Aug. 28, 1928. 1,682,388

R. B. LINCOLN

INDUCTION FURNACE

Filed March 21, 1927

Fig. 1.

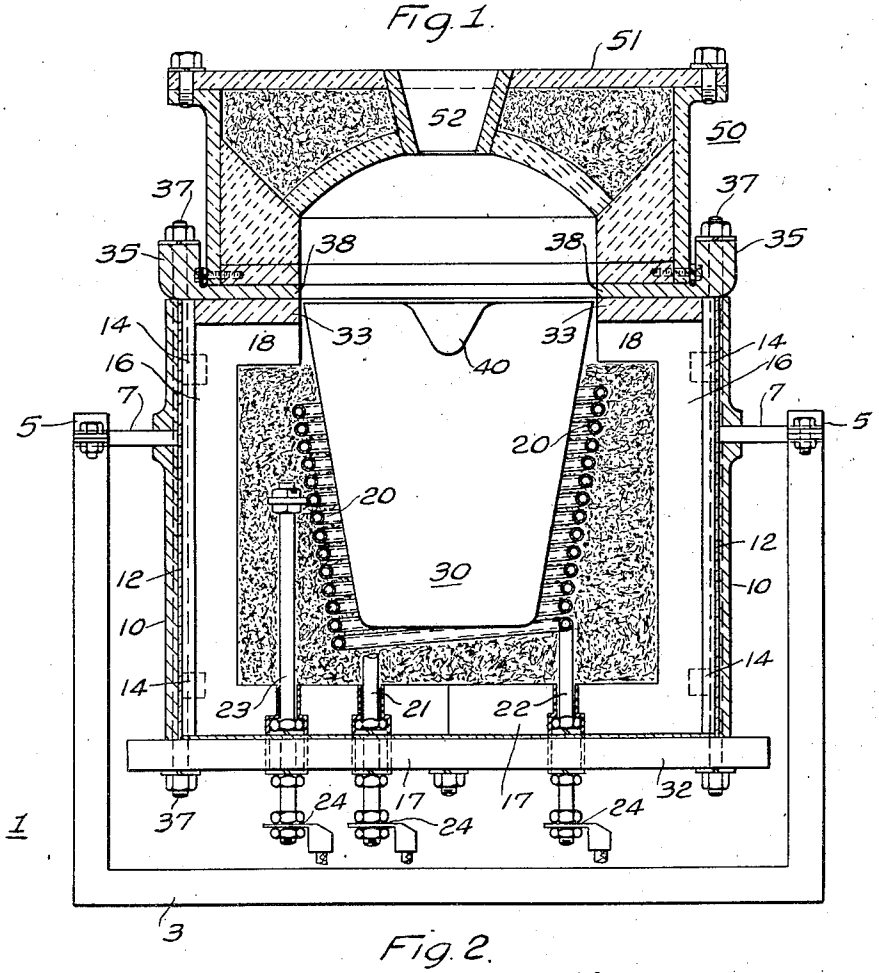
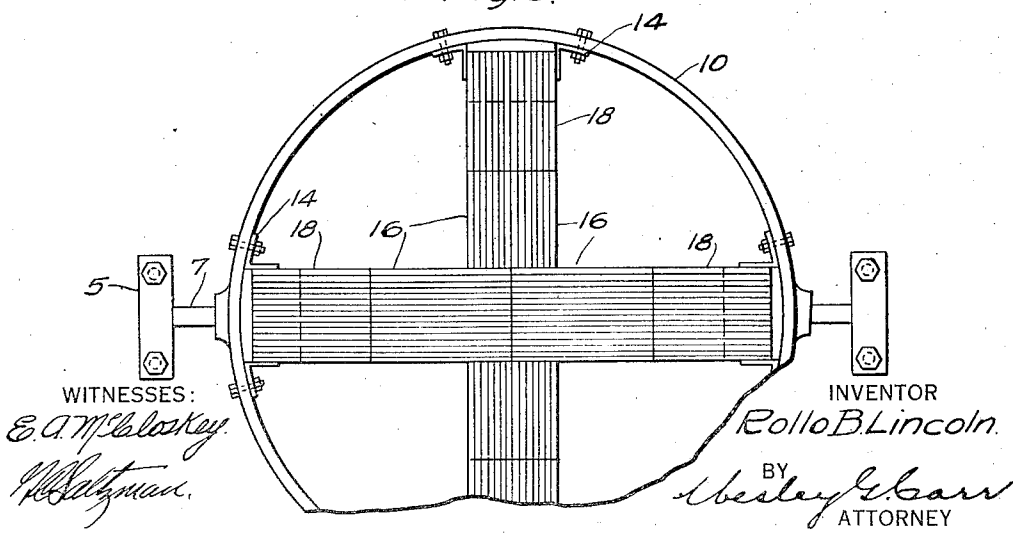


