Sept. 10, 1940. G. DELPECH 2,214,123

ELECTRICAL FURNACE

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Fig. 1.

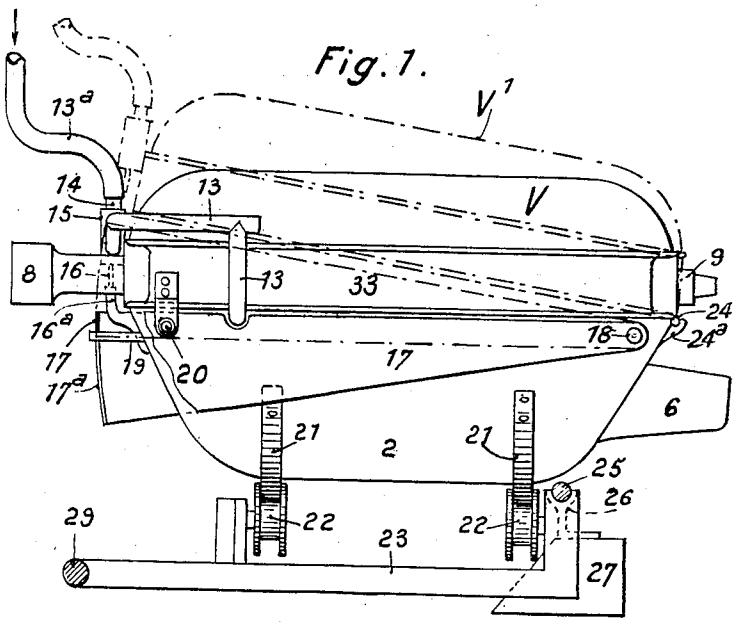
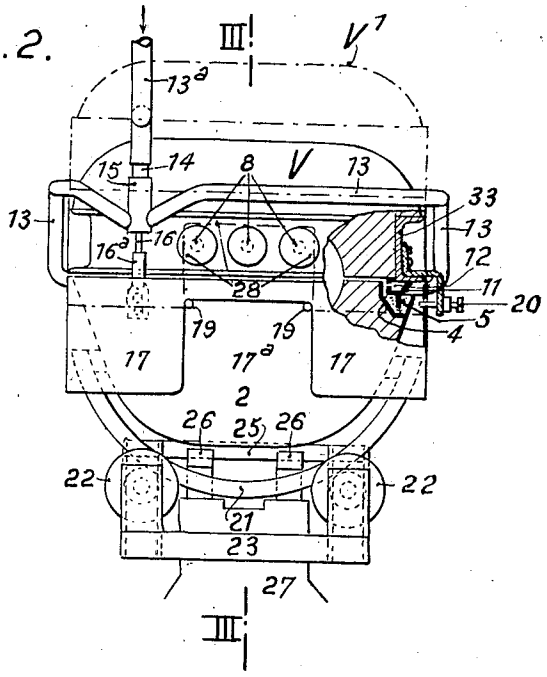


Fig. 2.



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Fig. 3.

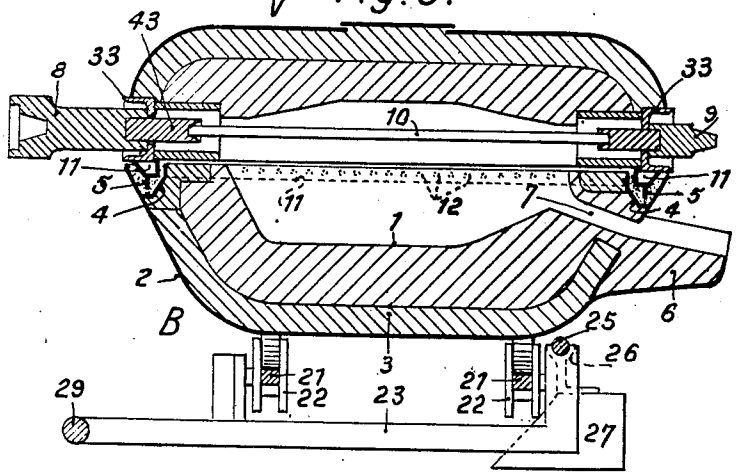


Fig. 4.

