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3,196,943

DISTRIBUTOR FOR HEAT EXCHANGE APPARATUS

Filed July 18, 1963

2 Sheets-Sheet 1

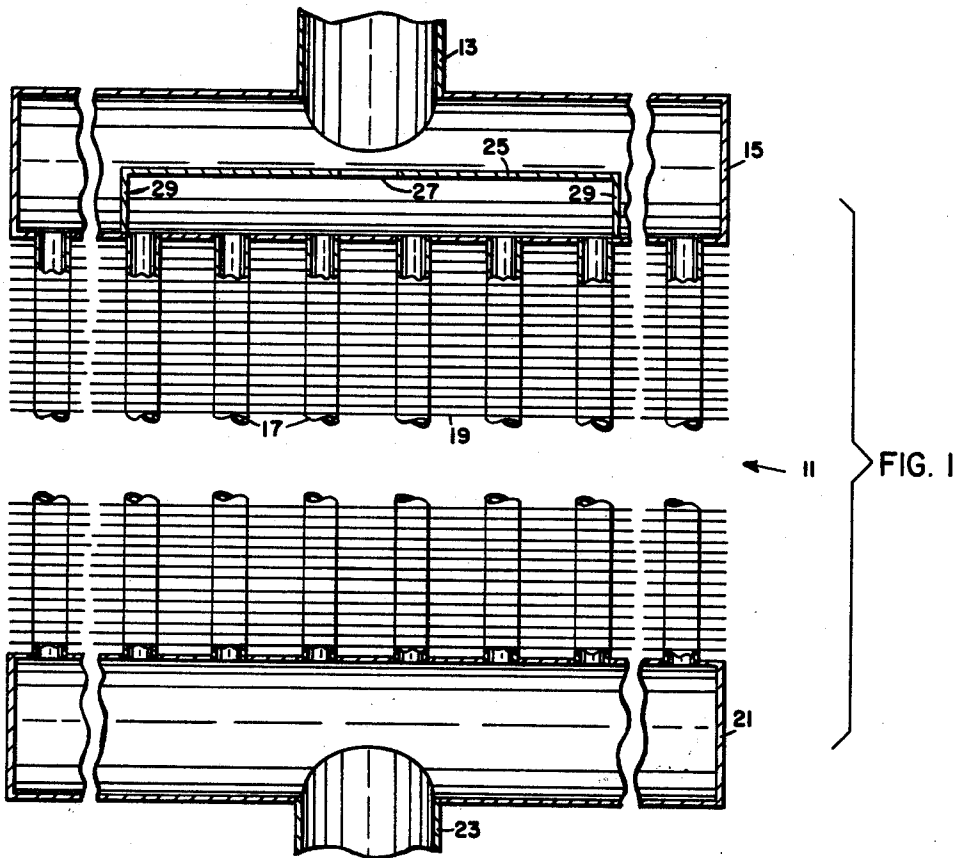
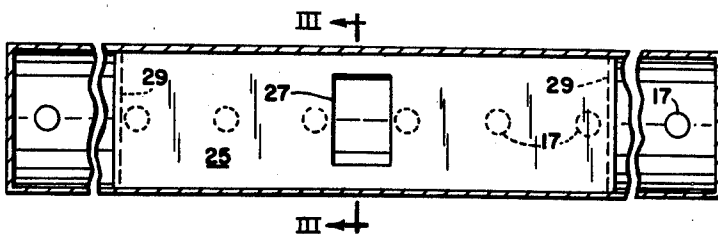


