April 18, 1939. K. ERDMANN 2,154,737

ELECTRIC FURNACE

Filed Dec. 29, 1936

Fig.1

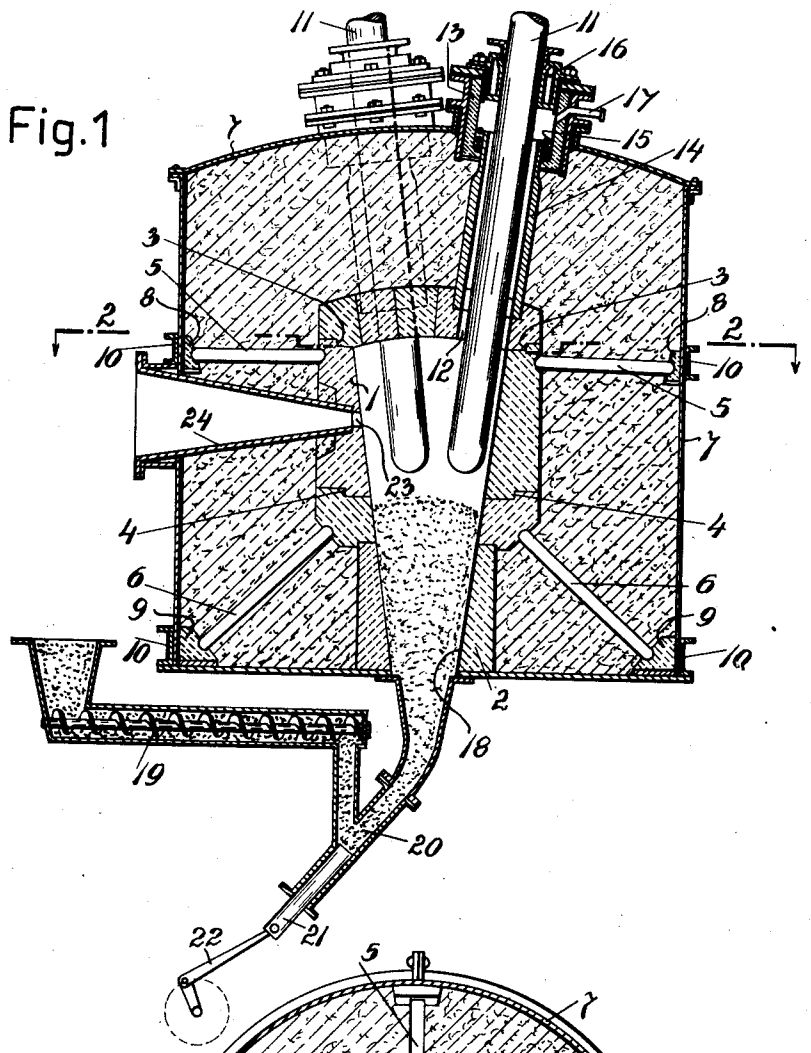
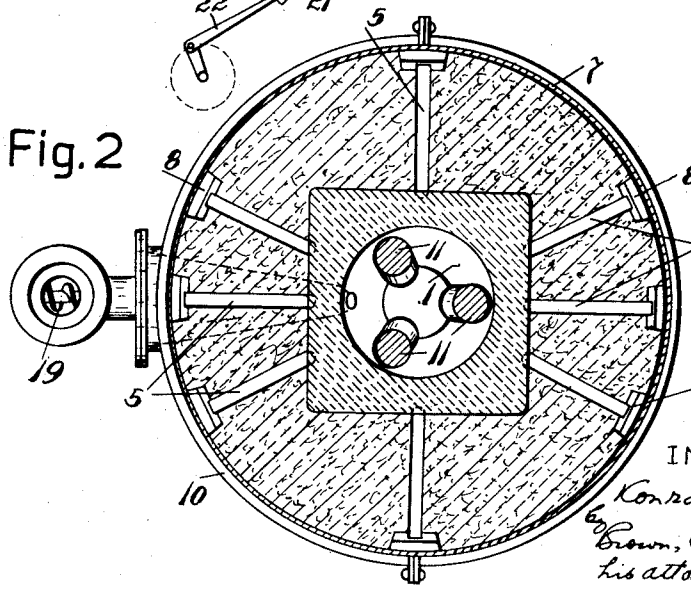


