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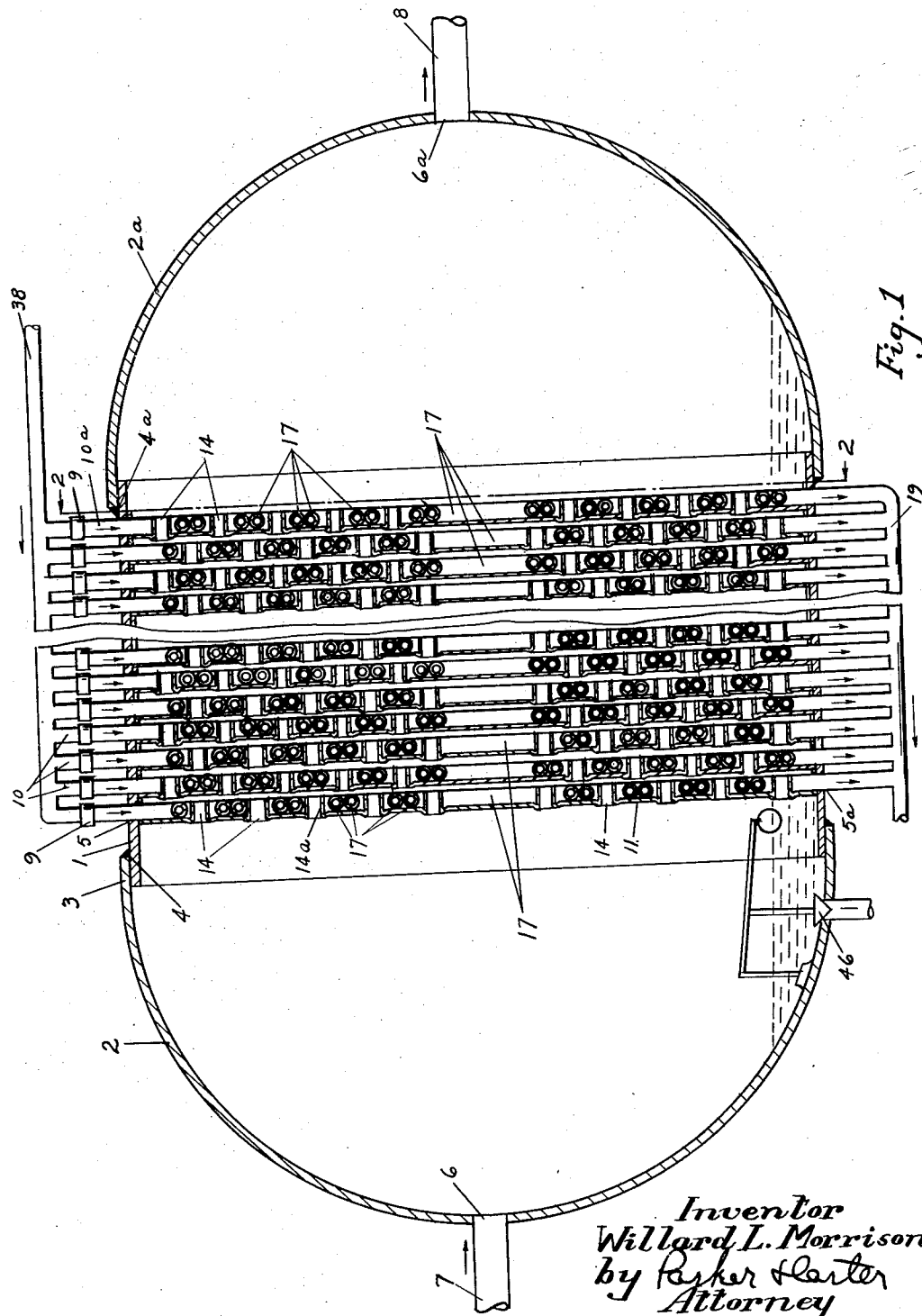
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HEAT EXCHANGER

