March 21, 1967 A. G. BUTT 3,310,105

HEAT EXCHANGER WITH COMBINED CLOSING MEMBER AND FLUID DISTRIBUTOR

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FIG. 1

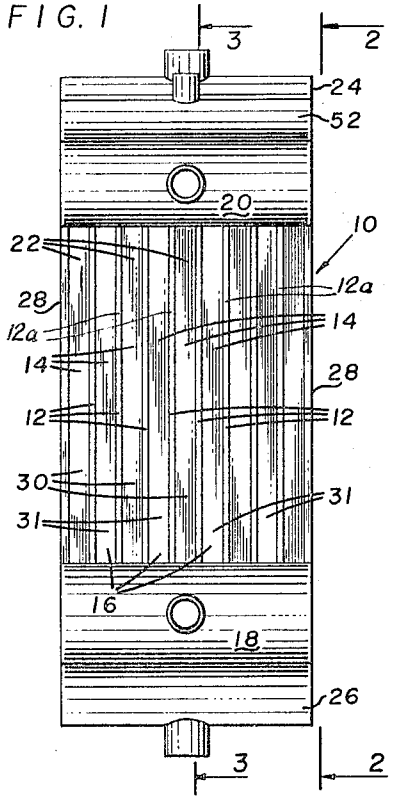


FIG. 2

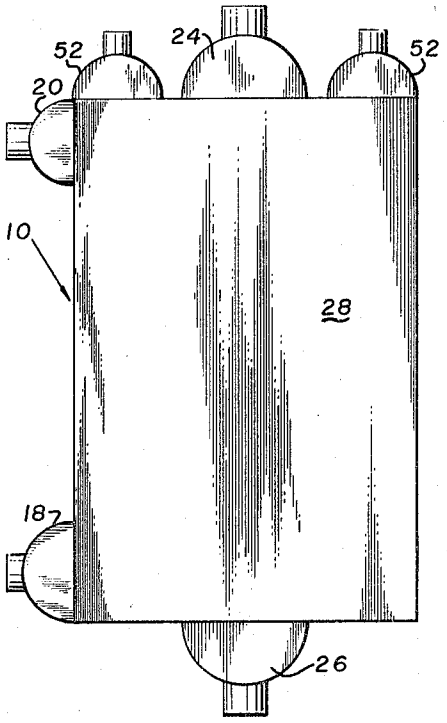


FIG. 3

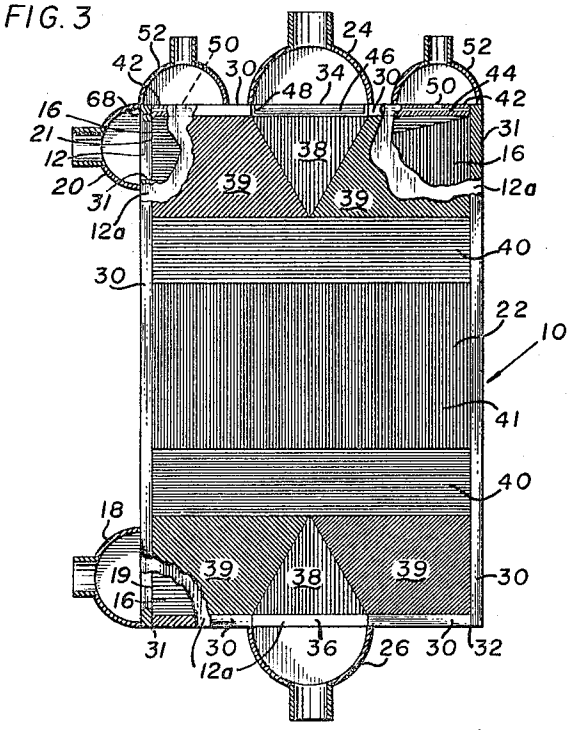
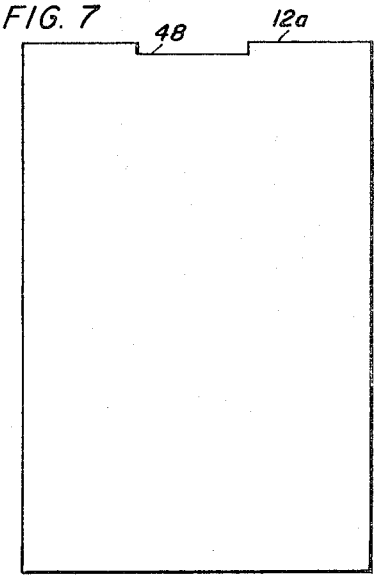


