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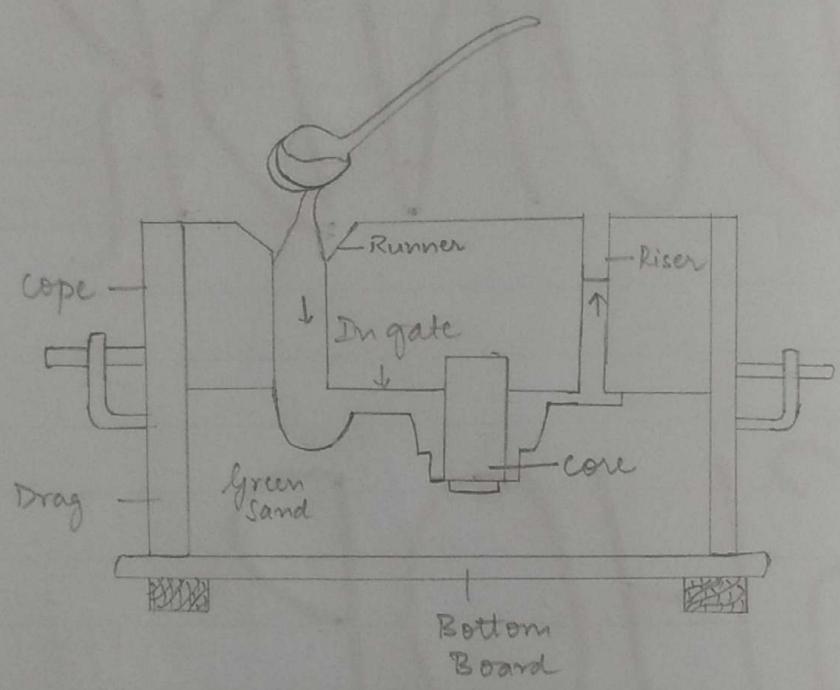
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FOUNDRY

SHOP

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SAND CASTING

Introduction...

Production of components using casting has been used since earliest days of civilisation. A lot of shapes can be prepared by casting process. To make casting of a desired component, a cavity of desired shape is produced and molten metal is poured into it. Such a cavity is called a mould. The process of moulding consists of all operations done to make a mould.

→ Pattern

It is a model used to get the required casting. It is used to produce mould cavity in sand.

→ Foundry

The place where moulding and casting are done.

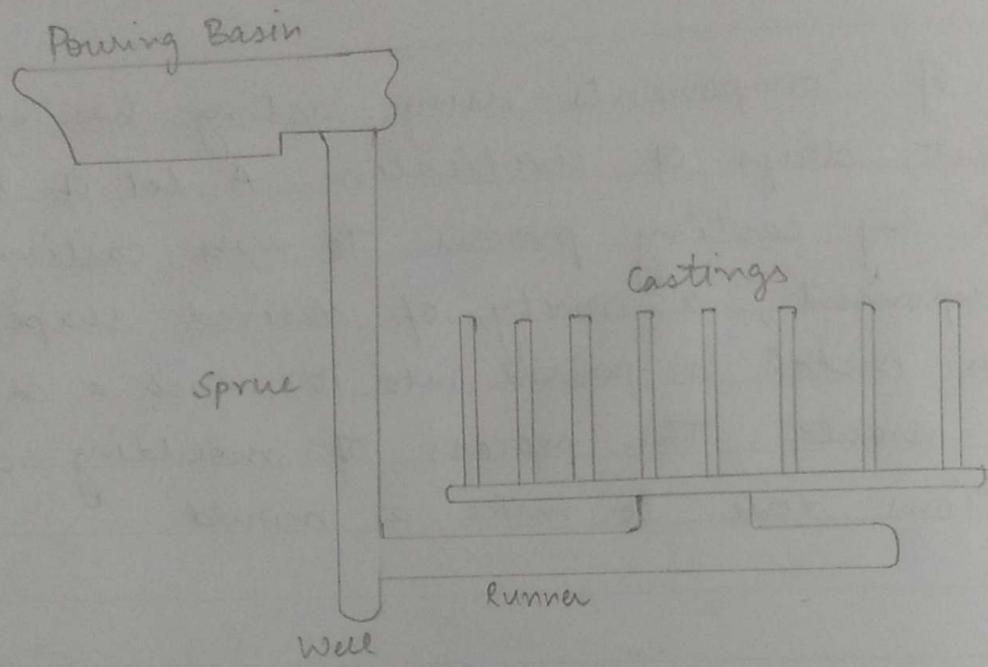
→ Moulding Sand or Green Sand.

