United States Patent [19]

Ross

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[54] **REFRIGERATING SYSTEM**

[75] Inventor: **Robert R. Ross,** Wheaton, Ill.

[73] Assignee: **H. A. Phillips & Co.,** St. Charles, Ill.

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[21] Appl. No.: **524,779**

[52] **U.S. Cl.** **62/503;** 62/509

[51] **Int. Cl.²** **F25B 43/00**

[58] **Field of Search** 62/503, 509, 512, 513, 62/174, 149

[56] **References Cited**

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2,641,113	6/1953	Schumacher	62/174
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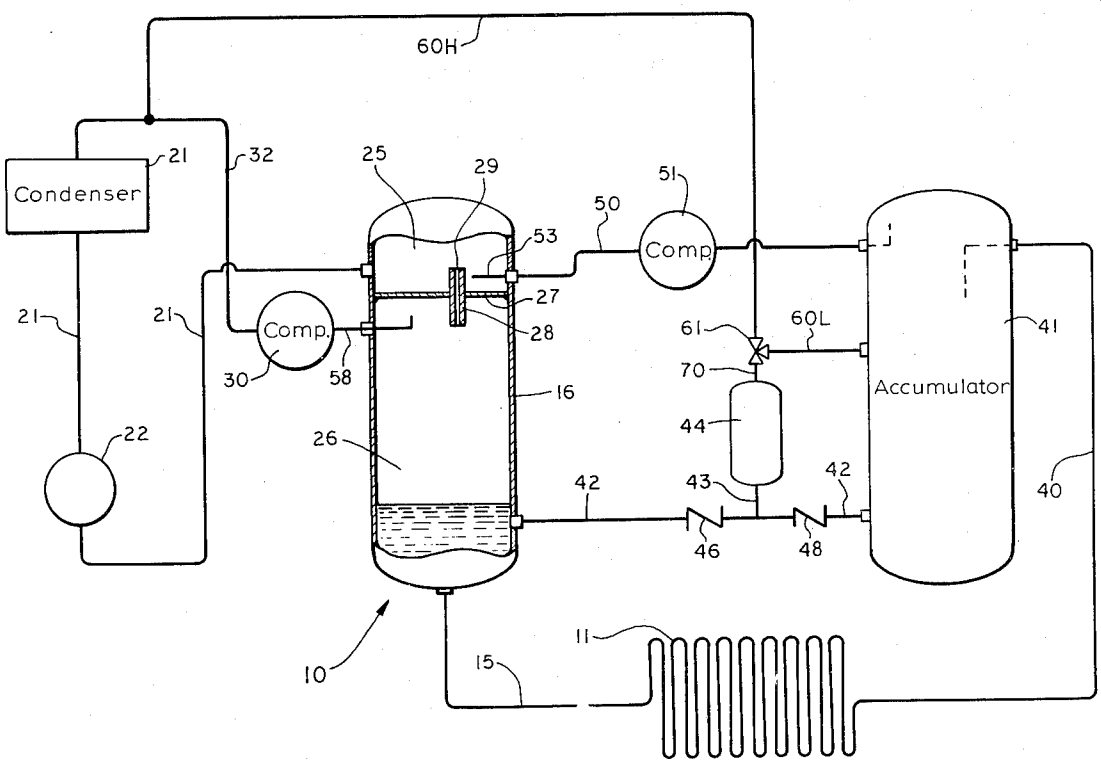
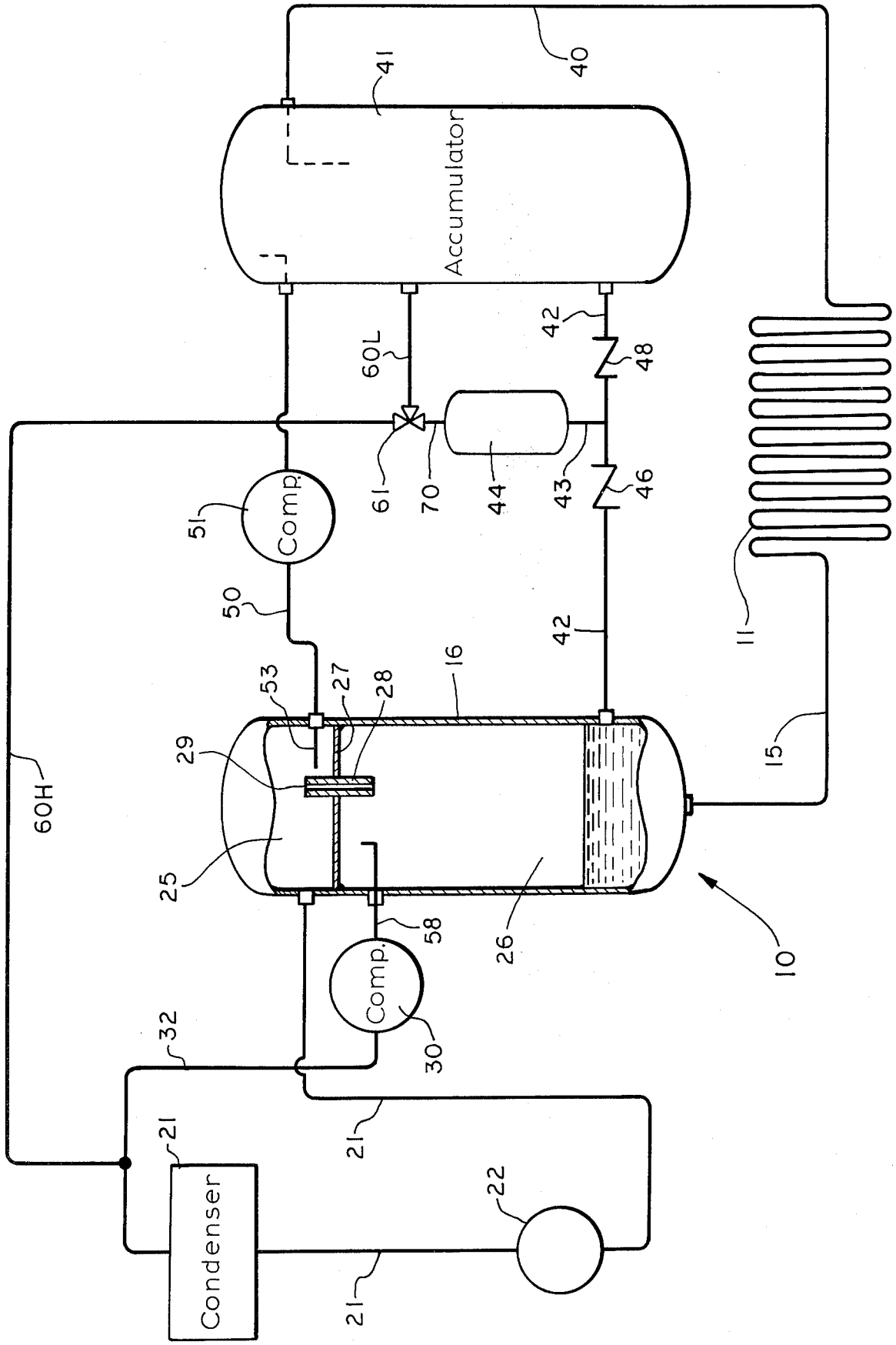
Primary Examiner—William F. O'Dea
Assistant Examiner—Ronald C. Capossela
Attorney, Agent, or Firm—Hume, Clement, Brinks, Willian, Olds, & Cook, Ltd.

