Page No.:
Date :

UNIT → 2

☆ Pattern - (Key points)

(i) Casting
(ii) Advantages of Casting
(iii) Limitations of Casting
(iv) Terms used in Casting
- Pattern
- Mould
- Sand
- Vent
- Core
- Chaplets
- Grating System

(1.) CASTING - In this process, liquid metal is used. The solid metal/material is first melted and then poured into a cavity which resembles closely the shape of the final object to be made. The molten metal is then allowed to solidify and removed from the cavity after the solidification. This solidified object is called casting.

- APPLICATION → It has application in engine parts. For example - connecting rod, cylinder block, Piston, crank shaft.

✡ Advantages of Casting :-

(i) Any complex shapes internal or external can be made from casting.
(ii) Casting is used to cast both ferrous and non-ferrous metals.
(iii) Tools required are not expensive.
(iv) Casting of any size and weight can be made

✡ Limitations of Casting :-

(i) Dimensional accuracy achieved is not good
(ii) Surface finishing obtained is not good.
(iii) It cannot be done with the help of the machines.

✡ Terms used in Casting

- Pattern
- Mould
- Sand
- Vent
- Core
- Chaplets
- Gating System

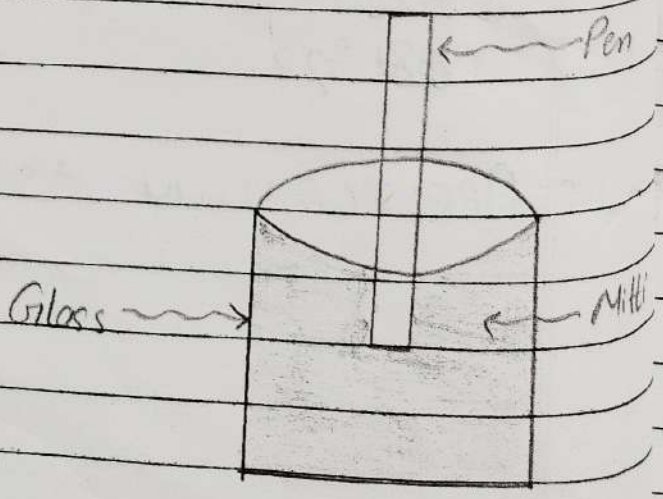

fig: Understanding Casting.

Date :

PATTERN

- It is defined as the model of the desired product
- The patterns are generally made up of wood, wax and metal

→ Types of pattern →

(i) Solid / single Piece = This pattern is made without joints in its construction.

(ii) Split / Two Piece = Some patterns can not be made in single piece because of difficultics encountered in the cavity. So, for this reason pattern is made into 2 pieces.

(iii) Multi - Piece = For the complex shapes, some patterns are made in more than 2parts.

(iv) Match - Plate = These types of patterns are mounted with one-half on the one side of the plate and other half directly opposited to other side of the plate.

(v) Gated → To produce good casting, it is necessary to ensure that full supply of molten metal flows into every part of the cavity. The provision for such passage is called Gated pattern.

(vi) Skeleton - The patterns for very large castings would require a large amount of pattern material. These are hollow patterns and are made up of wooden frame.

(vii) Pattern with loose pieces - There are some patterns which cannot be withdrawn once they are put into moulding sand. For such patterns, these are usually made with one or more loose pieces for the removal of the pattern.

(viii) Follow Board - It is a wooden pattern and it is used for supporting a pattern which is very thin, fragile and may collapse under pressure.

✱ Pattern Allowances →

It plays an important role in obtaining adequate patterns. The patterns size is never kept same as that of the desired casting bcz casting is subjected to various effects during cooling and hence, these are called pattern allowances

⇝ Types of Allowances

(i) Shrinkage
(ii) Machining
(iii) Draft / Taper
} +ve

(iv) Distortion
} +ve

(v) Shake/Rapping } -ve

Date :

(i) Shrintage - As the metal solidifies and cools, it shrunks in the size to compensiate for this. Pattern is made larger than the finished casting by the mean of a shrintage allounce.

(ii) Machining - For good surface finish, machining of casting is required. So, for machining pattern is made more than the normal size.

(iii) Draft/Taper - At the time of withdrawing pattern from the cavity, the vertical faces of the pattern are in the contact with the sand which may damage the cavity. So, this danger is decreased by keeping vertical faces of the pattern tapered.

(iv) Distortion - If the shape of the casting changes, it is called distortion of casting. This distorting can be eliminated by constructing the pattern initially disorted.

(v) Shake/Rapping - When a pattern is shaped in the mould before it is withdrawn, the cavity in the mould is slightly increased. So, inorder to compensiate this pattern is made slightly smaller than the actual size.

