Sept. 24, 1935. A. S. LOCKE 2,015,487

REVERSIBLE EXPANSION MEANS FOR INTERCHANGEABLE CONDENSER AND EVAPORATOR FUNCTIONS

Filed Dec. 29, 1933 2 Sheets-Sheet 1

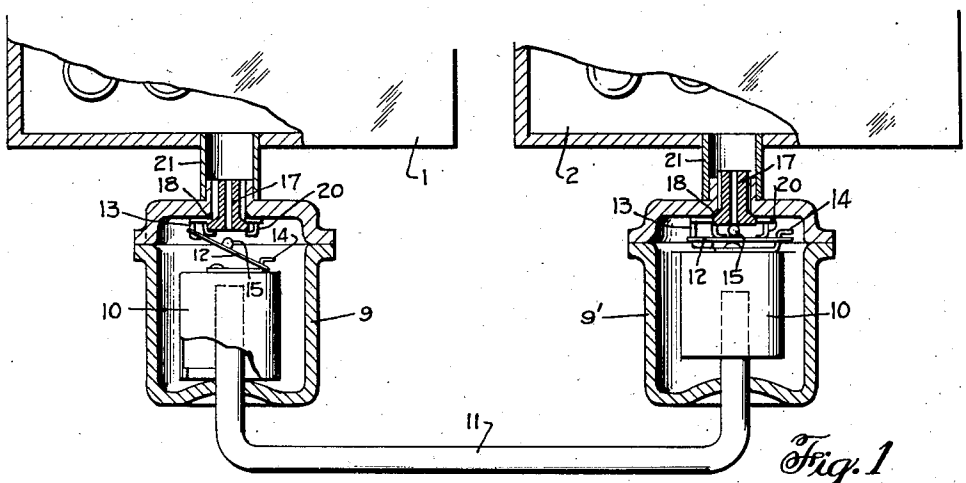


Fig. 1

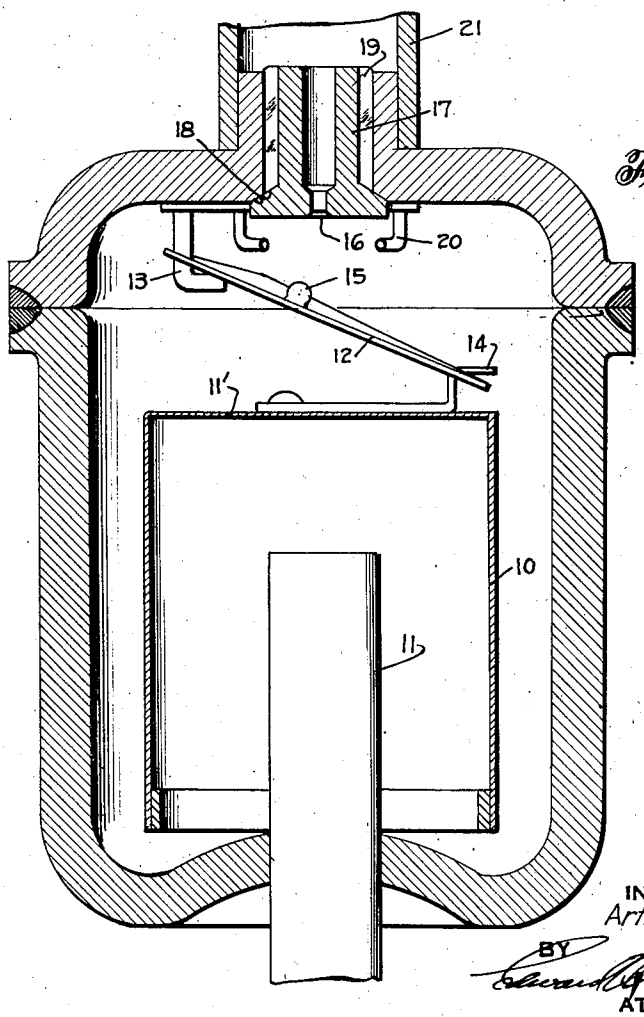


Fig. 2

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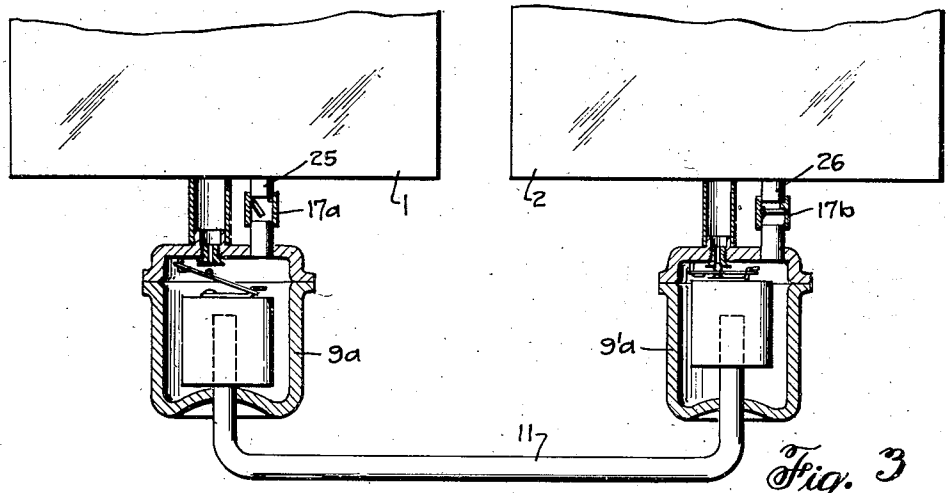
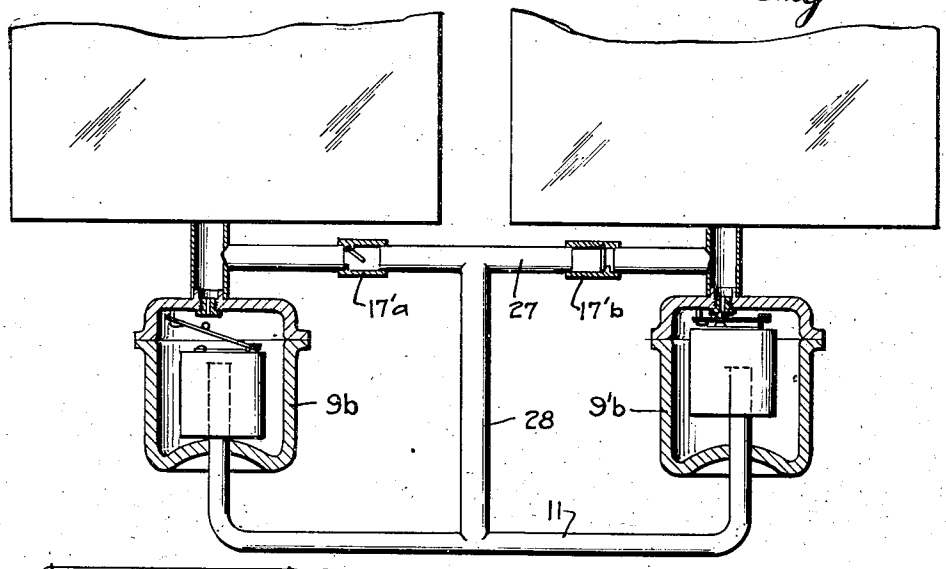


Fig. 3

Fig. 4



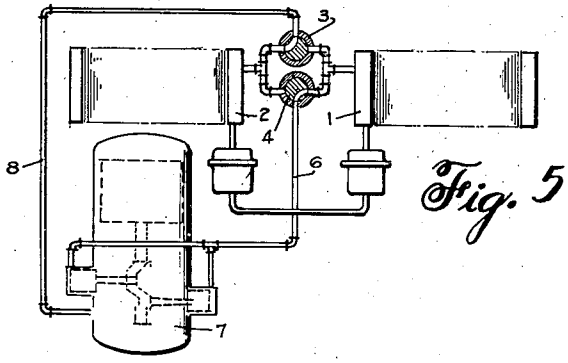


Fig. 5

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2,015,487

REVERSIBLE EXPANSION MEANS FOR INTERCHANGEABLE CONDENSER AND EVAPORATOR FUNCTIONS

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Application December 29, 1933, Serial No. 704,421

7 Claims. (Cl. 62—115)

This invention relates to refrigerant expansion means and more particularly to improved means whereby refrigerant may flow freely in one direction through the expansion mechanism but will be automatically restricted in its opposite direction of flow to effect the expansion operation.

The present invention is particularly adapted to refrigerating systems wherein the condenser and evaporator elements are adapted to have their functions interchanged to permit the refrigerating system to be used for heating as well as cooling purposes. Such an interchangeable system is particularly adapted for air conditioning units, especially of the room type employing complementary heat exchange elements of the air cooled type, wherein outside air is passed over one of said elements and room air over the other.

It is one object of my invention to provide in an interchangeable system of the foregoing type improved refrigerant expansion means whereby the refrigerant may flow freely from one heat exchange element to the other but will be restricted during flow in the opposite direction, thereby to provide the expansion function. Another object in this respect is to provide an improved means whereby the free flow and reverse restricted flow is brought about automatically in response to the flow of refrigerant in one direction or the other.

