June 3, 1941. L. W. ATCHISON 2,244,382

DIFFERENTIAL PRESSURE VALVE

Filed Jan. 30, 1940

Fig. 1.

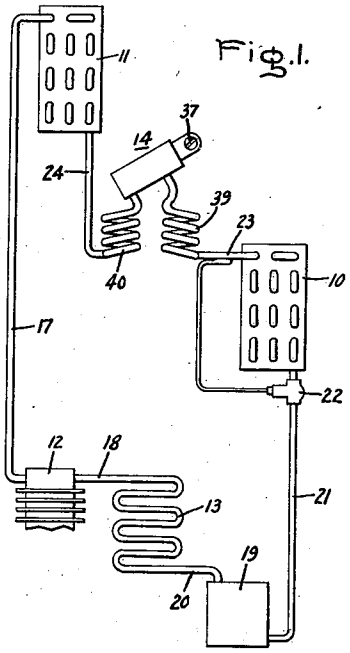


Fig. 4.

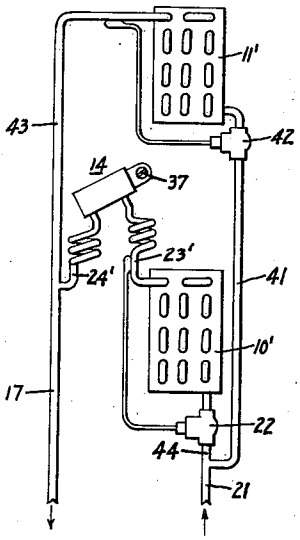


Fig. 2.

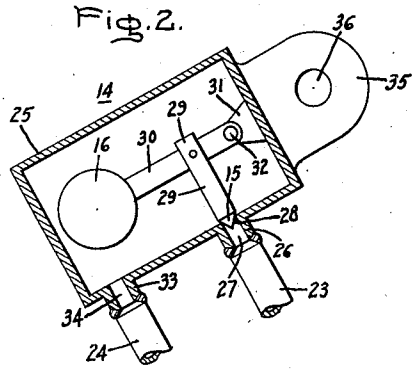
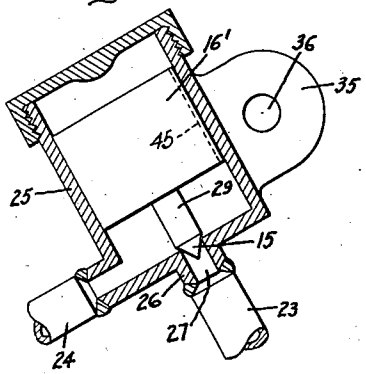


Fig. 3.



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DIFFERENTIAL PRESSURE VALVE

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Application January 30, 1940, Serial No. 316,327

7 Claims. (Cl. 62—8)

My invention relates to refrigerating apparatus and more particularly to refrigerating apparatus including a plurality of evaporators adapted for operation at different temperatures.

It is an object of my invention to provide a new and improved arrangement which is simple in structure and reliable in operation for obtaining a temperature differential between a plurality of refrigerant evaporators.

A further object of my invention is to provide a new and improved apparatus for controlling the operation of refrigerating apparatus of the above type according to the pressures existing therein.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawing in which Fig. 1 is a schematic diagram of a refrigerating system utilizing evaporators in series and embodying the principles of my invention; Fig. 2 is an enlarged view, partly in section, of the differential valve employed in the system of Fig. 1; Fig. 3 is a modification of the differential valve illustrated in Figs. 1 and 2; and Fig. 4 is a schematic diagram illustrating the principles of my invention as applied to a two-temperature refrigerating system utilizing parallel evaporators.

In the illustrative system disclosed in Fig. 1, I have illustrated a series refrigerating system having a high temperature evaporator 10, a low temperature evaporator 11 and a refrigerant liquefying unit including a compressor 12 and condenser 13. In a refrigerating system including high and low temperature evaporators with a common compressor and condenser it is necessary to provide means for maintaining a pressure differential between evaporators. For this purpose I provide a differential valve device 14 between the evaporators 10 and 11. As illustrated in Fig. 2, the valve proper 15 is weighted as by means of a weight 16. Inspection of Figs. 1 and 2 will show that the valve 15 will open to permit refrigerant to be conducted to the low temperature evaporator 11 when the force due to the pressure in high temperature evaporator 10 becomes high enough to overbalance the combined forces due to the pressure on valve 15 caused by the pressure in the low temperature evaporator 11 and the component of weight acting along the axis of valve 15, that is acting in a direction to close the valve 15. The valve device 14 is pivotally mounted to permit variation of the loading of the valve 15. In Fig. 4, I have illustrated a system in which evaporators 10' and 11' are arranged in parallel relationship. The valve 15, in device 14, is disposed between the outlet of evaporator 10' and the suction conduit 17. Valve 15 will open when the pressure in evaporator 10' attains a value greater than the pressure of suction line 17 and the aforementioned component of weight. In both systems, the aforementioned pressures acting to close the valve 15 are substantially the same as the pressures in the low temperature evaporators 11 and 11' respectively.

