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AUTOMATIC REFRIGERANT SLUG DISINTEGRATOR

Filed March 25, 1954

2 Sheets-Sheet 1

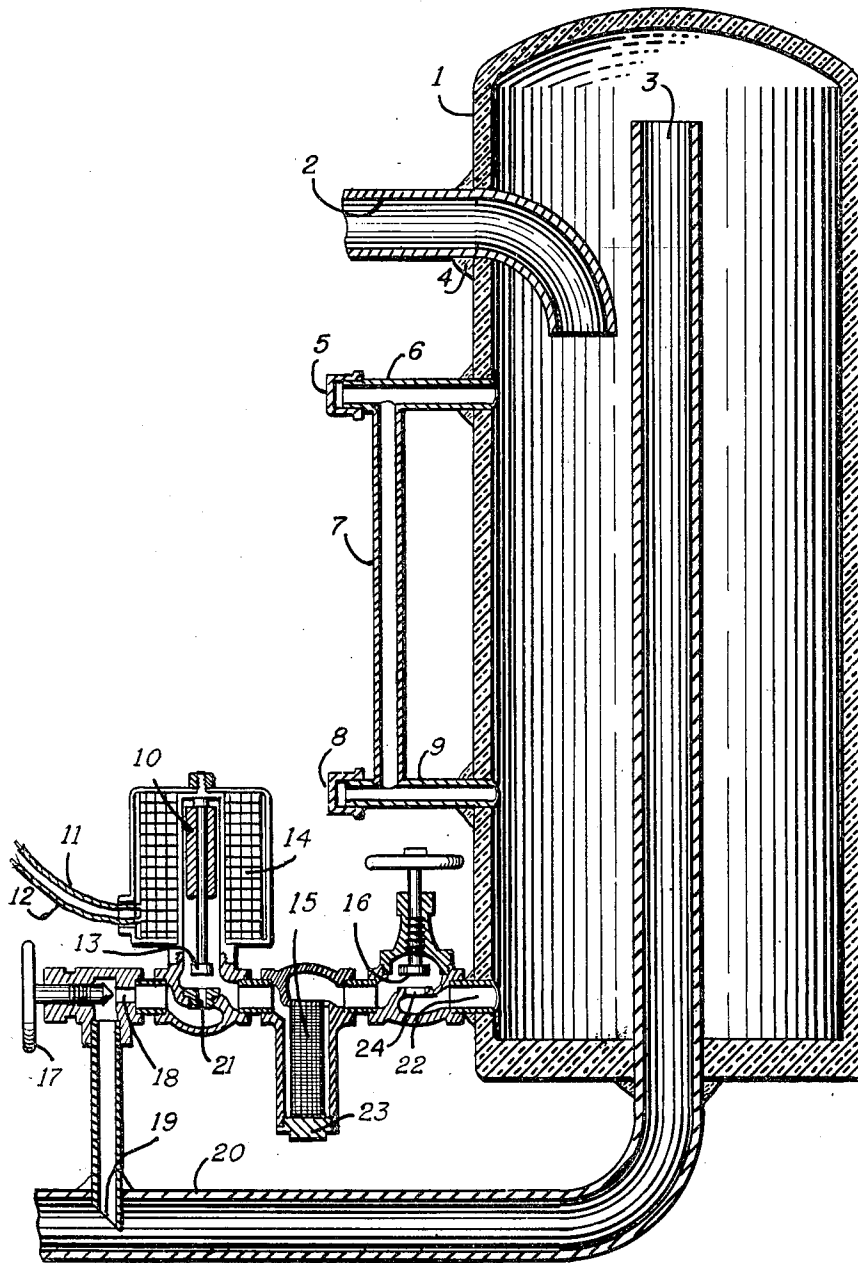


FIG. 1.

