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Cooper

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[54] AIR CONDITIONING CONTROL SYSTEM

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[51] Int. Cl. F25b 41/04
[58] Field of Search 62/217, 222, 223, 224, 62/225, 209, 210

[56] References Cited
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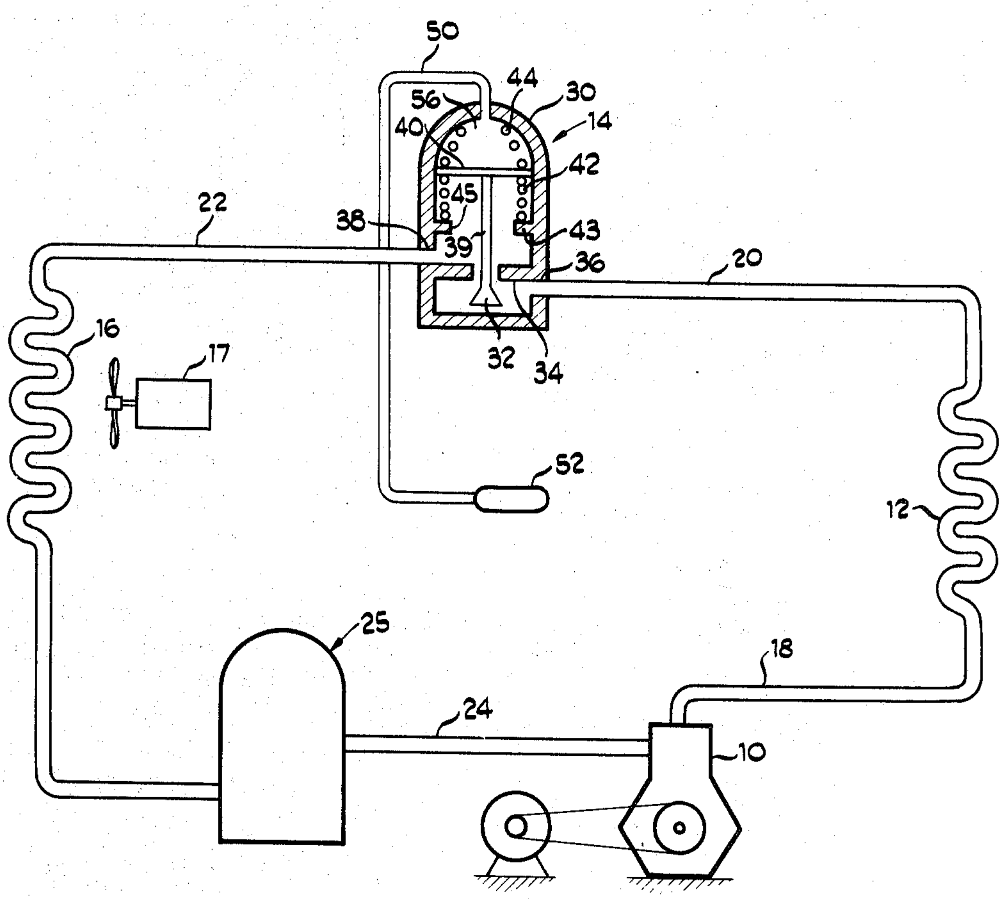
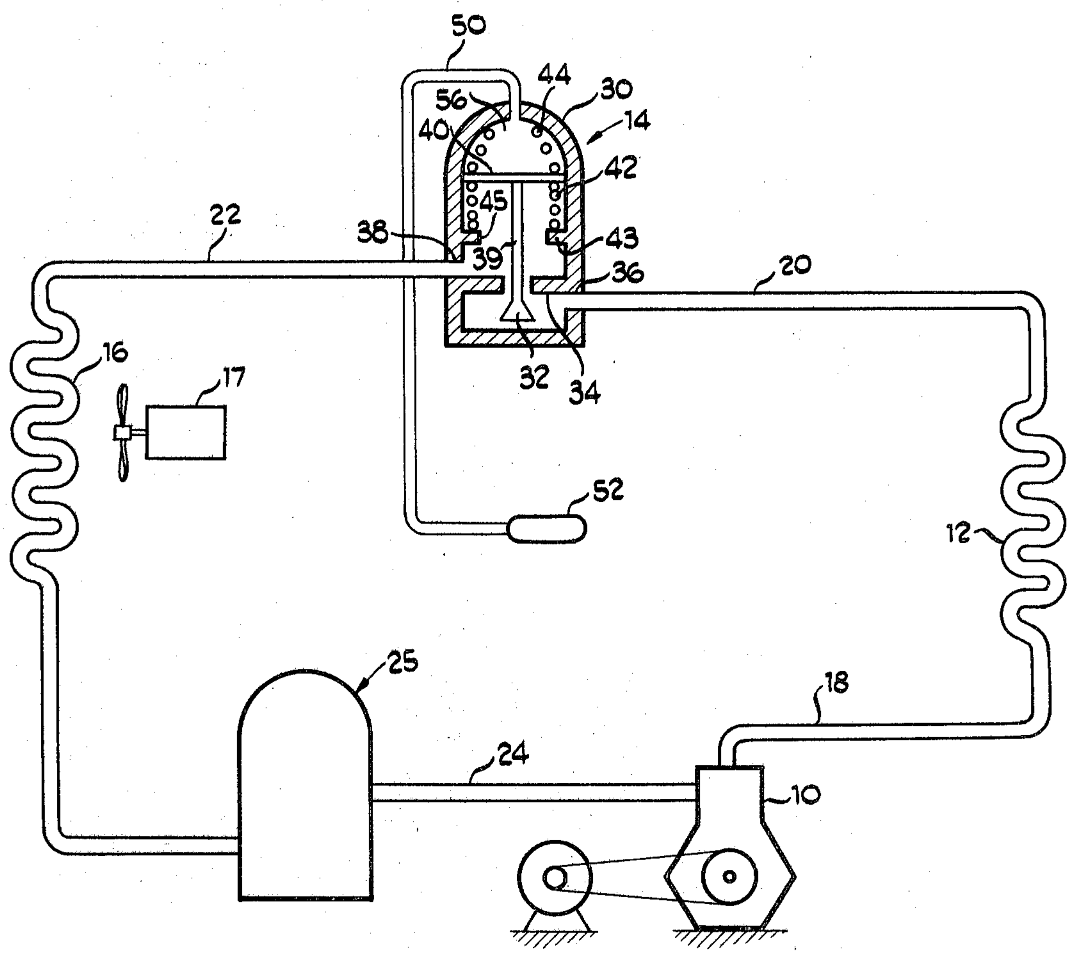
[57] ABSTRACT

