

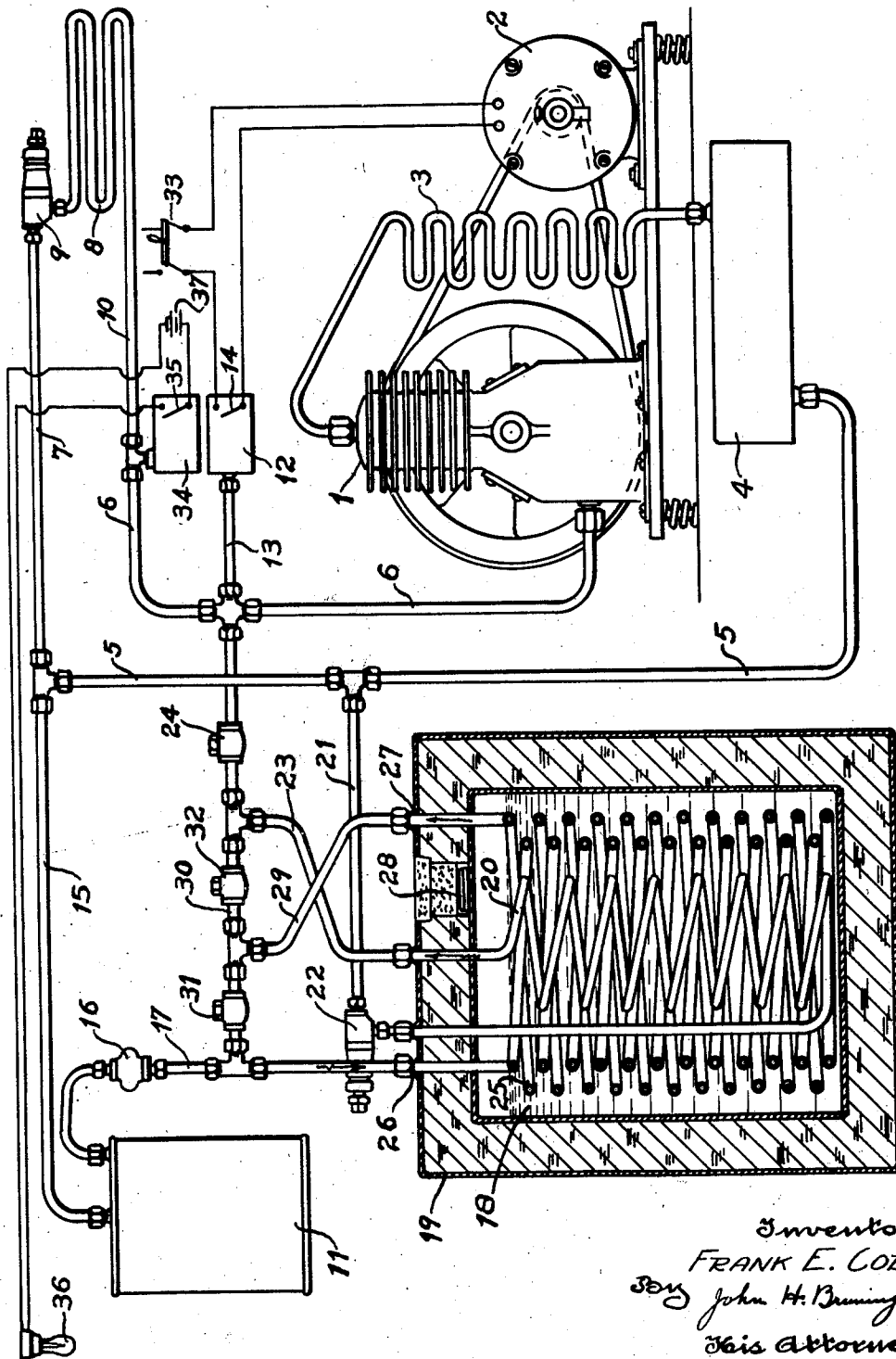
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REFRIGERATING SYSTEM

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REFRIGERATING SYSTEM

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This invention pertains to refrigerating systems of the expansion or flooded type and more particularly to systems automatically operated to maintain a more or less uniform refrigeration.

