June 24, 1924. 1,498,990

R. BEYER

ELECTRIC FURNACE

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Fig. 1.

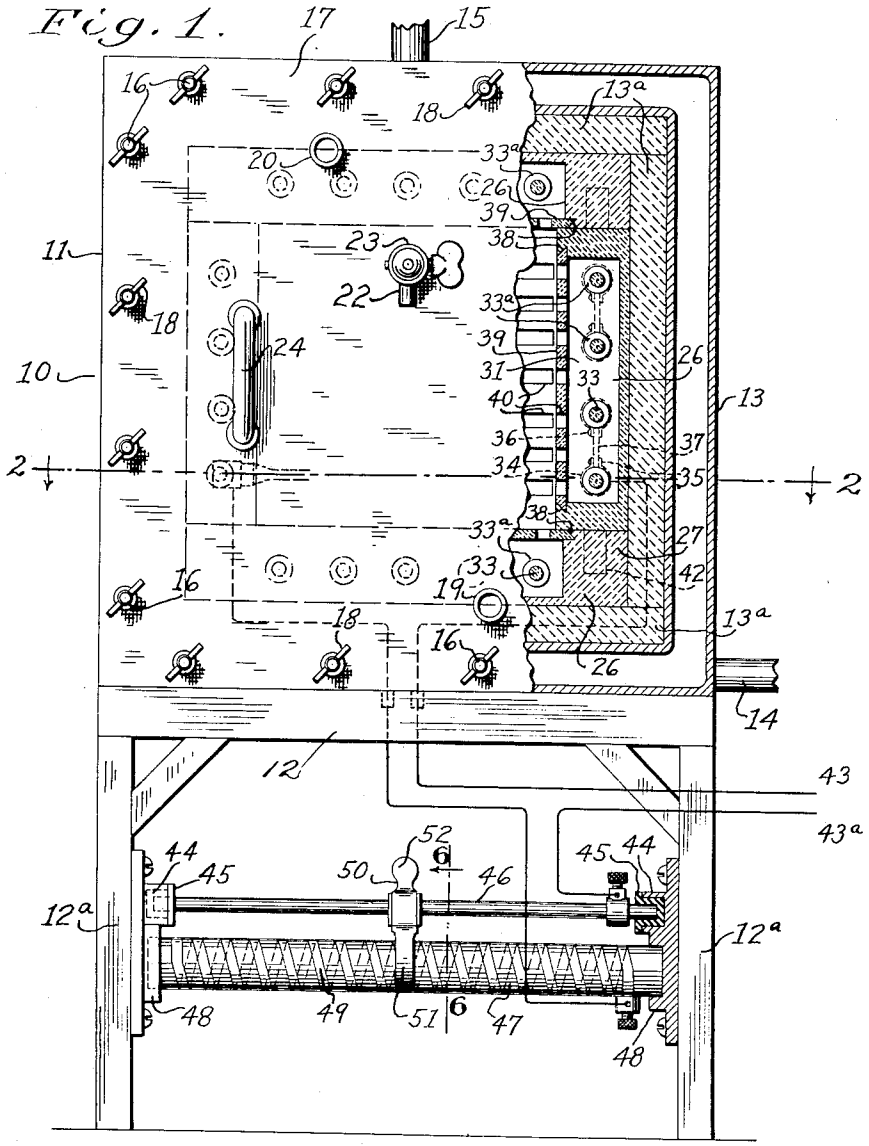
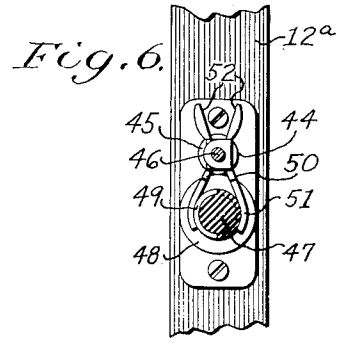



Fig. 6.




