J. M. LOHR & H. W. GILLETT.

ELECTRIC FURNACE.

APPLICATION FILED AUG. 31, 1915.

1,162,178.

Patented Nov. 30, 1915.

2 SHEETS—SHEET 1.

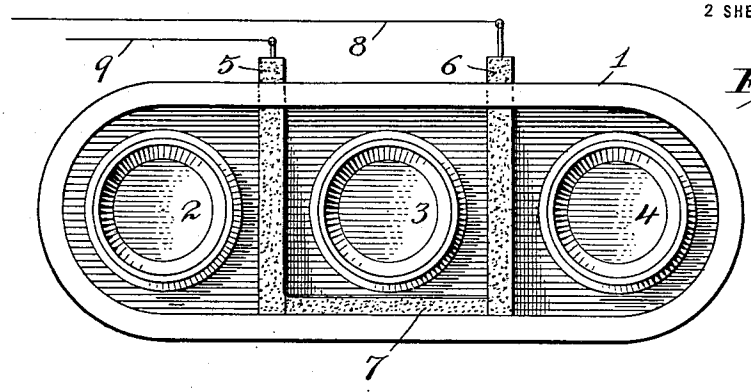


Fig. 1.

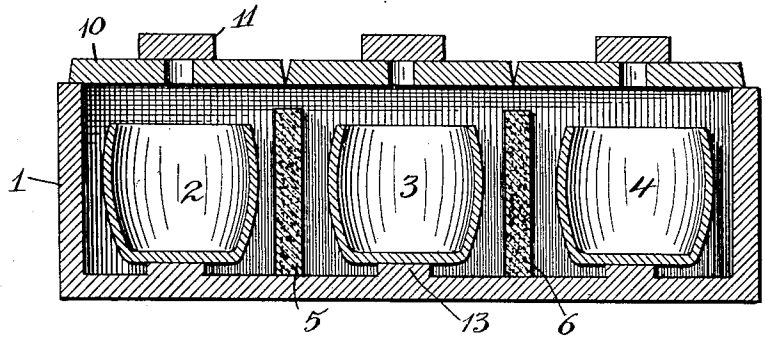


Fig. 2.

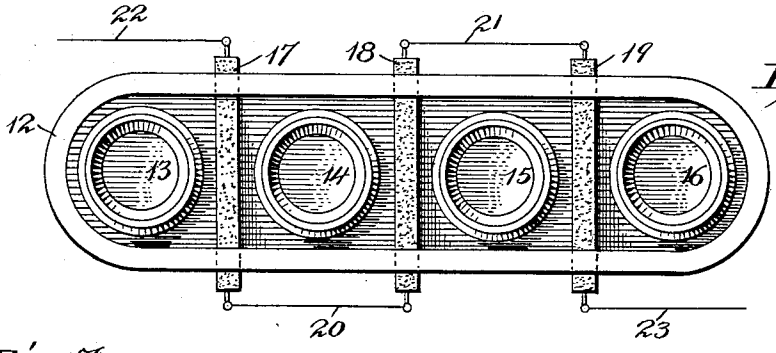
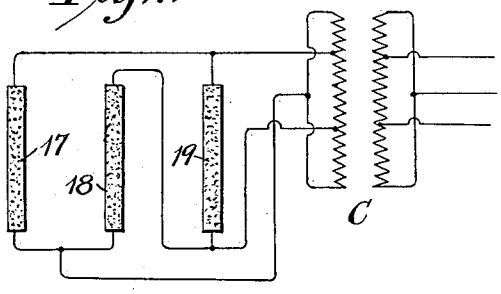


Fig. 3.

Fig. 7.



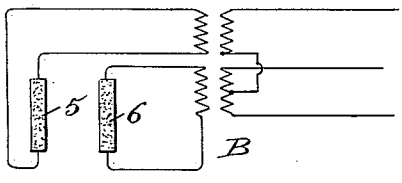


Fig. 6.

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2 SHEETS—SHEET 2.

Fig. 4.

