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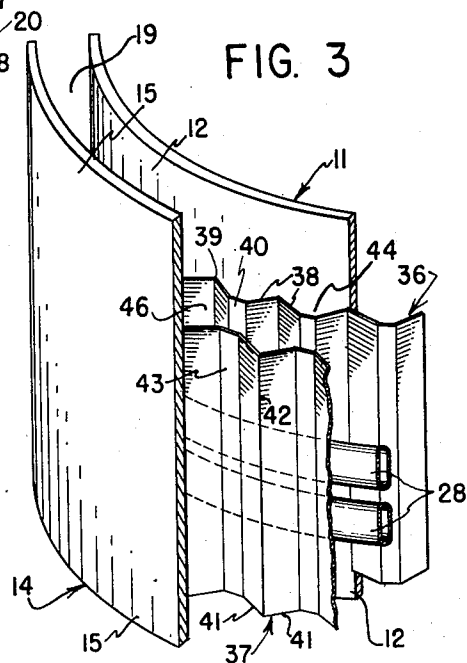
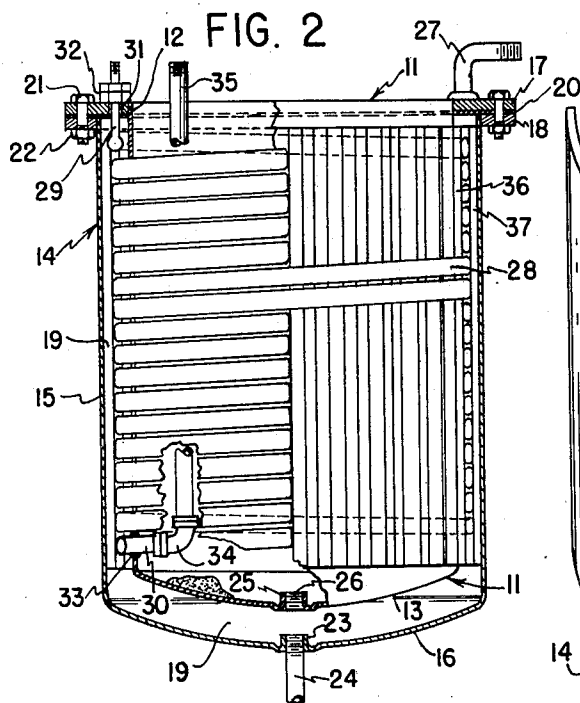
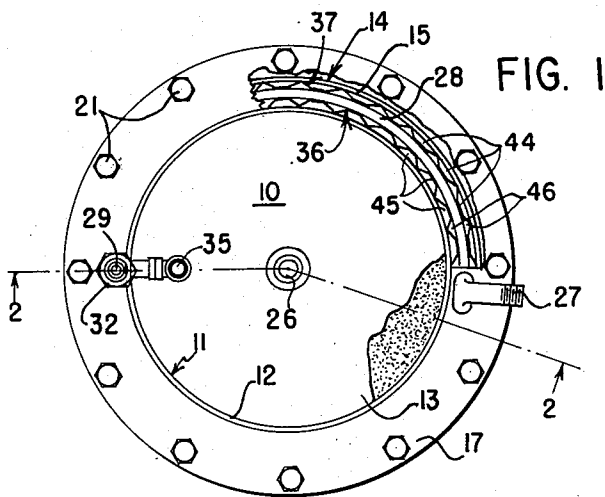
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2,668,692

