LECTURE

NOTES

ON

Sub: MES

SEM: 4th Semester

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Manufactured method

Manufacturing : method

Q → What is manufacturing method ?

→ Manufacturing is the making of woods from automobiles parts, electronics parts, clothes, different industrial etc.

→ A manufacturing process is how to manufacture build or creats a product it can be a complex activity that involves a range machinary, tools and equipment with many levels up automation use computers, robots and cloud base technology.

→ If the manufacturing process is good it produce good product for the customer.

→ Some manufacturing processes are :

(i) Machining
(ii) Joining
(iii) Forming
(iv) Casting etc.

Forming processing manufacturing :

Forming process :

Forming is a mechanical process used in manufacturing industries where materials undergo plastic deformation an accure required shapes and sizes by application of suitable stresses, such as compresion shears and tension.

Some commonly used forming processes are

(1) Forging
(2) Rolling
(3) extrusion etc.

2. Joining process :-

Common type of joining processes used in manufacturing industries are Welding, brazing, Soldering, bending, bolting, screwing, riveting etc.

3. Casting process :-

Casting :- Casting is a manufacturing process in which a liquid material is usually poured into a mold which contains a hollow cavity of the desired shape and then allowed to solidify. The solidify part is also known as casting.

Different type of casting :-

1. Sand casting
2. Investment casting
3. Die casting
4. Low pressure casting
5. Centrifugal casting
6. Gravity die casting
7. Vaccum die casting
8. Squeezing die casting.

4. Forging process :-

(i) Forging is a manufacturing process involving the shaping of a metal through hammering, pressing, or rolling.

(ii) These compressive process are delivered with a hammer or a die.

Forging is done both the temprature
1. Cold forging
2. Hot forging.

(iii) The metals used in forging are carbon steel, alloysteel & stainless steel, aluminium, brass, copper etc.

The forging process can produce parts with super mechanical properties with minimum waste.

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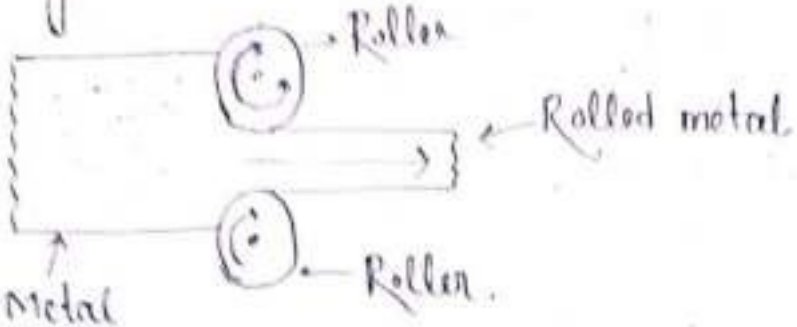
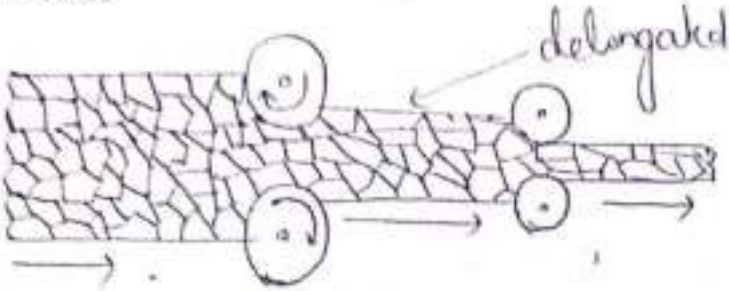
5. Rolling





In rolling the metal is plastical deform by passing it between rollers rotating in opposite direction.
The main objective of rolling is to decrease the thickness of the metal. ordinarily there is negligible increase in width so that the decrease thickness in an increase in length

Types of rolling mills

(1) Two high rolling mills
(2) Three high rolling mills
(3) Four high rolling mills
(4) Cluster rolling mills
(5) Continuous rolling mills
(6) Planetary rolling mills

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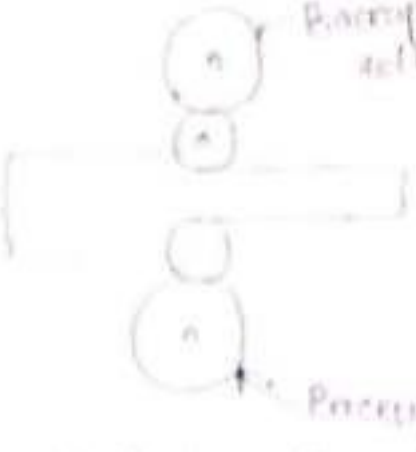
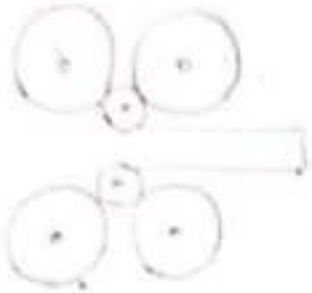
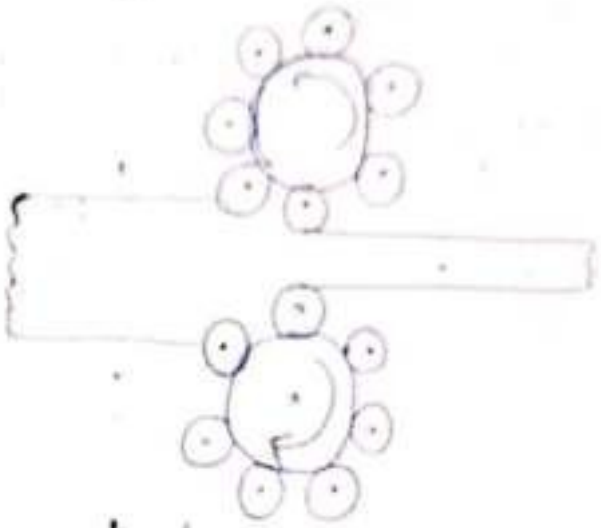
(3 high rolling mill)



(4 high rolling)



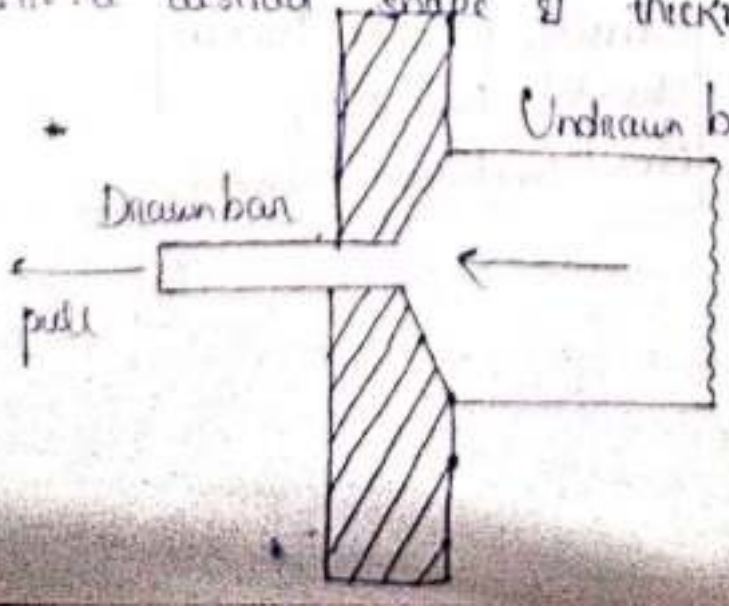
(Cluster rolling)



(planetary rolling mill)

Drawing of metal

Drawing is a metal working process which uses tensile processes to stretch metal glass or plastic.
As the metal is drawn (pulled) is stretches thereby into a desired shape & thickness.



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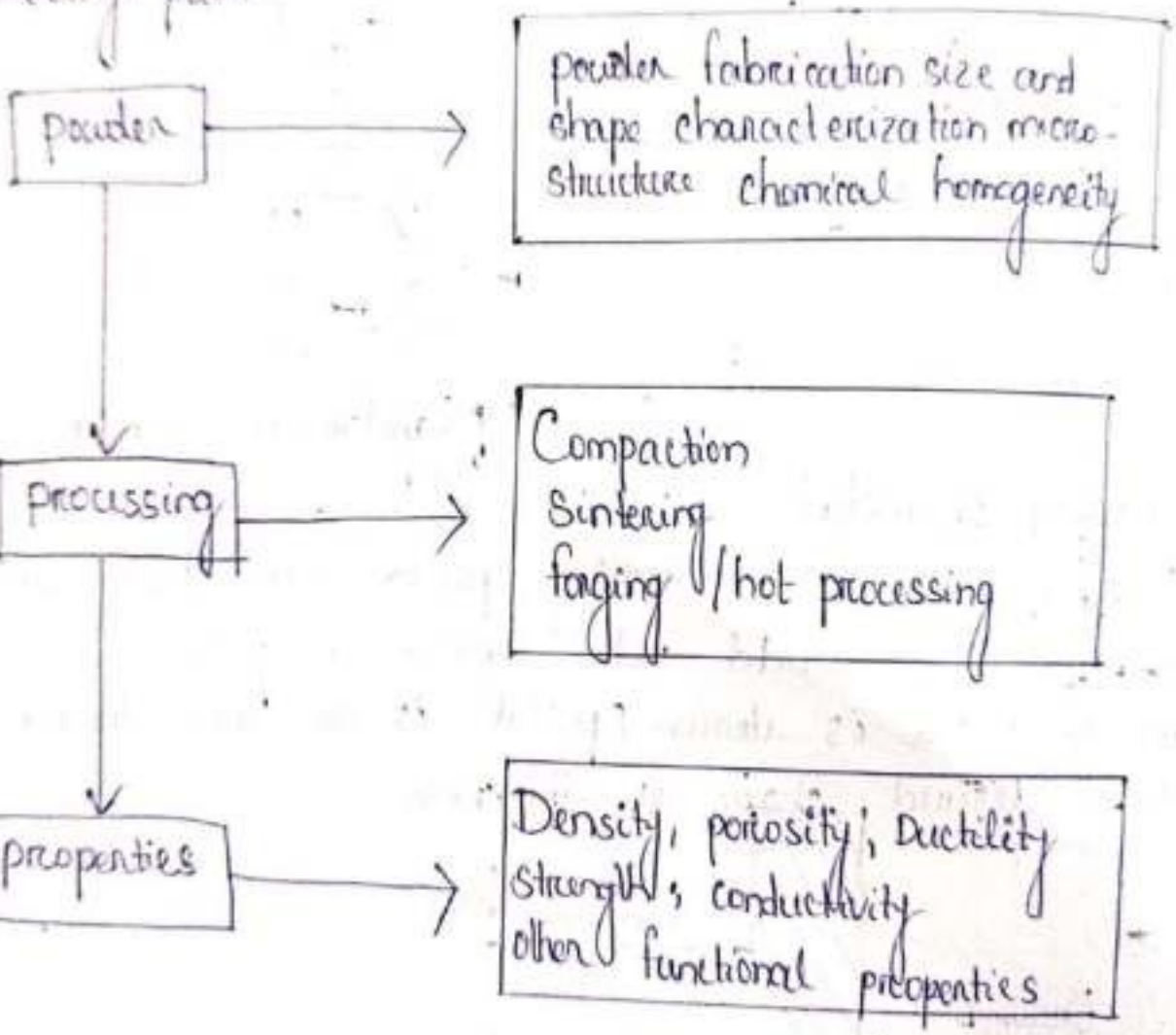
Different types of drawing

2. Sheet metal drawing
3. Wire drawing
5. Tube drawing
4. Cold drawing
5. Hot drawing

Powder metallurgy process :

Powder metallurgy is a metal forming process performed by heating contact metal powders to just below their melting point.



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Process of powder metallurgy :-

1. Powder metal
2. Mixing (with binder & chemical)
3. Compacting
4. Sintering (before sintering when necessary we can do pre-sintering process)
5. Final product.

Joining process

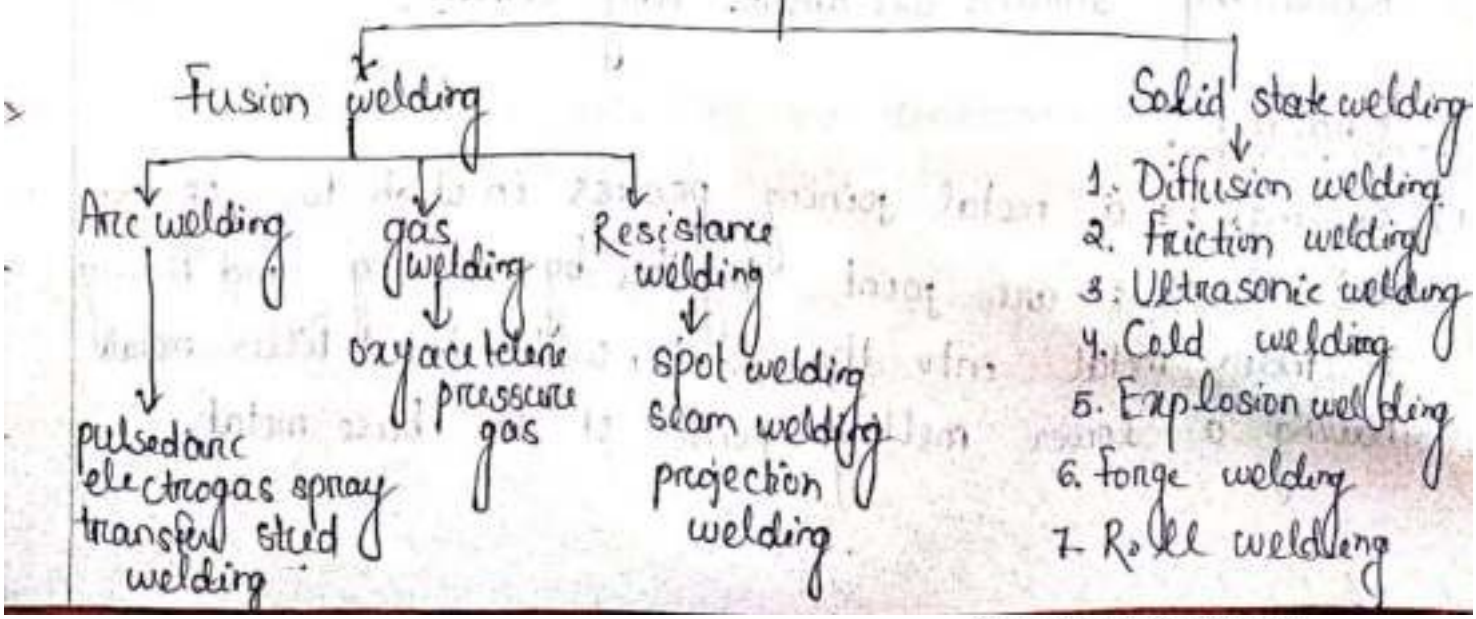
1. Welding
2. Soldering
3. Brazing
4. Reveted joints (temporary joints)

1. Welding :

(i) Welding is a fabrication process where two similar or dissimilar metals are joined together by the application of heat & pressure.

(ii) Welding is a permanent joining process.

Types of welding process.



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08

2. Soldering:

(i) Soldering is a process in which two or more items are joint together by melting and putting a filler metal into the joint.

(ii) The filler metal having a lower melting point than the adjointing metal.

→ Differences between welding & soldering

Welding	Soldering
1. Melting temp always above 450°C. or melting temp of the base material	1. Temp. is below for 450°c here base metal is not melted
2. In welding use of flux is opertional.	2. Use of flux is mandatory in soldering
3. Heat sources in welding process are plasma electric arc, electrical resistance and laser.	3. Heat sources in soldering soldering iron, ultrasound electrical resistance, oven.
4. In welding deformation is very low.	4. In soldering deformation is very hard.
5. Remaining strains are absent.	5. Remaining strains are very common.

3. Brazing:

(i) Brazing is a metal joining process in which two or more metal items are joint together by melting and flowing a filler metal into the joint, with the filler metal having a lower melting point of the base metal.

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8

(i) Brazing is used in brass copper, Stainless steel, aluminium, zinc coated, ceramic.

