Oct. 19, 1954 J. L. AMMONS 2,692,027

OIL SEPARATOR FOR REFRIGERATION SYSTEMS

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Fig. 1

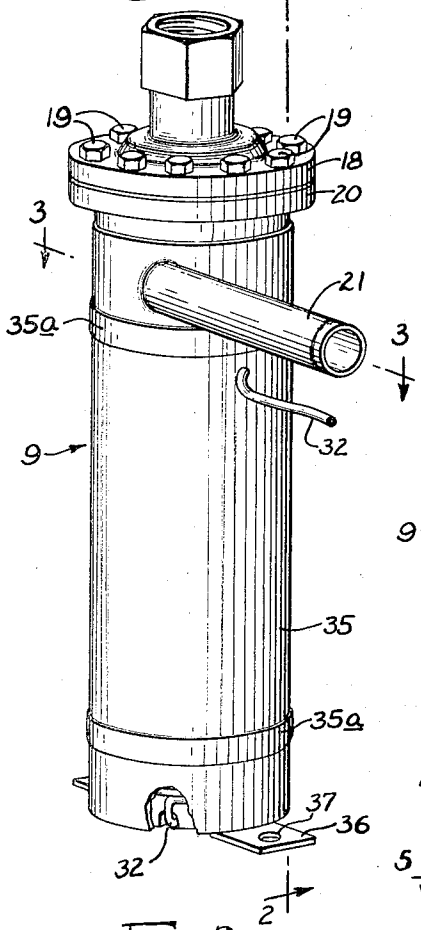


Fig. 2

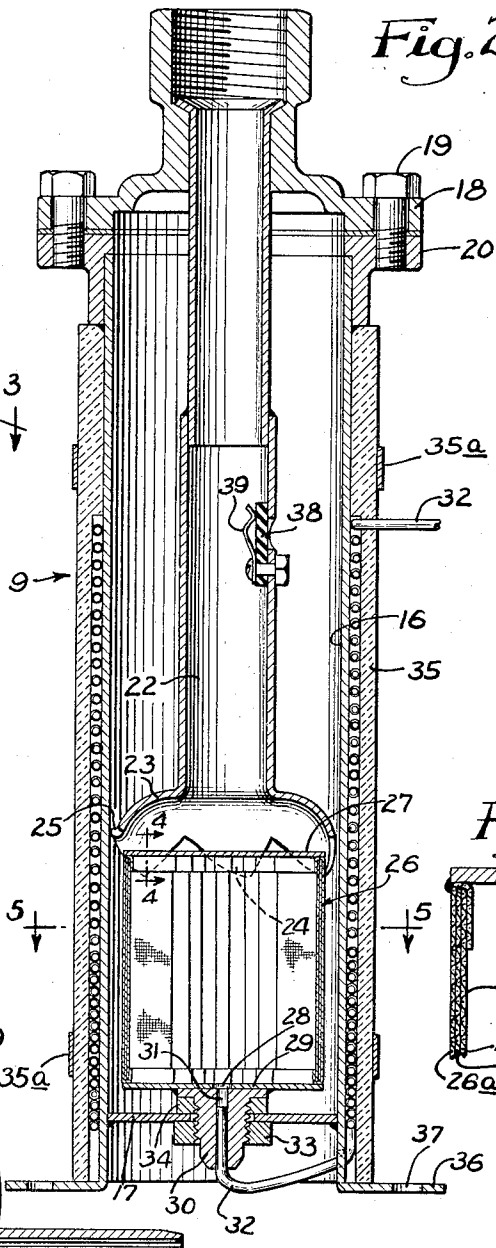


Fig. 3

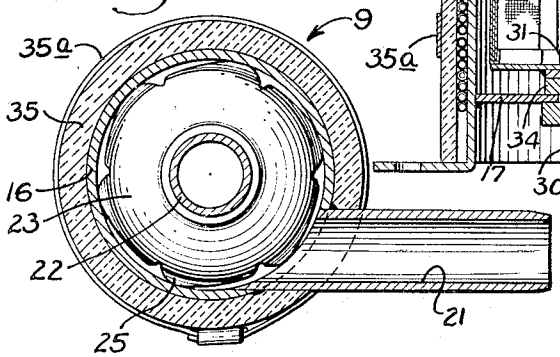
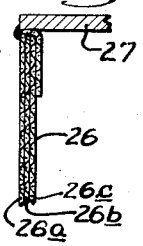


