Oct. 15, 1929. J. W. CUTHBERT 1,732,039

REFRIGERATING MACHINE AND METHOD OF REFRIGERATION

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Fig. 1

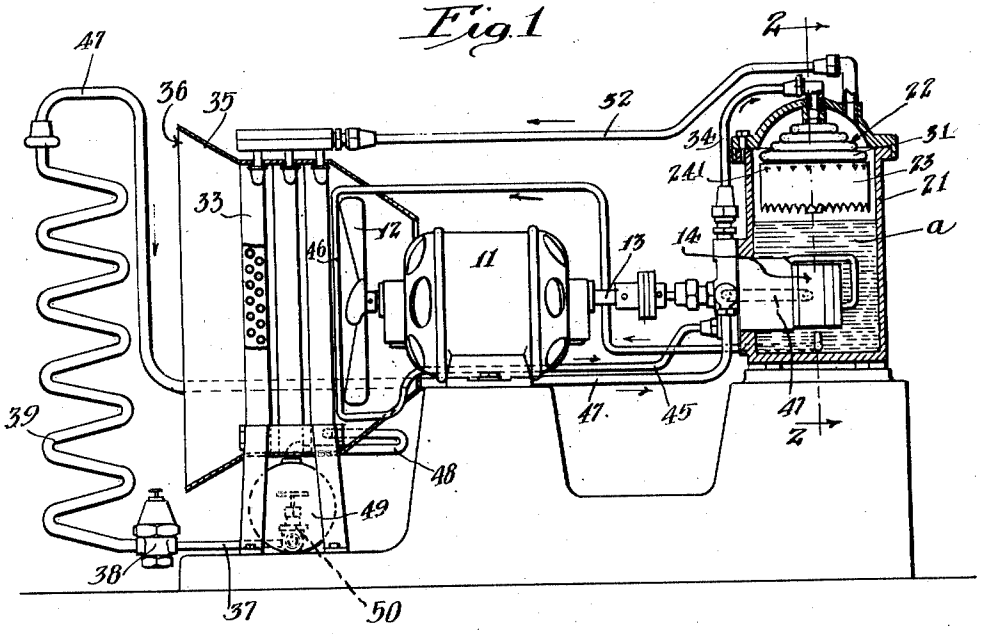


Fig. 2

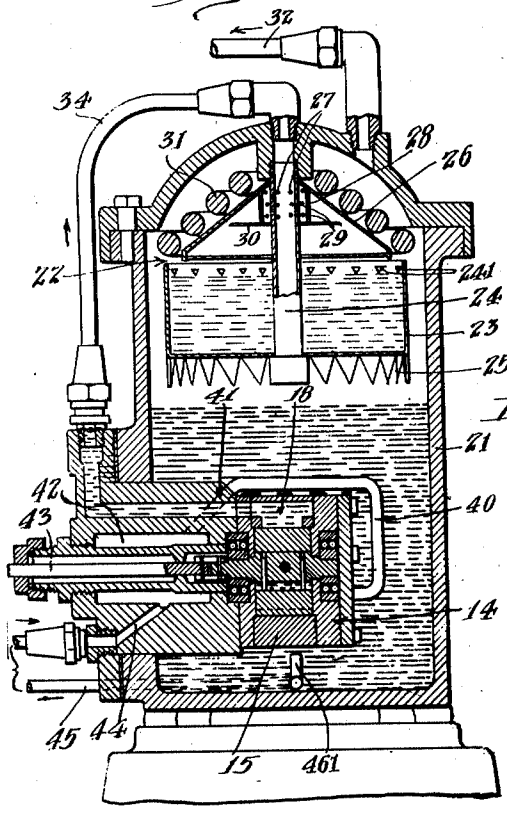


Fig. 3.

