Sept. 29, 1925. 1,555,646

W. L. R. EMMET

LIQUID HEATER

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Fig. 1.

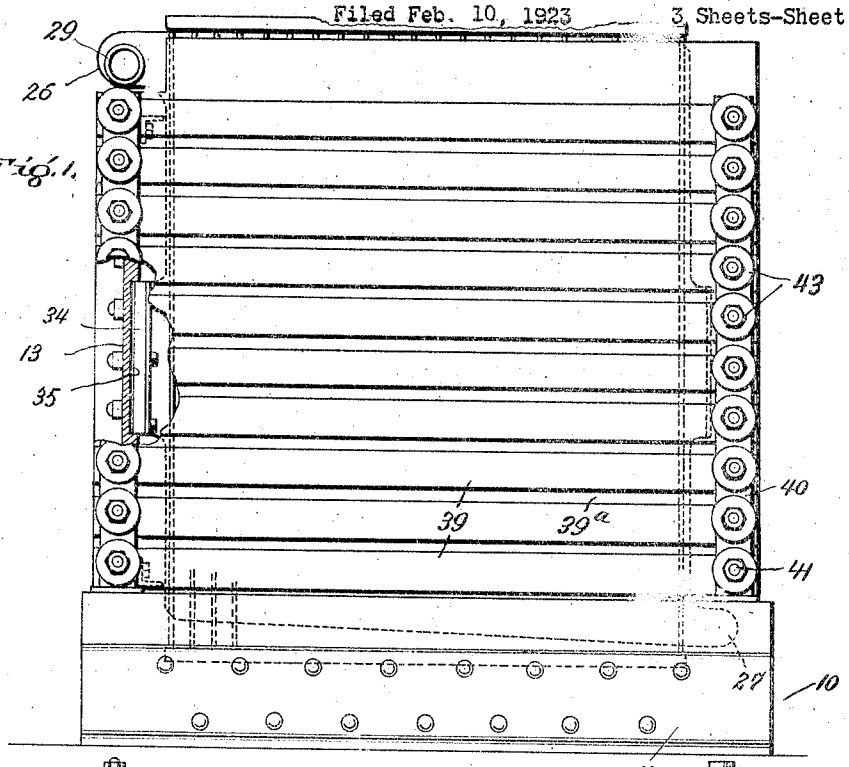
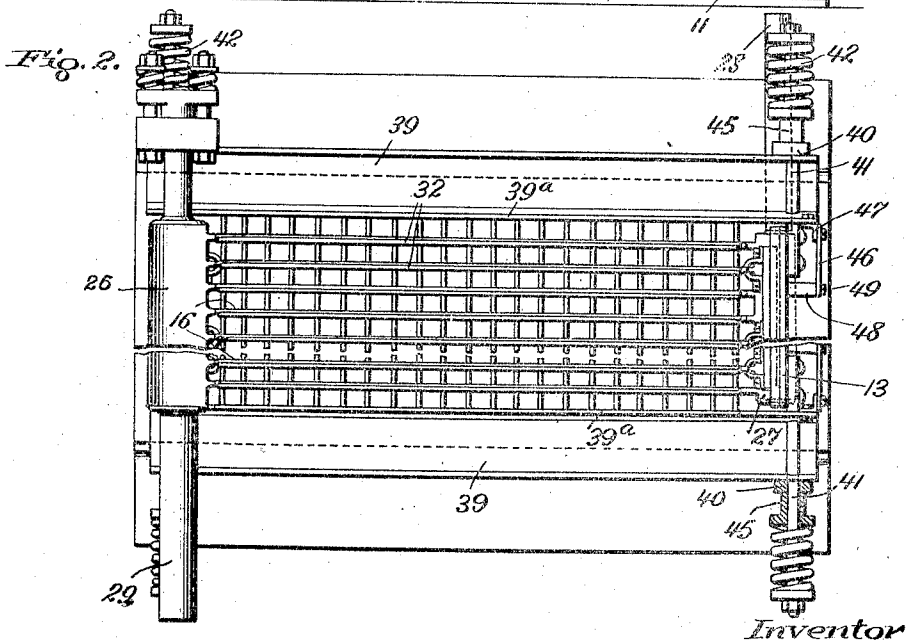


Fig. 2.



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Fig. 3.

