

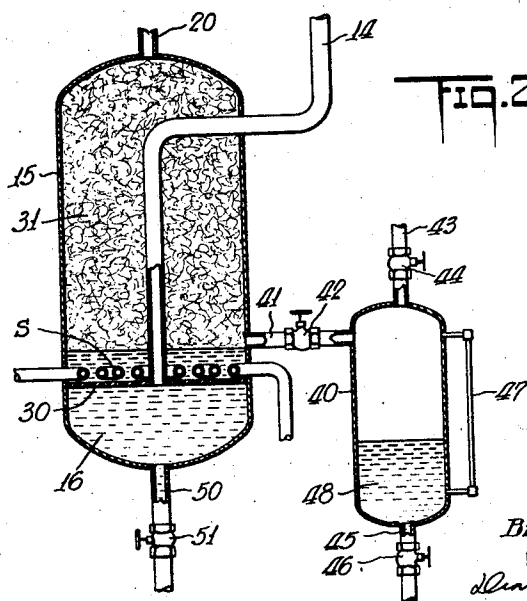
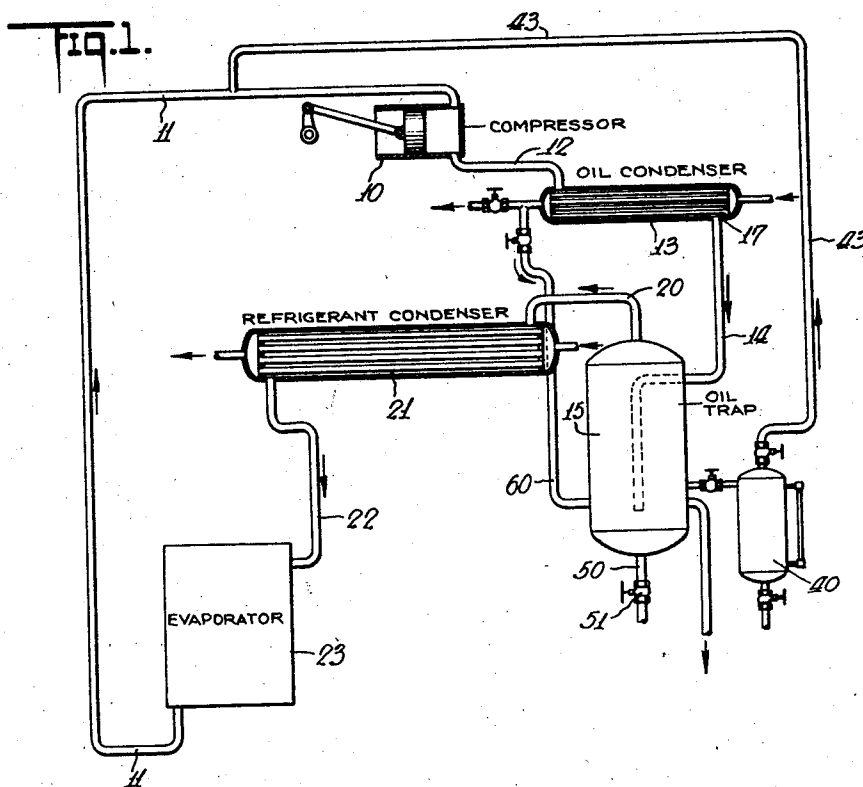
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REMOVAL OF OIL FROM REFRIGERATING SYSTEMS

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REMOVAL OF OIL FROM REFRIGERATING SYSTEMS

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This invention relates to a means for removing oil from the volatile refrigerant circulated in a refrigerating system of the type employing a compressor for the refrigerant gas. In normal operation certain small amounts of the lubricating oil used to lubricate the compressor are carried along with the compressed gas to the condenser and then to the evaporator where they are left behind as the refrigerant vaporizes to a gas.

Oil in the system lowers the efficiency as it collects upon the heat exchange surfaces of both the condenser and the evaporator, and materially reduces the coefficient of heat transfer. Various means have been developed heretofore for separating this extraneous oil from the useful refrigerant, but so far as known all of these means so far proposed have possessed inherent limitations tending to restrict their utility.

