

June 15 , 1926.

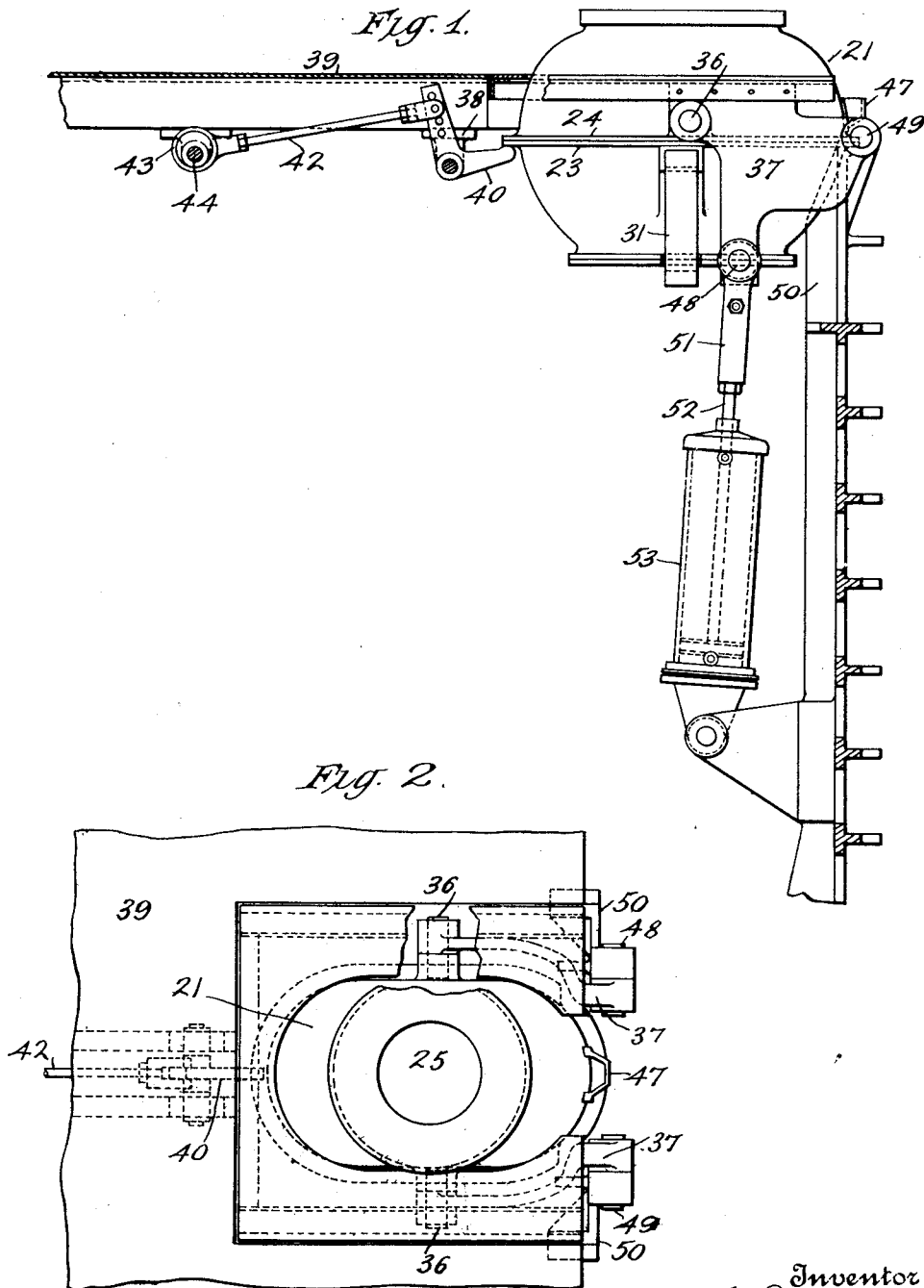
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Filed May 28 1923

