E. F. COLLINS.

ELECTRIC FURNACE.

APPLICATION FILED APR. 17, 1914.

1,156,668.

Patented Oct. 12, 1915.

2 SHEETS—SHEET 1.

Fig. 1.

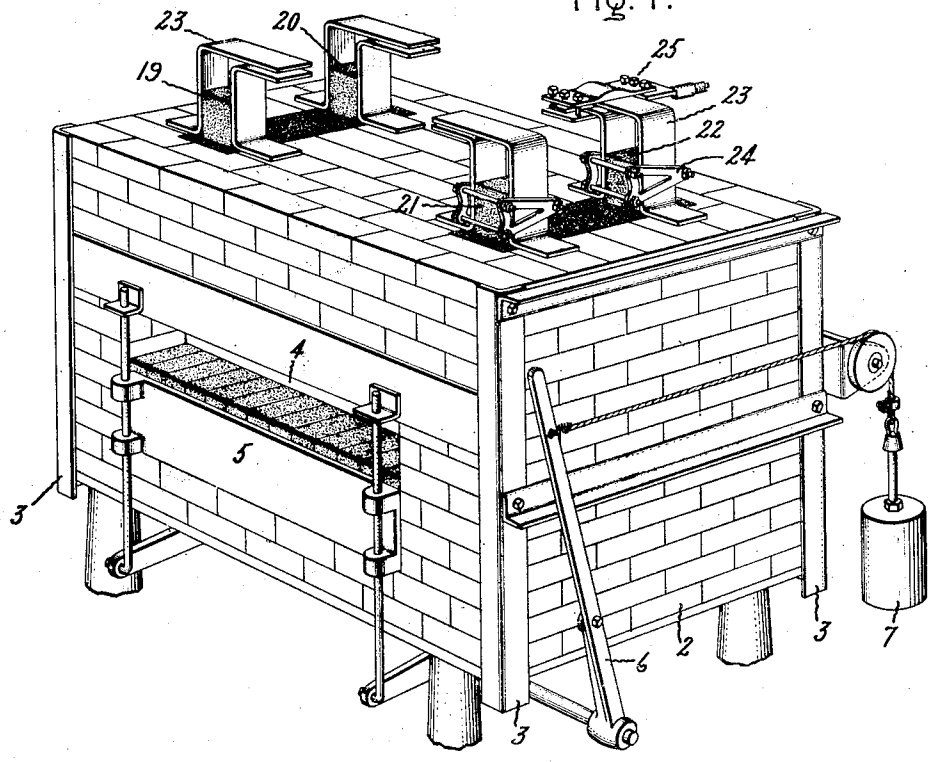
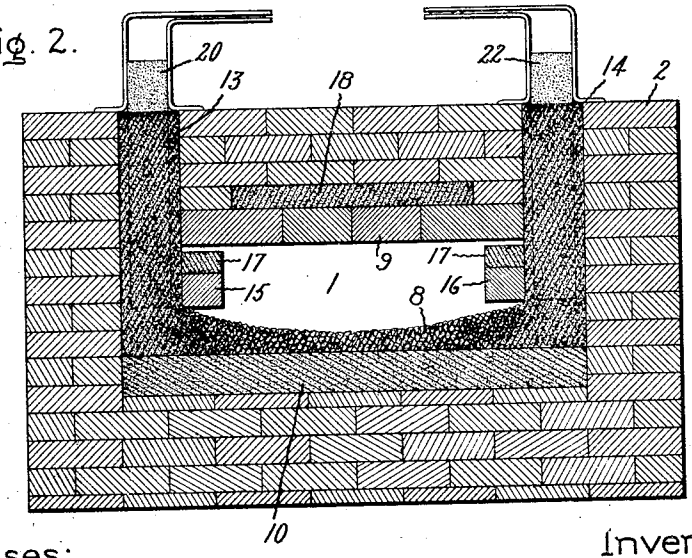


