June 27, 1950 J. F. WINKLER 2,512,758

COMBINED REFRIGERANT PURIFIER AND CONTROL APPARATUS

Filed Oct. 3, 1946 2 Sheets-Sheet 1

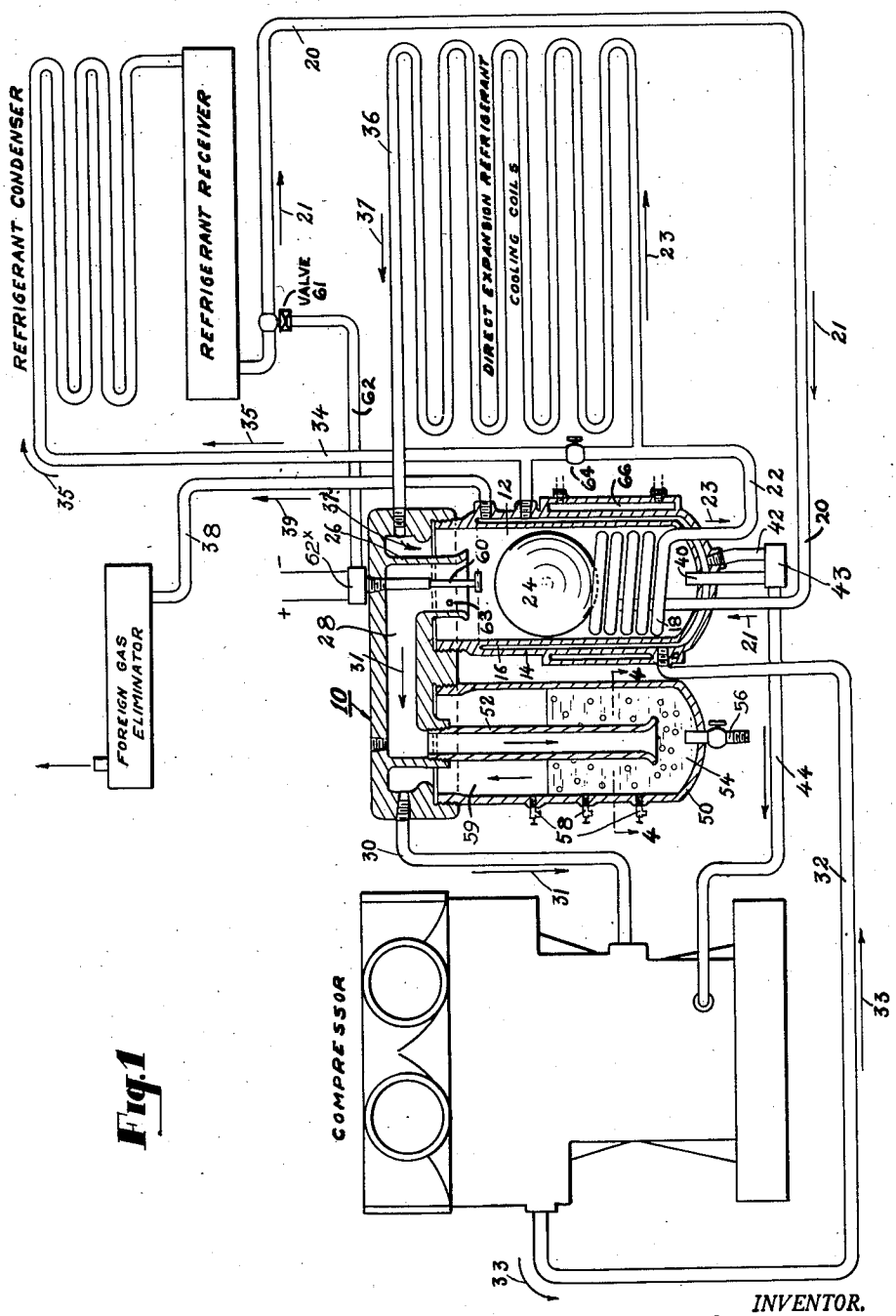


Fig. 1

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Fig. 4

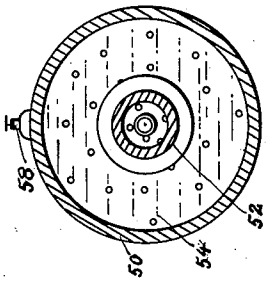


Fig. 5

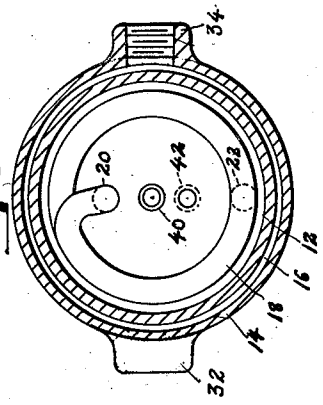


Fig. 3

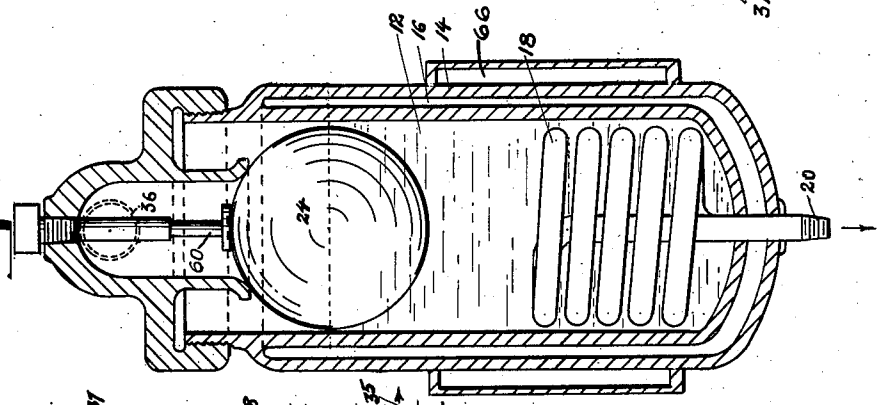
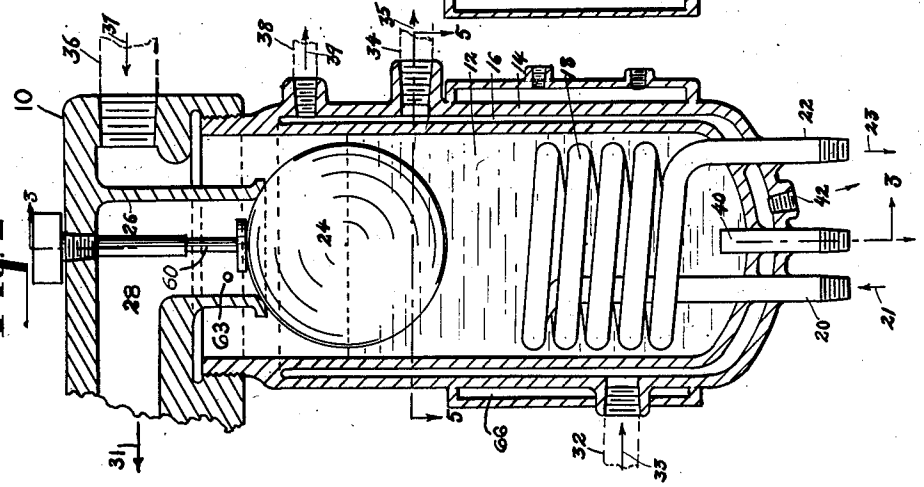


Fig. 2



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COMBINED REFRIGERANT PURIFIER AND CONTROL APPARATUS

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9 Claims. (Cl. 62—127)

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My invention relates to a combined refrigerant purifier and control apparatus adapted to be used in connection with refrigerating systems for the purpose of purifying the refrigerant which circulates in such systems and for otherwise affecting or modifying the operation of the refrigerating system.

One object of the invention is to produce an improved refrigerant purifier and control apparatus of the type set forth.

A further object of the invention is to produce an improved refrigerant purifier and control apparatus which can be used with almost any type of refrigerating apparatus without in any way modifying the structure of such apparatus, and which can be incorporated in such apparatus by merely cutting it into the lines which connect the compressor with the evaporator.

A still further object is to produce an improved refrigerant purifier and control apparatus which will automatically purge foreign or non-condensing gases, which will remove any lubricant that may be carried with the gas and will return such lubricant to the compressor, and which will effectively remove any moisture which may be carried by the refrigerant gas.

A still further object is to produce an improved refrigerant purifier and control apparatus which will prevent any liquid refrigerant from reaching the compressor so as to avoid the damage which usually results when a "slug" of liquid refrigerant happens to reach one of the cylinders of the compressor.

