

Feb. 16, 1937.

J. M. BARCLAY ET AL

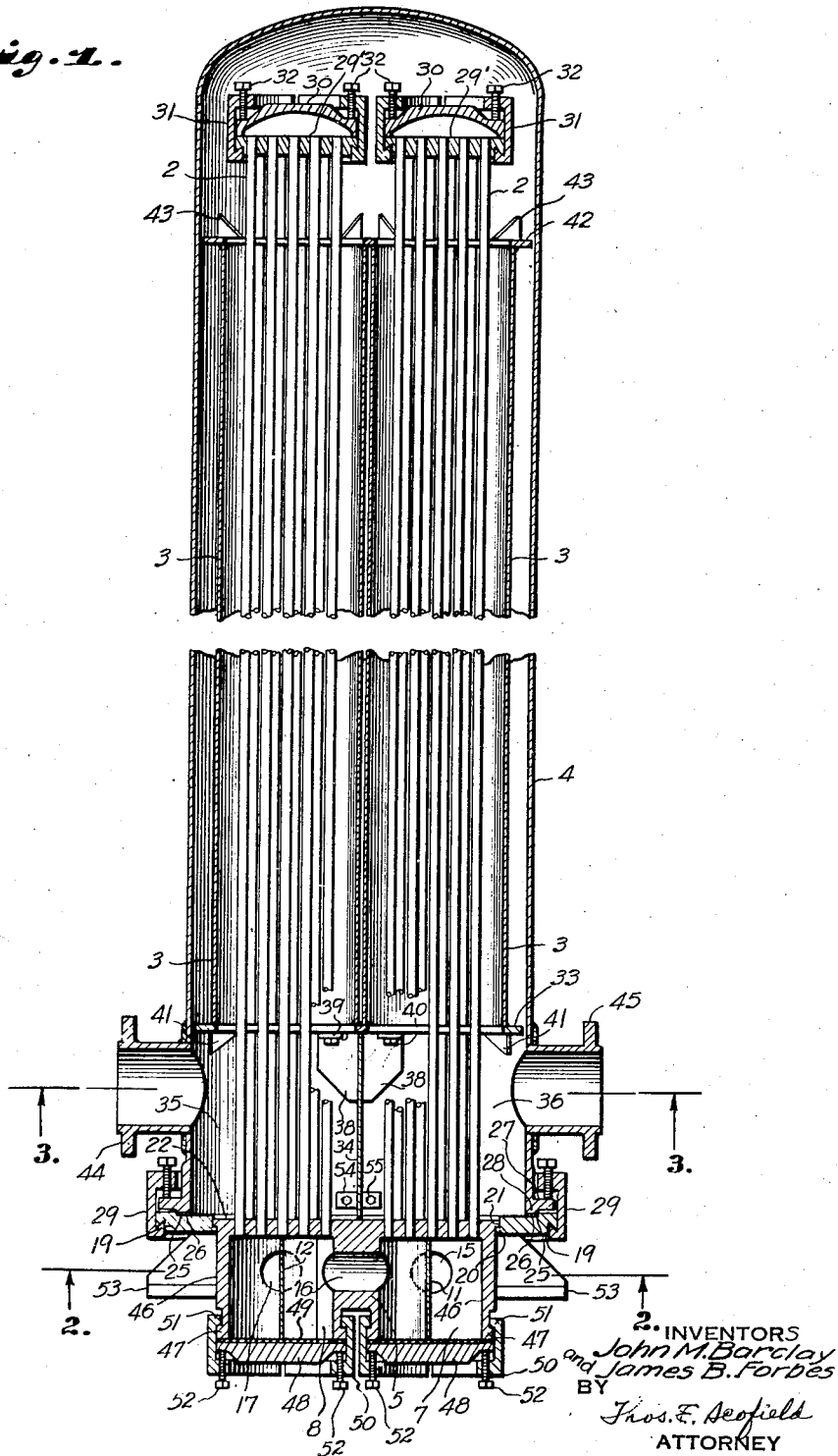
2,071,277

HEAT EXCHANGER

Filed Sept. 28, 1935

3 Sheets-Sheet 1

Fig. 1.



Feb. 16, 1937.