Filed April 26, 1946

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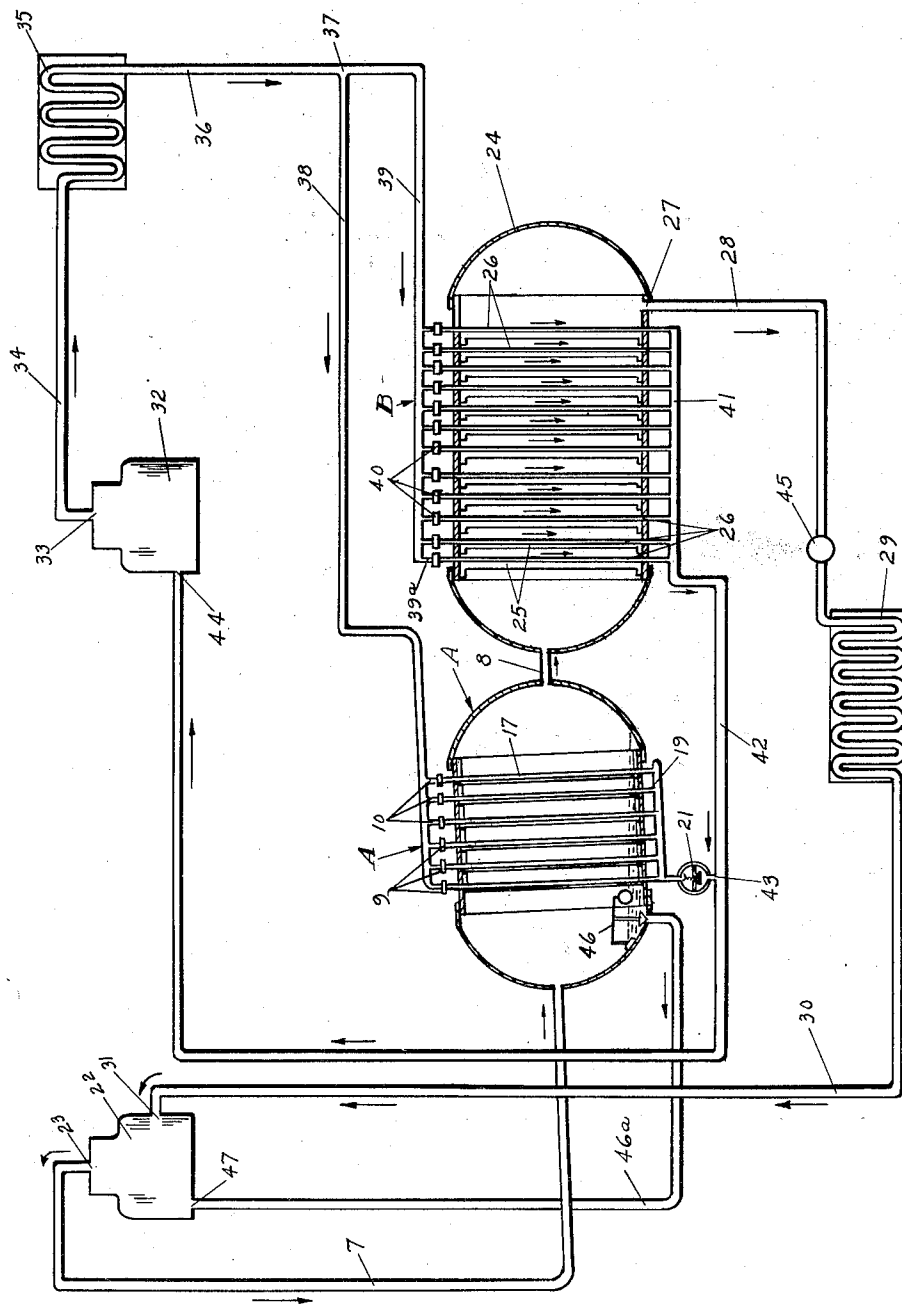


