Dec. 16, 1941. W. G. CLARK 2,266,002

ELECTRIC FURNACE

Filed June 10, 1940

Fig. 1

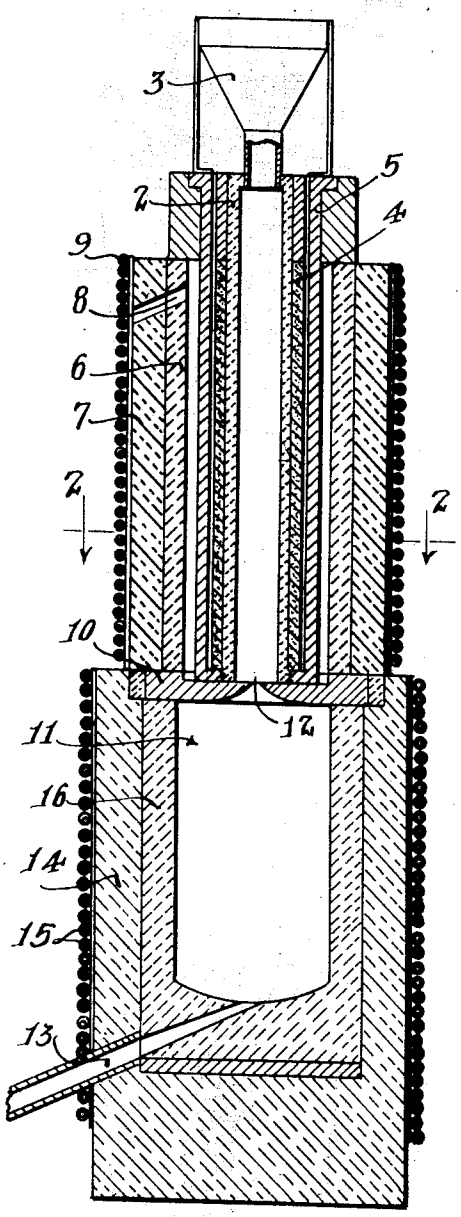
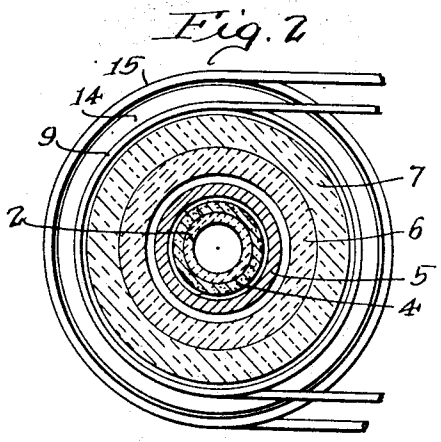


Fig. 2



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2,266,002

ELECTRIC FURNACE

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5 Claims. (Cl. 13—26)

This invention relates to an electric melting furnace of the so-called induction type, in which an alternating current of proper frequency circulating in a coil or helix surrounding a conducting core generates heat in the conducting core as a short-circuited secondary.

The furnace of the present invention is particularly designed to melt materials which are supplied to the furnace in comparatively small or granular form, and the furnace is so arranged that the melting takes place in a chamber separate from an accumulation chamber into which the melted material passes as soon as it reaches the molten condition and in which the molten material is accumulated and kept at the molten temperature by means entirely independent and separate from the means employed for melting the material in the melting chamber.

It is known that the destruction of refractory linings in a furnace in which steel or other materials of high melting temperatures are melted is excessively heavy and constitutes a substantial charge against each ton of material melted. The destruction of the refractory linings is due to the fact that in order to subject the unmelted material to the proper degree of temperature necessary to melt it and to supply the latent heat of melting it becomes necessary to subject the surrounding refractories to a temperature substantially higher than the melting point. The destruction of the refractory increases rapidly as the temperature increases and the cost is in proportion to the area subjected to the high temperature.

