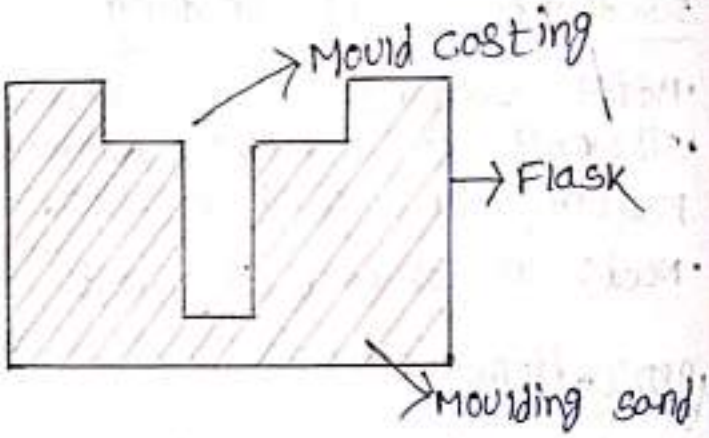
Types of pattern

18.11.22

1. Single piece pattern
2. Split pattern (two piece pattern)
3. Multi piece pattern
4. Cope and drag pattern
5. Match plate pattern
6. Gated pattern
7. Loose piece pattern
8. Sweep pattern
9. Skeleton pattern
10. Segmental pattern

1. Single piece pattern





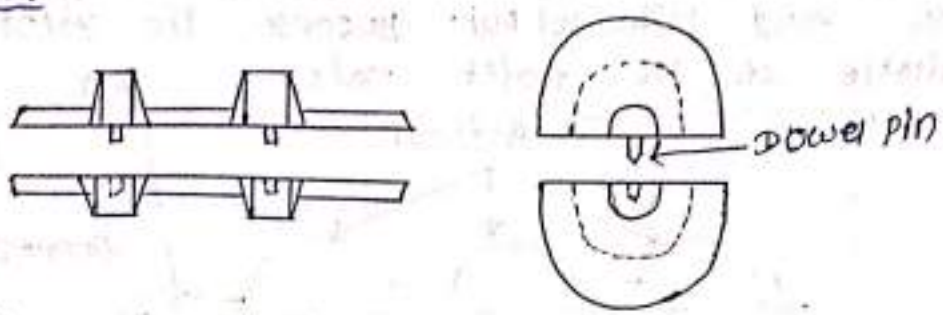
These are simplest type of patterns which are made up of a single piece as shown in figure. This type of pattern is used only in case where the job is very simple and does not create any withdrawl problem.

The entire portion of pattern is expected to be in drag and one of the surface is expected to be flat which is used as the parting line.

It also used for the application of small scale productions or in prototype development.

28.11.22

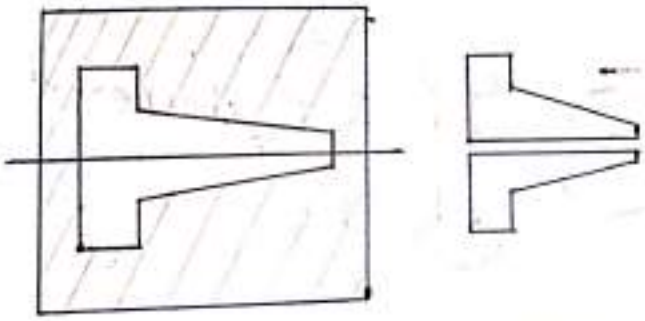
③Split pattern:-



This is the most widely used type of pattern for making intricate shape of casting. when there is difficult of withdrawl from the mould cavity.

In this type of pattern one part is in drag and other in the cope. The two halves of the pattern should be aligned properly by making use of the dowel pin. which are fitted to the cope half.

④ cope and drag pattern



These are similar to split pattern in addition to splitting the pattern, the cope and drag halves of the pattern along with the getting and rising system are attached separately to the metal. The cope and drag moulds may be produced using these pattern separately by the two moulders. But they can be assembled to form a complete mould.

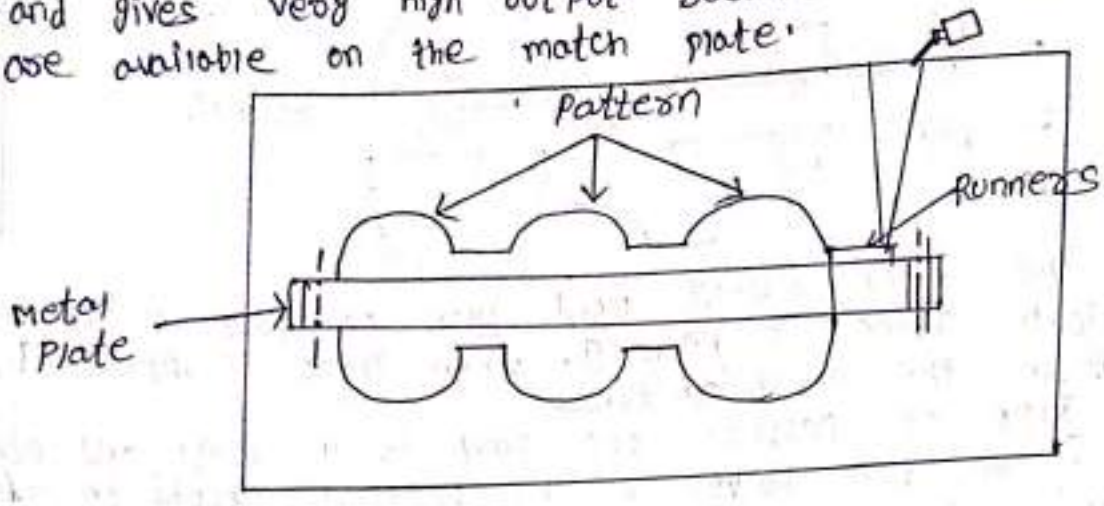
This type of pattern's are used for casting of heavy and inconvinent for handeling of metals

⑤ Match plate pattern

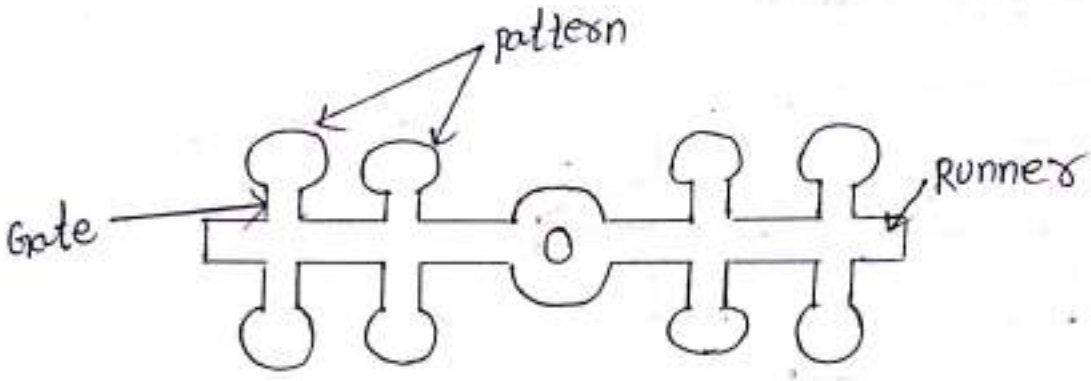
Basicaly match plate pattern is a split pattern in which cope and drag areas are on the opposite faces of the metalic plate. This metalic plate is termed as Match plate.