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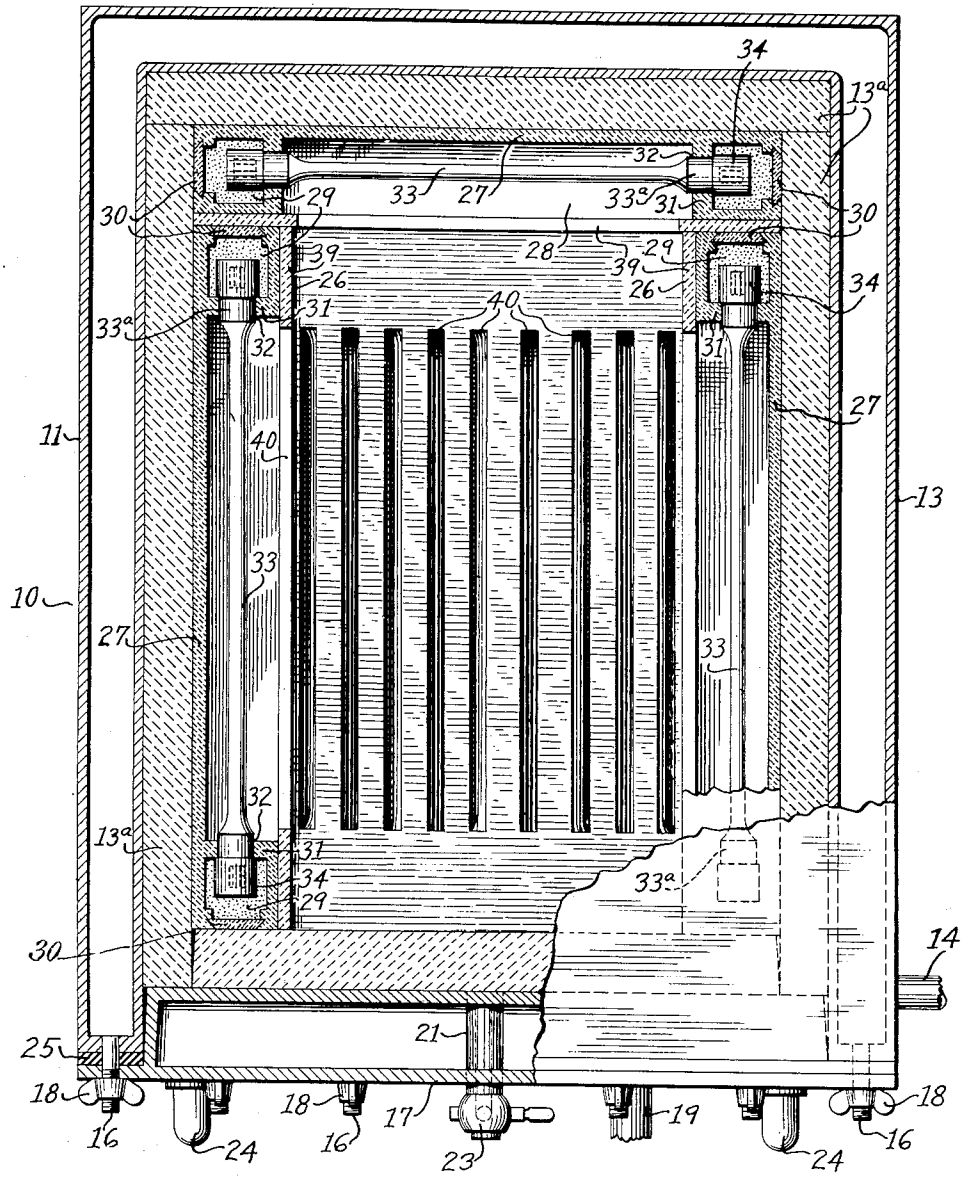
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Fig. 2.




