Jan. 1, 1924 1,479,582

C. A. BRAYTON, JR

INDUCTION FURNACE

Filed Sept. 24, 1920 2 Sheets-Sheet 1

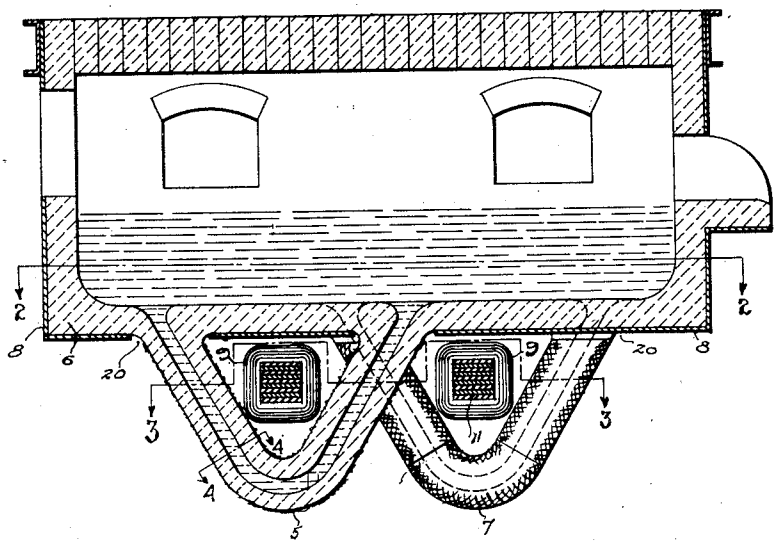


Fig. 1

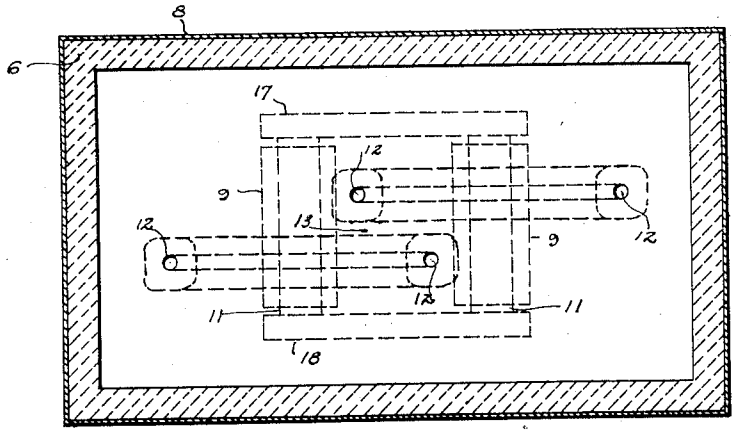


Fig. 2

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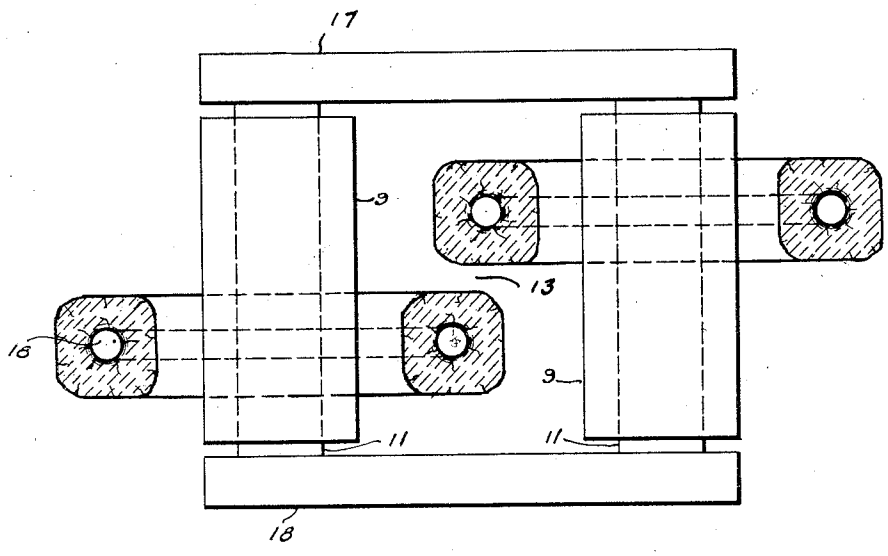


