No. 630,617. Patented Aug. 8, 1899.

A. T. MARSHALL.

AUTOMATIC EXPANSION VALVE FOR REFRIGERATING APPARATUS.

(Application filed Feb. 11, 1898.)

(No Model.)

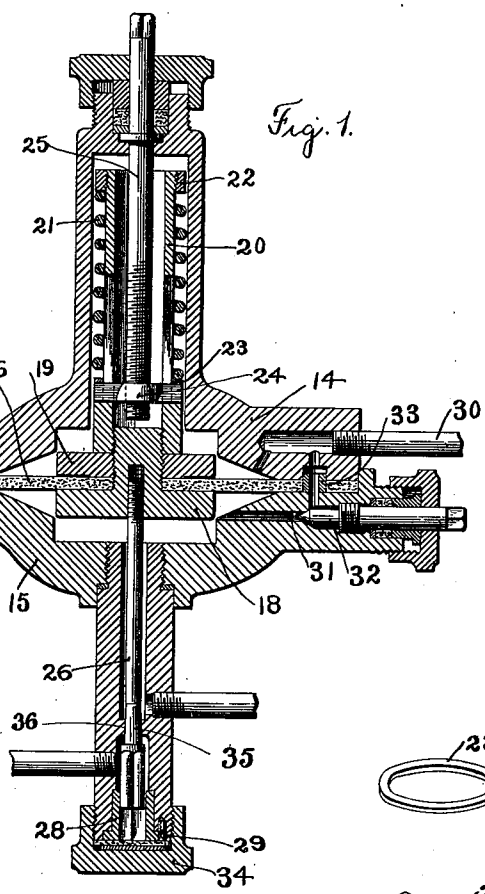

Fig. 1.

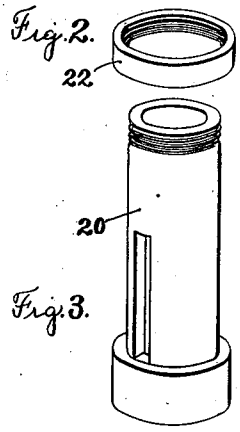

Fig. 2.

Fig. 3.

Fig. 4.

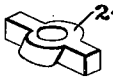

Fig. 5.

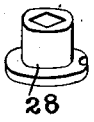

Fig. 6.

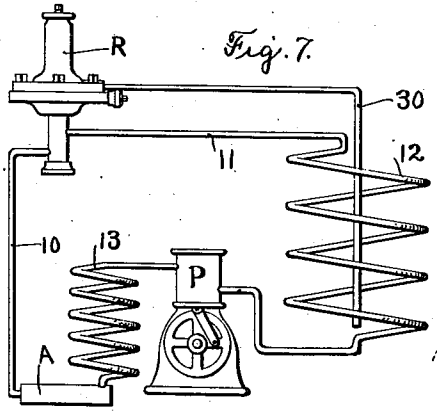

Fig. 7.

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AUTOMATIC EXPANSION-VALVE FOR REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 630,617, dated August 8, 1899.

Application filed February 11, 1898. Serial No. 669,895. (No model.)

To all whom it may concern:

Be it known that I, ALBERT T. MARSHALL, a citizen of the United States, residing at Brockton, in the county of Plymouth and State of Massachusetts, have invented a new and useful Automatic Expansion-Valve for Refrigerating Apparatus, of which the following is a specification.

My invention relates to a regulator for automatically controlling the flow of the refrigerating medium in the pipes of a refrigerating apparatus; and the object of my invention is to provide a strong, simple, inexpensive, and durable regulator for automatically controlling the flow of the refrigerating medium, so as to produce the greatest possible efficiency of the apparatus in connection with which the same is employed.

To these ends my invention consists of the parts and combinations of parts, as hereinafter described, and more particularly pointed out in the claims at the end of this specification.

In the accompanying drawings, Figure 1 is a sectional view of an automatic expansion-valve for refrigerating apparatus constructed according to my invention. Figs. 2 to 6, inclusive, are detail perspective views of parts thereof; and Fig. 7 is a diagrammatic view of a refrigerating apparatus provided with an automatic regulator constructed according to my invention.