HEAT EXCHANGER

Filed Oct. 19, 1950

2 Sheets-Sheet 1



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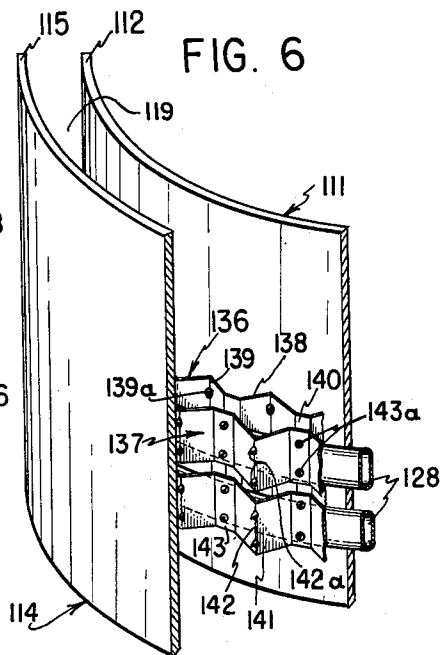
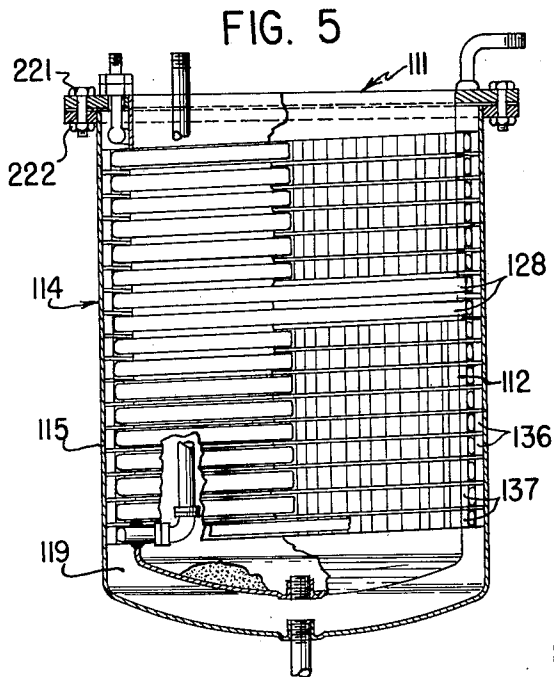
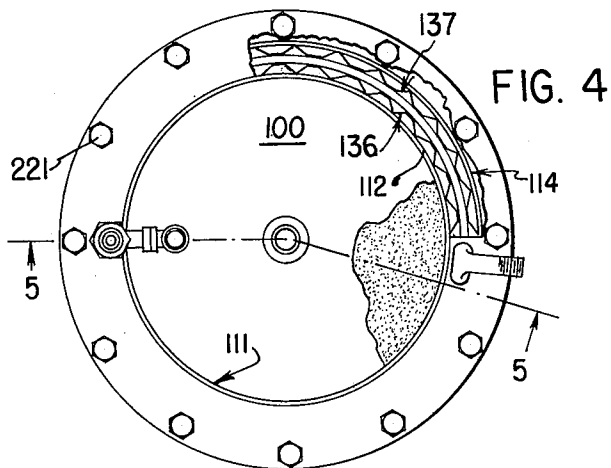
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HEAT EXCHANGER

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

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5 Claims. (Cl. 257-241)

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The present invention relates to heat exchangers and more particularly to heat exchangers that are especially constructed to serve commonly as the condensing units in refrigerating systems and as the water heating units in hot water storage and supply systems employed in heat pump arrangements.

It is the general object of the present invention to provide a heat exchanger of improved and simplified construction and arrangement that is efficient and economical in operation.

Another object of the invention is to provide a heat exchanger comprising an improved arrangement for positioning a conduit in a chamber defined by surrounding walls so as to obtain good heat transfer between a first fluid in the chamber and a second fluid in the conduit and to obtain poor heat transfer between the conduit and the surrounding walls.

A further object of the invention is to provide a heat exchanger of the character noted that embodies an improved arrangement for mounting the condenser conduit in the water chamber so as to promote efficient heat exchange between the refrigerant in the condenser conduit and the water in the water chamber and so as to retard heat exchange between the condenser conduit and the surrounding walls defining the water chamber.

