

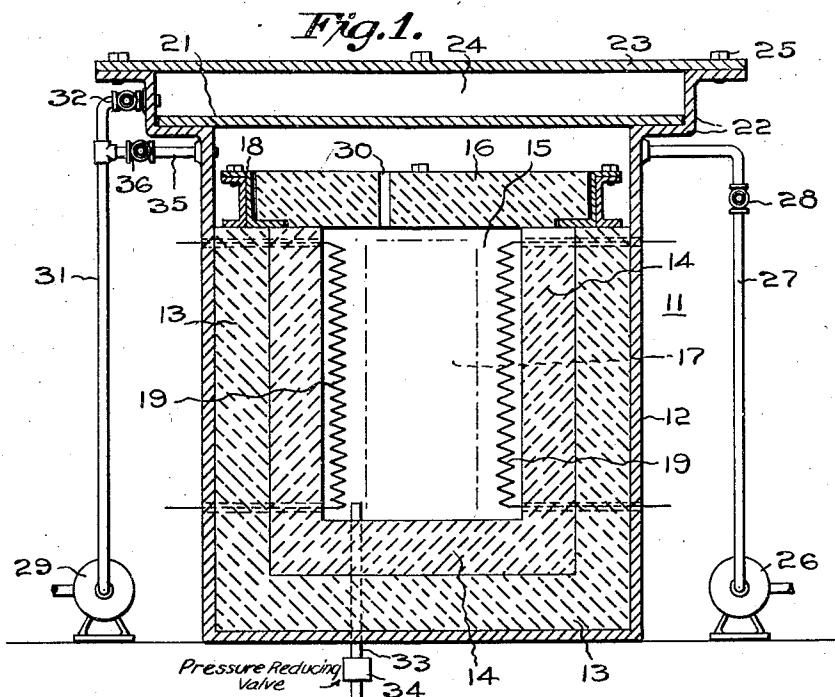
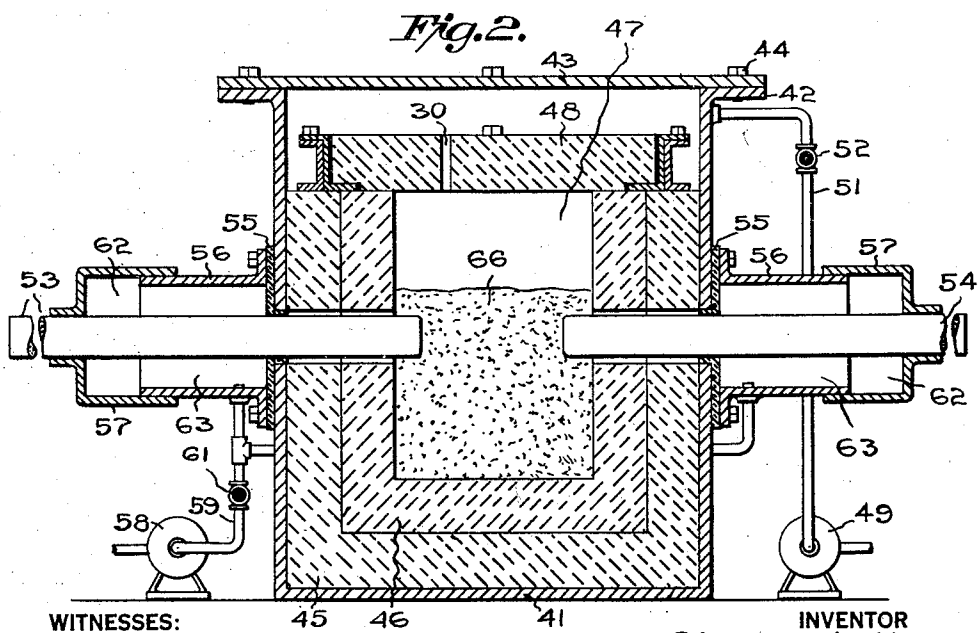
**Feb. 15, 1927.**

