

June 25, 1929.

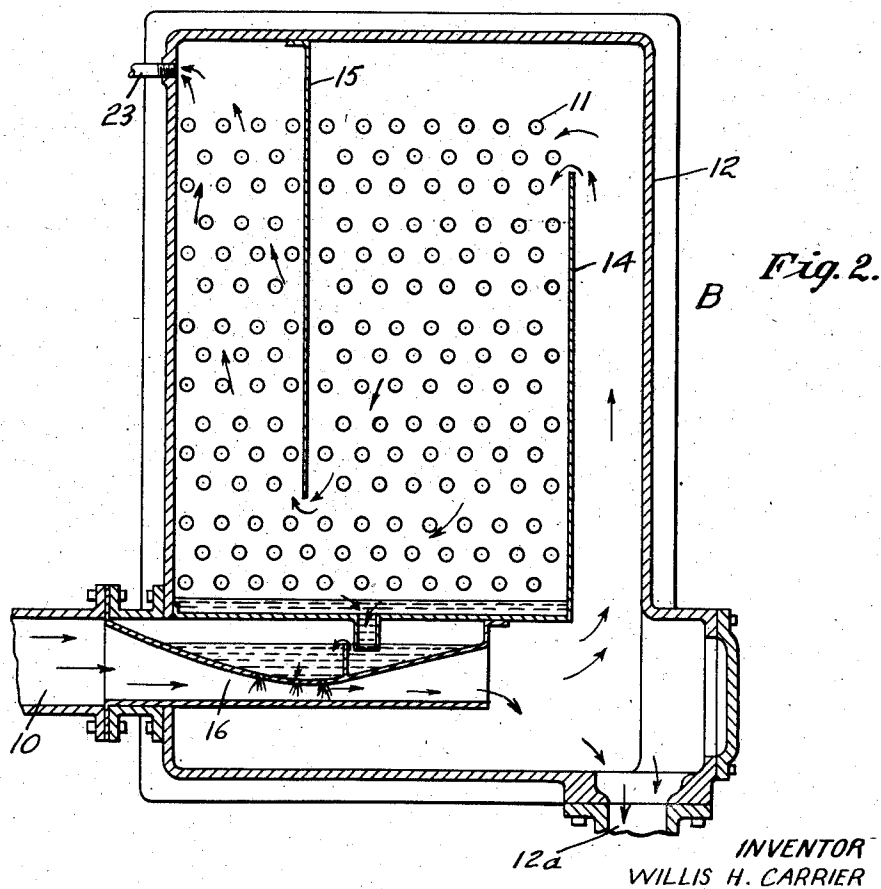
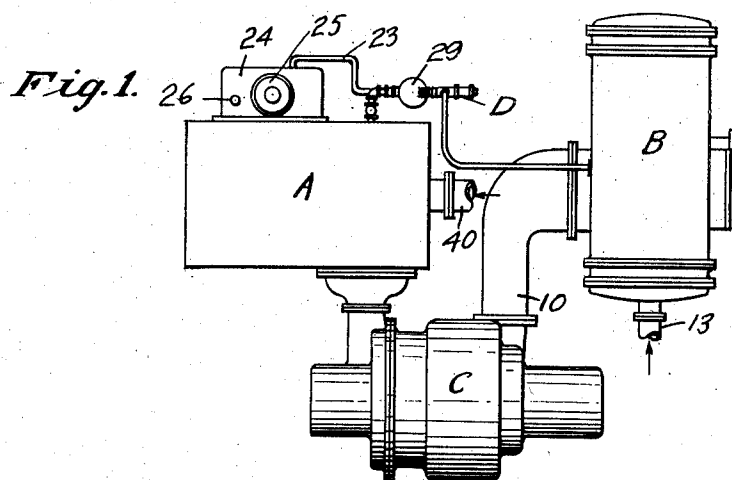
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METHOD OF AND APPARATUS FOR REFRIGERATION

