

Oct. 25, 1932.

A. B. MODINE

1,884,097

HEAT EXCHANGE DEVICE

Filed Oct. 14, 1929

3 Sheets-Sheet 1

Fig. 1.

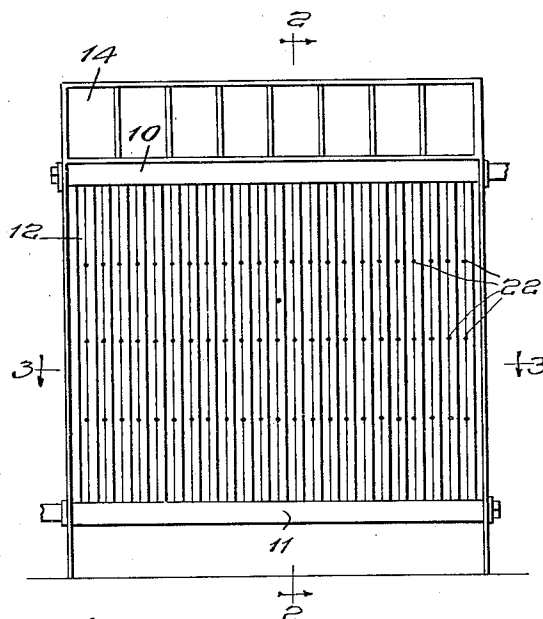


Fig. 2.

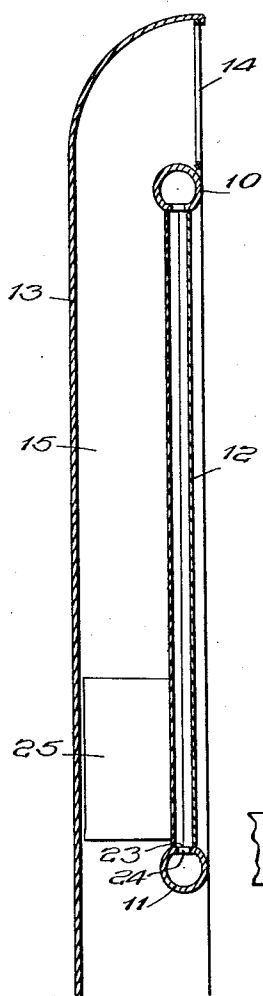


Fig. 13.

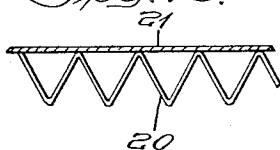


Fig. 3.

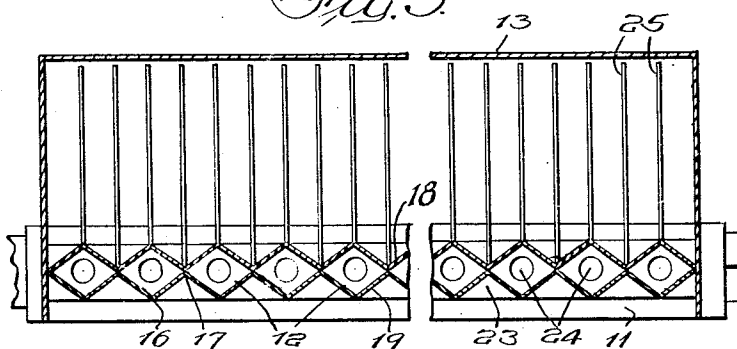
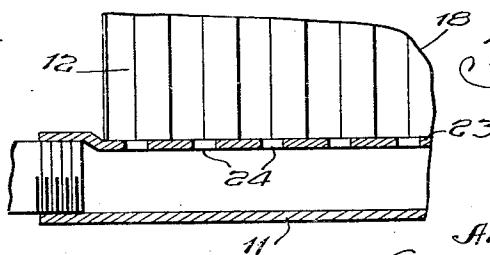


Fig. 4.



