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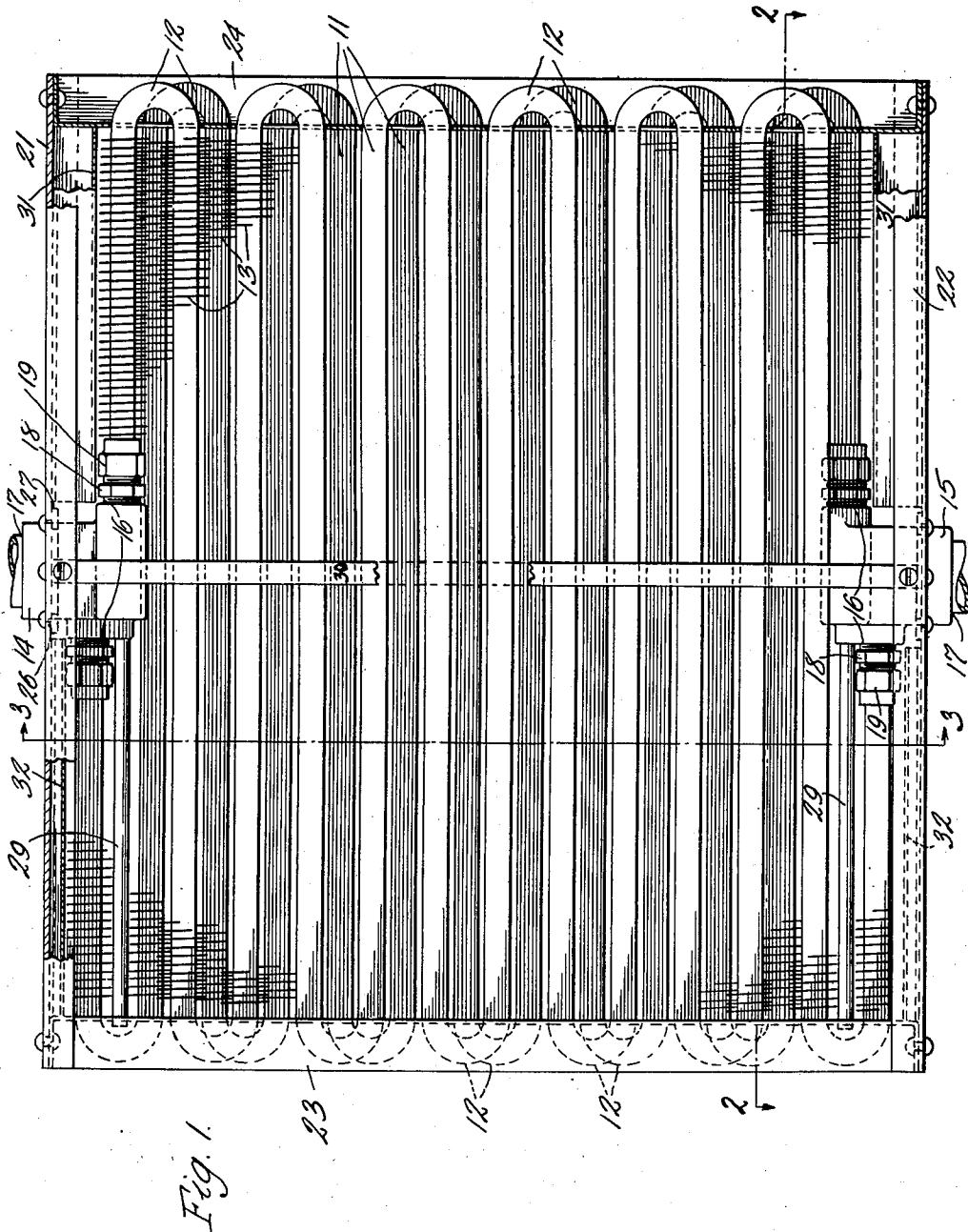
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1,832,147

