

Sept. 11, 1934.

G. M. KERANEN

1,973,533

FURNACE CONSTRUCTION

Filed Jan. 22, 1931

5 Sheets-Sheet 1

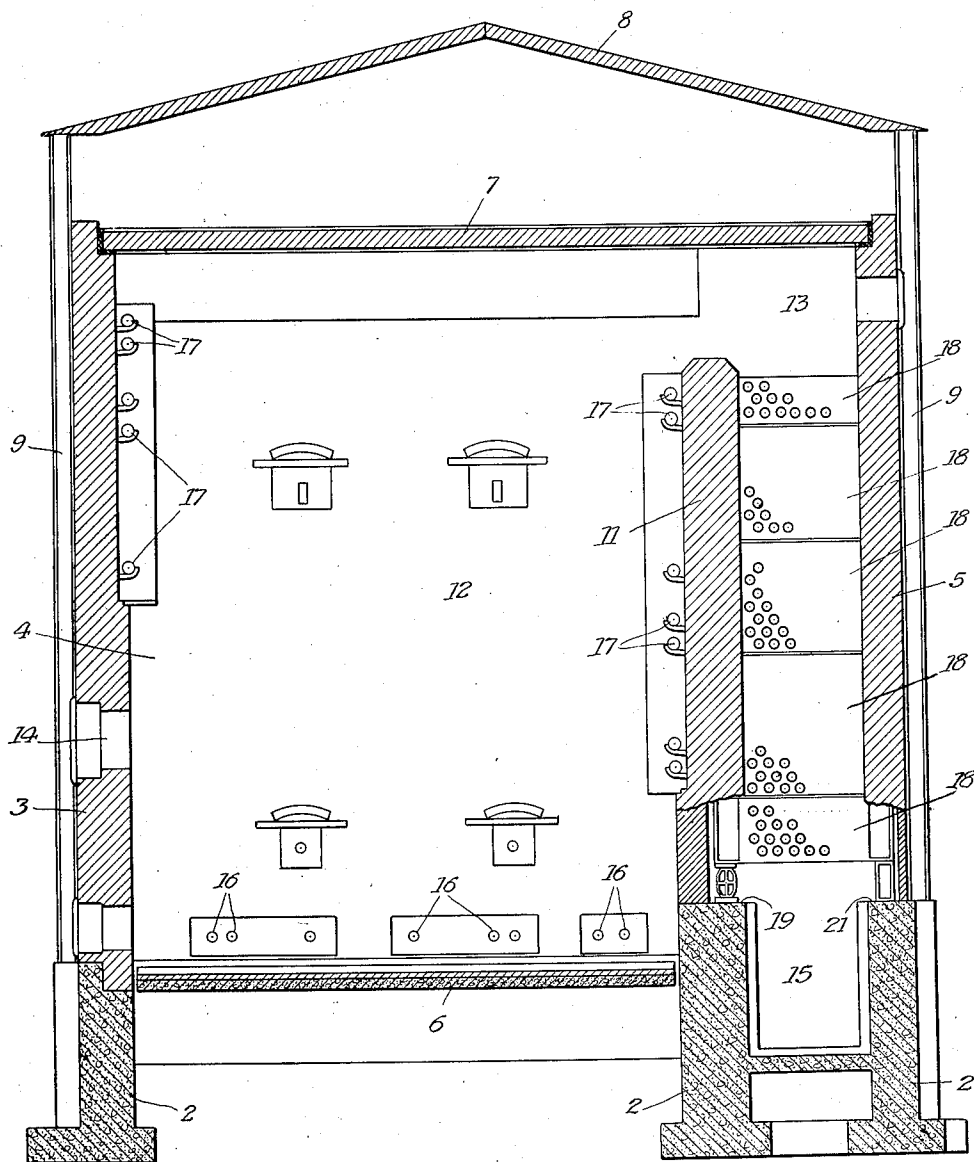


Fig. 1.

