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EXPANSION VALVE FOR REFRIGERATING SYSTEMS

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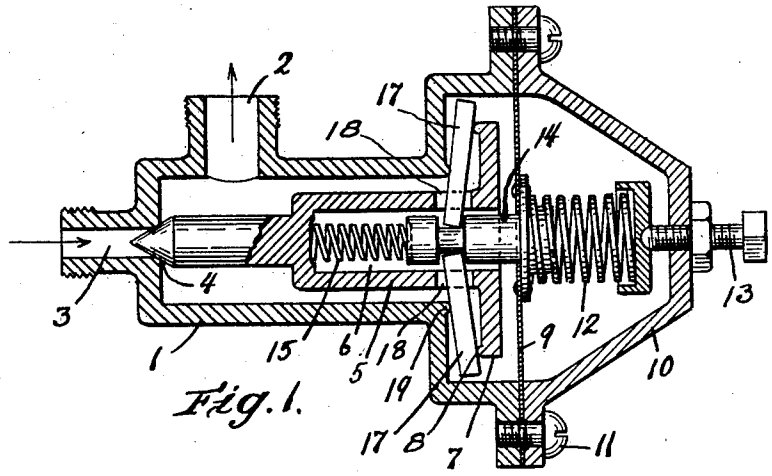

Fig. 1.

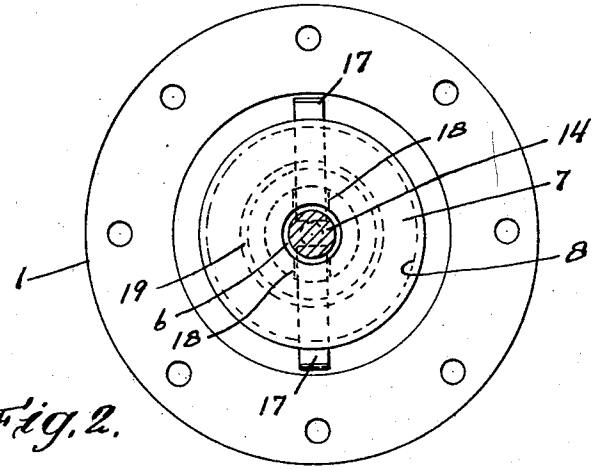

Fig. 2.

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UNITED STATES PATENT OFFICE

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EXPANSION VALVE FOR REFRIGERATING SYSTEMS

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This invention relates to expansion valves of the type of which are employed in closed circuit expander, compressor, condenser refrigerating systems, to control the supply of refrigerant to the expansion coil or chamber, and more particularly, to a pressure controlled type of valve which opens when the pressure in the expansion chamber, or the "back pressure" is reduced to a predetermined point and closes again when the back pressure is raised to another predetermined point.

In devices of this type it is customary to operate the needle valve, which directly controls the passage through which the refrigerant passes to the expansion chamber, by means of a diaphragm which is open to the low pressure of the system at its inner side and is subject to atmospheric pressure at its outer side, this action usually being supplemented by a spring, the action of which is usually partly neutralized by a spring of lighter weight located within the casing, and the arrangement being such that when the pressure in the expansion chamber is reduced to such an extent that the combined action of this pressure and of the light weight spring is over balanced by the atmospheric pressure and the action of the heavier spring, the needle valve will be opened to permit the discharge of refrigerant from the high pressure side to the low pressure side of the system.

In practice the means for causing the needle valve to be opened sometimes fail to act, so that a dangerously high pressure is likely to be built up in such case. This failure of the needle valve to open is frequently due to an accumulation of frost, or ice on the diaphragm, so that it becomes inflexible, or on coils of the outer spring for actuating the diaphragm, so that it is prevented from acting to force the latter inward, and this is likely to occur even though the diaphragm and spring are encased to prevent access of air thereto, the movement of the diaphragm tending to cause air to be drawn in to and out of the chamber in which it is encased.

The object of my invention is to provide a simple and compact form of valve device of the type above referred to, in which the arrangement is such that, when the supply side of the system is raised to a predetermined point above the normal high pressure, but is still well below a pressure which would be dangerous, the valve will be forced open and the accumulation of pressure above this point will be prevented.