Fig. 5

Inventor
Willard L. Morrison
by Parker & Carter
Attorneys

Aug. 28, 1951

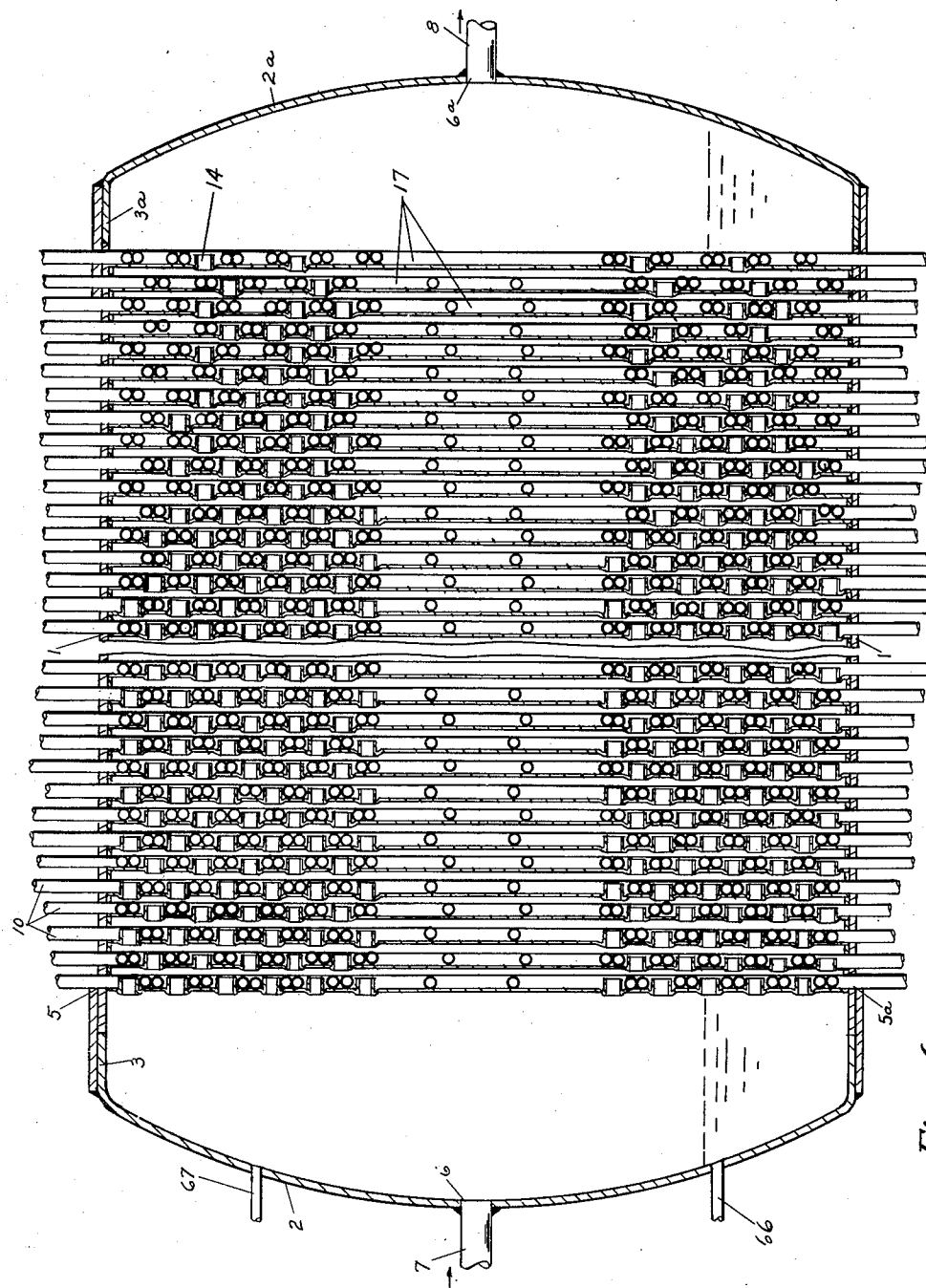
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Inventor
Willard L. Morrison
by Parker & Carter
Attorneys

UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

Willard L. Morrison, Lake Forest, Ill.

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17 Claims. (Cl. 183—32)

1

My invention relates to an improvement in heat exchange means.

One purpose is to provide a heat exchanger which may advantageously be used in refrigerating cycles.

Another purpose is to provide a heat exchange unit which may be employed in refrigerating cycles in which a plurality of different volatile refrigerants may be employed.

Another purpose is to provide an improved oil separator for refrigerating cycles, and an improved method of separating oil from compressed vapor.

Another purpose is to provide means for removing super-heat from the compressed refrigerant vapor.

Another purpose is to remove from a refrigerant, oil or substances which would be injurious to the refrigerant expansion means.

Another purpose is to reclaim oil vapor in a refrigerating system.

Another purpose is to remove heat from the oil before returning it to the compressor of a refrigerating system.

Other purposes will appear from time to time in the course of the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawings wherein:

Fig. 1 is an axial section through a device for separating the oil from a volatile refrigerant;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 2;

Fig. 4 is a view taken on the line 4—4 of Fig. 3;

Fig. 5 is a diagrammatic drawing illustrating an oil separator in a refrigeration circuit; and

Fig. 6 is an axial section through a modified form.

Like parts are indicated by like symbols throughout the specification and drawings.