In certain types of such automatic systems a single condensing unit is arranged to supply a refrigerant to a plurality of refrigerating devices. Such refrigerant is usually supplied in liquid form and the refrigerating device operates to vaporize the liquid, the refrigerating effect being obtained by absorption of heat during such vaporization. The function of the condensing unit is to re-absorb the heat from the vaporous refrigerant and to condense the same to liquid form for re-circulation in the system. In such installations if the duty required of one of the refrigerating devices is heavier than that of another, there is a tendency for the condensing unit to operate frequently in response to demands from the heavily loaded device, and as a consequence the other device may have imposed upon it a more intense refrigerating action than is desired.

One of the objects of this invention, therefore, is to provide means whereby the excess service required by a heavily loaded refrigerating device may be supplied without operating the main condensing unit with excessive frequency.

Under certain conditions, as for instance in bars where a special refrigerating device is applied for cooling beer as it is dispensed, an intense and frequent refrigerating action is required at the beer cooling device and such device must be maintained in service in order to avoid spoilage of the beer dispensed. Accordingly, if for instance the main condensing unit should get out of order so that some time might elapse before it could be serviced and repaired the beer dispensing refrigerating device would cease to function and its business would be practically suspended until the condensing unit could be repaired.

Another object of this invention, therefore, is to provide extra refrigerating capacity capable of supplying a so-called hold-over of refrigeration for a considerable period in case the main condensing unit is rendered inoperative.

Another object is to provide a heat absorbing device of novel construction and mode of operation capable of providing the extra refrigerating effect required by a heavily loaded device.

Another object is to provide such an absorbing device so arranged that during its operation any oil which may be carried thereto by the flow

of refrigerant from the main condensing unit will not be permitted to accumulate therein but will be transmitted back to the condensing unit.

Another object is to provide such an auxiliary absorbing device adapted to smooth out fluctuations in demand upon the main condensing unit imposed by different refrigerating devices operating under different conditions.

Another object is to provide such a device which may itself be cooled or refrigerated by the main condensing unit.

Further objects will appear from the following description taken in connection with the accompanying drawing in which the figure represents a view partly in diagrammatical form and partly in section of a system of refrigeration embodying this invention.

The system selected for illustration in the drawing is one including an instantaneous liquid cooler such as is ordinarily used for cooling beer as it is dispensed together with one or more other refrigerating devices which may be used for general cooling purposes, such as refrigerating food supplies or cooling beer in storage or the like. It is understood, however, that the invention may be applied to other types of installations to which its action may be suitable.

Referring now to the drawing the main condensing unit illustrated is represented as a compression-condenser of the ordinary type including a compressor 1 driven by a motor 2 of any suitable type. In the illustration an electric motor is shown. The drive may, however, be by internal combustion engine or other suitable prime mover. The compressor 1 compresses the vaporous refrigerant and delivers the same to a condensing coil shown conventionally at 3 which may be cooled in any suitable manner not indicated in the drawing and in which the vapor is condensed to a liquid and delivered to a receiver 4. This unit may be of any ordinary type well known in the art.

From the condensing unit in accordance with the usual practice a liquid line 5 goes out to the system to be refrigerated from the receiver 4, while a suction line 6 carries the vapor back from the system to the compressor 1. The liquid line 5 may have various branches going to different refrigerating devices. In the illustration a branch 7 goes to a refrigerating device 8 through an expansion valve or metering device 9 and the vapor is returned by the branch 10 to the suction line. The device 8 may be arranged for cooling any desired compartment for storage of perishable material and the like. This unit may

be one of several connected to, and operated by, the main condensing unit.

