Oct. 19, 1965 R. M. HENDERSON 3,212,525

VALVES FOR REFRIGERATION APPARATUS HAVING COOLING AND/OR HEATING CYCLES

Filed Oct. 18, 1962 3 Sheets-Sheet 1

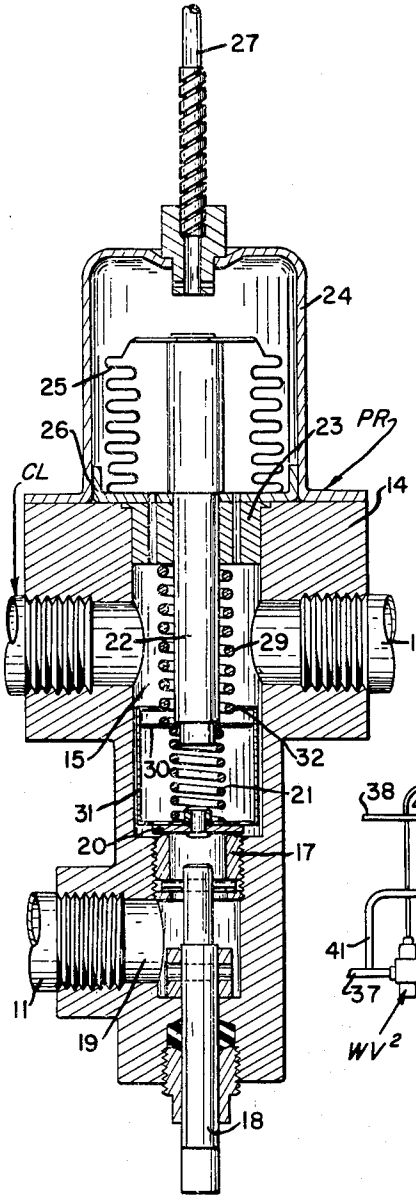


FIG. 2.

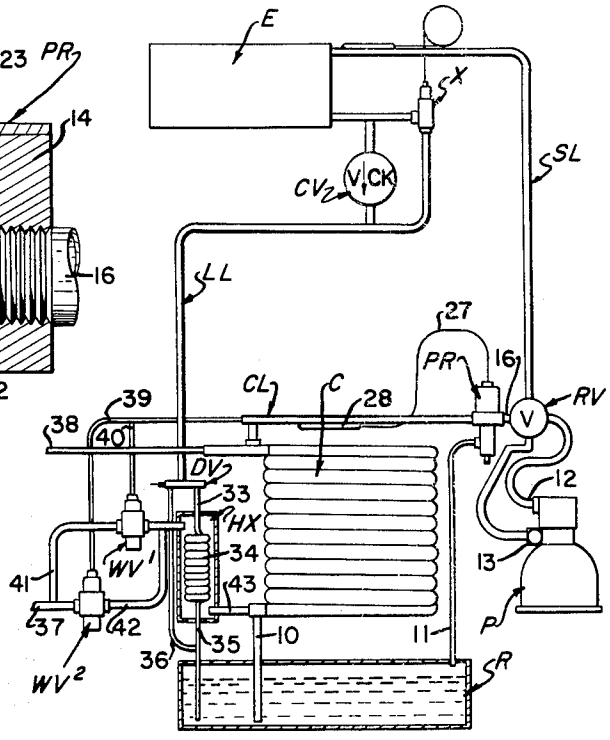


FIG. 1.

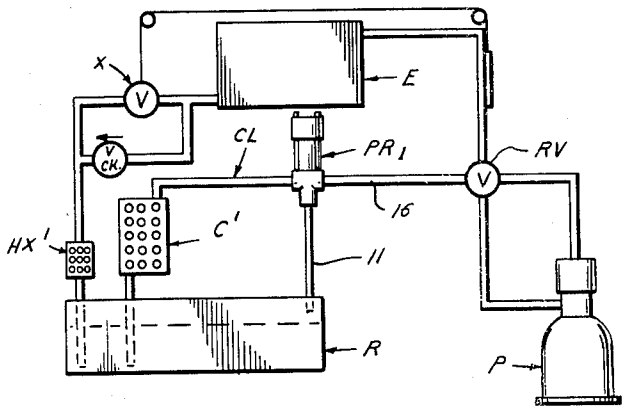
INVENTOR.
RAY M. HENDERSON
BY Hayden + Travel
ATTORNEYS

