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[54] **EXPANSION VALVE**
3 Claims, 2 Drawing Figs.

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 [51] Int. Cl..... **F16k 31/12**
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61.2, 61.3; 62/225, 224, 223, 222; 137/495,
505.27; 236/92 B

ABSTRACT: An expansion valve for controlling the flow of a fluid medium and being connected to a pressure-generating sensor has a valve housing defining a valve chamber and a valve head with a membrane therein reacting to the pressure coming from said sensor. A valve pin, connecting the membrane with the valve body of the valve for joint movement therewith, has a bore connecting the outlet end of the valve with an inner membrane chamber. The valve pin passes through a packing located between the inner membrane chamber and the valve chamber for preventing a flow of the medium from the valve chamber into the inner membrane chamber.

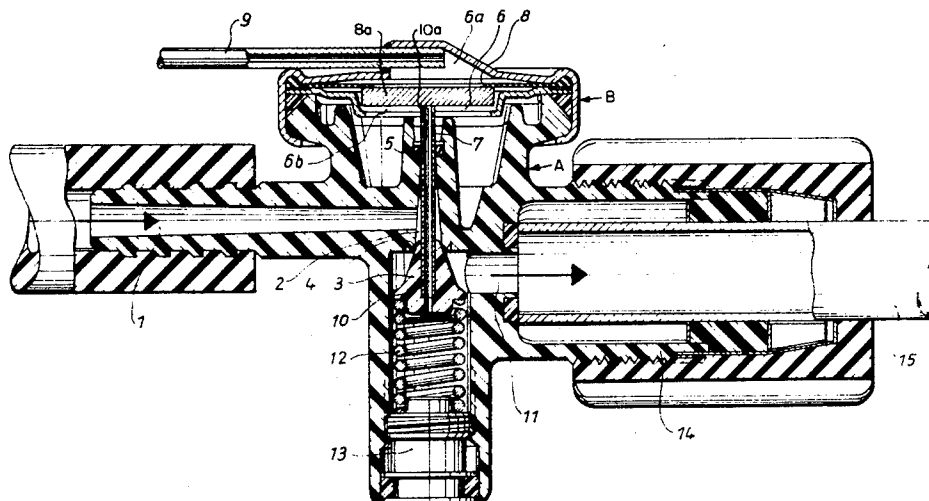
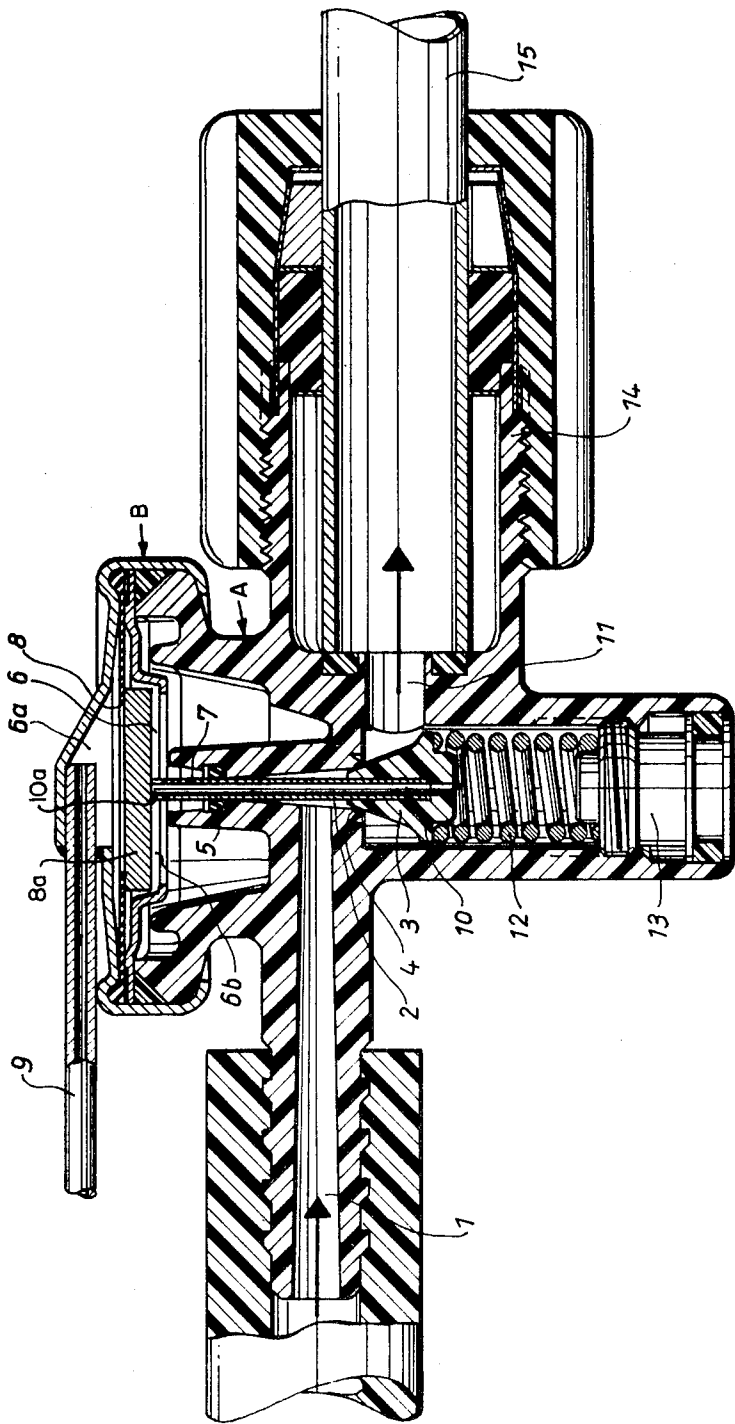