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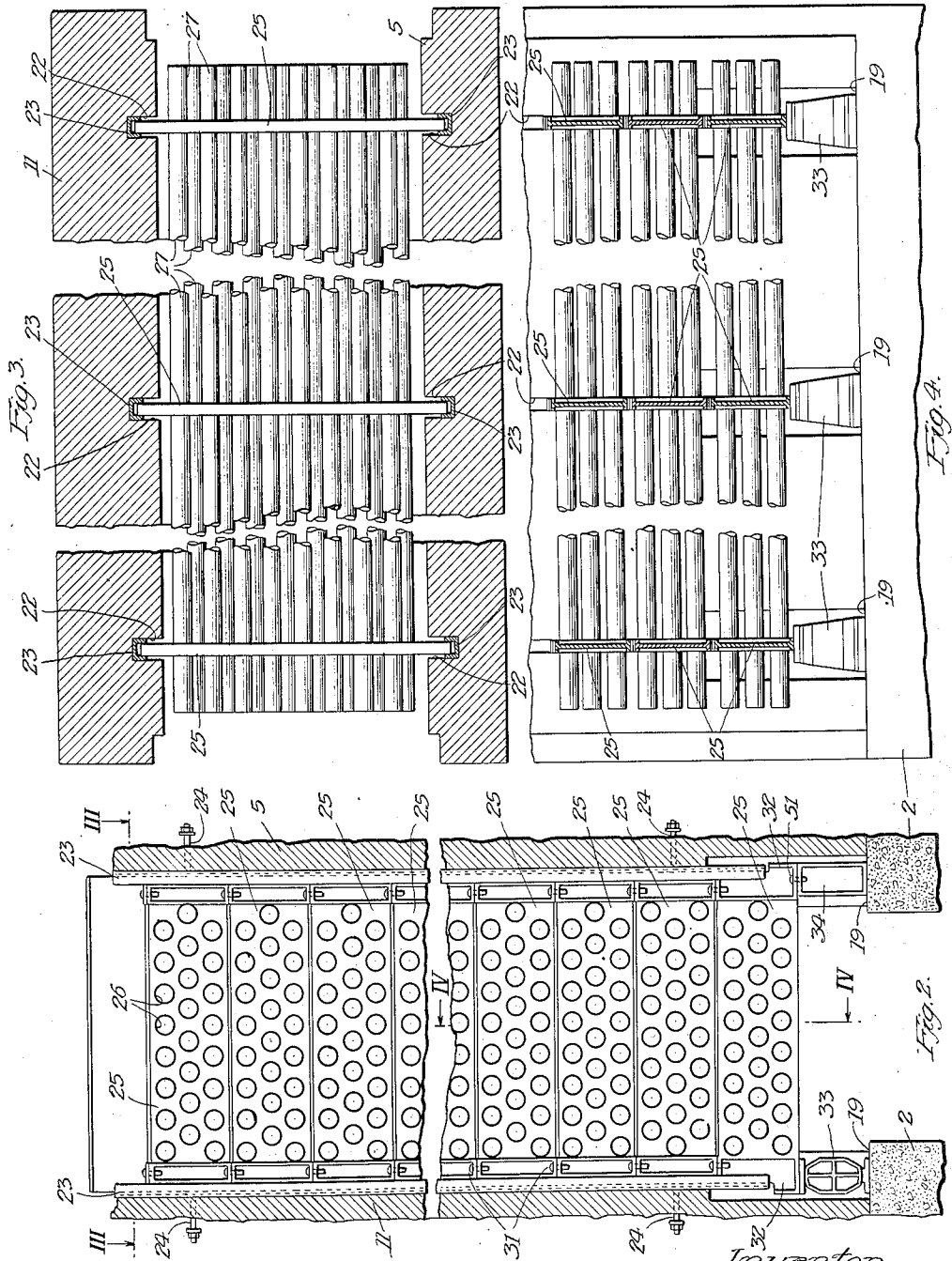
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5 Sheets-Sheet 2



