

**March 5, 1968**

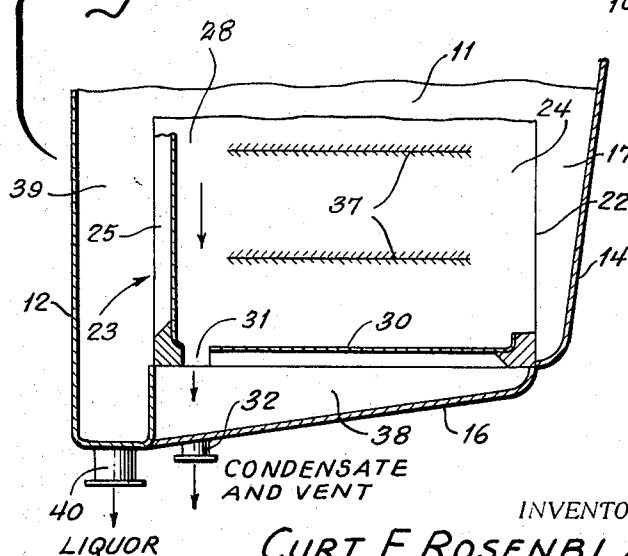
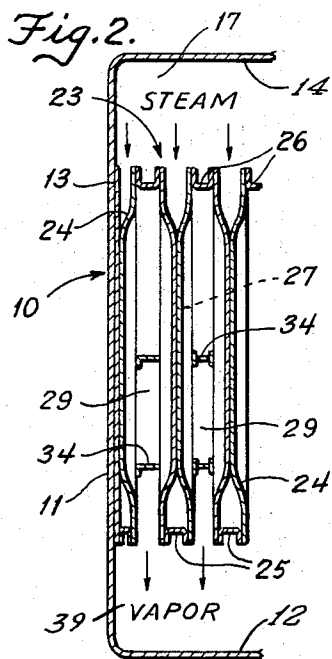
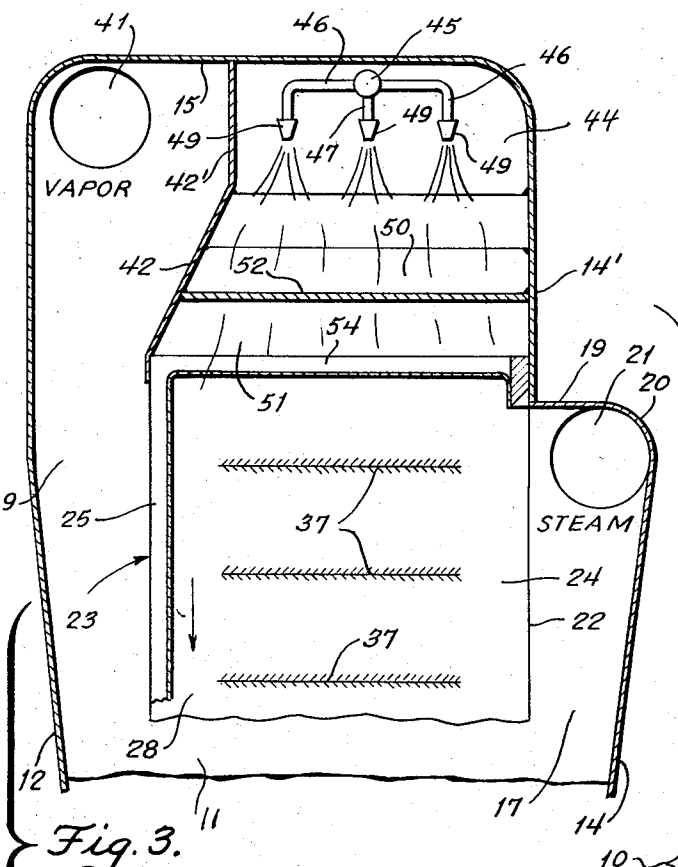
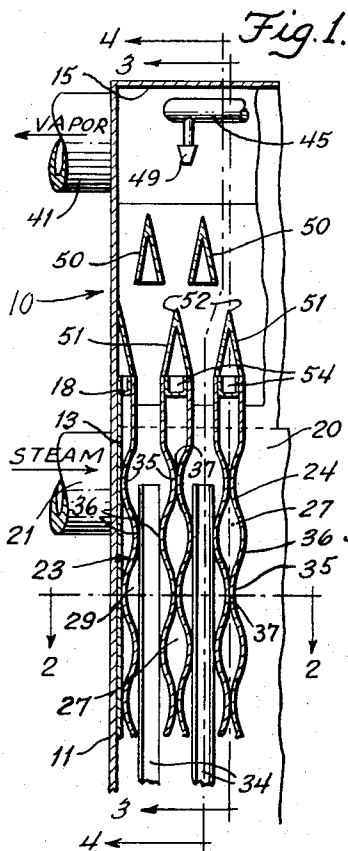
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**3,371,709**