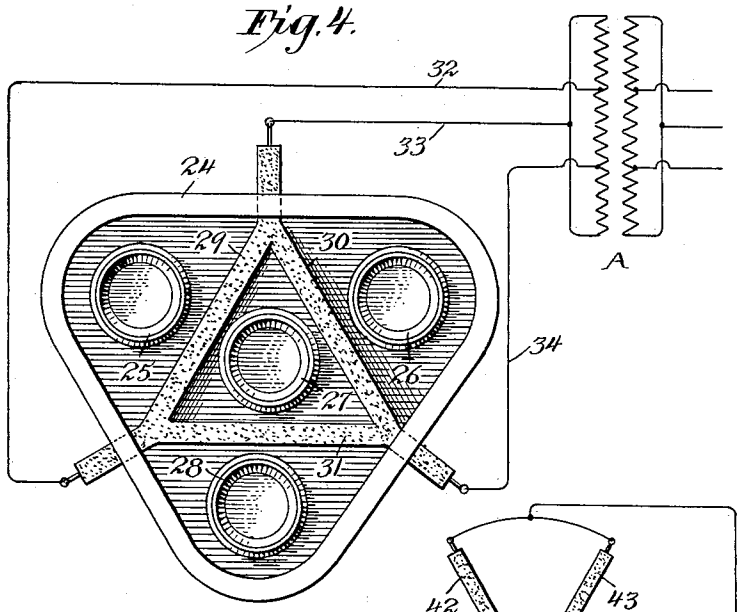
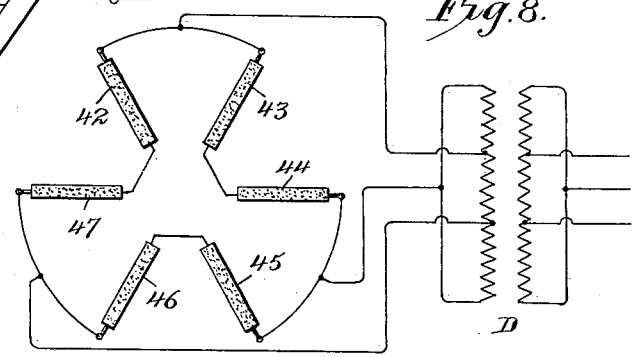


Fig. 8.



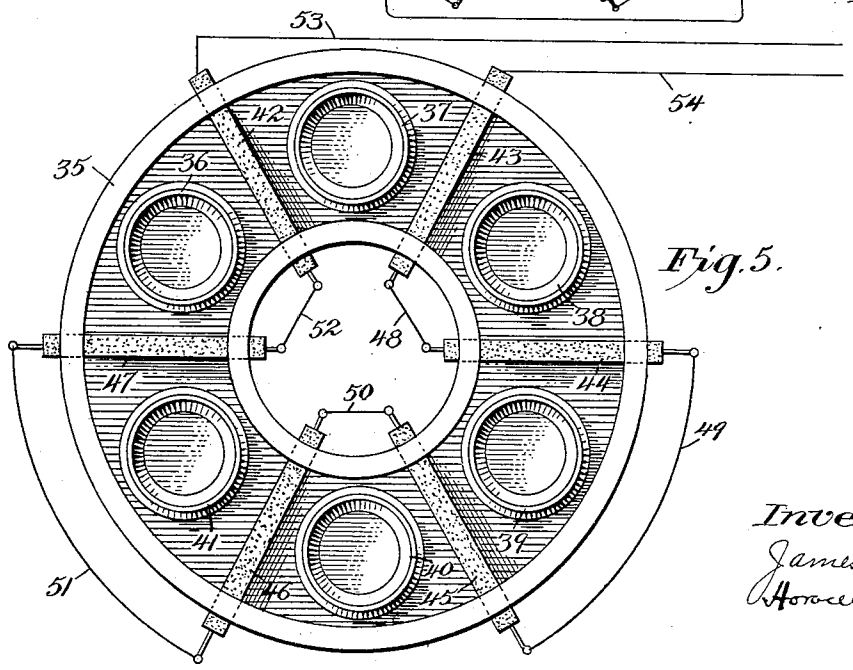


Fig. 5.