Filed Aug. 21, 1924

2 Sheets-Sheet 1



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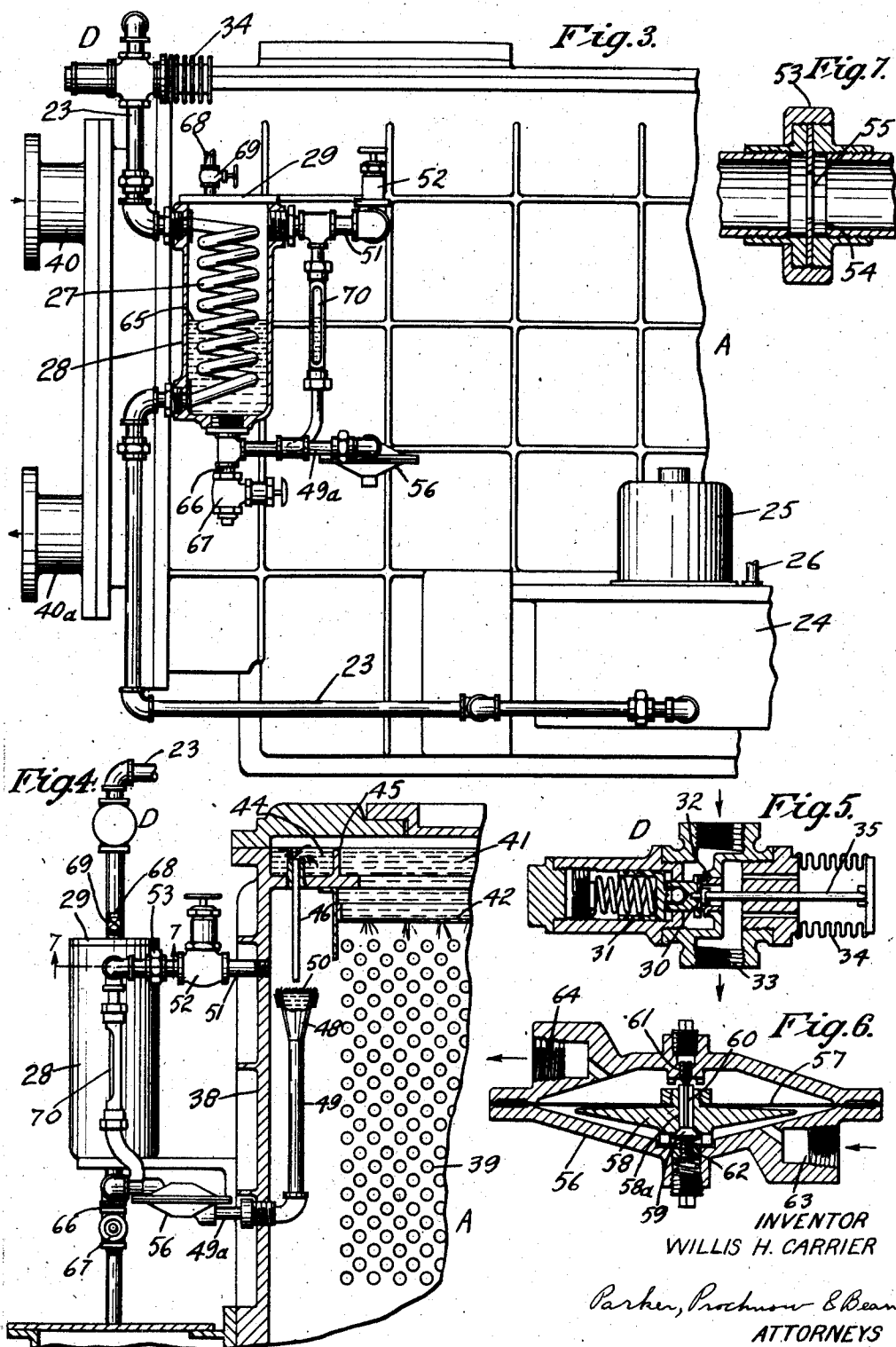
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METHOD OF AND APPARATUS FOR REFRIGERATION

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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR REFRIGERATION.

Application filed August 21, 1924. Serial No. 733,296.

This invention relates to an improved method of refrigeration and more particularly to a method of refrigeration in which the liquid refrigerant is automatically rectified during the refrigeration operation, and the heat in the warm fluid from the condenser is used for the rectification of the liquid refrigerant.

The invention further relates to a refrigeration apparatus adapted to carry out the improved refrigeration method.

In the refrigeration system disclosed in my copending application, Serial No. 656,152, filed Aug. 7, 1923, an uncondensed mixture of gaseous impurities and some vapor of the refrigerant from the main condenser is passed through a supplementary water cooled condenser to further condense the refrigerant vapor before the final separation of the gaseous impurities from the condensate. Also, in said system, in order to rectify the liquid refrigerant to separate it in vapor form from impurities such as oil, water, dirt, etc., I subjected the liquid refrigerant during the operation of the system to the indirect heating action of warm liquid refrigerant returning from the condenser.