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5 Sheets-Sheet 3

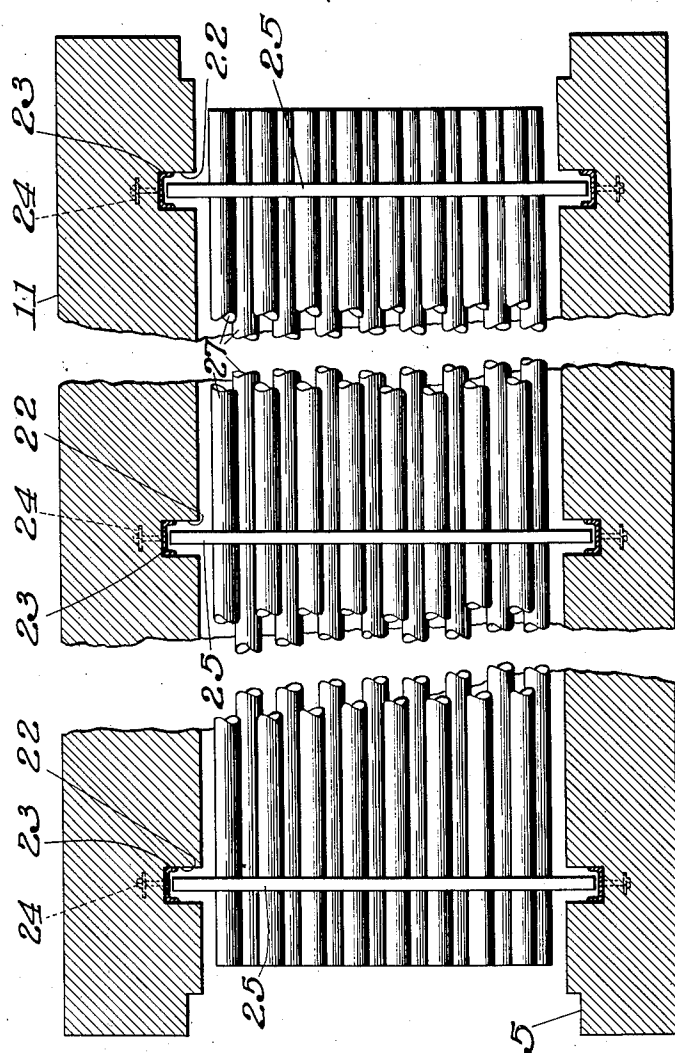


Fig. 3A

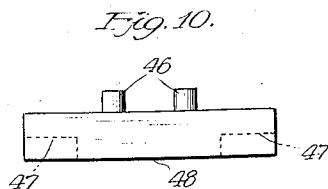
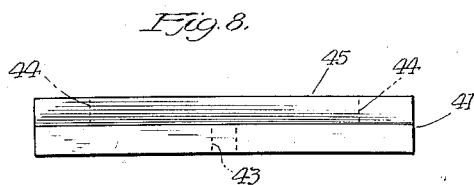
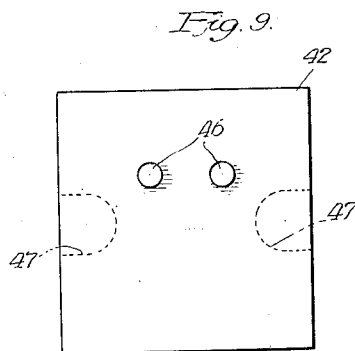
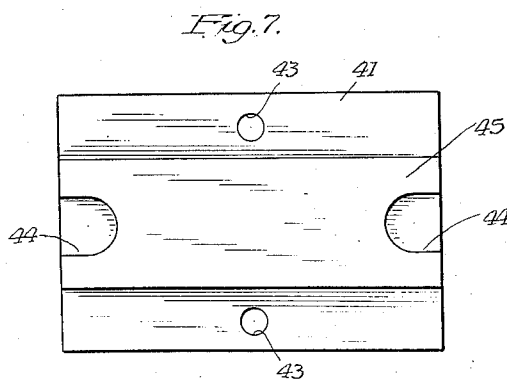
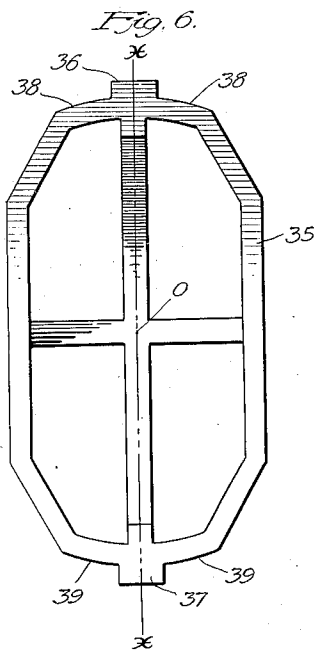
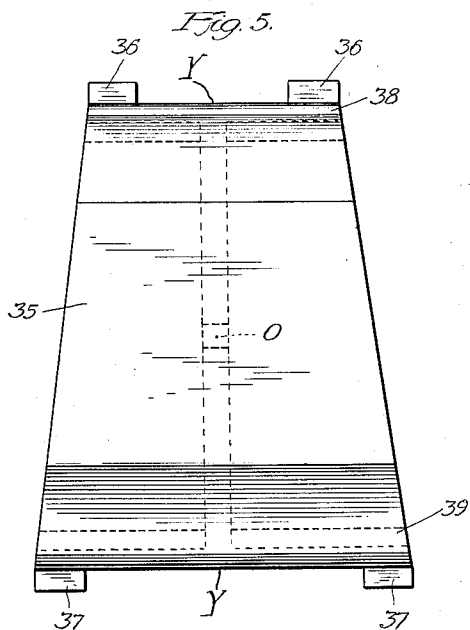
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5 Sheets-Sheet 4



