March 11, 1958 S. L. REESE ET AL 2,826,624

VAPOR SHIELD FOR INDUCTION FURNACE

Filed Dec. 5, 1956

Fig-1

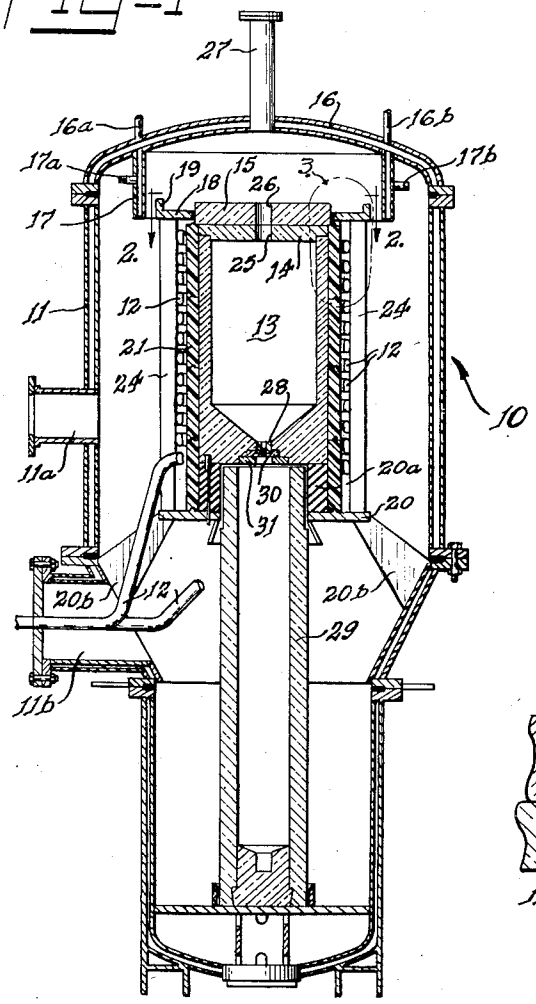


Fig-2

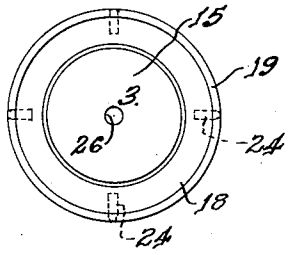
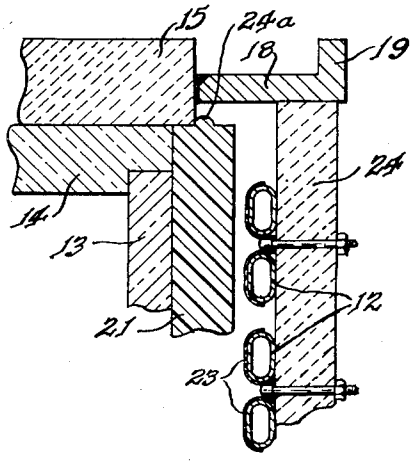


Fig-3



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2,826,624

Patented Mar. 11, 1958

2,826,624

VAPOR SHIELD FOR INDUCTION FURNACE

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Application December 5, 1956, Serial No. 626,557

4 Claims. (Cl. 13—27)

This invention relates to an induction furnace. More particularly the invention relates to a furnace of this type in which the vapors generated thereby are prevented from corroding and shorting the uncovered inductive heat source.

In an induction furnace, it is customary practice to wind a coil about a crucible, the coil acting as a heat source for the crucible in which materials may be heated. A cover might be used to protect the coil from attack by corrosive substances which are often emitted by materials when they are heated but would hamper the inspection and/or replacement of the coil, since considerable time would be required for applying a coil cover, degassing, chipping before examination, and other operations connected with the use of a coil cover. Thus it is desirable to employ an uncovered coil.

