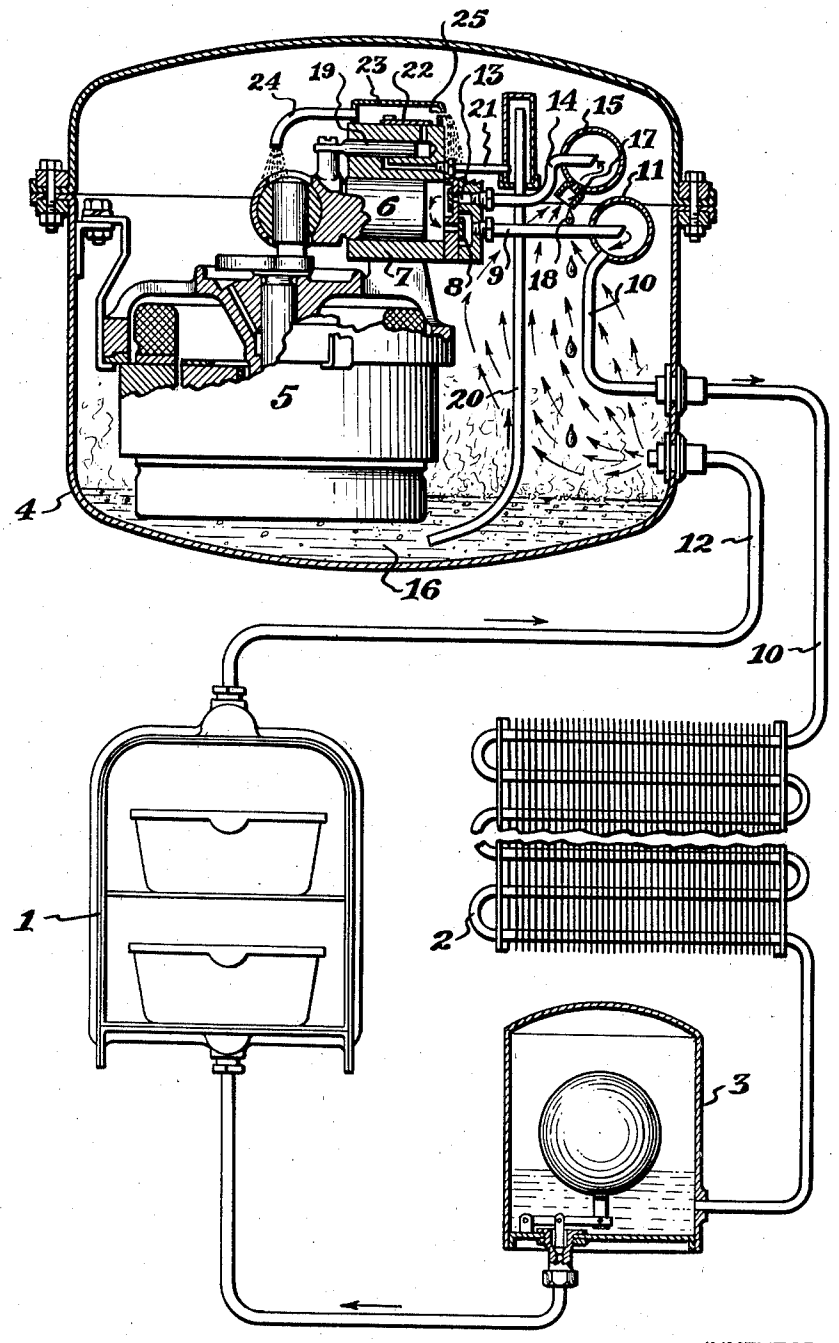
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REFRIGERATION SYSTEM

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REFRIGERATION SYSTEM

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My invention relates to the operation of refrigeration systems, such for example, as the systems of household refrigerators, wherein there is used oil for lubricating a compressor and a refrigerant characterized by being miscible with or soluble in the oil. Most modern systems, which, of course, comprise a compressor, a condenser and an evaporator are in the form of a closed system or circuit which contains both the refrigerant and the oil. The use of a refrigerant miscible with the oil gives rise to a number of serious problems. In the first place it is necessary to keep the oil in the place where its function is required. Oil in a condenser or evaporator has no utility and may lead to trouble. The oil must be kept in sufficient volume in a crank-case or dome where it can perform its sole function, that of lubricating moving parts. It follows that the refrigerant elsewhere must be as free as possible from oil in order to do its work properly. It also follows that the oil must be kept as free from refrigerant as possible in order that its viscosity and therefore its lubricating quality be not reduced.