I have found that the cold liquid refrigerant delivered to the rectifier may be used to advantage as a cooling medium for condensing the refrigerant vapor from the gaseous impurities by utilizing the warm vapor and gaseous impurities as the heating medium for the rectifier, thus eliminating the supplementary condenser and simplifying the apparatus. The heat from the warm gas and vapor mixture from the condenser acts to rectify the liquid refrigerant which in turn acts as the cooling medium for condensing the refrigerant vapor from non-condensable impurities, and one piece of apparatus serves the double purpose of supplementary condenser and rectifier. By using the warm, uncondensed gases and vapors from the condenser as the heating medium in the rectifier, the latent heat of vaporization, as well as the heat of the liquid refrigerant condensed is available for heating purposes in rectification, thus insuring a sufficient amount of rectification with a comparatively small volume of heating medium. The condensation of the refrigerant vapor in the gas mixture is also effected with a smaller and simpler heat exchange surface than is necessary in a water cooled condenser as the liquid refrig-

erant from the evaporator has a lower temperature than the cooling water.

One object of the invention, therefore, is to improve methods of refrigeration in the respects above indicated. Other objects are to provide a method of refrigeration in which the condensation of refrigerant vapors in a mixture of gas and vapor withdrawn from the condenser, accomplishes the rectification of the liquid refrigerant to separate it as a vapor from non-vaporizable impurities; also to provide a refrigeration apparatus for carrying out the above method in which a single piece of apparatus serves the double purpose of condenser and rectifier; also to provide a method of refrigeration in which a mixture of gas and vapor is withdrawn from an ascending current of the mixture in the main condenser to effect a preliminary gravity separation of the condensible and non-condensable fluids before the subsequent separation thereof by condensation in the rectifier; also to provide a practical method of, and reliable and sensitive apparatus for automatically maintaining a substantially uniform rate of rectification regardless of the purity of the liquid in the rectifier; and also to improve refrigeration methods and apparatus in other respects hereinafter described and set forth in the claims.

In the accompanying drawings:

Fig. 1 is a diagrammatic plan view of a refrigeration apparatus embodying my invention.

Fig. 2 is a vertical sectional view through the condenser of the refrigeration apparatus.

Fig. 3 is a fragmentary sectional elevation showing the evaporator and the improved rectifier-condenser.

Fig. 4 is a view showing the rectifier in elevation and a fragmentary sectional elevation of the evaporator.

Fig. 5 is a central sectional view of the vapor check valve for the rectifier-condenser.

Fig. 6 is a vertical sectional view of the regulating valve for the rectifier-condenser.

Fig. 7 is a sectional view through the restriction device on line 7-7, Fig. 4.

Referring to the drawings, A is the evaporator, B the condenser and C the compressor of a refrigeration apparatus such, for instance, as described in my above mentioned copending application. This type of refrigeration apparatus is especially designed for operating with refrigerants such as dichloro-

ethylene etc., under vacuum in both the evaporator A and in the condenser B but other pressures may be used, such, for example, as below atmospheric pressure in the evaporator A and above atmospheric pressure in the condenser B and other refrigerants may also be used. The vapors of the refrigerant are withdrawn from the evaporator A by a compressor C of any suitable construction, but preferably centrifugal in type.

From the compressor C the vapors of the refrigerant, including any air or other non-condensable gases which occur in the refrigerant as impurities, are delivered into the condenser B through an inlet pipe 10 at a pressure preferably, but not necessarily, below one atmosphere. The condensable refrigerant vapors are condensed by means of water at normal temperatures or other suitable condensing medium which is circulated through suitable tubes 11 arranged in the condenser casing 12. Preferably the condensing water enters through an inlet pipe 13 at the top of the condenser, flows back and forth through successive groups of tubes 11, and leaves through an outlet pipe, not shown, at the bottom of the condenser, so that the flow of water through said tubes is in a counter-current direction to the flow of the densest vapor in the condenser as will be further explained presently. Suitable baffles or walls 14 and 15 arranged in the condenser casing, cause the refrigerant vapor entering the condenser to first pass downwardly over a portion of the cooling tubes, then under the baffle 15, and upwardly over the remaining tubes in the ascending passage formed by said baffle 15, so that the densest vapor, together with any air or other gaseous impurities which may be present, must rise in said passage to reach an outlet at the top thereof through which the vapor and gases are withdrawn from the condenser. The mixture of air and vapor in the proportion of about 95% vapor to 5% air, is lighter than the vapor alone so that during the ascent of the vapor and gases gravity tends to separate the dense refrigerant vapor from the air with the result that a smaller proportion of the vapor will be withdrawn with the air from the top of said passage. No air will accumulate in the first or descending passage of the condenser between the baffles 14 and 15 because the greater velocity of the refrigerant vapors through this portion of the condenser sweeps all air with it under the baffle 15.