Fig.2



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2,154,737

ELECTRIC FURNACE

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In Austria January 10, 1936

1 Claim. (Cl. 13—9)

This invention relates to electric furnaces, and more particularly to electrode furnaces, of the type in which a heating chamber or a muffle made from slabs or bricks which are highly refractory but pervious to gas, is encased by a heat-insulating material and inserted in a gas-tight outer casing or shell.

An object of the invention is to provide a furnace in which reactions can be carried out at very high temperatures due to losses through heat conduction being considerably reduced.

Another object of the invention is in an electrode furnace to provide an insulation around the electrodes passing through the outer casing or shell, and the insulating material into the heating chamber, which is adapted to allow for expansion and contraction of the heating chamber without the outer casing or shell being subjected to detrimental stress.

Further objects of the invention will appear as the description proceeds.

In furnaces of the specified type the thrust of the arch and the forces tending to tilt the side walls have to be taken up by the outer shell and its strengthening members, and this has hitherto been accomplished by extending the top of the furnace and if necessary also the bottom of the furnace up to the outer shell. Since refractory materials are good heat conductors a heat-conducting connection is provided in this manner between the muffle and the cold outer shell, which entails very considerable loss of heat. Many an electrothermic process, for example the recovery of magnesium from magnesia by heating an intimate mixture of the material to be reduced with carbonaceous reducing agents cannot therefore be conducted in the known types of electrode furnace at as high temperatures as is desirable. When carrying out this reaction in electrode furnaces in which the electrodes are inserted from above uprightly into the furnace chamber there results, in consequence of heat conduction through the top, the further drawback that the temperature in the annular gap around the electrodes falls far below the temperature prevailing in the furnace chamber with the result for example in the reduction of magnesium oxide that the magnesium vapors and the carbon monoxide, which are stable in the presence of each other at the high temperature inside the furnace chamber but interact at lower temperatures whereby reformation of magnesia takes place, react with each other in the annular gap, so that there becomes deposited in the gap a mixture of magnesium, magnesium oxide, and carbon, which bridges across the gap and establishes a conducting connection between the electrode and the furnace wall.

In accordance with the invention the losses due to heat conduction are very considerably reduced by virtue of the fact that the wall of the heating chamber or muffle is supported against the gas-tight outer casing or shell with the aid of individual struts which traverse the heat-insulating material filling out the space between the muffle and the outer shell, this filling material preferably consisting, in a manner known per se, of loose material (preferably soot). Since the struts have no other function than to transmit the thrusting forces from the walls or also from the top and bottom of the heating chamber to the outer casing or shell their cross-section may be relatively slight, so that the losses due to heat conduction are very considerably less than is the case with known furnaces in which the top is extended to the outer casing or shell. Experience has shown that, by virtue of the described form of supporting, under otherwise precisely equal circumstances the temperature in the heating chamber can be increased by about 200° C. Moreover, if the furnace is constructed as an electrode furnace it is in this way also prevented that a conducting connection between the electrode and the furnace may occur.

In electrode furnaces care must be taken to ensure that current cannot pass from the electrodes to the heat-insulating material filling out the space between the heating chamber and the outer shell. In accordance with the present invention this result is achieved by providing the portion of the electrodes which transverses the heat-insulating material, with a sleeve consisting of two slidably inter-fitting tubes of refractory material, of which the outer tube is secured to the outer casing or shell while the inner tube is inserted in the wall of the heating chamber. In consequence of this feature the muffle can expand and contract without the casing or shell being subjected to detrimental stress. The two parts of the electrode sleeve have a tight joint, formed for instance with the aid of asbestos cord, between them, to prevent gases or vapors from passing from the annular space between the electrode and the sleeve, into the heat-insulating material.