In this type of pattern both gates and runners are also available on the match plate.

This type of pattern requires very less hard work and gives very high output. Because the gates and runners are available on the match plate.



⑥ Gated Pattern



This type of patterns are used for making up multiple components inside the single mode.

Gated pattern is nothing but the pattern consisting of one or more patterns which are joined by the different pattern gates.

These are loose patterns where gates and runners have already attached.

⑦ Loose piece pattern

This type of pattern is also used when the it is not possible to withdraw the pattern from the mould cavity.

Hence during moulding the obstructing part of the contour is held as a loose piece by a core. After moulding is over, first the main part is remove and then loose

piece are recovered through the gap generated by the main pattern.

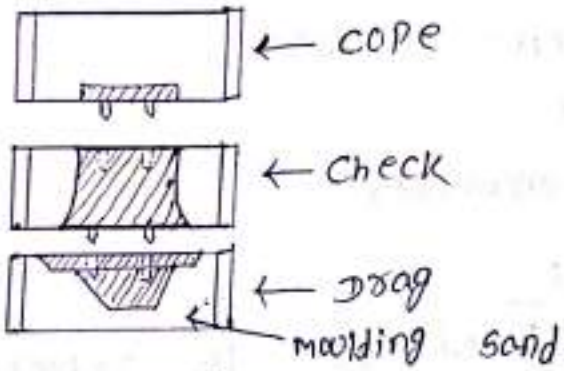
For this type of casting process skilled worker is required and making of job is also expensive.

08.12.22

③Multi Piece pattern

It is of three piece pattern. The top part of which is in cope, bottom is in drag and the middle part of this moulding box is called check.

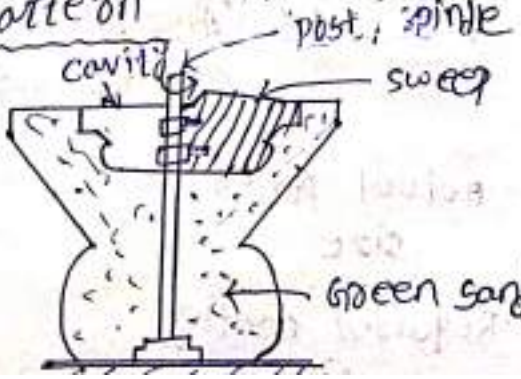
The three patterns will be connected by using dowel pins



Moulding box is clamped by using clamp.

This type of pattern is used for complex casting that requires three or more parts instead of two.

④Sweep pattern



• Sweep pattern consists of three parts spindle, base and sweep which is a wooden board. spindle engine vertical direction and the base is attached with the sand.

• The plane is rotated about an axis with 360° is called sweep.

• sweep pattern is used for the preparation of mould of large cemetrical casting by means circular cross-section.

(*) Pattern allowances

A pattern is the exact replica of a casting but it has slightly a large dimensions. This change in pattern in casting due to various reasons is known as pattern allowances in casting.

There are different types of pattern allowances are provided in metal casting

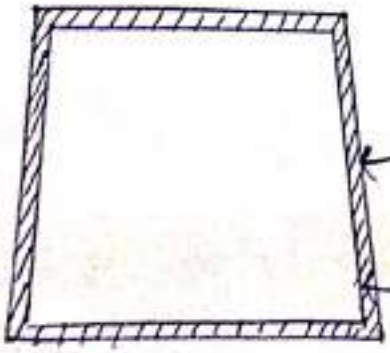
(i) shrinkage allowances
(ii) Draft allowances
(iii) Distortion or camber allowances
(iv) Machining allowances
(v) Shake or rapping allowances.

(i) shrinkage allowances

shrinkage is defined as the reduction in the dimension of the casting during the cooling or solidification process.

• This is a general property of all materials whose magnitude of shrinkage varies from material to material.

• shrinkage is of three types :- (a) liquid shrinkage
(b) solidification shrinkage
(c) solid shrinkage



(a) liquid shrinkage :- It refers to the reduction in volume when the metal changes from liquid to solid state at the solidification temperature.

(b) solid shrinkage :- It is the reduction in volume when a metal losses temperature in the solid state. The shrinkage allowances is provided to take care of this reduction.

The rate of contraction with temp. on the material.

12.10.22

Shrinkge allowances for various metals

Material	pattern dimension (mm)	section thickness (mm)	shrinkage allowances (mm/m)
Gray cast iron	up to 600		10.5
	600 to 1200		8.5
White cast iron			16.0 to 23.0
Ductile iron.			8.3 to 10.4
Plain carbon steel	up to 600		21.0
	600 to 1800		16.0

(ii) Draft allowances

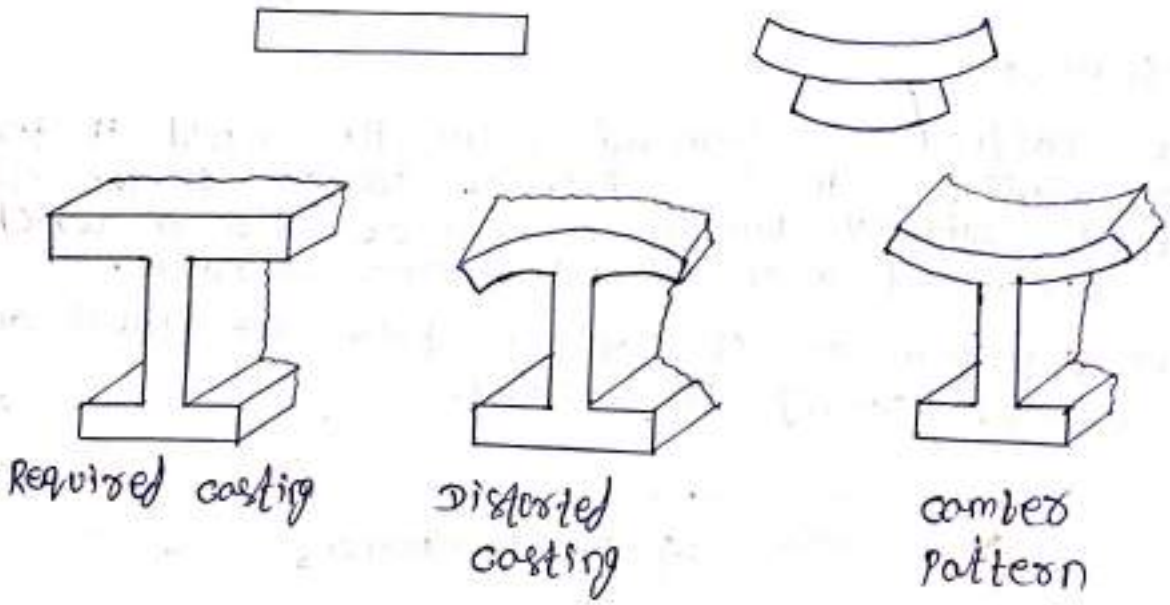
- When the pattern is removed from the mould it becomes difficult to withdraw in the direction parallel to the surface which causes slightly damage of surface due to which the pattern is converted in to slightly tapper surface.
- This allow easy removal of pattern from the mould and does not effect casting by any way.

