July 14, 1931. F. R. WEST 1,813,979

FLOW CONTROL FOR REFRIGERATING SYSTEMS

Filed July 8, 1926

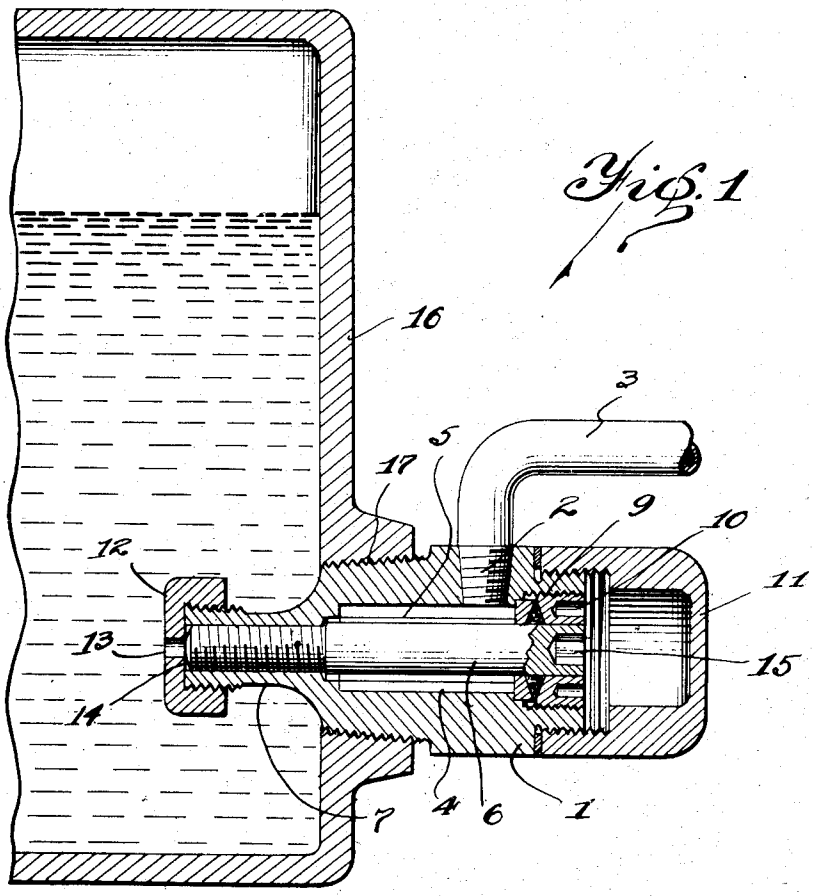


Fig. 1

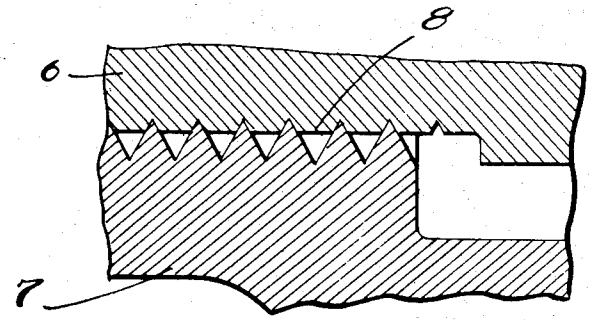


Fig. 2

INVENTOR.
Frank R. West.

BY
Stuart C Barnes
ATTORNEY.

Patented July 14, 1931

1,813,979

UNITED STATES PATENT OFFICE

FRANK R. WEST, OF DETROIT, MICHIGAN, ASSIGNOR TO RICE PRODUCTS, INC., OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN

FLOW CONTROL FOR REFRIGERATING SYSTEMS

Application filed July 8, 1926. Serial No. 121,088.

This invention relates to a "flow control for refrigerating systems", and has to do particularly with a novel means for and method of controlling and maintaining a uniform flow of refrigerant under pressure from the condensing unit to the cooling unit.