J. M. BARCLAY ET AL

2,071,277

HEAT EXCHANGER

Filed Sept. 28, 1935

3 Sheets-Sheet 2

Fig. 2.

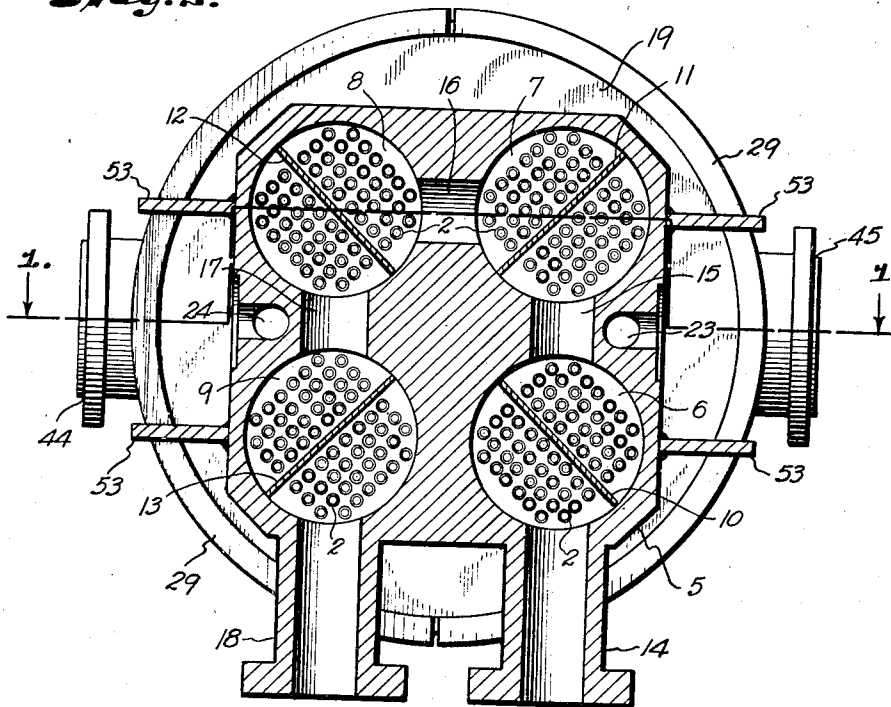
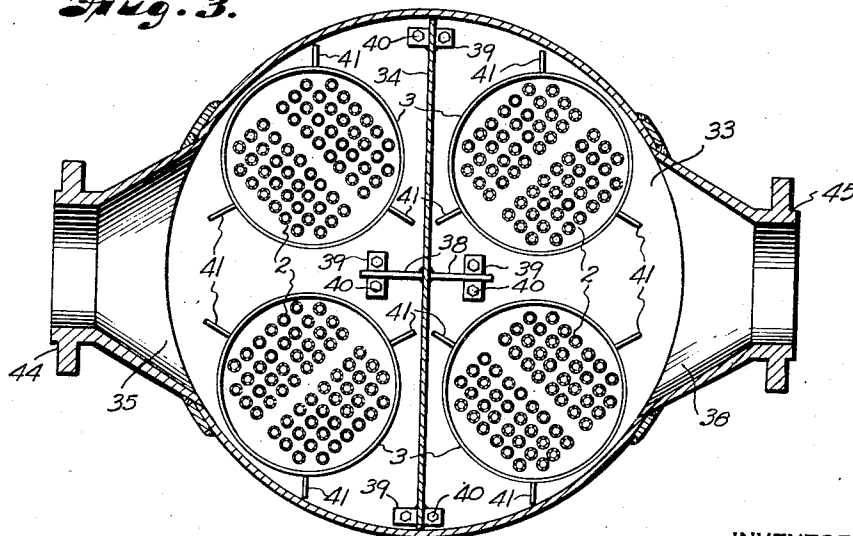


Fig. 3.



INVENTORS
John M. Barclay
and James B. Forbes
BY
Thos. F. Hesfield
ATTORNEY

Feb. 16, 1937.

