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3,042,380

HEAT EXCHANGER CONSTRUCTION

Filed April 20, 1959

2 Sheets-Sheet 1

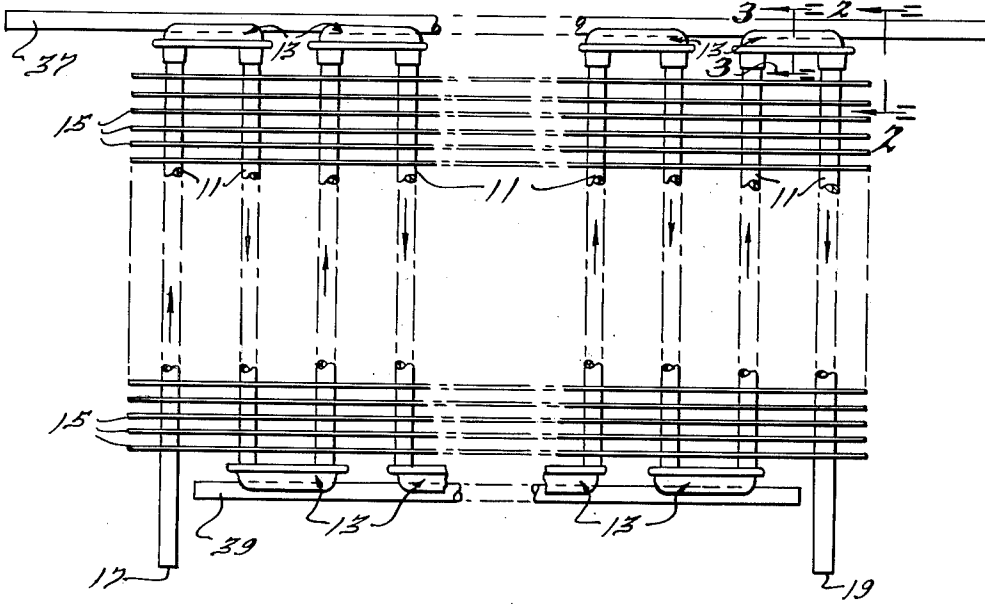


FIG. 1.

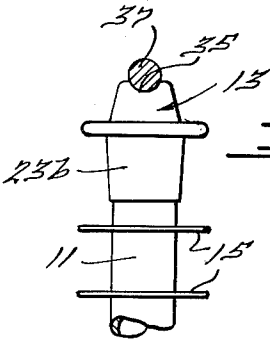


FIG. 2.

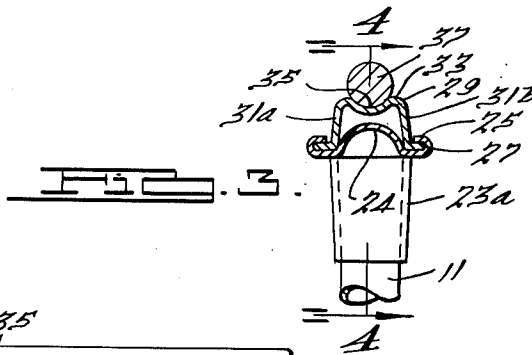


FIG. 3.

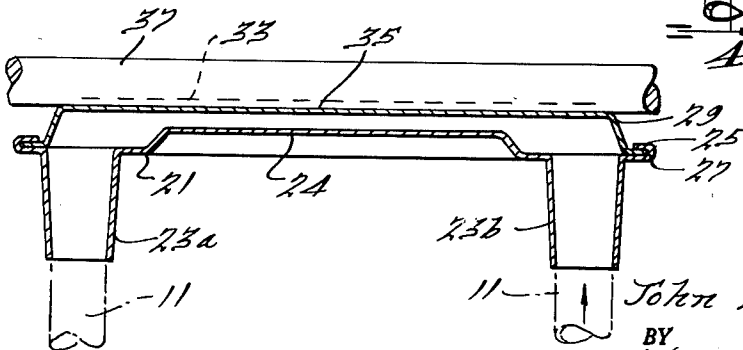


FIG. 4.

