June 10, 1930. E. L. SMALLEY 1,762,701

HEATING ELEMENT MOUNTING MEANS

Filed June 22, 1929 2 Sheets-Sheet 1

Fig. 1

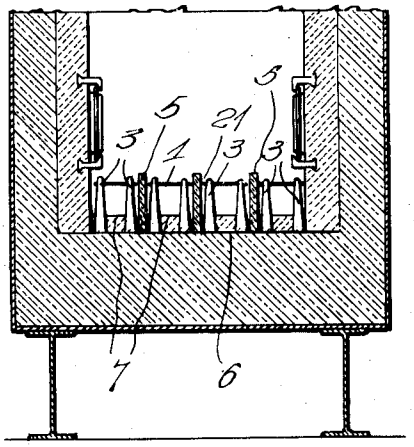


Fig. 2

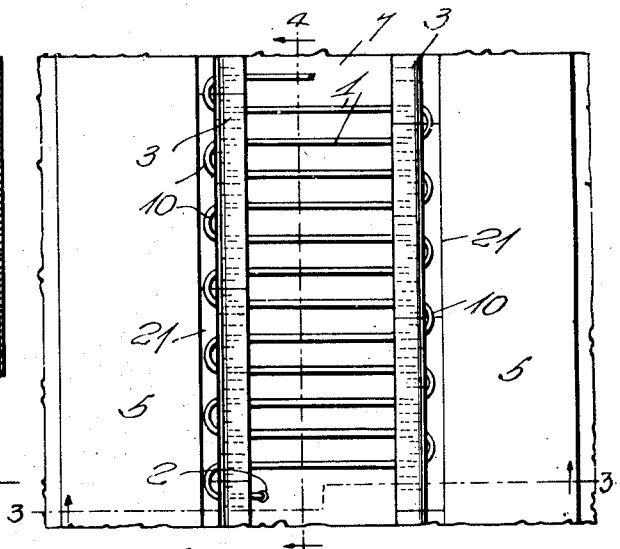


Fig. 3

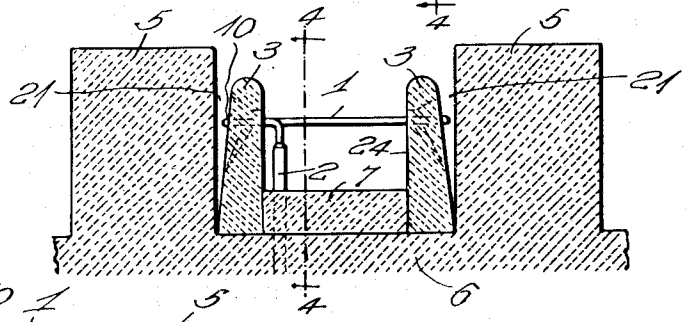


Fig. 4

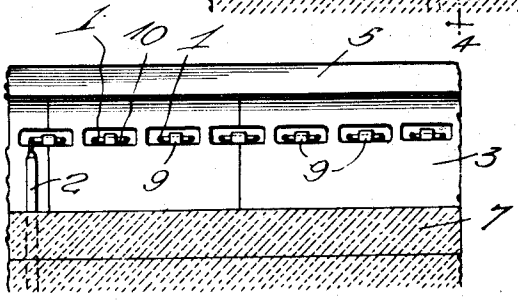
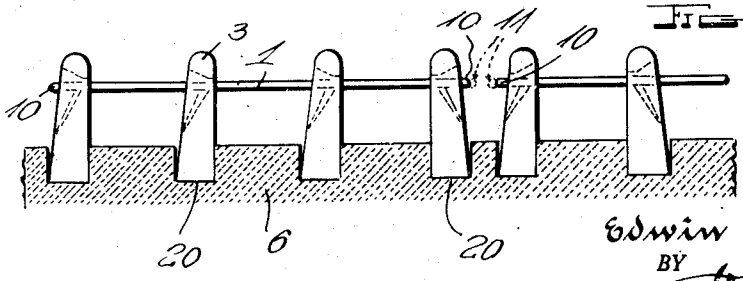


