

June 24, 1924.

1,499,317

R. BEYER

ELECTRIC FURNACE

Filed Jan. 17, 1921

2 Sheets-Sheet 1

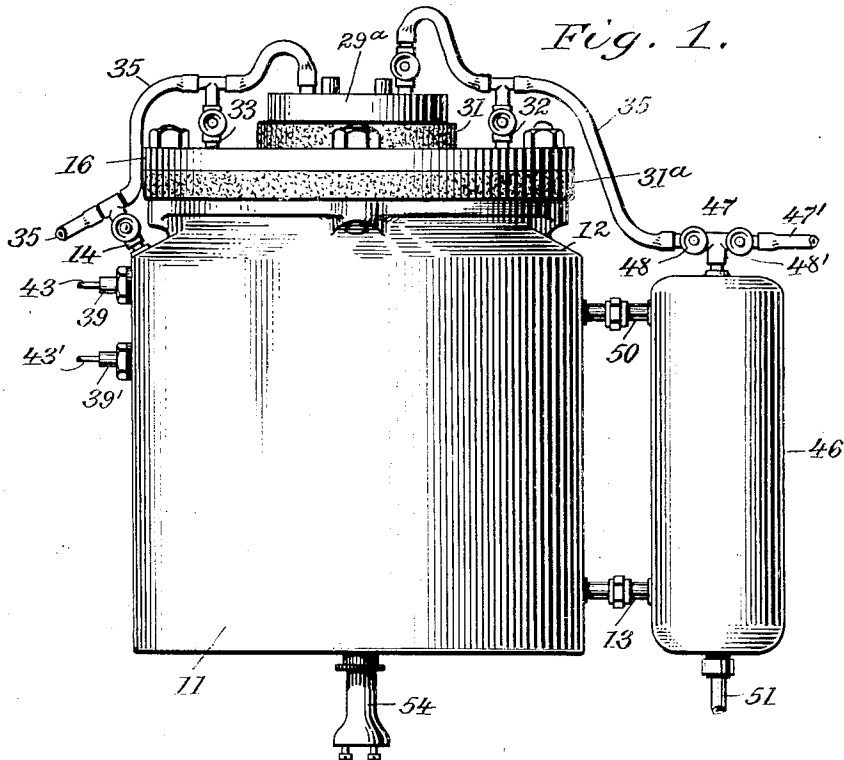


Fig. 1.

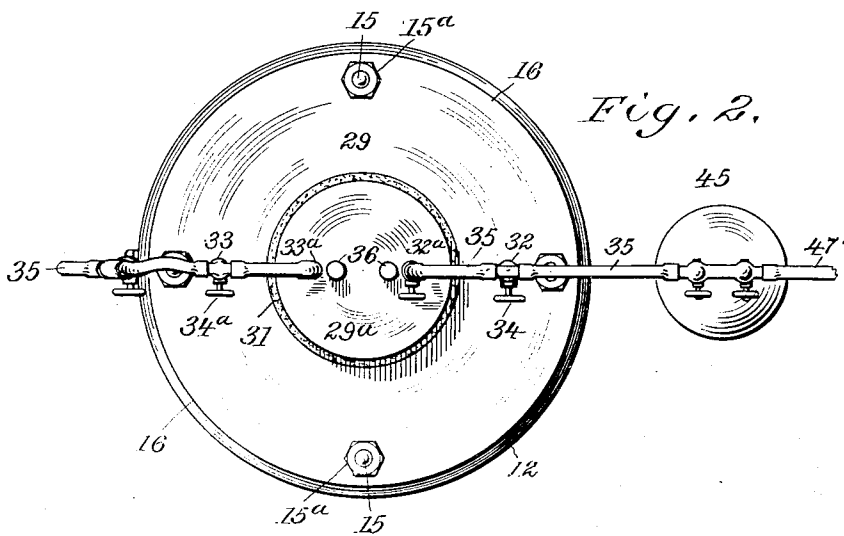


Fig. 2.

