Nov. 28, 1933. W. E. MOORE 1,937,064

METHOD OF TREATING METALS

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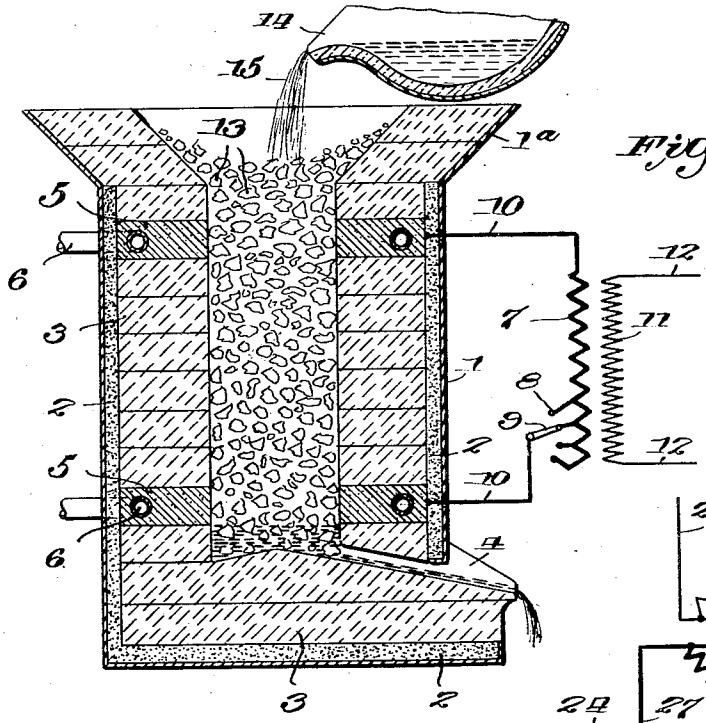


Fig. 1.

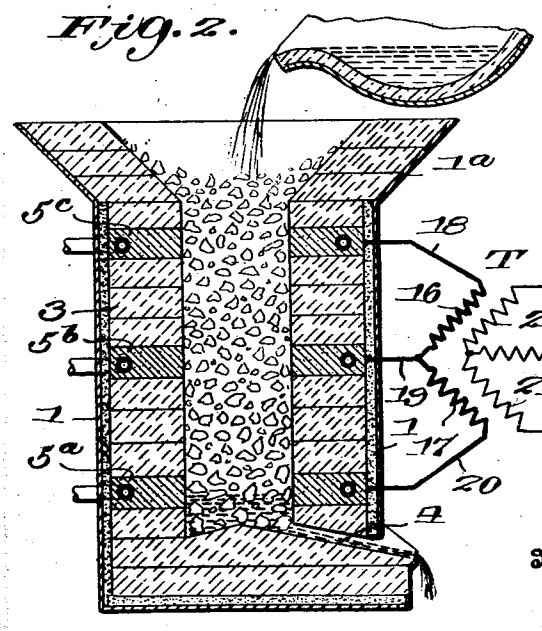


Fig. 2.

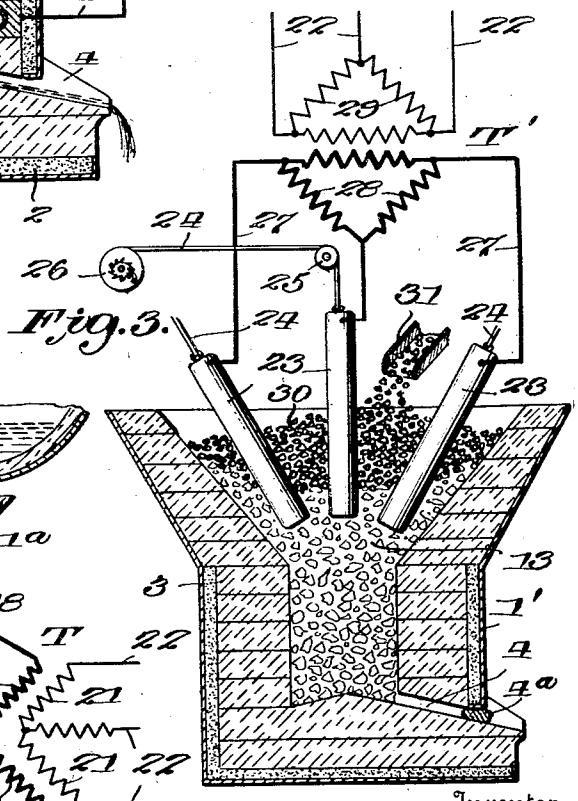


Fig. 3.

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METHOD OF TREATING METALS

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11 Claims. (Cl. 75—22.5)

This invention relates to electrical metallurgical furnaces, and more particularly to means for and a method of treating metals in such furnaces.

The specific object of the invention is to provide an improved means for and method of treating molten iron or steel to refine and deoxidize the same, and to completely carburize the metal so as to produce a standard grade of cast iron. In its broader aspects, however, the invention is not limited to iron and steel, but may be employed as well in the treatment of non-ferrous metals.