Fig. 5



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HEATING ELEMENT MOUNTING MEANS

Filed June 22, 1929 2 Sheets-Sheet 2

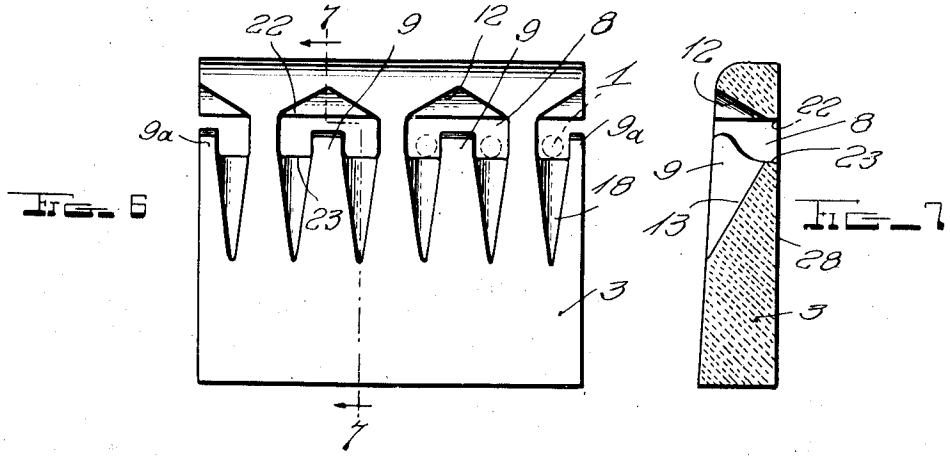

Fig. 6 Fig. 7

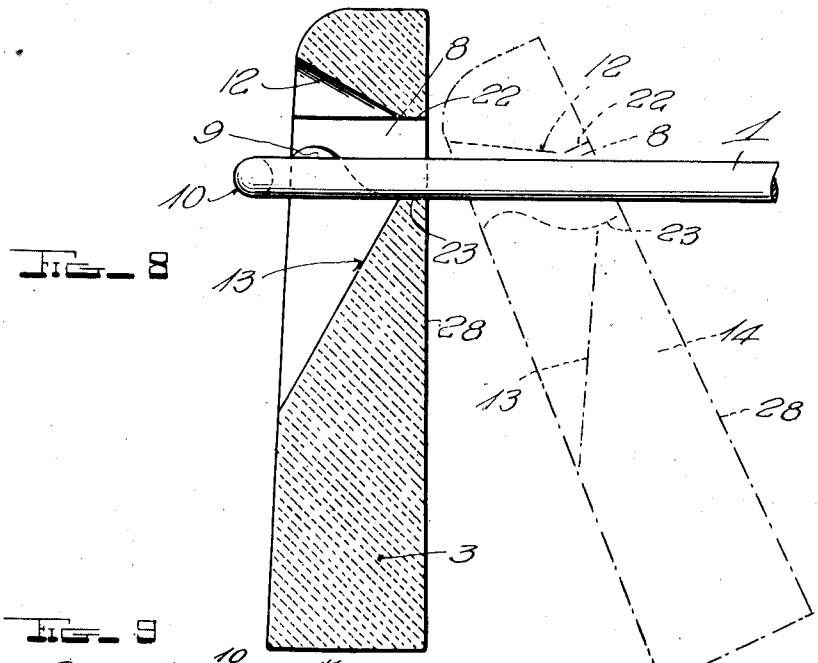

Fig. 8

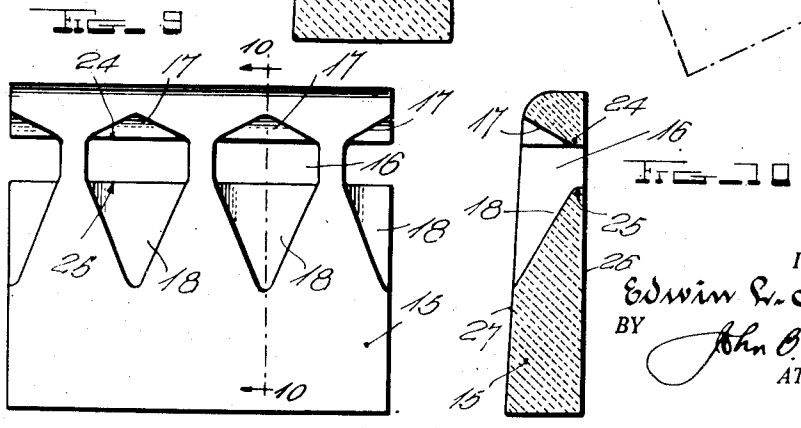

Fig. 9 Fig. 10

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Patented June 10, 1930 1,762,701

UNITED STATES PATENT OFFICE

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HEATING-ELEMENT-MOUNTING MEANS

Application filed June 22, 1929. Serial No. 373,013.

My invention relates broadly to electric furnaces and more particularly to a construction of mounting for the electrical heating element in the bottom or hearths of furnaces.

One of the objects of my invention is to provide a construction of heating element mounting means for electric furnaces, wherein the resistor may be positively supported from a multiplicity of positions and maintained in a predetermined position both with respect to the lateral and vertical movement of the resistor.

Another object of my invention is to provide a construction of refractory for the support of a heating element, wherein the refractory is provided with means for maintaining the resistor in a predetermined alignment and preventing excess upward or lateral movement while permitting normal expansion of the heating element or resistor under operating conditions.

Still another object of my invention is to provide for the construction of a refractory for mounting heating elements in an electric furnace where the refractory is formed to allow the free release of heat upon that portion of the element covered by the refractory while the accumulation of scale or other foreign matter immediately adjacent the resistor at the points of support in the refractory is substantially eliminated.

A further object of my invention is to provide a construction of refractory for the support of a resistor in an electric furnace having means for interlocking portions of the heating element in an electric furnace and maintaining the relative position of the heating element with respect to the work.

Other and further objects of my invention reside in the provision of a construction of ceramic refractories for supporting a preformed heating coil in an electric furnace as set forth more particularly in the specification hereinafter following by reference to the accompanying drawings in which:

