Aug. 14, 1923. 1,464,499

O. A. COLBY ET AL.

ELECTRIC FURNACE RESISTOR MOUNTING

Filed March 5, 1921 2 Sheets-Sheet 1

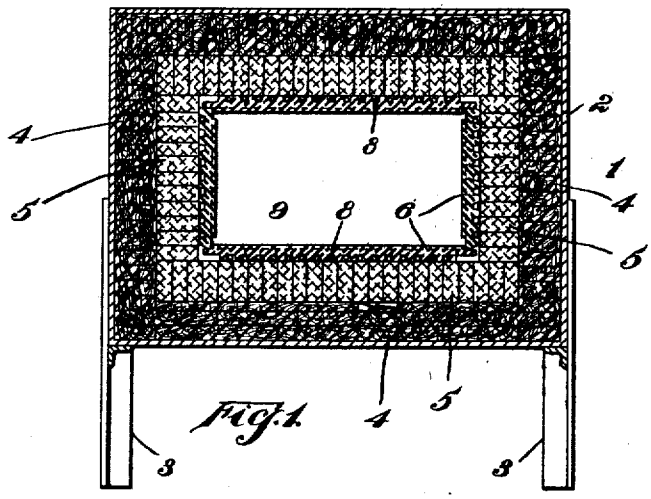


Fig. 1.

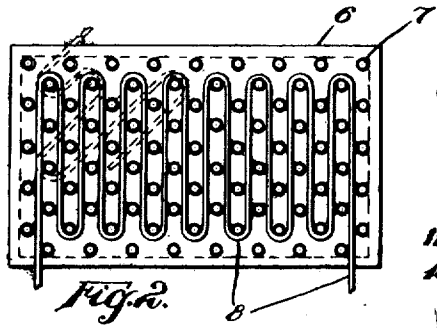


Fig. 2.

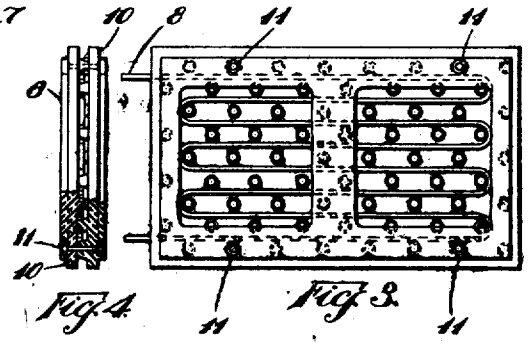


Fig. 4. Fig. 3.

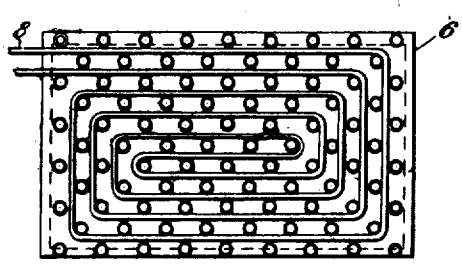


Fig. 5.

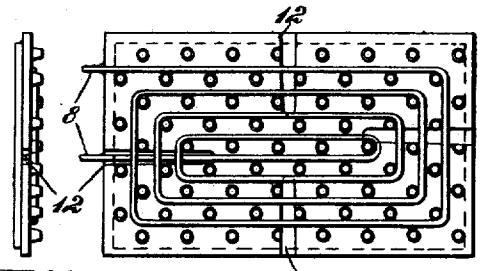


Fig. 7. Fig. 6.

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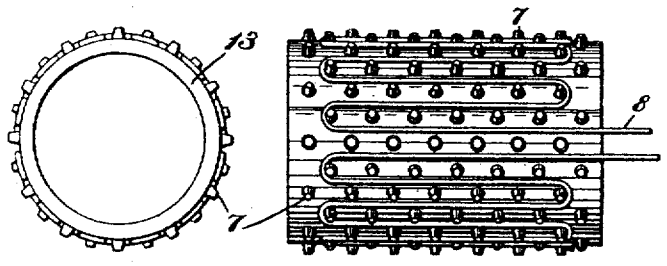


Fig. 8. Fig. 9.

