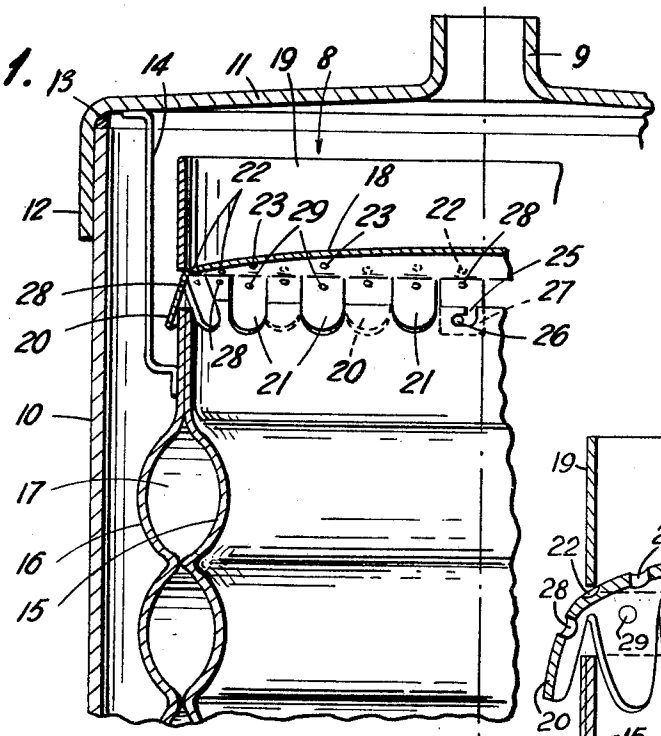
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FALLING FILM HEAT EXCHANGER

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Fig. 1.



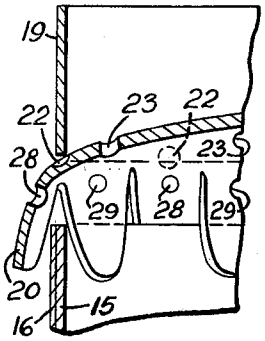
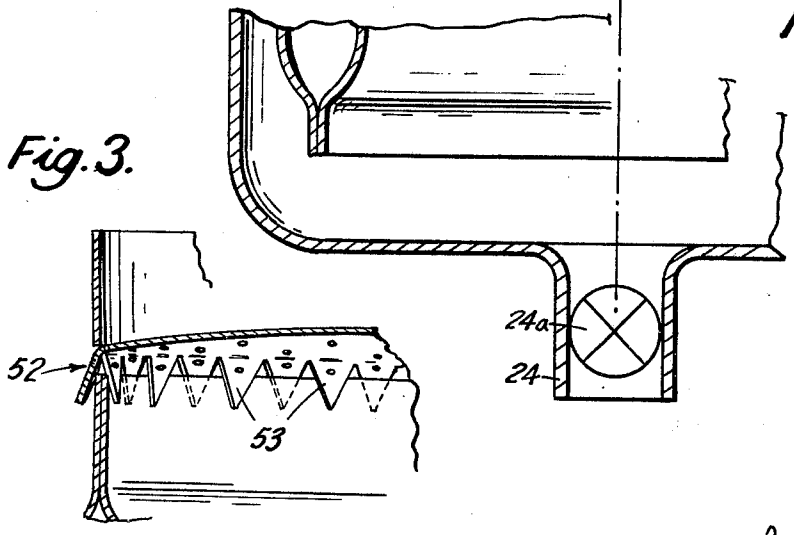


Fig. 1a

Fig. 3.



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Fig. 2.

