Jan. 7, 1969 E. W. BOTTUM 3,420,071

SUCTION ACCUMULATOR

Filed March 10, 1967 Sheet 1 of 2

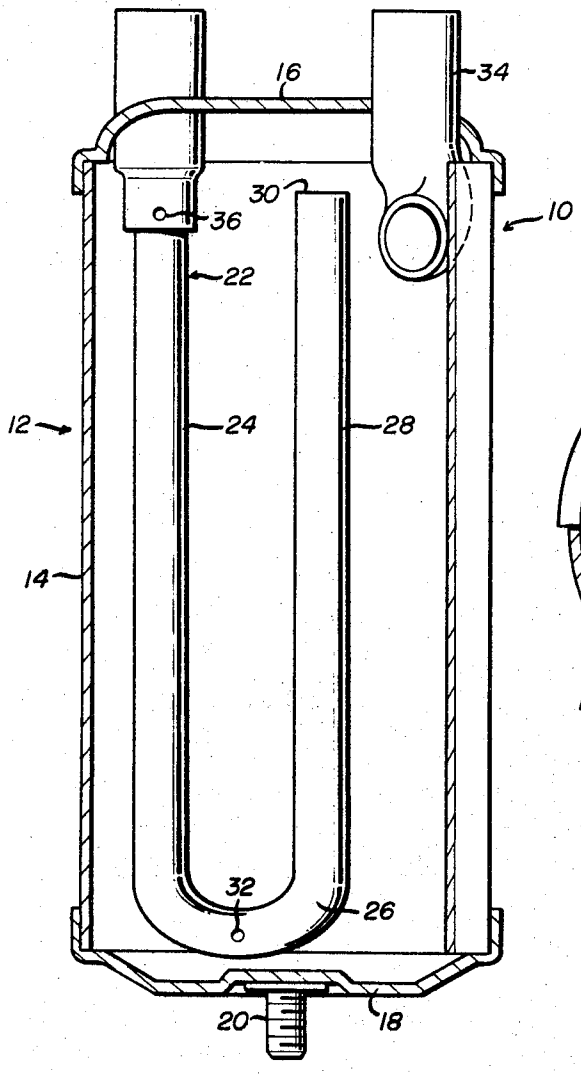


Fig. 1

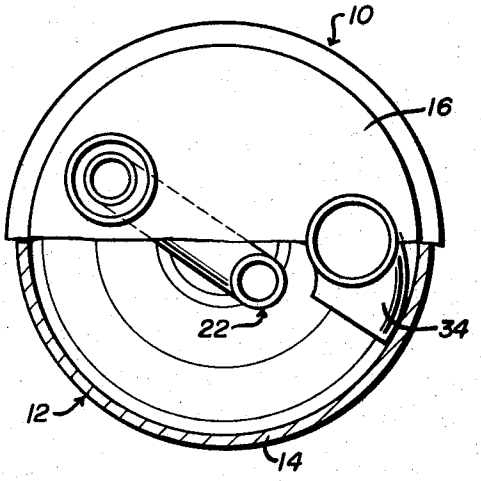


Fig. 2

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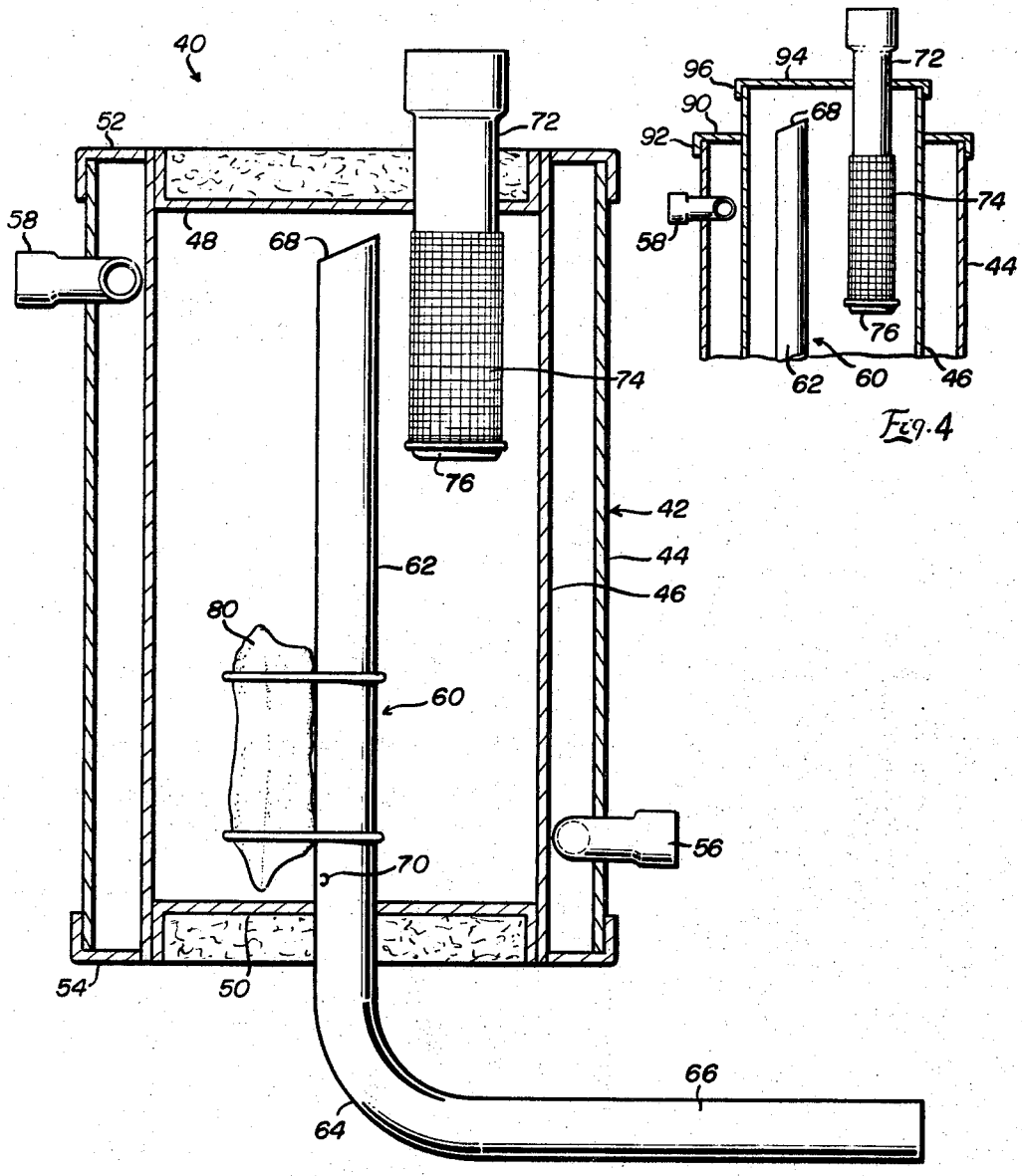


Fig. 3

Fig. 4

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United States Patent Office 3,420,071 Patented Jan. 7, 1969

3,420,071

SUCTION ACCUMULATOR

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Filed Mar. 10, 1967, Ser. No. 622,127
U.S. Cl. 62—503 7 Claims
Int. Cl. F25b 43/00

ABSTRACT OF THE DISCLOSURE

A suction accumulator is provided with a casing having upper and lower ends and a side wall. A conduit extends through the casing and terminates near the upper end thereof for providing an inlet path for introducing gaseous refrigerant having liquid refrigerant entrained therein into the casing. The terminal portion of the conduit is constructed to direct gas and liquid refrigerant against the side wall of the casing where the liquid can deposit and run down to the lower end of the casing. This avoids introduction of liquid into the outlet from the casing which is a tube having an open end adjacent the casing upper end. The outlet tube also has an opening adjacent the lower end of the casing. Suction is applied to the outlet tube and gas is drawn through the open end thereof while liquid is drawn through the bottom opening. In one embodiment, the side wall of the casing comprises an inner tube and an outer tube which form a heat exchange passageway. All joints between the inner and outer tubes and the end closures for the tubes are available externally to allow furnace brazing of the joints and convenient repair and servicing.

Background of the invention

The present invention relates to a suction accumulator for a refrigeration system, and more particularly to a suction accumulator incorporating an inlet structure constructed to avoid creating turbulence within the unit and in one embodiment an improved heat exchange structure.

An 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 perhaps causing damage. Sometimes 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 from the accumulator resulting in unmetered flow to the compressor.

Summary of the invention

The present invention constitutes an improvement over prior accumulators in that the inlet to the accumulator is so constructed as to direct the flow of incoming gas away from trapped liquid. In one embodiment, an inlet conduit is provided within the accumulator and so angled to result in avoiding creating turbulence of the liquid trapped within the accumulator. In another embodiment a strainer is provided at the inlet to break up the flow of incoming gas while straining out any particles which may be present in the gas.

