Refrigeration Suction Accumulator

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UNITED STATES PATENTS
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Abstract

A suction accumulator is provided for the compressor of a refrigeration system. The accumulator includes a casing having an inlet and an outlet. A U-shaped conduit is provided within the casing. One leg of the conduit extends from a point adjacent the bottom of the casing to the casing outlet. The other leg extends from the casing bottom and terminates in an open end within the casing. A metering opening is provided in the bend of the U-shaped conduit to meter liquid refrigerant into the conduit. The open-ended leg is adapted to receive gaseous refrigerant which passes through the U-shaped conduit and on to the compressor of the system.

The inlet comprises a tubular member which extends from a point anteriorly of the casing into the casing. A fluid guide surface is provided on the inner end of the tubular inlet to direct incoming fluid exiting from the inlet at an angle to the longitudinal axis of the inlet and tangentially around the inner periphery of the accumulator casing to thereby reduce turbulence within the casing. The guide surface is defined by a wall portion of the tubular inlet. The inlet wall is deformed inwardly and the downstream edge is severed from the main portion of the tubular member. The wall is bent onto the opposite wall surface to provide an opening at the guide surface. This construction may also serve as an outlet in some pressure vessel applications.

6 Claims, 4 Drawing Figures
REFRIGERATION SUCTION ACCUMULATOR

BACKGROUND OF THE INVENTION

The accumulator of the type with which the present invention is concerned is provided between the compressor and the evaporator of a refrigeration system to trap any liquid refrigerant emanating from the evaporator and feed this liquid refrigerant to the compressor at a metered rate. Flow is accomplished by means of the suction created by the compressor. Feeding of the liquid refrigerant back to the compressor at a metered rate prevents large amounts of liquid refrigerant from suddenly entering the compressor and causing damage.

Liquid accumulates in the accumulator, and if the incoming gases are directed in the form of a jet at the liquid, some of the liquid may be splashed into the outlet, resulting in unmetered flow to the compressor. Additionally, this may cause undesired foaming of the liquid in the accumulator.

In my U.S. Pat. No. 3,420,071, issued Jan. 7, 1969, I have disclosed one means for directing the flow of incoming gas away from trapped liquid. The inlet conduit provided at the inlet to the accumulator is bent to an L-shape to cause the incoming refrigerant gas to flow tangentially around the inner periphery of the accumulator casing. This system is operative. However, the present invention provides an improved form of inlet structure in which a portion of the inner end of the inlet conduit is severed partially from the sidewall of the inlet and bent into the conduit to form a scooplike fluid guide surface to accomplish a change of flow direction of the incoming gas. The present invention is advantageous in that little or no pressure drop occurs at the inlet, the structure is inexpensively manufactured, installation and mounting of the accumulator casing is simple and low cost, and no separate restriction is necessary to control the passage of refrigerant gas into the accumulator casing. While the invention is described in connection with an accumulator, the inlet structure may be used as an inlet for other closed vessels.

SUMMARY OF THE INVENTION

The suction accumulator is provided for the compressor of a refrigeration system. The accumulator comprises a casing having an inlet and an outlet. The outlet comprises a conduit which is provided within the casing extending from a point adjacent the bottom of the casing to the casing outlet. Gas passes through the conduit which then acts as a suction tube to draw liquid from the casing and expel it into the casing outlet at a metered rate. The inlet comprises a tubular member extending into the casing. A fluid guide surface is provided on the inner end of the inlet to direct incoming fluid exiting from the inlet at an angle to the longitudinal axis of the inlet around the inner periphery of the accumulator casing to thereby reduce turbulence within the casing. The guide surface is defined by a portion of the inlet wall. The portion of the inlet wall is deformed inwardly into the conduit with the downstream edge thereof being severed from the main portion of the conduit and bent onto the opposite wall surface of the conduit to thereby provide an inlet opening at the guide surface.

