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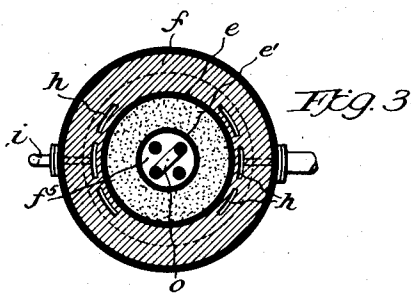
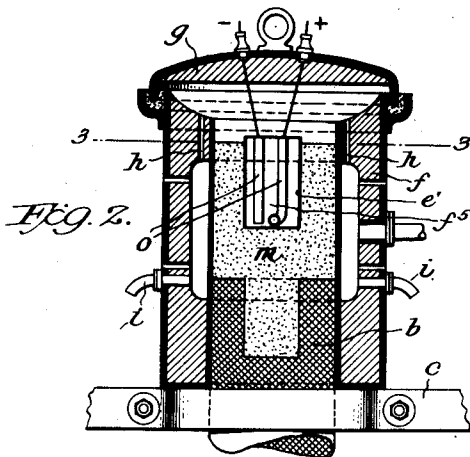
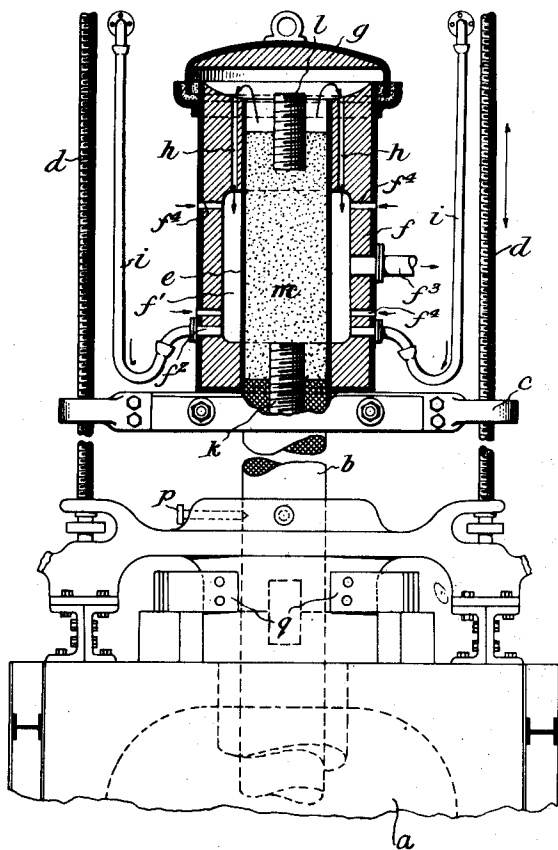
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METHOD OF AND APPARATUS FOR FORMING CONTINUOUS ELECTRODES

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Fig. 1.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR FORMING CONTINUOUS ELECTRODES.

Application filed March 20, 1923. Serial No. 626,391.

To all whom it may concern:

Be it known that I, ALOIS HELFENSTEIN, a citizen of Switzerland, residing at Vienna, Austria, have invented certain new and useful Improvements in Methods of and Apparatus for Forming Continuous Electrodes, of which the following is a specification.

This invention relates to a method of and apparatus for forming continuous electrodes, i. e. producing electrodes at the place of their immediate use as continuations of the electrode portion extending into the furnace.

According to the invention the forming and baking of the raw material from which the electrode is prepared takes place in advance of the point at which the current enters the electrode and is effected by external heating by means of a heating arrangement surrounding the mould, or in the case of hollow or very large electrodes, by means also of a heating device applied within an inner mould. Heat may be produced by the use of liquid or gaseous fuel, or by means of electrical heating resistances.

According to the invention, it is intended to utilize, although provision may be made for burning gas from a separate supply, combustible gases resulting from the processes carried out in the furnace and also such gases as are developed during the burning operation, from the raw mix from which the electrode is formed, by conducting such gases into the heating apparatus and using the heat of combustion thereof to burn the electrodes.

In order to bring about a reliable union between the electrode in operation and the part to be added thereto, solid parts such as pieces of metal or graphite or electrode carbon rods are inserted in the electrode mass so as to project therefrom and form anchoring elements for the next addition. The same object can be accomplished by forming the free end of the electrode mass to be burned with threaded or channeled portions for receiving the electrode mass of the next addition in interlocking relation.

The mould and the heating arrangement associated with it, on the one side, and the electrode adjusting clamp, on the other side, are so correlated that the former may par-

ticipate in any adjusting movement of the electrode, or may be moved relatively thereto, preliminary to the application of a new charge of electrode material.

In case the electrodes have a large cross-section, it is advisable to use both an outer mould and an inner mould, and to provide a heating device also in the latter. While in such case the outer mould may be advantageously heated by means of gas, preferably including the gases given off from the electrode mass during the baking operation, the inner mould is preferably heated by an electric resistance element.