Further features of the invention pertain to the particular arrangement of the elements of the heat exchanger, whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which Figure 1 is a plan view, partly broken away, of a heat exchanger embodying the present invention; Fig. 2 is a fragmentary side elevational view of the heat exchanger, taken principally along the line 2-2 in Fig. 1; Fig. 3 is an enlarged fragmentary perspective view of the heat exchanger shown in Figs. 1 and 2; Fig. 4 is a plan view, partly broken away, of a modified form of the heater exchanger embodying the present invention; Fig. 5 is a fragmentary side elevational view of the heat exchanger, taken principally along the line 5-5 in Fig. 4; and Fig. 6 is an enlarged fragmentary perspective view of the heat exchanger shown in Figs. 4 and 5.

Referring now more particularly to Figs. 1 to 3, inclusive, of the drawings, there is illustrated a

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heat exchanger 10 embodying the features of the present invention and comprising an inner substantially cup-shaped member 11 provided with a tubular side wall 12 and a convex bottom wall 13, and an outer substantially cup-shaped member 14 provided with a tubular side wall 15 and a convex bottom wall 16. A first outwardly extending substantially annular flange or ring 17 is secured to the upper end of the side wall 12 in surrounding relation therewith and adjacent to the open end thereof; and a second outwardly extending substantially annular flange or ring 18 is secured to the upper end of the side wall 15 in surrounding relation therewith and adjacent to the open end thereof. The inner member 11 and the outer member 14 are arranged in nested relation so that the side walls 12 and 15, as well as the bottom walls 13 and 16 are disposed in spaced-apart relation defining a substantially cup-shaped chamber 19 therebetween, the flange 17 overlying the flange 18 and closing the open end of the chamber 19. A substantially annular sealing gasket 20 is arranged between the adjacent surfaces of the flanges 17 and 18; and the flanges 17 and 18 are secured together in fluid-tight relation by an arrangement including an annular series of bolts 21 extending through aligned holes formed in the flanges 17 and 18 and cooperating nuts 22.

A substantially centrally disposed inwardly extruded fixture or spud 23 is formed in the bottom wall 16 and receives a cooperating threaded inlet conduit 24 arranged to supply a first fluid into the lower portion of the chamber 19 between the bottom walls 16 and 13. Similarly a substantially centrally disposed inwardly extruded fixture or spud 25 is formed in the bottom wall 13 and receives a cooperating threaded plug 26. An opening is formed in the inner portion of the flange 17 and carries a substantially L-shaped fixture 27 constituting an outlet conduit for the first fluid in the chamber 19. Thus it will be understood that the first fluid is admitted into the lower portion of the chamber 19 via the inlet conduit 24 and is withdrawn from the upper portion of the chamber 19 via the outlet conduit 27.

Arranged within the chamber 19 is a substantially helical conduit 28 that is preferably in the form of a continuous tube having a substantially oval cross-section that may be produced by flattening of the tube from an initial substantially circular cross-section. The conduit 28 extends continuously in the form of a helix from a position just below the flange 18 to a position just above the bottom wall 13, the conduit 28 being

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arranged throughout its length in spaced-apart relation with respect to the side walls 12 and 15. The upper inlet end of the conduit 28 is provided with an upwardly projecting inlet connector 29 arranged to supply a second fluid into the upper portion of the conduit 28; and the lower outlet end of the conduit 28 is provided with an inwardly projecting outlet connector 30. The inlet connector 29 projects through an opening 31 formed in the inner portion of the flange 17 and is removably sealed in place by a packing gland 32; while the outlet connector 30 projects through an opening formed in the lower portion of the side wall 12 and is rigidly secured in place by welding, or the like, indicated at 33. Also the inner end of the outlet connector 30 supports an elbow 34 to which there is secured a riser conduit 35 arranged within the cavity of the member 11. Thus it will be understood that the second fluid is admitted into the upper end of the conduit 28 via the inlet connector 29 and is withdrawn from the lower end of the conduit 28 via the outlet connector 30, the elbow 34 and the riser conduit 35.