In the drawing:

FIG. 1 is a side elevational view in section of one embodiment of the suction accumulator of the present invention;

FIG. 2 is an enlarged sectional view of the inlet to the accumulator of FIG. 1 taken substantially along the line 2—2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is a sectional view of the inlet to the accumulator taken substantially along line 3—3 of FIG. 2, looking in the direction of the arrows; and

FIG. 4 is a partial view in section of the inlet to an accumulator forming another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in FIGS. 1 through 3, the suction accumulator 10 includes a casing 12 which comprises an open-ended tube 14 having an upper end closure 16 and a lower end closure 18 secured thereto by brazing.

An outlet tube 20 extends through the upper end closure 16. The outlet tube 20 is U-shaped. One leg 22 of the tube 20 extends downwardly to a point adjacent the lower end closure 18. The tube is then provided with a bend 24 and a second leg 26 extends upwardly and terminates in an open end 28 adjacent the lower end closure 16. A small metering opening 30 is provided in the tube bend 24. Another opening 23 is provided in leg 22 at the upper end to equalize pressure in both of the legs 22, 26.

An inlet tube 32 also extends through the upper end closure 16 of the tube 14. The inlet tube 32 extends for a short distance into the casing 12. One wall portion 34 of the tube 32 is deformed inwardly into the tube 32 to form a scoop for directing the flow of incoming fluid into the casing. The tube 32 is slit at 36 for approximately half the circumference of the tube. The wall portion 34 is then deformed inwardly in the general shape of a curved scoop with the marginal edge 38 engaging the inner surface of the wall portion 40. The edges 42, 44 of the wall portion 34 converge at the inner end 46 of the tube and define a generally V-shaped section. As indicated by the arrows 48 in FIG. 3, incoming fluid impinges against the wall portion 34 and is directed in a curved path to exit from the tube at approximately right angles to the longitudinal axis of the tube and generally tangentially to the inner surface of the casing tube 14.

In operation of the accumulator, cold refrigerant gas having a small amount of entrained liquid refrigerant therein enters the accumulator through the inlet tube 32. The incoming gases, which move at a relatively high velocity, are directed tangentially against the inner wall of the casing and follow a circular path around the casing interior. The gases are then free to expand, with resultant reduction of the velocity thereof. As a consequence, incoming gases are not directed as a high-speed jet against any liquid which may be retained in the lower portion of the casing 12. This prevents turbulence of the liquid which may result in objectionable foaming and also prevents splashing of liquid into the open end 28 of the U-shaped tube 20. The introduction of liquid into the U-shaped tube through the open end 28 by splashing is undesirable because it is desired to control the rate at which liquid enters the U-shaped tube.

The refrigerant gases which enter the casing are drawn into the open end 28 of the U-tube 20, pass through both legs of the U-tube and exit via the leg 22. The gases are passed from the U-tube 20 to the compressor of the refrigeration system (not shown). The compressor, which creates a suction, draws the gaseous refrigerant from the accumulator at a relatively rapid rate.

Liquid refrigerant which enters the accumulator through the inlet tube 32 drops to the bottom of the accumulator and is subsequently drawn through the opening 30 and then through the leg 22 and out of the accumulator. It will be appreciated that the liquid which is metered into the leg 23 is entrained in the stream of gaseous refrigerant. It remains entrained in the gas as it passes from the accumulator and is drawn to the compressor of the system. The opening 30 acts as a restriction and causes liquid refrigerant to be metered into the compressor at a controlled rate. The accumulator thus acts to prevent large amounts of liquid refrigerant from suddenly entering the compressor. Such sudden surges of liquid may result in seriously damaging the compressor.

During operation of the refrigeration system, there are times when an unusual amount of refrigerant will collect in the accumulator. For example, when the system is shut off, such as is the case with an intermittently operated air conditioning system, the refrigerant tends to condense in the entire system.
and collect in the accumulator. A similar situation may occur when the system is operated under low load conditions. The metering of the liquid refrigerant via the opening 30 results in liquid refrigerant being delivered to the compressor at a non-harmful rate.