2 Sheets-Sheet 1



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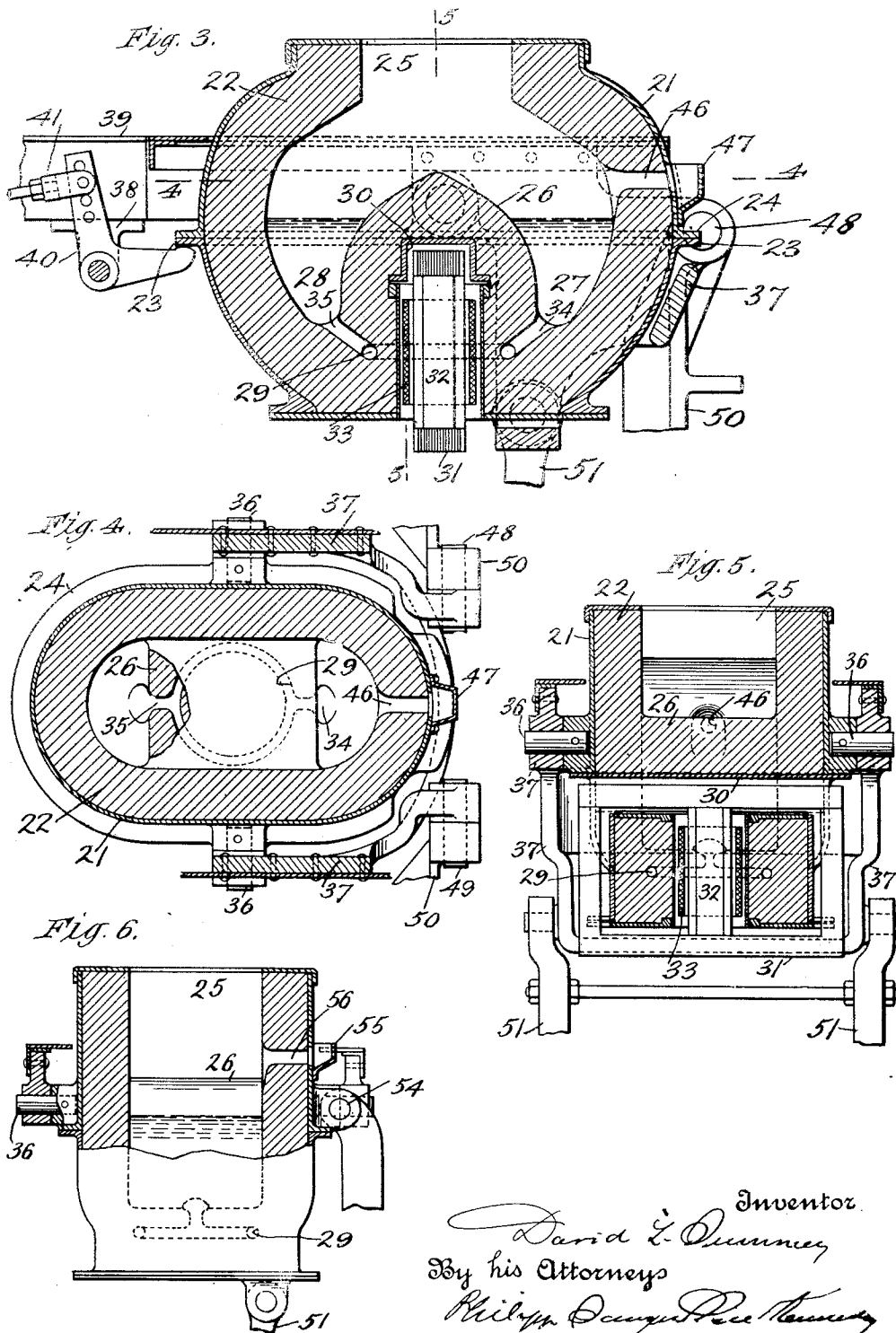
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UNITED STATES PATENT OFFICE.

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ELECTRIC INDUCTION FURNACE.

Application filed May 28, 1923. Serial No. 641,801.

This invention relates to electric induction furnaces.

It is the principal object of the invention to provide an improved induction furnace, and particularly one that avoids stirring of the bath by electrical effects.

With this general object in view, the invention consists in the combinations, details of construction and arrangements of parts which will first be described in connection with the accompanying drawings and then more particularly pointed out.

