

E. J. KOCHER
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TEMPERATURE RESPONSIVE CONDENSER
Filed Nov. 16, 1961

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INVENTOR.
E. J. Kocher
BY
Lieber, Lieber & Nilles
Attorneys

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3,088,292

REFRIGERATION SYSTEM HAVING AN ATMOSPHERIC TEMPERATURE RESPONSIVE CONDENSER

Erich J. Kocher, Milwaukee, Wis., assignor to Vilter Manufacturing Corporation, a corporation of Wisconsin
Filed Nov. 16, 1961, Ser. No. 152,771
4 Claims. (Cl. 62—196)

This invention relates generally to improvements in the art of refrigeration, and it relates more especially to an improved mode of controlling the actuation of refrigerating systems wherein the functioning of the condenser is affected more or less by changes in temperature of the ambient atmosphere.

The primary object of the present invention is to provide an improved refrigeration system which is simple in construction and which is effectively operable under the influence of changes in atmospheric conditions.

It has heretofore been proposed to provide refrigeration or air-conditioning systems capable of being operated in conjunction with a condenser exposed to and affected by ambient atmospheric conditions. In such prior systems, proper functioning is obtained even when the outdoor temperature becomes higher or lower than the temperature required in the space being conditioned by the evaporator by means of valving and flow arrangements which cause variances in the effective cooling surface of the condenser. While these prior systems are feasible and operable, they do nevertheless require the use of relatively complicated and unreliable equipment in order to effect automatic and proper functioning of the systems.

It is therefore an important specific object of this invention to provide a simplified and more reliable automatically functioning refrigeration or air-conditioning system embodying an atmospheric temperature responsive or controlled condenser.

Another important object of the present invention is to provide a refrigerating system in which the delivery of refrigerant to an evaporator is controlled by an air-cooled or evaporative condenser cooperating with a compressor and receiver, and wherein the proper functioning of the condenser is effected by variations in receiver pressure as produced by fluctuations in the temperature of the refrigerant delivered by the compressor.

A further important object of the invention is to provide a refrigeration system having an atmospheric temperature responsive condenser the capacity of which is controlled by variable flooding as induced by changes in the compressor discharge temperature acting upon the pressure in the receiver.

These and other more specific objects and advantages of the invention will be apparent from the following detailed description.

A clear conception of the construction and operation of a typical refrigeration system embodying the present invention will be apparent from the drawing accompanying and forming a part of this specification in which the various parts are identified by suitable reference characters.

FIG. 1 is a diagrammatic illustration of the improved refrigeration system; and

FIGURE 2 is an enlarged central vertical section through a typical pressure actuated diaphragm valve for controlling the gas pressure in the receiver.

While the invention has been illustrated as having been incorporated in a system having a single evaporating coil adapted to be used either for ordinary refrigeration or for air-conditioning purposes, it is not intended to confine the system to any particular usage; and it is also contemplated that specific descriptive terms be given the broadest interpretation consistent with the disclosure.

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Referring to the drawing, the improved system comprises, in general, a compressor 4; an atmospheric temperature responsive refrigerant condenser 5; a compressed refrigerant gas supply line 6 connecting the compressor 4 discharge with the inlet of the condenser 5; a sealed liquid refrigerant receiver 7; an evaporator 8; a liquid refrigerant conducting means or pipes 9, 10 connecting the outlet of the condenser 5 with the bottom of the receiver 7 and with the intake of the evaporator 8; a heat exchanger 11 applied to the supply line 6 within the receiver 7; a conduit 12 connecting the top of the receiver 7 with the supply line 6 and having therein a pressure actuated valve 13; and a refrigerant return line 14 connecting the exit of the evaporator 8 with the suction or intake of the compressor 4.

The compressor 4 may be of any suitable type adapted to receive spent gaseous refrigerant from the evaporator 8 through the suction line 14 and to compress and deliver the gaseous refrigerant under high pressure through the supply line 6 to the condenser 5, and the operation of this compressor is controlled by a device 16 cooperating with a valve 17 in the pipe 10 which supplies liquid refrigerant to the evaporator 8. The condenser 5 may be of the type known either as "air-cooled" or "evaporative," both of which are responsive to or controlled by the temperature of the ambient atmosphere and the capacity of which is variable by causing more or less liquid refrigerant to back up in its coils, and this condenser 5 is preferably located outdoors externally of a wall 18 of the building in which the refrigeration system is housed.

The refrigerant gas supply line 6 may be provided with a purge valve 20, and the refrigerant inlet and outlet of the condenser 5 may be provided with the usual flow control valves 21, 22, respectively, while the refrigerant intake and exit ends of the evaporator 8 may also be provided with the usual refrigerant flow control valves 23, 24, respectively, in a well-known manner. However, the provision of the heat exchanger 11 associated with the compressed refrigerant supply line 6 beneath the normal liquid refrigerant level within the receiver 7, and the provision of the automatically functioning gas pressure relief valve 13 in the conduit 12 connecting the space within the sealed receiver 7 above the liquid level therein with the supply line 6, constitute important features of the present improved refrigeration system.

As shown in FIG. 2, the gas pressure release valve 13 may be of the type comprising a casing 26 having a valve plunger 27 therein adapted to control the flow of refrigerant gas through the conduit 12; a flexible diaphragm 28 sealing the casing interior from the ambient air and clamped in position by a cap 29; and a relatively heavy compression spring 30 coacting with the diaphragm 28 and reacting against a cap screw 31 adjustable relative to the cap 29 to vary the pressure at which the plunger 27 opens and closes the passage through the conduit 12. A relatively light spring 32 may also be interposed between the diaphragm 28 and the casing 26 in order to prevent the plunger 27 from sticking in closed position when the diaphragm is subjected to gas pressure, but the specific construction of the valve 13 is not novel.