**1,617,359**

**S. WESTBERG**

## HEAT TREATING FURNACE

Original Filed March 18, 1925      2 Sheets-Sheet 1



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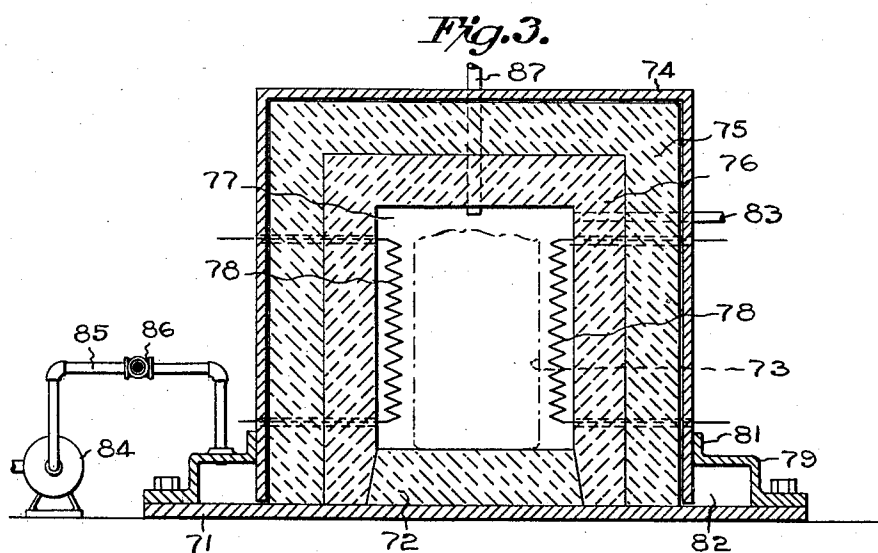
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WITNESSES:

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## UNITED STATES PATENT OFFICE.

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## HEAT-TREATING FURNACE.

Application filed March 18, 1925, Serial No. 16,404. Renewed July 17, 1926.

My invention relates to heat treating means and particularly to electrically heated heat-treating furnaces.

The object of my invention is to provide an electric furnace that is substantially sealed, thereby preventing the inflow of air to the furnace chamber.

In practicing my invention, I provide a furnace chamber having electric heating means associated therewith, which chamber is separated from an auxiliary chamber by a common wall member, the combination of the two chambers forming a unitary structure. The furnace chamber is subjected to the operation of a vacuum pump to remove the air therefrom and produce a partial or a substantially complete vacuum therein.

The auxiliary chamber is subjected to the operation of a pressure pump that forces either an inert or a reducing gas into the chamber. The auxiliary chamber effectively seals the furnace chamber, thereby providing a structure that may be used for treating metallic articles with heat without the undesirable oxidizing effect that occurs with furnaces having no means for excluding air.

In the drawings,

Figure 1 is a view, in vertical section, through a furnace embodying my invention, Fig. 2 is a view, in vertical section, through a modified form of device embodying my invention, and

Fig. 3 is a view, in vertical section, through a still further modification of the device embodying my invention.

Referring more particularly to Fig. 1 of the drawings, a furnace 11 comprises a container 12 that is preferably of metal and that may be of any suitable or desired shape in contour, although I prefer to employ a substantially circular container that is open at the top portion thereof. The container 12 is lined with a suitable refractory outer lining 13, of heat-insulating material, and an inner lining 14 of a high-temperature resisting refractory material, the two linings being so arranged and disposed in the container 12 as to provide a furnace or chamber 15 therein.

A heat-insulating cover member 16 encloses the lower portion of the furnace chamber that is designated more particularly by the numeral 15 and which is adapted to receive the material to be heat treated therein. This material is indicated generally as

a relatively large mass 17 of solid material. The member 16 is provided with suitable peripheral metallic portions 18 that serve to strengthen the same and permit of easy and quick removal and replacement thereof.

Electric heating means, comprising a plurality of resistor members 19, is located in the furnace chamber, the ends of the resistor members being brought out through suitable bushings extending through the refractory linings and casing 12. This construction is indicated generally only as any method known in the art may be employed.

While I have indicated resistor members as comprising the electric heating means, I do not wish to be restricted thereto, as I may employ high frequency electric currents traversing a suitable coil, or I may employ inductive heating at ordinary frequencies.

The furnace chamber proper is enclosed at the top thereof by a metal plate 21 that is of such shape as to conform to the general form of the casing 12, which at the upper portion thereof is provided with an annular flange portion 22 to provide a seat for the plate 21. An external cover member comprising a metal plate 23, is provided to enclose an auxiliary chamber 24, the member 23 being secured against the upper portion of the casing 12 by a plurality of bolts 25. The auxiliary chamber 24 and the furnace chamber 15 are enclosed within the one container member 12 and serve as a practical unitary structure for the purpose set forth.

A suction or vacuum pump 26 is directly connected to the upper portion of the furnace chamber 15 by a pipe 27, a valve 28 being located therein to permit of adjusting the amount of gaseous fluid being removed from the furnace chamber 15. The removal of the gaseous fluid within the furnace chamber 15 provides either a partial or a substantially complete vacuum therein. The cover member 16 has an opening 30 therethrough to permit free communication between the portions of the chamber 15 above and below the cover member 16.