Fig. 4



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Fig. 5

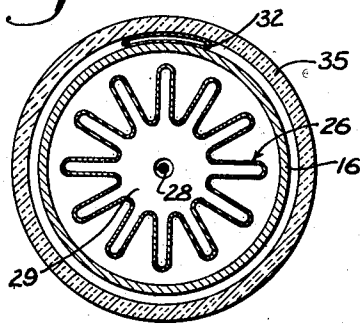


Fig. 6

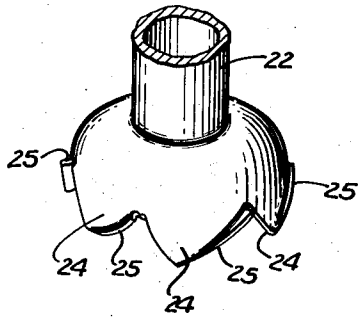
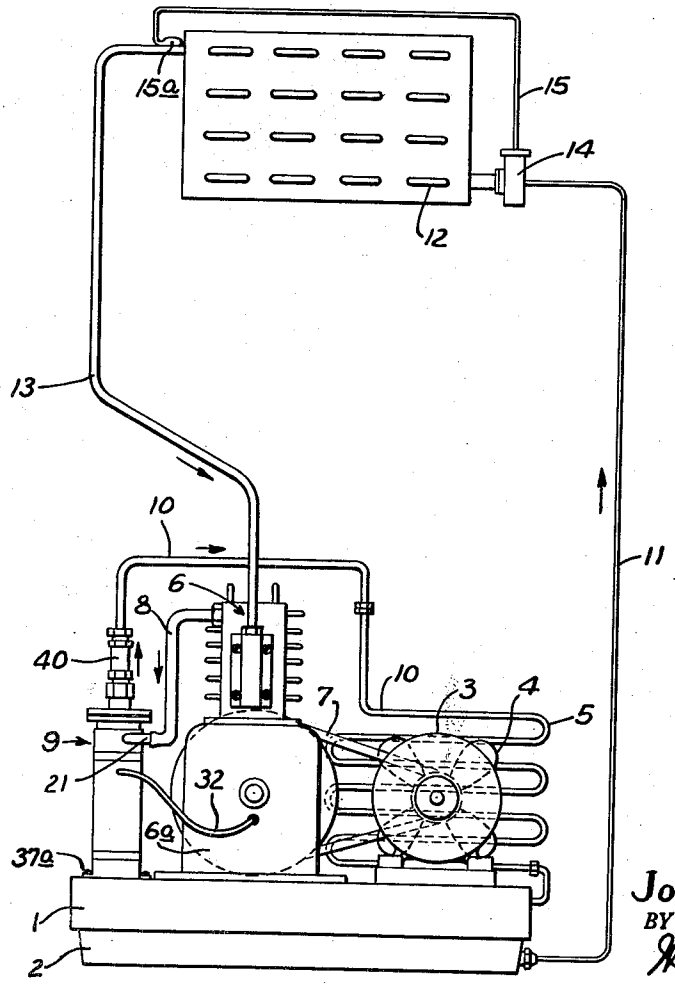


Fig. 7



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OIL SEPARATOR FOR REFRIGERATION SYSTEMS

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Application September 10, 1951, Serial No. 245,954

5 Claims. (Cl. 183—66)

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This invention relates to improvements in oil separators and more particularly to oil separators to separate oil from a refrigerant fluid while the refrigerant system is being operated. The refrigerants are of the dichlorodifloromethane refrigerants or refrigerants of kindred nature suitable for the purpose.

In the operation of mechanical refrigeration units oils that are used to lubricate the compressor often find their way into the refrigerant system and, since the refrigerant fluid is miscible with oil, it is very difficult to extract the oil from the refrigerant, so as to give the refrigerant a high efficiency and also salvage the oil for re-use.

When the concentration of oil within the refrigerant system exceeds 1%, the boiling point of the refrigerant is materially effected, causing a drop in the efficiency of the refrigerant unit. It is therefore the purpose of the present invention to remove the oil that gets into the refrigerant fluid and direct it back to the mechanism for reuse as a lubricant.

Various separators have been proposed heretofore, but these for the most part were complex in construction, uncertain in operation and lacked dependability.

An object of this invention is to provide an oil separator for the separation of oil from refrigerant fluid that has a certain affinity for oil and is miscible therewith.

Another object of the invention is to provide an apparatus for the separation of oil from the refrigerant and return the oil to the crank case for re-use as a lubricant.

Another object of this invention is to provide an oil separator for refrigerant systems that is continuous in action and that requires little or no attention, but which separates the oil from the refrigerant and returns it to the crank case of the mechanism for re-use in a continuous manner.