In one specific aspect of the invention I provide a float actuated valve-controlled orifice in combination with means for freely bypassing refrigerant around said orifice in one direction of flow but which automatically closes said bypass in the opposite direction of flow so as to allow fluid flow only through the restricted orifice for expansion purposes, a pair of the foregoing expansion devices being arranged in opposed series relation whereby fluid expansion is effected in either direction of flow without undue restriction to the flow.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawings in which:

Fig. 1 is a diagrammatic illustration of an expansion system for interchangeable complementary heat exchange elements embodying one form of my improved arrangement;

Fig. 2 is an enlarged vertical section through one of the float controlled expansion devices;

Figs. 3 and 4 are arrangements similar to Fig. 1 but embodying modified forms of the by-passing action in combination with a float controlled expansion means;

Fig. 5 is a diagrammatic view of means for interchanging the condenser and evaporator functions in combination with a compressor.

In the particular embodiments of the invention which are shown herein merely for the purpose of illustrating certain specific forms among possible others that the invention might take, I have disclosed in Fig. 1 a pair of complementary heat exchange elements 1 and 2 employed in a compressor-condenser-evaporator circuit. As shown in Fig. 5 the condenser and evaporator functions may be interchanged merely by rotating valves 3 and 4 so as to connect the discharge 6 of compressor 7 to one element and to connect the suction side 8 to the other element or vice versa depending upon which element is to serve as a condenser or evaporator. Inasmuch as the condenser and evaporator are preferably of the air cooled type, it is seen that outside air passing over the element serving as an evaporator will absorb heat from the outside atmosphere and transfer the same to the element serving as the condenser over which room air would flow. The cooling operation of the unit causes the heat exchange element, say 1, to serve as a condenser over which outside air flows to cool the same while the element 2 would function as the evaporator to cool the room air.

To effectively permit this interchange of functions so that proper expansion of the fluid may be had for either heat exchange element depending upon the direction of refrigerant flow therein, there is provided a pair of traps 9 and 9'. Each of these traps is identical in construction and hence description of one will suffice for both except that it will be noted that they are interconnected by a pipe 11 through the bottom thereof. The trap comprises, as shown more particularly in Fig. 2, a float 10 having a closed upper end, except for small timing leak port 11', but open at its lower end. The pipe 11 projects upwardly through the lower open end of the trap and preferably into float 10. A lever 12 is more or less freely pivoted on a fixed pin 13 carried by the trap casing while the other end of said lever 12 is likewise pivoted to a hook 14 secured to the top of float 10. A small ball valve 15 is slightly relatively movably supported on lever 12 so as to properly seat against an expansion orifice 16. This orifice is formed centrally of a check valve 17 normally resting on a seat 18 and provided with a series of vertical flutes 19. Stop pins 20 are carried by the trap casing and project beneath

check valve 17 but out of the path of lever 12. The trap is, of course, connected as by a pipe 21 to its heat exchange element.

Operation.—Assuming element 1, of Fig. 1, to be functioning as a condenser and element 2 as an evaporator, it is seen that the high pressure in condenser 1 will force check valve 17 downwardly against stop pins 20, thereby allowing free flow of refrigerant liquid through flutes 19 to trap 9 and thence down under and inwardly of the lower open edge of float 10 to pipe 11 from which it enters the other trap 9'. As long as only liquid flows through pipe 11, this liquid will pass beneath the lower edge of float 10 of trap 9' and thence upwardly through its orifice 16 to the evaporator 2. The float 10 of trap 9' will remain in its lower position due to its weight and due to the fact that the trap is entirely filled with liquid. Also check valve 17 thereof will remain closed because of the high pressure on its under side and the reduced pressure on its upper side. However, if the condenser is not condensing refrigerant fast enough so that refrigerant gas flows through trap 9 over to trap 9', then the refrigerant gas will accumulate in the upper end of float 10 thereof and cause it to rise due to its lower end being sealed in liquid. This will cause ball 15 to seat against orifice 16 and temporarily prevent flow of refrigerant into the evaporator 2. However, the gas in the upper closed end of the float will gradually leak through its port 11' and allow the float to lower by its own weight. Thereupon more refrigerant will flow solely through expansion orifice 16 to the evaporator, it being assumed that the size of port 11' is such that float 10 will be in its closed position long enough to permit more refrigerant gas to be condensed in condenser 1 so that when trap 9' does open only refrigerant liquid will flow over through pipe 11.