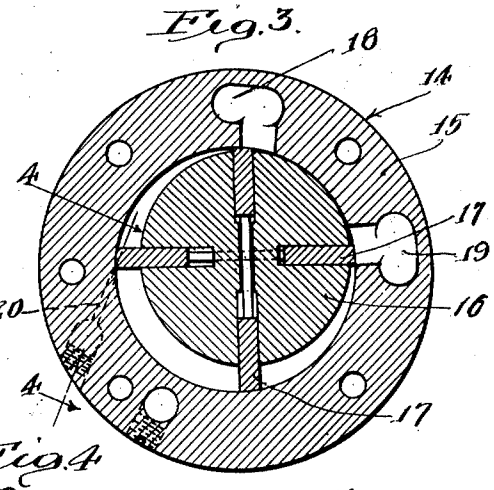
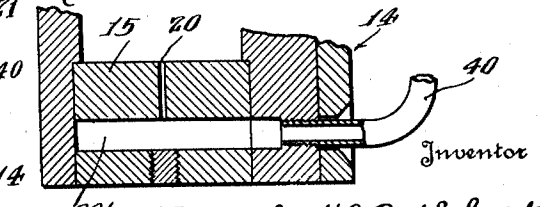


Fig. 4



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REFRIGERATING MACHINE AND METHOD OF REFRIGERATION

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Fig. 5

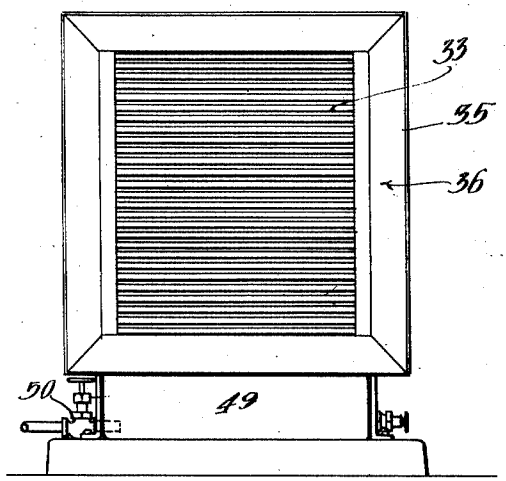


Fig. 6

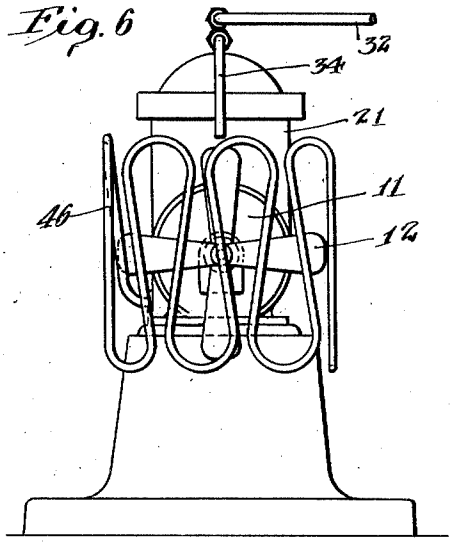


Fig. 7

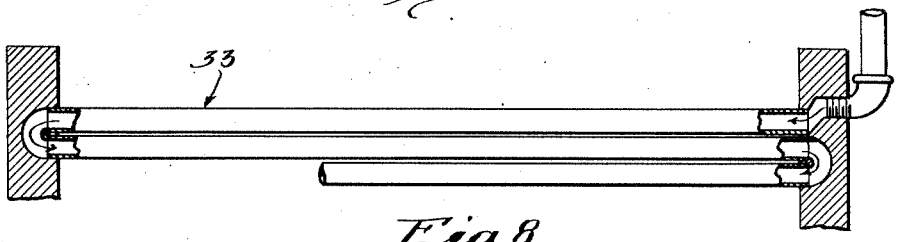
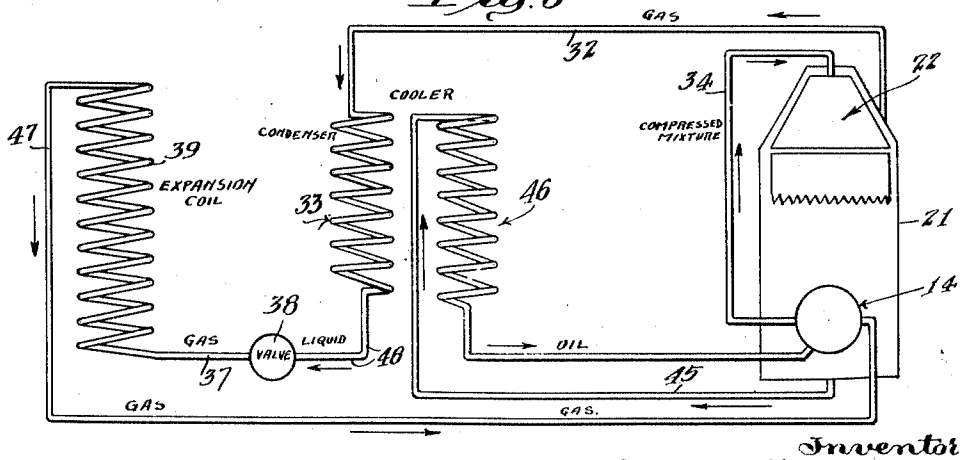


Fig. 8



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UNITED STATES PATENT OFFICE

JOSEPH W. CUTHBERT, OF LA CANADA, CALIFORNIA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO ROTORITE CORPORATION, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

REFRIGERATING MACHINE AND METHOD OF REFRIGERATION

Application filed March 5, 1925. Serial No. 13,086.

This invention relates to refrigerating machines of the type employing a refrigerating agent that produces low temperature by sudden reduction of pressure of said agent. The invention also relates to the method of refrigeration.

An object of this invention is to produce a machine of this type that is automatic in operation and that will run for a long period of time, even years, without any attention whatsoever being given to it.

An important object of the invention is to effect complete separation of the refrigerating agent and lubricant prior to expansion of the refrigerating agent.

Another important object is to effect cooling of the compressor by cooling of the cooling medium away from the zone of condensation and separation of the lubricant and refrigerating agent.

Another object is to construct the machine so that the heat resulting from compression of the gas is used to the best advantage in aiding separation of the gas and the lubricant used in the compressor cylinder.

Another object is to construct the machine so that the lubricant employed to absorb heat from the compressor will function at a higher temperature to heat the mixture of gas and oil compressed in the compressor and will then be cooled and admitted to the cylinder at a lower temperature to lubricate the cylinder and the pressure elements operating therein.

