SPECIAL CASTING PROCESS

Sand Moulds may be used for casting ferrous and non-ferrous materials but these moulds can be used once, because the mould is destroyed after the metal has solidified. This will increase the cost of production. In order to meet these requirements, following casting methods may be used:-

1) Permanent Mould casting
2) Die casting
   a) Hot chamber die casting
   b) Cold chamber die casting.
3) Centrifugal Casting
   a) True Centrifugal casting
   b) Semi Centrifugal casting
   c) Centrifuging
4) Investment casting.

PERMANENT MOULD CASTING :-

A casting made by pouring molten metal into a mould made of some metallic alloy or material of permanence is known as permanent mould casting. It is also known as Gravity die casting. Since permanent mould castings are costly, therefore it is recommended for mass production. The moulds are not destroyed after removing the casting and may be reused many times.

The iron and steel moulds are suitable for non-ferrous castings. the steel moulds coated with refractory material, such as graphite, are succesfully used for production of iron castings.

Advantages :-

Permanent mould casting have some distinct advantages over sand mould casting. these advantages are :-

i) closer dimensional tolerances.
ii) Better surface Finish.
iii) Greater Mechanical strength
iv) Lower percentage of Rejection.
v) More economical prod^n in lager quantities.

Disadvantages :-

(i) Lack of permeabilities.
(ii) High Costs of Mould.
(iii) Difficulty in removing the casting from the mould since mould cannot be broken up.

Limitations :-

Permanent metal moulds can be advantageously used for small and medium sized non ferrous castings, but are impractical for large castings and metal and alloys of very high melting temperature.

Applications :-

(i) Carburettor bodies.
(ii) Refrigeration castings
(iii) Hydraulic Brake Cylinders.
(iv) washing m/c gears and gear covers.
(v) oil pump bodies.
(vi) Aircraft and missile castings
(vii) Type writer segments.

DIE CASTING

Die casting is defined as the process which uses the permanent mould (called die) and the molten metal is introduced inside the die by means of Pressure. The casting produced by die casting method require very little machining. The dies are usually made in two parts which must be locked securely before molten metal is forced into them under high pressure of 7 to 700 MPa. The pressure may be obtained by the application of compressed air or by hydraulic operated pistons. Externally applied high pressure accurated with high velocity with which the liquid metal is injected into the die and these conditions give a unique capacity for the prod^{n} of intricate components at relatively low cost.

The casting thus produced has excellent dimensional accuracy, surface finish and does not require any finishing operation, except for the removal of surplus metal. This process is widely used for small sized objects of non-ferrous metals such as brass, copper, and Aluminium etc for rapid production.

Advantages :-

* very high rate of prod^{n} is achieved.
* Surface finish of 0.8 microns can be obtained.
* Longer die life is obtained.
* less floor space is required
* Unit cost is minimum.

into the gooze neck to force the molten metal into the die.

In the second method, the plunger acts inside a cylinder formed at the end of the gooze neck, which is immersed in a pot of molten metal. A port is provided near the top of the cylinder to allow the entry of the molten metal. The downward stroke of the plunger pushes the molten metal through the gooze neck into the die.

Advantages :-

It is a simple machine as regards its construction and operation.

(ii) Machine exerts pressure on molten metal more effectively.

Disadvantages :-

(i) Ferrous alloys are not die-cast because of their high pouring temperature.

(ii) The maximum size of the casting to be made is restricted.

(iii) Machine and dies have high costs hence the process proves uneconomical for small scale prodn.

Applications :-

Produces castings of low melting point metals such as zinc, tin and lead.

(ii) Also used to produce some magnesium castings.

