March 28, 1933. A. B. MODINE 1,903,125

RADIATOR

Filed Dec. 26, 1930 2 Sheets-Sheet 1

Fig. 1.

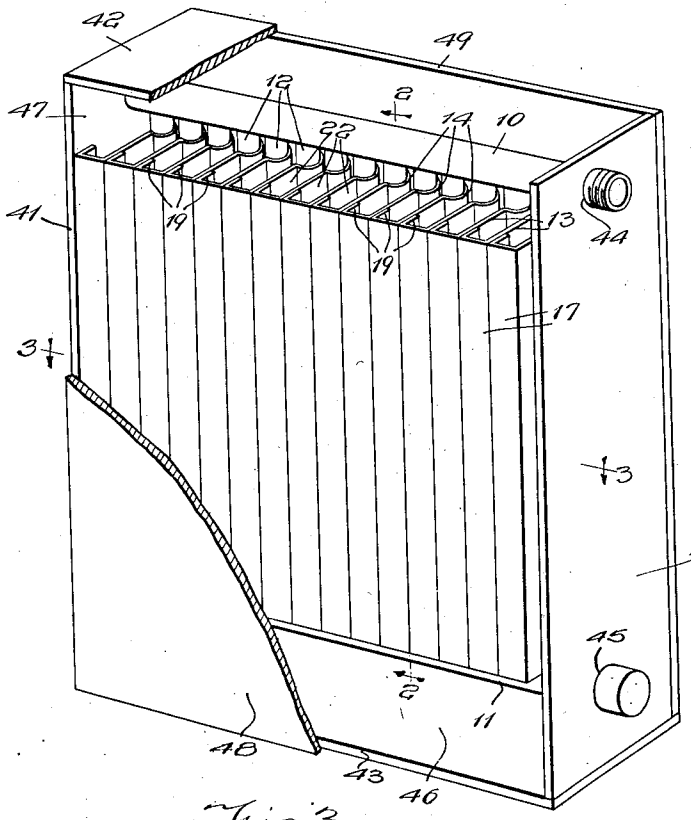


Fig. 2.

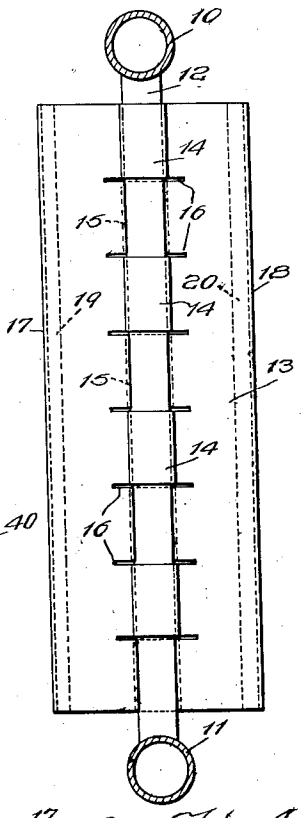


Fig. 3.

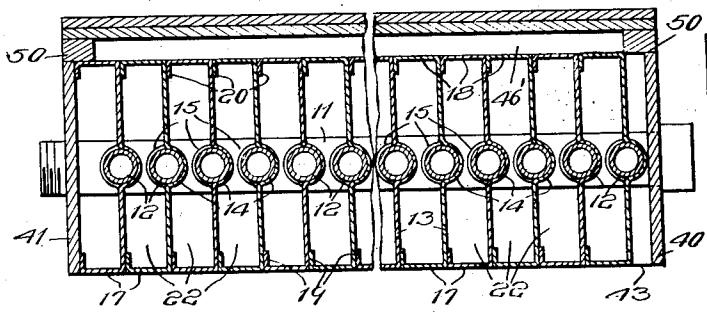
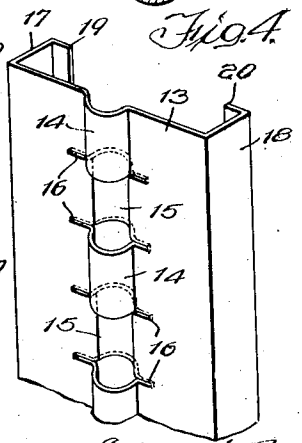


Fig. 4.