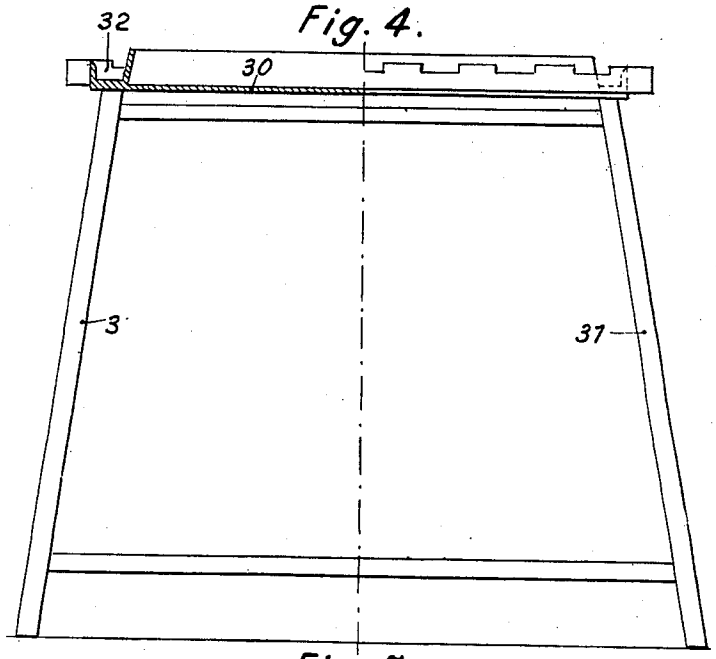
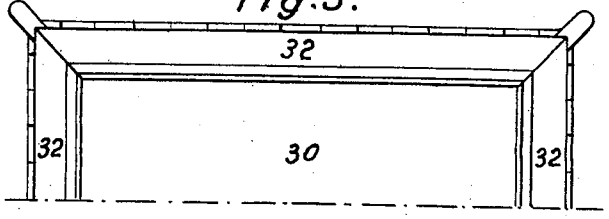


Fig. 5.



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Fig. 6.

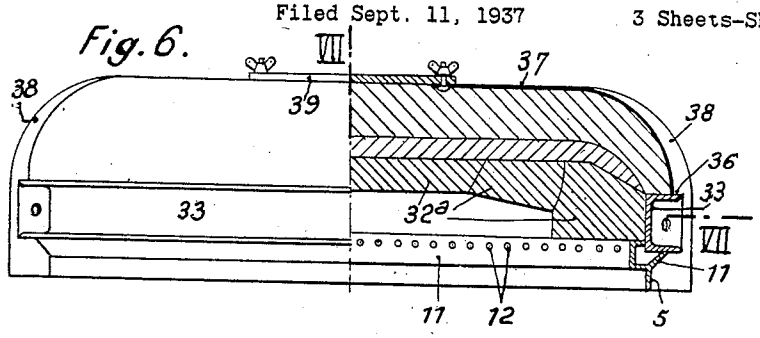


Fig. 7.

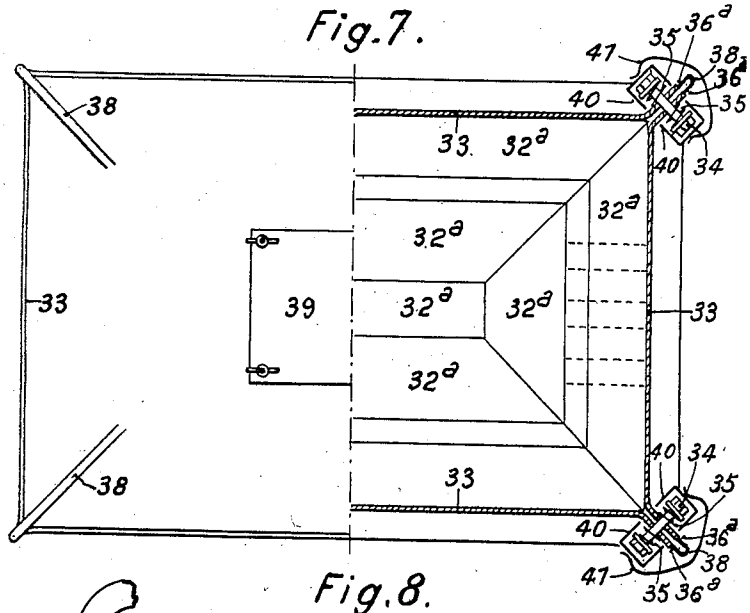
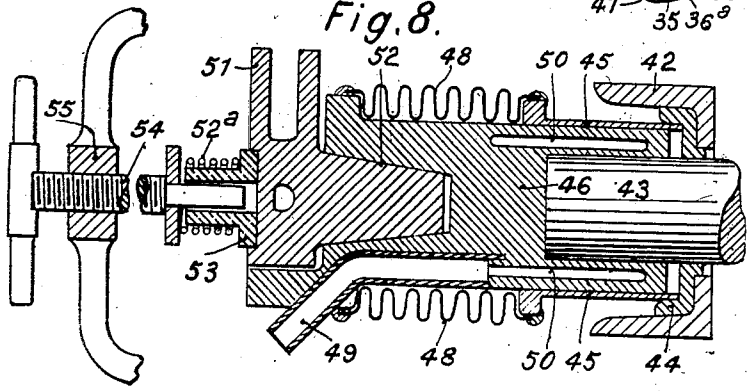