FIG. 7



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HEAT EXCHANGER WITH COMBINED CLOSING MEMBER AND FLUID DISTRIBUTOR

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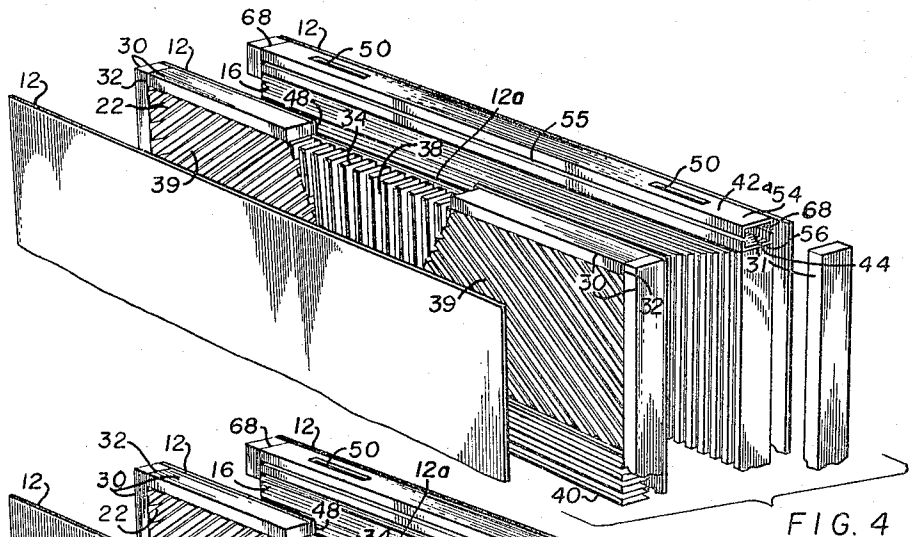