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Fig. 5.

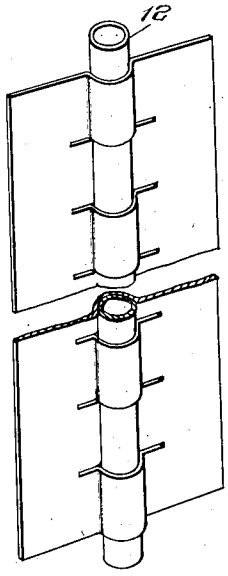


Fig. 6.

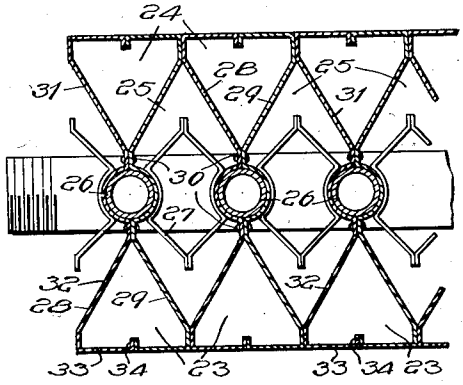


Fig. 7.

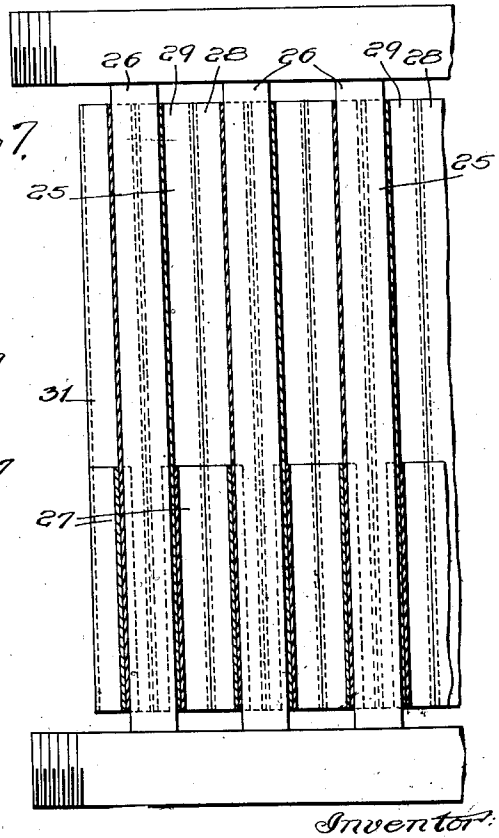
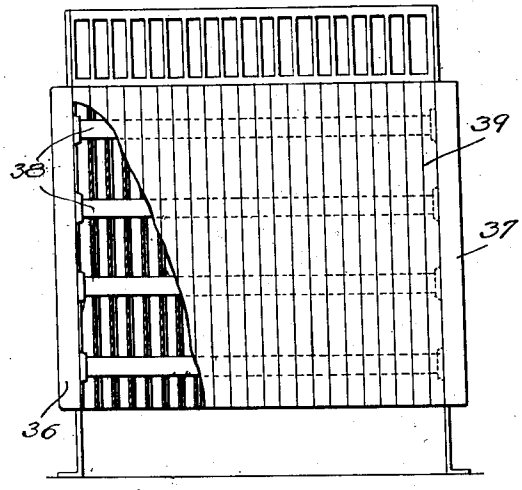


Fig. 8.



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UNITED STATES PATENT OFFICE

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RADIATOR

Application filed December 26, 1930. Serial No. 504,717.

The invention relates to heat transferring devices and has among its principal objects the provision of an element for conducting heating media providing direct means for transferring heat and having combined therewith a member providing an indirect heating surface, the latter being heated by the former by conduction.

It is another object of the invention to construct the means providing the indirect heating surface to produce ducts through which air may travel, be heated and be discharged therefrom in a heated condition.

Another object of the invention is to provide the structure with means compensating for relative expansion and contraction of the elements.

The invention has as a further object constructing the indirect heating surfaces in a manner so that a heat radiating surface is produced.

Another object of the invention is to construct the indirect heating surfaces so that air passages are produced, said surfaces having portions which engage each other to thereby induce heat to one from the other and provide heat radiating surfaces.