HEAT EXCHANGE DEVICE

Filed Nov. 8, 1929

2 Sheets-Sheet 1



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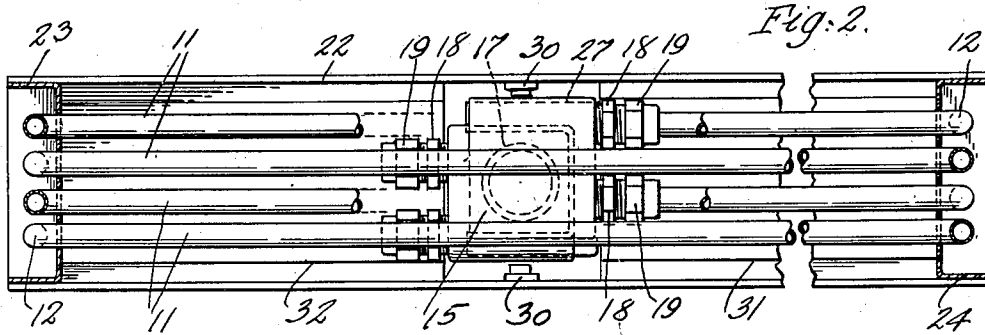
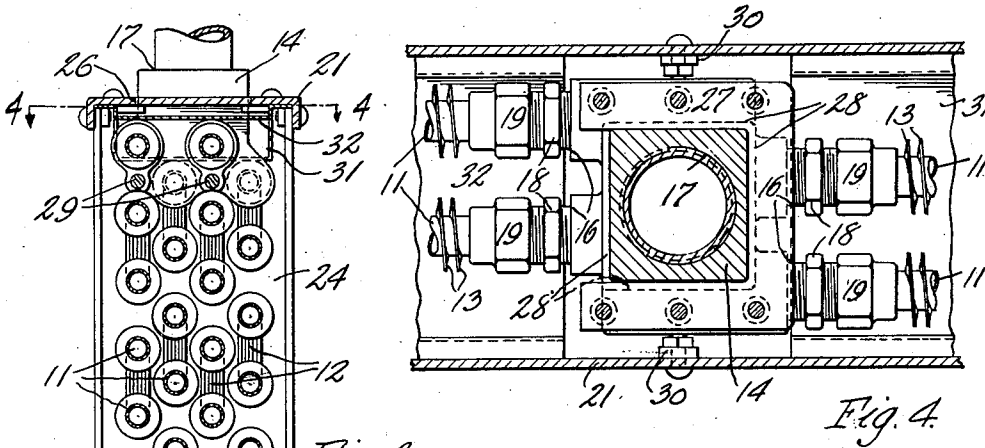
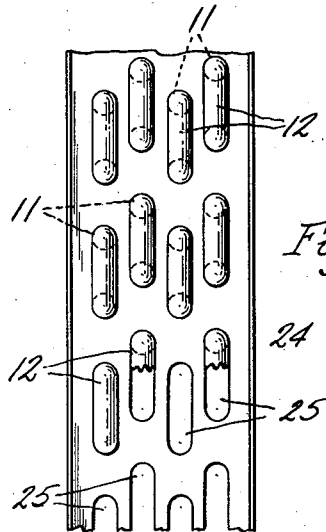
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HEAT EXCHANGE DEVICE

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This invention relates to improvements in heat exchange devices such as radiators, steam heaters and the like, and more particularly to devices of this sort which comprise a plurality of relatively thin walled radiating tubes, preferably provided with exterior radiating fins to increase their radiating surfaces, and which are connected for the passage of steam or other medium through the tubes for the exchange of heat with another medium, such as air, which passes over the exterior surfaces of the tubes.

One object of the invention is to provide a practical, desirable and efficient heat exchange device of this sort which is of simple but very rugged construction adapting it for use with either low or high pressure steam.

Other objects of the invention are to provide a device of this sort having a novel arrangement of parts affording a large radiating surface with the minimum number of joints; also to provide a heater or radiator of desirable construction in which the radiating tubes are supported so as to be retained in the intended relation but so as to permit free expansion and contraction of the tubes; also to provide a heater or radiator of this sort which is provided with a frame which protects the tubes and to which the headers or pipe connections are secured so as to prevent strain on the radiating tubes or joints when connecting the pipe lines to and disconnecting them from the headers or radiators; also to improve heat exchange devices in the other respects hereinafter described and set forth in the claims:

In the accompanying drawings:

Fig. 1 is a front elevation, partly in section, of a heater or radiator illustrating one embodiment of my invention, the radiating fins being omitted from portions of the tubes to simplify the drawings.

Fig. 2 is a sectional plan view thereof on line 2—2, Fig. 1, omitting the radiating fins.

Fig. 3 is a transverse, sectional elevation thereof on line 3—3, Fig. 1.