For a full understanding of the principles of operation on which the invention is based and the advantages resulting therefrom, reference is made to the accompanying drawings in which

Fig. 1 is an elevation, partly in section, of an embodiment of the invention;

Fig. 2 is a sectional view showing a modification thereof; and

Fig. 3 is a section on line 3—3, Fig. 2.

In the drawings, *a* represents the interior of an electric furnace, which may be of any desired construction, *b* an electrode in operation, *c* the electrode adjusting clamp and *d* the driving spindles therefor. Below the adjusting clamp *c* is disposed a guide frame including set screws *p* or other mechanism for clamping the electrode in fixed position independently of the adjusting clamp *a*. This guide frame is supported upon the furnace and provides facilities for supporting the electric contact terminals *q* in contact with the electrode *b*.

Upon the adjusting clamp is mounted a device for applying heat to the outer mould *e*. This device preferably comprises a body *f* of heat-insulating material defining a central chamber *f*¹, the upper and lower portions having a sliding fit with the mould *e*. The chamber *f*¹ has gas inlets *f*² connected with conduits *i* through which gases generated in the electric furnace may be introduced to heat the mould *e* and an outlet *f*³ for the gases. The upper end of the body *f* is closed by a removable cover *g*. The arrangement is such that between the cover *g*, the mould *e* and the upper end of the body *f* is provided a gas space which is con-

nected through channels h in the body f with the chamber f^1 . Air ducts f^4 may be provided for effecting combustion of the gases in the chamber f^1 .

5 The operation is as follows:

Considering as the starting point of the cycle of operation the conditions represented in Fig. 1, it may be assumed that the electrode material has just been packed into the mould e . The gases from the furnace a pass through the conduits i into the chamber f^1 , flow around the mould e and pass out through the outlet f^3 . As the baking operation proceeds the gases evolved from the material m in the mould pass into the space above the upper end of the material m and through the channels h into the chamber f^1 and supplement the heating effect of the gases coming from the furnace.

20 The material in the mould is thus heated to the temperature required for the baking operation. As previously suggested a separate source of gas may be used whenever necessary to produce the desired amount of heat.

When the material m has been exposed to the heat a sufficient length of time, the heating operation may be interrupted to allow the baked material m to cool. Cooling is accompanied by contraction which causes the electrode material to separate from the walls of the mould.

From time to time in proportion to the rate at which the working electrode is being consumed, the adjusting clamp mechanism is advanced to feed the electrode into the furnace. When such movement takes place the mould e and the material m together with the heating device, move with the working electrode b and the adjustment clamp c .

When in the meantime the baking operation has been completed and the new addition has been freed from the mould by contraction as above mentioned, the electrode may be clamped in position by means of the set screws p and the clamp c may be loosened and moved upwardly relatively to the electrode to any desired position. The set screws p may then again be loosened to permit again the normal feeding operation by means of the clamp c and spindles d .

55 The heating device may remain inoperative or may be used again according to the condition of the material m .

When the electrode has been fed into the furnace far enough to make the continuation or extension necessary a new charge of electrode material is filled into the mould and forced down tight and the heating operation is repeated.

As is indicated in Fig. 1, a screw-threaded stud l may be inserted into the upper portion of the new charge to afford a reliable anchoring of the new electrode portion and

a dependable union to make the electrode practically continuous. Instead of a screw-threaded stud, various other forms of anchoring means are of course available.

In case the electrode has a large cross-section, a second inner mould e' is used, of such length and width as will in conjunction with the outer mould f insure a satisfactory baking of the material. As indicated in Figs. 2 and 3, the mould e' may be advantageously heated by means of an electric resistance element o , although it is generally feasible to employ other sources of heat. At the end of the baking operation, the inner mould e' and the heating element are removed and the hole may be filled with fresh material, whereupon the heating element may be placed on top of the plug thus formed to separately bake it. As an alternative, if no other anchoring means are provided, the hole may receive an anchoring piece such as the stud l previously referred to, together with electrode material and the anchor may thus be separately baked into the electrode.

In case of hollow electrodes, an inner mould and heating arrangement similar to the mould e' and device o are used with the difference, of course, that the mould and heating device are of greater axial extent.

While I have described what I believe to be a particularly advantageous construction for carrying out the objects of the invention, there is of course considerable latitude in regard to detail.

It is understood that the relationship between the moulds, the heating devices and the electrode is the essential feature, and it is immaterial in that respect whether the electrodes move vertically, horizontally or obliquely.

I claim:

1. The mode of forming continuous electrodes for use in an electric furnace, which consists in maintaining a working electrode of such length that a substantial portion thereof extends outside the furnace, feeding the working current to the electrode at points inwardly of the end thereof, moulding electrode material to the end of the electrode outside the furnace during the normal feeding-in movement thereof and applying gaseous heating means to such moulded material to bake the same outside said furnace.