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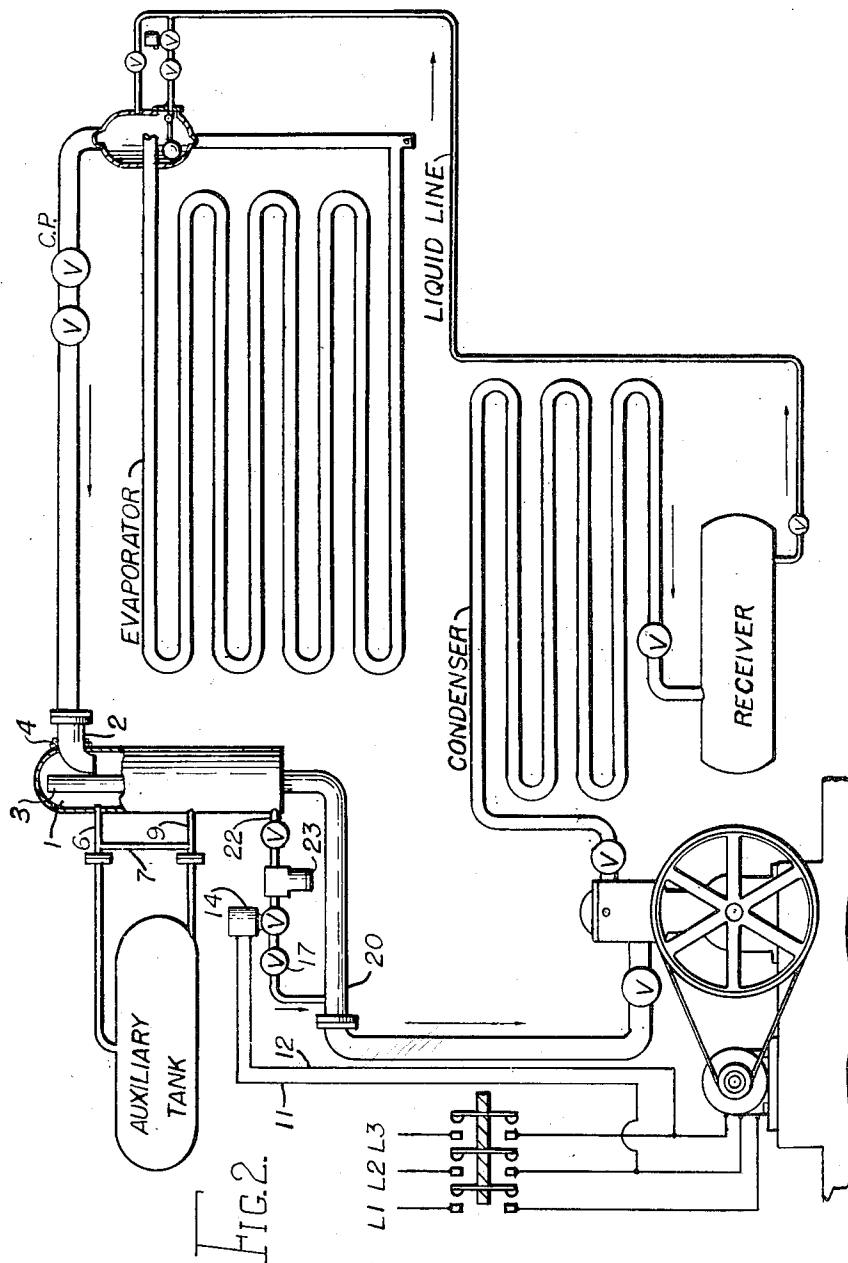
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2 Sheets-Sheet 2



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AUTOMATIC REFRIGERANT SLUG DISINTEGRATOR

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2 Claims. (Cl. 62-117.7)

My invention relates to the compression of refrigerant gas within refrigeration systems of the compression type wherein the compressor elements have a high rotative speed, and is directed more particularly to the problem of controlling slugs of refrigerant and oil which may intermittently be otherwise emitted from the evaporator elements from whence they may enter the compressor elements via the suction pipe.

The principal object of my invention is to protect refrigerant gas compressors by providing a comparatively inexpensive and simple device which will automatically arrest the aforesaid slugs of refrigerant and oil before they enter the compressor elements, with cooperative means to meter a small amount of this liquid at a comparatively slow rate so that the compressor will receive a small amount of liquid over a long period of time, rather than a large amount of the said liquid over a short period of time, with means to automatically stop the flow of all liquid whenever the compressor stops, and further means to manually stop the flow of the aforesaid liquid when desired.

As the quantity of refrigerant contained within any evaporator is limited, and the channels through which liquid refrigerant enters the said evaporator are also limited in size, then it is obvious that the emission from evaporator of liquid refrigerant and oil slugs will be intermittent rather than constant except in extreme cases such as when an operator opens a liquid by-pass valve leading into evaporator and forgets to close the said by-pass valve at the proper time, or when an operator starts to "pump out" an evaporator which contains a large amount of oil, which oil will increase in volume by emulsification if the pressure acting upon the said oil is reduced suddenly when the expanded oil will cause the emission of a large quantity of liquid from the aforesaid evaporator.

Heretofore it has been the custom to trap liquid slugs in an accumulator which is essentially a liquid separator where liquid and gas enter a closed vessel via gas inlet pipe, with the said gas passing out through a gas outlet pipe while the said liquid settles in the lower part of the said closed vessel, with means for pumping this liquid into the condenser by the use of a liquid refrigerant pump which will pump oil as well as liquid refrigerant.