J. M. BARCLAY ET AL

2,071,277

HEAT EXCHANGER

Filed Sept. 28, 1935

3 Sheets-Sheet 3

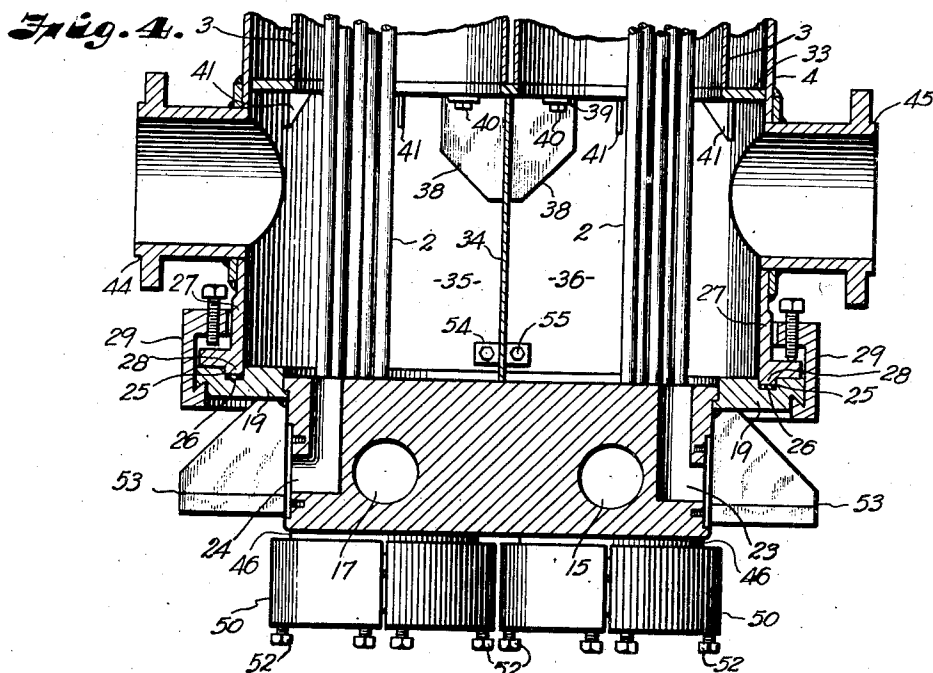
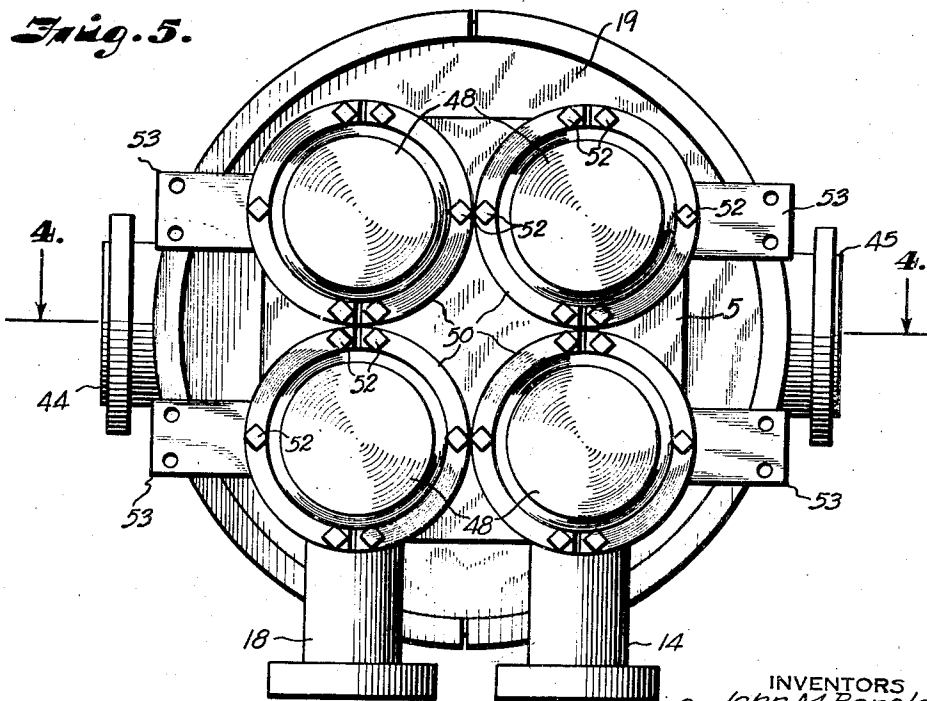


Fig. 5.