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GATING SYSTEM =

- The passage way for bringing the molten metal to the mould cavity is called gating system.
- It has 5 main components-

(i) Pouring Cup
(ii) Sprue
(iii) Runner
(iv) Gate
(v) Riser

In this process, molten metal is poured into a pouring basin, then the metal transfer along the runner and finally through the gates, reaches into the mould cavity

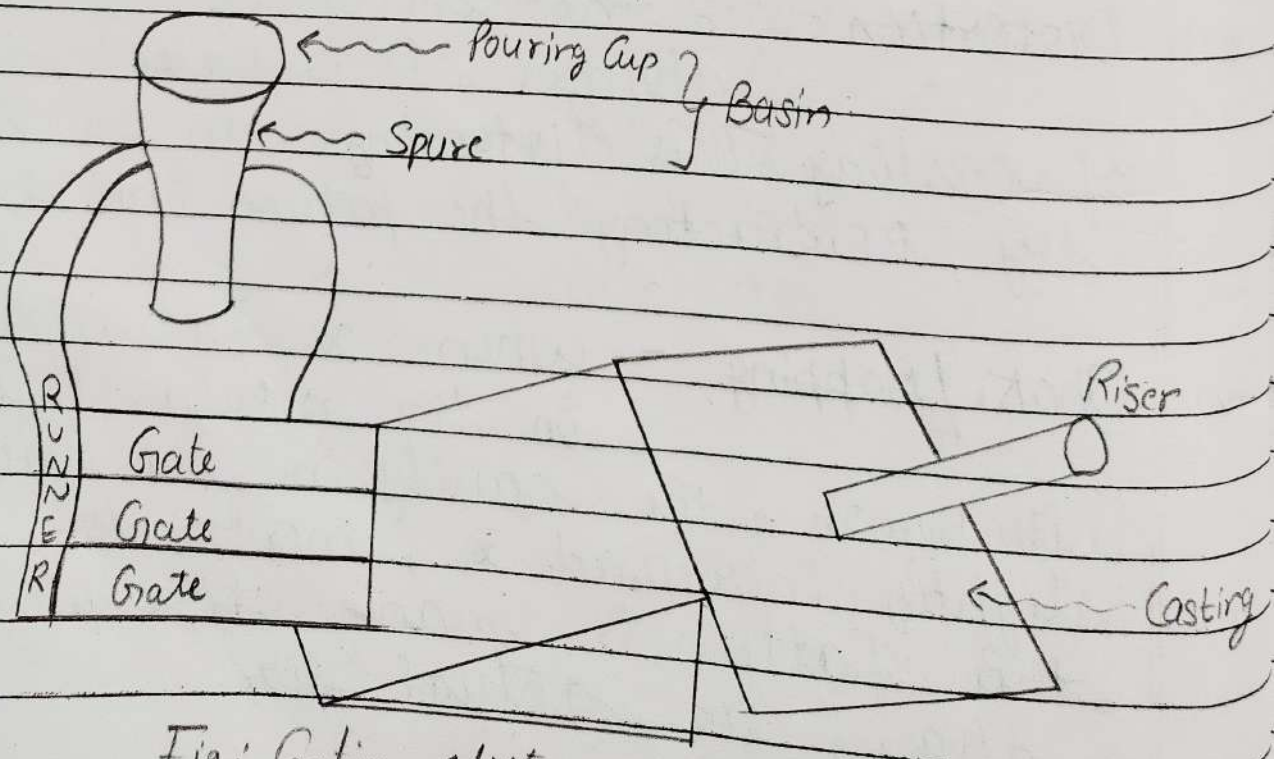

Fig: Gating system

Page No.:
Date :

Main Constituents of Moulding Sand:

- The principle constituents of moulding sand are:-

(i) Silica Sand (80 - 82 %)
(ii) Binder (2 - 10 %)
(iii) Additives (2 - 10 %)
(iv) Water (2 - 18 %)

① Silica Sand → (80 - 82 %) →

- It is the major portion of the sand.
- It is there in the moulding sand to improve the thermal Stability

② Binder → (2 - 10 %) →

- The purpose of adding the binder to the moulding sand is to improve the sufficient strength.
- The commonly used binder is clay

③ Additives → (2 - 10 %) →

(i) Sea Coal (1 - 10 %) → Improves surface Appearance
(ii) Asphalt (0.2 - 2 %) → Improves surface finish
(iii) Silica Flour (upto 3.5 %) → Improves strength
(iv) Graphite (0.3 - 2.10 %) → Improves surface finish
(v) Wood Flour (0.5 - 2 %) → Improves flowability
(vi) Corn Flour (0.25 - 2 %) → Minimize sand expansion defects.

4. Water → (2-8%) →

The clay content added to the sand will not give the required strength untill a suitable quantity of water is added to it.

Preparation of Moulding sand-

(i) Mixing of sand-

- It is the process by which we add clay/binder which are rich in characterstic in which sand lacks.

(ii) Tempering

- The process by which adequate amount of water is added to the sand is called tempering of sand.

(iii) Sand Conditioning

- It means the uniform distribution of the binders and additives around the sand, so that it flows and takes up the detail of pattern.

- It can be done with the help of machine & also it can be done manually.

Page No.:
Date :

(iv) Sand Testing →

It is a common physical test in which we judge the sand condition by gripping a handful of sand and then release the pressure of the fingers.

