The Pattern

A pattern is a replica of the object to be cast, used to prepare the cavity into which molten material will be poured during the casting process.

Pattern used in sand casting may be made of wood, metal, plastics or other materials.

The different between pattern and casting:

- The main different between a pattern and the casting is their dimensions.
- A pattern is slightly larger in size as compared to the casting, because a pattern carries shrinkage allowance, is given a machining allowance to clean and finish the required surface and carries a draft allowance.
- A pattern may not have all holes and slots which a casting will have**.**
- A pattern may be in two or three pieces whereas a casting is in one piece.
- A pattern and the casting also differ as regards the material out of which they are made.

Sprue system in casting process;

in casting, a sprue is the passage through which a molten material is introduced into a mould, and the term also refers to the excess material which solidifies in the sprue passage. It is a large diameter channel through which the material enters the mould.

A sprue is tapered with its bigger end at the top to receive the liquid metal, the smallest end is connected to the runner.

The purpose of a sprue in a casting mould;

- Feed the casting at a rate consistent with the rate of solidification
- Act as a reservoir for molten metal.
- Feed molten metal from the pouring basin to the gate.
- Help feed the casting until all solidification takes place.

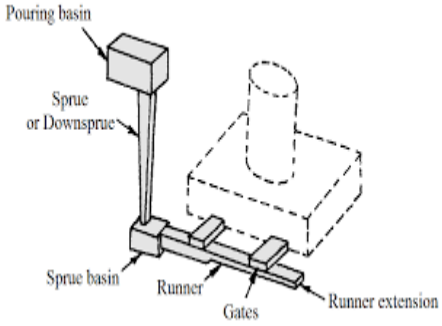
Types of sprue in casting :
There are three types of sprue (the sprue can be wax, plastic or metal):

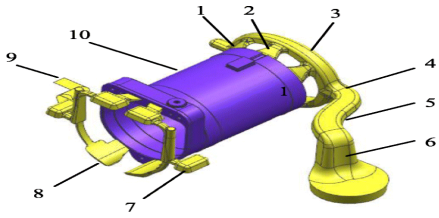
1.The primary sprue; as the liquid metal enters the sprue from the pouring basin and travels down, it accelerates under the influence of gravity. This acceleration has two effect(a. the metal has a high velocity, b. the metal pulls away from the wall of the sprue with consequent turbulence).

2.The down sprue: To reduce fluid instability compared with the first type by used down sprue, this type reduce the effect of flow molten metal on the wall of sprue with low velocity and good surface finish but it difficult get the required thermal gradient.

3.The side sprue; Be in the middle state between the first and second type, usually used for the small and complex parts.

The first one of sprue is not very desired for non-ferrous metal casting, which is foam during casting like the aluminium.





1- Inner gate 2- Fan shaped sprue 3– 3D sprue 4- Channel connection 5- Branch sprue 6- Down sprue 7- 2D slag ladle 8- 3D slag ladle 9- Exhaust passage 10 - Workpiece

Side-down sprue type(للاطلاع)

The Riser system

A riser also known as a feeder, is a reservoir built into a metal casting mould to prevent cavities due to shrinkage. Most metals are less dense as a liquid than as a solid so castings shrink upon cooling, which can leave a void at the last point to solidify.

Riser are only effective if three conditions are met:

- The riser cool after the casting.
- The riser has enough material to compensate for the casting shrinkage.
- The casting directionally solidifies toward the riser.

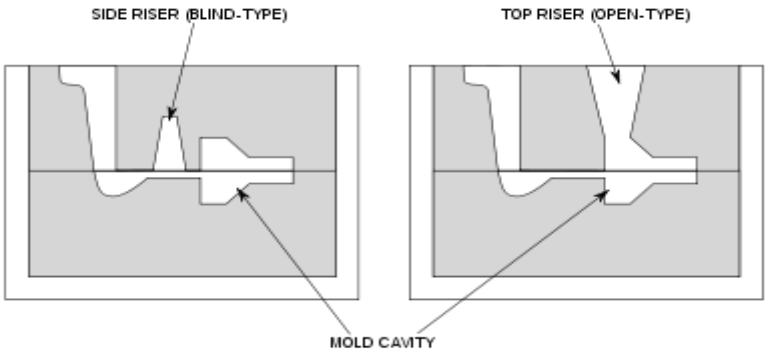
Types of riser:

Types of riser based on three criteria; where it is locate, whether it is open to the atmosphere, and how it is filled:-

1. **Open or top riser;** the surface of the riser will be open to the atmosphere. The open riser is usually placed on the top of the casting. gravity and atmosphere pressure causes the liquid metal in the riser to flow into the solidifying casting. open risers are advantageous because they take up less space in the flak than a side riser, plus they have a shorter feeding distance.

2. **blinder riser;** it is completely enclosed in the mould and not exposed to the atmosphere. The metals cools slower and stay longer promoting directional solidification. The liquid metal is fed to solidifying casting under the force of gravity alone.