In the drawings:

Fig. 1 is a view in side elevation of a furnace constructed in accordance with the invention;

Fig. 2 is a top plan view with parts broken away;

Fig. 3 is a vertical cross-sectional view through the furnace;

Figs. 4 and 5 are cross-sectional views taken on the lines 4—4, 5—5 respectively of Fig. 3; and

Fig. 6 is a vertical sectional view with parts in end elevation, showing a modified construction.

Referring to the drawings, there is provided, in the present embodiment, a furnace body comprising a shell 21 and a lining 22 of suitable refractory material. This body is generally bowl shaped, having flat sides and bulging ends, as more clearly appears in the drawings. For convenience, the main shell may be formed in two parts, the top part having a flange 23 resting on a similar flange 24 on the bottom part. At the top of the furnace is a charging opening 25.

In constructions embodying the invention to the best advantage the hearth or space for the charge is in the form of a plurality of symmetrically arranged pockets or chambers. To this end, as here shown as an example, extending across the interior of the furnace below the charging opening is a ridge 26 of refractory material conveniently formed as a continuation of the furnace lining. This ridge has sloping or curved sides, as appears in Fig. 3 and divides the furnace interior into two diametrically opposed pockets 27, 28, opening out of the common space between opening 25 and the ridge 26, and extending downwardly, as more fully appears in Fig. 3. In the embodiment illustrated the charging opening 25 is centered on the main vertical axis of the furnace body and the pockets 27, 28 are sym-

metrical with this axis, the tendency of the ridge 26 being to divide the charge into the two pockets.

The invention includes a transformer primary and core and a secondary channel,—that is, a channel for the metal bath which plays the part of the secondary. In constructions embodying the invention to the best advantage the secondary channel is located in a horizontal plane and is symmetrical with and equidistant from the primary. Although capable of various constructions, in that here shown as an example, near the bottom of the furnace, is a circular channel 29 lying in a horizontal plane and concentric with the charging opening. As shown, the channel 29 is circular in cross section.

Extending across the furnace below the crest of ridge 26, there is provided a transformer casing member 30, the furnace body being suitably formed to accommodate the transformer elements as appears in the drawings. The transformer here illustrated includes a laminated core 31 in the form of a closed E. The central leg 32, in cross section, has the form of a Greek cross and around this central leg is wound a cylindrical primary coil 33, located concentrically with the secondary channel 29.

With a secondary element symmetrical with and equidistant from the primary element, the transformer is capable of high efficiency, thus making possible a highly efficient induction furnace. Furthermore, with a secondary channel such as that described, the length gives a good power factor, and the length can be increased to obtain more power, as for low resistance metals, without increasing the head of metal and so increasing pressure on the lining. The construction further lends itself to flexibility of use, as more heating capacity can be obtained either by increasing the voltage for a given resistor channel or by increasing the length of the resistor channel, with the same cross section, for a given voltage.

There is provided means of communication between the pockets 27, 28 and the channel 29. Although capable of various constructions, in the embodiment here illustrated, opening out of the pockets 27, 28, near the bottom thereof, are two diametrically opposed passageways 34, 35 opening into the channel 29.

Suitable electric current being supplied

to the primary 33 of the transformer, the metal bath in the channel 29 acts as a secondary and currents are induced therein, as will be apparent to those skilled in the art, these induced currents heating the bath.

There is provided means for causing a mechanical stirring of the bath and in constructions embodying the invention to the best advantage the furnace body is periodically rocked in the direction of the passages 34, 35. While this may be accomplished in various ways, the furnace may be pivoted off center, whereby it is tilted one way by gravity, mechanism being provided for tilting it in the opposite direction. Although capable of various constructions, in that here illustrated as an example, at the sides of the furnace body are gudgeons 36 pivotally mounted in a frame 37 later referred to. It will be noted that the pivots just described are slightly off center. In other words, the pivots are offset from the center of gravity so that the tendency of the furnace is to tilt to the left as viewed in Fig. 3.