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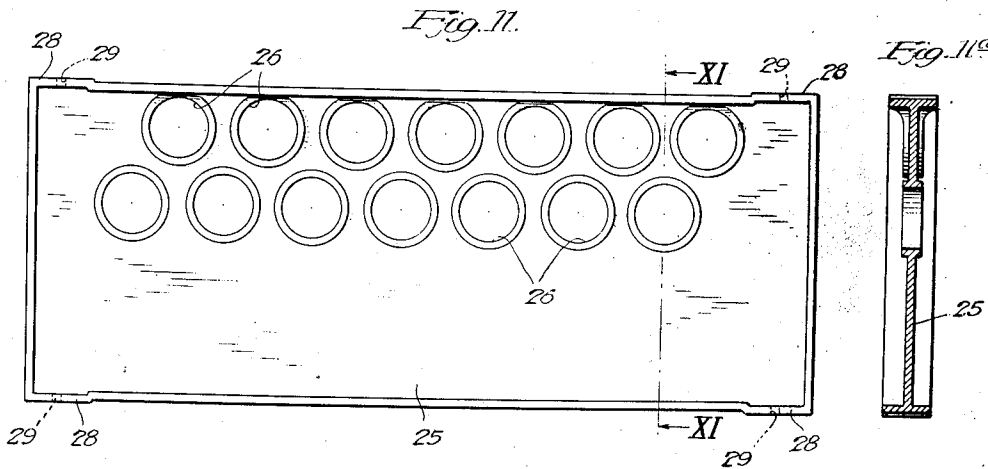
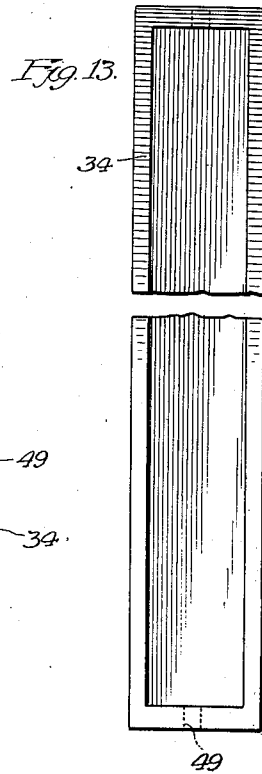
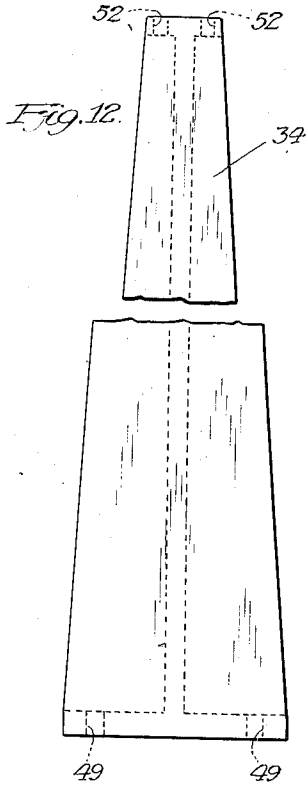
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FURNACE CONSTRUCTION

Filed Jan. 22, 1931

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

1,973,533

FURNACE CONSTRUCTION

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Application January 22, 1931, Serial No. 510,415

21 Claims. (Cl. 122—510)

This invention relates to furnace construction and more particularly to tube supporting and mounting means constructed and arranged properly to support sets or banks of tubes, regardless of expansion and contraction movements of the tubes and/or the supports, and designed to permit the tubes and/or the supports to move in predetermined directions as they expand and contract under the influence of varying temperature conditions.

