Q. Explain the common allowances provided on patterns.

Ans. ***Pattern Allowances***

(i) ***Shrinkage:-*** When any metal cools, it naturally shrinks in size. Hence, if the actual object itself is used for the pattern, the resulting casting would be slightly smaller than desired. To compensate for this possibility, a shrink rule is used in laying out of measurements for the pattern. A shrink rule for cast iron is 10 mm per meter (the average shrinkage for cast iron) longer than the standard rule. When metal patterns are to be cast from the original patterns, double shrinkage must be allowed.

(ii) ***Draft :-*** When a pattern is drawn out from a mould, the tendency to tear away the edges of the mould in contact with the pattern is greatly decreased if the surfaces of the pattern are given a slight taper in a direction parallel to which it is being withdrawn. This tapering of the sides of the pattern, known as draft, is done to provide a slight clearance for the pattern as it is lifted up. The amount of draft on exterior surfaces is about 10 to 20 mm per meter. On interior holes, which are fairly small, the draft should be around 30 mm per meter.

(iii) ***Finish :-*** When a draftsman draws up the details of a part to be made each surface to be machined is indicated by a finish mark. The mark indicates that additional metal must be provided at this point so that there will be some metal to machine. The amount that is to be added depends upon the size, shape of casting, but in general, the allowance for small castings and average sized castings is 3 mm.

(iv) ***Distortion :-*** This allowance applies only to those castings of irregular shapes, which are distorted in the process of cooling as a result of metal shrinkage. Such an allowance depends on the judgment and experience of the pattern maker, who understands the shrinkage characteristics of the metal.

(v) ***Shake :-*** When a pattern is rapped in the mould before it is withdrawn, the cavity in the mould is slightly increased. In an average sized casting this increase in size can be ignored. In large castings or in one that must fit without machining, however, shake allowance must be considered by making the pattern slightly smaller.

Q. Discuss the advantages split and multi-piece patterns.

Ans. *Following are the advantages of split and multipiece patterns.*

1. Complicated designs can be constructed in these types of patterns.
2. They facilitate easy withdrawal from cope and drag box.
3. These pattern are easy to contact as compared to solid or single piece pattern.

Q. What are the factors, which should be considered before designing a casting?

Ans. The important factors to keep in mind when designing a casting to obtain maximum strength and minimum casting include:

1. Design for directional solidification.
2. Design for minimum stresses.
3. Design for metal flow.
4. Cast-well design.
5. Design for minimum casting.
6. Design for expected tolerances.
7. Functional design.

Q. Write short notes on the following casting defects.
1) Cuts and washes
2) Drops

Ans. ***1) Cuts and washes*** *:-* These defects occur due to the erosion of sand from the mould or core surfaces by the molten metal. The cavities formed on the mould and core surfaces due to this erosion are filled by the molten metal and the same appear on the casting surface as an surface as an excess metal in the form of ragged spots. These spots are called scabs. The eroded sand appears as a sand inclusion some-where else in the casting. These cuts and washes take place due to insufficient strength of mould and core, lack of binding material in the facing and core sand and faulty gating. Obviously, the remedy of the defect lies in adequate ramming, additional of sufficient binders in facing and core sands and improved gating system.

2) Drops :- This defect appears as an irregular deformation of the casting. It occurs on account of a portion of the sand breaking away from the mould and dropping into the molten metal. The above breaking takes place due to low green strength in the sand, too soft ramming, insufficient reinforcement of the cope or other sand projections. Increase in green strength of the sand by suitable modification in its composition, hard ramming and adequate reinforcing of cope and other sand projections by means of bars, nails and gaggers etc. are the principal remedies of this defect.

Q. What are the factors which govern the selection of a proper material for pattern making.

Ans. *Factors effecting the selection of pattern material:-*

1. *Number of castings to be made.*
2. *Method of moulding to be used, i.e., hand or machine.*
3. *Type of casting method to be used.*
4. *Degree of accuracy in dimensions and the quality of surface finish required on the castings.*
5. *Design of casting.*

Q. How are the patterns classified ? Explain the use of solid pattern.

Ans: On the basis of material used in construction of patterns, they are classified as :

(1) Wooden patterns
(2) Metal patterns
(3) Plaster patterns
(4) Plastic patterns
(5) Wax patterns

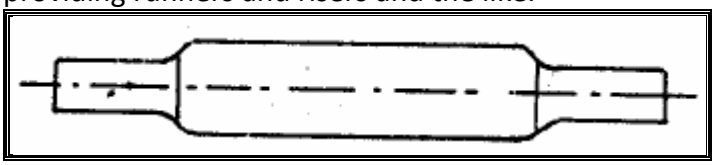
On the basis of number of pieces used in construction, patterns are classified as

(1) Solid or single piece pattern
(2) Two piece or split pattern
(3) Multi-piece pattern
(4) plate pattern

Solid or Single piece pattern :-

A single piece pattern is the simplest of all the patterns, is made in one-piece and carries no joint, partition or loose pieces. Depending upon the shape, it can be moulded in one or two

boxes. This pattern is the cheapest but its use can be done to a limited extent of production only since its moulding involves a large number of manual operations like gate cutting, providing runners and risers and the like.



Q. Write short notes on 1) Functions of a pattern 2) Core boxes

Ans.

1) *The main functions of a pattern are :*

(i) To produce the mould cavity of appropriate shape and size in which the molten metal can be poured to obtain desired casting.

(ii) To produce seats for cores in the mould in which cores can be placed to produce cavity in the casting. These seats in the mould are called coreprints and the corresponding projections on the pattern, which produce these seats, are also known as coreprints.

(iii) To establish the parting surfaces and lines in the mould.

(iv) To establish distinct locating points in the moulds of which the corresponding points on the casting are used as reference points, for checking the casting dimensions and relative location of machined and other surfaces.

