Aug. 22, 1933. G. L. SIMPSON 1,923,644

ELECTRIC HEATING FURNACE

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Fig. 1

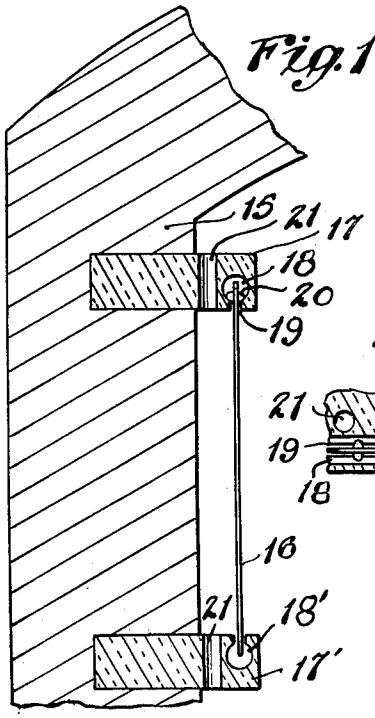


Fig. 2

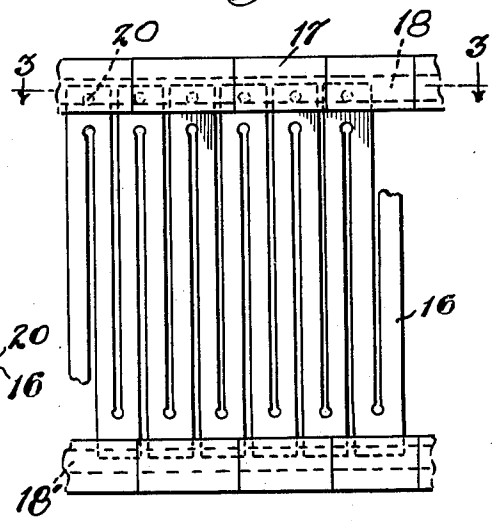


Fig. 3

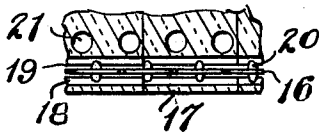


Fig. 4

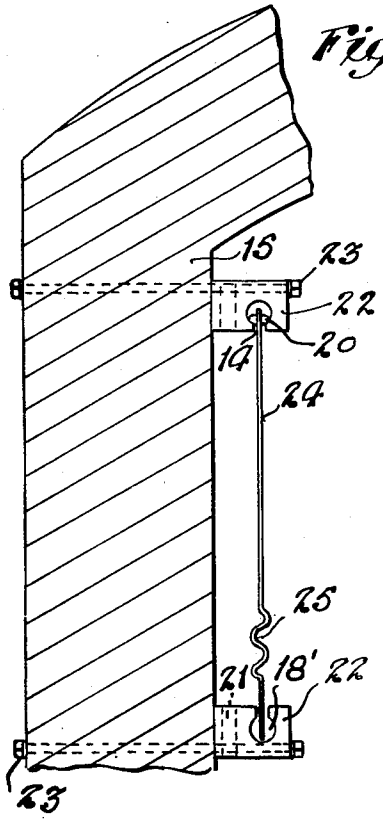
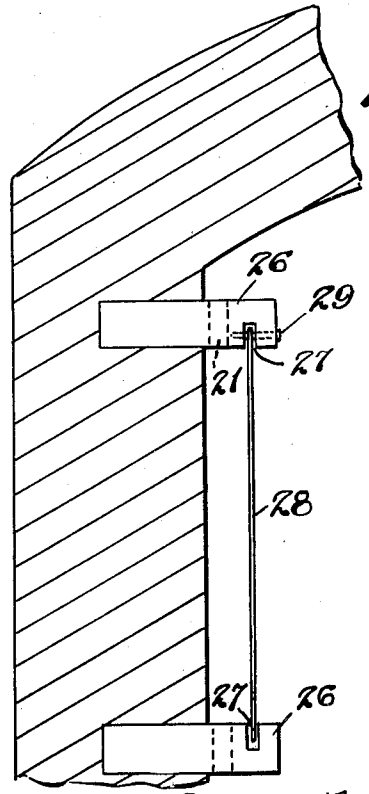