Draft allowances for various metals

Pattern material	Height of given surface	Draft angle of surface (degree) External surface	Internal surface
Wood	20	3.00	3.00
	21 to 50	1.50	2.50
	51 to 100	1.00	1.50
	100 to 200	0.75	1.00
Metal & Plastic	20	1.50	3.00
	21 to 50	1.00	2.00
	51 to 100	0.75	1.00
	100 to 200	0.50	0.75

16.12.2022

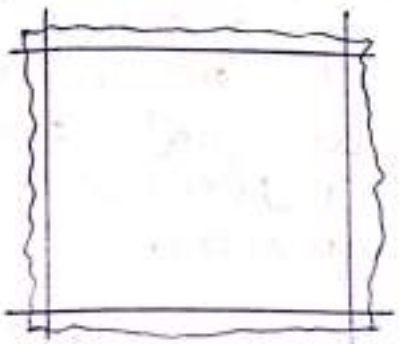
(iii) Distortion or camber allowances



During cooling of molten metal, stress is developed in the casting due to uneven metal thickness in the casting which causes distortion or bending in casting. camber is provided in the oposite direction so that when bending occurs due to uneven thickness of metal, casting becomes straight. This change in pattern shape to compensate

bending while casting is known as camber allowances.

(iv) Machining allowances



Before machining

After machining

We know that the product of a casting process is very poor surface finish. Hence the surface of final product of casting is rough, that should be required good surface finish, so to obtain good surface finish the final product of casting is machined with the process like turning, milling, grinding or shaping to improve the surface finish.

Machining allowances on patterns for sand casting

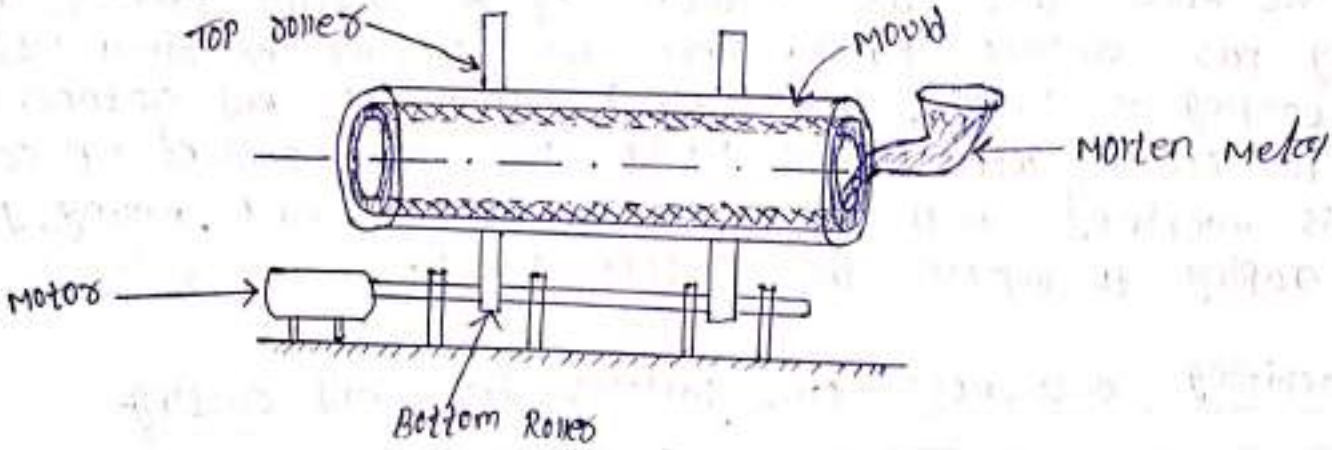
Dimension (mm)	Allowances (mm
Cast iron	surface
up to 300	3.0
301 to 500	4.0
501 to 900	5.0.
cast steel	
up to 150	3.0
151 to 500	5.5
Grey cast iron	
up to 200	1.5
201 to 300	1.5
301 to 900	2.5

(v) Shake or rapping allowances

When the pattern is to be removed from the sand of casting the pattern will have to be shaken slightly to remove it from the sand which causes a slightly increase in dimension of casting. To compensate this increase in dimension of casting the pattern are made slightly smaller from casting. This change in dimension of pattern is known as shaking or rapping allowances.

19.12.2022

Centrifugal casting



In centrifugal casting process the mould is rotated rapidly about its central axis and the molten metal is poured in to it. Due to the centrifugal force a continuous pressure acts on metal as it solidifies.

This centrifugal force plays a major role is shaping and feeding of the casting.

There are 3 main types of centrifugal casting process.

(i) True centrifugal casting
(ii) semi-centrifugal casting
(iii) centrifuging casting or pressure casting

(i) True centrifugal casting

In this process the castings are made in a hollow, cylindrical mould rotated about an axis common to both casting and mould. The axis may be horizontal, vertical or inclined but usually the mould is rotated in horizontal plane.

Spinning speed of mould to give a centrifugal force of the order of 50-100 times of gravity.

The mould used for this process may be either of permanent type or a sand line mould. The wall thickness of the cylindrical hole is governed by the quantity of metal we introduced in to the spinning mould.

Molten metal is poured in to the rotating mould with the help of a laddle. Initially during pouring the mould is rotated at a slow speed.

22.12.22

The axis of rotation can be either horizontal, vertical or at any angle between these positions.

In this process a cylindrical mould is made to rotate on its own axis at a speed such ~~as~~ that the metal being poured is thrown to the outer surface of the mould cavity. The metal solidifies in the form of a hollow cylinder. The casting cools and solidifies from outer surface towards the axis of rotation, thus provides direction of solidification to produce castings free from shrinkage. The rotating of mask should be dynamically balanced to reduce vibrations during casting process.

Advantages

- Quick and economical than other methods.
- Risers, cores are eliminated.
- Ferrous and non ferrous metals can be cast.
- Good surface finish.

Disadvantages

- Mechanical composition of alloy are not uniform.
- Good for production of cylindrical parts only.
- The equipment is expensive.
- only those component which are axis cemetry can be produced

Applications

- This process is normally used for making of hollow pipes, tubes, hollow bushes.

Moulding Sand

It is the sand used as a moulding material in the foundry shop. It is used for all types of castings, nonferrous metals, iron, steel etc.

It can withstand the high temperature of molten metal and does not react chemically with molten metal.

composition of moulding sand

① Silica (SiO_2)
② Binder (clay)
③ water
④ Additives

① Silica sand

→ It contains 80 to 90% silicon dioxide. They are specified according to their average size and shape.
→ It is the product of quartz rocks or the decomposition of granite which is composed of quartz and feldspar.

② Binder

→ The binder is used to bind the sand grain together and brings strength.
→ It is added to bring the property of cohesiveness.
→ Easily molded, reusable.
→ Some common binders are clay, sodium silicate and portlan cement.

③ water or moisture

→ moisture contents in the moulding sand should be 2-6%.
→ When water is added to clay it penitrates the mixture and formed a microfilm which coodes the surface of flake shaped clay particle.