→

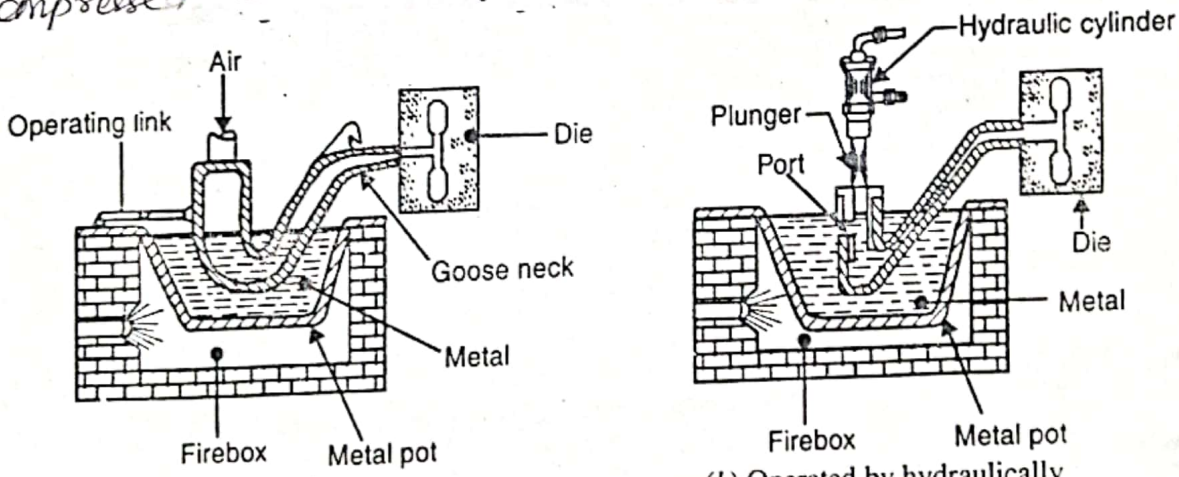
Disadvantages:-

* Only economical for non-ferrous alloys.
* Cost of die and die-casting Equipment is high.
* It is not economical for small runs.
* Die casting usually contain some porosity due to entrapped air.

Two types of die casting machines commonly used for die-casting:-

1. Hot chamber die casting machine:-

In hot chamber die casting machine, the molten metal is forced in the die-cavity at pressure from 7 to 14 MPa. The pressure may be obtained by the application of Compressed air or by hydraulic plunger.



(a) Operated by direct air pressure.

(b) Operated by hydraulically operated plunger.

Fig. 13.1. Hot chamber die casting machine.

In the first method, the goose neck is lowered into the molten metal for filling it, it is then raised and connected to the die neck. A suitable mechanism is provided to raise and lower the goose neck. The Compressed air at a pressure of about 2.5 to 5 MPa is now injected