It has heretofore been the common practice in constructing tube chambers in furnaces, such as convection or soaking chambers in oil pipe stills or preheaters, to support the sets or banks of tubes and the individual tubes of the sets or banks in a substantially immovable manner from the floor or from the side walls or to secure them in some more or less rigid fashion from the roof of the setting. Such arrangements, however, are not satisfactory. Undesirable stresses are set up in the tubes, the supports, the walls, etc., under varying heat conditions to which the several parts of the structure are inevitably subjected. Expansion and contraction movements of the tubes or their supports and the setting with respect to one another also contribute to the stresses and strains. Furthermore, it is undesirable to support the tubes from the foundation indirectly through the roof or side walls of the setting for reasons which are obvious. The net effect of the various conditions affecting the setting, the tubes and their supports, is to cause or tend to cause break-down of the setting with danger of rupture of the tubes which, in the case of an oil still or pre-heater, could be a very serious thing indeed.

Consequently, one of the primary objects of the present invention is to provide a constructional arrangement whereby the tubes are loaded directly upon the foundation instead of through roof trusses or beams and columns or through the side walls and columns and thence to the foundation.

Another important object of the present invention is to provide an arrangement whereby the tubes, the tube supports, the chamber walls, etc. may move relatively to one another under the influence of expansion and contraction forces without strains or stresses leading to deterioration and breakdown and whereby the several parts of the setting, as well as the tubes and their supports, may expand and contract in normal directions over a long period of time without serious deterioration. The construction and arrangement are such that the tubes individually or in

sets or banks may be said to "float" in the heating chamber, although they are or may be supported at one or more places within the chamber directly upon the foundation or ground.

Still another object is to provide a special type of tube bank or tube set support so constructed as to assist in carrying out the foregoing objects.

A further object is to provide a rocker support for the tube bank or set supports of a peculiarly desirable character adapted to function as a support under all normal positions of the tube bank supports during expansion and contraction movements thereof or of associate parts.

Many additional objects, as well as the advantages, uses and purposes of the invention, will be or should become fully appreciated and understood after reading the following description and claims and after considering the accompanying drawings, in which:

Fig. 1 is a sectional elevation of a pipe still or pre-heater showing a preferred form of the invention applied thereto.

Fig. 2 is an enlarged sectional elevation of one end of the convection section of the pre-heater or pipe still shown in Fig. 1, with portions broken away for simplicity.

Fig. 3 is a plan section taken along the line III—III of Fig. 2.

Fig. 3A is a plan section along line III—III of Fig. 2 showing an enlarged view of the channels.

Fig. 4 is a sectional view taken substantially along the line IV—IV of Fig. 2.

Figs. 5 and 6 are respectively side and front elevational views of a preferred form of rocker support.

Figs. 7 and 8 are respectively top plan and side elevational views of a base plate upon which the rocker shown in Figs. 5 and 6 is adapted to be mounted.

Figs. 9 and 10 are respectively top plan and side elevational views of a cap plate adapted to be mounted upon the top of the rocker supports shown in Figs. 5 and 6 and to come between the same and the tube supports proper.

Fig. 11 is a front elevational view of one of the tube set supports.

Fig. 11a is a section taken along the line XI—XI of Fig. 11 and

Figs. 12, 13 and 14 are respectively side elevational, top plan and front or end elevational views of a stationary support.

The pre-heater chosen for illustration of the invention comprises a foundation 2, walls 3, 4 and 5, a floor 6, a false or refractory roof 7 and

a roof 8. Columns 9 arise from the foundation to support the roof and a bridge wall 11 divides the chamber into a radiant section 12 and a convection section 13. Burner openings 14 (one only shown) receive the burners which feed the fuel into the radiant section 12, where it is burned, the products of combustion passing through the radiant section over the top of the bridge wall 11, down through the convection section 13 to the bottom thereof, into a flue passage 15 connecting with a stack or other place of disposal.

