Feb. 21, 1967 P. A. WELLER 3,304,741

OIL SEPARATOR ARRANGEMENT FOR A REFRIGERATION SYSTEM

Filed Aug. 31, 1965 2 Sheets-Sheet 1

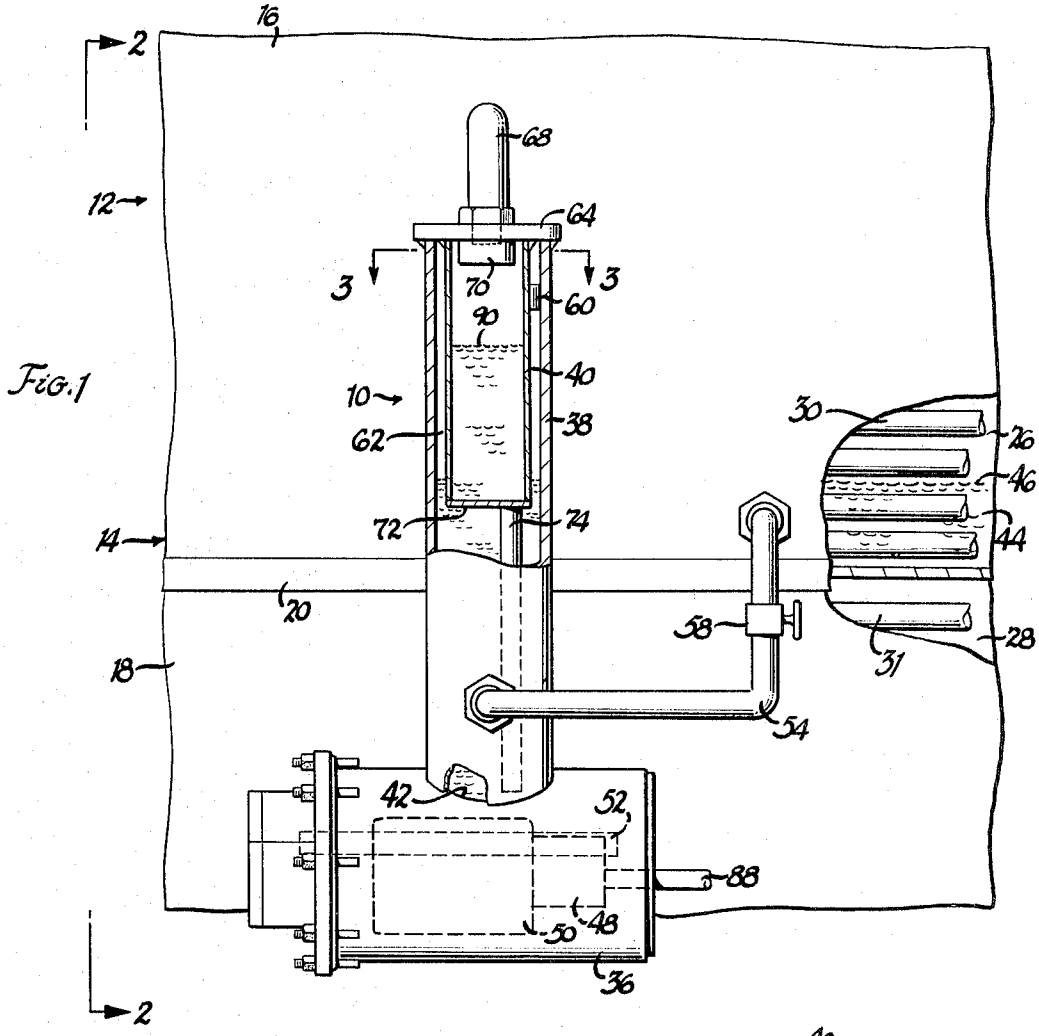


Fig. 1

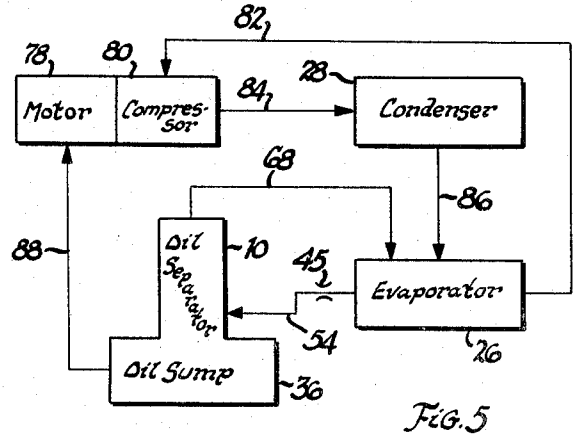


Fig. 5

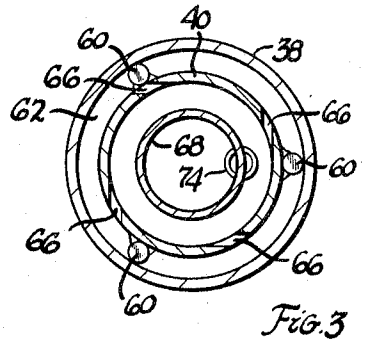


Fig. 3

Inventor:
PETER A. WELLER

By

WILSON, SETTLE, BATCHELDER
ATT'YS. & CRAIG

Feb. 21, 1967 P. A. WELLER 3,304,741

OIL SEPARATOR ARRANGEMENT FOR A REFRIGERATION SYSTEM

Filed Aug. 31, 1965 2 Sheets-Sheet 2

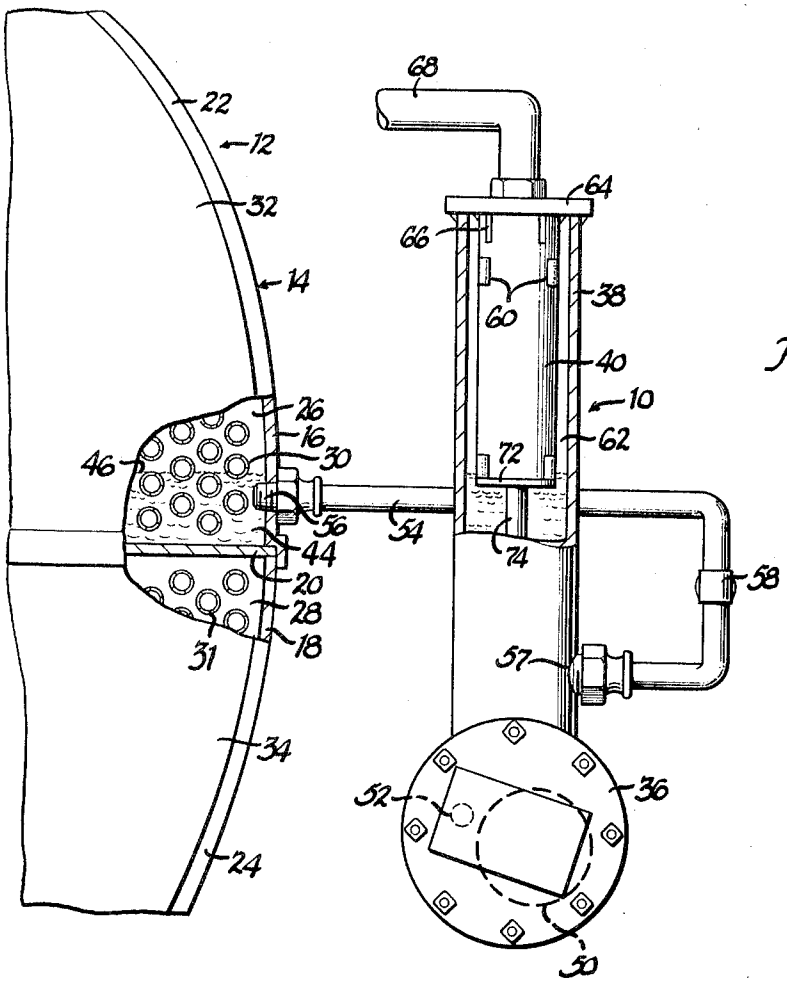


FIG. 2

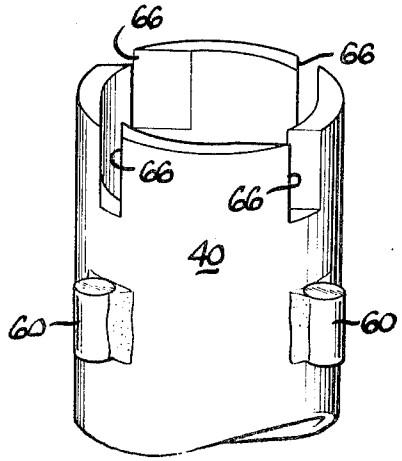


FIG. 4

Inventor.
PETER A. WELLER
By
WILSON, SETTLE, BATCHELDER
ATT'YS. & CRAIG

United States Patent Office 3,304,741 Patented Feb. 21, 1967

3,304,741

OIL SEPARATOR ARRANGEMENT FOR A REFRIGERATION SYSTEM

Peter A. Weller, Farmington, Mich., assignor to American Radiator & Standard Sanitary Corporation, New York, N.Y., a corporation of Delaware

Filed Aug. 31, 1965, Ser. No. 483,948
9 Claims. (Cl. 62—471)

The present invention relates to an oil separator arrangement for a refrigeration system, and more particularly to an oil separator arrangement wherein a predetermined amount of oil is always maintained in the system refrigerant and wherein the separator construction is configured to avoid drawing of oil from that collected in the separator along with refrigerant which is exhausted therefrom.

