

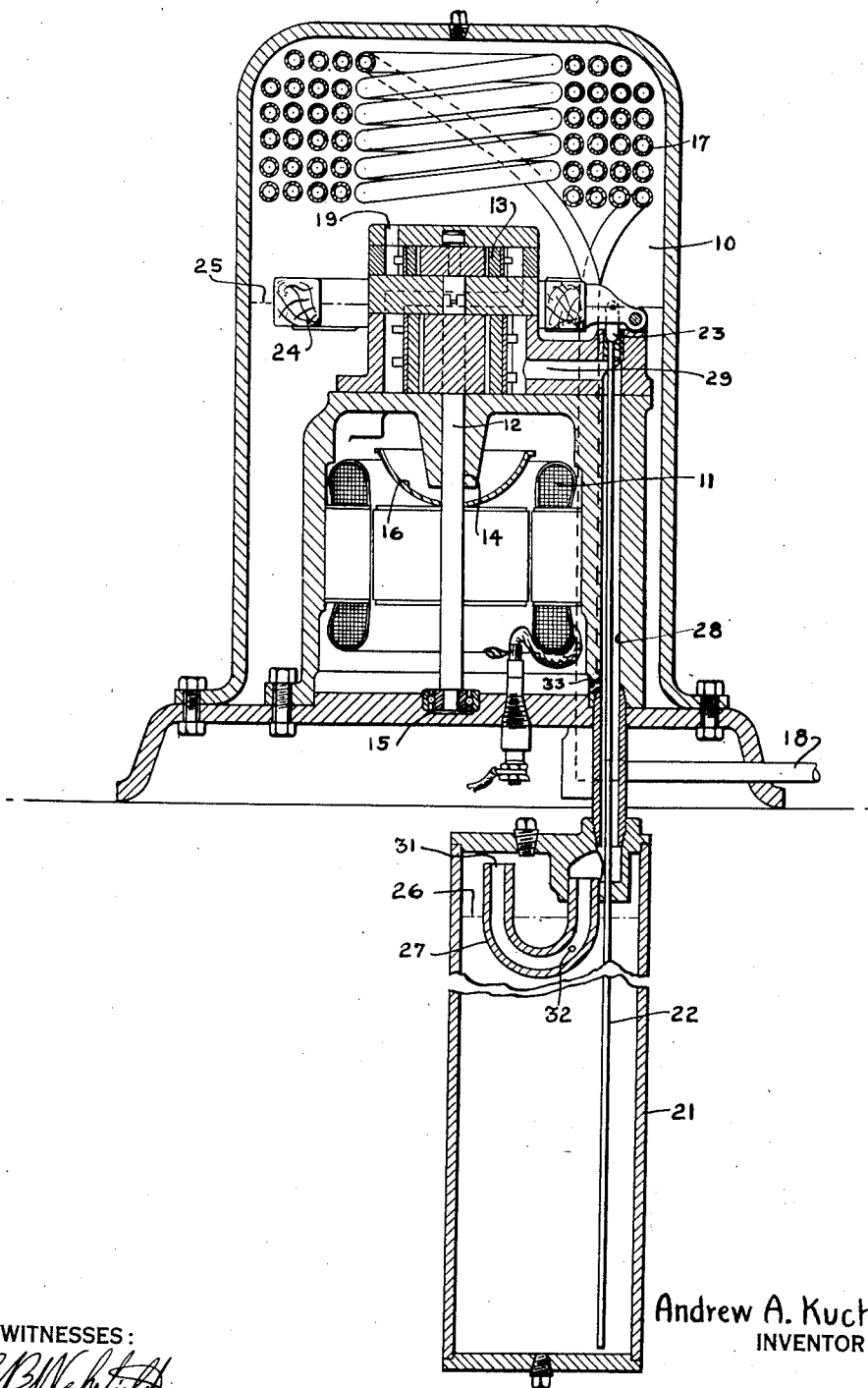
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WORKING FLUID FOR REFRIGERATION

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WITNESSES:

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WORKING FLUID FOR REFRIGERATION

Application filed August 11, 1928. Serial No. 128,656.

My invention relates to the art of refrigeration, particularly as practiced by the so-called compression process, and it has for an object to provide an improved working fluid for use in processes of the character designated which shall have the required physical characteristics and which shall possess both refrigerating and lubricating qualities.