A refrigerating apparatus employing anhydrous ammonia or similar refrigerating mediums ordinarily comprises a pump or compressor, a storage-chamber for the condensed liquid refrigerating medium, and expansion pipes or coils in which the refrigerating medium is allowed to expand into the form of vapor. The admission of the refrigerating medium to the expansion-coils is controlled ordinarily by a small needle-valve, which is termed the "expansion-valve."

The efficiency and economy attained in refrigerating apparatus depend on the adjustment of the expansion-valve. If the expansion-valve is opened sufficiently to allow a quantity of refrigerating medium to enter the expansion-coils greater than can be exhausted or taken care of by the pump, the expansion medium will pass through the pump while still in the form of a liquid, and as the cooling or refrigerating action depends upon the vaporization of the refrigerating medium an excessive feed of the refrigerating medium will allow the brine tank or compartment being refrigerated to become gradually warmer, even while the compressor or pump is working under its full capacity. On the other hand, if the expansion-valve is throttled or closed so tightly as to allow the admission of but small quantities of the refrigerating medium to the expansion-coils the vaporization of this small quantity of refrigerating medium will cool but a small section of the expansion-coils, the remainder of the expansion-coils being inoperative, while at the same time the compressor or pump will be working against a comparatively high vacuum.

To obtain the best results from any given refrigerating apparatus, it is essential that the expansion-valve should be set so that all of the refrigerating medium fed into the expansion-coils should be just equal to the capacity of the compressor or pump—that is to say, the quantity of liquid fed to the expansion-coils should not be sufficiently great to allow any of it to pass to the compressor in the form of a liquid, while at the same time it should be sufficient to allow vaporization to take place throughout the entire expansion-coil.

The especial object of my present invention is therefore to provide an expansion-valve for refrigerating apparatus having an adjustable resistance or spring-pressure normally tending to keep the same closed and which is also acted upon by the pressure of the refrigerating medium in the circulating-pipes opposed by a thermostatic pressure. To accomplish this purpose, the preferred form of my automatic regulator for refrigerating apparatus comprises a two-part casing, a flexible diaphragm secured in place between the parts thereof, a valve-stem extending from one side of the diaphragm, and a slotted tube extending from the opposite side of the diaphragm and having a coiled spring normally tending to close the valve, the tension of which may be adjusted by an adjusting-screw extending to the outside of the casing, the features of novelty of said automatic regulator being more particularly pointed out in the claims at the end of this specifica-

tion. A thermostatic pipe or chamber is connected to one of the parts of the two-part casing, and a quantity of the refrigerating medium can be admitted to and confined in the thermostatic pipe through a valve-controlled by-pass formed entirely within the casing.

Referring to the refrigerating apparatus illustrated diagramatically in Fig. 7, A designates a receptacle for the condensed or liquid refrigerating medium, from which the same passes through a circulating-pipe 10 to the automatic regulator R, thence through a circulating-pipe 11 to the expansion-coil 12. The vaporized refrigerating medium is pumped from the expansion-coil 12 by a pump or compressor P and is passed through a condensing-coil 13, which may be cooled by a water-jacket in the ordinary manner, condensing the refrigerating medium back into a liquid and returning the same to the receptacle A.

The automatic regulator R, as illustrated in Fig. 1, comprises a casing formed by the castings 14 and 15, which are clamped together by bolts 17, so as to secure a flexible diaphragm 16 in place between said castings. On the under side of the diaphragm is a disk 18, having a threaded spindle extending up through the diaphragm. A nut or washer 19 is threaded onto the spindle of the disk 18, and also threaded onto the spindle of the disk 18, so as to form a check-nut for the collar 19, is a slotted tube 20. Coiled around the slotted tube 20 is a spring 21, which is confined at its upper end by a collar 22. Mounted inside of the slotted tube 20 is a nut 24, having arms which extend through the slots in the tube 22 to support a washer 23, which engages the lower end of the coiled spring 21. As shown most clearly in Figs. 1 and 5, the nut 24 is slabbed or cut away on diagonally opposite sides, so that it can be readily introduced into the tube 20 in position to have its arms extend through the slots thereof. An adjusting-screw 25 is threaded into the nut 24 and extends up through a stuffing-box to the outside of the casing, the upper end of the bolt being squared, so that it can be readily turned or adjusted by a suitable handle or wrench when desired.