It is, therefore, an object of the invention to provide a suction accumulator with inlet means which avoids creating turbulence of the liquid contained in the accumulator.

Another object of the invention is to provide such a suction accumulator which is particularly useful in systems which are operated intermittently such as heat pumps, air

conditioning systems and other commercial refrigeration systems.

A still further object of the invention is to provide an accumulator which also performs a heat exchanging function.

In the drawings:

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

FIGURE 2 is a top plan view of the accumulator of FIGURE 1 with portions of the top broken away for clarity;

FIGURE 3 is a side elevational view in section of another embodiment of the suction accumulator of the invention; and

FIGURE 4 is a fragmentary sectional view of another embodiment of the invention.

As illustrated in FIGURE 1, the suction accumulator **10**, includes a casing **12** which comprises an open-ended tube **14** having an upper enclosure **16** and a lower enclosure **18** secured thereto. A threaded stud **20** is provided on the lower enclosure **18** for securement of the accumulator to a supporting structure.

An outlet tube **22** extends through the upper enclosure **16**. The outlet tube **22** is U-shaped. One leg **24** of the tube **22** extends downwardly to a point adjacent the lower enclosure **18**. The tube is then provided with a bend **26** and a second leg **28** extends upwardly and terminates in an open end **30** adjacent the upper enclosure **16**. A small metering opening **32** is provided in the tube bend **26**.

An inlet tube **34** extends through the upper enclosure **16** into the casing interior. The inlet tube **34** extends for a short distance into the casing and is then curved to match the curvature of the interior surface of the casing and is aimed in a direction substantially horizontal.

In operation of the accumulator, cool refrigerant gas having a small amount of entrained liquid refrigerant therein enters the accumulator through the inlet tube **34**. The incoming gases, which move at a relatively high velocity, impinge against the interior wall of the casing and are directed in 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 **30** of the U-shaped tube. The introduction of liquid into the U-shaped tube by splashing is undesirable because it is desired to control the rate at which liquid enters the U-shaped tube.

An additional advantage of directing the incoming gases tangentially against the interior surface of the casing is that entrained liquids in the gas will be centrifugally separated from the gas. As will be appreciated, the entrained liquids are heavier than the gas and are thrown against the surface of the casing and deposited thereon for eventual flow towards the bottom of the casing.

Another feature of the inlet which will be noted is that there is no need to control the passage of refrigerant gases into the casing through the inlet tube **34** by means of a restriction. The use of a restriction would result in the pressure of the incoming gases being reduced. The present inlet permits incoming refrigerant gases to freely pass into the casing without a pressure drop. If there were a pressure drop, energy would be lost, thus decreasing the efficiency of the system and requiring the compressor to work harder to draw refrigerant from the accumulator.

The refrigerant gases which enter the casing are drawn into the open end **30** of the U-tube **22**, pass through both legs of the U-tube and exit through the outlet and

thence to the compressor. The compressor, which creates a suction, draws the gaseous refrigerant through the accumulator at a relatively rapid rate.

Liquid refrigerant which enters the accumulator through the inlet tube **34** drops to the bottom of the accumulator and is subsequently drawn through the opening **32** and then through the leg **24** into the compressor. The opening **32** 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.

A pressure equalizing means for the outlet conduit **22** comprises a small opening **36** provided in the uppermost portion of the leg **24** of the outlet conduit **22**. It will be noted that the opening **36** is approximately at the same level as the open end **30** of the leg **28**. The provision of the opening **36** causes the pressure in leg **24** to always be equal to the pressure in leg **28**. The importance of this is that gas pressure within the casing **12** cannot force the head of liquid which may be present in the U-tube into the compressor as a single slug.

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 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. At such times, the level of refrigerant may rise above the bend **26** of the U-tube. There will then be a considerable quantity of refrigerant within the legs of the U-tube. The gas pressure within the casing may at the same time, rise to a level where it is sufficient to force this liquid head through the U-tube and on into the compressor. This is undesirable as it is desired to have the compressor be the controlling force in drawing liquid through the tube. As a result of the provision of the opening **36**, such unwanted flow of liquid into the compressor is prevented because the gas pressure in both legs of the U-tube is the same and thus refrigerant will not be forced in either direction as a result of this gas pressure.