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Fig. 3

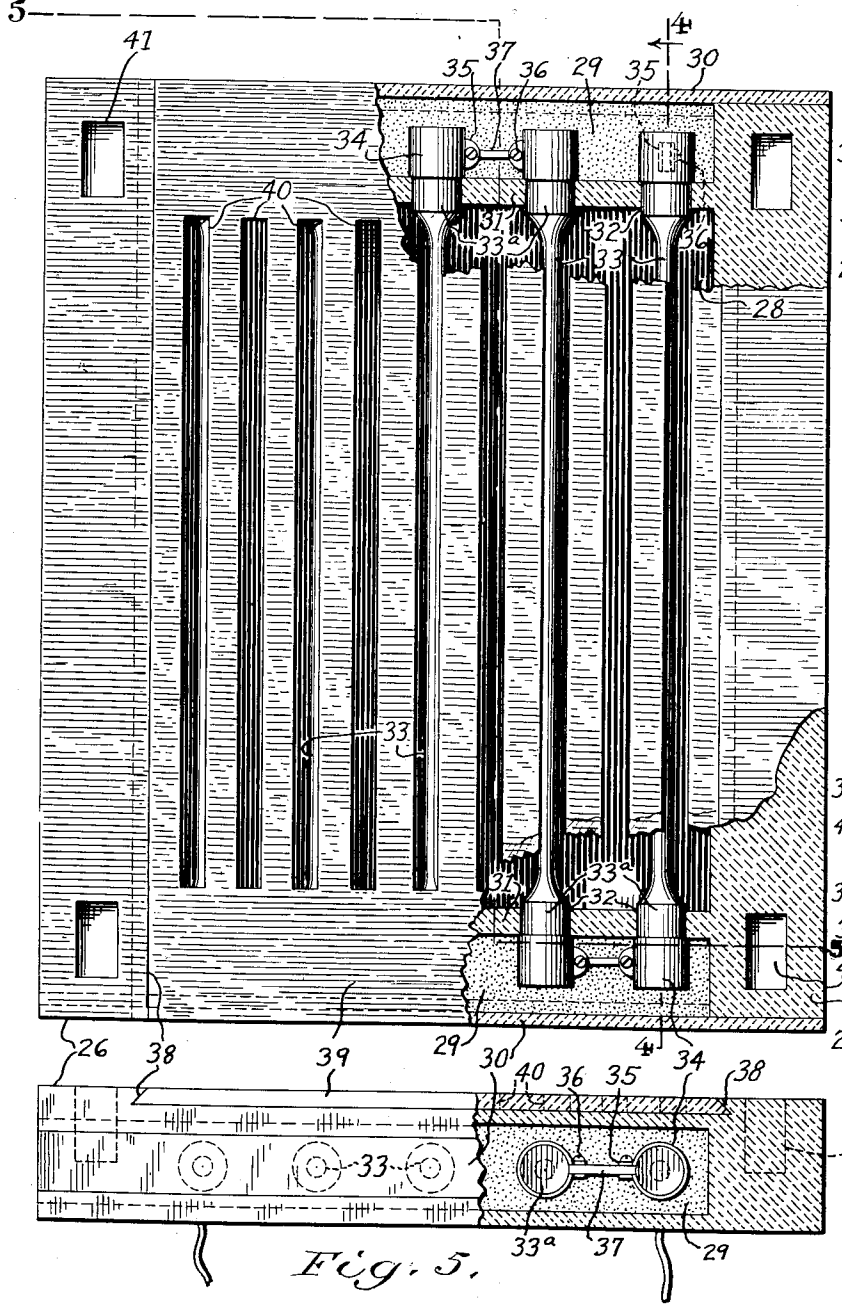



Fig. 4.

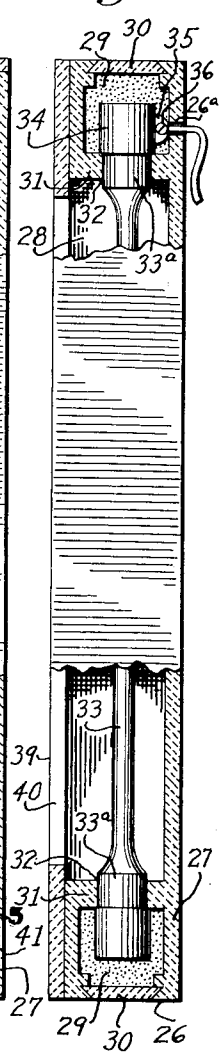



Fig. 5.