Fig. 8.



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UNITED STATES PATENT OFFICE

2,214,123

ELECTRICAL FURNACE

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Application September 11, 1937, Serial No. 163,413
In France September 11, 1936

11 Claims. (Cl. 13—21)

This invention relates to furnaces, in particular those heated by heat radiation originating from electrical heating elements installed within the heating chamber and carried by its cover.

It is an object of this invention to permit access to the interior of the heating chamber during operation while its content and heaters are still hot, without affecting substantially the temperature and the condition of that content and those heaters.

It is another object of the invention to prevent entrance of air to any detrimental extent to the heaters and other elements within the heating chamber while they are hot and the chamber is opened.

It is still another object of the invention to construct the cover of the furnace in such a way that it is capable of expanding when heated.

It is a further object of the invention to provide for a tight closure of the heating chamber without preventing or rendering difficult its being opened during operation.

It is another object of the invention to reduce the space between the cover and the heaters it carries and the level of the melt in the shell.

These and other objects of the invention will be more clearly understood when this description proceeds with reference to the drawings in which Fig. 1 shows a side elevation of a furnace according to this invention, Fig. 2 a front elevation thereof, with parts broken away, Fig. 3 a cross-section along the line III—III in Fig. 2 and, in part, side elevation thereof. Fig. 4 shows an elevation and Fig. 5 a plan view of a table serving to support the cover during charging of the shell, Fig. 6 shows partly in elevation and partly in vertical cross-section a particular structure of a cover and Fig. 7 a plan view and horizontal cross section thereof along line VII—VII in Fig. 6, while Fig. 8 shows, in section, partly in elevation, an electrical terminal of the electrodes of the furnace.

Identical reference numbers in different figures designate identical parts.

In furnaces, particularly electrical furnaces for heating and smelting a batch of material, it is often desired to inspect the progress of the process or to add some substances to the batch or to agitate it or to perform other operations such as refining, all of which necessitates opening of the heating chamber. In such cases air can enter the heating chamber, affect the temperature therein and attack the batch and/or heaters and their terminals, particularly if the latter contain or are of graphite. In order to perform such operations, sufficient space must be left between the cover and the grill of the heaters it carries and the level of the batch. It necessitates a large distance between those heaters and that level, which reduces the heating action and requires a relatively large space within the cover in which, in turn, a large volume of air is enclosed which attacks the heaters and the batch if capable of oxidation at elevated temperatures. Furthermore, large openings made in the furnace for performing the operations mentioned above permit the undesired admission of additional large amounts of air into the hot heating chamber.

According to this invention it is made possible to build the furnace flat and to reduce the distance of the grill of the heaters and the inner surface of the cover from the level of the batch without impairing or preventing the possibility of watching and influencing the process, and without exposing the heaters and terminals to the attack of fresh air if the heating chamber is opened.

According to this invention, additional means are provided which cover the gap between the cover and the shell of the furnace when the former is lifted for the purposes mentioned. In addition thereto, protective gases are admitted or a protective atmosphere is created underneath the cover and around the heaters and terminals if the latter ones are exposed to open air either when the furnace is opened for the mentioned purposes or when the cover is removed for charging the shell. The protective gases or atmosphere are shut off, however, when the furnace is closed. Thus, the space and the volume of gas above the level of the batch in the closed chamber are reduced to a desirable minimum while sufficient space is left for affecting the batch during operation by lifting the cover without permitting, however, undesired or detrimental access of fresh air into that chamber. By removing the cover from the shell the latter can be conveniently charged. The heaters and terminals are protected against air while they are hot, and their life is correspondingly prolonged.