The present invention has as an object the provision of a simple and effective means for removing the oil from the refrigerant in an inexpensive, reliable manner.

A further object is the provision of means whereby the oil as removed from the refrigerant serves to remove additional oil from the refrigerant during the continued flow of the latter.

Another object is to arrange an oil filter in such a manner in the refrigerating system that the entire supply of refrigerant is compelled to pass through the filter at all times.

Another object is to provide an effective oil filter which will possess an effective filter action without imposing a high resistance to the flow of refrigerant therethrough.

Another object is to provide the refrigerating system with an oil filter means constructed in such a manner that oil may be removed without loss of any refrigerant held in solution with such oil.

Other objects and advantages of the invention will become more apparent when considered in connection with the accompanying drawing in which

Fig. 1 is a diagrammatic view illustrating an application of the invention in connection with a conventional refrigerating system, and

Fig. 2 is a view drawn to a larger scale and illustrating one form of filter apparatus by means of which the invention may be practiced.

The refrigerating system shown in Fig. 1 is an ammonia system having an oil lubricated compressor 10 to compress the expanded ammonia or other refrigerant vapor entering through pipe 11. The gas may be compressed to 150 or 200 pounds per square inch, and acquire a rather high tem-

perature, and a certain amount of the lubricating oil used in the compressor often mixes with the compressed gas as a vapor or liquid droplets, and passes out with the gas through the pipe 12 to the condenser. Since the condensation temperature of oil vapor is appreciably higher than the condensation temperature of refrigerant gas, the temperature of the mixed gases will be lowered to such an extent that the oil vapor will condense into the form of small drops of liquid oil while the cooled ammonia remains in the gaseous phase.

In carrying out my invention I provide two condensers, one cooled to a temperature at which the oil but not the refrigerant gas will condense, and the other cooled to a temperature at which the refrigerant gas will condense and provide means between the condensers for separating and retaining the oil.

The first condenser 13 may be of any suitable type using cold water or other temperature lowering medium which will lower the temperature of the mixture to such a point that the oil vapor will condense into liquid at the prevailing pressure and temperature maintained in the condenser. After condensing the oil from the refrigerant gas, the entire mixture of cooled but not liquefied gas and the liquefied oil is delivered from the condenser 13 through pipe 14 into a filter 15 and discharged beneath the surface of a liquid oil bath 16 maintained in the filter at all times. In order to insure a continuous and complete removal of the refrigerant gas and liquid oil from condenser 13, the pipe 14 connects as at 17 with the lowest point in the condenser so that condensed oil cannot accumulate in the condenser or be removed separately therefrom.

In lieu of the practice of prior oil removal means wherein the liquefied oil is removed separately from the condensing apparatus, I find it advisable to prevent any stagnant pool of oil from forming in such condenser and contemplate so arranging the entrance of pipe 12 into and the exit of pipe 14 from the condenser in such a way that the gases passing under high pressure therethrough will continually scour any condensed oil from the heat exchange surfaces and thus enhance the condensing action. Upon passing through the bath of oil 16 in filter 15 the refrigerant gas rises to the top of the filter and passes through pipe 20 into the main condenser 21 cooled by water or otherwise to such a temperature that the refrigerant gas is completely liquefied under the necessary operating pressure. In so passing through the filter 15 as described more particularly hereafter, the gas is freed from

all oil vapor. The liquefied ammonia leaving condenser 21 then passes through pipe 22 to any desired evaporator 23 and after fulfilling its refrigerating function passes in a gaseous state back into return line 11 at reduced pressure.

The improved filter means, shown in greater detail in Fig. 2, has the inlet pipe 14 carrying the refrigerant gas and liquid oil drops terminating at a substantial distance below the surface S of the oil bath 16. A screen 30 is disposed around the end of the pipe 14 and serves to hold an additional filter medium 31, such as steel wool or the like, contained in the upper portion of the filter 15.