(v) To minimise defects in castings.

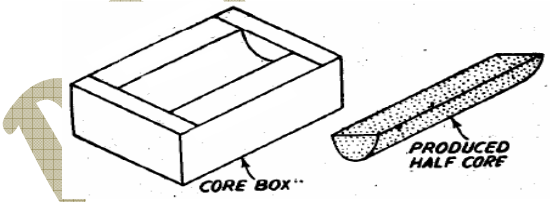
(vi) To enable production of green sand or rammed-up cores within the mould itself.

(vii) To minimise the cost of casting.

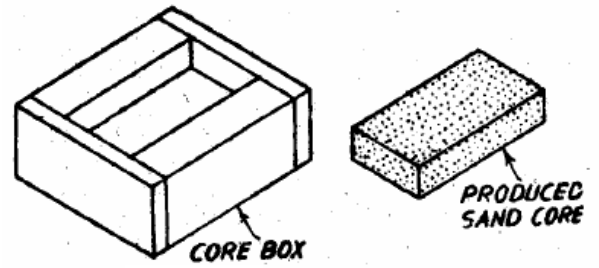
2) Core boxes :-

Core boxes are used for making cores. They are either made single or in two parts. Their classification is, generally, according to the shape of the core or the method of making the core. The common types of core boxes are the following :-

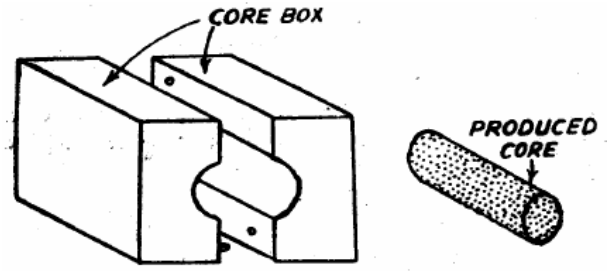
1. ***Half core box :-*** To prepare the core in two halves which are later on cemented together to form the complete core.(See fig.).



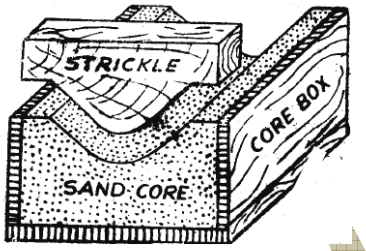
2. ***Dump core-box :-*** Used to prepare complete core in it. Generally, rectangular cores are prepared in these boxes.(See fig.)



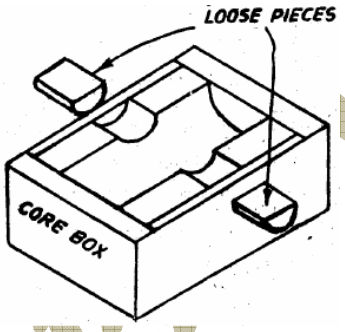
3. ***Split core-box :-*** It is made in two parts, which can be joined together by means of dowels to form the complete cavity for making the core.(See fig.)



4. ***Strickle type core-box :-*** It is used to form cores of irregular or unsymmetrical shapes, as shown in fig.



5. ***Loose piece core-box:-*** It is used to prepare, in the same core box, the two halves of a core of which the halves are not identical in shape and size. (See fig.)



Q. Explain the causes and remedies of following casting defects.

Ans.

1 ***Fusion***

CAUSES:

a)Low refractoriness in moulding sand.

b) Faulty gating.

c) Too high pouring temperature of metal.
d) Poor facing sand.

REMEDIES:

(a)Improve refractoriness.
(b)Modify gating system.
(c)Use lower pouring temperature.
(d) Improve quality of facing sand.

2 ***Short metal***

CAUSES:

(a)Too low pouring temperature.
(b)Excess sulphur Content in metal.
(c) Faulty gating.
(d)High moisture content in moulding sand.

REMEDIES:

(a) Use higher pouring temperature.
(b) Reduce sulphur content.
(c) Modify gating system.
(d) Reduce moisture content.

3 ***Shift***

CAUSES:

(a) Worn-out or bent Clamping pins.
(b) Misalignment of Two halves of pattern.
(c) Improper support of core.
(d) Improper location of core.
(e) Faulty core boxes.
(f) Insufficient strength of moulding sand and core.

REMEDIES:

(a)Repair or replace the pins.
(b) Repair of replace dowels causing misalignment.
(c) Provide adequate support to core.
(d) Locate the core properly.
(e) Repair or replace the core boxes.
(f) Increase strength of moulding sand and core.

Note :- *There is always a possibility of asking question on " Casting defects, their causes and remedies". Students are advised to Refer table 11.1 containing total 18 defects in Workshop technology by* **B.S.Raghuwanshi.**

Q. What is the purpose of die casting?

Ans.

The method of die casting serve the following purpose:

1) Increasing production rate.
2) Effecting greater economy.

3) Improving quality of casting.
4) Eliminating or minimising the need of further machining.
5) Provide better dimensional control.
6) Production of better surface finish.

Q. What is permanent mould? Specify its advantages and disadvantages?

Ans.

When the mould made from metals like C.I. or steel then, while casting such mould is not destroyed or rebuilt after every casting. Since can be use for long period such mould is known as permanent mould.

Advantages of permanent mould:

1) Increases the speed of casting process.
2) Have very long life.
3) Results in better surface finish than sand casting.
4) Castings in large quantities can be produced economically.
5) Casting method requires less skill and at same time number of rejections are less.

Disadvantages of permanent mould

1) These moulds are much costlier than sand mould.
2) It can be successfully used for casting very high temperature alloys
3) Gates, runners and risers can not be shifted and positioned any where at will.
4) May produced several defects in casting like stress and surface hardness due to surface chilling effect.

Q. Explain the difference between gravity die casting and pressure die casting.

Ans.