Fig. 4 is a fragmentary, sectional plan view on an enlarged scale on line 4—4, Fig. 3.

Fig. 5 is a fragmentary end elevation of the device with part of the bent portions of the

radiating tubes omitted to show the tube supporting slots in the frame end plate.

In the following description the device is termed a heater for the sake of brevity and clearness, but it is to be understood that it is not thereby intended to restrict the invention to heaters only, since the invention is applicable to heat exchange devices for various purposes.

The heater comprises a plurality of spaced substantially parallel radiating tubes 11, preferably arranged horizontally in a plurality of rows or banks one behind the other as regards the direction of the passage of air through the spaces between the tubes, with the several tubes of each row or bank joined end to end in series so as to form a continuous serpentine coil or passage through which steam or other medium circulates.

As shown, a single long tube is bent to form each coil composed of the tubes 11 joined end to end in series by bent portions 12 of the long tube located alternately at opposite ends of the heater. While a single, long, jointless tube, bent to form each coil is preferred because this avoids joints except at the two ends of the coil, nevertheless, as will be appreciated, some of the advantages of the invention would result from a coil composed of separate, spaced tubes joined in series by tubular or hollow connections at opposite ends of the heater. The radiating tubes may be and preferably are provided with exterior helical radiating fins 13 for increasing their radiating surface. The fins being preferably omitted from the bends joining the parallel straight tubes.

Each long coil thus composed of connected, spaced or parallel tubes is joined at one end to a supply or inlet header or connection 14 and at its opposite end is preferably joined to a discharge or outlet header or connection 15 so that steam or other fluid supplied to one header or connection can circulate through the coil to the other header or connection. In the preferred arrangement, the tubes 11 of each coil are arranged horizontally one above the other, and the supply header or connection 14 is located at

the top of the bank or row of tubes midway between the opposite ends of the heater, while the discharge header or connection 15 is located at the bottom of the bank or row of tubes midway between the ends of the heater. The upper end of the coil or the top tube of the bank is connected to one side of the supply header 14 and the lower end of the coil, or the bottom tube of the bank is connected to the discharge header 15 at the opposite side thereof. In a multiple row or bank heater such as shown in the drawings, the coils forming the adjacent banks or rows of tubes are preferably connected alternately to the opposite sides of the headers in different planes and at different elevations so that with the same spacing between the tubes of each coil the tubes of one coil or one bank will be located opposite the spaces between the tubes of the next adjacent coil or bank. Thus in the four-row heater illustrated the first coil is connected to the right-hand side of the top header 14 adjacent the front thereof, and the other end of this coil is connected to the left-hand side of the bottom header 15 at the front thereof, and the upper end of the second coil, which is located in vertical plane back of the first coil, is connected to the left-hand side of the top header, between the front and back thereof, and the lower end of this second coil is connected to the right-hand side of the bottom header 15 between the front and back of the header. The third coil is connected to the headers at the same sides thereof as the first coil and at the same elevation, but in a plane back of the second coil while the fourth coil is connected to the same sides of the headers as the second coil and at the same elevation in a plane in rear of the third coil. Thus, each header has holes 16 in its opposite sides for the attachment of the radiating coils, two holes in each end in the four-row heater shown, and the header has a hole 17 in the side thereof between its ends, and at right angles to the coil holes, for the attachment of the supply or discharge pipe for the heater.

The described arrangement of the coils locates the tubes of the first and third banks at the same elevations, one in rear of the other, and the tubes of the second and fourth banks opposite the spaces between the tubes of the first and third banks. The air in passing through the heater flows through the spaces between the horizontal tubes, and the described staggered arrangement of the tubes insures a more uniform contact of the air with the surfaces of the tubes in the different banks.

The heater is encased as presently explained so that the flow of the air through the heater is in a path or direction at right angles to the face of the heater or perpendicular to the planes of the coils.

While the heater is preferably installed in a position in which the tubes 11 extend horizontally in vertical banks or rows, as shown in the drawings, the heater could be installed in other positions, and the claims, except where expressly limited to such a position of the parts, are intended to cover a similar relative arrangement of the tubes, although their positions by reason of different positions of the heater, may be different.