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FIG. 3



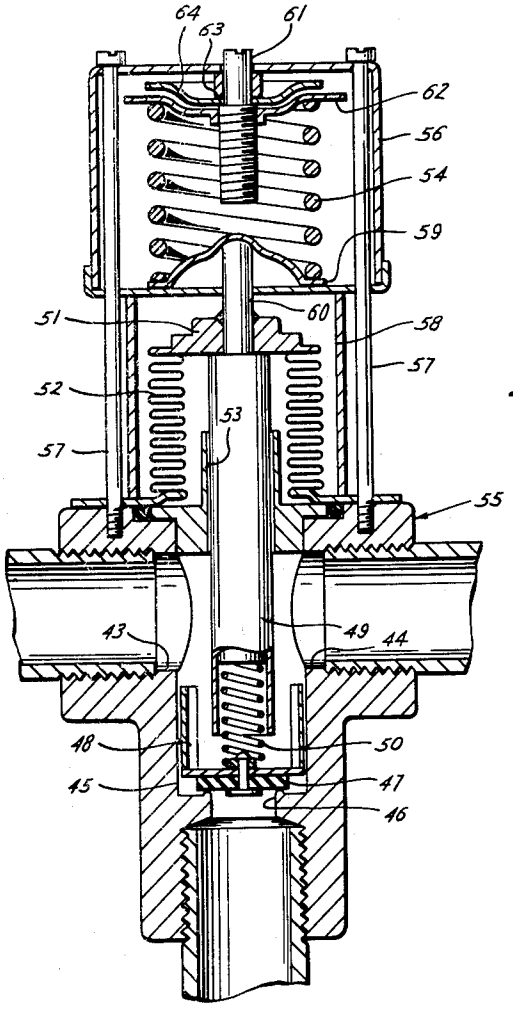


FIG 4

RAY M. HENDERSON
INVENTOR.

BY Hayden & Prawel

ATTORNEYS

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FIG. 5

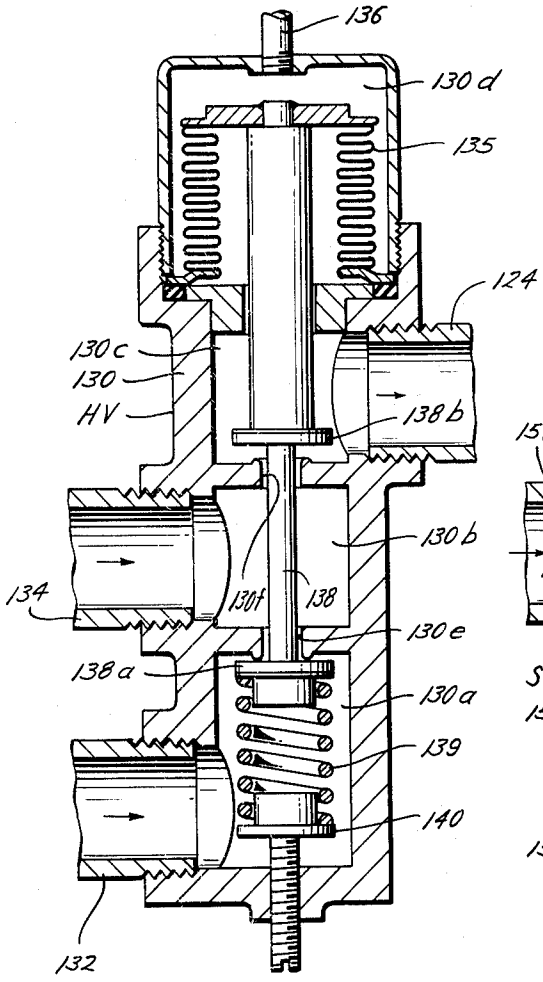
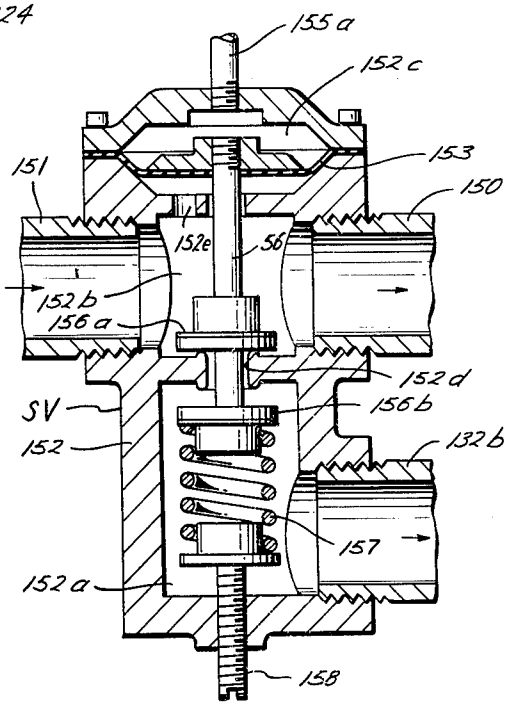


FIG 6



RAY M. HENDERSON
INVENTOR.