The radiant section 12 contains floor tubes 16, wall tubes 17 and roof tubes (not shown), suitably supported therein, while the convection section 13 contains one or more banks or sets of tubes 18. The invention pertains to the matter of supporting the banks or sets of tubes in the convection section.

The bridge wall 11 and the wall 5 may be recessed at the top of the foundation to provide shoulders 19 and 21 upon which the weight of the tubes and their supports may be carried. There may be as many of these recesses in these walls at directly opposite places as the number of supports required to support the tubes. In the present embodiment three such recesses are illustrated but more or less may be provided as necessity may dictate. Extending vertically upward in the walls in parallel relationship from the lower notches or recesses are grooves 22 within which channels 23, preferably made of fire resistant metal, are disposed and secured as by bolts 24 which extend into the walls. These channels serve as guides for plate-like tube supports 25 through apertures 26 in which the tubes 27 are slidably (removably) carried. The clearances between the walls of the channels 23 and the sides and ends of the plate-like supports 25 are such that the plate-like supports may move vertically of the convection chamber or section and may move longitudinally or transversely thereof only to a slight extent, thereby permitting the plate-like tube supports 25 to float. This structure is shown in Fig. 3A.

As intimated above, the tubes, during expansion and contraction, may move in the direction of their axes with respect to the plate-like supports 25. The plate-like supports 25 which, in the embodiment illustrated, are made of heat resistant metal castings, although they may be formed other than by casting, are free to move vertically in the guides and may move with the tubes transversely of the chamber to some extent so that it may be said that the tubes are mounted for substantially universal movement. Therefore, as the tubes, the walls, the supports, etc., expand and contract under varying temperature conditions they may move together or relatively to one another as occasion may require and no undue stress is placed on one part by another, thereby eliminating strains and serious results.

The plate-like supports 25 which are made thin to provide the least possible interference to passage of products of combustion, are supported one upon the other in superposed or stacked relation and are held in this position by the channel guides 23. Each of these plate-like supports 25, one form of construction of which is best illustrated in Figs. 11 and 11a, is provided with a boss 28 projecting from adjacent each end of each side edge beyond the general plane of the side edge intermediate the bosses so that when these plate-like supports are stacked upon one another contact between the supports occurs only at their end portions on the bosses. In this way the

load of every higher support and the tubes carried thereby above the bottom support will be carried to the sides of the chamber and there transmitted to the foundation. The topmost plate support at its top side and the bottommost plate support at its bottom side need not be provided with the bosses 28, as will be obvious, although if for any reason it should be desirable to standardize the plate supports as, for instance, to simplify casting, each may be made with bosses on each side edge. In order to simplify erection of the plate-like tube supports and to maintain them in alignment with one another, the bosses 28 may be drilled, as indicated at 29, for the reception of rivets 31 loosely therethrough. The rivets may be dropped into the holes as the supports are being stacked.

The bottom plate-like support is preferably provided with an extending portion 32 in order to increase its contact surface with those supports upon which it in turn is supported. These last mentioned supports comprise a rocker support 33 and a fixed abutment support 34 beneath each set or stack of the plate-like tube supports. The rocker support comprises a rocker member 35, having positioning bosses 36 and 37 and arcuate rocker faces 38 and 39, a base plate 41 and a cap or top plate 42. The base plate 41 is provided with apertures 43 for the reception of stud bolts by which the plate may be secured to the foundation 2, with recesses 44 in its top face within which the positioning lugs 37 are adapted to be loosely received and a flat surface 45 upon which the rocker 35 may rock, while the top or cap plate 42 is provided with positioning studs 46 adapted to be loosely received in corresponding apertures or recesses formed in the edge of the bottom plate-like support 25, with recesses or notches 47 within which the positioning lugs 36 are adapted to be loosely received and with a smooth surface 48 adapted to rest upon the curved surface 38 at the top of the rocker.

