J. FRANKENBERG.

AUTOMATIC EXPANSION VALVE.

APPLICATION FILED MAY 10, 1919.

1,402,926. Patented Jan. 10, 1922.

Fig. 1.

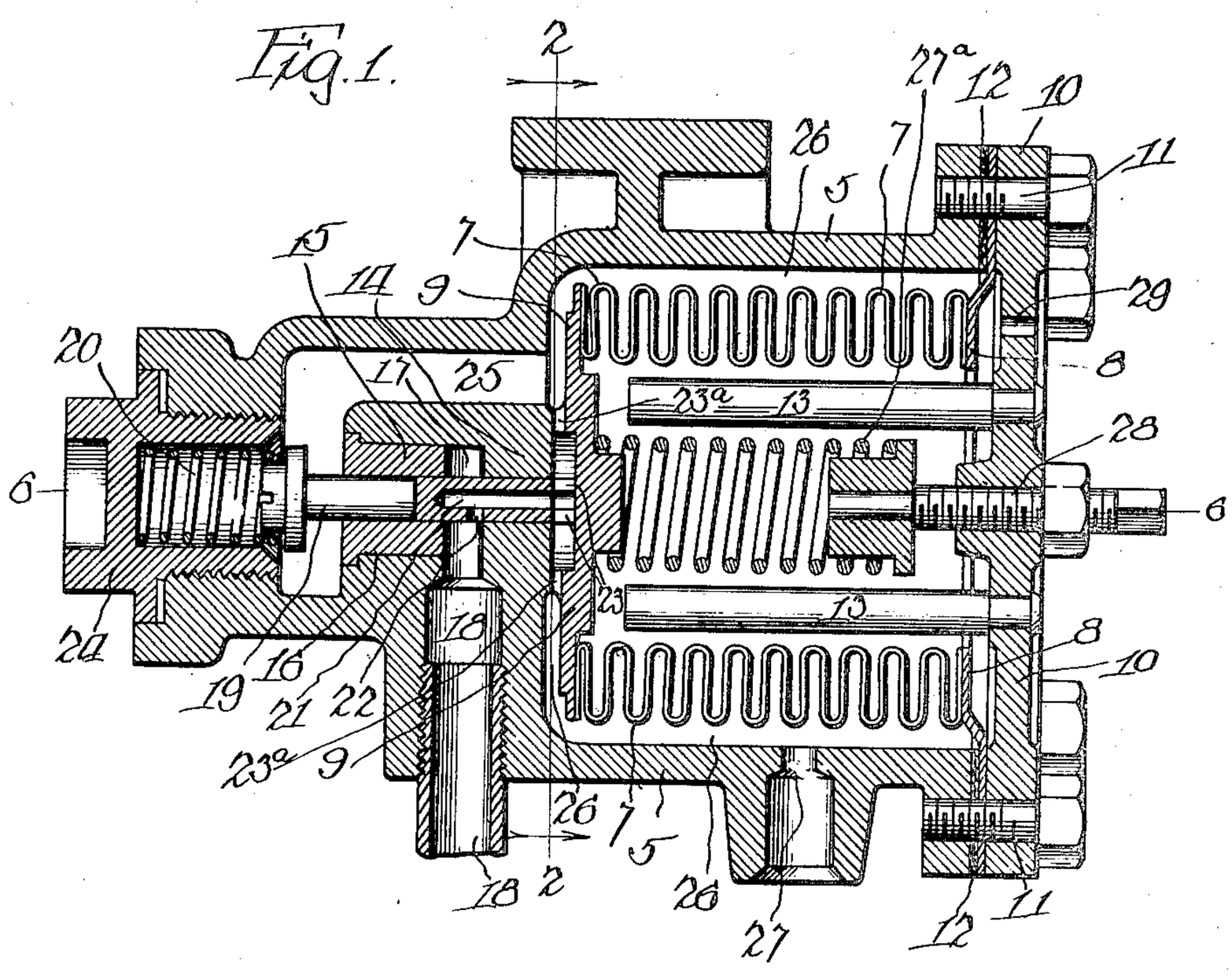


Fig. 2.