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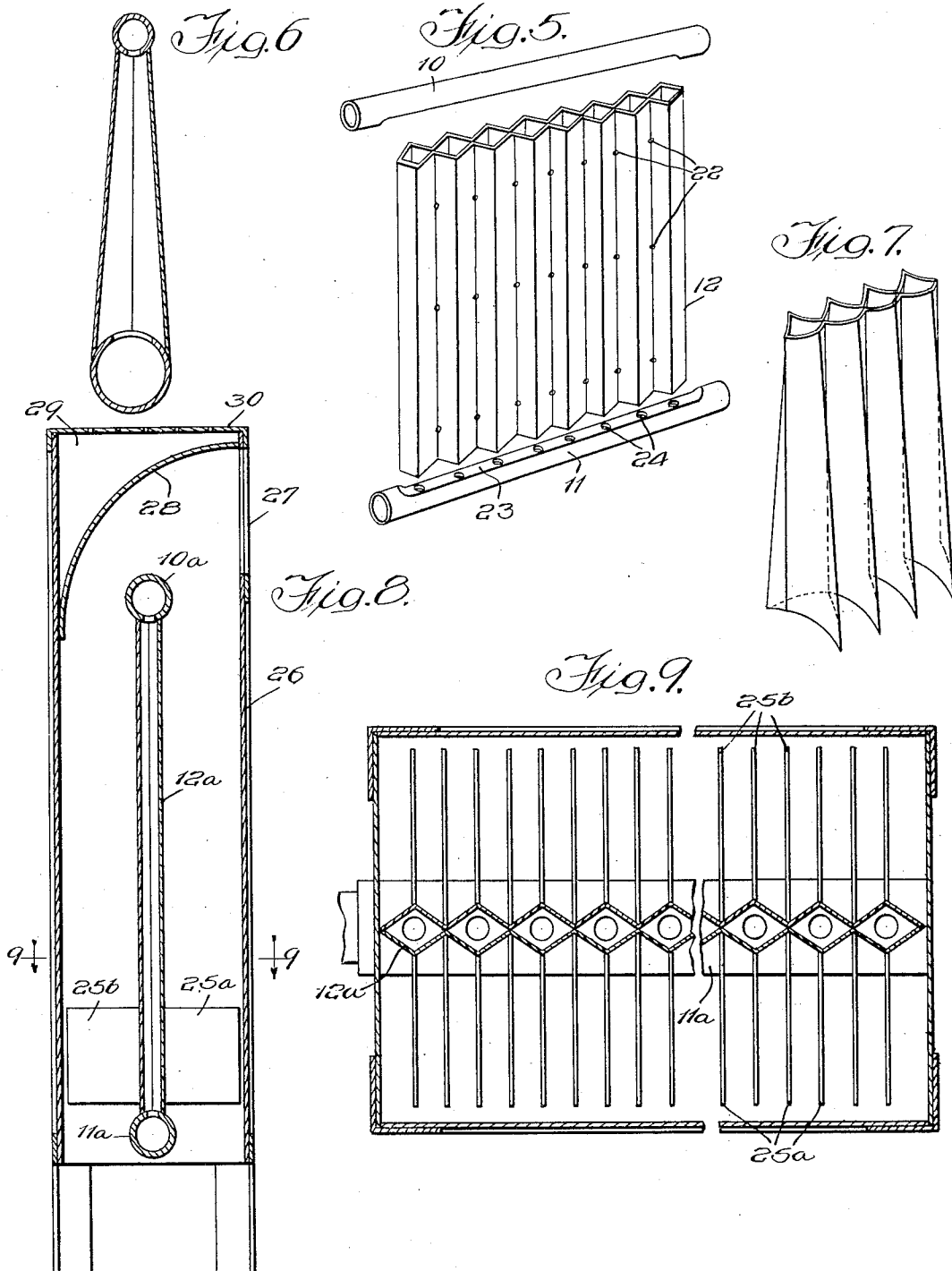
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HEAT EXCHANGE DEVICE

