April 12, 1949. H. A. PHILLIPS 2,466,863

REFRIGERANT INJECTOR AND SURGE DRUM ARRANGEMENT

Filed July 3, 1947 2 Sheets-Sheet 1

Fig. 1.

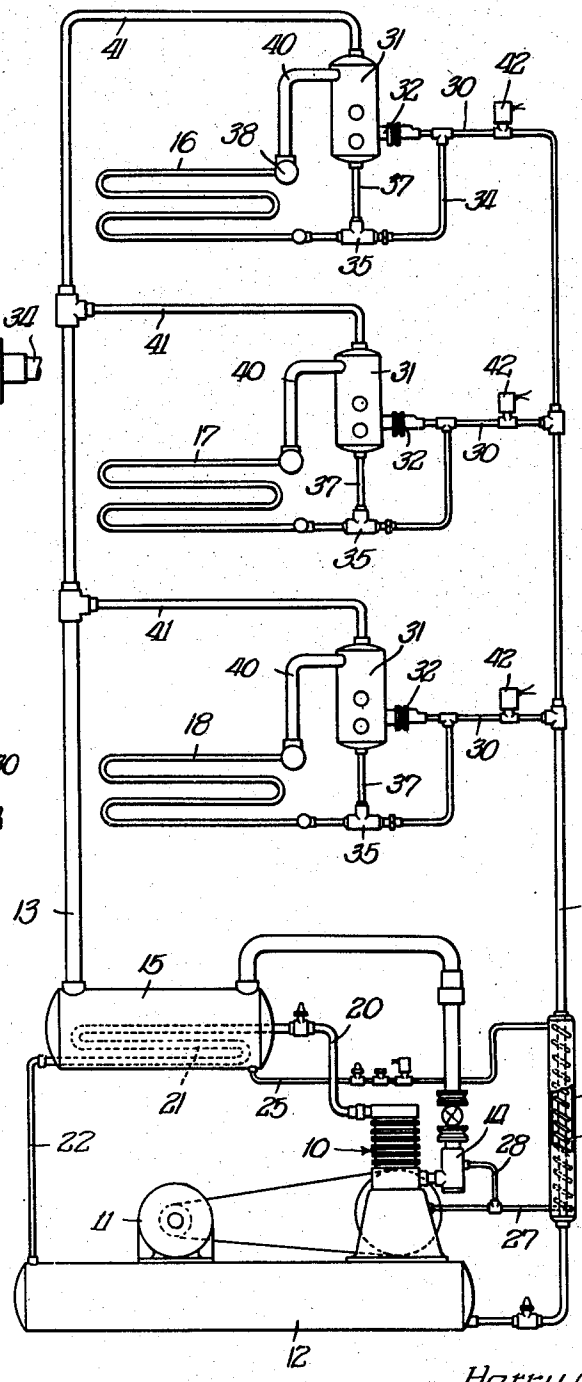

Fig. 2

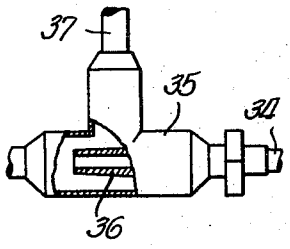

Fig. 3

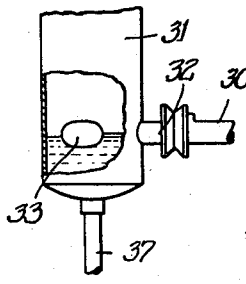

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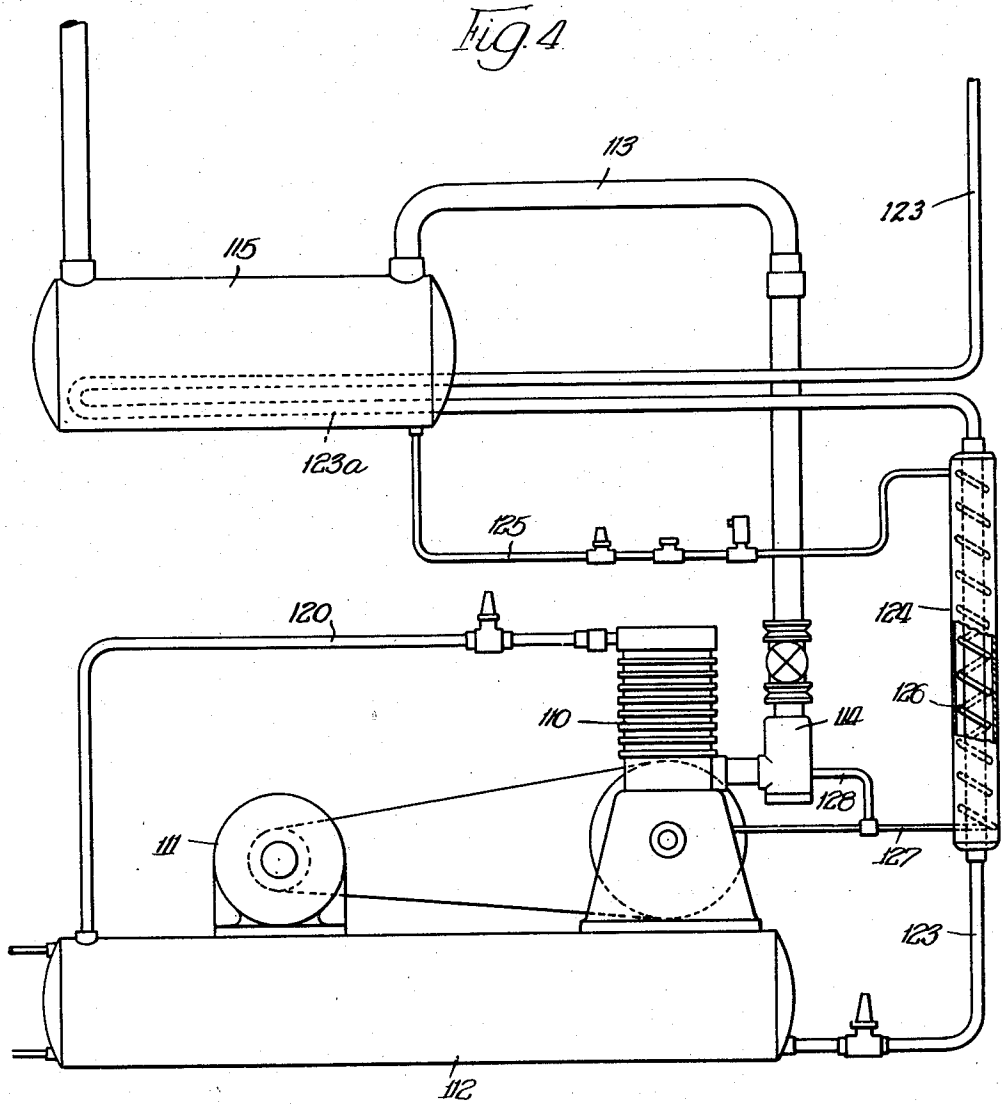
Fig. 4



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REFRIGERANT INJECTOR AND SURGE DRUM ARRANGEMENT

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Application July 3, 1947, Serial No. 758,903

7 Claims. (Cl. 62—115)

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The invention relates to refrigeration and has reference more particularly to an improved system of refrigeration and apparatus therefor including a plurality of evaporators each employing recirculating injector equipment in combination with a small surge drum for flooding the coils of its respective evaporator as disclosed and claimed in my Patent No. 2,123,021 granted July 5, 1938.

An object of the invention resides in the provision of refrigerating apparatus employing a plurality of evaporators in combination with improved structure which will make possible the use of simple recirculating injectors for the liquid refrigerant on flooded coils without requiring elaborate control means in connection with said plurality of evaporators.

A further object of the invention resides in the provision of refrigerating apparatus employing a plurality of evaporators and which will incorporate a recirculating injector and a small surge drum on each evaporator to facilitate oil return while achieving economy in installation. In connection with refrigerating apparatus of this character the invention contemplates the provision of a suction line accumulator for receiving liquid refrigerant passed over from time to time by the various surge drums and in combination with said accumulator a drier coil is provided for evaporating any such liquid refrigerant which may be received by the suction line accumulator.

Another object of the invention is to provide refrigerating apparatus of the character described wherein the suction line accumulator will be provided with a drier coil connecting with the high pressure refrigerant line whereby any liquid refrigerant in the accumulator drum is evaporated and sufficient heat is removed from the high pressure refrigerant to effect condensation so that liquid flow of the refrigerant to the condenser-receiver will be free and unobstructed.

Another object of the invention is to provide a refrigerating system wherein oil return from the evaporators is assured even at small loads.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more fully described and particularly pointed out in the specification, drawings and claims appended hereto.

In the drawings which illustrate an embodiment of the device and wherein like reference characters are used to designate like parts—

Figure 1 is an elevational view illustrating a refrigerating system embodying the improvements of the invention;

Figure 2 is a fragmentary detail view of a recirculating injector;

Figure 3 is a fragmentary detail view of a surge drum; and

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Figure 4 is a fragmentary elevational view illustrating a modified form of refrigerating apparatus coming within the invention.