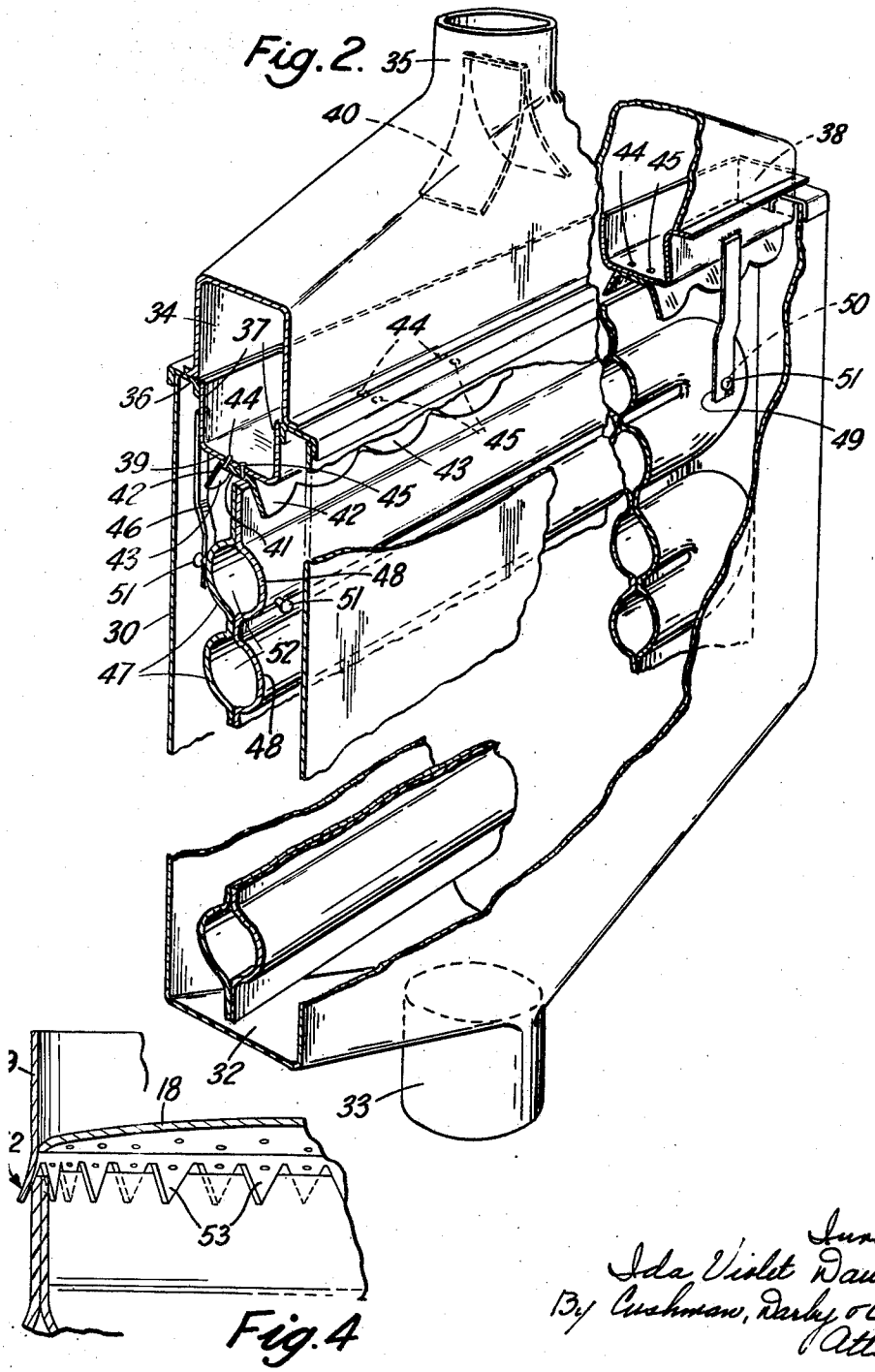


Fig. 4

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FALLING FILM HEAT EXCHANGER

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Int. Cl. A23c *3/04*; F28d *3/02*; B01d *47/00*
U.S. Cl. 165—117 21 Claims

ABSTRACT OF THE DISCLOSURE

The invention provides a heat exchanger having two downwardly extending side walls between which a fluid flows and a distributor for distributing a liquid to flow over the outer surface of the two walls which distributor comprises a tray or trough arranged above the two walls and having two sets of holes for directing the liquid onto two sets of projections which extend downwardly from the bottom of the tray or trough one set on one outer side of the walls and one set on the other outer side of the walls.

This invention relates to heat exchangers of the kind having two opposed downwardly extending walls between which a fluid flows in use and a distributor for distributing a liquid to flow over the outer surfaces of the two walls, which two walls may comprise opposite sides of a hollow body, for example, a body formed from a tube helically wound or formed in a zig-zag configuration, or a body formed from two downwardly extending plates arranged so as to provide one or more passages between them through which the fluid flows.

According to the invention in a heat exchanger of the kind described is characterised in that said distributor comprises a tray or trough for receiving said liquid and which tray or trough lies above the two walls and in that two sets of projections extend downwardly one set on one outer side of the walls and the other set on the other outer side of the walls and the tray or trough is provided with two sets of holes arranged to direct liquid on to the two sets of projections respectively so that liquid flows from the tray or trough to the projections to be directed on to the two outer walls.

Alternate projections may extend downwardly on opposite sides of the walls.

The projections may diverge away from one another as they extend downwardly.