Most modern refrigerators are of the so-called hermetically sealed type, that is to say, having a sealed dome or casing in which are located both the motor and the compressor. For the purpose of an exemplary disclosure I shall describe my invention as applied to such a type.

So far as I am aware, hermetically sealed refrigerators employing oil-miscible refrigerant have always been arranged as follows: The inlet port of the compressor is connected directly by a suitable conduit to the evaporator; but the outlet port of the compressor opens into the dome or casing. The dome is connected with the condenser by a suitable conduit; and those skilled in the art will understand that between the condenser and evaporator there is a connection including any of the known means for controlling the supply of liquefied refrigerant to the evaporator.

In this construction the dome is subjected to the highest working pressures encountered in the system. The dome contains the oil body, diluted of course with a large quantity of refrigerant. It has been recognized that this dilution is a serious matter and various suggestions have been made toward reducing it. One suggestion of which I am aware has been to employ the heat generated by the motor and the compressor for driving as much of the refrigerant out of the oil as possible. This suggestion does not perfectly solve the problem, however, for several reasons. The great pressure to which the mixture of oil and refrigerant is subjected resists the boiling off of the refrigerant by heat. Moreover the amount of refrigerant so eliminated depends also, of course, upon the degree of heat which can be secured; and this is subject in large measure to external temperature changes. Thus the operation is non-uniform.

The fundamental object of my invention is to provide solutions for these problems as will hereinafter appear. In doing this I secure a number of incidental but none-the-less important advantages which will later be pointed out or will be apparent to one skilled in the art upon reading these specifications.

I have found that as a mixture of oil and refrigerant is subjected to progressively lower pressure by the compressor in a refrigerator system, this results in separating the gas from the oil, and that this is not only effective in removing from the oil very much more of the refrigerant gas than can be removed otherwise, but is also substantially independent of external conditions of temperature and the like. The place to subject the mixture of oil and refrigerant to the low pressure is, of course, at the point where the oil is collected for lubricating purposes. In the so-called hermetically sealed refrigeration jobs, the oil is collected inside the dome which also houses the motor and the compressor. Therefore, in the practice of my invention as applied to such a system the dome, instead of being a high pressure dome, is made to be a low pressure dome and to this end is usually connected directly to the evaporator. The compressor inlet opens directly into the dome; whereas the compressor outlet by suitable conduits is connected directly to the condenser of the refrigeration system. Thus the dome is progressively exhausted and its pressure reduced as the compressor operates during each cycle of the machine. The oil in the dome during the operation of the compressor is subjected to progressive lower pressure which causes the refrigerant actively to boil out of the oil until at the close of the cycle an equilibrium is reached in the oil-refrigerant solution at the lowest pressures which are obtained. It will be understood, of course, that in normal operation a complete separation of oil and refrigerant is never obtained; but this is not necessary. A working body of oil is, however, maintained very much freer from the refrigerant than has been possible in refrigerating systems heretofore. Reliance is not had, therefore, on heat to remove refrigerant from the oil; and because the reduced pressure

is so very much more effective in freeing the oil from the refrigerant, the system becomes quite independent of temperature conditions.

Moreover, my system gives to the refrigerant a much enhanced margin of safety. It is not economical to make a large dome a heavy one; yet where a dome is employed on the high side of the compressor it must for safety's sake be able to withstand extremely large pressures, generally much greater than those pressures which the refrigeration system must withstand as a whole, when it is out of operation, i. e. shipped or stored under conditions of relatively high external temperature. The reason for this is that if stoppage occurs in the line feeding the evaporator, i. e. if a float valve sticks, the compressor will continue to run and will build up an extremely high pressure which must be withstood by the dome, if the dome is on the high side of the system. This has been responsible for the bursting of many domes in service. Again, where the refrigerating system is subjected to very low external temperatures, the liquefied refrigerant will condense in a high side dome, and accumulate below the oil requiring expensive precautions for its removal. All of these incidental but important difficulties are avoided in my system.