Figure 1 illustrates the ceramic refractories of my invention positioned in an electric furnace; Fig. 2 is a plan view of the refractory of my invention assembled in an electric furnace; Fig. 3 is a cross-sectional view taken through the refractories and a portion of the furnace on line 3—3 of Fig. 2; Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 3 and showing the ceramic refractories of my invention in side elevation; Fig. 5 is an end elevation of the bottom of an electric furnace and showing the ceramic refractories of my invention assembled thereon for the support of a heating element in a manner modified from the construction illustrated in Figs. 1 to 4; Fig. 6 is an elevational view of one form of ceramic refractory embodying my invention; Fig. 7 is a cross-sectional view taken on line 7—7 through the ceramic refractory shown in Fig. 6; Fig. 8 is an enlarged cross-sectional view of the ceramic refractory shown in Figs. 6 and 7 and illustrates in dotted lines the method of assembling a heating element for the support of such element in an electric furnace; and Figs. 9 and 10 illustrate in side elevation and cross-section a modified form of refractory embodying my invention, Fig. 10 being taken on line 10—10 of Fig. 9.

In the construction of ceramic refractory of my invention, I provide means whereby the strands of the heating element, such as a rod or ribbons, may be maintained in predetermined alignment with respect to the work on the furnace hearth and yet have sufficient freedom for expansion and contraction under operating conditions. The ceramic refractory supports the heating element in such manner that the heat may be freely released therefrom and not confined by any portion of the supporting means. The refractory is so shaped that accumulation of scale adjacent the point of support of the heating element is prevented. By arranging a multiplicity of ceramic refractories constructed in

accordance with my invention in the bottom of an electric furnace the heating element is maintained out of contact with adjacent structures and heat transferred at maximum efficiency to the work under heat treatment in the furnace. The coil is free to expand and contract although the turns cannot shift laterally and shunt one with respect to the other by reason of interlocking means at the return bends along the opposite edges of the coil.