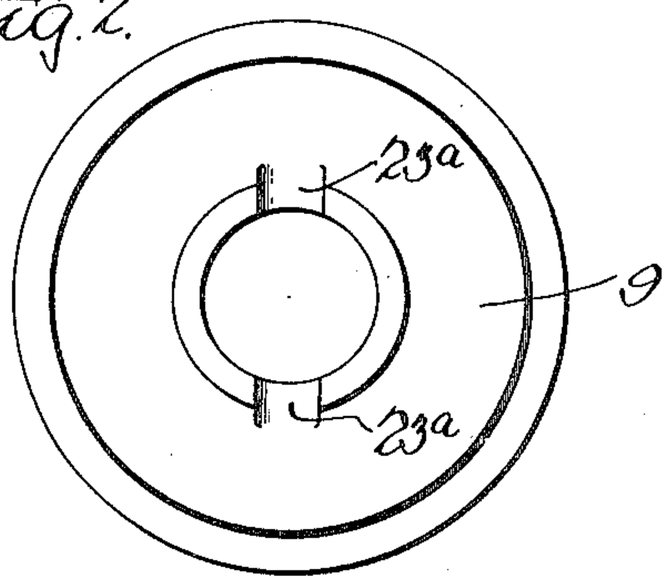
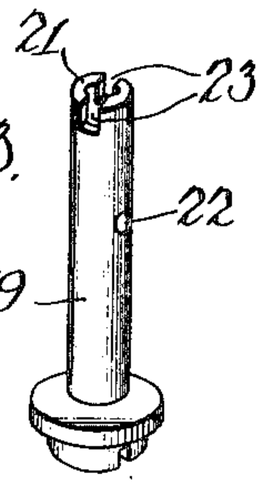


Fig. 3.



Witness:

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UNITED STATES PATENT OFFICE.

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AUTOMATIC EXPANSION VALVE.

1,402,926. Specification of Letters Patent. Patented Jan. 10, 1922.

Application filed May 10, 1919. Serial No. 296,239.

To all whom it may concern:

Be it known that I, JULIUS FRANKENBERG, a citizen of the United States, residing at the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in an Automatic Expansion Valve, of which the following is a specification.

This invention relates to improvements in an automatic expansion valve, to be used for any purpose or in connection with any kind of an apparatus to which it may be found adapted or applicable, but particularly for and in connection with domestic refrigerating apparatus using sulphurous acid or any other kindred refrigerant, which apparatus is so well understood by those skilled in the art to which the invention pertains, as to require no illustration herein, but which will be referred to in a general way.

The invention consists in certain peculiarities of the construction, novel arrangement, combination and operation of the various parts thereof as will be hereinafter more fully set forth and specifically claimed.

The principal object of the invention is to provide an automatic expansion valve primarily intended for small domestic refrigerating units using sulphur dioxide or any other kindred refrigerant. The very nature of such an apparatus demands a device of small dimensions, and since the refrigerator or back pressure is generally kept at about one pound gage pressure only, large disc diaphragms must be employed to attain the necessary responsiveness or sensitiveness of operation. However, lack of space in a domestic refrigerator does not permit of large dimensions of these discs, and furthermore, any disc diaphragm valve requires adjustment from time to time, a feature absolutely fatal to the successful operation of a domestic refrigerating unit.

A further object of the invention is to eliminate the effect of varying condenser pressure by introducing a balanced piston valve, thereby accomplishing a result impossible by any other type of balanced valves, such as double bead valves generally employed in reducing valves of large capacity. Where oil is circulated to a greater or lesser degree along with the refrigerant, or where dirt may accumulate and clog up the small valve openings, it may, at times, become necessary to automatically open the valve fully in order to free the same of any such obstruction. To accomplish such a result by the ordinary disc diaphragm, additional complicated mechanism must be provided for, all of which disadvantages are obviated in my device.

In the accompanying drawing, which serves to illustrate an embodiment of the invention—

Fig. 1 is a central vertical sectional view of the valve.

Fig. 2 is an elevation of the bellows head taken on line 2, 2 of Fig. 1, looking in the direction indicated by the arrows, and

Fig. 3 is a detached perspective view of the piston valve.

Corresponding numerals of reference refer to like parts throughout the different views of the drawing.