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3 Sheets-Sheet 2



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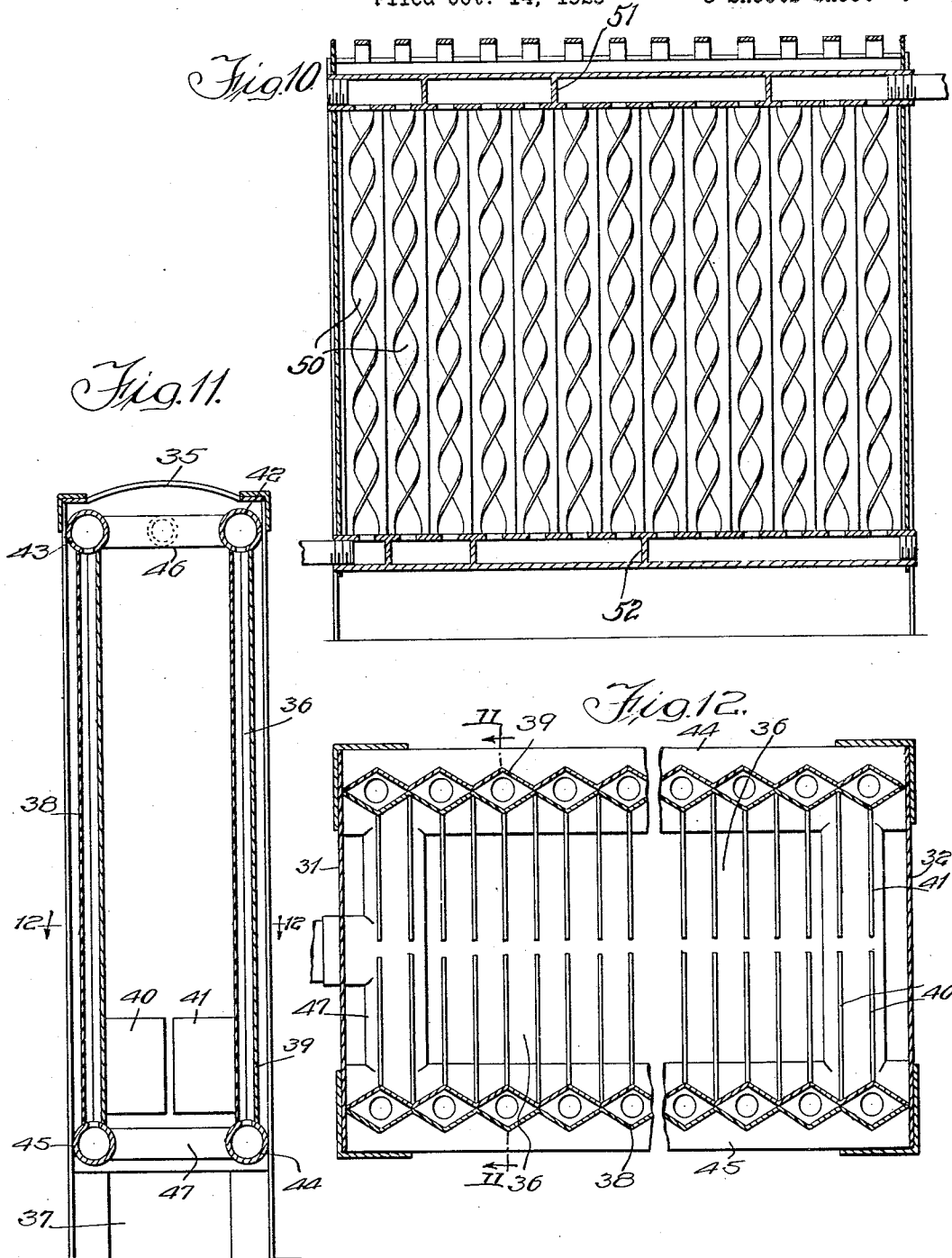
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HEAT EXCHANGE DEVICE

Filed Oct. 14, 1929

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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HEAT EXCHANGE DEVICE

Application filed October 14, 1929. Serial No. 399,507.