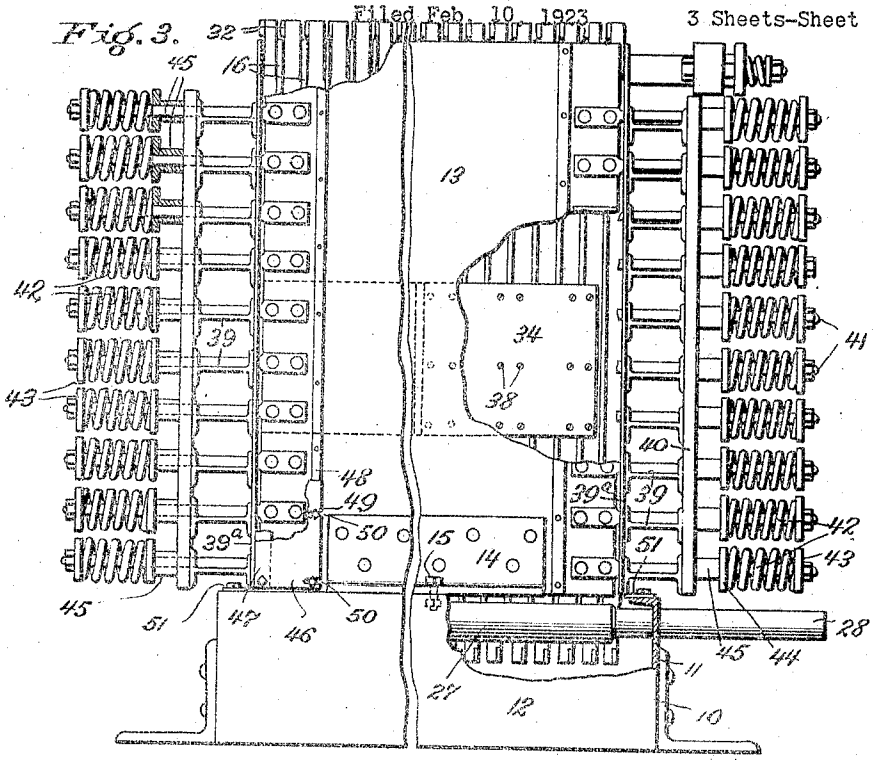


Fig. 4.

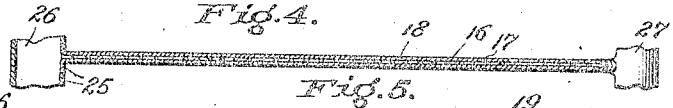
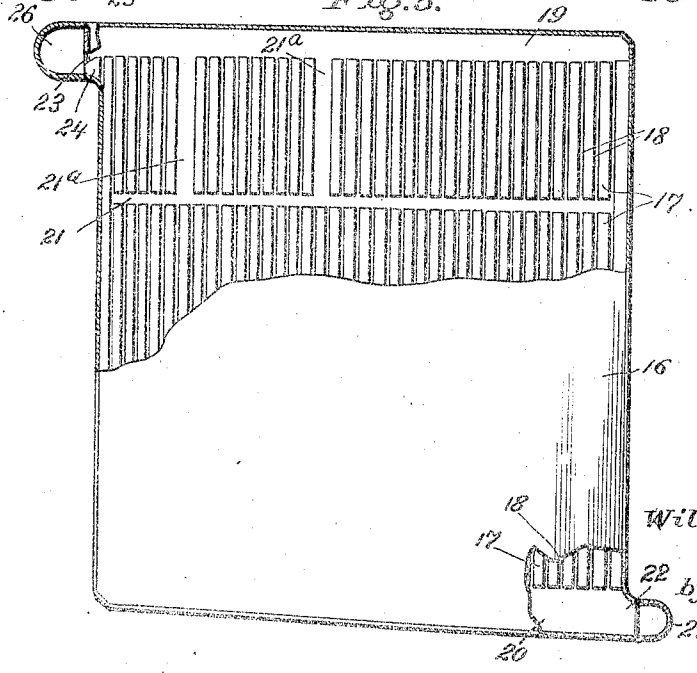


Fig. 5.



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LIQUID HEATER

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Fig. 6.