# FALLING FILM PLATE HEAT EXCHANGER

Filed June 15, 1965

4 Sheets-Sheet 1



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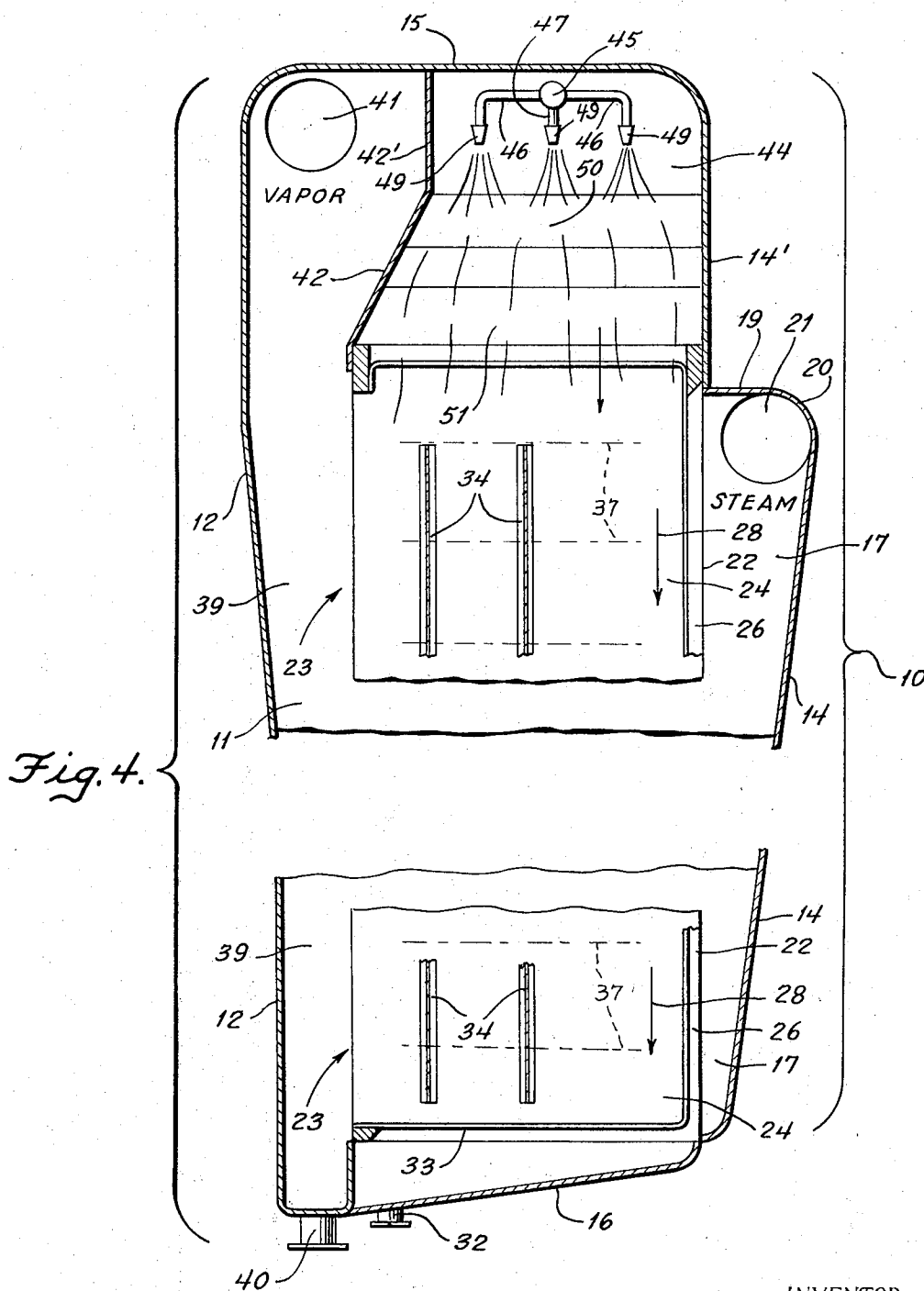
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FALLING FILM PLATE HEAT EXCHANGER

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4 Sheets-Sheet 2



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FALLING FILM PLATE HEAT EXCHANGER

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Fig. 7.

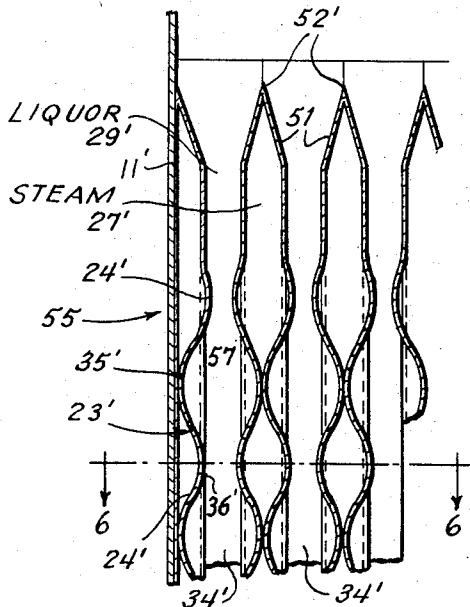


Fig. 5.

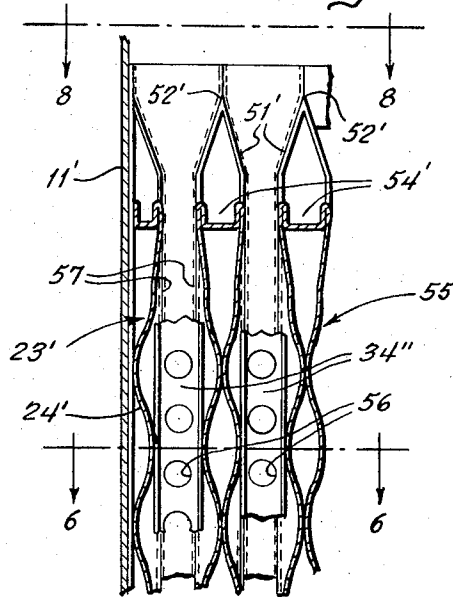


Fig. 6.

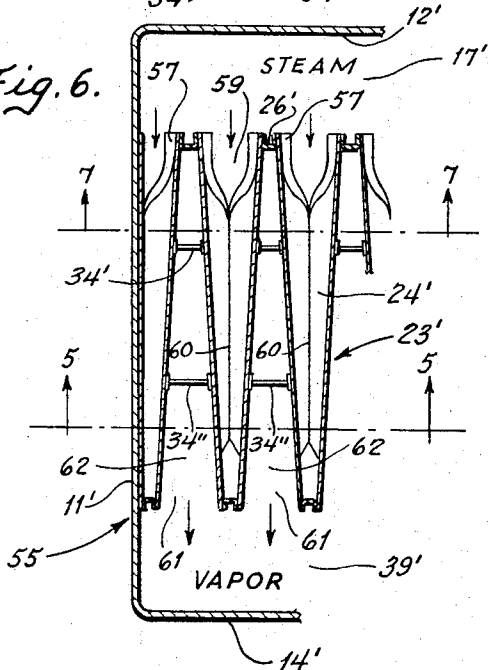
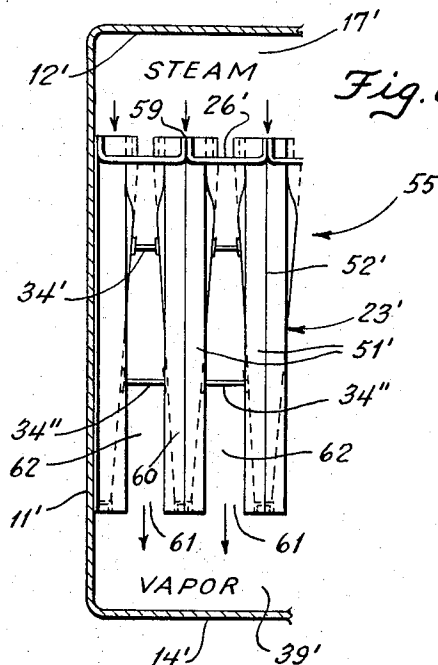


Fig. 8.