Fig. 5



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Fig. 6

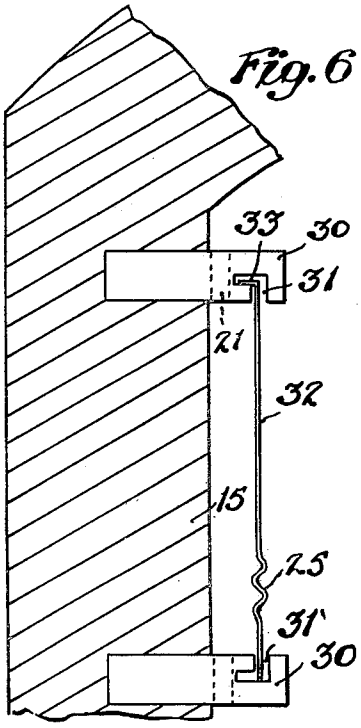


Fig. 7

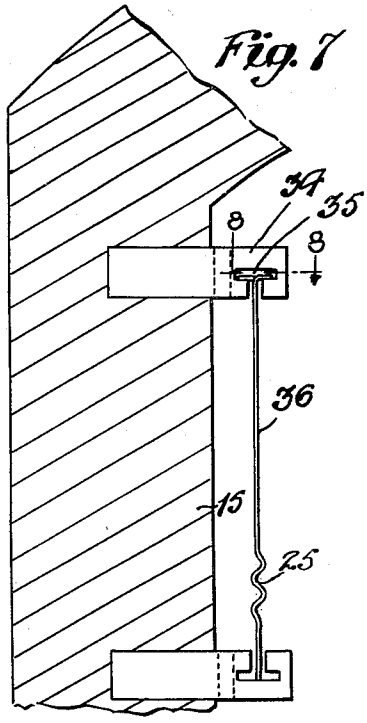


Fig. 8

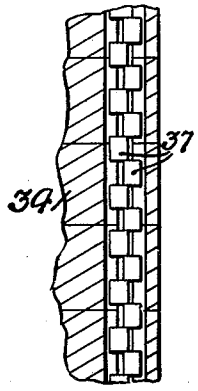


Fig. 9

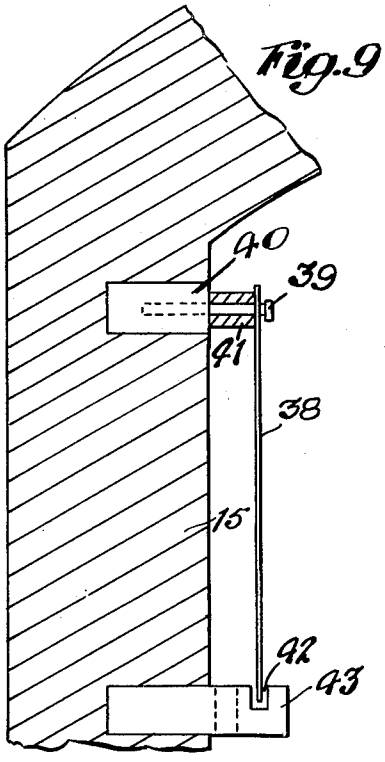


Fig. 10

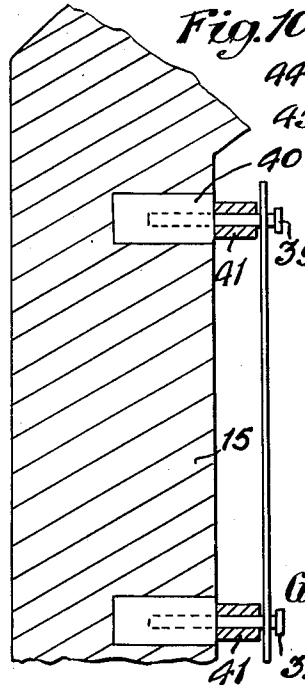
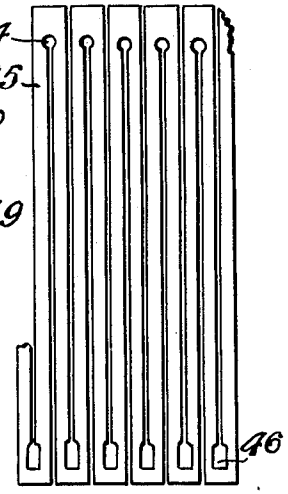