INVENTORS
John M. Barclay
and James B. Forbes
BY
J. H. Seafeld
ATTORNEY

UNITED STATES PATENT OFFICE

2,071,277

HEAT EXCHANGER

John M. Barclay, Brooklyn, and James B. Forbes,
Mount Vernon, N. Y., assignors to Alco Prod-
ucts Incorporated, New York, N. Y., a corpo-
ration of Delaware

Application September 28, 1935, Serial No. 42,646

15 Claims. (Cl. 257—223)

Our invention relates to a heat exchanger for the refining and condensation of hot oil vapor, and is more particularly concerned with appa-
ratus of this type in which a cooling liquid is circulated through bundles of tubes connected to a common stationary header.

The purpose and object of our invention is to improve heat exchange apparatus of this type in a manner which will effect a material saving in the manufacturing cost by reason of the interchangeability of the parts, promote ease of replacement and repair of parts which may become defective and provide for a more efficient contact of the hot vapor with the cooling tube surfaces.

With this and other objects in view, we have revised the usual stationary header so that each tube bundle is connected to one of a plurality of communicating compartments formed in a solid channel member and symmetrically positioned about the center of the channel. In connection with the use of such compartments, we have employed a series of small cover members, each serving to seal a compartment and each being adapted for use as a cover member for any one of the compartments. In addition, we have also modified and changed the complementary features of the apparatus by surrounding the tube bundles with shrouds to guide the hot vapor into more efficient contact with the cooling tubes, the shrouds being attached to the shell of the apparatus so as to be readily removable therewith to expose the tube bundles for cleaning or replacement.

In a simple and efficient form of the invention, we provide a channel member consisting of a solid square steel billet which has been hogged out to provide a plurality of liquid compartments symmetrically positioned about the center of the billet. Attached to the base, or fixed tube sheet portion of the channel are bundles of cooling tubes each capped at the free end with a floating header and each communicating at the other end with one of the liquid compartments. Each tube bundle and floating header is identical, insuring simplicity of part construction and interchangeability. Each liquid compartment is divided internally by a partition to guide the liquid flow from one half section of a compartment, through a portion of the associated tube bundle, through the floating header thereof and through the remaining portion of the tube bundle to the other half section of the compartment. The compartments are connected by passages formed in the channel member so that cooling liquid introduced into

the first compartment will flow serially through the various tube bundles and compartments and be removed from the last compartment. Each of the compartments is closed by a cover member clamped to the channel by a split removable clamping ring. Inasmuch as like parts for each compartment cover member are identical, interchangeability is a featured characteristic.

Attached to the channel member is a circular channel flange to which a shell enclosing the tube bundles is fastened. Each tube bundle is enclosed through its major portion by a shroud forming a vapor flue to secure more efficient contact of hot vapor with the surfaces of the cooling tubes. Baffles arranged within the shell guide the entering hot vapor through a set of the shrouds, the vapor returning through a different set of shrouds and discharging from the shell. The shrouds are removable with the shell to which they are attached. The guide members are connected to the various transverse shroud support members to guide the floating headers into and out of the shrouds as the shell is replaced or removed.

In the accompanying drawings which form a part of the instant specification and which are to be read in conjunction therewith and in which like numbers refer to like parts throughout the several figures;

Figure 1 represents a sectional elevation of a preferred form of our invention.

Figure 2 is a section taken on the line 2—2 of Figure 1.

Figure 3 is a section taken on the line 3—3 of Figure 1.

Figure 4 is a sectional view taken on the line 4—4 of Figure 5.

Figure 5 is a bottom plan view of the heat exchanger shown in Figure 1.

The heat exchanger shown in the illustrated embodiment of the invention is provided with a stationary header to which are connected a plurality of symmetrically positioned tube bundles 2 encased in shrouds 3 forming vapor flues and a shell 4 surrounding the tube bundles and shrouds, the shell being attached to the stationary header.

The stationary header consists of a channel member 5 forged from a solid billet of steel and having a substantially square cross section. Symmetrically formed within the channel are substantially cylindrical liquid compartments 6, 7, 8 and 9, each divided internally by partitions 10, 11, 12 and 13 respectively. A nozzle 14 is fastened to the channel member 5 and communi-

cates through an opening therein with the liquid compartment 6 for feeding cooling liquid thereto. The pairs of liquid compartments 6—7, 7—8, and 8—9 are connected with each other by means of the fluid conducting passages 15, 16 and 17, respectively, formed in the channel member. A nozzle 18 is fastened to the channel member and communicates through an opening therein with the liquid compartment 9 for discharging cooling liquid therefrom.