The conduit 28 is positioned within the chamber 19 by an arrangement including inner and outer substantially tubular corrugated sheet structures 36 and 37. More particularly the structure 36 is arranged between and in contact with the side wall 12 and the conduit 28; while the structure 37 is arranged between and in contact with the side wall 15 and the conduit 28. Specifically in the structure 36, the flutes 38 of the corrugations terminate in rather sharp peaks 39 engaging the adjacent side wall 12, and in rather flat plateaus 40 engaging the convolutions of the conduit 28; whereby the area of contact between the structure 36 and the conduit 28 is considerably greater than the area of contact between the structure 36 and the side wall 12 so that in effect the structure 36 is arranged in good heat-conducting relation with the conduit 28 and in poor heat-conducting relation with the side wall 12. Similarly in the structure 37, the flutes 41 of the corrugations terminate in rather sharp peaks 42 engaging the adjacent side wall 15, and in rather flat plateaus 43 engaging the convolutions of the conduit 28; whereby the area of contact between the structure 37 and the conduit 28 is considerably greater than the area of contact between the structure 37 and the side wall 15 so that in effect the structure 37 is arranged in good heat-conducting relation with the conduit 28 and in poor heat-conducting relation with the side wall 15.

In view of the foregoing, it will be understood that the structure 36 is wrapped around the side wall 12; the conduit 28 is wrapped around the structure 36; the structure 37 is wrapped around the conduit 28; and the side wall 15 embraces the structure 37. Moreover the structure 36 cooperates with the side wall 12 to define upstanding channels 44 therebetween accommodating the passage therethrough of the first fluid in the chamber 19; and the structure 37 cooperates with the side wall 15 to define upstanding channels 45 therebetween accommodating the passage therethrough of the first fluid in the chamber 19. Finally the structures 36 and 37 cooperate with each other to define upstanding channels 46 therebetween accommodating the passage therethrough and about the convolutions of the conduit 28 of the first fluid in the chamber 19.

The heat exchanger 10 is admirably suited for use commonly as the condensing unit in a re-

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frigerating system and as the water heating unit in a hot water storage and supply system in a heat pump arrangement. When the heat exchanger 10 is employed for the purpose noted, the compressed gaseous refrigerant from the compressor of the refrigerating machinery is admitted via the inlet connector 29 into the upper end of the conduit 28 and passes downwardly through the convolutions of the conduit 28 toward the outlet connector 30. Initially the compressed gaseous refrigerant entering the inlet connector 29 contains considerable super heat which is extracted therefrom in the upper portion of the conduit 28 so that the compressed gaseous refrigerant is condensed in the mid-portion of the conduit 28, whereby, the refrigerant is liquified and accumulates in the lower portion of the conduit 28. The liquid refrigerant accumulating in the lower portion of the conduit 28 is sub-cooled therein and is then discharged via the outlet connector 30, the elbow 34, and the riser conduit 35 into a suitable receiver, or the like, provided in the refrigerating machinery. Of course the liquid refrigerant is ultimately expanded through an expansion valve into an evaporator; and the refrigerant in gaseous form is withdrawn from the evaporator into the compressor unit of the refrigerating machinery in order to complete the cycle. The water from the lower portion of the storage tank of the hot water storage and supply system is admitted via the inlet conduit 24 into the lower portion of the chamber 19 and rises upwardly therethrough into the outlet conduit 27 from which it is discharged into the upper portion of the storage tank noted. As the water rises upwardly through the chamber 19, it is heated by virtue of the heat exchange relation thereof with the refrigerant in the conduit 28. Since the water is arranged in good heat relation with both the conduit 28 and the structures 36 and 37, as previously noted, the water rises in the chamber 19 due to a thermosiphon action and passes through the channels 44, 45 and 46. It further will be observed that the refrigerant in the conduit 28 and the water in the chamber 19 are arranged in counter-flow relation so as to provide a more constant temperature gradient therebetween through the chamber 19; and the lower end of the chamber 19 accommodates the accumulation of flocculent lime and other foreign materials that are precipitated or settled out of the water as it rises in the chamber 19 about the conduit 28 and the structures 36 and 37.