It is a mixture of sand and additives like sodium silicate used to create mould cavity.

→ Components required for moulding

- Moulding Sand (Green Sand)
- Moulding Boxes
- Pattern
- Moulding Tools

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Gating System

Study of Moulding Sand

COMPOSITION:

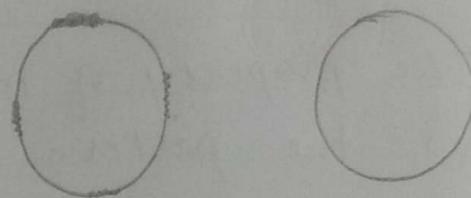
It is a special type of sand used for making moulds. It has 3 components:

- **Sand:** It has silica, clay and moisture. Silica is the main constituent. It has 80-90% silicon dioxide. Si gives refractoriness to the soil. Clay is another constituent which provides more binding strength to the sand. Generally sand has 5-20% clay. Moisture is the water added to the sand. It gives the bonding action. In general, 2-8% water is added to the soil.
- **Binders:** Binder is added to moulding sand to add the property of cohesiveness. The binder binds the sand grains together and brings strength. There are 3 types of binders:
 - (i) Clay Type Binders (Ex: Bentonite)
 - (ii) Organic Binders (Ex: Resin)
 - (iii) Inorganic Binders (Ex: Sodium silicate)
- **Additive:** By adding an additive, prop. like strength, refractoriness and permeability can be increased. Ex: sea coal, saw dust, cow dung, silica flour.

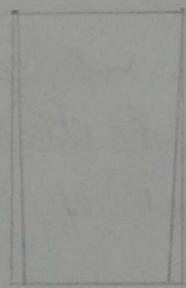
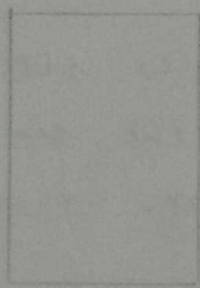
PROPERTIES OF MOULDING SAND

- **Porosity and Permeability:** It is the property of moulding sand by which sand allows the steam and gases to pass through it. When molten metal is poured into the mould, gases are released. If gases are not removed, casting defects like blow holes will occur.
- **Plasticity:** The property of moulding sand by which sand acquires the pattern shape & maintains it.
- **Adhesiveness:** Property by which sand particles stick to another body. The moulding sand sticks to the side of moulding boxes & does not fall out of the box.
- **Cohesiveness:** Property by which sand particles stick to each other. It is called strength of sand. Because of this, mould remains strong & does not break when molten metal is poured.
- **Refractoriness:** This property allows moulding sand to withstand high temperature of molten metal & it doesn't melt.

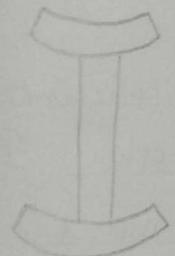
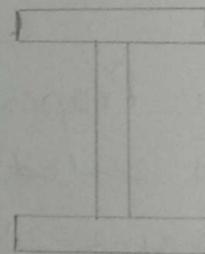
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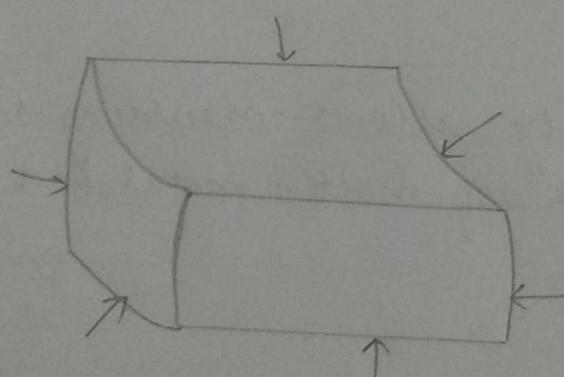
Machining Allowance