A still further object of the invention is to produce an improved refrigerant purifier and control apparatus which is simple in construction, so that it has no parts to go out of order, which is automatic in operation and which is inexpensive to make and install.

A still further object is to produce an improved refrigerant conditioner which may be used as a means of heat storage for thawing ice from low temperature evaporators by the use of hot compressed refrigerant gas; the thawing being accomplished periodically and automatically by suitable controls.

These and other objects are attained by the invention as set forth in the following specification and illustrated in the accompanying drawings, in which:

Fig. 1 is a diagrammatic view, partly in side elevation and partly in section, of a conventional refrigerating apparatus provided with my improved conditioner.

Fig. 2 is an enlarged vertical sectional view of

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the right-hand portion of the refrigerant conditioner shown in Fig. 1.

Fig. 3 is a section on line 3—3 of Fig 2.

Fig. 4 is an enlarged section on line 4—4 of Fig. 1.

Fig. 5 is a section on line 5—5 of Fig. 2.

Referring first to Fig. 1, there is shown, diagrammatically, a refrigerating apparatus comprising a compressor, a condenser, a liquid refrigerant receiver and an evaporator or expansion coil, the compressor shown being of the self-contained, hermetically-sealed type and the evaporator being of the direct expansion type.

In a conventional refrigerating apparatus of this type, one end of the evaporator is connected to the low pressure or intake side of the compressor, one end of the condenser is connected to the discharge or high pressure side of the compressor and the other end of the condenser is connected, with or without an intervening expansion device to the other end of the evaporator. According to my invention, the improved conditioner is interposed between the compressor on one side and the condenser and evaporator on the other.

As shown, my improved conditioner includes a receptacle 12, having a jacket 14 which forms a chamber 16 surrounding the receptacle 12. In the lower portion of the receptacle 12 is a coil 18 the upper end of which is connected by a pipe 20 to the liquid refrigerant receiver and the lower end of which is connected by a pipe 22 to the evaporator. The liquid refrigerant thus flows from the receiver through the pipe 20, as indicated by the arrows 21, through the coil 18, and to the evaporator through the pipe 22, as indicated by the arrows 23.

Above the coil 18 is a float mechanism or a buoyant ball 24 which is adapted to rise as the receptacle 12 is filled with liquid, until the ball abuts and closes the lower end of an outlet pipe 26, which, according to one embodiment of the invention, can be connected through a passage 28, directly to the pipe 30 leading to the intake side of the compressor, as indicated by the arrows 31.

The discharge side of the compressor is connected to the conditioner by a pipe 32 so as to deliver the compressed refrigerant to the lower end of the chamber 16, as indicated by the arrows 33. From a portion of the chamber 16 above the coil 18, a pipe 34 conducts the compressed gas to the condenser, as shown by the arrows 35.

The refrigerant liquefied in the condenser collects in the receiver, from which it flows, through

pipe 20, and in any suitably controlled manner, to the evaporator after passing through the coil 18. The refrigerant evaporated in the expansion coil or evaporator flows, through a pipe 36, into the top of the receptacle 12, as shown by the arrows 37. The top of the chamber 16 is connected by a pipe 38 to a non-condensing gas eliminator, as indicated by the arrow 39. The non-condensing gas eliminator may be of any type now available and is, therefore, not shown or described in detail.

Operation of the structure thus far set forth will now be described, it being assumed that the pipe 26 is connected, by the passage 28, directly to the pipe 30 which leads to the intake side of the compressor.

When the compressor is put in operation, it draws evaporated refrigerant from the expansion coil, through the pipe 30, passage 28, receptacle 12 and pipe 36. The low pressure, relatively cool evaporated refrigerant is compressed and delivered to the condenser through the pipe 32, the chamber 16 and the pipe 34. The liquefied refrigerant collects in the receiver and flows through the pipe 20, into the coil 18, and from the coil 18, through the pipe 22, to the expansion coil or evaporator.

By this means, the hot compressed gas and the liquefied refrigerant, in flowing through the chamber 16 and through the coil 18, respectively, are brought into contact with the relatively cold low pressure gas flowing through the receptacle 12 and with any liquid refrigerant which may be drawn into the receptacle 12 from the evaporator. This arrangement serves to cool the hot refrigerant gas and the liquid refrigerant, and thus increases efficiency, and it also serves to evaporate such liquid refrigerant as may reach the receptacle 12 so as to prevent liquid refrigerant from reaching the compressor.