A channel flange 19 formed from a circular flat plate whose central portion has been cut away to provide an opening adapted to snugly fit about the periphery of the square channel member 5 embraces the channel member and is welded thereto in such position that a depressed peripheral portion of the channel flange forming a shoulder 20 bears upon a projecting peripheral portion of the channel member 5 forming a tongue 21. The channel member and channel flange thus positioned by the tongue 21 and shoulder 20 form a condensate basin 22 from which liquid may be drained through the condensate drains 23 and 24 formed in the channel member 5. The channel flange 19 at its shell side is provided with a depressed peripheral portion forming an annular gasket recess 25. A gasket 26 is located within the recess to insure a tight seal between the shell and the channel flange 19. The shell 4 is provided with a flange 27 welded or otherwise suitably attached to the shell proper, the flange having a projecting peripheral portion forming an annular tongue 28 adapted for insertion in the recess 25 of the channel flange 19. The shell tongue 28 is adapted to be drawn into sealing engagement with the gasket 26 in the recess 25 of the channel flange 19 by means of a series of split removable clamping rings 29 engaging the shell flange 27 and the channel flange 19 as shown.

Connected to the channel member 5 at its upper or fixed tube sheet portion are identical tube bundles 2, each having the tubes at one end of the bundle passing through the channel member 5 and in communication with one of the liquid compartments 6, 7, 8 or 9. Each bundle consists of a large number of tubes in an amount necessary to provide the required cooling area. The opposite or free ends of the tubes of each bundle are each connected to separate floating headers straddling the partitions in the respective compartments. These headers are the same for each tube bundle and consist of floating tube sheets 29' and cap members 30 held in sealing engagement with the floating tube sheets by means of split clamping rings 31 and the clamping bolts 32.

Shrouds 3 enclose each of the tube bundles 2 through a major portion of their length. These shrouds form vapor flues adapted to promote more efficient contact of the hot vapor with the cooling tubes and are supported at their lower end by a perforated plate 33 arranged transversely of the tube bundles 2 within the shell 4. A vertical partition 34 divides the space between the header 1 and the plate 33 into a pair of vapor compartments 35 and 36. The partition 34 has a portion of one end fitting within the condensate basin 22, the opposite end being attached to the support plate 33 by means of gussets 37 and 38 welded or otherwise suitably attached to the partition and bolted to the support plate 33 by flanged portions 39 through which pass the bolts 40. The lateral portions of the partition 34 are fastened to the shell 4 by means of the flanges 54 through which the bolts 55 pass into engagement

with the shell. A plurality of guide members 41 are fastened to the support plate 33 about each of the openings in the plate through which the tube bundles pass. These members 41 serve to guide the passage of the floating head through the openings in the support plates when the shell is lowered around the tube bundles. The support plate 33 is welded or otherwise suitably attached to the shell 4.

The upper ends of the shrouds 3 are similarly attached to a support plate 42 fastened to the shell 4 in any suitable manner, this support plate being provided with openings sufficiently large to permit the passage of the floating heads there-through. Guide members 43 are fastened to the support plate 42 about the openings therein to aid in the passage of the floating heads through the support plate as the shell 4 is withdrawn from about the tube bundles. A flanged vapor nozzle 44 is attached to the shell 4 for introducing hot vapor into the vapor compartment 35 and a similar flanged vapor nozzle 45 is attached to the shell 4 for removing vapor from the vapor compartment 36.

The channel member 5 is formed with the cylindrical flanges 46 projecting therefrom, each defining the entrance to one of the liquid compartments 6, 7, 8 or 9. The flanges 46 are formed with a shoulder 47 adapted to be engaged by a clamping ring. Identical cover members 48 each having a flat face rest upon the flanges 46 and the respective compartment partitions 10, 11, 12 and 13, gaskets 49 being provided between the flanges and the cover members to insure a liquid-tight seal. Split clamping rings 50, each having shoulders 51 adapted to engage the shoulders 47 of the flanges 46 are provided with a plurality of clamping bolts 52 adapted to engage a narrow annular peripheral portion of the cover members 48. The channel flange 19, channel member 5 and covers 48, together form the stationary header. The entire unit is adapted to be supported in an upright position as shown in Figure 1 by means of the supporting lugs 53 welded to the channel member 5.