Another object of the invention is to employ a tube for heating media and to associate therewith a plate providing an indirect heating surface, the two being in intimate contact wth each other longitudinally of the tube.

Another object of the invention is to employ a tube and plate such as just referred to and construct the plate so that a unit may be produced, the unit having a plurality of ducts through which air may circulate and be heated.

Another object of the invention is to provide a shipping crate for the structure and to employ certain elements of the crate to produce means whereby air is induced to contact and flow in a manner to be heated by the device.

The invention has these and other objects, all of which will be explained in detail and more readily understood when read in conjunction with the accompanying drawings which illustrate various embodiments of which the invention is susceptible, it being understood that various changes and modifications may be resorted to without departing from the spirit of the appended claims forming a part hereof.

In the drawings, Fig. 1 is a perspective view of a heat exchange device embodying the features of the invention;

Fig. 2 is a section taken on the line 2—2 of Fig. 1, with the crate removed;

Fig. 3 is a section taken on the line 3—3 of Fig. 1 showing certain portions of the structure shown in Fig. 1 rearranged;

Fig. 4 is a perspective view of one of the indirect heating surfaces illustrated in Figs. 1 to 3;

Fig. 5 is a perspective view of another indirect surface which may be employed;

Fig. 6 is a transverse sectional view of a radiator showing another modification which may be resorted to and having auxiliary radiating means associated therewith;

Fig. 7 is a front elevation partially in section of the device shown in Fig. 6; and

Fig. 8 is a front view of another arrangement which may be resorted to.

By referring to Figs. 1, 2 and 3 and particularly Fig. 1, it will be noted that fluid supply pipes or manifolds 10 and 11 are employed which are connected to the supply and return of a heating system, not shown. A plurality of vertically parallelly arranged tubes or direct heating surfaces 12 are employed which have their opposite ends connected with the manifolds 10 and 11, to thus have heating media supplied thereto from one of said manifolds. Each of these tubes 12 has a plate 13 providing an indirect heating surface associated therewith, the indirect surfaces 13 being in intimate contact with the tubes 12 so that the heat of the direct surfaces or tubes 12 is induced to the indirect surfaces 13.

Each of the indirect surfaces 13 is provided with means whereby association of the tubes or direct surfaces with the indirect surfaces is facilitated. To this end, each of the indirect surfaces 13 is provided with oppositely extending recessed portions 14 and 15 most clearly shown in Fig. 4. These oppositely facing recessed portions conform to the out-

line of the tube and allow the tube to be introduced to these recesses to associate the direct heat radiating surface with the indirect surface and form intimate contact therewith, it being understood that the tubes and indirect surfaces 13 may be brazed or otherwise secured against displacement relative to the tubes.

It will be noted by referring to Fig. 4 that the plates or indirect surfaces 13 are each provided with slits such as 16 which provide means for compensating for relative expansion and contraction of the tubes and plates 13. It will further be noted by referring to Fig. 4 that the recesses 14 and 15 are in the present instance arranged longitudinally of the elements or plates 13 and at the center between the longitudinal edges thereof and that each of said indirect surfaces is bent laterally at its marginal edges to provide the parallel walls 17 and 18 and are again bent or otherwise formed to provide the flanges 19 and 20. It is understood that the flanges 19 and 20 of one indirect heating surface 13 are arranged in contact with a similar portion of an adjacent surface 13 and thus produce the parallel passages 22 which are parallel with the tubular elements 11 and thus provide means whereby air may be circulated through the device, be heated and be discharged therefrom in this last mentioned condition.

It is manifest that when the portions such as 19 and 20 of one indirect surface are arranged in contacting relation in the manner above described the portions 17 and 18 provide means for heating by radiation.

It is manifest that the structure just described including the tubular elements 12 and the plates or indirect surfaces generally designated 13 provide a simple arrangement whereby the heat of the heating fluid supplied to the tubes 12 is transmitted by conduction to the indirect surfaces such as those generally designated 13.

It is further manifest that the individual indirect surfaces 13 include a construction which when associated with an adjacent indirect surface produces air passages 22 through which air may travel and become heated. It is also evident that the portions such as 17 and 18 also become heated and thus will heat air contacting with these portions.