The valve consists of a housing 5 substantially of circular cross section to its axis 6, except where openings, ports, etc., are provided. While the valve may be operated in any position, the horizontal one as shown is preferable, in order to drain the valve of liquid SO_2 and oil while in operation. Within the housing 5 is located a member 7, made of suitable thin sheet metal, preferably circular in cross section, and provided with a suitable number of circumferential corrugations, to make this member flexible axially. This member is now known commercially under the name of "Sylphon bellows." These members or bellows are generally subject to bursting or internal pressure and are therefore of the closed type, while in my device, the bellows are subjected to collasping pressure, or external pressure only, that is, the inside of the bellows is exposed to atmospheric pressure, while in the former the pressure is on the outside. I have purposely chosen the open or inverted type of bellows for the following reasons: While under working conditions, these bellows are subject to slight pressures only, it may be possible that said pressures may rise to 110 pounds or more per square inch under certain conditions, in fact, any part of the refrigerating apparatus must be made safe for such eventualities. The closed type of bellows, to have the required flexibility, will not stand a pressure greater than about 35 pounds per square inch without collapsing, while the open type as employed in my device, will stand a pressure of 125 pounds or more per square inch, when properly prepared, and yet perfectly perform its proper

functions at all times and under all conditions. Other reasons, why the open type of bellows is a mechanical necessity in this valve, will be enumerated farther on. The open end of the bellows 7 as shown is attached to an angular thin ring or flange 8, made of suitable metal. The other end of the bellows 7, however, is terminated or closed by a head 9 of peculiar design. Both the flange 8 and head 9 are soldered to the bellows to procure tight joints. The open end of the bellows is bolted to the casing or housing by means of the head 10 and bolts 11, and a suitable gasket 12 is interposed to make the joint formed by the parts 5 and 8 gas tight. The stroke or movement of the bellows 7 is limited by the two buffer rods 13, which are fastened to the head 10, and by the internal projection 14 of the valve casing. A bushing 15 is firmly pressed into an opening 16 in the projection 14 of the valve casing 5, but leaves a cylindrical space 17, which is in communication with an opening 18, which, in turn, is connected to the liquid supply or the high side of the refrigerating apparatus. Coinciding with the axis 6 a cylindrical stem 19, hereafter to be called the piston valve, is permitted to move or slide freely, but is held at all times against the head 9 of the "Sylphon bellows" by means of a compression spring 20, which presses against the enlarged part of the valve stem as shown. This free movement of the piston valve is possible only by employing open bellows, and a spring as above described, as the closed type of bellows would cause the piston valve to bind or stick, since it would be necessary to permanently attach the bellows to the piston valve. Such a combination however, is machanically incorrect, because the axes of the bellows and valve rod could never practically be made to coincide. The piston valve has a port 21 and an opening 22 and two slots 23 for purposes hereinafter explained. The removal of plug 24 permits of an easy assembling of the whole apparatus. A port 25 is provided to establish constant communication with the low side of the refrigerating apparatus and for such other purpose as in explained below.

The device operates as follows: As shown in the drawing, the head 9 rests against the seat of the projection 14 of the casing. In this position the port 22 of the piston valve is fully uncovered. Liquid under condenser pressure will enter the valve at 18, flow through the openings 22, 21, 23 and 23[a] into the space 26 formed by the valve body 5 and bellows 7, thence into the low pressure side at 27. An instant increase of the suction or back pressure will take place compressing the bellows axially until the head 9 rests against the buffer rods 13. As the compression spring 20 will make the piston valve 19 follow any movement of the bellows, the valve port 22 will have traveled beyond the upper edge of the space 17, thereby cutting off entirely the liquid supply. The above would represent the two extreme positions of the piston valve 19, and it is clear, therefore, that there must be a certain intermediate position of the piston valve corresponding to the suction pressure to be maintained, and that such pressure depends upon the amount of the compression of both springs 20 and 27[a], which latter spring rests against the head 9, and an adjusting screw 28, threaded in the head 10. Exact regulation of the suction pressure may be had by means of the adjusting screw 28 in a manner well known to the art. It may also be mentioned in this connection that any air confined in the space formed by the bellows and the flanged head 10 is vented through a hole 29 in said head, thus allowing free movement of the bellows.

