

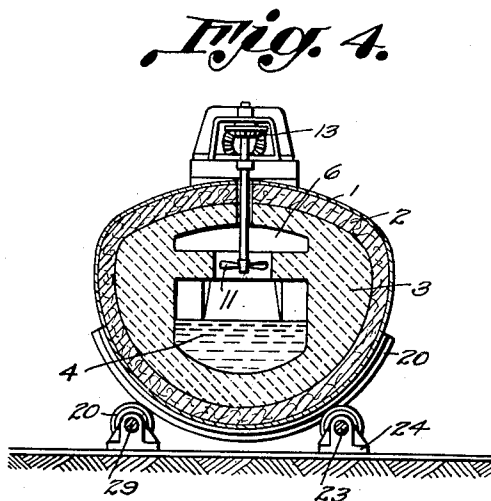
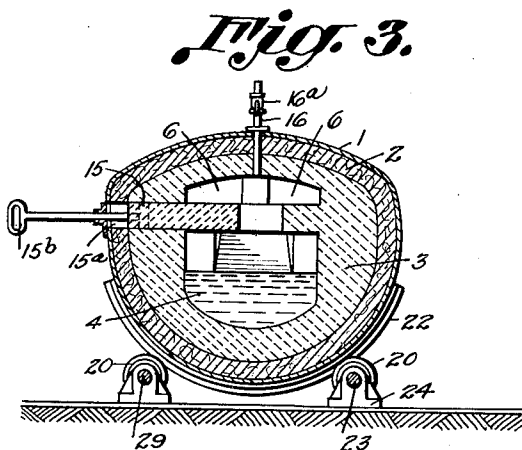
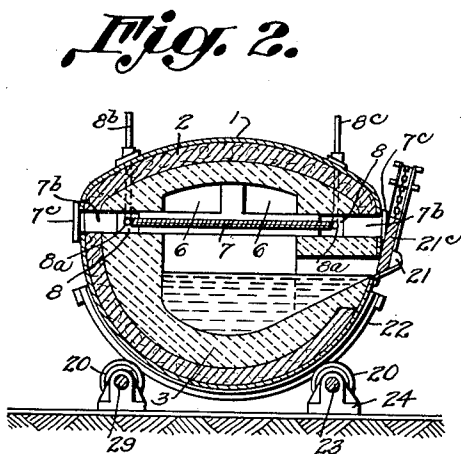
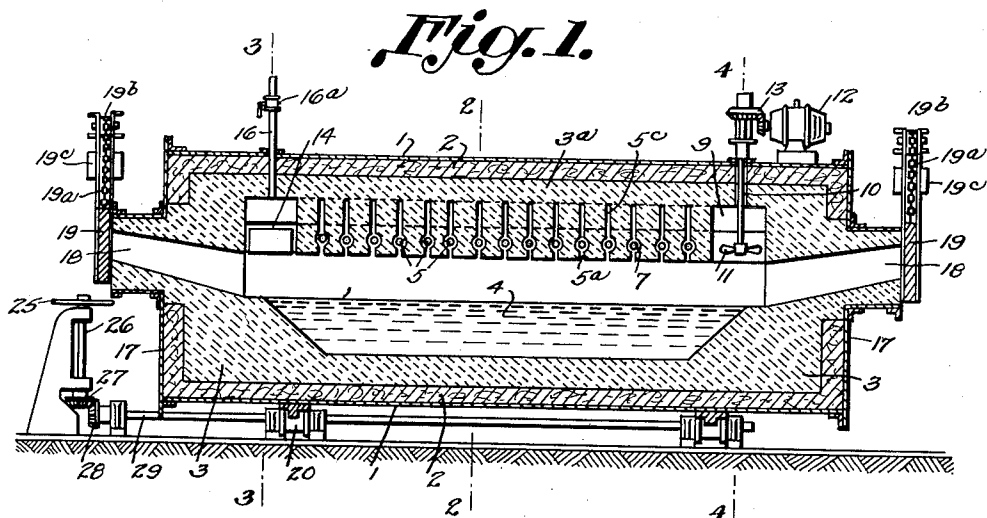
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APPARATUS FOR SMELTING ALUMINIUM AND OTHER LIGHT METALS