Referring to the drawings, and for example to Figures 1 and 6, I illustrate heat exchange members which may advantageously be used in separating oil from the compressed refrigerant. However, it should be understood that the heat exchanger therein shown may also be employed for other purposes. In Fig. 5 I illustrate a refrigerant cycle diagram in which one heat exchange unit, generally indicated at A, serves as an oil separator, and a second and similar unit, generally shown at B, serves as a condenser. It will also be understood that the type of heat exchange member for unit shown has a wide variety of applications.

2

Referring specifically to Fig. 1, I illustrate an outer housing including the cylindrical shell 1 and the end members 2 and 2a, for convenience shown as hemispherical. It will be understood, however, that the shape of the housing thereby formed may be changed or varied to suit the needs of the particular installation. Spanning the housing thus formed, I illustrate a series of suitable discs 11. Each disc has a plurality of apertures 14, these apertures being surrounded by cylindrical offset tubular portions 14a. As will be clear from Fig. 1, whereas the discs 11 may be uniformly spaced, the apertures 14 of each disc are aligned with a plate or closed portion of the adjacent disc. It will be understood that, in the use of the device, refrigerant under pressure is delivered through the inlet 6 in the housing head 2, along the duct 7 extending from any suitable compressor unit generally indicated at 22 in Fig. 5. Thus at the left end of the heat exchange unit, referring to the portion of the parts as shown in Fig. 1, refrigerant under pressure is being delivered. This refrigerant flows through the relatively restricted apertures 14 and impinges, in a series of jets, against the plate of discs 11 from left to the right. This process continues until the refrigerant gas or vapor flows through the last disc 11, and into the space within the right hand end or shell 2a. The refrigerant then flows outwardly through the aperture 6a and along the passage 8 to the condenser unit B, as will be clear from Fig. 5. Thus the refrigerant, in a series of impinging jets, is passed, step by step, through the interior series of plates 11.

Each of the plates is cooled by evaporator coils of a secondary or additional refrigerant system. Referring to Fig. 1 the refrigerant flows along a supply duct 38 to a series of branches 10. In each branch there may be any suitable pressure reducing means 9. The volatile refrigerant, at reduced pressure, flows through the secondary refrigerant tubes or coils 10a, which pass through inlet apertures 5 of shell 1, spiral around the plates, pass out through the outlet apertures 5a of the shell 1, and reach the return passage or manifold 19. Thus each of the plates 11 is adequately cooled by having a secondary refrigerant coil or evaporator, there being a coil for each plate. The arrangement of the coil or evaporator tubes 10a will be widely varied, but a practical arrangement is illustrated in Fig. 2, in which each coil 10a is shown as passing spirally to the center of the plate 11, and retracing itself, whereby a double coil or spiral is employed, with diametrically opposed inlets

and outlets in the coil of shell 1. Any suitable means may be employed for maintaining the evaporator coils 16a in proper heat exchange relationship with each plate 11. I indicate the intermediate portions of the coils 16a and 17 in Figures 2 and 3, with the two coils contacting each other and also the adjacent surface of the plate 11. If desired, any suitable thermally conductive cement may be employed to maintain adequate heat exchange relationship between the opposed surfaces.

In considering the structure for the cycle as a whole, it will be understood that the primary refrigerant is circulated or cycled by any suitable compressor unit 22. The primary refrigerant passes through the outlet aperture 23, along the high pressure vapor supply duct 7 to the unit A. In the unit A, by the above discussed impingement process, the refrigerant vapor is initially reduced in temperature and the oil is separated out. The oil gathers in a pool in the bottom of the unit A and may escape through any suitable float control valve, such as 46. Thence it flows along the return line 46a to the low side of the compressor as at 47. The oil-free refrigerant then passes to the unit B of Fig. 5, along the passage 8. The unit B of Fig. 5 need not be described in detail, since it may be identical with A except for the elimination of the oil removal mechanism, and for a possible increase in the number of plates 11. The refrigerant passes through the plates 11, through a structure identical with that shown in Fig. 1, and the condensed refrigerant passes from the unit B, along the high pressure liquid passage 28 toward the evaporator 29 of the primary system. Any suitable pressure reducing means 45 may be employed, in order to maintain the proper pressure condition for causing the evaporation in the evaporator 29 at the desired temperature. The evaporated refrigerant flows from the evaporator 29 along the low pressure or return duct or passage 30 to the compressor low side inlet 31.