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2 Sheets-Sheet 2

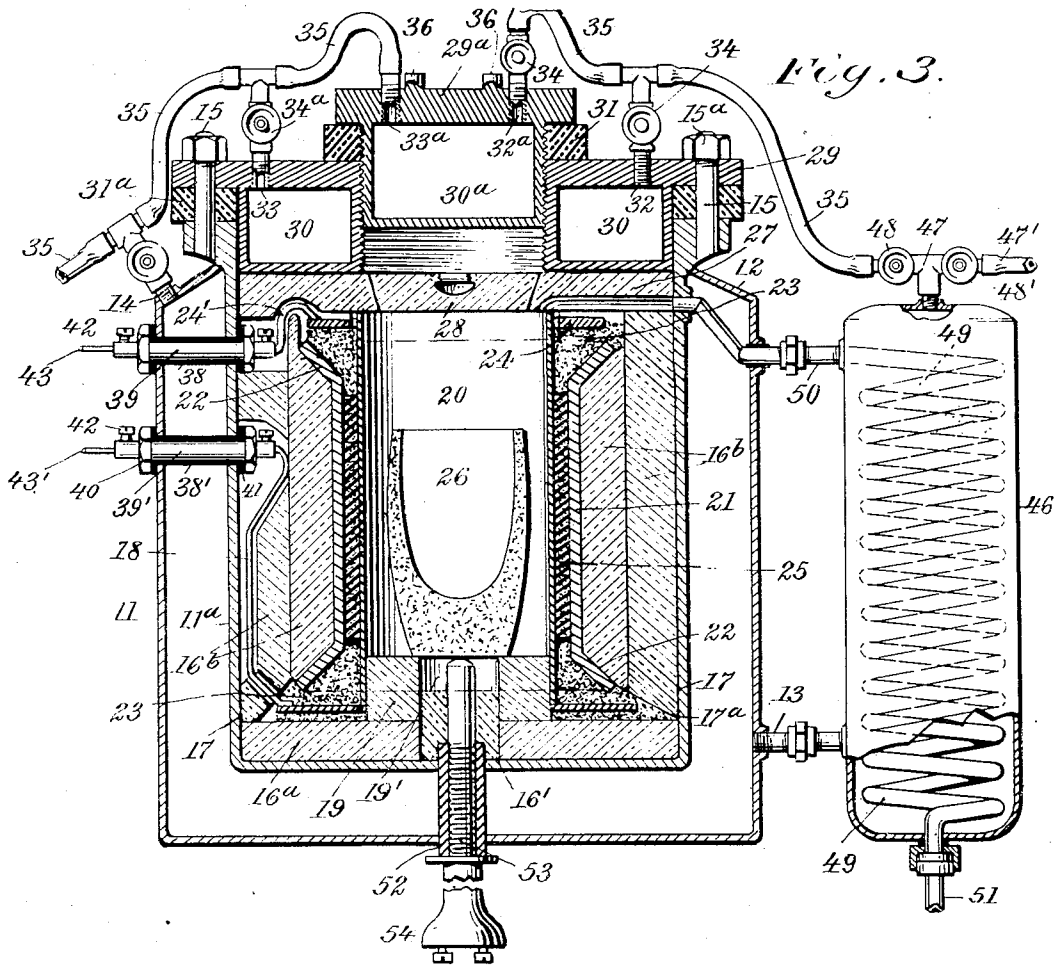


Fig. 3.

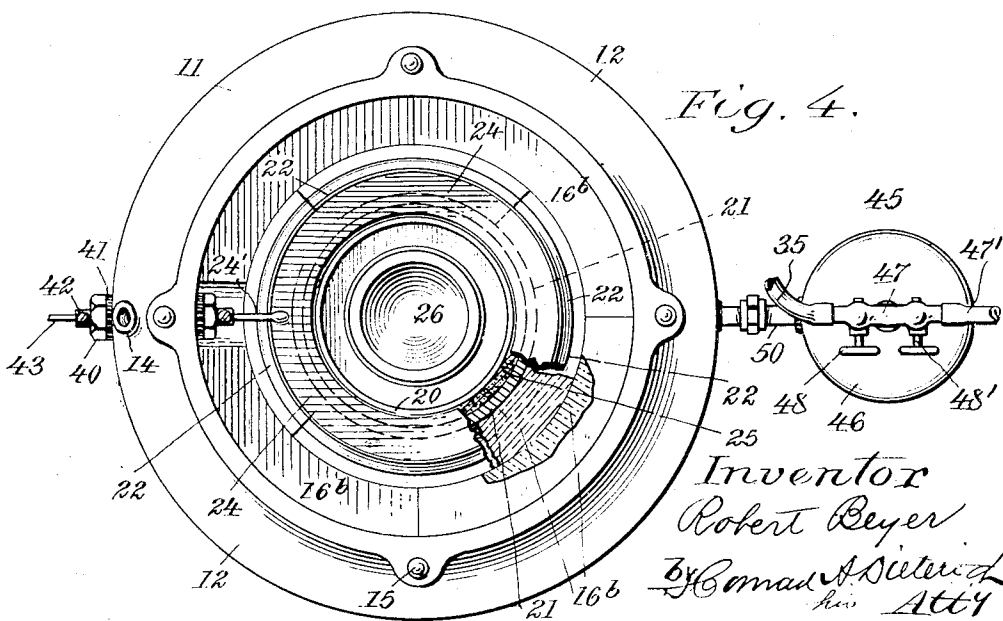


Fig. 4.

