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J. FLEISCHER

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REFRIGERATION

Original Filed July 24, 1931 2 Sheets-Sheet 1

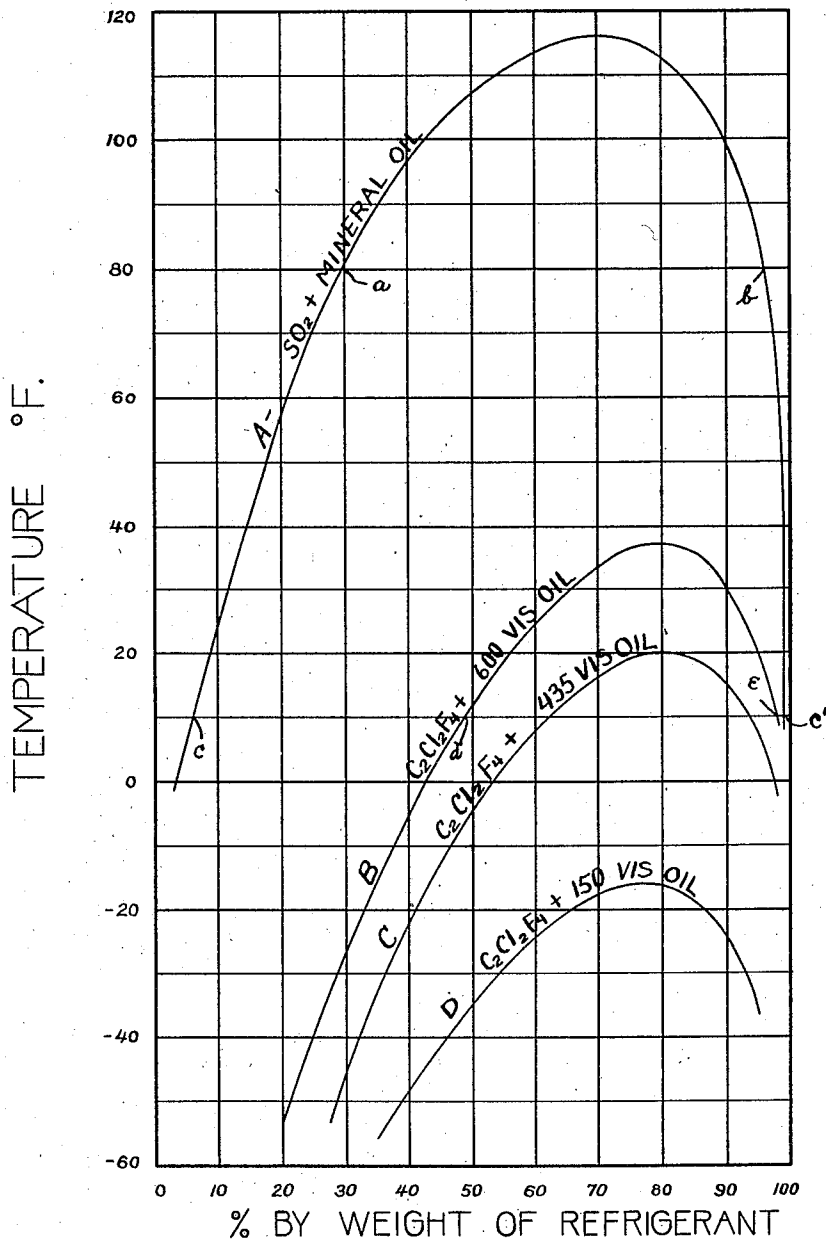


Fig. 1

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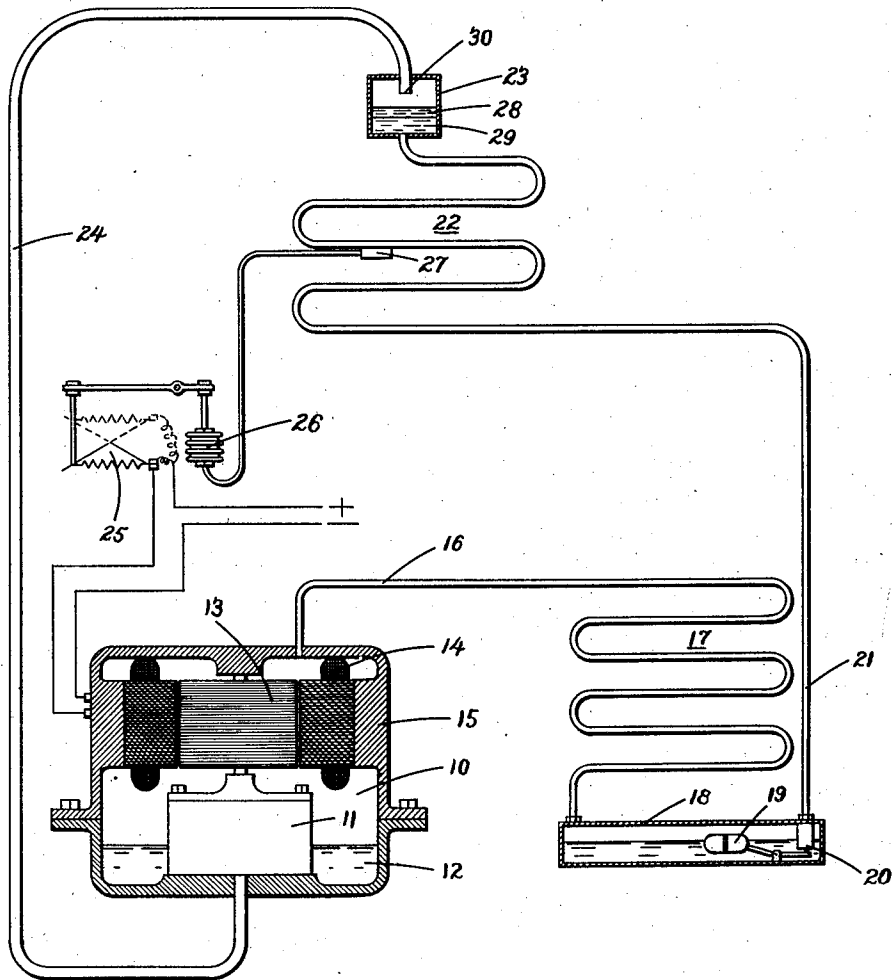


Fig. 2

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REFRIGERATION

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Renewed December 5, 1934

3 Claims. (Cl. 62—178)

This invention relates to refrigeration.

In refrigerating apparatus in which a refrigerant is compressed, condensed and evaporated in a closed cycle, a lubricant is generally provided for the moving parts working within the closed cycle of the apparatus. Normally the parts which require lubrication are the moving members of the compressor, or of the motor-compressor unit, if the motor is enclosed within the closed cycle of the refrigerating system, so that the refrigerant comes in contact with moving parts of the motor. Normally it is not necessary to lubricate any other parts within the closed cycle. It would be an ideal condition, if the lubricant could be retained or localized at these moving parts. However, it is practically impossible to completely separate the refrigerant and lubricant at the discharge of the compressing mechanism, and, as a consequence, a small amount of lubricant is continuously carried along with the refrigerant into the condenser and evaporator of the system and must be returned to the compressor to prevent lubricant starvation of the compressor. A large proportion of the trouble encountered in refrigeration systems, particularly of the household type, is due to the failure of the lubricant to return to the compressor after it has been carried away by the refrigerant.