The construction of ceramic refractory will be more clearly understood by reference to the drawings wherein the heating element is shown as comprising the turns 1 in the form of coils having straight portions disposed in a substantially horizontal plane connected at their ends by return bends 10 and lodged in apertures 8 of the ceramic refractory 3. The ceramic refractories are disposed at suitable distances from each other as shown in Fig. 1 to support the turns of the coil substantially at right angles to the vertical plane of the refractories and where the conductor is long, a multiplicity of refractories may be disposed along the conductor as represented in Fig. 5. Each coil has two terminals one of which has been designated at 2 which may extend through the side walls of the furnace or downward through the bottom of the furnace as indicated in Figs. 2, 3 and 4. The refractories 3 are disposed between the piers 5 and are positively spaced apart by a ledge 7 extending in a trough or groove between the piers 5. The piers 5 provide means for supporting the charge or work above the heating element and may be substantially capped with metal to permit movement of the work over the piers in a manner where the piers will resist abrasive wear of the charge.

The refractory of my invention is applicable to various forms of furnaces and the piers 5 and ledges 7 may be a part of the base portion of the furnace indicated at 6 and all constructed of any suitable material such as fire-brick. Instead of supporting the refractories on the base of the furnace extending in a substantially horizontal plane the refractories may fit into grooves formed in the furnace base. In the refractory 3 I provide apertures 8 and centrally of each aperture and adjacent one side thereof there is an upwardly extending lug or boss 9 which when assembled with the coil 1 is lodged between two adjacent strands of the heating element 1 and adjacent the return bends 10. In this manner the turns are positively spaced and are prevented from moving out of alignment, although sufficient movement is permitted to allow freedom of contraction and expansion under operating conditions.

In types of furnaces where a heating element of substantial length is required the pedestal refractories 3 may be mounted in grooves 20 at the bottom of the furnace and provide means of support for the heating element at a plurality of points along the length of the element. In this type of furnace the charge is generally supported above the heating element 1 as on rotating rollers, which convey the work through the furnace out of contact with the furnace bottom.

In Fig. 5 I have indicated the fact that the heating element 1 is free to expand as shown in dotted outline 11, but the heating element cannot shift laterally because of the lugs 9 interlocking with return bends 10 along one edge of the coil, and by similar interlocking means in the return bends at the opposite edge of the coil. In this maner I do not depend on any adjacent part of the furnace walls to keep the heating coil in its original alignment. This has the added advantage of permitting an increased amount of heat releasing coil surface in a given hearth space of the furnace bottom.

The construction of the refractory 3 is shown more clearly in Figs. 5 and 6, wherein the return bend of the heating element 1 is maintained in position by the lug 9 which is positioned adjacent one side of the refractory 3. In the abutting ends of the refractories provision is made whereby lugs 9 are made up of the portions 9^a on each end of the refractories, so that abutment of the refractories end to end provides a continuous succession of upstanding lugs between which the return bends are anchored.

The refractory 3 has a beveled face 12 disposed at an acute angle with respect to the axis of the aperture 8 and extending upwardly to permit the free release of heat from that portion of the coil 1 which may be covered by the refractory. The refractory has a beveled face 13 extending at an acute angle to the axis of aperture 8 and extending downwardly in the opposite direction to the deflection of beveled face 12 to prevent any scale or foreign particles from becoming lodged either on the coil 1 or the coil supporting surface of the refractory.

It will be observed that the resistor is supported in a manner in which the turns are substantially spaced and insulated by air dielectric. The assembly of the heater element is such that the straight strands of coil 1 connected by return bends permit the free passage of foreign particles, such as scale, from the charge, which particles may readily fall between the turns to the surface of ledge 7 therebeneath. Thereafter such foreign particles and scale may be readily dislodged as by compressed air and the débris thus removed from time to time.