The condenser B shown is provided with a saturator or device 16, disclosed in my aforesaid application for the purpose of saturating and cooling the vapor entering the condenser and partially relieving the work of the condenser. The liquefied refrigerant is caused to discharge from the condenser through the saturator or device 16 through which the refrigerant vapor is delivered from

the compressor into the condenser. This saturator is constructed and operates as described in said application. The cooled liquid from the condenser meeting the warm vapor from the compressor flowing through the saturator passage 16, cools and saturates the vapor so that when the vapor reaches the condensing tubes of the condenser it is already cooled and condensed to some extent, and to that extent relieves the work of the condenser. The liquefied refrigerant passes from the main condenser through outlet pipe 12^a and is trapped back to the evaporator A, as explained in my said application.

In my above mentioned application, a supplementary water cooled condenser is located in the upper portion of the ascending passage in the condenser casing 12 for condensing and separating the densest portion of the refrigerant vapor from the air or other gaseous impurities. I have found, however, that this condensation effect can be obtained to advantage and said supplementary condenser dispensed with by employing the rectifier of the present invention which utilizes the cool refrigerant liquid from the evaporator as the cooling medium. This liquid refrigerant has a lower temperature than water at normal temperatures and, therefore, a smaller heat exchange surface and one of simpler construction is possible for the same condensation effect, and at the same time the heat in the gases from the condenser is used for rectification of the refrigerant liquid and the separation of said refrigerant as a vapor from non-volatile liquid impurities such as oil, water, etc., contained therein.

A vapor outlet pipe 23 connects with the upper end of the ascending passage of the condenser B for the purpose of withdrawing the uncondensed refrigerant vapors and gaseous impurities therefrom by means of suitable evacuation mechanism, such, for example, as disclosed in my above mentioned application, said mechanism comprising an air and vapor separating chamber 24 positioned on the side of the evaporator casing and a motor 25 located on the top of said chamber which actuates a pump to circulate refrigerant liquid through an ejector and separator in said chamber. The pipe 23 connects with said ejector, which acts to withdraw the vapor and gaseous impurities from the condenser through the pipe 23. The uncondensed air and other gaseous impurities are discharged into the atmosphere from the separating chamber 24 through a discharge pipe 26 and the liquid refrigerant, which is condensed and separated in said chamber 24 is returned to the evaporator by a suitable mechanism, all as more fully described in said application. Any other suitable air evacuating and separating means could be displayed.

Between the condenser casing 12 and the separating chamber 24 the pipe 23 is formed

into or suitably connected with a condensing coil or device 27 which is contained in or otherwise suitably arranged to heat a rectifier chamber 28 preferably, but not necessarily, cylindrical in form and having a cover 29. A check valve D is located in the line 23, preferably between the condenser casing 12 and the rectifier chamber 28 so that said line is closed when the apparatus is shut down but is opened automatically when the evacuator motor 25 is started. This check valve may be of any suitable construction. As shown it has a valve member 30 which is yieldingly pressed by a spring actuated plunger 31 against a valve seat 32. When a vacuum is created in the suction port 33 of the check valve D, a bellows diaphragm 34 contracts and a rod 35 between the diaphragm head and valve member 30 pushes the valve member 30 open so that vapors can be withdrawn from the condenser B through the pipe 23 and check valve.

The liquid refrigerant is delivered to the rectifier for rectification during the operation of the refrigeration apparatus, preferably as follows. The evaporator A shown (see Fig. 4) is provided with a casing 38 and a number of heat exchange tubes 39 through which water or other medium to be cooled passes, said medium being admitted to said coils through an inlet pipe 40 and being discharged therefrom through an outlet pipe 40^a. A chamber 41 is formed in the evaporator casing 38, above the tubes 39, and the refrigerant liquid is returned from the condenser to this chamber to be evaporated. The chamber 41 is provided with a perforated bottom 42 which distributes the liquid refrigerant onto the tubes 39 in numerous small streams. An overflow chamber 44 is formed in the receiving chamber 41 by a wall 45, and an overflow pipe 46 has its upper end located above the bottom of said overflow chamber so that when the refrigeration apparatus is operating, a portion of the liquid refrigerant will continuously overflow from the chamber 44 into the pipe 46. The pipe 46 delivers the liquid refrigerant into a funnel 48 at the top of a stand pipe 49, said funnel preferably having a wire mesh 50 across its top to prevent the splashing of any dirty liquid out of stand pipe 49 into the evaporator casing 38. The stand pipe 49 connects at its bottom with a pipe 49^a which passes out of the evaporator casing 38 and is connected to the bottom of the rectifier chamber 28.