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Fig. 9.

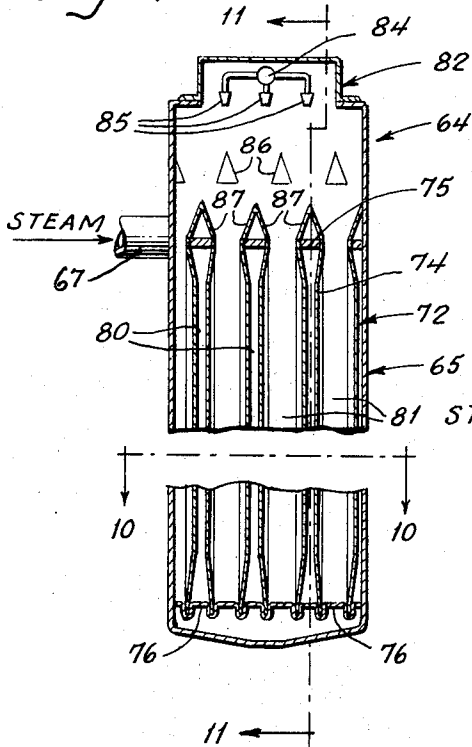


Fig. 11.

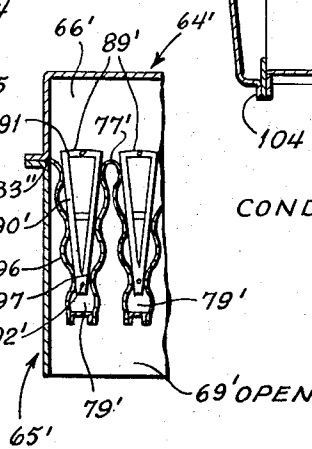
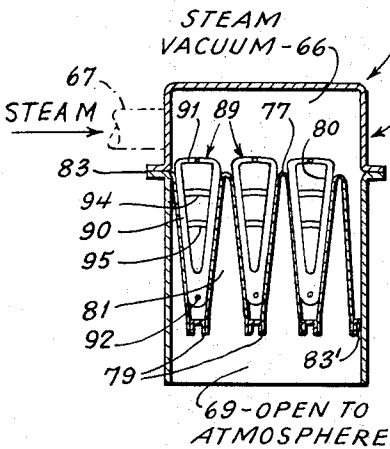
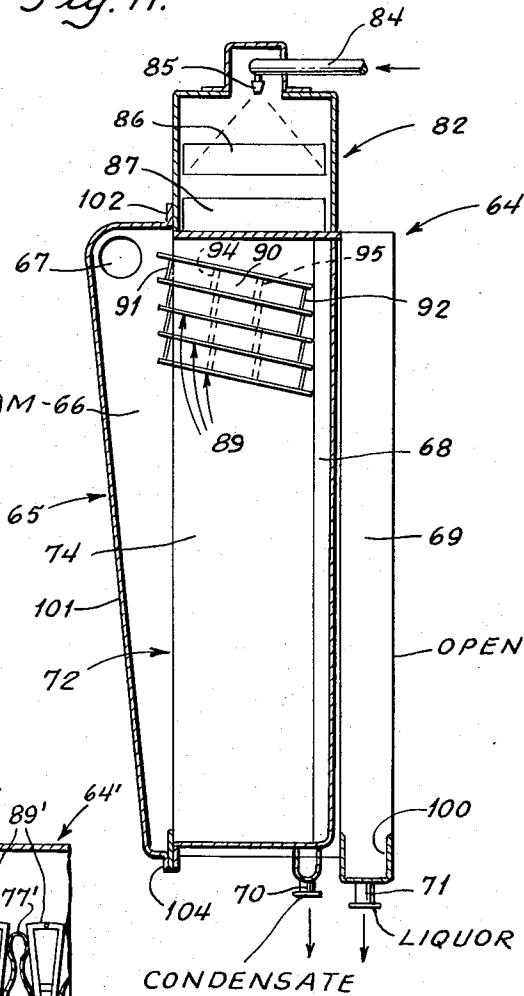


Fig. 10.

Fig. 12.

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## FALLING FILM PLATE HEAT EXCHANGER

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Filed June 15, 1965, Ser. No. 464,011

24 Claims. (Cl. 165-115)

### ABSTRACT OF THE DISCLOSURE

A heat exchanger or evaporator having generally vertically extending heat exchange plates joined at pairs of alternating opposite vertical edges to make a structure having channels alternately opening at one side and then the other. Liquid is applied in the form of a film on to the wall surfaces of one set of channels at the tops thereof and a vaporous heating medium is introduced into the other set of channels through the open sides thereof. The plates are preferably thin and are strengthened by corrugating them or by means of horizontal or vertical supports or combinations of the same. The corrugations or supports serve to direct the flow of condensate from the heating medium in a generally horizontal direction for discharge.

In the description that follows, the first two embodiments of the heat exchanger of the invention are closed condensers, and the second two are of the open design. The disclosed heat exchanger may employ condensing vapors as the heating medium in a first system of channels of the heat exchanger, and may employ cool liquor or boiling liquor as a cooling medium in a second system of channels of the heat exchanger, the two systems of channels being in heat exchanging relationship with each other. The plates of the heat exchanger of the invention may be made of extremely light gauge sheet material, and may be made free from internal joints and attachments to the heating surface. By providing for the removal of the condensate formed on the heating surfaces as quickly as possible, the film coefficient on the vapor side of the heat exchanger is greatly improved.