Cold chamber die casting Machine :-

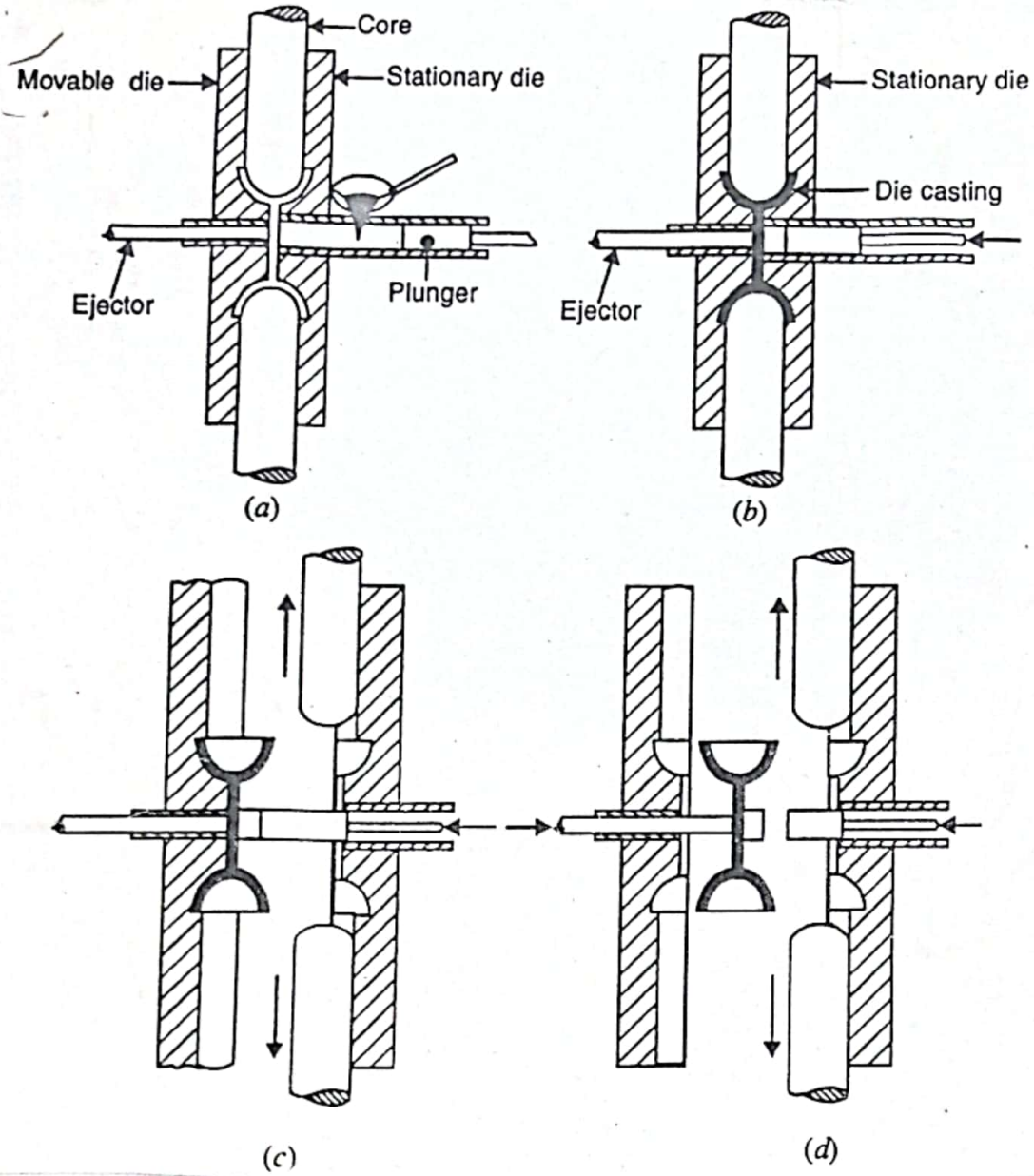
In cold chamber die casting machine, the melting unit is not an integral part of die casting machine. Molten metal is brought and poured into the die machine with the help of ladle. Molten metal which is poured into the cold chamber die casting machine is at a lower temperature as compared to that poured into hot chamber machine.

For this reason, a cold chamber die casting process has to make use of pressure much higher than those in hot chamber process.

High pressure tends to increase the fluidity of molten metal pouring relatively lower temperature which produces castings of dense structure, sustained dimensional accuracy and free from blow holes. Dies to be made stronger in order to bear high pressure.

The cold chamber die casting machine consists of a pressure chamber of cylindrical shape fitted with a piston or ram that is usually operated by hydraulic pressure. A measured quantity of molten metal is brought in a ladle from the melting pot to a chamber and forced into the closed die-sections by applying hydraulic pressure upon the piston. The complete cycle is completed in the following four steps:-

1. Metal is loaded in the chamber.
2. The plunger forces the metal into the die-cavity shown in fig. (b)
3. After the metal solidifies, the die is opened shown in fig (c)
4. The casting together with slag of the excess metal, is ejected from the die (in fig (d)).



Advantages :- The rapid and economical production of large quantities of identical parts can be achieved.

(ii) The parts having smooth surface and close dimensional tolerances may be produced, very little machining is required.

(iii) seperation of melting unit from the working parts of die casting machine increase its life and Efficiency.

Disadvantages :- since very high pressure are involved in cold chamber die casting, die will have to be made stronger.

(ii) Uneconomical because cost of Equipment and die is high.

(iii) It require special skill in maintenance.

Applications :- Cold chamber die casting m/c are used for making castings of Aluminium, Magnesium, Brass, Copper & its alloys.