Still another object of this invention is to provide an oil and gas separator for refrigeration systems that does not require an auxiliary power driven means for separating the oil from the refrigerant fluid.

A still further object of the invention is to provide an oil separator for refrigerant fluid that is simple in construction, effective in operation, inexpensive and easy to install.

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An embodiment of this invention, in which like parts are designated by like reference characters in the several views, is illustrated in the accompanying drawings, in which:

Fig. 1 is a perspective view of the oil separator for refrigeration fluid, shown removed from the unit and with parts broken away and shown in section to bring out the details of construction;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1, looking in the direction indicated by the arrows;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1, looking in the direction indicated by the arrows;

Fig. 4 is an enlarged fragmentary sectional view taken on the line 4—4 of Fig. 2, looking in the direction indicated by the arrows;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 2, looking in the direction indicated by the arrows;

Fig. 6 is a fragmentary perspective view of the lower end of an inner tubular member; and

Fig. 7 is a side elevational view showing the invention installed with a refrigeration unit.

With more detailed reference to the drawing, the numeral 1 designates a base of a refrigeration unit which contains a receiver tank 2. The motor 3 provides power means for the operation of the mechanism of the refrigeration system and has a fan 4 thereon, which is driven by the motor 3 for cooling the condenser coil 5 of the refrigeration apparatus.

A compressor 6 is operated through belt drive 7 by motor 3 to compress the refrigerant gas and force it out at high velocity through pipe 8 leading into an oil separator, which oil separator is generally designated by the numeral 9. The gas then flows out through outlet pipe 10 into condenser coil 5 where it is cooled and condensed into receiver tank 2. A pipe 11 leads from the bottom of receiver tank 2 to an evaporator 12 to furnish proper refrigeration. A pipe 13 connects the inlet side of the compressor with the evaporator coil 12 for creating a suction on the refrigerant to draw it through expansion valve 14, the tube 15 leads from thermo-control bulb 15a to the expansion valve 14 for the actuation thereof.

The oil and gas separator 9 comprises a casing 16 which has a bottom 17 for closing the lower end thereof. A flanged top 18 is provided for

closing the upper end of the casing 16. The casing 16 has a tangential inlet 21 near the upper end thereof and an axial outlet passage 22 which has a belled-out portion 23 on the lower end, which belled portion is fluted at 24, as will best be seen in Fig. 6. In conformity with the currents created by the inlet 21, the flutes 24 have upturned edges 25 that slope downwardly to convey any precipitation that may assemble on axial tube 22 downwardly into a screen 26. The screen 26 is preferably formed in a fluted design with an imperforate head 27 at the upper end and a single perforation forming an outlet 28 in the lower end 29. A threaded spud 30, is soldered or otherwise secured to the bottom 29 so a hole 31 therein will be in register with the outlet perforation 28 formed in the bottom portion of the screen member 26. A capillary tube 32 is fitted within hole 31 and sweated or otherwise secured therein so as to insure a fluid tight joint. A nut 33 is screw threaded into threaded spud 30 so as to securely anchor the screen member 26 in place.

A gasket 34 insures a tight seal between the bottom portion 17 and the spud 30.

A capillary tube 32 leads outward and is coiled around casing 16 throughout the greater portion of the length of the casing and then extends outward to enter the crank case 6a of the compressor 6 at a point above the normal oil level in the compressor crank case. An insulation member 35 covers the coil of capillary tubing 32 so as to maintain the coil at substantially the same temperature as the refrigerant fluid therein. The insulation member 35 is held in place by bands 35a passing therearound.

The oil separator may be of sufficient size to pass the required amount of oil for the compressor for which it designed, and preferably has outstanding base lug members 36 that have holes 37 formed therein to enable screw bolts 37a to pass through for bolting the separator to the base 1.

The size of the openings within the capillary tube 32, the length of the tube, and the temperature at which the capillary tube is maintained will determine the amount of oil that will pass therethrough from the separator to the crank case of the compressor. Upon determining the amount of oil to be passed, a tube having the correct internal diameter and the proper length is selected to perform the function of discharging the oil from the separator to the crank case.

The screen generally designated at 26 is preferably formed of fluted construction, as will best be seen in Fig. 5, which construction gives a relatively large exposed screen area compared to the size of the screen member. The top member 27 is soldered or otherwise secured around the fluted portion of the screen, as is the bottom portion, so as to insure the oil passing into the interior of the screen member 26 will pass through the screens for removing all foreign matter therefrom.