The heating surface required for a given service operation is substantially reduced both by the improvement of the film coefficient on the vapor side, and by reducing the heat conductivity resistance by using light gauge material for the heat exchanger plates. As a result of the reduction in weight of the plates, and of operating the heat exchanger with a relatively small differential in pressure between the two channel systems, the cost of the means for supporting the plates is markedly reduced.

The invention has among its objects the provision of a novel heat exchanger of the falling film type.

Another object of the invention is the provision of a heat exchanger of the type indicated wherein the film coefficient on the vapor side is markedly improved.

A further object of the invention is the provision of a falling film plate type heat exchanger employing plates of novel construction which permits the use of extremely light gauge material for the heating surfaces, and the avoiding of all kinds of internal joints or attachments to the heating surfaces.

A still further object of the invention lies in the substantial reduction in the area of heating surface required for a given service operation.

Yet another object of the invention lies in the marked reduction of the cost of supporting the heating surfaces or plates of the heat exchanger.

The above and further objects and novel features of the invention will more fully appear from the following description when the same is read in connection with the accompanying drawings. It is to be expressly understood,

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however, that the drawings are for the purpose of illustration only, and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts through the several views,

FIG. 1 is a fragmentary view in vertical cross section through a first illustrative embodiment of heat exchanger in accordance with the invention, the section being taken along a plane disposed normal to the broad extents of the plates of the heat exchanger.

FIG. 2 is a fragmentary view in horizontal section through the heat exchanger of FIG. 1, the section being taken along the line 2-2 of FIG. 1 looking in the direction of the arrows;

FIG. 3 is a fragmentary view in vertical cross section through the heat exchanger of FIG. 1, an intermediate portion of the heat exchanger being omitted for economy of space, the bottom portion of the heat exchanger being shown, the section being taken along the line 3-3 of FIG. 1 looking in the direction of the arrows;

FIG. 4 is a fragmentary view in vertical cross section through the first illustrative heat exchanger, the view being similar to FIG. 3 but being taken along the line 4-4 of FIG. 1 looking in the direction of the arrows;

FIG. 5 is a fragmentary view in vertical section through a second embodiment of heat exchanger in accordance with the invention, the view being taken along the line 5-5 of FIG. 6 in the direction of the arrows;

FIG. 6 is a fragmentary view in horizontal section through the second illustrative embodiment of heat exchanger, the section being taken along the line 6-6 in both FIGS. 5 and 7 looking in the direction of the arrows;

FIG. 7 is a fragmentary view in vertical section through the second embodiment of heat exchanger, the section being taken along the line 7-7 of FIG. 6;

FIG. 8 is a fragmentary view in horizontal section through the second embodiment of heat exchanger, the section being taken along the line 8-8 of FIG. 5 looking in the direction of the arrows;

FIG. 9 is a view in vertical cross section through a third embodiment of heat exchanger in accordance with the invention, an intermediate portion of the heat exchanger being broken away for economy of space in illustration, the section being taken along a plane disposed normal to the broad extents of the plates of the heat exchanger;

FIG. 10 is a view in horizontal section through the heat exchanger of FIG. 9, the section being taken along the line 10-10 of FIG. 9 looking in the direction of the arrows, the vapor or steam supply conduit being shown in phantom lines;

FIG. 11 is a view in vertical cross section through the third embodiment of heat exchanger, the section being taken along a vertical plane disposed normal to the main extents of the heat exchanger plates, the section being taken along the line 11-11 of FIG. 9 looking in the direction of the arrows; and

FIG. 12 is a fragmentary view in horizontal section taken similarly to the section of FIG. 10 showing a fourth embodiment of heat exchanger in accordance with the invention, such fourth embodiment of heat exchanger employing plates of a somewhat different construction from those of the embodiment of FIGS. 9, 10, and 11.

As is apparent from the above, there are shown and described herein four illustrative embodiments of heat exchangers made in accordance with the present invention. The first such embodiment is shown in FIGS. 1-4, inclusive; the second in FIGS. 5-8, inclusive; the third in FIGS. 9, 10, and 11; and the fourth in FIG. 12. The first and second embodiments of heat exchanger are of the

closed type; the third and fourth embodiments are of the open type, wherein the vapor channel system is closed and the liquor channel system is open to the atmosphere. All of such illustrative embodiments of the present invention represent modifications of and improvements upon the falling film type evaporator described and claimed in applicant's previous application Ser. No. 423,492, filed Jan. 5, 1965. The improvements upon the evaporator disclosed in such previous application have been generally indicated above and will be more fully discussed in the following description of the various embodiments of the evaporator of the present invention.

Turning now to the first embodiment of heat exchanger, illustrated in FIGS. 1-4, inclusive, such heat exchanger, which is generally designated by the reference character 10, has an enclosure having end walls of which one is shown at 11, opposite sidewalls 12 and 14, an upper wall 15, and a bottom wall 16. The heat exchanger in this instance is adapted for the evaporation of a cooking liquor by using steam as the heating medium. Thus the enclosure of the heat exchanger 10 is provided with a steam-receiving space 17 along one side thereof, such space being formed by the sidewall 14 of the enclosure, which rises at a small angle with respect to the vertical and is joined to a short horizontal wall portion 19 of the enclosure at a part-cylindrical wall portion 20 within which the end of a steam supply pipe 21 extends as shown. The steam-receiving space 17 thus in effect constitutes a manifold which is disposed outwardly of the right-hand (FIGS. 3 and 4) vertical edge 22 of the heat exchanger plate set 23.