1. In gravity die casting pouring is done simply due to gravity and no external pressure is applied. But for pressure die casting external pressure is applied to free the molten or semi molten metal in to the die cavity.
2. In P.D.C. the pressure is applied to the force the fluid in die cavity. The fluid alloy fills the entire die including all minute cavities. Hence intricate can beproduced successfully but as compared to G.D.C.
3. We get better dimensional tolerance and better surface finish in P.D.C. compared to G.D.C.
4. P.D.C. can be made fully or semi automatic.
5. P.D.C. metal in semi molten state can be cast which not possible in G.D.C.
6. As the arrangement to develop the pressure is needed in case of P.D.C. it needs some costly equipments which increases the build up cost for P.D.C. Hence the equipments use for P.D.C. are costlier than G.D.C.

Q. Explain Jamming of cupola.

Ans. Jamming of cupola may be permanent or temporary. If the molten metal is not taped out before its level rises to high in the well, the slag which floats on the surface of molten metal, will start flowing into wind belt through the tuyeres and air passage will be choked and the cupola jammed. Thus, the furnace is put to an unusable condition then it is known as

permanent jamming. Iron and slag around the tuyeres openings get solidify. Due to the low temperature at the tuyeres openings which results in the closing of air passage and supply of air is temporarily stopped termed as temporary jamming. This can be prevented by frequent poking of this solidified material by poking bar, through tuyeres.

Q. State the advantages and disadvantages of die casting?

Ans.

Advantages of die casting are

1. It requires less floor space as compared to other casting processes.
2. Rate of production is high. 75 to 150 casts per hour in cold chamber and 300 to 350 casts per hour in hot chamber process.
3. Die casting dies retain their accuracy for a very long time.
4. Very thin sections can be cast and holes upto minimum of 1.6 mm diameter can be easily cored.
5. High surface finish is obtained and often no further finishing is required.
6. Cost per unit is minimum hence economical.

***Disadvantages* of die casting**

1) All metals and alloys can not be cast.
2) The cost of machines, dies and other equipment used is high.
3) Not economical for small quantity production.
4) Heavy casting cannot be cast.
5) Special precautions are necessary for evacuation of air from die cavity, otherwise cause porosity.

Q. State the differences between cold chamber die casting machine and hot chamber machine.

Ans. Following points shows the difference between *cold chamber die casting (machine)* and *Hot chamber die casting (machine).*

Cold chamber die casting (Machine)

1. Heating chamber is not integral part of machine unit. Metals are melted in a self contained pot in an auxiliary furnace.
2. Non ferrous metals and alloys having high melting point usually above 5000C. are cast.
3. Requires operating pressure of 300 to 1600 kgf/cm2.
4. Usually 75 to 150 castings per hour can be produced.
5. Semi solid metals and alloys can be cast.
6. Usually nickel-chrome steel is used for die.

Hot chamber die casting (Machine)

1. Heating chamber is integral part of machine unit.
2. Metals an alloys having low melting point usually below 5000C. are cast.
3. Requires comparatively low operating pressure below 150 kgf/cm2.
4. Usually 300 to 350 castings per hour can be produced.

5. Semi solid metals and alloys can not be cast.
6. Usually hardened and tempered chrome-vanadium or chrometungsten steel is used for die.

Q. How permanent mould casting differ from sand casting?

Ans.

Permanent Mould Casting

1. Mould is a permanent one and is neither destroyed nor remade after each cast.
2. Requires less floor space area.
3. Moulds are costly.
4. Rate of production is high.
5. Economical for large quantity production.
6. In order to enable and easy and unrestricted removal of casting, the runner and riser are normally kept on the parting line.
7. Better surface finish is obtained.
8. Less skill operator is required.
9. Eliminates many defects found in sand casting but need greater precaution against chilling effect on the casting surface.

Sand Casting

1. Mould is not permanent.
2. Requires more floor space area.
3. Cost of mould is less.
4. Rate of production is slow.
5. Used for small quantity of production.
6. The runner and riser can be suitably positioned at will.
7. Surface finish inferior than permanent mould casting.
8. Comparatively more skill operator is required.
9. No need of such precaution against chilling effect on casting surface.

Q. Sketch and explain the construction and operation of hot chamber die casting machine.

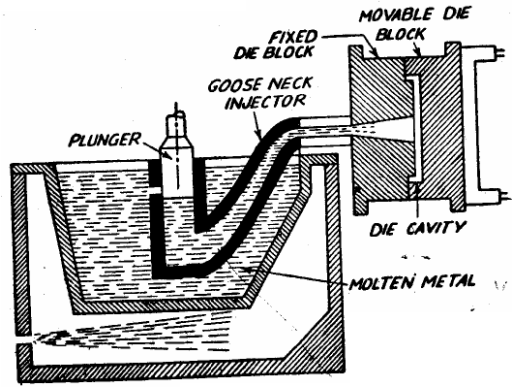
Ans. In the hot chamber die casting machine the metal melting unit forms an integral part of machine. It mainly consist of hot chamber and a goose neck type metal container made of cast iron.

Construction

This type of machine having goose neck type container which always remains immersed in the metal pot. Cylindrical shape is formed at the end of goose neck, a plunger acts inside the cylinder. A port is provided near the top of the cylinder. Goose neck injector is connected to stationary die by nozzle and movable die can move to from die casting and injecting the casting. Die is provided with proper injecting mechanism.

Operation

As the plunger move upward the port get open and molten metal enters into cylinder. Downward movement of plunger closes the port and forces the molten metal inside die cavity through nozzle. After solidification plunger moves upward at the same time movable die move away from stationary die to inject the casting. Injecting mechanism cause to inject the casting. Plunger starts downward movement and movable die moves towards the stationary die to form required casting. The cycle is further repeated.