When the improved refrigeration system has been constructed and assembled as above described, and the various valves have been properly adjusted, adequate operating pressure can be maintained throughout the year by merely controlling the pressure within the receiver 7. When the system is operating normally, the receiver 7 should be amply supplied with liquid refrigerant derived from the condenser 5 through the pipe 9, so that the heat exchanger 11 will be completely submerged in the liquid. When the compressed warm refrigerant vapor is forced through the supply line 6 by the compressor 4, this vapor

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heats the liquid refrigerant in the receiver 7 and thereby raises the pressure within this sealed receiver.

This increase in receiver pressure automatically opens the diaphragm relief valve 13 at the predetermined pressure to which this valve has been set, and thereby releases the excess pressure into the supply line 6 without forcing liquid refrigerant from the receiver back into the condenser 5. But whenever the compressor discharge pressure drops and falls below the relief valve setting, this valve closes and liquid refrigerant will be forced out of the receiver 7 by the gas pressure in the latter and flows through the pipes 9 into the condenser 5 thereby reducing the available condensing surface. This operation continues until the pressure within the condenser equals the receiver pressure, whereupon normal flow of liquid refrigerant from the condenser 5 to the receiver 7 and evaporator 8 is resumed.

Thus, it will be noted that the heat exchanger 11 and the relief valve 13 cooperate with the condenser 5 and receiver 7 to automatically maintain proper and most effective circulation of the refrigerant through the system regardless of variations in the ambient air temperature which controls the functioning of the condenser 5. The improved system is not only simple but is also highly reliable, and its functioning may be varied by merely adjusting the single relief valve 13 which is interposed between the refrigerant gas supply line 6 and the receiver 7. The system will also operate effectively regardless of whether the ambient air temperature is above or below that of the space being refrigerated.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention:

1. A refrigerating system comprising, a refrigerant gas compressor, an atmospheric temperature responsive gaseous refrigerant condenser, a compressed refrigerant gas supply line directly connecting the discharge of said compressor with the inlet of said condenser, a liquid refrigerant receiver, a liquid refrigerant evaporator, liquid refrigerant conducting means directly connecting the outlet of said condenser with said receiver below the liquid refrigerant level therein and also connecting said condenser outlet with the liquid refrigerant intake of said evaporator, a heat transfer device associated with said gas supply line in heat exchange relation with said receiver to heat the liquid refrigerant confined within said receiver responsive to compressor discharge pressure, a conduit connecting said receiver above the liquid refrigerant level therein and being provided with valve means for relieving excess gas pressure over a predetermined value from the receiver into said gas supply line, and a gaseous refrigerant return line connecting the exit of said evaporator with the intake of said compressor.

2. A refrigerating system comprising, a refrigerant gas compressor, an atmospheric temperature responsive controlled gaseous refrigerant condenser, a compressed refrigerant gas supply line connecting the discharge of said compressor with the inlet of said condenser, a liquid refrigerant receiver, a liquid refrigerant evaporator, liquid refrigerant conducting means connecting the outlet of said

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condenser with said receiver below the liquid refrigerant level therein and also connecting said condenser outlet with the liquid refrigerant intake of said evaporator, a heat transfer device responsive to compressor discharge pressure coacting with said gas supply line in heat exchange relation with said receiver beneath the liquid level therein to convert liquid refrigerant confined within the receiver into gas, a conduit connecting said receiver above the liquid refrigerant level therein and being provided with valve means operable by said gas for relieving excess gas pressure over a preselected setting from the receiver into said gas supply line, and a gaseous refrigerant return line connecting the exit of said evaporator with the suction side of said compressor.

3. A refrigerating system comprising, a refrigerant gas compressor, an atmospheric temperature controlled gaseous refrigerant condenser, a compressed refrigerant gas supply line connecting the discharge side of said compressor with the inlet of said condenser, a liquid refrigerant receiver, a liquid refrigerant evaporator, liquid refrigerant conducting means connecting the outlet of said condenser with the intake of said evaporator and with said receiver below the liquid refrigerant level therein, a heat transfer device associated directly with and responsive to pressure conditions within said gas supply line located in and in heat exchange relation with the receiver and being operable to convert liquid refrigerant confined within said receiver into gas, a conduit connecting said receiver above the liquid refrigerant level therein and being provided with a valve for relieving excess gas pressure above a predetermined value from the receiver into said gas supply line, and a gaseous refrigerant return line connecting the exit of said evaporator with the suction side of said compressor.

4. A refrigerating system comprising, a refrigerant gas compressor, an atmospheric temperature controlled gaseous refrigerant condenser, a compressed refrigerant gas supply line directly connecting the discharge side of said compressor with the inlet of said condenser, a liquid refrigerant receiver, a liquid refrigerant evaporator, liquid refrigerant conducting means directly connecting the outlet of said condenser with said receiver and with the liquid refrigerant intake of said evaporator, a heat transfer device responsive to conditions in said gas supply line and located within said receiver in heat exchange relation to the liquid refrigerant therein to gasify some of the liquid refrigerant confined within the receiver, a conduit connecting said receiver above the liquid refrigerant level therein and being provided with a receiver pressure actuated valve for relieving excess gas pressure above a predetermined value from the receiver into said gas supply line in order to vary the capacity of said condenser, and a gaseous refrigerant return line connecting the exit of said evaporator with the suction side of said compressor.

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