Another object is to effect cooling of the compressor in such manner that the heat abstracted from the compressor will be carried away from the chamber in which the compressor and separator for the lubricant and refrigerating agent are positioned.

Other objects and advantages will appear in the subjoined detailed description.

The accompanying drawings illustrate the invention:

Fig. 1 is a side elevation, partly in section, of a refrigerating machine constructed in accordance with the provisions of this invention.

Fig. 2 is an enlarged vertical section on the line indicated by 2—2, Fig. 1.

Fig. 3 is an enlarged cross section through the compressor chamber and rotor.

Fig. 4 is a sectional elevation on the line indicated by 4—4, Fig. 3.

Fig. 5 is a front elevation of the condenser and reservoir.

Fig. 6 is a front elevation of Fig. 1 with the condenser and reservoir omitted.

Fig. 7 is an enlarged fragmental sectional detail of the radiator.

Fig. 8 is a diagrammatic view of the circulating system of the machine.

The prime mover or source of operating power is indicated at 11, being, in this instance, an electric motor. Preferably this motor is provided with a fan 12. The prime mover 11 is connected by a shaft 13 to a compressor indicated in general at 14.

The compressor 14 may be of any suitable type and, in the instance shown, is of the rotary type as such type is deemed at the present time to answer the purpose to better advantage than a reciprocating type. The compressor casing or cylinder is indicated at 15 and the rotor at 16, said rotor being eccentrically positioned in the casing 15 and having slidably mounted compressing elements 17 operating in a manner well understood in the art relating to rotary compressors to force liquid ahead of them out of a port provided in the cylinder for that purpose, such port being indicated at 18. The intake port of the compressor is indicated at 19 in the cylinder and the rotor and cylinder are properly lubricated by a lubricant admitted to the cylinder through a port or ports 20 provided in said cylinder.