BY Hayden & Prawel

ATTORNEYS

United States Patent Office 3,212,525
Patented Oct. 19, 1965

3,212,525

VALVES FOR REFRIGERATION APPARATUS HAVING COOLING AND/OR HEATING CYCLES

Ray M. Henderson, 139 E. Ridgewood Court, San Antonio, Tex.; Hallie Henderson, widow of said Ray M. Henderson, deceased

Filed Oct. 18, 1962, Ser. No. 231,487
6 Claims. (Cl. 137—625.4)

This application is a continuation-in-part of my copending United States application Serial No. 137,362, filed September 11, 1961, and now Patent No. 3,088,293 and also Serial No. 36,200, filed June 15, 1960, and now Patent No. 3,074,249.

This invention relates to new and useful improvements in valves, and particularly valves for refrigeration apparatus having cooling and/or heating cycles.

An object of this invention is to provide new and improved valve means responsive to fluid pressure changes for controlling fluid flow therethrough.

Another object of this invention is to provide new and improved valve means adapted to be urged to one position by resilient means and to another position by fluid pressure.

A further object of this invention is to provide a new and improved valve means having a diaphragm controlled valve stem with a poppet valve thereon for regulating gaseous refrigerant flow in a refrigeration system.

Still another object of this invention is to provide valve means particularly adapted to the regulation and control of the refrigerant pressure in the receiver of a refrigeration system during reverse cycle operation thereof in response to a condition of the refrigerant leaving the evaporator.

Yet another object is to provide a novel pressure differential valve for aiding reverse cycle or defrosting operations of a refrigeration system which is operable in response to changes in the temperature or pressure of the refrigerant leaving the evaporator to control the pressure at the inlet of the evaporator to thereby control the amount of liquid transmitted thereto through said inlet.

Other objects, features, and advantages of my invention will become apparent from the following description taken in connection with the accompanying drawings in which like reference numerals indicate like parts and in which:

FIG. 1 is a schematic view of a reverse cycle refrigeration system illustrating my invention;

FIG. 2 is a sectional view of the pressure regulating valve shown in FIG. 1 whereby the novel results of my invention are obtained;

FIG. 3 is a schematic view of another form of reverse cycle refrigeration system illustrating my invention;

FIG. 4 is a sectional view of the pressure regulating valve shown in FIG. 3;

FIG. 5 is a sectional view of another form of valve which is particularly adapted for use in reverse cycle refrigeration; and

FIG. 6 is a sectional view of still another form of valve which is especially suitable for use as a superheat valve in controlling refrigerant flow.

The condensing unit shown in FIG. 1 is of the water cooled type, but it could be of the air cooled type as illustrated in FIG. 3 or a combination of both without materially affecting the adaptations and functions of this invention and in view of this, the scope of my invention is not to be limited to any particular type of system.

In the conventional refrigeration system shown in FIG. 1 there is a compressor P, a condenser C, a receiver R, an evaporator E, an expansion valve X, and the usual connections therebetween, the functional operation of which

is well known and understood. A water valve WV^1 regulates the rate of supply of water to the condenser.

In combination with this conventional refrigeration system is shown a reverse cycle heating system designed for defrosting evaporator E, including a reversing valve RV, an expansion valve bypass including a check valve CV, a heat exchanger HX, a liquid diverting valve DV, a reverse acting water valve WV^2, a liquid connection **10** known as a dip tube between the receiver and the condenser C, a bypass conduit connection **11** between the receiver and the conduit or condenser line CL which connects the condenser and the compressor in which is incorporated a pressure regulating valve PR, forming an important feature of my invention.

In this defrosting system, the reversing valve RV is of the conventional type and is operable by various means, preferably automatic, to reverse the flow of refrigerant in most parts of the system to thereby cause hot gas from the high side **12** of the compressor to be diverted through the suction line SL to the evaporator E where it will function as a heating medium to melt the frost which has accumulated during the refrigeration cycle of the system. The absorption of heat from this gas during this defrosting process will cause the gas to condense in the evaporator and become a liquid, which will flow by gravity to the bottom of the evaporator where it can pass through the check valve CV into the liquid line LL when the pressure conditions permit this valve to open. Simultaneously with this diversion of hot gas to the evaporator, the condenser line CL is connected through the reversing valve RV to the low side **13** of the compressor. This connection of the condenser to the low side will cause a pressure drop in the condenser and thereby convert the condenser into an evaporator. In this manner, the regular refrigeration evaporator will become a condenser during the defrosting operation and the regular condenser will become an evaporator, which will sometimes be referred to in this description and claims as a "second evaporator." On such reverse cycle, the receiver actually functions as an evaporator since gaseous refrigerant is removed therefrom and therefore, the receiver is sometimes referred to as "first evaporator means" in the claims. It will be understood that a separate second evaporator, not used during the refrigeration cycle, might be used during the heating cycle if desired and condenser C cut out of the circuit.