Fig. 11



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Fig. 12

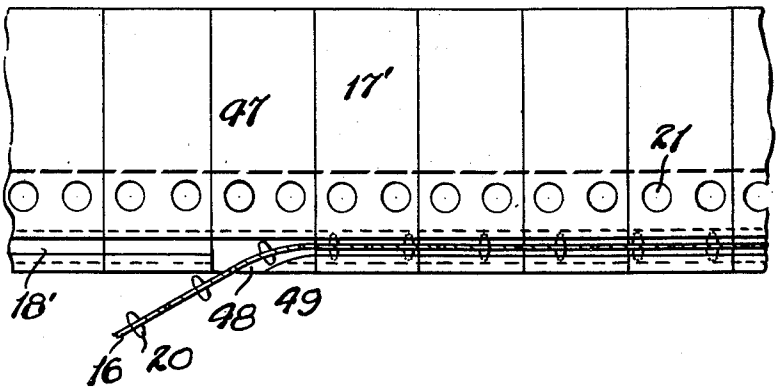
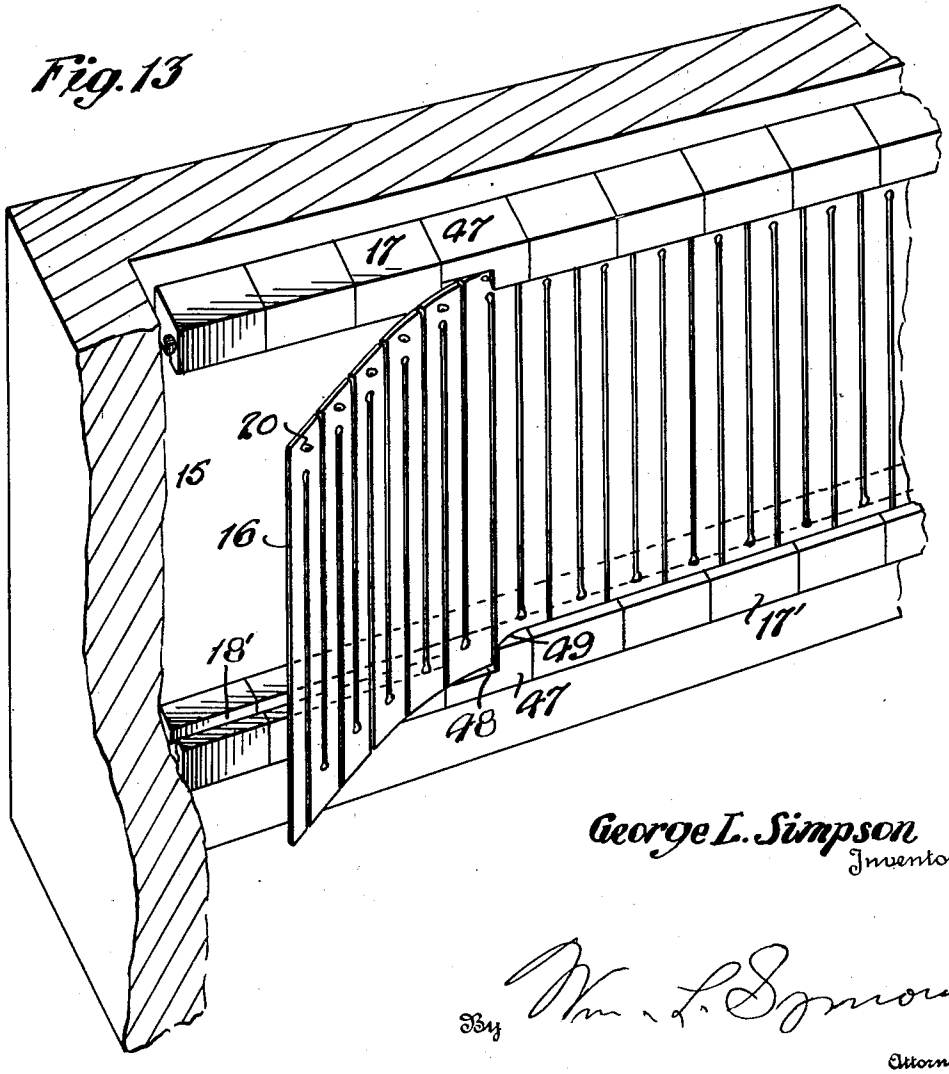


Fig. 13



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Patented Aug. 22, 1933

1,923,644

UNITED STATES PATENT OFFICE

1,923,644

ELECTRIC HEATING FURNACE

George L. Simpson, Coraopolis, Pa., assignor to Pittsburgh Research Corporation, Pittsburgh, Pa.