It is intended that small leakage of liquid will take place in this valve mechanism along the piston valve 19 into the low pressure side of the refrigerating apparatus, and this is a very desirable feature, especially in small refrigerating apparatus, since the condenser and suction pressures will equalize after the shut down of the prime mover which is important, especially, when an electric motor is used. And port 25 is purposely provided which will serve in the same time to make this valve absolutely balanced, a highly important feature in view of the low suction pressures at which a SO_2 machine operates. Under normal conditions the opening 22 is very slightly uncovered, but on account of the long stroke of the bellows it may be fully thrown open to blow out the valve or clear it of any possible obstruction.

Having thus fully described my invention what I claim as new and desire to secure by Letters Patent is—

1. In an automatic balanced expansion valve, the combination of a suitable housing, and an open or inverted "Sylphon bellows" located therein, forming a space in constant communication with the low pressure side of a refrigerating apparatus.

2. In an automatic balanced expansion valve, the combination of a suitable housing, an open "Sylphon bellows" located therein having one end attached hermetically to said housing and the other free to move, a balanced cylindrical valve operatively located in said housing and means for making the movement of said balanced valve coincide at any instant with the movement of the "Sylphon bellows."

3. In an automatic balanced expansion valve, the combination of a suitable housing, an open "Sylphon bellows" suitably attached thereto and having free movement in the direction of its axis, said movement to be con-

trolled by predetermined suction pressure, regulating compression springs or other suitable mechanical means, a balanced piston valve provided with suitable ports and openings to admit the necessary liquid supply to the low pressure side of the refrigerating apparatus, said piston valve having simultaneous motion with the "Sylphon bellows" caused by two opposing springs and by an increasing or decreasing suction pressure.

4. In an automatic balanced expansion valve, the combination of a suitable housing, an open "Sylphon bellows" suitably located therein, and subject to the suction pressure of the refrigerating apparatus causing the same to expand or contract axially, a balanced piston valve always in contact but not attached to the movable head of the bellows, said balanced piston valve and said movable head having ports to establish proper flow of liquid SO_2 into the low pressure side of the valve, a bushing permanently located in the housing for the purpose of forming with said housing a port accurately located in relation to the travel of the valve stem, the housing having a suitable port communicating with the space between the bellows and housing for the purposes of balancing the piston valve, a removable plug screwed into the housing forming a receptacle for a spring and furnishing means for quick removal of the valve stem, and a suitable compressing spring for regulating the desired suction pressure.

5. In an automatic expansion valve, the combination of a suitable housing, with an open "Sylphon bellows," said bellows cooperating with a suitable balanced piston valve for the purpose of controlling the liquid supply to the suction side of the refrigerating apparatus thereby maintaining a constant predetermined suction pressure.

6. An automatic balanced expansion valve including in combination, a cylindrical open "Sylphon bellows," and a housing enclosing said bellows and connected at one of its ends to the open end of the bellows, the said housing having its wall spaced from the bellows and provided in its end connected to the bellows with a vent opening communicating with the latter and the atmosphere, and a pair of opposed springs exerting their tension on the closed end of the bellows.

7. An automatic balanced expansion valve including in combination, a cylindrical open "Sylphon bellows" and in communication with the atmosphere, and a housing enclosing said bellows and connected at one of its ends to the open end of the bellows, the said housing having in the closed end of the bellows an internal apertured projection and provided in its end connected to the bellows with a vent opening communicating with the latter and the atmosphere, a pair of opposed springs exerting their tension on the closed end of the bellows, means carried by the housing to restrict axial movement of the bellows, and means to regulate the tension of said springs.

8. In an automatic balanced valve, the combination with a housing having an inlet and an outlet port and an inward projection near one of its ends, of an annular flange located in said housing near the opposite end thereof, an open "Sylphon bellows" secured at one of its ends to said flange around the opening in said flange, the housing having in its end adjacent to said flange a vent opening and a port between its wall and said projection, buffer rods extended from the vented end of the housing into said bellows, a plate head secured to and closing the opposite end of the bellows and having a centrally disposed recess in its outer face provided with an outlet, a spring-pressed balanced piston valve movably located in said projection across said inlet port and provided with a port to register with the inlet port and extended through one of its ends and having an outlet at said end, the apertured end of said stem in constant contact with said plate head within the recess thereof, and adjusting screw seated in the vented end of the housing and extended into the bellows, and a spring resting at one of its ends against the plate head and at its other against said screw.

JULIUS FRANKENBERG.