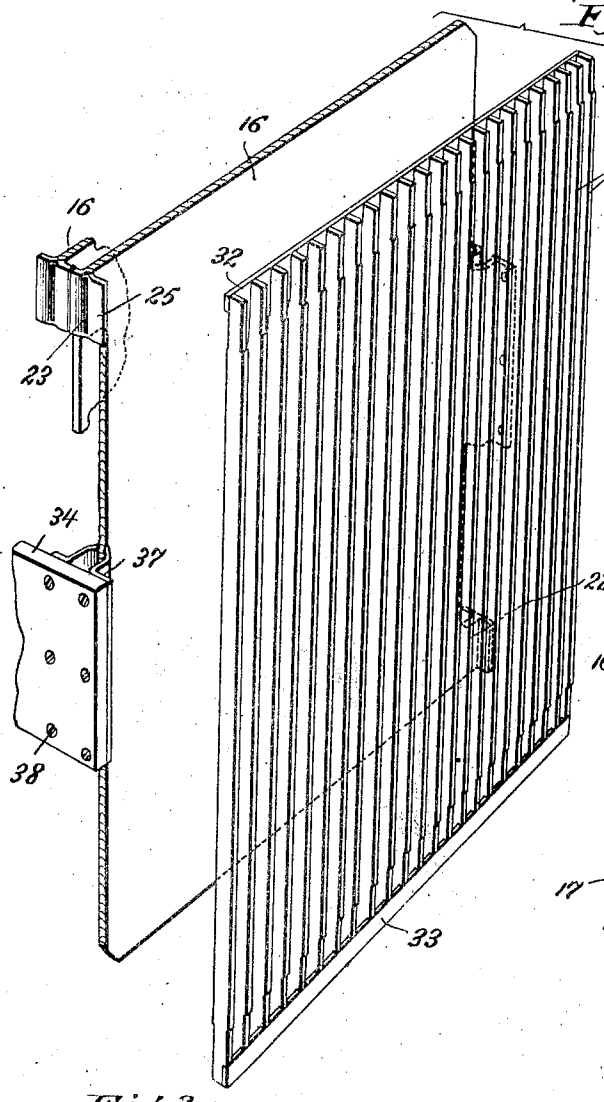


Fig. 7.

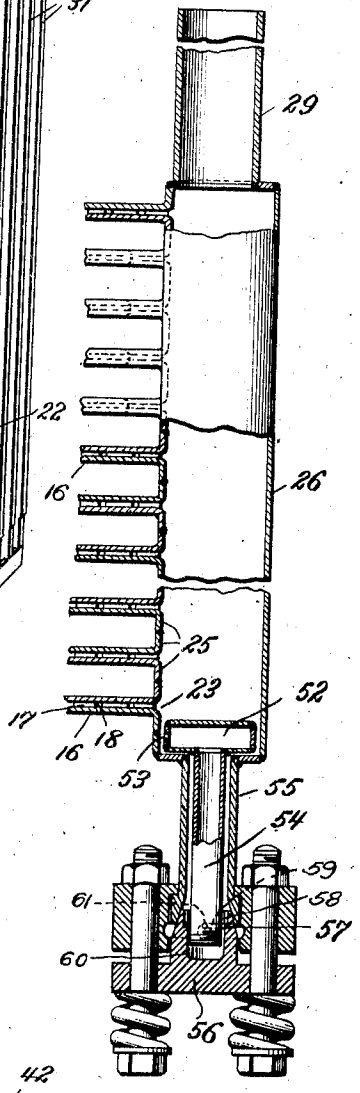
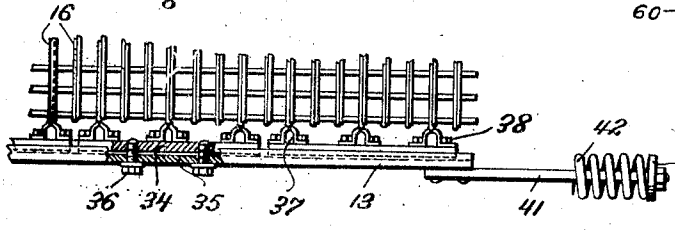


Fig. 8.



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Patented Sept. 29, 1925. 1,555,646

UNITED STATES PATENT OFFICE.

WILLIAM L. R. EMMET, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

LIQUID HEATER.

Application filed February 10, 1923. Serial No. 618,377.

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Liquid Heaters, of which the following is a specification.

The present invention relates to liquid heaters and particularly to heaters for heating a liquid used to feed a boiler in a power house, the heat utilized being that of the furnace gas after the gas has passed through the boiler. An application of my invention is the heating of the feed mercury used to supply mercury to the mercury boiler of a mercury turbine system such as that disclosed in my Patent Number 1,167,158, dated January 4, 1916, and features of my invention are particularly well adapted for this application. It will be understood, however, that my invention is not necessarily limited to this use.