The curved supporting surfaces 38 and 39 of the rocker 35 are preferably struck on equal radii originating along the center line X—X of the rocker, but are preferably cylindrical surfaces in order to provide line contacts with the bottom and top plates 41 and 42. In the illustrated embodiment, the origin of the radii is at O, but the radii may be of greater or lesser length and even of unequal length for various purposes. For instance, if it be desired to assist the several parts, carried by the support, to return to an initial position in which the center of loading passes down the center line X—X, the radii of curvature of the surfaces 38 and 39 may be made greater than the distance between either point Y and the point O. Other arrangements should occur to those skilled in the art. The fixed abutment support 34 comprises, as does the rocker support, a piece of cast or otherwise formed metal of heat resisting qualities but unlike the rocker support is rigidly secured to the foundation in any suitable manner as by means of bolts passing through suitable apertures 49. The top of the support is secured to the bottom of the bottom plate-like support 25 by means of rivets 51 which are loosely disposed through apertures 52 formed through the top of the support 34 and aligned apertures, not shown, formed through the bottom of the lowermost plate 25.

It should thoroughly be appreciated that the arrangement is unique and provides a most satisfactory manner of supporting the tubes within a chamber such as the convection chamber illus-

trated. The tubes may freely expand in the direction of their axes and, even should they buckle, the force of buckling will not be effective against the walls or any other portion of the setting. The tubes, the supports and the walls may move relatively to one another without imposing stresses of any material nature on one another and the loading falls directly upon the foundations where it should fall. The load of each upper plate-like support falls on any lower one at the place or places where it is most desirable to have it fall and where provision may be made to carry the loads so that it is unlikely that any strain will be imposed on portions of the plate-like supports through which the tubes pass. The rocker supports on one side of the chamber and the fixed abutment supports on the other side of the chamber direct lateral expansion in one direction and in a direction in which it may be most desirable to have the expansion take place, while a line contact is at all times maintained between the rocker and the load.

While I have illustrated and described what is at present a preferred form of the invention and one embodiment thereof, it should be obvious that the invention is susceptible of many modifications and variations, as well as embodiment in other structures bearing little, if any, resemblance to that illustrated. Hence, I do not desire to be limited to what has been shown and described, but only by the spirit of the invention and the scope of the appended claims.

I claim:

1. In a heater, a chamber comprising a pair of substantially parallel walls spaced from one another, a bank of tubes extending substantially horizontally within said chamber and between said walls, a floating support within said chamber for said tubes supported from beneath and adapted to move vertically and horizontally in said chamber, and means for guiding said support during its vertical movements.

2. In combination in a heater, a pair of substantially parallel, spaced and substantially vertically extending opposed guides secured to opposed faces of said walls, a floating tube support carried by said guides and movable longitudinally thereof, a rest for supporting said tube support from beneath and a tube carried by and movable, with respect to its axis, relative to said support.

3. A construction as defined in claim 2 in which said guides are channels and said support is a plate.

4. In combination, a tube, a support for said tube extending transversely thereof and movable in the direction in which it extends, means for supporting one end of said support in substantially fixed position, and a rocker for supporting the other end of said support.

5. In combination, a heating chamber, a bank of tubes in said chamber, and means for supporting said bank of tubes under conditions of expansion and contraction comprising, a support for said tubes movable with the tubes in paths substantially normal to the axes of the tubes and movable in paths substantially parallel to the axes of said tubes, a rest for supporting said tube support from beneath and means for guiding said support during said movements.

6. In combination, a heating chamber, a tube support, a bank of tubes in said chamber and supported by but unsecured to said support, said support being movable with said tubes in paths

substantially perpendicular to the axes of the tubes and movable in paths substantially parallel to the axes of said tubes, a rest for supporting said tube support from beneath and means for guiding said support during movements along either path.

7. In combination, a heating chamber including a pair of vertical walls spaced from one another, a bank of tubes disposed in said chamber between and with their axes extending substantially parallel to said walls in a horizontal direction, a guide extending vertically of each of said walls on the face opposed to the opposite wall, a floating support for said tubes having sliding engagement with each of said guides for movements therealong and a rest for supporting said tube support from beneath.

8. In combination, a heating chamber including a pair of vertical walls spaced from one another, a bank of tubes disposed in said chamber between and with their axes extending substantially parallel to said walls in a horizontal direction, a guide extending vertically of each of said walls on the face opposed to the opposite wall, a support for said tubes having slidable engagement with each of said guides for movement therealong, and a rocker support for supporting one end of said support.

