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ELECTRIC FURNACE FOR MELTING METALS

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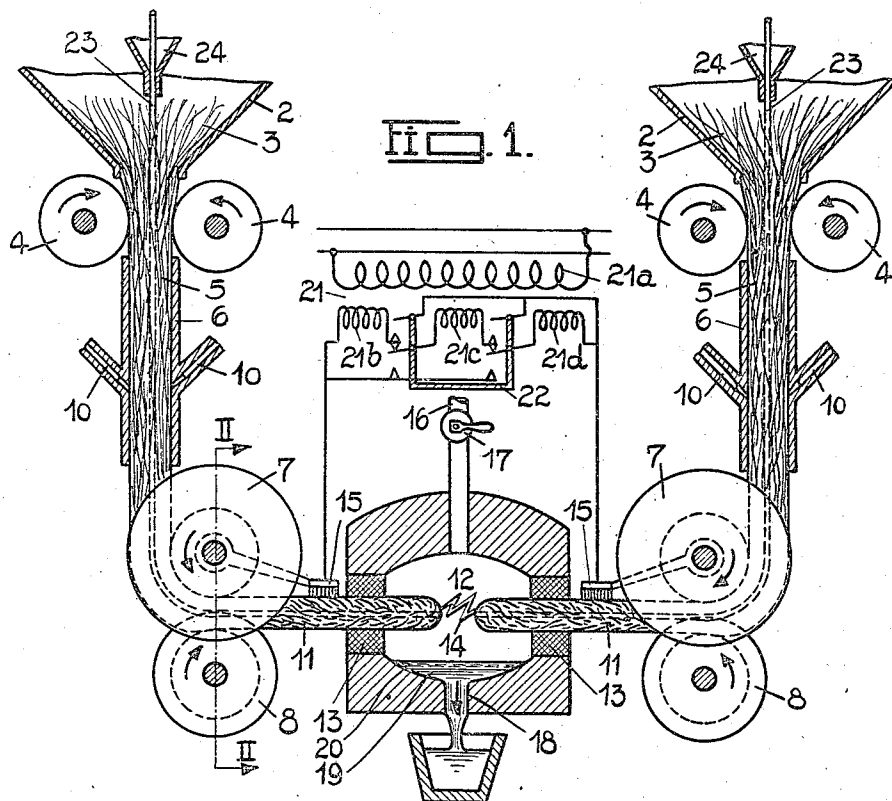


Fig. 2.

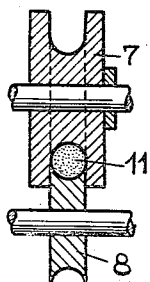


Fig. 3.

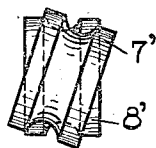
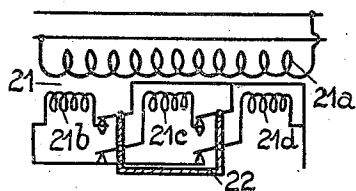


Fig. 4.



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## UNITED STATES PATENT OFFICE

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## ELECTRIC FURNACE FOR MELTING METALS

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## 2 Claims. (Cl. 13—19)

In electric arc furnaces for the manufacture of metallurgical products, particularly alloys, by fusion, the means of fusion employed is the heat developed by one or more electric arcs passing between two or more infusible or at least very refractory electrodes, or between said electrodes and the molten bath itself.

These electrodes are essentially formed of carbon. They may have a fixed length, necessitating the stoppage of the furnace for their replacement after wear, or they may be fed constantly from the outside to permit continuous working.

In either system, this intervention of the carbon in the operation of refining the charge of the furnace is not desirable, because it may involve carburisation of the molten bath. Furthermore, the wear of graphite electrodes forms a continual expense which is not negligible.

It is an object of the present invention to remedy these disadvantages.

The electric arc furnace according to the invention comprises metallic electrodes forming the charge of the furnace.

This furnace presents the very important advantage that it may be put into operation so to speak instantaneously, since the striking of the arc causes the ends of the electrodes to melt. It may therefore readily be put into normal service during the few hours when the electricity companies are able to supply current at a reduced tariff.