As shown in the drawings, the coils are detachably joined to the cast headers by unions each comprising a screw threaded nipple 18 rigidly secured to the header, and a screw threaded sleeve or nut 19 which surrounds the end of the coil and is adapted to screw onto the nipple to clamp the outwardly flanged end of the coil between the end of the nipple and an internal shoulder on the sleeve or nut 17. However, the headers could be of other construction and the coils or tubes connected thereto in any other suitable way, but preferably, detachable connections are employed so that the coils can be individually secured to and disconnected from the headers.

The heater is preferably mounted or encased in a rectangular frame which protects the coils or banks of tubes, the walls and radiating fins of which are usually made of relatively thin copper and are comparatively frail and easily bent. The frame may be, as shown, composed of flanged sheet metal top and bottom plates or members 21 and 22 rigidly secured by riveting, welding or otherwise to flanged sheet metal end plates or members 23 and 24 respectively. As shown, see Figs. 1 and 2, the end members have out-turned flanges on all four edges thereof, and the top and bottom ends of the end members extend between the intumed front and back flanges of the top and bottom members.

Means are provided at the ends of the frame for loosely supporting the tubes at their end portions. For this purpose, in the construction shown, the end plates 23 and 24 are provided with slots 25 through which the bends of the coils extend and in which they are loosely supported so that the tubes are free to expand and contract lengthwise. The tubes or coils are thus retained in the intended relative position but nevertheless the ends of the tubes are free to move on the supports thus provided at the ends of the frame in the expansion and contraction of the tubes or coils.

The top or inlet header is preferably secured to the top frame member 21 so as to be held rigidly therewith, and the other header is preferably similarly secured to the bottom frame member 22 so that when connecting the pipe lines to and disconnecting them from the headers, the tubes or coils and the joints between the same and the headers will be relieved from strain. For this purpose the top header is preferably secured in an opening 26 in the frame top

member 21 by a U-shaped key or securing plate 27 which straddles the header, extending into narrow grooves 28 in its three sides, and is riveted or otherwise rigidly secured to the frame top member 21 around the opening 26 through which the header extends. The header is thus rigidly held from turning, lateral and endwise movement in the opening in the frame member 21. The other header is similarly secured in an opening in the bottom frame member by a U-shaped key plate 27 entering grooves in the header and riveted or otherwise secured to the bottom frame member.

Rods 29 are preferably provided as shown, each attached to and extending from one side of each header to the adjacent end member of the heater frame and extending into a hole in said frame member. These rods serve to obstruct the spaces between adjacent tubes and restrict the flow of air therethrough. Tie bars 30 are also shown connecting the middle portions of the top and bottom frame members to strengthen and stiffen the frame.

Because of the described arrangement of the tubes at different elevations in the different banks or rows, the bottom tubes joined to one end of the bottom header and the top tubes joined to one end of the top header are spaced farther from the bottom and top frame members respectively than the tubes connecting with the opposite ends of the headers. In order to obstruct these spaces so as to restrict the passage of air therethrough, baffles 31 formed for instance by channel-formed plates, are secured to the top and bottom frame members in position to substantially close these spaces. Similar, but shallower baffles 32 may also be employed between the opposite ends of the headers and the rear end of the frame.

A heater constructed as described can be used for either low or high pressure steam. When the coils are made of long, jointless tubes, the only joints are those between the ends of the coils and the headers. Cast iron headers of small size and strong and simple form can be used which will easily withstand the pressure and water hammer. The construction is very desirable, first because expansion and contraction are perfectly taken care of, since the tubes can expand and contract freely in opposite directions without doing any damage, and second because it enables compliance with the demand of the trade for the location of the steam and drip connections in small heaters at the middle of the heater top and bottom instead of at the ends.

I claim as my invention:

1. A heat exchange device comprising a coil composed of a plurality of spaced, substantially parallel radiating tubes joined at their ends by hollow portions to form a continuous passage for a fluid medium, fluid in-

let and outlet connections joined to the opposite ends of said coil and located and stationarily supported between the opposite ends of said radiating tubes, and supporting means for the end portions of said radiating tubes which retain the tubes in position but permit free expansion and contraction of the tubes.

2. A heat exchange device comprising a jointless coil composed of spaced substantially parallel radiating tubes connected at their ends in series by bends to form a continuous passage, fluid inlet and outlet connections joined to the opposite ends of said coil and located and stationarily supported between the ends of the parallel radiating tubes, and supporting means adjacent the ends of the radiating tubes which retain the several tubes in position while permitting free expansion and contraction of the tubes.