→ The differences between brazing & welding

Brazing	Welding
1. Base metal doesn't fused.	1. Base metal is fused.
2. Brazing needs low temp. & lower power.	2. Welding its high temp & with high power.
3. Distortion is low.	3. Distortion is high.
4. Low stresses in joint.	4. High stresses in joint.
5. Microstructure of base metal has no change	5. Microstructure of base metal changes.
6. Dissimillar metal easy to joint.	6. Dissimillar metal difficult to joint.
7. Thin sheet can be joined	7. Thin sheet difficult to weld.
8. Low strength of joined	8. High strength of joined

Metal inert gas (MIG) / Gas metal arc welding :

(i) MIG welding process is a gas shilded metal arc welding process which uses the high heat of an electric arc betn a continuously fed

(ii) Consumable electrode wire and the material to be weld.

1. In this process the wire is fed continuously from a reel through a gun to constant surface which impacts the current upon the wire.
2. The current trasends from 100 to 400 Amp. depending on the diameter of the wire. & the speed of melting of the wire may be upto 8 mtr/mnt.

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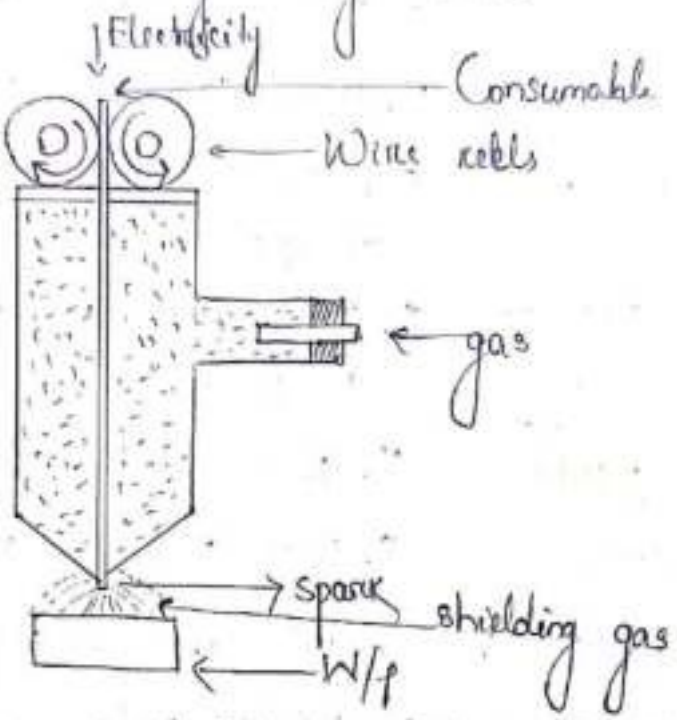
3. The welding machine is dc constant voltage & the welding gain gun can be air or water cool.
4. The wire diameter usually 0.9 to 1.6 mm. Some times 3.2mm also.
5. In this mig welding process the welding area is shielded with a gas which will not combine with the metal.
6. This gas protect the hot metal surface from the atmospheric air while welding being done.



(MIG WELDING)

Equipment required :-

1. Welding power source
2. Welding torch and wire electrode
3. Wire feed mechanism and driving roles electric motor etc
4. Shielding gas cylinder pressure regulator
5. Electrode wire inert gas.
   CO_2 is used for welding of steel & for welding Al, cu, argon or argon-helium mixtures are used.

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Advantages of MIG welding process

1. Here flux is required.
2. High welding speed
3. Increase corrossion resistance
4. Easily automated welding
5. Weld all metals excluding alluminium & stainless steel.
6. High economy

Disadvantage

1. Highen initial set up cost.
2. Highen maintainance cost due to extra electronic component.
3. The setting of plant variable require a high skill labour.
4. Some times radiation effects are more sevire.

APPLICATIONS

(i) Carbon and low alloy steels can be welded.

(ii) Heat resisting alloys can be welded

(iii) The metals welded MIG welding processes are stainless steel, alluminium ~~steel~~ & it's alloys, copper and it's alloys, magnesium alloys, high zinc alloys.

Gas tungsten arc welding or Tungsten inert gas welding process (TIG) :—

(i) This process called TIG welding because tungsten inert gases are used for shielding.

(ii) This arc welding process uses intense of heat and electric arc between a non-consumable tungsten electrode and the material to be welded.

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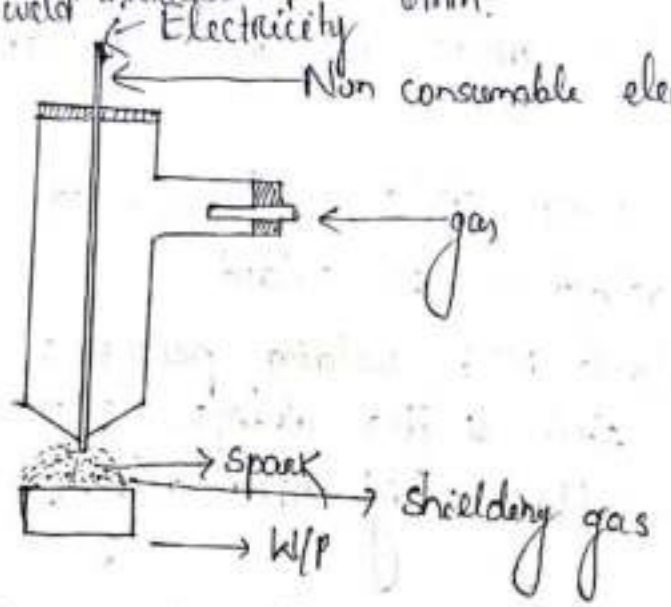
The shielding is obtain from an inert gas such as helium or argon or a mixture of two.

- Argon is more widely used because it is a heavier gas.
- Filler metal may or may not be used.
- Filler metal (wire) may be fed manually or automatically
- Electrodes used in the process are made of tungsten and tungsten alloys.
- The tungsten electrode is used only to generate an arc which doesn't melt the tungsten. Because the melting point is over 3300°C. Tig welding is well adopted to weld thickness upto 6mm.



(TIG WELDING)

Equipment required for TIG :-

1. Welding torch, tungsten electrode & filler metal
2. Welding power source
3. Inert gas cylinder, pressure regulator
4. Cooling water supply
5. Water and gas Solenoid valves.

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Inert gas ordinarily used in TIG welding :-

(i) Argon
(ii) Helium
(iii) Argon - helium mixture
(iv) Argon - oxygen mixture
(v) Argon - hydrogen mixture

Base metals welded :-

(i) Carbon and alloy steel
(ii) Stainless steel
(iii) Heat resisting alloys
(iv) Refractory metals
(v) Alluminium alloys
(vi) Copper alloys
(vii) Magnesium alloys
(viii) Nickel alloys etc.

TIG welding is well adopted to weld thickness upto 6 mm.

Different types or metals of resistance welding Process :-

1. Butt welding → upset butt welding
   → Flash butt welding
2. Spot welding
3. Seam welding
4. Projection welding

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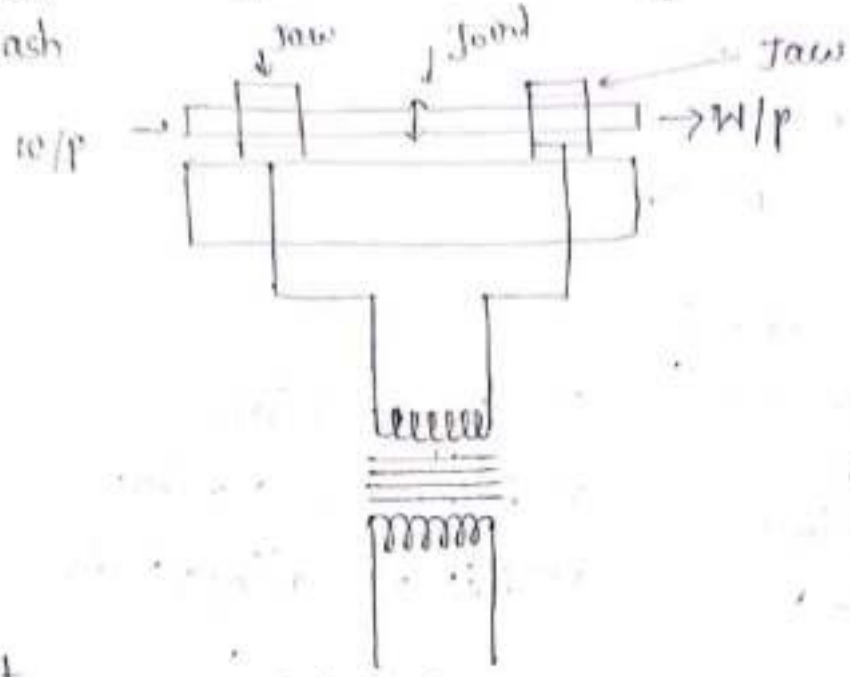
1 Butt welding :-

There are two types of butt welding

(1) Upset

(2) Flash

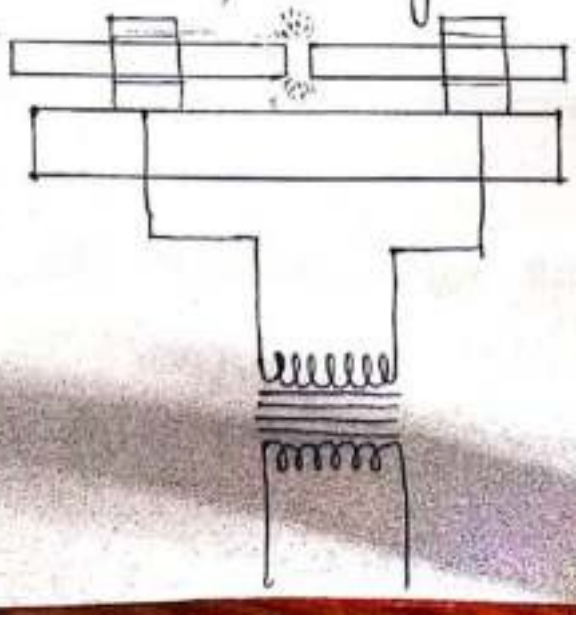


→ Upset

Upset butt welding

(i) In upset butt welding the parts to be welded are clamped edge to edge in copper jaws of welding machine and brought together in a solid contact, while current flows to heat the joint, at this joint the pressure applied upsets or forges the parts together.

(ii) Upset butt welding is used is non-ferrous material for welding bars, rods, wire, tubing, formed parts.



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15

→ Flash

1. In flash butt welding process edges are brought together in light contact
2. A high voltage starts a flashing action between the two surfaces and continues as the parts advance slowly and the forging temperature is reach.
3. The upsetting action process and the impurities caused by the flashing.
4. The force and metal is called the flash.
5. The inner weld metal is free of upsides. Many different materials and combinations can be flash butt welded such as steels ferrous alloys, cast iron, are most easily welded. The flash butt welding process is used in automobile construction such as on the body axels, wheels, frame and other parts.

The materials can't be flash butt welded are lead, tin zinc, antimony, bismuth and their alloys the copper alloys etc.

2. Spot welding :—

(i) Spot welding is employed to join over lapping strips, sheets or plates of metal are small areas.

(ii) The pieces are assemble and placed betn two electrodes which must poses high electrical and thermal conductivity and retain the required strength at high temperature, so they are made of pure copper and alloys of copper or tungsten or copper or chromium for continuous working.

(iii) When the current is going to the work pieces are heated at their areas of contact to welding temp. and with the mechanical pressure the electrodes are forced against the metal to be welded.

(iv) Upto 12mm total thickness metal can be welded by spot welding.

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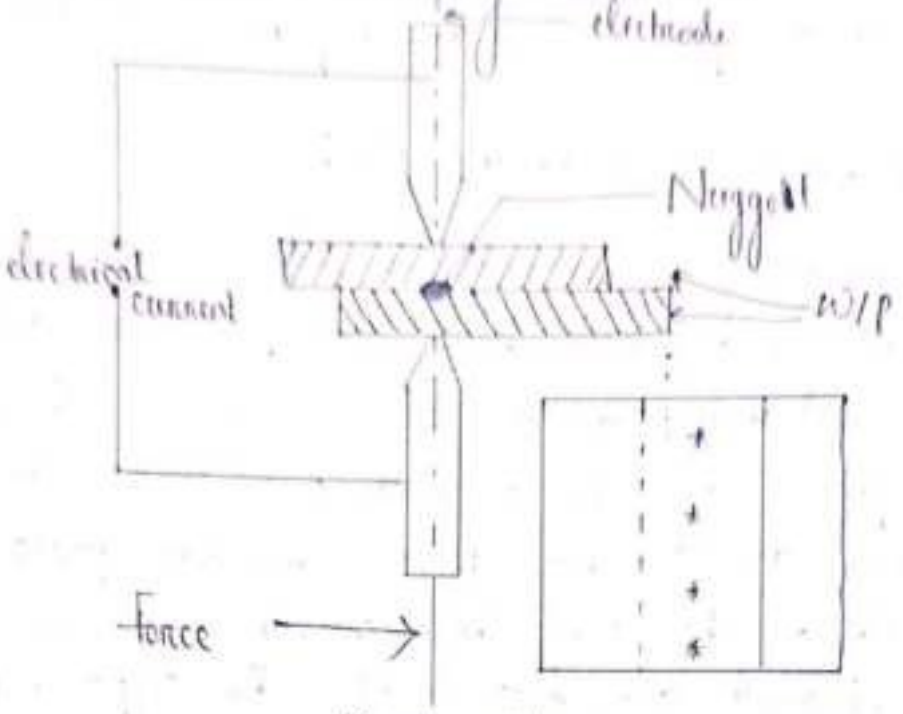
(v) All types of sheet metal structures can be welded where mechanical strength is required rather than air or water tightness.

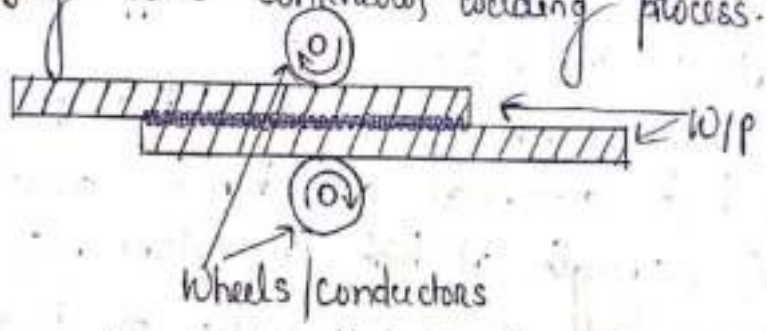
Ex: Boats, cones, enclosing cases etc.



(Spot welding)

3. Seam welding :—

(i) A seam welding is a continuous welding process.



(Seam welding)

(ii) It is a method of making continuous joint between two or lapping pieces of sheet metal.

(iii) In this type of process the work is placed between the two wheels which serves as conductors for producing continuous welds.

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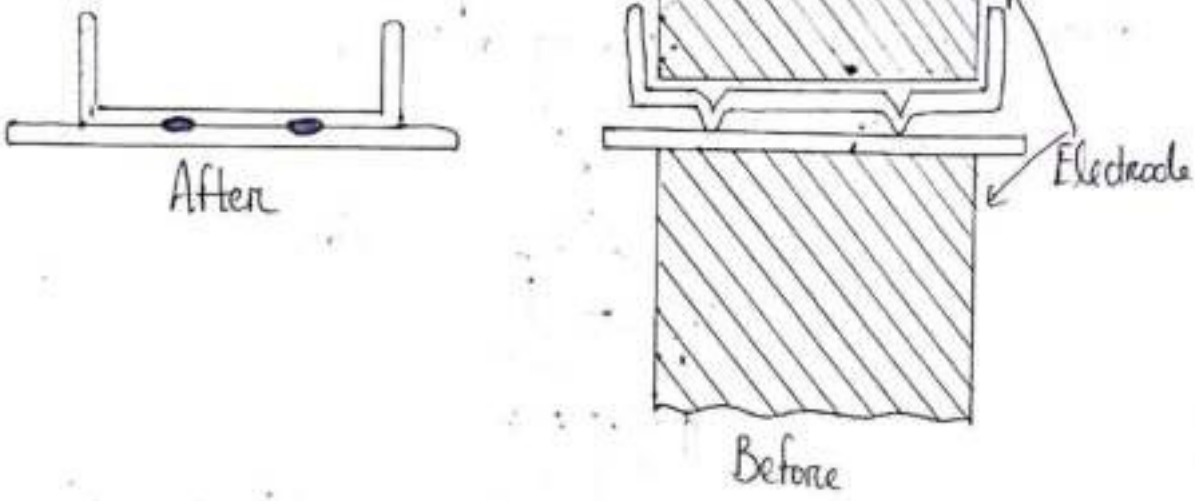
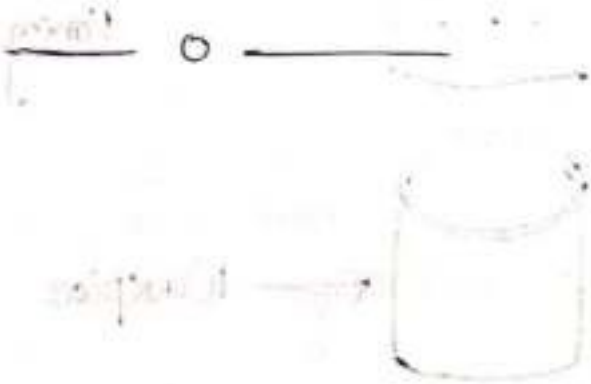
4. Projection welding :

(i) Projection welding is a modification of spot welding.