The oil separator arrangement of the present invention is particularly suited for operation in connection with a refrigeration system employing an evaporator of the semi-flooded type. In the typical evaporator construction, a plurality of elongated tubes extend through an elongated sealed shell. The tubes are spaced apart both vertically and horizontally. Fluid to be cooled circulates through the tubes. Liquid refrigerant is injected into the shell and forms a pool of liquid at the bottom of the shell submerging some of the lowermost tubes. The pressure and temperature conditions within the shell cause the liquid refrigerant to vaporize. Vaporization of the refrigerant causes a boiling or bubbling action in the pool of refrigerant. This action results in splashing of liquid refrigerant from the pool onto tubes above the pool with resultant vaporization of the so splashed refrigerant to cool the fluid passing through the upper tubes.

It has been learned through experience that it is desidable to have a small percentage of oil in the pool of liquid refrigerant. The small percentage of oil markedly improves the splashing action and results in improved wetting of the tubes. The exact mechanism causing this improvement is not definitely known. However, it is known that it is desirable to have the oil in the pool.

The oil in the refrigerant is lubricating oil which becomes intermixed with refrigerant because of leakage from the motor system or from froth which gets by the oil separator. In current practice, the oil is separated from the refrigerant and returned to an oil sump for subsequent use as lubricant.