When during defrosting the pressure in the second evaporator is reduced below the pressure in the receiver R, liquid refrigerant will flow from the receiver R through the dip tube **10** to the second evaporator and will be evaporated by the usual boiling process to absorb heat from the water or air, whichever the case may be, which is supplied to the condenser as a heat bearing agent for heat exchange with the refrigerant.

Pressure regulating means is provided to control release of gaseous refrigerant from receiver R and first releases excess pressure from the receiver to permit normal circulation of refrigerant to commence immediately after the system is placed on reverse cycle. The pressure regulating means then regulates the rate of flow of liquid refrigerant into the second evaporator in accordance with a condition of the refrigerant leaving the second evaporator. This release of refrigerant may be through a valved bypass line directly interconnecting the receiver and compressor or it may be through the condenser by the use of a dip tube in the receiver whose height may be controlled as in my copending application Serial No. 499,912, Patent No. 2,904,967.

My improved pressure regulating valve PR, as shown in detail in FIG. 2, is provided with a body **14** having a bore **15**. Communicating with this bore is the condenser line CL, already referred to, and opposite thereto.

This bore is also connected to the reversing valve RV by a conduit **16**. In the lower part of the bore **15** is an adjustable valve seat **17** which is threaded into the body and adjustment is made possible by a stem **18** connected thereto and extending out of the lower end of the valve body, this stem being suitably packed, as shown, so that leakage cannot occur. Below the valve seat **17** there is provided a chamber **19** which has connected thereto the conduit **11** already referred to and connected to the top of the receiver R above any liquid line. Cooperating with the adjustable valve seat **17** is a check valve disc **20** for controlling the flow of refrigerant vapor past the valve seat **17** from the receiver to the bore **15** above the valve seat. The check valve disc **20** is acted upon by a pressure spring **21** interposed between the disc and the lower end of a plunger stem **22**, which plunger stem extends upwardly through a perforated guide **23** at the top of the bore **15** and into a cap **24**. A pressure responsive member such as a bellows **25** is positioned in the cap with its free end connected to the top or free end of the plunger stem and the other end of the plunger being connected to a closure plate **26** for the cap. The pressure responsive member **25** is exposed on one side to suction pressure through guide **23** and its movement is therefore influenced by the pressure of the gaseous refrigerant generated by condenser C.

The interior of the cap outside the bellows is connected by a capillary tube **27** to the bulb **28** attached to the condenser line CL as shown in FIG. 1. The movement of the plunger is controlled by the bellows **25** and the pressure in the cap and the movement of the plunger is further under the control of a compensating spring **29**, said spring being interposed between the perforated guide **23** and a washer **30**, welded or otherwise secured on the lower end of the plunger stem. Valve pressure spring **21** bears against the under side of washer **30**. An open top cage **31** encloses spring **21** and washer **30**. The bottom of the cage is secured to valve member **20**. The top of the cage has an inturned flange **32** overlying washer **30**. As soon as plunger **22** moves upward a sufficient distance to engage washer **30** and flange **32**, the valve member **20** is limited against further movement away from plunger **22** and further upward movement of plunger **22** will unseat valve member **20**.

Again referring to FIG. 1, it will be noted that the reversing valve RV is associated with the suction line SL between the evaporator and the compressor P and the liquid line LL coming from the evaporator is connected to the diverting valve DV which has a conduit **33** connected to the coil **34** of the heat exchanger HX, which in turn is connected by a conduit **35** to the bottom of the receiver. Another line **36** from the diverting valve bypasses the heat exchanger. The water valves WV^1 and WV^2 control the flow of water from the water supply line **37** to the chamber surrounding the heat exchanger and through the condenser to the water discharge line **38**. These water valves will be controlled by pressure in the condenser line CL, such being accomplished by conduits **39** and **40** leading to the control chambers of the water valves. It will be noted that the water line between the heat exchanger HX and the water supply **37** is divided into two lines **41** and **42**, with water valve WV^1 in the line **41** and the water valve WV^2 in the line **42**. The chamber of the heat exchanger is connected to a usual coil in the condenser, not shown, by a conduit **43**.

During the refrigeration cycle hot refrigerant gases in line CL will heat bulb **28** and the pressure within cap **24** will be such as to maintain the plunger **22** in its full down position. The valve disc **20** of the pressure regulating valve PR will remain closed and inoperative and such will have no effect in the system. This condition occurs because receiver pressure is transmitted to the lower side of disc **20** from the receiver R through conduit **11** and condenser pressure is transmitted to the top side of said disc by the direct connection to the condenser through

the line CL. As a result, the high side of the compressor is effective on the top of the disc **20** and it is held seated.