Draft Allowance



Distortion
Allowance



Shrinkage Allowance

PATTERN ALLOWANCES

Study Of Patterns

A pattern is a replica of desired casting, used to produce a mould cavity into which liquid metal is poured. When pattern packed in a suitable material produces cavity, called a mould. This cavity when filled with molten metal produced desired casting.

→ PATTERN MATERIAL

The selection of pattern material depends upon:

- (i) Type of production of casting & type of moulding processes.
- (ii) Flexibility in changing pattern designs.
- (iii) Number of castings
- (iv) Material should be easily worked, shaped & joined.
- (v) Pattern shd be strong, hard & durable.

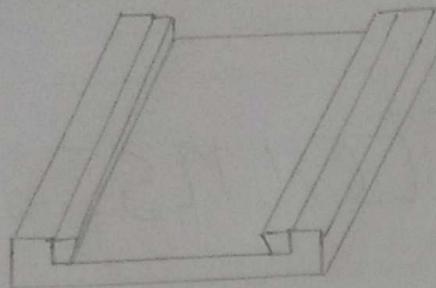
Widely used pattern materials:

- (i) wood & wood products
- (ii) Metal & Alloys
- (iii) Plastics & Rubbers.

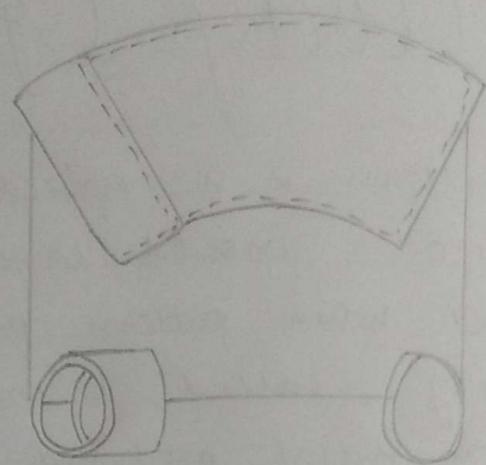
→ PATTERN ALLOWANCES

- (i) Shrinkage allowance
- (ii) Machining & finishing allowance
- (iii) Draft & taper allowance
- (iv) Distortion allowance
- (v) Shake or rapping allowance.

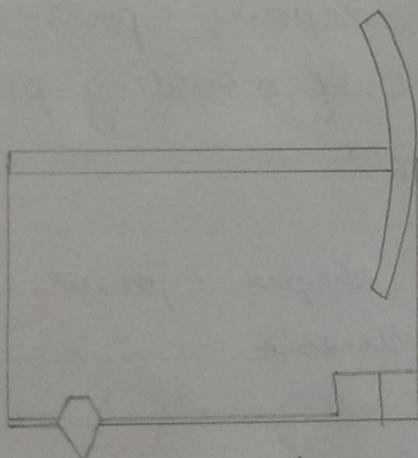
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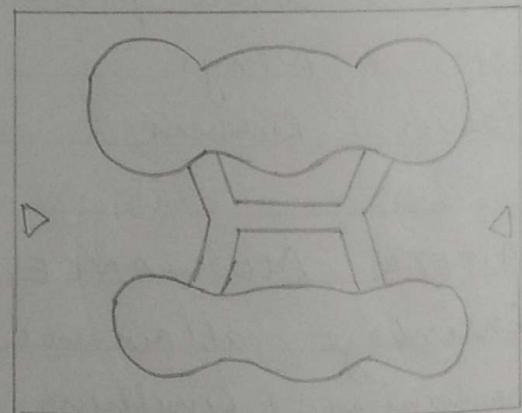
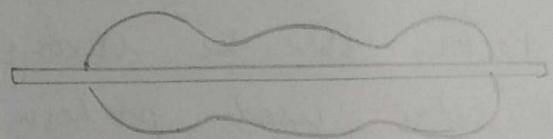
Single piece pattern