One method for oil separation which is presently widely used is to constantly drain liquid from the pool of liquid refrigerant in the evaporator and pass this liquid through the oil separator to separate the oil from the refrigerant. The refrigerant is returned to the evaporator and the oil is returned to an oil sump. Constant draining of refrigerant into the separator tends to dilute the oil in the oil sump when the oil content in the refrigerant is low and additionally causes a shortage of oil in the evaporator with consequent reduced efficiency of operation of the evaporator.

The present invention solves this problem by providing an efficient oil separator construction which will maintain a specific amount of oil in the evaporator and which will prevent the dilution of the oil in the oil sump. Additionally, the improved oil separator construction, which operates on the principle of centrifugal separation, is directly connected to the oil sump in a manner to prevent

drawing of oil from the sump into the refrigerant which is exhausted back to the evaporator from the separator.

It is therefore an object of the invention to provide an oil separator arrangement for a refrigeration system.

Another object of the invention is to provide an oil separator arrangement for operation in connection with a refrigerant evaporator of the flooded type wherein a specified amount of lubricating oil is maintained in the evaporator as a film on the pool of refrigerant within the evaporator.

A further object of the invention is to provide an oil separator construction of the centrifugal type which is directly attachable to the oil sump in a position thereabove for direct draining of oil from the separator into the sump without the danger of drawing oil from the sump and again mixing it with the refrigerant exhausted from the separator.