→ Bonding quality of clay depends upon maxium thickness of water film.

④ Additives

→ It is used to improve the properties of moulding sand. (surface finish, dry strength, refractoriness).
→ some common additives are sea coal, silica flour, saw dust, pitch.

Types of Moulding sand

① Green sand
② Dry sand (contain max thermal stress)
③ Loam sand
④ Facing
⑤ parting sand
⑥ Baking sand

① Green sand

→ If the sand contains 2-6% of moisture then that sand is called green sand.
→ It is a mixture of silica sand with 18 to 30% of clay and having a total water of 6 to 8%.
→ Clay and water furnish the bond for green sand.
→ It is fine, soft, light and porous.
→ It is used for making simple, small and medium size casting.

② Dry sand

→ If the moisture available in the moulding sand evaporates because of high temperature of molten metal then the sand is called dry sand.
→ which has less water and more thermal strength.
→ It is suitable for large castings.
→ The mould does not causes defect which occurs due to moisture.
Application :- engine blocks, large gears, big housing, construction parts are making by using dry sand mould.

③ Loam Sand

→ It is a sand which are more clay and fine sand.
→ It contains silica, graphite, clay and water.
→ Usually for large casting like bell, roller, pulley.

④ Facing Sand

→ Facing sand is used to form the face of the mould.
→ It is next to the surface of the pattern and it comes in contact with molten metal when poured in mould.
→ It is made up of silica and clay without addition of used sand.
→ Layer of facing sand in mould usually 20-30mm.

⑤ Parting Sand

→ It is a pure silica sand used to avoid shrinking of the moulding surface with other surface.
→ It separates cope and drag without cleaning.
→ It is the mixture of silica and brick powder.

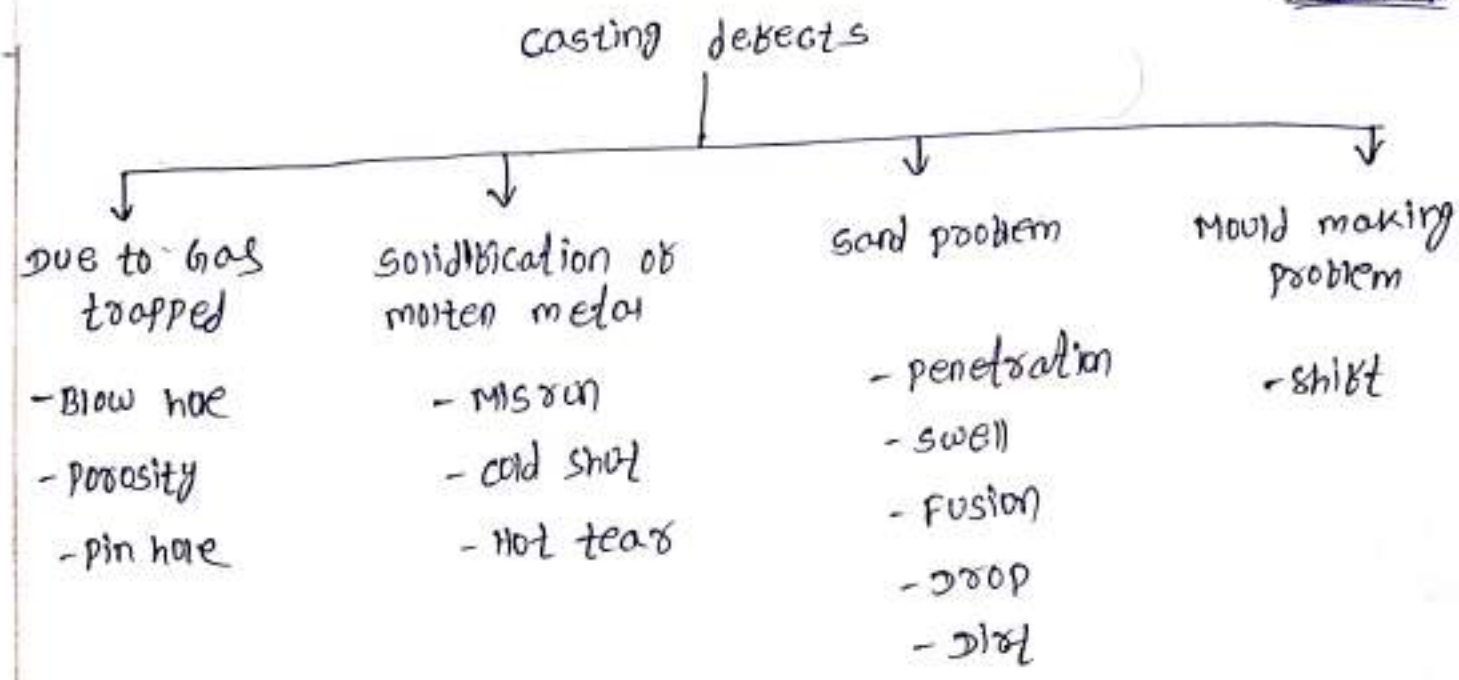
⑥ Backing Sand

→ Sand which is placed at the extreme end of the mould to support the facing sand is known as baking sand.
→ Already used sand can be used as baking sand.
→ Strength, refractoriness, permeability of the sand is more than the facing sand.

Properties of moulding sand

1) Adhesiveness
2) Cohesiveness
3) Collapsibility
4) Dry strength
5) Flowability or Plasticity
6) permeability
7) Refractoriness

05.01.2023


Casting defects
Due to Gas trapped
- Blow hole
- Porosity
- pin hole
Solidification of molten metal
- Misrun
- cold shut
- Hot tear
Sand problem
- penetration
- swell
- Fusion
- Drop
- Dirt
Mould making problem
- shift

06.11.22

Shell Moulding

Shell moulding is a casting process in which the mould is a thin shell made up of sand held together by thermosetting resins.

Die casting

Die casting may be defined as the process by which a casting is made by injecting molten metal under high pressure in to a permanent mould.

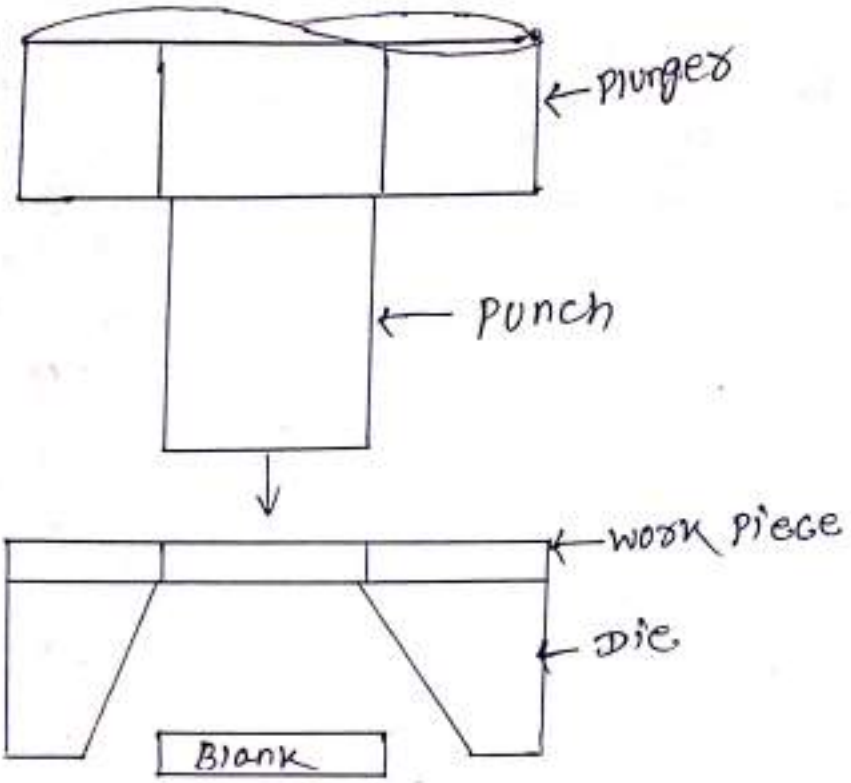
Advantages

→ Not applicable for high melting point metals and alloys. Ex - steel.
→ Large parts can not be cast.
→ High die cost.
→ some gasses may be trapped in the form of porosity.