Hitherto in the art of automatic refrigeration embodying the principle of compression and expansion, it has been the practice to use three primary units, namely: the compressor, a cooling unit, and a condensing unit. One of the most difficult problems of the art has been in the maintaining of a uniform amount of refrigerant in the cooling unit, where the flooded type system has been utilized, and the maintaining of a constant rate and degree of expansion where the direct expansion principle has been utilized. Regardless of weather the direct expansion or flooded type principle has been utilized in effecting the heat transfer, both of these systems have necessitated the use of complicated and expensive devices and apparatus such as expansion valves, floats and headers for effecting more or less efficient results.

The present invention relates particularly to the flooded type system of refrigeration and it is the object of this invention to entirely obviate the necessity of such various floats and movable parts as have been utilized in the prior art. The present device overcomes these objections of the prior art by providing a uniform flow injector between the condenser and the cooling unit, which injector is adjustable to accurately and positively cause a uniform flow of refrigerant from the condenser to the body of liquid within the cooling unit. This positive uniform flow is accomplished by inserting means between the condenser and the cooling unit, whereby the refrigerant is not only restricted but is caused to positively pass towards and into the liquid within the cooling unit by means of capillary action. More specifically, I have provided a novel adjustable means for causing the refrigerant to pass towards the cooling unit in a helical path whereby back flow of the refrigerant is prevented and whereby each helical coil through which the refrigerant passes acts as a hydraulic trap.

A further object of the present invention is the provision of a simple, inexpensive and compact device for controlling and maintaining a uniform flow of refrigerant to the cooling unit so as to entirely do away with the ordinary form of expansion valve and float valve, and which device is so constructed as to in a large measure prevent any accumulation of dirt and sediment, or any other material becoming lodged in such conduit.

Fig. 1 is a fragmentary sectional view of my novel injector unit and illustrating the manner of connecting the same to a standard condenser and cooling unit of a refrigerating system.

Fig. 2 is a fragmentary enlarged detail view illustrating the manner of turning down one set of threads whereby to provide a helical capillary conduit for conducting the refrigerant in a helical path to the cooling unit container.

Heretofore, attempts have been made to do away with float valves and expansion valves by providing metered orifices whereby to restrict the flow of refrigerant to just the desired amount to supply the correct amount of refrigerant corresponding to the capacity of the particular unit. However, these metered orifices have been objectionable and have been commercially discarded for the reason that they have not prevented back flow of the refrigerant, and furthermore when in commercial use they have almost invariably become clogged up with fine particles of sand or sediment or from the freezing of some small particle of moisture trapped in the refrigerant.

The present device, although restricting the flow of refrigerant, contemplates a means for preventing clogging of any sort, and also contemplates means for preventing any back flow of refrigerant. As shown in Fig. 1, my novel injector assembly comprises a housing 1, and an inlet port 2, for suitably receiving a refrigerant conducting conduit 3. This conduit 3 is designed to be connected to any standard type condenser adapted to liquefy the expanded refrigerant gases. The form

of condenser has no particular bearing on this invention, and it will be obvious that any standard condenser may be utilized in supplying condensed or liquefied refrigerant to my injector device.

The injector housing is drilled out, as at 4, to receive a cylindrical strainer member 5, and a screw 6. One end of the injector housing or body is preferably reduced, as at 7, and this reduced end is drilled and tapped to provide suitable threads for receiving one end of the screw 6, which end is threaded with threads corresponding to the tapped threads in the injector. The threads on the end of the screw 6 are turned down, as shown at 8 in Fig. 2, whereby the threads on the screw 6 only partially fill the threads which are tapped into the injector body.

The closed end of the injector housing is provided with internal threads, as at 9, for receiving suitable packing and a packing nut 10 for sealing this end of the injector housing. This stuffing box arrangement permits the turning of the screw 6 at any time to effect adjustment without the loss of the liquid or gas. The injector housing may be turned down and provided with suitable threads to receive an additional sealing cap 11.

The reduced tapped end of the injector is provided with external threads for receiving a cap 12, which is provided with an orifice 13 which normally permits a free flow of liquid refrigerant after it passes from the last helical passageway formed by the threads. The end of the screw 6 is rounded, as at 14, whereby the screw may be locked against the cap by screwing it into the injector housing as far as possible thus making it possible to lock or seal the liquid in the cooling unit whenever the occasion requires.

