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DISTRIBUTOR HEAD FOR HEAT EXCHANGERS

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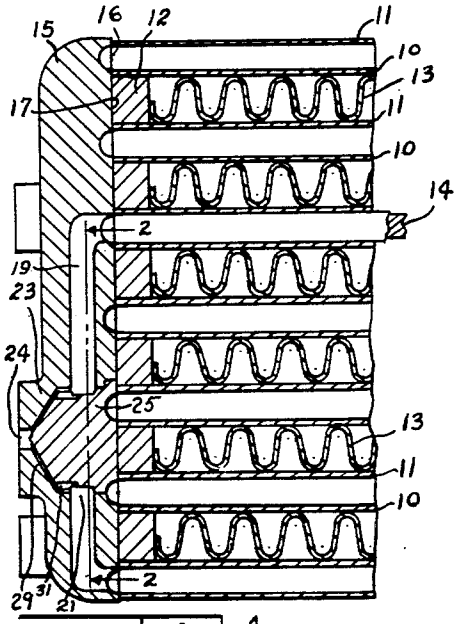


Fig-1

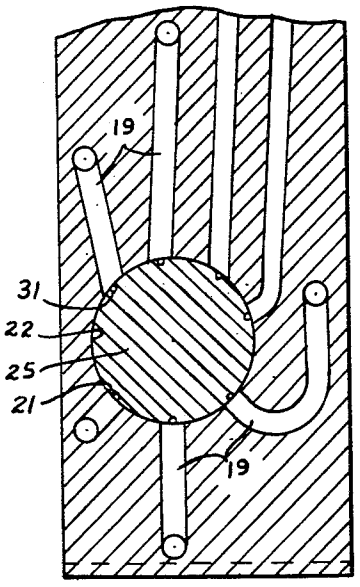


Fig-2

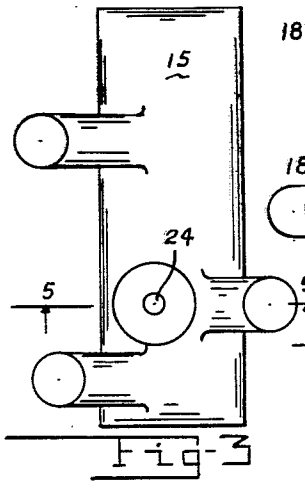


Fig-3

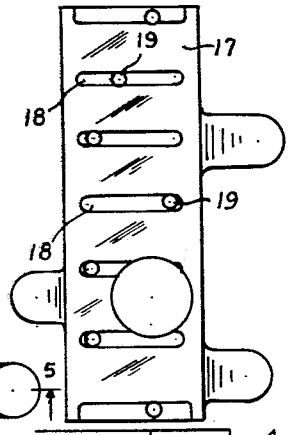


Fig-4

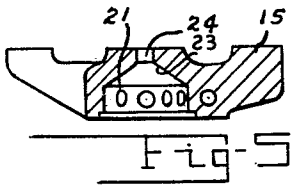


Fig-5

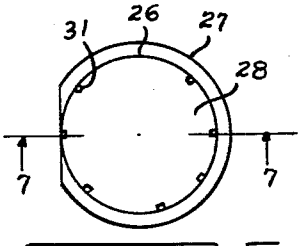


Fig-6

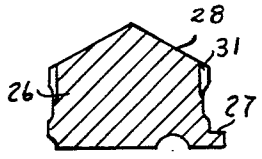


Fig-7

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DISTRIBUTOR HEAD FOR HEAT EXCHANGERS

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This invention relates to heat transfer devices providing a plurality of separated flow paths conducting an evaporative liquid in heat transfer relation to another fluid of a different temperature. Although not so limited, the invention has especial reference to systems circulating a refrigerant such as liquid ammonia for use as a coolant.

An object of the invention is to supply the evaporative refrigerant to the face of the heat exchanger core under conditions achieving an evenly distributed fluid supply to the several flow passages of the heat exchanger even though the coolant may be composed of unmixed components of liquid and vapor.

Another object of the invention is to provide distributing means as described mounted on to be an integral part of the heat exchanger structure and accomplishing its distributive function without materially increasing the size of or altering the basic configuration of the exchanger.

A further object of the invention is to utilize distributing means as described which is simple and compact of construction and which does not involve the use of joined tubes and manifolds and is hence reliable in operation and free of difficulties caused by vibration and shock.

A still further object of the invention is to incorporate in the distributing means devices to insure a uniform flow to the several flow passages of the heat exchange core, and in a manner avoiding appreciable reduction in pressure of the flowing fluid.

Other objects and structural details of the invention will appear from the following description when read in connection with the accompanying drawings, wherein:

FIG. 1 is a fragmentary view in longitudinal section of a heat exchanger in accordance with the illustrated embodiment of the invention, showing the distributor unit applied to the face of the heat exchanger;

FIG. 2 is a fragmentary view in longitudinal section taken substantially along the line 2—2 of FIG. 1 and relatively enlarged;

FIG. 3 is a view in elevation of the unitary distributor and at a scale reduced with respect to FIG. 1, showing the outer face thereof;

FIG. 4 is a view like FIG. 3 showing the inner face of the distributor;

FIG. 5 is a view in cross section, taken along the line 5—5 of FIG. 3;

FIG. 6 is a top plan view of the insert plug in the distributor head; and

FIG. 7 is a view in cross section along the line 7—7 of FIG. 6.