Q. State the advantages and disadvantages of die casting?

Ans. ***Advantages of die casting*** **are**

1. It requires less floor space as compare to other casting processes.
2. Rate of production is high. 75 to 150 casts per hour in cold chamber. 300 to 350 casts per hour in hot chamber process.
3. Die casting dies retain their and more accuracy for a very long time.
4. Very thin sections can be cast and Holes upto minimum of 1.6 mm.
5. High surface finish is obtained and often no further finishing is required.
6. Cost per unit is minimum hence economical.

Disadvantages of die casting *are:*

1. All metals and alloys cannot be cast.
2. The cost of machine dies and other equipment used is high.
3. Not economical for small quantity production.
4. Heavy castings cannot be cast.
5. Special precautions are necessary for evacuation of air from die cavity, otherwise cause porosity.

Q.Describe the process of true centrifugal casting with the help of neat diagram.

Ans. 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. The mould used may be either of permanent type or a sand lined mould usually end cores are used to prevent the molten metal, thrown out from end.

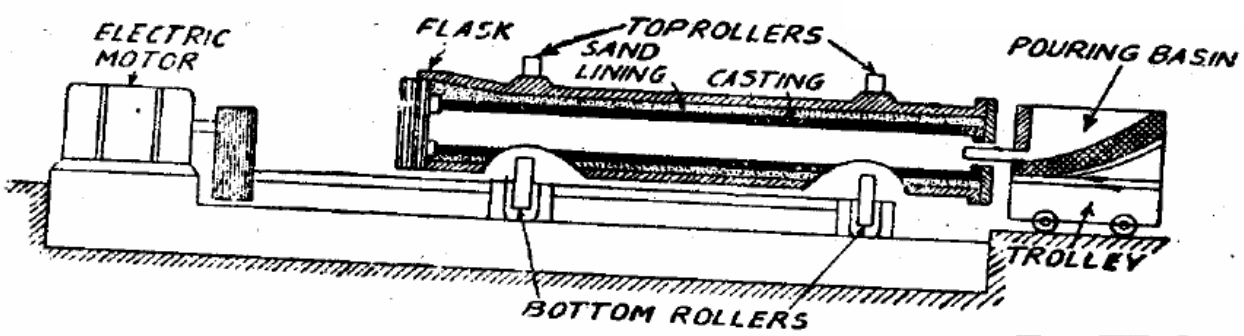


Fig shows horizontal true centrifugal casting machine. Having a large cylindrical mould for casting cast iron pipes. The mould consists of an outer metallic flask provided with rammed sand lining inside. The mould is rotated between two sets of rollers, mounted on a shaft driven by a variable speed motor. Pouring basin is formed on the body of a trolley.
Molten metal is poured while Mould is rotating, due to the centrifugal force metal is directed towards the periphery. While pouring Mould is rotated at slower speed, after pouring, speed is increased to effect even distribution of the metal all along the inside surface of the mould and proper directional solidification. After solidification flask is replaced by new one and the process is repeated. The use of this process is limited only for symmetrical shaped objects, such as pipes, rolls, cylinder sleeves and liners, piston-ring stock, bearings bushing etc.

Q. Explain the 'core' with the use. What are the characteristics of a good core?

Ans. A core can be defined as a body of sand, generally prepared separately in a core box, which is used to form a cavity of desired shape and size in a casting. However, there are some exceptions to this definition. For example in a pattern can be used to form a core as a part of the mould, this being known as a green sand core. Similarly, in permanent moulds or dies, the cores are formed by the metallic moulds themselves as an integral part of them. Cores which are prepared separately in core boxes are called dry sand cores, and held and located in the moulds in the seats formed by the core prints provided on the patterns. The main characteristics required in a good core are the following :

1. It must be sufficiently permeable to allow an easy escape to the gases formed.
2. It should be highly refractory to withstand the intense heat of molten metal.
3. It should be enough hard and strong to bear its own weight and the force of molten metal.
4. It should have high collapsibility i.e.; it should be able to disintegrate quickly after the solidification of the metal is complete.
5. It should not carry such constituents, which will give rise to excessive gases on coming in contact with the molten metal.

Q. What is investment casting? What are its main advantages and disadvantages?

Ans.

Following are the steps of investment casting:

1. First of all master pattern is made from wood or metal.

2. By using gelatin or an alloy of low melting point and master pattern, master mould is formed.
3. The master Mould is filled with liquid wax or by thermo plastic polystyrene resin which when solidified forms a wax pattern.
4. The wax pattern is coated with slurry consisting of silica flour and small amounts of kaolin and graphite mixed with water. This process referred to as the investment of the pattern.
5. The pattern is then used to make up moulds similar to those used in the conventional moulding process, but the pattern within the mould is not taken out of the mould, which is not opened after this moulding process.
6. Finished mould is dried in air for 2 to 3 hrs. and then baked in an oven about 2 hrs. to melt out the wax or remove the wax with the help of a solvent degreaser.
7. After this the mould is sintered at about 10000C to improve its resistivity. Finally it is cooled down to a temp. between 800 and 7000C for casting. The castings are obtained by gravity, pressure vacuum or centrifugal operations. After the metal is cooled the plaster is broken away and gets feeders are cut out. The castings so obtained are finally cleaned by sand blasting, grinding or other finishing processes.

Advantages

1. Better dimensional accuracy, the normal tolerance being ± 0.005 mm.
2. Better surface finish
3. Thin sections of the order of 0.75 mm can be cast
4. Intricate machining of the casting is avoided
5. Castings are sound and have large grains as the rate of cooling is slow.

Disadvantages

1. Moulds used are single purpose, i.e.they can be used only once.
2. It is expensive process and hence is adopted only where small number of intricate and highly accurate parts are to be manufactured.
3. This process is suitable for small size parts.
4. They present the same difficulty where cores are to be used.
5. Process is slow.