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UNITED STATES PATENT OFFICE

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APPARATUS FOR SMELTING ALUMINIUM
AND OTHER LIGHT METALS

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2 Claims. (Cl. 13—20)

This invention relates to apparatus for smelting aluminium or other similar light metals, and more particularly to apparatus for smelting aluminium or the like in which the heat required for smelting the metal is produced by electric current.

Furnaces have lately been used for smelting aluminium alloys or pure aluminium in which a series of spirally wound heating wires consisting of a metal of high electric resistance is disposed in the roof of the smelting chamber above the trough containing the molten metal, which are adapted to be heated by electric current and to give up their heat to the metal which is introduced into the smelting chamber of the furnace. Smelting furnaces of this type are particularly suited per se for smelting aluminium alloys and similar light metals, because it is possible in them to keep the atmosphere in the furnaces entirely reducing, so that the losses due to oxidation of the heated metal are relatively small, at any rate considerably smaller than in smelting furnaces heated by gas or oil. When operating in practice with the electric furnaces described above it is easy to reduce the smelting losses which arise when dealing with block aluminium to about 1.5%, whereas in the same case they would amount to about 2.5 to 3% in the ordinary gas-heated furnaces.

In spite of these advantages electrically heated smelting furnaces have not hitherto been used to any great extent for smelting aluminium owing to the fact that the thermal efficiency of such furnaces as hitherto constructed is relatively poor. This is due to the fact that at the smelting temperatures which have mainly to be considered for aluminium and aluminium alloys, lying roughly between 660 and 750° C. the transmission of heat by radiation from the heating wires to the metal under treatment is very small. It is known that heat radiation is only strongly effective at temperatures above 800° C. whereas the heat radiation below this temperature reaches only a very small amount.

In order to overcome this defect and to improve the thermal efficiency of aluminium smelting furnaces of the type referred to it has been attempted to make the smelting trough chamber very small and to dispose the heating wires at a short distance above the metal bath. Such a

construction has not received approval however because in the smelting of aluminium and the like when solid metal is being introduced into the metal bath or slag in being removed from the surface of the bath molten metal may easily splash up against the roof of the furnaces. These splashes come into contact with the heating wires situated in the roof of the smelting chamber and damage them by forming aluminium alloys of lower melting point and better electric conductivity, so that the heating wires become melted through at these points or short circuits are caused between the coils of the heating wire spirals thereby leading to more or less large sections of the spirals becoming cold.

One object of my present invention is to provide an improved apparatus for smelting aluminium and similar light metals wherein the heat required for smelting the metals is supplied by electrically heated wire spirals disposed in the roof of the smelting furnace, whereby a substantially higher thermal efficiency is obtained without effecting the safety of the furnace, and particularly of the heating elements.

I have found that by suitable movement of the gases contained in the smelting chamber of the furnace between the heating wire spirals and the metal bath or the metal which is to be smelted the thermal efficiency of the furnace may be raised considerably owing to the fact that in this case the quantity of heat transferred by convection is remarkably greater than when the furnace gases are not moved.

In order to obtain this improvement of heat transference by convection according to my present invention I provide in the smelting chamber of the furnace or in a flue or channel connected therewith a ventilator or other suitable apparatus for moving gases which is adapted to be rotated from without and forces the furnace gases towards the furnace roof and consequently towards the heating wire spirals or through apertures or flues provided in the furnace roof in such a manner that the gases are kept in circulation between the heating wires and the surface of the molten metal.