INVESTMENT CASTING PROCESS

Investment casting process also known as lost wax Process or precision casting. Investment casting is suitable for casting a wide range of shapes and contours in small-size parts, especially those that are made of hard to machine materials. This process produces excellent surface finish for the casting. In this process, the mould is made in a single piece, and consequently, there is no parting line. This adds to the dimensional accuracy of the casting. Hence the casting produced by this method are within very close tolerances and do not require subsequent machining. Though the process is Elaborate and expensive, it has been found very suitable for casting turbine and jet engine parts made of high temperature and high strength alloy.

— In this process, Pattern is used to make a die out of soft material. eg. Aluminium. Therefore wax or plastic is injected into the die to form an expendable pattern. The Expendable pattern is rinsed in alcohol to remove grease and dirt. After drying, the Pattern is dipped in a slurry composed of silica flour, water and some bonding agent. Then, the pattern is taken out of the slurry and rotated to produce a uniform coating, to

fill inside corners and to drain out the excess slurry. Finally, fine grain silica sand is sprinkled onto the wet slurry surface. The coating thus produced on the Expendable pattern after drying is called a precoat.

- The coated wax assembly is now invested in the mould. This is done by inverting the wax assembly on a table, and then surrounding it with a paper-lined steel flask and pouring the investment moulding mixture consisting of either sand 95%, water 27 to 31% and 5% alumina cement with 3% or more Ethyl silicate around the pattern. The mould material settles by gravity and completely surrounds the pattern as the work table is vibrated. This moulds are then allowed to dry in air for 2 to 3 hours.

- The wax is melted out of the hardened mould by heating it in an inverted position at 90°C to 150°C. The melted wax may be collected and re-used.

- The mould is again heated at the rate of 40°C to 70°C per hour from about 150°C to 1000°C for ferrous alloys and 650°C for aluminium alloys, the temperature is controlled so that the mould is at a temperature desirable for pouring the particular alloy.

The mould is clamed to a special type of furnace which is then inverted for pouring molten metal directly from the furnace into the mould. After cooling the vessel is removed and the hard refractory investment is knocked off by a hammer or other vibratory means. Finally, the adhered investment material is removed from the casting surface by sand-blasting or a tumbling operation.

Advantages :—

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

Disadvantages :—

1) Investment moulds as well as the materials from which they are made are use for single purpose. They cannot be reused. This increases cost of production.
2) The larger objects are impractical for investment casting due to Equipment size limits.

Applications:-

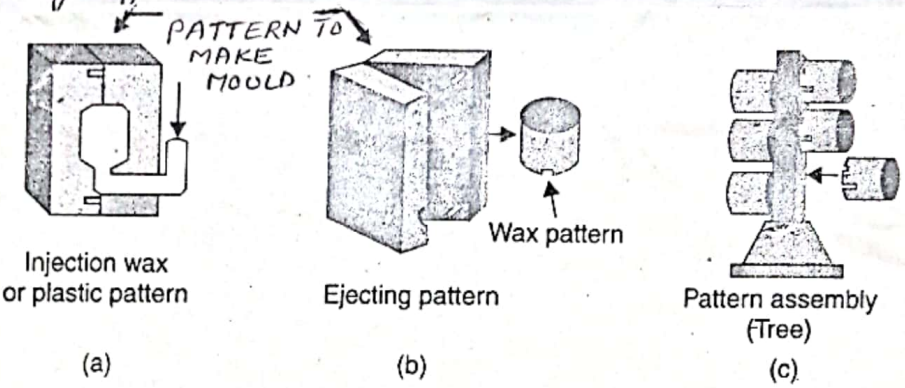
(i) To fabricate difficult-to-machine and difficult to work alloys into highly complex shapes such as hollow turbine blades.