Another object of the invention is to arrange the oil separator for direct draining of liquid thereinto from the refrigerant evaporator, the oil separator being so arranged with respect to the liquid head in the evaporator to prevent draining of liquid from the evaporator when it is undesired to have further separation of system refrigerant and oil.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a side elevational view with portions broken away for the purpose of clarity of an oil separator construction connected to a refrigerant evaporator forming one embodiment of the present invention;

FIGURE 2 is an end elevational view of the construction shown in FIGURE 1 with parts broken away with the purpose of clarity;

FIGURE 3 is a sectional view of the separator taken substantially along the line 3—3 of FIGURE 1;

FIGURE 4 is a perspective view of the upper portion of the inner tube assembly of the separator of FIGURE 1; and

FIGURE 5 is a diagrammatic views of a refrigeration system incorporating the structure of the present invention.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseolgy or terminology employed herein is for the purpose of description and not of limitation.

Referring to FIGURES 1 and 2, it will be noted that an oil separator **10** is located closely adjacent to a unitary refrigeration evaporator-condenser structure **12**. The evaporator-condenser structure includes a fluid-tight shell **14** which comprises an upper elongated portion **16** which is substantially elliptical in cross section and a lower elongated shell portion **18** which is also substantially elliptical in cross section. The portions **16**, **18** are separated by a horizontally disposed flat wall **20**. The ends of the shell **14** are provided with end covers **22**, **24** to completely seal the interior of the shell to form an upper evaporator compartment **26** and a lower condenser compartment **28**.

A plurality of water tubes **30** extend horizontally through the evaporator compartment **26**. The tubes **30** are separated vertically and horizontally. Similar tubes **31** are provided in the condenser compartment **28**. Water boxes **32**, **34** are provided at the ends of the shell **14**. Each water box serves its respective compartment and acts to provide liquid communication between adjacent groups of tubes, referred to as "tube bundles" to permit the fluid in the tubes to circulate several times through the compartments, first in one direction and then in the other direction, for maximum exposure to the environment within the compartments.

The oil separator **10** is mounted directly atop a cylindrical oil sump **36**. The oil separator has an outer vertically directed tube **38** and an inner vertically directed tube **40**. The lower end of the outer tube **38** is open and is directly secured to the oil sump **36** over an opening **42** in the oil sump to provide open communications between the tube **38** and interior of the sump.

It will be noted that a pool of liquid refrigerant **44** exists within the evaporator compartment **26**. The level **46** of the pool of refrigerant is sufficient to cover the lowermost of the tubes **30** in the evaporator compartment. In operation, liquid refrigerant is delivered from the condenser compartment and injected into the evaporator compartment at a point beneath the level **46** of the pool of refrigerant **44**. The incoming refrigerant, which comes from a relatively high pressure source, is subjected to reduced pressures within the evaporator compartment and a portion thereof immediately flashes into vapor causing gas bubbles to occur in the refrigerant pool **44**. As these bubbles rise and pass through the surface of the pool, they cause splashing of liquid refrigerant from the pool onto the uppermost tubes **30** and result in wetting of all the tubes within the evaporator compartment. A small percentage of oil is normally maintained on the pool of refrigerant **44** and, as previously discussed, this oil results in improved wetting of the tubes **30**.

It will be noted that the oil sump **36** is located well beneath the pool of refrigerant **44**. However, the outer tube **38** forming part of the separator extends upwardly to a point well above the level **46** of the pool of liquid refrigerant within the evaporator compartment **26**. This arrangement provides a liquid head relationship between the separator **10** and refrigerant pool **44** which, as will be hereinafter discussed, results in the desired control of the amount of oil within the evaporator compartment.

An immersion pump **48** and motor **50** are positioned within the oil sump **36**. The pump **48** serves to pump lubricating oil through a conduit **88** from the sump **36** and deliver it to the compressor motor for lubrication thereof as required. An electrical immersion heater **52** is also located within the sump **36**. The heater **52** serves to elevate the temperature of the oil within the sump to drive off refrigerant contained therein to thus maintain a low concentration of refrigerant in the oil within the sump and assist in separation of the oil and refrigerant.

A conduit **54** leads from the evaporator compartment **26** to the outer tube **38** of the separator **10**. The inlet **56** of the conduit **54** draws liquid refrigerant with oil intermixed therein from the pool of refrigerant **44**. The outlet **57** of the conduit **54** into the tube **38** is located well beneath the inlet **56** so as to permit gravity drain from the evaporator into the oil separator.