A liquid heater for a liquid such as mercury must be so constructed that the liquid spaces are small because of the small amount of liquid used in the system and the necessity of a rapid transfer of heat to the liquid. At the same time the temperatures involved are high. Furthermore, it is very important that the heater be absolutely tight and free from leaks. These requirements offer great difficulties in actual practice for the spaces must be kept filled to prevent overheating and all joints must be kept tight and so constructed as not to be affected by expansion and contraction.

The object of my invention is to provide an improved heater of the above referred to type, and for a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing, Fig. 1 is an end view of a heater embodying my invention, a fragment at one side of the view being broken away to show the parts behind; Fig. 2 is a top plan view, the central portion being broken away; Fig. 3 is a side view with certain parts broken away; Fig. 4 is a transverse sectional view of one of the liquid grids; Fig. 5 is a side view of a grid with one wall partly broken away; Fig. 6 is a perspective view of adjacent grids and a separator; Fig. 7 is an enlarged detail view partly in section of the upper header and a clean-out means for the boiler, and Fig. 8 is a top plan detail view of certain parts.

Referring to the drawing, 10 indicates a hollow rectangular base which is formed of angle irons, the end walls of the base being indicated at 11 and the side walls at 12. At 13 are rectangular plates which form the side walls of the heater. Plates 13 are provided at their lower ends with angle bars 14 which rest on side walls 12 and are fastened thereto each by a single centrally located bolt 15. This arrangement permits the side plates to expand and contact freely relatively to the base.

Located between side plates 13 are spaced grids 16 through which the liquid to be heated flows. Referring particularly to Figs. 4, 5, 6 and 7, each grid comprises two plates welded together at their edges and held in spaced relation to each other by spacing strips 17, which define a series of spaced vertical passages 18 between the two plates. Strips 17 terminate short of the top and bottom of the grid to provide transverse passages 19 and 20. They are also interrupted adjacent their upper ends to provide a transverse passage 21 and two or more enlarged vertical passages 21^a. At one lower corner is an admission opening 22 which communicates with passage 20 and at the diagonally opposite upper corner is a discharge opening 23 which communicates with passage 19. In opening 23 is a dam 24 which serves to define the liquid level in the grid. At the edges of openings 22 and 23 are flanges 25 and when the grids are assembled in spaced relation to each other flanges 25 are welded together and into the open side of a trough shaped member to provide upper and lower headers 26 and 27. Connected to lower header 27 is an inlet pipe 28 and connected to upper header 26 is a discharge pipe 29. The grids are held in spaced relation to each other by separators or frames 30 each of which comprises a number of flat strips 31 held in spaced relation to each other by upper and lower cross pieces 32 and 33 to which the edges of the strip are suitably fastened.

The grids are supported on side walls 13 by means of a series of plates 34 which lie in transverse grooves 35 in the side walls. The plates 34 in each groove 35 are best

shown in Fig. 8, the middle plate being fastened by bolts 36 and the others being free to expand and contract and move along the groove. Plates 34 are slightly spaced apart so they may move independently of each other. Only part of the grids are connected to the plates, every fourth one being shown connected in the present instance, the connection being made by holders 37 which are welded to the edges of the grids and fixed to plates 34 by bolts 38.

Grids 16 and separators or frames 30 are assembled between side plates 13 and are held in engagement with each other by end walls which are yieldingly connected to the side walls, the arrangement being such that while the end walls hold the grids and separators tightly together to prevent the walls of the grids from spreading there is sufficient yield in the connection to permit of expansion and contraction due to temperature changes. The end walls are required to be strong to prevent bulging and may with advantage be constructed of a series of I beams 39 mounted between end plates 39ª and vertical end bars 40. This gives a rigid wall structure which at the same time is comparatively light in weight. The end structures are supported by a series of rods 41 which pass through openings in bars 40, the webs of I beams 39 and end plates 39ª and are fastened at their inner ends to the edges of side walls 13. The outer ends of rods 41 are surrounded by springs 42 located between washers 43 at the ends of the rods and flanges 44 on spacing sleeves 45. Sleeves 45 surround rods 41 and at their inner ends bear against end bars 40. By this arrangement the end walls are yieldingly connected to the side walls by rods 41 and springs 42.