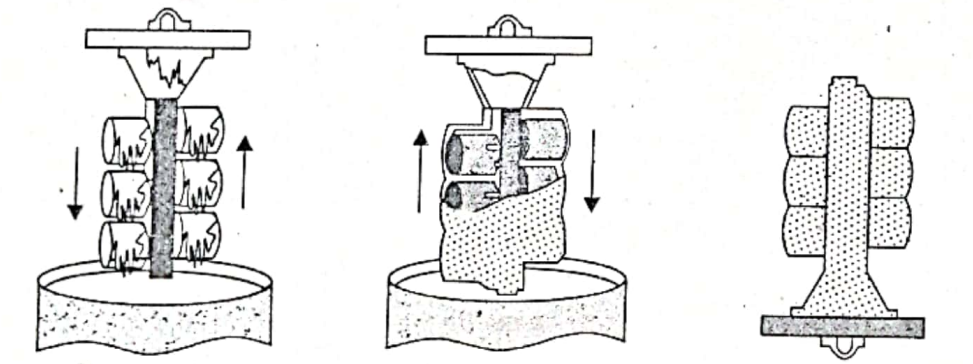
(ii) parts for sewing machines, locks, rifles and burner nozzles.

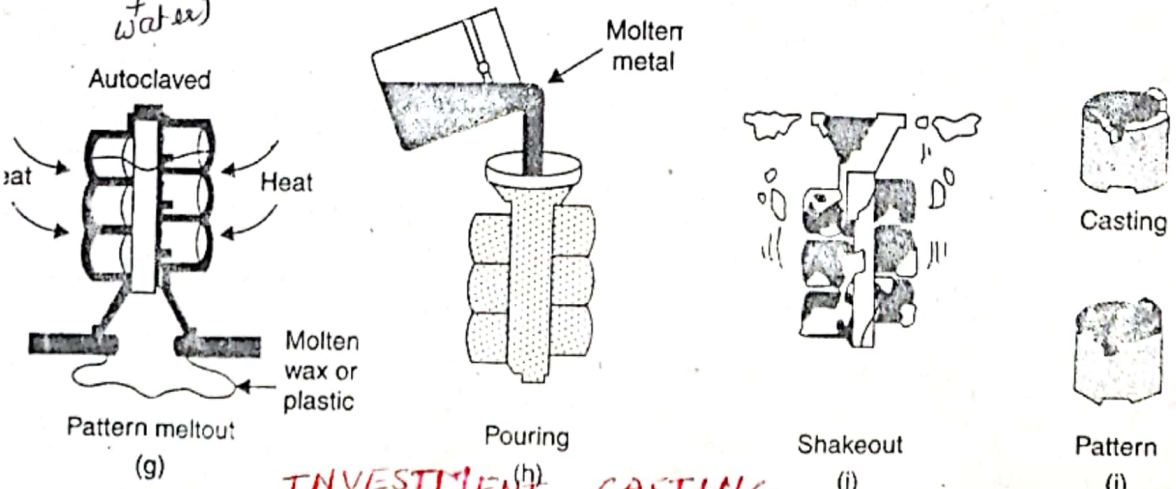
(iii) Jet aircraft engine (jet) outlet nozzles.

(iv) Milling cutters and other type of tools.

(v) Parts of gas turbine used in locomotive propulsion







INVESTMENT CASTING

CENTRIFUGAL CASTINGS

A casting process in which molten metal is poured and allowed to solidify while the mould is revolving, is called Centrifugal process. The castings produced under this centrifugal force are called centrifugal castings. The centrifugal castings can be classified into the following three types:-

① True centrifugal casting :-

In this process, the mould is made of metal and lined with refractory material or sand. The molten metal is poured by laddle into the cavity of rapidly rotating mould. The centrifugal force directs the fluid metal to the inner surface of the mould with considerable pressure where solidification occurs forming hollow castings. This process is especially employed for casting articles of symmetrical shape. eg cast iron pipes, sleeves, steel gun barrels and castings of cylindrical form.