Alternate pairs of the plates 24 of the plate set 23 are closed along their vertical right-hand edges by U-shaped spacer and sealing bars 26 which are welded thereto. Such pairs of plates 24 with their closure bars 26 form liquor-receiving channels 29 of the heat exchanger or evaporator. The plates forming the other channels, which alternate with channels 29, are closed along their left-hand edges (FIGS. 3 and 4) by U-shaped spacer and sealing bars 25. Such latter plates and their closure bars 25 thus form steam-receiving channels 27. It will thus be seen that one vertical edge of each of the steam-receiving channels 27 is open to the steam-distributing space 17 but is closed at its other vertical side, and that the vertical side edges of the liquor-receiving channels 29 confronting the steam-distributing space 17 are closed, and that the other edges of the liquor-receiving channels are open. The lower ends of the steam-receiving channels are sealed by bars 30 of inverted U-shape.

Steam thus introduced into the channels 27 from the space 17 is, in the main, condensed within such channels; the condensate from such steam, which is collected in the steam channels in a manner to be described, flows outwardly from channels 27 into the vertically extending space 28 presented along the left-hand edges of the steam channels 27 as seen in FIG. 3. Each U-shaped bar 30 terminates at its left somewhat short of the vertical bar 25 to provide a condensate discharge opening 31 at the bottom of each steam-receiving channel 27. All of such discharge passages 31 communicate with a sump 38 which extends across the extent of the heat exchanger. A conduit 32 provides for the discharge of condensate from the sump 38.

The pairs of plates 24 which form each of the liquor channels 29 are not only closed at their right-hand edges (FIGS. 2 and 4) by the vertical U-bars 26, as above described, but are also closed at their upper ends by bars 54 (FIGS. 1 and 3) and at their lower ends by horizontal U-shaped bars 33 (FIG. 4). Thus the liquor channels 29 are isolated from the steam channels 27. The left-hand (FIGS. 3 and 4) edges of the liquor channels 29 are open to a vertically extending space 39 within the enclosure of the heat exchanger, such space 39 being drained of liquor by a conduit 40 communicating with the lower end of space 39. The upper end of space 39

communicates with a conduit 41 through which the vapor resulting from the evaporation of the liquor is exhausted from the enclosure of the heat exchanger or evaporator.

In the embodiment of heat exchanger of FIGS. 1-4, inclusive, the heat exchanger plates 24 are similar and are corrugated in a horizontal direction with long shallow wave-like formations, the peaks 36 and valleys 35 (as viewed from within the liquor channel 29) of successive plates being aligned as shown, whereby the liquor channels 29 vary in width from a maximum at the location of confronting valleys 35 of the plates and a minimum at the location of confronting peaks 36 of the plates. The corrugations of the plates are sufficiently shallow and gradual in their change of angle so that the liquid film on the surfaces of the plates in the liquor-receiving channels follows such surfaces and does not drop off or form drops.

The corrugations in the plates 24 are such that within the steam-receiving channels 27 the convex portions of the plates at the locations of the valleys 35 at least substantially contact each other to form a plurality of steam-receiving sub-channels which are substantially closed at their tops and bottoms. It is sufficient in most instances for such portions of the plates in the form of ribs substantially to contact each other, as shown at 37, although in some cases it may be preferred to weld the plates together along their rib lines 37. Such zones of substantial contact and/or connection between successive plates forming the steam-receiving channels each forms a condensate collecting means whereby the condensate formed in each steam-receiving sub-channel flows to the left (FIG. 3) along such line of substantial contact or connection and then falls downwardly in the above-described space 28 into the sump portion formed at the bottom of each steam-receiving channel.

As is clear in FIG. 2, the corrugations on the plates 24 are located centrally thereof and throughout the greater part of the width of the plates. The vertical edge portions of each plate, however, are flat and lie in the plane of the peaks 36 of the corrugations of the plates. The above-described vertical U-bars 25 and 26 are disposed between and welded to such flat vertical edge portions of the plates constituting the respective two channel systems, likewise as shown in FIG. 2.

The plates 24, because of their stiffening by being corrugated as shown and described, are of relatively light weight and thus may be easily and economically supported. This is particularly true when the differential in pressure existing between the media in the two-channel systems is small. It is desirable, however, further to support and brace the plates, which may be done in the following manner: A plurality (two shown) of vertically disposed angle bars 34 (FIGS. 1, 2 and 4) are located within each of the liquor-receiving channels. Bars 34 have a width such that they span the distance between the peaks 36 of the corrugations in the plates. In the embodiment shown, the bases of the angle bars 34 are secured as by being welded to the peaks 36 of one of the plates, the other edge of the angle bars merely tightly contacting the peaks of the corrugations on the confronting plates. In an alternative construction (not shown) the bars 34 are unattached to either of the plates forming the liquor-receiving channel, such bars being bound together to form a frame which may be readily removed from the liquor-receiving channels as by being slid outwardly through the open vertical edges of such liquor channels, there being provided a suitable detachable portion of the side wall 12 of the enclosure (not here illustrated) confronting the plate set 23.

In the plate set 23, as shown, the portion thereof along the end walls, of which one is shown at 11, are formed by a flat plate 13 and the confronting first corrugated plate 24. The steam-receiving space between plate 13 and the first corrugated plate 24 is sealed by appropriate U-bars, there being a U-bar 18 at the top of such first plate

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24, as shown; the space thus formed constitutes a steam-receiving channel which has roughly  $\frac{1}{2}$  the volume of the channels provided between each two subsequent confronting corrugated plates 24.

The mechanism for introducing liquid, here specifically cooking liquor to be evaporated, into the liquor-receiving channels 29 is generally similar to that described and claimed in the above-referred-to previous application Ser. No. 423,492. Such liquid distributing means is contained within an upper housing portion formed in part by an extension 14' of the wall 14, a part of the upper wall 15, and by inner sidewall portions 42 and 42' which forms a space to which the upper ends of the liquor-receiving channels 29 are open but from which the steam-receiving channels 27 are isolated.