When defrosting takes place by an operation of the reversing valve RV, generally automatically, the pressure in the condenser C will immediately be reduced by a pumping of gas therefrom by the low side of the compressor. The suction pressure of the codenser which now becomes a second evaporator, as previously indicated, will also immediately be reduced and assume a value below the pressure in the receiver. This causes the check valve disc **20** to be unseated and gas from the receiver is released into the condenser line CL, now connected to the low side of the compressor. The receiver pressure is consequently reduced, but controlled and limited by the functioning of the valve PR.

Thus, during the initial stage of defrosting when plunger **22** is in its full down position and the receiver pressure is necessarily greater than the suction pressure of the condenser acting as a second evaporator, the difference in pressure between the receiver and the second evaporator will become equal to the pressure exerted by the spring **21** on the check valve disc.

From experience it has been determined that the most efficient operation of a condenser used as an evaporator is obtained by a flooded condition or by maintaining the liquid level in the condenser as near the top as possible without flooding over into the suction line and the compressor. This condition is maintained throughout the defrosting operation by the functioning of this valve.

It is common practice to lift liquid by providing adequate pressure behind the liquid to be lifted. In this operation, pressure of sufficient force to lift the liquid refrigerant from the receiver to the desired height in the second evaporator is maintained above the liquid in the receiver, and it is a function of valve PR to so regulate this pressure that there will be sufficient pressure exerted on this liquid to lift it to the required height in the evaporator and to control this pressure to the extent that the liquid will not be forced out of the top of the evaporator into the compresser. It is another function of this valve to regulate the liquid level in proportion to the usable heat exchange surface of the evaporator to thereby control the super heated condition of the refrigerant during the evaporating process.

With respect to this, the spring **21** is important as it is of such compressive strength as to hold sufficient pressure in the receiver over the amount of pressure on top of the liquid in the condenser-evaporator, with stem **22** in full down position, to lift the liquid from the receiver to at least the point at which the bulb **28** is fastened in heat exchange relation with the evaporator suction or the point at which it is desired to stop the rise of liquid in the evaporator and maintain the liquid level. The power substance or the composition with which the bulb is charged is of a substance having a low boiling point, preferably the same refrigerant as used in the system. When the boiling liquid in the evaporator reaches the point of heat exchange relation with the bulb **28**, heat is absorbed from the refrigerant in the bulb which will cause the temperature to be reduced and thereby reduce the pressure in the cap **24** which is exerted against the bellows **25**. This reduction of pressure in the cap **24** will permit the pressure of the refrigerant, which is exerted against the inside of the bellows, to extend the bellows to thereby move the stem **22** upwardly to thereby reduce the pressure of the spring **21** against the top of the valve disc **20**, which in turn will reduce the amount of pressure difference between the receiver pressure and the evaporator suction pressure. This reduction in pressure difference will cause the height of the liquid level in the second evaporator to be reduced and heat will no longer be taken from the bulb by refrigerant evaporating in line CL adjacent the bulb. The pressure in the power element will then increase by absorption of heat from the superheated gas in the suction line to again exert pressure on the bel-

lows which is greater than the suction pressure, to thereby cause movement of the stem **22** downwardly and increase the pressure difference across valve **20** to cause the liquid level to rise in the condenser C which is serving as the second evaporator. In many instances pressure conditions will be such that, after excess pressure is released from the receiver and the pressure in bulb **28** reduced by giving off heat to the system refrigerant, the valve will regulate pressure with the cage flange **32** and washer **30** in abutting relationship. The chilling and heating action of the system refrigerant on bulb **28** will soon reach an equilibrium condition and valve **20** will maintain a differential which will hold the frost line at or just below bulb **28**.

By this action it is apparent that the boiling liquid in the condenser C which is serving as the second evaporator will be limited in its passage through the condenser C serving as the second evaporator by the placement of the bulb **28**, and that the boiling liquid will be held at the desired level in the condenser by regulation of the pressure difference between the receiver and the suction side of the condenser C serving as the second evaporator.

It is obvious that in various condensing units and their application the pressure difference required to lift the liquid to the proper height in the condenser acting as a second evaporator will vary, and therefore a variation of the spring pressure on the check valve disc will be necessary. To accomplish this variation of spring pressure the valve is provided with the adjustable seat **17**. This valve seat may be raised or lowered to a limited extent. By moving the seat upwardly, the spring pressure of spring **21** will be increased to thereby increase the pressure difference, and by downward adjustment the spring pressure and pressure difference will be decreasd. This adjustment may also be used for adjusting the liquid level proportionately to the amount of usable heat exchange surface of the evaporator to thereby adjust and regulate the superheat of the expanded refrigerant.