[57] **ABSTRACT**

A recirculating refrigeration system. The system includes a receiver tank separated into an upper chamber and a sump chamber by a bulkhead. Liquid refrigerant from a condensor is delivered to said receiver tank above said bulkhead and accumulates thereon to a predetermined level. Excess liquid flows into said sump chamber from where it is delivered to an evaporator. Vaporized refrigerant is returned to the upper chamber of the receiver tank below the liquid level to cool it before it is returned to a compressor and from there, in liquid form, back to the condenser.

4 Claims, 1 Drawing Figure




Accumulator
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REFRIGERATING SYSTEM

FIELD OF THE INVENTION

This invention is in the field of refrigeration. It relates more particularly to refrigeration systems of the large, industrial type.

BACKGROUND OF THE INVENTION

H. A. Phillips & Co. of Chicago, Illinois, assignee of this application, has long been a leader in the design, development and installation of industrial type refrigeration systems. A pioneer in recirculating systems, its engineers have constantly sought new and improved refrigeration systems and equipment. Systems and components for refrigeration which have been developed at Phillips include those disclosed in Phillips U.S. Pat. No. **2,570,979;** Phillips U.S. Pat. No. **2,589,859;** Phillips U.S. Pat. No. **2,641,281;**Richards U.S. Pat. No. **2,841,962;** Richards et al. U.S. Pat. No. **2,871,673,** and Ross U.S. Pat. No. **2,966,043.** Of course, research and development continues toward more efficient and less expensive systems.

SUMMARY OF THE INVENTION

It is an object of the invention to provide an improved recirculating refrigeration system. It is another object to provide a recirculating refrigeration system employing a new and improved combination intercooler and receiver. It is still another object to provide a system receiver of this type which cools returning refrigerant gas in refrigerant liquid from the condenser without passing the gas through sub-cooled liquid being forced to the evaporators.