It has heretofore been generally proposed to employ in compression refrigerators a lubricant which is immiscible with the refrigerant, that is, a refrigerant and a lubricant which separate readily by gravity. Many liquids possessing to a greater or lesser extent this property have been used, generally with incomplete success, since no combination of a refrigerant and a lubricant has been found in which the liquids do not mingle to some slight extent when brought together under the conditions of agitation obtaining in a compression refrigerator. Mechanical separators of various types have been employed with some of these machines in order to facilitate the separation of the refrigerant and the lubricant. This expedient has improved the operation but has not resulted in accomplishing a complete separation of the refrigerant from the lubricant. In machines employing such refrigerants and lubricants, continued operation generally results in some of the lubricant being dissolved in the refrigerant and possibly some of the refrigerant in the lubricant. However, the percentage of refrigerant dissolved in the lubricant is so small that the solution thus produced has substantially no refrigerating qualities while its effectiveness as a lubricant is materially lessened. On the other hand, where the lubricant is dissolved in the refrigerant, the effectiveness of the refrigerating fluid is impaired and the percentage of lubricant contained therein is so small as to make it entirely unsuited for lubricating purposes. In such machines, therefore, there results, after a continued period of operation, a lubricant whose lubricating qualities have been impaired by its solution with some refrigerant and a refrigerant whose refrigerating quali-

ties have been impaired by its solution with some lubricant.

In the present invention, I have departed radically from previous attempts to use refrigerants and lubricants which are immiscible and I have evolved a single liquid, which I term a working fluid, which working fluid is capable of not only producing the required refrigerating effect but of lubricating the refrigerating machine as well. This working fluid consists of a refrigerant and a lubricant which readily mix in substantially all proportions, one with the other, to form a physical solution or a homogeneous liquid of a character that its constituents are soluble in each other and not separable mechanically or gravitationally. By using such a working fluid, I am able to overcome completely the lubrication difficulties heretofore experienced in the operation of compression refrigerators.

In obtaining a working fluid of this character, a wide range of refrigerants and lubricants may be employed. I have found by experiment that castor oil serves best as a lubricant and that it forms a homogeneous solution in substantially all proportions with sulphur dioxide. However, I may employ as equivalents of sulphur dioxide either ethyl chloride or methyl chloride. All of the foregoing refrigerants are well known and widely used. I have further found that castor oil forms a physical solution with any of these refrigerants in substantially all proportions. The amount of castor oil employed in proportion to the amount of refrigerant depends upon the type of machine wherein it is utilized and especially upon the type of compressor or pump employed. I have found, that, with some machines, very satisfactory results can be obtained by using about $\frac{1}{3}$ castor oil and $\frac{2}{3}$ liquid refrigerant by volume.

I have found that under severe centrifugal tests, this admixture of castor oil and sulphur dioxide, exhibits no tendency to separate into its constituents and hence may be said to constitute a true physical solution. This characteristic of my working fluid I have defined by the term "mechanically inseparable". The refrigerant may be separated from the lubri-

cant, however, by a distillation process. As stated heretofore, such a mixture is homogeneous, by which is meant that a body of such liquid possesses the same physical characteristics and properties throughout all portions.

It is generally recognized that sulphur dioxide exerts a corrosive action upon some metals. However, I have found that by mixing it with castor oil, this corrosive action is not found and hence my working fluid may be said to be non-corrosive, a highly desirable quality.

In the drawing accompanying this application, I show one form of compression refrigerator in which a working fluid such as heretofore described may be employed. This is a type of machine which is similar to that shown and described in a co-pending application of mine, Serial No. 550,445, filed April 7, 1922, and entitled "Refrigerator". This machine comprises a chamber 10 within which is disposed an electric motor 11 connected through a shaft 12 to a compressor 13. The compressor shown is of the rotary, two-stage type although it is to be understood that my working fluid may also be readily employed with compressors of the reciprocating type. The shaft 12 is carried in upper and lower bearings 14 and 15 and an arrester 16 is secured to the shaft within the housing of the motor to catch liquid draining downwardly along the shaft from the compressor.

Disposed within the chamber 10, are a plurality of condensing coils 17 having an inlet 18 for the admission of cooling water and an outlet, not shown. The compressor 13 discharges through the port 19 into the condensing chamber 10 and the condensed liquid is conveyed to a cooling element or evaporator 21 by a conduit 22. A valve 23 operated by a float 24 is provided for controlling the flow of liquid through the conduit 22.