The screen member 26 is made up of an outer screen 26a, the center screen 26b and an interior screen 26c, each of which has a progressively more closely woven mesh, with the screen 26a overlapping the top and bottom ends of the screen 26b and 26c, as will best be seen in Figs. 2 and 4. The screen members 26a and 26b and 26c of ninety, one hundred twenty and two hundred mesh, respectively, which screens, when arranged in the manner described form a capillary action, as well as a progressive filtering action and the screen further serves to give a stabilizing effect on the oil in the capillary tube 32 following to the crank case 6a.

The screen member 26 is centered and is held in rigid relation in the lower portion of the oil separator compartment by means of threaded spud 30 which is screwed in place by nut 33. The upper end of the screen telescopes up into the flutes 24 of the lower end of the axial outlet tube 23. The openings intermediate the flutes and the oil separator screen are sufficiently large to permit the escape of refrigerant gas upward through the axial tubing 22 so long as the oil level in the casing 16 is below the lower edge of the flutes. However, as the oil level builds up to close the openings an increased pressure is placed upon the surface of the oil within the casing 16, which in turn increases the pressure passing out through capillary size tube 32 to crank case 6a which pressure decreases as the level of the oil becomes lowered below the openings formed between the flutes 24. If the oil level should increase momentarily, the increased pressure within chamber 16 will cause the opening of a resiliently pressed valve member 38, that is held closed by a spring 39. This outlet valve 39 is preferably made of a rubber-like material, such as synthetic rubber and the like. As the gas discharged from tube 21, under a velocity that often attains a speed of 800 to 1200 feet per minute, the centrifugal force will cause the heavier particles of liquid to be thrown against the walls of the cylindrical casing 16, and as the gas and oil spirals downward toward the openings formed between the flutes 24, the oil will be thrown out of the refrigerant gas and will collect on the wall of the cylindrical casing 16 and the exterior walls of the axial outlet tube 22 to be drained into the lower compartment of the casing 16 and ultimately discharged therefrom. The refrigerant gas will pass upward through axial outlet pipe 22 and through a check valve 40 positioned at the upper end of oil separator 9. Thence the gas will pass downward through condenser coil 10 as herein before described.

Operation

In the operation of refrigeration systems wherein the refrigerant, such as dichlorodifloromethane, or other refrigerant having similar characteristics, having the suction side of the compressor in common with the crank case of the compressor, an excess of oil often finds its way upward between the pistons and discharges into an outlet line of the system. With an oil separator 9 installed adjacent the outlet side of the compressor and connected thereto by means of pipe 8, which pipe 8 interconnects with pipe 21 that enters the oil chamber 16 at a tangent, as indicated in Figs. 1 and 3, will cause a spinning action of the gases and the oil mixed therewith so as to whirl the oil outwardly and downwardly to collect in the lower portion of the cylindrical casing 16, and since there is a constant pressure on the oil in this chamber, by the action of the compressor, while the compressor is running and by the pressure maintained by the check valve 40, after the compressor has stopped, the oil that passes through screen 26a by capillary attraction, to the interior of the screen member 26 and discharges, under pressure, through orifice 28 and opening 21 into capillary tubing 32 which has an aperture therein of a guaged size, to pass a certain quantity of fluid in accordance with a given length of the capillary tube, therefore with the capillary tube coiled around casing 16, the oil

within the capillary tube is maintained at substantially the same temperature as the gases passed outward through the casing 16 and outlet tube 22. Therefore, all oil that settles into the lower portion of chamber 16 will be returned to the crank case of the compressor of the refrigeration system by means of the capillary tubing 32, as will best be seen in Fig. 7, and since there is a suction on the end of the capillary tube within the crank case and a pressure on the opposite end thereof, the oil will continuously flow therethrough as long as the device is in operation and as long thereafter as pressure is maintained in the chamber 16 by check valve 40, or, until the oil is exhausted from the lower compartment of the oil separator 8. It is to be understood that this operation is continuous and requires no attention, once the tubing has been calibrated to pass the required amount of oil.

While the invention has been described and illustrated in some detail in the preferred embodiment thereof, it is to be understood that changes may be made in the minor details of construction, and adaptations made to various installations without departing from the spirit of the invention as set forth in the appended claims.