Shell Pattern



Segmental Pattern



Match Plate Pattern

PATTERN TYPES

→ PATTERN TYPES

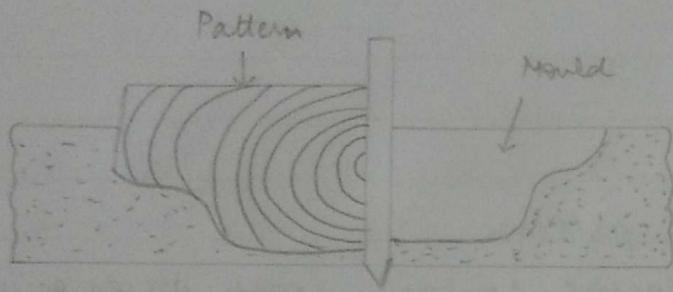
- One piece (solid) pattern
- It is the simplest type of pattern
- Made from one piece & doesn't contain loose pieces or joints.
- Inexpensive
- Used to make simple large sized casting.
- Usually made of wood or metal depending upon quantity.
- Stuffing box of steam engine may be cast with help of this.

- Split Pattern
- Pattern of intricate casting can not be made in one piece, so it is made split in two pieces.
- Upper & lower parts of the pattern are accommodated in cope and drag portions of the mould respectively.
- Dowel pins are used to keep alignment b/w 2 parts
- Taps & water stop-cork are produced with help of split pattern.

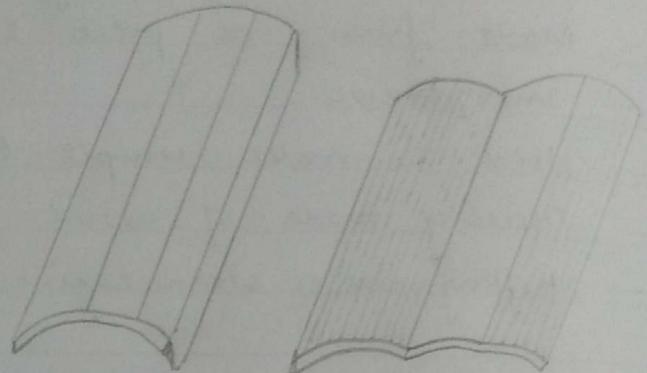
- Loose piece Pattern
- Certain patterns can't be withdrawn once they are embedded in moulding sand, such patterns are made with one or more loose pieces for facilitating their removal from the moulding box.

- Match Plate Pattern
- When split pattern are mounted with one $\frac{1}{2}$ on one side & other $\frac{1}{2}$ on other half directly opposite, such pattern is called match plate pattern.

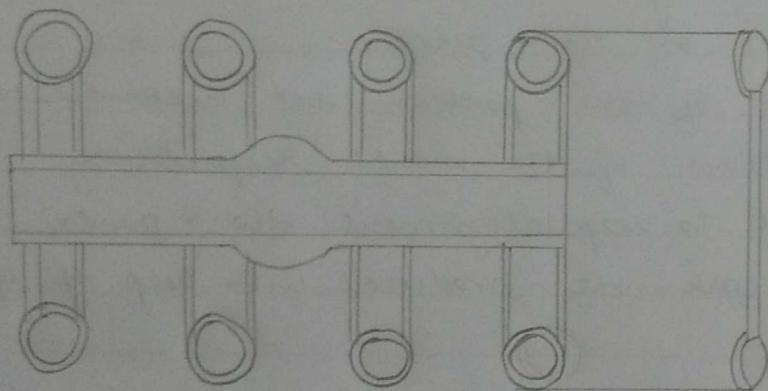
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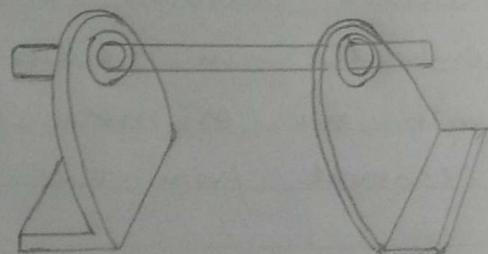
Sweep Pattern