Fig. 1



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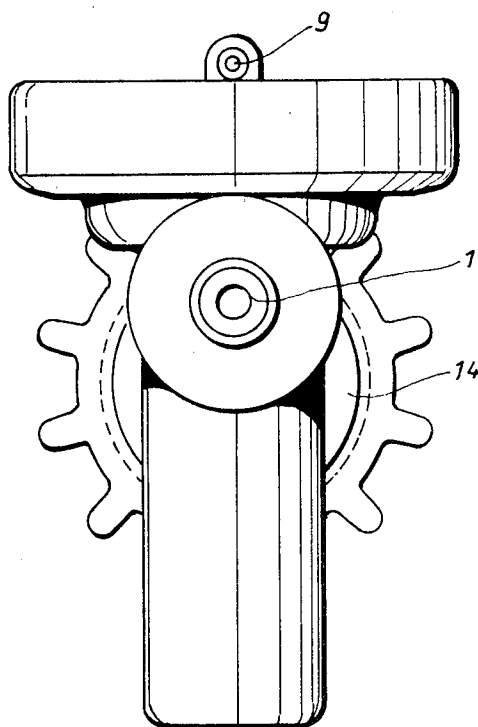
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Fig. 2



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EXPANSION VALVE

BACKGROUND OF THE INVENTION

This invention relates to valves, and especially to expansion valves of a construction in which a valve pin is used for operation of the valve body and wherein the valve pin is operated by a membrane located in a membrane chamber which is divided by the membrane into an outer membrane chamber and an inner membrane chamber.

The outer membrane chamber and the inner membrane chamber of this type of valve are airtight in relation to each other. The outer membrane chamber is connected with a pressure-generating sensor whereas the inner membrane chamber is connected to the medium which passes through the valve.

The flow of the medium through such an expansion valve is regulated by the movement of the pressure-operated membrane which opens and closes the valve transmitting its movements to the valve body with the help of the valve pin.

The movement of the membrane or its position in the membrane chamber is determined by the control pressure exerted against the membrane in the outer membrane chamber and the pressure of the medium in the inner membrane chamber of the expansion valve.

