

May 8, 1956

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2,744,946

ELECTRIC FURNACE AND HEATING UNIT THEREFOR

Filed Nov. 25, 1953

2 Sheets-Sheet 1

Fig. 1.

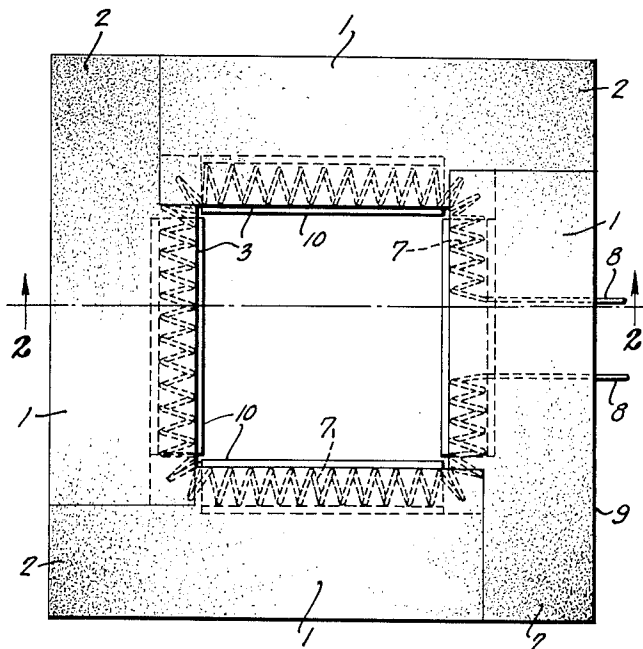


Fig. 4.

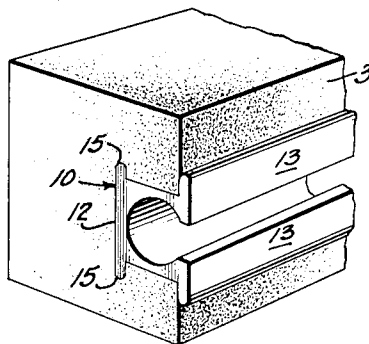


Fig. 5.

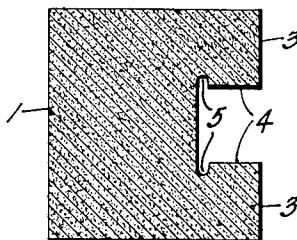


Fig. 2.

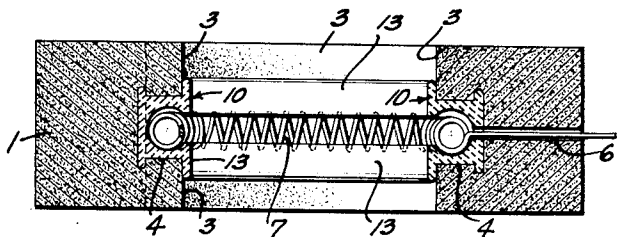


Fig. 8.

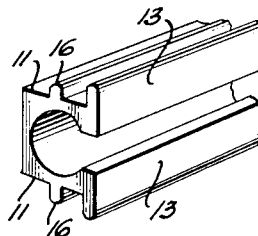
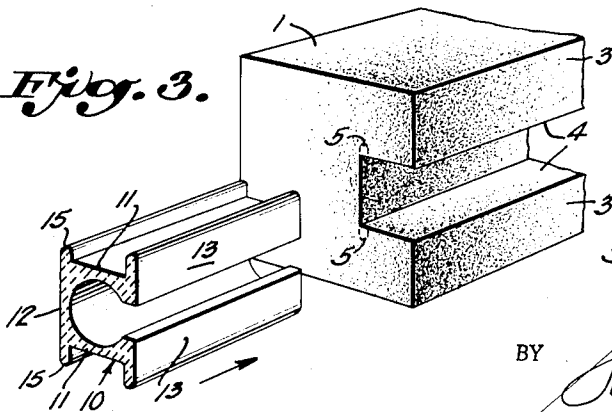


Fig. 3.



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Fig. 6.

