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REFRIGERATING APPARATUS

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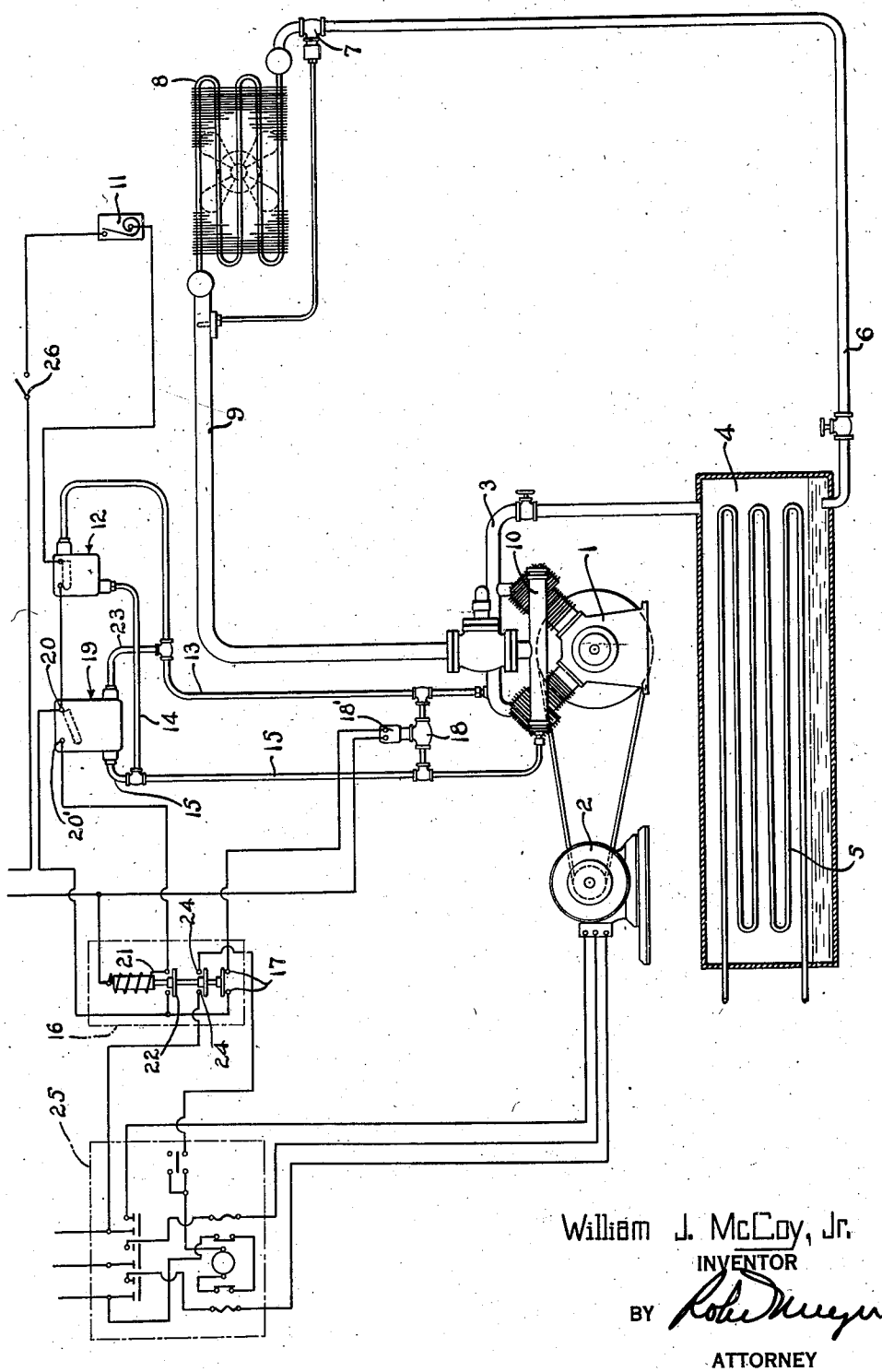

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REFRIGERATING APPARATUS

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9 Claims. (Cl. 62—115)

This invention relates to refrigerating apparatus of the type employing a compressor for compressing refrigerant, which compressor is powered or operated by an electric motor.

In a system or apparatus of the type in which this invention is embodied, the operation of the compressor is controlled by the temperature produced by the evaporator, such control being effected by the stopping and starting of the compressor, as the temperature varies.

An object of the present invention is to provide a means for producing a condition of equalized pressure in the suction and discharge manifolds of the compressor so that the motor torque required for starting the compressor will be reduced to the minimum.

