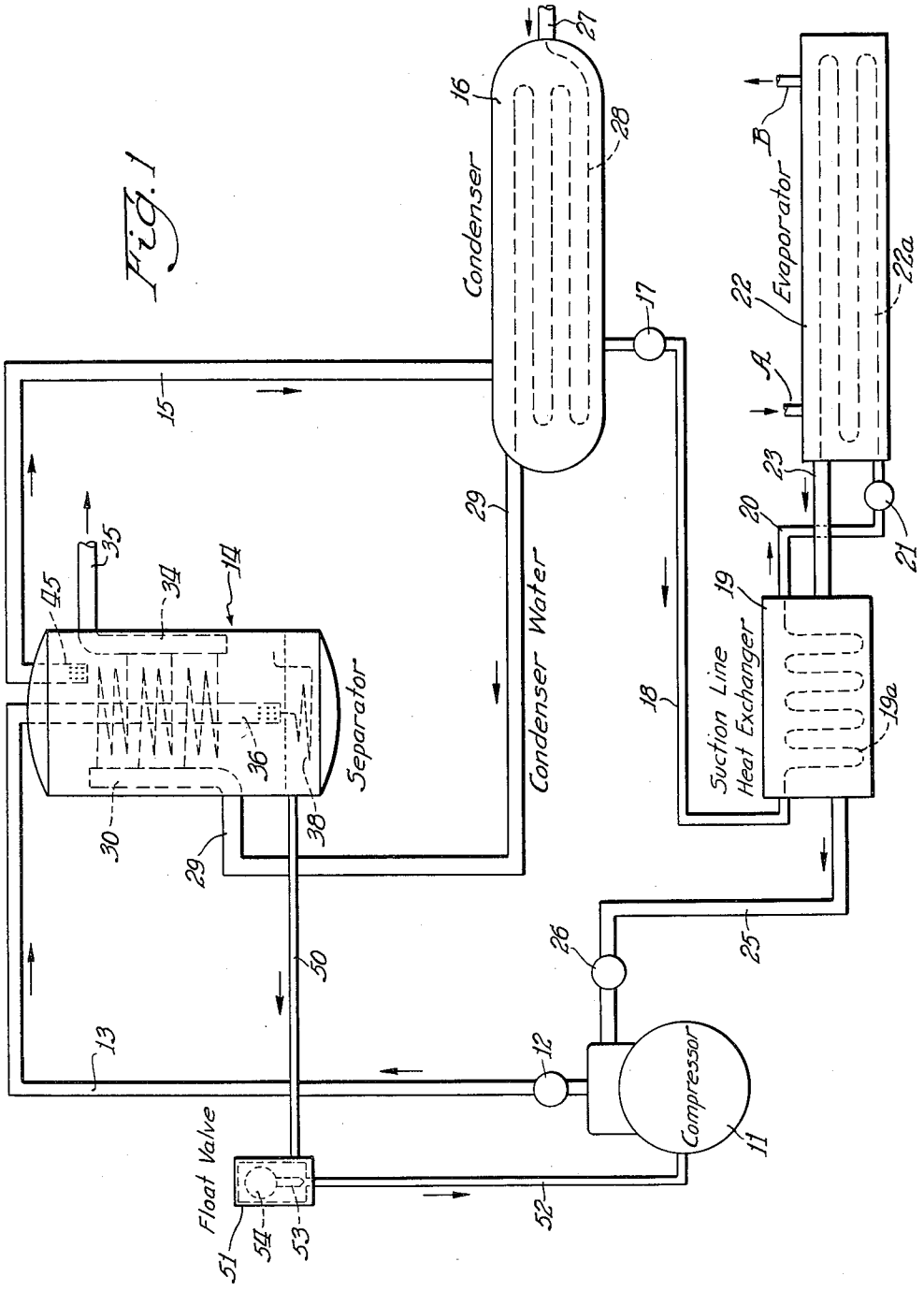
Feb. 20, 1962 T. F. MILLER 3,021,689

OIL SEPARATOR FOR REFRIGERATION SYSTEM

Filed July 7, 1959 2 Sheets-Sheet 1

Fig. 1



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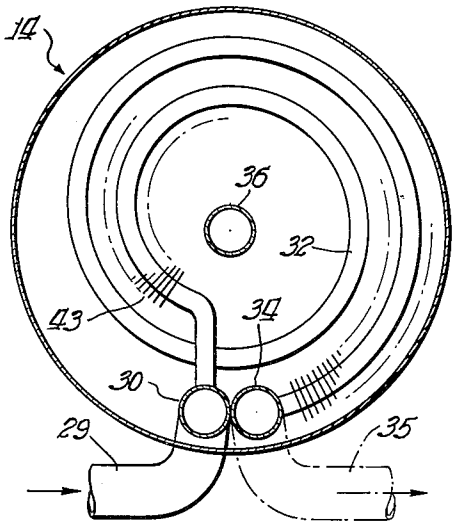


Fig. 3

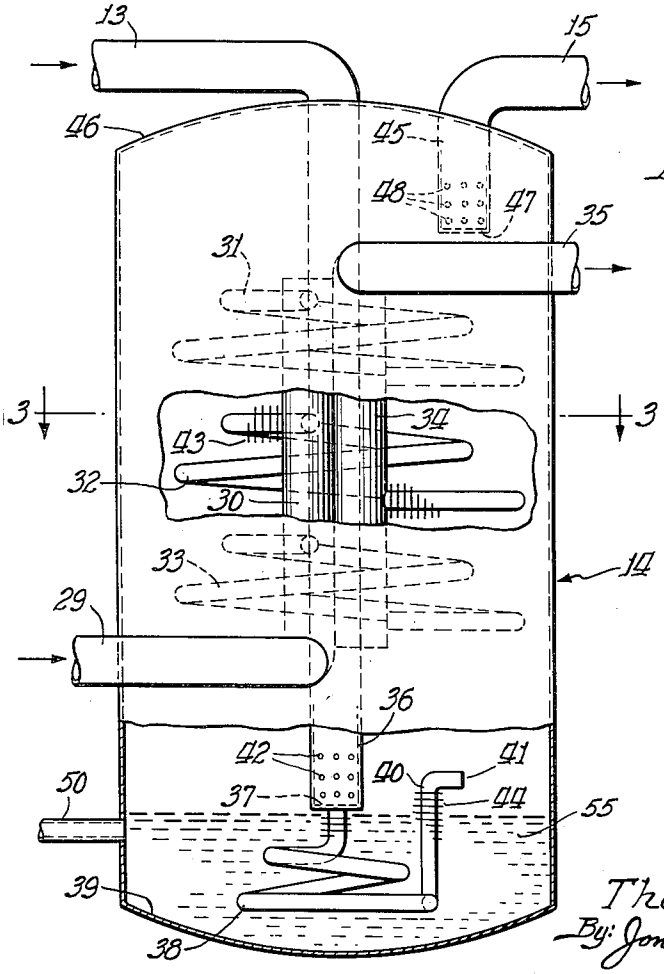


Fig. 2

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OIL SEPARATOR FOR REFRIGERATION SYSTEM

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7 Claims. (Cl. 62—192)

This invention relates to oil separating means for refrigeration systems more particularly of the commercial or industrial expansion-compression type in which a coolant such as water is circulated through the condenser.

It is well known that compressors for low boiling point refrigerants lose some of their lubricating oil to the refrigerant, thereby increasing the cost of operation of the compressor and reducing the efficiency of the refrigerant. Removal of such oil and return to the compressor is desirable for both purposes.

The present invention aims to provide an improved and simplified oil separating means which can be interposed in the circulation path of the system and which advantageously permits use for the purpose of the discharge water from the condenser.

In a further important aspect, the present invention provides means for reheating the separated and liquefied oil, by means of the refrigerant itself, by a regenerative heating step, to further drive out refrigerant from the oil.