(ii) The current and pressure are localised at the weld section by the use of embosed, machined or coined projections on one or both pieces of the work.

(iii) The flattening out of these projections under pressure results in good welds at all points of contact.





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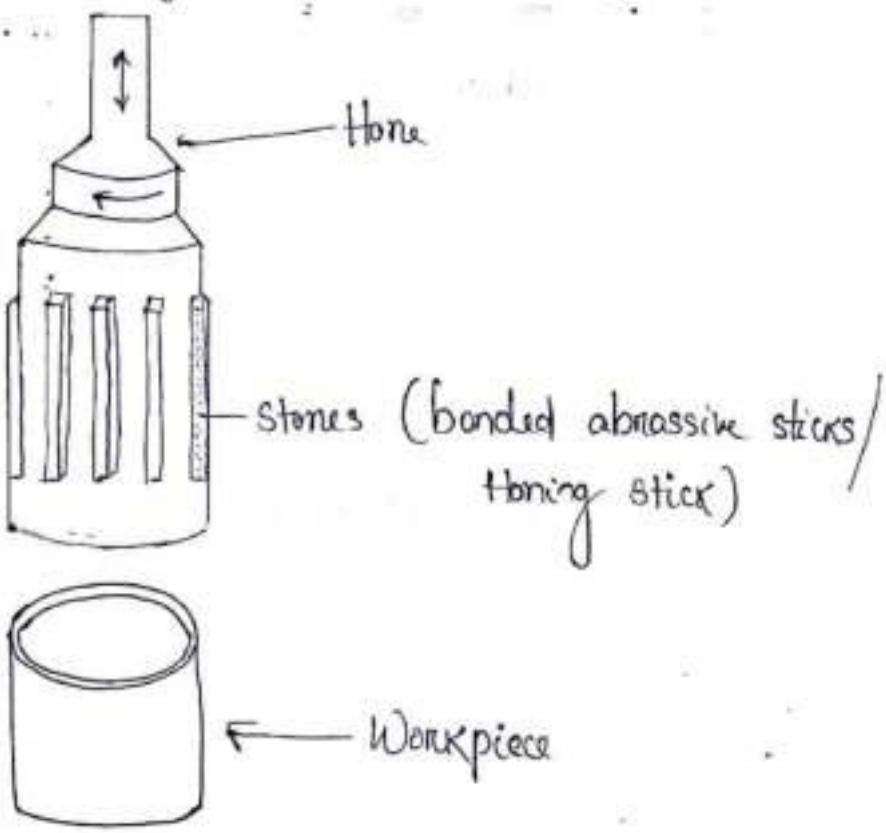
Super finishing Operation

1. Super finishing is a mechanical material removal process e.g performed on material surfaces after they have already undergone some type of finishing or other surface modification process.
2. Super finishing removes the residual, amorphous, layer e.g left from the previous process.

Top

1. Honing :-

(i) Honing is finishing process in which a tool called hone carries out a combine rotary and reciprocating motion while the w/p doesn't perform any working motion.



(ii) Honing is an abrassive machining process, that produces a precession surface on a metal w/p by scrubbing and abrassive stone against it along a controlled path.

(iii) Honing is primillarly used to improve the geometric form of a surface, but may also improve the surface texture.

(iv) The sticks are equally spaced about the perphere of a honing tool. They are held against the work surface with controlled light pressure, usually exercised by small springs.

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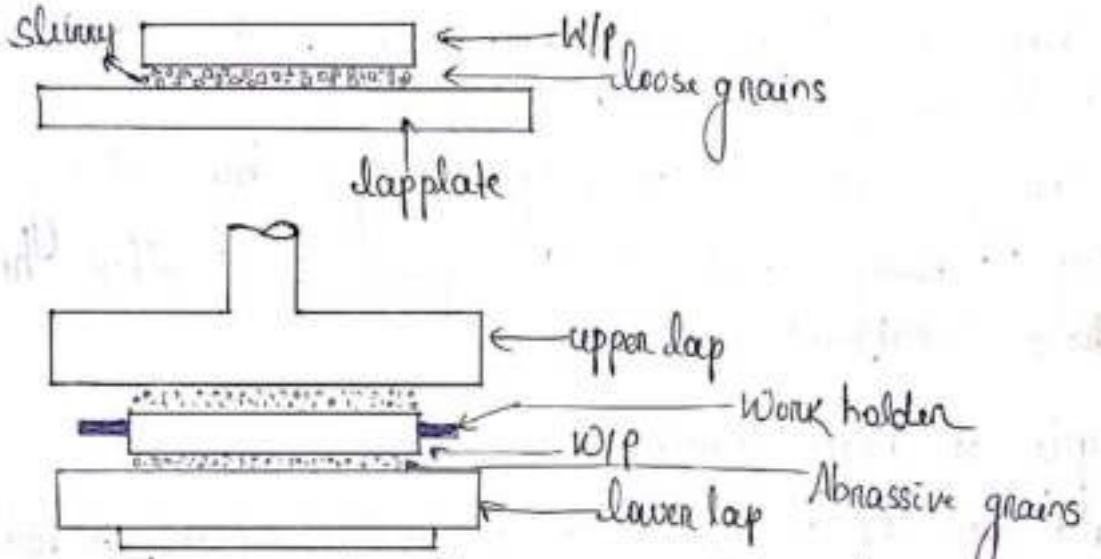
2. Lapping :—

(i) Lapping is a machining process in which two surfaces are rubbed together with an abrasive between them by hand movement or using a machine.

(ii) This can take two forms the first type of lapping involves rubbing a brittle material such as glass against a surface such as iron with as abrassive (aluminium oxide, emery, silicon-carbide, jewellers rouge, diamond etc) between them

(iii) The lapping tool is called lap, which is made of soft materials like copper, lead or wood.

(iv) The lap has the reverse of the desired shape ~~shape~~ of the workpart.



(v) Lapping can be used to obtain a specific surface roughness. It is also used obtain very accurate surfaces usually on flat surfaces.

Lapping method are 2 types

(a) Hand lapping :—

- This type of lapping with the help of hand workpieces on lap must be hold withen hand.
- This is used molding dies, metal moldes, valves sheets etc.

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(b) Machine lapping :-

- Machine lapping is used to obtain a high surface finish. In this the workpiece is held bet" two wheels, this is fed with the abrasive grain machine.
- This is used in the surface finish of the balls, ball bearing gears crankshaft.

Heat treatment

Any solid metal normally has a definite cell shape & size at a certain energy state, but in some metals the shape as well as the size change from one energy state to another.

The energy state is usually changed by adding and taking away heat. Such a process is called heat treatment.

Principle of heat treatment :-

- Metals are never heated to the melting point in heat treatm
- Therefore all the reaction within the metal during the heating and cooling cycle, takeplace while the metal is in solid state
- During ordinary heat treating operations, steel, is seldom heated above 982°C
- In using iron carbide carbon diagram we need only two concern our selves with that part which is always solid steel.

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: Heat treatment :

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Phase transformation in steel :

→ When steel is heated above austenite temp. and is allowed to cool under different conditions (different rate's of pulley), the austenite in steel transforms into a variety of micro-constituents.
→ Various micro constituents are a) Austenite
(b) Ferrite
(c) Cementite
(d) Pearlite
(e) Martensite.

(a) Austenite :

→ Austenite is the solid solution of carbon and other alloying elements. Ex- Mn, Ni etc
→ Austenite is normally not stable at room temp.
→ It is non-magnetic & soft.
→ It is called γ-iron. (F.C.C). It has F.C.C crystal structure

(b) Ferrite :

→ Ferrite is softest structure that appears on Fe-C equilibrium diagram.
→ It has B.C.C crystal structure. (Body centred cube)
→ It is also known as α-iron.

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(c) Cementite :-

→ Cementite is also known as iron carbide (Fe_3C)
→ It contains 6.67% carbon by weight
→ It is typically hard & brittle
→ Cementite is the hardest structure that appears on the Fe-C equilibrium diagram.

(d) Pearlite :-

→ Pearlite is the product of austenite decomposition by an eutectoid reaction.
→ It contains 0.8% carbon & is formed at 723°C (1333°F).

(e) Martensite :-

→ It is a meta stable phase of steel formed by transformation of austenite below the maximum temprature.
→ Martensite is the consider to be highly stressed α-iron is super ~~stee~~ saturated is carbon.

⇒ Introduction of Iron-carbon equilibrium diagram) :-

- An equilibrium diagram is graphic representation of the effect of temp. & composition up on the phases present in an alloy.
- An equilibrium diagram is constructed by plotting temp. at Y-axis and percentage composition of alloy along X-axis.
- This Fe-C diagram indicate the phase changes that occure during heating and cooling.

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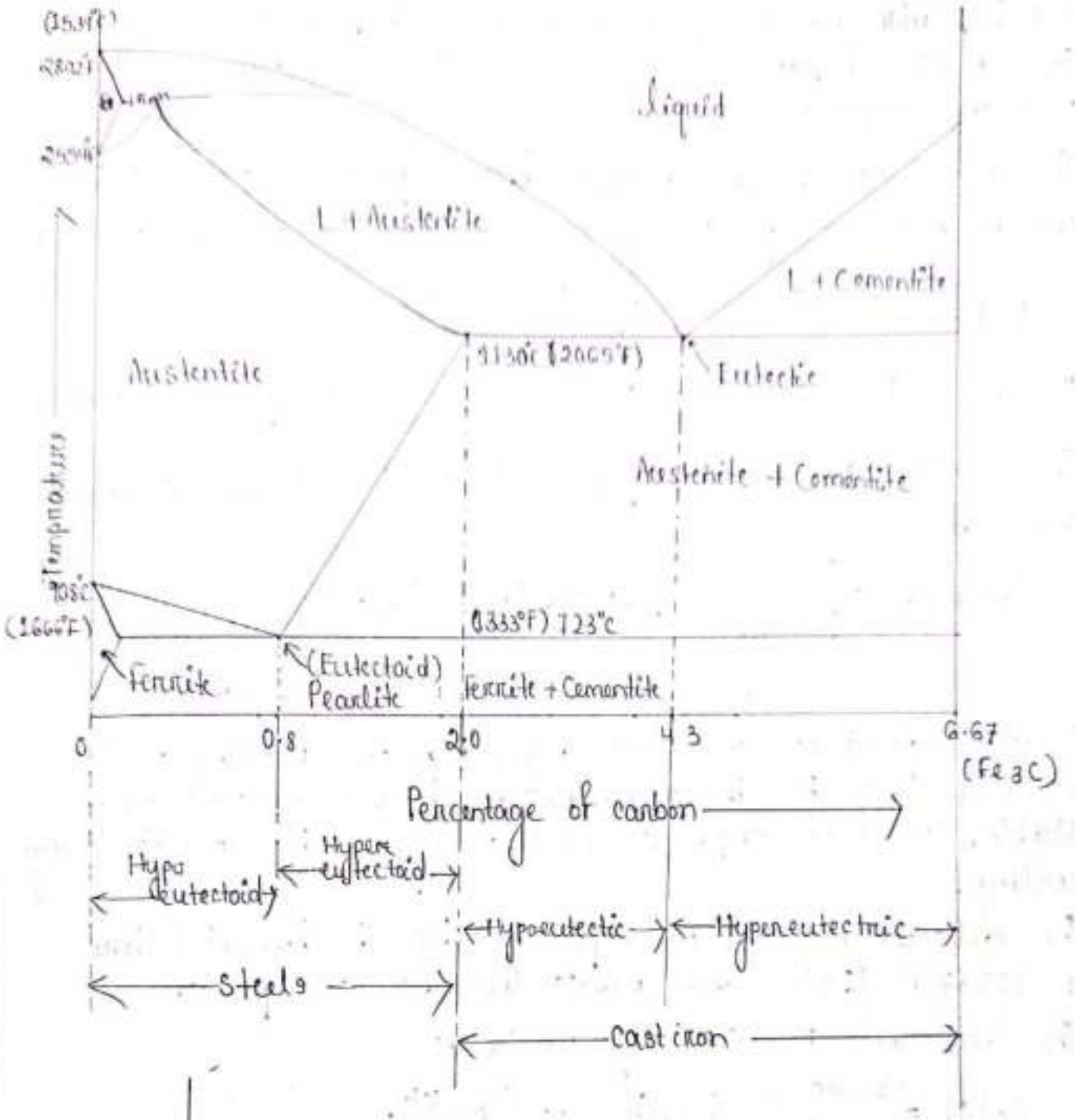
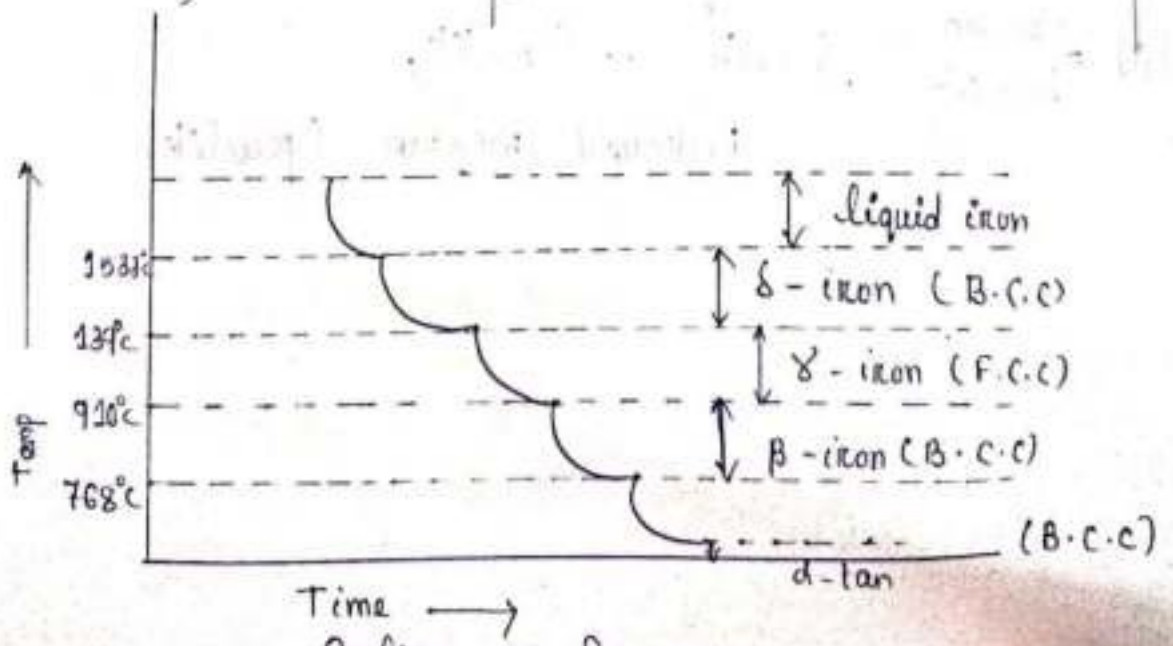
23 Iron-carbon phase diagram (Iron Carbon equilibrium diagram)





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→ An Fe-C equilibrium diagram forms a basis for differentiating among iron, hypoeutectoid steel (0.008 to 0.8%), hypereutectoid steel (0.8 to 2%), hypoeutectic cast iron (2 to 4.3%), hypereutectic cast iron (4.3 to 6.67%)

→ The Fe-C equilibrium diagram has a peritectic and eutectic and an eutectoid. peritectic reaction equation may be written:

$$\text{Delta } (\delta) + \text{Liquid} \underset{\text{Heating}}{\overset{\text{Cooling}}{\rightleftharpoons}} \text{Austenite}$$

The horizontal line at 1536°C shows the peritectic reaction

→ The eutectic reaction takesplace at 1133°C (2066°F) & the eq may be

$$\text{Liquid} \underset{\text{heating}}{\overset{\text{Cooling}}{\rightleftharpoons}} \underbrace{\text{Austenite} + \text{Cementite}}_{\text{Eutectic mixture (ledebunite)}}$$

→ Eutectic point is an 4.3% carbon, eutectic mixture isn't usually seen in the microstructure, because austenite isn't stable at room temp. & must undergo another reaction during cooling.