The operation of the condensing unit is preferably controlled by automatic means controlling the operation of the motor 2. Such means are indicated at 12. Ordinarily such a device may be connected by a line 13 to the suction line 6 and is usually constructed so as to be operable by the pressure within the suction line to close a switch 14 when the pressure reaches a predetermined value indicating a certain rise of temperature for the system. The device 12, though operated by pressure, is in reality a thermostatic device as its function is to maintain a low temperature in the system refrigerated by starting the action of the condenser whenever that temperature rises above that predetermined point. Accordingly, although actuated by pressure, such pressure is a function of the temperature and the device 12 may properly be considered a thermostatic device and it will be so named hereinafter, the term "thermostatic device" being used to include either temperature or pressure operated devices.

A so-called instantaneous liquid cooler is represented at 11. This may be applied to the cooling of beer, as suggested above, or to other similar service. A characteristic of such a device is that it must operate at frequent intervals and must be capable of quick absorption of a considerable amount of heat. Under such circumstances it may demand considerably more of the refrigerating effect provided by the condensing unit than other devices such as 8. The device 11 may be connected to the liquid line 5 by a branch 15 and the vapor may be returned therefrom through a regulating valve 16 to a line 17. If the return line 17 were connected directly to the suction line 6 the extra service required by the device 11 might cause the condensing unit to operate at such frequency that the unit 8 which is also connected to the suction line 6 would be chilled to too great an extent. In order to balance this effect an auxiliary heat absorbing device is provided.

Such a heat absorbing device may comprise a brine tank 18 in a suitable insulating enclosure 19. The term "brine tank" as hereinafter used will be understood to include a tank for any type of freezing solution whether actually a brine solution or of any other type. In fact a solution of alcohol in water is usually used in such a tank and has been found to give satisfactory service. Mounted within the tank 18 is an expansion coil 20 connected to the liquid line 5 by a branch 21 through an expansion valve or metering device 22 in the usual manner. The other end of the coil 20 is connected by a branch 23 to the suction line 6 through a check valve 24 whose function will be described presently. Also mounted in the tank 18 is a condensing coil 25. This coil is shown as a double coil having both its inlet end 26 and its outlet end 27 brought out of the tank 18 at points above the level of the solution therein and preferably at the top of the tank. A filler opening 28 may be provided through which the solution may be supplied to the tank.

In connecting the auxiliary absorbing device to the system the coil 20 is connected as already described while the coil 25 has its inlet connected to the line 17 and its outlet connected by a branch 29 to a cross line 30 to which the branch 23 of the expansion coil is also connected.

The line 30 extends from the outlet line 17

of the instantaneous cooler 11 to the suction line 6 and has connected thereto, as described, the branches 29 and 23. Included in the line 30 and so as to separate these branches from each other and from the line 17 are check valves 31 and 32. These valves are set to open in response to a flow of vapor therethrough from the line 17 toward the suction line 6, but to close so as to prevent a flow in the reverse direction. These valves are preferably spring-controlled and adjustable so as to open at a definite pressure. The adjustment is usually made so that the valve 32 is set at a slightly higher pressure than the valve 24, while the valve 31 is set at a slightly higher pressure than the valve 32.

The operation of this system is as follows: Assuming that the system is started up for the first time with all parts at atmospheric temperature, the motor 2 is started by closing the line switch 33, the switch 14 being closed automatically on account of the temperature. This sets the condensing unit into operation so that the vaporous refrigerant in the system is compressed by the compressor 1 and condensed to liquid in the condensing coil 3 whereby it is delivered to the receiver 4. This liquid goes out over the line 5 to the refrigerating devices 8 and 11 and to the expansion coil 20 in the absorbing device. The action of the coil 20 is to cool the solution in the brine tank 18 and the unit continues to operate until this solution has been reduced in temperature to the desired point. This is usually around 22° F. and the solution may be such that a certain amount of ice is formed in the brine tank 18. When the proper temperature has been established in the system the pressure in the suction line 6 is reduced sufficiently so that the device 12 operates to open the switch 14 and shut down the condensing unit.

The action of the device 8 may follow the ordinary routine usual to such devices. This is included in the illustration to represent one or more standard devices of this type which may be included in the installation.