A refrigerant control system, particularly useful for air conditioning apparatus, including means for operating the system with a relatively high evaporator pressure during the time the temperature within the cooled space is being reduced to its desired level. While such temperature level is being reduced, a constant pressure expansion device is adjusted to maintain the control point at a lower temperature (and pressure) to effect dehumidification.

1 Claim, 1 Drawing Figure

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AIR CONDITIONING CONTROL SYSTEM

BACKGROUND AND SUMMARY OF THE INVENTION

In U. S. Pat. No. 3,260,064 issued to A. B. Newton on July 12, 1966 there is described an air conditioning system including a compressor, a condenser, an expansion device, and an evaporator, all connected in a closed, vapor cycle refrigeration circuit. An important feature described and claimed in the aforementioned patent is the use of means for sensing the superheat of gas leaving the evaporator and means varying the capacity of the compressor operated in response to the amount of superheat to maintain the correct balance between the compressor capacity and the refrigeration load. This sytem also uses a constant pressure expansion device between the condenser and evaporator to maintain the evaporator pressure at a predetermined value.

In certain automotive air conditioning applications, especially in the larger size vehicles, which are conventionally furnished with adequately sized evaporator coils, the critical part of the system is in the compressor. At low suction pressures the efficiency of the compressor is materially reduced in that the refrigerant taken in the suction side of the compressor is in a smaller quantity and less work can be performed on the refrigerant. Automotive applications also present a problem with respect to start-up conditions. For example, the temperature of the air in an enclosed vehicle space, if the auto is parked in the sun with the air conditioning off, may reach as high as 160°F. During the time which is required to bring this temperature down to the desired level, commonly referred to as "pull-down," the system should be operated in such a manner as to bring this temperature down as fast as possible to avoid discomfort to the occupants. On the other hand, it is desirable to provide dehumidification of the air being circulated within the vehicle space.

In order to satisfy the first objective, i.e., rapid pull-down, the evaporator pressure should be kept relatively high. This allows more refrigerant to be taken into the compressor suction and provides for efficient use of the entire evaporator coil surface. In others words, during pull-down under normal conditions the refrigerant will completely evaporate in the first section of the evaporator coil. Beyond this point, the temperature of the refrigerant vapor rises (is superheated) and then passes to the compressor suction port. With an adequately sized evaporator coil the pressure can be raised to effectively increase the capacity of the compressor and utilize most of the evaporator coil surface. To satisfy the requirement of dehumidification after pull-down has been completed, the evaporator pressure should then be lowered to a point slightly above the temperature at which coil freeze up can occur.