The helical continuous passageway formed by the cut away threads 8 of the screw 6 comprises a triangular shaped passageway for the refrigerant liquid which gives a large surface area. This triangular passageway also acts as a capillary tube or passageway for resisting the flow, as well as causing positive feeding of the liquid towards the body of liquid within the cooling unit. By adjusting the screw 6 inwardly or outwardly, it will be obvious that it is possible to vary the resistance to a minimum resistance, as desired. I have provided a hexagon hole 15 in the end of the screw 6, whereby such screw can only be adjusted by the insertion of a hexagon wrench therein, thus preventing to a large degree the accidental adjustment or movement of such thread. The whole end of the injector housing, including the helical capillary passageway, is immersed in the liquid of the cooling unit.

In Fig. 1, I have diagrammatically illustrated the cooling unit which may be designated 16, and the injector housing is threaded into such unit as at 17. The purpose of this immersion of the whole end of the injector in the liquid in the cooling unit is to keep the liquid refrigerant as it passes through the injector as cold as possible, whereby to create a minimum resistance relative to the maximum expansion inside the cooling unit and thus maintain a high refrigeration efficiency.

In operation, the liquid refrigerant is designed to enter the injector unit at 2 under a predetermined pressure, and then enter the space between the walls of the injector housing and the screen filter, whereby the liquid in passing through the filter will be thoroughly cleaned. The pressure of the liquid will then force it through the triangular shaped passageway or conduit formed between the turned down threads of the screw and the tapped threads of the injector, whereby the small cross-sectional area of this passageway and its long helical length will place the liquid under resistance and thus regulate and control its flow and at the same time positively advance the liquid by reason of the capillary action set up due to this design of the helical passageway formed at the periphery of the screw. This resistance to the flow of the liquid and the capillary effect caused by the liquid traveling around the screw in a helical manner may be easily and accurately adjusted, and it is this possibility of adjustment that contributes largely to the success of my device in positively controlling the flow of liquid refrigerant to the cooling unit in a desired manner without the use of expansion valves or float members. The end of the injector housing and the end, or all of the helical passageways being submerged in the liquid in the cooling unit, the capillarily restricted flow of the liquid will be made positive and no fluctuations or pulsations will be possible due to any tendency of the liquid to gasify in the helical passageway. The injector device is adapted for use with refrigerating units of varying ice melting capacity, and by ascertaining a certain head pressure, a certain back pressure, and a certain number of R. P. M. of the compressor it is possible to adjust the screw member back and forth according to the desired capacity of the unit to maintain a certain required level of liquid in the cooling unit.

If for any reason the helical passageway becomes clogged from the freezing of moisture or collection of silt, or if it is desired to remove the screen to clean the injector, it will be obvious that it will only be necessary to tighten the screw against the cap at one end whereby to lock the refrigerant within the cooling unit and then remove the screen. Furthermore, by moving the screw member back and forth it will also be obvious that any sediment or frozen moisture in the passageway will be loosened up.

It will thus be obvious that I have provided a compact, simple and extremely efficient device for controlling and effecting a positive uniform flow of the refrigerant to the cooling unit and for adjustably controlling the quantity of liquid so fed to the unit so as to maintain a given desired level, or evaporative level of the liquid within the cooling unit without the use of expansion valves or other complicated apparatus between the condenser and the cooling unit. It is a well known fact in the domestic refrigerating art that a large proportion of all the trouble with domestic refrigerating units has been found to lie within the expansion valve, or the float valve. The present device entirely does away with these service troubles of the past in that it is positive in its action, is highly efficient and is substantially fool-proof so that when once adjusted to meet the requirements of the refrigerating system of a certain capacity, the correct flow of refrigerant into the cooling unit will be predetermined at all times.

What I claim is:

1. A device of the class described for refrigerating systems, comprising relatively movable elements having interfitting threaded portions cooperating to form a helical passageway for conducting the refrigerant to the cooling unit, and means for moving one of said elements to vary the length of and resistance to the flow of refrigerant through said passageway.