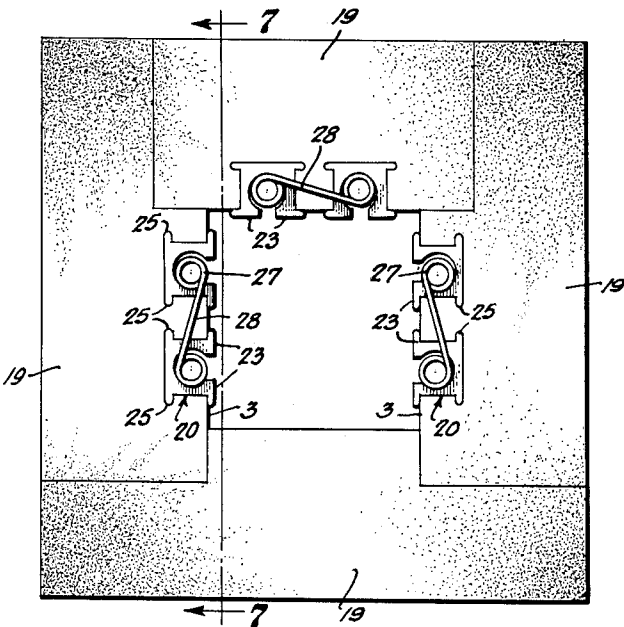


Fig. 7.

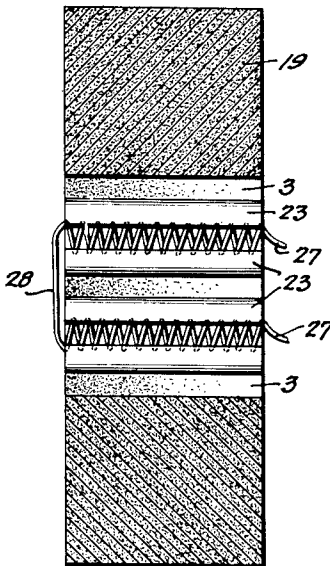


Fig. 9.

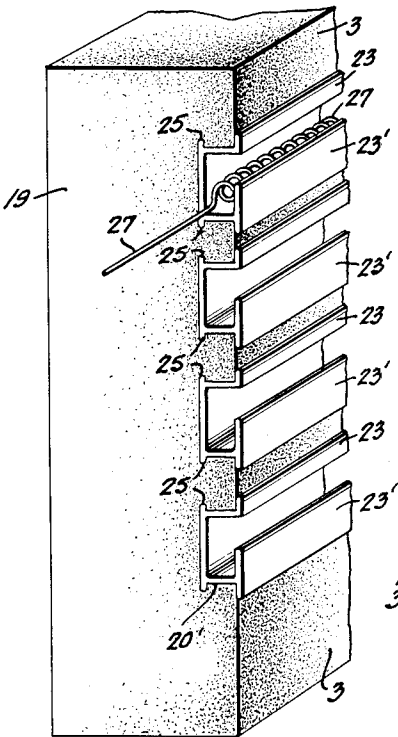


Fig. 10.

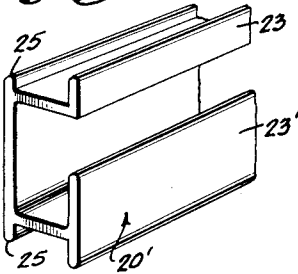


Fig. 11.

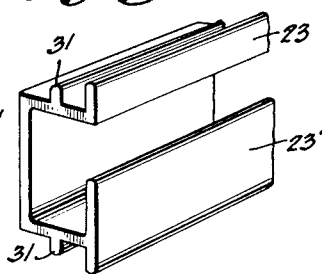
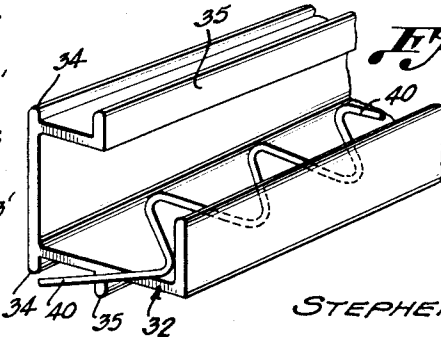


Fig. 12.



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ELECTRIC FURNACE AND HEATING UNIT THEREFOR

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9 Claims. (Cl. 13—22)

This invention relates to heating units for high temperature electric furnaces.

It is the object of the present invention to provide heating units for high temperature electric furnaces which are rugged and economical in construction and which are serviceable for long periods of time, after which time they may be replaced easily with new units.

It is another object of the invention to provide heating units for electric furnaces which are self-sustaining and which units require no extraneous mounting attachments of metal or ceramic material.

It is a further object of the present invention to provide grooves in the walls of electric furnaces formed of soft modern insulating firebrick in which may be mounted hard refractory supporting channels for retaining electric wire elements which are adapted when heated to generate an intense degree of radiant heat, the direction of radiation of which may be controlled by the variation of the shapes of the wire-retaining channels.