Referring to the drawings, the refrigerating system selected for illustrating the present invention consists of a compressor indicated by numeral 10 which is driven by the motor 11, the said compressor and motor being suitably supported on the tank 12 comprising a condenser-receiver. The compressor has connection with the main suction line 13 through the suction line trap 14. An accumulator drum 15 is interposed in the main suction line and said drum receives the low pressure gaseous refrigerant from a plurality of evaporator coils 16, 17 and 18. The high pressure refrigerant line 20 leads from the compressor and has connection with the coil 21 located within the accumulator drum 15. From the drum the high pressure refrigerant line is continued by pipe 22 which connects with the condenser-receiver at the left end thereof. The liquid refrigerant such as ammonia is conducted from the condenser-receiver by line 23 providing the still 24 and which extends upwardly for connection with the evaporators 16, 17 and 18, respectively. An oil return line 25 has connection with the bottom of the accumulator drum 15 at the right hand side thereof and said oil return line includes the coil 26 located within the still 24 and forming a heat exchanger therewith whereby any liquid refrigerant passing over with the oil is evaporated. The connection 27 at the bottom of the coil conducts the oil return line to compressor 10. A by-pass 28 is provided in said connection leading to the suction line trap 14 for returning evaporated refrigerant to the compressor.

The refrigerating system of the invention finds particular application when serving a plurality of evaporators employing surge drums and recirculating injectors respectively. For example, referring to the evaporator 16, it will be seen that the liquid refrigerant line 30 connecting with the line 23 supplies liquid refrigerant to the surge drum 31, there being interposed in the line 30 the valve 32 operated by float 33, Figure 3. In advance of valve 32 the liquid supply line 30 is provided with a by-pass connection 34 leading to the recirculating injector 35 provided with the nozzle 36, Figure 2. The recirculating injector also has connection through pipe 37 with the bottom of the surge drum 31 and accordingly said injector operates to recirculate liquid refrigerant through the coils of the evaporator 16 and which recirculating effect is facilitated by the injector action of the liquid refrigerant discharged by nozzle 36. The evaporated refrigerant from the coils upon entering the header 38 is conducted by the pipe 40 to the top of the surge drum 31 and from said drum the gaseous refrigerant is

drawn off by suction line 41 connecting with the main suction line 13 of the system. Any liquid refrigerant which may enter the surge drum will be collected at the bottom of the drum and eventually recirculated by the recirculating injector 35 along with some liquid refrigerant from the refrigerant supply line 23.

The evaporators 17 and 18 are constructed similar to evaporator 16, each including a surge drum 31, a float operated valve 32, and a recirculating injector 35. The control of liquid refrigerant from the supply line 23 to the plurality of evaporators may be controlled thermostatically or otherwise by a solenoid valve 42. The evaporators are operated so as to maintain their coils in a flooded condition and which is provided for by the surge drums and the float operated valves associated therewith. The liquid refrigerant surrounding the nozzle of each injector is supplied thereto by its particular surge drum and includes recirculating refrigerant and some liquid refrigerant supplied by line 30. This liquid refrigerant is fed into the coils of the evaporator by the injector action of the liquid refrigerant and gas issuing from the nozzle of the injector. When the solenoid valve 42 remains open the evaporator is in continuous operation and liquid refrigerant as above described will be supplied to the nozzles of the injectors.

In a refrigerating system employing a plurality of evaporators it has been found desirable to employ small surge drums such as 31 in connection with each evaporator. The surge drums provide for flooded operation of the coils, which in combination with the recirculating injectors has proven highly efficient. However, there may be some passage of liquid refrigerant from the surge drums from time to time to the main suction line of the system. Accordingly, the invention contemplates the provision of an accumulator drum and a drier coil located within the drum. The drier coil 21, as shown in Figure 1, has connection with the high pressure, high temperature gaseous refrigerant line 20 and said coil and the accumulator drum should have sufficient surface to evaporate any liquid slop-over that may possibly occur from the surge drums. In operation the cool gaseous refrigerant in the accumulator drum will have a cooling effect on the coil removing sufficient heat from the high pressure, high temperature gaseous refrigerant in the coil to cause condensation so that liquid flow to the condenser-receiver will take place in a free and unobstructed manner.