2. A device of the class described for controlling the flow of refrigerant to the cooling unit of a refrigerating system comprising two members having cooperating surfaces shaped to provide a continuous helical passageway for conducting the refrigerant to the cooling unit by capillary action, and means for varying the relative positions of said surfaces for varying the length of said helical passageway.

3. A device of the class described for controlling the flow of refrigerant to the cooling unit of a refrigerating system, comprising an injector housing insertable within the cooling unit and partially immersed by the liquid in said unit, and threads in said injector housing for receiving the threaded end of an adjustable screw, the threads of one of said members being turned down to provide a helical passageway for the refrigerant whereby to conduct by capillary action to the cooling unit.

4. Means for controlling the flow of refrigerant to the cooling unit of a refrigerating system, comprising a member positioned between the condenser and cooling unit and provided with two relatively movable members having complemental threaded portions forming a passageway for conducting the refrigerant by capillary action to the cooling unit, the threads on one member being cut away whereby said passageway is substantially triangular in cross section.

5. A device of the class described for feeding and controlling the flow of refrigerant to the cooling unit of a refrigerating system, comprising two members having cooperating surfaces complementally formed to provide a capillary passageway for conducting the refrigerant to the cooling unit, and means for moving one of said members relative to the other for varying the effective length of said passageway.

6. A device of the class described for controlling the flow of refrigerant to the cooling unit of a refrigerating system, comprising housing insertable in the cooling unit, said housing being provided with a passageway of relatively small cross section for effecting feeding of the refrigerant by capillary action, the portion of said housing provided with said passageway being immersed in the refrigerant within said cooling unit.

7. A device of the class described for controlling the flow of refrigerant to a cooling unit, comprising means complementally formed to provide a helical passageway of relatively small cross section for feeding and restricting the flow of refrigerant to the cooling unit, and means operable by the relative movement of said complementally positioned parts to seal the refrigerant within the cooling unit.

8. An expansion device for refrigerating systems comprising a pair of members having closely fitting surfaces, a groove formed in one of said surfaces and closed by the other of said surfaces whereby to form a capillary passageway between said members, means for introducing refrigerant into said passageway from the high pressure side of said system, and means for conducting refrigerant from said passageway to the low pressure side of said system, the resistance to flow of refrigerant through said passageway serving to maintain the difference in pressure between the high and low pressure sides of said system.

9. A device of the class described for a refrigerating system, comprising a unit comprising two cooperating relatively movable parts, the cooperation being effected by interfitting threaded members on said two parts, said threaded members being shaped to form a passageway of such restricted cross section as to effect a capillary feeding of the refrigerant, and means for adjusting one of said members relative to the other member to vary the effective length of said passageway.

10. A device of the class described comprising a pair of members having matching surfaces and a groove formed in at least one of said surfaces enclosed by the other of said surfaces to form a capillary passage-way for conducting refrigerant from the high pressure side of the system to the low pressure

side of said system, said capillary passageway being the only means between the high and low pressure sides of the system for controlling the flow of the refrigerant.

11. A device of the class described comprising a member of relatively small surface area provided with a capillary groove of relatively great length formed in the surface thereof, a second member contacting against said surface and completing said groove, means for introducing refrigerant into one end of said groove, and means for conveying refrigerant from the other end of said groove.

12. A device for feeding and controlling the flow of refrigerant into the cooling unit of a refrigerating system, comprising means having a relatively small cross section for controlling the flow of the liquid in a column and maintaining a predetermined body of liquid in the cooling unit, a part of said means being immersed within the body of refrigerant in the cooling unit and the end of said means terminating within said body of refrigerant.

13. A device for feeding and controlling the flow of liquid refrigerant into the cooling unit of a refrigerating system, comprising means having a conduit of relatively small cross section and long length, said conduit being formed to feed the liquid in a helical column, part of said conduit being immersed within the refrigerant in the cooling unit to prevent surging action of the liquid and to effect positive capillary feeding.

In testimony whereof I affix my signature.

FRANK R. WEST.