→ The eutectiod reaction is represented by the horizontal line of (1333°F) 723°C and marks the eutectic point.

→ The eutectoid reaction eqn written as

$$\text{Solid} \underset{\text{heating}}{\overset{\text{Cooling}}{\rightleftharpoons}} \underbrace{\text{Ferrite} + \text{Cementite}}_{\text{Eutectoid mixture (pearlite)}}$$

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Heat treatment process :—

1. Heat treatment process is a series of operations involving the heating & cooling of metals in the solid state.
2. His purpose is to change a mechanical property so that the metal will be more useful, serviceable and suited for definite purpose.
3. By heat treating a metal can be made harder, stronger, more resistant to impact. heat treatment can also make a metal softer and more ductile.

Classification of heat treatment process —

Various heat treatment process can be classified as

1. Annealing
2. Normalising
3. Hardening
4. Tempering
5. Martempering
6. Austempering
7. Maraging

1. Annealing :—

(i) It is a heat treatment process in which a material is taken toward elevated temp. Kept their for some time & then left to cool.

(ii) Due to annealing process, it gives a completely stable structure reducing hardness.

(iii) The purpose of annealing :—

- Soften the steel
- Improve machinability
- Increase or restore ductility and toughness
- Relive internal stresses.

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- Reduce or eliminate structural homogenity
- Refine grain size.
- Prepare steel for subsequent heat treatment.

(iv) In annealing metal is heating 20° above anti critical temp.
(v) It allowed to soaking for 1 to 2 hrs in that temp.
(vi) Cooling very slowly 100° c/hr.

2. Normalising :—

(i) Heating material 40 to 50° C above its critical temp.
(ii) Heating it for about 15 mnts at their temp.
(iii) It used for remove internal stresses and restructure the material grain.

purpose of normalising

(i) To elemenate internal stresses.
(ii) Increase strength
(iii) Normalising is done on cold work parts to remove internal stresses and restructure the material grains.

3. Hardening :—

(i) Heating the material above critical temp.
(ii) Holding it to that temp. & quenching.
(iii) Hardenability is usually interfitted as the ability to become uniformly hard or to hardens in depth.
(iv) Hardening process allow the material to transform to a much harder, stronger structure and then tempering.

4. Tempering :—

(i) When a piece of metal or steel is taken out of the quenching medium, as already straighted, it is hard brittle and will have sevior unequally distributed internal stresses. besides other on favorable characterstics.

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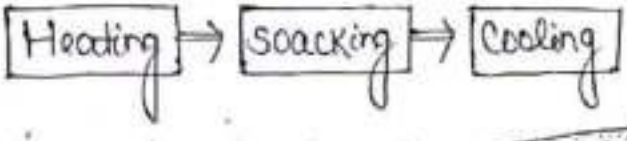
(ii) In general · tempering restores ductility and reduces hardness & results in some decreases in hardness.

(iii) Tempering process is

1. To stabilize the structure of the metal
2. To reduce internal stresses & produce during previous heating.
3. To reduce some of the hardness produce during hardening & to increase the ductility of the metal.
4. To give the metal right structural conditions, combined with toughness shock resistance.

Heat treatment process



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Case hardening (surface hardening) :—

(i) The oldest known method of producing a hard surface on steel is case hardening or carburising.

(ii) The steel used for this purpose is usually a low carbon steel of about 0-15 % carbon.

(iii) Which doesn't respond appear appreciably to heat treatment.

(iv) In this process the outer layer is converted into a high.

(v) Carbon steel with a carbon content ranging from 0.9 to 1.2% carbon.

(vi) If it receives proper heat treatment, it will have an extremely hard surface on the outside and a soft ductile core.

Vaccume hardening :—

(i) With the vaccume hardening process the heat treating for the metal happens in a vaccuth.

(ii) Removing air from the environment during the hardening process can often lead to better and more predictable, results. usually, the process involves using a vaccume pump to remove the air from a sealed chamber where heat treating will happen.

Benifits of vaccum hardening :

1. No discaloration
2. Avoid oxidation
3. Improve multiple properties
4. Environmentally friendly
5. Faster results

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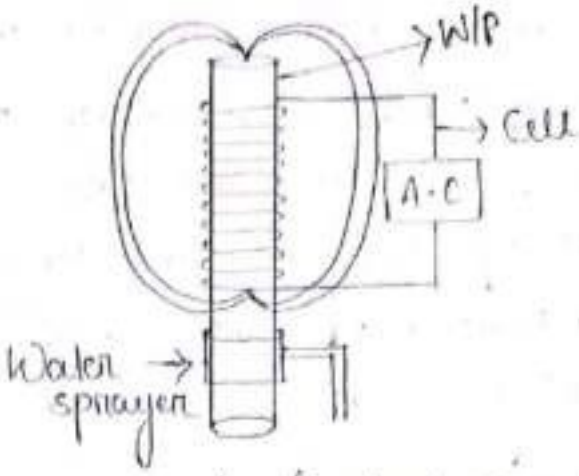
Induction hardening :—

(0.4 to 0.5% carbon)



(i) In this process a high frequency current of about 2,000 hertz is passed through a copper conducter block which acts as a primary coil of a transformer.

(ii) The heating effect is due to the induced eddy current and hysteress loss in the surface material.

(iii) Induction heating has proved satisfactory for many surface hardening operations as required on the bearing areas of crank shafts, camshafts, axleshafts and similar wearing surfaces.

(iv) The hardening temp. is about 750°c to 760°c for 0.5% carbon steel and 790°c to 800°c for alloy steel.

(v) The heated areas are then quenched immediately by spray of water delivered through ~~remo~~ numerous small holes in the block.

Defects in hardening :—

Due to hardening some defects occurs such as

- Oxidation and decarburization.
- Quenching cracks
- Distortion and warpage
- change in dimension
- Soft spots
- Mechanical properties not conforming to specification.

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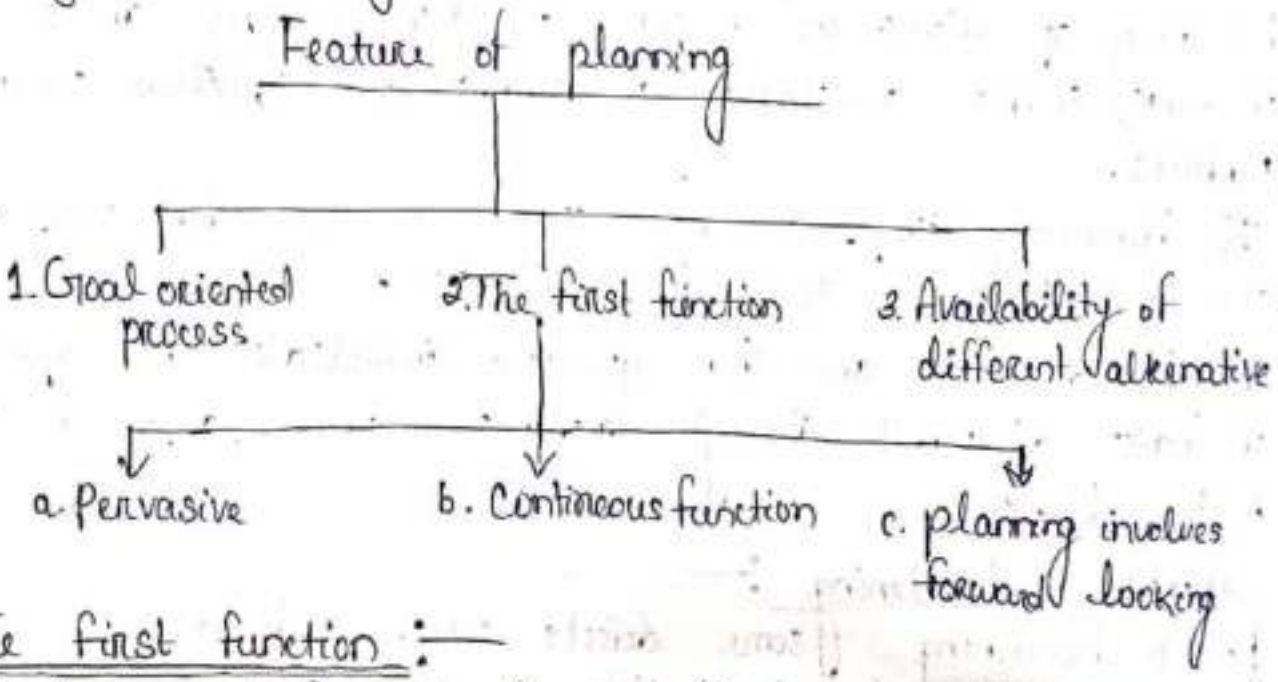
PROCESS PLANNING

4.1 PLANNING :-

- It is bridge between starting and end.
- Planning refers to thinking in advance what is to be done, how is to be done and who is going to do it.
- Setting up objectives and targets for a fixed time period and formulating action plan to achive them effectively and efficiently.

1 Goal oriented process :-

* Planning starts with the determination of objective's. After setting up the objective, the next step to decides through which the it can be achived. The process of always emphasis on integrating the efforts of individuals achivement of organizational goal.



2 The first function :-

(i) The first and foremost function of a manager is to determine the objectives on which the organization has to work on.

(ii) All the other functions of a manager start after setting up an standardised objective.

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3)

(a) Pervasive :—

(i) The concept of planning doesn't restricts with top level management only. every department has to make plan to the need and requirement of resources for the compacting of basic plan of the organisation.

(b) Continuous function :—

Planning is a never ending process as the managers have to make changes in the plan according to the need and requirement of the regular changing business environment.

(c) Planning involves forward looking / futuristic :—

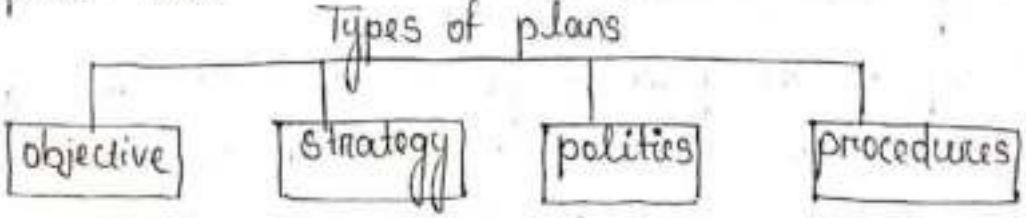
(i) To achive the objective in the near feature the managers always tries to predict the future and make plans according to their prediction and post experiences.

(ii) The prediction of future can only be possible after planning the buisness environment properly.

3 Availability of different alternatives :—

(i) The function of planning requires only when different alternatives are available.

(ii) We can't imagine planning in the absence alternatives as in planning managers evaluate different alternatives and select the most appropriate one.



Objective :—

(neither single use nor standing plan)

* Objective should be SMART as -

→ S - specific
→ M - Measurable
→ A - Achive vable
→ R - Relevant
→ T - Time bound

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... 02

(i) For example increase in sale by 10% by six moths or decrease in rejections by 2% by one months.

Features of objectives :-

(a) All objectives are guided towards objectives.

(b) Serve as guide line over all business planning.

(c) Define the future state of affairs which the organisation to realise

(d) These are usually set by top level management.

PROCESS PLANNING :-

- Planning process starts with setting up objectives as the objectives of the organisation are directed towards the achievements of the organisational objective only.
- Managers always try to set up objectives which can be achievable in the specific time period.

1. Developing premises :-

After setting up the objectives the next step is to make assumptions regarding the future.

premises are the base on which plans are made, that is estimated demand for the product, change in goverment policies and market conditions etc.

2. Listing up various alternatives :-

The next step of the planning process is to list down all the alternatives available for the achivement of organisational goal. The manager makes a list of all the alternatives.

3. Evaluating the different alternatives :-

After making the list of the available alternatives, the next step is to evaluate each and every alternatives. That is checking its positive and negative endepects.

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4 Setting an alternatives :—

The best among the available alternative is selected. It should be noted down that it is not necessary that the organisation can get the an accurate alternative which the managers is looking for. in such a case where an exact alternative is not available The managers select the combination of different alternatives.

5. Implementation of plan :—

In the above all steps. managers makes a framework (blue print) of the plan. but a blue print is useless untill and unless they are put into action.

So the next step is to communicate the plans with the employes and after ~~discussing~~ discussing the plans managers starts allocating the resources according to the blue print.

6. Follow up :—

As planning is a continuous process, so the work of managers doesn't ends after putting the plan into action. They had to examine the activities on a regular bases and to compare them with the predetermined plan and if any variation exist then they has to make change accordingly.

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4.2. Materials for the screw nut, bolt, washer & shaft.

Screws :—

(1) Screws & bolts are usually made of steel where great resistance to weather or corrosion is required like in very small screws, or medical implants materials such as stainless steel, brass, titanium, bronze, silicon bronze or monel may be used.

Manufacturing process of screw :—

(a) There are two different manufacturing process for making screws.

(b) Most screws are made with the thread rolling method.

(c) Machining is used to make small or specialized screws that can't be made by thread rolling.

(d) The first step in making a screw with the thread rolling method is called "cold heading".

(e) A wire, is fed into a machine to straighten in, then cut it to length.

(f) The machine then cuts the head into the disired ~~to cut~~ shape.

There are three techniques that can be used to cut the blank screws to give it threading.

- **Reciprocating die**

There are two flat dies one is stationary & another move, back & forth. The screw is rolled between the two dies.

- **Centreless cylindrical die**

The screw is rolled two or three round dies to create a thread.

- **Planetary rotary die**

As the screw is helps stationary, several die cutting machines

Materials for screw :—

Q. What are screws made for ?

- Steel : This is the most common material for screw because steel is cheap, but steel is weaker.
- Copper : Copper screws are goods for fighting against corrossion copper is durable over the long tongue.
- Aluminium : Aluminium is not as durable as other materials but it light in weight.
- Titanium : When we need a blend of straingth & lightness go with titanium.

Coating of screws — Screws can be coated copper, ceramic zinc & other materials which can provide extra straingth extra protection against corrosion.

Manufacturing process of Nuts & Bolts :—

Bolts :—

(i) Bolts are made from both cast steel, wire rod.

(ii) After spending 2 to 3 hrs. in the furnace make soft and dipped into sulphuric acid, for cleaning the rust particles.

(iii) Then the cast steel wire rods lubricate for making the after works easier.

(iv) Then forming the rods by cold forging process. The forming machine straingth the wire rod and thus cut into pieces.

(v) Each piece go through the die to make perfectly round and through a series of dies that progressively the shape of the head and one end.

(vi) The machine can produced three handed bolts in one minute. The next machine from the opposite end of the bolt which chamfer.

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(vii) After that high pressure roller press in the thread pattern for making thread on the bolt.

(viii) Then we use various device to check the caliper bolt, a micrometer for checking the length, calipers for checking the width of the head & ring gauge to check the threads.

(ix) After that we finally looked over final product.

Nuts :—

(i) Nuts are prepared is hot forging process.

(ii) They cuts steel bars into small pieces (slugs) then heat them into 1200°C to make them malleable.

(iii) The slugs then punched by hydraullic hammers to make the hexagon.

(iv) Then one taper tool enter in to this hexagon to make thread with a lubricant oil.

(v) The nut and bolts are then kept in a oven attemp. about 870°C foam hour. This gives them the required strength.