The device 11 will ordinarily operate at frequent intervals and will absorb a considerable amount of heat so that a considerable volume of vapor is developed thereby and delivered to the line 17. This vapor passes into the condensing coil 25 and is condensed to liquid therein. If the production of vapor by the device 11 should occur in sufficiently large volume the pressure in the line 17 would increase to a sufficient extent to open the check valve 31 and permit the excess vapor to pass down the branch 29 and into the outlet end 27 of the coil 25. Accordingly, both ends of the coil 25 may be utilized for condensing the vapors produced by the device 11. Under ordinary operation the inlet end alone will accommodate the vapors produced. The arrangement of the valve 31, however, is such as to render both ends of the coil available in case of need. As the refrigerating capacity of the solution in the tank 18 is considerable, condensation of vapors received from the device 11 may continue for a considerable period of time before the temperature of the solution is raised to a great extent. Such temperature, however, does increase gradually and in accordance with such increase the pressure in the outlet line 27, 29 gradually rises. After a certain period this pressure becomes sufficiently great to open the valve 32 whereupon any uncondensed vapor may flow along the line 30 past the valve 24 and into the suction line 6. Here it establishes increased pressure in the starting

device 12 so that the switch 14 is closed and the condensing unit set into operation.

With the condensing unit in operation the suction established in the line 6 keeps the valves 24 and 30 open and draws the uncondensed vapor from the line 27, 29. The reduced pressure established in this end of the coil 25 now promotes evaporation of the condensed refrigerant liquid in the lower coils thereof. Such evaporation in turn produces a refrigerating effect absorbing heat from the solution and again reducing its temperature to the desired point. When such temperature is attained the pressure in the suction line is again reduced to a value such as to cause the automatic device 12 to shut down the condensing unit. In this way the extra refrigerating capacity of the brine tank 18 is made use of to lengthen the cycle of operation of the condensing unit to such a value as to be proper for taking care of the requirements of the device 8 and such other similar devices as may be connected to the system.

The expansion coil 20 and its expansion valve or metering device 22 are so adjusted that a certain amount of refrigeration is provided thereby in a substantially continuous operation. This effect is adjusted to a low value sufficient to take care of leakage losses of heat in the tank 18 and such other requirements as may result from irregularities in the operation of the system.

It will be noted that the coil 25 provides both a condensing coil and expansion coil. The vapors passing thereto from the line 17 are condensed during the period when the main condensing unit is shut down. On the other hand, while the condensing unit is operating the liquid in the coil 25 evaporates and thus produces the cooling effect of an expansion coil. Furthermore this auxiliary absorbing device has a substantial refrigerating capacity once it has been cooled down to the proper temperature. The tank is usually constructed of such dimensions as to have a refrigerating capacity capable of carrying the load imposed upon it by the device 11 for a period of say four or five hours. Accordingly, in case of accident to the main condensing unit such as to interfere with its operation, the system will continue in operation for a sufficient length of time to enable the main condensing unit to be serviced and put in proper repair so as to resume operation usually before the refrigerating capacity of the brine tank is exhausted.

An important feature of this device is that when lubricating oil used for lubricating the compressor 1 is carried into the refrigerating system, as is usually the case in a pressure condensing system, such oil finally finds its way into the coil 25. Here it is carried through the coil from the inlet to the outlet side with the condensing liquid refrigerant. Upon subsequent evaporation of the refrigerant during operation of the condensing unit such evaporation usually takes place with a considerable amount of ebullition so that the oil contained in or floating upon the liquid refrigerant is thrown up in the form of a spray and is carried with the vapor out of the coil 25 and back through the suction line to the crankcase of the compressor 1. It has been found that during normal operation only a small percentage of the total quantity of oil in the system is found at any time in the coil 25. Accordingly, this device operates to return to the compressor any lubricating oil that may find its way into the system.

