June 16, 1942. H. C. FISHER 2,286,481

INDUCTION FURNACE

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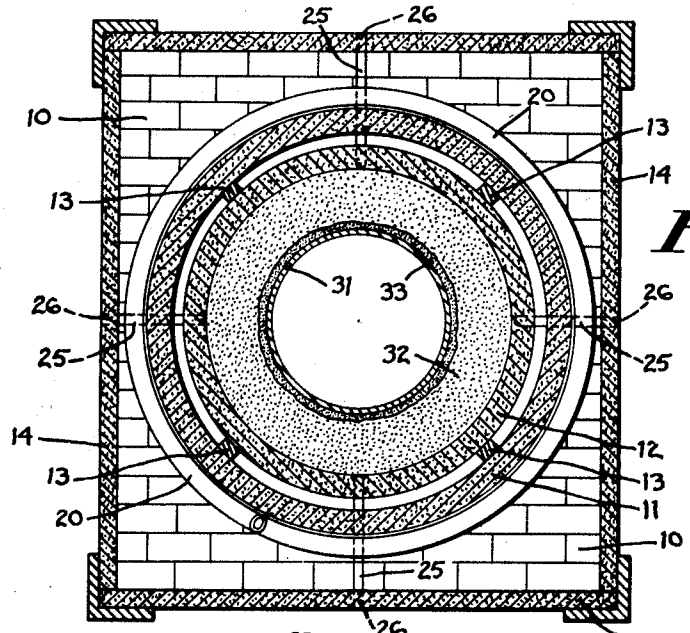


Fig. 2

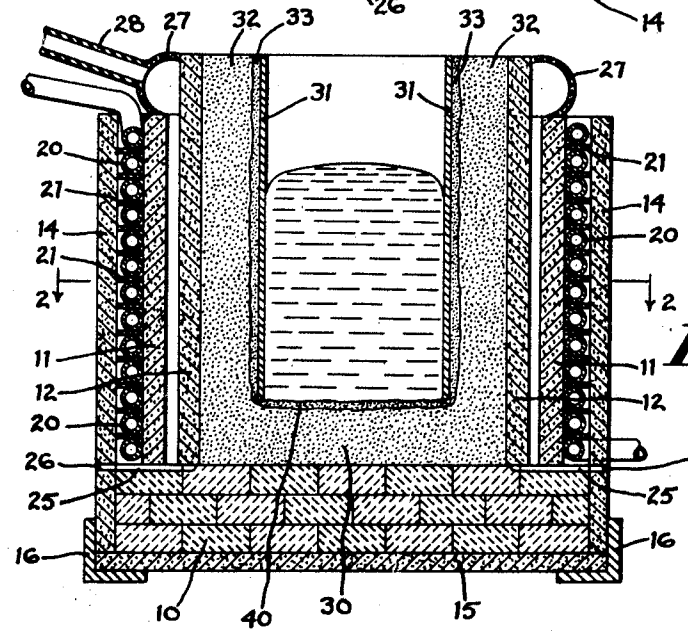


Fig. 1

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INDUCTION FURNACE

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1 Claim. (Cl. 13—27)

The invention relates to induction furnaces.

One object of the invention is to provide an induction furnace with an air cooled wall supplementary to the water cooled coil. Another object of the invention is to provide an induction furnace lining with cooling ducts inside of the coils and incorporated in the lining.

A further object of the invention is to provide a safer induction furnace. Another object of the invention is to create a sharper heat gradient between the outside and the inside of induction furnaces. Another object of the invention is to trap any molten metal which may leak through the lining of an induction furnace before it comes in contact with the induction coil.

Another object of the invention is to cause freezing of the slag constituents and metal inside of the refractory lining of an induction furnace to stop the approach of molten metal to the induction coil. Another object of the invention is to provide a path of escape for any metal that has penetrated through the refractory lining, thereby saving the induction coil from damage and warning the operator to shut off the power.

Another object of the invention is to provide an induction furnace with a stronger wall so that the lining can be rammed in place without danger of breaking the wall or damaging the coil. Other objects will be in part obvious or in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, all as will be illustratively described herein, and the scope of the application of which will be indicated in the following claim.

In the accompanying drawing showing one of many possible embodiments of the mechanical features of the invention,

Figure 1 is a vertical axial sectional view of a furnace constructed in accordance with this invention, and

Figure 2 is a cross-sectional view taken on the line 2—2 of Figure 1.