For a better understanding of the system as such, reference is now made to the drawing where I have shown in a diagrammatic way a series of elements and a combination suitable for the practice of my invention in the aforesaid exemplary embodiment. In this drawing which, as indicated, is diagrammatic in character, dimensions have been disregarded and various operating parts have been shown in operating relationship but displaced from their normal positions in order that all of the parts could be shown in a single view.

In the drawing, (and first tracing through the elements of the closed system), 1 designates an evaporator adapted to be fed with liquid refrigerant from a condenser 2, through a high side float valve mechanism indicated generally at 3. Specific description of these elements is not necessary because their form and function is well understood by the skilled worker in the art. It will further be understood that the high side float valve is merely exemplary of the various means which may be employed to control the level of liquid refrigerant in the evaporator 1, such for example, as a capillary tube or equivalent restricted flow device. My system is likewise operative in connection with flooded evaporators having interior float valves to control the liquid level, and with evaporators which are of the non-flooded type.

4 designates the dome of a hermetically sealed refrigeration unit. It contains the motor 5, which through appropriate operating mechanism drives the piston 6 of a compressor 7. 8 designates the outlet port including the valve of the compressor 7; and it will be noted that this outlet port is connected by means of conduits 9 and 10 directly with the condenser 2. 11 is a muffler connecting the conduits 9 and 10, located within the dome 4 and making for silent operation. It will be noticed that the elements 9, 10 and 11 form a closed system, not opening into the dome. This system conducts the compressed refrigerant through the dome, as indicated. On the other hand, the evaporator 1 is connected by a low pressure conduit 12 directly with the dome 4. The inlet port 13 of the compressor 7 effectively opens into the dome as shown. In the exemplary embodiment there is a conduit 14 connected with the inlet port 13 and passing into a muffler 15; but this muffler opens into the dome as will presently be described more in detail.

In the operation of the system thus far described the compressed refrigerant goes directly from the compressor 7 to the condenser 2, where its temperature is lowered and where under the influence of temperature and pressure, it becomes liquefied. It is then fed by suitable means to the evaporator 1 where it is subjected to reduced pressure, vaporizes, and produces the desired lower temperature. The vaporized refrigerant passes through the conduit 12 to the interior of the dome 4; and the inlet of the compressor opens into this dome as has previously been indicated.

The dome is designed to hold in its lower portion a body of lubricant indicated at 16. The refrigeration system is one employing a refrigerant miscible with this lubricant. The operation of the compressor will be such, in the system described, as to subject the interior of the dome 4, and therefore the lubricant body 16 contained therein, to progressively lower pressures. Under the influence of these low pressures the refrigerant mixed or dissolved in the body of the oil will boil off and be compressed and returned to the system. In this way the body of the oil at the end of each cycle is kept relatively free from refrigerant, and as the oil that passes through the system returns to the compressor housing or dome its contained gas is exhausted.

It will be understood that when oil returns with the refrigerant through the conduit 12 and is subjected to the low pressure inside the dome, such oil will tend also to give up the refrigerant mixed therewith as indicated; and oil particles relatively free of refrigerant will tend to collect on various parts of the apparatus in the dome 4 and on the walls of the dome, and will flow down and be collected in the oil body 16. Of course, there will be at most times within the dome a fine mist of oil in the atmosphere of the dome. Some of this mist will be drawn into the compressor with the refrigerant gas to be compressed; but this is desirable, and such relatively reduced quantity of oil may have an important function in lubricating the interior of the compressor cylinder. However, to prevent too much of this oil passing with the refrigerant into the remainder of the system, I prefer to provide entrance means for the inlet port of the compressor such as that shown at 17. This is a bell shaped fitting connected with the muffler 15. The open end of the fitting is pointed downwardly. Thus oil collecting on the muffler and adjacent the enlarged opening of the fitting 17 will tend to drip off as at 18, rather than to be sucked into the compressor with the refrigerant gases. Another way of referring to this function of the apparatus is that it operates as a separator to a certain extent.

My system thus operates not only to provide a body of oil at the point of service for lubricant which is as free as possible from refrigerant, but also operates to keep the refrigerant in the remainder of the parts of the apparatus as free as possible from oil.

