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ELECTRICALLY HEATED FURNACE.
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Fig. 8

Fig. 9

Witnesses.
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[Diagram of electrically heated furnace with various components labeled]
My invention relates to electrical furnaces primarily intended for melting metals, but also applicable for heating metals, ores, or other materials for various other purposes.

It is well-known that the melting of non-ferrous metal is most advantageously effected in crucibles made from a mixture of plumbago and clay. Hitherto, however, it has only been possible in practice to construct crucibles which are directly heated by fuel for dealing with charges of about ten hundred-weights, more or less, owing to manufacturing difficulties, and to the fact that, when heated, they become relatively soft so that they are liable to burst under the internal pressures to which they are subjected; also there are difficulties in operating the furnaces in which they are mounted. Furthermore, in an electrically heated furnace of large capacity where the crucible or container is of the standard crucible shape and is heated by the passage of an electric current through it, it has been necessary to make the walls so thick as to disadvantageously reduce their electrical resistance.

The object of this invention is to provide an electrically heated furnace wherein much heavier charges of metal can be dealt with than heretofore, without making the walls of the melting vessel excessively thick, thereby allowing the use of a higher voltage and a lower current than hitherto, and at the same time to obviate a number of disadvantages resulting from the use of containers of ordinary crucible type, such, for instance, as difficulties in mixing the metals, pouring and skimming the dross and collecting the fumes during melting and pouring operations.

According to this invention the melting vessel or container which constitutes the resistance through which the heating current flows is constructed in the form of a trough supported by and mounted in an outer casing. The trough is advantageously of an elongated or boat shape, the ends of which are connected to the electric circuit without applying end pressure to the said melting vessel or container. These ends are extended and formed with terminals (hereinafter referred to as trough terminals) to receive the conductor terminals and are preferably proportioned to reduce to a minimum the combined loss of energy due to the conduction of heat back from the trough and to the generation of heat due to the flow of current through them.

The conductor terminals are preferably of the water cooled type and designed to clip, or be clipped, or clamped, to the trough terminals.

The said trough terminals can be of rectangular, cylindrical or conical form and the conductor terminals, fitted on to those, correspondingly shaped; or, instead of forming a single terminal at each end of the trough, two or more terminals may be formed, each of which has an independent conductor terminal applied to it.

The trough or container constructed as before described is mounted in the metal casing which is lined with refractory thermal insulating brick with the terminal ends projecting therefrom and is supported therein on a bed or refractory thermal insulating powder which allows the trough to expand and contract freely under variations of temperature.

The trough or container may be lined inside with a material such as clay, bauxite, zirconia or carborundum to prevent electrical contact or chemical action between the metal and the body of the trough, and the trough is also advantageously glazed or coated externally to prevent oxidation.

My invention will be readily understood by reference to the accompanying drawings, in which:

- Figures 1, 2 and 3 are respectively a side view, a plan view and an end view of the improved melting vessel or container, having rectangular terminals, and
- Figures 4, 5, 6 and 7 are perspective views illustrating modifications in the form of the terminals.
- Figure 8 is a front view showing the container mounted in a casing.
- Figure 9 is a plan of the same, and
- Figure 10 is a side view.
- Figure 11 is a sectional plan of the container.
tainer and the casing in which it is directly mounted.

Figure 12 is a section on the line 12—12,
Figure 8.

Figure 13 is a section on the line 13—13,
Figure 12.

a indicates the melting vessel or container which, as hereinafter described, is in the form of a trough provided with a pouring spout a; say, at about the centre of its length, and having the extended ends a', a'' which form terminals on to which the conductor terminals can be applied.

As shown in Figures 1 to 3 the trough terminals are of rectangular section, whilst, as shown in Figure 4, the said terminals have vertical bevelled faces; in Figure 5, the trough is formed with bifurcations so as to provide at each end two independent terminals of similar form to that shown in Figure 4. Figure 6 shows the terminal of cylindrical form and Figure 7 a terminal of conical form.

Whatever may be the form of trough terminals the conductor terminals are of annular form clamped to the said trough terminals and are made hollow so that water may be circulated through them for cooling purposes. As shown in Figures 11 and 13, these conductor terminals are in the form of hollow plates e which are clamped upon opposite sides of the trough terminals by clamping bolts d and nuts e, and have water circulating pipes f connected to them, which pipes extend through trunnions, hereinafter referred to, on the casing b.

The container a is mounted, as hereinafter described, in a casing b through the ends of which the terminals a' project; for instance, as shown in Figures 11 and 13, so as to permit of the application of the conductor terminals without the employment of end pressure.

In practice, the metal casing b is of considerably larger sectional area than the trough a so as to allow of the space between the said trough and casing being filled with refractory thermally insulating material g, and is made to extend above the top of the trough in such a manner as to form a receptacle or space h for bulky scrap or swarf which can be charged into it and will gradually drop into the trough as the melting proceeds.

The chamber a can be lined if necessary with slabs of the same material as the trough a with terminals extending from the casing so that they can be heated electrically.