In considering the secondary refrigerant cycle, a second or separate compressor unit 32 is employed. It delivers high pressure refrigerant vapor through outlet 33 and the high pressure duct 34 to any suitable condenser unit 35. Thence the condensed, but high pressure, refrigerant flows along the duct 36. It branches at 37 into high pressure supply ducts 38 and 39. The duct 38 delivers to the separate high pressure supply branches 10, and thus to the above described evaporator system for the unit A. The duct 39 delivers to a series of branches 39a, each with its individual pressure reducing means 40. It will be understood that the discs indicated at 25 in Fig. 5 may be identical with the discs 11 of the Fig. 1 although more numerous. Each of the discs will be understood to have an evaporator coil 26 which may be identical with the evaporator coils shown at 16a and 17 in Figures 1 and 2. Each such coil 26 delivers to a low side return duct or manifold 41 and thence by the low pressure line 42 to the low side inlet 44 of the compressor 32. As will be clear from Fig. 5, the manifold 19 also delivers to the low pressure line 42. It passes the pressure control valve 21 effective to keep the pressure in the space between the valve 21 and the pressure reducing means or restrictors 9 at a level sufficiently above the pressure on the suction side of the pressure control valve 21 to constitute a temperature high enough to avoid causing the removal of all of the super-heat from

the refrigerant, thereby avoiding condensation of refrigeration in the separator unit A. To summarize the operation and system, a primary compressor 22 cycles the volatile refrigerant first through an oil separator unit A where oil is removed without condensation of the refrigerant and next through the condenser unit B, wherein the refrigerant is condensed and delivered, as a liquid, to the pressure reducing means 45. Both the separator unit A and the condenser unit B receive a secondary refrigerant from the compressor 32. This refrigerant is evaporated in the coils 17 and 26 respectively, but at very different temperatures or pressures. Thus the oil is removed and returned directly to the primary compressor 22, and the oil-free vapor refrigerant is then condensed in the unit B, and cycled through any apertured evaporator.

Whereas I have shown a highly advantageous system in which oil is removed from the system, I have also illustrated a heat exchange member which may advantageously be employed for oil separation, for condensation, and for other purposes.

It will be understood that whereas I have described and shown a practical and operative device, nevertheless many changes may be made in size, shape, number and disposition of parts without departing from the spirit of my invention. I therefore wish my description and drawings to be taken as in a broad sense, illustrative or diagrammatic.

For example, Fig. 6 illustrates a variant form of oil separating member in which I employ a progressively reduced number of apertures 14 toward the discharge end of the unit. It will be evident the same numbers have been applied to the same elements as in the corresponding Fig. 1 except that an exterior oil float chamber may be employed. Thus the valve 46 is omitted and an oil discharge passage 66 is shown, in the end member 2. 67 indicates a pressure control passage effective for use with an exterior oil float unit, the details of which are not shown, since it does not of itself form part of the present invention.

It will be understood that, in heat exchangers of the above type, it may be advantageous, as in the oil separator unit A, to employ a progressively reduced number of apertures 14. Also, it will be understood, it may be practical under some circumstances to vary or change the diameter of the apertures.

I claim:

1. In a heat exchange member, a housing, an inlet duct and an outlet duct, baffle means in the housing between said inlet and outlet ducts, said baffle means including a partition having nozzles therein, and means for cooling said partition and the fluid passing through said nozzles, including a coil adapted for the evaporation of a volatile refrigerant.

2. In a heat exchange member used in refrigeration, a housing, an inlet duct for said housing, an outlet duct extending from said housing and a baffle system in said housing including a plurality of ported baffles, the ports of each baffle being aligned with closed portions of the adjacent baffle, and means for cooling said baffles.

3. In a heat exchange member used in refrigeration, a housing, an inlet duct for said housing, an outlet duct extending from said housing and a baffle system in said housing including a plurality of ported baffles, the ports of each baffle being aligned with closed portions of an adjacent

baffle, and means for cooling said baffles, including refrigerant coils in heat exchange relationship with said baffles.

4. In an oil separator for refrigerant cycles, a housing, an inlet duct extending to the housing and an outlet duct extending from the housing, an oil discharge duct extending from the housing at a level substantially lower than said outlet duct, and baffle means in the housing, between said inlet and outlet ducts, including a plurality of nozzled partitions, the nozzles of said partitions being positioned and formed to direct refrigerant against a closed portion of an adjacent baffle, and means for cooling said baffles, and the refrigerant passing through said nozzles, and impinging against said baffles.

5. In an oil separator for refrigerant cycles, a housing, an inlet duct extending to the housing and an outlet duct extending from the housing, an oil discharge duct extending from the housing at a level substantially lower than said outlet duct, and baffle means in the housing, between said inlet and outlet ducts, including a plurality of nozzled partitions, the nozzles of said partitions being positioned and formed to direct refrigerant against a closed portion of an adjacent baffle, and means for cooling said baffles, and the refrigerant passing through said nozzles, and impinging against said baffles, including evaporator coils in heat exchange relation with said baffles.

