A. REYNOLDS.

ELECTRIC FURNACE.

APPLICATION FILED FEB. 10, 1908.

935,548. **Patented Sept. 28, 1909.**

Fig. 1.

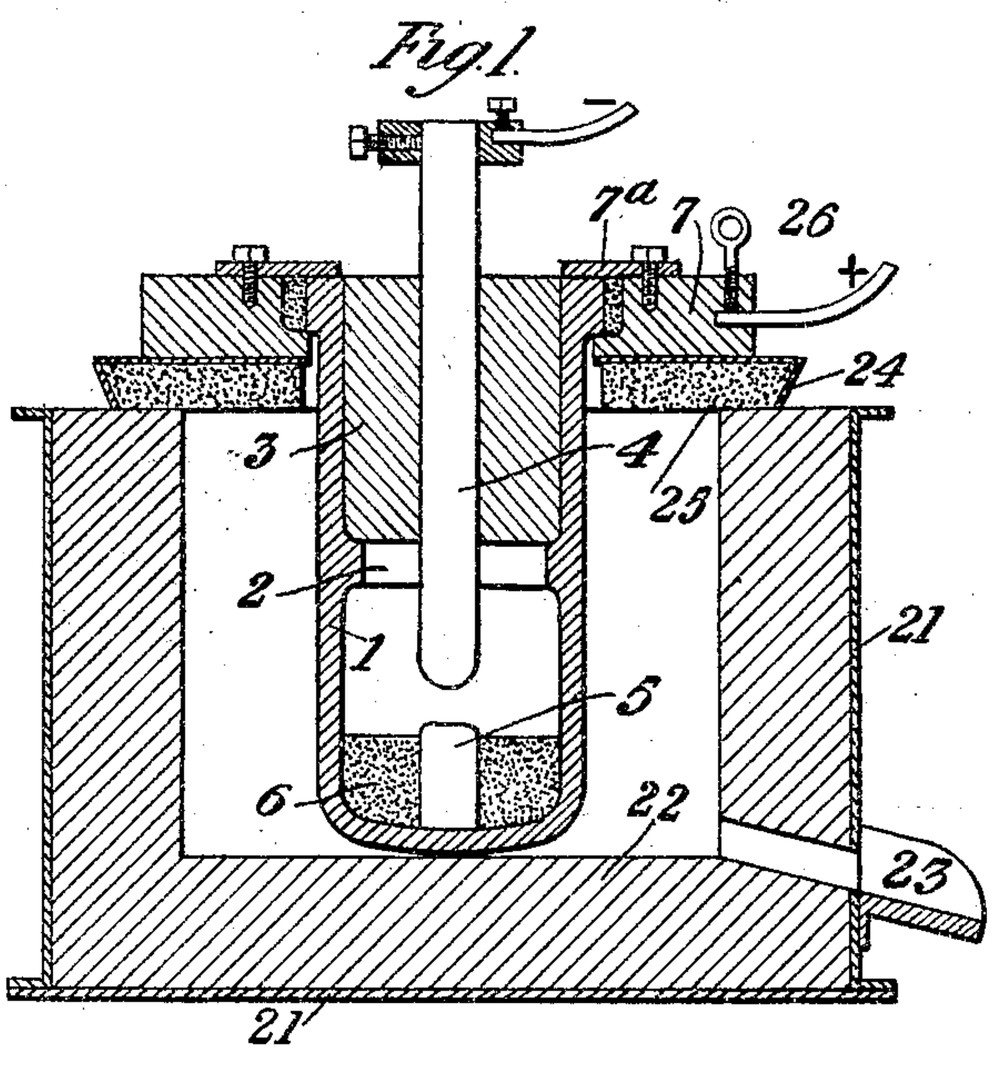


Fig. 2.

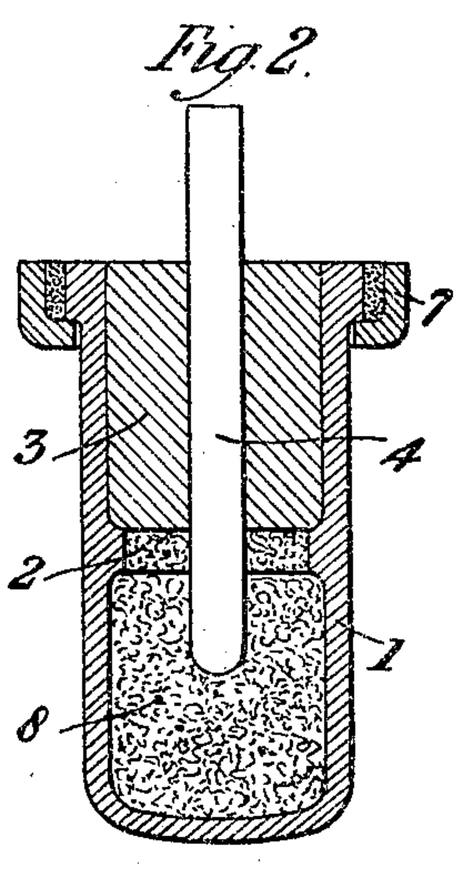


Fig. 3.