The receptacle h extends into an upper casing i provided with a refractory lining f which contains a removable cover k in sections which is again arranged beneath a hinged metal cover k' of the said casing i also in sections. In the lining f are formed longitudinal flues l, l, which communicate through branch passages m, m with the preheating chamber h which flues are themselves connected at one end to a common flue n, as indicated, for instance, in Figures 8, 9 and 10. The flue n can have connected to it a flexible or other pipe (not shown) in connection with an exhaust fan so that fumes which rise from the melting chamber during the charging or stirring operations can be evacuated and thereby prevented from affecting the hygienic conditions of the shop or building in which the furnace is fixed. P, P' are hinged covers closing the other ends of the flues l, l.

Furthermore I advantageously form around the mouth of the pouring spout a' a chamber or space o which is also in communication with one of the flues l so that any fumes which escape from the spout during the pouring operations will also be collected and evacuated. As shown, a damper p is provided for shutting off this spout chamber o from the flue l when desired.

In order to allow for the free expansion and contraction of the melting vessel a under variations of temperature I bed the said melting vessel upon a layer g' of insulating material, such as soot or sand or a mixture of these materials. When using this material, however, it is necessary to provide for the exclusion of air, as otherwise the material will gradually oxidize, and I, therefore, propose, to fit around the juncture of the trough terminal and the trough proper a collar g of thermally insulating refractory material, Figures 10, 11 and 13. This collar is bedded on the thermally insulating powder g' in the same way as the main part of the trough a, but reduces the temperature of the powder at this point so that an asbestos packing gland ring g' can be placed round the outer edge of the collar thus giving it freedom of movement and at the same time retains the insulating powder g' in position and thus prevents the entry of air thereto.

As a further precaution, and under certain conditions, I propose to enclose the terminals e, where they project outside the casing, in boxes as indicated, for instance, at g', g'' in Figures 8, 9, 11 and 13 which boxes are themselves lined with suitable insulating material, such as asbestos, and filled preferably with soot.

The casing b containing the melting vessel a may be mounted upon trunnions so that it can be tipped, or it can be mounted in any other convenient manner to allow of this tipping movement. As shown in the drawings, the said casing is mounted upon trunnions r, r' the axial line of which passes close to the mouth of the spout a' in a well known manner, and the casing b has fixed to it a toothed segment s to which motion is communicated.
through a worm \( t \) and suitable gearing from a hand-wheel \( u \) for tipping the furnace. Also counter-balance weights such as \( v \) are advantageously provided for facilitating the tipping operation in a well known manner.

It is to be understood that the melting vessel \( a \) instead of being provided with a spout may be provided with a pouring lip or with means for drawing off the metal from the bottom and that an opening or openings normally closed by covers may be provided to allow of skimming or removing dross or slag either prior to or during the pouring operations.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is:

1. An electrically heated furnace including a casing provided with end openings, a crucible formed of an electric current conducting substance supported in said casing in a manner to withstand internal pressure and being free to expand and contract relatively to said casing under variations of temperature, the ends of said crucible extending through the end openings of the casing and being accessible for the ready application of conductor terminals from the exterior of the casing, and conductor terminals connected to the ends of said crucible.

2. A furnace of the type claimed in claim 1 in which the conductor terminals are connected to the sides only of the ends of the crucible.

3. A furnace of the type claimed in claim 1 in which the crucible is supported within the casing by a lining of yielding non-conducting material.

4. A furnace of the type claimed in claim 1 in which the crucible is supported within the casing by a lining of yielding non-conducting material, and packing glands maintaining said lining in position.

5. A furnace of the kind claimed in claim 1, in which the crucible is provided with a receptacle extension which is located in the casing and is designed to receive bulky scrap, and a lining for said extension adapted to be heated electrically.

6. A furnace of the kind claimed in claim 1 having a gas flue designed to be connected to an exhaust fan for discharging gases from the crucible.

7. A furnace of the kind defined by claim 1 in which the ends of the crucible are of substantially cylindrical shape and in which the conductor terminals are provided with water cooling means.

8. A furnace of the kind defined by claim 1 in which the ends of the crucible and the conductor terminals are enclosed in boxes containing insulating material.

9. A furnace of the kind defined by claim 1 in which the ends of the crucible and the conductor terminals are enclosed in boxes containing insulating material.

10. A furnace of the kind defined by claim 1 in which the ends of the crucible and the conductor terminals are enclosed in boxes containing insulating material.

11. An electrically heated furnace including a casing having a refractory lining and end openings, an elongated trough-shaped crucible formed of current conducting material located within said lining and having integral end terminals, and conductor terminals connected to said end terminals which extend through said openings.

12. A furnace of the kind defined by claim 11 in which a non-conducting yielding substance is arranged between the lining and said crucible.

13. A furnace of the kind defined by claim 11 in which the crucible is provided with a hollow refractory extension having a refractory cover, and means for withdrawing gases from said extension and crucible.

14. A furnace of the kind defined by claim 11, in which the crucible is provided with a hollow refractory extension, and flues provided in said extension for withdrawing gases from the crucible.

15. A furnace of the kind described including an elongated boat-shaped thin walled crucible formed of an electric current conducting substance and providing a trough shaped chamber, integral end extensions provided at the ends of the crucible, and conductor terminals connected to the sides only of said end extensions.

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