Methods of Moulding →

(i) Bench
(ii) Floor
(iii) Pit
(iv) Machine

① Bench Moulding - If the moulding is carried out on a bench, it is called bench moulding. It is suitable for small and light casting.

② Floor Moulding - The moulding done on the foundry mold is called floor moulding. It is used for medium and large castings.

③ Pit Moulding - The moulding done in a pit is called pit moulding. It is used for extremely large moulding.

④ Machine Moulding - The moulding done by machine is called machine moulding. The ramming of sand, forming the gate

Date :

and drawing out the pattern can be done with the help of machine effectively.

* Fettling (Cleaning of Casting)

(1) Rough Cleaning → For Ductile Material - Power Hacksaw
→ For Brittle Material - By Impact

(2) Surface Cleaning → Sand Blasting
→ Hydro Blasting
→ Pickling

(3) Surface Finishing

* Casting Objects → Causes
→ Remedies

- Gas Trapped
  - ↳ Blow Holes
  - ↳ Porosity
- Solidification
  - ↳ Shrinkage
  - ↳ Mis Runs
  - ↳ Hot Tears
- Sand Problem
  - ↳ Cuts & Washes
  - ↳ Metal Penetration
  - ↳ Drop

1.) Blow Holes :- This appears as holes in the casting if these holes are visible on the surface of the casting.

Date :

They are called blow holes. whereas if these occurs below the surface of casting are called closed blow holes.

CAUSE - (i) Excessive moisture in the moulding sand

REMEDIES- (i) The moisture content in the sand must be controlled and kept at desired level

2.) Porosity :- When the metal solidifies some gases may be released and create small voids called Porosity

CAUSE - High moisture & High pouring temperature

REMEDIES -

3.) Shrinkage :- During the solidification of metal there are high chances of shrinkage.

CAUSE - Quality gating system

REMEDIES -

4.) Mis Run - When the metal is unable to fill the cavity completely & thus leaving unfilled portion called misrun.

CAUSE - system and lack of fluidity in molten metal

REMEDIES - Increasing the pouring temperature of molten metal increases the fluidity.

5.) Hot tears - When the pulling is not done in some part & it is visible as hot tears

CAUSE: The cause of this effect is hard ramming

REMEDY:

6.) Cuts & washes - This effects occurs due to erosion of sand from the mould

CAUSE: Low strength of the core.

REMEDY:

7.) Metal Penetration - When the molten metal enters into the spaces b/w the sand it is known as metal penetration.

CAUSE - (i) Low strength of the core
(ii) Soft ramming

REMEDY: This defect can be eliminated by using high strength core and proper ramming.

8.) Drop: If the portion of the sand breaks away from the mould & drops it is called drop effect.

CAUSE: The cause of this effect is Soft ramming

REMEDY: Proper ramming should be done (neither too hard

Date :

UNIT ⇒ 4 "Welding"

☆ Welding

☆ Classification of Welding ~

- Plastic (Pressure)
  - Heat supplied by
    - Electric Current
      - Resistance Welding
        - Spot
        - Seam
- Fusion (Non-Pressure)
  - Heat supplied by
    - Gas
      - Oxy-Acetylene
    - Electric Arc
      - Arc Welding
        - TIG
        - MIG

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(*) Welding - It is the process of joining similar or disimilar metal with the help of heat and with or without the application of pressure.

APPLICATION ~

- It is used in the fabrication work & also used for repairing broken parts.

Date :

(i) Plastic Welding ~ In this process, the pieces of metal to be joined are heated to a plastic state and then forced together by the external pressure.

(ii) Fusion Welding ~ In this process, the pieces of metal to be joined are heated to a molten state without the application of pressure.

- Resistance Welding - It is a process, that join metals by passing an electric current through them to create heat and melt metal at interface.

(i) Spot welding - • If we need to join two pieces of metal together, spot welding is the process which can do this very quickly.
• It uses two Copper electrodes to concentrate welding current into small area which creates weld of the metal