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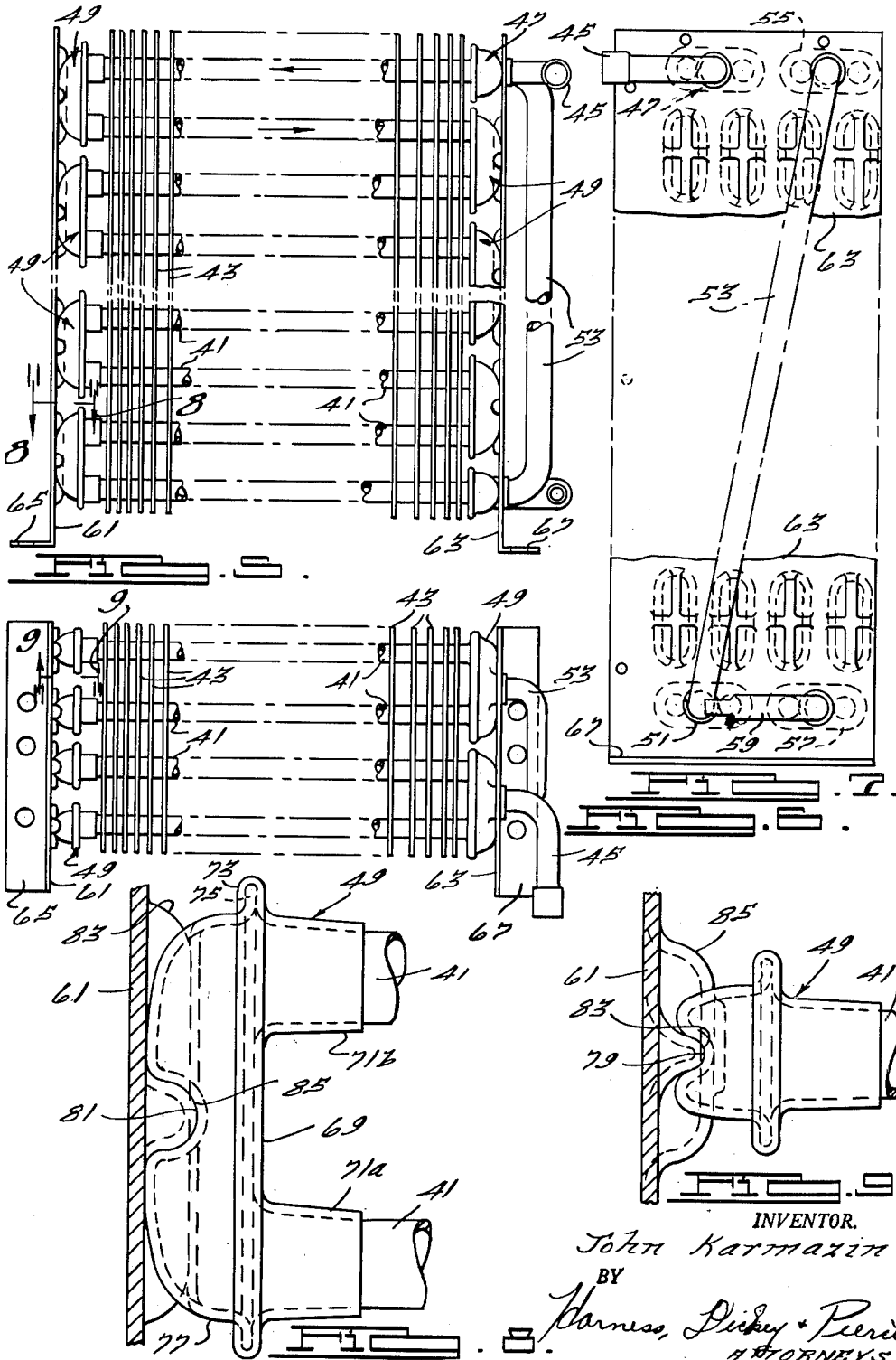
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HEAT EXCHANGER CONSTRUCTION
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5 Claims. (Cl. 257-148)

This invention relates to heat exchangers and particularly to condensers, evaporators, or the like for use in refrigeration systems.