The foregoing, and other objects and advantages, will be apparent from the following description, taken together with the accompanying drawings, showing an illustrative embodiment of the invention, and in which drawings—

FIGURE 1 is a somewhat schematic or diagrammatic view of a commercial refrigeration system with the means of the present invention incorporated therein;

FIGURE 2 is an enlarged detail view, partly in section, of the separator tank shown schematically also in FIG. 1; and

FIGURE 3 is a sectional view taken on the line 3—3 of FIG. 2.

Referring in detail to the illustrative construction shown in the drawings, the refrigeration system shown in FIG. 1 is in part conventional and incorporates the usual compressor 11 from which the gaseous refrigerant, such as that sold under the trademark "Freon," is discharged through compressor discharge valve 12 and pipe 13 into the separator tank 14 of the present invention, which will be later more fully described. From the tank 14 the gas flows through pipe 15 to the usual condenser 16, from which the refrigerant issues as a liquid, past the shut off valve 17, and through conduit 18 to the suction line heat exchanger 19, through coils 19*a* in the latter through pipe 20, past the so-called expansion valve 21, to the usual refrigerator evaporator or water chiller 22, where the refrigerant changes from a liquid back to a gas, the latter returning through pipe 23, through suction line heat exchanger 19, through pipe 25, past compressor suction valve 26, and back to the suction side of the compressor 11.

Refrigerator evaporator 22 may serve as a water chiller by having water enter therein through inlet A, and, after contact with the evaporator coil 22*a*, pass out therefrom through outlet B.

Turning now to the expedients of the present invention, and in accordance with the latter, condenser water, which enters the condenser 16 through water inlet pipe 27 and passes through the condenser through the pipes or coil 28, instead of being returned to the drain or sent to the cooling tower or the like, is led by pipe 29 to the separator tank 14 of the present invention, as and for the purposes later herein described.

Tank 14 is representative of any suitable receptacle for the purpose. As here shown, and as best seen in

FIG. 2, pipe 29 leads into a header 30 located vertically within the separator tank. Header 30 has a number of pipe coils, in this instance three, designated as 31, 32 and 33, connected thereto, which are also in communication with another header, header 34, similarly arranged in parallel with the header 30.

Header 34 discharges the condenser water, which has passed through tank 14, through pipe 35 to the drain or sewer, or, if desired, to a cooling tower or the like.

Further in accordance with the present invention, pipe 13 which is in communication with the compression side of the compressor, as previously mentioned, is also led into the separator tank 14 by a vertical terminal 36 therein that depends downwardly centrally thereof in parallel with the water pipe headers 30 and 34 and to a point therebelow. Pipe terminal 36, which provides an inlet for the gaseous refrigerant and undesirably entrained lubricant into the separator tank 14, is partially closed at its lower end as at 37 except that this closure is apertured to provide a nipple for one end of a tubing 38 that hangs below the terminal 36 and approaches the bottom wall 39 of the tank 14 and then is turned upwardly in a standpipe 40 that has an outlet 41 well above the lower wall 39 of the tank for a purpose presently described. At its lower end, above the tubing 38, the pipe terminal 36 is ported as by a number of perforations such as 42 forming restricted openings therein, also for a purpose presently described.

For purposes of enhanced heat exchange, coils 31, 32 and 33 desirably carry the usual fins 43, and, similarly, tubing 38 has the fins 44. These fins it will be understood may be of a suitable number and location to enhance the heat exchange.

At the upper end of tank 14, pipe 15, leading to the condenser, has a terminal 45 that serves as an outlet for the gas from the separator tank, and, like the terminal 36, is supported by the upper wall 46 of the tank. Terminal 45 is relatively short and extends for a relatively short distance below the tank upper wall 46 and preferably has a closed end 47 with perforations 48 distributed thereabove adjacent its closed end. Terminal 36 passes down through coils 31, 32 and 33.