Referring to the drawings, Figs. 1, 2 and 3, the furnace comprises a base such as a shell or receptacle B for the batch or material to be melted or heated and a curved cover V. The shell consists preferably substantially of hearth 1, a bottom of refractory material which is outwardly surrounded by a lining 3 of refractory material possessing low heat conductivity and

an outside metal mantle 2. The upper trough-shaped surface of the hearth is shaped so as to receive the material to be heated. The upper edge of the mantle is provided with a circumferential groove 4, which contains sand or any other suitable powdery or plastic material, to receive a downwardly protruding rim 5 of the cover. Thereby gas-tight closure is secured during the melting process.

A spout or nozzle 6 is arranged in the axis of the furnace and is provided with an inclined channel 7 the inner end of which lies above the level of the melt. This channel is closed by means of a plug during the melting or heating process. In the cover V electrical terminals 8 and 9 for electrodes 10 are arranged. In the exemplification of the drawing, three such electrodes with pairs 8, 9 of terminals are shown. The electrodes can be electrically arranged in series or in parallel if they are supplied with direct or single-phase current, or in star or in triangle connection if they are supplied with three-phase current.

A circumferential tubular rim 11 which is arranged at the lower edge of the cover V is provided with a number of holes 12 (Figs. 2, 3) on its inside facing the interior of the shell. These holes are preferably arranged along the longer sides of the rim. Tubes 13 (Figs. 1 and 2) are connected with the longer sides of tubular rim 11 and with a flexible conduit 13*a* through tube 14 and casing 15 in which a valve (not shown) is arranged. This valve is normally open but automatically closed if the cover V contacts the shell B and a stem 16 connected with the valve is placed on an abutment 16*a* provided on the outside of the mantle 2.

As it is to be seen in Figs. 2 and 3, the rim 11 provided with a conduit for a fluid is received by and submerged in the groove 4. The heating chamber of the furnace if closed is surrounded by the refractory material of the shell and the cover, and the rim 11 is protected against the heat developed in that chamber by the upper edge of the lining 3.

A shield 17 of sufficiently heat resisting material is pivotally connected with the shell at 18. Its horizontal cross-section is approximately U-shaped. In its smaller front side, Fig. 2, a recess 17*a* is provided which can be of any desired shape and area. It rests normally upon two abutments 19, but can be connected with the cover in any desired relative position by means of screws 20. Obviously, this screw connection can be made a permanent one if no relative adjustment of the shield 17 and the cover V is desired.

On its outside the receptacle of the furnace is provided with two rails 21 supported by rollers 22 rotatably arranged on a frame 23 which is pivotally supported at 25 by brackets 26 mounted on a base 27.

In operation, the cover V is lowered upon the shell B, and the heating chamber is thereby tightly closed. The material deposited upon the surface 1 is heated by radiant heat developed by the heaters 10. If desired the furnace can be oscillated around its longer axis due to its support by rails 21 and rollers 22. Stops, not shown, can be employed in order to limit that oscillating movement and to ensure that the batch does not overflow the upper edges of the shell.

If it is desired, e. g., to observe the state of the material within the furnace while the heating process proceeds, or if it is desired to add material to the batch in the furnace, one can lift and turn the cover V which at its rear end is pivotally connected with the shell by means of a pivot 24 received by a bearing 24*a* secured to the shell. This bearing is open on its upper side so that the cover with its pivot 24 can be raised and removed, as it will later on be described herein in more detail. If the cover is raised and turned on its pivot 24, it ultimately arrives at the position V^1, shown in dash-dotted lines in Figs. 1 and 2. The shield 17 being connected with the cover by means of the screws 20 was taken along by the cover and thereby turned around its pivots 18 into the position also shown in dash-dotted lines in Figs. 1 and 2. Thereby the gap resulting between the shell and the cover when the latter was raised is covered by the shield 17, and the entrance of surrounding fresh air into the hot heating chamber is substantially prevented except for the small area of the aperture 17*a* in the shield which, when the shield was raised, arrived at the position 28 shown in dash-dotted lines in Fig. 2. Through that aperture the interior of the heating chamber can be conveniently watched during operation and any desired manipulation can easily be performed.