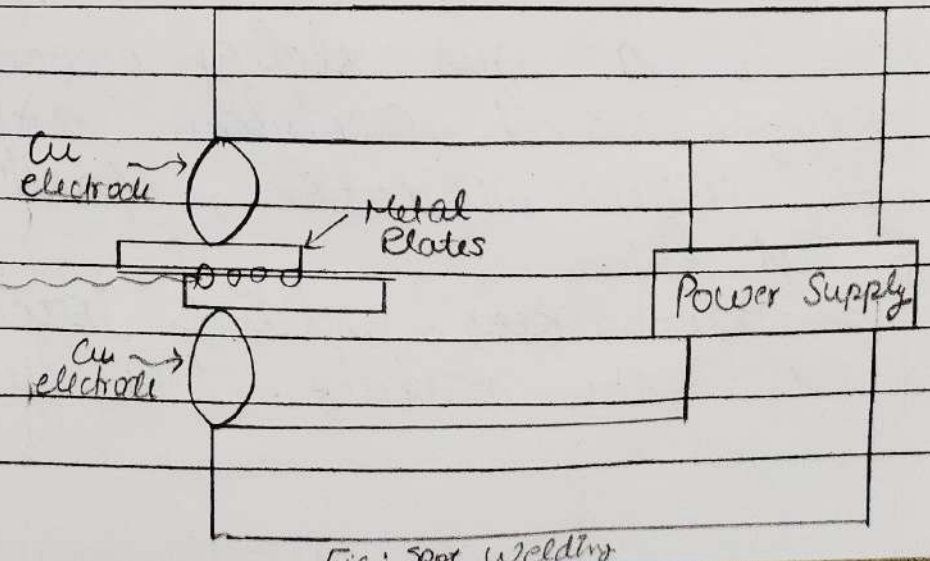


Fig: Spot Welding

(ii) Seam Welding → This process is done by passing electric current through the rollers on the opposite side of two pieces of the metals, thereby, heat from the current passes through the metal. So, this process is also known as continuous welding process