I accomplish this object in the manner hereinafter described and as illustrated in the accompanying drawing, in which Fig. 1 is central longitudinal sectional view of an expansion valve embodying my invention, and

Fig. 2 is an end view thereof.

According to my invention I provide a casing 1, which has a port 2 adapted to be connected to the low pressure side of the system and a port 3, adapted to be connected to the high pressure side thereof. A needle valve 4 is provided in the casing and arranged to seat in the port 3 against the pressure of the high pressure side. The stem 5 of said valve is provided with a central longitudinal bore or chamber 6, which extends from the opposite end thereof for approximately half its length, and a circular flange 7 is formed integrally with said stem and has an annular rib 8 on its inner side. A flexible diaphragm 9 is clamped to the open end of the casing by means of a cap 10 and screws 11. A coiled spring 12 is arranged within the cap 10 in engagement at its inner end with the outer side of the diaphragm and an adjusting screw 13 is threaded in the cap and in engagement with the outer end of said spring. An actuating stem 14 is disposed in axial alignment with the valve stem 5 and is telescopically arranged in the chamber 6 thereof, with its outer end in position for engagement with the inner side of the diaphragm 9. A spring 15 is interposed between the inner end of the stem 14 and the bottom of chamber 6. A pair of levers 17 are extended in opposite relation thru apertures 18 in the side of the chamber 6 of the valve stem and the inner ends thereof are disposed in an annular groove formed in stem 14, the outer ends thereof being arranged to engage the rib 8 on flange 7, and

the middle portions thereof being fulcrumed on an annular rib 19 on the casing 1.

With the above described construction, when the pressure against the inner side of the diaphragm 9 is sufficient to overcome the combined action of atmospheric pressure and of spring 12 on its outer side, the spring 15 will act to hold the valve 4 closed, as shown in Fig. 1. This position of the parts may be considered as the normal position. When the pressure within the casing is reduced to a predetermined point, so that the inward pressure over balances the outward pressure on the diaphragm, it will be sprung inward, forcing the stem 14 inward and causing levers 17 to be swung so as to be forced against the flange 7 and open the valve 4 against the action of spring 15, this action being assisted by the fluid pressure which is being built up against the valve in the high pressure side of the system, or in port 3. This condition will continue until the circulating pump stops and the pressure in the valve casing rises sufficiently to overbalance the inward pressure on the diaphragm and permit the spring 15 to close the valve.

Assuming however, that the outer spring 12 should become ineffective for any reason, as by having its coils become frozen together, or by having the diaphragm so stiffened by ice as to become inflexible, it will be apparent that when the pressure within the casing is reduced, the diaphragm will not be forced inward and in consequence, the valve 4 will not be lifted from its seat thereby. The tension of spring 15 is however such that when the pressure in port 3 rises to a substantial extent above that at which the valve would normally be opened by the inward force on the diaphragm, this pressure, acting against the valve 4, will overcome the action of spring 15 and cause valve 4 to be unseated, so that the refrigerant will pass from the high pressure to the low pressure side of the system, the pressure in the high pressure side thus being prevented from rising above a predetermined point. The danger of having excessive or unsafe pressures built up in system from failure of the diaphragm to be moved inward is thus avoided. The construction also is advantageous over a construction in which the pressure in the high pressure side tends to hold the valve against its seat, which arrangement has been commonly employed, as the higher the point to which the pressure rises the more difficult it becomes to unseat the valve. On the contrary with the above described construction, the higher the point to which this pressure rises the more easily the valve is opened, so that in case the valve should tend to stick or become frozen to its seat, the pressure against the valve will ordinarily act to open it, when it otherwise would not be opened automatically. In warm weather there is also considerable tendency for the pressure in the high pressure side of the system to run substantially higher than in cool weather, and this increased pressure tends to cause the valve 4 to be opened earlier and close later with the above described construction, than would be the case if the pressure tended to hold the valve to its seat, and thus tended to restrict circulation when maximum circulation was desirable.