The valve in the casing 15 was closed while the cover rested upon the shell. If the cover is raised, the valve stem 16 is lifted from the abutment 16*a* and opens so that any desired fluid substance supplied through the conduit 13*a* can flow into the hollow interior of the rim 11. When this rim is lifted with the cover it leaves the groove 4 and its holes 12 face now the interior of the heating chamber so that the fluid substance discharges freely through those holes into that chamber under the cover V above the level of the batch or melt in the shell, surrounding or covering from below the heaters and the terminals. The substance may be a liquid which evaporates when it contacts the hot heaters and terminals thereby forming around them a protective atmosphere. Or the substance can be, e. g., a neutral gas which is protective by its nature, or it can be a combustible gas which upon contact with the hot heaters or terminals will inflame, and its combustion products will form the desired protective atmosphere. In any case, due to this protective atmosphere, air entering the heating chamber through the aperture 28 cannot reach and attack the material of the heaters or terminals made of graphite.

As soon as the heating or smelting of the material in the furnace is completed, the shell with the cover usually resting thereon, is tilted on the axis 25. To this end any known means can be applied for turning the support 23 by raising its end 29, such as an electrical hoisting device or mechanical hoisting device, after the plug in the spout 6 has been removed, and the content of the heating chamber is thus discharged.

In order to charge the furnace anew, the cover is preferably entirely removed by suitable means such as a hoist; this is possible due to the fact that the bearing 24*a* is open on its upper side. The cover can then temporarily be deposited upon a support shown in Figs. 4 and 5, and the receptacle B is freely accessible and can be conveniently charged. By raising the cover the valve within the casing 15 is automatically opened in the way described above, and a protective atmosphere is created around the heaters and their terminals. This as also advisable in case the electrical current feeding the heaters has been cut off after the heating was completed while the heaters remained still hot.

The support upon which the cover is posi-

tioned consists substantially of a flat receptacle 30 forming a table on a level with the upper opening of the shell and filled with refractory powdery material which is supported by feet 31. A groove 32 filled with refractory material such as sand forms the rim of that table and resembles the rim 4 of the shell. The rim 11 of the cover enters into the groove 32, and the stem 16 contacts the edge of that groove whereby the valve in casing 15 is automatically closed and the supply of protective substance into the hollow rim 11 is shut off. This is permissible because no air can accede to the heaters and their terminals which are secluded from the air by table 30.

The cover may be of any known or desired structure. In order to obtain a flat and resilient structure as it is shown in Figs. 6 and 7, it is made of a frame 33 consisting of four U-shaped iron parts bent at an angle of 45° at their ends through which bolts 34 traverse and press them together by means of springs 35. To this frame a covering of metal 37 is soldered at 36*a* which along its diagonal is provided with folds or gussets 38 which reach the lower level or surface of the frame 33 and serve to permit expansion of the parts of the frame when heated. Bricks 32*a* of refractory material are mounted on the frame 33 and form a base for a filling of suitable material introduced through an opening of the covering 37 between the latter one and those bricks. The opening in the covering is closed by a detachable member 39. Cups 40 are tilted over the heads of the bolts 34 and held in contact with the iron pieces 33 by springs 41 thus forming a tight enclosure for those bolts and preventing air to enter the heating chamber from the outside. By this structure an air-tight and elastic cover is obtained which permits expansion of the frame when heated and when the bricks also expand.

Fig. 8 shows by way of example a particular structure of an electrical terminal 8 which is air-tight and permits expansion of the electrode when heated.

On two side parts 42 of the frame 33 passages for the terminals are provided which consist of members 43 of graphite to receive the electrodes proper, as shown in Fig. 3. On the member 43, Fig. 8, a tubular part 45 is screwed or otherwise fastened by means of bolts (not shown) and an insulating intermediary piece 44. Inside that tube 45 another member 46 is slidably arranged. A bellows-folded cylindrical cuff 48 surrounds member 46 and is soldered to it at one end and to the tube 45 at its other end. The support 43 of graphite is pressed into that member 46. A cooling channel 50 is provided in member 46 and is connected through tube 49 with a supply of cooling water. A clamp 51 which is to receive the end of the electrical cable is provided with a cone 52 which enters into the member 46. A spring 52*a* coiled around an insulating piece 53 presses the cone 52 permanently into member 46 and thereby maintains the desired electrical contact. The pressure in spring 52*a* can be regulated by screw 54 and a plate connected therewith adjacent to the spring. Screw 54 is provided with a suitable handle and traverses a frame 55 which is suitably connected with the frame part 42.