As an example of the operation of the preferred form of our invention, hot oil vapor enters through the nozzle 44 into the vapor compartment 35 from which it passes in two parallel streams through the vapor flues formed by the pair of shrouds 3 communicating with the vapor compartment 35 into the space at the upper portion of the exchanger between the shell 4 and the upper support plate 42. From there the vapor is redirected by the shell and passes downwardly through the remaining pair of vapor flues into the vapor compartment 36 from which it is discharged through the vapor outlet nozzle 45.

At the same time cold oil or other suitable cooling medium is fed through the nozzle 14 into one half of the compartment 6 from which it flows through the tubes of the associated bundle communicating with the half portion of the compartment to the floating header 2 straddling the partition 10, returning from the floating header through the remaining tubes of the bundle to the other half of the compartment 6. The oil then flows through the passageway 15 to the adjacent half of the compartment 7 shown in Figure 2 where the operation is repeated for a separate bundle, the oil then flowing through the passageway 16 into the compartment 8 and finally through the passageway 17 into the compartment 9 from which it discharges through the nozzle 18.

It will be observed that we have accomplished

the objects of our invention and have provided heat exchange apparatus which is extremely simple and capable of being manufactured at a cost which is appreciably lower than that heretofore customary with heat exchange devices of this type. We have provided heat exchange apparatus in which standardization of parts with attendant ease of construction and replacement has been effected by reason of the symmetrical construction of the stationary header, the tube bundles and the interchangeability of equivalent parts. It will also be observed that we have provided heat exchange apparatus in which a more efficient exchange of heat from vapor to liquid is accomplished by virtue of the shrouds which form vapor flues about the tube bundles and yet which are capable of being removed with the exchanger shell from about the tube bundles in a manner not heretofore contemplated by the prior art.

It will be obvious that our invention is intended to embrace heat exchange apparatus similar to that shown and described, but which includes any number of tube bundles symmetrically positioned and individually connected to symmetrically located, separately covered liquid compartments.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of our claims. It is further obvious that certain changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is, therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described the invention, what is claimed is:

1. Heat exchange apparatus comprising a channel member having a plurality of liquid compartments symmetrically arranged therein, a bundle of cooling tubes associated with each of said compartments, said bundles being connected at one end to said channel member, a partition in each compartment, a floating header for each tube bundle straddling the partition in the respective compartment, a cover for each compartment, said covers being interchangeable and means for clamping each cover individually to said channel member.

2. Heat exchange apparatus as defined by claim 1, said channel member being forged from a unitary steel billet.

3. Heat exchange apparatus as defined by claim 1, said channel having an opening for admitting cooling liquid into one of said compartments, a separate opening for withdrawing liquid from another of said compartments and passageways connecting said compartments to form a continuous passage for the flow of cooling liquid through said compartments and tubes.

4. Heat exchange apparatus comprising a unitary channel member having a plurality of liquid compartments formed symmetrically therein, a plurality of flanges formed by said channel member, each of said flanges defining an entrance to one of said compartments, a separate cover member for each of said compartments, said cover members resting upon said flanges, means for clamping said covers to their associated flanges, a partition in each of said compartments, a bundle of cooling tubes associated with each compartment, said bundles being connected at one end to said channel member, a floating header

for the other end of each tube bundle, said floating headers straddling the partitions in the respective compartments.

5. Heat exchange apparatus as defined by claim 4, said liquid compartments being cylindrical and so arranged in said channel member that their respective centers will each lie at the corners of a common rectangle.

6. Heat exchange apparatus as defined by claim 4, each of said flanges being cylindrical and provided with a shoulder adapted to be engaged by said clamping means, and each of said clamping means comprising a removable split ring.