(vi) Then the nuts and bolts are rapidly cooling with oil fore (5 min) making it hard.

(vii) Now the steel is hard but brittle. So then the nuts are bolts are heated for another one hour for removing the brittleness and maintain their strength.

Materials used for produced nuts & bolts

1. Carbon steel
2. Alloy steel
3. Low or medium carbon steel
4. Titanium
5. Plastic & other exotic materials
6. Silicon Bronze
7. Brass
8. Aluminium
9. Chrome etc.

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Manufacturing process of washer :—

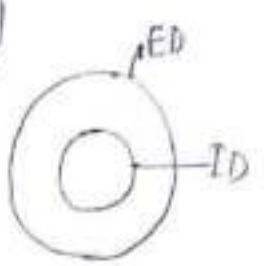
(i) Washers are thin plates of metal or non metallic material with a hole, usually in the middle.

(ii) These parts are usually used to relieve or distribute pressure of a nut, an axle bearing or a joint.

Materials of washer :—

1. Steel
2. Stainless steel
3. Copper
4. Brass
5. Titanium
6. Aluminium
7. Rubber
8. Plastic
9. Nylon
10. Teflon
12. Zinc

Slotted washer



Flat washer

Manufacturing process :—

(i) The manufacturing process of mild steel washer is very simple.

(ii) Recycling iron ore and get pure iron.

(iii) Addition of 0.2% carbon and some amount of brass in pure iron to make mild steel alloy as raw material.

(iv) Rolling of mild steel alloy into sheet of desire thickness as per required washer thickness.

(v) Making of punching die as per the required internal and external diameter of washer.

(vi) Feed the mild steel alloy sheet into punching machine.

(vii) As per the use of number of die per stock, equal number of washer would produce.

Materials of washer :—

- Steel - Carbon steel, spring steel, A2 (304) stainless steel & A4 (316 / 316 L). stainless steel.
- Non-ferous metal : Copper, brass, aluminium, titanium, iron, bronze, inconel, monel & hastelloy.

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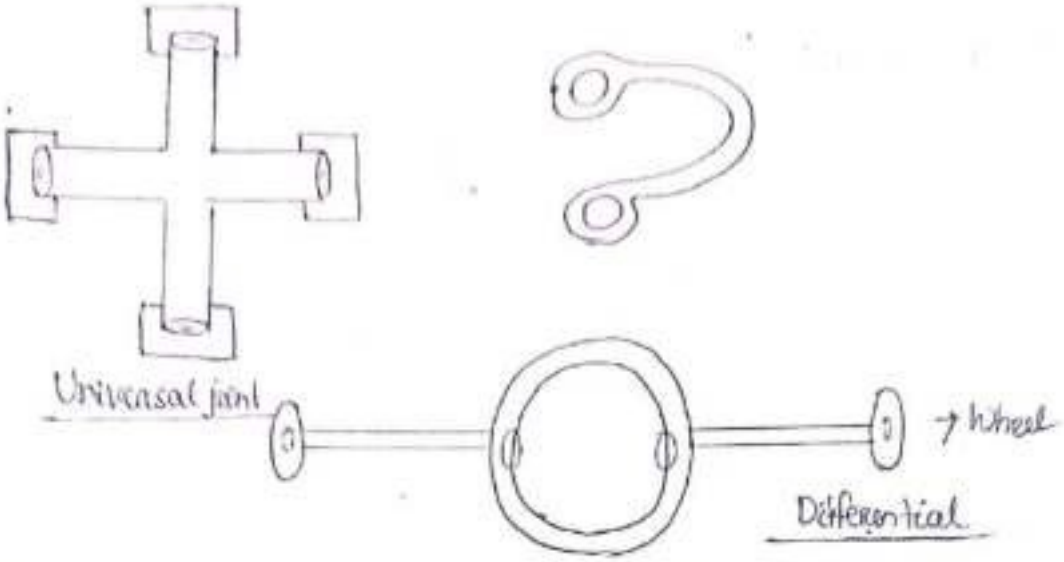
Manufacturing process of shaft :—



→ The most common process used to manufacture shafts by CNC turning. Using this technique, workers or automated process affix or clamp bars of materials to chucks and rotate them.

→ While rotating, specialized tools use cutting and other subtractive process to create and shape the end product.

The materials used for shafts are :—

- Ferrous materials - (Standard carbon steels, stainless steels incoel and titanium.
- Non-ferrous metal - (aluminium, brass, bronze and other exotic or precious steel).
- Plastic and other polymers.
- Graphite and other non metals materials.

The dimensions of shafts which are apply for various part sizes.

- Diameter - We build parts as small as 0.10" diameter and as large as 15" diameter.

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- Length - Our parts range from 1" to 60" in length.
- Face groove depth - We build shafts with face groove depths of no more than 1".
- Weight - Our typical shafts have a maximum weight of upto 100 lbs.

Machining process used for shaft manufacturing :—

1. Boring
2. Drilling
3. Turning
4. Internal & external threading
5. Internal & external spining and teeth cutting
6. Rotary broaching etc.

— o —

Methods of lubrication :—

1. Manual feed lubrication
2. Self lubrication
3. Aerosol lubrication
4. Auto lubrication system.

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Methods of lubrication

1. Manual feed lubrication
2. Self lubrication
3. Aerosol lubrication
4. Auto lubrication system.

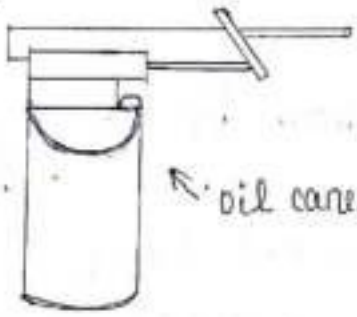
1 Manual feed lubrication :-

(i) In this system lubricants are directly inserted in the oil holes with the help of oil cans or handguns.

(ii) Satisfactory lubrication is obtained with this system, but in this system it can't be determined.

(iii) Whether right quantity of lubricant has reached at right place without contamination.

(iv) Hence the use of this system of lubrication is decreasing rapidly.



2. Self lubrication :-

(i) It is known as automatic lubrication and also untralised lubrication system, where the right amount of lubricant is used to various locations of the machinary.

(ii) By this type of lubrication the in accessible parts can be lubricated.

(iii) Automatic lubrication is highly
- → Self
- → Accurate &
- → Ensures proper functioning of the machinary

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It contains
- Controller
- Pump
- Reservoir
- Metering valve
- Supply lines
- Feed lines

3 Aerosol Feed lubrication :— (Water proof lubricant)

(i) Aerosol lubricants come in a variety of chemical combinations each with their own specific uses.

(ii) These products are intended to apply a longer easily lubricant coating to moving parts, reducing friction and wear.

(iii) They are prepared from light oils to aerosolized greases. (aerosol - a substance enclosed under pressure and released as a fine spray by means of propellant gas).

4. Autolubrication system :—

Auto lubrication system can be classified various types.

- Single line parallel system
- Dual line parallel system
- Single line progressive system
- Mist lubrication system
- Multipoint direct lubrication system

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46 = Bearing material: A antifriction bearing =

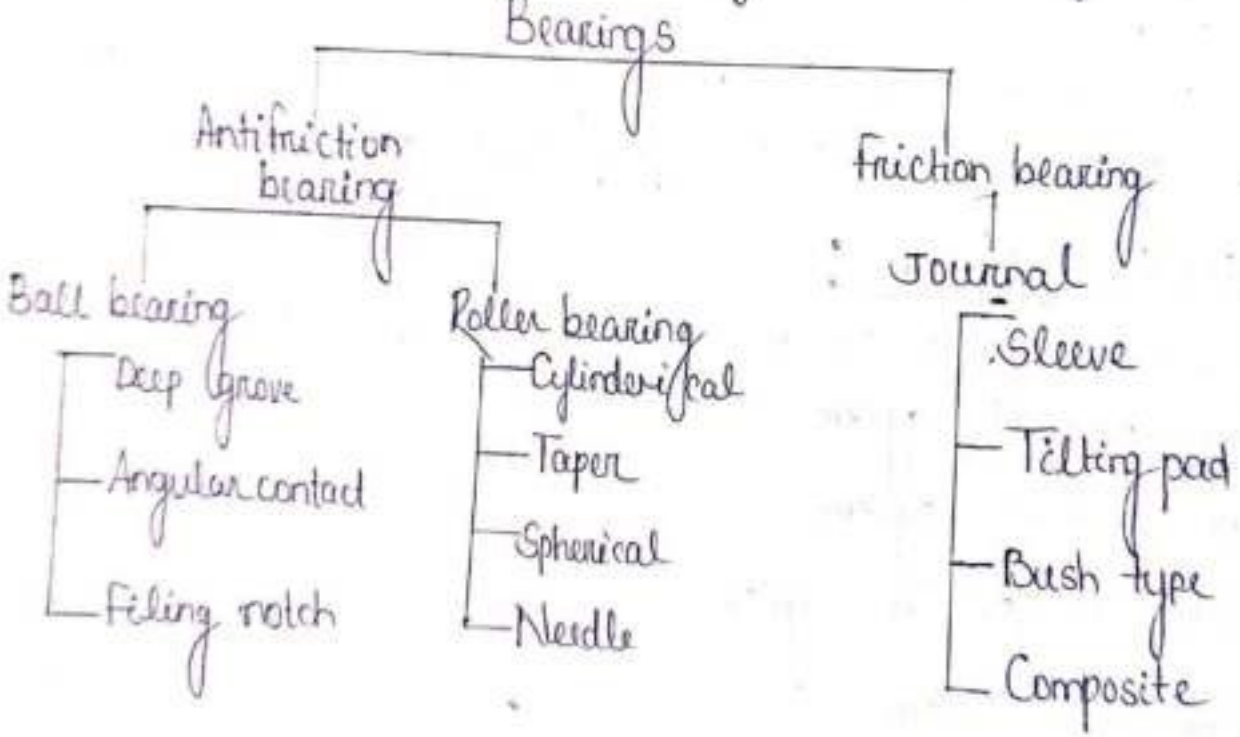
Introduction to bearing

(i) Bearing is a machining element which support another moving machining element (known as journal).

(ii) It provides a relative motion between the contact surface of the members while carrying a load.

(iii) To reduce the frictional resistance and wear at some cases to carry away the heat generated, a layer of fluid (Known as lubricant) may be provided.

(iv) The lubricant used to separate the journal & bearing is usually a mineral oil refined from petrolium, but vegetable oils, silicon oils, greases etc may be used.



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: An Overview on steam Turbines, IC Engines, Refrigeration :

Working principle of boilers & turbines :—

Working principle of boiler :

(i) Hot gases are formed by burning fuel in the furnace.

(ii) These gases are made to come in contact with the water vessel. the point where the heat transfer takes place b/w the steam & water.

(iii) Thus the boilers basic principle is to convert water into steam with heat energy.

(iv) There are various type of boilers available to use for different purposes.

Efficiency of boiler :—

⇒ It is defined as the total percentage of heat exported by the outlet steam to the total supplied fuel.

$$\text{Boiler efficiency (\%)} = \frac{\text{heat exported by out steam}}{\text{heat supplied by the fuel}} \times 100$$

Classification of boiler :—

According to the relative passage of hot gases and water the boiler is classified into two types.

(i) Fire - tube - boiler

(ii) Water - tube - boiler

(i) Fire - tube - boiler :—

This is the one where the hot combustion gases are surrounded by the water.

(ii) Water - tube - boiler :—

In this the water flows via the tubes surrounded by heat combustion gases.

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Turbine :—

(i) Turbine is a rotary mechanical device for extract the potential energy and kinetic energy of fluids and convert into mechanical energy.

(ii) This mechanical energy converts into useful work.

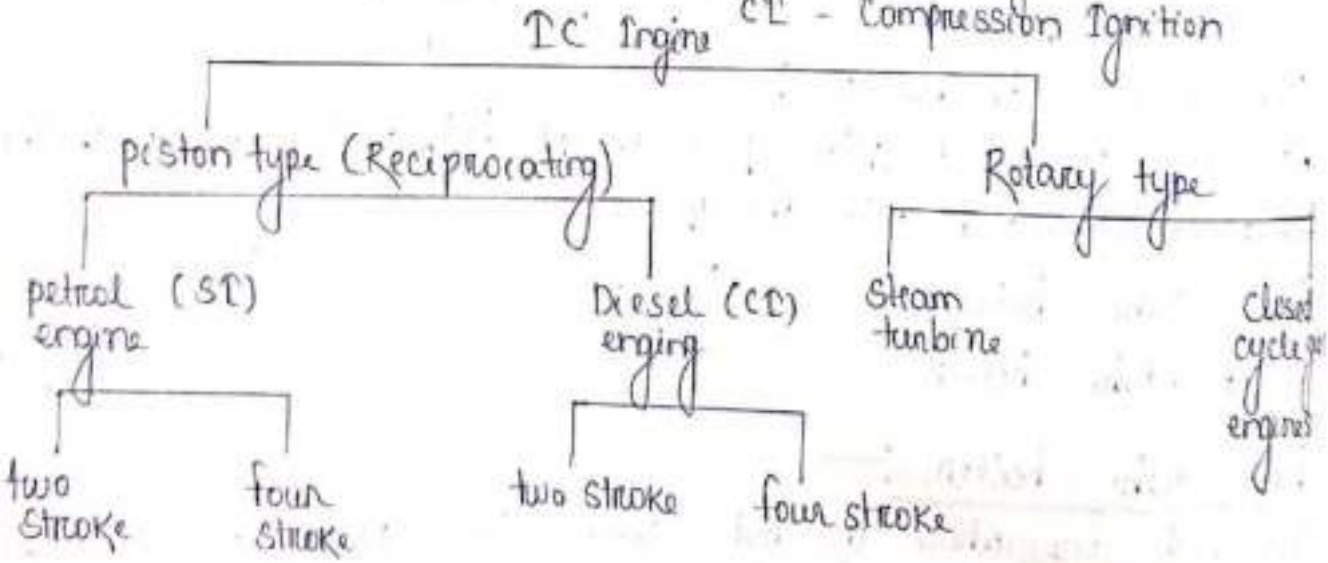
(iii) The work produced by a turbine can be used for generating electrical power when combined with a generator.

Types of turbine

(i) Steam turbine
(ii) Gas turbine
(iii) Water turbine
(iv) Wind turbine

Types of IC engine construction :—

IC - Internal combustion, SI - Spark ignition, CI - Compression Ignition



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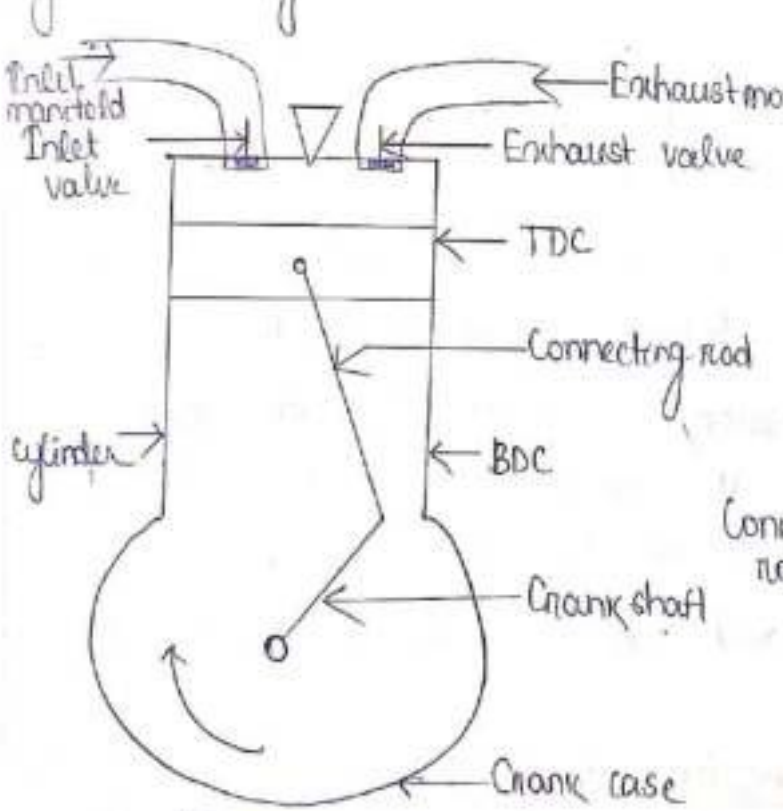
Ignition System :—

i) (Spark) An ignition system generates a spark or heats an electrode to high temp. to ignite a fuel air mixture in spark ignition internal combustion engines, oil fired and gas fired furnaces, liquid rocket engines etc.