Still following the present invention, leading off from the lower region of the separator tank 14, but below the lower end 37 of the pipe terminal 36, and below the outlet 41 of the standpipe 40 of the tubing 38, is a tube 50 that leads through a float valve casing 51 and through tube 52 back to the compressor 11, to return the retrieved lubricant thereto. Float valve mechanism 51 includes the needle valve 53 controlled by the float 54 and by the level of liquid lubricant in the casing 51. The latter in turn will correspond to the level of liquid lubricant in separator tank 14. Tube 50 is horizontal and spaced above the lower end of tank 14 to leave an oil pool or bath 55 therein.

Operation of the device is as follows:

Mixed refrigerant gas and vaporized oil from the high pressure side of the compressor passing through pipe 13 is at an elevated temperature and under substantial pressure. This mixed pressurized gas and vaporized or entrained oil passes into the oil separator 14 through the terminal 36 and some of it exits from the terminal through the perforations or openings 42. The mixed gas and vaporized oil thus leaving terminal 36 at a lowered velocity rises relatively slowly in the separator tank 14 into contact with the relatively cool finned water pipes 31, 32 and 33. Consequently, there is a drop in the temperature of the mixed gas and vaporized oil which causes the entrained oil to congeal or liquefy and drop to the bottom of the tank 14 to form the pool or bath 55 therein. Tank 14 advantageously also serves in this respect somewhat as a pre-condenser by assisting in par-

tially cooling the gas before it gets to the main condenser 16. Thus the refrigerant gas in the lower end of tube terminal 36 is somewhat reduced in temperature, but not sufficiently to liquefy the refrigerant. Furthermore, the refrigerant will remain a gas while passing through the tank 14 because of the differential in temperature between the tank 14 and condenser 16, the temperature of the water entering the main condenser 16 being lower than that of the water in the separator tank.

At the same time, since the perforations 42 constitute a restricted opening for the mixed gas and vaporized oil from the terminal 36, all of the latter will not pass through these perforations and some of it will find its way through the regenerating tubing 38 which lies immersed in the bath 55, and, after passing therethrough, will exit from the mouth 41 of the standpipe 40 and will move upwardly in the tank 14 joining therein the mixed gas and vaporized oil which has previously emerged through the perforations 42. In passing through the tubing 38, the gaseous refrigerant, which is still at a relatively high temperature, will lose some of its heat to the bath 55 and will thus raise the temperature of the bath sufficiently to drive off gaseous refrigerant that may still be entrained in the oil, but not sufficiently to revaporize the oil, since the temperature of the gaseous refrigerant in the regenerating coil 38 has now been lowered from what it was before it entered the separator tank.

The refrigerant now separated from the oil and still in gaseous form, having dropped in temperature but still under pressure, will rise in the tank 14 and will pass through the perforations 48 of the outlet mouth 45 to the pipe 15, being led thereby to the condenser 16. Any residual vaporized oil which may remain in the gaseous refrigerant as it rises in the tank 14 is advantageously precipitated by the closed end 47 of the outlet terminal 45 for the gas.

In passing through the condenser 16 the refrigerant is further lowered in temperature by contact with the coils 28 for the condenser water which is at a relatively low temperature. The temperature of the refrigerant is then sufficiently reduced so that, at the pressure maintained thereon, the refrigerant emerges from the condenser as a liquid. This liquid refrigerant passes through the pipe 18 to the suction line heat exchanger 19 through the coils 19*a* in the latter. Passing through the heat exchanger 19 the liquid refrigerant is further lowered in temperature by the gaseous refrigerant passing back from the evaporator to the compressor 11. The thus further cooled liquid refrigerant is led by the pipe 20 to the so-called expansion valve 21 where a restricted stream of liquid refrigerant is allowed to escape into the expansion coils 22*a* of the refrigerator evaporator 22. The drop in pressure on the refrigerant causes the latter to boil or change back to a gas in the expansion coils 22*a*, this change of state absorbing heat from the air, water or other medium surrounding the expansion coils 22*a* of the evaporator.

As is well known in the art, the compressor maintains a suction in the coils 22*a*, return pipe 23, heat exchanger 19, and return pipe 25, maintaining a low pressure in this suction side of the compressor through which the gaseous refrigerant is returned to the compressor to be again discharged therefrom from its high pressure side through the pipe 13, thus completing the cycle.