During the passage of the compressed refrigerant through the chamber 16, and when the refrigerant gas is heavier than the non-condensable gases, the non-condensable gases will rise to the top of the chamber 16 and will flow through the pipe 38 to the foreign gas eliminator to be automatically purged off. The refrigerant gas flows to the condenser through pipe 34.

If, because of operating at low temperatures, or if for other reasons, a large amount of liquid refrigerant should collect in the receptacle 12, the ball 24 or other float mechanism will rise and will close the lower end of the duct 26, to prevent liquid refrigerant from reaching the intake side of the compressor.

During the passage of the refrigerant gas through the compressor, the refrigerant gas is brought into contact with the lubricant and particles of lubricant are entrained in the refrigerant. As the refrigerant flows through the receptacle 12 and through the chamber 16, the lubricant separates and is drained through the pipes 40 and 42 into the receptacle 43, from which it is returned to the compressor through the pipe 44. The receiver 43 is available on the market and therefore need not be shown nor described in detail. It is sufficient to state that this receiver is normally closed and that it opens only when a predetermined quantity of oil is present. The relatively small quantities of refrigerant which pass back to the crank case of the compressor on opening of the receiver 43 do not materially affect the operation of the apparatus.

The structure thus far described constitutes a complete and operative device which can be used successfully in almost any type of refrigerating systems. However, if it is desired, under certain circumstances, to provide means for drying or otherwise treating the refrigerant, I provide another receptacle 50 which is interposed between the passage 28 leading from the receptacle 12 and the pipe 30 leading to the compressor. The receptacle 50 is provided with a pendant conduit 52, the upper end of which is connected to the passage 28 and the lower end of which is open and disposed near the bottom of the receptacle 50. The receptacle 50 is filled to the desired extent with any desired desiccating or purifying medium 54. A bottom valve controlled outlet 56 is provided for draining the medium 54, and vertically-spaced side cocks 58 may be provided for indicating and for controlling the level of the medium in the receptacle 50.

As will be clearly seen from Fig. 1, the evaporated refrigerant moving from the receptacle 12 to the compressor will now travel through the passage 28 and the pipe 52, and will bubble upwardly into the upper portion 59 of the receptacle 50, from which the evaporated refrigerant is conducted by the pipe 30 into the compressor. The purifying and/or desiccating receptacle 50 may or may not be incorporated in the system, as indicated by the nature of the refrigerant or by other attendant circumstances.

In order to stop the flow of refrigerant to the evaporator when the level of liquid refrigerant in the casing 12 reaches a predetermined point, I provide a plunger 60 which normally occupies a lower position and which, when raised to a predetermined point by the rise of the ball 24 will, close a valve 61 on the line 20 which connects the receiver to the evaporator. The valve 61 may be operated by a solenoid and, in that event, it will be connected, by wires 62 to a normally open switch 62x which is closed by plunger 60. The switch 62x is connected to a source of electric current in the usual way. If desired, a float, operating independently of the ball 24, may be used. Alternately, means can be provided which, in response to the high degree of vacuum which will be produced when the lower end of the pipe 26 is closed by the ball 24, will close the valve 61 or will put the compressor out of operation until this condition has been remedied before the compressor is again started up. In order slowly to dispose of the liquid refrigerant in the casing 12 when the lower end of the conduit 26 is closed by the ball 24, I provide a small hole 63 in the wall of the conduit 26, at a point above the mouth thereof, so as to permit the refrigerant to be drawn off slowly by the compressor. The size of the hole 63 is such that, if any liquid refrigerant is drawn through it, the amount of such refrigerant will be so small that it will be evaporated before it reaches the compressor.

In order to provide for defrosting of a low temperature evaporator, a valve 64 is cut into the pipe 34 and the pipe 34 is connected to the line 22 which leads from the coil 18 to the evaporator. By this arrangement when the valve 64 is open, the hot refrigerant gas which flows from the chamber 16 into the pipe 34, instead of continuing on to the refrigerant condenser, will be partly diverted to the evaporator. After coming into contact with the cold surfaces of the evaporator, and being cooled or condensed while the evaporator is defrosted, the refrigerant flows through pipe 36, as indicated by arrows 37, and into the receptacle 12.

Since there always is hot discharge gas in the

chamber 16, any liquid reaching the receptacle 12 will evaporate upon contact with the walls of the receptacle and will return to the compressor in the form of a gas as previously described.