Open riser is usually bigger than a blinder riser because the open riser loses more heat to mould through the top of the riser.



Types of riser

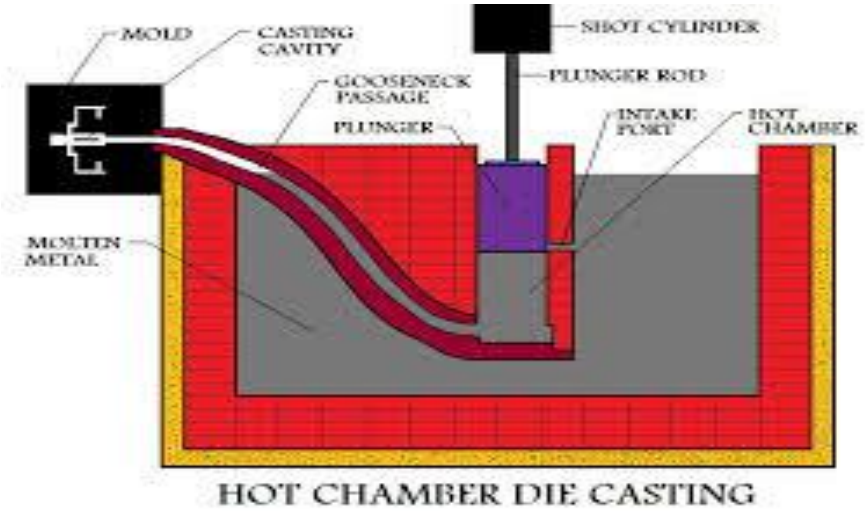
Die casting

pressure die casting;

pressure die casting is a quick, reliable and cost-effective manufacturing process for production of high volume, metal components that are net-shaped have tight tolerances. Basically, the pressure die casting process consists of injecting under high pressure a molten metal alloy into a steel mould(or tool).

The dies are usually made in two parts which must be locked securely before molten metal is forced into then under high pressures of 7 to 700 Mpa. The pressure may be obtained by the application of compressed air or by hydraulically operated piston. The ferrous alloys are not yet commercially die-casted because of their high pouring temperature.
There are two main types of die casting machines:

1.hot chamber machines; used for alloys with low melting temperatures, such as zinc, tin and lead. The temperature required to melt other alloys would damage the pump, which is in contact with the molten metal. The molten metal is forced in the die cavity at pressures from 7 to 14 Mpa. The pressure may be obtained by the application of compressed air or by a hydraulically operated plunger.



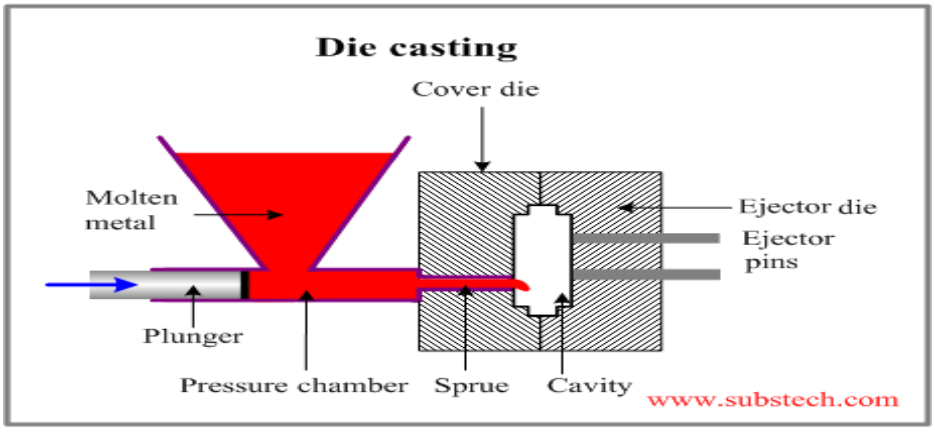
2.Cold chamber machines; used for alloys with high melting temperatures that cannot be cast in hot chamber machines because they would damage the pumping system., such alloys include aluminium, brass and magnesium. The process is completed in the following four steps:

1. The metal is loaded in the chamber.

2. The plunger forces the metal into the die cavity.

3. After the metal solidifies, the die is opened.

4. The casting, together with the slag of the excess metal is ejected- from the die.



Cold chamber of die casting

The process of die casting:
The process for die casting consist of five main stages;

1. Clamping: each die half is first cleaned from the previous injection and then lubricated to facilitate the injection of the next part. The two die halves are closed inside the die casting machine.
2. Injection: the molten metal injected into the die at high pressure.
3. Cooling: the molten metal that is injected into the die will begin to cool and solidify once it enters the die cavity. the die cannot be opened until the cooling time has elapsed and the casting is solidified.
4. Ejection: after the predetermined cooling time passed, the die halves can be opened and an ejection mechanism can push the casting out of the die cavity.
5. Trimming: the excess material along with any flash that has occurred, must be trimmed from the casting.