In manufacturing the heat exchanger 10, the tube from which the conduit 28 is formed may be initially substantially circular in cross-section, whereby the tube is first flattened to provide the substantially oval cross-section so that the conduit 28 has a larger surface area relative to the cross-sectional area thereof. The structures 36 and 37 may be suitably formed from sheet stock. The structure 36 may then be wrapped around an appropriate mandrel; then the conduit 28 may be wrapped in helical form around the structure 36; and then the structure 37 may be wrapped around the helical conduit 28. The inlet connector 29 and the outlet connector 30 are then suitably secured to the opposite ends of the conduit 28 or suitably fashioned from the tubing thereof. This subassembly is then removed from the mandrel and assembled upon the inner member 11. At this time, the inlet connector 29 is arranged to project through the opening 31 formed in the flange 17, and the outlet connector

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30 is arranged to project through the opening formed in the lower portion of the side wall 12. The packing gland 32 is assembled upon the outer end of the inlet connector 29 in order to provide the fluid-tight joint between the inlet connector 29 and the adjacent wall of the flange 17 surrounding the opening 31 formed therein. Also the outlet connector 30 is suitably welded, as indicated at 33, into the opening formed in the lower portion of the side wall 12 in order to provide the fluid-tight joint therebetween. The outlet fixture 27 is suitably secured in the associated opening provided in the flange 17 in order to provide the fluid-tight joint therebetween; and the inlet conduit 24 is suitably threaded in the associated spud 23 provided in the bottom wall 16 in order to provide the fluid-tight joint therebetween. Also the elbow 34 is secured to the inner end of the outlet connector 30; and the riser conduit 35 is suitably secured to the elbow 34. At this time, the complete subassembly of the inner member 11, the conduit 28 and the structures 36 and 37 may be assembled with respect to the outer member 14, the sealing gasket 20 being arranged between the adjacent surfaces of flanges 17 and 18. Ultimately the bolts 21 are positioned and the cooperating nuts 22 are set so as to provide the fluid-tight chamber 19. At this time, the inlet connector 29 and the riser conduit 35 may be appropriately plumbed into the refrigerating machinery, as previously explained, and the inlet conduit 24 and the outlet conduit 27 may be appropriately plumbed into the hot water storage and supply system, as previously explained.

In the construction of the heat exchanger 10, it is preferable that the inner member 11, together with the flange 17, and the outer member 14, together with the flange 18, are formed of steel; and the conduit 28 and the structures 36 and 37 are formed of copper or brass. By forming the conduit 28 and the structures 36 and 37 of copper, excellent heat exchange therebetween is obtained; and by forming the members 11 and 14 of steel, heat exchange thereto from the structures 36 and 37 is retarded. In order further to insure heat exchange between the conduit 28 and the structures 36 and 37, this sub-assembly, as a whole, may be tin-dipped prior to assembly upon the inner member 11 in the manner described above; although this precaution is not ordinarily necessary. Moreover in order further to retard the heat-exchange between the structures 36 and 37 and the inner and outer members 11 and 12, the side walls 12 and 15 and the respective bottom walls 13 and 16 may be formed of stainless steel; however, this precaution is not ordinarily necessary.

It will be appreciated that the outer member 14 may be readily removed from the assembly of the inner member 11, the conduit 28, and the structures 36 and 37 to facilitate cleaning of the chamber 19 by removal of the bolts 21 and the cooperating nuts 22. Moreover the provision of the plug 26 in the spud 25 carried by the bottom wall 13 of the inner member 11 provides for ready access into the interior of the chamber 19 when the inner and outer members 11 and 14 are in assembled relation.

When the heat exchanger is incorporated in the associated refrigerating system and in the associated hot water storage and supply system, in the manner previously explained, it is preferable to embed it in suitable insulating material, which insulating material is normally packed

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within the cavity of the inner member 11. This arrangement prevents loss of heat from the conduit 28 to the ambient air and other supporting elements.