The above described construction is very compact, and may be housed in an ordinary cylindrical casing of practically the same form as the construction which has usually been employed for this purpose.

It is also simple and but slightly more expensive to manufacture than such prior construction.

I claim:

1. An expansion valve comprising a casing having an inlet port and an outlet port respectively adapted for connection to the high pressure side and to the low pressure side of a closed circuit refrigeration system, a valve stem reciprocally movable within the casing and having a valve at one end, to be moved against the pressure supplied to said inlet port to close the same, a spring adapted and arranged to engage said stem and hold said valve closed against the normal fluid pressure supplied to said inlet port and to yield to permit the valve to be opened by an abnormal pressure supplied thereto, a pressure controlled device on said casing arranged to be moved outwardly to an inoperative position by the pressure within the casing when raised to a predetermined point and to be moved inwardly from said position when said pressure is reduced below said point, and engaging means between said device and said stem arranged to move said stem to open said inlet port when said device is moved inwardly.

2. An expansion valve comprising a casing having an inlet port and an outlet port respectively adapted for connection to the high pressure side and to the low pressure side of a closed circuit refrigeration system, a valve having a stem disposed within the casing and longitudinally movable in one direction to close said inlet port against the pressure of the fluid supplied thereto and oppositely movable by said pressure to an open position, a spring arranged to engage said stem and to hold said valve in closed position against a normal pressure supplied to said inlet port and to yield to permit the valve to be forced open by an abnormal pressure supplied thereto, a pressure controlled diaphragm closing one side of the casing and outwardly movable by the pressure within the casing, and normally actuated to move inwardly when the pressure is reduced to a predetermined point, and a lever fulcrumed within the casing at its middle portion and arranged to be engaged at

one end by said diaphragm and at its opposite end with said stem, to move the stem to open the valve when the diaphragm is moved inwardly.

3. An expansion valve comprising a casing having an inlet port and an outlet port respectively adapted for connection to the high pressure side and to the low pressure side of a closed circuit refrigeration system, a valve stem disposed within the casing and having a valve at one end, said stem being longitudinally movable in one direction to close said inlet port against the pressure of the fluid supplied thereto and oppositely movable by said pressure to an open position, a spring arranged to engage said stem and to hold said valve in closed position against a normal pressure in said inlet port and to yield to permit the valve to be forced open by an abnormal pressure therein, a pressure controlled diaphragm arranged to close one side of the casing and to be moved outwardly by the pressure within the casing, means for moving said diaphragm inwardly when the pressure within the casing is reduced to a predetermined point, an actuating stem disposed within the casing in alignment with said valve stem and arranged to be moved by said diaphragm towards said valve when the diaphragm is moved inwardly, and a lever arm arranged to be engaged at one end by said actuating stem and to engage said valve stem at its opposite end to move the valve stem in a direction to open the valve.

4. An expansion valve comprising a casing having an inlet port and an outlet port respectively adapted for connection to the high pressure side and to the low pressure side of a closed circuit refrigeration system, a valve stem disposed within the casing and having a valve at one end, said stem being longitudinally movable in one direction to close said inlet port against the pressure of the fluid supplied thereto and oppositely movable by said pressure to an open position, a spring arranged to engage said stem and to hold said valve in closed position against a normal pressure in said inlet port and to yield to permit the valve to be forced open by an abnormal pressure therein, a pressure controlled diaphragm arranged to close one side of the casing and to be moved outwardly by the pressure within the casing, means for moving said diaphragm inwardly when the pressure within the casing is reduced to a predetermined point, an actuating stem aligned with said valve stem and telescopically arranged at its inner end with the opposite portion of the valve stem from its valve with its outer end arranged for arrangement with the inner side of said diaphragm, a lateral projection on said valve stem, and a lever arm fulcrumed on said casing and engaged at one end with said actuating stem and at its opposite end with said projection, to move said valve stem to open its valve on inward movement of the diaphragm.

In testimony whereof, I have signed my name to this specification.

ALBERT F. SAWYER.