In order that my improved apparatus and method may be clearly understood, reference is had to the accompanying drawing, forming part of this specification, and in which:—

Figure 1 is a vertical section through one form of furnace, adapted for the carrying out of my improved method;

Figure 2 is a similar view, showing a slightly different form of furnace; and

Figure 3 is likewise a similar view, showing a still further modified construction and arrangement of furnace.

Referring to the drawing, and more particularly to Figure 1, I provide a special furnace comprising an air tight steel case or shell 1, lined throughout with refractory material such as fire brick 3, a layer of asbestos or other heat insulating material being interposed between the refractory lining and the steel shell, as indicated at 2.

The furnace is preferably in the form of a vertical, cylindrical shaft, and is provided, at the bottom, with a tap hole 4, for discharging the treated metal. The upper end of the furnace is open and is preferably enlarged or flared, as indicated at 1^a.

Suitable electrodes are built into the furnace walls, these electrodes consisting, as shown in Figure 1, of annular rings or blocks 5. These may be made of carbon or graphite, or even of metal, and are preferably water cooled by means of circulating pipes, as indicated at 6.

In Figure 1, I have shown two such electrodes, one located near the top and one near the bottom of the furnace. Current is supplied to these electrodes by means of a transformer comprising a secondary winding 7, provided with taps 8 and a switch 9, by means of which the voltage may be regulated. The current is supplied to the electrodes through leads 10. The primary winding of the transformer is indicated at 11, and is shown as supplied with alternating current through conductors 12.

Having provided a furnace constructed as described, I fill the interior thereof with a mass or column of granular, electrically conducting material, as indicated at 13. By the word "granular", I wish to be understood as meaning material in the form of lumps or fragments with interstices between them. This material may well consist of broken coke, graphite, electrode carbon, silicon carbide or other carbide, the essential requirement being that the material be capable of conducting the electricity and withstanding heat, and that it have a relatively high resistance. In some cases, material belonging to the class of so-called secondary conductors, which require preheating, may be employed, although, of course, where the object is to refine and carburize iron or steel, carbonaceous material must be used.

It will be observed that the column of granular conducting material 13 is in contact with the electrodes 5 and serves to conduct the current from one to the other. Thus, the current is caused to traverse or travel longitudinally through the column of material, such column thus constituting a resistor element, and as a result of its relatively high resistance, becoming very highly heated or incandescent. The tap hole 4 at the bottom of the furnace is normally kept closed, as by means of a plug such as indicated at 4^a in Figure 3, and therefore, all air is practically excluded from the mass or column of heated material. Consequently, notwithstanding the high degree of heat, the carbonaceous material is not oxidized to any appreciable extent, except on top, where it comes in contact with the atmosphere.

The metal to be treated is preferably previously melted, and is brought to the furnace in a molten state, as by means of a suitable ladle 14. This molten metal is then poured into the top of the furnace, as indicated at 15 in Figure 1, the metal falling upon the bed of incandescent granular material and trickling down through the same. After passing through the column of material, it accumulates at the bottom of the furnace, and is drawn off through the tap hole 4 from time to time, as required.

If the charge being treated consists of iron or steel, the passage of the metal through the incandescent mass of carbonaceous material results in a complete de-oxidation thereof, and furthermore, if the metal is not already saturated with carbon, it will take up or absorb sufficient

carbon from the mass to saturate it, and when discharged from the tap hole, it will consist of refined cast iron of standard carbon content.

If desired, there may be placed on top of the column of carbonaceous material, a layer of desulphurizing material such as lime, fluorspar, etc., and also suitable quantities of alloys, such as ferro-manganese, may, in addition, be placed on top of the carbonaceous material, so that as the molten metal is poured over them, they are dissolved and combined with the charge to form a product of any desired composition.

It has heretofore been attempted to carburize a charge in an ordinary electric furnace by throwing in suitable quantities of coke or other forms of carbon. I have found, however, that when using this method, the coke floats on top of the molten metal, and that the lower side of the pieces of coke quickly become coated with ash, which then prevents further action of the metal on them. With my present improved process, there is practically no ash present in the interior of the column of carbonaceous material, and the metal, trickling through the mass, comes thoroughly into contact with the material and is quickly and completely carburized.

In Figure 2, I have shown practically the same idea embodied in a two-phase furnace. In this furnace, three annular electrodes 5^a, 5^b and 5^c are employed, vertically spaced apart, as shown, and supplied with current from a transformer T, having two secondary windings 16 and 17. These two windings are connected at one end and the junction is connected with the middle electrode by means of a conductor 19. The two free ends of the windings 16 and 17 are connected with the upper and lower electrodes by means of conductors 18 and 20, respectively. The primary winding of the transformer T is shown as comprising three star connected coils 21, supplied with current through conductors 22. The arrangement shown constitutes the well known three-phase, two-phase transformer, in which the secondaries are connected in what is known as open delta.