While the mechanism for tilting the furnace in the opposite direction may vary, it may conveniently comprise an oscillating member engaging the lower side of an abutment on the furnace. As here illustrated as an example, pivoted to a suitable support, such as a bracket 38 hung from the charging floor 39, is a bell crank lever 40. Pinned to one arm of this bell crank is a yoke 41 on a link 42 oscillated by an eccentric 43 on a slow moving shaft 44 suitably connected with a source of power. The free arm of the bell crank engages the under side of the flange 23, which forms, with flange 24, an abutment. Upon rotation of the eccentric 43, the bell crank will alternately tilt the furnace to the right as viewed in Fig. 3 and permit tilting in the opposite direction under the force of gravity. Thus the furnace is periodically rocked back and forth on its pivots.

When the furnace is tilted, for example to the right as viewed in Fig. 3, the molten bath in the channel flows through the passage 34 into the pocket 27 to make contact with and further the melting of more of the charge. Upon the reverse tilt the flow is into the opposite pocket with a like effect. This alternate movement of the furnace effectively stirs the bath and this stirring is entirely mechanical, as distinguished from stirring by various electrical effects such as are known in the art.

With the construction described there is no local overheating as the bath in the channel must circulate. Furthermore, the surge of the bath and settling of the charge as the furnace rocks, prevents "matting" and avoids the manual agitation of the charge during melting that is ordinarily found

necessary with induction furnaces. There is no so-called "pinch" effect because any tendency to a "pinch" effect in the resistor circuit is counteracted by a similar effect elsewhere in that circuit.

There is provided means for tilting the furnace for pouring and this is accomplished without interfering with the stirring mechanism. Although capable of various constructions, in that illustrated as an example in Figs. 1 to 5, in the end of the furnace body opposite the bell crank 40 is a passageway 46 leading to a spout 47. At this same end of the furnace, the frame 37 is pivotally connected, as at 48, 49, to a standard or support 50. Near the bottom of the frame 37 is pivotally connected a link 51 mounted on the piston rod 52 of an air hoist 53, or the like, of any suitable construction.

Upon operation of the air hoist the frame 37 and furnace body, moving as a unit, are tilted on the pivots 48, 49 until the melted charge is poured out via the spout 47. It will be noted that this tilting for pouring is in the direction of the passage 34. With this construction the furnace may be completely emptied, as the passage 34 opens out of the lowest part of the channel 29.

It may be desirable to retain part of the melted charge when pouring takes place. This may be accomplished, for example, by pouring in a direction at right angles to that described. Fig. 6 illustrates a modification in which the frame pivots are displaced 90° from the pivots 48, 49, one pivot 54 being shown. The spout 55 and pouring passage 56 are similarly displaced, being in one side of the furnace instead of at the end. With this construction, when the furnace is tilted for pouring, the lowest part of the channel 29 is cut off, and the molten metal gravitating into that part of the channel remains there to aid in starting the next melt.

With both of these constructions, the abutment formed by flanges 23, 24 simply lifts away from the end of the bell crank 40 when the furnace is poured. There is, therefore, no interference between the rocking and the pouring and no disconnections or other manipulations are necessary for pouring.

The operation of the furnace will be clear from the above without further description.

What is claimed is:

1. In an electric induction furnace, in combination, a furnace body having a channel for the bath, a primary transformer element, the bath in said channel serving as a secondary and being heated by the currents induced therein, and means for causing the furnace body to rock, at such intervals and in such manner as to stir the bath.

2. In an electric induction furnace, in combination, a furnace body having a channel for the bath, located in a horizontal

plane, a primary transformer element, the bath in said channel serving as a secondary and being heated by the currents induced therein, and means for causing the furnace body to rock at such intervals and in such manner as to stir the bath.

3. In an electric induction furnace, in combination, a furnace body having a channel for the bath, a space for the charge and a plurality of communicating passages between said channel and the charge space, a primary transformer element, the bath in the channel serving as a secondary and being heated by the currents induced therein, and means for causing the furnace body to rock in the direction of said passages at such intervals and in such manner as to stir the bath.

4. In an electric induction furnace, in combination, a furnace body having a channel for the bath, a charging opening, a plurality of symmetrically arranged pockets for the charge, and communicating passages between said pockets and the channel, and a primary transformer element, the bath in the channel serving as a secondary and being heated by the currents induced therein.

5. In an electric induction furnace, in combination, a furnace body having an annular channel for the bath, a charging opening, a plurality of symmetrically arranged pockets for the charge, and communicating passages between said pockets and the channel, and a primary transformer element, the bath in the channel serving as a secondary and being heated by the currents induced therein.