The compressor cylinder projects into the lower portion of a housing 21 which may be termed the compressor housing, there being suitable means, indicated in general at 22, in the upper portion of the housing 21 to separate the refrigerating agent and the lubricant which becomes mixed in the compressor cylinder. The cooling medium for cooling the compressor is indicated at *a* in the housing 21 and preferably the level of said cooling medium is well above the top of the compressor 14. This cooling medium *a* may be any suitable fluid and I prefer that it be a

lubricant because the housing 21 constitutes a reservoir for the lubricant that is used for lubricating the compressor. However, as will be made clear hereinafter, the lubricant is not admitted to the interior of the compressor casing directly from the housing 21 but said lubricant is first cooled by running it through a suitable cooler. It will be obvious that the compressor may be entirely above the level of the oil in the reservoir if so desired. The compressor is cooled by the oil admitted to its interior and not primarily by the oil in the reservoir; therefore immersion is immaterial.

Though the separating means 22 may be of any desired construction, I prefer to construct it as follows: In the upper portion of the housing 21 is a receptacle, overflow pan or oil well 23 which is suspended by a tube 24 passing downwardly therethrough. Near its upper margin the receptacle 23 is provided with a number of small openings or ports 241 and, preferably, the lower margin of the receptacle 23 is serrated as indicated at 25. Above the receptacle 23 is a conical member or hood 26 which tightly fits around the tube 24, there being ports 27 in the tube 24 beneath the hood 26. Enclosing the portion of the tube 24 having the ports 27 is a tubular member 28 which contacts at its upper edge against the hood 26 so as to form an inner chamber around the tube. The member 28 is provided with ports 29 and the lower end of the member 28 is closed by a member that projects laterally to form a horizontal baffle 30. Surrounding the hood 26 is a wire coil 31. A pipe 32 communicates at one end with the upper portion of the housing 21 above the separating means.

The tube 24 connects with a pipe 34 outside of the housing and the pipe 34 communicates with the port 18 to convey the compressed mixture from the compressor to the separating means. The pipe 32 connects with a suitable condenser, indicated in general by the character 33. The condenser 33 is disposed in front of the fan 12 and preferably it and the fan are within a casing 35 which surrounds the forward end of the motor 11 and is open at its front end as indicated at 36 for air drawn by the fan 12 through the condenser 33. The condenser 33 is connected at its lower end by a pipe 48 to a receiver 49 which in turn is connected to a pipe 37 provided with a control valve 50 and with an expansion valve 38. The pipe 37 connects to one end of an expansion coil 39 which is positioned in the chamber, not shown, that is to be subjected to the cooling action of said coil. The other end of the coil 39 connects with a pipe 47 which discharges into the port 19. The ports 20 receive lubricant through a duct 201 in the cylinder 15 and said duct communicates with a pipe 40 which connects with a port 41 opening into a chamber 42 that surrounds the compressor shaft 43 within the pump casing near the cylinder bore. Lubricant is supplied to the chamber 42 through a duct 44 that connects with a pipe 45, there being a cooler 46 formed of a portion of said pipe and said cooler consisting of several passes or turns of pipe positioned in front of the fan 12, between the said fan and condenser 33. The other end of the pipe 45 communicates with the lower portion of the housing 21, preferably at a substantial distance above the bottom of said housing as indicated at 461.

To place the refrigeration machine in operation, the motor 11 will be operated, thus compressing a mixture of lubricant inducted through the pipe 40 and refrigerating agent inducted through the pipe 47 and forcing said mixture through the pipe 34 into the separating means 22. Here the mixture passes out of the tube 24 into the chamber 28 and from the chamber 28 into the hood 26 and the lubricant discharges from the hood into the receptacle 23 while the gas escaping from the hood and receptacle flows up around the hood and between the wire coils 31 where it is further freed of lubricant. The gas thus separated flows into the pipe 32.