With the refrigerating system of the invention it becomes possible to use simple liquid recirculating injector equipment on flooded coils and which will not require an elaborate control method for controlling the multiple evaporators. Also the oil return to the compressor is simplified since the cost of building small surge drums and one accumulator is generally less than that required to build large drums for each evaporator. Also the simplified oil return assures return of oil even at small loads.

In Figure 4 a modified refrigerating system is disclosed wherein the drier coil for the accumulator drum includes a section of the liquid refrigerant line located beyond the condenser-receiver instead of in advance of the same, as in Figure 1. The compressor 110 is driven by motor 111 with both elements being suitably supported by the condenser-receiver tank 112. The compressor has connection with the main suction line 113 through the suction line trap 114 and in

accordance with the invention said main suction line includes an accumulator 115. The high pressure refrigerant line 120 from the compressor has connection directly with the condenser-receiver. Liquid refrigerant from the condenser-receiver is delivered by the line 123 providing the still 124 and this liquid line beyond the still includes a coil 123a which enters the accumulator drum 115 to provide the drier coil for evaporating any liquid refrigerant which may accumulate in the drum. A heat exchanging effect takes place between the high temperature liquid refrigerant and the low pressure gas in the accumulator which has the effect of evaporating any liquid refrigerant which may slop over from the plurality of evaporators connecting with the system and at the same time the liquid refrigerant is materially cooled in advance of delivery to the evaporators. The bottom of the accumulator drum has connection with line 125 for draining oil from the drum and said line connects in turn with the coil 126 located within the still as previously described. The oil is eventually returned to the compressor by line 127 and by the bypass 128 delivers to the compressor any gaseous refrigerant evaporated by the still.

It will be understood that a plurality of evaporators are connected in parallel between the liquid refrigerant line 123 and the suction line 113 and that each evaporator includes a surge drum and a recirculating injector as described in connection with Figure 1.

The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings as various forms of the device will of course be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

What is claimed is:

1. In a refrigerating system, the combination with evaporator means, of a suction line connecting the evaporator means with a compressor, a high pressure line for supplying liquid refrigerant to the evaporator means, an accumulator drum in the suction line, said high pressure line including a coil having location within the drum to provide a heat interchanger whereby any liquid refrigerant in the drum is evaporated, and a connection leading from the bottom of the drum for draining any oil accumulating in the drum and returning the same to the compressor.

2. In a refrigerating system, the combination with a plurality of evaporators of the flooded type, of a suction line connecting with the discharge ends of said evaporators, a high pressure refrigerant line for supplying liquid refrigerant to the evaporators, an accumulator drum in the suction line, a coil in said drum connecting with and forming part of said high pressure line to provide a heat interchanger whereby any liquid refrigerant in the drum is evaporated, and a connection leading from the bottom of the drum for draining any oil accumulating in the drum.

3. A refrigerating system as defined by claim 2 additionally including a still for the oil connection provided by the high pressure refrigerant line for evaporating any liquid refrigerant in the connection which may have been drained thereby from the drum.

4. In a refrigerating system using ammonia or other refrigerant liquids lighter than and immiscible in oil, the combination with a plurality of evaporators, of a compressor, a suction line connecting the evaporators with the low pressure side

of the compressor, a high pressure refrigerant line connecting the high pressure side of the compressor with the evaporators, an accumulator drum interposed in the suction line between the evaporators and the compressor, a coil provided by the high pressure refrigerant line and having location in the drum, and a connection leading from the bottom of the drum for draining any oil accumulating in the drum, said connection joining with the compressor whereby said oil is returned thereto.

5. A refrigerating system as defined by claim 4, additionally including a heat interchanger for evaporating any liquid refrigerant in the oil by bringing the oil connection into heat exchanging relation with the high pressure refrigerant line.

6. In a refrigerating system using ammonia or other refrigerant liquids lighter than and immiscible in oil, the combination with a plurality of evaporators, of a compressor, a receiver for liquid refrigerant, a suction line connecting the discharge ends of the evaporators with the low pressure side of the compressor, an accumulator drum interposed in the suction line between the evaporators and the compressor, a refrigerant line connecting the high pressure side of the compressor with the receiver and including a coil having location within the accumulator drum, a liquid refrigerant line connecting with the receiver for supplying liquid refrigerant to the evaporators, and a pipe having connection with the bottom of the accumulator drum for draining any oil accumulating in the drum, said pipe joining with the compressor whereby said oil is returned thereto.

7. A refrigerating system as defined by claim 6, additionally including a heat interchanger for evaporating any liquid refrigerant in the oil by bringing the oil pipe into heat exchanging relation with the liquid refrigerant line.

HARRY A. PHILLIPS.

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