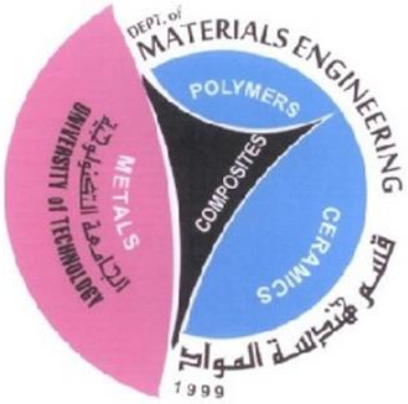


Materials Engineering Department
General Materials Branch

Casting Technology II

Fourth Class

Lecture Sixteen :Foundry Practice

FURNACES

The types of furnaces most commonly used in foundries are

1. Cupolas,
2. Direct fuel-fired furnaces,
3. Crucible furnaces,
4. Electric-arc furnaces,
5. Induction furnaces.

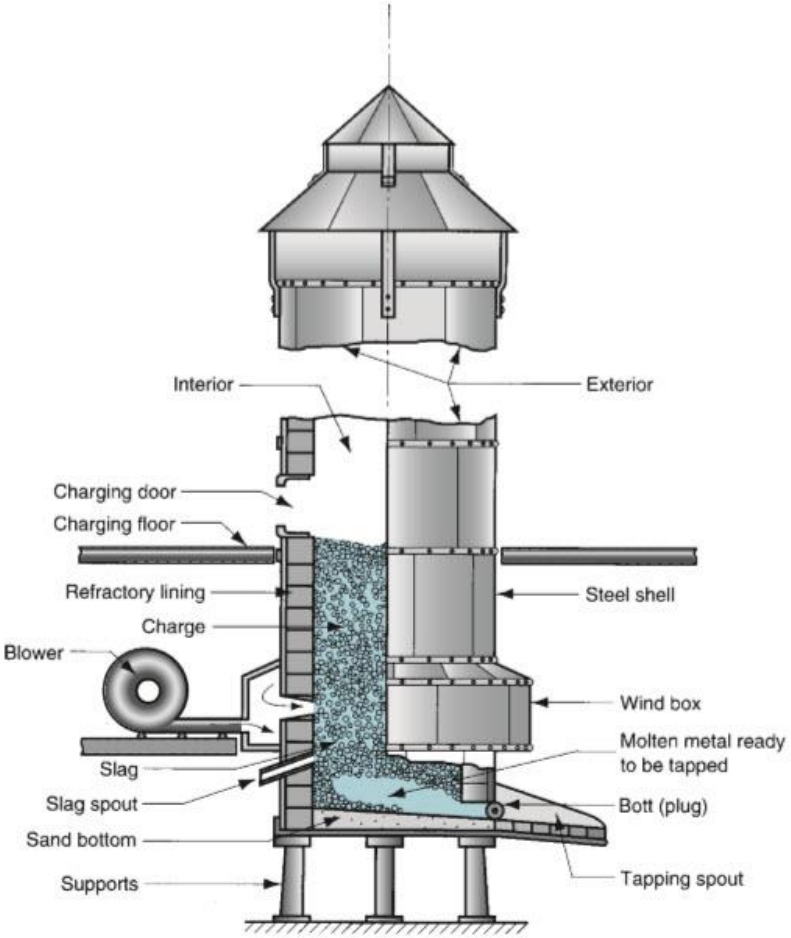
Selection of Furnaces

Selection of the most appropriate furnace type depends on factors such as

1. The casting alloy i.e. its melting and pouring temperatures
2. Capacity requirements of the furnace ;costs of investment, operation, and maintenance
3. Environmental pollution considerations

Cupolas

- A vertical cylindrical furnace equipped with a tapping spout near its base .
- Cupolas are used only for melting cast irons
- Although other furnaces are also used, the largest tonnage of cast iron is melted in cupolas



Direct Fuel-Fired Furnaces

- A direct fuel-fired furnace contains a small open-hearth, in which the metal charge is heated by fuel burners located on the side of the furnace.
- Direct Fuel fired furnaces are generally used in casting for melting non-ferrous metals such as Copper base alloys and aluminum Base Alloys

Crucible Furnaces

- These furnace smelt the metal without direct contact with a burning fuel mixture. For this reason, they are sometimes called indirect fuel-fired furnaces. Three types of crucible furnaces are used in foundries:

A. Lift-out type,
B. Stationary,
C. Tilting

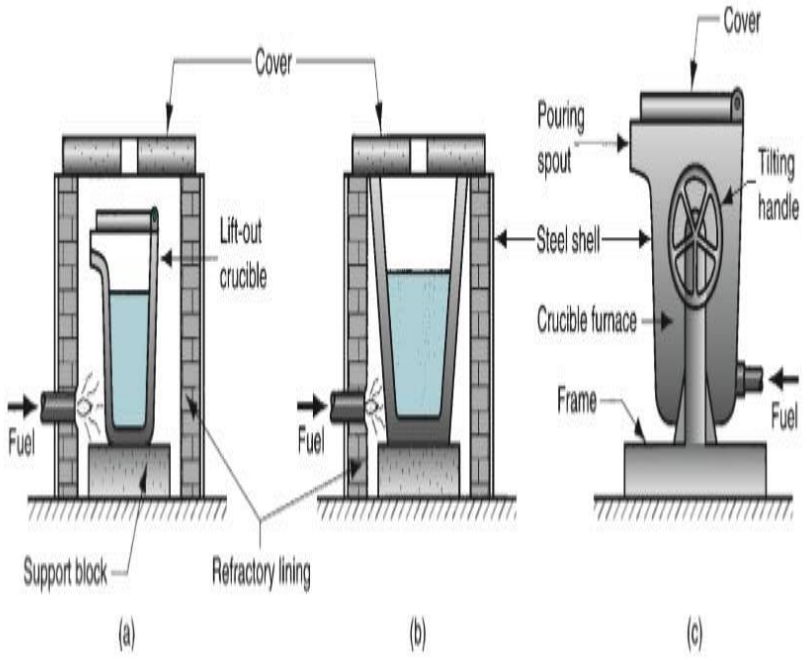


FIGURE 11.19 Three types of crucible furnaces: (a) lift-out crucible, (b) stationary pot, and (c) tilting-pot furnace.

Crucible Furnaces

- Crucible furnaces are used for nonferrous metals such as bronze, brass, and alloys of zinc and aluminum. Furnace capacities are generally limited to several hundred pounds

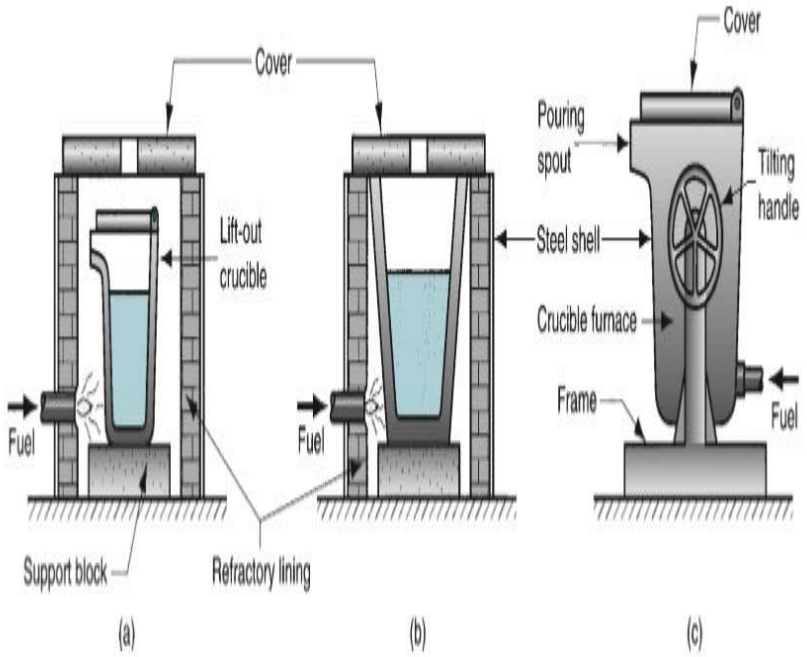


FIGURE 11.19 Three types of crucible furnaces: (a) lift-out crucible, (b) stationary pot, and (c) tilting-pot furnace.