The present practice is to use a motor for the operation of the compressor which will develop sufficient torque that the compressor will positively be started, regardless of the pressure differential imposed upon the compressor. This requires a torque of approximately 225% to 250% of the full load running torque. Where reduced voltage starting is required, the compressor will not necessarily start, under such reduced voltage, since sufficient torque may not be developed. When full voltage is applied, however, the compresser motor will develop sufficient torque and function to start the compressor, regardless of the differential in pressure.

Under certain circumstances it is considered satisfactory for the compressor motor not to actually start upon application of the reduced voltage, provided the interval between this initial application of voltage and the actual starting of the motor under application of full voltage does not exceed three to five seconds. In the usual installation this interval is necessary to allow the control equipment of the power source to respond and carry the additional load imposed by the motor. In certain applications, however, it is desirable that the compressor start with the initial application of the reduced voltage. The present invention makes it possible to start the compressor upon such initial application of reduced voltage, under equalized pressure.

Other devices for the purpose of starting the compressor with low torque do not provide equalization on demand of the thermostat for cooling, but function to prevent starting of the compressor until the desired degree of equalization has taken place through natural means. With such devices accurate control of temperature is not possible. Still other devices of this type require equalization at a definite pressure, whereas in the present device of this application, the differential pressure control is responsible only to the difference in pressure, which is the controlling function desired.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawing, showing a

Refrigerating apparatus

of the preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

Referring more particularly to the drawing, wherein a refrigeration system embodying the present invention is shown in diagram, the compressor 1 is operated by means of the electric motor or prime mover 2. The exhaust 3 of the compressor delivers the compressed refrigerant to a condenser 4, which condenser is cooled by means of circulation through the coil 5 of a cooling medium, such as water. The refrigerant is condensed under pressure in the surface condenser 4, which is of the approved cooling water circulation type. The liquid refrigerant is then withdrawn from the condenser 4 through a conduit or pipe 6, which delivers the liquid refrigerant to a thermal expansion valve 7, through which it is allowed to expand to a gas or vapor in the evaporator coil 8, cooling the air or other medium which passes over the surfaces of such evaporator coil. The outlet from the evaporator 8 is connected by means of the conduit or pipe 9 to the suction 10 of the compressor 1, where the pressure is raised to a point where the refrigerant will condense in the condenser 2, thus completing the cycle.

During normal operation the compressor 1 is controlled to maintain the suction pressure in the evaporator 8, as required to produce the temperature required or desired. For such control a thermostat 11, reacting to the temperature produced by the evaporator, functions to stop and start the compressor, as necessary, for maintaining the suction pressure in the evaporator 8 and the resultant produced temperature of the cooled medium. The compressor operating conditions are limited by a high and low pressure cut-out 12, having an adjustable differential control. This cut-out 12 is of any suitable type readily obtained upon the market. It functions to prevent excessive operating overloads, should a condition of low suction pressure or high dis-

charge pressure occur, that would normally result in an overload on the compressor motor 2, by breaking the power circuit through such motor and stopping its operation. The cut-out 12 is connected by conduit or suitable piping 13 to the discharge of the compressor 1, and by like piping 14 and 15 to the low pressure or suction side of the compressor 1.

For illustration, assume the compressor 1 is not in operation. When the thermostat 11, acted upon by the temperature produced by the evaporator 8, requires refrigeration, it acts to complete the electrical circuit therethrough, through the high and low pressure cut-out 12 to the magnetic contactor 16, and through the normally closed contacts 17 thereof to complete the circuit, energizing the equalizer solenoid valve 18. This solenoid valve 18 is located between the high pressure conduit 13, connected to the discharge 3 of the compressor 1, and the low pressure conduit 15, connected to the suction 10 of the compressor 1. The energization of the solenoid opens its valve, permitting the pressures in the suction and discharge sides of the compressor to become equalized.

A differential pressure control 19 is connected to the low pressure side or suction of the compressor 1 through piping 15, and to the high pressure side or discharge 3 of the compressor 1 through piping 13 and 23.

When the desired degree of equalization necessary or sufficient to permit the instant starting of the compressor is reached, the differential pressure control 19, which is of any suitable type obtainable upon the market, functions to momentarily complete the electrical circuit from connection 20 thereof through connection 20' thereof to the magnetic coil 21 of the magnetic contactor 16, energizing said coil 21 and thereby completing the "hold-in" circuit through contact 22, maintaining the magnetic contactor 16 in energized position.

Simultaneous with this latter operation, the normally closed contacts 17 of the magnetic contactor 16 are opened, by reason of the energization of the contactor, thus breaking the circuit through the solenoid 18' of the solenoid valve 18, de-energizing it and allowing the valve thereof to close, cutting off communication between the high and low pressure sides of the cycle. By the same operation, e. g. energizing the magnetic contactor 16, the contacts 24 are closed, completing the circuit to the compressor starter 25, thus energizing the compressor motor 2 and starting the compressor.