Inventor
 Robert Beyer
 By Conrad A. Dietrich
 His Atty

UNITED STATES PATENT OFFICE.

ROBERT BEYER, OF MERAN, ITALY.

ELECTRIC FURNACE.

Application filed January 17, 1921. Serial No. 437,805.

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 a high temperature electric furnace in which a more perfect electrical connection may be obtained between the source of electric energy and the heating element of the furnace.

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

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 or protected as to prevent any undue loss of heat.

Further, said invention has for its object to provide an electric furnace which is so constructed that the cooling or protecting medium cannot enter the interior of the furnace proper or the crucible or article therein and cause an explosion.

Further, said invention has for its object to provide a furnace in which the hot gases produced or caused within the interior or operative part of the furnace may be so cooled or condensed that the same may be withdrawn without injury to or interference with the suction apparatus.

Further 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 drawings forming part of this specification, wherein like numerals indicate like parts—

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

Fig. 2 is a top or plan view thereof;

Fig. 3 is a central vertical section taken on the line 3—3 of Fig. 2; and

Fig. 4 is top view of the furnace with the cover portion removed to show the interior construction thereof.

In said drawings, the furnace as a whole consists of a double-walled receptacle comprising an outer receptacle 11, made of sheet iron or other suitable material, and enclosing an inner casing 11^a, preferably made of steel. The inner casing and the outer receptacles 10 and 11 are united at their tops by an inclined annular portion 12 and form a water-jacket having an inlet pipe 13 and an outlet 14. The inner casing 11^a extends above the upper edge of the outer receptacle 11 and is provided with upwardly extending bolts 15 having nuts 15^a for securing the cover 16 in place thereon.

The inner casing 11^a is provided at its base with a horizontal lining member 16^a formed of a suitable refractory material, such as zirconium, or a compound thereof, and the inner wall is provided with a filling or lining consisting of a plurality of segmental plates 16^b composed of suitable refractory insulating material.

17 denotes a contact plate, preferably formed as an annular copper plate which is disposed upon a layer of comminuted or granulated carbon 17^a provided upon said bottom lining member 16^a, and connected with one terminal 18 leading to a source of electric energy.

19 denotes a support of similar refractory material which is of smaller outline than the bottom lining member 16^a and is centrally disposed thereon. The support 19 is provided with a central opening 19' which registers with a corresponding opening 16' in the bottom lining member 16^a. Within the inner casing 11^a and resting upon the annular copper conducting plate 17 is disposed a cylindrical member 20, also formed of a suitable refractory substance, which is capable of withstanding an extremely high temperature and of being rendered incandescent, such as zirconium or a compound thereof.

21 denotes a cylindrical member of slightly larger diameter than the cylindrical member 20, which is disposed about said cylindrical member in spaced relation thereto in order to form an annular space between the outer wall of said member 20 and the inner wall of the member 21.

The spaces between the upper and lower

ends of said cylindrical member 20 and the corresponding flaring ends 22 of the surrounding member 21 are packed with comminuted or granulated carbon 23, which serves as an electric conductor. Above the upper flaring end of the member 22 and surrounding the upper end of the cylindrical member 20 is disposed an annular contact plate 24 connected with the other terminal 24' leading to a source of electric energy.

The comminuted or granulated carbon 23 serves to conduct the electric current from the annular contact plates 17 and 24 to the tubular carbon member 25 disposed between the inner cylindrical member 20 and the member 21 surrounding the same.

The upper and lower ends 22 of the member 21 are flared outwardly to support or retain reserve supplies of comminuted or granulated carbon in order to maintain the due electrical connection of the annular plates 17 and 24 with the tubular carbon member 25 in case of shrinkage or other loss which might occur in said tubular carbon member 25.

