United States Patent

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[33] **Italy**
[31] **5109 A/69**

[54] **REFRIGERATOR SYSTEM**
5 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **62/217,** 62/228
[51] **Int. Cl.** **F25b 41/04**
[50] **Field of Search** 62/196, 197, 226, 228, 244, 323, 243

[56] **References Cited**
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ABSTRACT: A pressurized refrigeration system having a condenser, an evaporator, and a compressor is provided with an isobaric valve between the evaporator and the compressor. The isobaric valve is sensitive to the output pressure of the compressor to restrict the flow of refrigerant fluid into the compressor when the output pressure of the fluid from the compressor increases above a first predetermined value. The isobaric valve also has a normally closed pressure-sensitive switch which operates to disconnect the compressor from its drive means if the pressure of the refrigerant fluid from the compressor falls below a second predetermined value, such as when a leak occurs in the refrigeration system.

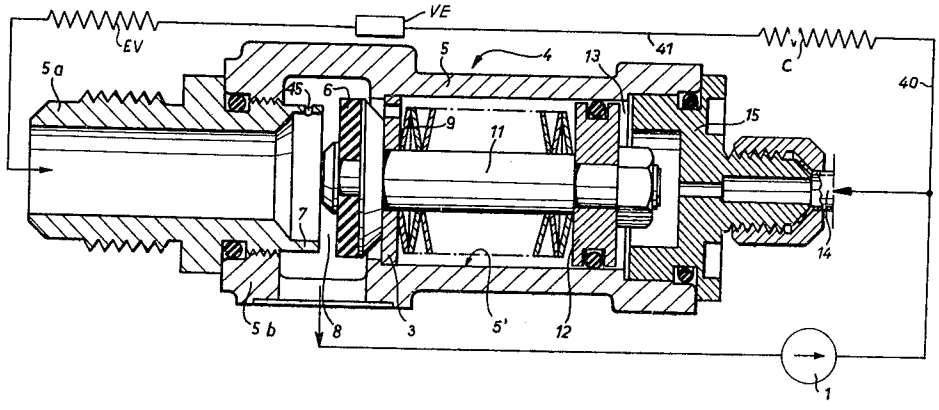


Fig. 1

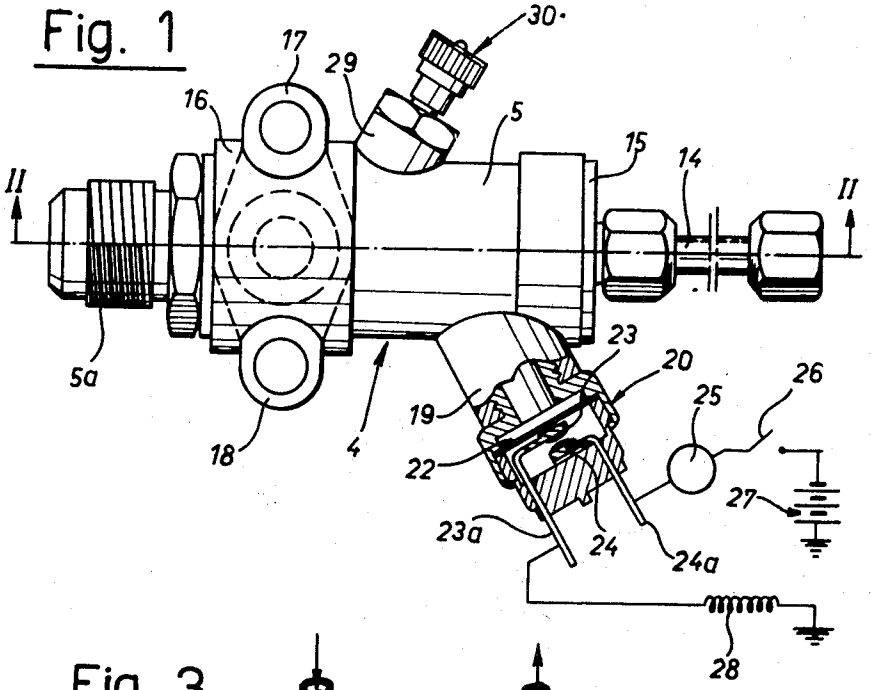
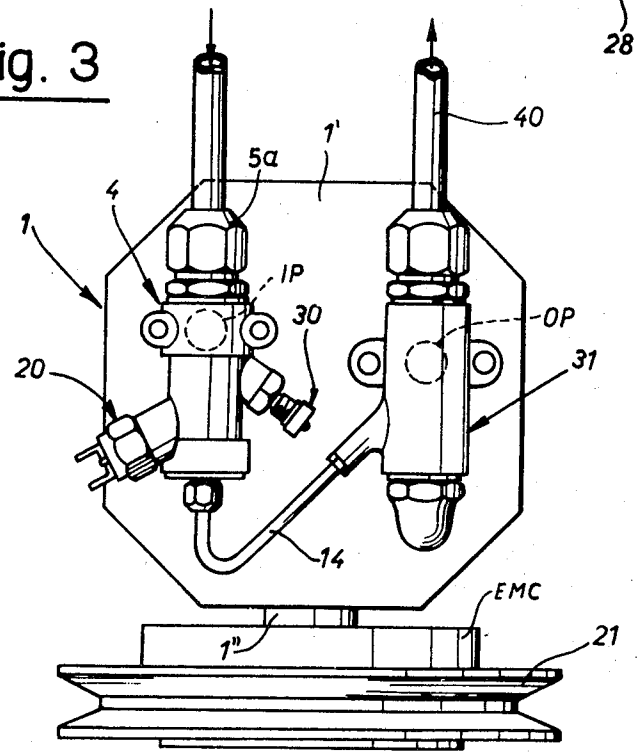