An object of the present invention is to protect an uncovered induction coil in a furnace by providing means to condense vapors which might otherwise condense on the uncovered coil and so corrode and/or short the turns of the coil. This object is accomplished in the present invention by a fluid-cooled chamber which is located immediately above the region where the vapors are formed and by means to deflect the vapors to contact the walls of the chamber whereon they will be condensed.

Other objects will become apparent from the detailed description that follows and from the attached drawings, in which:

Fig. 1 is a vertical sectional view taken through the induction furnace of the present invention;

Fig. 2 is a plan view taken along lines 2—2 of Fig. 1; and

Fig. 3 is a fragmentary sectional view of the portion in the circle 3 in Fig. 1.

The furnace of the present invention is designated by the reference character 10 and comprises a hollow furnace shell 11 having a vacuum port 11*a* and a power port 11*b*, an induction coil 12, and a crucible 13 having a lid 14 and a cover 15.

A novel condensing means is provided within the furnace of the present invention and comprises a hollow top 16 having an inlet nipple 16*a* and an outlet nipple 16*b*, a hollow annular apron 17 having an inlet connection 17*a* and an outlet connection 17*b*, and an annular disc 18 having an annular lip 19.

Crucible 13 is supported vertically within the furnace shell 11 by a furnace table 20, a base insulator 20*a*, and mechanical supports 20*b*. The mechanical supports are joined to the interior of the furnace shell 11 by welding or similar means. A wall 21 of insulator blocks is built around the crucible and rests on the furnace table 20. Induction coil 12 surrounds the wall 21 in spaced relationship thereto and comprises a double helix the turns of which are retained at a fixed spacing, as shown in Fig. 3, by brackets 23 and four rigid members 24 to which the brackets are attached and which extend the length of the coil and are spaced generally equally about the coil.

Crucible lid 14 has a peripheral groove that insures

good contact between the rim of the crucible 13 and the lid. Crucible cover 15 lies on the crucible lid 14 without being attached thereto and is centered thereon by an annular projection 24*a* at the upper end of the wall 21. Central openings 25 and 26 of the lid 14 and cover 15, respectively, register with one another. The annular disc 18 is joined to the peripheral sides of the crucible cover 15 with a ceramic paste to effect an airtight bond. Disc 18 is formed to be concave on its upper side so that it will not sag downwardly due to its own weight at the elevated temperatures of the furnace when in operation. Lip 19 is welded to the periphery of annular disc 18, the lip being disposed transversely to the disc to form a shallow cup-like element with the disc. Annular apron 17 is disposed radially outwardly of the annular disc 18 in a fixed spaced relationship to the disc to form an annular space between the elements. The area of this annular space is made greater than the area of vacuum port 11*a* to minimize the drawing of vapors past the lip 19 and to increase the probability that vapors will contact and be condensed by the top 16 and the annular apron 17. Annular apron 17 is secured at its upper rim to the top 16 of the furnace 10 by welding or by other suitable means. Top 16 is hermetically sealed to furnace shell 11 to effect an airtight chamber. A sight tube 27 is located at the center of the top 16 and has its axis coincident with that of the crucible 13, the lid 14, and the cover 15. A source of vacuum, not shown in the drawings, may be coupled to the interior of the furnace 10 through the vacuum port 11*a* of furnace shell 11.

In the base of the crucible 13 there is a pour plug 28 having a blind hole through which molten materials may flow under gravity to a mold 29 which is positioned under the crucible. Pour plug 28 is retained in position by a knockout slide 30 and a knockout slide retainer 31 which are positioned under the pour plug at the base of the crucible and above the mold 29. A detailed description of the construction and operation of this crucible pour mechanism is given in Bravard et al. application Serial No. 564,594, filed February 7, 1956. The knockout slide 30 has a recess in which the bottom of the pour plug 28 rests. Striking the knockout slide 30 shears the lower portion of the pour plug 28 from its upper portion and opens up the blind hole in the pour plug permitting material to flow therethrough. There is a through hole provided in the knockout slide 30 so that after the slide is struck, this through hole is aligned with the hole in the pour plug 28 and with a through hole in the knockout slide retainer 31. Material is thus permitted to flow unimpeded under gravity from the crucible 13 to the mold 29.