FIG. 2

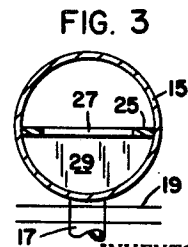


FIG. 3

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FIG. 4

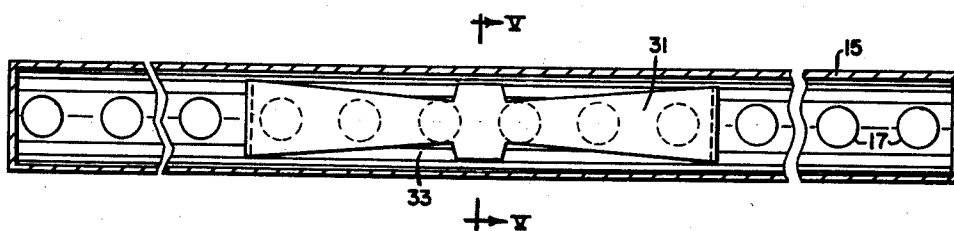


FIG. 5

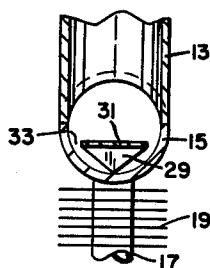
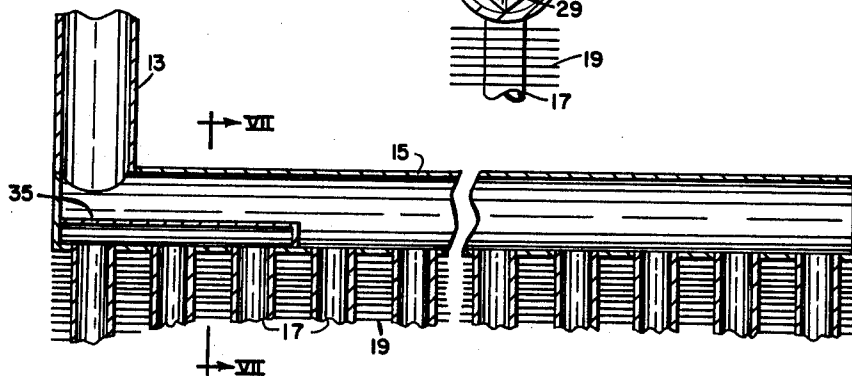
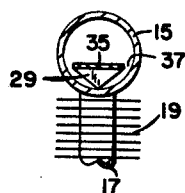


FIG. 6

FIG. 7



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3,196,943
DISTRIBUTOR FOR HEAT EXCHANGE
APPARATUS

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3 Claims. (Cl. 165—174)

This invention relates to heat exchange apparatus. More particularly this invention relates to an improved distributor or header for a heat exchanger which serves to distribute a fluid medium in a manner providing substantially equal flow to heat exchange tubes.

Heat exchangers of the kind under consideration, generally comprise a plurality of heat exchange tubes, frequently with an extended finned surface, which are connected at one end into a supply header and on the opposite end into a return header. The headers are frequently made out of a pipe several times the diameter of the tubes to be affixed therein; however, they may be made from a casting, or fabricated from metal plates. The inlet or outlet connection into the header generally is of the same diameter as the cross section of the header and is secured therein in the plane of the tubes at either an end, or in the middle, of the header.

As a consequence of this construction, the tubes most directly opposed to the inlet connection of the header receive the full impact of the high fluid dynamic pressure when the fluid passes through the header into the tubes connected thereto. Thus, the tubes opposite the inlet connection will have an above-average flow, whereas the tubes adjacent such tubes will receive a below-average flow due to their location in an under-pressure area caused by the turning loss as the fluid passes from the elbow or T-connection to the ends of the inlet header. In some instances the under-pressure area has been found to actually be so low as to draw a suction upon those tubes in its immediate region. This differential flow in the tubes of conventional heat exchangers therefore results in inefficient heat transfer since all the tubes are not able to operate at design capacity.

It is therefore, a primary object of this invention to provide a heat exchanger in which the heat transfer efficiency is improved.

Another object of this invention is to provide a heat exchanger containing means within its distributor or inlet header which distributes a fluid medium to substantially equalize the flow to the different heat exchange tubes.

A further object of this invention is to provide a fluid distributor or inlet header with a plurality of zones having different dynamic and static pressures to insure a better distribution of fluid to each heat exchange tube connected thereto. Other objects of the invention will be readily perceived from the following description.

This invention relates to a heat exchanger including a plurality of heat exchange tubes, an inlet header and an outlet header, through which a fluid passes in heat exchange relation with a medium to be treated. A distributing baffle member is provided within the inlet header to assure an equal distribution of fluid to each inlet opening of the tubes. This baffle member comprises a plate extending longitudinally of the header having a length sufficient to shield a portion of the inlet openings which lead to those heat exchange tubes generally opposite the inlet connection to prevent the discharge of fluid entering the header from flowing directly into these openings, while dispersing fluid to all the tube openings assuring equal fluid distribution throughout the heat exchanger for an improved heat transfer operation.

This invention further relates to a distributor or inlet header for a heat exchanger which includes a casing hav-

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ing an inlet connection therein through which a fluid enters the casing and a plurality of openings opposite the inlet connection adapted to receive heat exchange tubes. A baffle plate is secured within the casing and extends longitudinally of the casing. The plate is placed between the inlet connection of the casing and a group only of the openings generally opposite the inlet casing. The number of openings in the group is substantially less than the total number of the openings in the casing. The baffle plate has at least one opening therein substantially less in area than the area of the plate to permit flow of fluid through the plate. The baffle plate is of such size as to extend longitudinally of the casing beyond the center line of the inlet connection toward one end of the casing a distance substantially equal to two diameters of the inlet connection.