Q. Describe centrifugal casting and state its advantages and limitations. Draw a sketch of the same.

Ans. Centrifugal casting is casting method in which, molten metal is poured while mould is rotating, due to the centrifugal force metal is directed towards the periphery. The cold metal is forced towards the outer side of the casting by the centrifugal force, where as the hotter metal remains on the inner side of the casting to provide the required feeding of metal during solidification. Although many different shapes can be cast through this process, but those with symmetrical shapes are best suited for it.

Centrifugal casting methods can be classified as follows: -

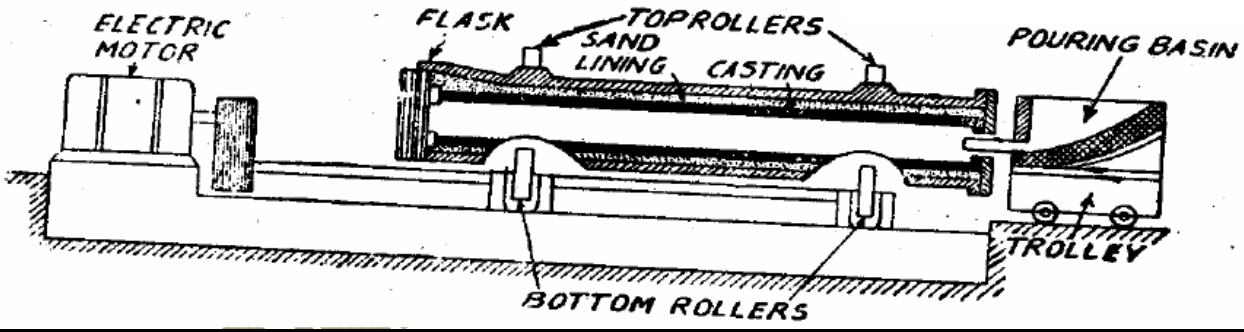
a) *True centrifugal casting*
b) *Semi centrifugal casting*
c) *Centrifuging*

Advantages: -

1. Due to the forced movement of the molten metal castings are dense sounds and free from porosity.
2. The use of gates, feeders and central core is eliminated, making the method less expensive
3. Mass production is possible with less rejection.
4. Mechanical and physical properties of castings are improved.
5. Parts are produced closer to finished dimensions with consequent saving in machining.

Disadvantages: -

1. Need heavy initial investment.
2. Need skilled labour.
3. Economical only for mass production.
4. Expensive maintenance cost.
5. The process is limited to only cylindrical and circular parts with a limited range of sizes.



Q. What is meant by felting and why is it required? Explain in brief

Ans.

Castings, when taken out of the mould, are not in the same condition in which they are desired since they have sprue, risers, gates, etc. attached to them. Besides, they are not completely free of sand particles. This operation of cutting off the unwanted parts, cleaning and finishing the casting is known as felting. This includes:

1. Removal of cores from the castings.
2. Removal of gates, risers, runners, etc. from the castings.
3. Removal of fins, and other unwanted projections from the castings.
4. Removal of adhering sand and oxide scale from the surface of the castings (surface cleaning).
5. Repairing castings to fill up blowholes, straightening the warped or deformed castings.

Q. What do you understand by design of casting?

Ans.

Design of casting includes following: -

1. Design for directional solidification.
2. Design for minimum stresses
3. Design for metal flow.
4. Cast-well design.
5. Design for minimum casting.
6. Design for expected tolerances.
7. Functional design.

Q. Describe shell moulding in terms of the following :-

(i) Its principal
(ii) Patterns for it.
(iii) Materials used in making shell
(iv) Steps in the process
Use sketches at appropriate places.

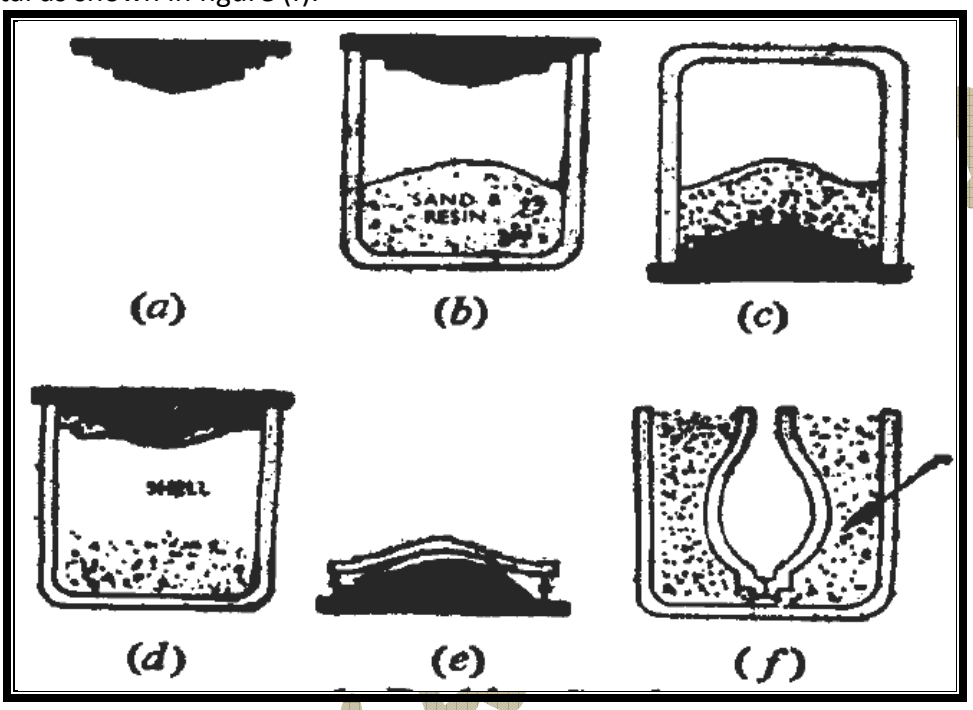
Ans.