6. In a heat exchange member for fluids, a housing, a plurality of partitions in an intermediate part of said housing, means for delivering a fluid, a gaseous state, and under pressure, to the interior of said housing at one side of said plurality of partitions, means for withdrawing the fluid from the other end of the housing, beyond said partitions, means for cooling said partitions, said partitions being apertured in staggered relationship, whereby a fluid passing through the apertures of one partition impinges against a solid portion of an adjacent partition.

7. In a heat exchange member for fluids, a housing, a plurality of partitions in an intermediate part of said housing, means for delivering a fluid, in gaseous state, and under pressure, to the interior of said housing at one side of said plurality of partitions, means for withdrawing the fluid from the other end of the housing, beyond said partitions, means for cooling said partitions, said partitions being apertured in staggered relationship, whereby a fluid passing through the apertures of one partition impinges against a solid portion of an adjacent partition, the means for cooling said partitions, including evaporator elements and means for cycling a volatile refrigerant therethrough.

8. In an oil separator for refrigeration systems, a heat exchanger adapted to be positioned in the line of flow of a volatile refrigerant, said heat exchanger including a housing, a plurality of partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, and means for cooling said partitions to a temperature adequate for oil separation but above the temperature of condensation of the refrigerant, means for withdrawing oil from the spaces between the partitions and from the heat exchanger.

9. In an oil separator for refrigeration systems, a heat exchanger adapted to be positioned in the line of flow of a volatile refrigerant, said heat exchanger including a housing, a plurality of

partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, means for cooling said partitions to a temperature adequate for oil separation but above the temperature of condensation of the refrigerant, the material of the partitions being laterally displaced about each aperture to form a nozzle, means for withdrawing oil from the spaces between the partitions and from the heat exchanger.

10. In an oil separator for refrigeration systems, a heat exchanger adapted to be positioned in the line of flow of a volatile refrigerant, said heat exchanger including a housing, a plurality of partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, means for cooling said partitions to a temperature adequate for oil separation but above the temperature of condensation of the refrigerant, the number of apertures per partition being progressively reduced, in part or all of the partition series, along the direction of movement of the refrigerant toward the condenser, means for withdrawing oil from the spaces between the partitions and from the heat exchangers.

11. In an oil separator for refrigeration systems, a heat exchanger adapted to be positioned in the line of flow of a volatile refrigerant, said heat exchanger including a housing, a plurality of partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, means for cooling said partitions to a temperature adequate for oil separation but above the temperature of condensation of the refrigerant, and means for removing the separated oil from the housing.

12. In an oil separator for refrigeration systems, a heat exchanger adapted to be positioned in the line of flow of a volatile refrigerant, said heat exchanger including a housing, a plurality of partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, means for cooling said partitions to a temperature adequate for oil separation but above the temperature of condensation of the refrigerant, and means for removing the separated oil from the housing, including a float controlled oil discharge valve.

13. In a condenser for refrigeration systems, a housing, a plurality of partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, and means for cooling said partitions to a temperature adequate to cause condensation of the refrigerant.

14. In a condenser for refrigeration systems, a housing, a plurality of partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, and means for cooling said partitions to a temperature adequate to cause condensation of the refrigerant, including evaporators in heat exchange

7

relation with the partitions, and means for cycling a refrigerant through said evaporators.

15. In a condenser for refrigeration systems, a housing, a plurality of partitions in said housing, said partitions being apertured in staggered relationship, whereby the refrigerant passing through the apertures of one partition impinges against a solid portion of an adjacent partition, and means for cooling said partitions to a temperature adequate to cause condensation of the refrigerant, including evaporators in heat exchange relation with the partitions, and means for cycling a secondary refrigerant through said evaporators.

16. In a heat exchange member for fluids a housing having an inlet and an outlet, and means for cooling a fluid flowing between said inlet and outlet, including a plurality of transverse partitions having nozzle apertures therein, the apertures in one partition being aligned with closed areas in the next partition, and means for cooling said partitions.

17. In a heat exchange member for fluids, a housing having an inlet and an outlet, means for causing a flow of fluid at relatively high velocity away from said inlet and toward said outlet, a

8

wall between said inlet and outlet, and means for cooling it, and means for directing said fluid in one or more jets for impingement against said cooled wall.

WILLARD L. MORRISON.

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