It will be understood that the flow of reclaimed oil back to the compressor through tube 52 is controlled by float valve 53 so as to maintain a bath or pool of such oil in tank 14 for the regenerative heating step described but at a level below standpipe mouth 41. The oil will flow back to the compressor only when its level rises above tube 50 in the bath 55.

Advantages afforded by the present invention include the use of the discharged condenser water to cool the oil separator coils, which water would otherwise be unused after it leaves the condenser, and the regenerative heating of the reclaimed oil pool sufficiently to further drive off gas refrigerant therefrom while not sufficiently to revaporize the oil.

An oil separator device of the present invention has been found to remove all or substantially all of the oil from the gaseous refrigerant so that when brought to the liquid state at the condenser the refrigerant is practically free of oil. This increases the cooling capacity of the refrigeration system by a substantial percentage, thus effecting economies in operation and enhancing the efficiency thereof.

An illustrative embodiment of the invention having been described, in accordance with the statutes, such changes may be made, including modifications or additions, as fall within the scope of the appended claims without departing therefrom.

The invention having been described, what is here claimed is:

1. In an oil separator for refrigeration system embodying a compressor and a water-cooled condenser, the combination with a separator tank, of pipe coils in the upper end of said tank, means for circulating discharge water from the condenser through said pipe coils, means for introducing combined pressurized refrigerant and vaporized oil from the compressor into said tank including a pipe terminal extending downwardly in said tank to a point below said pipe coils but spaced above the lower wall of the tank, a tube coil extension of said terminal extending below the terminal to adjacent the lower wall of the tank whereby to be immersed in a bath of reclaimed oil in the lower part of the tank, a restricted port in said terminal above said tube, a termination of the tube coil extending above the remainder of the tube coil and having an outlet in the region of said port, an outlet for the gaseous refrigerant adjacent the upper end of the tank and in communication with the condenser, means for maintaining said bath at a predetermined level below said port and said tube mouth but above the remainder of the tube coil, and means for conducting overflow oil back to the compressor.

2. The structure of claim 1 wherein said port is provided with a plurality of perforations.

3. The structure of claim 1 wherein the gaseous refrigerant outlet has a closed mouth and surrounding perforations.

4. The structure of claim 1 wherein the tank carries a pair of vertically arranged parallel headers and the pipe coils are in parallel communication with each of said headers.

5. The structure of claim 1 wherein the level of the bath is controlled by a float valve.

6. In an oil separator for refrigeration system embodying a compressor and a condenser, the combination with a separator tank, of pipe coils in the upper end of said tank, means for circulating a coolant in the pipe coils, means for introducing combined pressurized refrigerant and vaporized oil from the compressor into said tank including a pipe terminal extending downwardly in said tank including a pipe terminal extending downwardly in said tank to a point below said pipe coils but spaced above the lower wall of the tank, a tube extension of said terminal extending below the terminal to adjacent the lower wall of the tank whereby to be immersed in a bath of reclaimed oil in the lower part of the tank, a restricted port in said terminal above said tube, a termination of the tube extending above the remainder of the tube and having an outlet above the oil bath, an outlet for the gaseous refrigerant adjacent the upper end of the tank and in communication with the condenser, means for maintaining said bath at a predetermined level below said port and said

tube mouth but above the remainder of the tube, and means for conducing overflow oil back to the compressor.

7. In an oil separator for refrigeration system embodying a compressor and a water-cooled condenser, the combination with a separator tank, of pipe coils in the upper end of said tank, means for introducing combined pressurized refrigerant and vaporized oil from the compressor into said tank including a pipe terminal extending downwardly in said tank to a point below said pipe coils but spaced above the lower wall of the tank, a restricted port in the terminal lower end, an outlet for the gaseous refrigerant adjacent the upper end of the tank and in communication with the condenser, and means for conducting reclaimed oil back to the compressor.

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