It will be appreciated from the above that the invention permits to design the means for gas-tightly closing the furnace in its closed position independent from the additional means for protecting its interior against the surrounding atmosphere and other conditions when the furnace is open. The gas-tightly closing means can be made as compact and efficient as possible as is known in the art, and properly protected against the heat developed in the furnace during operation. The additional means arranged outside the cover and base independent from the means for gas-tightly closing the furnace, may consist of a simple shield which does not interfere in any way with operating the furnace and particularly opening it. The cover may be lifted vertically or tilted on a pivot relative to the base, and any desired distance between the cover and base of the opened furnace can be taken care of by proper dimensioning of the shield. Any desired position of the opening in the shield relative to the gap can be adjusted according to any requirement of operation.

It is to be understood that the invention is not limited to any particular feature hereinbefore described by way of example only but to be derived in its broadest scope from the appended claims.

What I claim is:

1. A furnace comprising, in combination, parts forming a base and a cover, said parts capable of having different relative positions and arranged to enclose a heating chamber in one and to be at least partially spaced from and to leave a gap between each other in another of said relative positions, said parts provided with rigidly attached means cooperating in said first position to gas-tightly seal said chamber and to permit access to it substantially all over said gap in said other position, separate screening means having an opening arranged outside said parts and their sealing means, said screening means movable relative to said parts and their sealing means into different positions in one of which said gap is substantially covered and access to it permitted through said opening, and means operatively connecting said screening means with one of said parts for placing said screening means into said covering position when said parts are in said spaced position.

2. A smelting furnace comprising, in combination, parts forming a base and a cover, said parts capable of having different relative positions and arranged to enclose a smelting chamber in one and to be at least partially spaced from and leaving a gap between each other in another of their relative positions, means for gas-tightly connecting said parts in said first mentioned position, additional means movable independently from said first mentioned means arranged outside said parts and adapted to substantially cover said gap, said means provided with an opening permitting in their covering position access to a part of said gap, and adjustable means operatively connecting said additional means with one of said parts for securing said additional means and its opening in proper and adjustable position relative to said gap when said parts are spaced from each other.

3. A smelting furnace comprising, in combination, parts forming a receptacle for a batch and a cover, said parts pivotally connected with each other so as to be capable of occupying different relative positions in one of which they enclose a smelting chamber while in another one they leave a gap between each other, means for gas-tightly connecting said parts in said first mentioned position, additional means movable independently from said first mentioned means arranged outside said parts adapted to cover said gap and provided with an opening permitting access to said gap in their covering position, said

additional means pivotally connected with one and adjustably with the other of said part so as to permit adjustment of the position of said additional means and their opening relative to said gap.

4. An electrical furnace comprising, in combination, parts forming a base and a cover having a downwardly projecting rim, said parts capable of having different relative positions and arranged to enclose in one of them a heating chamber and in another of them to be at least partially spaced and to leave a gap between each other; means associated with said parts for gas-tightly connecting said parts in said first mentioned position; additional means arranged independent from said first mentioned means outside said parts and operatively connected with one of said parts so as to substantially cover said gap and provided with an opening permitting access to a part of said gap in their covering position; electrical heater elements sensitive to open air at elevated temperature arranged inside and supported by said cover; controlled means combined with and extending over a substantial part of the inside circumference of said rim for causing a protective atmosphere around said heater elements; and means dependent upon the relative position of said parts for controlling said controlled means, rendering said controlled means operative when said parts are spaced from each other and inoperative when said parts are in their closed position.

5. A furnace comprising, in combination, parts forming a receptacle for material to be heated and a cover, said parts pivotally and detachably connected with each other so as to be capable of occupying different relative positions in one of which they contact each other and enclose a heating chamber, in another one they are inclined towards and leave a desired gap between each other, while when detached they are entirely separated from each other, and means pivotally connected with one end and adjustably and detachably connected with the other of said parts, said means adapted to substantially cover said gap and capable of permitting access to a part of said gap if connected with said other part in its said other relative position.