A constructional example of a furnace according to the invention is illustrated in the accompanying drawing, in which Fig. 1 is a vertical section of the furnace, and Fig. 2 a section on the line 2—2, Fig. 1.

The closed heating chamber 1 rests upon the pedestal 2, and is so built up, from refractory materials in the form of slabs and bricks, that the top and the bottom terminate flush with the side walls. The side walls are provided at the top with a shoulder 3 and at the bottom with a shoulder 4, so that the thrust of the top arch composed of bricks becomes transmitted to the side walls and from these latter to the bottom. The side walls and the bottom are supported against the gas-tight outer shell 7 of metal by means of struts 5 and 6. According to the constructional example shown in the drawing the struts are inserted with their inner end in cupped recesses in the side walls and bottom, respectively, and with their outer end in sockets 8 and 9 which are connected in a suitable manner to the metal shell. If desired, the portion of the metal shell which takes up the lateral pressure of the socket-like abutments may be strengthened by means of reinforcements, for example U-section irons 10. The space between the heating chamber and the metal shell is filled with soot.

The struts 5 and 6, which consist of refractory material, for example graphite or the material used for manufacturing carbon blocks, are only subjected to compression or to buckling stress, and can therefore be made relatively thin, so that the amount of heat conducted to the outside by the struts is small.

The electrodes 11, which traverse the shell 7, are led-in through the top of the heating chamber in a known manner so that between the electrode and the top of the heating chamber an annular gap 12 is left whereby the passage of current from the electrode to the top is prevented. In order to preclude also the possibility of current passing from the electrodes to the insulating material which surrounds all the walls of the heating chamber in approximately the same thickness of layer, the portion of the electrodes which passes through the insulating material is encased in a tube of refractory material which penetrates the outer shell and is fitted with its lower end in the top of the heating chamber. In order to allow for the expansion of the heating chamber this protective sleeve is composed of two slidably inter-fitting and tightly jointed parts, namely a short length of tube 13 made from heat-insulating material which is secured to the outer shell and a carbon tube 14 mounted on the top of the heating chamber and slidable in the tube 13. The packing of the joint can be effected for example by means of asbestos cord 15 wrapped around the upper end of the tube 14. The tubular member 13 carries the water-cooled stuffing-box 16 of the electrode and is provided with an inlet pipe 17 through which an indifferent or reducing gas, for example hydrogen, may be introduced to flush the annular gap between the electrode and the top of the furnace, so that the gaseous and vaporous products of reaction evolved in the furnace are prevented from entering this gap.

The furnace is charged from below through a flared passage 18 the charge being fed by a conveyor screw 19 into a feed pipe 20 from which it is pushed into the passage 18 by means of a piston 21 which is actuated by a crank gear 22. The gaseous and vaporous products of reaction pass through an opening 23 in the side wall of the heating chamber into a condenser 24.

In the case of furnaces of small dimensions the top of the heating chamber may be made of a plate, although in this case also struts must be provided, so that any lateral compressive forces or thrusts occurring if the plate should crack during the furnace run are transmitted to the outer shell.

According to the provisions of the patent statutes I have explained the principle and construction of my invention and have illustrated and described what I now consider to represent its best embodiments. However, I desire to have it understood that within the scope of the appended claim the invention may be practised otherwise than as specifically illustrated and described.

I claim:

Electric furnace comprising a heating chamber made from refractory material resting on a support for taking up the weight of the chamber, an outer casing surrounding said heating chamber so as to form an intervening space between said casing and said chamber which space is filled up with heat-insulating material, individual struts being provided traversing said space and filling material to carry the thrust from the heating chamber to the outer casing, and electrodes passing through the top of the outer casing into the heating chamber through a sleeve consisting of two interfitting tubes of refractory material, the outer tube being secured to the outer casing and the inner tube inserted in the head of the heating chamber.

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