7. Heat exchange apparatus comprising a stationary header having a plurality of pairs of cylindrical liquid compartments formed symmetrically therein, an opening formed in said header for charging cooling liquid to a compartment of one of said pairs, a separate opening formed in said header for discharging cooling liquid from a compartment of another of said pairs, passages formed in said header connecting said compartments to form a continuous fluid passage, a partition in each compartment, a tube bundle associated with each compartment, said tube bundles being connected at one end to said header, a floating header for the other end of each tube bundle, said floating headers straddling the partitions in the respective compartments, a shell enclosing said tube bundles, said shell being fastened to said stationary header, a shroud for each tube bundle, said shrouds forming vapor flues around said bundles, means for introducing a stream of vapor into said shell, means for discharging the stream of vapor from said shell and means positioned within said shell for causing the stream of vapor in its passage through said shell to flow simultaneously through a plurality of said shrouds.

8. Heat exchange apparatus comprising a unitary channel member having a lateral peripheral portion projecting to form a tongue, a channel flange embracing said channel member, said channel flange having a portion of its inner periphery depressed to form a shoulder resting against said tongue, said channel member having an end periphery spaced from the plane of an end periphery of said channel flange so as to form a condensate collecting basin.

9. Heat exchange apparatus as defined by claim 8 including a passage formed in said channel member for withdrawing condensate from said collecting basin.

10. Heat exchange apparatus comprising a unitary channel member having a plurality of liquid compartments formed symmetrically therein, a flange defining an entrance to each of said compartments, said flanges being integral with and formed by said channel member and each having an end peripheral portion projecting to form a shoulder, a cover member for each of said compartments, said cover members sealingly engaging said flanges, a clamping device for each of said cover members, said clamping devices having one end portion engaging a cover member, and the other end portion engaging an associated shoulder.

11. Heat exchange apparatus comprising a unitary channel member having a plurality of liquid compartments formed symmetrically therein, a cylindrically shaped flange defining the entrance to each of said compartments, said flanges being integral with and formed by said channel member and each having an end peripheral

eral portion projecting to form a shoulder, a cover member for each of said compartments, said cover members each having a planar surface and engaging said flanges, a removable split clamping ring for each of said cover members, said clamping rings having one end portion flanged for engagement with said flange shoulders, the other end portion being provided with a plurality of bolts adapted to engage an annular peripheral portion of the respective flange cover members.

12. Heat exchange apparatus comprising a channel member having a plurality of liquid compartments formed symmetrically therein, a tube bundle for each compartment, said tube bundles projecting from said channel member, a cover for each compartment, a channel flange embracing said channel member and integrally connected thereto, a shroud for each tube bundle, a shell enclosing said tube bundles and attached to said channel flange, a vapor inlet to said shell, partitions within said shell for causing vapor to flow in one direction through a pair of said shrouds and to return in the opposite direction through a different pair of said shrouds and a vapor outlet from said shell.

13. Heat exchange apparatus comprising a stationary header, a plurality of tube bundles connected to said header, a floating header for each tube bundle, a shell surrounding said tube bundles, said shell being fastened to said stationary header, a pair of partitions spacedly positioned within said shell transversely of said tube bundles, a shroud around that portion of each tube bundle between said partitions, a partition positioned within said shell longitudinally of said

tube bundles between said stationary header and the adjacent transverse partition, a vapor inlet opening in said shell at one side of said longitudinal partition and a vapor outlet opening in said shell at the opposite side of said partition.

14. Heat exchange apparatus comprising a stationary header, a plurality of pairs of tube bundles connected to said header, a floating header for each tube bundle, a shell surrounding said tube bundles, a pair of perforated partitions spacedly positioned within said shell transversely of said tube bundles, said tube bundles passing through the perforations in said partitions, a shroud around that portion of each tube bundle between said partitions, said shrouds having their ends connected to said partitions and forming a plurality of vapor flues, an imperforate partition positioned within said shell longitudinally of said tube bundles in the plane between pairs of said tube bundles, said partition extending from said stationary header to the adjacent transverse partition to thereby form a pair of vapor compartments, a vapor inlet opening in said shell communicating with one of said compartments and a vapor outlet in said shell communicating with the other of said compartments.

15. Heat exchange apparatus as defined by claim 13, said stationary header having a depressed peripheral portion forming an annular recess, said shell having a projecting peripheral portion forming a tongue fitting within said recess and a gasket in said recess between said shell and header.

JOHN M. BARCLAY.
JAMES E. FORBES.