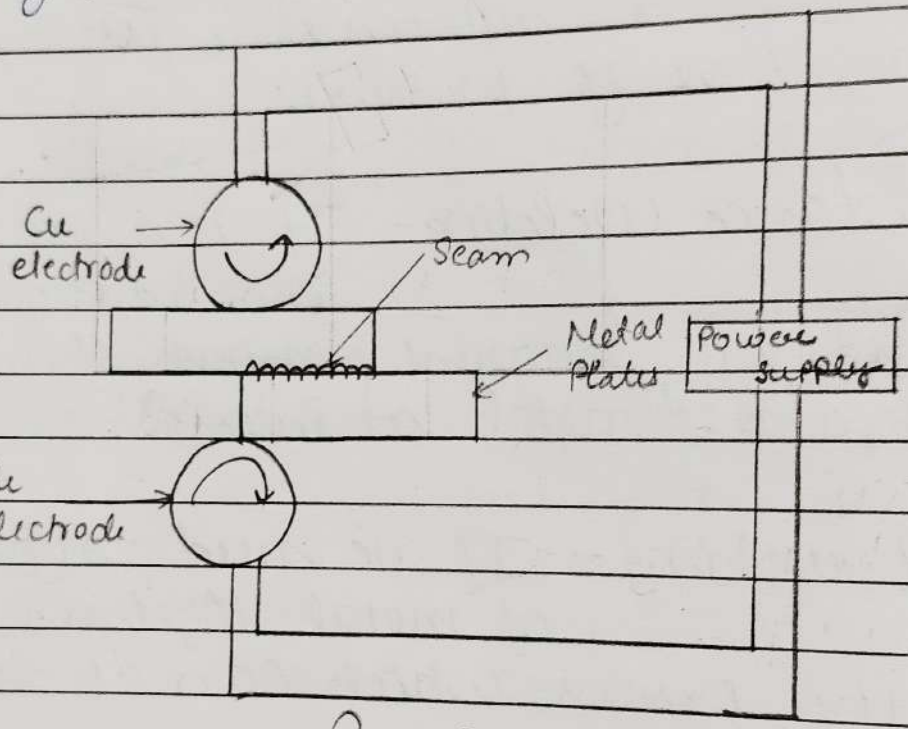


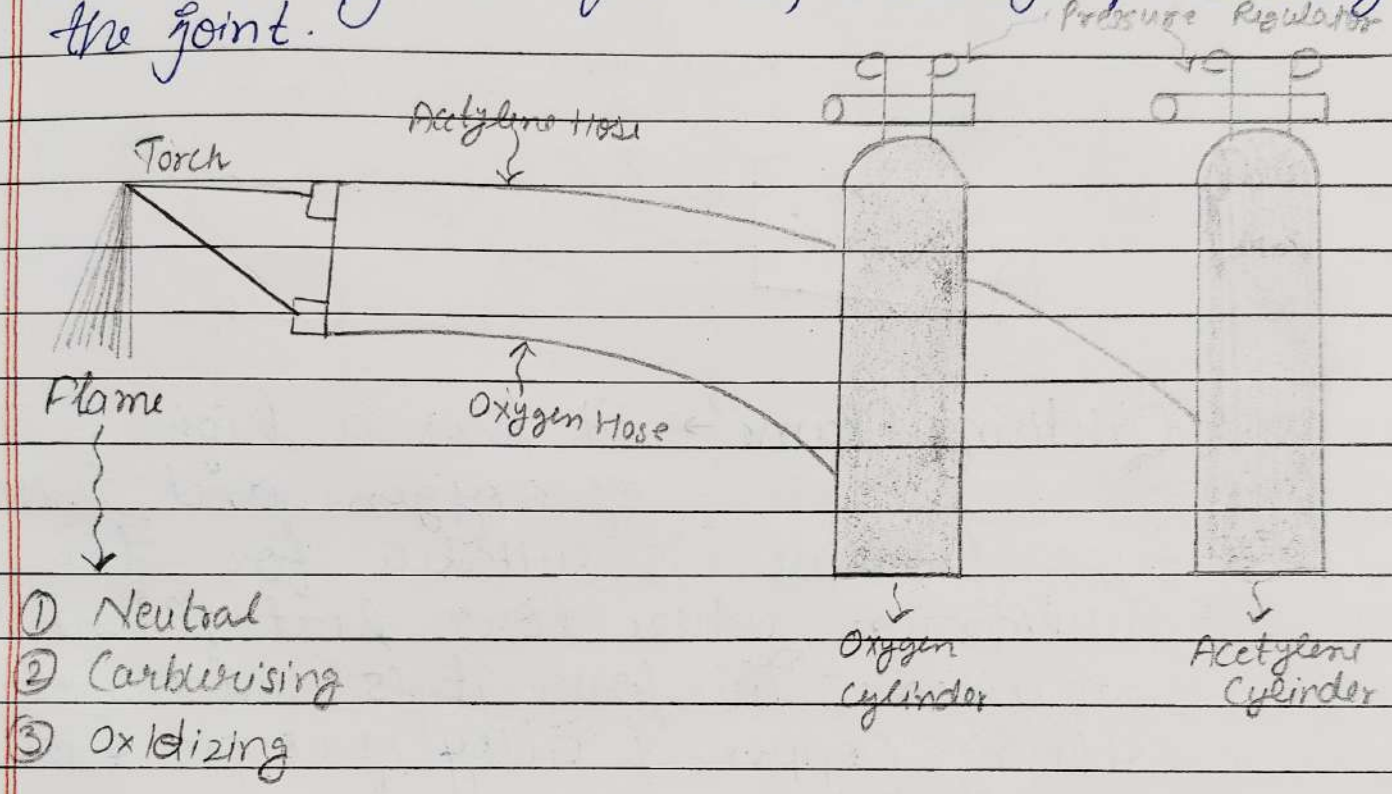
Fig: Seam Welding

- OXY ACETYLENE WELDING →

It is a gas welding process in which oxygen and acetylene are mixed together in correct proportion, producing a hot flame.
In this process, welding torch is used to weld the metals. The fuel gas and

Date :

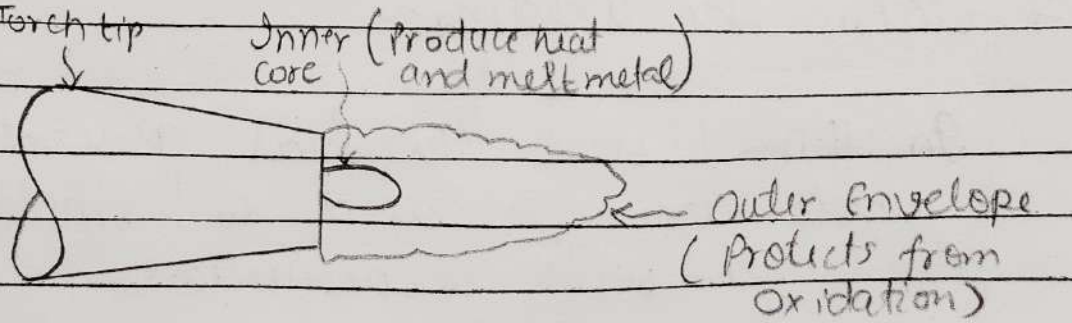
the oxygen gas are stored in the two cylinders. Pressure regulators are provided to manage the gas pressure. The gas flow through the gauges with the welder controlling the flame, thereby producing the joint.