Thus the liquid refrigerant rises in the rectifier chamber 28 around the condenser coils 27 to a level depending on the head of liquid in said stand pipe 49 and also on the pressure of the vapors above the liquid in said rectifier chamber since, when the pressure in the rectifier chamber 28 reaches a certain point, the liquid discharging from the pipe 46 will overflow the funnel 48 because of the fact that

said stand pipe 49 is full of liquid. A vapor return pipe 51 connects the upper end of the rectifier chamber 28 with the evaporator casing 38 and is provided with a hand cut off valve 52 of usual construction. A restriction device 53 (see Fig. 7) is provided in the vapor pipe 51 being preferably located between the valve 52 and rectifier chamber 28 and consisting of a removable transverse plate 54 in the pipe having an opening 55 therethrough for the passage of the vapor. The pressure of vapor in the rectifier chamber 28 depends upon the size of this restriction opening and any desired pressure can be secured by using a plate with an opening of appropriate size.

In the pipe 49^a leading from the stand pipe 49 to the bottom of the rectifier chamber 28, a sensitive regulating or check valve 56 is located. This valve is preferably of the following construction. A flexible diaphragm 57 dividing the valve casing into upper and lower chambers, carries a valve seat member 58 through which is a central fluid passage 58^a. The valve member 59 is provided with a grooved guide stem 60 passing through the passage 58^a and is normally held stationary between a stop screw 61 engaging the upper end of said stem and a spring pressed safety stop screw 62 engaging the lower end of the valve member. The valve casing has an inlet port 63 below the diaphragm 57 and a discharge port 64 above said diaphragm. The valve prevents the back flow of any liquid from the rectifier chamber 28, but whenever the head of liquid in the stand pipe 49 becomes sufficient to overcome the pressure of the vapor in the rectifier chamber 28, the diaphragm 57 is deflected upwardly and lifts the valve seat off of the valve allowing liquid to flow from the stand pipe 49 into the rectifier chamber 28. In the event of an abnormally high pressure in the rectifying chamber the safety screw will permit the valve to yield downwardly with the valve seat so as to prevent injury to the valve or seat while nevertheless holding the valve closed.

It is desired to cause the liquid refrigerant to be distilled or rectified at a substantially uniform rate, notwithstanding variations in its purity, and the mechanism described is especially suited for this purpose. The warm vapors from the condenser B passing through the condenser coil 27, transfer their heat through the walls of said coil to the liquid refrigerant in the rectifier chamber surrounding said coil, causing said refrigerant to boil and to distill off vapors of the refrigerant which pass through the restriction opening 55 and return pipe 51 into the evaporator casing 38. When operating for a considerable length of time, the liquid in the rectifying chamber 28 becomes more and more contaminated with the impurities, such as oil, water and the like, contained in the refrigerant so that the evaporation in pounds

of refrigerant per unit of condenser coil surface continually decreases. When the refrigerant liquid is fresh in the rectifier chamber 28 the vapors are given off rapidly and the comparatively high vapor pressure caused in the rectifying chamber by the restriction opening 55 overbalances the head of liquid in the stand pipe 49 and holds the valve 59 closed so as to maintain the liquid level 65 in the rectifier chamber 28 comparatively low with a smaller portion of the condenser coil 27 in contact with said liquid thus causing a reduction in the rate of evaporation. As the liquid becomes more polluted, the vaporization is less rapid so that the vapor pressure is reduced and permits the valve 59 to open and the liquid to rise higher in the rectifier chamber 28 because of the head of liquid in the stand pipe 49 and thus automatically increase the rate of evaporation from the polluted liquid. Therefore the net evaporation or pounds of refrigerant vapor per unit of time passing through the pipe 51 is automatically maintained substantially uniform regardless of the purity of the liquid in said rectifier chamber. The described regulating means for the rectifier are very sensitive. The regulating valve will open and close with small differences in the head of the liquid in the stand pipe and maintain a substantially uniform action of the rectifier.