The physical construction of the inlet tube 32 possesses certain practical advantages when compared, for example, to an inlet tube which has the inlet end curved to match the curvature of the interior surface of the casing and aimed to eject gases in the same manner as the present inlet tube. The mechanical process of bending of the inner end of such a tube is expensive as compared with the stamping process involved in fabricating the tube 32. Additionally, the tube 32 is advantageous in that it is easily mounted and assembled onto the accumulator. This results from the fact that at no point is the diameter of the tube 18 enlarged nor out of round. This permits a packless mounting which is not the case with mounting of a bent tube because such a bent tube requires a relatively large opening for insertion thereof into the casing. Further, there is only a minimal pressure drop in the use of the tube 32 as against the larger pressure drop inherent in an L-shaped tubular construction. A pressure drop is undesirable because it involves the loss of energy, thus decreasing the efficiency of the system and requiring the compressor to work harder to draw refrigerant from the accumulator.

FIG. 4 illustrates an embodiment similar in many respects to that shown in FIG. 1. In FIG. 4, the accumulator 50 comprises a casing 52 of the construction previously described. An inlet tube 54 of the type utilized in the FIG. 1 embodiment extends through the casing wall instead of the top into the casing interior adjacent the upper portion of the casing. It will be noted that the inlet tube 54 is angled downwardly so that the outlet 56 directs the stream of refrigerant at a slightly downwardly inclined angle to thereby provide a downward helical spiral of the gas stream. This is advantageous in that it prevents undue turbulence of the refrigerant gases in the upper portion of the casing, which turbulence results in a reduction of the energy lever of the incoming gases. Instead of angling the tube 54 downwardly, it may be placed horizontally and turned so that the outlet is aimed to direct the gas stream in a downward helical spiral.

A U-shaped outlet tube, of the type described in connection with FIG. 1, is provided within the casing 52 for the purpose previously described.

While the inlet tube 32, described in connection with FIG. 1, or the inlet tube 54, described in connection with FIG. 4, have been discussed in connection with an accumulator construction, it will be appreciated that this tube has valuable application to other types of vessels wherein it is desired to change the direction of an incoming fluid stream and therefore the invention is not restricted to the use of the inlet tube in connection with an accumulator. The tubes 32, 54 may also serve as outlets in some pressure vessel applications. For instance, in some cases, an accumulator is placed on the low side of the refrigeration system and attached to the evaporator coil. Such an accumulator may be of the horizontal type in which the inlet for gas and liquid is provided at one end of the vessel or casing and no U-tube is employed. A tube such as the tubes 32, 54 may be used as an outlet in this accumulator structure. Any splashing or boiling in the accumulator casing would tend to be baffled by the outlet so that liquid droplets would not be readily carried back in the suction line. Currently, some accumulator structures of this general type are being marketed with the addition of a separate scoop-type baffle. The use of the present tubular construction would obviate the necessity for a separate baffling member.

What I claim as my invention is:

1. In a suction accumulator for the compressor of a refrigeration system, said accumulator comprising a casing having an inlet and an outlet, a conduit within the casing extending from a point adjacent the bottom of the casing to the casing outlet, said conduit acting as a suction tube to draw liquid from the casing and expel it into the casing outlet at a metered rate, said inlet comprising a tubular member extending into the casing, a fluid guide surface on the inner end of said inlet to direct incoming fluid exiting from the inlet at an angle to the longitudinal axis of the inlet around the inner periphery of the accumulator casing to thereby reduce turbulence within the casing, said guide surface being defined by a portion of the inlet wall, said portion of the inlet wall being deformed inwardly into the tubular member with the upstream edge thereof being severed from the main portion of the tubular member and bent into the opposite wall surface of the conduit to thereby provide an exhaust opening at the guide surface.

2. A suction accumulator as defined in claim 1, and further characterized in that said upstream edge is severed for approximately half the circumference of said tubular member.

3. A suction accumulator as defined in claim 1, and further characterized in that said tubular member is substantially circular in cross section.

4. A suction accumulator as defined in claim 1, and further characterized in that the fluid guide surface is disposed to direct incoming fluid at substantially a 90° angle to the longitudinal axis of the inlet and tangentially of the inner periphery of the accumulator casing.

5. A suction accumulator as defined in claim 1, and further characterized in that said tubular member is angled with respect to the casing to direct the incoming fluid helically with respect to the axis of the casing.

6. A suction accumulator as defined in claim 1, and further characterized in that said portion of the inlet wall is curved in the general shape of a scoop with the marginal edge thereof engaging the inner surface of the wall portion of said inlet.