

Traditional Manufacturing Processes

Casting

Forming

Sheet metal processing

Powder- and Ceramics Processing

Plastics processing

Cutting

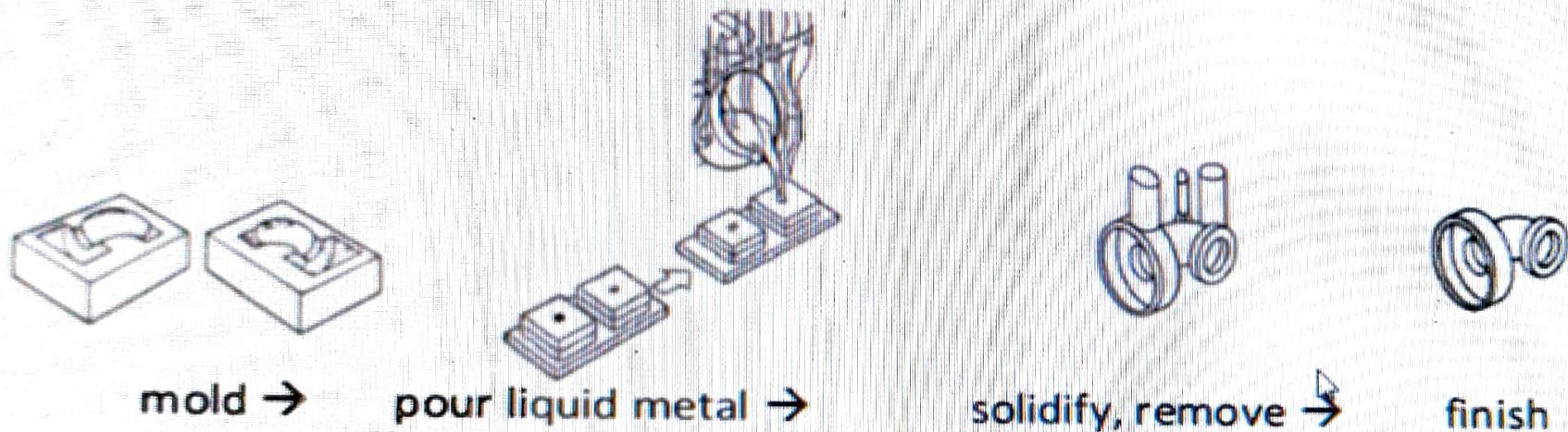
Joining

Surface treatment



Casting

Casting is a manufacturing process in which molten/liquid material is poured into a mold containing a cavity of specific shape, and then allowed to solidify. The solid casting is then taken out and cleaned to complete the process



Advantages

- VERSATILE:

- complex geometry, internal cavities/ external shapes, hollow sections
- Wide range of Weight and size
 - small (~10 grams) → very large parts (100 tones)
 - Teeth Zipper (few mm) → Ocean Liner Propeller (10 m)
- Net Shape, Near Net Shape
- Any Metal (that can be melt)
- Some metal can only be cast
- Simplified Construction
- Some Engineering properties are only possible in casting
 - Isotropic
 - Machinability
 - Damping capacity
 - Good Bearing qualities
 - Strength and Lightness

- ECONOMICAL:

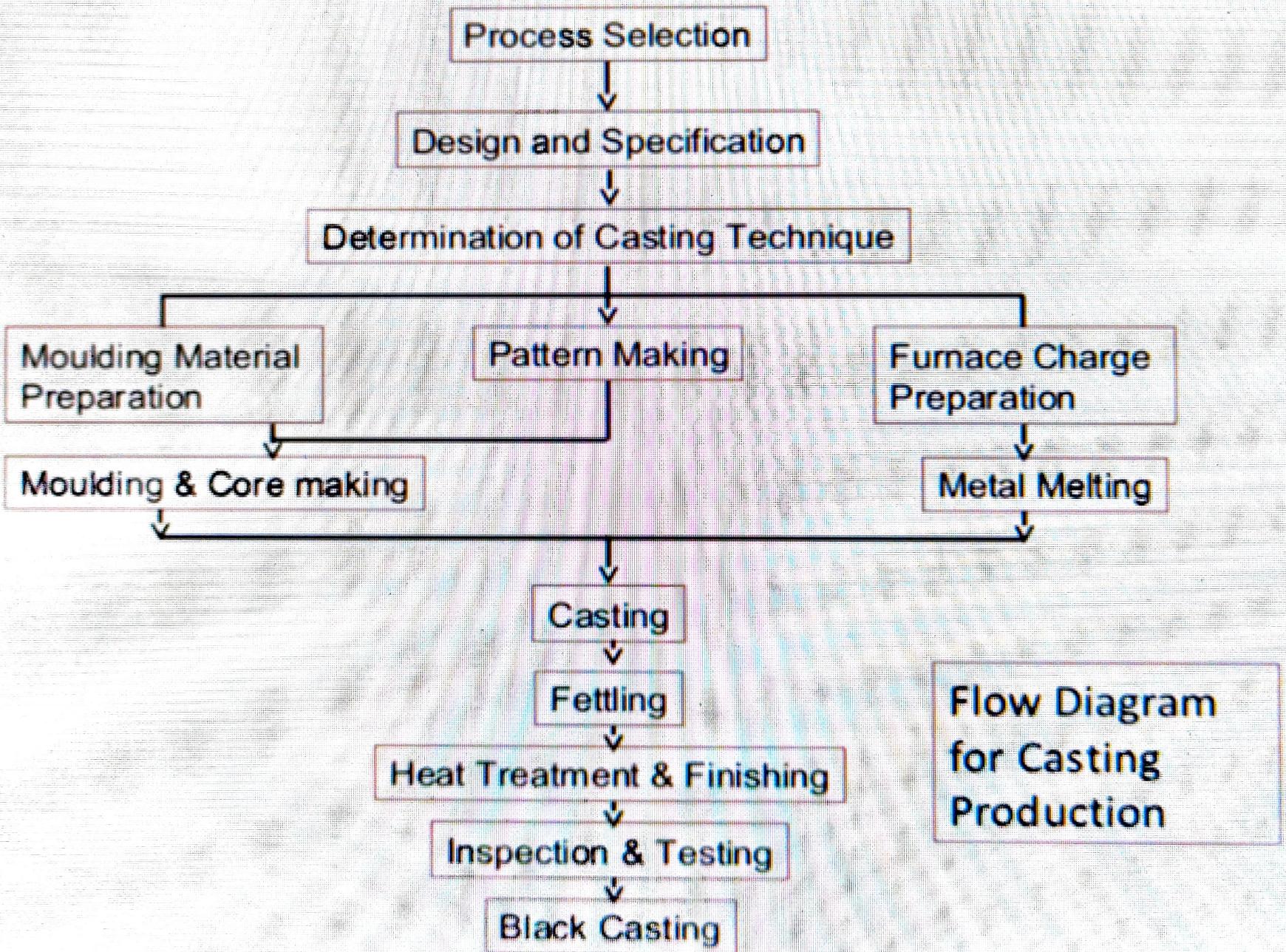
- little wastage (extra metal is re-used) Low cost
- Suitable for mass production

Types of Foundries

- Based on material
 - Ferrous , Non ferrous, gray Iron, Steel, Brass, Light metal
- Based on nature and Organisational Framework
 - Jobbing foundry(A foundry that creates a wide variety of castings, in small quantities for a range of customers)
 - Production foundry
 - Semi Production foundry
 - Captive foundry(A foundry operation that is wholly incorporated into a larger manufacturing operation)
 - Independent foundry

Casting Process

- Preparing a mold cavity of the desired shape with proper allowances and provided with means for the escape of air or gases.
- Melting the metal with acceptable quality and temperature.
- Pouring the metal into the cavity.
- Solidification process designed and controlled to avoid defects.
- Casting removal.
- Finishing, cleaning and inspection operations.



Pattern:

- ◆ A Pattern is a model or the replica of the object to be cast.
- ◆ Except for the various allowances a pattern exactly resembles the casting to be made.
- ◆ Patterns may be in two or three pieces, whereas casting are in a single piece.
- ◆ A pattern is required even if one object has to be cast.
- ◆ The quality of casting and the final product will be effected to a great extent by the planning of pattern.

Functions of Patterns:

- A Pattern prepares a mould cavity for the purpose of making a casting.
- A Pattern may contain projections known as core prints if the casting requires a core and need to be made hollow.
- Risers, runners and gates may form a part of the pattern.
- Patterns properly made and having finished and smooth surfaces reduce casting defects.
- Properly constructed patterns minimize overall cost of the casting.