It is further evident that by the provision of the means 16 that direct and indirect surfaces having different coefficients of expansion may be associated with each other and the relative difference of expansion compensated for.

The structure shown in Fig. 5 substantially corresponds to that shown in Figs. 3 and 4, however, differs therefrom in that the structure shown in Fig. 5 contemplates the elimination of the portions such as 17, 18, 19 and 20, shown in Fig. 4.

By referring to Figs. 6 and 7, it will be seen that a slightly different form of indirect heat radiating surface is illustrated, which, however, embodies the same principles as those described in connection with the previous structures. The construction illustrated in Fig. 6 produces a plurality of parallel independent air passages upon opposite sides of the heating fluid conducting tubes with an air duct between the tubes 26 and the first mentioned passages. These passages are respectively designated 23, 24 and 25. This structure also contemplates the utilization of auxiliary indirect heating means which is generally designated 27, the latter being interposed between the direct heating surfaces 26 and within the air passage generally designated 24. It is understood that the same means for connecting the direct and indirect surfaces with each other as explained in connection with the preceding structures may be employed and that compensating means such as 16 may also be used to compensate for the difference of expansion and contraction between the direct and indirect heating surface. Since the construction of one indirect heating surface associated with one of the direct surfaces in the structure shown in Fig. 6 corresponds to that of another, it is believed that the description of one indirect surface will suffice for an understanding of the construction of the remaining indirect surfaces. In the structure shown in Fig. 6 a plurality of pairs of plates are utilized, the plates being respectively designated 28 and 29. These plates may be connected with each other by spot welding, riveting or any other method as indicated at 30. The plates 28 and 29 are formed to provide the diverging portions 31 and 32 and the portions 33 and the portions 34. It is therefore evident that when one plate or surface 28 is associated with another such as 29 that air passages such as 23 and 24 are formed on the opposite sides of the direct surface or tubular member 26. It is also evident that when one pair of plates such as 28 and 29 is arranged upon an adjacent tube 26 that an air space or passage 25 is provided.

As before stated, this structure may have auxiliary heating means such as 27 associated therewith and arranged in the air passages 25 between the tubular passage or direct surfaces 26 and 27 in contact therewith so that this auxiliary means 27 may be heated by induction by virtue of its contact with said tubular passages or direct surfaces.

In Fig. 8, another form is illustrated in which vertically disposed headers or manifolds 36 and 37 are employed having transversely arranged direct heating surfaces or tubular elements 38 connecting the headers with each other. This last mentioned structure contemplates arranging indirect surfaces, generally designated 39 in contacting relation with the direct surfaces, it being understood that the indirect surfaces may em-

body structures such as shown in Figs. 3, 5 and 6 to produce air passages and means for heating air by radiation.

As before stated, it is contemplated to employ the crate in which the heating unit is shipped as a casing to induce air to flow through the tubular passages above referred to. This crate which forms the case is comprised of sections 40, 41, 42 and 43, it being understood that the sections 40 and 41 are apertured as indicated at 44 and 45 to receive the ends of the headers or manifolds 10 and 11. The apertures 44 and 45 are located a suitable distance inwardly of the ends of the sections 40 and 41 to thus provide a space 46 at the lower end of the crate or casing and a space 47 at the upper end of the crate or casing, it being understood that the ends of the manifolds 10 and 11 project a suitable distance beyond the faces of the sections 40 and 41 so that the manifolds may be coupled with the supply and return sides of the heating system. Suitable pieces of material 48 and 49 are nailed or otherwise fastened to the edges of the sections 40 to 43 on opposite sides of the sections and thus the entire heat radiating device is enclosed within the casing when ready for shipment. Prior to the setting up of the structure, the covering or material 48 is removed from this face to the crate and is placed along side the material 49 which will provide insulation and prevent the dissipation of heat through the adjacent wall of the building structure in which the device is set.

It is manifest that by tacking or otherwise securing a strip such as 50 to the edges of the sections 40 and 41 and then applying the material 48 and 49 thereto, that an air passage will be produced which is bounded on one side by said material and upon the other side by the adjacent wall of the heating unit and thus this wall of the heating unit may be employed to perform the work of heating air passing between it and the wall formed by the material 48 and 49.