According to a preferred form of construction, the furnace according to the invention comprises devices for the continuous introduction of the charge in the form of electrodes consisting essentially of compressed rods of any desired profile and with a basis of metallic fibres which have practically the same cross-section throughout their entire length and are distributed in a practically uniform manner throughout the entire length of said rods.

A furnace of this kind permits the proportions of the various components of the charge to be readily regulated and the composition of the charge to be modified if desired, in order to take into account the result of analyses made on samples of the molten metal or alloy.

The furnace according to the invention may in addition be very advantageously provided with a discharge orifice for the molten products, so arranged as to permit the continuous discharge of said products.

It is thus possible, by means of a furnace of

relatively small dimensions, to produce a high tonnage of metal.

Other features and details of the invention will appear in the course of the description of the accompanying drawing which shows a construction of a furnace according to the invention diagrammatically and merely by way of example.

Figure 1 shows in part vertical section an electro-metallurgical furnace according to the invention.

Figure 2 is a diametrical section on the line II—II of Figure 1.

Figure 3 shows a press for effecting a twisting of the whole of the fibres at the same time as a compression.

Figure 4 shows another connection of the source of current according to Figure 1.

In these various figures, the same reference numerals denote the same parts.

Figure 1 shows a metallurgical electric arc furnace whereof the electrodes are formed by the agglomeration of metallic fibres under pressure. Said fibres are fine and long elements which have practically the same cross-section throughout their entire length and are considerably interlaced. Said fibres are distributed in a practically uniform manner throughout the entire length of the rods which they form.

The electrodes enter the gas-tight enclosure of the furnace 12 through friction bushes 13 of refractory material. Said bushes may likewise be made of some other material cooled by water circulation. Each electrode, in proportion to its fusion in the furnace under the action of the heat developed by the arc, is formed by a continuous press.

These electrodes are formed of metallic fibres 3 which have been charged in a hopper 2. The mass of fibres 3 is drawn from the hopper 2 by rolls which subject said mass to a first compression. The cylinder 5 thus formed is guided in a tube 6 towards a second continuous press consisting of rolls 7 and 8 (Figures 1 and 2) similar to the rolls of rolling mills.

The cylinder 5 is strongly compressed between said rolls and on leaving the latter forms an agglomerated rod 11 which has a very compact texture and is very rigid even when fabricated cold and without any binding agent.

Its composition may readily be varied by mixing additional materials with the fibres in the hopper 2, either in the form of powder or in the form of fibres.

Additional materials may likewise be intro-

duced between the two compressions to which the fibres are subjected. In particular, such addition may be effected by blowing powder between the fibres through nozzles 10.

5 The rigidity of the electrodes may likewise be increased by imparting a twisting movement to the whole of their fibres during the compression of the latter. For effecting said twisting, it is merely necessary, instead of directing the axes  
10 of the compressing rolls parallel as shown in Figure 2, to cause the axes of these rolls to make a slight angle, as shown in Figure 4 for the rolls 7' and 8'.

The furnace charge may be readily obtained  
15 by mixing metallic fibres of different metals or alloys or by adding thereto, in the form of powder, either metals or alloys or other substances.

It is likewise possible to introduce into each  
20 electrode one or more metallic continuous wires of appropriate nature. It is possible to introduce continuous metallic wires into the mass of fibres in order to obtain particularly regular low percentage proportions of certain additions. All the metallic and other materials entering into  
25 the composition of the electrode are thus extremely divided and intimately mixed, which assists their combination at the moment of fusion.

The wires are introduced for example into the  
30 mass of fibres as shown in Figure 1. The wire 23 shown is guided in the axis of the hopper 2 by another hopper 24. Each press may likewise be fed by a ribbon or cylinder of metallic fibres which has undergone preliminary compression  
35 in a press not shown.

The current for feeding the arc 14 is supplied to the electrodes at their entry to the furnace by brushes shown diagrammatically at 15 in Figure 1. Said brushes may be rendered integral with  
40 the bearings of the rolls of the adjacent press, so as to benefit from the good contact resulting from the powerful pressure set up in said presses.