As previously stated, an object of this invention is to control the liquid level or the supply of liquid to an evaporator by controlling or regulating the difference of pressure between one side of the evaporator and the other. This regulation of pressure is accomplished by the adjustment of spring pressure against the top of the valve disc of my improved pressure regulative valve PR. Both manual and thermostatic or automatic adjustment of the spring pressure has been provided, and therefore the improved valve may be adjusted manually to control the liquid level without the use or operation of the thermostatic means. Although manual adjustment might require more time and trouble, satisfactory results may be obtained.

In addition to the above described refrigerant evaporation regulating means, the water control system including two water control valves WV^1 and WV^2 and a heat exchanger HX are employed, as shown in FIG. 1. This water control system is illustrated and described in detail in my copending application Serial No. 397,309 referred to above and therefore need not be further described or discussed herein.

Referring now to FIGS. 3 and 4 this invention is illustrated in a system having an air cooled condenser C^1 and heat exchanger HX^1, and the liquid level in the condenser is controlled during the heating cycle without the use of bulb **28** by a pressure regulating valve PR^1.

Referring particularly to FIG. 4 of the valve PR^1 is interposed in the conduit between the condenser C^1 and compressor P and permits free flow of refrigerant therethrough from inlet passageway **43** to outlet passageway **44**. Bypass conduit **11** communicated with the inlet **43** and outlet **44** through passageway **45**. Fluid flow through passageway **45** is controlled by a valve set **46** in passageway **45** and a cooperating valve member **47**. Valve member **47** is free floating in passageway **45** and is guided in its movement to and from seated position by guide **48** which slidably engages the wall of passageway **45**.

A plunger **49** is reciprocally mounted in the valve body **55** and biases the valve **47** toward its seat. A spring **50** is interposed between valve member **47** and plunger **49** and permits valve **47** to leave its seat when the system is placed on reverse cycle operation to relieve the excess pressure in receiver R.

The plunger **49** is secured to the free end **51** of bellows **52** and reciprocates with changes in suction pressure in line CL to vary the force exerted by spring **50**. In this manner the differential between suction pressure and receiver pressure is varied with changes in suction pressure. Suction pressure reaches the inside of bellows **52** through plunger guide **53**.

Adjustment of the force exerted by spring **50** is provided by a biasing means such as spring **54** mounted externally of valve body **55** in a cage **56**. Cage **56** is secured to body **55** by through bolts **57** and held in spaced relationship therewith by cylindrical spacer **58** surrounding bellows **52**. The force of spring **54** is exerted on the bellows through an end plate **59** which engages a stem **60** carried by bellows **52** and extending into cage **56**. The force exerted by spring **54** may be selectively varied by rotating adjusting screw **61** which is threadedly carried in top end plate **62** for spring **54**. Screw **61** has a shoulder **63** which engages thrust plate **64** and holds the screw **61** against longitudinal movement by the force of spring **54**. Screw **61** also provides a stop for limiting expansion of the bellows during the cooling cycle.

During the cooling cycle of the system valve member **47** remains seated as the pressure in line CL is always greater than receiver pressure. As soon as the cycle of operation is reversed, hot gas condensing in evaporator E reduces evaporator pressure. Compressor P is also acting to reduce pressure in line CL. Under the influence of these two factors valve **47** will unseat and gas from receiver R will be bypassed until excess pressure is removed permitting check valve CV to unseat and normal circulation to begin. Bellows **52** will begin to function to regulate suction pressure at this time. The force exerted by spring **54** will be adjusted to maintain a suction pressure which will maintain a desired liquid level in condenser C^1, now functioning as a second evaporator. Suction pressure and the liquid level in condenser-evaporator C^1 are directly related and an increase in the amount of liquid in condenser-evaporator C^1 will cause an increase in suction pressure which will flex bellows **52** and reduce the force tending to hold valve member **47** on its seat. Valve member **47** will unseat and bleed off pressure from the receiver R which will permit the liquid level in condenser-evaporator C^1 to fall. As this liquid level falls, suction pressure reduces and bellows **52** contracts and the force tending to seat valve member **47** increases and seats the valve member to prevent further reduction of receiver pressure.

Heater HX^1 continuously provides sufficient heat to vaporize a small amount of refrigerant and provide more pressure in receiver R than necessary to support the desired level of refrigerant in condenser-evaporator C^1. It will be understood that this heat could be provided by directing some of the condenser air over the receiver R or by any other desired means. In some instances it may be found that the system will develop sufficient pressure without special provisions for heat and if so heater HX^1 may be omitted altogether.

While in both of the systems illustrated a single valve both relieves excess pressure in receiver R at the beginning of the heating cycle and thereafter regulates the differential between suction and receiver pressure it will be understood that these two functions might be accomplished by separate valves.