It is an object of the present invention to provide a return conduit having improved flow regulating and pressure resistant characteristics for interconnecting the ends of standard heat transmitting conduits in a heat exchange unit.

It is another object of the present invention to provide a heat exchange unit having spaced parallel fluid conduits provided with novel means for supporting and bracing the conduits in a rigid assembly.

It is another object of the present invention to provide a heat exchange unit of the above character having means for restricting the flow of fluid within the unit.

It is another object of the present invention to provide a heat exchange unit of the above character having superior ability to withstand high internal pressures.

It is a still further object of the present invention to provide a heat exchange unit of the above character which is sturdy in construction, efficient in operation and inexpensive of manufacture.

Other objects and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is an elevational view of a heat exchange unit embodying the principles of the present invention;

FIG. 2 is an enlarged view, partly in section, of the structure illustrated in FIG. 1 taken from the line 1-1 thereof;

FIG. 3 is an enlarged sectional view of the structure illustrated in FIG. 1 taken from the line 3-3 thereof;

FIG. 4 is a sectional view of the structure illustrated in FIG. 3 taken along the line 4-4 thereof;

FIG. 5 is a front elevational view of a condenser core illustrating another form of the invention;

FIG. 6 is a plan view of the structure illustrated in FIG. 5;

FIG. 7 is a side elevational view of the structure illustrated in FIG. 5;

FIG. 8 is an enlarged sectional view of the structure illustrated in FIG. 5 taken along the line 8-8 thereof; and

FIG. 9 is an enlarged sectional view of the structure illustrated in FIG. 5 taken along the line 9-9 thereof.

Referring now to the drawings, FIGURE 1 illustrates a heat exchanger core having a plurality of spaced parallel and coplanar conduit sections or tubes 11 which are connected together at their opposite ends by end connectors or generally U-shaped return conduits 13 to provide a sinuous path of flow from one tube 11 to the next throughout the length of the core. A plurality of spaced cooling fins 15 are transversely mounted on the tubes 11 and serve as secondary surface areas for the unit to increase the transfer of heat. It will be understood that the tubes 11 and the fins 15 may be constructed in various manners, and in particular may be made in accordance with the principles taught in my Patent No. 2,134,665, dated October 25, 1938.

While fluid may be passed through the core in either direction, for purposes of illustration one of the tubes 11

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on one side of the core is provided with an open end which may be nominally designated as an inlet opening 17. Similarly, one of the tubes 11 at the opposite side of the core has an open end which may be termed an outlet opening 19. Thus, fluid entering the core through the inlet 17 will follow the sinuous path through the core indicated by the arrows in FIG. 1, and fluid flowing in one direction through a given tube 11 will reverse its direction of flow in passing through the next adjacent tube.

The end connectors or return conduits 13 not only provide fluid communication from one conduit 13 to the next, but are also inwardly deformed or grooved in predetermined amounts to serve as restrictors for regulating the flow of fluid between the various parts of the core. Such deformations or grooves, which will be subsequently described in detail, additionally serve to reinforce the connectors against high internal pressures and also provide means by which the connectors may be supported in a rigid spaced assembly. Preferably, the connectors are fabricated from two stamped sheet metal parts which are interlocked and bonded together. The first of said parts comprises an inner elongated sheet member 21 having a pair of integral spaced tube portions 23a and 23b which are parallel to one another and are adapted to fit over the adjacent ends of a pair of tubes 11. A portion of the member 21 between the tube portions 23a and 23b is inwardly depressed or crowned to form a rib 24 which not only strengthens the member 21 against high internal pressures, but also restricts the flow of fluid through the connector. The edge 25 of the member 21 is crimped or reversely bent over the outturned flange or lip 27 of an outer shell or cap member 29. Together with the member 21, the cap 29 forms an intermediate connector portion to provide sealed fluid communication between the tube portions 23a and 23b which form end portions of the connector. The cap 29 is elongated to conform to the member 21 and includes a pair of opposite elongated side wall portions 31a and 31b interconnected by a top portion 33. The top portion 33 of the cap 29 is indented or depressed to form an elongated external groove 35 extending longitudinally thereof. The groove 35 serves as a reinforcing rib for the shell 29 and further restricts the flow of fluid through the connector.