It will be understood, of course, that the compressors of modern refrigerators do not operate continuously but are designed to operate in cycles for the saving of power. Thus there are extended periods when the compressor is not operating. During such periods the pressure in the dome gradually rises and as it rises refrig-

erant in the dome gradually dissolves in the oil 16 again, depending on the elapsed time. But when the system is in service, the pressure inside the dome 4 will always be less than pressure elsewhere in the system, and in these circumstances, the amount of refrigerant which becomes dissolved in the oil in the dome is less than it would ordinarily be. However, as soon as the next cycle starts and the dome is lowered in pressure by the compressor, the boiling of the refrigerant out of the oil body 16 proceeds actively to the equilibrium point.

Therefore, as indicated, the body of oil 16 is maintained at the working point comparatively free of refrigerant at all times and quite free of refrigerant during the operation of the condenser. Oil may, therefore, be withdrawn from the body 16 and used within the dome for lubricating purposes where its effect would be greatly enhanced, because it is relatively undiluted by the refrigerant. In an exemplary refrigeration system, the oil initially introduced into it may have, say, a viscosity of 150. With the normal charge of a refrigerant which is miscible with the oil, say the common refrigerant freon, under conditions of shipment or storage, the viscosity of the oil will be reduced to around 100 due to dilution with the refrigerant. This gives an indication of how essential it is to keep the oil for lubricating purposes as free of the refrigerant as possible. With a body of oil 16 in the dome 4 kept relatively free of refrigerant the lubrication problem is solved merely by delivering this oil to the parts to be lubricated and returning the oil to the lower part of the casing. I have indicated at 19 a pump for oil, connected as shown to the main drive of the compressor. This pump withdraws oil from the body 16 by means of a conduit 20 connected to the inlet conduit 21 of the oil pump by a device which, in this instance, is a trap to maintain a body of oil continuously at the inlet of the oil pump 19. The pump, being constructed as shown, has no inlet valve. An outlet valve is shown at 22 and the oil from the pump 19 is delivered into a housing 23, from which a portion of the oil flows through a conduit 24 to those parts which require lubrication. Another portion of the oil flows, through an opening 25 in the housing 23, over the cylinder block of the compressor, so as to cool it. The particular type of oil pump and the particular manner of delivery of oil to the various parts to be lubricated, and the particular construction of these parts for efficient lubrication by being bathed in oil, do not constitute limitations upon my invention; and the constructions employed to this end need not here be described in detail. For the construction and arrangement of such parts in an exemplary compressor structure of the type diagrammatically illustrated here, reference may be made to my co-pending application Serial No. 121,630, filed January 21, 1937, which has matured into Patent No. 2,138,664, issued November 29, 1938.

It will be noted in my system that no gas can condense in the dome 4, for the reason that this dome is kept under reduced pressure. Therefore, there is neither the problem of artificially heating the oil so as to drive refrigerant from it, nor the problem of vaporizing liquid refrigerant in the dome, as has in the past been met by the inclusion in the dome of automatically operating heating devices.

I have described my invention in connection with one exemplary form of construction of refrigerating mechanism. It will be understood that it is not so limited, but may be applied to different types of construction with the same force and effect. It will further be understood that in the light of these teachings the skilled worker in the art can adapt my invention to varying types of construction of refrigerating mechanism without departing from the spirit of it. Therefore, the appended claims are not to be taken as limited otherwise than as set forth in their terms.

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

1. In a refrigerating system of the type employing a lubricant, and a refrigerant which is miscible with said lubricant, a dome, a motor and a compressor located in said dome, an evaporator and condenser located outside said dome, a connection between said evaporator and said condenser, a connection between said condenser and the high side of said compressor, a connection between said evaporator and said dome and a connection between the low side of said compressor and said dome, whereby said dome is subjected to the lowest working pressures generated in said system by the action of said compressor and whereby oil in said system will tend to collect in said dome and be freed of refrigerant therein, said connection between the low side of said compressor and said dome comprising a muffler, and a down-turned bell-shaped entrance means therefor.

2. In a closed refrigerating system, a dome, a compressor in said dome having its inlet port connected to said dome, and its outlet port connected to conduit means passing through said dome, whereby said dome is a low pressure dome, entrance means for refrigerant and entrained oil to said dome, whereby said refrigerant may be exhausted from said entrained oil by said low pressure and whereby said oil collects in said dome, and means for restricting entrance of said oil to said compressor comprising down-turned entrance means for the inlet port of said compressor acting as a separator, and having a bell shaped opening therein, to reduce the speed of flow of incoming refrigerant and to cause the oil to drip therefrom.

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