Preferably the two sets of projections extend downwardly from the bottom of the tray or trough.

The tray or trough may embody an encircling flange which extends both upwardly and downwardly of the bottom of the tray the downwardly directed portion of the flange being slit and the material between the slits being bent outwardly of the flange to form said projections.

In the case where the tray or trough is circular one set of holes in the tray may be nearer the flange than the other set of holes, and which first set of holes is arranged to direct streams of liquid over the outer surfaces of the projections extending to one side of said flange and the other set of holes is arranged to direct streams of liquid over the projections extending to the other side of said flange.

Instead of the projections being formed by the slitting of a downwardly extending part of a flange on the tray or trough opposite edges of a strip may be cut away or slit to form said two sets of projections which are directed downwardly and the remaining portion of the strip is attached to the bottom of the tray or trough.

The holes in the bottom of the tray or trough may

extend through said remaining portion of the strip so that liquid is directed on to the inner faces of the projections down which it flows.

Additional holes may be formed in the bottom of the tray or trough so as to direct liquid on to the outer faces of the projections.

In any of the above arrangements holes may be formed in the projections themselves so that liquid which has flowed through a hole in the bottom of the tray or trough may flow from one side of a projection to the other.

Each projection may have converging edges so as to come to a point at its lower end.

Alternatively each projection may have a downwardly directed convexly curved edge.

Preferably the bottom of said tray or trough is shaped so that the liquid collected by the tray or trough tends to flow towards the aforesaid two sets of holes.

Means may be provided for detachably connecting the tray or trough to the upper part of said container.

The upper edge of one of the walls may be provided with a number of bayonet or key hole slots and the aforesaid flange may be provided with studs which are engageable with the slots.

In any of the above arrangements the two walls may comprise the opposed walls of the convolutions of a helically coiled pipe. The convolutions of which may be joined together.

Alternatively the walls may be formed by cylindrical or flat sheet metal parts which are impressed with zig-zag or helical cavities which register with one another.

In any of the above arrangements the walls may be supported within a closed casing having an inlet passage at the upper end through which said liquid enters at the top and a passage at the bottom of the casing through which the liquid leaves.

The two walls may be supported on the bottom of the casing by feet and/or suspended from the top wall or cover part of the casing.

The top of the casing may comprise a detachable lid having a flange which encircles the main body of the casing suitable sealing rings being provided between these parts.

Preferably the upper edge of the flange on the tray or trough is spaced away from the inner surface of the top of the casing.

The following is a description of a number of embodiments of a heat exchanger according to the invention reference being made to the accompanying drawings in which:

FIGURE 1 is a part elevation and part section through one form of heat exchanger;

FIGURE 2 is a part elevation and part section through an alternative form of heat exchanger;

FIGURE 3 is a view of a part of a distributor for a heat exchanger; and

FIGURE 4 is a fragmentary longitudinal vertical sectional view, similar to FIGURE 3, of a modified embodiment.

The cooler comprises an outer casing **10** having a detachable lid **11** provided with a flange **12** which encircles the outer casing, a sealing ring **13** being provided between the top edge of the casing and the removable lid **11**.

Suspended from the lid of the casing by struts **14** is a cooler which may be formed with inner and outer walls **15** and **16** which are pressed to form a continuous cooling passage **17** which is connected at opposite ends to a refrigerating apparatus and passage **17** constitutes an expansion chamber for the gas from a refrigerator.

Resting on the upper edge of the cooler is a liquid distributing tray indicated by the arrow **8** and which comprises a slightly domed bottom wall **18** upwardly extending from which is an encircling flange **19**. Formed at the

junction between the bottom wall **18** and the flange **19** are a number of projections formed by tongues or petals **20, 21** which are rounded at their lower extremities. Alternate tongues **20** are bent outwardly and the others **21** are bent inwardly so as to straddle the upper edge of the cooler which supports them. In an alternative arrangement (illustrated in FIGURE 4) the flange **19** may extend below the bottom wall **18** of the tray and be slit and shaped at its lower edge to provide the tongues or petals.

The bottom wall **18** of the tray is provided with two sets of holes **22, 23**, the holes **22** being arranged closer to the upstanding flange **19** than the other holes and are arranged to direct the liquid from the tray on to the outer surfaces of the petals **20**, whereas the other holes **23** are arranged to direct the liquid on to the other petals **21**. The outwardly directed petals **20** are formed with holes **28** disposed opposite the holes **22**, and the inwardly directed petals **21** are formed with holes **29** disposed opposite the holes **23**. Thus the liquid runs down the upper and lower surfaces of the petals and is thus distributed evenly over both the outer and inner surfaces of the cooler. It is found that the provision of the holes **28** and **29** in the petals themselves prevents the liquid from the holes in the tray splashing away from the petals. To provide a greater volume of flow and to assist in promoting an even flow of the liquid, each of the holes **22, 23, 28, 29** may be replaced by two or more holes arranged side by side.