As may be seen in FIG. 1, when the return members 13 are positioned on the opposite ends of the tubes, the grooves 35 are aligned in two rows, one at the top and the other at the bottom of the core. By this means a pair of spaced rods 37 and 39 may be positioned at the top and the bottom of the core, respectively, and seated in the aligned grooves 35. The rods 37 and 39 form a permanent portion of the core assembly and are brazed or otherwise bonded to the cap members 13 at the grooves 35 thereof. Thus positioned, the rods 37 and 39 reinforce the cap 29 against deformation or rupture from high internal pressures, maintain the tubes 11 in rigid, properly spaced assembly, and provide means which may be clamped or fastened by suitable supporting elements (not shown) to support the core.

FIGS. 5-9 illustrate another form of the invention which is particularly adapted for larger size exchange units. The embodiment therein illustrated comprises a condenser core having a plurality of spaced parallel conduit portions or tubes 41 which are arranged in a plurality of vertically spaced horizontal rows. A plurality of spaced heat conductive fins 43 are mounted transversely on the tubes 41 to provide secondary heat transfer surface areas for the unit.

Fluid is admitted into the core through an inlet tube

45 which is connected to a manifold 47. The manifold 47, in turn, is fitted to the ends of two horizontally adjacent tubes 41 to cause incoming fluid to flow in the direction indicated by the uppermost arrow in FIG. 5. Upon reaching the end of said first pair of tubes 41 the fluid is passed to a subjacent pair of tubes 41 by an end connector or U-shaped return conduit 49, where the direction of flow of the fluid is reversed. Additional return conduits 49 interconnect the vertically adjacent of said tubes 41 at the opposite ends thereof so that the fluid passes through the left-hand side of the core (as viewed in FIG. 7) in a sinuous vertically descending path until it reaches the end of the lowermost tubes 41 on the left-hand side. The fluid is then collected through a manifold member 51 and flows upwardly through a diagonal tube 53 to a distributing manifold 55 and thence to a horizontally spaced pair of conduits 41 on the upper right-hand side of the core (as viewed in FIG. 7). The fluid then descends through the right-hand pairs of tubes in a sinuous path similar to its descent on the left-hand side of the core, and is eventually collected through a manifold 57 and passed out of the core through an outlet tube 59.

The entire core assembly is supported and braced by means of a pair of supporting members or panels 61 and 63 arranged on opposite sides thereof adjacent the return conduits 49. The supporting members 61 and 63 are in the form of embossed sheets having apertured flange sections 65 and 67 by means of which the entire assembly may be bolted or otherwise fastened to a supporting frame or base (not shown). The supporting panels 61 and 63 are substantially identical except that the panel 63 is suitably apertured to permit the passage of the manifolds 47, 51, 55 and 57 therethrough.

As was mentioned above, the panels 61 and 63 are suitably indented or embossed and such indentations are designed to cooperate with conforming grooves or indentations formed in the return members 49, as shown in detail in FIGS. 8 and 9. Each of the return conduits 49 includes an elongated inner sheet member 69 having a pair of integral spaced tube portions 71a and 71b extending inwardly therefrom and adapted to receive the ends of a vertically adjacent pair of tubes 41. The marginal edge 73 of the section 69 is crimped over the lip or peripheral flange 75 of a similarly elongated shell or cap member 77, which, together with the section 69 forms a fluid-tight intermediate connector portion joining the tube portions 71a and 71b. The outer surface of the cap 77 is inwardly deformed to define an elongated exterior groove 79 extending longitudinally thereof. In addition, a transverse groove 81 is formed across the top of the cap 77 intersecting the longitudinal groove 79 at its center. The grooves 79 and 81 not only strengthen the shell 77 against internal pressures but, inasmuch as the shell is made of relatively thin sheet material, the formation of the grooves reduces the cross sectional area of the intermediate connector portion and restricts or chokes the passage of fluid through the connector. By controlling the magnitude of deformation or restriction in each of the connectors the velocity, pressure and rate of flow of the fluid within various parts of the core may be regulated in any desired manner.