Application January 11, 1932. Serial No. 585,994

35 Claims. (Cl. 13—25)

My invention relates to electric heating furnaces and more particularly to a means and method for supporting resistance heating elements therein.

An important object of my invention is to provide a support for resistance elements, such as those shown and described in my co-pending application No. 580,689 for Electric heating furnaces filed December 12, 1931, which consist of plates which may be unbroken or slit and which, for the best results, should be supported in spaced relation to the walls of the furnace.

Another object of my invention is the provision of a resistor support which will permit free expansion and contraction of the resistor element.

A further object of my invention is to support a resistance heating element in spaced relation to the walls of the furnace to permit the utilization of the heat of that side of the resistor which faces away from the charge.

Yet another object of my invention is the provision of a resistance heating element which may be readily removed and replaced.

Other objects and advantages of my invention will be apparent during the course of the following description.

In the accompanying drawings, which form a part of this specification, and wherein like characters of reference denote like or corresponding parts throughout the same,

Figure 1 is a fragmentary sectional view of a furnace showing my improved resistance element mounted therein,

Figure 2 is an elevation of a portion of the resistor and the supporting blocks therefor,

Figure 3 is a detail sectional view on the line 3—3 of Figure 2,

Figure 4 is a fragmentary sectional view of a portion of a furnace having a modified form of resistor and resistor support,

Figure 5 is a similar view of a further modification of my invention,

Figure 6 is a similar view of still another form of my invention,

Figure 7 is a similar view of a still further form of my invention,

Figure 8 is a detail section on the line 8—8 of Figure 7,

Figure 9 is a fragmentary sectional view of a furnace embodying yet another form of my invention,

Figure 10 is a similar view of another modification of my invention,

Figure 11 is an elevation of a portion of the resistor shown in Figure 10,

Figure 12 is a sectional view of a portion of the resistor element and illustrating one method of inserting the resistor into the supports, and,

Figure 13 is a perspective view illustrating the method of inserting the resistor into the supports.

In the drawings, wherein for the purpose of illustration is shown a preferred embodiment of my invention the numeral 15 designates a portion of the wall of a heating furnace, such for example as shown in my co-pending application referred to above. The resistance element 16 may be an unbroken plate or it may be provided with suitable slits, as shown in Figure 2, although other forms of resistance elements may obviously be used. A horizontal row of supporting blocks 17 of refractory material are embedded in the wall 15 adjacent the top thereof and project a substantial distance inwardly from the wall, as seen in Figure 1. Each of the blocks is provided adjacent its projecting end with a transverse cylindrical bore 18 which communicates with the lower face of the block by means of a transverse slot 19 the width of which is substantially less than the diameter of the bore 18. The resistor plate is adapted to extend through the slot 19 into the bore 18 and is provided adjacent its upper end with pins or projections 20 which extend through the plate 16 and project from both sides thereof. The projections 20 are too large to be pulled through the slot 19 and therefore rest upon the lower walls of the bore 18 and support the plate 16 in spaced relation to the wall 15.

In order to prevent contact of the lower end of the plate 16 with the wall 15 or with the charge I provide a second row of blocks 17′ having grooves to receive the lower end of the plate. The blocks 17′ may, for convenience of manufacture, correspond exactly with the blocks 17, but are arranged in an inverted position. The groove receives the plate 16 which does not extend to the bottom thereof, to allow for expansion, and the plate is prevented from swinging into contact with the wall 15.

In place of the groove 18′ any other form of groove may be employed, such as a plain groove. In place of the cylindrical bore 18, any other form of bore may be used, such as a rectangular bore. It is necessary however to have a ledge or shoulder upon which the pins 20 may rest, and this shoulder is provided by the difference in width between the slot 19 and bore 18.