Shell moulding :- Shell moulding is a method of metal casting, in which conventional rammed sand moulds are replaced by relatively thin, rigid shells of approximately uniform wall thickness. By the same technique, hollow cores can be made to replace the traditional solid rammed and baked cores normally used in green sand moulds.

The main steps in shell moulding are as follows:-

1. A metal pattern usually of cast iron having the same profile as that of the required casting is heated to 1500-2500C in an oven. It is taken from the oven and a stripping agent, usually silicon 5 to 10 % solution in paraffin or water, is sprayed on the pattern to facilitate the subsequent withdrawal of the shell from the pattern.
2. As shown in figure,(b),the pattern is clamped to the dump box which is mounted on trunions. In the box, the dry sand resin mixture is the shell forming medium.
3. The dump box is inverted, as shown in figure (c), so that the dry sand mixture falls on to the hot pattern face. The hot pattern face causes the resin to soften and flow. After about 30 seconds, the resin component of the sandresin mixture softens and fuses to form a fairly uniform shell about 60 cm thick on the pattern face.
4. The dump box is returned to its original position as shown in figure (d), and excess of sand-resin mixture falls back to the bottom of the box leaving a shell adhering to the hot pattern surface. The partly cured shell is then placed in an oven for final curing. This is carried out at about 4000C and may take about two minutes.

5. When curing is complete, the shell becomes rigid and is stripped from the pattern by spring loaded ejector pins, which pan through the pattern plate as shown in figure (e).
6. Two such shells are fixed together to form the complete mould, with the help of bolts, clips or glue and placed in a suitable box with proper backing and to receive the molten metal as shown in figure (f).



Sand for shell moulding.

Usually zircon sand of rounded grain shape, free from organic impurities and having a grain size of 100 to 150 mesh (B.S.) is used. Coarser sands increase shell strength but lower surface finish. Finer sands improve the surface finish but weaken the shell. Although zircon sand is costlier than silica sand, it gives, a stronger shell for a given percentage of resin binder and a good surface finish.

Binder for shell moulding:

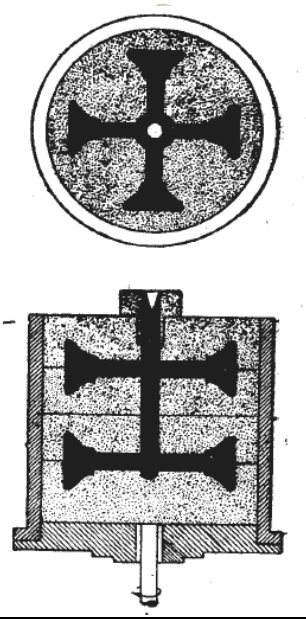
The binders used are resins of thermosetting type and the most common resin are phenol formaldehyde, urea formaldehyde, and polyesters. The resins are used in the powdered form and when subjected to about 2000 to 2500C, they melt instantly and turn into a rubbery state and harden after one or two minutes. The usual amount of resins in the sand moisture varies from 3 to 10 per cent.

Q. What is centrifuguring ? Describe the process stating its differences with other centrifugal casting method?

Ans.

This is also sometimes known as pressure casting. It mainly differs from true centrifugal or semi-centrifugal casting methods in that unlike the latter two, the axis of rotation and that of the moulds do not coincide with each other, as the moulds are situated at a certain distance

from the central vertical axis or rotation all around the same. Shapes of castings do not carry any limitations in this method and a variety of shapes can be cast. A number of small mould cavities are made around a common central sprue and connected to the same through radial gates. For a higher rate of production the stacked moulds can be used with advantage. As in semi-centrifugal force used to force the molten metal from the central sprue into the mould cavities through the radial gates. Sectional view through a typical mould for centrifuging is shown in Fig.



Q. Explain hot chamber die casting machine?

Ans. The main parts of a hot chamber machine are shown Fig. This is operated by a hydraulic plunger. This plunger acts inside a cylinder formed at on end of the goose-neck type casting submerged in the molten metal. A port is provided near the top of the cylinder to allow the entry of the molten metal into it. When the bottom of the plunger is above the port the cylinder is connected to the melting pot through this port. The down stroke of the plunger closes this port, cuts off the metal supply and applies pressure on the molten metal present in the goose neck to force the same into the die cavity through the injecting nozzle. After a certain period of time the plunger is raised up, causing the remaining molten metal in the nozzle and channel to fall back into the goose neck casting. Just before the end of its upward stroke the plunger uncovers the port, through which more molten metal enters into the cylinder. The dies are then opened and the casting ejected. Zinc based low melting point alloys are generally cast in these machines.

Q. State its advantages and disadvantages?

Ans.

Advantages

1. Surface finish a good
2. Dimensional accuracy is high
3. Thin sections upto 2 mm can be cast

4. Sand handling is minimum
5. Permeability of the shell is high
6. Surface chilling of the castings is absent and the castings are free from skin hardening
7. Less floor area is required
8. It is highly adaptable for mechanisation.
9. Cost of cleaning the casting is low
10. Casting defects are minimum
11. Shells can be stored
12. It allows for greater detail and less draft
13. Unskilled labour can be employed.

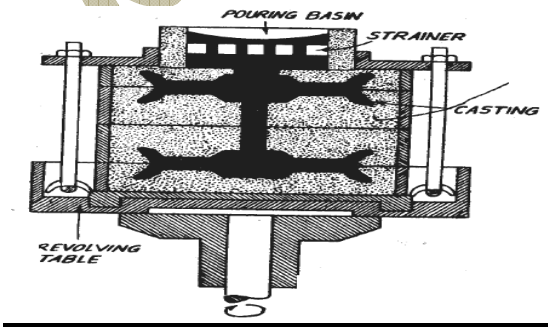
Disadvantages

1. Higher pattern cost
2. Higher resin cost
3. Not economical for small runs
4. Dust-extraction problem
5. Complex jobs cannot be shell moulded.