By means of the construction thus provided and particularly by means of the location of this construction in series with the preliminary condenser 13 and the main condenser 21 of the refrigerating cycle, the following operation of oil removal will occur.

After the refrigerant gas enters pipe 14 at a temperature lower than that at which oil will condense under existing conditions, the oil drops swept along with this gas will remain in liquid state. In passing into contact with the oil bath 16, which too is at a temperature lower than that at which oil will condense, the refrigerant gas will merely bubble through this liquid without taking up any oil vapor. The drops of oil entering with the gas have a mutual attraction for the similar oil in bath 16 and tend to agglomerate with such oil bath. Since the velocity of the refrigerant gas drops as it leaves the end of pipe 14, it will bubble through bath 16 at low speed and will not mechanically sweep the oil out of the filter through pipe 20. To prevent any oil droplets from being carried out with the gas, a loosely packed barrier 31, which may comprise steel wool or the like is provided. As will be apparent the bath 16 and the packing of steel wool do not provide any appreciable resistance to the flow of the gas and thus do not impose any additional load on compressor 10. In order to remove the thus recovered oil from the system, I provide the filter with a draw off vessel 40 attached thereto by means of pipe 41 having any suitable valve 42. This valve may, if desired, be operated automatically by a float control mechanism (not shown) or may be operated manually. From the top of vessel 40 extends a pipe 43 controlled by a valve 44 and leading back into the intake side of compressor 10. The lower portion of vessel 40 is provided with a drain pipe 45 controlled by a valve 46 through which the recovered oil may be drawn off.

To aid in determining when the valve 46 should be operated, any suitable gauge 47 may be provided. As will be noted the interconnecting pipe 41 enters filter 15 at the upper surface S of the oil bath 16 and valve 42 is customarily maintained in open position while valves 44 and 46 are maintained in closed position. As a consequence, after the liquid oil drops removed from the refrigerant raise the level of oil bath 16, this oil flows into draw off vessel 40 and forms a bath 48 therein.

A certain amount of refrigerant gas will be contained in the vessel 40 above the surface of the oil, and since the system is maintained under high pressure it is likely that some of the refrigerant may actually be in solution in such oil. In order to avoid loss of any refrigerant, the following steps may be followed in drawing off oil from the vessel 40. Valve 42 is first closed and valve 44 gradually opened. As valve 44 is opened the suction of compressor 10 is exerted through

pipe 43 and removes the entrapped gaseous refrigerant from the vessel 40 and due to the lowered pressure upon the bath 48 in such vessel any refrigerant in solution will flash off and be returned into the refrigerant cycle. If this results in a partial vacuum in the vessel 40, the valve 42 may be slightly opened after valve 44 is closed and enough gas permitted to enter vessel 40 to raise the pressure very slightly above atmospheric. The valve 46 may then be opened to draw off a portion but not necessarily all of the oil. The valve 46 is then closed, the valve 42 opened and the normal oil overflow from the filter permitted to continue. This draw off of oil may be done at as frequent intervals as necessary and without in any way interrupting or interfering with the normal operation of the system.

For the purpose of introducing the original bath of oil 16 at the start of an installation or for draining it away when occasion demands, I provide an outlet pipe 50 from the filter 15 controlled by a valve 51.

In some cases it may be found that a small amount of ammonia may liquefy in the condenser 13 and pass into the filter 15. To prevent this, any suitable means may be provided for maintaining the temperature of the filter above the liquefying point of the refrigerant gas under the temperature employed. Merely as an example, I have shown a pipe 60 taking the warm water from the condenser 13 and leading to a coil in the filter 15 above the plate 30. This pipe as well as the pipes supplying liquid to the two condensers may be provided with thermostatically controlled valves.