In order to insure continuous operation and prompt correction of trouble, an indicating device is provided adapted to give a warning of failure

of the condenser unit to operate when it should. An automatic device 34 similar to the switch 12 is connected to the suction line 6 so as to be operated by the pressure therein. This device is adjusted to operate at a pressure slightly above that for which the device 12 is adjusted. Accordingly, the device 34 will not operate until a pressure somewhat higher than that of the device 12 is active in the suction line. The device 34 controls a switch 35 which in turn controls a signal device such as a lamp 36 located at the station of the attendant so that his attention will be attracted thereby. This device is preferably supplied by a separate source of power such as a battery 37. It will be clear that this arrangement is adapted to give warning of any failure of the main condenser. Supposing, for instance, that the power supply 33 should fail or that there should be trouble in the motor 2 or for any other reason the condensing unit should fail to operate, the pressure in the suction line 6 would operate to close the switch 14. This according to normal operation should start the condensing unit. Upon failure to start the pressure in the suction line will continue to increase until a value is reached sufficient to operate the device 34 whereupon the switch 35 will be closed and the indicator 36 will call the attendant's attention to the fact that conditions require the operation of the condensing unit and that it is not operating. This arrangement serves to give immediate warning of such trouble so that immediate attention may be given to rectify the trouble and maintain the system in operation.

It will be seen that this invention provides a simple and effective arrangement for smoothing out the peaks in the operation of such a device as 11 and to convert the load to which the system is subjected thereby to a relatively steady load. This makes it possible to operate on a condensing unit having a relatively long cycle of operation and the cycle may be adjusted by providing proper capacity in the auxiliary absorbing device so that other normally operating devices such as 8 may function satisfactorily on the same system. The absorbing device furnishes an auxiliary means for condensing the refrigerant and provides for a definite direction of flow therethrough, while at the same time provision is made for an excessive surge of vapor so that both ends of the condensing coil 25 may be utilized for condensing the same. Accordingly, an emergency capacity of practically double the normal capacity is provided for such condensation.

The auxiliary absorbing device is completely self-operating once it is connected to the system. By the expansion coil 20 the system may be started up at any time from atmospheric temperature and will automatically take up normal operation after a certain lapse of time sufficient to cool the brine in the tank 18 to the proper temperature. The device further provides considerable holdover capacity so that in case of trouble the system may be kept in operation until the trouble can be corrected. This is assisted by the fact that the indicating device 34, 36 gives prompt warning when attention is required for the correction of any trouble.

While this embodiment of the invention has been described as constituting a unitary system, it will be understood that individual features or sub-combinations thereof may be useful by themselves without references to other features, and that the use of such individual features or sub-

combinations is contemplated by this invention and within the scope of the appended claims. It is obvious that various changes may be made, within the scope of the appended claims, in the details of construction without departing from the spirit of this invention; it is to be understood, therefore, that this invention is not limited to the specific details shown and/or described.

Having thus described the invention what is claimed is:

1. In a refrigerating system of the character described having a main condensing unit, and an evaporator connected thereto; an auxiliary refrigerating device, comprising, a brine tank, a condensing coil therein open at one end to said evaporator and at the other to the suction side of said unit, and means independent of said coil for cooling the brine in said tank.

2. In a refrigerating system of the character described having a main condensing unit, and an evaporator connected thereto; an auxiliary refrigerating device, comprising, a brine tank, a condensing coil therein open at one end to said evaporator and at the other end to the suction side of said unit, and a cooling coil in said tank, said last coil being connected to receive refrigerant from said unit independently of said first coil.

3. In a refrigerating system of the character described, a main condensing unit, a plurality of expansion elements connected to receive refrigerant from said unit, and an auxiliary refrigerating device connected to receive refrigerant from said unit and all the refrigerant vapor from one or more of said elements, connections to deliver uncondensed vapor from said auxiliary device and said elements to said unit, another of said elements being connected to deliver refrigerant vapor directly to said unit.

4. In a refrigerating system of the character described, a main condensing unit, a plurality of expansion elements connected to receive refrigerant from said unit, and an auxiliary refrigerating device connected to receive refrigerant from said unit and all the refrigerant vapor from one or more of said elements, connections to deliver uncondensed vapor from said auxiliary device and said elements to said unit, another of said elements being connected to deliver refrigerant vapor directly to said unit, and means to prevent flow of refrigerant vapor from said other element to said device.