Fig. 3

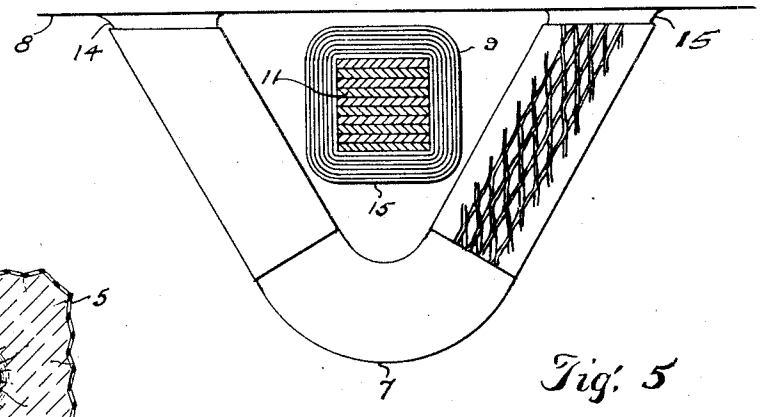


Fig. 5

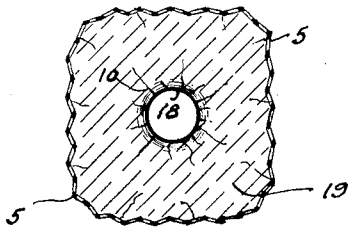


Fig. 4

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UNITED STATES PATENT OFFICE.

CHARLES A. BRAYTON, JR., OF CLEVELAND, OHIO, ASSIGNOR TO THE INDUCTION FURNACE COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

INDUCTION FURNACE.

Application filed September 24, 1920. Serial No. 412,549.

To all whom it may concern:

Be it known that I, CHARLES A. BRAYTON, Jr., a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Induction Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to the construction of the refractory elements of an electric furnace of the induction type wherein there is a bath and loop channels below the bath and communicating therewith, these channels with the bath, forming the secondary circuit, surrounding an induction coil which constitutes the primary circuit. It has been an accepted theory that the more refractory material used in such a furnace, the greater would be the life of the channels. I find that this is not the case, but in the course of time the use of such thick channel walls results in disturbance of the regulation of the furnace, due to the increase in the conductive cross section of the channel caused by the metal permeating through the lining and by consequent radiating cracks filling with the metal.

An object of this invention is to construct a furnace having a thin lining of such material that the lining of the channel portions may be maintained at a relatively cool temperature and thereby prevent the molten metal from permeating through the refractory lining and likewise prevent incipient fractures from growing.

Another object of the present invention is to provide an efficient and economical construction of the bath basin and the walls that form the communicating channels about the primary coil, so that the refractory material may be quickly molded and dried without having fractures occur in the same.

The invention is hereinafter more fully described in connection with a convenient embodiment of the same as shown in the drawings and the essential features of the invention are set out in the claims.

In the drawings Fig. 1 is a vertical cross section through one of the loops of the secondary showing the elements of the furnace which form the primary and secondary circuits; Fig. 2 is a horizontal cross section taken on the line 2—2 of Fig. 1 wherein the spacing of the connections of the loops with the bath are shown; Fig. 3 is an irregular section taken along the line 3—3 of Fig. 1 showing the cross sections of the vertical channels and a plan view of the primary windings; Fig. 4 is an enlarged cross section of one of the channels showing the relative size of the cross section of the channel opening to the cross section of the refractory material which forms the walls of the same; Fig. 5 is a vertical section of the primary coil and core and an exterior view of one of the channel loops.

Referring to the parts by numerals, in Fig. 1, 6 represents the hearth of the furnace which may be formed of magnesite or other refractory material that can be worked in plastic form. The channel loops 5 and 7, I prefer to have molded contiguous with the hearth and of a modified U-form as shown in Fig. 1.

The hearth body has a metal shell 8 extending around and under it with four openings thru which the walls of the loops are molded in such manner as to form a homogeneous continuation of the bath basin 6. These loops are so spaced that each one surrounds separate legs of the primary winding 9 in such manner that air circulation about the primary and the walls of both loops may be insured. The openings of the loops as indicated at 12, Fig. 2, are likewise spaced in such manner that an air space 13 is provided between the walls of the same. Thus by causing proper circulation about the primary and loop walls, rapid heat radiation from the exterior surfaces of the refractory material forming the loops is maintained, and any permeation or fracture which may start to develop from the interior wall of the channel, such as is indicated at 10, Fig. 4, immediately becomes congested due to the metal solidifying before it has penetrated through the lining any distance that would be harmful to the proper operation of the furnace. The primary winding 9, likewise, may be maintained at a proper operating temperature due to the open construction of the under sections of the furnace.

The core 11 of the primary is built up of rectangular laminations of suitable and economical means, and the ends 17 and 18, Fig. 2, are also exposed to air circulation.

The cross section of the loop channel as shown at 18, Figs. 3 and 4, is preferably uniform throughout the length of the channel and its area is proportioned in relation to the width, breadth and depth of the bath. This proportioning is selected on the basis of data gained by experiments of an extensive character to attain the object, namely, that the cross section of the loop channel shall be of sufficient thinness to insure quick and permanent solidification of any metal that may start to permeate through the wall.

The outside of the wall preferably such as shown in Fig. 5 is reinforced by expanded metal which is also utilized as part of the mold for forming the same. This expanded metal reinforcement is shown parted at 14 and 15, Fig. 5, thereby preventing formation of a complete circuit on the exterior of the furnace due to induction. I find that it is a convenient method to construct the mold with the expanded metal connected to the bottom or supporting plate 8 and subsequent parting may be accomplished upon starting the furnace at which time the current induced in the expanded metal encounters a maximum resistance at the point of juncture 20 and consequently melts away while leaving the refractory lining intact.