Referring to the drawings, the invention is disclosed as embodied in a plate type heat exchanger wherein a plurality of spaced apart superposed plates define alternate flow paths for two fluids of different temperature which achieve a heat transfer relation through the separating plates. In general, and as indicated in FIG. 1, a heat exchanger of this type comprises a series of stacked plates of a number selected in accordance with the number of fluid passes or fluid flowing ducts to be provided. The series

of plates may be considered to be comprised of a plurality of plates 10 and 11 arranged in alternating order. These plates have substantially the same configuration and are made of a thin light weight metal. A plate 10 and an underlying plate 11 are held spaced apart by strips 12 marginally disposed on two sides of the plates. Fins 13 are disposed between each plate 10 and its underlying plate 11. Each plate 11 and an underlying plate 10 are held spaced apart by other marginal strips 14 at right angles to the strips 12. The arrangement is one devised to bring two fluids into heat transfer relation through separating plates. To this end the marginal strips or pieces 12 close opposite side edges of overlying and underlying plates 10 and 11 and define therewith a fluid flowing duct open at its opposite ends for flow of a first fluid which may be air therethrough. Similarly the marginal pieces 14 cooperate with a respective overlying plate 11 and an underlying plate 10 to define ducts at right angles to the aforementioned ducts for flow therethrough of a second fluid which is in the illustrated instance a refrigerant. The described ducts are in alternating relation to one another so that between and through each plate 10 and 11 an exchange of heat takes place as between the different fluids. The corrugated strip fins 13 aid in the absorption and transfer of heat. In the assembly of the exchanger the several parts are brought together in the manner illustrated and held in a suitable fixture while dipped in a brazing process or otherwise unitarily connected in a similar metal working method. Since the hills and valleys of the fin material 13 are in contact with adjacent plates these portions are united with the plate. An effective heat transfer connection so is made, and, in addition a plurality of positive ties is formed between adjacent plates in a manner to resist bulging or separation by the contained pressure of the fluids in the heat exchanger. The fins are made of a thin and ductile material corrugated or crimped to the configuration shown and placed between adjacent plates of the heat exchanger with the side edges of the fin strip in contact with the marginal closure pieces, the strip being in effect confined along its side edges by such marginal pieces.

In accordance with the instant inventive concept the marginal strips or pieces 12 are in relatively projecting relation to the adjacent side edges of the plates 10 and 11. The exposed front edges of the strips further are machined or otherwise formed to be flat and to occupy a common plane. A manifold or distributor head 15 mounted thereon accordingly finds a level flush position tending to close off the space between adjacent strips 12. This space, indicated at 16, forms the inlet to a flow passage as defined by an upper plate 11 and a lower plate 10. The assembly comprising the plates 10 and 11 and the several strips 12, 13 and 14 forms the core of the heat exchanger which may be surrounded by a suitable case (not shown) which alone or in conjunction with the marginal strips 13 and 14 may close the sides of the inlet spaces 16. The marginal pieces 12, on the side of the core illustrated, define a face of the core through which the described flow passages open at superposed spaced apart locations.

The manifold or distributor 15 is mounted on such face of the core and is secured thereto as for example by the brazing process previously mentioned. The distributor is a unitary device made, in accordance with a feature of the invention, as a metal casting. An inwardly facing

surface 17 thereof is machined for mating engagement with the machined surfaces of the strips 12 and further in such surface is a longitudinal series if spaced apart laterally extending grooves 18. Each grooves 18 marks the terminus of a passage 19 which has its beginning at a radial opening 21 in a recess 22 which at its one end opens through the surface 17. The opposite end of the recess 22 is reduced in diameter through a conical configuration 23 and terminates in a relatively small diameter axial opening 24. The latter is suitably connected in the refrigerant circulating system to serve as an inlet for the flowing fluid enroute to the heat exchange core. Closure means 25 is installed in the recess 22 through the surface 17 so that fluid admitted to recess 22 is compelled to find and enter the several ducts 19 whereby it is conducted to the several transverse grooves 18 in the surface 17.

The position of the distributor upon the face of the core is such as to align the transverse grooves 18 with the spaces 16 at the inlet ends of the flow passages communicating therewith. The fluid flow accordingly is from inlet opening 24 through recess 22 to the several ducts 19 and thence to the several flow passages in the core which have their inlet ends facing the distributor 15 to be supplied therefrom. A duct 19 is provided for each groove 18 and the latter are provided in such number and arrangement as to agree with the number of and arrangement of flow passages in the core.