If there should be an overflooding of liquid into the chamber 12, the float 24 will protect the compressor, as previously described.

When the defrosting operation is complete, the valve 64 is closed, and the normal refrigeration cycle will again take place.

The defrosting operation and the operation of the valve 64 may be effected manually or automatically, as desired.

If very rapid defrosting of a low temperature evaporator is desired, a heated jacket 66, which will use steam, electricity, hot water, or any other source of heat, may be superimposed upon the outer shell 14 or may be placed in the chamber 16 itself. The jacket is used as a means of superheating the compressed refrigerant gas, and will greatly hasten the defrosting of the evaporator.

What I claim is new and desire to secure by Letters Patent is:

1. A refrigerating apparatus including a compressor, a condenser, and an evaporator, a conditioner including a first casing, a second casing disposed in heat transfer relation to said first casing, means conducting low temperature refrigerant from said evaporator to said first casing, means conducting refrigerant gas from said first casing to the intake side of said compressor, means conducting high temperature compressed gas from the discharge side of said compressor to said second casing, means conducting said high temperature gas from said second casing to said condenser, a non-condensing gas eliminator, and means connecting said second casing with said eliminator for removing non-condensing gases.

2. The structure recited in claim 1 together with means for conducting oil precipitated from the refrigerant in either of said casings back into the compressor.

3. The structure recited in claim 1 together with means responsive to the presence of liquid in said first casing for stopping the flow of refrigerant into said evaporator when the liquid in said first casing has reached a predetermined level.

4. A refrigerating apparatus including a compressor, a condenser, and an evaporator, a conditioner including a first vertical casing, a conduit depending into the upper position of said first casing, a second casing disposed in heat transfer relation to said first casing, means conducting low temperature refrigerant from said evaporator to said first casing, means connecting said conduit to the intake side of said compressor for conducting refrigerant gas from said first casing to said compressor, a buoyant ball in said first casing adapted, when liquid is present in said first casing, to rise and close said conduit to interrupt communication between the intake side of said compressor and the interior of said first casing, means conducting high temperature compressed gas from the discharge side of said compressor to said second casing, and means conducting said high temperature gas from said second casing to said condenser.

5. A refrigerating apparatus including a compressor, a condenser, and an evaporator, a conditioner including a first casing, a second casing disposed in heat transfer relation to said first casing, means conducting low temperature refrigerant from said evaporator to said first casing, means conducting refrigerant gas from said first casing to the intake side of said compressor, means conducting high temperature compressed gas from the discharge side of said compressor to said second casing, means conducting said high temperature gas from said second casing to said condenser, a receiver for collecting refrigerant liquefied in said condenser, conduit means connecting said receiver with said evaporator, means responsive to the presence of a predetermined amount of liquid in said first casing for preventing flow of refrigerant from said receiver to said evaporator.

6. The structure recited in claim 4 in which a relatively small hole is provided in a wall of said conduit and at all times connecting the interior of said first casing with the intake side of the compressor for permitting gradual movement of refrigerant from the interior of said first casing to said compressor regardless of the position of said ball.

7. A refrigerant purifier and control device including an inner receptacle and an outer receptacle forming a chamber there between, there being a first opening, formed in the wall of said outer receptacle and leading into said chamber, for admitting the end of a pipe leading to the intake side of a refrigerant condenser, an evaporator a coil in said inner receptacle with one end of said coil connected to the discharge side of said condenser and with the other end of said coil leading to intake side of said evaporator, a pipe leading from the discharge side of said evaporator to said inner receptacle, a compressor a wall structure defining a passage leading from the upper portion of said inner receptacle to the intake side of said compressor, means in said inner receptacle operable, when the level of liquid refrigerant in said inner receptacle rises to a predetermined level, to close the end of said passage which leads from said inner receptacle, to prevent the flow of liquid refrigerant into the compressor, and means also operable by the rise of the liquid to a predetermined level in said inner receptacle, to stop the flow of refrigerant from the condenser to the evaporator.

8. The structure recited in claim 7 in which an opening is formed in the wall of said passage above said end thereof to permit evaporated refrigerant to pass from the said inner receptacle to said compressor while said end of said passage is closed.

9. The structure recited in claim 7 together with a refrigerant purifier interposed between said inner receptacle and the intake side of said compressor, and means for causing the refrigerant to pass through said purifier before reaching said compressor.

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