9. In combination, a heating chamber including a pair of substantially vertical walls spaced from one another, a plurality of banks of tubes in said chamber between and with their axes extending substantially parallel to said walls in a horizontal direction, a plate-like support for each bank of tubes, the tubes of the banks being unsecured to said supports, said supports being stacked upon one another on edge and extending in a plane substantially normal to the axes of the tubes of their respective banks, means connected with the said chamber walls for guiding said supports during expansion and contraction movements, and means on certain of said supports for placing the load of an upper support and its bank of tubes upon a lower support at the end portions thereof adjacent said chamber walls.

10. In combination, a heating chamber including a pair of substantially vertical walls spaced from one another, a plurality of banks of tubes in said chamber between and with their axes extending substantially parallel to said walls in a horizontal direction, a plate-like support for each bank of tubes, the tubes of certain of the banks finding floating support on said supports, said supports being stacked edgewise upon one another and extending substantially from one said wall to the other across said chamber and in substantially the same vertical plane, and means for placing the load of an upper support and its bank of tubes upon the end portions of a lower support adjacent said chamber walls.

11. In a heating chamber, a pair of substantially vertically extending spaced guides in said chamber, and a plurality of plate-like tube supports disposed in said chamber and stacked edgewise upon one another in a vertical direction between said guides, said supports being slidably engaged with said guides for vertical movements relative thereto.

12. In a heating chamber, a pair of substantially vertically extending spaced guides in said chamber, a plurality of plate-like tube supports disposed in said chamber and stacked edgewise upon one another in a vertical direction between said guides, said supports being slidably engaged with said guides for vertical movements relative

thereto, and means for effecting the loading of one of said supports above the bottom support upon the side edges of the bottom support adjacent said guides.

- 5 13. In a heating chamber, a pair of substantially vertically extending spaced guides in said chamber, a plurality of plate-like tube supports disposed in said chamber and stacked edgewise upon one another in a vertical direction between
10 said guides, said supports being slidably engaged with said guides for vertical movements relative thereto, means for effecting the loading of each support above the bottom support upon the side edge portions only of the immediately underlying
15 support, a fixed abutment support beneath one side end of the bottom support for supporting the same, and a movable abutment beneath the other side end of the bottom support adapted continuously to support the said other side end under expansive and contractive movements of the bot-
20 tom support.

14. A tube support comprising a plate-like piece of metal of generally rectangular shape having an opening therethrough within its perimetrical
25 bounds for passage of a tube, and a boss adjacent each end of one side edge projecting beyond the general plane of the side edge intermediate the bosses.

15. A tube support comprising a plate-like piece
30 of metal of generally rectangular shape having a plurality of tube receiving openings therethrough, and means formed on the side edge surface of one side edge adjacent one end thereof for spacing the major portion of said side edge surface
35 from a corresponding surface of a similar support.

16. A tube support as defined in claim 15 formed by casting and having an integral rib about its perimeter on each side face.

17. In a heater, a chamber, a plurality of banks
40 of tubes in said chamber, a plurality of superimposed supports for said tubes, a means for supporting the lowermost tube support from be-

neath, and channels for guiding said superimposed tube supports during vertical and horizontal movements.

18. In a heater, a chamber, a plurality of banks
80 of tubes in said chamber, a plurality of superimposed tube supports which are movable with the tubes in paths substantially normal to the axes of the tubes and movable in paths substantially parallel to the axes of said tubes, means for supporting the lowermost tube support, and means
85 for guiding said superimposed tube supports during said movements.

19. In a heater, a chamber, a bank of tubes extending in a substantially horizontal plane within said chamber, a floating support for said
90 tubes extended transversely thereof, a rest beneath said support and guides extending in alignment with one another and substantially vertical within said chamber and cooperating with said support for guiding the latter during vertical and
95 horizontal movements.

20. In a heater, a walled chamber, a plurality of floating supports in said chamber supported from beneath, a plurality of tubes in said chamber carried by said supports, and guides for limiting
100 the movement of said supports in directions substantially parallel to the axis of said tubes, said supports also being movable in said guides in a direction normal to the axes of said tubes.

21. In a heater, a chamber, a bank of tubes located within said chamber and a floating support for said tubes comprising a plate engageable
105 with said tubes, means providing a rest upon which the lowermost end of said plate bears, and stationary guide means for the plate for limiting movement of the plate in at least two planes and
110 for providing sufficient clearance between the plate and guides to permit of a predetermined limited movement of the plate along three intersecting axes.

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