Selection of Pattern Materials:

The following factors assist in selecting proper pattern material:

- No. of castings to be produced.
- Metal to be cast.
- Dimensional accuracy & surface finish.
- Shape, complexity and size of casting.
- Casting design parameters.
- Type of molding materials.
- The chance of repeat orders.
- Nature of molding process.
- Position of core print.

Materials for making patterns:

- a. Wood
- b. Metal
- c. Plastic
- d. Plaster
- e. Wax.

1. Wood Patterns:

These are used where the no. of castings to be produced is small and pattern size is large.

Advantages:

- ✓ Inexpensive
- ✓ Easily available in large quantities
- ✓ Easy to fabricate
- ✓ Light in weight
- ✓ They can be repaired easily
- ✓ Easy to obtain good surface finish

Limitations:

- Susceptible to shrinkage and swelling
 - Possess poor wear resistance
 - Abraded easily by sand action
 - Absorb moisture, consequently get wrapped
 - Cannot withstand rough handling
 - Life is very short

Commonly used woods for making patterns:

- a. Teak
 - b. Pine
 - c. Mahogany
 - d. Deodar etc..

2. Metal Patterns:

These are employed where large no. of castings have to be produced from same patterns.

Advantages:

- ✓ Do not absorb moisture
- ✓ More stronger
- ✓ Possess much longer life
- ✓ Do not warp, retain their shape
- ✓ Greater resistance to abrasion
- ✓ Accurate and smooth surface finish
- ✓ Good machinability

Limitations:

- Expensive
- Require a lot of machining for accuracy
- Not easily repaired
- ↳ • Ferrous patterns get rusted
- Heavy weight , thus difficult to handle

Commonly used metals for making patterns:

- i. Cast iron
- ii. Aluminium and its alloys
- iii. Steel
- iv. White metal
- v. Brass etc..

3. Plastic Patterns:

Advantages:

- ✓ Durable
- ✓ Provides a smooth surface
- ✓ Moisture resistant
- ✓ Does not involve any appreciable change in size or shape
- ✓ Light weight
- ✓ Good strength
- ✓ Wear and corrosion resistance
- ✓ Easy to make
- ✓ Abrasion resistance
- ✓ Good resistance to chemical attack

Limitations:

- Plastic patterns are Fragile
- These are may not work well when subject to conditions of severe shock as in machine molding (jolting).

4. Plaster Patterns:

Advantages:

- ✓ It can be easily worked by using wood working tools.
- ✓ Intricate shapes can be cast without any difficulty.
- ✓ It has high compressive strength.

- *Plaster may be made out of Plaster of paris or Gypsum cement.*
- *Plaster mixture is poured into a mould made by a sweep pattern or a wooden master pattern, in order to obtain a Plaster pattern.*

5. Wax patterns:

Advantages:

- ✓ Provide very good surface finish.
- ✓ Impart high accuracy to castings.
- ✓ After being molded, the wax pattern is not taken out of the mould like other patterns;
- ✓ rather the mould is inverted and heated; the molten wax comes out and/or is evaporated.
- ✓ Thus there is no chance of the mould cavity getting damaged while removing the pattern.

➤ *Wax patterns find applications in Investment casting process.*

TYPES OF PATTERNS

Types of patterns depend upon the following factors:

- i. The shape and size of casting
- ii. No. of castings required
- iii. Method of moulding employed
- iv. Anticipated difficulty of moulding operation

Types of Patterns:

- 1. Single piece pattern.**
- 2. Split piece pattern.**
- 3. Loose piece pattern.**
- 4. Match plate pattern.**
- 5. Sweep pattern.**
- 6. Gated pattern.**
- 7. Skeleton pattern**
- 8. Follow board pattern.**
- 9. Cope and Drag pattern.**

1. Single piece (solid) pattern:

- Made from one piece and does not contain loose pieces or joints.
- Inexpensive.
- Used for large size simple castings.
- Pattern is accommodated either in the cope or in the drag.