It is a principal feature of this invention to provide a system in which the control point of the automatic expansion device is adjusted during pull-down to reduce the evaporator pressure, thereby achieving both objectives of fast pull-down and dehumidification. This may be accomplished by means of a thermally responsive bulb which senses interior air temperature (or a related variable indicative thereof) and readjusts the control or balance point of the expansion device by producing an opposing force on the actuating diaphragm. With respect to the related variable sensed, this may be the temperature of refrigerant leaving the evaporator coil or the temperature of air on the evaporator coil.

DESCRIPTION OF THE DRAWINGS

The single FIGURE is a schematic or diagrammatic view of an air conditioning system constructed in accordance with the principles of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As shown in the FIGURE, the air conditioning system of the present invention includes a compressor **10**, a condenser **12**, an expansion device **14** and an evaporator **16** all connected to provide a closed circuit refrigeration system. Refrigerant compressed by the compressor **10** is delivered to the condenser through line **18**. The liquified refrigerant is then passed through line **20** to expansion device **14**, which will be discussed in more detail below. After the refrigerant passes through the expansion device from high pressure side to low pressure side, it flows through line **22** to the evaporator **16** which cools the air circulated over it by fan **17**. The refrigerant then flows through line **24**, commonly referred to as the suction gas line, to the suction connection of compressor **10**.

As previously described in copending application Ser. No. 99,806, A. B. Newton, filed Dec. 21, 1970, now U.S. Pat. No. 3,688,517, issued Sept. 5, 1972, a superheat regulating valve **25** is located between the evaporator and the compressor in line **24**. Since the construction and operation is described in detail in the above-identified Newton application it is incorporated by reference.

Expansion device **14** comprises a valve having a casing **30**, a valve member **32** adapted to be seated on valve seat **34**, inlet **36** and outlet **38**. Valve member **32** is connected to a stem **38** which is secured at its opposite end to an actuating diaphragm **40**. Spring **42** is seated upon a spring support member **43** and tends to urge the valve member toward a closed position against seat **34**. Spring **44** located in the upper portion of the casing **30** engages the diaphragm **40** and biases the same in a downward position tending to open the valve by urging valve member **32** away from the seat.

As noted above, an important feature of the invention is the provision of means for establishing a control signal indicative of the interior air temperature and using such signal to vary the control point of the expansion device **14**. At the upper portion of the casing **30** there is provided a fluid connection, by means of capillary tube **50**, to thermal expansion bulb **52**. The chamber **56** formed between the casing **30** and diaphragm **40**, together with the capillary and bulb, form a closed system.

Assuming that the vehicle is in a condition where the interior space is relatively warm, the bulb **52**, which as previously noted may be located in a position to sense interior air temperature, off-coil air temperature, or suction line refrigerant temperature, will be relatively warm. Accordingly, the fluid charge in the bulb and capillary will be at a high pressure, tending to establish a relatively high pressure not only within the bulb itself but also in chamber **56** which is part of the same closed system. This pressure acting against the upper surface of diaphragm **40** will tend to bias the valve member to its open position and establish a control point effecting a relatively high pressure on the downstream side of the valve, and in the evaporator itself. After the system has been operating for a few minutes (and until the pressure in chamber **56** decreases), the pressure on the downstream side of the valve will be maintained constant by the pressure acting against the under side of the diaphragm **40.** For example, if the load is changed so as to increase the downstream pressure, this pressure will be applied through passage **45** to the under side of the diaphragm **40,** tending to close the valve. If the pressure is reduced for some reason, the opposite result occurs. After the system has been operating for a while at the higher evaporator pressure, the bulb temperature will be reduced tending to reduce the pressure in chamber **56** to relieve the pressure on the upper surface of the diaphragm. This will gradually shift control point at lower and lower pressures until such time as the pull-down phase has been completed. At this point, the evaporator pressure will be established at a point slightly above the temperature at which freeze up can occur, but at a low enough temperature to effect the desired dehumidification of air passing through the evaporator coil.

While this invention has been described in connection with a certain specific embodiment thereof, it is to be understood that this is by way of illustration and not by way of limitation; and the scope of the appended claim should be construed as broadly as the prior art will permit.

What is claimed is:

1. A combination comprising: a compressor; a condenser; a constant pressure expansion device; and an evaporator all connected to provide a closed, vapor cycle system through which a refrigerant is circulated; means for circulating air to be conditioned through said evaporator to a space, the temperature of which is to be controlled; a superheat regulating valve interposed between said evaporator and said compressor to control the flow of refrigerant therebetween and maintain a predetermined superheat of refrigerant flowing to said compressor; means for establishing a control signal which is a function of the temperature of air within the controlled space and means for applying said signal to said constant pressure expansion device to vary the control point thereof, and the corresponding evaporator pressure, whereby the evaporator pressure is established at a lower value when the temperature of the controlled space is below some predetermined value.

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