The invention relates to heat exchange devices and has among its principal objects the utilization of a relatively thin sheet of material fashioned in a manner to produce a plurality of separate fluid passages.

One of the objects of the invention is to employ a sheet fashioned or formed in the manner above outlined which, when associated with another preferably similar shaped portion produces fluid passages, the passages thus formed permitting the inlet and outlet passages connected with said first mentioned passages to expand and contract relatively to each other without resulting in a leak or break at the connection produced between the fluid passages and the inlet and outlet passages.

A further object of the invention is the provision of a device constructed according to the above and the association of heat exchange or radiating fins therewith, the fins being adapted to be arranged in the path of a current of air which travels through the casing in which the heat exchange device is located.

The invention has these and other objects, all of which will be more readily understood when read in conjunction with the accompanying drawings which show various forms of which the invention is susceptible, it being, therefore, obvious that other 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 front elevation of a heat exchange device embodying one form of the invention;

Fig. 2 is a section taken on the line 2—2 of Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 1;

Fig. 4 is a sectional view of a fragment of the structure shown in Figs. 1, 2 and 3;

Fig. 5 is a perspective view showing certain elements of the heat exchange device in separated relation to each other;

Fig. 6 is a sectional view of a modification;

Fig. 7 is a perspective view of one of the elements illustrated in Fig. 6;

Fig. 8 is a vertical section similar to Fig. 2 showing another modification which may be resorted to;

Fig. 9 is a section taken on the line 9—9 of Fig. 8;

Fig. 10 is a front elevation of still another modification;

Fig. 11 is a section taken on the line 11—11 of Fig. 12;

Fig. 12 is a section taken on the line 12—12 of Fig. 11; and

Fig. 13 is a sectional view of a fragment of still another construction which may be employed.

The structure shown in Figs. 1 to 5, inclusive, contemplates a heat exchange device having a fluid inlet 10 and fluid outlet 11 which are connected together by the transversely arranged fluid passages 12—12. This structure is designed to be arranged within a casing 13 having an outlet passage 14. The outlet fluid passage 11 of the structure is preferably arranged in spaced relation to the lower end of the casing 13 so as to provide a space for permitting the introduction of air into the casing 13. It will be noted that the fluid passages 12, in this structure, are arranged relatively to the casing 13 to provide one wall of the radiator unit and, therefore, will give off heat to the surrounding atmosphere contacting with the fluid passages 12 and also provide means whereby air may be heated as it passes through the passage 15 produced between a wall of the casing and the fluid passages 12. As before stated, it is one of the principal objects of the invention to construct the fluid passages 12 of a sheet of relatively thin gauged material which sheet is fashioned to produce said fluid passages when like portions of the same or a similar sheet are brought into proper relation with each other. To this end a sheet of relatively thin corrugated material is employed, the corrugations providing the alternate ridges 16 and the grooves 17. It is evident that when a sheet of this formation is bent intermediate its ends and the sections thereof respectively designated 18 and 19 are brought into the relation most clearly shown in Fig. 3 with the ridges and grooves of one

section located opposite the ridges and grooves of the other section, fluid passages such as 12 are formed. It is evident that this same construction may be produced by employing two separate sheets of similar formation and also that fluid passages such as 12 may also be produced by means of a sheet such as 20 formed to provide the alternate ridges and grooves and the flat sheet 21 most clearly shown in Fig. 13. When the parts 18 and 19 are brought into the relation thereof shown in Fig. 3, said sections are secured together in any convenient manner as for instance by spot welding the sections together as indicated at 22 in Fig. 5.