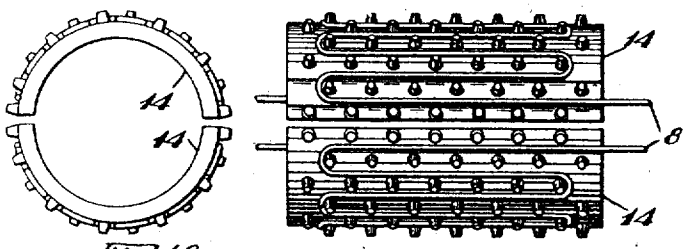


Fig. 10. Fig. 11.

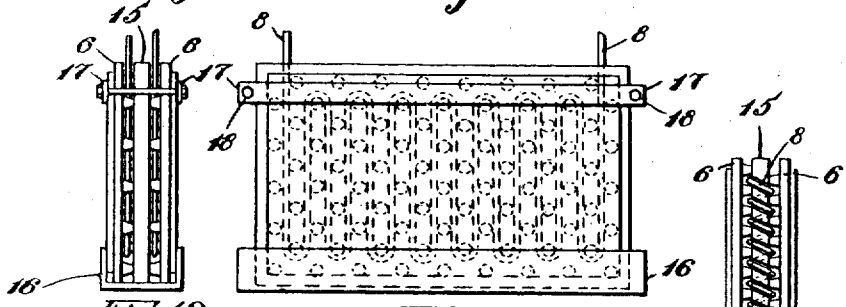


Fig. 12. Fig. 13.

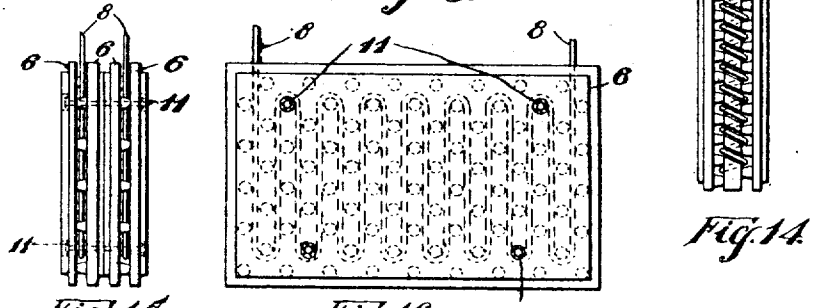


Fig. 14.

Fig. 15. Fig. 16.

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Patented Aug. 14, 1923. 1,464,499

UNITED STATES PATENT OFFICE.

ORA A. COLBY, OF IRWIN, AND THOMAS A. REID, OF PITTSBURGH, PENNSYLVANIA, ASSIGNORS TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

ELECTRIC-FURNACE-RESISTOR MOUNTING.

Application filed March 5, 1921. Serial No. 449,685.

To all whom it may concern:

Be it known that we, ORA A. COLBY, a citizen of the United States, and a resident of Irwin, in the county of Westmoreland and State of Pennsylvania, and THOMAS A. REID, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electric-Furnace-Resistor Mountings, of which the following is a specification.

Our invention relates to electric furnaces and particularly to electric-resistance furnaces, and one of its objects is to provide a relatively simple and easily manufactured refractory resistor-supporting means.

Another object of our invention is to provide a refractory resistor-supporting means which shall permit of constructing a plurality of furnace chambers of different sizes by suitable combination of a plurality of individual members.

Several forms of refractory resistor-supporting members are known in the electric-furnace art. One of the most common is a refractory member having a plurality of parallel-extending grooves in one face, in which grooves the resistor may be located. This type does not permit of changing the general form of resistor used therewith its relative location thereon and, accordingly, it is one of the objects of our invention to provide a resistor-supporting means which will permit of locating a resistor in different positions on the member.

In practicing our invention, we provide a refractory member which has a plurality of integral spaced projections on one surface thereof, these projections being so alined as to permit of locating a resistor on the member extending either laterally, longitudinally, or diagonally of said supporting member.

In the drawings,

Figure 1 is a view, in vertical cross-section, of an electric resistance furnace in which is located the device embodying our invention;

Fig. 2 is a view, in front elevation, of a refractory resistor-supporting member embodying our invention, upon which is located a resistor;

Fig. 3 is a view, in front elevation, of two cooperating refractory members, one of which is illustrated in Fig. 2, in combination with a skeleton-type refractory member;

Fig. 4 is a view, in side elevation, of the members illustrated in Fig. 3;

Fig. 5 is a view, in front elevation, of a resistor-supporting member illustrated in Fig. 2 but with a resistor element of different form mounted thereon;

Fig. 6 is a view, in front elevation, of a plate of different form from that illustrated in Figs. 2 and 5 and a resistor element of different form mounted thereon.