A valve **58** is provided in the conduit **54**. The valve **58** is closed during start-up of the refrigeration system to prevent back flow of oil from tube **38** into evaporator **26** through conduit **54** when the pressure in tube **38** is sufficiently higher than the pressure in evaporator **26** as can occur during startup. An orifice **45** is provided in conduit **54** to meter the flow of refrigerant and is located in the lower portion of conduit **54** to maintain a liquid head at the orifice and prevent flashing of the refrigerant and subsequent vapor locking to the orifice which will prevent normal flow.

The inner tube **40** of the separator is positioned concentrically within the outlet tube **38**. A plurality of cylindrical positioning elements **60** are welded to the exterior of the inner tube **40** for exact positioning of this tube. An annular passage **62** is thus defined between the inner and outer tubes **38**, **40**. The upper end of the tube **40** is secured to a circular plate **64** as by welding. The plate **64** has a diameter larger than the diameter of the outer tube **38** and thus also closes the top of the tube **38**. The plate **64** is secured to the upper end of the tube **38** as by welding to result in a fluid-tight connection.

A plurality of slots **66** are provided in the upper end of the inner tube **40** to provide fluid communication with the tube **38**. As will be noted, the slots **66** are not directed radially outwardly from the center of the separator **10**, but extend at a substantially tangential angle with respect to the inner surface of the inner tube **40**. This arrangement causes a centrifugal action of vaporized refrigerant resulting in separation of entrained oil from the refrigerant as will be discussed hereinafter.

A conduit **68** extends from the center of the plate **64** to the evaporator of the refrigeration system. The inlet **70** of the conduit is provided in the upper portion of the inner tube **40** to receive vaporized refrigerant and exhaust it to the evaporator.

The lower end of the tube **40** is sealed by a cover plate **72** which is secured thereto as by welding. A conduit **74** extends through the plate **72** downwardly through the outer tube **38** and terminates within the sump **36**.

Before describing the operation of the oil separator **10**, attention is directed to FIGURE 5 which diagrammatically illustrates the refrigeration system in which the components of the present invention are incorporated. The system includes an electric motor **78** which drives a centrifugal compressor **80**. The compressor **80** draws vaporized refrigerant from the evaporator compartment **26** via line **82**. The vaporized refrigerant is compressed within the compressor **80**. The hot compressed gas is then fed from the compressor into the condenser compartment **28** via line **84**. The refrigerant gas condenses into a liquid in the condenser **28** and is then discharged via line **86** to the evaporator **26** where it is again vaporized to result in the cooling action. The refrigeration cycle is then repeated.

As previously discussed, liquid refrigerant having oil intermixed therein flows from the evaporator compartment into the oil separator via line **54**. This liquid is separated into vaporized refrigerant which is drawn from the oil separator via line **68** and liquid oil which flows from the oil separator into the oil sump via the line **74**.

Oil is pumped from the oil sump via the line **88**. The amount of oil which is supplied to the motor-compressor is regulated in a known manner (not shown).

The volume of lubricating oil necessary in a given refrigeration system depends entirely on the capacity of the system and the type of equipment being used. However, for any given system, the total amount of oil necessary is predetermined. The amount of oil present at any given time in the motor-compressor unit for lubricating purposes is a predetermined fact. The amount of oil present in the sump and associated portion of the separator is also a predetermined fact. Therefore, it is only necessary to subtract the amount of oil in the sump and the amount of oil in the motor-compressor from the total amount of oil in the system to determine the amount of oil intermixed with the system refrigerant. The amount of oil in the evaporator may then be determined by prorating the amount of refrigerant within the evaporator as against the amount of refrigerant within the system as a whole. Thus, the amount of oil within the evaporator may be controlled by preventing further separation of oil and refrigerant when the volume of oil present within the sump combined with the volume of oil present within the motor compressor equals a predetermined volume. This is the manner in which the amount of oil within

the evaporator is controlled in accordance with the present invention.