After the machine is in operation a short time, the body of cooling lubricant *a* will increase somewhat in temperature, thus facilitating gasification of the refrigerating agent and separation of said agent from the lubricant in the separating means 22. These gases will then flow through the pipe 32 to the condenser 33 where said gases are condensed to form a liquid and such liquid flows into the reservoir 49, thence by the pipe 37 to the expansion valve 38 and thence through the coil 39. Because of the compressor drawing upon the gas in the pipe 47, there will be a partial vacuum in the coil 39 and the expansion valve will permit the liquid in the pipe 37 to discharge into such partial vacuum, thereby gasifying the liquid refrigerating agent in the coil 39 and thus lowering the temperature of the coil 39 which abstracts heat from the chamber, not shown, in which the coil 39 is disposed. The gases then flow from the coil 39 to the compressor where the cycle of operations just described is again begun.

The lubricant separated from the gases and refrigerating agent by the means 22 drips from the serrated margin 25 into the body of lubricant *a* within the housing 21, the temperature of said lubricant being maintained constant by abstraction of heat from the compressor so that there is no danger of a mixture of the liquid refrigerating agent and lubricant being retained in the lower portion of the housing 21, thus avoiding any danger of the liquid refrigerating agent being injected with the lubricant into the compressor cylinder. Thus the lubricant *a* functions in one respect as a cooling medium for the compressor and it also functions to radiate heat

to the separating means 22 so that said means will function efficiently.

The cooling medium *a* is withdrawn from the housing 21 a little at a time and cooled, for this purpose flowing out of the housing through the pipe 45, through the cooling portion 46 of said pipe and back again to the compressor where the cooling medium is discharged into the duct 44. The cooling medium flows around the shaft 43 adjacent to the cylinder bore, thence by way of the duct 41, pipe 40 and duct 201 to the ports 20, thus discharging the cooling medium which, in this instance, is a lubricant, into the rotor chamber to lubricate the elements 17 and the wall of said chamber. This lubricant, after performing its function of lubricating the parts, mixes with the refrigerating agent and the mixture is forced through the duct 18 and pipe 34 to the separating means 22. The separating means functions to reduce the velocity of the mixture passing through it on the way to the condenser, thereby permitting complete separation of the oil and gas.

From the foregoing, it will be seen that the lubricant is efficiently cooled before it enters the compressor to perform its lubricating function, and that this cooling is effected at a point remote from the separating means 22, so that the separation of the oil and gas will occur under the conditions most conducive to efficient separation thereof. The temperature of the cooling medium *a* is maintained uniform, an essential to satisfactory operation of the machine, by reason of the fact that only the oil passing through the compressor is cooled prior to such passing and after it is drawn off from the zone in which the compressor operates and not the entire body of oil in the compressor housing. If such entire body were cooled, it would cause such fluctuations in temperature of said body as to produce more or less condensation of the refrigerating agent within the compressor housing and, as the specific gravity of said refrigerating agent is preferably greater than that of the oil, such condensation would in time raise the oil level to an extent that would cause the oil to pass over to the condenser and make the machine inoperative. As an example of the refrigerating agent that may be employed, I have used sulphur dioxide (SO_2).

The overflow pan or oil well 23 has a further function as follows: When the machine has been standing for long periods of time out of operation, the entire assembly cools off to the temperature of the room in which the machine is operating. Thus, when the machine is first started into operation after standing idle, there will be some condensation of the refrigerating agent in the pan 23, but, since the specific gravity of the refrigerating agent is greater than that of the oil, the liquefied gas will settle to the bottom of the overflow pan 23 and displace an equal amount of oil which, accordingly, will be caused to overflow through the ports 241 and unite with the main oil body in the lower portion of the compressor housing 19.