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

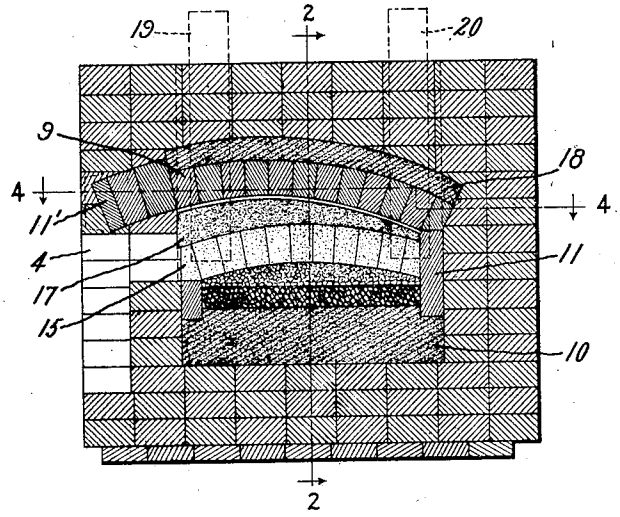
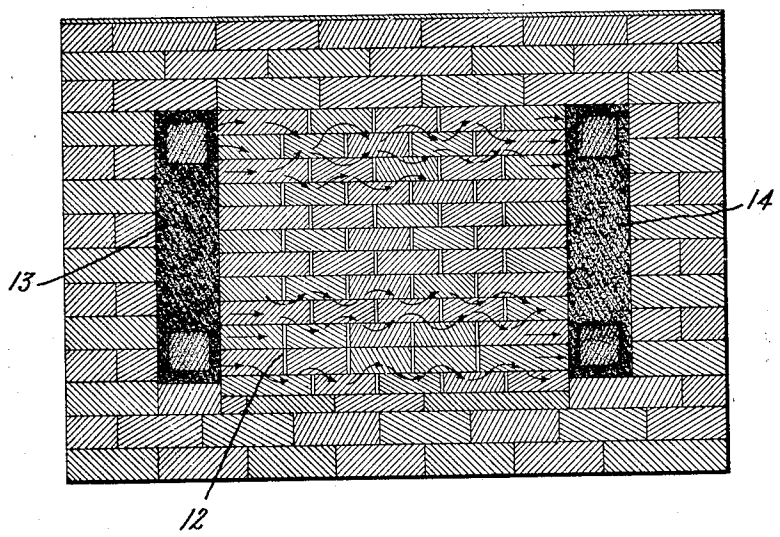


Fig. 4.



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UNITED STATES PATENT OFFICE.

EDGAR F. COLLINS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC FURNACE.

1,156,668. Specification of Letters Patent. Patented Oct. 12, 1915.

Application filed April 17, 1914. Serial No. 832,489.

To all whom it may concern:

Be it known that I, EDGAR F. COLLINS, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

The present invention relates to electric furnaces of the resistance type and its object is to provide a rugged, reliable furnace suitable for continuous operation for industrial purposes, such, for example, as the heating of metallic articles preliminary to forging or tempering.

Furnaces of this character require a properly distributed and steadily maintained temperature in the heating zone and considerable heat capacity so that the furnace temperature will not be unduly lowered by insertion of cold objects.

Resistance furnaces provided with a heating space containing a bed of resistance material serving as a heating means are known and it has also been suggested to construct an arch spanning the heating space as the resistor, but in each of these cases heat has been imparted to the articles to be heated from one direction only. Such a construction while operative for some purposes is not suited for a furnace into which articles to be heated are being continually inserted and withdrawn, as the cooling effect of the top or bottom of the furnace lengthens the time necessary for the articles to attain the desired temperature and produces unequal heating.

My invention provides a furnace in which an extended zone may be uniformly maintained at a required high temperature by radiation both from below and above, and the temperature distribution or gradient may be controlled in accordance with the requirements of the service. The electrical contact to the two heaters is made through the medium of finely divided conducting material contained in upwardly extending channels. The various novel features of my invention are pointed out with greater particularity in the appended claims.

In the accompanying drawings Figure 1 is a general perspective view of a furnace embodying my invention; Fig. 2 is a longitudinal section taken through line 2—2 of Fig. 3 which is a cross-section at right angles thereto; and Fig. 4 is a section taken on lines 4—4 through the arch above the heating space.

As shown particularly in Figs. 1 and 2, the main heating space 1 of the furnace is surrounded by fire-brick walls 2 supported by structural steel frame work 3. Access to the heat zone is afforded by opening 4 which may be closed by a door 5 operated by means of a gear including the lever 6 and counter-weight 7.

The heat is in part generated in a granular resistor 8 and in part in a conductive arch 9 located above the granular resistor. The granular resistor preferably consists of lumps of coke or similar carbonaceous material, the lumps being about $\frac{1}{4}$ to $\frac{3}{4}$ inch in diameter. This coke heater is supported by a hearth or bed 10 of suitable refractory material. For example, it may consist of material known as carborundum fire sand which I understand is a somewhat variable compound of silicon, carbon and oxygen and is obtained from the carborundum furnace. This material is converted when heated to a compact crystalline mass which carries some current and also acts as a heat distributer. It may be tamped in place using any suitable binder, such as water glass. The arch 9 immediately over the bed consists preferably of carborundum brick made by molding carborundum with a sticky carbonaceous binder. The arch 9 is supported by the fire brick side walls of the furnace as shown in Figs. 3 and 4 by fire bricks 11 and 11′. In order to increase the resistance of the arch and also to predetermine the amount of heat generated therein, the carborundum brick may be laid so as to cause the current to pass in a sinuous path from one row to another as shown in Fig. 4. For this purpose no mortar is placed between the abutting ends of the brick while the sides of the adjacent rows are joined by a suitable cement or mortar such as finely divided carborundum and a binder. The size of the brick is adjusted so that adjacent bricks will overlap, or if a still higher resistance is required as, for example, for the part of the heating chamber farthest removed from the door which is least subjected to cooling, two rows of brick may be laid with their ends adjacent but not cemented as shown at 12, Fig. 4, so as to still more increase the resistance. If desired the side walls may also be constituted of car-

borundum or other highly refractory material having a resistance of the same order of magnitude as carbon.