Fig. 7 is a view, in side elevation, of the parts illustrated in Fig. 6;

Figs. 8 and 9 are views, in side and in front elevation, respectively, of a modified form of a resistor-supporting member;

Figs. 10 and 11 are views, in side and in front elevation, respectively, of still another modification of the device embodying our invention;

Figs. 12 and 13 are views, in side and in front elevation, respectively, of a double heating element comprising such plates as are illustrated in Fig. 2;

Fig. 14 is a view, in side elevation, of a three-part resistor-supporting member, comprising such plates as are illustrated in Fig. 2 and embodying a resistor of a slightly modified form; and

Figs. 15 and 16 are views, in side and in front elevation, respectively, of a double heating element comprising two sets of such refractory members as are illustrated in Fig. 2.

An electric furnace 1 comprises a suitable outer metal casing 2 which is mounted on supporting members 3. An outer layer 4 of refractory insulating material is provided inside the casing 2 and may consist of asbestos wool or a material known in the art as nonpariel brick. Inside of the lining 4, we provide a lining of refractory insulating brick 5 which, however, must be of a kind to withstand the high temperature to which it will be subjected, and which, therefore, may be made of a material known in the art as cil-o-cel or insulbrix, which are two forms of diatomaceous earth.

A plurality of resistor-supporting members 6 are located inside of the inner lining 5 and are so designed that they may be placed in their proper operative position

relative to each other within the walls 5 and thereafter will maintain such position by reason of their form. Each refractory member 6 comprises, in general, a flat, relatively thin refractory plate, indicated as substantially rectangular in contour and having a plurality of spaced integral projections 7 on one surface thereof. These projections are alined both laterally, longitudinally and diagonally of said plate, for a purpose to be hereinafter set forth.

The length of the projections 7 is determined in accordance with the maximum thickness of a resistor member 8 which is located upon one surface of said plate in a manner to be hereinafter more clearly set forth.

In order to provide means for holding the member 6 in the furnace chamber 9, a peripheral groove 10 is provided on the smooth surface of the member 6, at the edges thereof, thus permitting the plates to cooperate to maintain their proper operative positions in the chamber 9 as illustrated in Fig. 1.

The projections 7 are made relatively small in area of cross-section and may be either square or circular in cross-section and are spaced relatively large distances apart, substantially as illustrated in Fig. 2.

The resistor 8 comprises, in general, a metallic wire, bar, strip, ribbon or strand of relatively large cross-section, bent into a form such as is indicated in Fig. 2 before it is mounted on the member 6 to have a series of end-connected convolutions. In a resistor element of the form illustrated in Fig. 2, the terminals of resistor 8 are located at opposite edges of the member 6 to permit of using a relatively short connecting means for connecting successive resistor elements located in different members 6 to form a complete circuit. If desired, we may form the resistor member 8 as indicated in Fig. 3 so that the convolutions thereof will be located longitudinally of the plate. It is further possible to so form the resistor 8 that it will lie diagonally of the member 6, as illustrated in the broken lines in Fig. 2 in which the resistor member is indicated in part only.

As indicated in Figure 1, the refractory member 6 is so located in the chamber 9 that the projections 7 will face and engage the inner surface of the wall 5, thus insuring that the resistor member 8 will be maintained in its proper operative position with regard to the member 6 at all times, and that the individual convolutions will be maintained in proper operative relation to each other. As stated above, we may locate the resistor member 8 in any desired relation on the member 6, but thus far, have found it desirable to so locate the resistor 8 on the member 6 that the convolutions of the resistor will have a relatively short length only, inasmuch as the material used has a relatively high linear expansion and we are able therefore, to keep the expansion of the individual convolution down to a relatively small value, thus permitting the use of relatively small clearances at the edges of the member 6.

If it is desired to interpose an additional refractory member 6 between the resistor element 8 and the furnace walls 5 for the protection of these walls which consist of relatively fragile material, we may make use of the modification illustrated in Figs. 3 and 4. It is to be noted that, if it is desired to use this modification, we may make the height of the projections 7 on each plate only one half as large as the thickness of the resistor member 8 and so aline them on the members 6 that they will mutually face and engage each other, or we may make the height of these projections equal to the thickness of the resistor member 8 and so aline them that they will interfit while still being properly alined to suitably support the resistor member 8, either in the position indicated in Fig. 2 or in the position indicated in Fig 3.