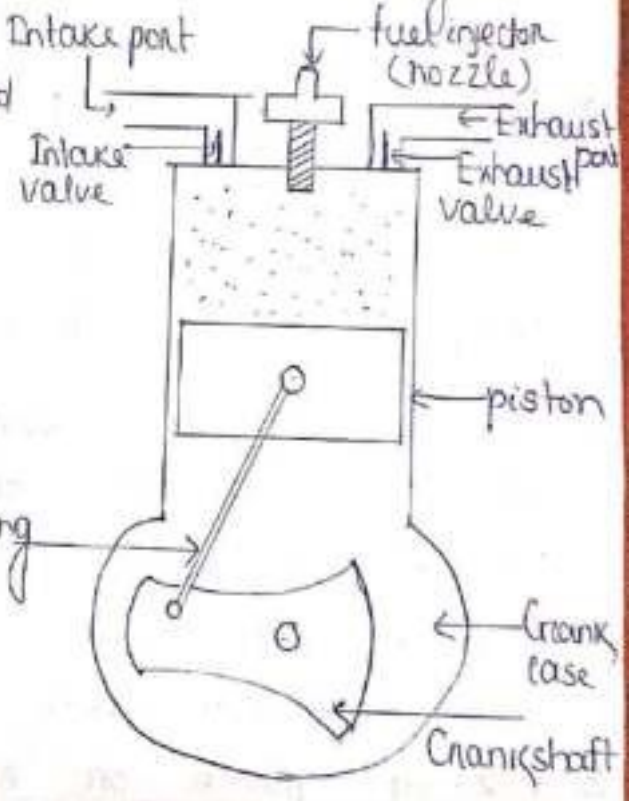
ii) The widest application for spark ignition (SI) Internal combustion engine (IC) is on petrol (gasoline) road vehicles such as cars & motor cycles.

• (Compression ignition) (CI) Diesel engines ignite the fuel-air mixture by heat of compression & don't need to spark.

• These usually have glow plugs in cold weather other engines may use a flame or a heated tube for ignition.



SI engine



CI engine

★ **Four stroke, ottocycle, Spark, Ignition engine :—** (petrol)

In a four stroke ottocycle engine spark ignition engine the four strokes are

1. Suction stroke
2. Compression stroke
3. Working, power or expansion stroke
4. Exhaust stroke

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1. Suction stroke :—

(i) During suction stroke, the piston is moved downward by the crankshaft which is revolved either by the momentum of the flywheel or by the power generated by the electric starting motor.

(ii) The inlet valve remains open & the exhaust valve is closed during this stroke.

(iii) The downward movement of the piston sucks air fuel mixture in the cylinder from the carburettor through with air.

2. Compression stroke :—

(i) During compression stroke, the piston moves upward thus, compressing the charge Ignition & much of the compression also takes place during this stroke.

(ii) The heat produced by the compression makes more homogeneous mixture of air & petrol inside the cylinder.

(iii) The heat makes the petrol easier to burn while the compression forces it into closer combination with the air.

(iv) The mixture under compression is ignited by the spark produced by a spark plug & the combustion is about half completed when the piston is at top dead centre.

(v) Both the inlet valve & exhaust valve remain closed during this compression stroke.

3. Working power or expansion stroke :—

(i) The expansion of the gases due to the heat of combustion exerts a pressure on the cylinder & piston, under the impulse the piston moves downward thus doing useful

(ii) Both the valve remain closed during this state.

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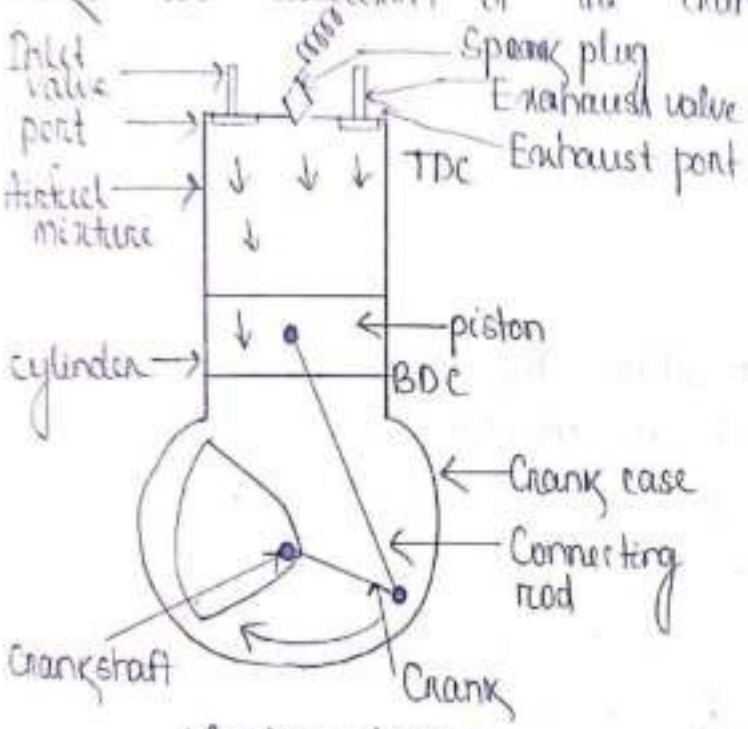
4. Exhaust stroke :—

(i) During this stroke the inlet valve remain closed and the exhaust valve opens.

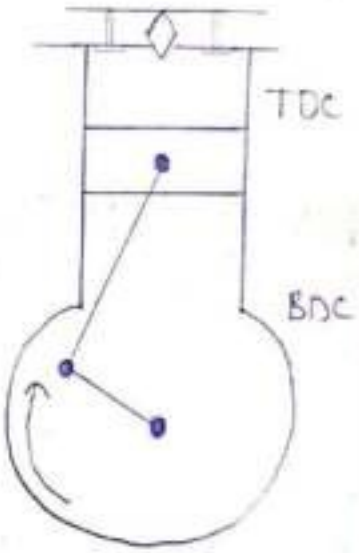
(ii) The greater part of the burnt gases escape because of their own expansion.

(iii) The piston moves upward and pushes the remaining gases of the open exhaust valve.

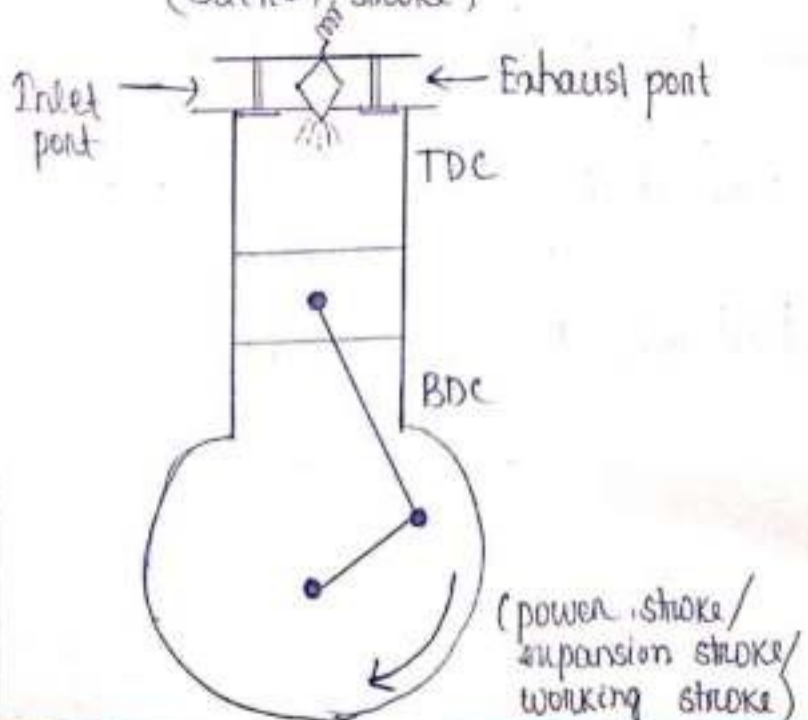
• Thus in this type of engine four stroke of the piston are required to complete the cycle and the four strokes make two revolution of the crank shaft.



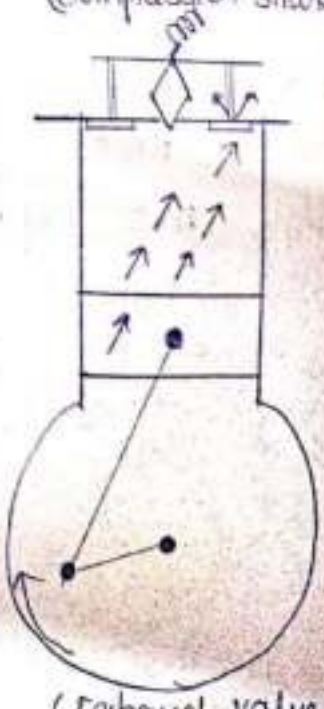
(Suction stroke)



(Compression stroke)



(power stroke/ expansion stroke/ working stroke)



(Exhaust value)

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★ Four-Stroke cycle diesel engine :—

- It is also known as compression ignition engine because the ignition takes place due to the heat produced in the engine cylinder at the end of compression stroke.

1. Suction or charging stroke :—

In this stroke the inlet valve opens and pure air is sucked into the cylinder as the piston moves downwards from the top dead centre (TDC) to the bottom dead centre (BDC)

2. Compression stroke :—

In this stroke both the valves are closed and the air is compressed as the piston moves upwards from BDC to TDC.

3. Expansion stroke :—

(i) Shortly before the piston reaches the TDC (during the compression stroke) fuel oil is injected in the form of very fine spray into the engine cylinder, through the nozzle known as fuel injection valve.

(ii) At this movement, temprature of the compressed air is sufficiently high to ingine the fuel.

(iii) Due to increased pressure, the piston is pushed down with a great force.

(iv) During this expansion, some of the heat energy is transform into mechanical work.

(v) Both the valves are closed and the piston moves from TDC to BDC.

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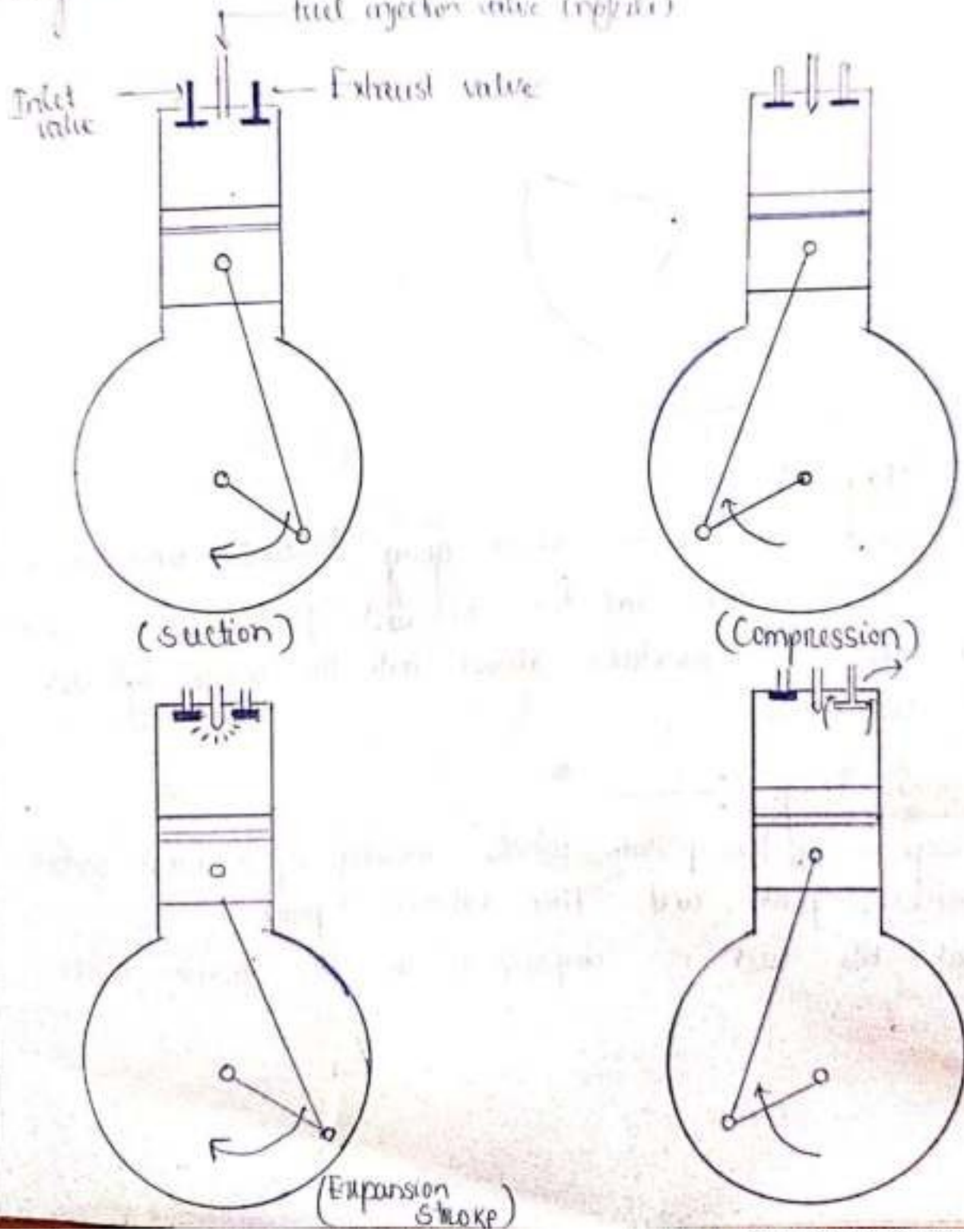
4. Exhaust stroke :-

(i) In this stroke exhaust valve is open & the piston moves BDC to TDC.

(ii) This movement of the piston pushes out the products of combustion from the engine cylinder through the exhaust valve into the atmosphere.

(iii) This completes the cycle and the engine cylinder is ready to suck the fresh air again.



