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ELECTRIC FURNACE METHOD

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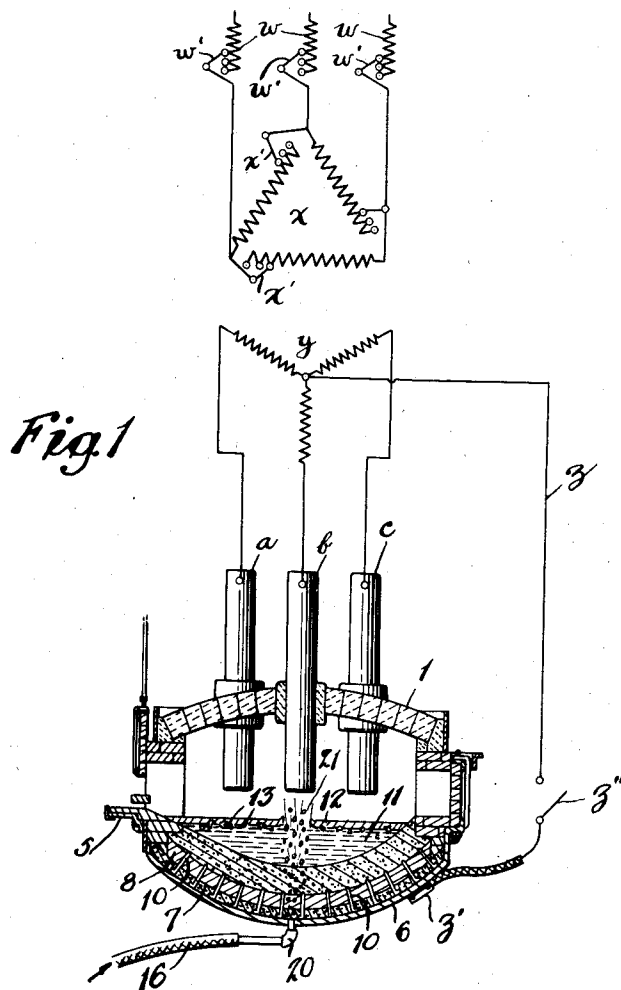
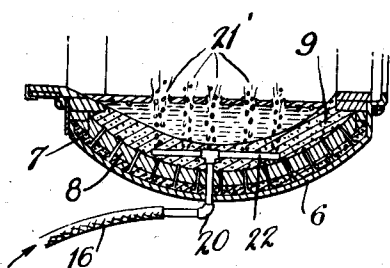


Fig. 2



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ELECTRIC FURNACE METHOD

Original application filed June 19, 1928, Serial No. 286,594. Divided and this application filed April 12, 1929. Serial No. 354,603.

This invention relates to metallurgical furnaces and more particularly to an improved furnace for and method of carburizing metallic charges.

5 It has heretofore been the common practice to construct the hearth or bottom of arc type metallurgical furnaces of refractory material, such as magnesite, dolomite or ganister, which becomes electrically conducting at high tem-
10 peratures. It has also been proposed to construct furnace bottoms of this kind of a layer of refractory material which is of progressively increasing conductivity from the top downward.

15 Such a bottom, however, does not give the best results for certain classes of work, and I now propose to provide a furnace bottom consisting of a layer of substantially uniform high conductivity throughout. I have also
20 found that when treating such metals as iron or steel for the purpose of carburizing them, it is desirable to form the furnace bottom or hearth of carbon or carbonaceous material capable of giving up carbon to the charge.

25 The present invention also seeks to provide means for treating the charge with gas or fluid as well as to facilitate the carburizing thereof by agitating the same while in contact with such a carbonaceous bottom or
30 hearth. In this connection, I have discovered that the carburizing action can be expedited by treating the charge by fluid or liquid hydrocarbons, and by mixing carbonaceous material with the charge and then agitating the
35 charge while such material floats upon the surface thereof.

The present application is a division of my prior application, Serial No. 286,594 filed
40 June 19, 1928.