Instead of having a continuous row of blocks 17 and 17′, the blocks may be spaced apart. Where the plate is slit however, as in Figure 2, each sec-

tion of the plate should engage a block to prevent twisting and warping of the resistor.

The blocks 17 and 17' may be provided with vertical openings between the bore 18 and wall 15 to permit a circulation of the furnace atmosphere and the utilization of the heat of the side of the plate 16 which faces the wall 15.

The plate 16 is supported at its upper end and does not extend to the bottom of the groove 18' nor to the top of the bore 18. Consequently freedom of expansion is provided, and this expansion of the plate will not interfere with the support thereof.

In Figure 4 the upper and lower blocks 22 are secured to the wall 15 by means of bolts or other securing means 23, instead of being embedded in the wall. In carrying out my invention, either form of securing means may be employed, however. The blocks 22 are otherwise similar to the blocks 17 and 17'. It is sometimes desirable to support the resistor plates at their lower ends, as well as their upper ends, for example, when the plates are so high or so heavy that they would otherwise tend to sag under their own weight. In Figure 4 the resistor plate 24 is supported at its upper end in the same manner as in Figure 1 but the lower end of the plate is arranged immediately adjacent the bottom of the block groove or may rest thereon. The plate will therefore be supported at top and bottom. In order to allow for expansion of the plate, I provide corrugations 25 which extend longitudinally of the plate, preferably adjacent the bottom thereof.

In place of the corrugations 25, however, I may utilize the space between the top of the plate 24 and the top of the groove in the upper block to take care of expansion of the plate. With such an arrangement, the pins 20 may be dispensed with, if desired, as the plate will be supported at its lower end. If the pin 20 is omitted, however, the plate will have to be of a construction such as will permit its standing on end without deformation under its own weight.

In Figure 5 the supporting blocks 26 are provided with plain grooves 27 into which the heating plate 28 projects. Pins 29 extend through the outer portion of the upper blocks and through the grooves 27 transversely thereof. The pins 29 extend through suitable openings in the top of the plate and serve to support the plate with its lower end spaced from the bottom of the groove in the lower blocks. If desired, the plate may rest on the bottom of the lower groove and be provided with corrugations as in Figure 4. If the strength of the plate permits, the corrugations and pins may be dispensed with, and the plate supported in the lower groove with its upper end spaced from the top of the upper groove.

In the form of my invention shown in Figure 6, the supporting blocks 30 are provided with substantially inverted L-shaped grooves 31. The plate 32 is bent over at its upper end to form a right angle flange 33 which rests upon the shoulder of the L-shaped groove and supports the plate. The lower end of the plate extends into the groove in the lower blocks 30 and may be spaced from the bottom of the groove as in Figure 5. The plate is shown, however, as resting upon the bottom of the lower groove and corrugations 25 are provided to take up expansion of the plate, although if desired the space between the flange 33 and the top of the groove 31 may be used to permit expansion of the plate.

In the form of my invention illustrated in Figure 7, the blocks 34 are provided with T-shaped grooves 35, the plate 36 having its upper end provided with a plurality of slits forming tabs 37 which are bent alternately in opposite directions to rest upon the shoulders of the groove 35, as seen in Figures 7 and 8. The plate 36 may be spaced from the bottom of the lower groove as shown in Figure 5, but it is shown as resting upon the bottom of the groove and has expansion taken up by corrugations 25 although this result may also be obtained by utilizing the space between the tabs 37 and the top of the upper groove.

In Figure 9 the plate 38 has openings adjacent its top which receive bolts 39 supported by refractory blocks 40 which are embedded in the walls of the furnace. A spacing element 41, of refractory material is arranged between the wall of the furnace and the plate 38 and is supported by the bolts 39. The lower end of the resistance plate extends into a groove 42 in lower blocks 43 which may be embedded in the furnace wall as shown, or which may be bolted to the furnace wall as in Figure 4. The bottom of the plate may be spaced from the bottom of the groove as shown in full lines, or may rest thereon and be provided with corrugations such as shown at 25 in Figure 4.

In Figure 10 the bolts 39, blocks 40 and spacer 41 are duplicated at the lower end of the plate and the plate is supported at top and bottom. The openings 44 in the plate 45, shown in Figure 11 receive the upper bolts 39 and elongated slots 46 in the plate receive the lower bolts 39 and permit freedom of expansion. The position of the openings 44 and 46 may be reversed, or openings such as 44 may be substituted for slots 46 and corrugations provided to permit expansion of the plate.