The present invention is more particularly concerned with induction furnaces which have only a primary coil, current being induced in the metal charge thereby heating it. It has been customary to run such furnaces on frequencies of 480 or 960 cycles, the primary coil being a spiral metal tube through which water is flowing. In the manufacture of such furnaces it has been common to place a sheet mica or asbestos cylinder inside of the coil, then to pour refractory granular material, referred to as cement, into the inside of the furnace and tamp to form a bottom. Thereafter a crucible core either of graphite or of metal would be set in place and a more refractory mixture tamped outside of this core and inside of the mica or asbestos cylinder. The electric circuit would then be completed and eddy currents induced in the crucible core would sinter the refractory material next to it.

Such furnaces have frequently failed in the past due to a crack forming in the sintered lining, the molten metal eventually reaching the water cooled primary coil. It is to be understood that after the furnace has been in operation a short time the sheet iron core which was originally introduced no longer exists.

Considering now the present invention and referring to Figure 1, I provide a furnace bottom 10 which may be made of any suitable refractory material such as insulating bricks. I provide a pair of asbestos cylinders 11 and 12 of slightly different diameters, locating one inside the other as shown in Figure 1. These may be held apart by suitable asbestos spacers 13. The cylinder 12 is longer than the cylinder 11 and extends above it as shown in Figure 1. These may be held apart by suitable asbestos spacers 13. The cylinder 12 is longer than the cylinder 11 and extends above it as shown in Figure 1, while both cylinders rest upon the refractory bottom 10. These two cylinders 11 and 12 together constitute a furnace wall having air passages for the cooling of refractory lining and for the escape of metal which may penetrate the lining.

I further provide an asbestos box including sides 14 and a bottom 15 which may be held together with suitable metal angles 16. This box may be rectangular in shape while the furnace proper is cylindrical. Inside the box and around the outer asbestos clyinder 11 is a coil 20, for example of copper tubing. The turns of the coil 20 are separated by suitable insulating material 21, for example a strip of asbestos or mica.

One end of the coil 20 is connected to a water supply and the other end is connected to waste in any suitable manner, as is understood in this art.

I form a number of depressions 25 in the bottom 10 which are connected with orifices 26 through the outer asbestos sides 14. Extending between the cylinders 11 and 12 is a semi-circular annular bustle pipe 27 which may also be made of asbestos and may be cemented to the cylinders 11 and 12. A suitable header 28 is

provided and this is connected to a source of air under moderate pressure.

The refractory core is made in the manner already described, that is to say, first a bottom layer 30 of a dry refractory mix is tamped into place, then an iron core 31 is placed in position and refractory granular material 32 is tamped around the core 31. Then the coil 20 is energized which induces a current in the core or shell 31 sintering a layer 33 of the refractory material 32, thereby forming a cylindrical lining. The iron shell 31 melts in this process. An iron charge can be introduced into the furnace during the sintering of the lining, in which case the iron core 31 simply becomes part of the charge.

By forcing air, gas or other suitable coolants between the asbestos cylinders 11 and 12, cooling of the refractory lining is effected and a sharper temperature gradient is achieved, keeping the loose grains of refractory material in the lining 32 relatively cool and rapidly freezing any metal that may leak through the sintered layer 33. It should be understood that this type of furnace purposely has a comparatively thin crucible formed of the sintered layer 33 and the bottom sintered layer 40, and a thick crucible wall is not desired, because whenever a crack starts, it usually runs through the entire sintered wall. In these furnaces a crack can go no further than the sintered layer. By keeping the outside of the loose granular lining 32 relatively cool and making the temperature gradient as steep as possible, the slag from the melt will be more viscous and will congeal closer to the metal charge than it will if the outside temperature is higher. This early congealing of the slag retards chemical reaction with the refractory and thereby promotes longer lining life.

The furnace of the invention is a safer furnace because when eventually the lining does give out there is a warning as the metal charge penetrates the asbestos cylinder 12 because the metal will run down through the air passage. These furnaces can become dangerous if the metal charge reaches the induction coil 20 and penetrates to the circulating water inside of it. Suitable temperature indicating apparatus may be installed in the offtake bustle pipe to indicate increasing destruction of lining or when lining becomes unsafe through erosion.

It will thus be seen that there has been provided by this invention a method and an apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth, or shown in the accompanying drawing, is to be interpreted as illustrative and not in a limiting sense.

I claim:

An induction furnace comprising an asbestos box, a refractory bottom in said asbestos box, a spirally wound hollow induction coil inside of said box whereby water may be circulated through the coil, a furnace wall having a passage inside of said induction coil, connections for admitting air under pressure to the passage, a lining of granular refractory material inside of said wall, and a sintered portion in the inside of said lining constituting the crucible for the furnace, the construction trapping any molten metal which penetrates the lining before it reaches the water cooled induction coil by allowing the molten metal to flow into the passage which is cooled by the air under pressure and which thereby cools the refractory granular material to cause a steep temperature gradient between the crucible and the wall, thereby quickly to freeze any metal or slag penetrating the sintered crucible to increase the life of the lining.

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