UNIT-5

PRESS WORK

13-01-23



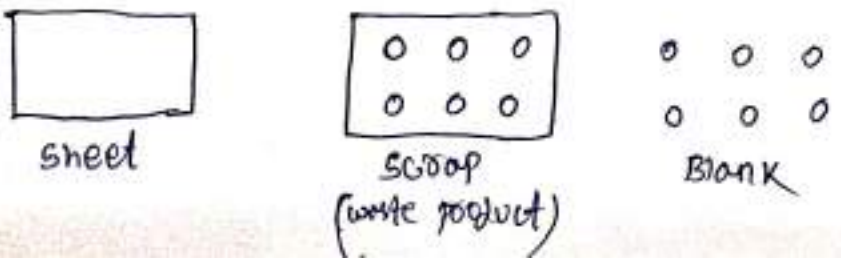
~~Blanking~~ :-

Press working :-

In sheet metal workshop, variety of useful items such as washers, utensils etc are made from sheets of metal. A special type of machine called press is used for this process. In this process a special type of die-punch assembly is used.

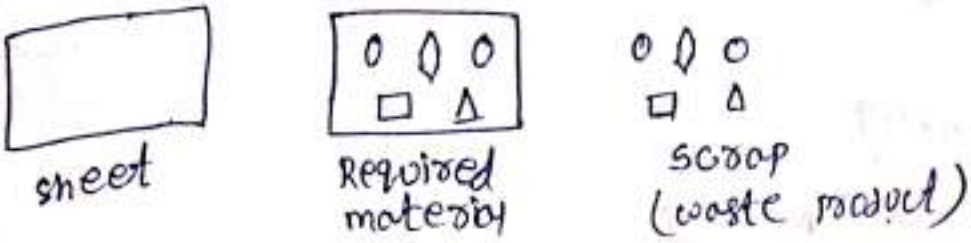
Blanking :-

Blanking is an operation of removing a piece of metal from a large sheet by punching with predefined shaped punch. The removed part is called Blank and it is useful part and rest sheet is called scrap.



This process used to cut gears, jewelry and complex parts.

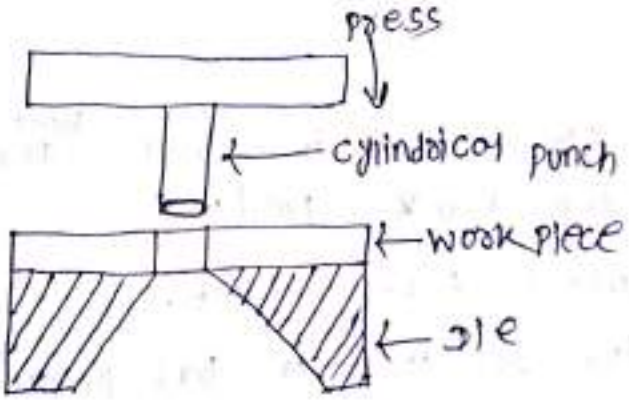
punching :-



It is similar operation like blanking except the desired part is sheet the blank is scrap.

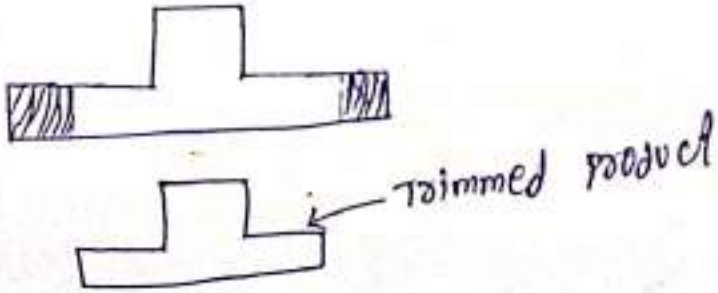
→ This process takes place on punching process and the negative allowances is provided on the punch. which give positive tolerance on sheet.

piercing :-



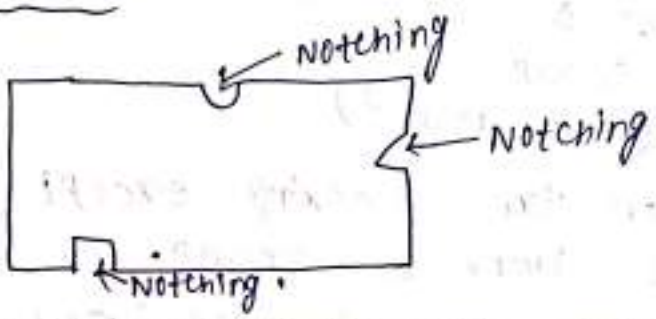
It is similar to punching process but we punching can perform different shape of holes. but in piercing we can perform only circular holes in the required sheet.

Trimming :-



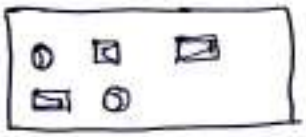
Trimming generally a metal removing process in which excess material is removed from the edge of the workpiece by using punch and die.

Notching :-



It is a process of removing various shapes from the materials edge of the workpiece. It creats notches at edges

Lanching



This is an operation in which hole ~~Punch~~ is formed without removing the blank part.

→No material removal takes place.

→The blank remains attached in bend room.

16.01.2023

Different types of dies

- Dies
  - Single operation dies
  - Multioperation dies
    - Compound dies
    - Progressive dies
    - Combination dies

Different types of punch

- Punch
  - Prick punch
  - Dot punch
  - Centre punch
  - Others
    - Hollow punch
    - Socket punch
    - Solid punch
    - Automatic punch
    - Letter and No. punch

Prick punch - Soft material - Aluminium, Copper.
Punching angle - 30°

Dot punch - punching angle - 60° - Mild steel

Centre punch - punching angle - 90°.

① Forging

Forging is the basic process in which the work piece is shaped by compressive forces applied through various dies and tools. It is the one of the oldest and most important metal working process.