Lagged Up Pattern



Gated Pattern



Left Right Hand Pattern

PATTERN TYPES

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- The match plate can be clamped with the drag using locator holes.
- The match plate has gates & runner attached to it
- After the cope & drag is removed, match plate pattern is removed.
- Cope & drag are then assembled & the mould is completed.
- Piston rings are produced with this pattern's help.

→ CORE

- It is a sand mass used to create cavity or holes in casting. The shape of core is similar to the type of hole required in the casting. Core is made by core sand in core boxes.

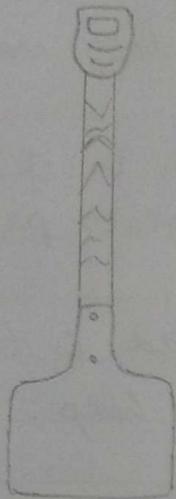
→ CORE PRINT

- It is the projection pattern. It forms a seat in the mould. The core is supported in the seat formed by core print.

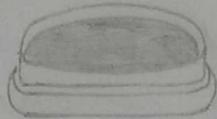
→ CORE BOX

- It is a pattern made of either wood or metal into which sand is packed to form the core. Wooden boxes are commonly used to make core boxes but metal boxes are used when cores are to be made in large numbers.

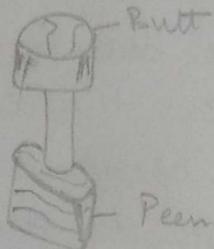
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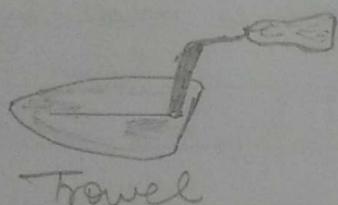
Shovel



Riddle



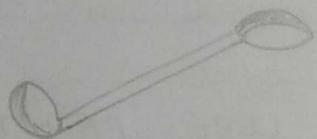
Hand Rammer



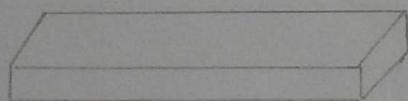
Trowel



Lifter



Slick



Strike off Bar

MOULDING Tools

Study Of Moulding Tools

→ Shovel

- It is a big tool used for mixing & transferring moulding sand. It is also used to carry moulding sand from sand pit to moulding box. It has a broad metal blade with long wooden handle.

→ Riddle

- It is a metal sieve used for removing foreign material such as stones, nails etc from the moulding sand. It has circular or square wooden frame with wire mesh at the bottom.

→ Rammer

- It's made of wood or cast iron for packing & ramming the sand. It has 2 ends - one end is cylindrical called butt edge, other is wedge shaped called peen.

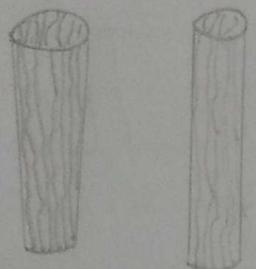
→ Trowel

- It is a rectangular metal blade & has a round/square end used to smoothen surface of the mould. It is also used to repair damaged portion of the mould.

→ Slick

- It is a double ended tool used for repairing & finishing.