Fig. 2.



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Patented Aug. 28, 1928. 1,682,388

UNITED STATES PATENT OFFICE.

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INDUCTION FURNACE.

Application filed March 21, 1927. Serial No. 176,885.

My invention relates to electric furnaces and more particularly to furnaces of the induction type.

An object of my invention is to provide a mechanically strong metallic casing or shell for an induction furnace, which is shielded from the flux induced by the inductor coil, so that relatively large induction furnaces of sufficient mechanical strength to hold the proportionately large metallic charge may be constructed.

In furnaces of the induction type wherein the melt or charge is substantially cylindrical and surrounded co-axially by an inductor coil, the use of a metallic shell to maintain the coil, crucible, and refractory in their operative positions is objectionable because of the current induced therein which undesirably heats the same and absorbs a considerable portion of the induced energy.

The use of a non-conducting shell, such as micarta, is, therefore, necessary to obviate this condition, but, because of the relatively low mechanical strength inherent in a shell of this type, the size of the furnace is definitely limited.

In practicing my invention, I provide a tiltably mounted furnace casing of sheet metal within which a crucible and coil are positioned in a mass of loose refractory material, with a plurality of laminated ferro-magnetic cores between the coil and shell to form a flux path of low reluctance between the ends of the coil.

In the drawings,

Figure 1 is a view, in vertical section, of a furnace embodying my invention.

Fig. 2 is a fragmentary plan view of the furnace shown in Fig. 1, certain parts being omitted to show the arrangement of the laminated ferro-magnetic members within the shell.

This application is similar to the co-pending application of P. H. Brace, Serial No. 125,165, filed July 27, 1926, and assigned to the Westinghouse Electric & Manufacturing Company, but differs therefrom in that the disclosure in that applicaion is directed to means for permitting the use of low-frequency alternating current for efficient inductive heating, while the present disclosure is directed to means for permitting the use of a metallic shell for an induction furnace, thereby increasing the mechanical strength of the furnace structure.

An induction furnace, designated broadly as 1, comprises a supporting frame 3, journalled at 5, 5 to receive trunnions 7, 7 carried by the furnace body on a horizontal line extending substantially through the center of gravity thereof.

The furnace proper comprises a cylindrical shell or casing 10 of sheet metal, lined with a thin layer 12 of electric insulating material. A plurality of ferro-magnetic laminations of substantially L-shape are grouped to form a plurality of cores 16, with the long arms thereof extending vertically along the wall of the shell against the lining 12 and secured in position by angle brackets 14 bolted to the shell 10 through the lining 12.

The short arms 17 of the cores 16 extend horizontally to substantially the center of the shell, with the ends thereof in abutting relation, as shown more particularly in Fig. 2. The upper ends of the vertical portions of cores 16 are formed to provide projections 18 extending horizontally a short distance toward the center of the cylindrical shell.

Within the space defined by the inner edges of said core portions 16, 17 and 18, is an induction coil 20 and a crucible 30 which are maintained in operative nested relation by a body of loose refractory material, which, in the present embodiment, is zircon sand.

The inductor comprises a substantially helically wound coil 20 having terminal extensions 21, 22 and 23 respectively connected to the ends thereof and to an intermediate point, and extending downwardly through suitably bushed apertures in core arms 17 and the base of the furnace body.

The coil 20 is formed of hollow material to permit the passage of cooling fluid therethrough, which cooling fluid is supplied to the coil through the terminal extensions 21 and 22 connected to the ends of the coil. Suitable means 24 are provided on the extensions outside the furnace for effecting the electrical connection thereof to a suitable source of power.