When the oil, water or other impurities have accumulated in sufficient quantity in the rectifying chamber, said liquid is drained from the rectifier chamber 28. For this purpose a drain pipe 66, controlled by a hand valve 67 is provided at the bottom of said rectifier and an air vent pipe 68 having valve 69 is provided at the top of the rectifier chamber 28. In withdrawing the polluted liquid from the rectifier chamber 28, the vapor outlet valve 52 is first closed, and the vent valve 69 opened which breaks the partial vacuum in the rectifier chamber 28 and increases the pressure in said chamber so that the regulating valve 56 closes. The drain valve 67 is then opened and the liquid drained out, after which the valves 67 and 69 are closed and the valve 52 opened, which again puts the device in operation as a combination rectifier and condenser. A gage glass 70 of the usual construction may be connected between the pipe 51 and pipe 49* for indicating the level of the liquid in the rectifier chamber 28 and for also indicating the color or purity of said liquid.

By employing the rectifier as a supplementary condenser for the vapor withdrawn from the main condenser and using cold liquid refrigerant from the evaporator as the cooling medium in the supplementary condenser, the amount of condensing coil surface necessary for the desired amount of condensation is considerably reduced since the temperature of said liquid refrigerant is considerably less than the normal temperature of cooling water,

so that the condensation is more effective and more complete. On the other hand by using the vapors from the main condenser as a heating medium for the rectifier instead of the warm liquid refrigerant from the condenser, the latent heat of vaporization of the condensing vapors in the condenser coil 27 is available for rectification of the liquid refrigerant in the rectifying chamber 28, whereas by using the liquid refrigerant from the condenser, only the heat of the liquid is available for rectification and a large quantity of the liquid would have to be circulated to provide an equal amount of rectification.

I claim as my invention:

1. The method of refrigeration which includes compressing the vapor of a liquid refrigerant, passing the compressed vapor through a condenser in indirect contact with a cooling medium in said condenser, withdrawing a mixture of uncondensed gases and vapors from said condenser, bringing the withdrawn gaseous mixture and portions of the cold liquid refrigerant of the system into indirect heat exchange relation so that the vapors in the gaseous mixture are further condensed and the liquid refrigerant is heated and partially vaporized by the heat in the gaseous mixture, and separating said vaporized refrigerant from less volatile ingredients in said liquid refrigerant and returning said vaporized refrigerant to be again used in the refrigeration method.

2. The method of refrigeration which includes compressing the vapor of a liquid refrigerant, passing the compressed vapor through a condenser in a direction opposite to the direction of flow of a flowing cooling medium in said condenser, withdrawing a mixture of uncondensed gases and vapors from the top of an ascending passage in said condenser, bringing the withdrawn gaseous mixture and portions of the cold liquid refrigerant of the system into indirect heat exchange relation so that the vapors in the gaseous mixture are further condensed and the liquid refrigerant is heated and partially vaporized by the heat in the gaseous mixture, and separating said vaporized refrigerant from less volatile ingredients in said liquid refrigerant and returning said vaporized refrigerant to be again used in the refrigeration method.

3. The method of refrigeration in which the vapor of a volatile liquid refrigerant is compressed and condensed, comprising the following steps, causing the refrigerant vapor to ascend in a substantially upright column of substantial height while being condensed by a condensing medium flowing in a counter current direction whereby non-condensable gas mixed with the vapor tends to separate from the vapor in said ascending column under the influence of gravity and rise to an overhead outlet, withdrawing the

gas and dense vapor through said outlet, and subjecting the withdrawn gaseous mixture to the cooling action of the liquid refrigerant to further condense the vapors from the gaseous mixture.

4. The method of refrigeration in which the vapor of a volatile liquid refrigerant is compressed and condensed, comprising the following steps, causing the refrigerant vapor after partial cooling to flow in an ascending direction while being further condensed, whereby non-condensable gas mixed with vapor tends to separate from the dense vapor in said ascending column under the influence of gravity and rise to an overhead outlet, withdrawing the gas and dense vapor through said outlet, and subjecting the withdrawn gaseous mixture to the indirect cooling action of a portion of the liquid refrigerant so that the remaining vapors in the gaseous mixture are condensed from the uncondensable gases and the liquid refrigerant is partially vaporized by the heat in the gaseous mixture, and separating and recovering said vaporized refrigerant from less-volatile ingredients in said liquid refrigerant.

5. In a refrigeration apparatus, the combination with a compressor, condenser and evaporator, of a supplementary condensing element, means for withdrawing uncondensed refrigerant vapor and gases from said condenser and passing same through said condensing element, a chamber associated with said condensing element, means for delivering cold refrigerant liquid to said chamber so that the vapor and gas mixture is indirectly cooled and the vapor condensed from the uncondensable gases, and the refrigerant liquid is also partially vaporized, and a vapor return passage connecting said chamber with a low pressure portion of the refrigeration apparatus whereby said vaporized refrigerant is separated from less volatile impurities.

