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C. L. AUGHEY ET AL
CAPILLARY REFRIGERANT CONTROL,
INCLUDING DEHYDRATOR
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2,505,934

FIG. 1

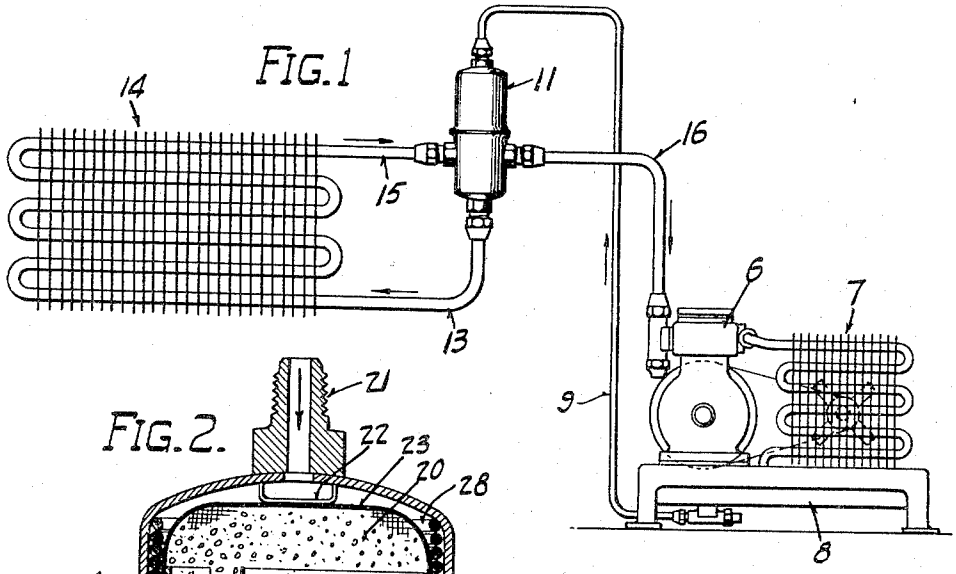


FIG. 2.

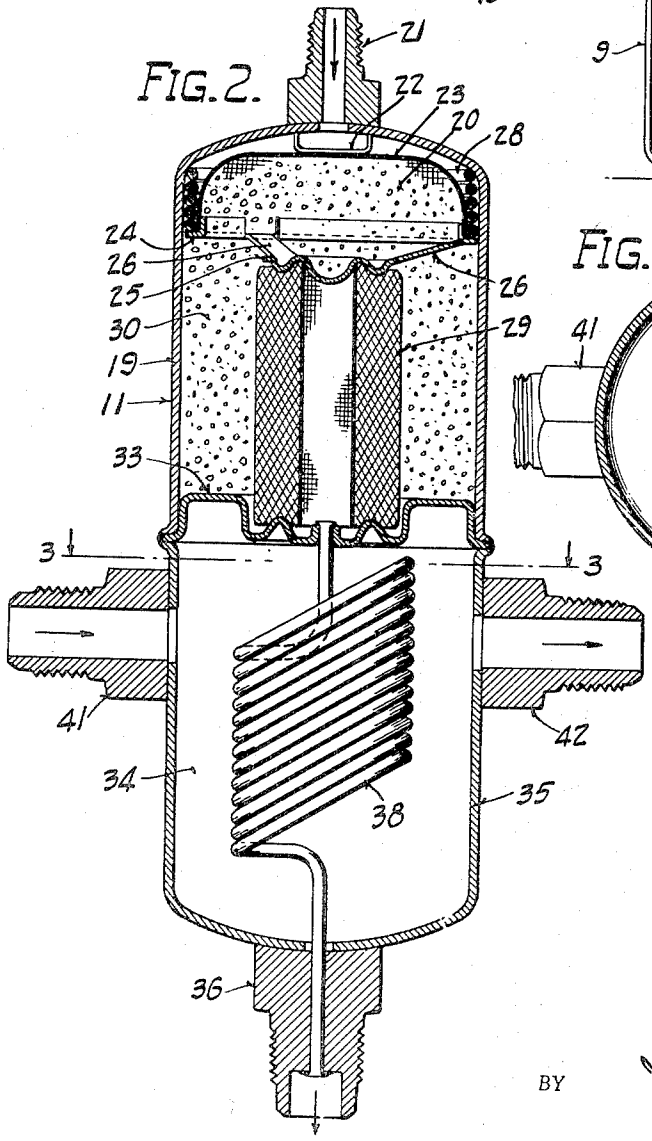
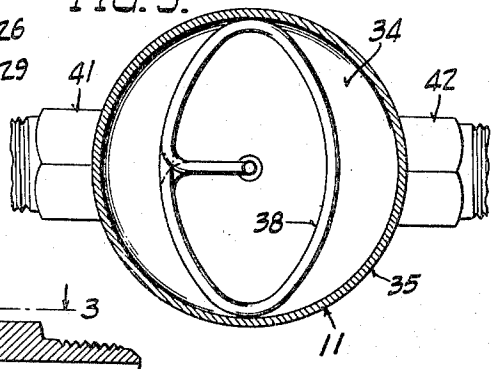