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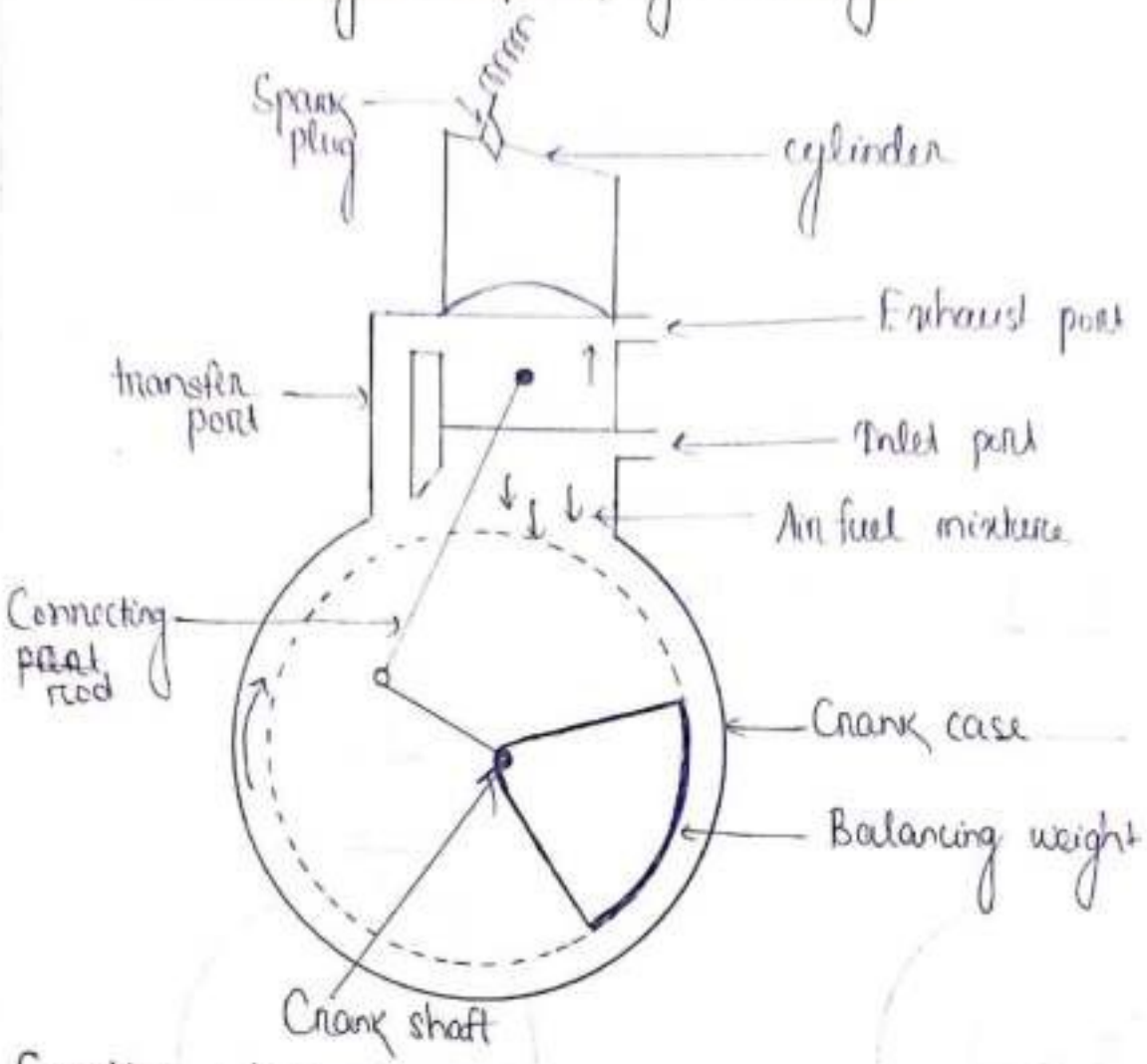
Two - Stroke cycle, spark Ignition Engine :—



1. Suction stage :—

- In this stage the piston, while going towards BDC covers both the transfer port and the exhaust port.
- The fresh fuel - air mixture flows into the engine cylinder from the crankcase.

2. Compression stage :—

- In this stage, the piston, while moving up, first covers the transfer port and then exhaust port.
- After that the fuel is compressed as the piston moves upward.

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3. Expansion stage :—

(i) Shortly before the piston reaches the TDC (during compression stroke), the charge is ignited with the help of a spark plug.

(ii) It suddenly increases the pressure and temperature of the products of combustion.

(iii) Due to rise in the pressure, the piston is pushed downwards with a great face force.

(iv) The hot burnt gases expanded due to high speed of the piston.

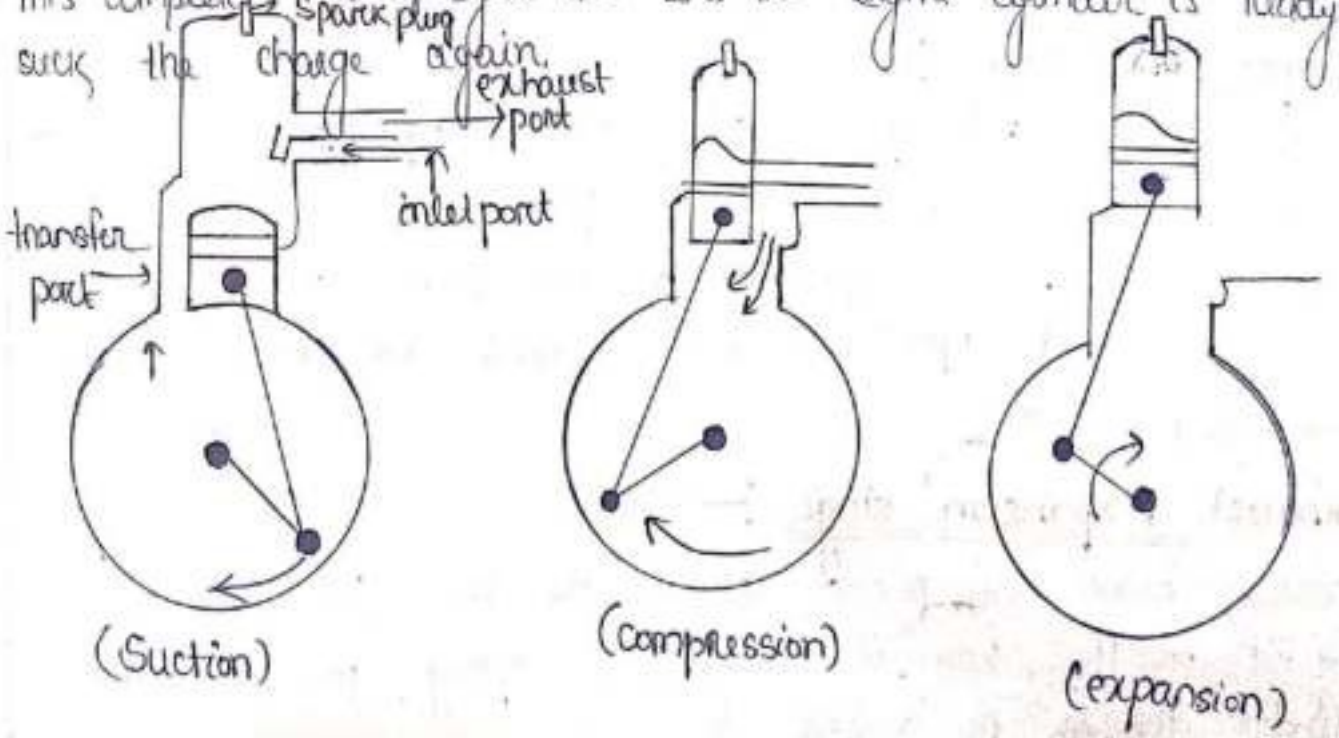
(v) During this expansion some of the heat energy produced is transferred into mechanical work.

4. Exhaust stage :—

(i) In this stage, the exhaust port is opened as the piston moves downwards.

(ii) The products of combustion from the engine cylinder are exhausted through the exhaust port into the atmosphere.

(iii) This completes the cycle and the engine cylinder is ready to suck the charge again.



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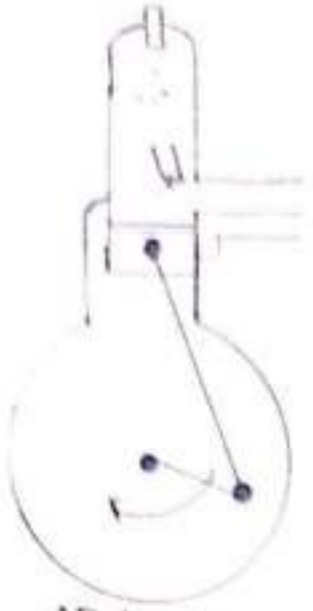

(Exhaust)

Two stroke cycle Diesel Engine :—

1. Suction stage :—

a) In this stage the piston will going down towards BDC uncovers the transfer port and the exhaust port.

b) The fresh air flows into the engine cylinder from the crank case.

2. Compression stage :—

a) In this stage, the piston while moving up, first covers the transfer port and then exhaust port.

b) After the air is compressed as the piston moves upwards the inlet port opens and the fresh air enters into the crank case.

3. ~~Exhaust~~ Expansion stage :—

a) Shortly before the piston reaches the TDC the fuel oil is injected in the form of very fine spray into the engine cylinder through the nozzle.

b) The fuel oil is assumed to be burnt at constant pressure.

c) Due to increased pressure, the piston is pushed with a great force.

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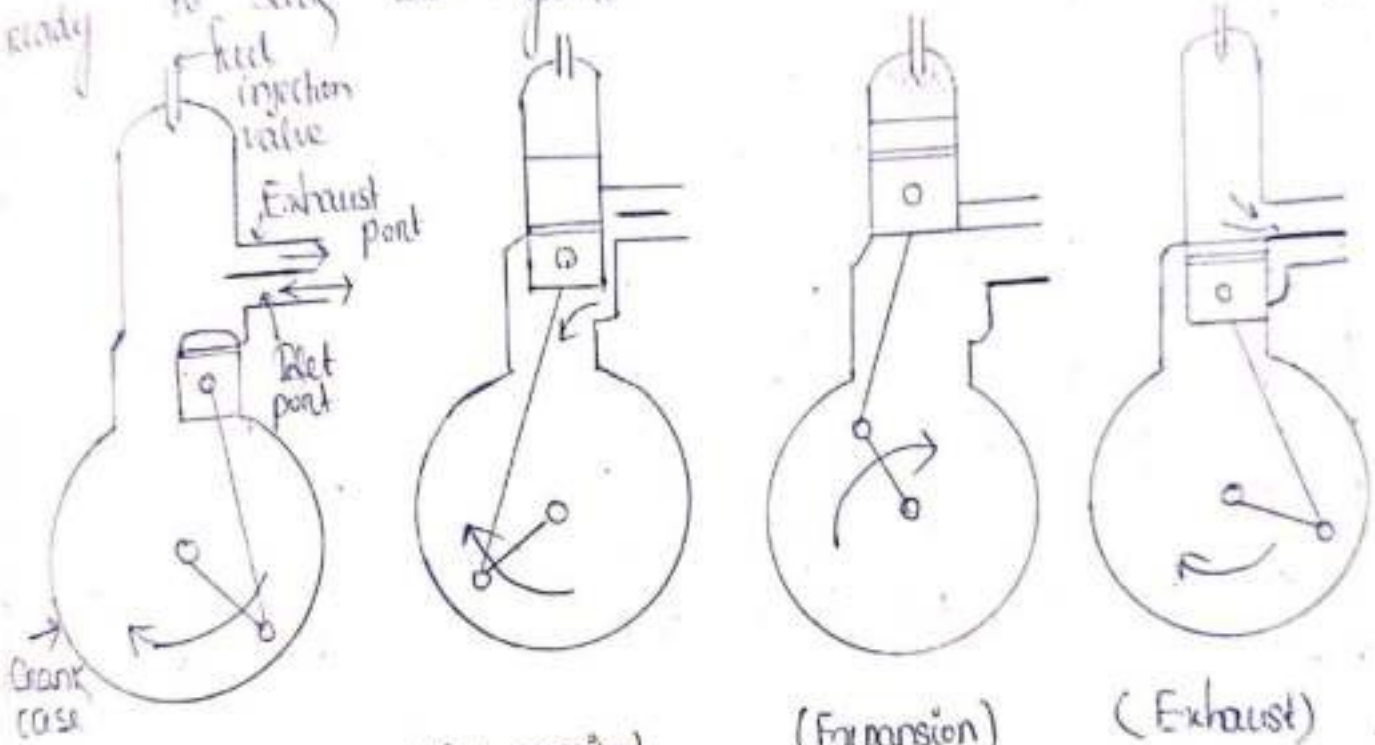
The hot burnt gases expanded due to high speed of the piston. During this expansion some of the heat energy produced is transformed into mechanical work.

4) Exhaust stage :-

In this stage the exhaust port is opened and the piston moves downwards.

The products of combustion is from the engine cylinder are exhausted through the exhaust port into the atmosphere.

This completes the cycle and the engine cylinder is ready to suck an again.



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Properties of steam :—

(i) Steam is the vapour or gaseous phase of water.
(ii) It is produced by heating of water it carries large quantities of heat within itself.
(iii) Hence it could be used as a working substance for heat engines & steam turbines.
(iv) It doesn't obey ideal gas close but in superheated state it behaves like an ideal gas.

Properties of water :—

(i) Water is universal solvent.
(ii) It is a medium for chemical reactions a product of cellular respiration.
(iii) Water has a high specific heat.
(iv) Water in a pure state has a neutral pH. As a result pure water is neither acidic nor basic. Water changes its pH when substance dissolved in it.
(v) Water conducts the heat more easiely than any liquid except mercury.
(vi) Water molecule exists in liquid from over and important range of temp. from 0-100°c.
(vii) Water has a high surface tension.

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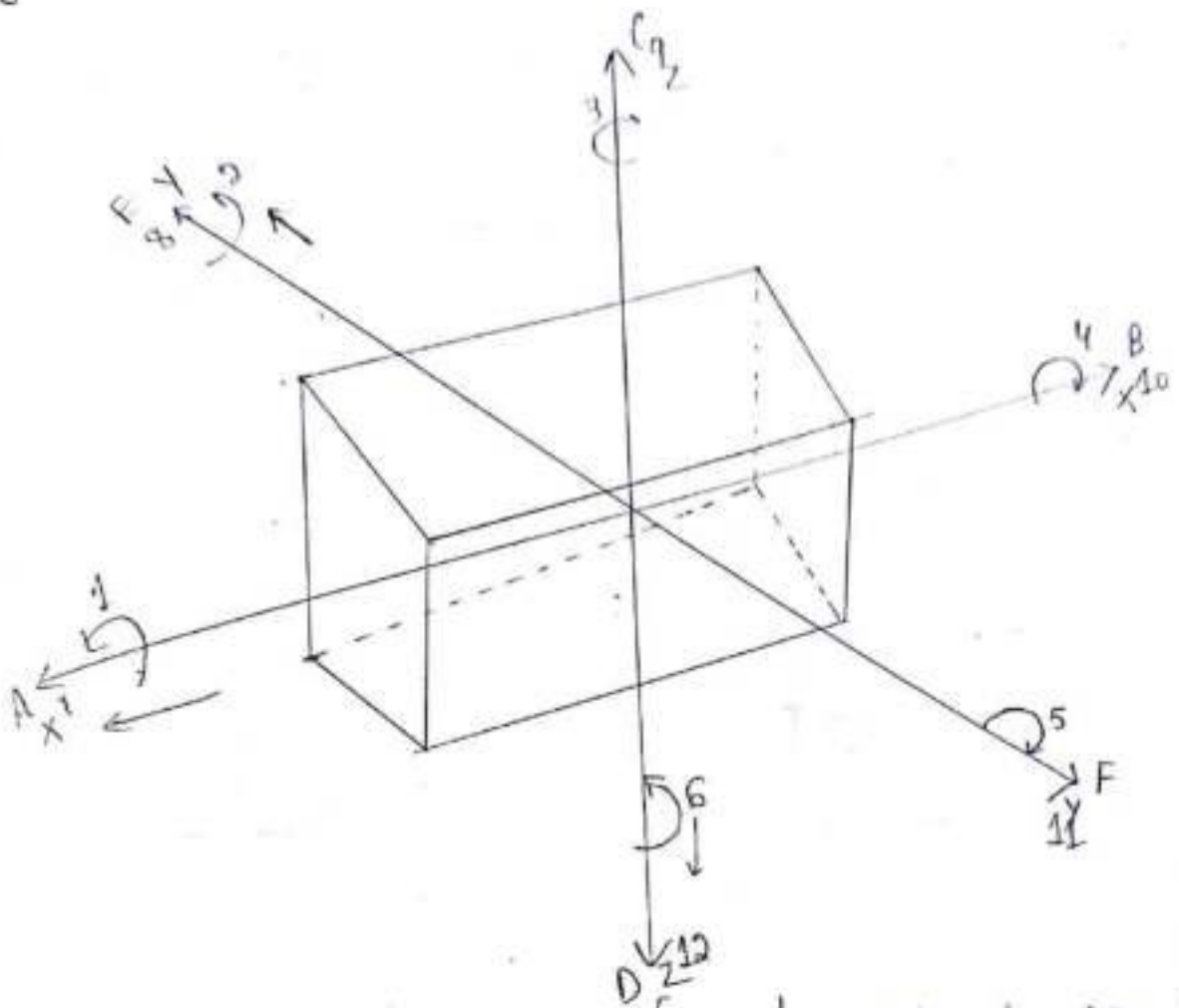
JIGS & FIXTURES

Degrees of freedom :—



- An unrestricted object is free to move in any of twelve possible directions and have twelve degrees of ~~fraction~~ freedom.

Principle of locations :—

→ The term location refers to establish a definite relationship bet^n the workpiece and the cutting tool or jig or fixture

→ The function of location is done by locators and the movement of part is restricted by clamps.

→ A rectangular block is free to move along the axis AB, CD, & EF. The body can also rotate about these axis.