It is a further object of the invention to provide an electric furnace which may be built up of sectional insulating firebricks having a wide range of adaptability in its physical as well as electrical characteristics in order to provide a universal furnace which may be used for different types of work requiring different heat treatments.

The invention proceeds upon the principle of constructing an electric furnace of soft modern insulating firebrick in which the sandstone or other siliceous material is easily friable in order to have formed therein with a high degree of facility, interlocking grooves, for retaining in interlocking engagement therewith channels of hard refractory material having external seating ribs thereon, which ribs may be easily seated in the grooves on the interior walls of the firebrick so that the channels serve as repositories for heating elements which produce radiant heat on the interior of the furnace. The ribs of the refractory channels may be routed directly into the grooves which are self-forming, by the pressing of the channels into the refractory brick in conjunction with a slight to-and-fro transverse movement, as a result of the highly friable nature of the firebrick, or the grooves may be prepared in advance by a milling or routing tool which provides undercut seats for the refractory channels.

The firebrick may be arranged in sets, one above the other, to form a top loading style of furnace, or the sets of firebrick may be arranged on the side of each other along a horizontal line to form a front loading style of furnace. The firebricks are interfitted and retained in a composite assembly by an enclosing frame the size of which may be varied in dependence upon the heating capacity sought to be attained, which is controlled by the length and number of heating-element channels and the spacing therebetween.

The provision of heating elements of electrical resistance wire or ribbon in spiral, sinuous or other tortuous outline, which are disposed within the channels, make possible the leading out of the connections from the

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heating elements through a common wall, whereat the terminals may be interconnected in series or parallel circuits or combinations thereof to vary the electrical resistance of the heating elements and thereby the temperature attainable with the furnace.

The channels, while having the common feature of ribs projecting from the walls thereof which are seated within interlocking grooves on the interior of the firebrick, may have varying flange formations on the exterior thereof to vary the direction and character of the radiant heat emanating from the channels.

Other objects and purposes will appear from the detailed description of the invention following hereinafter, taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a plan view of a furnace section forming a component part of a top loading style of electric furnace;

Fig. 2 is a vertical sectional view along line 2—2 of Fig. 1;

Fig. 3 is a perspective view showing the self-seating arrangement for interfitting a hard refractory channel within the internal wall of the soft insulating firebrick;

Fig. 4 is a perspective view showing the wall of insulating firebrick with the hard refractory channel in interlocking engagement therewith in condition for receiving a heating unit within the latter;

Fig. 5 is a vertical sectional view of the firebrick showing the interlocking grooves within the insulating firebrick prepared in advance for the reception therein of the ribs of the refractory channel;

Fig. 6 is a front elevation of a different embodiment of the invention having a plurality of interfitted insulating firebrick and forming a unit for a front loading style of electric furnace;

Fig. 7 is a vertical sectional view along line 7—7 of Fig. 6;

Fig. 8 is a perspective view of a different embodiment of refractory channel characterized by retaining ribs disposed at an intermediate point of the channel walls rather than at the extreme ends thereof;

Fig. 9 is a perspective view of a furnace wall showing a plurality of refractory channels seated within a vertical firebrick wall of an electric furnace;

Fig. 10 is an enlarged perspective view of the channel specifically shown in Fig. 9 and characterized by a retaining flange on the exterior thereof for securely retaining the heating element within the channel and for controlling the radiation effects therefrom;

Fig. 11 is a perspective view of another modification of the hard refractory channel shown in Fig. 10 in which the interlocking ribs are formed at intermediate points of the external walls of the refractory channel; and

Fig. 12 is a perspective view of still another embodiment of hard refractory channel adapted to accommodate a heating element of sinuous configuration.

In Fig. 1 of the drawings is shown one constructional form of an electric furnace or kiln incorporating the features of the present invention. This unit may form a layer of a top loading style of furnace and is constituted by four interfitted firebricks of soft modern insulating material having a porous texture and which is readily friable by scratching the surface thereof with a sharp instrument or object. The individual bricks are each formed of an enlarged portion 1 and a rabbetted end 2, against the latter of which fits the main enlarged portion of the adjacent brick. The inner walls 3 of the bricks are provided with longitudinal recesses 4 for the purpose of accommodating therein channels 10 of hard refractory material in which are seated the electrical heating elements 7 of coils of conductive material arranged in spiral, sinuous or other tortuous formation.