It is also possible according to the invention to provide flues in the roof of the furnace, through which the gases can be moved wholly or partially from above towards the heating wire

spirals disposed in the roof of the furnace and thence towards the surface of the molten metal by providing a ventilator at the entrance of the roof flue or flues for producing the necessary movement of the gas.

Finally I prefer to provide in the roof flues of the furnace valves or other suitable controlling elements by means of which the quantity of gases passing through the various flues can be varied. With these and other objects of my present invention in view I will now describe the nature of my invention on the line of the accompanying drawing in which:

Figure 1 is a longitudinal section through a smelting furnace constructed in accordance with the invention.

Figure 2 is a vertical cross section along the line 2—2 of Figure 1, and

Fig. 3 is a vertical cross section along the line 3—3 of Fig. 1.

Fig. 4 is a vertical cross section along the line 4—4 of Fig. 1.

In the embodiment of the invention illustrated an approximately semi-cylindrical housing 1 is provided with a lining 2 which is a poor conductor of heat, on which are disposed the walls 3 of the smelting chamber of the furnace which consists of a material such as sillimanite having a maximum resistance to molten aluminium.

Above the trough 4 for receiving the molten metal which is of approximately rectangular section a series of apertures 5 of substantially circular cross-section are provided in the roof 3a of the furnace transversely to the longitudinal axis of the trough, which are connected on the one hand by narrow orifices 5a with the space above the trough 4 and on the other hand by orifices 5c with two longitudinal flues or channels 6 arranged adjacent each other in the roof of the furnace.

The circular apertures 5 in the furnace serve to receive spirally wound heating wires 7 consisting for instance of a chrome nickel alloy of high electric resistance whose ends are connected in longitudinal channels 8 of the furnace to bus-bars 8a which are connected at 8b and 8c outside the furnace with a source of power not indicated in the drawing.

Direct or alternating current may be used for heating the wire spirals as preferred. Preferably the furnace wall is provided with apertures 7b laterally of the channels 8 in which the bus-bars 8a are situated, through which apertures the joints between the ends of the wire spirals 7 and the bus bars 8a are accessible from without. In order to prevent oxidizing gases from penetrating through the apertures 7b into the interior of the furnace, the apertures are closed by flaps 7c.

As shown in Fig. 1 the flues 6 open on both sides into the smelting chambers of the furnace. At one such opening, indicated at 9, a fan ventilator 11 adapted to be rotated by a vertical shaft 10 is disposed in such a manner that by rotation of the ventilator fan the furnace gases are moved out of the furnace chambers into the flues 6. The ventilator is driven by an electric motor 12 mounted on the furnace, which is connected to the fan shaft 10 through the intermediary of a bevel wheel gear 13 or other suitable means, the shaft 10 passing through an opening in the furnace roof as gas-tightly as possible.

At the other opening of the flues 6 into the smelting trough, indicated at 14 in Figure 1, a slide valve 15 is provided, by means of which the free section of the flue opening may be varied.

The valve 15 passes through an aperture 15a in the furnace wall, and carries externally a handle 15b by means of which it can be positioned in the desired manner from outside the furnace. By suitably positioning the valve 15 the current of gases forced by the ventilator 11 into the flues 6 can be passed wholly or partially through the heating wire apertures 5 to flow over said heating wires, and thence onto the surface of the metal. Thus a particularly advantageous transmission of heat from the heating wires to the liquid metal is obtained. When regulating the valve 15 however care must be taken that the vertical current of gases is not so strong that the oxide layer which collects on the surface of the molten metal is broken and the gases come into contact with the bare surface of the molten metal.

As when aluminium and similar light metals or metal alloys are smelted fairly considerable quantities of gases are liberated it is advantageous to provide the roof of the furnace with a relatively narrow gas discharge pipe 16 adapted to be closed by means of the throttle valve 16a. The gas discharge pipe commences from one of the roof flues 6.