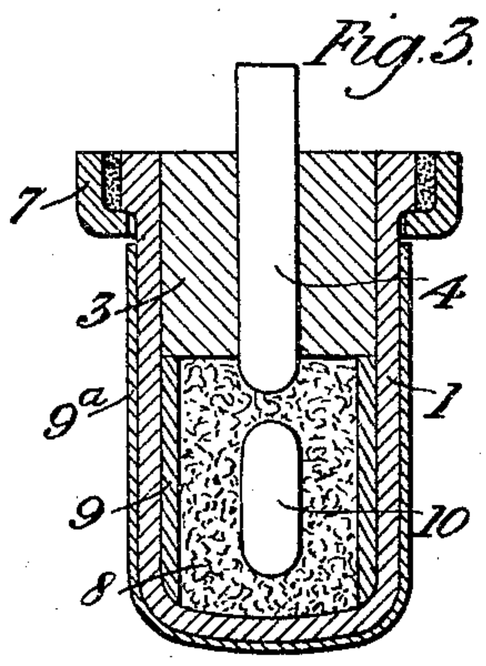
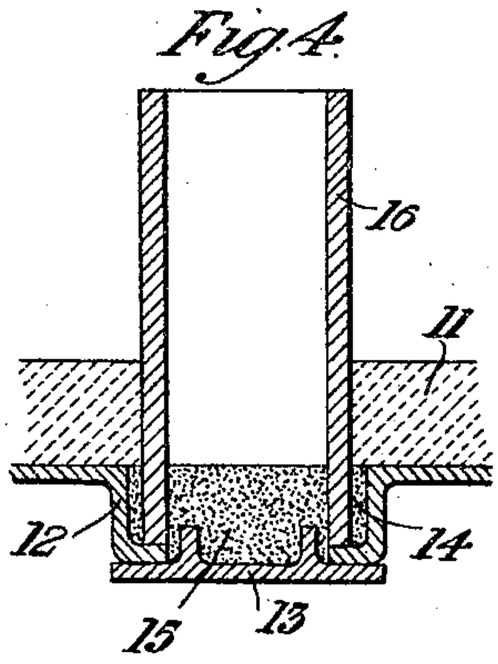


Fig. 4.



Witnesses:

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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE.

935,548. Specification of Letters Patent. Patented Sept. 28, 1909.

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To all whom it may concern:

Be it known that I, ALLEYNE REYNOLDS, a subject of the King of Great Britain, residing at 11 Queen Victoria street, in the city of London, England, consulting metallurgical engineer, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

For the economical working of electrically heated furnaces it is important that the ratio of the radiating and conducting surface to the volume of the charge should be as small as possible; that the heat should be applied either uniformly throughout the charge or to that portion of the charge in the bottom of the furnace, and that this condition should hold good irrespective of the quantity of the charge.

The object of the present invention is more particularly to secure the latter of these conditions of economical working by using one or more electrical heating elements which may be immersed in the charge. These heating elements consist of a close ended tube or pot of carbonaceous material, preferably plumbago, or of a tube of such material closed at the bottom by a carbon plug, forming one electrode, and of a carbon rod or rods within the tube forming the other electrode, the heat being produced either by arcing between the carbon rod and the carbon plug, or the bottom of the pot as the case may be, or a carbon rod sealed in the bottom of the pot or by means of an imperfect electrical conductor, such as loose carbon or a mixture of loose carbon with other material of greater resistivity or a solid resistance of carbon or of a carbon mixture, which bridges the space between the two electrodes.

The interior of the plumbago tube may be lined with an electrically insulating but thermally conducting refractory material such as carborundum or siloxicon, and the outside may be incased if necessary with any suitable refractory material which is inert to the charge or to the material of the furnace walls, as the case may be, at working temperatures.

In the accompanying drawings Figure 1 is a central vertical section of a furnace embodying the present invention, Figs. 2 and 3 are similar sections of slightly modified constructions of electric heating elements; and Fig. 4 is a part section of a furnace showing a tubular heating element embedded in the furnace floor.