Within the inner cylindrical member 20 may be disposed a crucible 26, or other article to be acted upon or treated in the furnace. Above the upper edge of the cylindrical member 20 and the lining member 16^b is disposed a lining of refractory material, such as zirconium, or a suitable compound thereof. The said lining consists of an annular member 27 having a central opening therein to receive and support a removable cover 28.

The cover 16 of the furnace is composed essentially of an annular outer plate 29 and a removable central circular part 29^a to permit of access being had to the central portion of the furnace without necessitating the removal of the entire cover 16 from the outer casing 11. The outer plate 29 is provided upon its underside with a depending, annular water-jacketed portion 30, and the under side of the central cover part 29^a is provided with a depending water-jacketed portion 30^a provided upon its outer side with screw-threads adapted to engage with the screw-threads upon the inner surface of the annular cover plate 29 and the water-jacketed portion 30 thereof.

In order to form fluid-tight joints between the flange of the cover part 29^a and the annular plate 29, and between said annular plate 29 and the upper edge of the outer receptacle 11, packings or gaskets 31, 31^a of rubber, asbestos-rubber, or other suitable material, may be interposed. The water-jacketed portion 30 of the annular cover plate 29 and the water-jacketed portion 30 of the central cover part 29 are, respectively, provided with inlet nozzles 32, 32^a and outlet nozzles 33, 33^a. The nozzles 32, 32^a, 33, 33^a, and the nozzle 14 of the outer receptacle 11

are connected by flexible tubing 35 with a suitable source of water supply, and with a waste. The said nozzles are also equipped with valves 34, 34^a, whereby to control the flow of the cooling medium to and from the cover parts 29, 29^a.

In order to render the cover part 29^a readily removable, the same is provided upon its upper side with studs 36 which are adapted to be engaged by a suitable tool or spanner whereby said cover part 29^a may be readily rotated to disengage the same from the surrounding cover part 27^a.

38, 38' denote insulating tubes which extend through the outer casing 11 and inner casing 11^a, through which extend tubular conductors 39, 39'. The tubular conductors 39, 39' have their inner and outer projecting ends screw-threaded and provided with nuts 40 and packing rings 41. The tubular conductors 39, 39' are further provided, adjacent to their inner and outer ends, with set screws 42, whereby the conductors 43, 43', leading from a source of electric energy, may be connected with the conductors 18 and 24' extending from the contact plates 17, 24, respectively.

45 denotes a condenser comprising a water jacket 46 having a nozzle 47 at its top connected by a pipe 47' with a source of water supply. The nozzle 47 is provided with valves 48, 48' for controlling the supply of water to the jacket 46 of said condenser. Within said jacket 46 is disposed a coil 49 having its upper end connected by a pipe 50 with the interior of the furnace, and at its other end connected by a pipe 51 with a suitable pump or exhausting apparatus, not shown.

52 denotes a tube secured in the bottoms of the outer and inner receptacles 11 and 11^a, which tubular member 52 has its inner surface screw-threaded to permit of the threaded engagement therewith of a tube 53 forming part of a pyrometer 54. The inner end of the pyrometer 54 extends into the registering opening 16', 19', formed in the lining member 16^a and the support 19 thereon.

The operation of my improved furnace is as follows:

The material to be treated is, for example, placed in a crucible 26 and disposed within the cylindrical member 20. Hereupon, the upper lining member 27 with its cover 28 are placed in position within the inner receptacle above the top of the cylindrical member 20, and the cover 16 then lowered into position and bolted in place by the bolts 15 and nuts 15^a. When the apparatus has been sealed and the proper electrical connections made, the current will be conducted by the conductors 43, 39, 24' to the upper contact plate 24 and thence by the comminuted or granulated carbon to the tubular carbon member 25, and return by the lower contact

plate 17, conductors 18, 39' and 43' to the source of electric energy. The electric current conducted to the tubular carbon member 25 serves to heat the same and the members 20 and 21. The vacuum pump is set in operation and the fluids present or produced within the cylindrical member 20, as well as within the inner receptacle 11^a, are conducted therefrom by the pipe to the condensing coil 49 and thence discharged by the suction pump.

In the operation of the furnace, the comminuted or granulated carbon, which serves as the means for conducting the current to and from the contact plates 17 and 24, also serves to protect the same.

As the temperature within the furnace may rise as high as 4000° C., the gases drawn from the interior of the furnace would cause the pump or exhausting apparatus to become so hot that the same, or the oil, or other lubricant used therein, would burn and thereby interfere with or entirely prevent the proper operation thereof. To prevent such action, the temperature of the gases is lowered to such an extent by the action of a suitable cooling medium, such as water circulating in the jacket 46 of the condenser, that the gases may be properly handled by the exhausting apparatus without danger of injury to or interference therewith.