Referring again to FIGURES 1–4, it will be appreciated that with the valve 58 open, liquid flows from the evaporator 26 into the outer tube 38. The pressure within the separator 10 is equalized or vented to evaporator 26 pressure by conduit 68. The temperature of the liquid within the separator is elevated by virtue of the heater 52. As a consequence of elevated temperature, refrigerant within the separator is rapidly vaporized. The oil contained within the liquid refrigerant does not vaporize and tends to settle into the sump 36. At the time of rapid pressure drop in the evaporator 26 such as at startup, a high suction is applied through conduit 68 to inner tube 40 thence through slots 66 to tube 38. This causes rapid lowering of pressure in tube 38 which causes violent flashing of the refrigerant in the oil in tube 38 and oil sump 36 and results in severe foaming of the oil. The refrigerant vapor and entrained oil foam enter the inner tube 40 via the slots 66. The angular direction of the slots results in a whirling vortex in the upper portion of the inner tube 40. This whirling action causes the entrained oil foam to impinge against the inner periphery of the inner tube 40 congealed into liquid droplets which eventually drip downwardly into the oil sump 36. The vaporized refrigerant, which does not condense on the tube 40, is drawn through the inlet 70 of the conduit 68 and thence to the evaporator. Thus loss of oil to evaporator 26 from tube 38 through conduit 68 is prevented.

As refrigerant and oil mixture flows from evaporator 26 to tube 38 through conduit 54, the refrigerant is vaporized and returns through conduit 68 to evaporator 26 and the oil remains in tube 38 and oil sump 26 thereby increasing the quantity of oil in tube 38 and raising the oil level. When the level of liquid within the outer tube 38 reaches the level 46 of the liquid within the evaporator 26, liquid will cease flowing from the evaporator into the separator because the liquid heads in each unit are equal. The separator and sump are positioned with respect to the evaporator so that when the liquid head within the separator is equal to the head within the evaporator, the volume of liquid within the separator and sump combined, along with that in the motor-compressor still results in sufficient oil to be present as a film on the liquid pool within the evaporator to result in efficient tube wetting within the evaporator.

The separator construction also incorporated another feature which prevents drawing of oil therefrom into the conduit 68 for undesired return to the evaporator. Under the starting conditions previously described, due to the large volume of refrigerant vapor released from the oil with rapidly lowering pressure, there will be a high vapor velocity through slots 66 resulting in an appreciably lower pressure in tube 40 than in tube 38 and in oil sump 36. As a result, liquid is drawn upwardly in the tube 40 above the level of the liquid in the tube 38 as indicated by the level 90. The capacity of the tube 40 and the relative vertical positionment of this tube are set so that the maximum level to which liquid can be drawn as the result of the possible reduction in pressure caused as aforesaid is still well beneath the inlet 70 to thus prevent liquid oil from ever being drawn into the conduit 68.

Having thus described my invention, I claim:

1. An oil separator arrangement for a refrigeration system, said system including an evaporator of the flooded type having a pool of liquid refrigerant therein, said pool of refrigerant normally having an amount of oil intermixed therein, said evaporator having heat exchange tubes located above and below the level of said pool therein, comprising an oil separator, said separator having a compartment for receiving liquid from said pool for subsequent separation of the oil from the refrigerant, a portion of said compartment being positioned above the level of the pool and a portion of said compartment being positioned below the level of the pool, said compartment having a construction such that the volume of the portion of said compartment beneath the level of said pool is predetermined with respect to the total amount of oil in the refrigeration system to always maintain the desired volume of oil in the evaporator, means connecting said compartment to the evaporator for gravity flow of liquid from the pool into the compartment whereby flow will cease when the level of liquid in the compartment equals the level of the pool in the evaporator, means adjacent the upper end of the compartment for centrifugally separating oil from refrigerant, an oil sump, means connecting said compartment to the oil sump for gravity flow of oil from the compartment to the sump, and exhaust means at the upper end of the compartment for flow of gaseous refrigerant from the compartment, said connecting means operating to intermittently drain oil from said pool to said compartment while maintaining a desired volume of oil in said pool.