In the accompanying drawings which form a part of this specification and wherein like characters of reference denote like or cor-
45 responding parts throughout the same,

Figure 1 is a view in vertical section of a three phase furnace constructed in accordance with the invention, and showing my improved means for agitating the charge,
50 and,

Figure 2 is a fragmentary vertical section

showing the furnace bottom and a modified means for agitating the charge.

In the drawings wherein for the purpose of illustration is shown a preferred embodiment
55 of my invention, the furnace is designated in its entirety by the reference numeral 1. This furnace is mounted in the usual way so as to be readily tilted to allow the charge to be poured from the spout 5. The furnace
60 mounting forms no part of this invention and is illustrated in Figure 1 of the drawings of my prior application referred to.

My improved furnace bottom consists of an outer shell 6 formed of metal plates, and a
65 supporting layer of refractory material such as basic or neutral bricks, a lining 7 of suitable mortar being interposed between the shell 6 and refractory layer 8.

The topmost or active layer 9, constituting the bottom or hearth of the furnace which is
70 in direct contact with the charge, rests upon the layer 8, and consists of carbonaceous material such as carbon, or graphite, or a carbonaceous composition such as a mixture of
75 graphite with ferro-alloys, or other metals. This layer 9 constituting the bottom or hearth proper is of substantially uniform high conductivity throughout, and is electrically connected to the metallic shell 6 by means of a
80 plurality of metal strips or fins 10 secured at one end to the shell 6, and having their other ends embedded in the layer 9 of carbonaceous material, such fins or strips extending through the refractory supporting layer 8.

The furnace is illustrated as having three
85 electrodes *a*, *b* and *c*, extending through the roof as usual, and connected to the ends of the secondary winding of a three phase transformer *x*, *y*, the primaries *x* being connected in delta, while the secondaries *y* are connect-
90 ed in star, the neutral point of which is connected by means of a conductor *z* to a clip or socket *z'* on the shell 6, a switch *z''* being preferably included in the circuit. This current not only passes from one electrode to
95 the other, but may flow also from one or more of the electrodes through the furnace bottom.

In order to vary the voltage and current
100 flowing through the electrodes and furnace

bottom, I preferably provide the primary windings with taps controlled by switches w' , and also include in the primary circuit suitable variable reactors w controlled by switches w' . By manipulating the switches w' and w , the voltage of the several phases may be controlled as desired.

When manufacturing and refining cast iron from iron or steel scrap or pig iron, it is often necessary to increase the percentage of carbon in the charge, that is to carburize it. I have found that one very effective way of doing this is to mix with the cold scrap when it is introduced into the furnace, a suitable amount of charcoal or coke. When the charge is melted, this solid carbonaceous material floats on top of the molten charge and mixes with the impurities to form a carburizing slag. I have found then, that when the charge is molten and in contact with the above described carbonaceous bottom or hearth on one side and in contact with the carburizing slag on the other side, it can be very effectively carburized by agitating the liquid mass.

In the drawing, 11 designates the molten or liquid charge on which floats a slag 12 containing lumps of solid carbonaceous material 13.

There are several ways in which this liquid charge can be agitated. Thus, for example, fairly good results can be obtained by simply thrusting a pole of green wood into the charge, the heat of the charge immediately vaporizing the volatile constituents of the wood, thus causing ebullition of the molten mass.

A more effective method, however, is to bubble a gas or fluid therethrough. The fluid employed may be either a non-oxidizing or reducing gas, such as nitrogen or hydrogen, under pressure, or it may be in the nature of a hydrocarbon, either gaseous or liquid. In the first case, the passage of the gas through the molten charge tends to prevent oxidation or to reduce oxides present, while in either case a violent bubbling or ebullition of the charge is produced, thus agitating the mass and bringing all parts thereof into intimate contact with both the carbonaceous bottom and the carburizing slag.

Moreover, if a hydrocarbon or oil is employed, the gases or vapors therefrom fill the space in the furnace above the charge and themselves constitute carbonaceous or carburizing material. Thus, by using a fluid hydrocarbon for bubbling through the charge, it performs the double function of agitating the molten mass, and at the same time supplying carbon which may be absorbed by the charge.