Shell moulding machines are of two types, (1) Semi automatic (2) Automatic.

Q. Illustrate and desirable the process of Semi- Centrifugal casting.

Ans. This process, which is also known as profiled centrifugal casting is widely used for relatively large castings which are symmetrical in shape, such as discs, pulleys, wheels and gears etc. In this method the mould is rotated about vertical axis and the metal poured through a central sprue. It is not necessary to cast only one mould at a time. Several moulds can be stacked together, one over the other, and fed simultaneously through a common central sprue, as shown in Fig. This provision increases the rate of production considerably. The centrifugal force is used to feed the metal outwards to fill the mould cavities completely. The centre of the castings is usually solid, but, if required, a dry sand central core may be used to produce the central hole. The speed of rotation of these moulds is much lower than that in true centrifugal casting. With the result the pressure developed is too low and the impurities are not directed towards the centre as effectively as in true centrifugal casting. The speed of rotation of these moulds is such that a linear speed of about 180 meters per minute is obtained on the outer edge of the casting. The moulds used may be of green sand, dry sand, metal or any other suitable material.



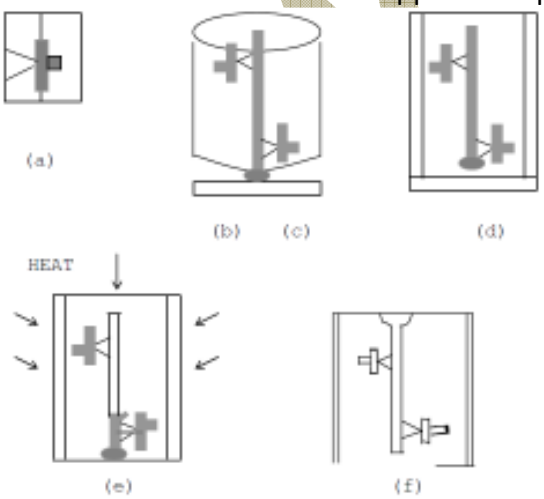
Q. Describe the complete procedure of investment casting. What are the main advantages and disadvantages?

Ans.

INVESTMENT CASTING :- It is also known as Lost was or Precision casting. The castings produced by this method are within very close tolerances and do not require subsequent machining.

The procedure adopted for investment casting is as follows.

1. First of all, a metal die for casting the wax pattern is made.
2. The wax patterns and gating systems are produced from the metal dies by injection. The wax is injected into the mould at 500C to 800C and at pressure of 35 kg/cm2 to kg/cm2.
3. The wax assembly is dipped into a slurry of a refractory coating material. A typical slurry consists of silica flour suspended in ethyl silicate solution of suitable viscosity to produce uniform casting after drying. After dipping, the assembly is coated by sprinkling it with silica and allowed to dry.
4. The coated wax assembly is now invested in the mould. This is done by inverting wax assembly on a table, surrounding it with a paper-linked steel flask and pouring the investment moulding mixture consisting of either sand 95%, water 27 to 31% and 5% alumina cement. The mould material settles by gravity and completing surrounds the pattern as the work table is vibratech the moulds are then allowed to dry in air for 2 to 3 hours.
5. The wax is melted out of the hardened mould by heating it in an invested position at 900C to 1800C. The melted wax may be collected and re-used.
6. The mould is again heated at the rate of 400C to 700C per hour from about 1500C to 10000C for ferrous alloys and 6500C for alluminium alloys. The temperature is controlled so that the mould is at a temperature desirable for pouring the particular alloy. The investment moulds may be poured under simple gravitational force or under the force of applied out pressure or by centrifugal force.



Following are the advantages and disadvantages investment casting.

Advantages :

1. The close tolerances (±0.05 mm) are easily maintained in average work.
2. It produces extremely smooth surfaces.
3. It eliminates post machining operations including thread cutting and gear tooth ferming.
4. It is adaptable to all metallic alloys.

Disadvantages:

1. The investment moulds as well as the materials from which they are made an single purpose, therefore they can not be reused. This increases cost of production.
2. The larger objects are impractical for investment casting due to equipment size limits.

Steps involved in making investment casting.

(a) Wax injected into die to make pattern.
(b) Pattern have been gated to central sprue.
(c) Placing a metal flask around the pattern assembly.
(d) Investing the wax pattern assembly.
(e) Removing wax pattern from investment mould.
(f) Pouring molten metal into the mold.
(g) Removing casting from the mold by breaking the mold material.

Q. What do you understand from 'Centrifugal castings'? How are the centrifugal casting methods classified?

Ans. The process of centrifugal casting is also known as liquid forging. It consists of rotating the mould at a high speed as the molten metal is poured into it. Due to the centrifugal force the molten metal is directed outwards from the centre, towards the inside surface of the mould, with considerable pressure. As a result of this a uniform thickness of metal is deposited all along the inside surface of the mould, where it solidifies, and the impurities being lighter remain nearer to the axis of rotation. This process enables the production of castings with greater accuracy and better physical properties as compared to sand castings. It also enables the production of distinct surface details and dense metal structure. Although many different shapes can be cast through this process, but those with symmetrical shapes are best suited for it. The better physical properties of the castings are the result proper directional solidification of the metal inside the mould. It is achieved because the denser(or cold)metal is automatically forced towards the outer side of the casting by the centrifugal force, whereas the hotter metal remains on the inner side of the casting to provide the required feeding of metal during solidification.

The centrifugal casting methods can be classified as follows:

1. *True centrifugal casting.*
2. *Semi-centrifugal casting.*
3. *Centrifuging.*

Q. What are the materials commonly used for making the moulds for centrifugal casting?

Ans. The moulds used in centrifugal casting methods are made of sand, metal or graphite. Sand moulds are generally preferred for slender castings where the metal has to flow a long distance. The use of these moulds minimizes chilling effect. For quantity production metal moulds are preferred. Metal moulds are made from cast iron, high carbon steel or alloy steel. Graphite moulds are largely used for non-ferrous castings.