30
17
29
16
5
15
14
II
II
5a
18
4
19
22
23
20
25
26
27
23a
24
24a
28

Fig. 3


40
1'
5a
4
1
IP
30
OP
31
20
14
EMC
1"
21

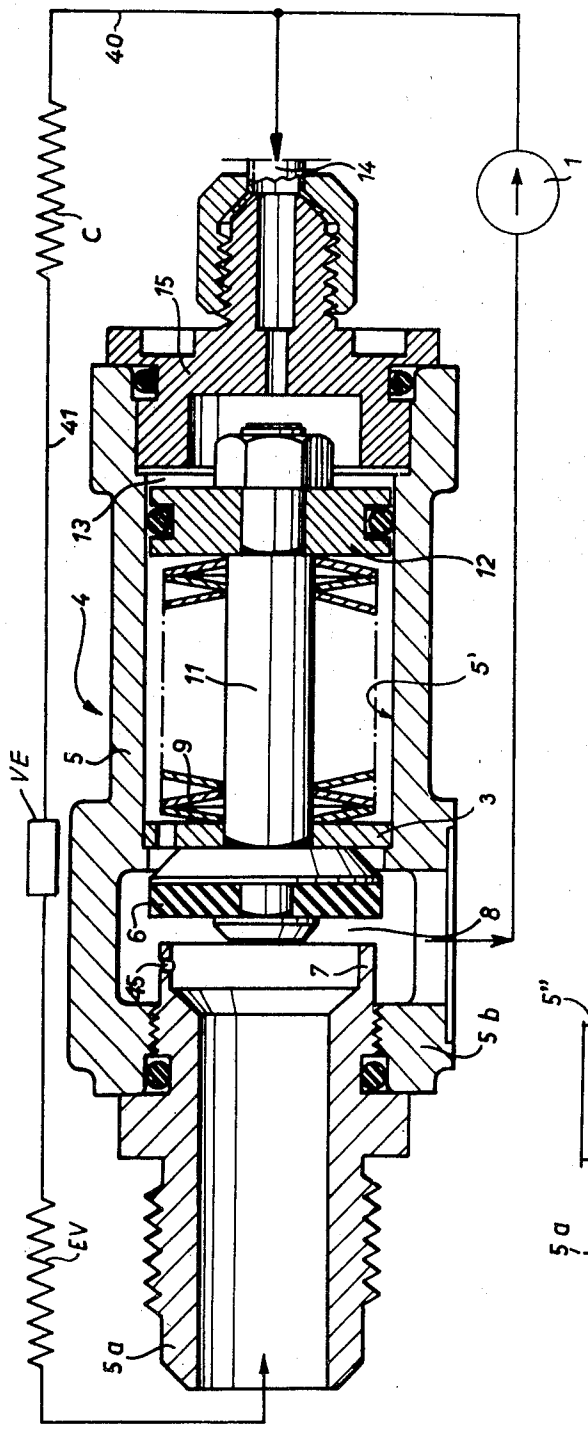


Fig. 2

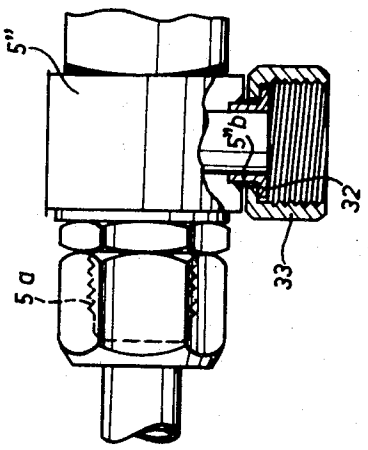


Fig. 4

REFRIGERATOR SYSTEM

This invention relates to a refrigerator system for air-conditioning installations, particularly for engine-powered vehicles, comprising an evaporator, a condenser, and a compressor in driving connection with the vehicle's engine, said system moreover comprising a valve ("isobaric valve") interposed between the evaporator and the compressor, the shutter of said valve being controlled by the pressure of the refrigerant fluid from the compressor to the condenser in such a way as to reduce the flow of the refrigerant fluid from the evaporator to the compressor when the pressure in the fluid from the compressor exceeds a predetermined level.

It is known to provide an isobaric valve, the shutter of which is controlled by a piston, sliding within the casing of the valve, to move the shutter from an extreme open position, against the action of a bias spring, to an extreme closed position. The casing of the valve forms with this piston a pressure chamber communicating with the outlet of the compressor. The spring is set to determine the maximum pressure of operation of the refrigerator assembly, so that no dangerous pressure is set forth by the compressor when the engine operates at a relatively high speed.

One object of the present invention is to bring about certain improvements in the systems of the above type so as to increase their reliability.

Another object of the invention is to achieve an isobaric valve designed to be assembled directly upon a compressor. A further object of the invention is to achieve an isobaric valve furnished with auxiliary members intended to ensure security of the refrigerating system against any leakage of refrigerant fluid.

One feature of the refrigerator system according to the invention is that the isobaric valve includes a pressure-sensitive switch communicating with the high-pressure chamber of the valve, electrically connected to the circuit of an electromagnetic clutch between the compressor and the engine of the automobile. The pressure switch operates to prevent the refrigerating system from operating, in the case of loss of refrigerant fluid.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of one embodiment of an isobaric valve according to the present invention;

FIG. 2 is an axial section on an enlarged scale, taken along the line II—II of FIG. 1;