The attached drawings illustrate a preferred embodiment of the invention in which:

FIGURE 1 is a cross-sectional view of a heat exchanger in accordance with this invention;

FIGURE 2 is a sectional view of an inlet header or distributor embodied in the heat exchanger shown in FIGURE 1;

FIGURE 3 is a sectional view of the inlet header taken along lines III—III of FIGURE 2;

FIGURE 4 is a sectional view of an inlet header or distributor showing a modified distributing means;

FIGURE 5 is a sectional view of the inlet header of FIGURE 4 taken along lines V—V of FIGURE 4;

FIGURE 6 is a sectional view of a portion of a heat exchanger having an inlet connection at one end provided with the header or distributor of the present invention; and

FIGURE 7 is a sectional view of the inlet header shown in FIGURE 6 taken along the lines VII—VII.

Referring to the drawings, there is shown in FIGURE 1 a heat exchanger 11 with an inlet header or distributor 15, a plurality of heat exchange tubes 17, having extending finned surfaces 19, and an outlet header 21. Distributor 15 contains an inlet connection 13 in one side thereof and tubes 17 connected to the distributor on the side opposite to inlet 13. Header 21 is connected to the opposite end of tubes 17 and includes an outlet connection 23 on the one side thereof opposite to the tubes 17.

The inlet header 15 is furnished with a distribution baffle plate 25 having a substantially centrally located aperture 27 of suitable size and shape. The baffle plate 25 includes a depending leg portion 29 at each end thereof secured to the lower portion of header 15 by any suitable means such as welding. The leg portions 29 locate the baffle plate 25 remote from the inlet openings of the heat exchange tubes 17 for a purpose later to be described.

Referring more particularly to FIGURES 2 and 3, baffle plate 25 divides the central portion of the inlet header 15 into a plurality of zones each having different dynamic and static pressures in order to effect a substantially equal flow distribution of fluid to the heat exchange tubes 17 as later described herein.

The sizes of the baffle plate 25 and aperture 27 are dependent upon the dynamic pressure of the fluid entering the inlet connection 13. The overall length of the baffle plate 25 is determined from the size of the inlet connection 13 which usually is of the same diameter as the pipe selected to form the header 15, or it is similarly related in size for constructions other than a pipe, i.e. castings or fabricated metal plates. This plate 25 extends beyond the center line of the inlet connection 13 toward one end of the header 15 a distance equal to two diameters of the inlet connection. The aperture 27 generally is rectangular as shown, but it may be of any configuration, for example oval, provided it is of an area approximating $\frac{1}{3}$ of the area of the inlet connection 13. The

aperture 27 must be situated in baffle 25 in a position in which it is not in direct alignment with any opening leading into one of the heat exchange tubes 17. The depending legs 29 position the distribution baffle 25 away from the inlet openings to those heat exchange tubes 17 centrally located in the heat exchanger 11. This position has proven to be generally about $\frac{1}{3}$ to $\frac{1}{2}$ the diameter of the inlet header 15 in order to obtain satisfactory distribution of the fluid to all the heat exchange tubes 17. While I have shown the distribution baffle 25 extending fully transverse of header 15, it is also contemplated that baffle 25 may be slightly removed from the wall of header 15 and thereby provide a longitudinal slot or slots on either side along the wall of header 15 which will also permit a portion of the fluid to flow therethrough to the tubes 17 under baffle 25.

FIGURES 4 and 5 show a header containing a modified baffle plate. There is provided a baffle plate 31 having reduced intermediate portions which, with the wall of header 15, define elongated openings or slots 33 on opposing sides of the header 15 along the longitudinal axis thereof. In a one row heat exchange coil, the opening or slot 33 may be on only one side, however, in a heat exchange coil having a plurality of rows, it is necessary to provide an opening 33 on both sides of the inlet header 15. The baffle plate 31 with the opening 33 on each side of the inlet header 15 functions in a similar manner as the baffle plate 25 of FIGURES 1 and 2 in that each of these baffle plates provides the same proportionate open area for fluid entry into the tubes encompassed by either baffle plate and each baffle plate will form a shield over the aforementioned tubes.

FIGURES 6 and 7 show a different embodiment wherein the inlet connection 13 is at one end of the header 15. In this type of construction a baffle plate 35 is provided which is shown to be of a form similar to that employed in the construction shown by FIGURES 4 and 5. If desired, this baffle plate 35 may be of the form shown in FIGURES 2 and 3. There is a narrow opening or slot 37 on each side of the baffle plate 35 along the longitudinal axis of the header 15. In accordance with the general construction heretofore set forth, there may be only one opening or slot 37, or none, depending upon the type of baffle plate 35 selected for this arrangement.