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Patented June 24, 1924 1,498,990

# UNITED STATES PATENT OFFICE.

ROBERT BEYER, OF MERAN, ITALY.

## ELECTRIC FURNACE.

Application filed July 5, 1921. Serial No. 482,334.

*To all whom it may concern:*

Be it known that I, ROBERT BEYER, a citizen of Germany, residing at Meran, Italy, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a full, clear, and exact specification.

My invention relates to improvements in electric furnaces, and the same has for its object more particularly to provide an electric furnace in which an exceedingly high temperature may be quickly produced and maintained with an economical use of electric current.

Further, said invention has for its object to provide an electric furnace in which the heat producing means and the material to be heated are so insulated and protected as to prevent any undue loss of heat.

Further, said invention has for its object to provide an electric furnace in which the heating units are in the form of hollow slabs or plates having heating elements disposed therein, and provided in certain of their walls or surfaces with openings to permit of the passage of the radiant heat.

Further, said invention has for its object to provide a furnace in which the heating units are so constructed and arranged that the same will not be injuriously affected by the action of any gases or acids present or produced in the furnace during the operation thereof.

Further, said invention has for its object to provide an electric furnace in which the heat may be maintained under a vacuum.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends my invention consists in the novel details of construction, and in the combination, connection and arrangement of parts hereinafter more fully described and then pointed out in the claims.

In the accompanying drawing showing an illustrative embodiment of the invention—

Figure 1 is a front elevation showing one form of electric furnace constructed according to, and embodying my said invention;

Fig. 2 is a horizontal section on the line 2—2 of Fig. 1;

Fig. 3 is a plan or top view showing one of the heating units, the same being partly broken away and in section to show the interior construction thereof;

Fig. 4 is a transverse section thereof on the line 4—4 of Fig. 3;

Fig. 5 is a detail longitudinal section on the line 5—5 of Fig. 3, and

Fig. 6 is an enlarged detail section on the line 6—6 of Fig. 1 showing the adjustable resistance.

In said drawings 10 denotes the furnace as a whole which is mounted upon a stand comprising a frame 12 provided with legs $12^a$.

The furnace 10 comprises an outer rectangular double-walled casing 11 formed as a water-cooled receptacle having an inlet 14 at its base, and an outlet 15 at its top adapted to be connected with a source of water supply.

The casing 13 is open at its front and provided with forwardly projecting bolts 16 to receive cover 17 adapted to be secured thereto by nuts 18.

By preference the cover 17 is made hollow and provided with an inlet 19 and an outlet 20 whereby to connect the same with a source of water supply. The cover 17 is further provided with a pipe 21 extending entirely through said cover terminating at its outer end in a nozzle 22 provided with a valve 23 to permit of the application of a pump for exhausting the interior of the furnace.

To facilitate the handling of the cover the same is provided with handles 24, and to insure a fluid-tight joint between the cover 17 and the front of the casing 13 a suitable packing 25 is interposed between the same.

The interior of the casing 11 which constitutes the heating chamber has its inner side walls as well as its top and bottom provided with lining members $13^a$ composed of plates of refractory material, such as zirconium, or a composition thereof.

26 denote removable heating units which are disposed upon said lining members $13^a$, and each composed of a base 27 formed of suitable refractory material such as zirconium, or a compound thereof, provided with a recessed central portion or chamber 28, and along its front and rear edges with longitudinal pockets 29 provided with slidable covers 30. The inner walls or partitions 31 of said channels are provided at regular intervals with registering apertures 32 in which are supported the opposite ends of resistance or heating elements in the form of

rods or pencils 33 composed of carbon or compositions of graphite and zirconium. The enlarged ends 33[a] of said elements 33 extend through said apertures 32 and into the pockets 29, and have their ends connected in series by split metal clamps 34 each having its ends 35 secured together by a screw 36 and embracing one end of a metallic bond 37. In order to insulate and protect said clamps 34 and bonds 37, the same, together with the ends of the elements, are embedded in a mass of granulated or comminuted zirconium oxid.