A plurality of clamping means, indicated, in general, by bolts 11, may be provided to hold the two cooperating plates in their proper relative positions.

If it is desired to expose the greater part of the resistor member 8 in the furnace chamber 9, we may make one of the members 6 of skeleton form, as indicated in Fig. 3, by which means substantially all of the heating element 8 may be exposed in the furnace chamber 9.

If it is desired to locate both terminals of the resistor element 8 relatively close together, this may be done by forming the resistor member 8 as is indicated in Fig. 5 in which the same refractory supporting member 6 is intended to be used, as indicated in Fig. 2.

If it is desired to bring out one terminal of the resistor element 8 substantially on a center line of the member 6, this may be done by forming the resistor element 8 as is indicated in Fig. 6. To permit of using this form of resistor member 8, it is necessary to slightly modify the refractory member 6 by adding slots or grooves 12 in which a small portion of a convolution may be located, and to provide sufficient clearance between the convolution located in the groove 12 and the overlying end connections as to make it safe to use this method. The plurality of grooves 12 permits of locating the resistor member in any one of four different positions on the member 6.

It may be noted that the refractory resistor-supporting members 6 thus far described are rectangular in contour and, therefore, are adapted to be used only in a furnace chamber which is either square or rec-

tangular in its dimensions. By suitably selecting the dimensions of the plate, as regards length and breadth, any suitable or desired dimension of furnace chamber may be obtained. If desired, a plurality of members 6 may be placed in abutting relation, either laterally or longitudinally, and a greater height of furnace chamber, or a greater extension thereof, or both, may be easily and quickly obtained, using the same unit plate member.

If it is desired to construct a refractory resistor-supporting member in circular form, this may easily be done as indicated in Figs. 8 to 11 inclusive. In Figs. 8 and 9, a single substantially tubular member 13 is provided having a plurality of integral projections or bosses 7 on the outer surface thereof. The projections 7 are alined substantially as described in connection with the member 6 illustrated in Fig. 2. The resistor member 8 may, therefore, be mounted on the member 13, with its convolutions extending longitudinally thereof or it may be so mounted on the member 13 that the convolutions will extend laterally thereof, in a manner similar to that illustrated by full lines in Fig. 2, or, if desired, the member 8 may be so shaped as to permit of mounting it on the member 13 with its convolutions extending diagonally thereof, in a manner similar to that illustrated by broken lines in Fig. 2.

If it is desired to make a resistor-supporting member, of sectional type, it may be made in two parts 14, each of substantially semi-tubular cross-section, and a suitably formed resistor member be mounted on each of the two members 14.

If it is desired to provide a furnace having a hinged top, the upper member 14 may be suitably secured to the upper part of a furnace (not shown) so as to permit of its being swung upwardly whenever it is desired to open the furnace.

Another modification of the device embodying our invention is illustrated in Figs. 12, 13 and 14. A plurality of resistor-supporting members 6 are placed in oppositely spaced relation, with a substantially flat plate 15 located therebetween. A resistor member 8 is located on the inner surface of each of the members 6, the projections 7 on each of the members 6 engaging one of the faces of the member 15 to properly hold the resistor member in its operative position. A metal member 16, substantially of channel section, may be provided at the bottom of the three resistor-supporting members, both to clamp the members together and also to serve as a supporting means for the heating element in case it is desired to place the heating element in the middle of the furnace chamber 9. A plurality of metal straps 17 and bolts 18 may be provided at the upper part of the heating element to hold the plates in proper relative positions.

The resistor members 8, as indicated in Figs. 12 and 13, are independent of each other, but, if it is desired to use only one resistor member, the method indicated in Fig. 14 may be employed. The three refractory members 6, 15 and 6 are located substantially as illustrated in Figs. 12 and 13 but the resistor element 8 is first formed in the shape of a flattened helix. By properly proportioning the length of the convolutions and of the end connections, it is possible to wind the resistor member 8 on a mandrel or former, (not shown) with the successive convolutions in close contact. After the wound resistor has been removed from the former, it may be extended into substantially the form illustrated in Fig. 14 and slipped on the plate 15. The members 6 may now be placed in position substantially as indicated in Fig. 14, and suitable clamping means, which may comprise bolts 11, as illustrated in Fig. 3, or members 16 at one edge and strips 17 with bolts 18 near the other edge, may be used to hold the parts of the heating element in proper operative relation to each other.