A liquor conducting pipe 45 extends through one wall of the upper portion 44 of the thus formed compartment, branch pipes 46 and a central pipe 47 being connected to pipe 45. Each of the branch pipes has a downwardly directed spray nozzle 49 on its lower end. Located within the upper compartment or spray hood and beneath the nozzles 49 thereof are a plurality of first or upper baffle members 50 and a plurality of second or lower baffle members 51. As in the invention described in the prior application, the lower baffle members 51 are made of sheet material such as metal having oppositely upwardly inclined portions forming an inverted V and joined or welded at the vertex 52. The lower baffle members 51 are disposed above the U-bars 54 which close the upper ends of the steam channels. The upper baffles 50 are disposed centrally above the liquor-receiving channels 29. The spray nozzles 49 and the baffles 50 and 51 are so located that spray from the nozzles is prevented from direct impingement upon the surfaces of the plates 24 within the liquor channels. The baffles function to form thin uniform films of liquor which flow downwardly along the heating surfaces of the liquor-receiving channels.

Although as above stated it is generally preferred that the heat exchanger plates 24 be welded along the lines of contact 37, this is not necessary when the pressure within the steam-receiving channels 27 is always lower than that in the liquid-receiving channels 29, which is the case when the plates serve as the heating surfaces in a vacuum steam condenser. When the pressure within the channels 27 is higher than that within the channels 29, no welding along lines 37 is required if the plates 24 at the outside, that is, within channels 29, are supported by the above-described vertical bars 34. Although such bars are shown as being imperforate in FIGS. 1, 2, and 4, it is to be understood that the bars may have openings drilled or cut into them to increase the area of flow through the channels 29 for the vapors liberated during the evaporation of the liquid. Such holes, for example, are shown at 56 in FIG. 5, which shows the second illustrative embodiment of heat exchanger, to be described.

Small leakages are permissible between the substantially contacting portions at 37 of the ribs of plates 24 forming the vapor channels 27, since the thus leaked condensate merely falls into one or more subsequent steam sub-chambers from which it is eventually discharged to flow downwardly along the vertical path 28. Welding of the plates 24 along lines 37 is, however, of advantage, since it presents a stiffer composite plate structure which can withstand appreciable internal pressures without any substantial deformation.

From the above it will be seen that the described corrugated construction of the heat exchanger plates in effect subdivides the steam-receiving channels into a plurality of sub-channels, each such sub-channel having as a film-removing means the zone of contact or substantial contact between confronting plates at the line 37. The thickness of the film of condensate in each sub-channel is thus limited, so that the overall film coefficient of the heat exchanger is greatly improved over that of a comparable

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heat exchanger but without the film-removing means of the invention.

Although the lines 37 are shown as being horizontal, it is to be understood that they may be inclined somewhat in the direction of condensate discharge from them. The term "generally horizontal" as applied to lines 37 or ribs providing the same or to the condensate film-removing means of the subsequently described embodiments is intended to cover both a horizontal orientation of such film-removing means and an inclination of them with respect to the horizontal as shown in FIG. 11, to be described.

The embodiment of heat exchanger shown in FIGS. 5-8, inclusive, is generally designated by the reference character 55.

The portions of the heat exchanger 55 which are generally similar to those of heat exchanger 10 are designated by the same reference characters with an added prime. This heat exchanger differs from the above-described heat exchanger 10 in a number of particulars: The heat exchanger plates, here designated 24', are shallowly corrugated with a wave-like formation in a horizontal direction, but such corrugations differ from those of the plates 10 of the first embodiment by being of variable depth. Thus such corrugations are deepest at the steam inlet side of the plate set of the heat exchanger, the depth of such corrugation constantly diminishing in the direction toward the vapor side of such plate set. Because of such variable depth of the corrugation of the plates, the assembled plates present steam-receiving channels 60 which are widest at their steam entry ends 59 and narrowest at the ends remote therefrom, the liquid-receiving channels 62 being widest at their vapor discharge ends 61 and narrowest at the ends remote from them. Finally, as above noted, the vertically extending bracing bars, here designated 34' and 34'', which are disposed within the liquid-receiving channels and which span the distance between the confronting plates thereof are provided with a number of apertures 56 therethrough to afford a greater area for the circulation of the vapors released.

The ends 57 of the plates 24' disposed at the steam manifold space 17' are flat, as shown, confronting flat edge portions of such plates being joined and sealed by U-bars 26'. The designs of the heat exchanger 55 shown in FIGS. 5-8, inclusive, is especially advantageous when used for the condensing of steam of larger specific volume.

The heat exchanger of the third disclosed embodiment, shown in FIGS. 9, 10, and 11, is generally designated by the reference character 64. Such heat exchanger 64 differs from those of the first two described embodiments primarily as to the character of the plate spacing and bracing means, such means in this instance being disposed within the steam-receiving channels 80. Such spacing and bracing means is also disposed at an angle to the horizontal whereby to aid the flow of condensate formed in the steam channels into the vertical portion 68 of the enclosure of the heat exchanger beyond the edges of the plates 74 thereof, such portion 68 leading to the condensate discharge conduit 70 thereof.

The heat exchanger 64 is provided with a partially open hood or housing generally designated 65 having at one side thereof (the left as shown in FIG. 11) a steam-receiving space 66 which is fed with steam through a conduit 67. At the other side of the hood 65 there is provided a vertical space 69 which is laterally open to the atmosphere. At the bottom of space 69 there is disposed an upwardly open tray 100 for collecting unevaporated liquor. Such liquor, which streams downwardly in the form of films on the vertical heating surfaces of the heat exchanger plates, is discharged from tray 100 by a conduit 71.

Alternate pairs of plates 74 of heat exchanger 64 are connected and sealed at their tops by spacer bars 75 and at their bottoms by U-bars 76. The plates 74 are folded upon themselves at a vertically extending bend 77, suc-

cessive thus formed plate pairs being joined at the other edge, shown at the bottom in FIG. 10, by bars 79. The left-hand vertical edge of the first plate 74 at the left (FIG. 10) is joined to the enclosure 65 at 83, as shown, the edge of the last plate 74 being joined to the right-hand wall of the enclosure at 83'. There are thus produced alternating vapor or steam-receiving channels 80 and liquor-receiving channels 81.

