Oct. 9, 1962 C. SHAW 3,057,937

ELECTRIC ARC FURNACES

Filed Dec. 3, 1957 2 Sheets-Sheet 1

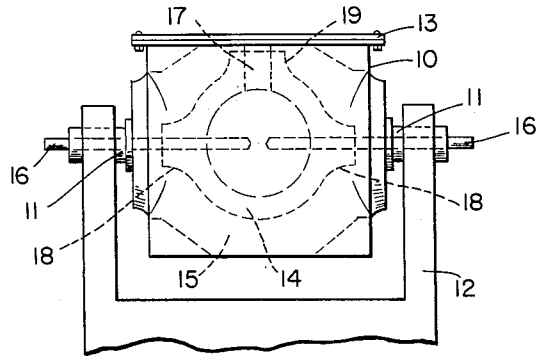


FIG. 1

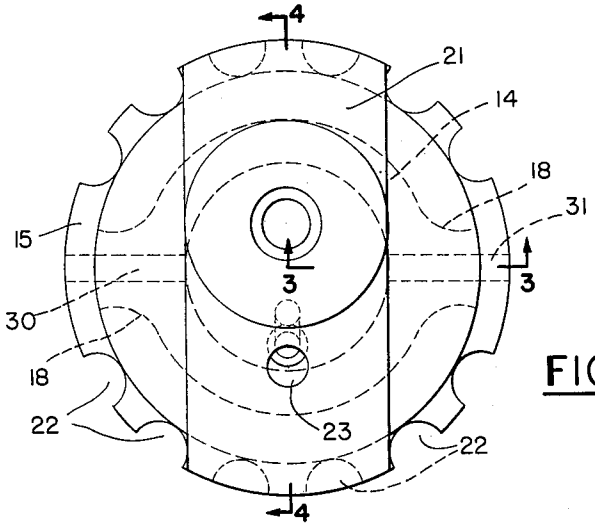


FIG. 2

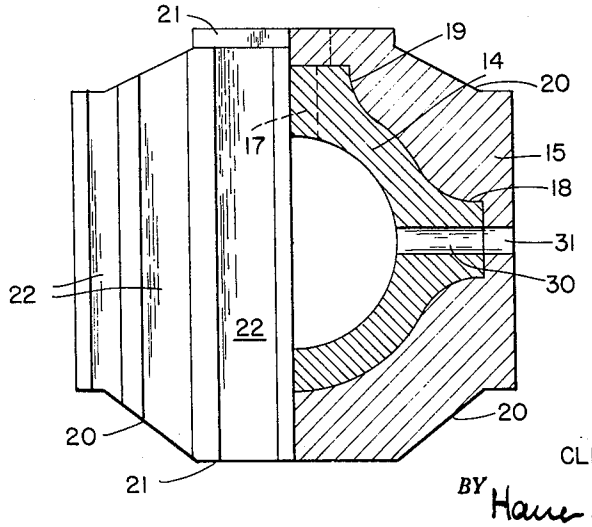


FIG. 3

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ELECTRIC ARC FURNACES

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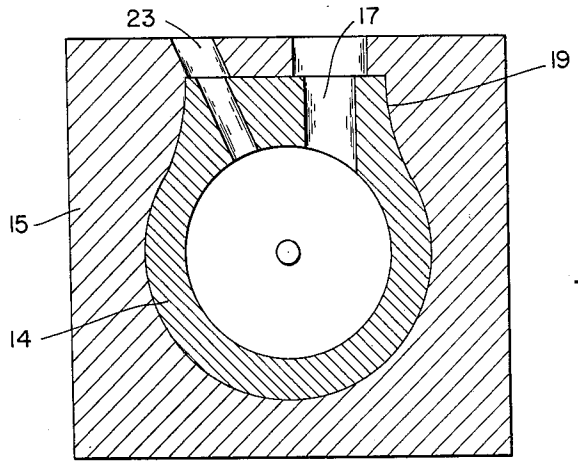