FIG. 3.



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CAPILLARY REFRIGERANT CONTROL, INCLUDING DEHYDRATOR

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3 Claims. (Cl. 62—8)

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This invention relates to improvements in a control device for compression-type refrigerating systems and particularly to a control device employing a passage or tube of relatively small cross-sectional area, or so-called capillary dimensions, in place of the well-known expansion valve for controlling the flow of refrigerant from the condensing unit to the evaporator.

It is therefore an object of the present invention to provide a unitary device for controlling the flow of refrigerant from the condensing unit to the evaporator of a compression-type refrigerating system in which the functions of removing moisture, of removing solid particles from the refrigerant, and of controlling the pressure are so correlated as to be obtained in a single structure.

Another object of the invention is to provide a pressure-reducing and limiting means for controlling the flow of refrigerant in a compression-type refrigerating system in which the pressure-reducing means functions also as a heat exchanger for sub-cooling the refrigerant flowing to the evaporator and for preventing the return of liquid refrigerant from the evaporator to the compressor.

Another object of the invention is to so arrange the same parts of a pressure-limiting device for controlling the operation of a compression-type refrigerating system as to fulfil both the pressure-limiting function and the function of trapping liquid refrigerant returning from the evaporator to the compressor.

Another object of the invention is to provide a control device of the capillary tube type for a compression-type refrigerating system in which the functions of drying and filtering the liquid refrigerant, of sub-cooling the liquid refrigerant flowing from the condensing unit to the evaporator, and of preventing the return of unvaporized refrigerant from the evaporator to the compressor are performed in a single, compact, and simplified unit.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 diagrammatically represents a refrigerating system of the compressor-condenser-evaporator type showing one arrangement of a control device, according to the present invention, with the various elements of such system;

Fig. 2 is a vertical sectional view taken on substantially a central plane through the refrigerant flow control means of the present invention; and

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Fig. 3 is a transverse sectional view taken on the plane of the line 3—3 of Fig. 2.

Referring to the drawings by characters of reference, the numeral 6 designates a compressor for receiving gaseous refrigerant and delivering the compressed refrigerant, still in gaseous form, to a condenser 7 in which the refrigerant is cooled and liquefied and is stored in a receiver 8 at approximately ambient temperature. The condenser-receiver 8 is connected by a conduit 9 with the control means of the present invention, generally indicated at 11, and which is connected by a conduit 13 with the inlet end of an evaporator 14. Liquid refrigerant supplied to the evaporator from the receiver 8 by the path above indicated is converted in the evaporator to the gaseous phase by the absorption of heat in the space about the evaporator which is to be cooled, and such gasified refrigerant returns from the outlet of the evaporator by way of the conduit 15, the control means 11, and a conduit 16, to the inlet or suction side of the compressor 6. The above elements of the system, except for the control means 11, may be of any character known to the art and require no further description.

Referring now to Figs. 2 and 3, the control means 11 comprises an upper casing portion or shell 19 partially defining a chamber 20 to which liquid refrigerant is supplied by way of the conduit 9 and a nipple 21 connecting the casing with the conduit. Liquid refrigerant flows into the chamber 20 from the receiver 8 under the discharge pressure of the compressor and impinges on a baffle 22 which, being a U-shaped plate open at the sides, disperses the refrigerant stream across substantially the entire cross-sectional area of the chamber so that the refrigerant may flow through substantially the entire area of a screen 23. The screen is shown as substantially semi-spherical and the periphery thereof is seated on the rim 24 of a spider having a hub or body portion 25 and legs or spokes 26 connecting the hub to the rim. The spider rim 24 is preferably a snug sliding fit in the shell 19 and forms a seat for one end of a spring 28, seating at the other end in the end of the shell portion 19. The spider hub 25, under the pressure of the spring 28, bears on a filter element 29 which is shown as a hollow cylinder occupying only a portion of the space within the chamber and which serves to remove all solid particles from the liquid refrigerant passing therethrough. The filter cartridge is of the string-wound type now in commercial use and requires no further description.