It will be appreciated that under normal operating conditions, gaseous refrigerant will be drawn through the U-tube as a result of both the suction from the compressor and the pressure of the incoming gases. The controlling factor in this flow is the difference in pressure, between the casing interior and the compressor. Thus, the opening **36** will not prevent flow of gaseous refrigerant into the compressor. As a result of the small size of the opening **36**, a considerable amount of gas will continue to flow through the open end **30** of the U-tube and on through the U-tube into the compressor. The gas which flows through the U-tube will carry with it refrigerant metered through the opening **32**. Thus, even though the pressure within both legs of the U-tube is the same, liquid will be carried to the compressor at a metered rate.

FIGURE 3 shows a suction accumulator **40** which constitutes another embodiment of the invention. The suction accumulator **40** includes a casing **42** which comprises an outer open-ended tube **44** and an inner open-ended tube **46** disposed concentrically within and spaced from the outer tube **44**. The open ends of inner tube **46** are closed by metal headers **48** and **50** which are recessed from one side, the recess being filled with foam insulation. The space between tubes **44** and **46** is closed at the ends by end caps **52** and **54** which fit over the ends of outer tube **44** and abut against the ends of inner tube **46**.

It may be noted that all joints between tubes **44** and **46**, end caps **52** and **54**, and headers **48** and **50** are available on the outside of the accumulator and, consequently, are easy to service and repair. The components described so far are all metal, preferably steel, and the joints can all be sealed by brazing in a hydrogen atmosphere in a furnace, which helps to make the construction relatively inexpensive.

Extending through the outer tube **44** are an inlet nipple **56** and an outlet nipple **58**. Hot liquid refrigerant may be introduced into inlet **56**, will flow through the passageway between tubes **44** and **46**, and then will flow out through outlet **58**. Heat exchange takes place between the hot liquid refrigerant and the cold gaseous refrigerant which flows through the inside of inner tube **46**. Thus, the accumulator **40** additionally serves as a heat exchanger. The portions of nipples **56** and **58** located in the space between tubes **44** and **46** are cut at an angle so that the mouth of each nipple is directed circumferentially of tubes **44** and **46**. The liquid refrigerant is therefore directed circumferentially as it flows in through inlet **56** to provide wiping circulation of liquid around the outside of the accumulator. This improves heat transfer. The space between tubes **44** and **46** is relatively thin, and this causes the liquid to flow at a relatively high velocity through that space.

Extending axially of tube **46**, through header **50** and horizontally outside of accumulator **40** is an L-shaped outlet tube **60**. The outlet tube has a vertical leg **62**, a bend portion **64** and a horizontal leg **66**. Leg **62** terminates in an open end **68** adjacent header **48**. A small metering opening **70** is provided where leg **62** and bend **64** merge together just above the lower header **50**.

An inlet tube **72** extends through the upper header **48** into the interior of the accumulator within inner tube **46** of casing **42**. At the lower end of inlet tube **46** is provided a strainer **74** through which all incoming gas and liquid must pass. The bottom end **76** of the strainer is solid, and the side walls of the strainer are perforated. Any particles in the fluid are removed by the perforate side walls of strainer **74**. The solid bottom end **76** of strainer **74** breaks up the flow of incoming gas and liquid and prevents this flow from impinging directly on liquid which accumulates within the accumulator. If this flow were not broken up, frothing and splashing of the liquid could take place resulting in introduction of some liquid into the open end **68** of outlet tube **60** producing an unmetered flow of liquid in tube **60**. The purpose of hole **70** is to provide a metered flow of liquid into outlet tube **60**, so any flow of liquid into the open tube end **68** is to be avoided.

A bag of desiccant **80** is placed somewhere within the accumulator, and in this embodiment it is wired to the outlet tube **60**. The desiccant removes water which may be contained in the refrigerant gas and so serves to dry the gas.

In operation of the embodiment of FIGURE 3, refrigerant gas containing a small amount of entrained liquid enters the accumulator through the inlet tube **72** and flows through the strainer **74**. The solid bottom **76** of the strainer directs the gas and liquid outwardly against the inner tube **46** of casing **42** and removes any particles from the incoming fluids. The liquid entrained in the gas deposits on tube **46** and runs down to the bottom of the accumulator and is subsequently drawn through the opening **70** into the outlet tube **60**. The opening **70** meters the liquid into tube **60** at a controlled rate and thus acts to prevent large amounts of liquid refrigerant from suddenly entering the compressor.

The refrigerant gas which enters the accumulator through inlet tube **72** is drawn into open end **68** of outlet tube **60**, flows through the outlet tube and from there to the compressor. The gas is sucked through outlet tube **60** by the compressor, and it picks up some liquid as it passes the metering opening **70**. While the cold gas is in the accumulator, it is dried by the desiccant **80** and there is some heat exchange with the warmer refrigerant liquid which flows between the inner tube **46** and the outer tube **44**. Thus, multiple functions are built into the accumulator

without making it unduly complex and without unduly increasing its cost.