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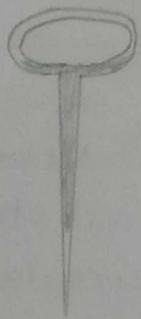
Sprue & Riser
pin



Swab



gate cutter



Vent Rod



Draw Spike

MOULDING Tools

→ Lifter

- It is used to lift the openings of deep moulds. It's also used to repair broken surfaces & is made of steel.

→ Strike off bar

- It is made of wood and has a straight edge. It is used to remove excessive sand from the mould after ramming.

→ Sprue pin

- It is tapered cylindrical wooden piece. It is used to make sprue hole to facilitate pouring of metal.

→ Bellows

- It is used to blow off loose sand particles from mould.

→ Swab

- Swab is a small brush used for applying small amount of water around the pattern before removing it from mould.

→ Gate cutter

- It is used to cut gates & runners in the mould.

→ Draw spike:

- It is a steel rod with a loop to remove pattern from the mould.

→ Vent Rod:

- It is used to make vent holes in the sand so that molten gases released during pouring, can easily escape from mould.

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Advantages

- Its use is wide spread, technology is well-developed.
- Material is inexpensive, capable of holding detail.
- Process is suitable for both-ferrous & non-ferrous castings.
- It handles a more diverse range of products.
- Mould preparation time is relatively short.
- Can achieve very close tolerance.
- High levels of sand reuse is achievable.
- The simplicity of process makes it ideally suited for mechanisation.

Limitations

- Typically limited to one or a small no. of moulds per box.
- Sand to metal ratio is relatively high.
- High level of waste is typically generated.



JOB - 1

AIM: To prepare a mould of gear blank pattern

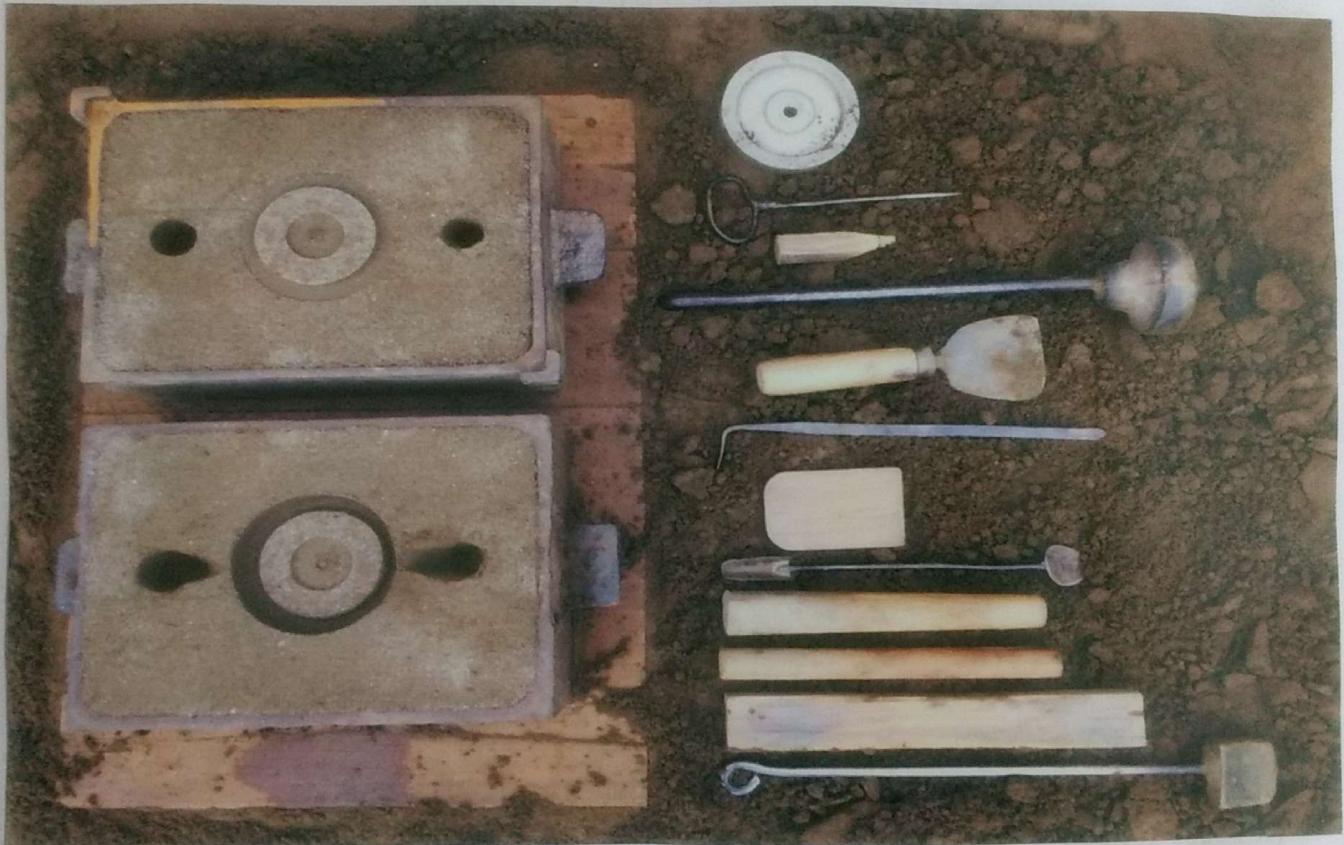
Job Material: Moulding green sand, parting sand, gear blank pattern, moulding flask.