It will further be understood that relief of receiver pressure in response to a condition of the gaseous refrigerant generated in condenser-evaporator C may be through the

condenser by utilizing the automatic dip tube shown in my application Serial No. 499,912 with plunger **22** or **49** connected to the free end of the dip tube bellows.

In FIG. 5, a modified valve is illustrated, which is preferably used as a heat control valve in a refrigeration apparatus having a heating and a cooling cycle, one form of which is illustrated in my copending U.S. application Serial No. 36,200. Such heat control valve is designated HV in FIG. 5 and includes a body **130** which is divided into four chambers **130***a*, **130***b*, **130***c* and **130***d*. The chamber **130***a* is in fluid communication with a flow line **132** which extends from a source of gaseous refrigerant such as the receiver R in FIG. 1.

The chamber **130***b* is in fluid communication with a flow line **134** which extends from the coil serving as the evaporator so as to therefore supply gaseous refrigerant to said chamber **130***b*. The chamber **130***c* is in fluid communication with a flow line **124** which is ordinarily connected to a compressor or compressors such as indicated at P in FIG. 1.

The chamber **130***d* is separated from the chamber **130***c* by a flexible diaphragm **135** formed of a flexible metallic alloy of brass or other similar material, and such chamber **130***d* is in fluid communication with the coil serving as the condenser through a tube **136**.

The chambers **130***a* and **130***b* are interconnected by a port **130***e* and the chambers **130***b* and **130***c* are similarly interconnected by a port **130***f*. The opening and closing of such ports **130***e* and **130***f* is controlled by a valve member **138** which has valve heads **138***a* and **138***b* formed thereon. The valve member **138** is also engaged by a spring or resilient member **139** at its lower end for applying an upward force to the valve member **138**. The force of such spring **139** is sufficient to close the port **130***e* in the absence of any pressure in the chamber **130***d*, but when the pressure in the chamber **130***d* exceeds the pressure in the chamber **130***c* by a predetermined amount which is sufficient to overcome the force of the spring **139**, then the valve member **138** is moved downwardly to open the port **130***e*. The amount of force applied with the spring **139** may be increased or decreased by an adjusting member **140** which is preferably threaded in the housing or body **130** of the valve HV for movement upwardly and downwardly with respect to such body **130**. Thus, as the adjusting member **140** is moved upwardly, the spring **139** is compressed to cause it to exert a greater upward force on the valve member **138**.

In the operation or use of the valve illustrated in FIG. 5, the pressure introduced through the tube or pipe **136** to the chamber **130***d* is normally from the high side of the refrigeration system and such pressure controls the opening and the closing of the valve member **138**. Thus, when the pressure in the chamber **130***d* is insufficient to overcome the force of the spring **139**, the valve head **138***a* is seated as illustrated in FIG. 5 so that there is flow only from the inlet tube **134**, into the chamber **130***b*, through the passage **130***f*, and then into the chamber **130***c*, and finally out through the outlet tube or pipe **124**. When the high pressure of the gas in the chamber **130***d* is sufficient to force the stem of the valve **138** downwardly against the spring **139** to open the passage **130***e*, fluid is admitted from both the inlets **132** and **134** and such fluid is discharged out through the opening **124**. If the pressure in the chamber **130***d* reaches an excessive amount, it is sufficient to close the valve head **138***b* to thereby close the inlet flow from both of the inlet tubes **132** and **134**.

When the valve HV is used for controlling the flow of refrigeration gases, the valve HV is set so that when the pressure in the line **136** from the coil serving as the condenser is extremely high because of the low heat requirement at the condenser coil, the valve member **138** is urged downwardly for the flow of the refrigerant from the line **132** and also the line **134** through the body **130** to the discharge tube or pipe **124**. As explained in my copending application Serial No. 36,200, such valve thereby controls the level of the refrigerant in the evaporator coil through the high pressure side of the refrigeration circuit.

In FIG. 6, a still further modified valve SV is illustrated which is specifically adapted for use as a superheat valve in the refrigeration apparatus disclosed in said U.S. application Serial No. 36,200, although it has other uses. A flow line or pipe **150** is connected to the body **152** of the valve SV. Normally, the line **150** is connected to a reversing valve such as indicated at RV in FIG. 1. The valve SV also has a second outlet line or pipe **132***b*. The valve SV is connected with the coil serving as the evaporator during the heating cycle by a flow line or pipe **151**. The body or housing **152** of the valve SV has internal fluid chambers **152***a*, **152***b*, and **152***c*. The chambers **152***a* and **152***b* are interconnected by a port **152***d*. A breather hole **152***e* is also provided as shown in FIG. 6.