Q. What is hot working ? State its principles, advantages and disadvantages.

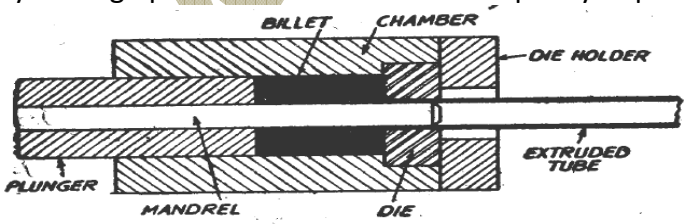
Ans. Mechanical working of metals above its recrystallisation temperature is known as *hot working*.

Advantages :

1. Larger deformation can be accomplished and more rapidly by hot working since the metal is in plastic state.
2. Porosity of the metal is considerably minimised.
3. Concentrated impurities, if any in the metal are disintegrated and distributed throughout the metal.
4. Grain structure of the metal is refined and physical properties improved.

Disadvantages :

1. Due to high temperature a rapid oxidation or scale formation takes place on the metal surface, leading to poor surface finish and loss of metal.
2. On account of the lost of carbon from the surface of the steel piece being worked the surface layer loses its strength, which is a disadvantage when the part is put to service.
3. This weakening of the surface layer may give rise to a latigue crack which may ultimately result in fatigue failure of the part.
4. Close tolerances cannot be maintained.
5. It involves excessive expenditure on account of high cost of tooling. This, however, is compensated by the high production rate and better quality of products.



Q.What are the specific advantages and limitations of cold working?

Ans.

Advantages and limitations:

1. 1.Better dimensional control than hot working is possible because the reduction in size is not much.
2. 2.Surface finish of the component is better because no oxidation takes place during the process.
3. 3.Strength and hardness of the metal are increased.
4. 4.It is an ideal method for increasing hardness of those metals which do not respond to the heat treatment.
5. 5.Only ductile metals can be shaped through cold working.

6. 6.Over-working of metal results in brittleness and it has to be annealed to remove the same.
7. Subsequent heat treatment is mostly needed to remove the residual stresses set up during cold working.

Q. What are the main characteristics of the hot working of metals or compared with cold working process?

Ans.

1. Above the re-crystallisation temperature, the metal becomes plastic and causes the growth of grains. By hot working, the grains are broken up and their parts are deformed into small and more numerous crystals or in other words the refinement of grain occurs. Metals possess little elasticity and low load is required to shape the metal as the strength and hardness decrease at elevated temperatures.
2. The porosity of the steel ingot can be eliminated to a greater extent.
3. Great latitude in shape and size of form is possible due to reduction of elastic limit.
4. A uniformity is established either by squeezing other impurities into fiber slags or distributing them throughout the mass.
5. Directional property resulting from a fiber structure is obtained.
6. Due to refinement of grains, mechanical properties such as toughness, ductility, elongation and reduction in area are improved.
7. The power required to finish the part ingot is less.
8. It can be used on most of the metals, because it is a rapid and economical process.

Q. Why forging generally preferred for those components which require high strength and resistance to shock? Explain briefly.

Ans.

Characteristics of the Forged Parts

1. It refines the structure of metal by closing up the cavities and by smashing up large grain formations.
2. Forged parts have directional properties and hence have good strength.
3. Mechanical properties such as percentage elongation, percentage reduction of area and resistance to shock and vibration are improved.
4. Cracks and blow holes are minimized

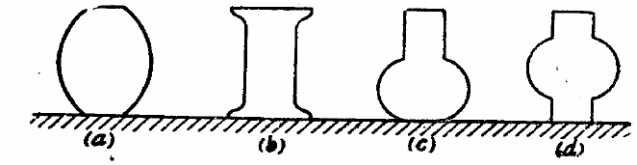
Q. Define up setting, piecing and punching operations as applied to not working of metals.

Ans.

Upsetting :- This is just opposite to drawing and involves increasing of the cross-sectional area usually by pressing or hammering in a direction parallel to the original ingot axis. In the process of upsetting, the shaft or rod is generally gripped in dies, and the head or flange upset either by a plain flattened ram or with further dies, shaped to give the desired contour.

Piercing :- This process is employed for the production of seamless tubes. It offers the most economical mechanical working, process for the manufacture of seamless tubes. It consists of

passing the hot rolled billet at 11000C. between two conical rollers and over a mandrel which helps in piercing and controlling the size of bore as the billet is forced over it.



(*a*) Shows the effect of heavy hammer blows.
(*b*) Shows the effect of light hammer blows.
(*c*) Local up-sets.
(*d*) Upsetting by heating the middle porlion of billet.
Up-set forging operations.

Q.Define the following terms related to cold working of metals.

Ans.

a. ***Blanking :-*** This is the operation carried out on presses and consists of cutting the outside contour of a stamping. Production of sheet-metal blanks of flat shapes requires a single-action press equipped with tools comprising a punch, a corresponding die, a stripper to keep the sheet from following the punch on its upstroke and means for aligning the sheet or strip of material and for spacing successive cuts. Cutting inside contours, i.e. holes and slots is called piercing. All these operations will be dealt in detail under the chapter of presses. However pressed-metal parts, or stampings are recommended for mass production. Stampings combine the virtues of lightness, a high degree of uniformity, and surfaces well adopted to receive protective and decorative finishes.

b. ***Swaging :-*** This operation consists of applying compressive or impact forces on the metal below the recrystallisation temperature. It causes the metal to flow in the predetermined shape according to the design of the dies. Rotary swaging and cold heading are the two important processes of swaging.