BRIEF DESCRIPTION OF THE DRAWING

The system embodying features of the invention, including its method of operation, together with additional objects and advantages thereof, is illustrated in the single schematic drawing FIGURE of the system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing FIGURE, a refrigeration system embodying features of the present invention is illustrated schematically at **10.** The system **10** is designed to provide highly efficient refrigeration in an industrial plant, for example, through the medium of an evaporator unit or units **11** which receive liquid ammonia refrigerant. In this light, the system **10** is adapted for the use of liquid ammonia refrigerant, but other refrigerants might also be used in systems embodying features of the present invention, including halogen compounds or methanes, for example.

The evaporator **11** receives refrigerant liquid through line **15** from a combination intercooler and receiver tank **16.** The tank **16,** in turn, receives liquid refrigerant from the condenser **20** through a line **21** in which a "high side" or liquid level control unit **22** is interposed.

The condenser **20** has received ammonia gas under a pressure of approximately **185** psi from the system's compressor **30** through a high pressure gas line **32.** The conventional condenser **20** liquifies the hot gas by removing a substantial portion of its heat while the gas is under pressure. Liquified ammonia leaves the condenser **20** through the line **21** hereinbefore referred to.

The flow of refrigerant liquid to the combination intercooler and receiver tank **16** is regulated by the "high side" control unit **22.** The control unit **22** is effective to regulate flow of liquid to the tank **16** depending upon the level of liquid in the line **21.** As long as the level of liquid in the line **21** is above a predetermined level, the unit **22** is effective to open line **21** to the passage of liquid, permitting liquid to flow to the tank **16.** A pressure drop occurs across the control unit **22** and, as a result, the pressure in the tank **16** is approximately twenty-five to forty **(25–40)** psi. If the liquid level in the line **21** drops below a predetermined point, the unit **22** closes the line **21** until additional liquid builds up therein.

The combination intercooler and receiver tank **16** is, according to the invention, separated into an upper chamber **25** and a lower chamber **26** by a horizontal bulkhead **27.** The bulkhead **27** is fluid tight, except for a liquid level maintenance pipe **28** which extends vertically through it. As illustrated, the upper end **29** of the pipe **28** extends a predetermined distance above the bulkhead **27.** This distance determines the depth to which liquid will accumulate on the bulkhead **27.**

Liquid refrigerant from the condenser **20** is introduced to the tank **16** through the line **21** above the bulkhead **27.** It accumulates on the bulkhead **27** up to the level of the upper end **29** of the pipe section **28.** The liquid refrigerant then pours down through the pipe section **28** into the lower chamber **26** of the tank **16,** which acts as a liquid refrigerant sump. The liquid in this sump chamber **26** is, at this point, sub-cooled and under a gas pressure of approximately **30** psi.

Liquid refrigerant from the sump chamber **26** of the tank **16** is forced to the evaporator **11** when it performs its refrigerating function, as has been pointed out, in an industrial freezer, for example. A combination of liquid and gas departs the evaporator **11** through the return line **40** to a low temperature accumulator **41.** The accumulator **41** returns the liquid refrigerant to the combination intercooler and receiver tank **16** in a manner hereinafter discussed, through the return line **42** connected by a branch line **43** to a dump tank **44.** Check valve **46** in the line **42** prevents backflow of liquid refrigerant from the sump chamber **26** of the tank **16** to the dump tank **44,** while check valve **48** prevents backflow of liquid from the dump tank **44** to the accumulator **41.**

The vaporized refrigerant; i.e., gas, in the accumulator **41,** flows through the return line **50** to the upper chamber **25** of the tank **16.** A booster compressor **51** in the line **50** raises the gas pressure to approximately **30** psi before this gas reaches the chamber **25.** In the chamber **25,** the line **50** terminates in a free end **53** which is below the level of the upper end **29** of the pipe section **28.** Accordingly, gas from the line **50** at approximately **30** psi is emitted below the level of liquid on the bulkhead **27.** This superheated gas is cooled by the refrigerant liquid.

The combination intercooler and receiver tank **16** is constantly receiving refrigerant vapor or gas in the aforedescribed manner. Flash gas is also being produced in the tank **16** in a well-known manner. This gas finds its way down through the pipe section **28** into the sump chamber **26** of the tank **16,** where it is drawn out of the tank **16** through the gas return line **58.** The gas return line **58** returns gas at a pressure of approximately **30** psi to the compressor **30.** The compressor **30**

functions in a manner hereinbefore described to recompress the gas to approximately **185** psi, and the cycle is then repeated.