Referring now to Figs. 4 to 6, inclusive, there is illustrated a modified form of the heat exchanger 100 that embodies the features of the present invention, and which is fundamentally of the construction of the heat exchanger 10, described above. In the interest of brevity, the construction and arrangement of the heat exchanger 100 will not be completely described as it will be understood that the principal elements thereof perform the same functions as the corresponding elements of the heat exchanger 10.

However the heat exchanger 100 embodies an improved arrangement of the structures 136 and 137 that are respectively arranged between the inner wall 112 and the conduit 128 and between the outer wall 115 and the conduit 128, in that the structures 136 and 137 are of helical form so that the edges of adjacent convolutions thereof are disposed in spaced-apart relation. This arrangement prevents the conduction of heat from the upper portions to the lower portions of the structures 136 and 137, except through the long convolutions thereof. Thus the opposite extremities of the helical structures 136 and 137 are in fact spaced-apart a distance many times greater than that of the height of the cup-shaped chamber 119 defined between the inner and outer cup-shaped members 111 and 114.

Specifically in the structure 136, the flutes 138 of the corrugations terminate in rather sharp peaks 139 provided with pairs of inwardly extending projections or dimples 139a engaging the side wall 112 and in rather flat plateaus 140 engaging the convolutions of the conduit 128; whereby the area of contact between the structure 136 and conduit 128 is considerably greater than the area of contact between the structure 136 and the side wall 112 so that in fact the structure 136 is arranged in good heat-conducting relation with the conduit 128 and in poor heat-conducting relation with the side wall 112. Similarly in the structure 137, the flutes 141 of the corrugations terminate in rather sharp peaks 142 provided with pairs of outwardly extending projections or dimples 142a engaging the side wall 115 and in rather flat plateaus 143 engaging the convolutions of the conduit 128; whereby the area of contact between the structure 137 and the conduit 128 is considerably greater than the area of contact between the structure 137 and the side wall 115 so that in fact the structure 137 is arranged in good heat-conducting relation with the conduit 128 and in poor heat-conducting relation with the side wall 115. In order to locate the structure 136 with respect to the conduit 128, pairs of outwardly extending projections or dimples, not shown, are carried on the plateaus 140 and disposed in embracing relation with respect to the sides of the associated convolutions of the conduit 128; and in order to locate the structure 137 with respect to the conduit 128, pairs of inwardly extending projections, or dimples 143a, are carried on the plateaus 143 and disposed in embracing relation with respect to the sides of the associated convolutions of the conduit 128.

The arrangement of the structures 136 and 137, described above, not only provides for the long direct heat conducting paths between the adjacent convolutions thereof, but it also further minimizes the contact area between the struc-

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flanges 136 and 137 and the respective side walls 112 and 115 so as further to minimize heat transfer between the conduit 128 and the side walls 112 and 115.

In manufacturing the heat exchanger 100, the conduit 128 and the structures 136 and 137 may be formed as a subassembly on an appropriate mandrel in a manner substantially identical to that described in conjunction with the manufacture of the heat exchanger 10; and then this subassembly is assembled upon the inner cup-shaped member 111 so that the outer cup-shaped member 114 may be secured in place to define the liquid-tight chamber 119 when the bolts 221 are set with respect to the associated nuts 222.

The utilization of the heat exchanger 100 commonly as the condensing unit in a refrigerating system and as the water heating unit in a hot water storage and supply system in a heat pump arrangement may be the same as that previously described.

In view of the foregoing, it is apparent that there has been provided a heat exchanger embodying an improved arrangement for positioning a conduit in a chamber defined by surrounding walls so as to insure good heat exchange between a first fluid contained in the chamber and a second fluid contained in the conduit, as well as to insure poor heat exchange between the conduit and the surrounding walls.