Electric-Arc Furnaces

- In this furnace type, the charge is melted by heat generated from an electric arc.
- Various configurations are available, with two or three electrodes Power consumption is high .
- But electric-Arc furnaces are the preferred method of melting in many foundries because of the

1. Rapid melting rates,
2. Ability to hold the molten metal for any desired period of time,
3. Greater ease of incorporating pollution control equipment

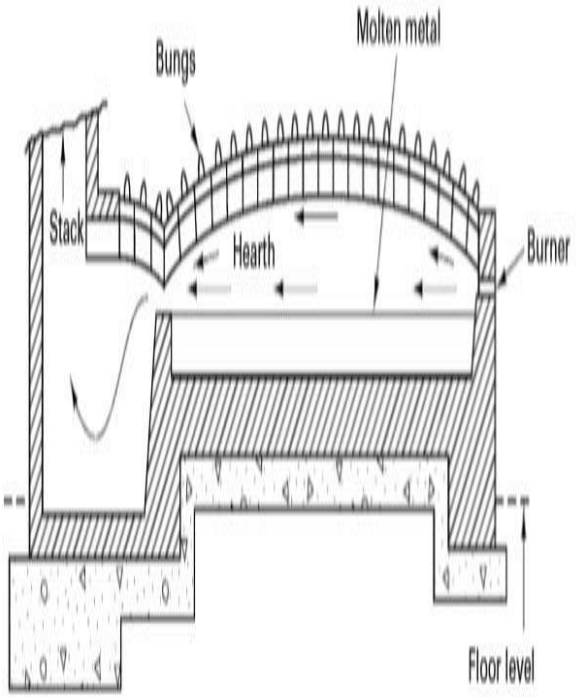


FIGURE 13-14 Cross section of a direct fuel-fired furnace. Hot combustion gases pass across the surface of a molten metal pool.

Electric-Arc Furnaces

- Arc furnaces are generally used with ferrous alloys, especially steel.
- Provide good mixing and homogeneity to the molten bath.
- Unfortunately, the noise and level of particle emissions can be rather high, and the consumption of electrodes ,refractories ,and power results in high operating costs

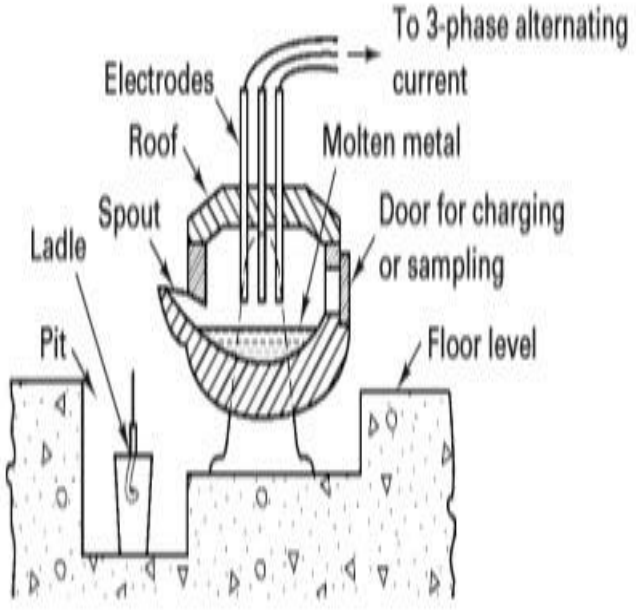


FIGURE 13-15 Schematic diagram of a three-phase electric-arc furnace.

INDUCTION FURNACES

- There are two basic types of induction furnaces. The high frequency, or coreless units, shown schematically in consist of a crucible surrounded by a water-cooled coil of copper tubing.

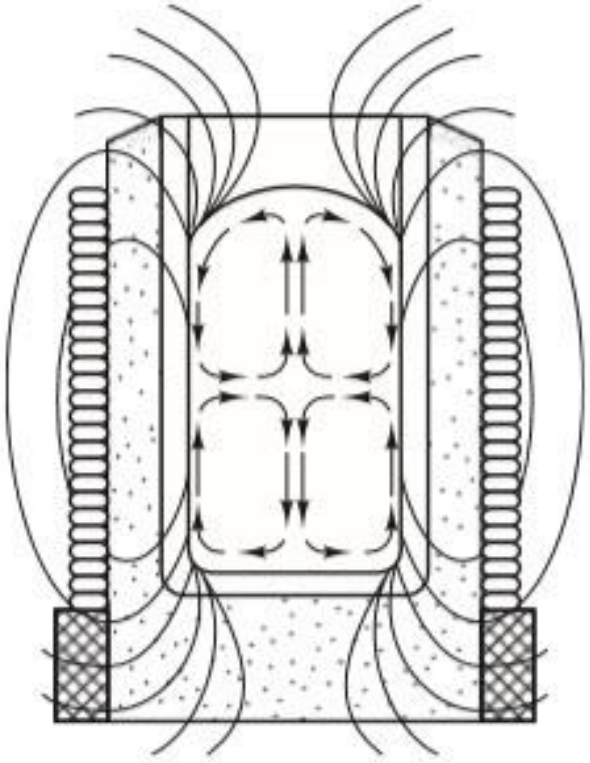


FIGURE 13-17 Schematic showing the basic principle of a coreless induction furnace.