FIG. 4

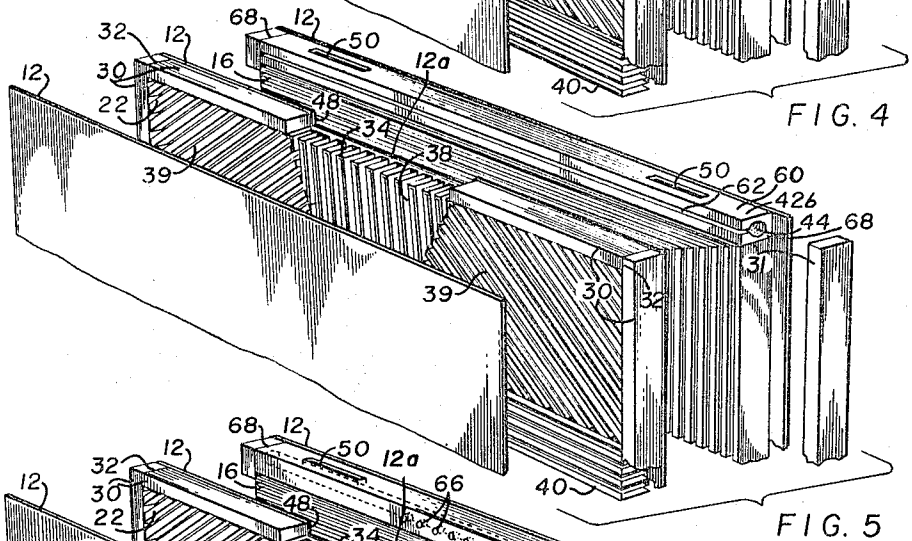


FIG. 5

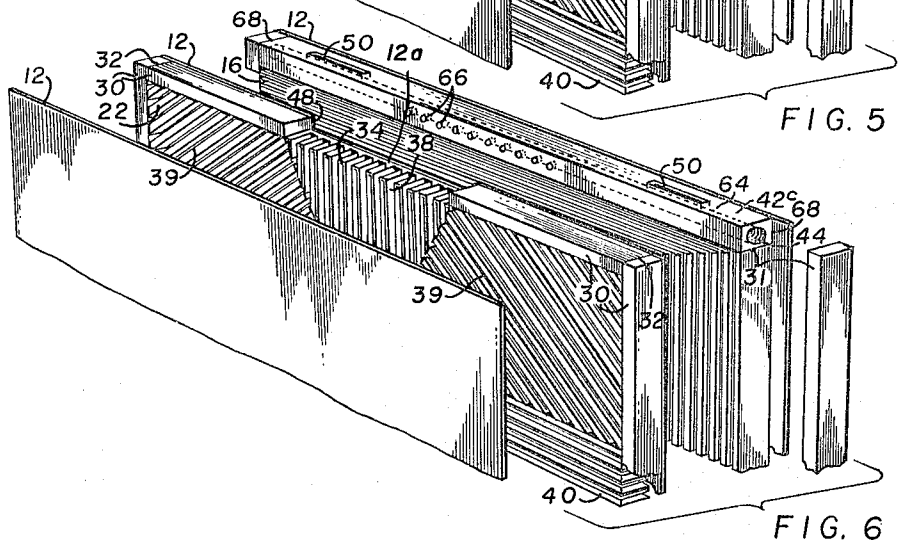


FIG. 6

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HEAT EXCHANGER WITH COMBINED CLOSING MEMBER AND FLUID DISTRIBUTOR

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10 Claims. (Cl. 165—166)

This invention relates to heat exchangers and especially to heat exchangers having spaced metallic plates defining therebetween fluid passages for the flow of heat exchange fluids. More particularly the present invention relates to such heat exchangers specifically adapted for the introduction of a two phase fluid, such as liquid and gas, into a single fluid passage. A problem has existed as to obtaining thorough distribution of one phase in the other.

It is a prime object of this invention to provide a means for simultaneously introducing both gas and liquid to the same passages of a plate type heat exchange core which permits relatively large changes in flow rates of either phase without disturbing the uniformity of distribution of one fluid within the other.

It is a further object of this invention to provide a gas-liquid distributor means which is useful with brazed heat exchangers.

It is another object of this invention to provide a gas-liquid distributor means which constitutes an integral part of a heat exchanger.

It is still a further object of this invention to provide a plate type heat exchanger with a closing member disposed in a first heat exchange fluid passage and arranged to uniformly distribute a second liquid heat exchange fluid to an adjacent passage conducting a third gaseous heat exchange fluid.

Other objects and advantages will become apparent as this specification proceeds to describe the invention with reference to the accompanying drawings in which:

FIGURE 1 is an elevational side view of the bar face side of a brazed plate type heat exchanger incorporating my novel liquid-vapor distributor;

FIGURE 2 is an elevational side view taken at 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken at 3—3 of FIGURE 1;

FIGURE 4 shows an enlarged exploded perspective view of a portion of the heat exchanger incorporating a first form of liquid distributor;

FIGURE 5 is similar to FIGURE 4 showing a second form of liquid distributor;

FIGURE 6 is similar to FIGURE 4 showing a third form of liquid distributor; and

FIGURE 7 is an elevational side view of a plate element of the heat exchanger.