To facilitate connection of the tubular passages thus formed with the inlet and outlets 10 and 11, said inlet and outlet may be provided with a relatively flat face such as 23 to which the edges of the sheets forming said passages 12 are brazed or otherwise secured. The tubular sheets forming said passages 10 and 11 are further provided with a plurality of apertures 24 which, after the sheets or sections 18 and 19 are brought into the relation thereof shown in Fig. 3 to form or complete the passages 12 and are arranged in proper relation relatively to the tubular passages 10 and 11 and are secured thereto, to complete a communication between the inlet passage 10, tubular passages 12 and the outlet passage 11, it being understood that the inlet passage 10 is also provided with apertures similar to those designated 24 provided in the outlet passage 11. From the foregoing description of this portion of the structure, it is manifest that a structure is provided wherein the passages 12 are formed of relatively thin gauged corrugated sheet material which allows for expansion and contraction of the inlet and outlet without creating a break at the connection formed between these elements.

In Figs. 6 and 7, a modified construction which may be employed to produce the passages such as 12 is illustrated. This construction corresponds to that previously explained, excepting that the material forming the passages 12 is designed to produce a tapered fluid passage construction when viewed from an end as shown in Fig. 6. This latter construction permits a relatively larger outlet to be associated with the structure which, in some installations, is of advantage.

A structure composed of relatively thin gauged material and formed to produce the passages 12 may, when so desired, be provided with the heat exchange fins 25. In the embodiment of the invention shown in Fig. 1, these fins extend a suitable distance rearwardly relatively to the inlet 11 and are arranged at one side and above said inlet so that when a unit composed of the sections 18 and 19 and the fins 25 are arranged within a casing such as 13, said fins will

project into the path of air entering the casing, to thereby heat the air prior to its escape through the opening 14 of the casing.

In the structure illustrated in Figs. 8 and 9, fluid passages 10a and 11a are connected together by water passages 12a, the latter of which are formed of a sheet which corresponds in contour with the sheets forming the tubes 12. This structure differs from the structure shown in Fig. 2 in that the heat exchange unit includes fins 25a and 25b which are arranged to project in opposite directions from the structure forming the tubular passages 12a. In the structure shown in Fig. 8, the heat exchange device is arranged substantially centrally of the casing generally designated 26, the casing being provided with a discharge opening 27, a deflector plate 28 and a chamber 29. The chamber 29 is provided to produce a humidifier and is arranged in the path of the heated air as it travels through said casing so that the water contained in said chamber may become heated and escape through the cover 30 and humidify the air contained in the room in which the device is located. The cover 30 is removable from the casing 26 so that the chamber 29 may be recharged with water when this becomes necessary. In this structure just referred to, the inlet and outlet passage 10a and 11a are provided with apertures similar to the apertures 24 to complete a passage between the inlet and outlet and the tubular passages 12a.

The structure illustrated in Figs. 11 and 12 will now be described. The structure illustrated in these last mentioned figures differs from that previously described in that the previously referred to devices may, under certain conditions when found necessary, be arranged in a recess provided in a wall whereas the structure illustrated in Figs. 11 and 12 is designed to be located in any suitable portion of the room and give off heat from opposite sides thereof. This construction contemplates the provision of a casing comprised of end walls 31 and 32, the sides of which are formed by the heat exchange devices, the upper end such as 35 of that structure being open to allow the escape of heated air from the interior of the casing of the device. The heat exchange device is arranged to provide a space 37 at the lower end of the casing and the tubular passages 38 and 39 of the heat exchange device are arranged in separated relation to each other to provide an air chamber 36. This arrangement allows the cool air adjacent the floor to enter the casing, pass between the tubular passages 38 and 39 and be discharged through the open end 35 of the casing. This structure also contemplates utilizing fins such as 40 and 41 which are respectively connected to and extend inwardly from the tubular passages 38 and 39 and will, therefore, en-

gage the air as it passes through the casing to thereby heat the air. The tubular passages 38 and 39 are respectively connected with the inlet passages 42 and 43 and the outlet passages 44 and 45. The inlet passages 42 and 43 are connected together through the agency of a manifold 46 and the outlet passages 44 and 45 are similarly connected through the agency of a manifold 47.