The flow line **132***b* is in communication with the fluid chamber **152***a*, and the flow lines **150** and **151** are in fluid communication with the fluid chamber **152***b*. A diaphragm **153** is positioned in the chamber **152***c* and is provided with air or other fluid under pressure above such diaphragm **153**. The portion of the chamber **152***c* above the diaphragm **153** is in communication with a temperature bulb or other source of gaseous pressure through the tube **155***a*. When the pressure of the air or other fluid within the chamber **152***c* reaches a sufficient amount to apply a downward force to the diaphragm **153** to overcome the upward force of the spring **157**, the valve head **156***a* moves to the closed position shown in FIG. 6.

The valve element **156** is directly connected to the diaphragm **153** so that the pressure within the chamber **152***c* controls the movement of the valve head **156***a*. The spring **157** acts against a flange **156***b* to apply a predetermined force to the valve member **156** for urging same upwardly. Such spring force is adjustable by longitudinally moving an adjusting plate or screw member **158** relative to the body **152** in basically the same manner as heretofore described in connection with the adjusting member **140** (FIG. 5).

The spring pressure **157** is set so as to cause the passage or port **152***d* to open and close during the heating cycle in accordance with fluctuations in the temperature at the temperature bulb located at the upper level of the coil serving as the evaporator during the heating cycle, as disclosed in my copending application Serial No. 36,200.

When the pressure in the chamber **152***c* drops due to an absorbing of heat from the temperature control bulb, the pressure on the diaphragm **153** is reduced sufficiently to permit the spring **157** to move the valve head **156***a* towards the open position. Obviously, the reverse effect is obtained when the pressure in the chamber **152***c* is increased sufficiently to move the valve head **156***a* to the closed position shown in FIG. 6. When the valve head **156***a* is in the closed position shown in FIG. 6, the flow of the refrigerant is from the inlet line or pipe **151** through the valve chamber **152***b* and out through the outlet line **150**. When the valve head **156***a* is unseated so as to open the port **152***d*, a portion of the flow from the inlet line **151** is directed through the port **152***c*, the chamber **152***a*, and is discharged through the line **132***b*.

From the above it will be seen that all the objects of my invention have been accomplished. There has been provided a means and method for regulating flow of liquid refrigerant to the second evaporator during the heating cycle in response to a condition of the gaseous refrigerant generated by the second evaporator as well as novel valve means for employment in the system.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus and method.

It will be understood that certain features and subcombinations are of utility and may be employed without

reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A valve for use in a refrigeration system, comprising:
   (a) a body having first and second interconnected inlet passageways and an outlet communicating with the passageways,
   (b) a valve seat and a valve member cooperable therewith for controlling flow through the first passageway,
   (c) said valve member urged toward its seat by a plunger mounted for reciprocation in the body,
   (d) a pressure responsive member securred to the plunger and reciprocating the plunger upon movement thereof,
   (e) said pressure responsive member exposed on one side to the second passageway whereby movement of the pressure responsive member is influenced by pressure conditions in the second passageway, and
   (f) means connected to the other side of said pressure responsive member from said first and second inlet passageways for varying the pressure of the gas acting on such other side.

2. The valve of claim 1, wherein the valve member is biased toward its seat by a resilient means interposed between the valve member and the plunger and wherein said body has passage means communicating said outlet with one of said inlet passageways when said valve member is seated and additional passage means for communicating both of said inlet passageways with said outlet when said valve member is unseated.

3. The valve of claim 1, wherein the other side of the pressure responsive member is exposed to a pressure vessel whose pressure is controlled by a temperature sensitive bulb.

4. A valve for controlling fluid flow in a refrigeration system, comprising:
   (a) a body having first and second inlet openings and an outlet opening, said body having a valve seat disposed between said first and second inlet openings,
   (b) a valve member reciprocal within said valve body and adapted to seat on said valve seat,
   (c) a flow passageway in said valve body communicating said first inlet opening with said outlet opening,
   (d) a second passageway downstream of said valve seat and extending from said second inlet opening through the valve body to said outlet opening,
   (e) fluid responsive means connected to said valve member for reciprocating same in response to fluid pressure changes acting thereon for controlling the flow of fluid to said outlet opening from said first inlet opening, and
   (f) means connected to the other side of said pressure responsive member from said first and second inlet passageways for varying the pressure of the gas acting on such other side.

5. The structure set forth in claim 4, including a pair of valve heads on the valve member adapted to seat and open for controlling the flow of the fluid through the valve body.

6. The structure set forth in claim 4, including means for urging the valve member to a position closing flow through the passageway from the second inlet opening to the outlet opening.

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M. CARY NELSON, *Primary Examiner.*

MILTON KAUFMAN, *Examiner.*