Extensive research has been carried on heretofore to develop means for insuring the return to the compressor unit of the lubricant from the remainder of the refrigerating system. In general, it has been heretofore proposed to allow the refrigerant and lubricant to separate from each other into layers in the evaporator and to provide means for skimming or aspirating the upper layer of lubricant from the evaporator by means of the returning gaseous refrigerant in order to return the lubricant to the compressor. An example of such a system is one in which sulphur dioxide and some type of mineral oil are used. With this type of refrigerant it has been found that the lubricant and refrigerant tend to separate out in layers, or phases, in the receiver of the condenser under certain unfavorable conditions of operation and also in the evaporator. It is advantageous to have the layer separation in the evaporator; but it is very disadvantageous to have such a separation in the receiver since it is necessary to submerge the intake of the refrigerant pipe leading from the receiver to the evaporator in the lower layer of liquid in the receiver. This permits a large accumulation of lubricant in the upper layer of the receiver which, when it grows

unduly in volume starves the compressor of its normal amount of lubricant.

Heretofore, also, it has been proposed to use a mixture of refrigerant and lubricant in which the constituents are completely miscible in all proportions in all parts of the refrigerating system. An example of this type of system uses methyl or ethyl chloride and mineral oil. This type of system overcomes the objection that the receiver of the condenser will accumulate unduly a large amount of lubricant, but it is open to the objection that the advantageous layer separation in the evaporator is not available as a means of returning the lubricant to the compressor.

