May 19, 1931. R. DUFOUR 1,805,469

ELECTRIC FURNACE

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Fig. 1

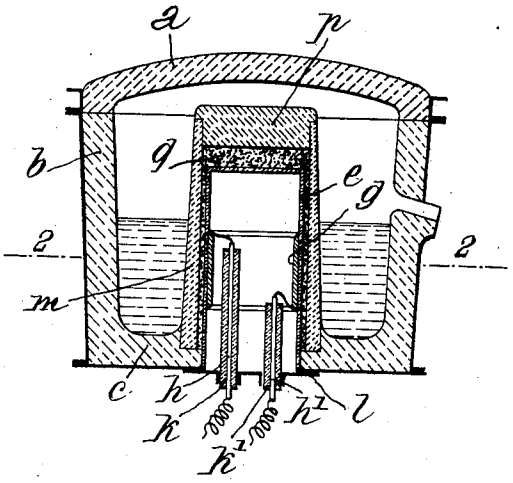
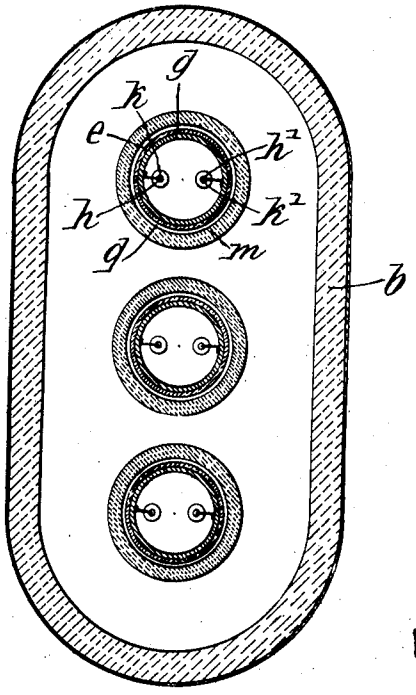


Fig. 2



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Fig. 3

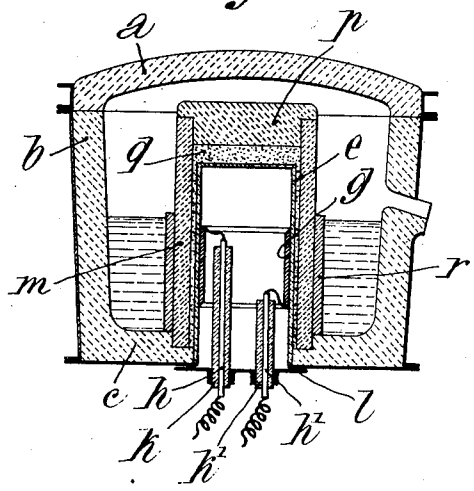
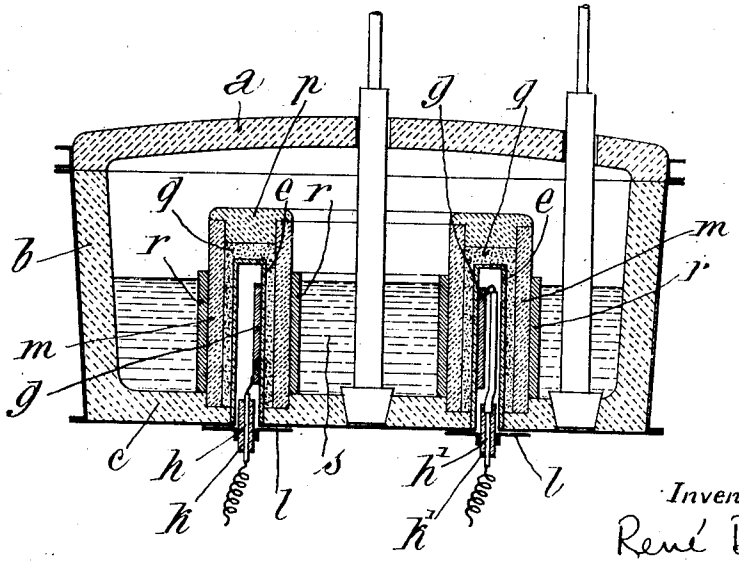


Fig. 4



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UNITED STATES PATENT OFFICE

RENÉ DUFOUR, OF PARIS, FRANCE

ELECTRIC FURNACE

Application filed July 28, 1927, Serial No. 209,111, and in Belgium August 4, 1926.