FIG. 4

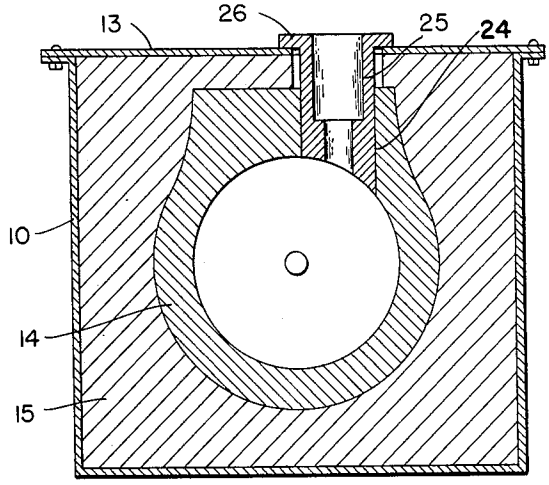


FIG. 5

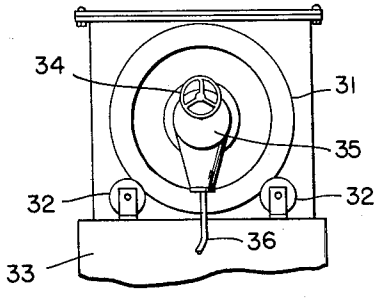


FIG. 7

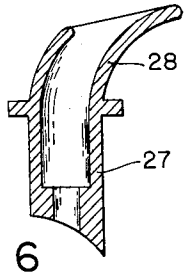


FIG. 6

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ELECTRIC ARC FURNACES

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5 Claims. (Cl. 13—35)

This invention relates to electric arc furnaces, and has for its object to provide improvements therein which facilitate the setting up of the furnaces and increase their adaptability.

Electric arc furnaces comprise a lining of refractory material surrounded with insulating material and housed in a metal container, and it has been the practice to pack loose insulating material or shaped bricks of insulating material around a molded lining, which, since the lining must be located in the correct position in the container, calls for skilled operators and takes considerable time.

According to one aspect of the present invention, an electric arc furnace comprising a furnace lining of refractory material housed in a metal container from which it is spaced by a mass of heat insulating material, is characterized in that the insulating material is in the form of a rigid block molded around the furnace lining.

The rigid block is preferably directly located in the container by engagement of at least parts of its external surface with the container walls.

The lining may be formed with a filling neck providing an orifice of large cross-sectional area, an apertured plug being provided to fit in the said orifice and provide a pouring opening of smaller cross-section than the orifice in the filling neck.

According to another aspect of the invention, a method of producing an electric arc furnace of the kind in which a lining of refractory material is housed in a metal container from which it is spaced by a mass of heat insulating material, which method comprises the steps of forming the furnace by molding, supporting the said lining in a mold, filling the mold around the lining with a mixture of an insulating refractory material and a binder, and allowing the mixture to set to form a rigid block enclosing the lining.

The invention is hereinafter described with reference to the accompanying drawings in which:

FIG. 1 is a front elevation of an electric arc furnace structure embodying the invention;

FIG. 2 is a plan view of the lining and insulating block of the furnace structure shown in FIG. 1;

FIG. 3 is a composite view, the left hand half being a front view, and the right hand half a sectional elevation on the line 3—3 in FIG. 2, of the lining and insulating block;

FIG. 4 is a section on the line 4—4 of FIG. 2;

FIG. 5 is a section, similar to FIG. 4, showing a modification;

FIG. 6 is a sectional view of a pouring spout adapted for use with the construction shown in FIG. 5; and

FIG. 7 is a side elevation of an electric arc furnace structure similar to that shown in FIGURE 1 but having the container mounted for tilting in a different manner.

Referring to FIG. 1 of the drawings, the furnace structure therein shown as an example of the invention includes a cylindrical metal container **10** supported by suitable mounting means shown as two hollow trunnions **11, 11** in a frame **12**, the axis about which the container **10** turns in the frame **12** being horizontal. The axis of the container itself is perpendicular to its axis of rotation, and one end of the container is provided with a removable cover plate **13**. Inside the container **10**, as shown in dotted lines, there is mounted a lining **14** of refractory material, the lining being embedded in a block **15** of insulating material which is so shaped as to locate the lining **14** accurately in the container **10**. The lining **14** and block **15** are formed with aligned holes **30, 31**, lying on the axis of the hollow trunnions **11, 11** for the passage of carbon rods, **16, 16** between which the arc is formed, and suitable mechanism (not shown) is provided for advancing and withdrawing the carbon rods and rotating the furnace for pouring. An opening **17** is formed in the lining **14** and in the block **15**, and registering with an opening in the plate **13**, provides for charging the crucible and pouring the charge when melted.

The lining **14** and the block **15** comprise respectively a refractory material and an insulating refractory material, the said material in each case being mixed with an ethyl silicate and sufficient water to hydrolyze the silicate, together with an acid or basic gelling accelerator as described for example in British patent specification No. 716,394.

The refractory material for the lining **14** may be fused alumina, magnesia, zirconia or chrome magnesite, and the refractory insulating material for the block **15** may be sillimanite or molochite.

The furnace lining **14**, FIGS. 1 to 4, is formed by molding about a wax core, the core being supported in the mold by means of a rod or tube which also serves as a core for the holes **30** in the lining through which the carbon rods pass. The lining **14** is generally spherical in shape, with external bosses **18, 18** around the holes for the carbon rods to increase its wall thickness at the points where the carbon rods pass through and so reduce the risk of fusion of the insulation around the carbon rods with possible resultant slagging of the charge, and another boss **19** surrounds the filling opening **17**. The materials of which the lining is formed are mixed into a slurry and poured into the mold, the said mold being vibrated during pouring and the binder is then allowed to gel before the mold is stripped off. After the mold has been stripped, the wax core is removed by steam heating, the lining then being air dried, baked for a period of six hours at a temperature up to 600° C., and furnaced, again for approximately 6 hours, at a temperature of 1350° to 1400° C.