2. An oil separator arrangement for a refrigeration system, said system including an evaporator of the flooded type having a pool of liquid refrigerant therein, said pool of refrigerant normally having an amount of oil intermixed therein, said evaporator having heat exchange tubes located above and below the level of said pool therein, comprising an oil separator, said separator having a compartment for receiving liquid from said pool for subsequent separation of the oil from the refrigerant, a portion of said compartment being positioned above the level of the pool and a portion of said compartment being positioned below the level of the pool, said compartment having a construction such that the volume of the portion of said compartment beneath the level of said pool is predetermined with respect to the total amount of oil in the refrigeration system to always maintain the desired volume of oil in the evaporator, means connecting said compartment to the evaporator for gravity flow of liquid from the pool into the compartment whereby flow will cease when the level of liquid in the compartment equals the level of the pool in the evaporator, means adjacent the upper end of the compartment for centrifugally separating oil from refrigerant, an oil sump, means connecting said compartment to the oil sump for gravity flow of oil from the compartment to the sump, heating means for raising the temperature of the liquid in the sump and in the compartment for vaporizing liquid refrigerant within the sump and compartment, and exhaust means at the upper end of the compartment for flow of gaseous refrigerant from the compartment.

3. The oil separator arrangement as defined in claim 2 and further characterized in that said heating means comprises a heating element positioned within the oil sump.

4. The oil separator arrangement of claim 2 and further characterized in the provision of a pressure source of lower pressure than the pressure in said compartment, said exhaust means being connected to discharge to said pressure source to thereby reduce the pressure within the compartment and cause vaporization of refrigerant therein.

5. An oil separator arrangement for a refrigeration system, said system including an evaporator of the flooded type operative with a pool of liquid refrigerant therein, said pool of refrigerant normally having an amount of oil intermixed therein, comprising an oil separator, said separator having an outer casing forming a first compartment for receiving liquid from said pool for subsequent separation of the oil from the refrigerant, an inner casing positioned within the outer casing forming a second compartment, a portion of said first compartment being positioned above the level of the pool and a portion of said first compartment being positioned below the level of the pool, means connecting said first compartment to the evaporator for gravity flow of liquid from the pool into the first compartment whereby flow will cease when the level of liquid in the first compartment equals the

level of the pool in the evaporator, opening means in said inner casing above the level of the pool for flow of gaseous refrigerant having oil entrained therein from the first compartment into the second compartment, said opening means being configured to direct the gaseous refrigerant with oil entrained therein in a whirling pattern within the second compartment for depositing of oil on the inner surface of the walls of the inner casing, an oil sump, means connecting said second compartment to the oil sump for gravity flow of oil from the second compartment to the sump, and exhaust means at the upper end of the second compartment for flow of gaseous refrigerant from the second compartment.

6. An oil separator arrangement for a refrigeration system, said system including an evaporator of the flooded type operative with a pool of liquid refrigerant therein, said pool of refrigerant normally having an amount of oil intermixed therein, comprising an oil separator, said separator having an outer casing forming a first compartment for receiving liquid from said pool for subsequent separation of the oil from the refrigerant, an inner casing positioned within the outer casing forming a second compartment, a portion of said first compartment being positioned above the level of the pool and a portion of said first compartment being positioned below the level of the pool, means connecting said first compartment to the evaporator for gravity flow of liquid from the pool into the first compartment whereby flow will cease when the level of liquid in the first compartment equals the level of the pool in the evaporator, opening means in said inner casing above the level of the pool for flow of gaseous refrigerant having oil entrained therein from the first compartment into the second compartment, said opening means being configured to direct the gaseous refrigerant with oil entrained therein in a whirling pattern within the second compartment for depositing of oil on the inner surface of the walls of the inner casing, an oil sump, said oil sump being directly connected to the lower end of the outer casing whereby oil contained within the outer casing will settle into the sump, means connecting said second compartment to the oil sump for gravity flow of oil from the second compartment to the sump, and exhaust means at the upper end of the second compartment for flow of gaseous refrigerant from the second compartment.