FIGURE 4 is a fragmentary sectional view of an embodiment of the invention which is identical to the embodiment of FIGURE 3 except for the construction of the end caps which seal the ends of the outer and inner tubes **44** and **46**. It may be seen that the inner tube **46** projects beyond the end of the outer tube **44**. The end of the outer tube **44** is closed by an annular end cap **90** which has a flange portion **92** overlapping the outer tube **44**. Similarly, the end of the inner tube **46** is closed by a circular end cap **94** which has a flange **96** overlapping the inner tube **46**. The joints between the end caps **90** and **94** and the outer and inner tubes **44** and **46** are all exterior, and so it is possible to seal these joints by brazing in a furnace, which helps to make the construction inexpensive. The external location of the joints also makes it easy to check the joints and simplifies service and repair of the joints. As in the embodiment of FIGURE 3, the tubes **44** and **46** and the end caps **90** and **94** may be made of steel. Only one end of the accumulator is shown in FIGURE 4, but it should be understood that the other end of the accumulator has the same construction.

Having thus described my invention, I claim:

1. An accumulator for a refrigeration system comprising a casing having an upper end, a lower end and a side wall, an inlet to said casing including a conduit extending into said casing substantially at the upper end and terminating adjacent the upper end thereof, said conduit providing a path for introducing gaseous refrigerant having liquid refrigerant entrained therein into said casing and being constructed to direct said gas and liquid toward said side wall of said casing where said liquid can deposit and run down to the lower end of said casing, and an outlet for said casing including a tube having an open end adjacent to said upper end of said casing and having a portion extending from said open tube end to said lower end of said casing, said tube extending through said casing at one of said ends thereof and having an opening therein adjacent said lower end of said casing, and said tube acting to draw gas through said open end thereof and draw liquid at a controlled rate through said opening therein for supplying said gas and liquid to further apparatus.

2. The accumulator as claimed in claim **1** in which said inlet conduit terminates in a strainer having a solid portion in the path of the incoming fluids and adapted to direct the fluids toward said side wall of said casing, said strainer serving to remove particles from said incoming fluids.

3. The accumulator as claimed in claim **1** in which said side wall of said casing comprises an outer tube and an inner tube, means supporting said tubes coaxially with said inner tube within and spaced radially from said outer tube, the space between said tubes providing a passageway for flow of a fluid, and an inlet to and an outlet from said passageway, said accumulator therefore having a function of exchanging heat between a fluid flowing in said passageway between said tubes and fluid provided in the interior of said inner tubes of said casing.

4. The accumulator as claimed in claim **3** in which said inlet and outlet for said passageway comprise tubes having mouths aimed circumferentially of said tubes to provide circular flow of fluid as it traverses said passageway.

5. The accumulator of claim **3** in which the ends of said passageway and also the ends of the space within said inner tube are closed by cap means forming joints with the inner and outer tubes, said joints all being sealed and available externally of said accumulator for service and repair.

6. An accumulator for a refrigeration system and capable of performing multiple functions, said accumulator comprising a casing having an upper end, a lower end and a side wall, said side wall comprising an outer tube and an inner tube supported coaxially within said outer tube and spaced radially therefrom to form a passageway between said tubes for flow of a fluid, an inlet to and an outlet from said passageway, said accumulator having a function of exchanging heat between a fluid flowing in said passageway and a fluid provided in the interior of said inner tube, an inlet to the interior of said inner tube including a conduit extending into said casing substantially at the upper end and terminating adjacent the upper end thereof, said conduit providing a path for introducing gaseous refrigerant having liquid refrigerant entrained therein into said casing, said conduit having a terminal portion constructed to direct said gas and liquid toward said inner tube of said casing where said liquid can deposit and run down to said lower end of said casing, and an outlet for said casing including a tube having an open end adjacent to said upper end of said casing and having a portion extending from said open tube end to said lower end of said casing, said last-named tube extending through said casing at one of said ends thereof and having an opening therein adjacent said lower end of said casing, and said last-named tube acting to draw gas through said open end thereof and draw liquid at a controlled rate through said opening therein for supplying said gas and liquid to further apparatus.

7. The accumulator of claim **6** in which the ends of said outer tube are closed by annular caps sealed to said inner and outer tubes, and the ends of said inner tube are closed by circular caps sealed to said inner tube, the joints between said caps and said tubes all being available on the exterior of said accumulator.

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