The closure means 25 has the character of a plug or insert device. It has intermediate its ends a cylindrical portion 26 having approximately the same diameter as the main portion of the recess 22 in such manner as to be received therein with a press fit. At the outer end of the insert device is a flange 27 adapted to seat in a complementary counterbore of the recess 22 and thereby limit inward movement of the insert device. At the opposite end is a conical formation 28 which is in approximately mating relation to the conical surface 23. The seating of the flange 27 in the counterbore of recess 22 is, however, such as to place the conical surface 28 short of contact with the surface 23 but in closely adjacent relation thereto in such manner as to define an intermediate cone shaped flow area 29. The apex of the conical formation 28 on device 25 extends approximately to and into the inlet opening 24 and is axially disposed with respect to such opening in a manner to obtain a substantially uniform deflection of the incoming fluid into the space 29. Flow from this space to the openings 21 of the several ducts 19 is by way of respective orifices 31. These are circumferentially spaced about the periphery of the insert device 25 at the juncture of cylindrical portion 26 and conical portion 28. They are formed by taking suitable longitudinal cuts, which are in the illustrated instance rectangular in shape, extending downwardly along the surface 26 to communicate with respective openings 21. The communication afforded by the individual orifices 31 to their respective openings 21 is a separated one since the surface 26 has, as described, a press fit in recess 22 so that communication between adjacent openings 21 is substantially precluded. Further, the several orifices 31 are machined to be identical to one another in their dimensions whereby the flow through the several orifices is uniform. Should it be desired to supply a greater or lesser portion of the incoming fluid to selected areas of the core face this could, of course, be achieved by varying the sizes of the orifices.

As noted, the fluid under control is a refrigerant, ammonia, Freon and the like, which as circulated in a cooling system of the present kind is normally in a liquid state. Under some conditions of operation, however, as in a reduction of fluid pressure to achieve a lower fluid temperature, a substantial part of the fluid may change phase and become a gas or vapor. Should no provision be made to compensate for this condition the fluid upon reaching the heat exchanger may separate into a liquid form passing through lower flow passages of the heat exchange core and a gas form passing through upper flow passages. Such a mode of operation, yielding inconsistent results and lowering the efficiency of the heat exchanger is undesirable. In accordance with the instant inventive concept no opportunity for such separation at the core face is permitted. The fluid is supplied in a continuously mixed state under uniform conditions to all parts of the core so that the quality of the fluid passing through lower flow passages is substantially the same as that of the fluid passing through upper flow passages. The fluid entering recess 22 is confined within conical space 29 and has no opportunity to expand. It is, moreover, directed in a shallow uniform stream over the surface 28 to the several orifices 31. The latter admit equal quantities of the fluid to the several ducts 19 which conduct it to the groove 18 and into respective flow passes of the core. The arrangement is, moreover, one achieving the desired results without any material increase in the size of the heat exchanger and one which moreover obviates the use of individual tubes, header chambers and the like which are vulnerable to vibration, shock and like operational conditions.

What is claimed is:

1. Heat exchange apparatus, including a core providing superposed liquid flow paths, separator strips mounted in one face of said core between said paths and in relative projecting relation thereto, outwardly facing sides of said strips being flat and occupying a common plane, and a liquid distributor mounted in superposed relation to said one face of said core, said distributor being formed with a planar surface in contacting relation to the said outwardly facing sides of said strip and said distributor further having a liquid inlet and a plurality of separated flow passages leading from said inlet to the said planar surface of said distributor, each of said flow passages opening through said surface between an adjacent pair of said strips to communicate with a respective flow path in said core.

2. Heat exchange apparatus according to claim 1, characterized by laterally elongated longitudinally spaced apart grooves in the said planar surface of said distributor in which said flow passages terminate, said grooves being aligned with respective flow paths in said core.

3. Heat exchange apparatus according to claim 1, characterized by insert means installed in said inlet inhibiting fluid expansion therein and defining orifices communicating said inlet with respective flow passages.

4. Heat exchange apparatus including a core providing superposed separated liquid flow paths, said flow paths having inlet ends opening through a common face of said core, a liquid distributor mounted on the said face of said core providing a liquid inlet and a plurality of liquid flow passages extending in separated relation from said inlet to communicate with respective inlet ends of said core paths, said inlet having the form of a recess in the interior wall of which circumferentially spaced apart openings define inlet ends of respective flow passages, and insert means installed in said recess in contacting engagement with the interior wall thereof, said means being cut away to define equal area orifices communicating with respective inlet ends of said flow passages.

5. Heat exchange apparatus including a core providing superposed separated liquid flow paths, said flow paths having inlet ends opening through a common face of said core, a liquid distributor mounted on said core and having a planar surface to lie in contacting superposed relation to the said face of said core, said distributor having a recess opening at its one end through said planar surface and admitting liquid at its opposite end, a plurality of separated flow passages communicating at their one ends with said recess at circumferentially spaced apart points on the interior wall thereof and opening at their opposite ends through the said planar surface at longitudinally spaced locations thereon to communicate with the inlet ends of respective flow paths in said core, and insert means installed in and closing the said one end of

said recess and defining orifice openings for uniform flow from said recess to said flow passages.

6. Heat exchange apparatus according to claim 5, characterized in that the inner end of said insert means and the said opposite end of said recess have complementary approximately conical configurations directing incoming liquid in a shallow uniform stream toward the periphery of said insert means, said insert means being cut away at its periphery to define said orifice openings.

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