Normally the medium enters the valve in a liquid state just below its boiling point. Upon entry into the valve the liquid medium expands and at the same time cools off and changes at least partially into a gaseous state in the evaporator.

BRIEF DESCRIPTION OF THE PRIOR ART

It is known to equip expansion valves with pressure pins movable in respective bores. The difference between the diameter of the pin and the diameter of the bore creates a space which serves as a connection between the expansion space of the valve and the inner membrane chamber. The injection of the medium into the inner membrane chamber is arranged in such a way that the stream of the expanded medium is not directed against the control head in which the membrane is located as this would influence unfavorably the proper functioning of the valve.

Experience has shown that expansion valves of this construction do not function properly unless they were installed in an upright position.

If such valves are installed in a horizontal position or with the control head upside down some liquid cooling medium collects below the membrane and evaporates during low capacity operation or during the starting operation of the valve. Consequently condensation takes place in the control head instead of at the sensor and the valve remains in its closed position until the collected cooling medium has completely evaporated.

SUMMARY OF THE INVENTION

The principal object of the invention is to provide a new expansion valve which will operate satisfactorily in any position. This is achieved in an expansion valve according to the invention by locating the valve pin in a packing which will seal the membrane chamber against the medium flowing through the expansion valve. At the same time a connection is provided between the inner membrane chamber and the low-pressure end of the expansion valve through a bore in the valve pin.

Thus the membrane which is sensitive to temperature differences is protection from contact with a comparatively warmer cooling medium. The necessary pressure connection between the medium and the inner membrane chamber is now provided from the low-pressure end of the valve via a bore in the valve pin and suitable openings connecting the bore with the surface of the pin. No cooling medium in liquid form can now reach the inner chamber, as any liquid cooling medium evaporates immediately in the bore of the valve pin.

If the installation in which the expansion valve is mounted has been out of operation for a sufficient length of time to per-

mit equalization of temperatures some cooling medium may have collected below the membrane; however upon starting the operation of the plate the collected cooling medium is removed by suction through the bore in the valve pin in its liquid state without producing any cooling effect.

In a preferred embodiment, the cooling medium flowing from the high-pressure end into the expansion valve and thus having a comparatively higher temperature is in contact with at least a part of the pin. Consequently the pin has a higher temperature than the temperature of the cooling medium at the low-pressure end.

As has been already mentioned, this type of expansion valve is arranged in such a way that the stream of the expanded cooling medium cannot be directed against the control head of the valve. In another preferred embodiment of the invention the construction of the expansion valve provides for a longitudinal inlet branch leading into a longitudinally extending valve chamber whose axis is substantially normal to the axis of the inlet branch. The packing of the valve pin provides an airtight insulation between the valve chamber and the inner membrane chamber. The valve body movable, in relation to a valve seat, between an open and a closed position regulates the flow of a cooling medium from the valve chamber into a longitudinal outlet branch whose axis is substantially normal to the axis of the valve chamber. Thus the cooling medium entering through the inlet branch and flowing through the valve chamber and the valve seat, with the valve body being in an open position, into the outlet branch, can enter the inner membrane chamber only from the low-pressure or outlet end through the bore in the valve pin.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the present invention may be readily understood it will now be described with reference to the accompanying drawing wherein:

FIG. 1 is a partially cross-sectional view of a valve according to the invention; and

FIG. 2 is a side elevation of the valve of FIG. 1 as seen from the left side of FIG. 1.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows an expansion valve having a valve housing A with an elongated inlet branch 1 and an elongated outlet branch 14.

An elongated valve chamber 2 having an axis substantially normal to the axes of the inlet branch 1 and the outlet branch 14, is formed within the valve housing. Valve chamber 2 is connected to a bore in the inlet branch to receive a cooling medium flowing through said inlet branch.