The compressor 1 will continue in operation until the temperature of the cooled medium reaches a predetermined degree, at which time the thermostat 11 opens the circuit through the high and low pressure cut-out 12, contact 20, to the magnetic contactor 16, de-energizing the magnetic contactor 16 and opening the contacts 24, consequently de-energizing the compressor starter 25 and stopping the compressor motor 2.

Each cycle of operation will set in motion the same sequence of starting, e. g. energization of the equalizer solenoid valve 18 until the differential pressure control 19 is operated, at which time the magnetic contactor 16 is energized and the compressor subsequently started. As this sequence is definitely under the control of the thermostat 11, under normal operating conditions, this arrangement functions to provide equalization at the moment the thermostat demands refrigeration, rather than allowing the equipment to stand inoperative until equalization has taken place through the rise in temperature or other natural means.

Once the thermostat 11 has placed the compressor in operation by the above sequence, the differential pressure control 19 no longer functions to control the magnetic contactor 16, and the compressor will remain in operation until either the thermostat 11, the hand switch 26, or the high and low pressure cut-out 12 interrupt the circuit to the magnetic contactor 16, de-energizing the contactor 16 and in consequence de-energizing the compressor starter and stopping the compressor.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, means responsive to said temperature responsive means for opening communication between said high and low pressure sides to equalize the pressure therein, and means active upon equalization of the pressure in the high and low pressure sides to cut off communication between said high and low pressure sides.

2. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, means responsive to said temperature responsive means for opening communication between said high and low pressure sides to equalize the pressure therein, means active upon equalization of the pressure in the high and low pressure sides to cut off communication between said high and low pressure sides, and means operated simultaneously with the cutting off of communication between the high and low pressure sides to start the compressor.

3. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, means responsive to said temperature responsive means for opening communication between said high and low pressure sides to equalize the pressure therein, and means active upon equalization of the pressure in the high and low pressure sides to cut off communication between said high and low pressure sides, said last-named means also acting to prevent starting of the compressor until equalization of pressure in said high and low pressure sides is accomplished.

4. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the

temperature produced by the evaporator for stopping and starting the compressor, means responsive to said temperature responsive means for opening communication between said high and low pressure sides to equalize the pressure therein, means active upon equalization of the pressure in the high and low pressure sides to cut off communication between said high and low pressure sides, a prime mover for operating said compressor, said cut-off means controlling operation of said prime mover.

5. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, means responsive to said temperature responsive means for opening communication between said high and low pressure sides to equalize the pressure therein, means active upon equalization of the pressure in the high and low pressure sides to cut off communication between said high and low pressure sides, a prime mover for operating said compressor, said cut-off means controlling operation of said prime mover and operative only upon equalization of pressure in said high and low pressure sides to permit starting of said prime mover.

6. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, a solenoid actuated valve located between said high and low pressure sides and actuated by said temperature responsive means to open communication between said high and low pressure sides to equalize the pressure therein, and means active upon equalization of the pressure in the high and low pressure sides to de-energize said solenoid actuated valve to cut off communication between said high and low pressure sides.

7. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, a solenoid actuated valve located between said high and low pressure sides and actuated by said temperature responsive means to open communication between said high and low pressure sides to equalize the pressure therein, and a differential pressure control element connected to both the high and low pressure sides and actuated by equalization of the pressure in said high and low pressure sides to de-energize said solenoid actuated valve to cut off communication between said high and low pressure sides.

8. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, a solenoid actuated valve located between said high and low pressure sides and actuated by said temperature responsive means to open communication between said high and low pressure sides to equalize the pressure therein, means active upon equalization of the pressure in the high and low pressure sides to de-energize said solenoid actuated valve to cut off communication between said high and low pressure sides, and means actuated simultaneously with the de-energization of said solenoid actuated valve to start the compressor.

9. Refrigerating apparatus comprising an evaporator, a condenser, and a compressor receiving refrigerant from the evaporator and discharging it under pressure into the condenser thereby providing high and low pressure sides in the refrigerating cycle, means responsive to the temperature produced by the evaporator for stopping and starting the compressor, a solenoid actuated valve located between said high and low pressure sides and actuated by said temperature responsive means to open communication between said high and low pressure sides to equalize the pressure therein, a differential pressure control element connected to both the high and low pressure sides and actuated by equalization of the pressure in said high and low pressure sides to de-energize said solenoid actuated valve to cut off communication between said high and low pressure sides, and means actuated simultaneously with the de-energization of said solenoid actuated valve to start the compressor.

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