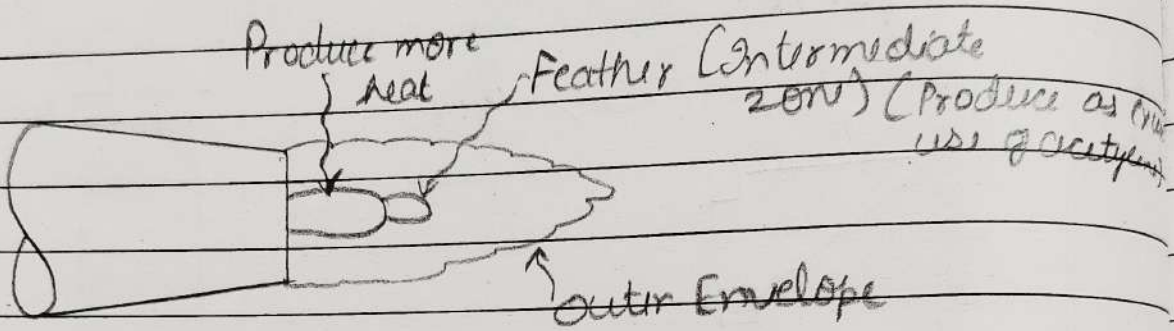
① Neutral
② Carburising
③ Oxidizing

⇝ Types of Oxy-Acetylene Welding :-

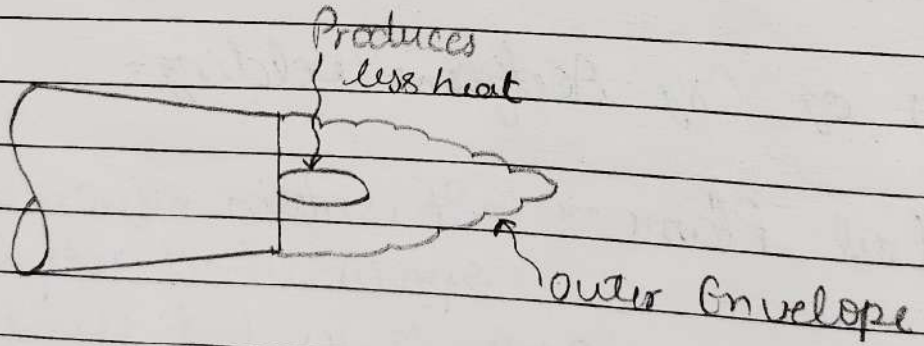
(i) Neutral Flame → It contain equal amount of oxygen and acetylene gas. This type of flame is used to weld steel, cast iron, aluminium & copper



(ii) Carborising Flame - It contain an excess of acetylene gas. This type of flame produces more heat. Therefore, it is used for welding of high carbon steel, nickel & non ferrous metals.



(iii) Oxidising Flame → It has a high content of oxygen and this type of flame is suitable for the application where low heat flame is required. Therefore, it is used for welding copper & alloy of copper such as bronze & brass.



Electric Arc welding -

In this process the heat generated by the electric arc is used to melt the metals and the weld is achieved.

Page No.:
Date :

#

In this process, the weld area is protected from atmospheric contamination by the use of inert gas shielding.

- Metal Inert gas welding (MIG) (GMAW)
- Tungsten Inert gas welding (TIG) (GTAW)

☆ Difference b/w MIG & TIG

	MIG	TIG
(i)	It is also known as gas metal arc welding (GMAW)	(i) It is also known as gas tungsten arc welding (GTAW)
(ii)	It has application in welding of aluminium & steel.	(ii) It has application in welding of stainless steel & copper alloy.
(iii)	High skilled operator is not required to perform this process.	(iii) High skilled operator is required to perform the process
(iv)	It can melt thick metal sheet upto 40mm	(iv) It can melt thin metal sheet upto 5mm.
(v)	It produces less quality of weld.	(v) It produces high quality weld
(vi)	The equipment used in this process is consumable electrode,	(vi) The equipment used in this process is non-consumable

Date :

feed rollers, DC power supply & inert gas cylinder	tungsten electrode, power supply which can be AC or DC & inert gas cylinder
(vi) It is a faster welding process	(vii) It is a slower welding process.

Page No.:
Date :

* Welding defects — Causes
                  — Remedies

- Cracks — Hot
          — Cold
- Porosity
- Under cut
- Incomplete fusion
- Incomplete Penetration
- Slag Inclusions
- Spatter

WELDING DEFECTS ~

(i) Crack - ◦ This is the most serious type of welding defect
◦ It is visible on the surface and is divided into two types. ~

(i) Hot Crack - ◦ This defect occurs during the welding process when the temperature is high

(ii) Cold Crack - ◦ This crack appears after the welding has been completed and the temperature has gone down
It mostly happens in the case of steel

(ii) Porosity +
~> Cause
◦ High welding speed
◦ Design of the joint is poor
◦ High content of carbon in the metal

~> REMEDIES

(ii) Porosity ~ • It occurs as a result of contamination
• The trapped gases create a bubble which are known as porosity

~> Causes - • Presence of moisture
• Improper gas sheilding
• Use of high gas flow

~> Remedies ~

(iii) UNDER CUT ~ This welding imperfection is the groove formation at the weld. Thereby reducing the cross-sectional thickness of the metal.

~ Causes - • Too high weld current.
• Too fast welding Speed.
• Poor welding technique.

~ Remedies

(iv) INCOMPLETE FUSION - This defect occurs when there is lack of fusion between the base metal and the

weld metal.

⇝ Causes - ° Low heat input
° Electrode diameter choosen is incorrect
° Electrode angle is incorrect
° Incomplete penetration

⇝ Remedies -

(iv) SLAG INCLUSIONS -

(v) INCOMPLETE PENETRATION - It occurs when the metal is not filled completely

⇝ Causes - ° Too much space between the metals we are welding together.
° Larger electrode diameter.