Having thus described the invention what is claimed is:

1. In an oil separator for separating oil from refrigerant gases in a refrigerant system having a compressor with a crank case, said oil separator comprising an upright cylindrical casing forming a chamber, a conduit forming a tangential inlet into said casing near the upper end thereof, an axial tube positioned within said casing and extending to a point a spaced distance above the bottom thereof and forming an outlet from said casing for the passing of refrigerant gases therefrom, a belled member having its greatest outer diametrical dimension substantially the same as the inner diameter of said casing, flutes on the lower side of said belled member and having peripheral openings formed therebetween, which belled member is mounted on the lower end of said axial outlet tube, and a screen member forming substantially a closed chamber located intermediate said belled member and the bottom of said casing which screen member has a capillary tubing connected to the bottom thereof and to the crank case of said compressor so said capillary tubing will pass oil from said oil separator to the crank case of said compressor.

2. In an oil separator for separating oil from refrigerant gases in a refrigerant system having a compressor with a crank case, said oil separator comprising an upright cylindrical casing forming a chamber, a conduit forming a tangential inlet into said casing near the upper end thereof, an axial tube positioned within said casing and extending to a point a spaced distance above the bottom thereof and forming an outlet from said casing for passing refrigerant gas therefrom, a belled member having flutes formed on the lower side thereof and in capillary transfer relation to the inner wall of said cylinder, said flutes each having an up-turned flange along one side thereof so as to present a substantially arcuate, downwardly sloping groove on each for directing oil downwardly therealong onto the inner bore of said casing, said belled member being formed on the lower end of said axial outlet tube, a closed screen member located intermediate said belled member and the bottom of said casing in such manner as to present an outlet for said refrigerant gases intermediate the top of said screen

and said flutes, and a capillary size tubing connected to said closed screen member so as to direct oil from said oil separator outward through said capillary tubing, which tubing is coiled around said upright cylindrical casing and connected to said crank case of said compressor so as to pass oil from said oil separator to said crank case.

3. In an oil separator for separating oil from refrigerant gases in a refrigerant system having a compressor with a crank case, said oil separator comprising an upright cylindrical casing forming a chamber, a conduit forming a tangential inlet into said casing near the upper end thereof, an axial tube positioned within said casing and extending to a point a spaced distance above the bottom thereof and forming an outlet from said casing for the passing of refrigerant gases therefrom, a transverse member having flutes on the outer side thereof which flutes are in contact relation with the wall of said cylinder, which transverse member is mounted on the lower end of said axial outlet tube, a screen member forming a substantially closed chamber located intermediate said transverse member and the bottom of said casing, said screen member having the outer periphery thereof formed of a multiplicity of fluted sides, and having a capillary tubing connected to an outlet aperture formed in the bottom of said closed screen member so said capillary tubing will pass oil from said oil separator to the crank of said compressor, to which crank case said capillary tube is connected.

4. In an oil separator for separating oil from refrigerant gases in a refrigerant system having a compressor with a crank case, said oil separator comprising an upright cylindrical casing forming a chamber, a conduit forming a tangential inlet into said casing near the upper end thereof, an axial tube positioned within said casing and extending to a point a spaced distance above the bottom thereof and forming an outlet from said casing for passing refrigerant gas therefrom, a belled member having flutes formed on the lower side thereof, said flutes each having an up-turned flange along one side thereof so as to present a downwardly sloping groove on each for directing oil downwardly therealong into contact with said casing, said belled member being formed on the lower end of said axial outlet tube, a closed screen member located intermediate said belled member and the bottom of said casing in such manner as to present an outlet for said refrigerant gases intermediate the top of said screen and said flutes, said closed screen member having an imperforate top and a bottom with a perforation formed therein, and a capillary tubing connected with said bottom perforation and to the crank case of said compressor for passing oil from said oil separator to said crank case.

5. In an oil separator for separating oil from refrigerant gases in a refrigerant system having a compressor with a crank case, said oil separator comprising an upight cylindrical casing forming a chamber, a conduit forming a tangential inlet into said casing near the upper end thereof, an axial tube positioned within said casing and extending to a point a spaced distance above the bottom thereof and forming an outlet from said casing for the passing of refrigerant gases therefrom, a belled member having flutes on the lower side thereof for directing oil into contact with the wall of said casing which belled member is formed on the lower end of said axial outlet tube, and a closed screen member located intermediate

said belled member and the bottom of said casing, said closed screen member having the outer periphery thereof formed of a multiplicity of layers of fine screen, with each inner screen being a progressively finer screen, which screen member has a multiplicy of fluted sides, and said screen member having an imperforate top and a bottom with a perforation formed therein to which a capillary tube is connected and which tube is also connected to the crank case of said compressor so as to pass oil from said oil separator to said crank case.

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