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UNITED STATES PATENT OFFICE.

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ELECTRIC FURNACE.

1,162,178. Specification of Letters Patent. Patented Nov. 30, 1915.

Application filed August 31, 1915. Serial No. 48,337.

(DEDICATED TO THE PUBLIC.)

To all whom it may concern:

Be it known that we, JAMES M. LOHR and HORACE W. GILLETT, citizens of the United States, and residents of the city of Ithaca, county of Tompkins, State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

This application is made under the act of March 3, 1883, c. 143, (U. S. Stat., 22, p. 625) and the invention described herein may be used by the Government of the United States, or any of its officers or employees in the prosecution of the work of the United States or by any person in the United States without payment of any royalty thereon.

This invention relates to electric furnaces and more particularly to multiple crucible liftout furnaces which may be used for melting substances such as brass and other alloys, or for heat treatment of metals and alloys.

One object of our invention is to so arrange the heating elements in the furnace that the maximum part of the heat developed will be imparted directly to the substances to be heated.

Another object is to keep the furnace walls as cool as possible to prevent their deterioration and economize heat.

Another object is to avoid the losses of heat energy which occur in the operation of prior furnaces.

Still another object is to effect these gains in efficiency while permitting easy access to the interior of the furnace to permit ready removal or manipulation of the heated material.

Another aim is to provide a furnace which may be adapted to existing fuel fired crucible furnaces.

Other objects will appear from the following description.

In the accompanying drawings Figure 1 is a plan view of one form of the invention with the furnace covers removed. Fig. 2 is a vertical longitudinal section thereof; Fig. 3 is a plan view of another form of the invention. Figs. 4 and 5 are plan views of still further modifications and Figs. 6, 7, and 8 are diagrams illustrating different electrical connections for the furnaces.

Referring to Figs. 1 and 2, the furnace comprises a casing 1 of any suitable refractory material, the casing being elongated so as to contain a series of spaced apart crucibles of any preferred shape. Transversely of the furnace between the crucibles and spaced therefrom are heating elements 5 and 6 which are here shown conventionally as carbon resistors but may be granular resistors of carbon or graphite in refractory troughs, plate resistors, second class conductors like silicon carbid with auxiliary starting heaters, or any other electric heaters including even arcs. The resistors divide the furnace into compartments in the bottom of each of which is a refractory spacer 13, such as a fire brick, which is smaller than the bottom of the crucible to allow a lifting device to engage the bottom of the crucible. This spacing means may be used in all species of our invention. There is sufficient space between the crucibles and the walls and resistors in all forms of our furnace to permit the use of bottom engaging lifting devices. The resistors 5 and 6 are shown in Fig. 1 connected in series within the furnace by a refractory conductor 7, which may be made of graphite. Power is derived from conductors 8 and 9. When desired the resistors may be connected in parallel. Either direct or alternating current may be used. Fig. 6 indicates one way of connecting the resistors 5 and 6 to a source B of two phase alternating current, the Scott connection being employed at source B.

In all forms of the furnace suitable removable refractory covers 10 and 11 may be used.

Fig. 3 shows a furnace similar to that of Fig. 1 except that the casing 12 is prolonged to contain four crucibles 13, 14, 15, 16 and three resistors 17, 18, 19. The three resistors and the power lines 22, 23 are connected in series by connectors 20, 21 outside of the furnace. The outside connection makes the structure more simple but slightly increases the heat loss by conduction through the projecting resistor ends.

Fig. 7 shows how the resistors 17, 18, 19 may be connected in delta from a source C of three phase alternating current.

The form of furnace shown in Fig. 4 includes a substantially triangular casing 24 divided into four compartments by a triangular resistor composed of sides 29, 30, 31.

Crucibles 25, 26, 27, and 28 are centrally disposed in these compartments. This triangular resistor is shown as connected in delta by wires 32, 33, 34 from a source of three phase current A.