Fig. 8 shows a return bend 10 of coil 1 lodged in refractory 3 and retained in operative position by lug 9, it being understood that the return bends at the opposite end of the straight strands of coil 1 are similarly retained. By dotted outline 14 I show the method of inclining refractory 3 so that when

it is so inclined it may readily be placed on the adjacent strands at the return bend end of the strands without interference of lug 9. The coil 1, return bend 10 and the refractory 3 are shown in operative position. It may thus be noted that the coil and refractory are self-interlocking when in an operative position.

In Figs. 9 and 10 I have shown a modified construction of the refractory shown at 15 which may be employed in the grooves or troughs between the piers 5 of the furnace construction illustrated in Figs. 1, 2 and 3 wherein the side walls 21 of the piers 5 serve to retain the coils 1 in the refractories in predetermined alignment. In this construction it is unnecessary to provide the lugs 9, but the apertures 16 are provided at one side with the downwardly extending face 18 and the upwardly extending face 17 where these faces are disposed at opposite acute angles with respect to the axes of the apertures 16. When the refractories are assembled between the piers 5 the heating element 1 is prevented from dislodgment by means of the abutment with the side walls 21 when either construction of refractory described herein is employed.

In some modified forms of the invention, I provide pockets in each face of the refractory and bevel the surfaces adjacent the aperture to edge positions lying intermediate the side faces of the refractory.

It will be observed that in the construction of refractory shown in Figs. 6, 7 and 8 the aperture 8 has substantially parallel extending side walls 22 at the top thereof and 23 at the bottom thereof, adjacent the face 28 of the refractory opposite the face which is provided with the beveled portions 12 and 13. The walls of the aperture extend parallel for a distance less than one-half of the thickness of the refractory member and thereafter connect with the opposite face of the refractory by means of the beveled or tapered walls which form sides of pockets which are formed in one face of the refractory.

In Figs. 9 and 10 the aperture 16 has an upper side wall 24 and a lower side wall 25 which extend parallel for a substantial distance on the face 26 of the refractory opposite the face 27 which is provided with beveled portions 17 and 18. In the two constructions the wall portion 23 and wall portion 25 provide the sole support for the conductor 1 enabling the ready release of heat from the heating element and eliminating the collection of scale around the support.

The constructions of refractories described herein have been found to be extremely practical in manufacture and successful in use, and while preferred embodiments of my invention have been described, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

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

1. In an electric furnace a preformed heating element, a support for said heating element, said support comprising a pedestal apertured for the passage of said preformed heating element therethrough and means carried by said support and positioned centrally with respect to the apertured portion thereof for maintaining said preformed heating element in a predetermined position with respect thereto.

2. In an electric furnace a preformed heating element, a support of ceramic refractory material, said support being apertured in a plurality of positions in a substantially horizontal plane for receiving the turns of said preformed heating element, each of the apertured portions of said support having means extending centrally therein for maintaining the position of said preformed heating element with respect to said support.

3. In an electric furnace having oppositely disposed wall portions, a combination of a preformed heating coil, a perforated supporting refractory positioned adjacent each of said wall portions, and means operative with the adjacent wall portions of the furnace for retaining the coils in operative position.

4. In an electric furnace, the combination of a preformed heating coil, and a perforated supporting ceramic refractory, and means carried by said refractory in the perforated portion thereof for the self-interlocking of the coils and refractories when in an operative position.

5. In an electric furnace, a heating coil, a multiplicity of refractories for supporting the turns of said heating coil, each of said refractories being apertured in a plurality of positions disposed in a substantially horizontal plane for the passage of the turns of said heating coil therethrough, the side of said refractory adjacent the apertured portions thereof being substantially beveled above and beneath the turns of said heating coil.

6. In an electric furnace, a heating element, a ceramic refractory member for supporting the turns of the heating element, said member comprising a vertically extending support apertured adjacent the upper extremity thereof for the passage of the turns of the heating element therethrough, said support having edge portions adjacent one face of said refractory for providing seats for the turns of said heating element, the opposite face of said refractory being beveled and terminating in said seats for the free radiation of heat from said heating element

and the elimination of accumulation of foreign matter adjacent the passage of said heating element through said refractory.