The lid **11** is provided with a central inlet passage **9** through which the liquid to be cooled enters the outer casing and falls into the tray. The bottom of the outer casing is provided with a discharge outlet **24** incorporating a shut off valve **24***a* so that instead of the liquid flowing continuously through the cooler and container it may be maintained for a longer period within the container should additional cooling be required.

The distributing tray **8** may be held in position on the upper part of the cooler by a bayonet slot and stud connection, the slot **25** being formed in an upper edge of the cooler and the stud **26** being carried on a lug **27** fixed to a downwardly extending projection on the tray. The stud **26** may be withdrawn from the slot **25** and the distributor tray can then be readily detached from the cooler. Alternatively the pin on the distributor may be arranged to lie within an enclosed slot in the upper edge of the cooler, for example a key hole slot. This allows a certain degree of upward movement of the distributor with respect to the cooler. Thus when the cooler is being cleaned, as mentioned earlier, by connecting the casing to a source of vacuum and passing detergent upwardly through it, the distributor is permitted to lift slightly, under the joint action of the vacuum and the pressure of the detergent, so as to permit a free flow of detergent around the petals **20, 21**. In an alternative arrangement, not shown, a spring or springs may be connected between the distributor and the top **11** of the casing so as normally to maintain the distributor in position on top of the cooler but which spring or springs can yield to permit upward movement of the distributor during cleaning as mentioned above.

Referring now to FIGURE 2 in which an alternative arrangement is shown the cooler comprises an outer casing having side walls **30** an end wall **31** and a bottom wall made up of walls **32** converging towards an outlet **33**. The casing is generally rectangular in configuration and is closed in an air tight manner by a cover **34** having an inlet **35** for the liquid. Detachably secured to the cover **34** by brackets **36** is a trough having side walls **37** end walls **38** and a bottom wall **39**. A deflector shown diagrammatically at **40** may be disposed between the inlet **35** and trough so that liquid is delivered evenly along the trough.

Disposed beneath the bottom wall **39** of the trough is an inverted channel section distributor the bottom **41** of which is welded or brazed to the bottom wall **39** of the trough and the side walls **42** of which diverge. The lower edges of the side walls are shaped to provide convexly curved downwardly directed projections **43**. The double thickness provided by the bottom walls **39** and **41** are drilled with two rows of holes **44, 45** extending along the length of the trough. The holes are drilled in an inclined manner so as to direct the liquid on to the inner surfaces of the diverging walls **42** and projections **43**. The projections may or may not be provided with holes so that in the former case the liquid flows over both the inner and outer surfaces of the projections.

Suspended by suspension members **46** beneath the distributor is the cooler proper which comprises two walls **47, 48** secured face to face. The suspension members may be slit at **49** at their lower end and provided with holes **50** into which may be inserted headed pins **51** on the walls **47** and **48**. The walls **47, 48** are pressed to for a zig-zag passage **52** opposite ends of which communicate with pipes leading to a compressor of a refrigerator and which pass through the cover **34**.

The liquid flowing down the insides of the projections **43** fans out and falls from the convexly curved edges on to the outer surfaces of the zig-zag passage over which it flows downwardly in a uniform manner.

As indicated earlier the holes **44** might be continued through the diverging walls **42** so that there is a flow of liquid over both the inner and outer surfaces of the projection **43**.

Alternatively the holes may be so formed in the trough that the liquid flows over the outer surfaces of the projections which may or may not be provided with holes so that in the former case the liquid flows over both the inner and outer surfaces of the projections.

In yet another arrangement the bottom of the trough may be formed with four rows of holes so that the liquid may flow directly to both sides of both projections.

Referring now to FIGURE 3 there is shown a part of the distributor tray indicated at **52** embodying an alternative form of projection **53** which has converging edges which come to a point at the end of the projection. The tray with the alternative form of projection may be adapted for use with either of the heat exchangers described.