A still further modification of a heating element comprises resistor-supporting members 6 is illustrated in Figs. 15 and 16 in which two double heating elements, substantially as illustrated in Figs. 3 and 4, are placed back to back and somewhat longer clamping bolts 11 are used to hold the four plates 6 and the two resistor members 8, in proper relative positions. It may be noticed, in connection with the opening provided in the plate 6 for the bolt 11, that this opening is surrounded by a boss or projection similar to the projections 7 hereinbefore described except that the area of cross-section is slightly larger. By this means, a refractory support is provided for the resistor member 8 around the bolt 11, thus insuring adequate insulation and support for the resistor member where it passes close to or around a clamping bolt 11.

It may be noted that the use of the device embodying our invention provides a unitary resistor-supporting member which may be easily molded and permits of locating the associated resistor member in a number of different positions thereon, as may be convenient or desirable in connection with different methods of connecting the individual resistor members of a electric furnace to each other and to the supply circuit. We may make use of the unitary heating element comprising a single plate 6 and its associated resistor element 8, or we may use two or three or even four such plates, as indicated, respectively, in Fig. 2, Fig. 3, Figs. 12 and 14 and Fig. 15, thus providing

not only a relatively simple resistor-supporting means but also a relatively flexible means composed of a refractory supporting member of simple shape.

The device embodying our invention further provides relatively simple means permitting the construction of a number of furnaces having furnace chambers of different sizes by the use of individual resistor-supporting members combined in various ways.

The use of the device embodying our invention, when built in semi-tubular or tubular form, further provides a combined muffle and resistor-supporting member, and the flat members also operate in substantially the same manner.

It may also be noted that we are able to double the heating capacity which may be provided at any one part of a furnace chamber without decreasing the dimension of the furnace chamber by any substantial amount, by means of suitably combined heating elements as illustrated in Fig. 12 and in Fig. 15, respectively.

Various modifications may be made in the device embodying our invention without departing from the spirit and scope thereof and we desire that only such limitations shall be placed thereon as are imposed by the prior art or are specifically set forth in the appended claims.

We claim as our invention:

1. An electric resistor-supporting means comprising a refractory member having a plurality of spaced integral projections on one surface thereof, said projections being operatively alined laterally and longitudinally of said member.

2. An electric resistor-supporting means comprising a refractory member having a plurality of spaced integral projections on one surface thereof, said projections being operatively alined laterally, longitudinally and diagonally of said member.

3. In an electric furnace the combination with a plurality of walls enclosing a furnace chamber and a resistor for said chamber, of means cooperating with said walls for supporting said resistor, said means comprising a refractory plate having a plurality of rows of relatively small integral projections facing said wall, said projections being spaced relatively large distances apart and operatively alined in at least two directions.

4. In an electric furnace the combination with a plurality of walls enclosing a furnace chamber and a resistor for said chamber, of means for supporting said resistor, comprising a plurality of cooperating refractory spaced plates each plate having a plurality of rows of integral projections, said projections being spaced relatively large distances apart and operatively alined in at least two directions.

5. In an electric furnace the combination with a furnace chamber and a resistor for said chamber, of a resistor-supporting means in said chamber comprising a refractory member having a plurality of rows of integral projections on one surface thereof, said projections being so arranged on said member as to permit of locating the resistor in either lateral or longitudinal extension on said member.

6. In an electric furnace the combination with a furnace chamber and a resistor for said chamber comprising a series of connected and substantially parallel-extending convolutions, of a resistor-supporting means in said chamber comprising a refractory member having a plurality of rows of integral projections on one surface thereof, said projections being so operatively alined in lateral and longitudinal directions on said member as to permit of so locating the resistor on said member that the convolutions thereof may extend either laterally, longitudinally, or diagonally of said member.

7. In an electric furnace the combination with a furnace chamber, and a resistor for said chamber, of a resistor-supporting means comprising a refractory plate having a plurality of rows of integral alined projections of relatively small surface area on one surface, and a second refractory plate having substantially the same external contour as said first plate and of skeleton construction and having a plurality of alined integral projections on one surface thereof, the two plates being located in opposed spaced relation to each other.