7. In an electric furnace, a heating element, a vertically extending refractory apertured adjacent the periphery for the passage of the turns of said heating element therethrough, one face of said refractory being beveled above and beneath the apertured portion thereof with the lower extremity of said apertured portions formed by an edge having a width substantially less than one-half the thickness of said refractory.

8. In an electric furnace, a heating element, a ceramic refactory member for supporting said heating element, said member being apertured adjacent the upper extremity thereof for the passage of the heating element therethrough, the lower extremities of the apertured portions of said refractory being formed by an edge having one side coincident with the plane of one face of said refractory member and the other side tapering to a position coincident with the plane of the opposite face of said refractory member.

9. In an electric furnace, a heating element, a supporting member constituted by ceramic refractory material for maintaining the turns of said heating element in position in said furnace, said member being apertured along the upper extremity thereof for the passage of the turns of said heating element therethrough, pockets formed in each face of said member adjacent the apertured portions thereof for permitting the radiation of heat from said heating element and preventing the accumulation of scale or foreign matter adjacent thereto.

10. In an electric furnace, a heating element, a ceramic refractory member supporting the turns of said heating element, said member being apertured for the passage of said heating element therethrough, the apertured portions of said element having walls extending substantially parallel for a distance from one face of said member substantially less than one-half the thickness of said member, said walls being connected to the opposite face of said member by tapered portions for permitting the free radiation of heat from said heating element and preventing the accumulation of scale and foreign matter adjacent the passage of said heating element through said member.

11. In an electric furnace, a heating element, a ceramic refractory member apertured adjacent the upper extremity thereof for the passage of the turns of said heating element therethrough, pockets formed in one face of said member adjacent the passage of the heating element through said member, said pockets terminating in edge supports for said heating element at the lower extremities of the apertured portions.

12. In an electric furnace, a heating element, a ceramic refractory member supporting the turns of said heating element, said member being apertured adjacent the upper extremity thereof for the passage of the turns of said heating element therethrough, pockets formed in one face of said member and terminating in the apertured portions thereof, and a lug disposed centrally of said pockets and dividing the apertured portions into two sections for predetermining the spacial relation of the turns of said heating element extending through the apertures in said member.

13. In an electric furnace, a heating element, a ceramic refractory member arranged to support the turns of said heating element, said member being apertured adjacent the upper extremity thereof with the walls of the apertured portion extending substantially parallel and normal to one face of said member, said walls being interconnected with the opposite face of said member by tapered portions extending substantially at acute angles with respect to the axis of the apertured portion of said member.

14. In an electric furnace, a heating element, a ceramic refractory member arranged to support the turns of said heating element, said member being apertured adjacent the upper extremity thereof for the passage of the turns of the heating element therethrough, the apertured portions thereof having walls extending substantially normal with respect to one face of said member throughout one portion of their length and tapered to the opposite face of said member throughout the remainder of their length, the lower walls providing supports for the turns of said heating element.

15. In an electric furnace, a heating element, a ceramic refractory member arranged to support the turns of said heating element, said member being apertured adjacent the upper extremity thereof for the passage of the turns of said heating element therethrough, the apertured portions thereof having walls extending substantially normal with respect to one face of said member through one portion of their length and tapered to the opposite face of said member throughout the remainder of their length, the lower walls providing supports for the turns of said heating element, and means extending from the last mentioned face of said member, centrally of the apertured portion thereof for maintaining the turns of said heating element in predetermined position with respect to said ceramic refractory member.

16. In an electric furnace, a heating element, a ceramic refractory member arranged to support the turns of said heating element, said member being apertured adjacent the upper extremity thereof for the passage of the turns of the heating element there-

through, the apertured portions thereof having walls extending substantially normal with respect to one face of said member throughout one portion of their length and tapered to the opposite face of said member throughout the remainder of their length, the lower walls providing supports for the turns of said heating element, and a lug projecting upwardly into the apertured portion of said member from the last mentioned face thereof and providing spacing means for positively aligning said heating element with respect to said member.

In testimony whereof I affix my signature.

EDWIN L. SMALLEY.