While there has been described which is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A heat exchanger comprising inner and outer substantially cup-shaped metal walls arranged in adjacent spaced-apart nested relation and cooperating to define a substantially cup-shaped chamber therebetween, first and second outwardly extending substantially annular flanges respectively carried by said inner and outer walls adjacent to the open ends thereof, said first flange overlying said second flange and removably secured thereto to close the open end of said chamber and to render it fluid-tight, a first fixture carried by said inner wall adjacent to the closed end thereof and communicating with said chamber, a second fixture carried by said first flange and communicating with said chamber, said first and second fixtures accommodating the passage through said chamber of a first fluid, a substantially helical metal conduit arranged within said chamber and surrounding said inner wall and disposed in spaced relation with respect to said inner and outer walls and accommodating the passage therethrough of a second fluid, a first open resilient metal structure arranged in said chamber between said inner wall and said conduit and in contact therewith, and a second open resilient metal structure arranged in said chamber between said outer wall and said conduit and in contact therewith, said conduit and said first and second structures being clamped between said inner and outer walls and supported in place therebetween in said chamber, said first structure accommodating ready passage therethrough of said first fluid in said chamber between said inner wall and said conduit and said second structure accommodating ready passage therethrough of said first fluid in said chamber between said outer wall and said conduit, said

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first structure being arranged in good heat exchange relation with said conduit and in poor heat exchange relation with said inner wall and said second structure being arranged in good heat exchange relation with said conduit and in poor heat exchange relation with said outer wall so as to promote heat exchange between said first and second fluids and to retard heat exchange between said conduit and said inner and outer walls.

2. A heat exchanger comprising inner and outer substantially cup-shaped metal walls arranged in adjacent spaced-apart nested relation and cooperating to define a substantially cup-shaped chamber therebetween, first and second outwardly extending substantially annular flanges respectively carried by said inner and outer walls adjacent to the open ends thereof, said first flange overlying said second flange and removably secured thereto to close the open end of said chamber and to render it fluid-tight, a first fixture carried by said inner wall adjacent to the closed end thereof and communicating with said chamber, a second fixture carried by said first flange and communicating with said chamber, said first and second fixtures accommodating the passage through said chamber of a first fluid, a metal conduit arranged within said chamber and disposed in spaced relation with respect to said inner and outer walls, a first connector carried by said conduit and projecting through a fluid-tight opening provided in said first flange, a second connector carried by said conduit and projecting through a fluid-tight opening provided in said inner wall, said first and second connectors accommodating the passage through said conduit of a second fluid, a first open resilient metal structure arranged in said chamber between said inner wall and said conduit and in contact therewith, and a second open resilient metal structure arranged in said chamber between said outer wall and said conduit and in contact therewith, said conduit and said first and second structures being clamped between said inner and outer walls and supported in place therebetween in said chamber, said first structure accommodating ready passage therethrough of said first fluid in said chamber between said inner wall and said conduit and said second structure accommodating ready passage therethrough of said first fluid in said chamber between said outer wall and said conduit, said first structure being arranged in good heat exchange relation with said conduit and in poor heat exchange relation with said inner wall and said second structure being arranged in good heat exchange relation with said conduit and in poor heat exchange relation with said outer wall so as to promote heat exchange between said first and second fluids and to retard heat exchange between said conduit and said inner and outer walls.

3. A heat exchanger comprising inner and outer tubular metal walls arranged in adjacent spaced-apart relation and cooperating to define a tubular chamber therebetween accommodating the passage therethrough of a first fluid, a substantially helical metal conduit arranged within said chamber and surrounding said inner wall and disposed in spaced relation with respect to said inner and outer walls and accommodating the passage therethrough of a second fluid, a first resilient corrugated sheet metal structure arranged in said chamber between said inner wall and said conduit and in contact therewith, a second resilient corrugated sheet metal structure arranged in said chamber between said