The present invention relates to electric furnaces and, more particularly, to those of the type intended to be heated by high frequency currents.

In high frequency furnaces, as hitherto constructed, it has been customary to place the induction coil around the outside of the crucible or similar furnace chamber. As a consequence, the capacity (diameter) of the chamber has had to be restricted to very narrow limits. Attempts to increase the diameter of the furnace chamber have necessitated diminution of the current frequency, since the latter is inversely proportional to the square root of the self-inductance of the heating coil and each increase in diameter by lengthening the heating coil, resulted in a proportional increase in the self-inductance of the latter.

One of the objects of the invention is to provide a form of furnace wherein the capacity of the furnace chamber is very materially increased without increasing the length i. e. the self-inductance of the heating coil.

Further objects will appear in the course of the detailed description now to be given with reference to the accompanying drawings, in which:—

Fig. 1 is a vertical section of one form of the invention;

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

Fig. 3 represents, in section a second form of the invention; and

Fig. 4, a section through a third inventive embodiment.

Referring to the various figures of the drawings, there is shown a furnace chamber formed of a movable wall a, fixed walls b and c, and a plurality of internal conical or cylindrical walls m adapted to receive a high frequency heating assembly. The latter is conveniently formed of a cylindrical quartz or similar insulating tube e carrying a spiral winding g (which may be cooled if desired) connected to proper electrodes h, h^1, the latter being enclosed in insulating sheaths k, k^1 and supported in position by a plate l. The heating assembly is protected from the furnace contents by refractory walls m, and refractory plug p which enclose an intermediate packing q of zirconia, alumina or similar heat insulating material.

From the foregoing it will be evident that the placing of the heating chamber outside, instead of inside, the heating coil, permits the diameter i. e. the capacity of the furnace to be very materially increased without increasing the self-inductance of the heating coil. It will be noted, moreover, that by arranging the heating coils in alignment (or in groups), there is an overlapping heating effect and a diminution of the heat losses. When it is desired to use 3-phase or multiphase high frequency currents it is only necessary to couple adjoining heating coils in proper relation.

With the heating coils almost entirely surrounded by the material to be treated a very high operating efficiency is assured.

The form of apparatus shown in Fig. 3 differs from that represented in Figs. 1 and 2 only in the addition of element r formed of metal, graphite, plumbago or similar conducting material, and intended to be heated by induced currents. This special design of furnace is particularly adapted for use in the chemical industries where the material being treated is itself a poor conductor of electricity.

The modification shown in Fig. 4 has a crucible s extending inside the heater winding from the outer crucible thus enclosing coils g on both sides and insuring a more perfect utilization of the inductive effects produced by the latter.

In the claims that follow, the designation "air-wound" applied to the heating coils is intended to distinguish from the type of coil ordinary employed in low-frequency induction furnaces wherein the coil is wound on an iron core. The term "high-frequency" is to be taken as limitative to frequencies exceeding 4500 per second.

What I claim is:—

1. A high frequency furnace comprising a plurality of insulated chambers, a coil located inside each chamber, said coils being of the air-wound type, and a furnace chamber external to said insulated chambers, said insulated chambers being so positioned that the

magnetic fields of the coils, contained therein, overlap when high frequency currents are supplied to the coil terminals.

2. A high frequency furnace comprising an insulated chamber, a coil inside said chamber, said coil being of the air-wound type, an electrically conducting element external to said insulated chamber and in inductive relation to the coil contained inside the latter, and a furnace chamber surrounding said electrically conducting element.

3. A high frequency induction furnace or heating apparatus, including an induction coil introduced into the charge material from the bottom of the furnace, so that both the inner and outer magnetic field of said coil traverses the charge material, and a separating element of non-metallic material between said coil and the interior of said furnace.

4. A high frequency induction furnace or heating apparatus, including a hollow electrically insulating inward projection of the furnace bottom and an induction coil arranged in said projection, so that both the inner and the outer magnetic field of said coil traverses the charge material.

5. A high frequency induction furnace comprising a furnace chamber, an air-wound induction coil extending through the bottom of said furnace chamber and a separating element of non-metallic material between said coil and the interior of said furnace.

6. A high frequency furnace comprising a furnace chamber and an air-wound coil extending through the bottom of said furnace chamber.

In testimony whereof I have hereunto set my hand.

RENÉ DUFOUR.