Tools used: Shovel, trowel, Peen and flat rammer, sprue and riser pin, strike off bar, smoother, vent rod, gate cutter, draw spike.

Procedure:

1. Place gear blank pattern in the middle of drag.
2. Sprinkle parting sand and fill the drag with green sand.
3. Use peen hammer 2 times, then flat rammer.
4. Remove extra sand using strike off bar & level the surface using smoother.
5. Sprinkle parting sand over the top & make vent holes.
6. Turn drag upside down.
7. Place cope over drag after sprinkling parting sand.
8. Place sprue & riser pin at appropriate place
9. Fill cope with green sand as before.
10. Remove extra sand & level the surface as before.
11. Sprinkle parting sand & make vent holes.
12. Remove sprue & riser pins.
13. Make pouring basin over sprue & place the cope by the side of drag upside down.
14. Remove the pattern using draw spike.

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15. Make gates using slick and gate cutter.
16. Now assemble cope over drag.

RESULT :

Now the mould is ready for drying and pouring

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JOB - 2

AIM: To prepare a mould of screw-jack body pattern

Job Material: Moulding green sand, parting sand, moulding flask, screw-jack body pattern.

Tools used: Shovel, trowel, peen & flat rammer, sprue & riser pin, vent rod, smoother, strike off bar, slick and gate cutter.

Procedure:

1. Place the drag on the moulding board
2. Place screw-jack pattern, such that the flat face touches the moulding board.
3. Sprinkle parting sand & fill it with green sand.
4. Use peen rammer twice & flat hammer once to ram the sand.
5. Use strike off bars to remove excess sand & level the surface using smoother.
6. Sprinkle parting sand & make vent holes.
7. Turn the drag upside down.
8. Place cope over drag & the other part of pattern
9. Sprinkle parting sand and place sprue & riser pins, such that riser is placed at the uppermost part of the pattern.
10. Fill the cope with green sand as done before.
11. After levelling, sprinkle parting sand & make vent holes.
12. Remove sprue & riser pins & make pouring basin over sprue
13. Place cope by the side of drag upside down.

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14. Now withdraw the pattern using vent rod. The pattern can be made free by gently tapping the sides with peen hammer.
15. Water can be applied by swab to protect the edges.
16. Same way, remove the other piece of pattern.
17. Make gates using slick and gate cutter.
18. Now assemble the cope over drag.

RESULT:

Now the mould is ready for drying and pouring.

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