6. In a refrigeration apparatus, the combination with a compressor, condenser and evaporator, of a supplementary condensing element, means for withdrawing uncondensed refrigerant vapors and gases from said condenser and passing same through said condensing element, a container associated with said condensing element, a stand pipe connected with the bottom of said container, and means for supplying relatively cold liquid refrigerant from the refrigerant circulating portion of the apparatus to said stand pipe so that said container fills with the relatively cold refrigerant liquid to a level determined by the liquid in the stand pipe, and the vapors in said condensing element are condensed from the uncondensable gases by indirect cooling, and the refrigerant liquid is partially vaporized and separated as a vapor from its impurities.

7. In a refrigeration apparatus, the com-

bination with a compressor, condenser and evaporator, of a condensing element, means for withdrawing uncondensed refrigerant vapors and gases from said condenser and passing same through said condensing element, a container associated with said condensing element, a stand pipe connected with the bottom of said container, and a valve between said stand pipe and said container adapted to prevent back flow of liquid from said container to said stand pipe, said stand pipe being arranged to receive relatively cold liquid refrigerant from the refrigerant circulating portion of the apparatus and deliver the same to said container to a predetermined level so that the refrigerant vapors are condensed from the uncondensable gases by indirect cooling and so that the refrigerant liquid is partially vaporized and separated as a vapor from its impurities.

8. In a refrigeration apparatus, the combination with a compressor, condenser and evaporator, of a condensing element, means for withdrawing uncondensed refrigerant vapors and gases from said condenser and passing same through said condensing element, a container associated with said condensing element, a stand pipe inside said evaporator adapted to receive liquid refrigerant from said evaporator and deliver said liquid into said container, a vapor pipe connected between the upper portion of said container and a low pressure portion of the refrigeration apparatus, and a restricted opening in said vapor pipe adapted to regulate the vapor pressure in said container.

9. In a refrigeration apparatus, the combination with a compressor, condenser and evaporator, of a condensing element, means for withdrawing uncondensed refrigerant vapors and gases from said condenser and passing same through said condensing element, a container associated with said condensing element, a stand pipe inside said evaporator adapted to receive liquid refrigerant from said evaporator and deliver said liquid into said container, a screen at the top of said stand pipe adapted to prevent splashing of liquid from said stand pipe into said evaporator, and a vapor pipe connecting the upper portion of said container with said evaporator, the liquid refrigerant in said container being adapted to condense the vapors in the condensing element from the uncondensable gases by indirect cooling and being also adapted to be partially vaporized and separated as a vapor from the impurities in said liquid refrigerant.

10. In a refrigeration apparatus, the combination with a compressor, condenser and evaporator, of a condensing element, a conductor between said condensing element and said condenser, a check valve in said conductor, means adapted to cause a partial vacuum in said condensing element so as to open

said check valve and withdraw uncondensed refrigerant vapors and gases from said condenser and through said condensing element, a container associated with said condensing element, and means for introducing relatively cold refrigerant liquid into said container so that the vapors in said condensing element are condensed from the uncondensable gases by indirect cooling and so that the refrigerant liquid is partially vaporized and separated as a vapor from its impurities.

11. In a refrigeration apparatus, the combination with a compressor, condenser and evaporator, of a condensing element, means for withdrawing uncondensed refrigerant vapors and gases from said condenser and passing same through said condensing element, a container associated with said condensing element, an open-topped stand pipe in said evaporator connected with the bottom of said container, an overflow pipe in said evaporator adapted to discharge liquid refrigerant from said evaporator into said stand pipe so that said container fills with said liquid to a level determined by the liquid in said standpipe, said liquid in said container being adapted to condense the vapors from the uncondensable gases in said condensing element and said liquid being also adapted to be partially vaporized and separated as a vapor from its impurities by the heat in the vapors in said condensing element.

12. In a refrigeration apparatus, the combination of a main condenser, an evaporator, a compressor adapted to withdraw vapor from said evaporator and discharge said vapor to said condenser, a cooling coil associated with said condenser for condensation of the refrigerant vapor, a substantially upright passage in said condenser adapted to cause the refrigerant vapor to ascend in a substantially upright column of substantial height past said coil in a direction opposite to the direction of flow of cooling fluid and to permit non-condensable gases to tend to separate from the refrigerant vapor under the influence of gravity, a condensing element arranged to receive the mixture of gas and vapor from the upper part of said passage and condense the refrigerant vapor from said gas, and means for cooling said condensing element by the liquid refrigerant.