After the machine has been in operation for a short period of time, under such starting conditions, and the running temperature of the machine is gradually attained, this liquefied refrigerating agent within the pan 23 is caused to evaporate and gradually pass off in a gaseous condition through the pipe 32 to the condenser or liquefying coils. The pan 23 will then become filled to overflowing by oil as said oil is separated out of the mixture of oil and refrigerating medium entering the upper end of the housing through the pipe 34.

The expansion coils will be proportioned to the capacity of the machine or the expansion valve regulated so that frost will not be present on the suction pipe 47 for long periods of time, as operation under such condition would be detrimental to the life of the compressor as well as causing a reduction in capacity of the machine. Furthermore, there would be the possibility of excess liquid being carried over and precipitated into the overflow pan 23 and thence into the main oil body in the lower portion of the housing.

The air drawn by the fan 12 through the condenser cools the condenser and passes through the motor 11 to keep the same cool.

I claim:

1. The method of refrigeration consisting in discharging a gaseous refrigerating agent and a lubricant into the cylinder of a compressor, compressing the mixture of gas and lubricant, abstracting heat from the compressor with a cooling medium, exposing the compressed mixture to heat radiated by the cooling medium while maintaining any liquefied refrigerating agent out of contact with the cooling medium to drive off the gas, cooling the gas to liquefy it, releasing the liquid refrigerating agent in a zone of lower pressure to gasify said agent, returning the gaseous agent to the compressor cylinder.

2. The method of refrigeration consisting in discharging a gaseous refrigerating agent and a lubricant into the cylinder of a compressor, compressing the mixture of gas and lubricant, abstracting heat from the compressor with a cooling medium, separating the gas and lubricant while maintaining the mixture out of contact with the cooling medium, cooling the gas to liquefy it, releasing the liquid refrigerating agent in a zone of lower pressure to gasify said agent, returning the gaseous agent to the compressor cylinder, and taking the cooling medium a little at a time away from the compressor, cooling it and returning it to the compressor.

3. The method of refrigeration consisting in discharging a gaseous refrigerating agent and a lubricant into the cylinder of a compressor, compressing the mixture of gas and

lubricant, separating the gas from the lubricant in the mixture, discharging the lubricant thus separated into a zone adjacent to the compressor to abstract heat from the compressor while maintaining any refrigerant which may have liquefied free from said zone, cooling the gas to liquefy it, releasing the liquid refrigerating agent at a reduced pressure to gasify said agent, returning the gaseous agent to the compressor cylinder, taking the heated lubricant a little at a time away from the compressor, cooling it, and returning the cooled lubricant to the compressor cylinder.

4. The method of refrigeration consisting in discharging a gaseous refrigerating agent and a lubricant into the cylinder of a compressor, compressing the mixture of gas and lubricant, abstracting heat from the compressor with a body of lubricant, exposing the mixture to heat radiated from said compressor while maintaining the mixture out of contact with the body of lubricant to separate the gas and lubricant in said mixture, discharging the lubricant thus separated into the heated body of lubricant, cooling the gas to liquefy it, releasing the liquid refrigerating agent at a reduced pressure to gasify said agent, returning the gaseous agent to the compressor cylinder, taking the heated lubricant a little at a time away from the compressor, cooling it, and returning the cooled lubricant to the compressor cylinder.

5. The method of refrigeration consisting in cooling a compressor in a body of lubricant, discharging a gaseous refrigerating agent and some of said lubricant into the cylinder of the compressor, compressing the refrigerating agent and the associated lubricant, separating the compressed refrigerating agent from the associated lubricant while maintaining said refrigerating agent which may have liquefied out of contact with the body of lubricant used to cool the compressor, returning the lubricant thus separated to the body of lubricant, liquefying the refrigerating agent, releasing the liquid refrigerating agent in a zone of lower pressure to gasify said agent, and returning the gaseous agent to the compressor cylinder.