3. A heat exchange device comprising inlet and outlet headers, a continuous radiating coil composed of a plurality of parallel portions connected end to end in series by bent portions, said coil being connected at one of its ends to one side of one header and at its other end to the opposite side of the other header, and a second similar radiating coil connected at opposite ends to said headers at the sides thereof opposite to the sides to which the first coil is connected, each of said coils having portions projecting to opposite sides of said headers and said coils being arranged in different substantially parallel planes, and the several parallel portions of each coil being uniformly spaced, and supporting means for the opposite ends of said parallel portions which retain the relative arrangement of the several coils but permit free expansion and contraction of said parallel portions.

4. A heat exchange device comprising inlet and outlet headers, a continuous radiating coil composed of a plurality of parallel portions connected end to end in series by bent portions, said coil being connected at one of its ends to one side of one header and at its other end to the opposite side of the other header, and a second similar radiating coil connected at opposite ends to said headers at the sides thereof opposite to the sides to which the first coil is connected, said coils being arranged in different substantially parallel planes with the parallel portions of one coil located opposite the spaces between the parallel portions of the next adjacent coil, and uniformly spaced apart, and supporting means for the opposite ends of said parallel portions which retain the relative arrangement of the several coils but permit free expansion and contraction of said parallel portions.

5. A heat exchange device comprising inlet and outlet headers, a plurality of coils each composed of spaced radiating tubes connected at their ends by hollow parts to form a continuous fluid passage, one of said

- coils being joined at its opposite ends to said headers at one side of each header and another of said coils being joined at its opposite ends to said headers at the opposite sides thereof, a protecting frame for said coils to which said headers are rigidly secured between the ends of the frame, said frame being open for the passage of air therethrough in a direction perpendicular to the planes of said coils, and means at opposite ends of said frame for supporting the radiating tubes adjacent their ends so that the tubes are retained in their relative arrangement but are free to expand and contract.
6. A heat exchange device comprising inlet and outlet headers, a plurality of coils each composed of spaced radiating tubes connected at their ends by hollow parts to form a continuous fluid passage, one of said coils being joined at its opposite ends to said headers at one side of each header and another of said coils being joined at its opposite ends to said headers at the opposite sides thereof, and a rectangular protecting frame having opposite members to which said headers are rigidly secured between the ends of the frame, and said frame having opposite end members provided with openings in which the end portions of said radiating tubes are supported but free to slide lengthwise.
7. A heat exchange device comprising upper and lower headers, a plurality of separate coils each composed of substantially horizontal radiating tubes joined at their ends by hollow parts to form a continuous fluid passage, one of said coils being joined at one of its ends to said upper header at one side thereof, and at its other end to said lower header at one side thereof, and another of said coils being joined at its opposite ends respectively to said upper and lower headers at the opposite sides thereof, each of said coils projecting to opposite sides of said headers, said coils being joined to said headers at different elevations so that the horizontal tubes of one coil will be located opposite the spaces between the horizontal tubes of another coil.
8. A heat exchange device comprising upper and lower headers, a plurality of coils each composed of substantially horizontal radiating tubes joined at their ends by hollow parts to form a continuous fluid passage, one of said coils being joined at one of its ends to said upper header at one side thereof, and at its other end to said lower header at one side thereof, and another of said coils being joined at its opposite ends respectively to said upper and lower headers at the opposite sides thereof, a rectangular protecting frame for said coils having top and bottom members provided between their ends with openings through which the upper and lower headers respectively extend and in which the headers are stationarily secured, and said frame having opposite end members provided with means by which the end portions of the horizontal radiating tubes are movably supported.
9. A heat exchange device comprising upper and lower headers, a plurality of coils each composed of substantially horizontal radiating tubes joined at their ends by hollow parts to form a continuous fluid passage, one of said coils being joined at one of its ends to said upper header at one side thereof, and at its other end to said lower header at one side thereof, and another of said coils being joined at its opposite ends respectively to said upper and lower headers at the opposite sides thereof, a rectangular protecting frame for said coils having top and bottom members to which said upper and lower headers respectively are rigidly secured between the ends of the frame, and air baffles one located between the bottom tube of one coil and the bottom frame member, and the other located between the top tube of another coil and said top frame member.
- LAWRENCE C. SOULE.