7. An oil separator arrangement for a refrigeration system, said system including an evaporator of the flooded type operative with a pool of liquid refrigerant therein, said pool of refrigerant normally having an amount of oil intermixed therein, comprising an oil separator, said separator having an outer casing forming a first compartment for receiving liquid from said pool for subsequent separation of the oil from the refrigerant, an inner casing positioned within the outer casing forming a second compartment, a portion of said first compartment being positioned above the level of the pool and a portion of said first compartment being positioned below the level of the pool, means connecting said first compartment to the evaporator for gravity flow of liquid from the pool into the first compartment whereby flow will cease when the level of liquid in the first compartment equals the level of the pool in the evaporator, opening means in said inner casing above the level of the pool for flow of gaseous refrigerant having oil entrained therein from the first compartment into the second compartment, said opening means being configured to direct the gaseous refrigerant with oil entrained therein in a whirling pattern within the second compartment for depositing of oil on the inner surface of the walls of the inner casing, an oil sump, means connecting said second compartment to the oil sump for gravity flow of oil from the second compartment to the sump, exhaust means at the upper end of the second compartment for flow of gaseous refrigerant from the second compartment, a pressure source of lower pressure than the pressure in said second compartment, said exhaust means being connected to discharge to said pressure source to thereby reduce the pressure within the first and second compartments and cause vaporization of refrigerant therein, said second compartment being positioned a sufficient distance above the oil sump to prevent drawing of oil into the exhaust means.

8. In a refrigerant system including a compressor, condenser and evaporator, said refrigeration system having an associated oil lubricating system, said lubricating system having a fixed volume of oil, portions of said oil entering said refrigeration system as the result of the lubricating process, said evaporator being of the flooded type operative with a pool of liquid refrigerant therein, said pool of refrigerant desirably having an amount of oil intermixed therein, an oil separator arrangement for separating oil from the refrigerant while still retaining the desired amount of oil in said pool, said oil separator comprising a compartment for receiving liquid from said pool for subsequent separation of the oil from the refrigerant, a portion of said compartment being positioned above the level of the pool and a portion of said compartment being positioned below the level of the pool, means connecting said compartment to the evaporator for gravity flow of liquid from the pool into the compartment whereby flow will cease when the level of liquid in the compartment equals the level of the pool in the evaporator, the volume of the portion of said compartment beneath the level of said pool being predetermined with respect to the total volume of oil in the lubricating system to always maintain the desired volume of oil in the evaporator.

9. In a refrigeration system including a compressor, condenser and evaporator, said refrigeration system having an associated oil lubricating system, said lubricating system having a fixed volume of oil, portions of said oil entering said refrigeration system as the result of the lubricating process, said evaporator being of the flooded type operative with a pool of liquid refrigerant therein, said pool of refrigerant desirably having an amount of oil intermixed therein, an oil separator arrangement for separating oil from the refrigerant while still retaining the desired amount of oil in said pool, said oil separator comprising an outer casing forming a first compartment for receiving liquid from said pool for subsequent separation of the oil from the refrigerant, an inner casing positioned within the outer casing forming a second compartment, a portion of said first compartment being positioned above the level of the pool and a portion of said first compartment being positioned below the level of the pool, means connecting said first compartment to the evaporator for gravity flow of liquid from the pool into the first compartment whereby flow will cease when the level of liquid in the first compartment equals the level of the pool in the evaporator, opening means in said inner casing above the level of the pool for flow of gaseous refrigerant having oil entrained therein from the first compartment into the second compartment, said opening means being configured to direct the gaseous refrigerant with oil entrained therein in a whirling pattern within the second compartment for depositing of oil on the inner surface of the walls of the inner casing, an oil sump, means connecting said second compartment to the oil sump for gravity flow of oil from the second compartment to the sump, the volume of the portion of said first compartment beneath the level of said pool and the volume of said oil sump being predetermined with respect to the total volume of oil in the lubricating system to always maintain the desired volume of oil in the evaporator, and exhaust means at the upper end of the second compartment for flow of gaseous refrigerant from the second compartment.

(References on following page)

9

References Cited by the Examiner

UNITED STATES PATENTS

2,813,404	11/1957	Hirsch	62—471
2,892,320	6/1959	Quick	62—471 X
2,900,801	8/1959	Honegger	62—473 X

10

FOREIGN PATENTS

622,043	4/1949	Great Britain.

MEYER PERLIN, *Primary Examiner.*
ROBERT A. O'LEARY, *Examiner.*
W. E. WAYNER, *Assistant Examiner.*