By means of the present invention a melting furnace is provided which is constructed so that the area of the furnace in which the material is melted is relatively small and from which the material passes on reaching the molten condition into a larger chamber wherein it is necessary to supply only sufficient heat to maintain the material at the molten temperature, so that in the larger area of the furnace the refractories are not subjected to the usual high temperatures. Accordingly, with the furnace of the present invention, the area of the refractory subjected to the highest temperature is made small so that the same can be economically replaced.

The furnace of the present invention is constructed to be operated continuously and the melting chamber or chambers of the furnace are heated by inducing electrical currents in tubes or series of rods surrounding a narrow melting chamber and placed close to the chamber so as to have the ability of heating rapidly a moving stream of the material to be melted to the desired melting temperature, and the narrow melting chamber is provided with a restricted outlet by means of which the material upon reaching the molten condition may flow under gravity into the accumulation chamber. The accumulation chamber of the present invention may be as large as desired and may in certain cases accumulate only the molten metal derived from a single melting chamber, or in other cases a plurality of melting chambers may feed the molten material into a single accumulation chamber. The accumulation chamber of the present invention may, if desired, be heated by the induction type of heating or in any other preferred or desired manner, and, for example, may constitute a form of hearth furnace in which one or a plurality of the melting chambers are maintained on the roof of the arch of the furnace.

The furnace of the present invention, together with numerous advantages thereof, will best be understood from a description of a preferred form or example of the furnace embodying the invention, and for this purpose I have hereafter described one form or example of an electric furnace embodying the present invention. The description is given in connection with the accompanying drawing, in which:

Fig. 1 is a vertical section of my furnace; and

Fig. 2 is a section taken on line 2—2 of Fig. 1.

Referring to the drawing, the furnace is indicated as comprising a refractory tube 2 which forms the melting chamber of the furnace and which may be in tubular form, or such other form as may best suit the requirements. At its upper end the refractory tube 2 is indicated as connected to a hopper 3, by means of which the material to be melted may be continuously introduced into the furnace. Surrounding the refractory tube 2 is a high temperature conducting material 4, such as a carbon or graphite tube, or a series of carbon or graphite rods. Outside of the conducting material 4 there is indicated a suitable supporting member 5. The body of the supporting member 5 is preferably spaced slightly from the conducting material 4 so as not to be excessively heated thereby. Surrounding the supporting member 5 and spaced therefrom is a tube of refractory material 6 to provide heat insulation for a tube or covering of heat insulating material 7. An opening 8 is indicated through the insulating material 7 and tube 6 for air insulating space between tube 6 and supporting member 5. Surrounding the insulating material 7 is a coil of conducting tube 9 which is to be employed to carry an alternating current of the proper frequency to induce currents in the high

temperature conducting material 4 which surrounds the inner refractory tube 2, whereby the inner refractory tube 2 may be heated up to any desired temperature which may be necessary to carry out the intended melting operations within the tube.

The refractory tube 2 which forms the melting chamber of the furnace is indicated as mounted on a roof member 10, which forms the roof of an accumulation chamber 11. The roof 10 has an opening 12 of restricted area for the purpose of providing a restricted discharge of melted material from the melting chamber into the accumulation chamber. Such opening may, for example ¼, ½, or 1 inch or more in size, depending upon the rate at which melting takes place in the melting chamber and the character of the material to be melted. The accumulation chamber 11 is formed of refractory material and may be of any desired form or shape and preferably provided with an outlet 13. I have indicated the accumulation chamber 11 as surrounded by heat insulating material 14, which supports a water cooled coil of tubing 15 which may carry suitable alternating current of the proper frequency for maintaining the contents of the accumulation chamber in the molten condition. It is to be understood that the molten material itself, where the furnace is operating to melt conducting material such as iron, constitutes the necessary short-circuited secondary in which heat is developed by currents induced from the coil 15. In certain cases where the furnace may be employed for melting materials which in the molten condition are not sufficiently conductive, such for example as glass, it may be necessary to provide the accumulating chamber with a surrounding wall of conducting material, as in the case of the melting chamber, or it may be preferable to heat the accumulating chamber by any other well-known means.

It is to be understood that the accumulation chamber 11 may be considered as elongated and the roof 10 thereof as mounting a plurality of the melting furnaces, all discharging through similar openings 12 into the accumulation chamber 11, although in some cases but a single melting chamber may be employed.