Adjustably threaded into the disk 18, on the under side of the diaphragm 16, is the expansion-valve stem 26. The valve-stem 26 carries a valve 35, coöperating with a valve-seat 36. At its lower end, below the valve, the stem 26 is squared or made polygonal and engages a corresponding socket in a locking-sleeve 28, said sleeve being held from turning by means of a pin 29 and being supported in place by a cap 34. A thermostatic receptacle or pipe 30 is connected to the upper casting 14 of the casing, and, as most clearly shown in Fig. 7, the thermostatic pipe is preferably carried through the brine tank or compartment being refrigerated by the expansion-coil 12, so as to be exposed to exactly the same temperature to which the expansion-coil is exposed.

A quantity of the anhydrous ammonia or other refrigerating medium can be admitted to the upper part of the casing of the regulator and to the thermostatic pipe 30 through a by-pass 31, controlled by a valve 32. The by-pass 31 is located entirely within the castings forming the casing of the regulator and extends up through the diaphragm 16.

In order to prevent the by-pass 31 from being closed by the compression of the diaphragm 16 when the clamping-bolts 17 are tightened, I preferably provide a small bushing 33, located in a socket in the casting 14, as shown in Fig. 1.

In adjusting and operating my regulator as thus constructed the adjusting-screw 25 may be turned so as to bring its nut 24 to the bottom of the slot in the tube 20 to positively open the expansion-valve, thus allowing an unrestricted flow of the refrigerating medium through the circulating-pipes 10 and 11. The valve 32 may then be opened to admit a quantity of the expansion medium to the upper part of the casing of the regulator and the thermostatic pipe 30. In the use of my automatic regulator it is essential to provide some means for positively holding the expansion-valve open. Otherwise the system could not be readily charged, and pressure being first introduced on the underside of the diaphragm would not be resisted by a thermostatic pressure and the expansion-valve would be held closed, thus obstructing the proper operation. The valve 32 is then closed, and as the thermostatic pipe 30 is exposed to the same temperature as the expansion-coil 12 the pressure in the expansion-coil will exactly balance the thermostatic pressure. The pump or compressor is then started and the adjusting-screw 25 is turned to raise its nut 24 and place the coiled spring 21 under tension, tending to close the expansion-valve. By means of this construction it will be seen that the normal pressure in the expansion-coil will be exactly balanced by the thermostatic pressure independently of the changes in temperature in the brine or compartment being refrigerated. The suction or vacuum caused by the pump normally tends to open the expansion-valve and is balanced or resisted by the tension of the spring 21.

To obtain the best results, the regulator is usually set so that as the refrigerating medium leaves the expansion-coils it has all just turned to vapor. This can be determined by observing the frosting of the circulating-pipes connected with the expansion-coils. For example, if the circulating-pipe frosts only at the outlet end of the expansion-coil it shows that an unnecessarily large quantity of expansion medium is being fed, and the tension of the regulating-spring 21 should be increased. On the other hand, if too small a

quantity of the refrigerating medium is being fed the outlet end of the expansion-coil will remain comparatively warm even after the apparatus has assumed its normal working conditions, and the tension of the spring 21 should be relaxed.

When the regulator has been properly adjusted, so that the quantity of refrigerating medium admitted to the expansion-coils is substantially equal to the capacity of the pump, the regulator will not thereafter need to be adjusted, and the changes in the temperature of the brine or compartment being refrigerated will not affect the proper feed of the refrigerating medium—that is to say, as the brine cools the pressure of the refrigerating medium in the expansion-coils and the thermostatic pressure will fall or be reduced simultaneously, so that these pressures will always balance each other and the resistance to be overcome by the pump will be substantially a constant.

Whenever it is desired to positively close the expansion-valve, so as to entirely stop the refrigerating action, the adjusting-screw may be turned to raise the nut to the upper end of the slots in its tube or to bring the convolutions of the spring into engagement with each other.