In some furnaces, such as box type furnaces, the resistor plates may be slid into place in the supporting blocks from the end of the row of blocks while building up the furnace walls. In some other types of furnaces, such as hood type furnaces, this method of inserting the plates may be impracticable and it is necessary to insert the plates at some point spaced from the ends of the block rows. This may be accomplished by leaving out one of the blocks or a portion thereof and flexing the plate to insert it into the grooves of the block through the open space left by the omitted block. Another method is that shown in Figures 12 and 13 in which a special block 47 is arranged in each of the rows 17 and 17'. The blocks 47 are similar to the blocks 17 and 17' but have their inner ends cutaway at 48 to the depth of the grooves 18 and 18' for a portion of their length, the remainder of the length of the blocks being curved to the grooves as at 49. The plate can then be inserted into the grooves through the cutaway portions 48 and guided by the curved portions 49 by flexing the plate as shown in Figures 12 and 13.

Other means than that shown may be utilized for inserting the plates into the grooved blocks, and the arrangement shown in Figures 12 and 13 is applicable to other types of plates and supporting blocks than those illustrated. It will also be seen that the various forms of my invention may be applied to other forms of plates than that illustrated, such as an unbroken plate, or a plate having a different arrangement of slots than that shown. The portion of the furnace wall indicated at 15 is a diagrammatic representation of the wall of any suitable type of furnace, as for

example, a box type furnace or a hood type heating furnace.

The supporting blocks in all forms of my invention may be embedded in the wall as in Figure 1, or bolted to the wall as in Figure 4, or secured in any other suitable manner.

In mounting the plate, its lower end is spaced from the bottom of the lower groove a distance which will permit maximum expansion of the plate without its contacting with the bottom of the groove. In all forms of my invention, however, the arrangement shown in Figure 4 in which this space is omitted and expansion taken up by the corrugations 25 may be used, or the top of the plate may be spaced a sufficient distance from the top of the upper groove to allow for maximum expansion of the plate.

The openings 21 may be used wherever it is desired to utilize the heat of the side of the plate facing away from the charge, or the same result may be obtained by spacing the blocks from each other. Not only do the blocks serve to support the plate, but where the plate is slit, as seen in Figure 13, the free ends thereof are confined by the walls of the block grooves and prevented from warping or becoming distorted.

While I have shown and described the preferred embodiment of my invention, it is to be understood that various changes in the size, shape and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. In an electric furnace, a resistor plate, means extending inwardly from the wall of the furnace to support said plate in spaced substantially parallel relation to said wall and to maintain the plate out of contact with the furnace wall and charge, said plate being free to expand and contract, and means whereby the heat from the side of the plate facing the furnace wall may be utilized to heat the furnace charge.

2. In an electric furnace, a resistor plate, a support extending inwardly from the wall of the furnace, said support having means to engage and to support the upper end of said plate in spaced relation to the wall of the furnace, and means carried by said furnace wall to prevent movement of the lower end of the plate toward and away from said wall.

3. In an electric furnace, a resistor plate, a pair of supports carried by the wall of said furnace and spaced apart vertically, said supports having means to hold the resistor plate in spaced relation to the furnace wall and to confine the upper and lower ends of the plate while permitting expansion and contraction of the plate.

4. In an electric furnace, a resistor plate, a support arranged in said furnace, said support having a groove therein adapted to receive the plate, said groove having a shoulder, and means on said resistor plate to engage the shoulder of the groove and support the plate.

5. In an electric furnace, a resistor plate, a pair of vertically spaced supports extending inwardly from the wall of the furnace, said supports having grooves on adjacent faces, said grooves being spaced from the furnace wall and adapted to receive the resistor plate to support the plate while permitting expansion and contraction thereof.

6. In an electric furnace, a resistor plate, a refractory support extending inwardly from the furnace wall, said support having a groove in the under side thereof, said groove being enlarged adjacent its upper end, the groove being adapted to receive the upper end of the resistor plate, and a projection on said plate adapted to be arranged in the enlarged portion of the groove to suspend the plate from the support.