outer wall and said conduit and in contact therewith, said conduit and said first and second structures being clamped between said inner and outer walls and supported in place therebetween in said chamber, means including pairs of spaced-apart outwardly extending projections carried by said first structure and embracing the opposite sides of the turns of said conduit for locating said first structure and said conduit with respect to each other, and means including pairs of spaced-apart inwardly extending projections carried by said second structure and embracing the opposite sides of the turns of said conduit for locating said second structure and said conduit with respect to each other, said first structure accommodating ready passage of said first fluid in said chamber between said first structure and said inner wall, said second structure accommodating ready passage of said first fluid in said chamber between said second structure and said outer wall, said first and second structures accommodating ready passage of said first fluid in said chamber therebetween and into contact with said conduit, the area of contact between said first structure and said conduit being greater than the area of contact between said first structure and said inner wall and the area of contact between said second structure and said conduit being greater than the area of contact between said second structure and said outer wall so as to promote heat exchange between said first and second fluids and to retard heat exchange between said conduit and said inner and outer walls.

4. A heat exchanger comprising inner and outer tubular metal walls arranged in adjacent spaced-apart relation and cooperating to define a tubular chamber therebetween accommodating the passage therethrough of a first fluid, a substantially helical metal conduit arranged within said chamber and surrounding said inner wall and disposed in spaced relation with respect to said inner and outer walls and accommodating the passage therethrough of a second fluid, a first resilient corrugated sheet metal structure arranged in said chamber between said inner wall and said conduit and in contact therewith, a second resilient corrugated sheet metal structure arranged in said chamber between said outer wall and said conduit and in contact therewith, said conduit and said first and second structures being clamped between said inner and outer walls and supported in place therebetween in said chamber, means including pairs of spaced-apart outwardly extending projections carried by said first structure and embracing the opposite sides of the turns of said conduit for locating said first structure and said conduit with respect to each other, means including inwardly extending first parts carried by said first structure and engaging said inner wall for locating said first structure and said inner wall with respect to each other, means including pairs of spaced-apart inwardly extending projections carried by said second structure and embracing the opposite sides of the turns of said conduit for locating said second structure and said conduit with respect to each other, and means including outwardly extending second parts carried by said second structure and engaging said outer wall for locating said second structure and said outer wall with respect to each other, said first structure accommodating ready passage of said first fluid in said chamber between said first structure and said inner wall, said second structure accommo-

dating ready passage of said first fluid in said chamber between said second structure and said outer wall, said first and second structures accommodating ready passage of said first fluid in said chamber therebetween and into contact with said conduit, said first structure being arranged in good heat exchange relation with said conduit and in poor heat exchange relation by said first parts with said inner wall and said second structure being arranged in good heat exchange relation with said conduit and in poor heat exchange relation by said second parts with said outer wall so as to promote heat exchange between said first and second fluids and to retard heat exchange between said conduit and said inner and outer walls.

5. A heat exchanger comprising inner and outer tubular metal walls arranged in adjacent spaced-apart relation and cooperating to define a tubular chamber therebetween accommodating the passage therethrough of a first fluid, a substantially helical metal conduit arranged within said chamber and surrounding said inner wall and disposed in spaced relation with respect to said inner and outer walls and accommodating the passage therethrough of a second fluid, a first resilient corrugated metal structure arranged in said chamber between said inner wall and said conduit and in contact therewith, and a second resilient corrugated metal structure arranged in said chamber between said outer wall and said conduit and in contact therewith, said conduit and said first and second structures being clamped between said inner and outer walls and supported in place therebetween in said chamber, said first structure accommodating ready passage of said first fluid in said chamber between said first structure and said inner wall, said second structure accommodating ready passage of said first fluid in said chamber between said second structure and said outer wall, said first and second structures accommodating ready passage of said first fluid in said chamber therebetween and into contact with said conduit, the area of contact between said first structure and said conduit being greater than the area of contact between said first structure and said inner wall and the area of contact between said second structure and said conduit being greater than the area of contact between said second structure and said outer wall so as to promote heat exchange between said first and second fluids and to retard heat exchange between said conduit and said inner and outer walls, said first and second structures being of substantially tubular form and respectively extending substantially continuously around the exterior of said conduit and between the opposite ends thereof.

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