In order to enclose and protect the heating elements 33, the base 27 is provided upon its upper surface adjacent to opposite sides with undercut grooves or recesses 38 to receive a cover plate 39 provided in its central portion, which registers substantially with the recessed portion or chamber 28 of the base 27, with a plurality of parallel openings 40 to permit of a certain amount of direct radiation of heat emitted by the elements 33.

Certain of the heating units 26 are provided in their upper sides along their edges with recesses 41 to receive the longitudinal tongues or projections 42 on the edges of the adjoining sections.

The end bonds 37[a] which serve to connect the heating or resistance elements 33 at the end of one heating unit 26 with the adjacent element 33 of the adjoining heating unit are carried through the rear of said units 26 through apertures 26[a] provided in outer side or bottom of the base 27, and the terminals 43, 43′ extending from the heating elements 33 are carried through registering openings 43[a] provided in the lower insulating plate and the bottom of the double-walled casing 13. Of said terminals, the terminal 43′ is connected directly with the source of electric energy.

44 denote sockets secured to the frame 12 below the casing 10 having insulating sleeves 45 therein in which are supported the ends of a conductor bar 46 adapted for connection directly with the other conductor leading to a source of electric energy. Below the bar 46 is disposed a bar 47 of suitable insulating material having its ends supported in sockets 48 secured to the frame 12. 49 denotes a resistance element arranged in spiral form upon said insulating bar 47 and connected at one end to the other conductor 43 extending from the heating element 33.

50 denotes an adjustable contact member slidably mounted upon the conductor bar 46; the said contact member 50 comprises a pair of spring pressed jaws 51 adapted to engage the spiral resistance 49 of the insulating bar 47, and a pair of finger portions 52 for operating said jaws 51.

In operation the article to be treated may be placed in a suitable container and then introduced into the heating chamber of the furnace, whereupon the cover 17 is then secured in place by the bolts 16 and nuts 18. The casing 11 and the cover 17 are then connected with a source of water supply by means of suitable pipes or tubes, not shown, which may be attached to the inlet nozzles 14, 19, and the outlet nozzles 15 and 20 of the casing and cover, respectively.

Hereupon the electric current is conducted by means of the bar 46, adjustable contact 50, resistance 49 to and from the terminals 43 extending from the heating units 26 and the source of electric energy. The desired strength of current being readily controllable by the adjustable contact 50 and the resistance 49.

As the circuit is closed, the heating elements 33 will become incandescent, and the heat emitted thereby will, in part, be absorbed by the body of the heating unit 26, and communicated to the heating chamber of the furnace, and, in part, be transmitted by radiation to the heating chamber through the openings 40 in the covers 38 of said heating units.

As a result of the construction and arrangement of the several parts of the apparatus, it becomes possible to maintain for considerable periods of time a temperature ranging as high as 3000° C., and considerably higher temperatures for briefer periods of time, without danger of injury to the apparatus.

It is to be noted that the temperature of the heating units 26 is capable of convenient control by varying the conducting qualities of the heating elements 33, i. e., by increasing or decreasing the zirconium oxide content, and thereby render the element 33 more or less efficient as an electric resistance medium.

Further, it is to be noted that, when desired, the ends of the resistance or heating elements extending into the pockets 29 instead of being connected by clamps 34 and bonds 37 may be electrically connected by a mass or comminuted carbon or other similar conducting medium disposed within said pockets 29.

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

1. An electric furnace comprising an outer casing, a refractory lining, and heating units disposed within said casing; said heating units each comprising a chambered base, heating elements therein, and a cover for said base, substantially as specified.