The space in the chamber 20, which is not

occupied by the filter 29, is filled with a bed of dehydrating material, indicated at 30, and may be composed of material such as activated alumina or silica gel, which has no effect on the refrigerant other than removal of the water therefrom, and which is not affected by the refrigerant, either before or after adsorption of water, and is otherwise suitable for use in the above location and for the above purpose. The filter 29 is seated in a cup-shaped depression in a partition or separator 33 which extends across one end of the shell 19 and completes definition of the chamber 20. It will be seen that both the spider hub 25 and the partition 33 are solid, except for an opening through the partition inside of the filter 29, and that the drying material 30 at least substantially fills the chamber 20 between the screen 23 and the partition 33. All of the liquid refrigerant received within the chamber 20 must therefore flow through the bed of drying material 30 and the wall of the filter 29.

Another chamber 34 is defined by a lower casing portion or shell 35 attached to the shell 19 and the partition 33, as by flanging and welding, as shown, to make a gas-tight joint, and has connected therewith a nipple 36 for connection with the conduit 13 and thereby with the inlet end of the evaporator 14. A tube 38 of relatively small cross-sectional area or so-called capillary dimensions connects the space within the filter 29 with the nipple 36. The tube 38 is preferably wound as an elliptical coil with the turns in contact with each other. The dimensions of the coil are such that the major axis of the ellipse defined thereby extends across the chamber 34 into contact with the wall of the shell 35, and the coil is preferably located with such major axis on a diameter through the shell 35 to form a barrier, at right-angles to the axis of the direct flow therethrough, of refrigerant returning from the evaporator 14 by way of the conduit 15 and a nipple 41, the chamber 34 and a nipple 42 connected with the conduit 16. The capillary coil 38 is also preferably shaped, as shown in Fig. 2, to shift the walls on the two sides of the major elliptical axis in opposite directions relative to each other so as to cause all of the refrigerant flowing through the chamber 34 to change its direction of flow a number of times.

If the refrigerant stream returning from the evaporator to the compressor has been only partially vaporized rather than completely gasified, so that the gaseous portion of the refrigerant carries droplets or particles of liquid therewith, such liquid particles are thrown against the baffle or barrier formed by the coil 38 due to the changes in direction required in the refrigerant stream and are either evaporated by heat exchange between such particles and the liquid refrigerant flowing through the coil or are dropped to the bottom of the chamber 34 from which they are evaporated by heat absorbed through the shell 35. It will be seen that the capillary coil 38 therefore performs the functions both of sub-cooling the liquid refrigerant flowing therethrough and of preventing the return of liquid droplets to the compressor. The coil may perform the above functions even though the dimensions thereof are such that the coil does not perform the third function of controlling or limiting the pressure of the liquid refrigerant supplied to the evaporator. Hence, the device may be used as a dehydrator, filter and trap in systems where other flow control means are present. By sub-cooling of the refrigerant is meant the lowering of the temperature of the refrigerant below its temperature in the condenser-receiver 8, as a result of the absorption of heat therefrom, to supply the latent heat of vaporization required to vaporize the refrigerant liquid droplets impinging on the coil. The prevention of the return of unvaporized refrigerant to the compressor avoids interference by liquid with the action of a machine designed only to receive and compress a gas.