The furnace shell 11, the top 16, and the annular apron 17 are of hollow double-wall construction. A pressurized coolant such as water is circulated through the space within the walls of the top 16 and the annular apron 17, nipples 16*a*, 16*b*, 17*a*, and 17*b* providing inlet and outlet connections with a source of coolant, not shown in the drawings. The furnace shell 11 is also cooled by a coolant such as water circulated therein.

The operation of the present invention is best understood when consideration is made of one of its applications. In an induction furnace in which materials are heated to drive off impurities as vapors, the induction coil of the furnace is prone to chemical attack by the vapors and shorting due to condensation of the vapors on the coil. Covering the coil eliminates these problems partially, but a covering also hampers inspection and/or replacement of the coil. The present invention protects the coil without employing any covering. As vapors emerge from the crucible 13 through the openings 25 and 26 in the lid 14 and cover 15, respectively, the vapors are condensed on the cooled top 16, the cooled

apron 17, and the disc 18. Thus the vapors will not condense on the coil 12. The disc 18 with its lip 19 prevents the condensed vapors from dropping on the coil 12.

There is great flexibility permitted the artisan in selecting materials to be used in constructing a furnace embodying our invention. However, we have used graphite as the material for the crucible 13, the lid, 14, the pour plug 28, the mold 29, the knockout slide 30, and the knockout slide retainer 31. Crucible cover 15, base insulator 20*a*, and members 24 are made of a highly refractory material, of which there are many such materials commercially available. The coil 12 is preferably made of copper tubing through which a coolant may be circulated; however, aluminum or some other electrically conducting material may be used with satisfactory results. Stainless steel or some comparable corrosion-resistant material may be used in the furnace shell 11, the top 16, the annular apron 17, the annular disc 18, and the annular lip 19. Furnace table 20 and supports 21*b* were formed from heavy steel plate since they are made to bear a great weight when the crucible 13 is loaded.

The intention is to limit the invention only within the scope of the appended claims.

What is claimed is:

1. In an induction furnace comprising a hollow furnace shell including a top, a crucible vertically disposed within the furnace shell, an induction coil disposed about the crucible, and a cover for the crucible located above the induction coil and having a central opening, the combination therewith, of an annular disc secured to and disposed about the cover to separate the region adjacent the induction coil from the region above the cover, an annular apron secured to the interior of the top and disposed about the annular disc, and means for cooling the apron and the top of the furnace shell whereby vaporous materials issuing from the crucible through the cover are condensed on the top of the furnace shell, the apron, and the annular disc and thus are prevented from being condensed on the induction coil.

2. In an induction furnace, the combination specified in claim 1, the annular disc having a lip secured to the periphery of and disposed transversely to the disc in the direction of the top of the furnace shell, whereby vaporous materials issuing from the crucible through the cover are directed to cause their contact with the top of the furnace shell and the apron.

3. In an induction furnace comprising a hollow furnace shell including a top, a crucible vertically disposed within the furnace shell, and an induction coil disposed about the crucible, the combination therewith, of an annular disc disposed adjacent to the upper part of the crucible and extending radially outwardly of the induction coil to separate the region adjacent the induction coil from the region above the crucible, an annular apron secured to the interior of the top of the furnace shell and disposed about the annular disc, and means for cooling the apron and the top of the furnace shell whereby vaporous materials issuing from the crucible are condensed on the top of the furnace shell, the apron, and the annular disc and thus are prevented from being condensed on the induction coil.

4. In an induction furnace, the combination specified in claim 3, the annular disc having a lip secured to the periphery of and disposed transversely to the disc in the direction of the top of the furnace shell whereby vaporous materials issuing from the crucible through the cover are directed to cause their contact with the top of the furnace shell and the apron.

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