2. An electric furnace comprising an outer casing, a refractory lining, and heating units disposed within said casing and forming the inner walls thereof; said heating units each comprising a chambered base, heating elements therein, means for con-

ducting current to said heating elements, means for controlling the current supplied to said heating elements, and a cover for said base, substantially as specified.

3. An electric furnace comprising an outer casing, a refractory lining, and heating units disposed within said casing and forming the inner walls thereof; said heating units each comprising a chambered base, heating elements therein, means for conducting current to said elements, a variable resistance for controlling the current supplied to said heating elements, and a cover for said base, substantially as specified.

4. An electric furnace comprising an outer casing, a cover therefor, a refractory lining within said casing, and heating units disposed within said casing and enclosed by said lining; said heating units each comprising a hollow base, heating elements extending across said hollow base and connected with a source of electric energy, and a cover for said hollow base, substantially as specified.

5. An electric furnace comprising an outer casing, a cover therefor, a refractory lining within said casing, and heating units disposed within said casing and enclosed by said lining; said heating units each comprising a hollow base, heating elements extending across said hollow base and connected with a source of electric energy, a variable resistance interposed between the source of electric energy and said heating elements, and a cover for said hollow base, substantially as specified.

6. An electric furnace comprising an outer water-cooled casing, a cover therefor, a refractory lining upon the inner walls of said casing, and a plurality of heating units disposed within said casing and enclosed by said lining; said heating units each comprising a hollow base, supports thereon, electric resistance elements mounted in said supports and connected together and with a source of electric energy, and a cover for said base, substantially as specified.

7. An electric furnace comprising an outer water-cooled casing, a cover therefor, a refractory lining upon the inner walls of said casing, and a plurality of heating units disposed within said casing and enclosed by said lining; said heating units each comprising a hollow base, supports thereon, electric resistance elements mounted in said supports and connected together with a source of electric energy, a variable resistance interposed between the source of electric energy and said heating elements, and a cover for said base, substantially as specified.

8. An electric furnace comprising a casing, a cover therefor, a refractory lining therefor, and a plurality of heating units disposed within said lining, said heating units each comprising a hollow base, longitudinal receptacles at its opposite edges, a filling of comminuted insulating material therein, a plurality of heating elements disposed in said base and having their ends extending into said longitudinal receptacles and the insulating filling therein, means for connecting the adjacent ends of said elements, and means for closing said receptacles, substantially as specified.

9. An electric furnace comprising a double-walled casing, a hollow cover therefor, means for securing said cover to said casing, a lining of refractory material within said casing, a plurality of separate heating units disposed within said refractory lining, means for interengaging the contiguous edges of said heating units; said heating units each comprising a base having a recessed central portion, and recessed portions at its opposite edges, a filling of comminuted insulating material disposed within the recessed edge portions, a plurality of parallel-disposed heating elements extending across said base and having their ends extending into said recessed edge portions and into the insulating filling therein, means for connecting the ends of said heating elements together, and a perforated cover removably secured upon said hollow base, substantially as specified.

10. An electric furnace comprising a double-walled casing, a hollow cover therefor, means for securing said cover to said casing, a lining of refractory material within said casing, a plurality of separate heating units disposed within said refractory lining, means for interengaging the contiguous edges of said heating units; said heating units each comprising a base having a recessed central portion, and recessed portions at its opposite edges, a filling of comminuted insulating material disposed within the recessed portions at the edges of said base, covers for said recessed edge portions, a plurality of parallel-disposed heating elements extending across said base and having their ends extending into said recessed edge portions and into the insulating filling therein, means for connecting the ends of said heating elements together, and with a source of electric energy, and a variable resistance interposed between said heating elements and said source of electric energy, and a perforated cover removably secured upon said hollow base, substantially as specified.

Signed at the city of New York, in the county and State of New York, this 27th day of May, one thousand nine hundred and twenty-one.

ROBERT BEYER.

Witnesses:
CONRAD A. DIETERICH,
JOSEPH G. QUINN, Jr.