In Fig. 3 is shown one mode of seating the channels

10 within the recesses 4, this being done by working in the end of the channel, which is provided with ribs 15 at the ends of the top and bottom walls 11 thereof into the end of the soft firebrick by means of longitudinal pressing motion in conjunction with slight to-and-fro transverse motions, whereby the ribs 15 effectuate a self-forming seat therefor by the production of oppositely disposed grooves 5 at the base of the recess 4. The ribs 15 constitute prolongations or extensions of the base 12 of the channel, which are seated against the base of the recess 4 while the opposite end of the channel is formed with flanges 13 on the opposite sides of an opening therebetween to permit the radiant effects of the heating element to pass to the interior of the furnace.

As shown in Fig. 2, the flanges 13 seat against the interior walls 3 of the bricks, which, together with the ribs 15, provide a secure interlocking retention of the refractory channels within the firebrick, without need of any extraneous mounts or clamping devices of metal or refractory material. The four channels extending around the periphery of the oven may accommodate a single coil 7 of wire, the ends 8 of which are passed through openings 6 in one of the firebricks for connection to a power source. An electric furnace or kiln of any desired capacity may be built up of a series of layers of heating units, as shown in Fig. 2 and the connections from the heating elements may be formed within a control panel adjacent the wall 9 in order to permit variation of the circuits to the heating elements in the several tiers. The furnace may assume any geometric formation other than rectangular, as shown.

While the channel 10 may be self-seating within the groove 4, as shown in Fig. 3, a rotary routing tool passed through recess 4 may cut grooves 5 on the opposite sides of the base of the recess 4 for the purpose of accommodating ribs 15 at the base of the refractory channel. Fig. 4 shows the channel in interlocked condition within the firebrick whether the interlocking grooves on the interior of the firebrick are formed by the channel itself or by a routing tool.

In Fig. 6 is shown an electric furnace or kiln which is especially adapted to form a unit of a front loading style of kiln in which sets of interfitting bricks 19 form successive sections of the furnace placed adjacent to each other in a horizontal line. The channels 20, of hard refractory material in this construction, are of a length corresponding to the thickness of the brick, and are provided with internal ribs 25 for interlocking engagement with self-forming or routed grooves on the interior of the individual firebricks. Likewise, the external flanges 23 face the interior walls of the brick sections on the opposite sides of the grooves 4, and provide longitudinal passages therebetween for the passage of the radiant heat from the wire coils 27 which are successively strung through the channels 20 arranged longitudinally in alignment with each other.

As shown in Fig. 7, the wire coils between adjacent channels are connected in series with each other by a bridging conductor 28 and the other ends of the coils are adapted to be successively passed through any number of channels in longitudinal alignment with each other along a horizontal line.

While the construction shown in Figs. 6 and 7 contemplates the provision of heating elements upon only three walls of the furnace, such heating elements may be provided on the side walls as well as on the top and bottom walls and may be supplemented by heating elements on the fixed back wall of the furnace as well as on the movable closure at the front thereof. Depending upon the purpose to be served by the kiln, the floor of the kiln may be provided with heating channels while the top is left clear. Likewise, the side-walls may be left blank of heating channels. Preferably, the channels are formed

in all of the walls and the circuits to the heating coils are varied to obtain different heating effects.

The heating channels of hard refractory material may be formed with the interlocking ribs 16 at intermediate points of the top and bottom walls thereof rather than at the ends thereof. As shown in Fig. 8, the ribs 16 are disposed midway of the upper and lower walls 11 and cooperate with correspondingly formed grooves in the soft firebrick in order to position the flanges 13 of the channels adjacent to the interior wall 3 of the firebrick.

In Fig. 9 is shown a plurality of refractory channels 20' interlocked within the firebrick wall 19 at different levels thereof by means of the ribs 25 interengaging in corresponding grooves on the interior of the firebrick remote from the interior wall 3. In order to better retain the spiral heating elements 27 within the refractory channels, the lower flange 23' may be extended upwardly in order to confine the heating wire within the channel, at the base thereof, and to impart the radiant effects thereof more uniformly by heating the refractory channels and the exposed flanges 23 and 23'.

While the channels shown in the embodiments of the invention shown in Figs. 1 to 7 have a generally rectangular exterior and a circular interior, the specific configurations may be varied and, as shown in Figs. 9 and 10, the channel interiors may also be of rectangular configuration.

In Fig. 11 the interlocking grooves of the channel are formed along an intermediate point of the top and bottom walls and are designated by numeral 31.