Another method which is most commonly used is the heater coil type of accumulator, wherein the warm liquid refrigerant from the condenser is conducted through the accumulator via a heater coil within the said accumulator where there is an exchange of heat from the warm liquid refrigerant to the cold liquid trapped within the aforesaid accumulator. This action cools the aforesaid warm liquid refrigerant while evaporating the aforesaid trapped liquid. In this case the non-volatile oil remains in the accumulator unless it is drained out manually, or it may be pumped out of the accumulator.

To attain the objective of my invention I have devised a novel device having desired flexibility of operational characteristics without the embodiment of a pump or heater coil, while having a wide range of capacities with means to automatically vary this capacity under extreme conditions.

Due to a unit type of design wherein one primary tank will serve a small refrigeration unit while an identical tank having an auxiliary tank attached will serve a larger refrigeration unit by simply changing the size of an orifice in an automatic liquid stop valve.

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Reference to the specification and drawing will enable those versed in the art to which this invention pertains to construct and use this device, and where shop terms are used in quotation marks, they will be readily understood by these persons.

The essential elements which cooperate to attain my objective are shown in the accompanying drawing, wherein Fig. 1, is a vertical half section of this invention as it would appear in the operating position when the compressor elements are operating, the liquid refrigerant being omitted for the sake of clarity; and

Figure 2 is a diagrammatic sketch showing a complete refrigerating system embodying the invention.

An accumulator tank is shown at 1, with a gas inlet pipe at 2, and the open end of the gas outlet pipe at 3.

The gas inlet pipe 2 is in communication with the evaporator elements and the accumulator tank, serving as a conduit for various amounts of gas, liquid refrigerant and oil which may intermittently be emitted from within the said evaporator elements. This gas inlet pipe is preferably welded to the shell of the said accumulator tank as at 4.

A pipe cap is shown at 5 and will be further described in relation to an auxiliary tank attachment, as will the pipes 6 and 9 with the pipe cap shown at 8.

The pipe 7 is a "telltale" pipe in communication with the pipes 6 and 9 and the inside of accumulator tank 1 via pipes 6 and 9. The purpose of this "telltale" pipe is to indicate the height of refrigerant liquid within the accumulator tank by producing frost on the outside of the said telltale pipe to a height which is usually slightly higher than the height of the liquid refrigerant within the accumulator tank. Obviously frost only forms on the outside of this pipe when the refrigerant temperature is below freezing temperature.

When large amounts of oil are trapped within the accumulator shell, then the upper part of the "telltale" pipe may show frost while the lower part containing oil remains free of frost.

A solenoid is shown at 10 with electrical conductors shown at 11 and 12, with the preferred conventional solenoid operated stop valve shown at 13, which valve is actuated to open automatically by the magnetic action of the solenoid coil shown at 14 acting on the solenoid 10 whenever electric current flows through the conductors 11 and 12. When electric current is off, then the valve closes by force of gravity.

A strainer is shown at 15, and is used to arrest the movement of solid matter which might hinder the operation of the solenoid valve 13.

The disc of a manually operated globe stop valve is shown at 16 while the hand wheel of a second stop valve is shown at 17. Turning of this hand wheel may either close the orifice 18, or the said orifice 18 may be only partially closed during operation if so desired.

The open end of a pipe is shown at 19 and within the gas outlet pipe 20. This open end of the pipe 19 is the terminus of the conduit shown at 22 which conduit is welded to the shell of the accumulator tank similar to the attachment shown at 4, and is also welded to the gas outlet pipe 20 to form a continuous conduit in communication with the element 20 and the inside of the accumulator shell, so that liquid may flow by gravity from within the accumulator tank, through the conduit 22, through the strainer 15, through the restricted orifice of the solenoid valve shown at 21, through the orifice of the manually operated valve shown at 18 and into the gas outlet pipe 20 at 19.

The orifice 24 and the valve disc 16 are only necessary to cooperate to close the said orifice 24 when it is desired to clean the strainer 15 after removal of the plug 23 while the orifice 18 is also closed.

In operation, the valves remain in the positions shown

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in Fig. 1, and the electric energy is conducted through the solenoid coil 14 via the conductors 11 and 12, with means to automatically open the electric circuit serving the said solenoid coil 14 whenever the compressor elements are stopped. This action automatically closes the orifice 21 so that no liquid can flow into gas outlet pipe 20 until the compressor elements are again in operation, when the orifice 21 is again automatically opened to allow liquid to flow by gravity from the lower part of the accumulator tank 1 into the gas outlet pipe 20 at 19, from whence the said liquid mingles with gas from the upper part of the accumulator tank and is carried in the direction of least pressure, which direction is into the suction valves of the compressor elements.

The rate of flow of liquid remains constant for any given height of liquid within the accumulator tank regardless of change of gas pressure, but where there is a tendency for the liquid to enter the accumulator faster than the said liquid is flowing out of the said accumulator, then the height of the aforesaid liquid will increase, which in turn will increase the static head of liquid and the velocity of the liquid passing through the orifice 21 will be greatly increased automatically.