Describing the system shown in Fig. 1 in greater detail, I have provided a compressor 12 for compressing refrigerant vapor. The compressor 12 preferably embodies a motor-driven compressor unit which may be of the type in which a compressor and motor are directly connected and enclosed within a hermetically sealed casing. Inasmuch as compressor units are well known in the art, complete illustration thereof is believed unnecessary. The compressor 12 withdraws evaporated refrigerant from the low temperature evaporator 11 through a suction conduit 17, compresses the gaseous refrigerant and delivers it to the condenser 13 through a conduit 18. Liquefied refrigerant flows from condenser 13 into a liquid receiver or float valve chamber 19 by way of a conduit 20. A low temperature evaporator 10 is supplied with refrigerant from the device 19 by way of a conduit 21, the refrigerant which passes therethrough being controlled by an expansion valve 22 of any suitable type.

Refrigerant is delivered to the low temperature evaporator 11 through conduits 23 and 24 and variable differential valve device 14.

Evaporators 10 and 11 may be of any desired form and may be operated at any two desired temperatures. For example, one may be maintained below the freezing temperature in order to freeze ice, desserts, etc., and also to maintain articles in a frozen state while the other evaporator may be used for the preservation of foods at temperatures above freezing.

In order to maintain a predetermined temperature differential between the evaporator or cooling element 10 and the evaporator or cooling element 11, I have provided a pressure responsive differential pressure valve device 14. As shown in Fig. 2, the differential pressure re-

sponsive valve device 14 includes a valve proper 15 arranged within an adjustably positioned casing 25. The casing 25 is provided with a boss 26 having a passage 27 therethrough for communication with the inlet conduit 23. The boss 26 and casing 25 cooperate to form a valve seat 28 for the valve 15. In the illustrated form of my invention, the valve 15 is formed at one end of a valve rod 29, the valve rod 29 being pivotally secured to an arm 30 intermediate the ends thereof. One end of the arm 30 is pivotally connected to a stud or ear 31 by means of a suitable fastening device 32, the stud 31 being suitably secured to or integral with a wall of the casing 25. In order to weight the valve 15 I have provided a weight member 16 suitably secured to the other end of arm 30. Casing 25 is provided with an outlet in the form of a boss 33 having a passage 34 therethrough for communication with outlet conduit 24. The conduits 23 and 24 may be secured to the bosses 26 and 33, respectively, in any suitable manner, as by welding, for example.

In order to vary the point of operation of the valve 15, the valve casing 25 is provided with an ear or trunnion 35 having an opening 36 therein so that the casing 25 may be pivotally connected to a suitable supporting structure in any suitable manner as by a bolt and nut for example, indicated by the numeral 37.

The operation of the system will be described in connection with Fig. 2. As refrigerant is evaporated in cooling element 10, the pressure therein will increase thereby tending to open the valve 15 by lifting the valve off its seat 28. Opposing this pressure and acting to close the valve 15 is the pressure existing in the low temperature evaporator 11 and the component of weight acting along the axis of valve rod 29. When the pressure in evaporator 10 becomes greater than the total of the pressure in evaporator 11 and the above-mentioned component of weight, the valve 15 will be lifted from its seat and refrigerant can then flow from evaporator 10 into evaporator 11. As soon as the difference in pressure between evaporators 10 and 11 decreases to the point where the force due to the pressure in evaporator 10 is less than the combined forces due to the pressure in evaporator 11 and the aforementioned component of weight, the valve 15 will again be seated cutting off communication between evaporators 10 and 11. It will be seen that if the casing 25 is arranged so that the valve rod 29 is in its vertical position, the component of weight acting along the axis of the rod 29 and valve 15 in a direction to close the valve 15 is a maximum. If the casing 25 is adjustably positioned or turned to a position in which the valve rod 29 is horizontal, there will be practically no component of weight tending to close the valve 15 and under this latter condition no differential of pressure will be maintained. Thus, in order to vary the temperature differential between evaporators 10 and 11 it is only necessary to loosen the fastening means 37, move the casing 25 to a position corresponding to the desired differential of temperatures and again secure the fastening means 37 to hold the casing in the desired position. Other methods of varying the position of the valve device 14 will occur to those skilled in the art. For example, the position of device 14 may be varied in response to the operation of a thermostatic device so that the differential can be varied according to load requirements.

If desired, reference indicia may be provided to indicate various degrees of difference in temperature.

As shown in Fig. 1, the conduits 23 and 24 have been provided with coiled portions 39 and 40, respectively, in order to provide a sufficient degree of flexibility in conduits 23 an 24 to permit pivotal movement of the casing 25. With differences of temperature commonly prevailing in two temperature installations, sufficient flexibility will be obtained by coiling the conventional copper tubing connections although any suitable material may be employed for the conduits 23 and 24.