I have discovered a mixture of lubricant and refrigerant which is capable of taking advantage of both systems heretofore used and in which the objections to either of the systems above described are absent. This mixture is one in which the refrigerant and lubricant are completely miscible in all proportions in the compressor and in the condenser at normal operating temperatures, and in which the lubricant and refrigerant are not completely miscible at the normal temperatures of the evaporator. With this mixture the lubricant and refrigerant separate out in layers in the evaporator and permit the use of the various means heretofore extensively developed for returning the concentrated lubricant layer from the evaporator to the compressor. As an example of this type of mixture I may use a fluorine containing compound such as dichlorotetrafluoroethane ($C_2Cl_2F_4$) and certain mineral oils of the proper viscosity in accordance with the charts shown.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a chart showing the solution properties of mixtures utilizing my invention, and also showing the properties of a mixture of sulphur dioxide and of a representative mineral oil used with sulphur dioxide in refrigerating systems now in common use; and

Fig. 2 is a diagrammatic representation of a refrigerating system charged with a refrigerant and lubricant mixture in accordance with this invention.

In household refrigerating machines, the evaporator is generally operated between temperatures of zero and 20° F., the condenser, in the summer time, usually operates at relatively high

temperatures, but during parts of the day, or at various seasons may operate at 80° F. and even lower. The compressor generally operates at temperatures above 100° F., but under certain conditions, parts of the compressor casing may not reach that temperature. These temperatures are given merely as an example, it being understood, however, that the compressor and condenser temperatures, particularly, may vary considerably, since if the condenser is to be air-cooled, its temperature will be dependent upon the atmospheric temperatures which in turn vary greatly from day to day and from season to season. Also if the condenser is water-cooled, its temperature is dependent upon the varying water temperatures throughout the country. Hence the temperatures given above are merely exemplary, and are given in order that the chart in Fig. 1 may be more readily understood.

The mixture of sulphur dioxide and a representative mineral oil, whose liquid phase chart is shown at A, Fig. 1, forms two layers, or phases, at various temperatures below about 117° F. Thus at 80° F. the mixture forms one layer (shown at a, Fig. 1) which has approximately 30%, by weight, of refrigerant and another layer (shown at b, Fig. 1) which has approximately 96%, by weight, of refrigerant. Since the oil is of lighter specific gravity than the refrigerant, the 30% refrigerant layer floats on the 96% refrigerant layer. Thus it is apparent that the liquid being discharged from a condenser containing these substances into a receiver separates, if at 80° F., into two layers of the proportions just given. The 96% refrigerant layer, or bottom layer, is removed from the bottom of the receiver to the evaporator by a pipe, with the consequence that the 30% refrigerant layer is untouched and becomes larger and larger in volume. An undue amount of lubricant may thus be trapped in the receiver, with a consequent lubricant starvation in the compressor unit. The mixture of sulphur dioxide and lubricant forms two layers in the evaporator which, if the evaporator is operating at 10° F., would be respectively 6%, by weight, of refrigerant (shown at c, Fig. 1) and 99% or more by weight of refrigerant (shown at c', Fig. 1). The 6% refrigerant or upper layer can be removed from the evaporator either by skimming or aspiration very readily and may be returned to the compressor. In this type of system it is possible to prevent an unduly thick layer of the 6% refrigerant mixture from forming in the evaporator. As a consequence in such a system, lubricant starvation in the compressor unit is liable to occur mainly by accumulation of lubricant in the receiver.

In using mixtures which are completely miscible at all temperatures prevailing in the refrigerant system, there is no liability of accumulating unduly any lubricant in the receiver, for the reason that substantially the same mixture which is discharged from the condenser is carried up from the receiver into the evaporator. However, since in the evaporator there is no layer, or phase, separation, it is not possible to take advantage of the skimming or aspirating means which have been so highly developed for use with such separable mixtures as sulphur dioxide and mineral oil.

In the chart shown in Fig. 1, as shown by curve B, it will be seen that a mixture of 600 viscosity asphaltic base mineral oil and $C_2Cl_2F_4$ separate into two layers or phases in the evaporator, assuming it to be at 10° F., but do not separate in

the receiver of the condenser, assuming it to be at 80° F. Such a mixture separates into two layers in the evaporator which have respectively 48% and 97%, by weight of refrigerant (shown at d and e, Fig. 1). The upper layer, which is rich in lubricant, may be returned to the compressor by any of the skimming or aspirating devices heretofore used for returning sulphur dioxide and mineral oil mixtures. In my improved system, therefore, there is much less liability for lubricant starvation of the compressor unit, than in prior systems, since there is no possibility of accumulating a large layer rich in lubricant in the receiver of the condenser, and since it is possible to effectively return the lubricant layer in the evaporator.