Liquor is introduced into the upper ends of the liquor-receiving channels in the same manner as in the previously described embodiments. Thus there is provided an upwardly extending hook portion 82 on the enclosure 65, there being a liquor supply pipe 84 extending into such hood and being provided with branch conduits to the lower ends of which there are connected downwardly facing spray nozzles 85. Liquor sprayed from nozzles 85 impinges upon a first set of upper baffle members 86 and upon a lower set of baffle members 87, both such baffle members being in the form of inverted V's. As before, the lower baffle members 87 are disposed above the upper ends of the steam-receiving channels, the upper baffles 86 being located centrally between baffles 87.

As in the case of the embodiment of FIGS. 5-8, inclusive, the steam channels 80 are widest at their entrance sides, shown at the top in FIG. 10, and progressively decrease in width toward the other side thereof and the liquor-receiving channels change in width in the opposite direction being narrowest at the bend 77 between the plate portions and widest at the edges of the channels immediately communicating with the vertical liquor-receiving space 69. In this embodiment the plates 74 are braced by separate removable bracing frames 89 of generally triangular shape, such frames having an upstanding bordering portion with elongated straight sides 90 forming substantially horizontal ribs extending into the vapor channels from the sides thereof and a shorter end portion 91. The longer sides 90 of frame 89 are preferably spanned by cross braces 94 and 95, respectively. The bracing members 89 may be retained between the plates forming the steam-receiving channels merely by frictional engagement therewith so that they may be readily removed when required as for cleaning the heat exchanger. Preferably, the bracing members 89 are disposed at an angle with respect to the horizontal, as indicated in FIG. 11, whereby to facilitate the flow of condensate collected by them downwardly therealong in a direction to the right in FIG. 11 and thence into the condensate-receiving portion or path 68 within the enclosure.

It will thus be seen that condensate from steam within the channels 80 will be collected upon the upper edges of the ribs 90 of the open frame 89. It is not necessary that the frames 89 have closed bottoms, since the condensate forms as a film upon the surfaces of the plates 74 and flows downwardly therealong until intercepted by the upper edges of the elongated members 90 of the frame.

The heat exchanger disclosed in FIGS. 9, 10, and 11 may advantageously be employed as a vacuum condenser, although it is not limited to such use. When such heat exchanger is employed as a vacuum condenser, the excess of pressure in the liquor channels over that in the steam channels causes the thin heat exchanger plates to be pressed firmly in upon the bracing and spacing frames 89, thus securely retaining them in place.

In the fourth illustrative embodiment in accordance with the invention, shown in FIG. 12, parts which are similar to those of FIGS. 9, 10, and 11 are designated by the same reference characters with an added prime. The main difference between the third and fourth embodiments is that whereas the plates 74 of FIG. 9, 10, and 11 are flat, the plates of FIG. 12, including the outermost plates of which one is shown at 96 and the intermediate plates 97 are shallowly corrugated in a vertical direction. Such corrugation of the plates serves to strengthen them against pressure and permits the number of bracing frame members 89' to be reduced. In the embodiment

shown in FIG. 12, elongated side members 90' of the bracing frame members are straight whereby to leave gaps between them and the inner surfaces of the plates 96 and 97 of the steam-receiving channels. Condensate from the steam in such embodiment is thus intercepted only partially by the rib portions 90' of the spacing frame, the remainder of the condensate flowing downwardly along the plates of the heat exchanger. In some instances it is preferred that the elongated side portions of the bracing frames 89' have a wave form complementary to that of the plates 96 and 97 whereby condensate will then be efficiently removed and discharged at the inner corner or pointed end of the bracing frame 89'. In such latter construction the side members or ribs 90' of the bracing frames may have an outer coating of resilient rubber or rubber-like material affixed thereto whereby such members make an efficient seal with the confronting surfaces of the heat exchanger plates.

The bracing frames 89 of FIGS. 9, 10, and 11 and the bracing frames 89' of FIG. 12 may be made of a number of suitable materials, including metal or reinforced high temperature resistant plastic materials such as fiber glass and the like. The latter construction of the bracing frames is desirable both in reducing their cost and also the weight of the heat exchanger in which they are incorporated.

As shown in FIG. 11, the portion 101 of the hood or housing 65 may be made separate and removable from the remainder of the housing, being detachably secured thereto by flanged joints, of which top and bottom joints are shown at 102 and 104, respectively. When it is desired to remove the spacing and bracing frames 89, this may readily be done by removing part 101 from the remainder of the housing, and then pulling the frames 89 out of channels 80 in the direction from right to left in FIG. 11.

Although a limited number of embodiments of the invention have been illustrated in the accompanying drawings and described in the foregoing specification, it is to be especially understood that various changes, such as in the relative dimensions of the parts, materials used, and the like, as well as the suggested manner of use of the apparatus of the invention, may be made therein without departing from the spirit and scope of the invention, as will now be apparent to those skilled in the art.

What is claimed is:

1. A plate heat exchanger of the falling film type, comprising a plurality of plates arranged to form two generally vertically disposed channel systems isolated from but in heat exchanging relationship with each other, means to introduce a liquid into one channel system adjacent the top thereof and to spread the thus introduced liquid into films which fall downwardly along the surfaces of the plates bounding the said one channel system, means to introduce a condensable vapor into the other channel system in indirect heat exchange relationship with the liquid films in the one channel system, said one channel system being formed of a set of pairs of said plates, said pairs of plates of said first set providing channels open at the tops of said plates and closed along the edge thereof of adjacent said means to introduce condensable vapor, said other channel system being formed of a second set of pairs of said plates, said pairs of plates of said second set providing channels closed at the top thereof and closed along the edge thereof remote from said means to introduce said condensable vapor, and means for isolating said channels of said one channel system from said channels of said other channel system along the bottoms thereof, a plurality of vertically spaced generally horizontally extending rib formations projecting into the channels of the said other channel system from the sides thereof to intercept and collect condensate formed from the vapor in said other channel system, the said other channel system being open at one of its vertical edges adjacent the end of each of said horizontally extending formations, and outlet means for receiving and discharging condensate from

said horizontally extending rib formations of said other channel system.

2. A plate heat exchanger of the falling film type as claimed in claim 1, wherein the said horizontally extending rib formations are a part of at least one of the plates of each pair thereof forming the said other, vapor-receiving channel system.