By referring to Fig. 12, it will be seen that the tubular passages 38 and 39 of the structure illustrated in Figs. 11 and 12 correspond with the tubular passages described in connection with other structures, and therefore, a detailed explanation of these is deemed unnecessary.

The structure shown in Fig. 10 discloses a heat exchange device constructed according to those previously explained having combined therewith a plurality of circulators 50, one of which is arranged in each passage, the circulators being preferably of spiral formation so that the heating medium is caused to travel a tortuous path in contact with the walls of the tubular passages and thus add to the heating efficiency of the device. It is understood that this last mentioned construction may be combined with any of those previously explained. The structure illustrated in Fig. 10 also contemplates provision of baffle plates 51 and 52 which are respectively located in the inlet and outlet passages and are provided to direct and cause circulation of the heating medium through the heat exchange device.

From the foregoing description of the invention, it is evident that a structure is disclosed whereby a heat exchange device having a plurality of fluid passages is provided, the passages being produced by means of corrugated or other similarly formed sheets which, when arranged in the manner illustrated and described, form tubular passages through which the heating medium may flow from the inlet to the outlet and heat the surrounding atmosphere. It is further manifest that by providing heat radiating fins and arranging them in the path of current of air, that said air will also be heated prior to its being discharged into the room.

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

1. A heat exchange device comprised of apertured tubular members providing a fluid inlet and outlet, a member connected with said fluid inlet and outlet and providing means for conveying fluid from said fluid inlet to said outlet, said member being comprised of a pair of corrugated elements formed of relatively light gauged sheet material connected together to provide open ended tubular fluid passages, said apertured tubular members being arranged at and connected with the ends of said corrugated ele-

ments to thus provide said heat exchange device.

2. A heat exchange device comprised of tubular members providing a fluid inlet and outlet, a member connected with said fluid inlet and outlet and providing a plurality of fluid passages between said fluid inlet and outlet, said member being comprised of a pair of corrugated elements connected with each other to provide open ended fluid passages, the edges of the ends of said passages being connected with said first mentioned members to provide a radiator unit comprised of said tubular members and elements.

3. A heat exchange device including a member providing a fluid passage between a fluid inlet and outlet, opposed walls of said member being formed of elements having alternate ridges and grooves, the grooves of one wall being arranged opposite the groove of the other wall, the ridges of one wall being arranged adjacent the ridges of the other wall with said ridges connected with each other to thereby provide passages between the ridges, the opposite ends of said fluid passages being formed to cooperate with tubular members arranged transversely of said passage and providing said inlet and outlet.

4. A heat exchange device comprised of tubular members providing a fluid inlet and outlet, a corrugated member formed of relatively thin sheet material connected with said fluid inlet and outlet and providing tubular passages arranged lengthwise of said tubular members for conveying fluid from said fluid inlet to said outlet, the width of said tubular passages being less than the diameter of said tubular members.

5. A heat exchange device comprised of tubular members providing a fluid inlet and outlet, a corrugated member connected with said fluid inlet and outlet and providing means for conveying fluid from said fluid inlet to said outlet, and fins connected with said corrugated member, said corrugated member being formed of sheet material, the edges of the opposite ends thereof being connected with said tubular members.

6. In a heat exchange device, the combination of a casing, a corrugated member forming one wall of the casing, a fluid inlet and outlet connected with said member, said member being formed of material which is of a gauge substantially less than that of said fluid inlet and outlet, said member being spaced from a side and end wall of said casing to thereby provide means for conducting air through said casing.

7. In a heat exchange device, the combination of a casing, a corrugated member having a fluid inlet and outlet connected thereto, said corrugated member being located in said casing in spaced relation to a side and

end wall of said casing, fins extending in opposite directions from said corrugated member, said casing having an opening which communicates with the interior of the casing to thereby provide means for conducting air through said casing.

In witness whereof, I hereunto subscribe my name this 7th day of October, A. D. 1929.

ARTHUR B. MODINE.

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