In operation, each baffle plate 25, 33 and 35 functions to shield those heat exchange tubes generally opposite the inlet connection 13 from the full impact of the high fluid dynamic pressure entering the header 15 and to disperse portions of the fluid to tubes adjacent the ends of the header 15 beyond the baffle plate. The fluid flow is such that the tubes 17 generally opposite the inlet connection 13 are supplied with fluid through the aperture 27 in one form, or the narrow slot 33, 37 along the reduced portion of baffle plate 31, 35 and the wall of header 15 in the modifications set forth heretofore. As the flow enters the header 15 through the inlet connection 13 it must turn to flow into each end and this action produces an under-pressure area in the portion of header 15 on each side adjacent the connection 13. Because of these under-pressure areas on either side of the inlet connection 13, the baffle plate is formed in such a way that high speed flow to the area under any of the baffle plates 25, 33 and 35 is decelerated to such an extent, that the concurring static pressure rise under the baffle plate compensates for the flow under-pressure above the baffle plate created due to the turning losses in the flow as it enters the header 15 through the inlet connection 13. Thus it can be seen that a distribution baffle plate in accordance with this invention is effective in providing a substantially equal supply of the fluid to each of the inlet openings of the heat exchange tubes 17.

The deceleration of the high speed flow and transformation effected by the distribution baffle plate of this invention improves the performance of a given heat exchanger by insuring a substantially even flow distribution

to all the heat exchange tubes employed therein. In addition, the turning losses of a fluid medium passing through a T-connection into the header that would otherwise effect a vortex turbulent area adjacent each side of the connection, and induce an under-pressure area over the tube inlets adjacent the central tube inlets normally under high fluid dynamic pressure are compensated for by utilizing the fluid dynamic pressure to increase the static pressure in the zone under the baffle plate and thereby equally distribute the flow evenly to all those heat exchange tubes encompassed by the baffle plate. The remaining heat exchange tubes also receive flow from the portion of the fluid dispersed above the baffle plate.

The distribution baffle plate of this invention may be employed in any heat exchanger wherein a fluid medium is passed through the exchange tubes from a fluid distributor or supply header and may be either a steam or a hot water coil; or any other heat exchanger, for example, condensing and evaporative heat exchange coils employed in a refrigeration system.

While I have described a preferred embodiment of the invention, various other advantages and applications will occur to those skilled in the art and it will be understood that the invention is not limited thereto since it may be otherwise embodied within the scope of the following appended claims:

I claim:

1. In a heat exchanger, the combination of
 - (a) a horizontally extending inlet header including an inlet connection on its upper side having a predetermined area and a plurality of openings on its lower side,
 - (b) a horizontally extending outlet header including an outlet connection and a plurality of openings,
 - (c) a plurality of heat exchange tubes disposed between said headers and affixed within said header openings, and
 - (d) a horizontally extending baffle plate having depending ends secured within said inlet header longitudinally thereof between said inlet connection and a group only of those header openings generally opposite said inlet connection, the depending ends of said plate being secured to the lower portion of said inlet header, the number of said openings in said group being substantially less than the total number of the openings in said inlet header, said baffle plate with said depending ends defining an interior zone encompassing said group of said header openings, said baffle plate having a substantially centrally located aperture therein substantially less in area than the area of the plate and having an area approximating about $\frac{1}{3}$ of the area of the inlet connection; the aperture being placed substantially opposite the inlet connection and being situated between two of the header openings to permit flow of fluid through the plate while preventing direct discharge of fluid into any of the header openings in the lower side thereof.
2. A distributor for a heat exchanger as defined in claim 1 wherein said baffle plate further comprises a length extending longitudinally of the casing beyond the centerline of the inlet toward one end of said casing a distance substantially equal to two diameters of the inlet.
3. In a distributor for a heat exchanger, the combination of a horizontal casing having an inlet connection therein through which a fluid enters and a plurality of openings opposite to said inlet connection adapted to receive heat exchange tubes, and a horizontally extending baffle plate having depending ends secured within said casing longitudinally thereof between said inlet connection and a group only of those openings generally opposite said inlet connection, the depending ends of said plate being secured to the lower portion of said casing the

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number of said openings in said group being substantially less than the total number of the openings in said casing, said baffle plate with said depending ends defining an interior zone encompassing said group of said openings, said baffle plate having a aperture therein substantially less in area than the area of the plate situated between two of the openings to permit flow of fluid through the plate while preventing direct discharge of fluid into any of the openings in the lower portion of the casing.

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