and on that account it is less efficient, since it must be allowed to cool between successive operations. Although a core is provided in this furnace to carry the current, a portion of the latter is undoubtedly carried by the charge itself.

**Cowles' Furnace for Aluminium Alloys. (See Fig. 4.)**

In this furnace, the charge becomes partly fused, and no doubt serves to carry the current, but during the heating of the furnace the current is carried by a carbon core and so the furnace may be included in this class.

Tone's resistance furnace for the reduction of metals is shown in Fig. 15. The central resisting core C is placed vertically in order to permit of continuous charging, which would break down a horizontal core. It is constructed of carbon blocks separated from each other so as to increase the resistance of the core. A and B are carbon electrodes for making electrical connection with the core. The charge is fed in around C, and the reduced and melted metal flows through small holes at the base of the furnace into the receptacles, D and E.

**Resistance Furnaces without Special Resistor and without Electrolytic Action.**

In these furnaces the material to be heated forms the resistor; it is usually solid, but may become molten during the operation. These furnaces may be divided into four classes:

(1) **Furnaces of the Acheson Type.**—The Acheson furnace can be run without a special resistor if the charge itself is a sufficiently good conductor of electricity; the charge remaining solid and being removed from the furnace at the end of the operation.

(2) **Shaft Furnaces with Lateral Electrodes.**—In these furnaces provision is made for the continuous or intermittent removal of the solid or liquid products, and for the introduction of fresh material while the furnace remains in continuous operation. They resemble the Acheson furnaces in having lateral electrodes and a horizontal flow of current.

In Fig. 16 is illustrated a furnace of this type. It consists of a chamber provided with lateral carbon electrodes and one or more tapping holes. It has a striking resemblance to a blast furnace, the electrodes representing the tuyeres. An objection to this type of furnace is that the current cannot be effectively regulated by moving the electrodes. The ore becomes heated and reduced to the metallic state in the upper part of the furnace, and the whole charge melts in the zone between the electrodes, and can be tapped out at the bottom.

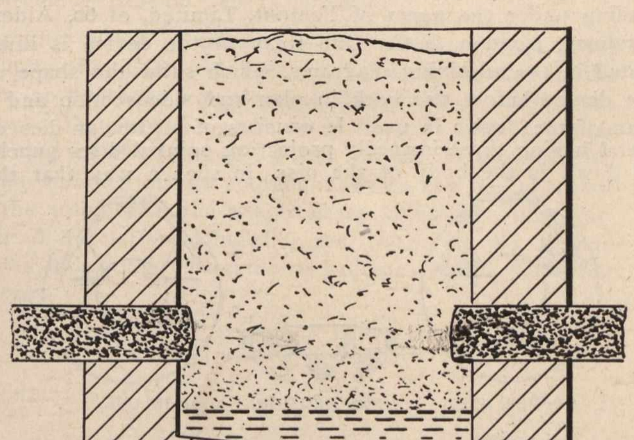

Fig. 16.—Shaft Furnace with Lateral Electrodes.

(3) **Shaft Furnaces with Central Electrodes.**—These consist of a vertical shaft provided with a refractory lining, and containing a movable carbon electrode hanging in the shaft and a fixed carbon electrode in the bottom of the furnace. The ore is fed around the upper electrode, and the current passes through the heated ore mixture between the electrodes.

Fig. 17 represents a shaft furnace with one large electrode hung in the middle, surrounded by the material to be heated. The other electrode, B, is fixed, forming part of the bottom of the furnace; and merely serves to make electrical contact with the fused material in the furnace. An advantage in this furnace is that the current can be easily regulated by raising or lowering the upper electrode. Moreover, the hottest part of the charge is in the middle

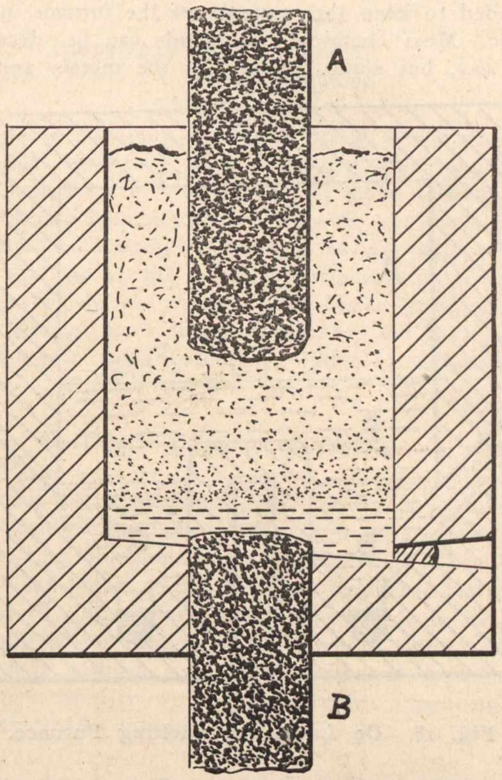


Fig. 17.—Shaft Furnace with Central Electrode.

of the furnace, thus leading to a greater economy of heat and to a longer life of the furnace walls.

Examples:—

**Heroult Furnace for smelting Iron Ores.**—This furnace, as used recently at Sault Ste. Marie for the electrical smelting of Canadian ores, is essentially of this type.

**The Keller Furnace for Smelting Iron Ores.**—This consists of two or more shaft furnaces, communicating below to a common receptacle for the fused iron and slag.*

(4) **Furnaces having a Liquid Resistor.**—These consist of a refractory reservoir, containing fused slag, or metal, through which the electric current passes. The liquid becomes superheated by the passage of the current, and is able to melt the fresh material, which can be added at intervals or continuously. The current is introduced by carbon electrodes, by water-cooled metal electrodes, or by induction.

Examples:—The De Laval furnace consists of a chamber, A, the lower part of which is divided into two troughs, B and C, containing molten metal, and electrical contact is made with these by metal terminals. A molten slag, E, fills the furnace above the dividing wall, and the electric current flows between B and C through the molten slag. The slag becomes superheated and dissolves the ore, F, which is added through a hole, K, in the top of the furnace. Alternating current should be employed to avoid electrolysis. The slag fills the furnace up to the hole, F, at which it overflows. The metal in the troughs overflows at the spouts, G and H, as fast as it is formed. In order to prevent the current melting away the wall between the troughs a water-cooled metal block, J, is inserted.

**The Gin Steel Furnace.**—This consists of a long, rectangular tank, folded with a zigzag form for compactness, containing molten steel. The current is introduced by water-cooled metal terminals, and fresh metal can be added to the molten steel superheated by the passage of the current.

---

* This, and the Heroult furnace, will be described in detail in a later article.