A valve body 3 cooperating with a valve seat 4 formed on one end of the valve chamber 2 is movable between an open and a closed position. Valve chamber 2 is also connected to the outlet 11 leading into a bore of the outlet branch when the valve body 3 is in its open position, permitting the flow of the cooling medium from the valve chamber 2 into the bore of the outlet branch 14 and into the evaporator 15 shown only schematically in the drawing.

A valve pin 7 having a narrow axial bore 10 is firmly attached on one end of the valve body 3 and on its other end to a membrane 8 located in a membrane chamber 6. The membrane chamber is defined by the inner walls of a valve head B.

The membrane 8 having a center piece 8a divides the membrane chamber 6 into an outer membrane chamber 6a and an inner membrane chamber 6b, the two chambers being pressure-tight in relation to each other. The outer membrane chamber 6a is connected by conduit 9 with a pressure-generating sensor not shown in the drawing.

The inner membrane chamber 6b is connected through the bore 10 and a side opening 10a in valve pin 7 with the outlet end 11 of the valve.

Any movement of the membrane 8 due to pressure changes in the outer or inner membrane chamber is transmitted to the valve body 3 by the valve pin 7.

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A packing 5 arranged to receive the valve pin 7 for slidable motion therein and located between the valve chamber 2 and the inner membrane chamber 6b prevents any flow of cooling medium from the valve chamber 2 into the inner membrane chamber 6b.

A spring 12 adjustable by adjusting screw 13 urges the valve body 3 upwardly into close contact with the valve seat 4 and thus keeps the valve in a closed position until the pressure exerted against the membrane 8 overcomes the pressure of the spring 12 and lifts the valve body 3 from its valve seat 4.

The cooling medium which enters the inlet branch in a liquid state or in a state close to the point of condensation flows from the inlet branch 1 through the valve chamber 2, and the open valve seat 4 and reaches in an expanded state the outlet branch 14 and therethrough the evaporator 15.

Thus it is evident that during the operation of the expansion valve liquid cooling medium cannot reach or come in contact with the membrane chamber 6.

The necessary pressure in the inner membrane chamber 6b, is obtained through the bore 10 and opening 10a in the valve pin 7 and through a bore in the valve body 3 connecting to bore 10, which transmits pressure of the medium from the outlet end of the valve to the inner membrane chamber 6b.

I claim:

1. An expansion valve comprising a valve housing having an inlet branch and an outlet branch said inlet branch including an elongated valve chamber; a valve head defining a membrane chamber therein; a membrane located in said membrane chamber and dividing said chamber into an outer and an inner membrane chamber, said outer and said inner membrane chambers being pressure-tight relative to each other, said outer membrane chamber being arranged for connection

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to means for applying pressure to said outer membrane chamber; a valve body and a valve seat located on one end of said elongated valve chamber remote from said valve head, said valve body being movable between an open and a closed position with regard to said valve seat; a valve pin firmly connected on one end to said valve body, extending through said elongated valve chamber, and arranged at the other end to be engaged by said membrane for transmitting movement of the membrane to said valve body, said valve pin having a narrow bore axially therethrough and said valve body having a bore connecting to said bore of said valve pin; a packing located on the other end of said elongated valve chamber close to said inner membrane chamber for preventing a flow of the medium from said valve chamber into said membrane chamber, said packing receiving said valve pin for slidable movement therein; and adjustable spring means located inside of said valve housing for urging said valve body in a direction opposite to the direction of the movement of said membrane in response to the pressure applied to said outer chamber, said bore in said valve pin and in said valve body connecting said inner membrane chamber with said outlet branch.

2. An expansion valve as set forth in claim 1 wherein said inlet branch and said outlet branch have axes parallel to each other and wherein the axes of the valve chamber and the valve pin are normal to the axes of said inlet and said outlet branches.

3. An expansion valve as set forth in claim 1, wherein the valve chamber is so arranged that the fluid medium flowing from the inlet branch into said valve chamber is in contact with said valve pin, for thermal transfer.

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