A force pump 29 is connected to the auxiliary chamber 24 by means of a pipe 31, a valve member 32 being located in the pipe 31 to permit of regulating the amount of inert or of a reducing gas that is forced therein by the pump 29 from a source of supply (not shown). The force pump 29 effects a

pressure in the auxiliary chamber 24 that is higher than the pressure in the furnace chamber 15. The intermediate plate 21 is maintained in its proper operative position on the annular flange portion 22 not only by the effect of the pressure in the auxiliary chamber 24, but also by the effect of the vacuum within the work-receiving compartment or chamber 15.

The inert or reducing gas in the auxiliary chamber 24 effectively seals the furnace chamber 14, whereby air is prevented from entering the furnace chamber, and oxidation of metal or other materials enclosed therein for the purpose of heat treating the same, is substantially prevented. Bright metallic articles, such as members of sheet steel, may be successfully subjected to heat without danger of oxidizing, tarnishing or otherwise dimming their luster and reducing the thickness of the sheet.

It may be desirable to permit an inert or a reducing gas to flow into the work-receiving compartment 15 during the operation of heat treatment of a mass of metal 17, and to this end, I provide a conduit 33 that has a pressure-reducing valve 34 located therein and which is connected to a suitable source of supply of an inert or a reducing gas as may be required. The conduit 33 has its inner end so located relatively to the mass of material 17 being heat treated, and to the exit conduit 27, that substantially all of the external surface of the material 17 will be bathed in the inert or reducing gas. The pressure-reducing valve 34 is provided in order that the effect of the incoming gas entering through the conduit 33 will not seriously disturb the vacuum condition effected by the vacuum pump 26.

In order to prevent in so far as may be possible, the inrush of air when removing the cover, and which as is well known, is a highly oxidizing agent for heated ferrous material, I provide a short conduit 35 having a valve 36 therein, that has its outer end connected to the conduit 31. During the operation of the furnace, the valve 36 is tightly closed, thereby preventing the entrance of any inert or reducing gas to the work-receiving compartment 15.

When it is desired to remove the mass 17 after heat treating, the valve 32 may be closed either partially or totally, and the valve 36 opened, whereby inert or reducing gas will flow into the furnace chamber 15, whereby a pressure will be built up within the container 12 and the entrance of a relatively large quantity of air when the cover members are removed is prevented.

Referring more particularly to Fig. 2, I have there illustrated a modification of the furnace shown in Fig. 1 and applicable more particularly to a method of electric heating, wherein the mass of material constitut-

ing the resistor, and the current is led into and from the mass of material by electrodes.

The construction illustrated in Fig. 2 may also be employed where the electric heating means is constituted by an electric arc.

A casing 41 of metal, such as steel, is provided with an upper annular flange portion 42, upon which is mounted a removable cover plate 43 that is secured to the container or casing 41, by a plurality of bolts 44. An outer lining 45, of refractory heat-insulating material, and an inner casing or lining 46, of a refractory high-temperature resisting material, is located within the container 41. A furnace chamber 47, is provided within the lower portion of the container 41 within the refractory linings. A removable cover member 48, of suitable refractory material, is provided and is normally in operative engagement with the linings 45 and 46. A suction pump 49 is connected by means of a conduit 51, having the valve 52 therein, to the furnace chamber 47 to remove the air and other gases therefrom.

A pair of elongated electrodes 53 and 54 extend into the furnace chamber in diametral relation to each other, suitable openings being provided in the container 41 and the refractory linings to permit of the electrodes projecting into the chamber 47. A plate 55, of electric-insulating material, is located against the outer surface of the container 41 adjacent to the openings therein, and is so dimensioned that it operatively engages the electrodes extending therethrough in order to reduce the amount of gas flowing into the furnace chamber along the electrodes, to the minimum possible amount.

An open-ended annular casing 56 is provided at each side of the container surrounding a portion of the lengths of the electrodes 53 and 54, and these containers are suitably mounted against and insulated from the metal container 41. A cooperating outer open-ended casing 57 is provided for each of the two casings 56, having an outer portion that fits closely around the electrodes 53 and 54, respectively, and that telescopes with the casings 56.

Suitable current connections, not shown, are provided to the electrodes 53 and 54. A force pump 58 is connected through a conduit 59 having a valve 61 therein to the two auxiliary chambers 62 and 63 that are formed by the cooperating telescoping casings 56 and 57. The pump 58 is connected to a source of supply of an inert or a reducing gas (not shown). A mass of material 66 is located within the lower portion of the furnace chamber 47, and is operatively engaged by the inner ends of the electrodes 53 and 54, if the material 66 is electrically-conducting. If the material 66 is not electric-conducting or if it is not de-

sired to permit the current to traverse the same, it will be located below the opposing electrodes which are then brought close enough together to cause an arc therebetween when connected to a suitable source of supply of electric energy.