13. In a refrigeration apparatus, the combination of a main condenser, an evaporator, a compressor adapted to withdraw vapor from said evaporator and discharge said vapor to said condenser, a plurality of cooling coils associated with said condenser for condensation of the refrigerant vapor, means for causing the mixed vapor and non-condensable gas to ascend in a substantially upright column of substantial height in said condenser and thereby cause the refrigerant vapor to tend to separate under the action of gravity

from the noncondensable gases, a condensing element arranged to receive a mixture of gases and vapor from the upper part of said condenser to which said column ascends and condense the refrigerant vapor from said gas, and means for cooling said condenser element by the liquid refrigerant.

14. In a refrigeration apparatus, the combination with a condenser, compressor and evaporator, of a chamber, means for heating refrigerant liquid in said chamber for partially vaporizing the liquid, a restricted vapor outlet for said chamber, and means for delivering liquid refrigerant to said chamber during the operation of the apparatus and regulating the level of liquid in said chamber in accordance with the difference in pressure of the entering liquid and the vapor pressure in the chamber.

15. In a refrigeration apparatus, the combination with a condenser, compressor and evaporator, of a chamber, means for heating refrigerant liquid in said chamber for partially vaporizing the liquid, a restricted vapor outlet for said chamber, means for delivering liquid refrigerant to said chamber during the operation of the apparatus, having provision for predetermining the pressure head of the entering liquid, and a valve which controls the delivery of the liquid to said chamber and operates under the control of said liquid head and the vapor pressure in said chamber.

16. In a refrigeration apparatus, the combination with a condenser, compressor and evaporator, of a chamber, means for heating refrigerant liquid in said chamber for partially vaporizing the liquid, a restricted vapor outlet for said chamber, a stand pipe open at its upper portion through which liquid refrigerant is delivered from the refrigerant to circulating portion of the apparatus to said chamber, and a valve which controls the liquid passage between the stand pipe and said chamber and operates in accordance with the difference in pressure of the liquid in the stand pipe and the vapor pressure in said chamber.

17. In a refrigeration apparatus, the combination with a compressor, condenser and an evaporator, of a chamber, means for heating refrigerant liquid in said chamber for partially vaporizing the liquid, a stand pipe connected with the bottom of said chamber, and means for supplying liquid refrigerant from the refrigerant circulating portion of the apparatus to said stand pipe so that said chamber fills with the refrigerant liquid to a level determined by the liquid in the stand pipe, and a vapor return passage from said chamber to a low pressure portion of the refrigeration apparatus, whereby the refrigerant liquid is partially vaporized and separated as a vapor from its impurities.

18. In a refrigeration apparatus, the combination with a compressor, condenser and

evaporator, of a chamber, means for heating
refrigerant liquid in said chamber for partially
vaporizing the liquid, a stand pipe connected
with the bottom of said chamber, and
5 a valve between said stand pipe and said
chamber adapted to prevent backflow of liquid
from said chamber to said stand pipe, said
stand pipe being adapted to receive liquid refrigerant
from the refrigerant circulating
10 portion of the apparatus and deliver the same
to said chamber to a predetermined level, and
a vapor return passage from said chamber to
a low pressure portion of the refrigeration apparatus
whereby the refrigerant liquid is partially
15 vaporized and separated as a vapor from
its impurities.

19. In a refrigeration apparatus, the combination
with a compressor, condenser and evaporator,
of a chamber, means for heating
20 refrigerant liquid in said chamber for partially
vaporizing the liquid, an open ended stand pipe
inside of the evaporator adapted to receive liquid
refrigerant from the evaporator and deliver said
liquid into said cham-

ber, a vapor return pipe connecting the upper
25 portion of said chamber with a low pressure
portion of the refrigeration apparatus, and a
restricted opening in said vapor return passage.

20. In a refrigeration apparatus, the combination
with a compressor, condenser and
30 evaporator, of a rectifying chamber, means
for heating refrigerant liquid in said chamber
for rectifying the liquid, a stand pipe inside
of the evaporator connected with the lower
35 portion of said chamber and adapted to receive
liquid refrigerant from the evaporator and deliver
the liquid into said chamber, a valve which controls
the delivery of liquid from said stand pipe to
said chamber and is
40 controlled by the differential pressures of the
head of liquid in the stand pipe and the vapor
pressure in said rectifying chamber, and a vapor
return passage connecting the upper
45 portion of said chamber with said evaporator.

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