FIG. 3 is a plan view of a valve according to the invention, shown attached to a compressor of an air-conditioning system for an automobile, and

FIG. 4 shows a modification of the valve according to the invention.

An isobaric valve generally indicated **4** is shown having a tubular casing **5**. The casing **5** has an axial inlet pipe nipple **5***a* protruding into a chamber **8** and a lateral outlet fitting **5***b* which is integral with the casing itself. The casing **5** also forms a cylinder **5'** within which there sealingly slides a piston **12** having a piston rod **11**. The piston rod **11** protrudes into the chamber **8** through a partition **3** and carries a shutter **6** which cooperates with an annular valve seating **7** on the nipple **5***a* to control the flow of fluid through the chamber **8** from the nipple **5***a* to the outlet fitting **5***b*.

The cylinder **5'** is provided with a cylinder head **15** which, with the cylinder **5'** and the piston **12**, forms a pressure chamber **13**. A pipe **14** is provided for connecting the pressure chamber **13** with the outlet of a compressor **1** to which the valve is attached so that the pressure of the fluid from the compressor tends to close the shutter **6** against the action of a cup spring **9** which biases the piston, and thus the shutter **6** toward an open position.

On either side of the fitting **5***b*, there are two symmetrical ears **17**, **18** having apertures for fixing bolts to attach the valve to the head **1'** of the compressor (as illustrated in FIG. **3**) the latter being driven by the engine (not shown) of a vehicle through a V-belt transmission including a pulley **21** and an electromagnetic clutch EMC on the shaft **1''** of the compressor.

The valve casing is formed with a lateral tubular branch **19** communicating with the pressure chamber **13** and having a pressure-sensitive switch **20** screwed therein. The switch **20** comprises a diaphragm **22** exposed to the fluid pressure in the pressure chamber **13** and two electrical contacts **23** and **24**, one of which is movable by the deflection of the diaphragm **22**, and the other of which is fixed, joined to respective pins **23***a*, **24***a*.

One pin **23***a* is electrically connected to the energizing winding **28** of the electromagnetic clutch EMC, and the other pin **24***a* is connected, with the interposition of a thermostatic switch **25** and of a hand-controlled switch **26**, to the battery **27** of the vehicle.