(i) Hand forging
(ii) Drop forging
(iii) Power forging
(iv) Machine forging

Casting

procedure of sand mould casting

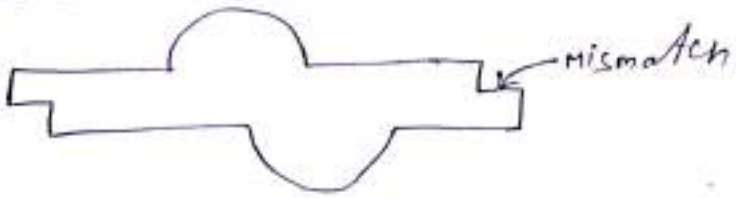
1. Place the mould in sand
2. setup the Gating system or pouring basic
3. Remove the mould pattern
4. Pour molten metal in to mold cavity
5. wait for metal to cool.
6. Break open mold to remove metal casting.

composition

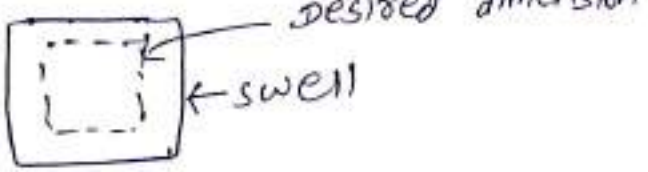
Silica (SiO_2) - 86% to 90%
Alumina (Al_2O_3) - 4% to 8%
Iron oxide (Fe_2O_3) - 2% to 5%
combined water - 2.5%
other inert materials - 1.5%

Casting defects

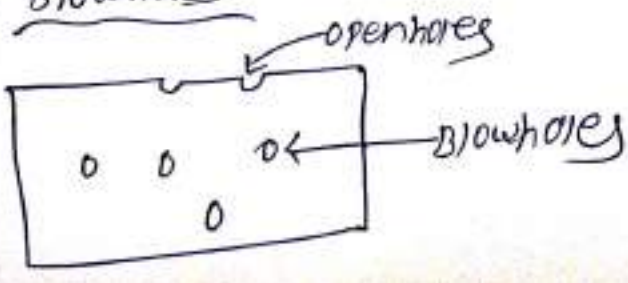
(i) Mismatch



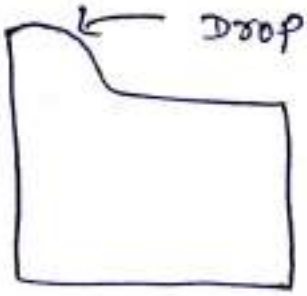
(ii) swell



(iii) Blowholes



(iv) Drop

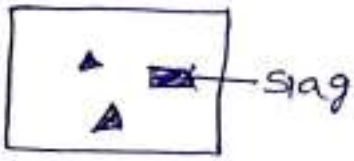


(v) Metal penetration

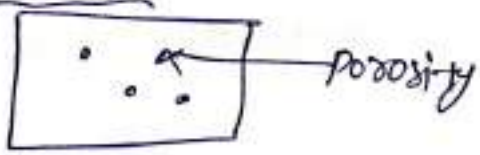
(vi) Hot tear or hot cracks

(vii) Rat tails or veins

(viii) Slag inclusion



(ix) Porosity



*) state the steps of core preparation.

- selection of core sand
- Mixing of sand with additives
- core shooting or blowing
- core venting
- Reinforcement cores
- Baking of cores
- core cleaning
- core inspection

*) what do we understand by economic of casting.

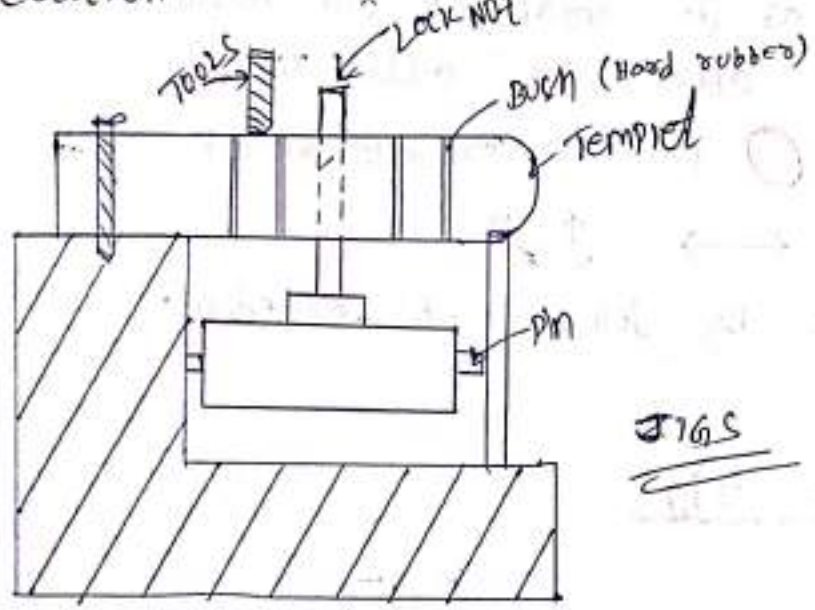
UNIT- 6

09.01.2023

Jigs and Fixtures

Jigs
→ Hold and support the workpiece and guides the tool.
Fixture
→ But fixture hold and support the workpiece but does not guide tool. EX - Bench vice.

→ Jigs are the work holding devices which holds, supports and locate the workpiece and guides tools to perform a specific operation.



JIGS

→ Fixtures are the work holding devices which holds and support and locate the workpiece but do not guides the cutting tool perform a specific operation.

Difference between Jigs and Fixture

JIGS	Fixture
⊙ It is used to hold and support the workpiece and guides the cutting tools.	⊙ It is also used to hold and support the workpiece but not to guide cutting tools.
⊙ It is lighter in construction.	⊙ It is heavier in construction.
⊙ It is not fixed with the machine tools.	⊙ It is fixed with the machine tools.
⊙ Gauge blocks are not necessary	⊙ Gauge blocks may be provided for effective handeling.
⊙ Jigs are perticularly used in drilling, reaming or taping and boring operation.	⊙ Fixtures perticularly in milling machine, shapers and slotting machine.

⊙ Its cost is more	⊙ Its cost is less as compare with jig.
⊙ The design is complex.	⊙ The design is less complex.

Degree of freedom (DOF)

It is defined as the rotational and translational movement of the workpiece about the axis. X,Y,Z.

Rotational — ○ (clockwise or anticlockwise)

Translational — ⟷ ↕ ↙

A body has 12 degree of freedom.