In the furnace illustrated in the drawing the solid metal is introduced from the end faces 17, where charging openings 18 are provided which are adapted to be closed by means of vertically sliding doors 19. To each of the doors 19 a chain 19a is secured which is guided over rollers 19b and at its free end carries a counter weight 19c corresponding approximately to the weight of the sliding door, whereby the raising and lowering movements of the door are considerably facilitated.

In the embodiment illustrated in the drawing the furnace is provided with rails 22 by which the body of the furnace is supported on rollers 20 rotatably secured in bearings 23 of the under frame 24 of the furnace. In order to empty the furnace the latter is rocked somewhat about its longitudinal axis, so that the liquid metal can run out of the opening 21 provided on one side of the furnace and adapted to be closed during the smelting operation by a lid 21c.

For the purpose of moving the furnace a hand wheel 25 is provided laterally adjacent same, which hand wheel is mounted on a shaft 26 connected by the bevel wheel 27 with a large bevel wheel 28 which is secured by the shaft 29 to one of the rollers 20. The transmission of the bevel wheel gear is preferably so selected that when the hand wheel 25 is moved a long way the furnace is only rotated a short distance, so that the furnace may be very sensitively adjusted.

Instead of disposing the gas circulating ventilator 10 only on one side of the furnace as shown in the drawing, it may be advantageous, particularly in the case of furnaces of great length, to provide it in the middle of the furnace, and to distribute the gas current into the roof flues towards the two ends. In this case it is obviously necessary to provide valves for regulating the flow of gas at both ends of the roof flues. It is also possible to provide more than one ventilator. Finally it is possible, instead of forcing the gases into a roof flue, to force them into lateral apertures in the furnace chamber or against baffles provided in the furnace, whereby a circulation of the gases between the heating wires and the metal bath is obtained.

I have described my present invention in a particular form of construction, but I do not wish

to be restricted to this particular embodiment. My invention may be variously embodied within the scope of the claims hereinafter made.

I claim:—

5 1. A furnace for smelting aluminium or other metals or metal alloys of similar properties, comprising a trough for the molten metal, electrically heated resistances disposed above same in such a manner that the heat is transferred from them
10 to the metal under treatment, horizontal channels provided wholly within the upper and lower extremities of the furnace roof, said resistances being disposed wholly within said channels so as to be protected by the furnace roof from
15 splashing of metal in said furnace chamber, flues also provided in said furnace roof above said channels and opening on both sides into the furnace chamber, the channels for the resistances in the furnace roof being communicably connect-
20 ed with said flues by upper horizontally restricted vertical ducts and with the furnace chamber by lower horizontally restricted vertical ducts in said furnace roof, and means for moving the gases contained in the furnace chamber in
25 circulation through said flues, thence through the upper restricted ducts to the channels and then the lower restricted ducts in the furnace roof, past the resistances to the metal under treatment, back to the furnace chamber.

2. A furnace for smelting aluminium or other metal or metal alloys of similar properties comprising a trough for the molten metal, electrically heated resistances disposed above same in such
80 manner that the heat is transferred from same to the metal under treatment, horizontal channels provided wholly within the upper and lower extremities of the furnace roof, transversely to the longitudinal axis of the furnace chamber, said resistances being disposed wholly within said
85 channels so as to be protected by the furnace roof from splashing of metal in said furnace chamber, flues also provided in the furnace roof above said channels and transversely thereof and opening on both sides into the furnace chamber, the
90 channels for the resistances in the furnace roof being communicably connected with said flues by upper horizontally restricted vertical ducts and with the furnace chamber by lower horizontally
95 restricted vertical ducts in said furnace roof, and a ventilator disposed at one of the mouths of said flues in such a manner that during the operation of the ventilator the furnace gases are moved in
100 circulation through the roof flues, thence through the upper restricted ducts to the channels and then the lower restricted ducts in the furnace roof, past the resistances to the metal under treatment, back to the furnace chamber.

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