The upper cover member 43 and the intermediate cover member 48 effectively prevent the inflow of any oxidizing agent, such as air into the furnace chamber, but such gaseous fluid may flow into the furnace chamber through the openings in the members 55 and along the electrodes. The action of the force pump 58 in filling the chambers 62 and 63 with an inert or reducing gas under pressure effectively prevents, therefore, the inflow of any oxidizing agent into these auxiliary chambers and from there into the work-receiving chamber 47.

The operation of this form of device embodying my invention is, therefore, substantially the same as that hereinbefore set forth in connection with Fig. 1 of the drawing.

Fig. 3 illustrates a still further modification of my invention and comprises a furnace of the inverted type wherein the cover member is removable from a base plate.

A base plate 71, that may be preferably of steel or iron, has located thereon a block or plate 72 of a suitable refractory material that is adapted to support a mass 73 of metal to be heat treated. A cover member 74, having an open bottom, has located therein an outer lining 75 of a suitable refractory heat-insulating material, and an inner lining 76 of suitable high-temperature resisting refractory material. The two linings are so disposed and arranged as to provide a furnace chamber 77 adapted to receive the mass of material 73. The electric heating means 78, here illustrated as a plurality of electric resistors, are adapted to be traversed by current. While I have illustrated the heating means as comprising resistor members, I do not wish to be restricted thereto, as an arc-producing heating means, or inductive heating may be employed if desired.

An annular member 79 is located on the base 71 and is provided with an upstanding flange 81 that is adapted to fit closely around the lower portion of the container 74. The member 79 provides an auxiliary chamber 82 of a substantially annular form around the lower portion of the casing 74.

A suitable suction pump (not shown) of the same type hereinbefore described in connection with Figs. 1 and 2 is provided and has a flexible connection with a conduit 83 extending into the chamber 77 to permit of removing an oxidizing gaseous fluid therefrom. A force pump 84 is connected, through a conduit 85, having a regulating valve 86 therein, to the auxiliary chamber

82, whereby the furnace chamber is effectively sealed against the introduction of an oxidizing agent into the chamber.

A conduit 87 is provided that will permit of the introduction of a reducing or an inert gas into the furnace chamber, as was hereinbefore described in connection with Fig. 1 and for the same purpose.

Various modifications and changes may be made without departing from the spirit and scope of the invention, and I desire, therefore, that only such limitations shall be placed thereon, as are imposed by the prior art.

I claim as my invention:

1. In an electric furnace, the combination with an electrically heated furnace chamber and an auxiliary sealing chamber therefor, of a common means forming a closure for each of said chambers.

2. In an electric furnace, the combination with an electrically heated furnace chamber, and means for maintaining the chamber at a pressure relatively lower than atmospheric pressure, of means for subjecting said chamber to a sealing medium containing an inert gas.

3. In an electric furnace, the combination with an electrically heated furnace chamber, of an auxiliary chamber associated therewith and containing an inert gas maintained at a relatively higher pressure than the pressure within the furnace chamber.

4. In an electric furnace, the combination with a furnace chamber having electric heating means associated therewith, a cover member for said chamber, an auxiliary chamber enclosed by said cover member, and means for separating said auxiliary chamber from said furnace chamber, of means for supplying an inert gas to said auxiliary chamber.

5. In an electric furnace, the combination with a furnace wall enclosing a plurality of chambers, of a common closure member for the chambers, electric heating means located in one chamber, and means for maintaining the chambers at relatively different pressures.

6. An electric furnace comprising a plurality of chambers maintained at relatively different pressures, an inert gas in one of the chambers, and an electric heating means in another of said chambers.

7. An electric furnace comprising a refractory wall enclosing an electrically heated furnace chamber, a closure member therefor, said closure member substantially forming a wall of an auxiliary chamber associated in operative relation with said furnace chamber, means for maintaining the furnace chamber at a given pressure, and means for maintaining an inert gas in the auxiliary chamber at a relatively higher pressure.

8. An electric furnace comprising a con-

tainer, a refractory lining therefor, an electrically heated chamber partially enclosed by said lining, a closure member for said chamber, said closure member substantially forming a wall of an auxiliary chamber partially enclosed by an extension of said container, another closure member for said auxiliary chamber, and means for maintaining an inert gas therein at a pressure relatively higher than the pressure in said furnace chamber.

9. In an electric furnace, the combination with an electrically heated furnace chamber, of an auxiliary chamber associated

therewith and containing a reducing gas maintained at a relatively higher pressure than the pressure within the furnace chamber.

10. An electric furnace comprising a plurality of chambers maintained at relatively different pressures, a reducing gas in one of the chambers, and an electric heating means in another of said chambers.

In testimony whereof, I have hereunto subscribed my name this 2nd day of March, 1925.

SIGURD WESTBERG.