12.01.23

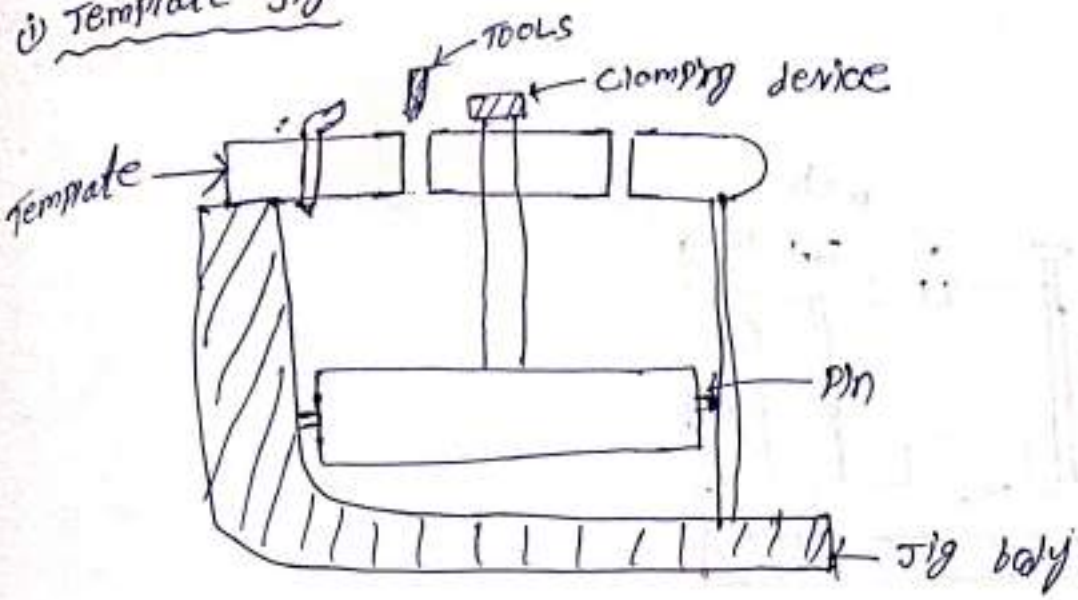
Component of Jig

Frame or Body
Pin
Clamp
Bush

Types of Jigs

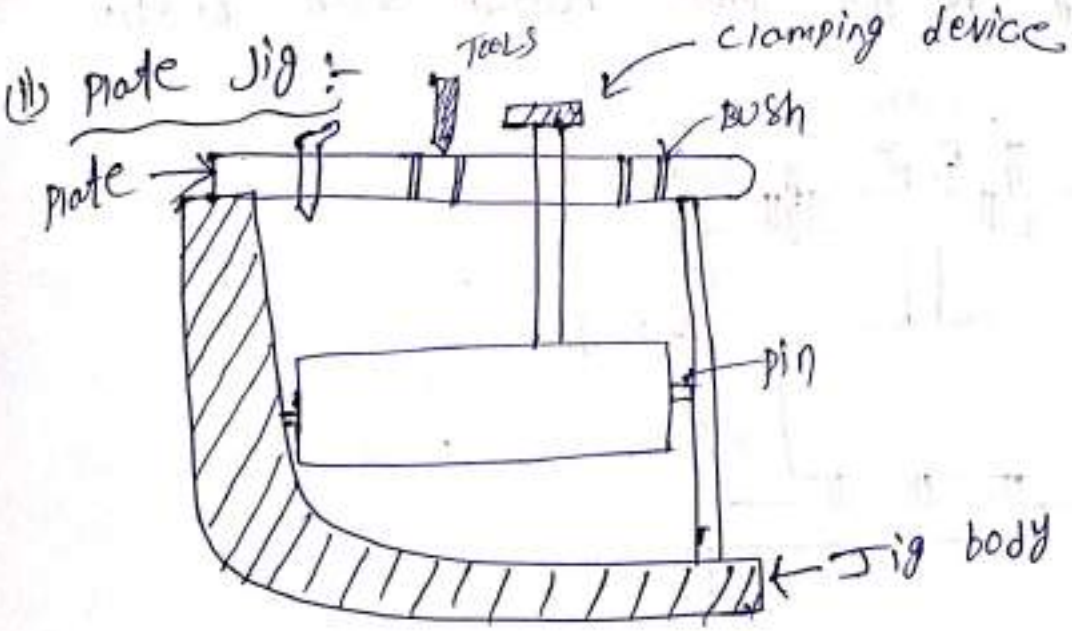
① Template jig
② Plate Jig
③ Open Jig
④ Box type jig
⑤ channel jig
⑥ Leaf jig

(i) Template Jig



This type of jig uses template over the jig body which guides the cutting tools. It is used for small scale production because of wear and tear in the template due to cutting tools.

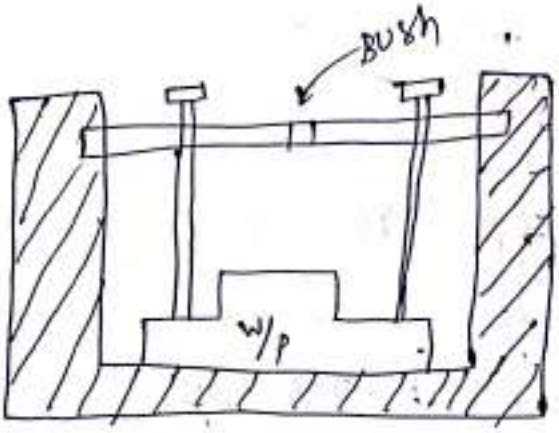
(ii) Plate Jig :-



This type of jig is used for mass production and during use of bush, this type jig is used for large no. of production in industries.

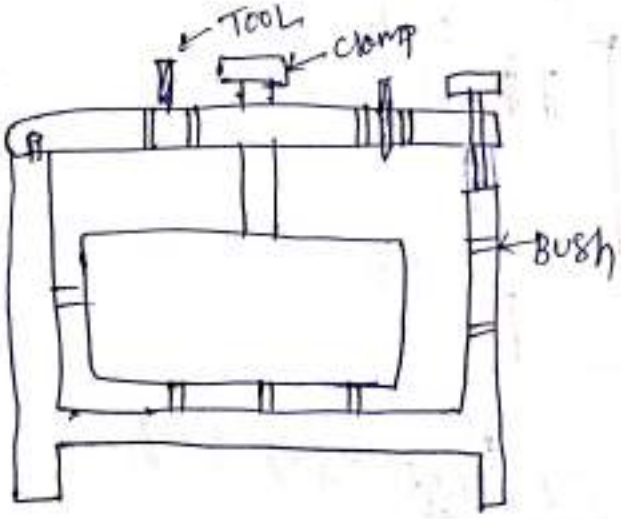
The hardened bush does not provide wear and tear of the plate.

(iii) Open Jig :-



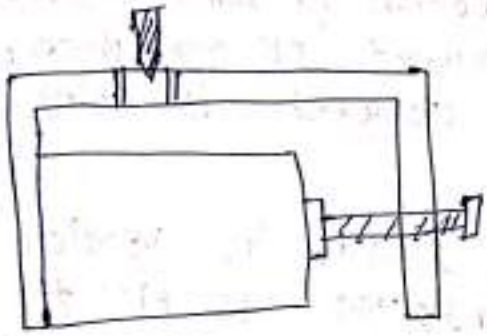
This type of jig is used for the drilling of irregular shape workpiece.
Jig plate is opened from the top side and workpiece is provided in the jig body and then clamped.
The tool is guided by the plate headed with bush.