A substantially cylindrical crucible 30, formed of electrically non-conducting refractory material, is adapted to contain the metallic charge, and is nested in coil 20, with the upper edge of the crucible somewhat above the portions 18 of cores 16.

The bottom of the metallic casing is closed by a metallic base plate 32.

Upon the extensions 18 of cores 16, and coextensive in width with the length thereof, is a refractory annular disc 33, the upper surface of which is substantially flush with the upper peripheral edge of shell 10. A metallic annular ring 38 rests upon the top of shell 10 and is provided with apertured lugs or bosses 35.

The metallic plates 32 and 38 are clamped together, with the shell 10 therebetween, by means of rods 37 which extend through apertures in plate 32 and the apertured lugs on plate 38, and are screw-threaded at the extremities thereof to receive securing nuts. The crucible is provided with a lip 40 which communicates with a suitable passage through the furnace wall and shell to provide a discharge spout for the molten material.

A cover 50, composed of refractory material and contained within a casing 51 of micarta or some similar material, is provided with a recess substantially co-extensive with the upper diameter of the crucible 30, and a passage 52 communicating with said recess for charging the crucible.

With the structure described, the laminated cores 16 are in the external path of flux induced by the coil, and, because of the relatively low reluctance of the cores, substantially all the induced flux will traverse the path defined by the metallic charge and the laminated cores, thereby, in effect, shielding the case from induced currents.

By my invention, relatively large induction furnaces adapted for commercial operation may be constructed which are of the required mechanical strength without an appreciable loss of power in the retaining shell.

Although, in the device disclosed, only four laminated cores are shown, it is obviously within the scope of my invention to increase or decrease the number of cores employed, depending upon the power input of the coil.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof, and I desire that only such limitations shall be placed thereon as are imposed by the prior art or specifically set forth in the appended claims.

I claim as my invention:

1. In an induction furnace, the combination with a helically wound inductor coil and a crucible nested therein, of a metallic casing surrounding said coil and crucible, and ferro-magnetic means within said casing in the exterior flux path of said coil for preventing the induction of electric currents in said metallic casing.

2. In an induction furnace, the combination with a helically wound inductor coil and a crucible nested therein, of a metallic casing surrounding said coil and crucible, and means for shielding said casing from the induction of electric currents therein, said means comprising a plurality of laminated ferro-magnetic members extending horizontally beneath said coil and vertically along the side thereof to provide a magnetic path of low reluctance about said coil and within said casing.

3. In an electric induction furnace, a metallic casing therefor, a plurality of L-shaped strips of ferro-magnetic material, means carried by said casing for maintaining said strips in groups with one leg thereof extending vertically along the wall of said casing and the other leg extending horizontally to substantially the center of the bottom of said casing to form a plurality of substantially U-shaped laminated members, an inductor coil within the space defined by the vertical portions of said laminated members and a crucible containing a metallic charge nested within said coil and co-axial therewith, whereby upon energization of said coil a flux is induced through said melt and said laminated members, thereby effectively shielding said metallic casing from induced currents.

4. In a coreless electric induction furnace, the combination with a substantially cylindrical crucible and a helically-wound inductor coil surrounding said crucible and coaxial therewith, of a metallic casing surrounding said coil and crucible, and means forming an incomplete magnetic path about said coil and adjacent to said casing to shield said casing from the induction of magnetic flux therein.

5. A coreless induction furnace comprising a helically-wound inductor coil and a crucible disposed in the magnetic axis thereof, a metallic shell surrounding said coil and crucible and means for preventing the induction of magnetic flux in said shell, said means comprising means forming a path of low reluctance in the exterior flux path of said coil and disposed between said coil and shell.

6. In a coreless induction furnace, the combination with a helically-wound inductor coil and a crucible nested therein, of means forming an incomplete path of low reluctance about said coil parallel to the major axis thereof, and a metallic casing surrounding said elements, whereby, upon energization of said coil, the induction of magnetic flux in said casing is prevented.

In testimony whereof, I have hereunto subscribed my name this 17th day of March, 1927.

ROLLO B. LINCOLN.