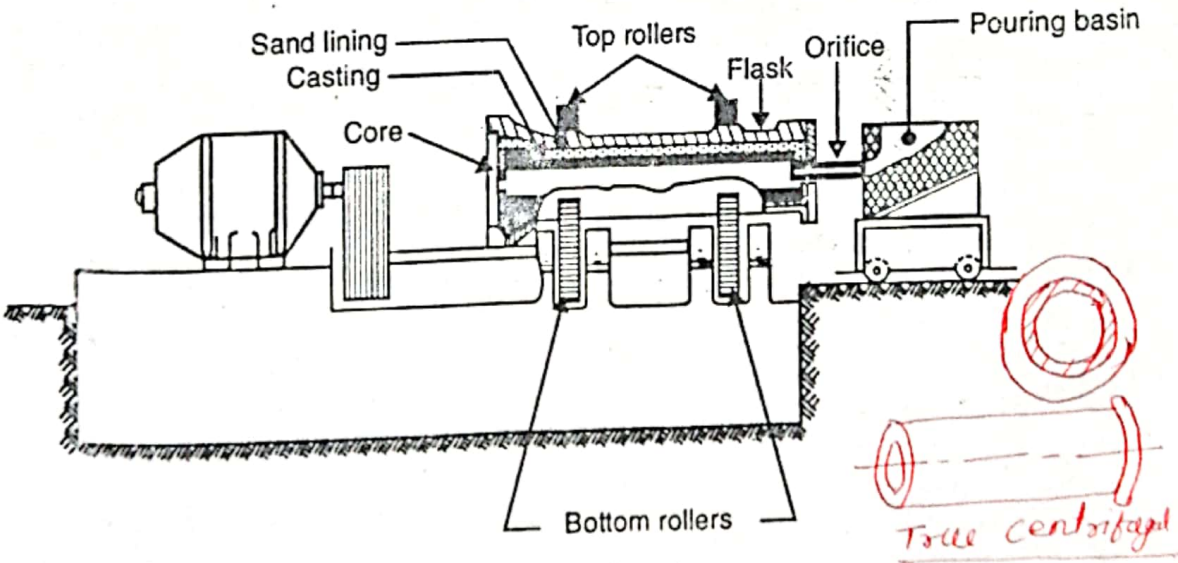


Fig. 13.3. Centrifugal casting.

Advantages :-

(i) It is quick and economical than other method.
(ii) It eliminates the use of risers, feed heads, cores etc.

(c) Ferrous and non ferrous metals can be casted by this process.

(d) The casting produced by this process have dense and fined grained structure with all impurities forced back to the centre where they can be frequently machined out.

(e) Good surface finish.

2. Semi Centrifugal Casting :-

In this process, the mould is rotated about its vertical axis in a properly balanced state. and the metal is poured into a central sprue from where it enters the hub. From the hub, it is forced outward to the rim by the centrifugal force. It may be noted, that several moulds can be casted at one time.

It is nearly similar to true centrifugal casting with the only difference that the central core is used to form the inner surface. the particular shape of the casting is produced by the mould and core shaped and not by centrifugal force. However centrifugal force aids in proper feeding of mould cavities.

Applications :- This process is employed for making large size castings which are symmetrical about their own axis such as pulleys, spoked or die wheels, gears, Propellers etc.

3. Centrifuging :- In this process, a number of small mould cavities are made symmetrically around a common central sprue. and the metal is fed to these cavities by radial gates. The mould cavities are filled under pressure from the centrifugal force of the metal as the mould is rotated.

In this case the mould cavities are not rotated about their own axis but they are rotated about the central sprue which act as the axis of rotation.

Application :- This method of casting, not limited to symmetrical objects, can produce castings of irregular shapes such as bearing caps or small brackets.