2. The mode of forming continuous electrodes for use in an electric furnace, which consists in maintaining a working electrode of such length that a substantial portion thereof extends outside the furnace, feeding the working current to the electrode at points inwardly of the end thereof, moulding and baking electrode material to the end of the electrode and then allowing the baked portion to cool, the moulding, bak-

ing and cooling operations being carried out while the working electrode is normally fed into the furnace.

3. The mode of forming continuous electrodes for use in electric furnaces, which consists in maintaining outwardly of the zone of entrance of the electric working current into the electrode a substantial electrode length, moulding electrode material to the end of the electrode while the latter is moved inwardly, applying heat externally to such moulded material to bake the same before the said end is itself the zone of entrance.

4. The mode of forming continuous electrodes for use in an electric furnace, which consists in maintaining a working electrode of such length that a substantial portion thereof projects outside the furnace, moulding electrode material to the end of the projecting portion, inserting an anchoring element in the end of the moulded material, baking the moulded material and then allowing it to cool, the moulding, baking and cooling operations being carried out while the working electrode is normally fed into the furnace and the working current being fed to the working electrode at points inwardly of the end of the projecting portion.

5. Arrangement for forming continuous electrodes for use in electric furnaces, including the combination with an electric furnace of means for feeding a working electrode into the furnace, said means being constructed and arranged outside the furnace to have a substantial range of movement toward and away from the latter, means carried by the feeding means for moulding and baking electrode material to the end of the working electrode, means for feeding the working current to the electrode at points inwardly of the range of movement of the feeding means and means inwardly of the range of movement of the said feeding means operative at will to hold the electrode in fixed position relatively to the furnace.

6. Arrangement for forming continuous electrodes for use in electric furnaces, including the combination with an electric furnace, of means disposed outside the furnace for feeding the working electrode, a mould outside said furnace, and a heating chamber surrounding the mould, both mould and heating chamber being mounted for movement with the feeding means, the feeding means being adjustable relatively to the electrode in the direction of length and the mould being disposed in axial alignment with the electrode.

7. Arrangement for forming continuous electrodes for use in electric furnaces, including the combination of electrode clamping mechanism positioned outside the fur-

nace and movable in alignment with the feeding movement of the electrode, a mould and a heating chamber therefor mounted on the clamping mechanism in the direction away from the furnace and means for passing gases from the furnace to the heating chamber.

8. Arrangement for forming continuous electrodes for use in electric furnaces, including the combination of electrode clamping mechanism positioned outside the furnace and movable in alignment with the feeding movement of the electrode, a mould and a heating chamber therefor mounted on the clamping mechanism in the direction away from the furnace, and means between the said clamping mechanism and the furnace for holding the electrode in fixed position relatively to the furnace.

9. Arrangement for forming continuous electrodes for use in electric furnaces, including the combination of electrode clamping mechanism positioned outside the furnace and movable in alignment with the feeding movement of the electrode, a mould and a heating chamber therefor mounted on the clamping mechanism in the direction away from the furnace, and means disposed between the the said clamping mechanism and the furnace for feeding the working current to the electrode.

10. Apparatus for forming continuous electrodes for use in electric furnaces, comprising in combination with a furnace, electrode feeding means including an adjustable clamp, a mould and a heating chamber therefor mounted on the clamp in alignment with the electrode and means for passing gases from the furnace into the heating chamber.

11. Apparatus for forming continuous electrodes for use in electric furnaces, comprising in combination with a furnace, electrode feeding means including an adjustable clamp, a mould and a heating chamber therefor mounted on the clamp in alignment with the electrode and means affording a gas conduit between the upper end of the mould and the heating chamber.

12. Apparatus for forming continuous electrodes for use in electric furnaces, comprising a mould outside such furnace, a heating chamber surrounding the mould, means for movably supporting the mould and its heating chamber in alignment with the electrode, means for adjustably holding the mould and the heating chamber in fixed relation relatively to the electrode and means for effecting relative movement between the mould and the heating chamber on the one side and the electrode on the other side.

13. In apparatus for forming continuous electrodes for use in an electric furnace the combination of a mould outside such furnace, defining the outer surface of the electrode, a heating chamber surrounding the

mould, means for passing gases from the furnace into the heating chamber, an inner mould defining a hollow space in the electrode and an electric heating device within
5 the inner mould, means for movably supporting the moulds and heating devices in alignment with the electrode, means for adjustably securing the said supporting means to the electrode and means for effecting relative axial movement between the moulds and
10 the heating devices on the one side and the electrode on the other side.

In testimony whereof, I affix my signature.

ALOIS HELFENSTEIN.

Witnesses:

CARL CONDEMBY,

ING. IGNAZ KNÖRFELMACHER.