Now referring to the drawings, it will be seen that heat exchanger **10** is comprised of a stack of planar rectangular thermal conductive metallic plates or sheets **12** arranged in superposed spaced parallel relationship defining a plurality of fluid passages **14** therebetween. Certain of these passages **16** are arranged to conduct a first heat exchange fluid via headers **18** and **20**. Others of these passages **22** are arranged to conduct a second gaseous heat exchange fluid via inlet header **24** and outlet header **26**. Passages **16** and **22** may be alternately arranged in the manner shown to provide for good heat exchange between the first and second exchange fluids. Outward of each of the outermost passages **14** is a side plate or sheet **28** having a configuration similar to plates **12** although somewhat thicker so as to provide armor for the heat exchanger core in addition to defining one side of a fluid passage.

The fluid passages **22** are provided with a first group of closing bars or members **30** sealingly bonded at adjacent ends as at **32** and interposed between and sealingly bonded to adjacent surfaces of adjacent plates **12** at the peripheral margins thereof. Certain of bars **30** have their adjacent ends spaced from each other so as to provide a fluid inlet **34** and a fluid outlet **36** to each of passages **22**. Header **24** is mounted in fluid communication with each of inlets **34** and header **26** is mounted in fluid communication with each of outlets **36**. Each passage **22** may be provided with triangular distributor sections **38** disposed adjacent inlet **34** and outlet **36** having fins extending longitudinally of the heat exchanger; with a trapezoidal distributor section **39** disposed to each side of each triangular distributor section (FIGURES 3–6) having fins inclined with respect to the longitudinal axis of the passage toward section **38**; and with a rectangular distributor section **40** adjacent the sections **39** having fins extending normally to the longitudinally axis of the passage. The fins of this last mentioned section known as "hardway" are perforated in any known manner to permit fluid to pass transversely therethrough. Fin packing **41** having longitudinally extending fins is disposed between the sections **40**. The fins of sections **38**, **39**, **40**, and **41** may be of corrugated sheet metal construction. Gas entering inlet **34** is distributed evenly across the width of passage **22** by fins **38**, **39**, and **40** from whence it passes in proper distribution through the heat exchanger packing **41**.

Passages **16** are provided with a second group of closing bars or members **31** sealingly bonded at adjacent ends and interposed between and sealingly bonded to adjacent surfaces at the margins of adjacent plates **12** forming passages **16**. Certain of the members **31** have their adjacent ends spaced from each other so as to provide a fluid inlet **19** and a fluid outlet **21** for each of passages **16** as shown in FIGURE 3. One of the closing bars or members **31** identified by numeral **42** (FIGURE 3), which is adjacent inlet **34** of the adjoining fluid passage, is provided with a longitudinally extending duct **44** which is provided with an outlet **46** for discharging liquid with uniform lateral distribution into inlet **34** of passage **22**. The plates **12** between passages **22** and **16** designated as numeral **12***a* may be notched as at **48** to permit fluid communication from outlet **46** to inlet **34**. Each of bars **42** is provided with one or more inlet apertures **50** which are arranged in fluid communication with one or more headers **52** for conducting a liquid heat exchange medium to inlets **50**. It will thus be seen that liquid entering headers **52** will flow through inlets **50**, through ducts **44**, through outlets **46**, into the inlet **34** for admixture with the fluid entering inlet **34** from header **24**. Thus, each member **42** functions as a closing member for a passage **16** and as a liquid distributor for uniformly distributing a liquid into an adjoining gas passage.

Thus during operation of the heat exchanger a first heat exchange fluid passes through passages **16** (see FIGURE 1) via headers **18** and **20** in heat exchange relation with a second gaseous heat exchange fluid passing in adjacent passages **22**. The second fluid is delivered to passages **22** via header **24** through inlets **34** and leaves passages **22** via outlets **36** and header **26**. The first heat exchange fluid in passages **16** is also heat exchanged with a third liquid heat exchange fluid passing in adjacent passages **22**. This third liquid fluid enters headers **52** and passes through ports **50** into ducts **44** where it is uniformly distributed along the inlets **34** for admixture with the second heat exchange fluid.