3. A plate heat exchanger of the falling film type as claimed in claim 1, wherein at least alternate plates are corrugated with the corrugations extending generally horizontal, the surfaces of said corrugations which bound the said other channel system forming at least part of said rib formations.

4. A plate heat exchanger of the falling film type as claimed in claim 1, wherein successive plates are similarly corrugated with the corrugations extending generally horizontal, successive pairs of plates being disposed symmetrically with the convex surfaces of said corrugations thereof aligned and closely confronting each other, said convex surfaces of said corrugations forming said rib formations on the plates bounding said other, vapor-receiving channel system.

5. A plate heat exchanger of the falling film type as claimed in claim 4, wherein the horizontal corrugations in the heat exchanger plates are generally of a wave-form, said corrugations being of a maximum depth at the vapor inlet edge of the other channel system and decreasing in depth toward the other vertical edge of said other channel system.

6. A plate heat exchanger of the falling film type as claimed in claim 1, wherein the end surfaces of said rib formations provided by confronting pairs of plates at least substantially contact along an extended generally horizontal line.

7. A plate heat exchanger of the falling film type as claimed in claim 6, wherein the central portion of said projecting rib formations contact and are bonded where they contact.

8. A plate heat exchanger of the falling film type as claimed in claim 1, comprising vertically extending spacer members disposed between and contacting the pairs of plates forming said one, liquid-receiving channel system.

9. A plate heat exchanger of the falling film type as claimed in claim 8, wherein the vertical spacer members have a plurality of spaced apertures therethrough, whereby to provide for the circulation of liquid in said one channel system therethrough.

10. A plate heat exchanger of the falling film type as claimed in claim 1, and including members separate from said plates providing the said generally horizontal rib formations and means for removably mounting said separate members in said other channels.

11. A plate heat exchanger of the falling film type as claimed in claim 10, and including frames spanning the said other channels, said separate members forming elongated side members of said frames, said side members closely confronting the bounding surfaces of said other channels.

12. A plate heat exchanger of the falling film type as claimed in claim 1, wherein said rib formations are generally parallel and incline in the same direction at a small angle with respect to the horizontal.

13. A plate heat exchanger of the falling film type, comprising a plurality of plates arranged to form two generally vertically disposed channel systems isolated from but in heat exchanging relationship with each other, means to introduce a liquid into one channel system adjacent the top thereof and to spread the thus introduced liquid into films which fall downwardly along the surfaces of the plates bounding the said one channel system, means to introduce a vapor into the other channel system from one vertical edge thereof in indirect heat exchanging relationship with the liquid films in the one channel system, said one channel system being formed of a set of pairs of said plates, said pairs of plates of said first set providing

channels open at the tops of said plates and closed along the edge thereof adjacent said means to introduce said vapor, said other channel system being formed of a second set of pairs of said plates, said pairs of plates of said second set providing channels closed at the top thereof and closed along the edge thereof remote from said means to introduce said vapor, and means for isolating said channels of said one channel system from said channels of said other channel system along the bottoms thereof, the confronting surfaces of the pairs of plates bounding the said other channel system presenting generally horizontally extending rib formations which project toward each other to intercept and collect condensate formed from the vapor, the other vertical edge of said other channel system, opposite said one vertical edge, having openings therein for the discharge of condensate collected upon said rib formations, and common outlet means for collecting and discharging condensate from said openings in said other vertical edge of said other channel system.

14. A plate heat exchanger of the falling film type as claimed in claim 13, wherein alternate ones of said plates are corrugated with the corrugations extending generally horizontally, the convex surfaces of said corrugations forming said condensate collecting rib formations on the plates bounding said other channel system.

15. A plate heat exchanger of the falling film type as claimed in claim 13, wherein the vapor-receiving channels are wide at their entrance edges and diminish in width toward their other edges.

16. A plate heat exchanger of the falling film type as claimed in claim 15, wherein the liquid-receiving channels vary in width in a direction reversely from that of the vapor-receiving channels.

17. A plate heat exchanger of the falling film type as claimed in claim 13, wherein successive ones of said plates are similarly corrugated with the corrugations extending generally horizontally, successive pairs of said similarly corrugated plates are disposed symmetrically with the convex surfaces of said corrugations thereof aligned and in closely opposed relationship to each other, said convex surfaces of said corrugations forming said condensate collecting rib formations on the plates bounding said other channel system.

18. A plate heat exchanger of the falling film type as claimed in claim 17, wherein the heat exchanger plates are further provided with a wave-formed horizontally arranged corrugation, said horizontal corrugation being of a maximum depth at the vapor inlet edge of the other channel system and decreasing in depth toward the other vertical edge of said other channel system.

19. A plate heat exchanger of the falling film type as claimed in claim 13, wherein the end surfaces of said rib formations at least substantially contact along an extended generally horizontal line the surfaces of the confronting plates bounding the said other channel system.

20. A plate heat exchanger of the falling film type as claimed in claim 19, wherein the central portion of the end surfaces of said rib formations of adjacent plates are bonded together along an extended generally horizontal line.

21. A plate heat exchanger of the falling film type as claimed in claim 19, wherein the said rib formations are disposed across generally the central extent of the plates and terminate at locations substantially spaced from the respective vertical edges of the plates, the vertical edge portions of the plates bordering the ends of said formations being flat, said flat vertical edge portions of pairs of plates forming said other channel system being spaced from and generally parallel to each other.

22. A plate heat exchanger of the falling film type as claimed in claim 21, wherein the space between said flat vertical edge portions of pairs of plates forming said other channel system is open at one edge of said other channel system to form an entrance passage for the said vapor and for the escape of condensate from the vapor from the con-

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densate collecting means between the plates, and means connecting and sealing together the said flat vertical edge portions of said pairs of plates at the other edge of said other channel system.

23. A plate heat exchanger of the falling film type as claimed in claim 13, comprising vertically extending spacer members disposed between and contacting the pairs of plates forming said one channel system.

24. A plate heat exchanger of the falling film type as claimed in claim 23, wherein the vertical spacer members have a plurality of spaced apertures therethrough, whereby to provide for the circulation of liquid in said one channel system therethrough.

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