The speed of the rolls 7 and 8 which regulates the feed of the electrodes may be controlled electrically in accordance with the potential difference between the electrodes by a device such as  
45 those employed for maintaining an electric arc of constant and adjustable length.

The furnace itself, lined internally with an appropriate refractory lining, is provided with a gas supply pipe 16 controlled by a cock 17. At the base of said furnace is a discharge orifice 18 for the finished products 19 and another orifice on a higher level, not shown, for the discharge of the  
55 slag 20.

This furnace has the advantage that it permits the passage of the arc between electrodes formed by the charge of the furnace itself. It consequently dispenses with the use of expensive carbon electrodes which in many cases exert a detrimental action on the molten bath of metal.

In view of the fact that the operation of refining the charge takes place in the arc itself between metallic or substantially metallic electrodes, the function of the internal lining of the furnace becomes of secondary importance, since the products of the reaction may be immediately discharged to the exterior in a continuous manner. The duration of contact between said products and the lining consequently becomes very short, which considerably simplifies the problem of the preservation and maintenance of the lining.

The continuous introduction of the charge in  
75 the form of electrodes into the furnace enables

the furnace to be maintained permanently under gaseous pressure, whereas the charging of ordinary electric furnaces necessarily interrupts the gas-tightness of their enclosure. The nature of the gas constituting the atmosphere of the furnace may be selected at will, and its pressure may even be raised as high as is desired, either because it is intended to raise the temperature of the arc or because it is desired to facilitate by said pressure the discharge of the molten or pasty products, or again because for special reasons, it is intended to dissolve considerable quantities of gas in the bath of molten metal.

It is also obvious that an electric furnace according to the invention may be constructed in forms different from that shown in Figure 1. More particularly, it is possible to conceive a furnace having a single vertical electrode of the type described, in which the arc passes between said electrode and the molten bath. Of course,  
20 it is also possible to employ any number of electrodes.

The composition of the elements which constitute the electrodes of the furnace (fibres and/or additional substances) and the proportion of these elements depend on the nature of the metal or of the alloy to be obtained. The dimensions and the rate of feed of these electrodes may also vary as a function of the dimensions of the furnace and of the composition of the electrodes.  
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The brushes 15 are connected to the secondary terminals of a transformer 21, the primary 21a of which is connected to alternating current supply mains. Said secondary comprises a plurality of windings, such as 21b, 21c and 21d connected  
35 in series.

Said windings may, however, likewise be connected in parallel as shown in Figure 4. In this case, the supply voltage of the furnace is lower but the feed current is higher. This parallel connection of the windings 21b, 21c and 21d of the secondary will be adopted when the furnace is to be used not as an arc furnace but as a resistance furnace. In such a case, simultaneously with passing from the series connection of Figure 1 to the parallel connection of Figure 4 by operating a switch 22, the electrodes will be brought into contact so that they will be heated by Joule effect mainly at their contacting ends. Contact between the electrodes will be maintained despite  
50 the fusion of the ends.

Due to this modification in the feeding of the electrodes and in the source of current, it is therefore possible to pass at will from arc furnace operation to resistance furnace operation, that is to say to operate the same furnace under very different temperature conditions.

A furnace according to the invention may be utilized for special metallurgical operations, such as the manufacture of "special" steels, refined ferro alloys. In each case, the composition of the charge should naturally be appropriate to the object aimed at, in accordance with the knowledge of the usual art.

What I claim is:

1. An electric furnace for the manufacture of metallic products, particularly alloys, by fusion, comprising at least one electrode constituted of compressed metallic elements, rolls similar to the rolls of rolling mills disposed so as to draw between them a mass of metallic elements to be compressed and to introduce continuously in the furnace the compressed electrode which they have formed by lateral compression, and a discharge orifice for the molten metal arranged in such a  
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manner as to permit the continuous discharge of said metal.

2. An electric furnace for the manufacture of metallic products, particularly alloys, by fusion, comprising metallic electrodes constituting the charge of the furnace, a source of alternating current for feeding said furnace, a transformer

connected between said source of current and said electrodes, said transformer comprising one primary winding and a plurality of secondary windings, and means for connecting said secondary windings either in series or in parallel.

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