7. In an electric furnace, a resistor plate, a refractory support extending inwardly from the furnace wall, said support having a groove in the under side thereof extending along the wall of the furnace, said groove being enlarged adjacent its upper end, the groove being adapted to receive the upper end of the resistor plate, a projection on said plate adapted to be arranged in the enlarged portion of the groove to suspend the plate from the support, and means to restrict the movement of the lower end of the plate.

8. In an electric furnace, a resistor plate, a refractory support extending inwardly from the furnace wall, said support having a groove in the under side thereof, said groove being enlarged adjacent its upper end, the groove being adapted to receive the upper end of the resistor plate, a projection on said plate adapted to be arranged in the enlarged portion of the groove to suspend the plate from the support, and means to restrict the movement of the lower end of the plate and permit expansion and contraction of the plate.

9. In an electric furnace, a resistor plate, a refractory support extending inwardly from the furnace wall, said support having a groove in the under side thereof extending along the wall of the furnace, said groove being enlarged adjacent its upper end, the groove being adapted to receive the upper end of the resistor plate, a projection on said plate adapted to be arranged in the enlarged portion of the groove to suspend the plate from the support, and means to support the lower end of the plate, said plate being free to expand and contract.

10. In an electric furnace, a resistor plate, a pair of vertically spaced supports extending inwardly from the wall of the furnace, said supports having grooves on adjacent faces, the grooves being adapted to receive the resistor plate to support the plate, said plate being provided with corrugations to allow expansion and contraction vertically of the plate.

11. In an electric furnace, a resistor plate, and a pair of supports carried by the wall of the furnace and extending inwardly therefrom, said supports being adapted to support the resistor plate in spaced relation with the furnace wall, and said plate being provided with longitudinally extending corrugations to allow expansion and contraction of the plate.

12. In an electric furnace, a resistor plate, a pair of supports carried by the wall of the furnace and extending inwardly therefrom, said supports having grooves to receive the resistor plate, and means on one of said supports to engage a portion of the resistor plate adjacent its upper end to support the plate in spaced relation to the furnace wall.

13. In an electric furnace, a resistor plate, a pair of supports carried by the wall of the furnace and extending inwardly therefrom, said supports having grooves to receive the resistor plate, and means on one of said supports to engage a portion of the resistor plate adjacent its upper end to support the plate in spaced relation to the furnace wall while allowing free expansion and contraction of the plate.

14. In an electric furnace, a resistor plate, a pair of supports carried by the wall of the furnace

and extending inwardly therefrom, said supports having grooves to receive the resistor plate, and a pin extending through the resistor plate and engaging one of the supports.

15. In an electric furnace, a resistor plate, a pair of supports carried by the wall of the furnace and extending inwardly therefrom, said supports having grooves to receive the resistor plate, and a pin extending through the resistor plate and engaging one of the supports to support the plate, said plate having corrugations to permit free expansion and contraction thereof.

16. In an electric furnace, a resistor plate, a support carried by the wall of said furnace and extending inwardly therefrom, said support having a substantially inverted L-shaped groove in the under side thereof, said resistor plate being bent over at its upper end to form a flange adapted to be received in the groove of the support.

17. In an electric furnace, a resistor plate, a support carried by the wall of said furnace and extending inwardly therefrom, said support having a substantially inverted L-shaped groove in the under side thereof, said resistor plate being bent over at its upper end to form a flange adapted to be received in the groove of the support, and means to restrict movement of the lower end of the plate while permitting expansion and contraction vertically of the plate.

18. In an electric furnace, a resistor plate, a support carried by the wall of said furnace and extending inwardly therefrom, said support having a substantially inverted L-shaped groove in the under side thereof, said resistor plate being bent over at its upper end to form a flange adapted to be received in the groove of the support, and means to support the lower end of the resistor plate, said plate having corrugations therein to permit expansion and contraction vertically of the plate.

19. In an electric furnace, a resistor plate, a support carried by the wall of the furnace, said support having a substantially T-shaped groove in the under side thereof, and said resistor plate having its upper end provided with tabs bent in opposite directions and adapted to be received by the groove in the support.

20. In an electric furnace, a resistor plate, a support carried by the wall of the furnace, said support having a substantially T-shaped groove in the under side thereof, and said resistor plate having its upper end provided with tabs bent in opposite directions and adapted to be received by the groove in the support, and means to restrict movement of the lower end of the plate while permitting expansion and contraction of the plate.