As is shown in FIG. **2**, the outlet of the compressor **1** is connected with the pressure chamber **13** through the pipe **14**, and a further pipe **40** connects said outlet with a condenser C. The fluid condensed in the condenser C flows to an evaporator EV through a pipe **41** containing an expansion valve VF and the vaporized fluid returns to the compressor via the nipple **5***a* and the valve-controlled chamber **8**. The inlet and outlet ports of the compressor are denoted by IP and OP, respectively, in FIG. **3**. The refrigerating fluid circuit just described above is "-pressurized," that is a superatmospheric pressure of a few atmospheres (e.g., 3 atmospheres gauge) is established therein by the refrigerating fluid in static conditions of the system. Under such conditions, the pressure-sensitive switch is normally closed. More particularly, when the valve as shown in FIG. **1** is connected into the circuit and the latter is charged with a refrigerating fluid, the static pressure in the system will deflect the diaphragm **22** thereby to close the contacts **23**, **24**, the switch **20** being set at a critical pressure value (e.g., 2 atm. gauge) which is the lowest static pressure value at which the system will still function efficiently.

The operation of the system is as follows.

Since the pressure-responsive switch **20** is normally closed when the system is sound, the winding **28** will be energized to engage the clutch EMC upon closure of the manually controlled switch **26**. Thus, the engine will drive the compressor and the delivery pressure of the latter at various speeds of the engine beyond a predetermined value will be automatically controlled by the isobaric valve **4** in the manner known in the art. Briefly, should the delivery pressure reach a predetermined value, the piston **12** will be displaced to progressively throttle the fluid passage through the chamber **8** thereby correspondingly reduce the output from the compressor.

Should a fluid leakage occur from the system, the static pressure will progressively drop until a value is reached at which the pressure-sensitive switch **20** is set; thus, the switch will break its associated circuit thereby to prevent energization of the clutch winding **28** until the efficiency of the system is restored by recharging the system with refrigerant fluid.

The isobaric valve is equipped with a small valve **30**, identical to a conventional tire-inflating valve, mounted in a tubular limb **29** and designed to permit connection of an air pump for the elimination of noncondensable substances on assembly of the system and for the subsequent loading of refrigerant fluid.

The isobaric valve is proportioned so as to be capable of direct attachment to the head **1'** of the compressor **1**, as illustrated in FIG. **3**, in place of the usual induction cock, with the economic advantage of also being able to replace this cock. The high-pressure tubing **14** is joined to an outlet cock **31**, placed upon the compressor next to the isobaric valve **4** and communicating with the outlet port OP.

In the alternative embodiment illustrated in FIG. **4**, the casing **5'** of the valve is furnished with an axial inlet pipe union **5''***a* with a lateral outlet pipe union **5'***b*, soldered to the casing. The pipe union **5''***b* bears an annular projection **32** which fits into a threaded ring nut **33**, which can be used for fixing the valve to a threaded connector associated with the inlet port IP of the compressor.

I claim:

1. In a pressurized refrigeration system having an evaporator,

a compressor for compressing a refrigerant fluid, said compressor having a low-pressure input connection, a high-pressure output connection,

drive means for said compressor,

an isobaric valve having an input connection to said evaporator, an output connection to said low-pressure input connection of said compressor, a passageway between said input connection of said isobaric valve, and said output connection of said isobaric valve, and a shutter in said passageway,

means for controlling said shutter in dependence on the pressure of said refrigerant fluid from said output connection of said compressor whereby said shutter reduces the flow through said passageway to reduce the flow of said refrigerant fluid to said input connection of said compressor when said pressure of refrigerant fluid from said output connection of said compressor exceeds a first predetermined value,

the improvement comprising an electrical circuit including electromagnetic clutch means in said drive means for said compressor,

said isobaric valve further including pressure-responsive switch means in said electrical circuit in communication with said high-pressure outlet connection of said compressor, said pressure-responsive switch means being operative to cause disengagement of said electromagnetic clutch means to disconnect said drive means from said compressor when said pressure of fluid from said output connection of said compressor falls below a second predetermined value.

2. The isobaric valve of claim 1 wherein said output connection of said isobaric valve is shaped for direct attachment to said input connection of said compressor.

3. The isobaric valve of claim 1 wherein said output connection of said isobaric valve is shaped with two ears whereby said isobaric valve can be bolted to said input connection of said compressor.

4. The isobaric valve of claim 1 wherein said output connection of said isobaric valve is shaped with an annular projection, a threaded ring nut mounted on said annular projection whereby said output connection may be coupled to a threaded connector.

5. The isobaric valve of claim 1 further comprising a valve in communication with said passageway between said input connection and said output connection of said isobaric valve whereby said isobaric valve can be connected to a pump for charging said refrigeration system with said refrigerant fluid.

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