In operation, liquid refrigerant flows from the receiver 8 through the conduit 9 and is dispersed by the baffle 22 throughout the cross-sectional area of the upper chamber of the casing. Due to the large increase in area from the conduit 9 to the chamber 20, the velocity of the refrigerant is greatly decreased so that refrigerant may flow through substantially the entire area of the screen 23 and may contact, at a relatively low velocity, with sufficient of the surface area of the material in the drier bed 30 to secure the effective abstraction of moisture from the refrigerant. The dried liquid refrigerant then flows through the wall of the filter 29 which removes solid particles therefrom and passes through the capillary coil 38 in its dried and filtered condition. The capillary coil forms a flow-restricting or pressure-reducing means which allows only a predetermined quantity of liquid refrigerant to flow to the evaporator 14 at a pressure lower than that in the receiver 8. All or a part only of the liquid refrigerant supplied to the evaporator may be vaporized therein dependent on the temperature of the space to be cooled. If such space is already at a low temperature, the refrigerant is only partially vaporized and the stream of refrigerant returning from the evaporator through the chamber 34 of the control device 11 to the compressor 6 is a mixture of gas and liquid carried by the gas in the form of droplets or small masses of liquid. The returning refrigerant stream impinges on the baffle formed by the special coiling and shaping of the capillary tube 38 which forces the refrigerant stream to change the direction of its flow several times. The liquid particles in such stream are either vaporized by heat interchange with the liquid refrigerant being conducted through the coil or are dropped to the bottom of the casing, thus sub-cooling the liquid refrigerant in the coil and trapping the droplets in the returning refrigerant stream in such position that they may be vaporized by heat absorption through the shell 35.

It will thus be seen that the present invention provides a device in which the liquid refrigerant is first screened, then dried and filtered before flowing through a pressure-reducing and heat-exchanging means to the evaporator. Such means acts to control the pressure of the refrigerant flowing from the condensing unit to the evaporator and also either separates out or promotes gasification of all of the refrigerant returning to the condensing unit while sub-cooling the liquid refrigerant supplied to the evaporator and thereby enhancing the operation of the system. All of the above functions are effectively performed in a single unit in which the elements are all functionally as well as structurally interrelated.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

We claim:

1. A control device adapted to be connected in a mechanical refrigeration system, comprising, a casing divided into a drier chamber and a trap chamber, each of said chambers having an inlet and an outlet, a drying agent in said drier chamber, a filter in said drier chamber, flow of fluid through the drier chamber being over said agent and through said filter, a coil of capillary tubing in said trap chamber and being positioned in the flow path between the inlet and outlet of the trap chamber, one end of said tubing being connected to the outlet from said drier chamber and the other end of said tubing extending through the trap chamber wall and being adapted for connection to an evaporator inlet, said drier chamber inlet being adapted to be connected to a compressor to receive refrigerant therefrom, said tubing being adapted to receive dry filtered refrigerant from the drier chamber and to control flow of such refrigerant to the evaporator, said trap chamber inlet and outlet being adapted to be respectively connected to the evaporator outlet and the compressor inlet, flow through the trap chamber serving to sub-cool the refrigerant in the tubing and to insure complete vaporization of refrigerant flowing from the trap chamber.

2. A control device adapted to be connected in a mechanical refrigeration system, comprising, a casing divided into a drier chamber and a trap chamber, each of said chambers having an inlet and an outlet, a drying agent in said drier chamber, a filter in said drier chamber, flow of fluid through the drier chamber being over said agent and through said filter, a coil of metallic capillary tubing in said trap chamber with its major axis at a right angle to and being positioned in the flow path between the inlet and outlet of the trap chamber, one end of said tubing being connected to the outlet from said drier chamber and the other end of said tubing extending through the trap chamber wall and being adapted for connection to an evaporator inlet, said drier chamber inlet being adapted to be connected to a compressor to receive refrigerant therefrom, said tubing being adapted to receive dry filtered refrigerant from the drier chamber and to control flow of such refrigerant to the evaporator, said trap chamber inlet and outlet being adapted to be respectively connected to the evaporator outlet and the compressor inlet, flow through the trap chamber serving to sub-cool the refrigerant in the tubing and to insure complete vaporization of refrigerant flowing from the trap chamber.

3. A device adapted for use in a compression type refrigeration system, comprising, a cylindrical chamber having an inlet diametrically opposed to an outlet, a coil of capillary tubing in said chamber with its longitudinal axis substantially perpendicular to the flow path between said opposed inlet and outlet, said coil being elliptical in plan with its major axis substantially normal to said flow path with the coil surface in contact with diametrically opposed portions of the wall of said chamber and having the tubing transverse to the longitudinal axis of the coil when viewed in elevation from a point lying on an extension of said major axis, the tubing between said major axis and said inlet being lower than the tubing between said major axis and said outlet.

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