Fig. 5 shows the crucibles 36, 37, 38, 39, 40, 41 arranged in a circular, closed or endless series in an annular trough-like casing 35, with radially arranged resistors 42,43,44, 45, 46, and 47 interposed between the crucibles. In the central opening, about which the furnace is arranged, are located connectors 48, 50, 52 which together with the outer connectors 49, 51 join the resistors in series with the power line wires 53 and 54. Any other connection may be used, if necessary, to adapt the furnace to the particular electric power service that is available.

In Fig. 8 the resistors are joined in delta to a source D of three phase current. Of course a star connection could be substituted in Figs. 7 and 8.

In all forms of the furnace suitable resistance to regulate the current may be interposed if desired.

It is an essential characteristic of all forms of our furnace that each side of every resistor radiates heat directly to a heating chamber containing a crucible or other object to be treated. In other words no resistor radiates heat directly to a side wall of the furnace without the interposition of a crucible or other material to be heated between the resistor and wall. For example in the furnace shown in Figs. 1 and 2 approximately one half of the heat from resistor 5 is radiated to crucible 3 and the other half to crucible 2. Similarly the heat from resistor 6 is divided between crucibles 3 and 4. In this particular form the speed of heating of the end crucibles 2 and 4 may be less than that of the middle crucible 3 which receives heat from both resistors. If the speed of heating in the end chambers is not sufficinet, they may be used as preheating chambers, the preheated material being transferred when ready to the middle chamber.

In the form of furnace shown in Fig. 5 there are no end chambers so that every chamber is heated by direct radiation from two resistors. This furnace may be constructed from existing types of fuel fired furnaces that are arranged about a central stack, the refractory walls of the combustion furnace being readily adapted to the electric furnace.

In ordinary electric crucible furnaces the single heating chamber is surrounded by resistors which in turn are surrounded by refractory walls. Approximately half the heat from these resistors radiates into the heating chamber, the other half radiating directly to the walls which accordingly become highly heated. This not only causes deterioration of the walls but results in great waste of energy. If the furnace is running continuously large amounts of waste heat are conducted through the walls and if the furnace is run intermittently large quantities of heat are uselessly employed in heating up the cooled walls at the beginning of each heating operation.

In our furnaces on the contrary, the walls are only indirectly heated and are at a much lower temperature. This diminishes the heat lost through the walls in continuous runs, and greatly lessens losses of energy in reheating the walls during intermittent runs. The furnace temperature is more easily regulated in consequence and the walls are more durable. The energy supplied to our furnaces for heating a given amount of material is therefore much less than (in some instances only half of) the energy consumed in usual types of crucible furnaces.

In the preferred form of our invention, the crucible chambers are practically uniform in size so that a predetermined size of crucible may be used interchangeably in all chambers.

While we have referred to the radiation of the heat to the crucible or material to be heated, it is apparent that part of the heat may also be carried from the resistors to the crucibles by convection without affecting the efficient operation as above set forth.

It will be noted that the number of chambers in furnaces employing our invention may vary from two chambers with one resistor between them up to any convenient number.

Various changes in details of construction and arrangement of parts may be made by one skilled in the art without departing from the spirit and scope of the invention as set forth in the following claims.

We claim:

1. An electric furnace comprising a refractory casing and electric heating elements dividing said casing into chambers, each heating element being located between two chambers so as to radiate heat directly into said chambers, the casing being only indirectly heated.

2. An electric furnace comprising a casing and spaced crucibles therein, electric heating elements located between and spaced from said crucibles so as to transmit heat directly to said crucibles and only indirectly to said casing.

3. An electric furnace comprising a casing, a closed or endless series of spaced crucibles therein, and electric heating elements located between the crucibles each heating element transmitting directly to two adjacent crucibles.

4. An electric furnace comprising an annular trough shaped casing, an annular series of crucibles therein, and electric heat-

ing elements located between the crucibles, each heating element radiating heat directly to a crucible on each side of it.

5. An electric furnace comprising a casing, a series of crucibles therein spaced from each other and from the casing, electric heating elements between but spaced from said crucibles, spacing means on the bottom of said casing of less area than the bottom of any crucible, whereby space is provided beneath and at the sides of said crucibles for manipulating and lifting the same.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."