In the form shown in Fig. 1, a plumbago pot is formed with an internal ledge 2 upon which rests a sleeve 3 of refractory insulating material such as magnesite, silicate of alumina, or other suitable substance or mixture, which encircles and guides the carbon electrode 4 by which the current is introduced to the heating element. The electrode 4 is suitably supported externally to the pot, preferably by means which admit of adjusting its position vertically in the usual manner. The sleeve 3 and particularly the lower portion thereof may, if necessary, be made of a more refractory material such as carborundum or siloxicon. A carbon rod 5 is secured in electrical contact with the bottom of the pot by suitable means as a ramming 6 consisting of a mixture of ground carbon and tar, or a bed of dry loose carbon may be substituted for the carbon rod and ramming. The electrical connection to the plumbago pot 1 may be conveniently made by ramming a mixture of finely ground carbon and tar between the rim of the tube and a metal ring 7 encircling it, and these parts are preferably formed with coöperating ledges as shown and the metal ring and attached connections are preferably made heavy enough to prevent flotation of the element when immersed in the charge. A cover plate or straps as indicated at 7^a secured to the ring 7 after the joint is made and extending over the rim of the tube serve to hold the latter in position in the ring. In this construction the heat is generated by an arc struck between the electrode 4 and the carbon rod or filling in the bottom of the pot which constitutes the other electrode and since the arc is practically completely cut off from access of air there is a comparatively slow consumption of the carbons and the whole of the heat generated is, with the heating element immersed in the charge, absorbed entirely by the charge.

In Fig. 1, 21 denotes the furnace casing, 22 the furnace lining of suitable refractory material, 23 the tap hole and spout, 24 the lid and 25 the refractory lining of the lid. The lead from the positive pole of the source of current is shown as secured in a socket in

the metal ring 7 by means of one of the eye bolts 26 by which the heating element is lowered or raised.

The construction of Fig. 2 is substantially identical with that of Fig. 1 with respect to the parts indicated by the same reference numerals, but in this case the interior of the pot 1 is filled with broken carbon 8 or other suitable imperfect electrically conducting medium and the heat generated in this resistance. The resistance of the carbon filling 8 would in general be much too small in the case of pots or tubes of dimensions suitable for the purpose intended and consequently some means are required for grading the resistance by reducing the average cross section or increasing the average length of the path available to the current. Fig. 3 shows a construction in which both these means are employed. The cross section available for the resisting medium is reduced and the average length of the path increased by lining the lower portion of the pot walls with a refractory insulating material 9 which is also a good conductor of heat, preferably with a carbid of silicon or silica, such as carborundum or siloxicon. A further increase of the resistance of the element is obtained by embedding in the resisting medium a rod or rods of blocks such as 10 of a similar material. The outside of the plumbago tube or pot may be incased in a suitable refractory material as indicated at 9^a, this material being preferably inert to the charge, or it may be of the same material as the furnace lining 22. It will be understood that the internal and the external linings 9, 9^a may be applied to the other constructions shown in the drawings.

The heating element may also be constructed as a plumbago tube having its lower end closed by a carbon plug, such a construction being preferable if the heating element is to be inserted or embedded, for example, in the floor of the furnace. In such a case, as shown in Fig. 4, the plumbago tube 16 is centered in an annular plate or ring 12 which may be a portion of the furnace casing or may be insulated therefrom. This ring is closed by a cap 13 and the spaces 14, 15 outside and inside the end of the tube are rammed up to the level of the furnace casing with a sealing material which is electrically conductive such as a mixture of ground carbon and tar.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim:—

1. For the generation of heat electrically in metallurgical furnaces, an electric heating element comprising a tube of carbonaceous material immersed in the furnace charge, means for closing the ends of the said tube, means for conducting an electric current to the interior of the tube, and means for converting electric energy into heat within the said tube, substantially as described.

2. For the generation of heat electrically in metallurgical furnaces, an electric heating element comprising a plumbago pot immersed in the furnace charge, a sleeve of electrically insulating refractory material supported in the upper portion thereof, a carbon electrode guided by the said sleeve within the pot, and means for conveying current to the pot and the said electrode, substantially as described.

3. For the generation of heat electrically in metallurgical furnaces, an electric heating element comprising a plumbago pot immersed in the furnace charge, and means for producing and maintaining an electric arc within the said pot, substantially as described.

4. For the generation of heat electrically in metallurgical furnaces, an electric heating element comprising a plumbago pot immersed in the furnace charge and having an internal lining of electrically insulating but thermally conducting material, and means for generating heat within the pot, substantially as described.

5. For the generation of heat electrically in metallurgical furnaces, an electric heating element, comprising a plumbago pot immersed in the furnace charge and a metal ring encircling and having a ledge supporting the upper end of the pot, said metal ring being connected electrically with the pot by a luting of finely ground carbon and tar rammed into the space between the metal ring and the rim of the pot, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALLEYNE REYNOLDS.

Witnesses:
OLIVER ISMAEL,
ALFRED JOHN MAXWELL.