If the amount of oil passing over with the gas and collecting in the trap is very large so that frequent draining of the oil is necessary, I may operate the valve 42 by a float in the liquid in the chamber 15.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a refrigeration system having oil vapor mixed with the gaseous refrigerant under pressure, the combination of a condenser receiving the oil refrigerant mixture and adapted to lower the temperature of said mixture below the condensing point of the oil vapor but not to the condensing point of the refrigerant, an outlet from a lower portion of said condenser through which the entire mixture of refrigerant gas and condensed oil is delivered at a velocity sufficient to prevent retention of films of condensed oil on the condenser surfaces and to prevent the formation of stagnant pools of oil in the condenser, whereby the movement of the materials under pressure will scour the condenser surfaces and sweep condensed oil therefrom, a second condenser for the gaseous refrigerant, and an oil trap between the two condensers.

2. In a refrigeration system having oil vapor mixed with the gaseous refrigerant under pressure, the combination of a condenser receiving the oil refrigerant mixture and adapted to lower the temperature of said mixture below the condensing point of the oil vapor but not to the condensing point of the refrigerant, an outlet from a lower portion of said condenser through which the entire mixture of cooled refrigerant gas and condensed oil is delivered at a velocity sufficient to prevent retention of films of condensed oil on the condenser surfaces and to prevent the formation of stagnant pools of oil in said condenser, a filter means for separating the condensed oil

from the gaseous refrigerant, and means for returning into the system any refrigerant entrapped with said separated condensed oil.

3. Means for removing oil from refrigerating systems, including a condenser receiving a warm oil gaseous refrigerant mixture under pressure and serving to condense said oil while cooling but not condensing the refrigerant gas, a pressure vessel having a bath of oil therein, means delivering the entire mixed contents of the condenser below the surface of said oil bath whereby the oil bath serves to agglomerate oil particles from said mixture and to filter oil from the gas, and means for delivering the removed oil and the filtered gas separately from said pressure vessel.

4. A refrigerating system including a compressor for a volatile refrigerant, two condensers in series, means for cooling the first condenser to a temperature at which oil vapors from the compressor will condense but above the condensing temperature of the refrigerant under the pressure employed, means for cooling the second condenser to a temperature at which the refrigerant gas will liquefy, an oil collecting chamber between said condensers, and means for delivering the gaseous refrigerant and condensed oil from the first condenser below the liquid level of the oil in said chamber.

5. A refrigerating system including a compressor for a volatile refrigerant, two condensers in series, means for cooling the first condenser to a temperature at which oil vapors from the compressor will condense but above the condensing temperature of the refrigerant under the pressure employed, means for cooling the second condenser to a temperature at which the refrigerant gas will liquefy, an oil collecting chamber between said condensers, a perforated plate within said chamber below the normal oil level therein, means for delivering a gaseous refrigerant and oil below the liquid level and below said plate, and means for conducting gaseous refrigerant from

the upper portion of said chamber to the second condenser.

6. A refrigerating system including a compressor for a volatile refrigerant, two condensers in series, means for cooling the first condenser to a temperature at which oil vapors from the compressor will condense but above the condensing temperature of the refrigerant under the pressure employed, means for cooling the second condenser to a temperature at which the refrigerant gas will liquefy, an oil collecting chamber between said condensers, means for delivering the gaseous refrigerant and condensed oil from the first condenser below the liquid level of the oil in said chamber, a second chamber, valve controlled connections between said chambers permitting oil to flow to the second chamber, a valve controlled drain from said second chamber, and a valve controlled connection between the upper portion of said second chamber and the intake of said compressor.

7. A refrigerating system including a compressor for a volatile refrigerant, two condensers in series, means for cooling the first condenser to a temperature at which oil vapors from the compressor will condense but above the condensing temperature of the refrigerant under the pressure employed, means for cooling the second condenser to a temperature at which the refrigerant gas will liquefy, an oil collecting chamber between said condensers, means for delivering the gaseous refrigerant and condensed oil from the first condenser below the liquid level of the oil in said chamber, a second chamber, valve controlled connections between said chambers permitting oil to flow to the second chamber and maintain a uniform oil level in the first mentioned chamber, a valve controlled drain from said second chamber, and a valve controlled connection between the upper portion of said second chamber and the intake of said compressor.

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