Where there may be short intervals of time when the height of the oil and refrigerant liquid may rise above the level of the pipe 6 with following long intervals of time when the liquid level may be as low as the liquid conduit 22, then it is necessary to increase the space for the accumulation of refrigerant liquid.

To increase this liquid accumulation space, it is only necessary to attach an auxiliary tank to the pipes 6 and 9 where the pipe caps 5 and 8 are shown. This auxiliary tank may be far removed from the accumulator tank 1 so long as it is located at the proper level to allow the free flow of liquid by force of gravity through the pipe 9 while the pipe 6 would act as an equalizing line attached to the upper side of the aforesaid auxiliary tank.

As it is very difficult to estimate the amount of liquid being emitted from evaporator elements without extensive tests, it may be found that the initial installation of this device provides either insufficient capacity or too great a capacity, in which case the size of the orifice 21 would either be increased or decreased to correct this condition.

My invention is shown in its most simple form, with the automatic liquid stop valve being a conventional electrically operated solenoid valve and having no means for draining the accumulator other than the liquid conduit 22.

Without departing from the scope of my invention, there may be added various heater coils or coil, drain lines, a conventional pressure, thermal or float operated automatic liquid stop valve in lieu of the solenoid valve shown, which solenoid valve would be electrically connected to the "load side" of an automatic starter, which automatic starter would control the operation of the compressor elements. The gas outlet pipe may also be placed entirely outside the accumulator tank by attaching the said gas outlet pipe at the top of the accumulator and re-routing the said gas outlet pipe down to the level where it is shown at 20.

In some isolated cases where a plurality of compressors are receiving refrigerant gas from a suction gas manifold which is common to all compressors, it is found that the compressor nearest the evaporator elements is receiving highly saturated refrigerant gas, while the compressor farthest from the said evaporator elements receives only superheated refrigerant gas, then it is advisable to locate the terminus of the liquid conduit 19 at a location within the said suction gas manifold nearest the compressor which is receiving superheated refrigerant gas and consequently is prone to operate at a high temperature.

Having described this device, I claim as my invention:

1. In a refrigerating system of the compression type having a high side including compression means driven by an electrically controlled prime mover, condensing

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means and a receiver to receive liquid refrigerant and having an expansion valve connected thereto, and also having a low side including an evaporator connected to the output of said expansion valve, and a conduit connecting said evaporator to the inlet of said compression means; an accumulator tank connected in series with said conduit whereby a portion thereof extends into said accumulator and comprises a gaseous refrigerant inlet having its inner extremity spaced apart from both the upper and the lower ends thereof, a second portion of said conduit having an open end terminating within said accumulator tank at a higher level than the end of said extremity, said second mentioned portion of said conduit leading from said accumulator to the inlet of said compression means, and solenoid valve means in communication with the bottom of said accumulator and connected to said second portion of the conduit for delivering refrigerant to said last mentioned portion of said conduit said valve means being actuated by a solenoid which is energized and opens the valve orifice and holds it open in time with the energization of said prime mover so that the valve orifice closes when the prime mover is at rest, and a tell-tale pipe interconnected with said accumulator tank and comprising a vertical pipe which is under the influence of refrigerant in said accumulator and adapted to have the portion thereof above the level of the liquid refrigerant in said accumulator coated with frost and to thereby indicate the liquid refrigerant level in said accumulator.

2. In a refrigerating system of the compression type having a high side including compression means driven by an electrically controlled prime mover, condensing means and a receiver to receive liquid refrigerant and having an expansion valve connected thereto, and also having a low side including an evaporator connected to the output of said expansion valve, and a conduit connecting said evaporator to the inlet of said compression means; an accumulator tank connected in series with said conduit whereby a portion thereof extends into said accumulator and comprises a gaseous refrigerant inlet having its inner extremity spaced apart from both the upper and the lower ends thereof, a second portion of said conduit having an open end terminating within said accumulator tank at a higher level than the end of said extremity, said second mentioned portion of said conduit leading from said accumulator to the inlet of said compression means, and solenoid valve means in communication with the bottom of said accumulator and connected to said second portion of the conduit for delivering refrigerant to said last mentioned portion of said conduit said valve means being actuated by a solenoid which is energized and opens the valve orifice and holds it open in time with the energization of said prime mover so that the valve orifice closes when the prime mover is at rest, and a non-transparent liquid level indicator on said accumulator tank comprising a generally vertical pipe having its upper and lower extremities connected to the upper and the lower portions respectively of said tank so that liquid refrigerant in said tank will rise to substantially the same level in said indicator and consequently the portion of said pipe above the liquid level therein is frosted when the system is operating and constitutes a visual indicator of the liquid level.

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