To prevent leakage at the corners of the heater when the side walls move away from the end walls I provide sealing plates 46 bolted to end plates 39ª as indicated at 47 and slidingly engaging supports 48 fixed to side plates 13. Sealing plates 46 are maintained in sliding engagement with supports 48 by bolts 49, the edges of the plates having slots 50 through which bolts 49 pass. Fixed on the end walls 11 of base 10 are thin plates 51 which serve to prevent leakage at these corners.

In header 26 (see Fig. 7) is a box 52 provided with a slot 53 in one side, and connected to box 52 is a short pipe 54 having a threaded end. Pipe 54 is housed in a tube 55 closed at its end by a cap 56. By removing cap 56 and attaching an air hose to pipe 54 the heater may be cleaned by blowing air through the grids, box 52 being moved along header 26 to bring slot 53 successively in line with the openings 23 to the grids. When cap 56 is in place, pipe 54 is locked to it by a bayonet connection 57 which serves to hold box 52 in the position shown in the drawing.

The bayonet connection 57 comprises a longitudinal slot 58 in the cap 56, which slot terminates at one end at the inner end of the cap 56. At its opposite end the slot 58 terminates in a groove 59 in the wall of a well 60, into which well the outer end of pipe 54 extends when in the position shown. A pin 61 carried by the pipe 54 is made to lock into the groove 59 by inserting the cap 56 in the end of tube 55 in such a position that the pin 61 moves through the slot 58 and enters the groove 59. By rotating the cap 56 to the position shown, the pin 61 is then made to move along the groove 59 out of alignment with slot 58 and lie therein as shown in the locked position. Being thus locked to cap 56, the box 52 and pipe 54 are prevented from accidentally being moved out into the header 26 and obstructing the same while the heater is in operation.

The heater may be mounted in any suitable manner with respect to a furnace, the arrangement being such that the flue gases enter at the top, flow through between the grids and out at the bottom. The liquid to be heated flows through pipe 28 to header 27 and from the header is fed through the openings 22 to grids 16, the grids being fed all in parallel. The liquid entering a grid flows along passages 20 and from it vertically upward through all the passages 18 to passage 19 from which it flows over dam 24 to outlet header 26 and thence to discharge pipe 29. Liquid in flowing through the grids is thus divided into a large number of small streams which are brought into contact with the heating surfaces of the grids so that a rapid exchange of heat takes place. Or, viewed from another aspect, the provision of the spacing strips 17 gives an extensive surface with which the liquid comes in contact for transfer of heat from the gases to the liquid. In some instances, a small amount of vapor may be formed in the grids, and passages 21 and 21ª are provided so that any circulation in the grids due to the formation of vapors will be confined to the upper portions of the grids. If vapors are formed in a grid, the boiling of the liquid is likely to cause a rapid flow in the passages 18 where boiling occurs and a down flow in other adjacent passages, and if passages 21 and 21ª were not present, the result would be a down flow of liquid in some passages from the top to the bottom of the grid. By providing passages 21 and 21ª any such circulation in a grid is confined to the top of the grid. Dam 24 serves to maintain the liquid level in the grid above the tops of spacing strips 17 and prevents the sides of the grids next the outlet opening 23 from robbing the other side of liquid.

The grids and separators are not fastened to each other but are only stacked together and held by the yielding end walls. This arrangement, while it holds the grids and

separators in firm engagement with each other, permits them to expand and contract freely. A heater of this type is usually not very wide so that the expansion parallel to the end walls is not great and no special provisions are required necessarily to take care of it; however as will be clear from the drawing, the separators and the major portion of the grids are free to expand in this direction, being mounted in spaced relation to side walls 13.

In connection with the grid structure, the strips 17 are preferably connected to only one of the side plates of the grid so that should any bulging of the side plates of a grid occur, no connections will be broken or the grid in any way damaged. However, the end walls hold the grids and separators in such firm engagement that it would be only under unusual circumstances that bulging would be liable to occur.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the invention shown is only illustrative and that the invention may be carried out by other means.

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

1. In a liquid heater, the combination of side walls, end walls, liquid grids between said walls, means which serves to hold said grids in spaced relation and means forming a yielding connection between the side walls and the end walls which permits expansion and contraction to freely take place in the direction of the end walls, and which maintains said end walls in clamping engagement with the grids.

2. In a liquid heater, the combination of side walls, end walls, liquid grids and separators between said walls, certain of the grids being supported by the side walls, the end walls being movable toward and away from each other and yielding means connected between the side walls and the end walls for moving the latter toward each other into clamping engagement with the adjacent grids thereby maintaining the grids and separators in firm engagement with each other.