6. In an electric induction furnace, in combination, a furnace body having an annular channel for the bath, a charging opening, a plurality of symmetrically arranged pockets for the charge, and communicating passages between said pockets and the channel, a primary transformer element, the bath in the channel serving as a secondary and being heated by the currents induced therein, and means for causing the furnace body to rock in the direction of said passages, thereby to stir the bath.

7. In an electric induction furnace, in combination, a furnace body having an annular channel circular in cross section for the bath, and a cylindrical primary transformer element concentric with said channel, the bath in said channel serving as a secondary and being heated by currents induced therein, and means for causing the furnace body to rock thereby to stir the bath.

8. In an electric induction furnace, in combination, a furnace body having a channel for the bath, a primary transformer element, the bath in said channel serving as a secondary and being heated by the currents induced therein, means for pivotally

mounting the furnace body off center of gravity, whereby the furnace body tends to tilt, and means for periodically tilting the furnace body in the opposite direction, thereby to stir the bath.

9. In an electric induction furnace, in combination, a furnace body having a channel for the bath, wherein the bath may be heated by currents induced therein, means for pivotally mounting the furnace body off center of gravity, whereby the body tends to tilt, an abutment on said body, a bell crank lever engaging said abutment, and means for oscillating said bell crank thereby to tilt the furnace body periodically in a direction opposite to said gravitational tilt. the resulting rocking of the furnace body serving to stir the bath.

10. In an electric induction furnace, in combination, a furnace body having a channel for the bath wherein the bath may be heated by currents induced therein, means for causing the furnace body to rock at such intervals and in such manner as to stir the bath, and means for tilting the furnace body to pour the melted charge.

11. In an electric induction furnace, in combination, a support, a frame pivotally mounted in said support, a furnace body pivotally mounted in said frame and having a channel for the bath wherein the bath may be heated by currents induced therein, means for causing the furnace body to rock on its pivot at such intervals and in such manner as to stir the bath, and means for tilting the frame on its pivot, thereby to move the furnace to pour the melted charge.

12. In an electric induction furnace, in combination, a furnace body having an annular, horizontal channel for the bath, a plurality of pockets for the charge, communicating passages between said pockets and said channel, and a pouring passage leading to a spout, means for causing the furnace body to rock in the direction of said passages, and means for tilting the furnace body in the direction of one of said passages to pour the charge, whereby the lowest part of the channel has an outlet when in pouring position.

13. In an electric induction furnace, in combination, a furnace body having a channel for the bath wherein the bath may be heated by currents induced therein, and a charging opening, a ridge, having sloping sides, located below the charging opening and dividing the furnace interior into two symmetrically arranged pockets for the charge, the furnace body having communicating passages between said pockets and said channel, and means for causing the furnace body to rock in the direction of said passages, thereby to stir the charge.

14. In an electric induction furnace, in combination, a furnace body enclosing a

hearth having a plurality of symmetrically arranged pockets, the furnace body having an annular channel for the bath, circular in cross section and arranged symmetrically with respect to said pockets, a cylindrical primary transformer element symmetrically located with respect to said channel, molten metal in the channel acting as a secondary and being heated by currents induced therein, the furnace body having symmetrically located passages connecting said channel with said pockets.

15. In an electric induction furnace, in combination, a furnace body enclosing a hearth having a plurality of symmetrically arranged pockets, the furnace body having an annular channel for the bath, circular in cross section and arranged symmetrically with respect to said pockets, a cylindrical primary transformer element symmetrically located with respect to said channel, molten metal in the channel acting as a secondary

and being heated by currents induced therein, the furnace body having symmetrically located passages connecting said channel with said pockets, and means for rocking the furnace, thereby to stir the charge.

16. In an electric induction furnace, and in combination, a furnace body having a channel for the bath and enclosing a space for the charge, the body having a ridgelike portion extending upwardly to form two symmetrically arranged pockets for the charge in the lower part of said space, and having communicating passageways between the lower parts of said pockets and said channel, and a primary transformer element, the bath in said channel serving as a secondary and being heated by the currents induced therein.

In testimony whereof, I have hereunto set my hand.

DAVID L. SUMMEY