Applications;

Several automobile components are manufactured using die casting including pistons, cylinder heads and engine blocks. Other die cast parts include pumps and valves.

Advantage of die casting:

- Economical for large production qualities.
- Good accuracy and surface finish.
- Thin sections possible.
- Rapid cooling (due to metal die) means good strength in casting.
- The die used more than once and life for longer periods.

Disadvantage of die casting:

- Generally limited to metals with low metal points.
- Part geometry must allow removal from die.
- High mould costs.
- It required special skill in maintenance.

Centrifugal casting

Centrifugal casting or Roto casting: is a casting technique that is typically used to cast thin-walled cylinders. It is typically used to cast materials such as iron, steel, stainless steel, concrete and alloys of aluminium, copper and nickel.

In centrifugal casting process, the molten metal poured at the centre of a rotating mould or die. Because of the centrifugal force, the lighter impurities are crowded

towards the centre of the mould. For producing a hollow part, the axis of rotation is placed at the centre of the desired casting. No cores are therefore required in casting of hollow parts although solid parts can also be cast by this process.

Applications:

Typical parts made by this process are pipes, flywheel, cylinder lines and other parts that are axi-symmetric.

Types of centrifugal casting:
There are three types of centrifugal casting are;

1.**true centrifugal casting:** this casting technique is employed when axis symmetrical objects with uniform diameter are to be produced. Core is not employed in these casting and these casting prepared in horizontal machine. This technique is best for the mass production of symmetrical objective. Applications of casting are bearings for machines, pipes and liners IC engine .

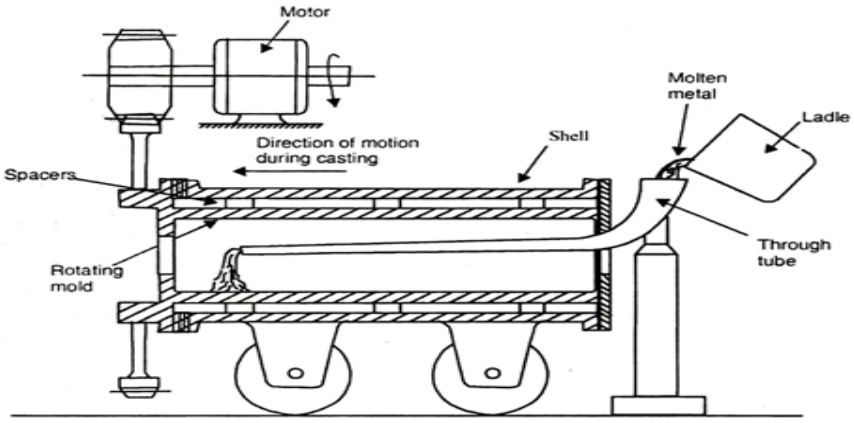


Fig. 4.15. A true centrifugal casting machine.

True centrifugal casting process(للاطلاع)

2.semi- centrifugal casting: These casting consist of a central core. It is used to cast gear blanks, sheaves and wheel etc. these casting are normally prepared in vertical machine.

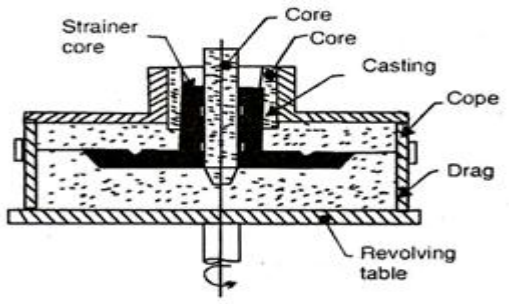


Fig. 4.16. Semi-centrifugal Casting.

Semi centrifugal casting process(للاطلاع)

3.centrifugal casting: this type of casting method is used for casting unsymmetrical casting castings in groups. Feeding to the mould cavities is done by central sprue by the action of centrifugal forces. This casting has better quality. This is used for produced the smallest parts.

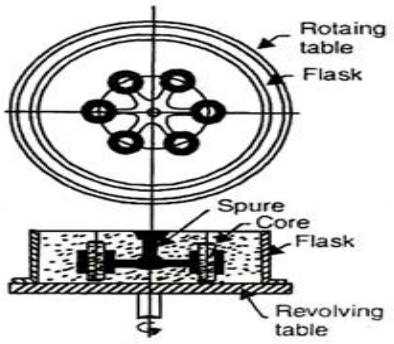


Fig. 4.17. Centrifuging casting.

Centrifugal casting process(للاطلاع)

Advantages of centrifugal casting

- Can form very large parts.
- Good mechanical properties.
- Good surface finish and accuracy.
- Low equipment cost.
- Low labor cost.
- Little scrap generated.

Disadvantage of centrifugal casting

- Limited to cylindrical parts.
- Secondary machining is often required for inner diameter.
- Long lead time possible.