INDUCTION FURNACES

- Coreless induction furnaces are used for virtually all common alloys ,
- with the maximum temperature being limited only by the refractory and the ability to insulate against heat loss.
- They provide good control of temperature and composition and are available in a range of capacities up to about 65 tons.
- Because there is no contamination from the heat source, they produce very pure metal.

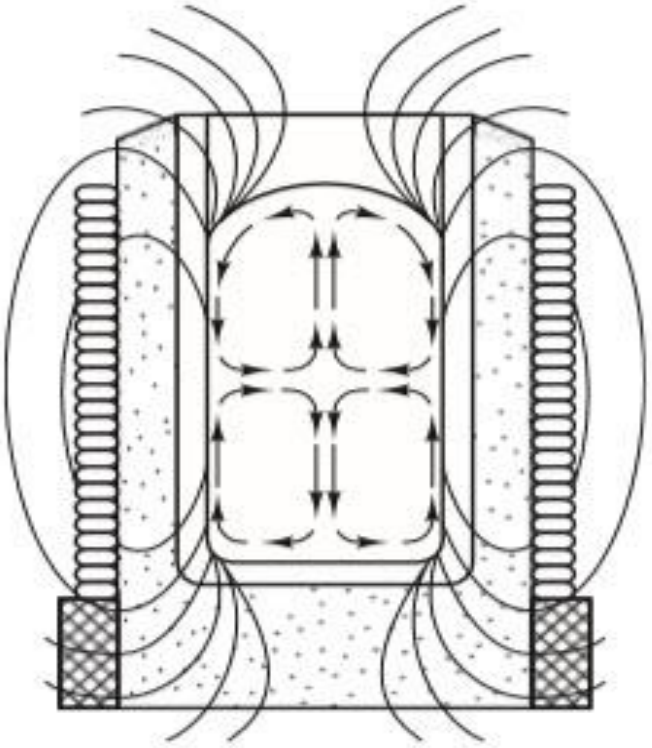


FIGURE 13-17 Schematic showing the basic principle of a coreless induction furnace.

INDUCTION FURNACES

- Low frequency or channel-type induction furnaces are also seeing increased use.
- Only a small channel is surrounded by the primary(current-carrying or heating) coil. A secondary coil is formed by a loop, or channel, of molten metal, and all the liquid metal is free to circulate through the loop and gain heat

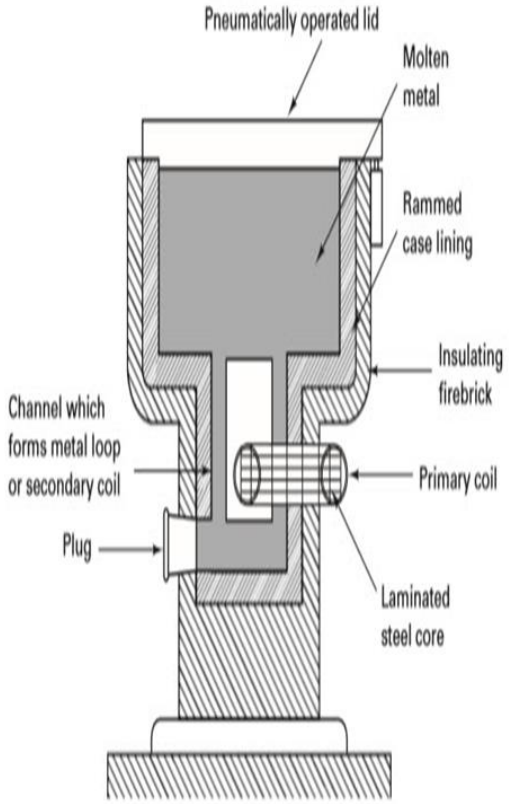


FIGURE 13-18 Cross section showing the principle of the low-frequency or channel-type induction furnace.