In Fig. 3, I have illustrated a modification of the weighted valve illustrated in Figs. 1 and 2, corresponding parts being numbered with the same numerals used in Figs. 1 and 2. In this modification, instead of providing a pivoted weight 16, a piston type weight 16' in the form of a reciprocable cylinder has been illustrated. However, the operation of the device is the same as that previously described. In order to equalize the pressure on the ends of piston 16', suitable communication therebetween is provided, as a passage 45.

In Fig. 4, I have illustrated a modification of my invention, corresponding parts being numbered with the same numerals used in Fig. 1. In this modification instead of illustrating a series refrigerating system I have illustrated a system in which high temperature evaporator 10' and low temperature evaporator 11' are arranged in a parallel relationship. Liquid refrigerant is supplied to the evaporator 11' through liquid line 21, branch liquid line 41 and expansion valve 42 of any desired type. The outlet end of the evaporator 11' is connected to the suction line 17 by means of a conduit 43. The evaporator 10' is connected to the liquid line 21 by means of a conduit 44, the flow of a refrigerant therethrough being controlled by a suitable expansion valve 22. The outlet end of the evaporator 10' is connected to the suction line 17 and conduit 43 by means of conduits 23', 24' and valve device 14.

The operation of the system shown in Fig. 4 is as follows: Refrigerant is furnished the low temperature evaporator 11' from liquid line 21 and conduit 44 in accordance with the operation of expansion valve 42. Refrigerant will be furnished the high temperature evaporator 10' when expansion valve 22 and valve 15 in the valve device 14 are open. From what has been said it will be seen that valve 15 will open when the pressure at the valve end of conduit 23' is equal to the combined forces due to the pressure at the valve end of conduit 24' and the component of weight acting to close the valve 15. Inspection of Fig. 4 shows that these pressures will be substantially equal to the pressures prevailing in evaporators 10' and 11' respectively.

While I have shown a particular embodiment of my invention, I do not desire my invention to be limited to the particular construction shown and described and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a refrigerating apparatus including a plurality of refrigerant evaporators, differential pressure flow controlling means associated with said evaporators for controlling the flow of refrigerant from one of said evaporators, said

means including a weighted valve, said valve being adjustably positioned whereby the component of weight of said valve tending to keep the valve in a flow preventing position may be varied.

2. In a refrigerating system comprising a first refrigerant evaporator and a second refrigerant evaporator, a weighted valve operating to permit the flow of refrigerant from said first evaporator when the force due to the pressure in said first evaporator and acting to open said valve is greater than the combined forces due to the pressure in said second evaporator and that component of weight of said valve acting in a direction to close said valve, said valve being adjustably positioned whereby the component of weight of said valve tending to keep the valve in a flow preventing position may be varied.

3. In refrigerating apparatus comprising a first refrigerant evaporator and a second refrigerant evaporator, a weighted valve operating to permit the flow of refrigerant from said first evaporator when the force due to the pressure in said first evaporator and acting to open said valve is greater than the combined forces due to the pressure in said second evaporator and that component of weight of said valve acting in a direction to close said valve, said valve being adjustably positioned whereby the component of weight of said valve tending to keep the valve in a flow preventing position may be varied.

4. In refrigerating apparatus comprising a first refrigerant evaporator and a second refrigerant evaporator, a weighted valve operating to permit the flow of refrigerant from said first to said second evaporator when the force due to the pressure in said first evaporator is greater than the combined forces due to the pressure in said second evaporator and that component of weight of said valve acting in a direction to close said valve, said valve being adjustably positioned whereby the component of weight of said valve tending to keep the valve in a flow preventing position may be varied.

5. In refrigerating apparatus comprising a first refrigerant evaporator and a second refrigerant evaporator, differential pressure valve means between said evaporators for controlling the flow of refrigerant from said first to said second evaporator, said means including a pivotally supported valve casing and a weighted valve within said casing.

6. In refrigerating apparatus comprising a first refrigerant evaporator and a second refrigerant evaporator, differential pressure valve means between said evaporators for controlling the flow of refrigerant from said first to said second evaporator, said means including a pivotally supported valve casing and a weighted valve within said casing, said differential pressure valve means operating to permit flow of refrigerant therethrough when the force due to the pressure in said first evaporator is greater than the combined forces due to the pressure in said second evaporator and the component of weight of said valve acting in a direction to close said valve.

7. In a refrigerating system having a first refrigerant evaporator and a second refrigerant evaporator disposed in parallel relationship, each of said evaporators having a refrigerant outlet, means including a refrigerant liquefying unit for supplying liquid refrigerant to said evaporators and conduits connecting the outlets of said evaporators to said liquefying unit, control means in the outlet of said first evaporator for controlling the flow of refrigerant therethrough, said means including a valve casing having a weighted valve therein, said casing being movable for varying the component of weight of said valve acting to close said valve, said means operating to permit the flow of refrigerant through said first evaporator when the force due to the pressure prevailing at the outlet of said first evaporator is greater than the combined forces due to the pressure prevailing at the outlet of said second evaporator and the component of weight of said valve acting in a direction to close said valve.

LEONARD W. ATCHISON.