It is evident that when the device is installed for use and the material 48 and 49 is arranged in the manner described, that the air passage 46′ is produced which will allow air to circulate through the structure and be discharged from the opening 47 which is capped by the section 42.

From the foregoing description it is evident that a unit comprised of a tube and plate is provided in which the plate is in direct contact with the tube to thus heat the plate. It is also manifest that when a unit comprised of these elements is arranged in co-operative relation to an adjacent similar unit air spaces are formed through which air may travel and become heated. In addition it can be seen that the face formed by the portions such as 17 and 18 provide means which will heat air by radiation.

Having thus described the invention what I claim and desire to cover by Letters Patent is:

1. In a device of the kind described, the combination of a pair of elements respectively providing direct and indirect heating surfaces, one of which is arranged longitudinally of the other and in direct engagement therewith, and means provided in the indirect surface compensating for expansion and contraction of one of said elements relatively to the other.

2. In a device of the kind described, the combination of a plurality of tubular elements providing passages for a heating media, a manifold arranged at the opposite ends of said tubular elements, members providing indirect heat transferring surfaces, said members being arranged longitudinally of said tubular elements and having an edge thereof in direct engagement therewith, with the opposite edge extended therefrom, and engaging an adjacent member and providing a wall of an air duct bounded by said indirect heat transferring members and fins engaging said tubes providing air passages located in said ducts.

3. In a device of the kind described, the combination of a plurality of tubular elements providing passages for a heating media, a manifold at the opposite ends of said tubular elements, plates providing indirect heat transferring surfaces, said plates being arranged longitudinally of said tubular elements and having portions in the same plane projecting in opposite directions from said tubular elements, said plates having the edges thereof formed to provide flanges for cooperation with the plates of adjacent tubular elements, to thereby provide air passages upon opposite sides of said tubular elements.

4. In a device of the kind described, the combination of a plurality of tubular elements providing passages for a heating media, a manifold at the opposite ends of said tubular elements, members providing indirect heat transferring surfaces, said members being arranged longitudinally of said tubular elements and projecting in opposite directions from said tubular elements in spaced relation to each other to thereby provide air passages upon opposite sides of said tubular elements, said members having means provided therein compensating for relative expansion and contraction of said elements and members.

5. In a device of the kind described, the combination of a plurality of tubular elements providing passages for a heating media, a manifold at the opposite ends of said tubular elements, members providing indirect heat transferring surfaces, said members being connected with and arranged longitudinally of said tubular elements and projecting in opposite directions from said

tubular elements in spaced relation to each other to thereby provide air passages upon opposite sides of said tubular elements, said members having means provided therein at said connection with said tubular elements compensating for relative expansion and contraction of said elements and members, said members having an edge thereof which is parallel with said tube formed to provide a wall of a duct extending parallel with said tube.

6. In a device of the kind described, the combination of a plurality of elements, each comprised of a plate and tube connected with each other and extending longitudinally of and in contact with each other and respectively providing direct and indirect heating surfaces, the indirect surface of one tube engaging a similar element of an adjacent tube and said elements cooperating with each other to provide a plurality of air passages of which one plate forms a wall for adjacent passages.

7. In a device of the kind described, the combination of a plurality of members, each member being comprised of a pair of elements respectively providing direct and indirect heating surfaces, the element providing the indirect surface having means provided therein for the reception of the other element and providing for the support of the indirect surface, said last mentioned surface having an edge contacting with an indirect surface of another direct heating surface and one of said indirect surfaces forming a wall of a plurality of open-ended ducts.

8. In a device of the kind described the combination of a plurality of tubular elements providing passages for a heating media, a manifold at the opposite ends of said tubular elements, a plate-like member connected with each of said tubular elements and extending in opposite directions from said tubular elements in spaced relation to each other, said plate-like members having opposed edges formed to provide flanges parallel with said tubes cooperating with the flange of an adjacent member to thereby provide a plurality of parallel open-ended ducts providing air passages.

In witness whereof I hereunto subscribe my name this 22nd day of December, A. D. 1930.

ARTHUR B. MODINE.