I claim:

1. A heat exchanger for heat exchange between two liquids comprising:

(a) means defining two opposed, downwardly extending walls between which one of the liquids can flow, said walls having means defining outer surfaces,

(b) means defining a container for the other liquid located above the two walls,

(c) means defining a first set of projections being sheet-like over the portion of their length closer to the container and extending downwardly from the container and overlying one of the walls,

(d) means defining a second set of projections being sheet-like over the portion of their length closer to the container and extending downwardly, from the container and overlying the other of the walls,

(e) the container having means defining two sets of openings located to direct said other liquid onto the two sets of said projections, respectively, so that said other liquid is distributed over the outer surfaces of the said walls.

2. A heat exchanger according to claim **1** wherein alternate of said projections extend downwardly on opposite sides of the outer surfaces of said walls.

3. A heat exchanger according to claim **1** wherein the projections diverge away from one another as they extend downwardly.

4. A heat exchanger according to claim **1** wherein the container includes means defining a bottom wall; and wherein the two sets of projections extend downwardly from said bottom wall.

5. A heat exchanger according to claim 1 wherein the container includes means defining a bottom wall and further embodies an encircling flange which extends both above and below the bottom wall, the flange having a lower portion slit at a plurality of angularly spaced locations and the parts of the flange between the slits being bent outwardly of the flange to provide said projections.

6. A heat exchanger according to claim 5 and where the container is circular wherein one of said sets of openings is nearer the flange than the other of said sets of openings, said one set of openings being arranged to direct streams of liquid over the outer surfaces of the projections extending to one side of said flange and the other set of openings being arranged to direct streams of liquid over the projections extending to the other side of said flange.

7. A heat exchanger according to claim 1 wherein a channel section member, having means defining a central web and two opposed walls, is secured to the bottom wall of the container, and wherein said opposite walls of the channel section member are slit to, respectively, form said two sets of projections.

8. A heat exchanger according to claim 7 wherein said channel section member is secured to said container bottom wall via said central web and wherein the openings in the bottom wall of the container extend through said central web so that said other liquid can be directed on to the inner faces of the projections down which it flows.

9. A heat exchanger according to claim 8 further comprising means defining additional openings in the bottom wall of the container arranged to direct liquid onto the outer faces of the projections.

10. A heat exchanger according to claim 1 wherein projections have means defining openings therethrough so that liquid which has flowed through said openings in the bottom wall of the container can flow from one side of a projection to the other.

11. A heat exchanger according to claim 1 wherein each projection has means defining converging edges so that each respective projection comes to a point at the lower extent thereof.

12. A heat exchanger according to claim 1 wherein the end of each projection, remote from the container, is convexly curved.

13. A heat exchanger according to claim 1 wherein the bottom wall of said container is shaped so that liquid collected by the container tends to flow toward the aforesaid two sets of openings.

14. A heat exchanger according to claim 1 further including means defining a casing; said opposed walls and the container being located in said casing; and means for detachably connecting the container to an upper part of the casing.

15. A heat exchanger according to claim 14 wherein the upper edge of one of the walls is provided with means defining a plurality of bayonet slots; wherein the container includes means defining a bottom wall and further embodies an encircling flange which extends both above and below the bottom wall, the flange having a lower portion slit at a plurality of angularly spaced locations and the parts of the flange between the slits being bent outwardly of the flange to provide said projections and wherein said flange is provided with a plurality of studs which are engageable with the slots to constitute said detachably connecting means.

16. A heat exchanger according to claim 1 wherein the two walls comprise laterally opposed walls of a helically coiled pipe which is wound to provide a plurality of convolutions.

17. A heat exchanger according to claim 16 wherein adjacent ones of the convolutions of the helically coiled pipe are joined together.

18. A heat exchanger according to claim 1 wherein the two walls comprise two respective sheet metal parts impressed with zig-zag extending cavities such that the cavities on the respective parts register with one another.

19. A heat exchanger according to claim 1 further including means defining a closed casing; wherein the two walls are supported within said closed casing; said closed casing having means providing an inlet passage at the upper end thereof through which said other liquid enters said closed casing having means providing a passage at the bottom of the casing through which said other liquid leaves.

20. A heat exchanger according to claim 19 wherein the top of the casing comprises a detachable lid having a flange which encircles the casing; sealing rings being provided between the flange and main body.

21. A heat exchanger according to claim 19 wherein the container includes means defining a bottom wall and further embodies an encircling flange which extends both above and below the bottom wall, the flange having a lower portion slit at a plurality of angularly spaced locations and the parts of the flange between the slits being bent outwardly of the flange to provide said projections; wherein the upper edge of the flange on the container is spaced away from the inner surface of the top of the casing.

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U.S. Cl. X.R.

159—13; 165—118; 261—112, 153