3. In a liquid heater, the combination of side walls, end walls yieldingly connected to the side walls, and liquid grids and separators between said walls and held in engagement with each other by the end walls.

4. A liquid heater comprising end walls and side walls, grids located between said walls, the end walls being in clamping engagement with said grids, separators holding said grids in spaced relation to each other and defining passages for a heating medium, said separators and grids being free to expand and contract independently of each other, and admission and discharge headers connecting said grids in parallel.

5. A grid for a liquid heater, said grid comprising two plates having longitudinal and transverse edges, fastened together in spaced parallel relation to each other along said edges, a plurality of spaced substantially parallel strips between the plates extending longitudinally thereof to form a plurality of longitudinally extending passages therebetween, said strips terminating short of the transverse edges, whereby are formed transverse passages connecting the ends of the first-named passages, and said strips being interrupted adjacent and substantially parallel with one of said transverse passages to form an intermediate transverse passage also connecting said first-named passages.

6. A grid for a liquid heater, said grid comprising two plates having longitudinal and transverse edges fastened together in spaced parallel relation to each other along said edges, a plurality of spaced substantially parallel strips between the plates extending longitudinally thereof to form a plurality of longitudinally extending passages therebetween, said strips terminating short of the transverse edges, whereby are formed transverse passages connecting the ends of the first-named passages, said strips being interrupted adjacent and substantially parallel with one of said transverse passages to form an intermediate transverse passage also connecting said first-named passages, and that portion of certain of the strips between the intermediate transverse passage and the more adjacent transverse end passage being removed whereby certain of the longitudinal passages are enlarged between said last-named transverse passages.

7. A grid for a liquid heater, said grid comprising two plates having longitudinal and transverse edges fastened together in spaced parallel relation to each other along said edges, a plurality of spaced substantially parallel strips between the plates extending longitudinally thereof to form a plurality of longitudinally extending passages therebetween, said strips terminating short of the transverse edges, whereby are formed transverse passages connecting the ends of the first-named passages, said strips being interrupted adjacent and substantially parallel with one of said transverse passages to form an intermediate transverse passage also connecting said first-named passages, and that portion of certain of the strips between the intermediate transverse passage and the more adjacent transverse end passage being removed, and means in opposite edges of the grid having flanged openings and providing conduit connections for the grid.

8. In a liquid heater, the combination of a base, a casing on the base, said casing comprising vertical side and end walls, the latter being movable and resiliently connected with the side walls, a plurality of parallel liquid-conducting grids in the casing, separators holding said grids in spaced relation to each other and defining passages for a heating medium, said separators and grids being clamped together between the end walls, transversely slidable supporting means for the grids carried by the side walls, and liquid admission and discharge headers connecting said grids in parallel.

9. In a liquid heater, the combination of a base, a casing on the base, said casing comprising vertical side walls which are secured to the base substantially midway of the length of their lower edges and movable vertical end walls, means forming a resilient connection between the side walls and the end walls for pressing said end walls inwardly of the casing toward each other, a plurality of parallel liquid-conducting grids in the casing, separators holding said grids in spaced relation to each other and defining passages for a heating medium, said separators and grids being clamped together between the end walls, supporting means for the grids carried by the side walls, said means comprising transverse grooves in the side walls and plates which lie in said grooves, and liquid admission and discharge headers connecting said grids in parallel.

10. In a liquid heater, the combination of a base, a casing on said base, said casing comprising vertical side and end walls, the side walls being secured to the base substantially midway of the length of their lower edges, means forming a resilient connection between the side walls and the end walls for pressing the end walls inwardly of the casing toward each other, said means comprising a series of rods joining the vertical edges of the side walls and extending outwardly therefrom in the planes of said walls, a spring on each rod and a series of I-beams pressed by the springs into engagement with the end walls, a plurality of parallel liquid-conducting grids in the casing, separators holding said grids in spaced relation to each other and defining passages for a heating medium, said separators and grids being held in clamped engagement with each other by the end walls, supporting means for the grids carried by the side walls, said means comprising transverse grooves in the side walls and plates which lie in said grooves, certain of said plates being secured in said grooves and certain other of said plates being slidable in said grooves, and liquid admission and discharge headers connecting said grids in parallel, said headers each comprising a trough-shaped member having an open side and flanges adjacent openings in the grids, which flanges are joined together and to the member to close said open side.

In witness whereof, I have hereunto set my hand this 9th day of February, 1923.

WILLIAM L. R. EMMET.