In order to prevent the overheating of the exterior portions of the furnace and the cover therefor, the water supplied by the pipe 47 is caused to pass through the flexible tubing 35 to the inlet nozzle 34 of the annular cover portion and to issue therefrom by the outlet nozzle thereof, and a certain amount of the water is caused to pass simultaneously into and out of the central cover portion 29^a by way of the inlet nozzle 32^a and outlet nozzle 33^a. The water is thence conducted from the outlet nozzles 33, 33^a by the tube 35 to the discharge nozzle 14 of the water jacket of the furnace and conducted from the furnace.

It is to be noted particularly that as the outer receptacle of the furnace and its cover are maintained at a relatively low temperature by the use of insulating linings, and by water jacketing the outer receptacle and its cover, it becomes possible to use rubber or similar material for the packings 31, 31^a without danger of burning the same, and thereby insure tight closures between the several cover parts and the receptacle, and thus permit the furnace to be operated under complete or substantially complete vacuum.

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

1. An electric furnace comprising an outer receptacle, an inner receptacle, an electric heating element disposed about said inner receptacle, insulating means interposed be-

tween the side walls and between the bases of said inner and outer receptacles, an insulating cover disposed above said inner receptacle and the insulating means surrounding the same, and a cover for sealing said outer receptacle, substantially as specified.

2. An electric furnace comprising an outer water-jacketed receptacle, an inner receptacle, an electric heating element disposed about said inner receptacle, insulating means interposed between the side walls and between the bases of said inner and outer receptacles, an insulating cover disposed above said inner receptacle and the insulating means surrounding the same, a water-jacketed cover for sealing said outer receptacle, and a water-jacketed removable portion for said water-jacketed cover, substantially as specified.

3. An electric furnace comprising an outer receptacle, an inner receptacle, an electric heating element disposed about said inner receptacle, means composed of refractory material interposed between said inner and outer receptacles, a cover mounted on said outer receptacle for sealing the same, a plate of refractory material interposed between said cover and inner receptacle, and removable portions on said cover and plate to permit access to said inner receptacle, substantially as specified.

4. An electric furnace comprising a water jacketed outer receptacle, an inner receptacle formed of refractory material and adapted to be rendered incandescent, means disposed about said inner receptacle for electrically heating the same, means composed of refractory material interposed between said heating means and said outer receptacle for insulating the same from each other, and a cover for sealing said outer receptacle, substantially as specified.

5. An electric furnace comprising a water jacketed receptacle, an inner receptacle formed of refractory material and adapted to be rendered incandescent, means disposed about said inner receptacle for electrically heating the same, means composed of refractory material interposed between said heating means and said outer receptacle for insulating the same from each other, a cover for said outer receptacle secured thereto, and a gasket under compression interposed between said cover and outer receptacle to provide a fluid tight joint therebetween, substantially as specified.

6. An electric furnace comprising a water jacketed outer receptacle, an inner receptacle, means for electrically heating said inner receptacle, a water jacketed cover secured to said receptacle, a gasket interposed between said cover and receptacle under compression to provide a fluid tight joint therebetween, and means interposed between said heating means and said outer

receptacle and cover for insulating the same, substantially as specified.

7. An electric furnace comprising a water jacketed outer receptacle, a water jacketed cover for sealing said outer receptacle, an inner receptacle, means for heating said inner receptacle, means composed of refractory material interposed between said heating means and said outer receptacle, means for exhausting said inner receptacle, and means for cooling the gases as the same are being exhausted, substantially as specified.

8. An electric furnace comprising an outer receptacle, an inner receptacle formed of refractory material, an electric heating element closely surrounding said inner receptacle, means for insulating said inner receptacle and said heating element from said outer receptacle, contact plates disposed above and below said electric heating element, conducting means loosely interposed between said contact plates and the ends of said electric heating element for electrically connecting the same whereby to heat said inner receptacle, substantially as specified.

9. An electric furnace comprising an outer fluid tight receptacle, an inner receptacle, means for heating said inner receptacle, means for exhausting said inner receptacle, and means for cooling the heated gases as the same are being exhausted, substantially as specified.

10. An electric furnace comprising an outer fluid tight water jacketed receptacle, an inner receptacle, means for electrically heating said inner receptacle, means for exhausting said inner receptacle, and means communicating with said water jacketed receptacle for cooling the heated gases as the same are being exhausted, substantially as specified.