In the operation of the furnace of the present invention the material to be melted, for example sponge iron, is fed into the melting chamber continuously through the hopper 3 preferably in a granular form. Sufficient temperature is induced in the conducting material 4 surounding the refractory tube 2 which forms the melting chamber to heat the feed material to the molten condition during its passage from the inlet to the outlet 12 of the melting chamber. The temperature to which the refractories are heated in the melting chamber is thus materially higher than the melting temperature, but because of the limited size of the refractory tube 2 forming the melting chamber any deterioration thereof due to the high temperature is not economically serious as the refractory tube 2 may be readily replaced. Upon arriving at the melting condition, the molten material passes through the opening 12 into the accumulation chamber 11 where it is maintained in the molten condition. It is necessary to heat the refractory material 16 which forms the walls of the accumulation chamber only to substantially the melting temperature of the material so that the walls of this chamber do not rapidly deteriorate in use. The product may be maintained in the molten condition in the accumulation chamber, into which chamber, if desired, may be introduced alloy materials or the molten material held until a suitable interval of time arrives for casting therewith.

While the particular electric furnace herein described is well adapted to carry out the objects of the invention, it is to be understood that the invention is not limited to the particular form shown but the electric furnace of the present invention may be subjected to numerous modifications, and the present invention includes all such changes and modifications as come within the scope of the appended claims.

I claim:

1. An electric melting furnace, which comprises a refractory member providing a narrow vertically extending melting chamber effective for rapidly heating a moving stream of material to a melting temperature, a conducting material surrounding the refractory, means for inducing currents in said conducting material for heating said refractory to a temperature sufficiently above the melting point of the material to be melted to effect melting of the charge while passing through said refractory member, a restricted outlet for said melting chamber, and a collecting chamber into which melted material from said refractory passes and may be retained in the molten condition by being subjected to a lower heating temperature.

2. An electric melting furnace, comprising a collecting chamber for melted material having means for retaining the contents thereof in a molten condition and provided with a roof, a narrow vertically extending independent melting chamber provided by a refractory mounted upon the roof of said collecting chamber and having a restricted communication through said roof to said collection chamber, and electric induction means for heating said refractory to a temperature sufficiently above the melting point of the material passing through said melting chamber to effect the melting of said material while the material is flowing through said chamber.

3. An electric melting furnace, comprising a collection chamber in which molten material is to be retained and having a roof, means for heating the material in said chamber to retain the same in a molten condition, a preliminary melting chamber formed by a narrow vertically extending refractory member mounted upon said roof and having a restricted communication through said roof with said collecting chamber, and electric induction heating means for heating said refractory member to a higher temperature than is applied to said collection chamber for heating the contents of the refractory to the molten condition during the passage of said contents therethrough.

4. An electric melting furnace, comprising a refractory member forming a narrow vertically extending melting chamber, a refractory member of comparatively large diameter forming a collecting chamber for molten material from said melting chamber and having a roof upon which said refractory member is mounted in restricted communication therewith, means for heating the contents of said collection chamber to retain the same in the molten condition, conducting material surrounding the refractory forming the melting chamber, heat insulating material surrounding said conducting material, a coil surrounding said heat insulating material through which electric currents may be passed for inducing heat in said conducting material to heat the same to a

higher temperature than maintained in said collection chamber and an air vented space between said heat insulating material and said refractory forming said melting chamber.

5. An electric melting furnace, comprising a narrow vertically extending refractory, a refractory member of compraratively large diameter having a roof upon which said narrow refractory is mounted and providing a restricted communication with the first-mentioned refractory and operative as a collection chamber for molten material received therefrom, means for heating said refractory of large cross-sectional area for retaining the contents of the same in the molten condition, conducting material surrounding said first-mentioned refractory and operative upon currents being induced therein for heating the contents of said refractory to the molten condition, and an electric induction coil surrounding said conducting material and first-mentioned refractory and operative for inducing currents in said conducting material to heat the same to a higher temperature than maintained in said collection chamber.

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