* Unit - 5 *

Primary Manufacturing Process

It involve the initial conversion of raw materials into useable forms. These processes typically shapes material without removing material to include

Casting - shaping material by pouring

Forming - changing the shape using mechanical force

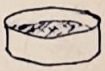
Joining - combining two metal pieces.

***Metal casting** - one of oldest manufacturing Process

Steps - Melting the metal.
→ Pouring the molten metal into the mold
→ Cooling & solidifying it in the shape of mold
→ Removing the final solidified product from the mold.

Tools Pattern - Replica of final casting product used to create mold cavity.

- molding box - Cope → Upper box
  Drag → Bottom box
  Cheek → middle part.
  } → container.
- molding Sand - Silica Sand, water, clay ...
- Riddle → Used to remove foreign particles.



- Rammer → used to compact sand.
- Sprue pin → Create sprue [] for pouring molten metal
- Vent rod → Create holes for passing gas.
- Bellow → blow air and clean loose sand.
- Crucible → melting the metal.

- Advantage - can produce complex shapes
  - Suitable for large components
  - Economical for mass production.

- Patterns - Single-piece pattern = simplest shapes
  Split pattern = complex parts, made in two halves.
  Match Plate pattern = pattern mounted on both side of plate
  Cope & drag pattern = Cope & drag are separately

*molding :- involves creating cavity that ~~took~~ hold molten metal. most common method → sand molding.

Type → Green sand, Dry sand, Shell mold,

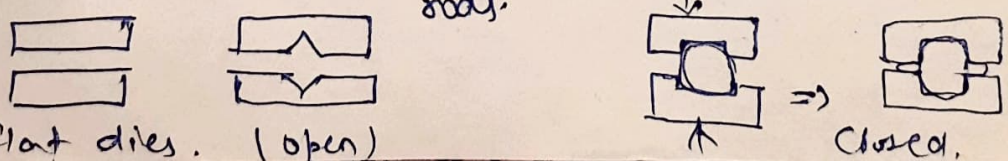
Furnace
- Cupola Furnace - mainly used for cast iron
- Induction Furnace - use electromangnetic induction
- Electric Arc Furnace - melt steel with electric arc
- * Crucible Furnace - non-ferrous metal.

* Metal Forming :- metal forming changes the shape and size of a material through plastic deformation.- No material is removed. It often improves strength & grain structure of metal.

* Forging - It involves hammering or pressing the metal while its hot or ~~cool~~ cold.

Types - Open-die forging - hammering on flat surface
Closed-die forging - Metal is pressed into dies shaped like the final product.

Application - crankshaft, gears, spanners, connecting rods.



* **Rolling** Process of reducing the thickness of changing the cross-section of a long workpiece by compressive forces applied through rollers.

Hot rolling - Above recrystallization temperature. Easier shaping.

Cold rolling - Below recrystallization temperature. Better surface, finish & strength.

Product - Sheets, beams, rails.

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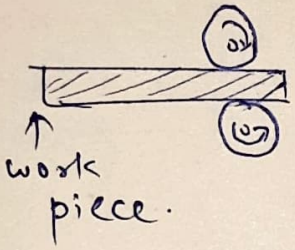

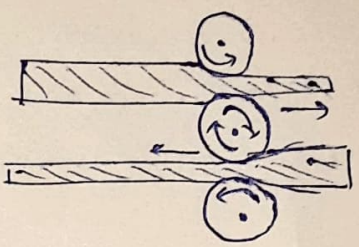

* **Extrusion** - Metal is forced through a die opening to form objects of a constant cross section.

- Direct - Metal and ram move in same direction.
- Indirect - Die moves towards stationary metal.

Product - Aluminum window fram, rods, tubing.

* **Drawing** - Drawing is used to pull metal through a die to reduce its diameter & increase length.

Types - wire drawing - making wire of copper, aluminum
Tube drawing - Reducing diameter of pipes.

use - Electrical wire, bicycle spokes, seamless tube.

Tools → Hammer, anvil, Tongs, swage block, forging dies, Rolling mill, Rollers, Ram or plunger, container, Drawing die, Drawing bench, Drum.

* Metal Joining Process :-

metal joining involves combining two or more metal parts to form a single unit. It may involve heating, pressure or filler material.

* **Welding** :- Joining metals by heating to the melting point & fusing them together.

Types - **Arc welding**

SMAW (Shielded Metal Arc welding)
MIG (Metal inert gas)
TIG (Tungsten inert gas welding)
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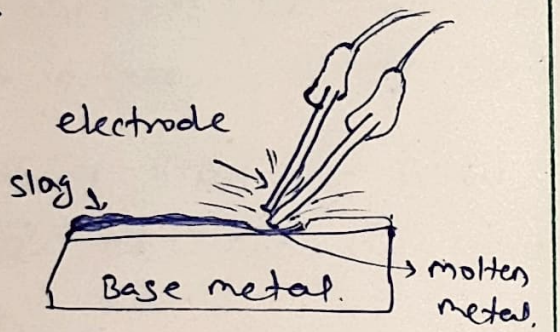
SMAW welding

mannual arc welding process that uses electrode coated with flux.



Gas welding

Oxy-acetylene flame used for cutting & joining.
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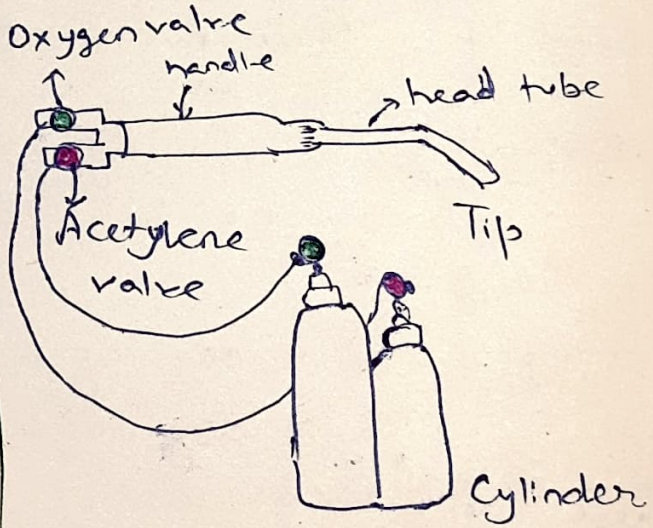
In one cylinder O_2 gas is stored & in another, acetylene is stored. when both gases are mixed at high pressure and temp, it produce heat spark (3200°C).



use to cut thick metal plates.

* **Brazing** Brazing joins metals using a filler metal with a melting point above 450°C but below the base metal. (capillary)
→ plumbing, bicycle frames.

* **Soldering** - similar to brazing, but uses a filler metal with a melting point below 450°C (Tin-lead alloy)
→ delicate jewelry, electrical connection.

Difference

Brazing	Soldering
1. melting temp. of filler above 450°C	melting temp. of filler below 450°C
2. Filler metal - Copper alloy, silver alloy	Filler metal → lead tin
3. Fluxes => borax	Fluxes → zinc chlorides
4. Better strength of Joint	less strength.