It will, of course, be understood that any suitable means for varying the voltage supplied to the three electrodes may be employed, such, for example, as taps, as indicated in Figure 1, or special switching means, as shown in my prior Patents, Nos. 1,242,464 and 1,272,077.

It will, moreover, be understood that the invention is not limited to the use of ring shaped or annular electrodes. Plain bars or blocks of graphite or the like may be set into the walls of the furnace, in place of the annular rings, if desired.

It is not even necessary to set the electrodes into or through the walls of the furnace. In Figure 3, I have shown an arrangement in which electrodes for supplying current to the resistor element may project into the top of the furnace.

Referring to Figure 3, I have shown a furnace in general similar to those illustrated in Figures 1 and 2, but not so high, such furnace being indicated at 1'. The furnace is preferably made with a flaring or hopper-shaped upper end and into such upper end project three electrodes 23. These electrodes extend down into and are embedded in the mass of granular material, constituting the resistor, and such material is heated by the current traversing the same between the electrodes. Each of the electrodes 23 is adjustably supported as by means of a cable 24, passing over a pulley 25 and attached to a suitable winding drum, as indicated at 26. The electrodes are supplied with current through conductors 27, connected with the secondary winding 28, of a suitable three-phase transformer T. The primary winding of this transformer is indicated at 29 and is connected with the power mains 22. It will be understood that the voltage supplied to the electrodes may be varied in any well known way, such as that disclosed in my above mentioned prior patents.

The type of furnace shown in Figure 3 may be used to treat previously molten metal, as shown in Figures 1 and 2, but instead of previously melting the metal, it may be charged into the top of the furnace in a solid state, as indicated at 30, by means of a suitable chute or the like, 31. The heat from the incandescent mass below the charge of metal serves to melt the same, and the molten metal trickles down through the incandescant material in the same manner as previously described. It will be understood that this method of charging the metal in the cold state into the upper end of the furnace may be employed in connection with furnaces of the types shown in Figures 1 and 2, as well as in that shown in Figure 3.

Owing to the fact that air is practically excluded from the interior of the furnace and from the mass of coke or other material through which the molten metal trickles, there is only a very small formation of ash, and moreover, owing to the exceedingly restricted consumption of the coke, only minute quantities of sulphur are released therefrom and absorbed by the metal.

What I claim is:—

1. Apparatus for treating metals comprising a refractory lined chamber in the form of a vertical shaft, open at the top, a stationary granular mass of carbonaceous material filling said shaft and constituting a resistor, and means for causing electric current to traverse said mass to heat the same.

2. Apparatus for treating metals comprising a refractory lined chamber having a discharge orifice at the bottom, a stationary granular mass of carbonaceous material filling said chamber and constituting a resistor, means for causing electric current to traverse said mass to heat the same, whereby the metal to be treated may be trickled from above down through said heated mass and escape from said discharge orifice.

3. A shaft type furnace having electrodes at its upper end and a loose carbonaceous material filling the shaft below the electrodes whereby material melted by the electrodes will pass downward through the carbonaceous material.

4. A shaft type furnace having electrodes at its upper end and a heated loose carbonaceous material filling the shaft below the electrodes whereby material melted by the electrodes will pass downward through the carbonaceous material.

5. A shaft type furnace having electrodes at its upper end and a loose carbonaceous material in the furnace below the electrodes and adapted to support material to be melted by the electrodes whereby the molten material will pass downward through the carbonaceous material.

6. A shaft type furnace having electrodes at its upper end and a heated loose carbonaceous material in the furnace below the electrodes and adapted to support material to be melted by the electrodes whereby the molten material will pass downward through the carbonaceous material.

7. A shaft type resistance furnace having an

electrode at each end, a loose carbonaceous resistance material within the furnace extending from one electrode to the other, a charging opening at the top of the furnace and a discharge opening at the bottom whereby material may be melted and continuously fed downward through the carbonaceous resistance material.

8. The herein described process of making commercial iron which consists in supporting a charge of ferrous scrap upon a porous carbonaceous resistor having an electric current passing therethrough and melting the charge and flowing the molten charge through the carbonaceous resistor for carburizing the charge and withdrawing the molten charge from the bottom of the carbonaceous resistor.

9. The herein described process of making commercial iron which consists in melting a charge of ferrous scrap and continuously flowing the molten charge through a porous carbonaceous resistor having an electric current passing therethrough for carburizing the charge.

10. The herein described process of making commercial iron and the like which consists in melting a charge of ferrous scrap, and flowing the molten charge through a heated permeable carbonaceous resistor material having an electric current passing therethrough.

11. The herein described process of treating metal which consists in supporting a charge of metal scrap upon a granular carbonaceous resistor having an electric current passing therethrough and melting the charge and flowing the molten charge through the carbonaceous resistor for carburizing the charge and withdrawing the molten charge from the bottom of the carbonaceous resistor.

WILLIAM E. MOORE.