The lining is then supported in another mold, again by means of the rod or tube passing through the holes to receive the carbon rods, and has formed around it the block **15** of insulating material. The material to form the block **15** is poured into the mold while the latter is vibrated, the binder is allowed to gel, and is then air dried for some days, after which it is furnaced at a temperature of 1250° to 1300° C. for a period of approximately six hours. As shown in the drawings this block **15** is generally cylindrical in shape, having an external diameter such that it fits closely in the container **10** and having cut-away portions at its ends forming shoulders **20** on opposite sides of flat lands **21, 21** which are symmetrical about a diametral plane of the block. The distance between the lands **21, 21** is such that the block fits snugly between the ends of the container **10**. The curved wall of the block is formed with substantially semi-cylindrical grooves running longitudinally thereof, as shown at **22**.

As shown in FIGS. 2 and 4, an additional hole **23** may be formed in the lining **14** and block **15**, directed towards the center of the cavity enclosed by the lining, to permit inspection of the arc when the furnace is in operation.

Furnaces according to the invention may be used to melt metal for pouring directly into molds clamped to the said furances, or for pouring into separate molds. The filling opening in the furnace lining **14** and block **15** may be of large diameter as shown at **24** in FIG. 5 to enable relatively large pieces of scrap metal to be inserted there-

into, a smaller and more conveinent orifice for pouring being provided by inserting a tubular plug **25** in the opening **24**. The plug **25** is formed with a flange **26** which, when the plug is inserted in the orifice **24**, rests against the end plate **13** of the container **10**. A mold may be clamped to the furnace by any suitable means so that its filling channel is disposed to mate with the orifice in the plug **25**. If the charge in the furnace is to be used to fill one or more molds which are not clamped to the said furnace, an alternative form of plug such as that shown at **27** in FIG. 6 may be used, that plug having a pouring spout **28**. A solid plug (not shown) may also be provided for completely closing the orifice **24**.

It will be understood that the shape of the insulating block may be modified, the said block being, for example, in the form of a cylinder fitting closely in the container **10**. The container may be mounted for tilting by means other than the hollow trunnions shown in FIG. 1, a suitable alternative method of mounting being shown in FIGURE 7. A pair of discs, one of which is shown at **31**, are provided, one on each side of the container **10**, the discs **31** being co-axial with the carbon rods and resting on pairs of rollers such as those shown at **32**, **32**, mounted on a fixed frame **33**. The carbon rods and their feed mechanism which may be of the conventional screw-and-nut type, operated by a handwheel **34**, are housed in casings **35** rotating with the container **10** about the axis of the discs, and current is supplied to the carbon rods through leads such as **36**.

What is claimed as new and desired to be secured by Letters Patent is:

1. The method of producing an electric arc furnace of the kind wherein a lining of refractory material is housed in a metal container from which it is spaced by a mass of heat insulating material, which method comprises the steps of forming the furnace lining by molding, supporting the said lining in a mold, filling the mold around the lining with a mixture of an insulating refractory material and a binder, and allowing the mixture to set to form a rigid one-piece block enclosing the lining.

2. The method according to claim 1 which comprises the further steps of preparing a wax core having the shape of the furnace cavity, supporting said core in a mold, forming the furnace lining by filling said mold with a mixture of discrete refractory material and a gelling binder, allowing the binder to gel, stripping the mold, melting out the wax core, drying and firing the lining, the said lining then being supported in the block-forming mold and the insulating block formed about it in the form of a one-piece block, and the said block being dried and fired after removal from the said mold.

3. The method according to claim 1 wherein the binder is a gelling binder which is allowed to gel after the filling of the block-forming mold.

4. The method of manufacturing a heat refractory block for insertion in a metal container of an electric arc furnace, said method comprising the steps of providing a mold core and supporting the same in a mold, molding a layer of hardening refractory material about said core, removing said core when said layer has hardened sufficiently to sustain its configuration, subjecting said layer to a drying and heat treatment to complete the hardening of the layer, the hardening layer forming an inner lining defining a furnace cavity, then placing and supporting said liner in another mold, and thereupon enveloping the liner with a layer of insulating hardening refractory material to form an outer liner having an outer configuration fitting the inner configuration of said container.

5. The method according to claim 4 and comprising the steps of supporting said mold core on rods in the mold and forming said first layer with bosses about said support rods, and then supporting the inner liner formed by said first layer in said other mold by rods disposed in alignment with said bosses, said support rods for the inner and outer lining constituting cores to form aligned holes through the liner for passing electrodes of the furnace therethrough.

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