⇝ Remedies -

(vi) SLAG INCLUSIONS - This defect is visible on the weld. It occurs when the flux melts on the surface of the weld joint

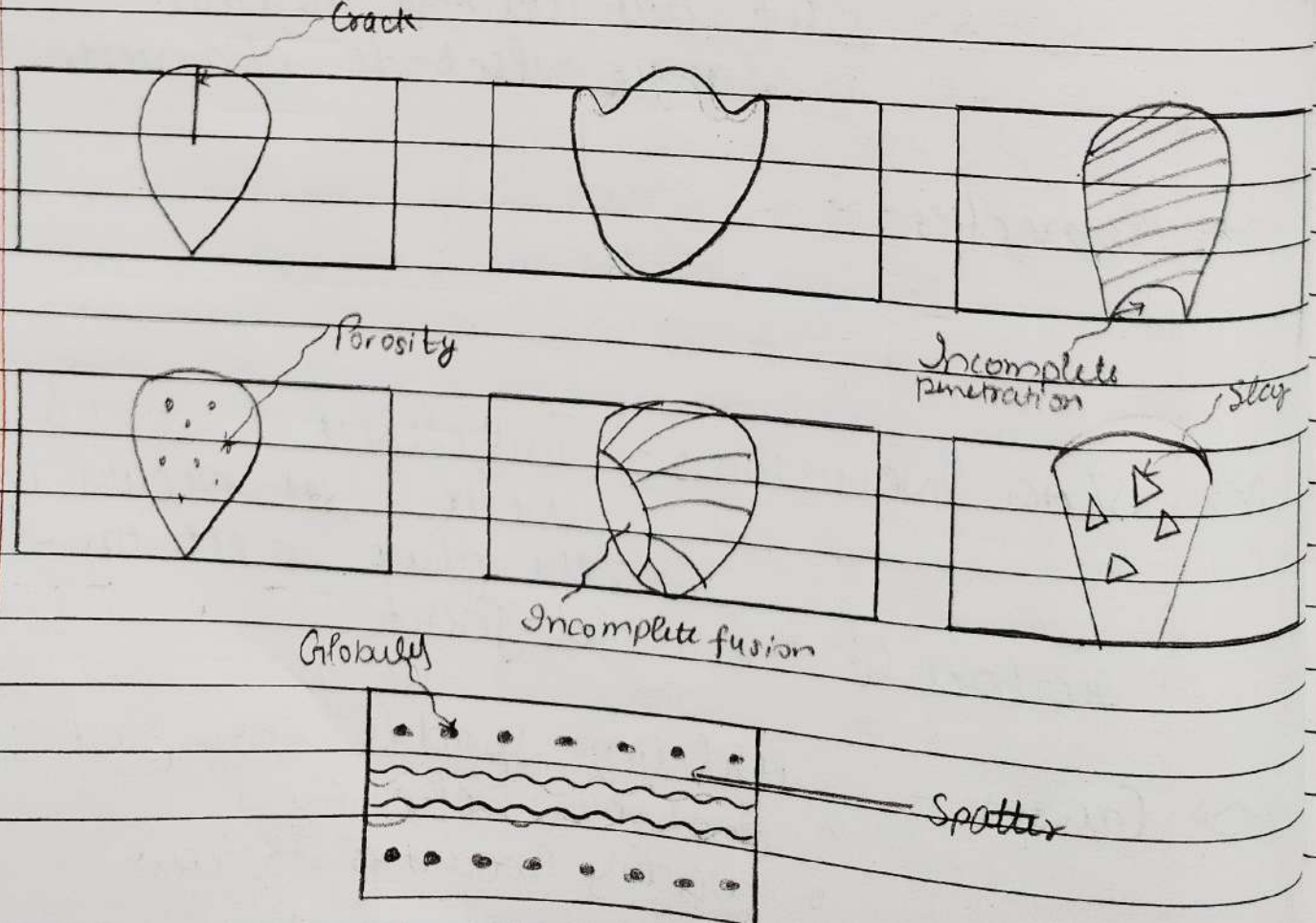
⇝ Causes - ° Welding speed is too fast
° Improper cleaning
° Welding current is too low

~ Remedies ~:

(vii) SPATTER - It is formed by droplets of molten metal that has scattered during welding leading to the forms of globules of the metal

~ Causes -
- Electrode angle is incorrect.
- Surface is contaminated
- Voltage setting is too low

~ Remedies -



Date :

* Soldering
* Brazing — Torch (Oxy - Acetylene Torch Flame)
  - Furnace
  - Electric

① **Soldering** - It is the process of joining similar or disimilar materials by the means of filler material. This filler material contains lead an tin.
Also, flux is used which is made up of zinc chloride and sodium chloride. The function of flux is to prevent outside contamination. Thereby, mating the joint stronger.
It is widely used in electronics industry for making electrical connections such as joining copper to PCB (Printed Circuit Boards) and it has also applicating in field of jewellery.