11. An electric furnace comprising a sealed water-jacketed outer receptacle, an inner receptacle therein capable of being rendered incandescent, a carbon member surrounding said inner receptacle, means for enclosing said carbon member, comminuted conducting material contacting with each end of said carbon member, and contact plates connected with a source of electric energy and contacting with said comminuted conducting material, substantially as specified.

12. An electric furnace comprising a sealed water-jacketed outer receptacle, an inner receptacle therein capable of being rendered incandescent, a carbon member surrounding said inner receptacle, a member formed of refractory material enclosing said carbon member, contact plates connected with a source of electric energy, a mass of comminuted electric conducting material interposed between said carbon member and said contact plates, contacting with

said enclosed carbon member adjacent to each end thereof, and means for exhausting said inner receptacle, substantially as specified.

13. An electric furnace comprising a water-jacketed outer receptacle, an inner receptacle, a tubular carbon member surrounding said inner receptacle, an inclosing member surrounding said carbon member, contact plates arranged adjacent to the ends of said carbon member and leading to a source of electric energy, granulated carbon interposed between the ends of said carbon member and said contact plates, insulating means interposed between said inner and outer receptacles, a water-jacketed cover for said outer receptacle, a separable section therefor; said insulating means having an opening therein, and a cover for said opening in register with the separable section of said water-jacketed cover, substantially as specified.

14. An electric furnace comprising a water-jacketed outer receptacle, an inner receptacle, a condenser communicating therewith and adapted for connection with an exhausting apparatus, a tubular carbon member surrounding said inner receptacle, an inclosing member surrounding said carbon member, contact plates arranged adjacent to the ends of said carbon member and leading to a source of electric energy, granulated carbon interposed between the ends of said carbon member and said contact plates, insulating means interposed between said inner and outer receptacles, a water-jacketed cover for said outer receptacle, a separable section therefor; said insulating means having an opening therein, and a cover for said opening in register with the separable section of said water-jacketed cover, substantially as specified.

15. An electric furnace comprising a water-jacketed outer receptacle, an inner receptacle, a tubular carbon member surrounding said inner receptacle, an enclosing member surrounding said carbon member, a mass of granulated carbon disposed adjacent to the opposite ends of said carbon member, contact plates embedded in said carbon masses and connected with a source of electric energy, insulating means interposed between said inner and outer receptacles, a water-jacketed cover for said outer receptacle comprising an annular member and a separable central member adapted for securement within said annular member, said insulating means having an opening therein, and a cover for said opening in register with the separable central member of said water-jacketed cover, substantially as specified.

16. An electric furnace comprising a water-jacketed outer receptacle, a water-

jacketed cover therefor, said water-jacketed
 cover having a central removable portion,
 an inner receptacle, a refractory material,
 a tubular carbon member surrounding said
 5 inner receptacle, an enclosing member sur-
 rounding said carbon member, said enclos-
 ing member having flaring ends, granulated
 carbon masses disposed within the flaring
 ends of said enclosing member, contact
 10 plates embedded in said carbon masses and
 connected with a source of electric energy,
 insulating means interposed between said
 inner and outer receptacles, said insulating
 means having an opening therein register-
 15 ing with said inner receptacle, and with the
 central opening of said water-jacketed cov-
 er, and a cover for said opening, substan-
 tially as specified.

17. An electric furnace comprising a
 20 water-jacketed outer receptacle, a water-
 jacketed cover therefor, an inner receptacle,
 a condenser communicating with said inner
 receptacle and adapted for connection with

an exhausting apparatus, a tubular carbon
 member surrounding said inner receptacle, 25
 an enclosing member surrounding said car-
 bon member, said enclosing member having
 flaring ends, granulated carbon masses dis-
 posed within the flaring ends of said en-
 closing member, contact plates embedded in 30
 said carbon masses and connected with a
 source of electric energy, insulating means
 interposed between said inner and outer re-
 ceptacles, said insulating means having an
 opening therein registering with said inner 35
 receptacle, and with the central opening of
 said water-jacketed cover, and a cover for
 said opening, substantially as specified.

Signed at the city of New York, in the
 county and State of New York, this 4th 40
 day of January, one thousand nine hundred
 and twenty-one.

ROBERT BEYER.

Witnesses:

CONRAD A. DIETERICH,
 JOSEPH G. QUINN, JR.