21. In an electric furnace, a resistor plate, a support carried by the wall of the furnace, said support having a substantially T-shaped groove in the under side thereof, and said resistor plate having its upper end provided with tabs bent in opposite directions and adapted to be received by the groove in the support, and means to support the lower end of the resistor plate, said plate having corrugations therein to permit expansion and contraction of the plate.

22. In an electric furnace, a resistor plate, a support carried by the wall of said furnace and extending inwardly therefrom, said support having a substantially inverted L-shaped groove in the under side thereof, said resistor plate being bent over at its upper end to form a flange adapted to be received in the groove of the support, whereby said plate is supported in spaced relation to the wall of the furnace, and means whereby the atmosphere of the furnace may circulate between the plate and furnace wall and vertically past the support.

23. In an electric furnace, a resistor plate, a support carried by the wall of the furnace, said support having a substantially T-shaped groove in the under side thereof, and said resistor plate having its upper end provided with tabs bent in opposite directions and adapted to be received by the groove in the support, whereby said plate is supported in spaced relation to the wall of the furnace, and means whereby the atmosphere of the furnace may circulate between the plate and furnace wall and vertically past the support.

24. In an electric furnace, a resistor plate, resistor supports carried by the wall of the furnace and extending through the resistor plate, said plate being free to expand and contract.

25. In an electric furnace, a resistor plate, a resistor support carried by the furnace wall and extending through the plate adjacent the upper end thereof, means to space the resistor plate from the furnace wall, and means to restrict movement of the lower end of the plate.

26. In an electric furnace, a resistor plate, a resistor support carried by the furnace wall and extending through the plate adjacent the upper end thereof, means to space the resistor plate from the furnace wall, and means to restrict movement of the lower end of the plate while permitting expansion and contraction of the plate.

27. In an electric furnace, a resistor plate, resistor supports carried by the wall of the furnace and extending through the resistor plate, said supports permitting expansion and contraction of the resistor plate, and means to space the plate from the furnace wall.

28. In an electric furnace, a resistance plate having slits therein dividing the plate into a plurality of connected sections, and means to support the plate in spaced relation to the furnace wall, said supporting means being carried by the furnace wall and serving to confine the sections of the resistor plate to prevent distortion thereof.

29. In an electric furnace, a resistor plate, a row of supporting members carried by the furnace wall and provided with bores extending therethrough, said bores communicating with the lower faces of the supporting members by means of restricted grooves, said plate having projections therein adapted to be received by the bores in the supporting members and being of a form to prevent their passage through the restricted grooves, and means whereby the resistor plate may be inserted in the bores of the supporting members at a point spaced from the end of the row of supporting members.

30. In an electric furnace, a resistor plate capable of being flexed, a pair of spaced substantially horizontal supporting members extending along the wall of the furnace and carried thereby, said supporting members having grooves therein to receive the upper and lower portions of the resistor plate, and means to insert the plate into the grooves of the supporting members at a point spaced from the ends of the supporting members.

31. In an electric furnace, a resistor plate having slits therein to form a circuitous path for the electric current, a pair of supports carried by the wall of the furnace and spaced apart, said supports having means to hold the resistor plate in spaced relation to the furnace wall and to

confine the upper and lower ends of the plate while permitting expansion and contraction of the plate.

32. In an electric furnace, a resistor plate, a pair of supports arranged in said furnace and spaced apart vertically, said supports having means to hold the resistor plate in spaced relation to the furnace wall and to confine the upper and lower ends of the plate while permitting expansion and contraction of the plate.

33. In an electric furnace, a heating element comprising a relatively thin metallic resistor plate supported in spaced relation to the furnace wall and out of contact with the furnace wall and charge.

34. In an electric furnace, a heating element comprising a relatively thin metallic resistor plate supported in spaced relation to the furnace wall and out of contact with the furnace wall and charge, and means to confine the upper and lower ends of the plate while permitting expansion and contraction of the plate.

35. In an electric furnace, a heating element comprising a relatively thin metallic resistor plate supported in spaced relation to the furnace wall and out of contact with the furnace wall and charge, and means to maintain the resistor plate substantially rigid against twisting and warping strains while permitting expansion and contraction of the plate.

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