* Soft - 38% Lead & 62% TIN
* Medium - 50% L
* Electrical - 58% L and 42% T
* Plumber - 70% L and 30% T

It has melting point less than 450°C and the joints made are not stronger when compared to brazing process

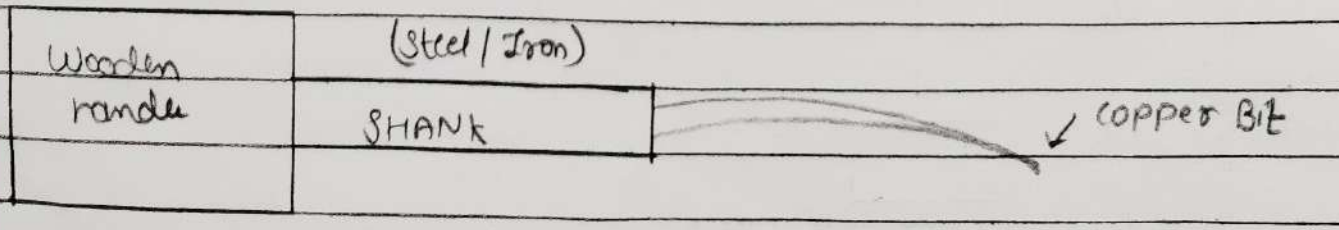


Fig: Electric Solder

(2.) Brazing - It is a process of joining of similar or dissimilar metal by means of filler material. This filler contains copper, zinc and tin.

- The mixture of spatter & borax with water is used as a paste on the metal parts. Then, the heat is applied and this heat can be generated by torch, furnance & Electric brazing
- In this process, the Melting Point is more than 450°c. The joints obtained through this process is strong than soldring but weaker when compared to welding

- It is used for fastining of pipe fitting, electrical Parts & it is also used to join parts of bicycle such as frame & rim

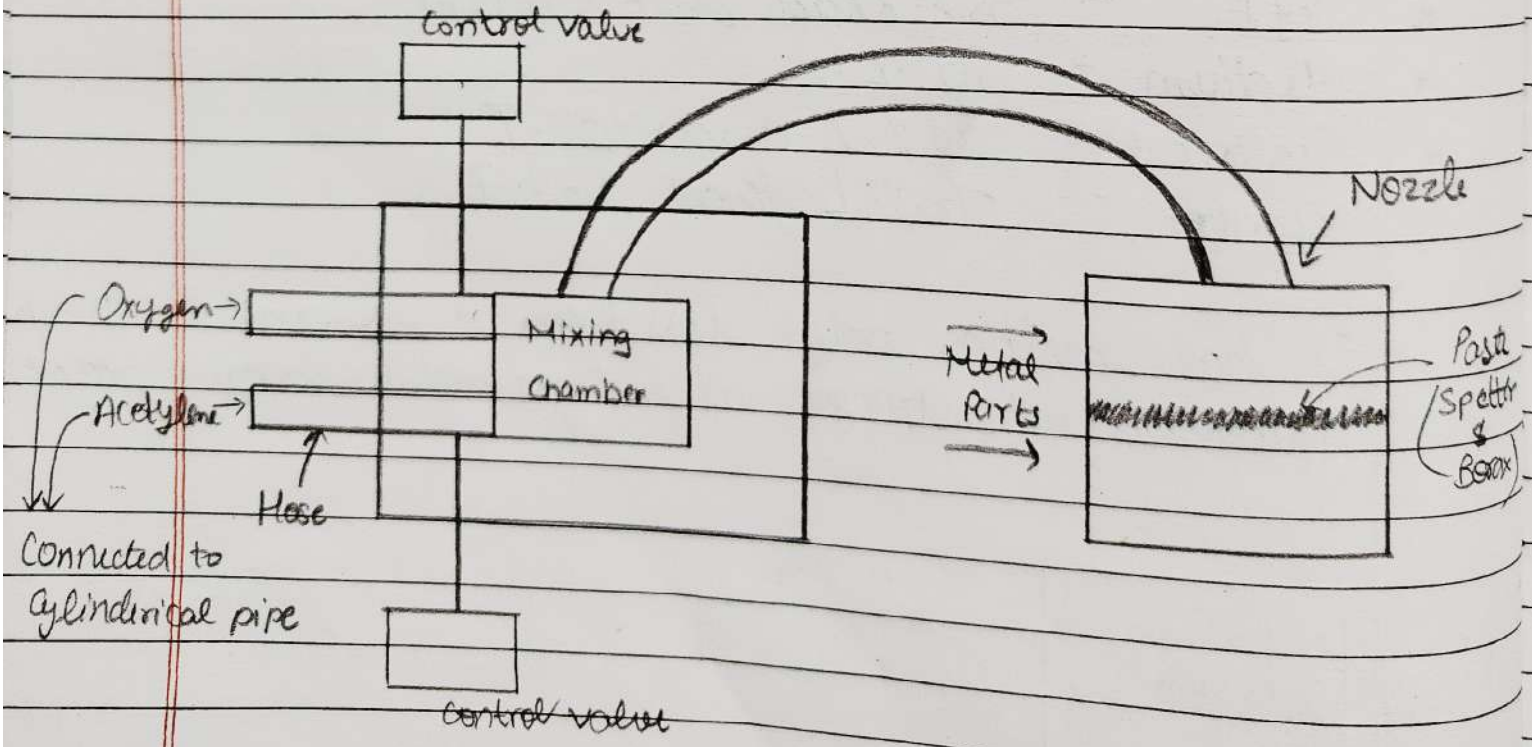


Fig: Torch Brazing