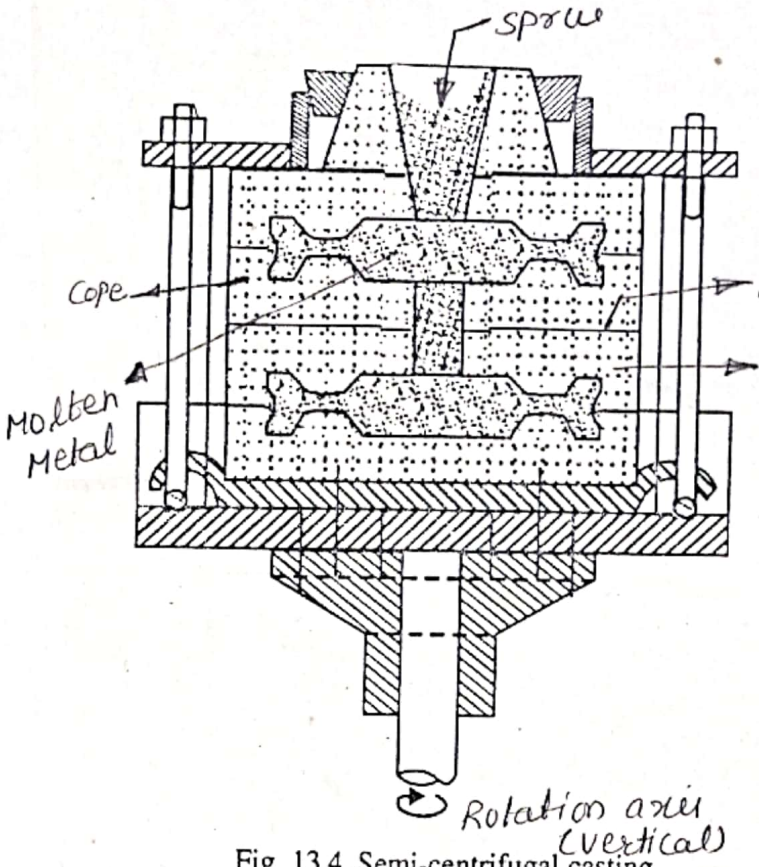


Fig. 13.4. Semi-centrifugal casting.

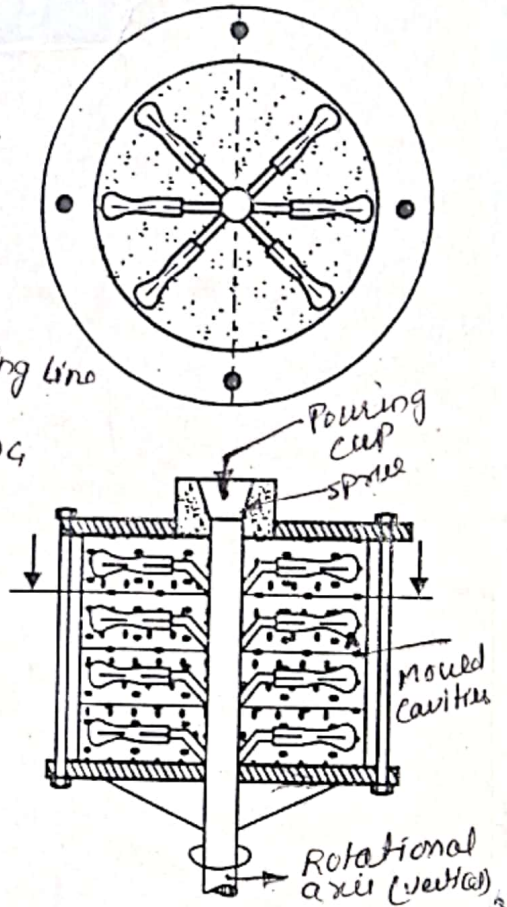
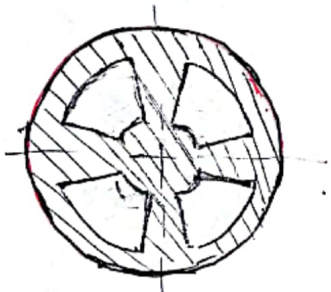
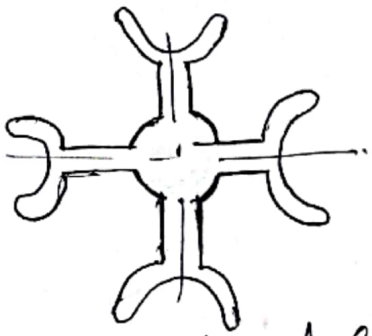


Fig. 13.5. Centrifuging.



Semi centrifugal casting



centrifugal casting