8. An electric heating means comprising a plurality of oppositely spaced refractory plates having a plurality of rows of spaced integral projections on one surface, a refractory spacing member located between said plates and a resistor member located on each of said plates.

9. An electric heating means comprising a pluraity of oppositely spaced refractory plates each having a plurality of rows of alined integral projections on one surface, a refractory spacing member located between said plates, a resistor member located on each of said plates and means for clamping all of said plates and said spacing member together.

10. An electric heating means comprising a refractory supporting-member having a plurality of rows of integral spaced projections on one surface, said projections being operatively alined laterally, longitudinally and diagonally of said member, and a resistor located on said member comprising a plurality of end-connected convolutions, the projections on said refractory member permitting limited movement both laterally and longitudinally, but preventing the operative engagement of, adjacent convolutions.

11. An electric heating means comprising a refractory supporting-member having a plurality of integral spaced projections on one surface, said projections being operatively alined laterally, longitudinally and diagonally of said member, and a resistor located on said member comprising a plurality of end-connected convolutions, the projections on said refractory member being adapted to maintain said convolutions in spaced relation to each other under all conditions of operation.

12. An electric resistor-supporting means comprising a refractory member having a plurality of staggered rows of relatively small spaced-apart integral projections thereon, the projections in alternate rows being alined laterally of said rows.

13. An electric-resistor-supporting means comprising a refractory member having a plurality of rows of relatively small spaced integral projections thereon, said projections being operatively alined longitudinally and laterally of said member.

14. An electric-resistor-supporting means comprising a refractory member having a plurality of rows of relatively small spaced integral projections thereon, said projections being operatively alined longitudinally, laterally and diagonally of said member.

15. An electric heating element comprising a refractory supporting member having a plurality of relatively small integral alined projections thereon, said projections being spaced apart a substantial distance both laterally and longitudinally of said member, and a relatively heavy and unyielding resistor member, preformed to comprise a plurality of substantially parallel-extending end-connected convolutions, operatively engaging the surface of said refractory member.

16. An electric heating element comprising a refractory supporting member having a plurality of rows of integral alined projections thereon, said projections being spaced apart a substantial distance both laterally and longitudinally of said member, and a relatively heavy and unyielding resistor member, preformed to comprise a plurality of substantially parallel-extending end-connected convolutions, operatively engaging the surface of said refractory member, the integral projections on said refractory supporting member being effective to maintain said convolutions in spaced-apart relation relatively to each other, but permitting the expansion and contraction thereof under operating conditions.

17. In an electric heating element, in combination, a relatively heavy and unyielding resistor member preformed to comprise a plurality of substantially parallel-extending straight convolutions, and a refractory supporting member having a plurality of rows of integral, relatively small, spaced apart projections thereon, said projections being so operatively alined on said refractory member as to permit of locating said resistor on said refractory support that the convolutions may extend either laterally, longitudinally or diagonally of said member and operatively engage the surface thereof.

18. An electric heating element comprising a relatively heavy and unyielding resistor having a plurality of substantially parallel-extending end-connected straight convolutions, and a refractory supporting member having integral means thereon for permitting said resistor to be located on said support in operative engagement with a surface thereof and with its convolutions extending in the same plane either laterally, longitudinally or diagonally of said supporting member.

19. An electric resistor-supporting means comprising a refractory member having a plurality of sets of spaced-apart integral projections thereon, said sets being operatively alined symmetrically on said refractory member both laterally and longitudinally thereof.

20. An electric resistor-supporting means comprising a refractory member having a plurality of spaced-apart rows of spaced-apart integral projections thereon, the projections in one row being displaced longitudinally thereof relatively to those in an adjacent row.

21. An electric heating element comprising a relatively heavy and unyielding resistor member preformed to comprise a plurality of substantially parallel-extending end-connected convolutions, and a refractory supporting member having a plurality of rows of integral, relatively small projections thereon, said projections being spaced apart relatively large distances laterally, longitudinally and diagonally and being so formed as to permit the assembly and the disassembly of the resistor member in a direction perpendicular to the plane of the supporting member.

In testimony whereof, we have hereunto subscribed our names this 17th day of February, 1921.

ORA A. COLBY.
THOMAS A. REID.