In the event that valves 2 and 3 are adjusted to interchange the functions of the heat exchange elements 1 and 2, then refrigerant condensed in what is now the condenser 2 will create a high pressure on top of check valve 17 of trap 9' and cause this check valve to move downwardly and thus permit free flow of refrigerant through its flutes 19 into trap 9' and thence in a left direction through pipe 11 to trap 9. The high pressure in this trap 9 will cause its check 17 to close, thereby permitting refrigerant to pass only through the restricted expansion orifice 16. The float for trap 9 will also function to control the refrigerant in the same manner as previously described for the other direction of flow.

From the foregoing disclosure it is seen that very effective means is provided whereby a plurality of expansion orifices are alternatively operative automatically in accordance with the direction of refrigerant flow through the system. Hence minimum resistance to the flow is obtained while at the same time maintaining complete expansion functions.

In the modification shown in Fig. 3 a separate check valve 17*a* is provided in a pipe 25 leading from the header of heat exchange element 1 to the float chamber of trap 9*a* while a similar check valve 17*b* is placed in a pipe 26 connecting the header of the other heat exchange element 2 with the other trap 9'*a*. In the modification of Fig. 4 opposed check valves 17'*a* and 17'*b* are disposed in a pipe 27 connected between the traps 9*b* and 9'*b* and their respective heat exchange elements. A pipe 28 connects with pipe 11 and pipe 27 at a point between check valve 17'*a* and 17'*b*.

The operation of these modified forms is the same as in the preferred form in that each of the check valves 17*a* and 17*b*, or 17'*a* and 17'*b*, will bypass liquid refrigerant around the expansion orifice of the respective traps depending upon which trap is functioning as the expansion element. The check valves in all forms are in effect bypasses around the expansion orifices because in each case an additional passage area is opened supplementary to the orifice passage. Hence it is seen that a relatively simple and yet very effective means is provided in all forms for insuring maximum efficiency in the fluid flow together with elimination of any possibility of a double expansion action such as might take place in case the flow had to pass through both expansion orifices.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A refrigerating system comprising, in combination, a pair of complementary heat exchange elements, a plurality of refrigerant expansion devices, one for each of said heat exchange elements, said devices having provision whereby they are alternatively operative to allow free flow of refrigerant through one and restricted flow through the other automatically in accordance with the direction of refrigerant flow from one heat exchange element to the other element.

2. A refrigerating system comprising, in combination, a pair of complementary heat exchange elements adapted to have their condenser and evaporator functions interchanged whereby the refrigerant flows from one element to the other or vice versa, refrigerant expansion mechanisms one associated with each of said heat exchange elements, and check valves associated with each expansion mechanism to permit free flow of refrigerant in one direction through one of said mechanisms but restricted flow through the other mechanism or vice versa automatically in accordance with the direction of refrigerant flow through said heat exchange elements.

3. A refrigerating system comprising, in combination, a pair of complementary heat exchange elements adapted to have their condenser and evaporator functions interchanged whereby the refrigerant flows from one element to the other or vice versa, a pair of series connected float operated expansion means one for each of said heat exchange elements, each of said expansion means having a check valve controlled passage to permit free flow of refrigerant therethrough in one direction but to prevent flow in the reverse direction.

4. A refrigerating system comprising, in combination, a pair of complementary heat exchange elements adapted to have their condenser and evaporator functions interchanged whereby the refrigerant flows from one element to the other or vice versa, expansion means associated with said heat exchange elements including a float controlled expansion orifice, and means automatically responsive to reverse flow through said expansion means for bypassing refrigerant freely around said orifice.

5. A refrigerating system comprising, in combination, a pair of complementary heat exchange elements adapted to have their condenser and evaporator functions interchanged whereby the refrigerant flows from one element to the other or vice versa, a float trap having an expansion

orifice associated with said heat exchange elements, and a check valve adapted to be opened or closed by high and low condenser and evaporator pressures in said heat exchange elements thereby to effect refrigerant expansion in only one direction of flow through said trap but to permit free flow therethrough in the opposite direction.

6. A refrigerating system comprising, in combination, a pair of complementary heat exchange elements adapted to have their condenser and evaporator functions interchanged whereby the refrigerant flows from one element to the other or vice versa, means providing an expansion orifice, a float actuated valve for controlling said orifice, and a check valve in which said expansion orifice is formed.

7. A refrigerating system comprising, in combination, a pair of complementary heat exchange elements adapted to have their condenser and evaporator functions interchanged whereby the refrigerant flows from one element to the other or vice versa, a pair of series connected expansion devices one associated with each of said heat exchange elements, and a check valve controlled passage adapted to bypass refrigerant around one or the other of said expansion devices automatically in accordance with the direction of refrigerant flow therethrough.

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