The chart in Fig. 1 also discloses in curve C the fact that a mixture of 435 viscosity asphaltic base oil and $C_2Cl_2F_4$ forms layers at 20° F. and under but not above. Since the evaporator temperatures normally used in domestic refrigerators sometimes rise to 20° F., this viscosity would be the limiting viscosity for such a system, it being understood, however, that when other temperatures are used in the system, then a different viscosity may be used successfully. The lowest curve D shows that a mixture of 150 viscosity asphaltic base oil and $C_2Cl_2F_4$ does not form layers above a temperature of -16° F. Such a mixture would therefore not be used in a system in which the evaporator temperature rises above -16° F., if it is desired to take advantage of the principles of my invention.

In Fig. 2 there is shown diagrammatically a refrigerating system for the purpose of illustrating the advantages of my invention. In this system, a motor compressor unit is shown at 10, in which a compressor 11 is partially submerged in a liquid rich in lubricant, shown at 12. The compressor is driven by a motor rotor 13 which derives its driving power from a stator 14. All of these parts may be enclosed in a single casing 15 so that all of the moving parts are subjected to lubrication derived from the refrigerant and lubricant mixture passing through the unit. The compressed fluid is discharged through the pipe 16 to a condenser 17 where the refrigerant is liquefied and is discharged into the receiver 18. Merely as an example, the expansion valve is shown to be operated by a float 19 which operates the valve at the inlet 20 of the pipe 21 which leads to the evaporator 22. The evaporator 22 may be provided with an aspirating chamber 23 from which the evaporated refrigerant, and some lubricant, are returned by the pipe 24 to the compressor 11. The motor is controlled by a snap switch 25 operated by an expansible bellows 26 which is connected to a thermostatic bulb 27. The snap switch 25 operates the motor intermittently to maintain the evaporator within predetermined temperature limits.

In this system it is evident that the liquid shown at 12 will be maintained at temperatures above 100° F. when the compressor is operated, since the liquid is subjected to the heat of compression, and, if desired, also to the heat of the compressor itself. The liquid in the receiver 18 is substantially at atmospheric temperature or slightly above, and may be taken as representative of the condenser temperature which under some conditions may be 80° F. The temperature in the aspirating chamber 23 may be taken as 10° F. Under such conditions a mixture of 600 viscosity asphaltic base oil and $C_2Cl_2F_4$, such as is shown at B, Fig. 1, is completely miscible

at 12 and 18, but forms, in the chamber 23, an upper layer 28 rich in lubricant and having only 49% refrigerant and a lower layer 29 rich in refrigerant and having 95% refrigerant. The upper layer 28 is therefore subjected to a greater degree to the aspirating action of the end 30 of the pipe 24 than is the lower layer 29. This insures that a heavy concentration of lubricant throughout the body of the evaporator shall not occur and thus prevents lubricant starvation in the compressor unit.

With a mixture of sulphur dioxide and mineral oil in a system such as shown in Fig. 2, it is possible that an upper layer may be formed in the receiver 18 which will be rich in lubricant. Since the pipe 21 removes only the lower layer, it would be possible for this layer of rich lubricant to become greater and greater in volume until undue starvation of lubricant would be effected in the compressor unit 10. With a refrigerant lubricant mixture which is completely miscible throughout the system, it is possible for the evaporator to contain such a concentrated mixture, rich in lubricant, that undue starvation of lubricant of the compressor unit 10 would occur. With a mixture in accordance with my invention, however, these disadvantages are removed from both of the prior systems and many advantages of both are retained.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be

adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. The method of refrigeration which comprises compressing, condensing and evaporating a refrigerant in a closed cycle, and carrying a lubricant with said refrigerant which is completely miscible with said refrigerant at the normal compressing and condensing operating temperatures but which is not miscible in all proportions at the normal evaporating operating temperatures.

2. The method of refrigeration which comprises compressing, condensing and evaporating dichlorotetrafluoroethane in a closed cycle, and carrying a lubricant with said dichlorotetrafluoroethane which is completely miscible with said dichlorotetrafluoroethane at the normal compressing and condensing operating temperatures but which is not miscible in all proportions at the normal evaporating operating temperatures.

3. The method of refrigeration which comprises compressing, condensing and evaporating a refrigerant in a closed cycle, mixing with said refrigerant a lubricant which is completely miscible with said refrigerant at certain normal operating temperatures in said cycle but which is not miscible in all proportions at the normal operating temperatures of other portions of said cycle.

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