FIGURES 4–6 show three different forms of closing bar **42** as designated respectively by numerals **42***a*, **42***b*, and **42***c*.

In FIGURE 4 closing bar 42*a* is comprised of a first channel 54 having its leg portions extending inward toward the heat exchange core and a second channel 56 disposed inwardly of channel 54 and having its leg portion spaced from and extending toward the leg portions of channel 54. Apertures 50 in channel 54 are provided for forming a fluid inlet for the fluid conducting duct 44 between the channels. The space between adjacent leg portions of the several channels presents an elongated outlet 55 from said duct. However, all of the outlet is sealed by the adjacent plates 12 except where plates 12*a* are notched out at 48 adjacent the inlet 34 of the adjoining passage.

In FIGURE 5 closing bar 42*b* is comprised of a single hollow extruded member 60 having a slot 62 at one side facing the inlet of the adjoining passage and extending into the hollow interior thereof. Slot 62 is closed by the adjacent plate 12*a* except where plate 12*a* is notched as at 48.

Liquid may enter inlets 50, pass longitudinally through the hollow interior of the extruded member 60 and emerge through the portion of slot 62 exposed by the notch at 48 for uniform distribution of liquid at the inlet 34 of the adjoining gaseous fluid passage.

In FIGURE 6 closing bar 42*c* is comprised of a single hollow member 64 having a plurality of longitudinally spaced bores 66 extending from the hollow interior to the external surface adjacent the notched portion at 48 of plate 12*a*. Fluid entering inlets 50 thereof is transmitted longitudinally within bar 64 from whence it is distributed evenly to the inlet 34 of the adjacent gaseous fluid passage via bores 66.

In all forms of the invention shown, the open ends of the closing bars 42 are closed by abutting closing members as at 68. The outlets of closing bars 42 provide good distribution of the liquid heat exchange fluid in the heat exchange passage conducting a gaseous heat exchange fluid in spite of variations in flow rate of either of such fluids. The distributor type closing bars 42 herein disclosed are extremely simple to connect by headers and require a minimum of cost and labor to install as they are simply brazed in place by salt bath or furnace.

Although I have described in detail specific embodiments of my invention, it is contemplated that various changes may be made without departing from the scope or spirit of my invention and I desired to be limited only by the claims.

I claim:

1. A plate type heat exchanger comprising first, second and third heat conducting plates stacked in spaced substantially parallel face-to-face relationship; sealing means extending between adjacent faces of said first and second plates along the margin thereof sealingly connecting said first and second plates thereby defining a first fluid passage between said first and second plates for the passage of a first heat exchange fluid; a fluid inlet and a fluid outlet for said first fluid passage; sealing means extending between adjacent faces of said second and third plates along the margin thereof sealingly connecting said second and third plates thereby defining a second fluid passage between said second and third plates for the passage of a second heat exchange fluid to be heat exchanged with said first heat exchange fluid; a fluid inlet and a fluid outlet for said second fluid passage; said last mentioned sealing means being a substantially closed duct extending along the margin of said second and third plates and sealingly bridging therebetween having the interior thereof connected in fluid communication with said first fluid passage adjacent the inlet thereof for directing a third heat exchange fluid for distribution at the inlet of said first fluid passage.

2. The device as defined by claim 1 wherein said last mentioned sealing means includes a pair of elongated parallel channel members each having its leg portions extending parallel to said plates toward and spaced from the other channel member; the space between adjacent leg portions of said pairs of channel members defining an elongated fluid distributing opening for distribution of said third heat exchange fluid at the inlet of said first passage.