(iv) Box Jig :-



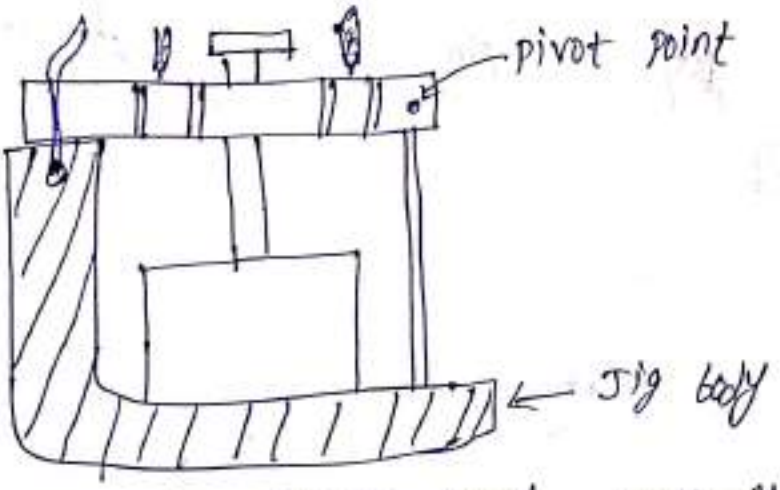
This type of jig used where there is drilling of several jobs/planes required at a time.

(v) Channel Jig



It is a simplest form of jig which looks like a channel and the tool is guided by the jig body.
This type of jig is used for small scale productions.

(vi) Leaf Jig



This type of jig is used ~~when there is~~ to reduce loading and unloading time of the work-piece.
This type of jig is used for mass production.

Fixtures

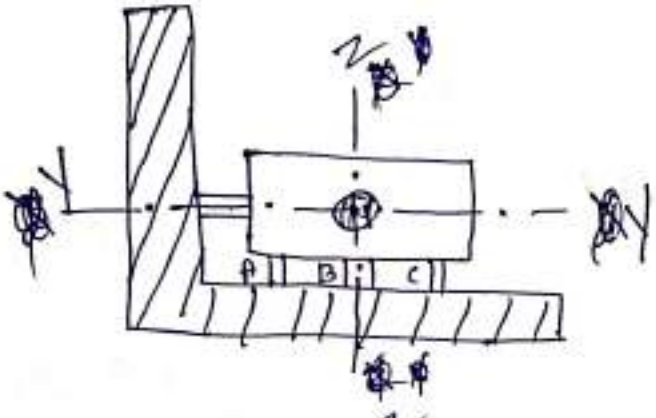
① Turning Fixtures
② Drilling "
③ Milling "
④ Shaping "
⑤ Planning "

(*) 3-2-1 principle.

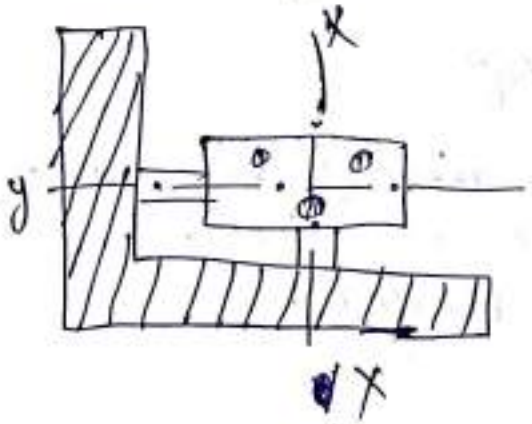
The 3-2-1 principle or location (6 point location) principle is used to constant the moment or workpiece along the three axis x, y, z. This is achieved by using 6 locating points,

3 points in base plate, 2 pins in vertical plane, 1 pin in a plane which is perpendicular to first two plane.

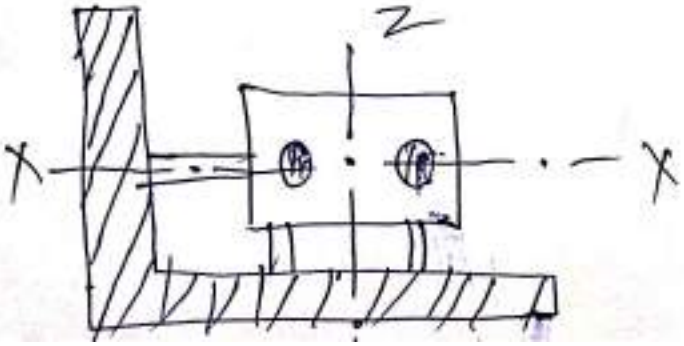
A bodies in space it has 12 degree of freedom but by using 3-2-1 principle we can constraint 9 degree of freedom and it allows 3 degree of freedom.



1 pin



3 pin



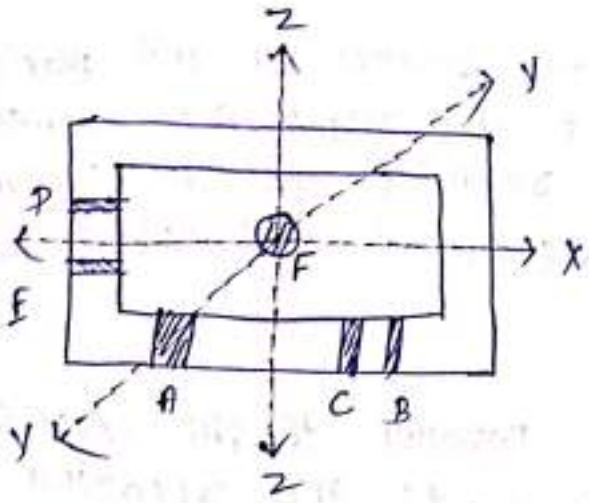
2 pin

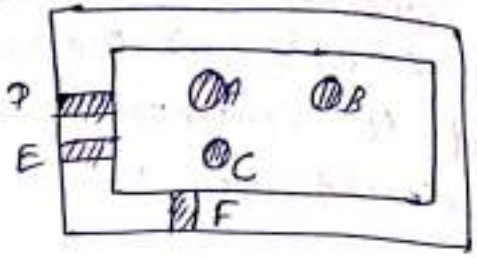
pin ABC on the base plane (a plane parallel to the plane which contains x and y axis) restrict the rotation of component about x axis, y axis. It also restrict the downward moment of component along z axis i.e it restrict 5 degree of component.

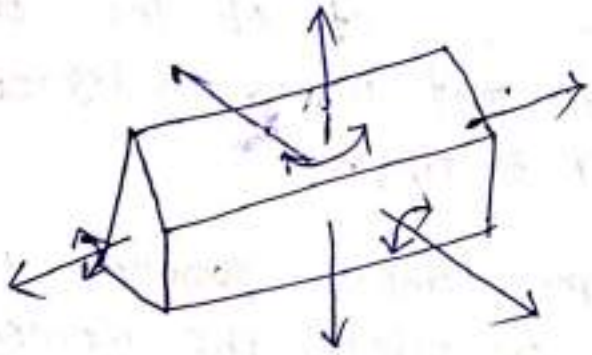
pin D, E is in the plane parallel to the plane containing x and z axis. It prevents the rotation of component about z axis and the moment of the body in negative y axis is prevented. That means 8 degree of freedom is restricted by using 5 pins.

The last pin F is in the plane parallel to the y and z plane. which restricts the moment of components along -X axis.

Thus by using these 6 pins 9 degree of freedom can be restricted and 3 degree of freedom remains free for the loading and unloading purposes. which can later be restricted by using clamps







3 pins - base plate

2 pins - vertical plane

1 pin - perpendicular to fixt plane.

3 pins

Rotational - X X (2)

Rotational - y y (2)

downward - z (1)

2 pins

Rotational - z z (2)

Backwood - X (1)
(Left side)

1 pin

Backwood - y (1)