C. GRUNWALD.

ELECTRIC INDUCTION FURNACE.

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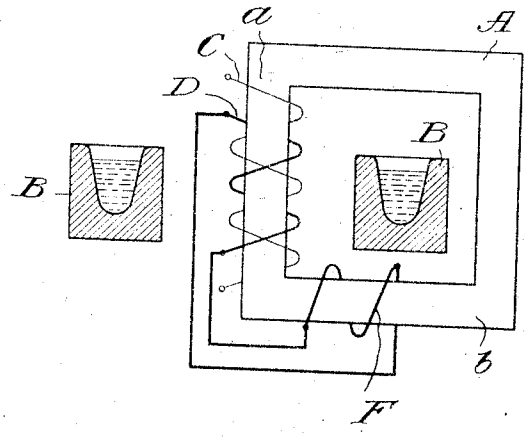

WITNESSES

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ELECTRIC INDUCTION-FURNACE.

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To all whom it may concern:

Be it known that I, CARL GRUNWALD, a subject of the Emperor of Germany, and a resident of Bredeney, in the Empire of Germany, have invented certain new and useful Improvements in Electric Induction-Furnaces, of which the following is a specification.

This invention relates to electric induction furnaces. It has been observed in operation of such furnaces that the upper surface of the melting bath is inclined, in consequence of the electro dynamic effect exerted between the primary winding and the melting bath. For example, when the primary winding, or a portion thereof is arranged concentric with the melting bath, repulsion takes place between the primary winding and the melting bath because the current induced in the latter flows in the direction contrary to that in which the primary current flows. Consequently the upper surface of the melting bath assumes such a position that the outer edge of the melting bath or that lying remote from the primary winding is higher than the inner edge. This exposure has disadvantageous consequences in that, on the one hand, owing to the accumulation of the electrically indifferent slag at the low places, the higher lying places are subjected to the oxidizing influences of the atmosphere, while on the other hand, the practice has shown that the accumulation of the slag at the lower lying portions causes a rapid destruction of the walls of the furnace. Attempt has already been made to overcome these difficulties by superposing, over the primary winding, a short circuited auxiliary winding in which a current is induced, during the operation of the furnace, in a direction opposite to that of the primary current and therefore counteracts the repulsion exerted upon the melting bath by the primary winding. But this arrangement results in an extraordinary great loss of energy since the auxiliary winding must possess a very great resistance in order that the current induced in it will not be too strong.

The present invention has for its purpose to avoid the disadvantages recited and attains this purpose by providing means, which electrically opposes and restricts the current, which is induced in the auxiliary winding superposed over the primary winding, which means is so located in relation to the melting bath that it has no appreciable influence upon the equilibrium of the melting bath.

In the accompanying drawing, one embodiment of the subject-matter of the invention is illustrated schematically.

Annularly arranged around one leg *a* of the transformer yoke A is the melting trough B. Upon the leg *a* is arranged a primary winding C as also an auxiliary winding D. Upon the lower transverse carrier *b* of the transformer yoke is located a second auxiliary winding F which possesses a lesser number of windings than the winding D. The two auxiliary windings D and F are connected together in such manner that the electromotive forces induced in them during the operation of the furnace are opposed.

When the primary winding C is fed by an alternating current, a current will be induced in the melting bath located in the melting trough B, which current always runs in the direction contrary to the current flowing in the primary winding. Repelling force is thus exerted by the primary winding C upon the melting bath, under the influence of which the upper surface of the melting bath seeks to rise at the outer edge. In the two auxiliary windings D and F electromotive forces are induced which, in consequence of the character of connection between the two windings above described, operate to oppose one another. Since the number of coils of the winding D is greater than those in the winding F the electromotive force induced in the winding D overbalances the electromotive force induced in the winding F. There results, therefore, in the windings D and F a current, the direction of which is determined by the direction of the electromotive force induced in the winding D, that is to say the current runs in the winding D in the opposite direction to that flowing through the primary winding and thus in the same direction as the current induced in the melting bath. The winding D consequently exerts upon the melting bath an attracting force. By the proper selection of proportion of the number of coils of the two connected windings D and F, it is easy to insure a balance between the attraction exerted upon the melting bath by the winding D and the repulsion exerted thereon by the primary winding C. In this case, the upper surface of the melting bath remains

level, since the winding F, as can readily be seen, occupies such a position that it is without appreciable influence upon the equilibrium of the melting bath.

The winding F can obviously be located at any other place on the yoke A in which it would be without appreciable influence upon the equilibrium of the melting bath.

Inasmuch as only the difference between the electromotive force induced in the two auxiliary windings D and F, alone comes into effect, the strength of current required to balance the repulsion exerted upon the melting bath by the primary wire C may be produced with a comparatively small resistance in the windings D and F so that loss of energy is correspondingly small.

Having thus described the invention, what is claimed as new therein and desired to be secured by Letters Patent, is:—

1. An electric induction furnace having an auxiliary winding for counter-acting the repelling effect of the primary winding upon the melting bath, and means electrically opposing and restricting the current induced in said auxiliary winding, disposed in such relation to the melting bath as to be without influence upon the equilibrium of the bath.

2. In an electric induction furnace having a primary winding to induce a current in the substance to be heated and an auxiliary winding to overcome the repulsion of the primary winding; a second auxiliary winding connected with and developing an electromotive force in opposition to but less than that of the auxiliary winding first named; said second auxiliary winding being located in a position which renders the electro-dynamic effect developed between it and the melting bath, without marked influence upon the equilibrium of the melting bath.

3. An electric induction furnace having a melting trough, a primary winding in inductive relation to the melting trough, an auxiliary winding in inductive relation to the primary winding and exerting an electro-dynamic influence upon the melting bath in opposition to that exerted by the primary winding, and a second auxiliary winding in inductive relation to the primary winding but developing an electro-motive force less than that of the first auxiliary winding, having connections through which it opposes and reduces the induced current in the first auxiliary winding and being located with relation to the melting bath so that the electro-dynamic effect developed between it and the melting bath is without marked influence upon the equilibrium of the melting bath.

4. An electric induction furnace comprising an annular melting trough, a transformer core having a leg concentric with said annular melting trough and a leg transverse thereto, a primary winding on said concentric leg of the core, in inductive relation to the contents of the trough, an auxiliary winding located in part on said concentric leg and in part, on said transverse leg; the part of the auxiliary winding located upon the concentric part of the core being in inductive relation to the primary winding and developing an electro-dynamic influence upon the contents of the melting trough, opposite to the electro-dynamic influence of the primary winding thereon; and the part of the auxiliary winding located on the transverse leg having a current induced in it by the primary winding in opposition to but less than that induced in the first named portion of the auxiliary winding; and the electro-dynamic effect between the contents of the melting trough and said portion of the auxiliary winding on the transverse leg being without marked influence upon the equilibrium of the melting trough.

The foregoing specification signed at Barmen, Germany, this 8th (eighth) day of March, 1909.

CARL GRUNWALD. [L. S.]

In presence of—
OTTO KÖNIG,
R. MEYER.