A body of my novel working fluid is provided in a liquid state in both the condensing chamber 10 and the evaporator 21. The levels of these two bodies of liquid are, during normal operation, such as indicated at 25 and 26 respectively. Provided within the evaporator 21 is a vapor conduit 27 which connects with a vapor conduit 28 communicating with the inlet port 29 of the compressor 13. The vapor conduit 27 is so formed as to reverse the flow of the vapor. It has its entrant portion 31 disposed well above the normal operating level of the liquid in the evaporator and has its lower-most portion disposed well below the normal operating level of the liquid within the evaporator. Provided in this lower-most portion is a small aperture or hole 32 for entraining liquid in the vapor conduit 27. A drain port 33 opens into the vapor conduit 28 to permit any liquid which may accumulate in the lower portion of the

housing of the motor to return to the compressor.

The operation of a machine such as described is as follows: The condensing chamber 10 and the evaporating chamber 21 are filled approximately to the levels indicated in the drawing at 25 and 26, with my novel working fluid. Prior to starting the motor, a quantity of the liquid working fluid fills the vapor suction tube 27 to the level of the liquid in the evaporator 21. The first rotations of the compressor 13 draw this liquid into the compressor so that a thorough priming of the moving parts is obtained during the initial operation thereof. The priming liquid not only lubricates the frictionally engaging surfaces but seals the working chambers of the pump against vapor leakage. As the rotation of the pump continues, vapors from the evaporator 21 are drawn through the conduits 27 and 28 to the suction port 29 of the compressor 13 from whence they are discharged into the condensing chamber 10 at an increased pressure. A fine stream or spray of the liquid in the evaporator 21 enters the vapor conduit 27 through the aperture 32 and is commingled with the vapors flowing through the conduits 27 and 28 to the compressor. This commingled liquid serves to seal and lubricate the pump in passing therethrough and is supplied continuously as long as the compressor is in operation. When a predetermined cooling action has resulted from the operation of the machine, automatic mechanism (not shown) cuts off the current to the motor and thus stops the action of the compressor. During the period of rest which follows, some of the liquid in the evaporator 21 fills the lower portion of the vapor conduit 27, placing the machine in readiness for starting again.

The lubrication of the shaft bearings 14 and 15 is accomplished from the liquid delivered to the compressor. Some of this liquid seeps down through the upper bearing 14 and, in view of the fact that this liquid has lubricating qualities in addition to its refrigerating qualities, it lubricates the bearing in passing therethrough. The liquid drains from the lower end of the bearing into the arrester 16 from whence it is thrown by centrifugal force to the side walls of the housing of the motor and collects in the bottom thereof. A shallow pool of liquid is constantly maintained therein for lubricating the lower bearing 15, the excess being carried away through the drain port 33 into the vapor conduit 28 wherein it commingles with the refrigerant vapor and, in combination with the liquid entrained in the evaporator, seals and lubricates the compressor in passing therethrough.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications,

without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

5 What I claim is:—

1. A working fluid for a refrigerating machine which consists of castor oil and a refrigerating fluid which forms with castor oil
10 a homogeneous mixture or physical solution in substantially all proportions.

2. A working fluid for a refrigerating machine which consists of castor oil and sulphur dioxide forming with the castor oil a physical
15 solution or homogeneous mixture in substantially all proportions.

3. A working fluid for a refrigerating machine which consists of sulphur dioxide and a lubricant which forms therewith a mechan-
20 ically inseparable homogeneous mixture in substantially all proportions.

4. A working fluid for a refrigerating machine which consists at least in part of castor oil, and sulphur dioxide.

25 5. A working fluid for a refrigerating machine which consists of sulphur dioxide and castor oil, the volume of liquid sulphur dioxide predominating over the volume of castor oil.

30 6. A working fluid for a refrigerating machine which consists of at least ten per cent castor oil by volume and a refrigerant which forms therewith a mechanically inseparable homogeneous mixture in substantially all
35 proportions.

7. A working liquid for a refrigerating machine which consists of sulphur dioxide and castor oil, the castor oil comprising at least
40 ten per cent of the volume of the working liquid.

8. A working fluid for a refrigerating machine which consists of substantially $\frac{1}{3}$ castor oil and $\frac{2}{3}$ liquid sulphur dioxide by volume.

45 9. The method of lubricating a closed-cycle refrigerating machine which consists in alternately compressing, condensing and expanding a refrigerant medium having intimately and homogeneously mixed therewith
50 particles of castor oil.

10. The method of lubricating a closed-cycle refrigerating machine which consists in alternately compressing, condensing and expanding sulphur dioxide having intimately
55 and homogeneously mixed therewith particles of a lubricating medium.

11. The method of lubricating a closed-cycle refrigerating machine which consists in alternately compressing, condensing and
60 expanding sulphur dioxide having intimately mixed therewith particles of castor oil.

In testimony whereof, I have hereunto subscribed my name this twelfth day of July,
1926.