It will, therefore, be understood that I contemplate carburizing a metallic charge in any one of the several ways mentioned, or by employing all of the several methods at the

same time. Thus, I may omit the solid carbonaceous material and produce the carburizing simply by agitating the molten mass in contact with my improved carbonaceous hearth, or I may agitate the mass by means of a fluid hydrocarbon as described, or I may use an inert gas and employ solid carburizing material in the form of a supernatant slag.

In addition to its carburizing function, my improved carbonaceous bottom is found to be highly resistant to both acid and basic slags.

In Figure 1 I have shown one method of forcing a fluid into and through the charge to agitate the same or to produce any other desired effect.

Where the furnace bottom is constructed, as described, of a layer of carbonaceous material supported upon a layer of refractory material and mortar, such bottom is, of course, quite porous, and I have discovered that it is sufficiently porous to permit streams of gas or other fluid to pass freely through the pores thereof.

In order to introduce the gas or other fluid so that it can flow through the porous bottom as described, I tap the metallic shell 6 on which the bottom rests, and insert therein one end of a pipe 20, as clearly shown in Figure 1. To the other end of this pipe, a hose 16 may be attached. Gas or other fluid entering the pipe 20 under pressure will make its way up through the pores of the several layers of material constituting the furnace bottom and will bubble freely up through the molten charge, as indicated at 21. Owing to the fact that the gas has to permeate through the pores of the mass of carbonaceous and other material forming the furnace bottom, such gas will be distributed or diffused and will pass upward through the charge in widely scattered relatively small streams.

In Figure 2 I have shown means by which the incoming stream of gas or fluid may be even more widely distributed and diffused through the charge than in the preceding figure.

Referring to Figure 2, it will be seen that I employ a pipe 20 tapped through the metallic shell 6, as before, but in this figure I extend the pipe a short distance upwardly and mount upon its upper end a transversely extending cross pipe or manifold 22, having a series of perforations therein along the length thereof. This manifold is embedded in the porous carbonaceous or other material forming the upper layer of the furnace bottom. It is obvious that with this arrangement, the gas entering the pipe 20 under pressure will be distributed over a wide area and will then be diffused as it permeates and passes up through the porous bottom and finally bubbles in small streams up through the molten charge, as indicated at 21'.

By virtue of the fact that, in the arrangements shown, the gas or other fluid is broken up into small streams and diffused throughout the charge, it is caused to come into intimate contact with all portions of the charge and the pipe is protected from the most intense heat of the furnace by being below or embedded in the material of the bottom.

While I have shown and described the preferred embodiment of my invention, it is to be understood that various changes in the size, shape and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. An electric metallurgical furnace having a bottom comprising a porous layer of carbonaceous material in direct contact with the charge, and means for forcing gas under pressure up through the pores of said layer and through the charge resting thereon whereby the charge is agitated to bring it into intimate contact with the layer of carbonaceous material.

2. An electric metallurgical furnace having a bottom comprising a metallic shell and a layer of porous carbonaceous material supported thereby, and means for causing gases to bubble up at a plurality of points and be thus distributed through the charge in a diffused state comprising a pipe tapping said shell and having at its end a manifold embedded in the porous material whereby the charge is agitated to bring it into intimate contact with the layer of carbonaceous material.

3. In an electric metallurgical furnace having a porous carbonaceous bottom, the method of carburizing the charge which comprises causing a fluid hydrocarbon under pressure to flow up through the pores of such bottom in a diffused state and thence up through the charge to agitate the charge and bring it into intimate contact with the fluid hydrocarbon and with the carbonaceous bottom.

4. In an electric metallurgical furnace having a porous carbonaceous bottom, the method of treating the charge which consists in causing a fluid under pressure to flow up through the pores of such carbonaceous bottom and thus up through the charge to agitate the charge and bring it into intimate contact with the carbonaceous bottom.

In testimony whereof I affix my signature.
WILLIAM E. MOORE.