Contact is made both to the granular resistor and to the conducting arch by upwardly extending columns 13, 14, of conducting material more finely divided and, therefore, of greater electrical conductivity than the granular resistor. I prefer to use for this purpose carbonaceous material, for example, coke, which has been powdered fine enough to pass through a screen having about 80 meshes to the square inch. These columns of carbonaceous material are supported by the walls of the furnace and by arches 15, 16 at the ends of the furnaces, best shown in Fig. 2. Above these arches is a layer of refractory material, as shown at 17, Fig. 3, which may be similar in character to the hearth 10, namely, carborundum sand compacted with a binder of water glass. A similar layer of carborundum fire sand is placed above the heating arch 9 as shown at 18, Fig. 3, for the purpose of conserving the heat generated in the arch. Current is introduced by carbon electrodes 19, 20, 21 and 22, which are embedded in the columns of powdered coke. Some of the advantages of this arrangement for introducing the heating current are as follows: The current being introduced from above causes a maximum heating effect to be obtained in the upper layers of the granular resistor thus protecting the bed-plate and causing the maximum heat to be obtained where it is needed, namely, nearest the work to be heated. The electrodes being laterally movable in the columns of conducting material, the distribution of the temperature may be regulated by moving them toward or away from the door through which the work is introduced. The vertical arrangement of the electrodes in the columns of powdered conducting material also affords such a good electrical contact that projecting ends of the electrodes themselves are not heated sufficiently to oxidize and will last indefinitely. The powdered coke or the like is maintained tightly packed around the electrodes by gravity. This powdered material must be replenished from time to time as it is gradually fed down into the heating zone of the furnace where it mixes to some extent with the coarsely granular material near the ends as indicated in the drawing. My experience has shown that when material as coarsely granular as that used in the heating resistor is packed around the electrodes that they operate at such high temperature as to render their life very short. Electrical contact is made to the projecting ends of the electrodes by copper plates 23 pressed against the sides of the electrodes by clamps 24. A suitable form of electrical terminal is indicated at 25.

I have found in a furnace as above constructed in which the heating arch is proportioned to carry about 30 to 40% of the total energy that temperatures up to about 1500° to 1600° C. can be steadily and uniformly maintained throughout the heating zone. Ordinarily when the furnace is used for forging copper the temperature may be only about 900° C. and for forging steel about 1200° C. and I have found by a long continued series of experiments in practical experience with the furnace that these temperatures can be accurately maintained with only such care as may be given the furnace by the workman engaged in the forge-shop.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. An electric furnace comprising walls of refractory materials inclosing a heating chamber, a heater of refractory material on the floor of said chamber, the upper wall of said chamber consisting of difficultly oxidizable refractory material having a higher resistance when cold than said floor heater and having a negative temperature resistance coefficient, constituting a heater over said chamber, and common means for passing electrical energy through both said heaters.

2. In an electric furnace, the combination of a heater of granular conductive material, vertical channels at each end of said heater, upwardly extending columns of granular conductive material therein contacting with said heater and comprising particles in a finer state of sub-division than said heater and electrodes embedded in said columns.

3. In an electric furnace, the combination of a refractory frame containing substantially vertical channels, a refractory supporting bed located below said channels, a coarsely granular carbonaceous material on said bed, said material constituting a heater, electrodes in said channels, and carbonaceous material in said channels more finely subdivided than said heater material surrounding said electrodes and electrically connecting each of said electrodes respectively to the heater.

4. An electric furnace comprising a refractory hearth, a refractory conductive granular material on said hearth, refractory walls inclosing the hearth, the upper wall being in part conducting and containing upwardly extending channels, a refractory conductive material in said channels more finely comminuted than the material on said hearth and electrically contacting therewith and electrodes transversely movable in said channels embedded in said finely comminuted material.

5. An electric furnace comprising a refractory hearth, lump shaped carbonaceous material on said hearth, walls of refractory compound containing silicon and carbon inclosing a space above said hearth the upper

wall being in part conducting and containing upwardly-extending channels, finely comminuted carbonaceous material passing through a screen having about 80 meshes to the square inch in said channels contacting with the material on said hearth and a plurality of electrodes embedded in the material in said channels.

6. In an electric furnace, a heater comprising rows of shaped pieces of resistance material, the sides of adjacent pieces being arranged to overlap each other, and a conducting cement between the sides of said pieces only, the ends being separated by a space whereby the current path through said heater includes resistance pieces of more than one row.

In witness whereof, I have hereunto set my hand this 16th day of April, 1914.

EDGAR F. COLLINS.

Witnesses:
E. J. VAN WIE,
HELEN ORFORD.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."