A further advantage in the specific construction which I have illustrated resides in the fact that by removing the lower cap 34 and locking-sleeve 28 the expansion-valve stem can be readily unscrewed and taken out to be cleaned or trued up.

I am aware that changes may be made in my automatic regulator for refrigerating apparatus without departing from the scope of my invention as expressed in the claims. I do not wish, therefore, to be limited to the form that I have shown and described; but,

What I do claim, and desire to secure by Letters Patent of the United States, is—

1. In an automatic refrigerating apparatus, the combination of the expansion-coil, and an automatic regulator comprising a diaphragm mounted in a closed casing so as at all times to be acted upon on one side by the pressure of the refrigerating medium in the expansion-coil, and on the other side by a thermostatic pressure, an expansion-valve arranged to be operated by the diaphragm, a coiled spring mounted within the casing, and an adjusting-rod extending to the outside of the casing and connected so that it may be used to positively open the expansion-valve, or may be used to adjust the tension of the coiled spring, so that the expansion-valve will automatically open at any desired difference between the thermostatic pressure and the pressure of the refrigerating medium, substantially as described.

2. In an automatic regulator for refrigerating apparatus, the combination of a casing formed by castings 14 and 15, a diaphragm 16 interposed between said castings, clamping-bolts 17 for securing the parts together, so that the diaphragm may be acted upon on one side by a thermostatic pressure, and on the other side by the pressure of the refrigerating medium, an expansion-valve 35 arranged to be operated by the diaphragm, a disk 18 having a threaded stud extending through the diaphragm, a collar 19 threaded on said stud, a slotted tube 20 threaded onto the stud and forming a check-nut for the collar 19, a spring 21 coiled on the slotted tube, a nut 24 having arms extending through the slots in the tube, and an adjusting-rod 25 journaled in a longitudinally-fixed position in the casing, and threaded into the nut 24, so that the adjusting-rod may move the nut 24 to the bottom of its slots to positively open the expansion-valve, or may raise the nut 24 to adjust the tension of the coiled spring, so that the expansion-valve will automatically open at any desired difference between the thermostatic pressure and the pressure of the expansion medium, substantially as described.

3. In an automatic regulator for refrigerating apparatus, the combination of a two-part casing, a diaphragm therein, circulating-pipes for the refrigerating apparatus connected to one part of the casing, an expansion-valve stem adjustably connected to the diaphragm, a thermostatic pipe opening into the other part of the casing, a valve-controlled by-pass formed entirely in said casing for admitting and confining a quantity of the refrigerating medium in the thermostatic pipe, a spring normally tending to hold the expansion-valve closed, and means for adjusting the tension of the spring to allow the expansion-valve to open at any desired difference between the pressure in the circulating-pipes and thermostatic pipe, substantially as described.

4. In an automatic regulator for ice-machines, the combination of a two-part casing, a diaphragm interposed between the parts of said casing, clamping-bolts for securing the parts of the casing together, circulating-pipes connecting to one part of the casing, a thermostatic pipe connected to the other part of the casing, said casing having a valve-controlled by-pass formed therein and extending through the diaphragm, and a bushing for preventing the diaphragm from closing the by-pass when the clamping-bolts are tightened, substantially as described.

5. In an automatic regulator for refrigerating apparatus, the combination of a casing formed by castings 14 and 15, a diaphragm interposed between said castings, clamping-bolts 17 for securing the parts of said casing together, a disk 18 having a threaded stud extending through the diaphragm, a collar 19 and slotted sleeve 20 threaded onto the stud of the disk 18, a spring 21 coiled on the sleeve 20, a nut 24 located inside the sleeve and having arms extending through the slots therein, an adjusting-screw 25 threaded into nut 24, an ex-

pansion-valve stem threaded into the disk 18, a locking-bushing 29 having a squared socket for engaging a corresponding portion of the valve-stem 26 to hold the same from turning, and a thermostatic pipe or chamber 30 opening into the upper part of the casing, said casing being formed with a valve-controlled by-pass 31 for admitting the refrigerating medium to the upper part of the casing and the thermostatic pipe 30, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

ALBERT T. MARSHALL.

Witnesses:

PHILIP W. SOUTHGATE.

LOUIS W. SOUTHGATE.