6. The method of refrigeration consisting in discharging a gaseous refrigerating agent and a lubricant into the cylinder of a compressor, compressing the mixture of gas and lubricant, separating the gas and lubricant while the heat evolved in the compressing operation is still in them and while any refrigerating agent which may have liquefied is out of contact with the cooling medium, cooling the gas to liquefy it, releasing the liquid refrigerating agent at a reduced pressure to gasify said agent, returning the gaseous agent to the compressor cylinder, cooling the lubricant, and returning the cooled lubricant to the compressor cylinder.

7. The method of refrigeration consisting in cooling a compressor in a body of lubricant, discharging a gaseous refrigerating agent and some of said lubricant into the cylinder of the compressor, compressing the refrigerating agent and the associated lubricant, exposing any refrigerant which has been liquefied together with the associated lubricant to the heat abstracted by the lubricant from the compressor while maintaining the liquefied refrigerating agent out of contact with the body of lubricant used to cool the compressor, returning the lubricant thus separated to the body of lubricant, liquefying the refrigerating agent, expanding the liquefied refrigerating agent to lower its temperature and gasify it, and returning the refrigerating agent thus gasified to the compressor cylinder.

8. A refrigerating machine comprising a housing to hold a body of lubricant, a compressor projecting into the lower portion of the housing, means to operate the compressor, means in the upper portion of the housing receiving a compressed mixture of refrigerant and lubricant from the compressor and operating to separate the refrigerant and lubricant, said separating means including a receptacle to receive the lubricant and refrigerant and maintain the refrigerant which may have been liquefied out of contact with the body of lubricant while said refrigerant gasifies, a condenser receiving gaseous refrigerant from the housing, an expansion valve receiving the condensed refrigerant from the condenser, an expansion coil connected with the expansion valve and with the compressor cylinder, and a cooler receiving lubricant from the housing and discharging said lubricant into the compressor cylinder.

9. A refrigerating machine comprising a housing to hold a body of lubricant, a compressor projecting into the lower portion of the housing, means to operate the compressor, means receiving a compressed mixture of refrigerant and lubricant from the compressor and separating the refrigerant and lubricant and maintaining the refrigerant mixture out of contact with the body of lubricant while said refrigerant gasifies, a condenser receiving gaseous refrigerant from the housing, an expansion valve receiving the condensed refrigerant from the condenser, an expansion coil connected with the expansion valve and with the compressor cylinder, and a cooler receiving lubricant from the housing and discharging said lubricant into the compresser cylinder.

10. In a refrigeration machine a casing, a fluid lubricant in said casing, a compressor and a receptacle in said casing, means in said receptacle for separating refrigerant from said lubricant, means for conveying compressed refrigerant and lubricant from said compressor to said receptacle, means for conveying said refrigerant to a condenser, and

means for allowing lubricant to flow out of said receptacle into the body of fluid lubricant in the casing.

11. In a refrigeration machine of the type wherein oil is mixed with the refrigerant and wherein said oil when separated from said refrigerant is cooled and injected into the compressor so that it acts as a cooling means for the compressor, the combination of a casing adapted to contain oil, a compressor in said casing, a receptacle comprising a trap, a conduit from said compressor to said trap, said receptacle being spaced above the oil level of the casing, whereby the heat communicated from the compressor effectually separates the refrigerant from the oil before the oil unites with the body of oil in the casing.

12. In a combination a casing adapted to contain oil, a refrigerant compressor extending within said casing, a receptacle in said casing and spaced above said compressor, a pipe for supporting said receptacle, means including said pipe for conveying mixture of compressed refrigerant and oil from said compressor to said receptacle, and baffles associated with said pipe for separating said refrigerant from said oil.

13. In a refrigeration machine, a condenser, an expansion valve, an expansion chamber, a compressor, an oil system including a casing, said compressor extending into said casing, a compressor shaft, a chamber surrounding said compressor shaft, an oil cooler, means for conveying oil from said casing to said cooler, means for conveying oil from said cooler to said chamber, and means for conveying oil from said chamber and for introducing it into the compressor.

Signed at Los Angeles, California, this 21 day of February, 1925.

JOSEPH W. CUTHBERT.