3. The device as defined by claim 2 wherein said second plate is notched at the periphery thereof adjacent the inlet to said first passage to accommodate passage of said third heat exchange fluid.

4. The device as defined by claim 1 wherein said last mentioned sealing means includes an elongated hollow bar having a longitudinal slot at the side adjacent said inlet to said first passage and penetrating to the interior of said bar.

5. The device as defined by claim 4 wherein said second plate is notched at the periphery thereof adjacent the inlet to said first passage to accommodate passage of said third heat exchange fluid.

6. The device as defined by claim 1 wherein said last mentioned sealing means includes an elongated hollow bar having a plurality of apertures spaced longitudinally therealong extending from the surface of said bar adjacent said inlet of said first passage into the hollow interior of said bar.

7. The device as defined by claim 6 wherein said second plate is notched at the periphery thereof adjacent the inlet to said first passage to accommodate passage of said third heat exchange fluid.

8. A plate type heat exchanger comprising first, second and third thermal conducting plates disposed in substantially parallel superposed face-to-face relationship; first means forming a fluid seal between said first and second plates adjacent the margins thereof defining a first fluid passage therebetween for a first heat exchange medium; means associated with said sealing means forming a fluid inlet to and fluid outlet from said first fluid passage; extended heat transfer surface disposed in said first fluid passage; second means forming a fluid seal between said second and third plates adjacent the margin thereof defining a second fluid passage therebetween for a second heat exchange medium; said last mentioned means including an elongated hollow member extending adjacent said fluid inlet of said first passage; means forming an opening from the interior of said elongated hollow member intermediate the ends thereof and disposed in fluid communication with said fluid inlet of said first passage; and means to supply the interior of said elongated hollow member with a third heat exchange medium to be mixed with said first heat exchange medium at said fluid inlet of said first passage.

9. A plate type heat exchanger comprising first, second and third heat conductive substantially rectangular plates superposed in spaced substantially parallel face-to-face relationship; a first group of bars sealingly bonded at adjacent ends and interposed between and sealingly bonded to adjacent surfaces of said first and second plates at the peripheral margins thereof; one end of one of said bars being spaced from the adjacent end of another of said bars thereby defining a gaseous fluid inlet to the space between said first and second plates bounded by said first group of bars; means forming a fluid outlet from said space; a second group of bars sealingly bonded at adjacent ends and interposed between and sealingly bonded to adjacent surfaces of said second and third plates at the peripheral margins thereof; means forming a fluid inlet and a fluid outlet with the space between said second and third plates bounded by said second group of bars; one of the bars of said second group adjacent said gaseous fluid inlet being hollow; means defining a fluid passage in said hollow bar extending from the hollow interior thereof to the exterior side thereof adjacent said gaseous fluid inlet; and means for supplying a liquid fluid to the interior of said hollow bar.

10. A plate type heat exchanger comprising first, second and third heat conducting plates of generally similar configuration spaced in superposed substantially parallel relationship; first sealing means extending between and sealingly bonded to adjacent faces of said first and second plates along the margins thereof thereby defining a first fluid passage between said first and second plates for passage of a first heat exchange fluid; a fluid inlet and a fluid outlet for said first fluid passage; second sealing means extending between and sealingly bonded to adjacent faces of said second and third plates along the margins thereof thereby defining a second fluid passage between said second and third plates for passage of a second heat exchange fluid to be heat exchanged with said first heat exchange fluid; a fluid inlet and a fluid outlet for said second fluid passage; said second sealing means including an elongated duct having its lateral extent briding between adjacent faces of said second and third plates along a margin thereof and having the exterior surface thereof sealingly bonded to each of said adjacent faces of said second and third plates thereby effecting a seal between said adjacent faces of said second and third plates; means

for connecting the interior of said duct to said first fluid passage adjacent said inlet of said first passage; and means for conducting a third heat exchange fluid to the interior of said duct for distribution in said first fluid passage.

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