Different radiating and heating effects may be obtained by varying the outline of the channel receptacle, and, as shown in Fig. 12, the channel 32 may have an enlarged or extended base for receiving a sinuous heating element 40 lying flatly against the bottom thereof. The interlocking ribs 34 at the base of the channel may cooperate with grooves formed in the soft firebrick and the flanges 35 extending exteriorly from the top and bottom walls may cooperate with the internal wall of the firebrick in the same manner as do flanges 23 and 23' in the constructional embodiment shown in Fig. 10. The heating troughs formed by channels 32 vary the radiant heating effects attained in the interior of the furnace.

If desired, the retaining ribs 34 may be disposed at an intermediate point of the top and bottom walls, corresponding to the disposition of the retaining ribs shown in the refractory channel of Fig. 11.

While I have described my invention as embodied in a specific form and as operating in a specific manner for purposes of illustration, it should be understood that I do not limit my invention thereto, since various modifications will suggest themselves to those skilled in the art without departing from the spirit of my invention, the scope of which is set forth in the annexed claims.

I claim:

1. A heating unit for an electric furnace comprising a heat resisting brick of friable material, a longitudinally extending channel of refractory material having integral ribs extending longitudinally from the external walls thereof for interlocking engagement within a recess formed in said brick, and a heating element fitted within said channel and supported in its entirety therein adjacent to a longitudinal opening therealong.

2. An electric furnace having an interior lining of firebrick formed of friable siliceous material, said lining having recesses extending therealong provided with undercut grooves along lines remote from the exposed face of said lining, longitudinally extending channels of refractory material having ribs extending longitudinally from the external walls thereof for interlocking engagement within said undercut grooves, flanges extending from the exposed ends of said channels for engagement with the exposed ends of said recesses, and an electric heating element fitted within each channel and completely supported thereby.

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3. An electric furnace having an interior lining of soft firebrick formed of friable siliceous material, said lining having recesses extending therealong provided with undercut grooves on the opposite sides of said recesses along lines remote from the exposed face of said lining, longitudinally extending channels of hard refractory material having ribs extending longitudinally from the external walls thereof for interlocking engagement within said undercut grooves, flanges extending from the exposed ends of said channels for engagement with the exposed ends of said recesses, and an electric heating element fitted within each channel and completely supported thereby.

4. An electric furnace as set forth in claim 3 wherein said ribs are disposed on opposite sides of the base of each channel.

5. An electric furnace as set forth in claim 3 wherein said ribs are disposed on the opposite side of each channel, between the base and open face thereof.

6. A heating unit for an electric furnace comprising a soft heat resisting brick of friable material, a longitudinally extending channel of hard refractory material of externally rectangular outline and internally circular outline having ribs extending longitudinally from the external walls thereof for interlocking engagement within grooves formed in said brick, and a spirally coiled heating element fitted within and completely supported by said internally circular channel adjacent to a longitudinal opening therealong.

7. An electric furnace having an interior lining of soft firebrick formed of friable siliceous material, said lining having recesses extending therealong provided with undercut grooves on the opposite sides of said recesses along lines remote from the exposed face of said lining, longitudinally extending channels of hard refractory material having ribs extending longitudinally from the external walls thereof for interlocking engagement within said undercut grooves, flanges extending from the exposed ends of said channels for engagement with the exposed ends of said recesses, each channel having an extended base terminating in an upwardly extending retaining wall, and a tortuous heating element lying flatly on said base.

8. An electric furnace having a prismatic interior lining of soft firebrick formed of friable siliceous material and

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defined by a plurality of walls, said lining having recesses extending longitudinally along each of said walls on a common level, said recesses being provided with undercut grooves along lines remote from the exposed faces of said lining, longitudinally extending channels of hard refractory material having ribs extending longitudinally from the external walls thereof for interlocking engagement within said undercut grooves, flanges extending from the exposed ends of said channels for engagement with the exposed ends of said recesses, and a continuous spiral heating element fitted within the channels on a common level supported exclusively thereby and having outlet leads extending from only one wall of the interior lining.

9. An electric furnace having an interior lining of soft fire brick formed of friable siliceous material, said lining having horizontal recesses extending therealong provided with undercut grooves on the opposite sides of said recesses along lines remote from the exposed face of said lining, longitudinally extending channels of hard refractory material of internally rectangular outline having ribs extending longitudinally from the external walls thereof for interlocking engagement within said undercut grooves, flanges extending from the exposed ends of said channels for engagement with the exposed ends of said recesses, said flanges extending vertically, with the lower flange being of greater depth than the upper flange adapted to restrict the rectangular passage on the interior of said channel, and a tortuous resistance element lying in said rectangular passage supported entirely by said channel.

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