5. In a refrigerating system of the character described, a main condensing unit, a plurality of expansion elements connected to receive refrigerant from said unit, and an auxiliary refrigerating device connected to receive refrigerant vapor from one or more of said elements and to deliver the same to said unit, another of said elements being connected to deliver refrigerant vapor directly to said unit, and an expansion coil for cooling said device connected to receive refrigerant from said unit.

6. In a refrigerating system of the character described, a main condensing unit, a plurality of expansion elements connected to receive refrigerant from said unit, an auxiliary refrigerating device connected to receive refrigerant vapor from one or more of said elements and to deliver uncondensed vapor to said unit, another of said elements being connected to deliver refrigerant directly to said unit, and means to indicate failure of said unit to operate.

7. In a refrigerating system of the character described, a main condensing unit, a plurality of expansion elements connected to receive refrigerant

erant from said unit, and an auxiliary refrigerating device connected to receive refrigerant vapor from one or more of said elements and to deliver uncondensed vapor to said unit, another of said elements being connected to deliver refrigerant vapor directly to said unit, thermostatic means for controlling the operation of said unit, and means set to operate at a higher thermal point than said controlling means adapted to indicate failure of said unit to operate.

8. In a refrigerating system of the character described, having a main condensing unit and an evaporator connected thereto; an auxiliary refrigerating device comprising, a brine tank, a condensing coil therein connected to receive refrigerant vapor from said evaporator, said coil being constructed and arranged to condense the gaseous refrigerant and to evaporate the liquid refrigerant condensed therein in accordance with changes of pressure in said coil and temperature in said tank, means for withdrawing the evaporated refrigerant from said coil, and separate means for cooling the brine in said tank.

9. In a refrigerating system of the character described having a main condensing unit and an evaporator connected thereto; an auxiliary refrigerating device comprising, a brine tank, means for cooling the same, a condensing coil therein having an inlet connected to receive refrigerant vapor from said evaporator, said coil being constructed and arranged to retain the liquid condensed therein and having an outlet connected to the suction line of said unit so as to evaporate the condensed liquid when suction is established, and means operable to connect said outlet to receive refrigerant vapor from said evaporator in order to condense such vapor in said coil.

10. In a refrigerating system of the character described, a main condensing unit, one or more evaporators connected in a circuit with said unit, a particular evaporator connected with said unit in a separate circuit from said first evaporators, and an auxiliary refrigerating device connected in said separate circuit to receive vapor from said particular evaporator and to be cooled by operation of said unit.

11. In a refrigerating system of the character described, a main condensing unit, one or more evaporators connected in circuit with said unit, a particular evaporator connected with said unit in a separate circuit from said first evaporators, and an auxiliary refrigerating device having a condensing coil connected in said separate circuit to receive refrigerant vapor from said particular evaporator in order to condense such vapor in said coil, and a separate evaporating coil in said device connected to said unit in order to cool said device.

12. In a refrigerating system of the character described, a main condensing unit, an evaporator connected thereto, an auxiliary refrigerating device having means connected to receive vaporous refrigerant from said evaporator and to deliver vaporous refrigerant to said condensing unit, and separate cooling means in said device connected to be refrigerated by operation of said unit adapted to cool said first means.

13. In a refrigerating system of the character described having a main condensing unit and an evaporator connected thereto; an auxiliary refrigerating device comprising, a refrigerant-condensing coil open at one end to said evaporator and at the other end to the suction side of said unit, said coil being formed to retain refrigerant condensed therein, and separate means connected

to receive refrigerant from said unit for cooling said coil.

14. In a refrigerating system of the character described having a main condensing unit, an auxiliary refrigerating device comprising a coil, means connected with said unit and operating to cool said coil, means connecting said coil into

the system so as to receive refrigerant vapor therefrom in order to condense such vapor in said coil, and means connecting said coil with the suction line of said unit in order to evaporate condensate contained in said coil.

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