6. An electrical furnace comprising, in combination, parts forming a base and a cover having a downwardly projecting rim, said parts capable of having different relative positions and arranged to enclose in one of them a heating chamber and in another of them to be at least partially spaced from and to leave a gap between each other; means for gas-tightly connecting said parts in said first mentioned position; additional means arranged independent from said first mentioned means outside said parts and operatively connected with one of said parts so as to substantially cover said gap and permitting access to part of said gap; electrical heater elements sensitive to open air at elevated temperature arranged inside and supported by said cover; controlled means combined with and extending over a substantial part of the inside circumference of said rim for admitting a gas under said cover for causing a protective atmosphere around said heater elements; and means dependent on the relative position of said parts for controlling said controlled means so as to admit gas when said parts are spaced from each other and to shut off that gas when said parts are in their closed position.

7. An electrical furnace comprising, in combination, parts forming a base and a cover, said parts capable of having different relative positions and arranged to enclose in one of them a heating chamber and in another of them to be at least partially spaced from and to leave a gap between each other; means associated with said parts for gas-tightly connecting them in said first mentioned position; additional means arranged independent from said first mentioned means outside said parts adapted to substantially cover said gap and provided with an opening permitting access to a part of said gap; electrical heater elements sensitive to open air at elevated temperature arranged inside and supported by said cover; controlled means for admitting a gas under said cover for causing a protective atmosphere around said heater elements, said means associated with one of said parts and arranged to lie inside said additional means in said spaced position and outside said heating chamber in said closed position of said parts; and automatic means dependent on the relative position of said parts for controlling said gas admitting means so as to admit gas under said cover when said parts are in a spaced position and to shut off that gas when said parts are in their closed position.

8. An electrical furnace comprising, in combination, parts forming a base and a cover, said cover provided with a downwardly projecting rim, said parts capable of having different relative positions and arranged to enclose in one of them a heating chamber and in another to be at least partially spaced from and to leave a gap between each other; means gas-tightly connecting said parts in said first mentioned position; additional means arranged independent from said first mentioned means outside said parts and operatively connected with one of said parts so as to substantially cover said gap and permitting access to part of said gap; electrical heater elements sensitive to open air at elevated temperature arranged inside and supported by said cover; a conduit formed in said rim and provided with discharge openings directed substantially towards said heaters for admitting a protective gas below said cover around said heater elements; and means dependent on the relative position of said parts for controlling the admission of gas to said conduit, so as to admit gas when said parts are spaced from each other and to shut it off when said parts are in their closed position.

9. In an electrical furnace as described in claim 8, said base provided with an upwardly projecting rim of refractory material, said latter rim, when said chamber is closed, positioned inside and close to said rim of the cover.

10. An electrical furnace comprising, in combination, parts forming a receptacle for material to be heated and a cover, said parts capable of having different relative positions and arranged to enclose in one of them a heating chamber and in another one of them to be at least partially spaced from and to leave a gap between each other; means for gas-tightly connecting said parts in said first mentioned position; means arranged independently from said first mentioned means outside of said parts adapted to substantially cover said gap and capable of permitting access to part of said gap; electrical heaters sensitive to open air at elevated temperatures, said heaters supported by said cover; means for admitting a gas under said cover for causing a protective atmosphere around said heaters, if

said parts are spaced from each other, said gas admitting means connected with one of said parts and arranged to lie inside said means covering said gap in said spaced position and outside said heating chamber in said enclosing position of said parts.

11. An electrical furnace comprising, in combination, parts forming a receptacle for material to be heated and a cover, said parts capable of having different relative positions and arranged to enclose in one of them a heating chamber and in another of them to be at least partially spaced from and to leave a gap between each other; means arranged independently from said first mentioned means outside of said parts adapted to substantially cover said gap and capable of permitting access to part of said gap; electrical heaters sensitive to open air at elevated temperatures, said heaters supported by said cover; means for gas-tightly connecting said parts in said first mentioned position and including means for admitting a gas under said cover for causing a protective atmosphere around said heaters if said parts are spaced from each other, said gas admitting means arranged to lie inside said means covering said gap in said spaced position and to gas-tightly engage said other part outside said heating chamber in said enclosing position of said parts.

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