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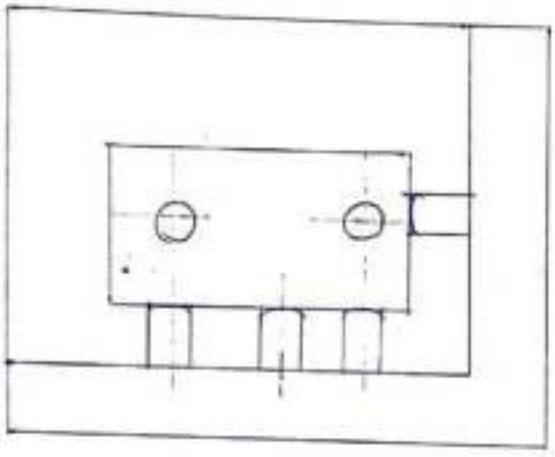
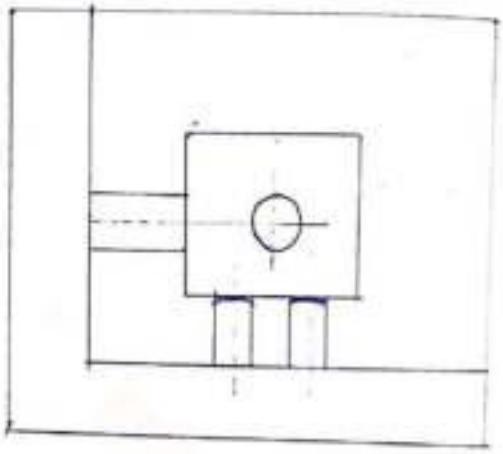
Six point locations of a rectangular block :—

(i) The bottom of the block is supported against three point that means the downward movements of the block along CD is restrained by three supporting points.

(ii) The movement along EF & AB axis are restrained by the double and the single points respectively.

(iii) The rotary movements of the block about AB, CD & EF axis are also restrained by the bottom, back & side points.





The six points thus serve to locate the block correctly while restraining all its movements.

Types of jigs

(1) Template jig

(2) Plate jig

(3) Diameter jig

(4) Box jig

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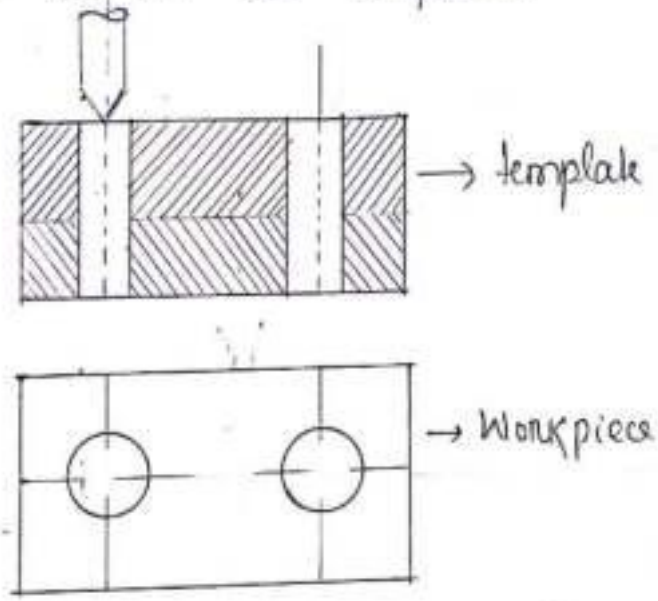
(1) Template Jig :—

(i) Template jig is the least expensive and simplest type of jig to use.

(ii) This type of jigs normally used for accuracy rather than speed.

(iii) A plate having holes at the desired positions serves as template which is fixed on the component.

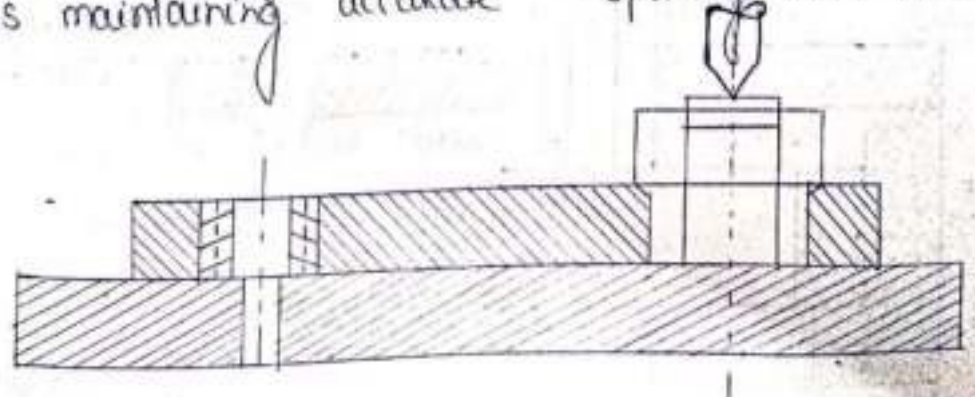
(iv) These holes of the template and the required holes are drilled on the workpiece at the relative positions with each other as on the template.



(2) Plate jig :—

(i) A plate jig is an improvement of the template jig by incorporating drill bushes on the template.

(ii) These plate jigs are employed to drill holes on large parts maintaining accurate spacing with each other.



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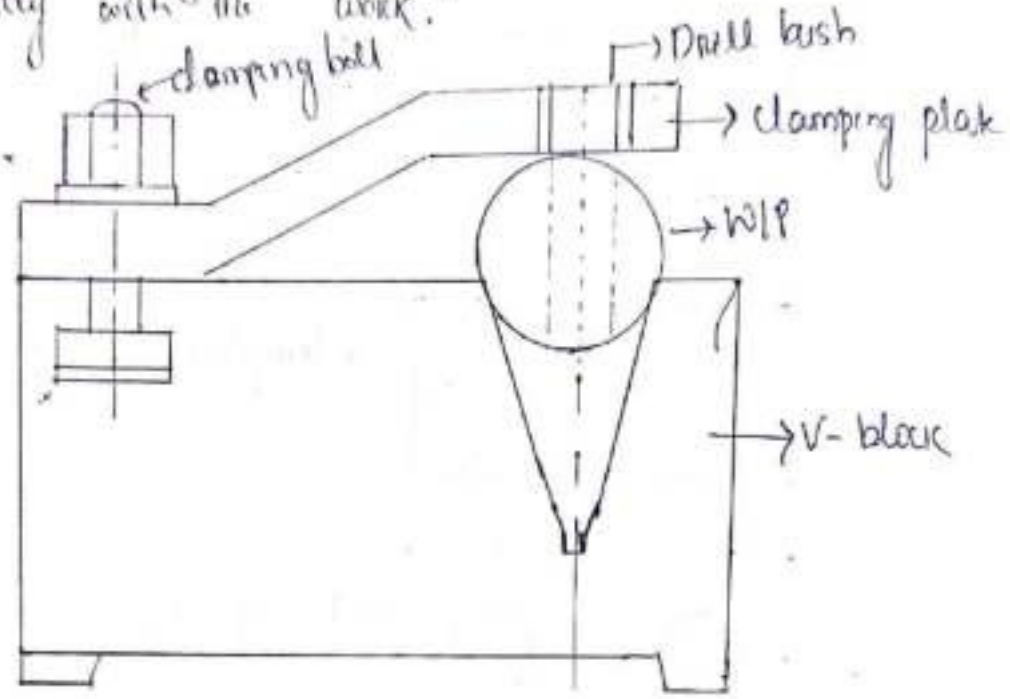
(iii) Diameter Jig :—

(i) The diameter jig is issued to drill radial holes on a cylindrical or spherical work pieces.

(ii) The work is placed on the fixed v-block and then clamped by the clamping plate which also locates the work.

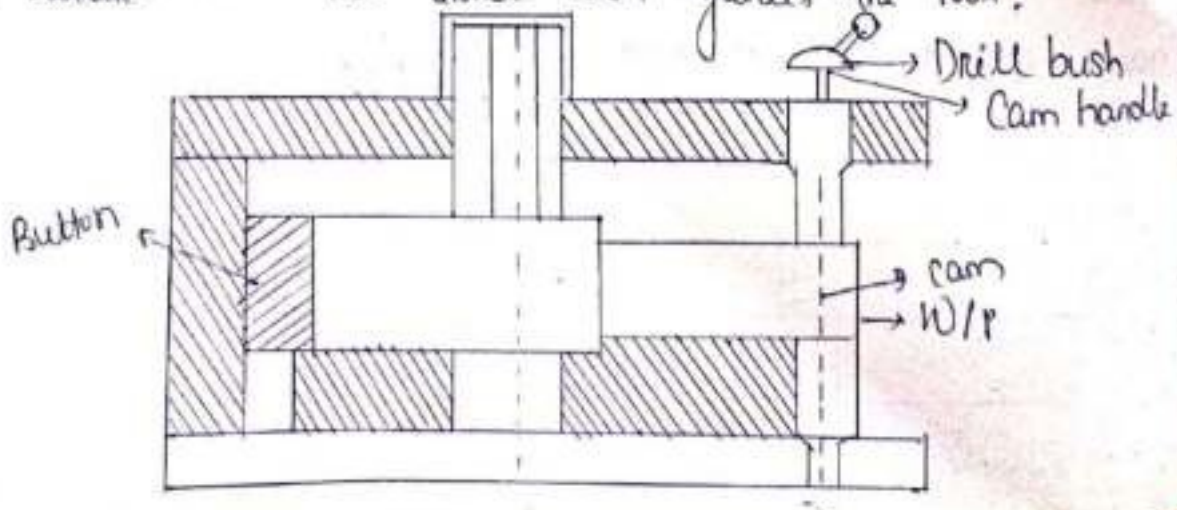
(iii) The work bed is guided through the drill bush which is said radially with the work.



(iv) Box jig :—

(i) It is a box like construction within which the component is located the buttons.

(ii) The work is clamped by rotating the cam handle which also locates it. The drill bush guides the tool.



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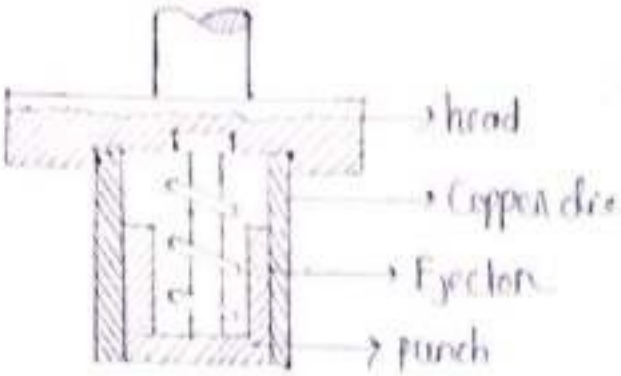
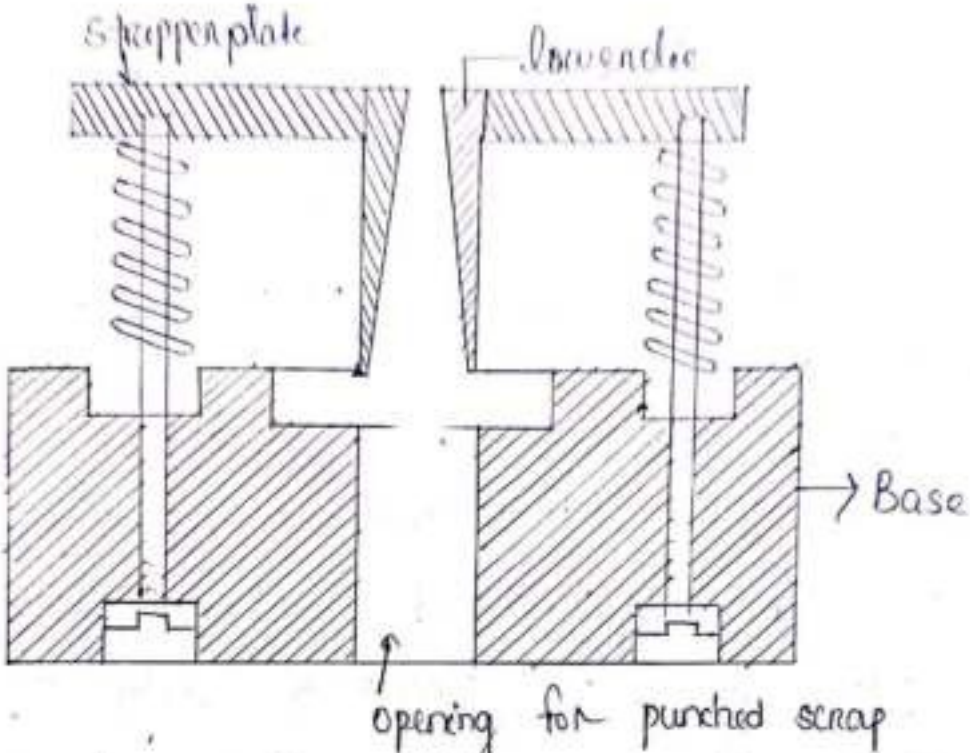
Compound die :—





(i) Compound dies perform two or more operations in as a single stage and assure the greatest accuracy of the product but are limited to relatively simple processes such as blanking punching etc.

(ii) The metal sheet is placed betⁿ the upper dies and the lower die.

(iii) Both blanking and piercing to carried out during the same stroke of the press.

(iv) The blanking operation on the metal sheet is carried out by the telescope action of the upper and lower dies as the upper die.

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(v) Compound dies make close tolerance and concentricity parts, as well all works done in one stroke.

Progressive dies :—

(i) In a progressive die two or more operation are performed simultaneously at a single stroke of the press by mounting separate sets of dies and punches at two or more different stations.

(ii) The metal is progressed from one station to the other till the complete part is obtained.

(iii) The sheet metal is fed into the first dies where a hole is pierced by the piercing die set in the first cutting stroke of the ram.

(iv) The plate is then advanced in station and the correct spacing is obtained by the stop.

(v) In the second cutting stroke of the ram. The pilot enters into the pierced hole and correcting locates it.

(vi) The two strokes are required to complete a washer each piece of washer is discharged on every strokes by of the ram due to the continuously on operation.

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Jig :—

1. Jig is a device which hold & locate the workpieces and also guide the cutting tool to its cutting position.
2. Jig is suitable for small workpieces.

Fixture :—

Fixture is used to hold and locate the workpieces.
Fixture is always placed on the worktable and suitable for largen workpieces.

Difference betn Jig & fixture :—

Jig	Fixture
1. Jig is a device primarily used to guide the cutter to repeatedly move at predefined locations on the w/p. Jigs can also hold, support and locate the workpiece.	1. Fixture is a device used to rigidly grip support and locate the w/p maintaining intened orientation. It doesn't guide the cutter to move to a particular location.
2. A jig is usually lighter in weight. Sometimes jigs are held only by hand without clamping.	2. Fixture is commonly heavier and robust as it is required to sustain the cutting f and vibration. It is clamped firmly with work table.
3. Jigs is considered easy to use and this less skill is required to operate this device	3. Fixtures is somewhat complicated to use and thus requires skill.
4. No. additional device is required for locating the cutter with respect to job.	4. Additional accessories like blocks, gauges, etc. are desired to accurately move the cutter in intened location.
5. Jig is frequently used in drilling, boring, reaming & tapping.	5. Fixture is employed in milling, planing, shaping, slotting etc.

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Advantages of Jigs & fixtures :—

Jigs and fixtures have made manufacturing processes less time consuming, more precise, and hassle free from a human factor perspective. The benefits of jigs and fixtures include but are not limited to the following:

→ Increase in production
→ The consistent quality of manufactured products due to low variability in dimension
→ Cost reduction
→ Inter changeability and high accuracy of parts
→ Inspection and quality control expenses are significantly reduced
→ The decrease in an accident with improved safety standards
→ Due to relatively simple maneuverability, semi-skilled workers can operate these tools reducing the workforce's cost.
→ The machine tool can be automated to a reasonable extent.
→ Complex, rigid and heavy components can be easily machined
→ Simple assembly operations reduce non-productive hours
→ Eliminates the need for measuring, punching, positioning, alignment and setting up for each workpiece, thereby reducing the cycle and setting up a time.
→ Increases technological capacities of machine tools
→ More than one device can be used simultaneously on a w/p
→ Setting higher values of some operating conditions like depth of cut, speed and rate of feed can be attained because of the increased clamping capability of jigs & fixtures.

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