I have found, after considerable experimenting, that the refractory material best suited to give the desired results may be composed of a composite mixture of ground magnesite, the granular structure of which is composed of screenings of various sizes, these sizes being dependent upon the grade of the magnesite being used, and also upon the coarsest grain in the mixture, the corresponding grades being of such size as to properly fill the voids in such a manner that the greatest density of the material may be attained. I have found, furthermore, that a fair grade of sodium silicate may be used as a binder in sufficient quantity to work the magnesite into a plastic condition, the consistency of stiff putty.

The channel is formed by suspending a fusible core of the proper diameter and shape within the mold so that its centre line is coincident with the centre line of the expanded metal form and the plastic material is then forced through the opening 20 in the supporting plate 8.

By constructing a furnace such as I have herein described it is possible to prevent the metal in the channels from burning through by maintaining a relatively cool temperature on the outside of the loop walls, which causes the metal to solidify in any incipient cracks that may be present in that portion of the lining that is in contact with the metal in the channel.

The lining can be molded as a unit without the presence of parting lines and the drying period is greatly decreased, due to the thin loop lining being exposed on all sides. The temperature of the primary windings and core may be likewise regulated by the construction of such a furnace as I have herein set forth.

Furthermore, by keeping the cross section of the channels uniform and of known area, the proper regulation of the furnace may be maintained throughout its life.

Having thus described my invention, I claim:—

1. In an induction furnace, the combination of a bath, a closed channel of uniform cross section thereunder and connected therewith and leading to and from the bath, said channel having a comparatively thin wall of substantially even thickness thruout its length and surrounded by a pervious metallic jacket, whereby said wall may be maintained at a relatively cool temperature to prevent permeation of the molten metal through the channel wall.

2. In an induction furnace, the combination of a refractory basin, hollow, comparatively thin walled refractory loops of uniform cross section leading to and from the basin in substantially vertical planes and parallel to each other and in relatively staggered position and a primary core and windings passing thru the openings of said loops.

3. In an induction furnace, the combination of a bath, a closed channel of uniform cross section leading to and from the bath, the walls of said channel being of comparatively thin cross section thruout its length, and reinforcing expanded metal about the exterior surface of the channel walls.

4. In an induction furnace, the combination of a bath, a refractory basin therefor, a closed channel of substantially uniform cross section leading from thereunder and returning thereto, hollow U-shaped loops of refractory material forming the channels and reinforcing pervious jackets about the exterior surface of the loops whereby considerable external surface of the refractory walls may be uniformly exposed to cooling air currents.

5. In an induction furnace, the combination of a bath, a refractory basin therefor, hollow U-shaped refractory loops connected thereto and thereunder, said loops surrounding a primary core and winding and so spaced in planes parallel to each other and normal to the bath that their proximate legs overlapping each other, whereby free ventilation of the primary and loops may be obtained.

6. In an induction furnace, the combination of a bath, a refractory basin therefor, U-shaped channels encircling a primary and leading from thereunder and returning thereto, the walls of said channels being of relatively thin refractory material and so

spaced as to permit sufficient air circulation about the primary and channel walls to maintain proper operating temperature of the same, and means for reinforcing the walls of said channels comprising pervious jackets surrounding said walls.

7. In an induction furnace, the combination of a bath, a refractory basin therefor, U-shaped channel walls connected therewith and encircling a primary, and pervious reinforcing means about said channel walls that may be used as molds for forming the same.

8. In an induction furnace, the combination of a bath, U-shaped channels connected thereto and thereunder, a refractory basin for said bath, refractory walls about said channels and pervious reinforcing metal about the exterior of said walls that may be used for molding the same.

9. In an induction furnace, the combination of a refractory basin, and a hollow, comparatively thin walled refractory loop of uniform cross section leading to and from the basin in a plane substantially vertical to said basin, the wall of said loop being composed of a wet mixture of granular magnesite and sodium silicate.

10. In an induction furnace, the combination of a bath, a refractory basin therefor, and a closed channel of substantially uniform cross section leading from thereunder and returning thereto, the wall of said channel being formed of a mixture of crushed magnesite and a concentrated solution of sodium silicate, whereby said mixture may be worked into a homogeneous plastic condition.

11. In an induction furnace, the combination of a bath, a refractory basin therefor, U-shaped channels leading from thereunder encircling a primary and returning thereto, the walls of said channels being of relatively thin refractory material composed of a homogeneous mixture of crushed magnesite and a concentrated solution of sodium silicate.

12. In an induction furnace, the combination of a refractory basin, hollow comparatively thin walled refractory loops leading to and from the basin and so positioned that their proximate legs overlap each other while being out of contact with each other, and a primary core and windings passing through the openings of said loops.

In testimony whereof, I hereunto affix my signature.

CHARLES A. BRAYTON, JR.