Examples:

1. Bodies of regular shapes.
2. stuffing box of steam engine.



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Fig: Single piece pattern

2. Split piece pattern:

- Patterns of intricate shaped castings cannot be made in one piece because of the inherent difficulties associated with the molding operations (e.g. withdrawing pattern from mould).
- The upper and the lower parts of the split piece patterns are accommodated in the cope and drag portions of the mold respectively.
- Parting line of the pattern forms the parting line of the mould.
- Dowel pins are used for keeping the alignment between the two parts of the pattern.
- Examples:
 1. Hallow cylinder
 2. Taps and water stop cocks etc.,

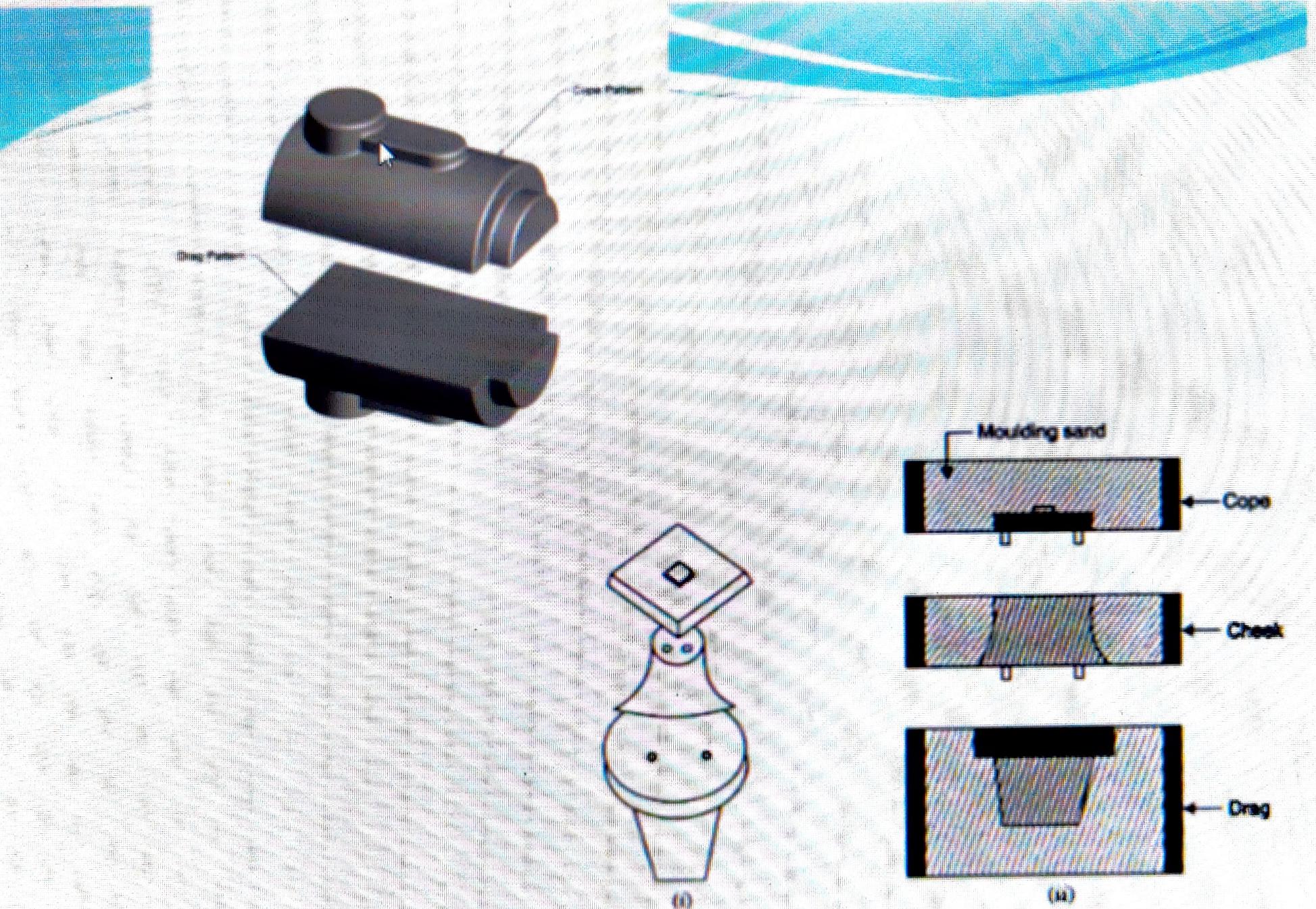
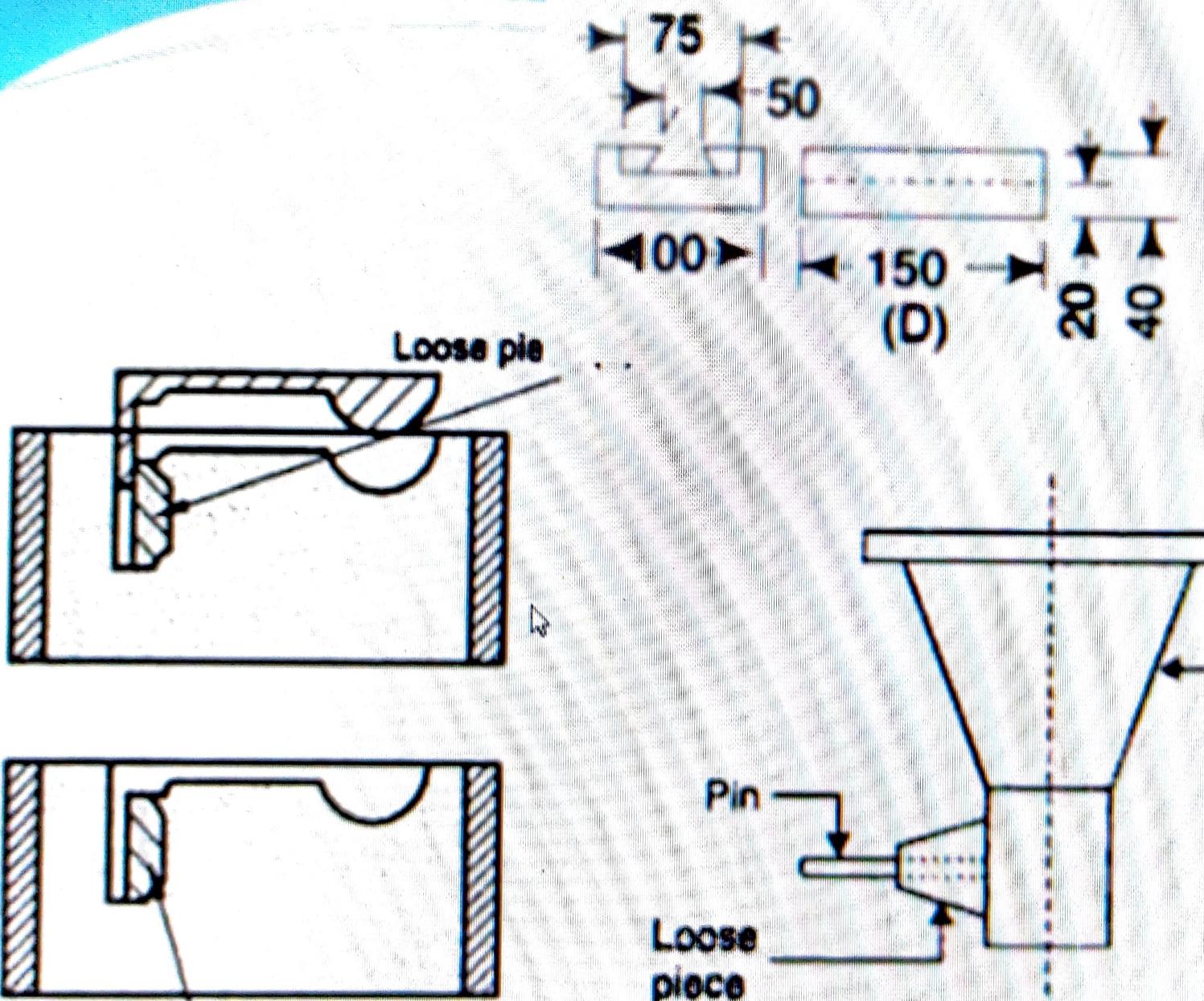


Fig. 2.3. Multipiece patterns.

3. Loose piece pattern:

- Certain patterns cannot be withdrawn once they are embedded in the molding sand. Such patterns are usually made with one or more loose pieces for facilitating from the molding box and are known as loose piece patterns.
- Loose parts or pieces remain attached with the main body of the pattern, with the help of dowel pins.
- The main body of the pattern is drawn first from the molding box and thereafter as soon as the loose parts are removed, the result is the mold cavity.



Loose piece left in the mold
after pattern removal (b)

Fig. 1.75. Loose piece pattern.

4. Match plate pattern:

- It consists of a match plate, on either side of which each half of split patterns is fastened.
- A no. of different sized and shaped patterns may be mounted on one match plate.
- The match plate with the help of locator holes can be clamped with the drag.
- After the cope and drag have been rammed with the molding sand, the match plate pattern is removed from in between the cope and drag.
- Match plate patterns are normally used in machine molding.
- By using this we can eliminate mismatch of cope and drag cavities.