Seated within the grooves 79 and 81 of each return conduit 49 are a pair of conformably shaped intersecting ridges or elongated bosses 83 and 85 embossed or pressed out of the panels 61 and 63 in suitably spaced locations to conform to the positions of the return members 49. The ridges 83 and 85 are brazed or otherwise bonded in the conforming grooves 79 and 81 of the return member 49 to support and brace the tubes 41 in predetermined assembled relation.

It will be apparent that in the manufacture of the heat exchange unit of the present invention the supporting panels 61 and 63 may be readily applied to the core and the proper relationship of the supporting panels to the

core instantaneously established. The brazing of the supporting panels 61 and 63 to the return members 49 may be accomplished simultaneously with the other brazing operations involved in the fabrication of the core.

While it will be apparent that the preferred embodiments herein illustrated are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A heat exchange unit including a plurality of spaced parallel conduits of substantially equal length, a plurality of return conduits interconnecting the ends of adjacent ones of said conduits to form a continuous path for the flow of fluid through said conduits, each said return conduit having an outer wall which is inwardly deformed to define an exterior groove of arcuate cross section, separate supporting members extending along opposite sides of the unit having portions thereof bonded to said return conduits in the grooves thereof for reinforcing said return conduits and for supporting and bracing said conduits in a rigid assembly.

2. A heat exchange unit including a plurality of spaced parallel co-planar conduits of substantially equal length, a plurality of return conduits interconnecting the ends of adjacent ones of said conduits to form a continuous path for the flow of fluid through said conduits, each of said return conduits having an outer wall on the side thereof opposite from said conduits provided with an elongated exterior groove of arcuate cross section disposed parallel to the plane of said conduits, whereby said grooves are aligned in two parallel rows on opposite sides of said conduits, and a pair of supporting rods each seated in one of the rows of said grooves for supporting and bracing said conduits in rigid assembly and for reinforcing said return conduits.

3. In a heat exchange unit, a plurality of spaced parallel tubes of substantially equal length, a plurality of return conduits interconnecting the ends of adjacent ones of said tubes to form a continuous path for the flow of fluid through said tubes, each of said return conduits having an outer wall on the side thereof opposite from said tubes provided with an exterior groove of arcuate cross section therein, a pair of supporting panels arranged one on each side of the unit adjacent said return conduits, said supporting panels having a plurality of spaced bosses seated and bonded in the grooves of said return conduits for reinforcing said return conduits against internal pressure and for maintaining said tubes in assembled relationship.

4. In a heat exchange unit, a plurality of spaced parallel tubes of substantially equal length, a plurality of return conduits interconnecting the ends of adjacent ones of said tubes to form a continuous path for the flow of fluid through said tubes, each of said return conduits having an outer shell on the side thereof opposite from said tubes provided with intersecting exterior grooves therein, a pair of supporting panels arranged one on each side of said unit adjacent said return conduits, said supporting panels having a plurality of embossed portions defining intersecting ridges conformably engageable in the grooves of said return conduits for supporting and bracing said tubes in rigid assembly.

5. In a heat exchange unit, a plurality of spaced parallel tubes of substantially equal length, a plurality of generally U-shaped return conduits interconnecting the adjacent ends of adjacent ones of said tubes to provide a continuous path of flow through said tubes, each of said return conduits having an enclosing wall on the side thereof opposite from said tubes provided with a groove of arcuate cross section therein, a pair of supporting members arranged one on each side of the core adjacent said return conduits and having portions thereof seated in the grooves of said return conduits and bonded to said return

conduits in said grooves whereby said tubes are maintained in a predetermined spaced assembled relation.

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