POURING PRACTICE

- Some type of pouring device ,or ladle, s usually required to transfer the metal from the melting furnace to the molds. The primary considerations for this operation are

1. To maintain the metal at the proper temperature for pouring
2. To ensure that only high-quality metal is introduced into the molds

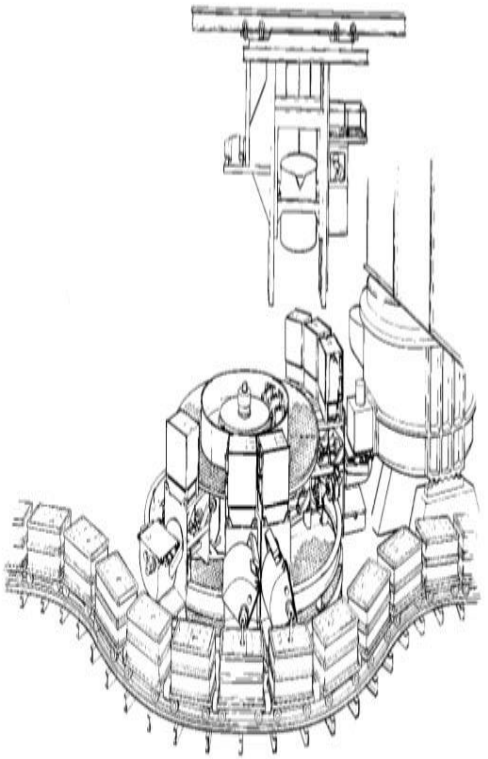


FIGURE 13-19 Automatic pouring of molds on a conveyor line. *(Courtesy of Roberts Sinto Corporation, Lansing, MI.)*

AUTOMATION IN FOUNDRY OPERATIONS

- Robots can do the following

1. dry molds,
2. coat cores
3. vent molds,
4. clean or lubricate dies.
5. They can tend stationary, cyclic equipment, such as die-casting machines

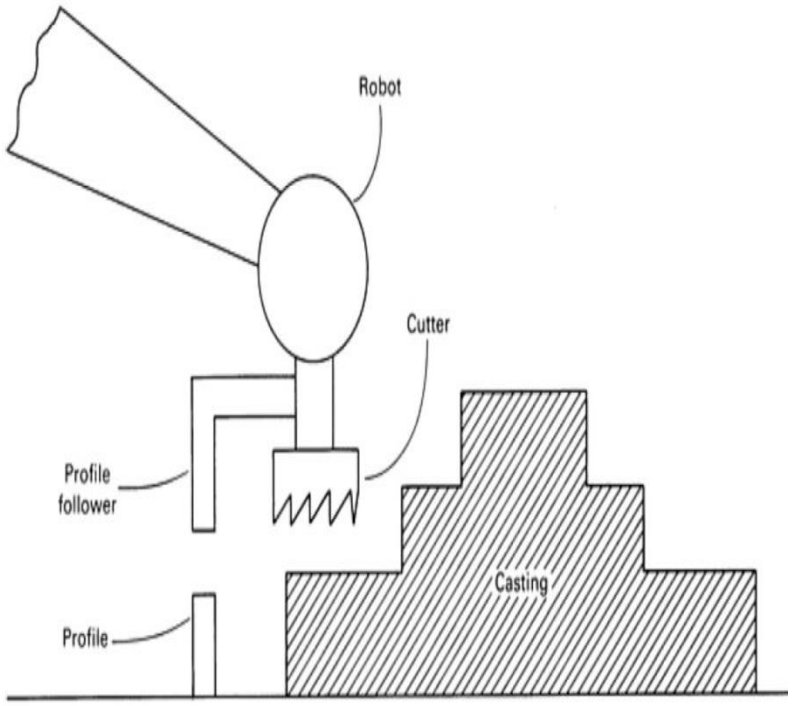


Fig. 2 Guidance template used to control the movement of the robotic arm

Benefits of Robotic Use in foundry

1-Increased productivity:
2- Reduced costs
3- Improved casting quality
4- High-speed precision
5- Performance flexibility
6- High uptime
7- Inflation resistance
8- Round-the-clock output
9-Improved worker morale

Foundry Robotic Applications

1. Level 0: This robot registers no information from the surroundings
2. Level 1: Capable of monitoring contact between two surfaces t*. An example of such a foundry application would be robots attached to core making machines*
3. Level 2: these robots incorporate visual and nonvisual imaging sensors. *Examples would include adaptively controlled grinding and torch cutting operations*