Tapped into the high pressure output line **32** is a high pressure branch line **60H**. The line **60H** is connected to a three-way dump valve **61** which is, in turn, connected through a low pressure brance line **60L** back to the accumulator **41**.

The three-way dump valve **61** also is connected, through a high pressure branch line **70**, to the dump tank **44**. Normally, the outlet of the valve **61** to the line **70** is closed while liquid refrigerant arriving in the accumulator **41** flows by gravity through the lines **42** and **43** into the dump tank **44**.

When the liquid level in the dump tank **44** rises to a predetermined point, the port in the dump valve **61** which is connected to the line **70** opens so that high pressure gas flows through the line **70** into the dump tank **44**. Pressure build-up in the dump tank **44** forces liquid refrigerant in the tank **44** through the lines **43** and **42** and past the check valve **46** into the combination intercooler and receiver tank **16**.

When the dump tank **44** has been emptied, as indicated by a level sensor, or after a predetermined time-delay period calculated to empty the tank, the high pressure outlet port of the three-way dump valve **61** closes and the low pressure outlet port to the line **60L** opens. Pressure in the dump tank **44** and the accumulator **41** is equalized. Dumping stops and liquid refrigerant again is permitted to flow by the force of gravity through the lines **42** and **43** from the accumulator **41** to the dump tank **44**.

According to the invention, the construction and arrangement of the combination intercooler and receiver tank **16** in the system permits gas from the accumulator **41** to be passed through liquid refrigerant in the tank without disturbing the sub-cooled liquid in the sump chamber **26** of the tank. This gas is introduced through refrigerant liquid above the bulkhead **27**.

While the embodiment described herein is at present considered to be preferred, it is understood that various modifications and improvements may be made therein, and it is intended to cover in the appended claims all such modifications and improvements as fall within the true spirit and scope of the invention.

What is desired to be claimed and secured by Letters Patent of the United States is:

1. A recirculating refrigeration system, comprising:

a. compressor means for compressing vaporized refrigerant,

b. condenser means for receiving compressed refrigerant gas from said compressor means and removing heat from said compressed gas to liquify all of a substantial portion of it,

c. receiver tank means for receiving liquified refrigerant from said means,

d. said receiver tank means including an upper chamber and a lower chamber separated by a bulkhead,

e. said upper chamber being connected to said condenser means for receiving said liquified refrigerant from said condenser means,

f. liquid level control means in said upper chamber for permitting a predetermined level of liquid refrigerant to accumulate on said bulkhead while causing any additional amount of liquid refrigerant to flow into said lower chamber and accumulate in a sump therein,

g. evaporator means,

h. liquid refrigerant from said sump being forced from said lower chamber to and through said evaporator means,

i. at least a substantial portion of said vaporized refrigerant from said evaporator means being returned to said upper chamber of said receiver tank means and introduced to said upper chamber below the level of liquid refrigerant on said bulkhead so as to cool said vaporized refrigerant,

j. means for permitting said cooled, vaporized refrigerant to return from said upper chamber to said lower chamber above said sump, and

k. means for returning said cooled, vaporized refrigerant from said lower chamber to said compressor means.

2. The refrigeration system of claim **1** further characterized in that:

a. said liquid level control means comprises pipe means extending vertically through said bulkhead,

b. the height of an open upper end on said pipe means establishing the liquid level in said upper chamber,

c. overflow liquid flowing down through said pipe means into said lower chamber sump,

d. cooled, vaporized refrigerant also passing into said lower chamber from said upper chamber through said pipe means.

3. The refrigeration system of claim **1** further characterized by and including:

a. an accumulator tank for receiving vaporized refrigerant and liquid refrigerant entrained therein from said evaporator means,

b. vaporized refrigerant in said accumulator tank being first compressed and then returned to said upper chamber of said receiver tank means,

c. and means for returning accumulated liquid refrigerant in said accumulator tank means to said lower chamber sump in said receiver tank means.

4. The refrigeration system of claim **3** further characterized in that:

a. said means for returning liquid refrigerant from said accumulator tank to said lower chamber sump of said receiver tank means including a dump tank and dump tank valve connecting said dump tank to a source of compressed refrigerant gas,

b. actuation of said dump tank valve being effective to permit compressed refrigerant gas to force accumulated liquid refrigerant in said dump tank into said lower chamber sump.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,919,859 Dated November 18, 1975

Inventor(s) ROBERT R. ROSS

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 53, "of" should be --or--.
Line 55, after "said" insert --condenser--.

Signed and Sealed this

twenty-fourth Day of *February 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks