

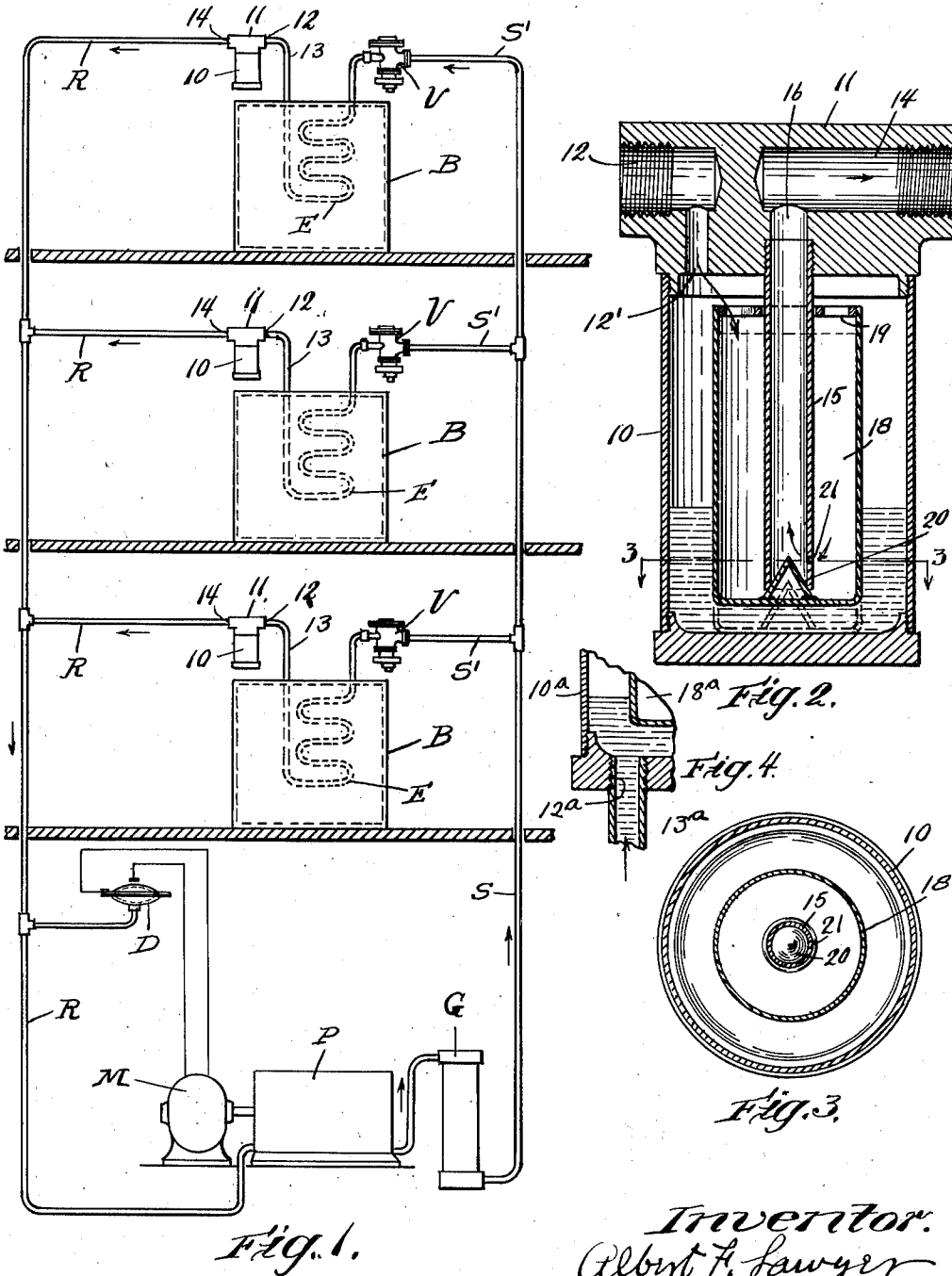
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REFRIGERATING SYSTEM

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REFRIGERATING SYSTEM

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This invention relates to refrigeration systems for household purposes and more particularly to systems especially adapted for apartment house use, in which it is desired to cool a series of refrigerators by means of a single motor and compressor connected to a corresponding series of expansion coils in the refrigerators by circulating pipes for the refrigerant.

In the operation of such systems, in which the requirements of the individual refrigerating units are likely to vary widely, difficulty has been encountered in controlling the supply to the different cooling units, so that refrigeration will be supplied thereto according to the particular requirements of each unit.

A type of system in general use for this purpose, comprises an expansion tank of a size sufficient to contain a volume of liquid refrigerant, which, when reduced to the temperature at which it is to be maintained, will meet the refrigerating requirements demanded, the level of the liquid refrigerant in the tank being maintained by a float controlled valve in the supply pipe thereto.

A primary objection to the use of this system for multiple units is the necessity of the use of a large volume of refrigerant in a single system, the volume thereof being increased in proportion to the number of units.

The proportion of refrigerant to the number of units employed may be reduced to such an extent that the total volume in a system, having for example, approximately six refrigerating units, will not be objectionable in amount by employing a brine tank having an expansion coil therein for each unit. With such an arrangement an expansion valve of the ball cock type cannot be employed, and a pressure controlled expansion valve is considered practically necessary. With such an arrangement, unless some means is provided to prevent it, the expansion coil will become filled with liquid refrigerant, and, as the coil is connected at opposite ends to the supply and return pipes of the pump, the liquid will be drawn into the return pipe and the pump will continue to operate indefinitely, as the pressure in the

coil will be prevented from rising sufficiently to cause the closing of the expansion valve, and, unless the expansion valve is closed, the pump will be unable to reduce the pressure in the return pipe sufficiently to operate the usual pressure diaphragm so as to shut off the motor which drives it.

Where a series of such units are operated from a single pump, the difficulties above referred to are increased on account of the practical impossibility of adjusting a series of pressure controlled expansion valves to open and close at the same pressures and, to some extent, on account of differences in elevation of the different units.

The objects of my invention are to provide, in connection with a multiple unit refrigerating system of the compression expansion type which employs an expansion coil having a pressure controlled expansion valve, in each unit, a simple and effective means for preventing over charging of any of the coils, or preventing the action of the pump from causing the discharge of liquid refrigerant from any coil of the system into the return pipe, for causing the expansion valve of any coil to close as soon as the coil becomes fully charged, so that when all the expansion valves are closed the operation of the pump may cause a sufficient reduction in pressure in the return pipe to operate automatic means for shutting off the motor which operates it, and for enabling a sufficient and uniform distribution of refrigerant to the different units, even though the expansion valves are adjusted to operate at somewhat different pressures and the units are located at different elevations.

I accomplish these objects by providing in the exhaust end of each expansion coil a form of trap device which is adapted to intercept the escaping liquid refrigerant and automatically close the discharge from the coil.

For a more complete description of the system and the specific means employed reference is made to the following specification, in connection with the accompanying drawings in which:

Fig. 1 is a diagram of a refrigerating system embodying my invention.

Fig. 2 is a longitudinal central sectional view of an automatic trap device which I employ in connection therewith, and

Fig. 3 is a sectional view at line 3—3 of Fig. 2.

The system illustrated in diagram is of the compressor, expander closed circuit type employing well-known apparatus, comprising an electric motor M, a compressor pump P and a condenser C. A main supply pipe S leads from the discharge end of the condenser to a suitable point, and a main return pipe R leads to the intake of the pump which, in turn delivers the compressed refrigerant to the condenser.

The automatic starting and stopping of the motor is controlled according to the variation of pressure in the return pipe R, any well-known pressure operated controlling device D for the motor being employed which will cause the same to maintain a minus pressure in the return pipe between certain limits.

I further provide a series of refrigerating units, the particular number thereof being immaterial, each unit comprising an expansion coil E, which will usually be submerged in a brine tank B and is connected thru an expansion valve V, by a branch pipe S' to the supply pipe S, the opposite end of the coil being connected to the return pipe R thru a branch return pipe R', the general arrangement of the connections of the different units being in parallel. The expansion valve V may be of any well-known type which is arranged to open the branch supply pipe S' automatically when the pressure in the coil is reduced to a predetermined point, and to close the same when the pressure in the coil is sufficiently raised.

When the back pressure rises sufficiently to cause the motor to start, and operate the compressor or pump, all the expansion valves will be closed and as the back pressure is reduced the expansion valve which is set to open at the highest back pressure will open first, so that refrigerant will be drawn into the coil thereof, while the other expansion valves remain closed.

As a result this coil is likely to become filled with liquid refrigerant before the back pressure is lowered sufficiently below the point at which the first expansion valve opened, to open any of the other expansion valves, and, as the pressure in this coil cannot rise so long as it is in open communication with the return pipe and the pump is operating, the expansion valve of the coil will remain open and liquid refrigerant will be drawn from the coil into the return pipe. Such a result is not only objectionable on account of loss of efficiency, but the flow thru the coil may be in such volume as to prevent the pump from lowering the back pressure sufficiently to cause the other expansion valves to open, so that the coil having the expansion valve

which opens first practically short circuits the other coils, or prevents refrigerant from being supplied to any of the other coils.

To avoid this difficulty and to provide means whereby, when any coil in the system becomes filled with liquid refrigerant, so that it is operating at its full refrigerating capacity, the circulation will then be forced thru the other coils of the system until they are all brought to the same condition as the first coil, I provide an automatic trap device in the branch return pipe of each coil close to the return end thereof and preferably within the refrigerated compartment. This device comprises a cylindrical receptacle 10, which is tightly closed at its top by a cap 11, said cap having an inlet passage 12, to which the discharge, or return end 13 of the coil is directly connected, said passage 12 opening to the receptacle, thru a side passage 12', close to the side thereof. A discharge passage 14 is also formed in the cap 11, to which the branch return pipe R' is connected, and a tube 15 is fixed in the middle of the cap and depends vertically therefrom, said tube being connected by a branch passage 16 to the passage 14 at its upper end, and having its lower end open. A cup 18 is concentrically arranged within the receptacle 10 and about the tube 15 and is slidably mounted on the latter, being guided by a spider 19 secured in the upper end thereof and fitted to the tube. A conical valve 20 is secured to the bottom of the cup in the middle thereof and in position to seat against the lower end of tube 15 to close the same. Under normal conditions the cup will rest on the bottom of the receptacle 10, so that the valve will be open, as indicated in the dotted line position of Fig. 2. As thus arranged, the vaporized refrigerant will normally be free to pass from the return end of the coil thru passages 12 and 13 into the receptacle 10, thence into cup 18 and up the pipe 15 into passage 14 and then on to the return pipe.

With this construction, when the coil having its expansion valve set to open at the highest back pressure becomes filled with liquid refrigerant, as before described, so that the pump would otherwise draw the liquid therefrom into the return pipe, as the liquid passes from the coil it will flow down thru the passage 13 into the receptacle 10 and continued operation will cause an accumulation of liquid therein, so that cup 18 will be floated and finally lifted to such an extent that the valve 20 will be seated, thereby preventing, for a time, circulation thru the coil, and permitting the pressure in the coil to rise sufficiently to cause the expansion valve to be closed. The same action will then take place in the other coils, usually in the order of the relative pressures at which their expansion valves open, but modified by the demands for refrigeration and location

of the different units. When the circulation thru all the coils has been arrested by the valves 20 thereof, the back pressure may then be reduced in the return pipe to a point which will permit the controlling device D to stop the motor. In the normal operation, the refrigerant in each receptacle 10 will become vaporized so that the valve 20 will open by its gravity and, when the back pressure in the return pipe is raised sufficiently, the device D will cause the motor to be started and the above described operation to be repeated.

As soon as the valve 20 of any coil is closed in the manner above described, the pressure in the coil will immediately be raised sufficiently to cause the expansion valve thereof to close, so that the pressure in the coil will begin to accumulate on account of outside heat. If this pressure should accumulate to a considerable extent before the liquid in the receptacle 10, which is connected thereto, vaporized sufficiently to permit the cup to fall and its valve 20 to open, the pressure on the surface of the liquid in the receptacle from the coil would act therethru on the unbalanced area of the valve 20 and tend to hold the latter closed. The minus pressure in the return pipe would also have the same tendency, so that the unbalance pressure on the valve 20 might be sufficient to hold the same closed after the refrigerant in the receptacle 10 had vaporized. To avoid possibility of such an occurrence, a small leak hole 21 is provided in pipe 15, which will permit the escape of sufficient gas from the coil to the return pipe to prevent the unbalanced pressure on the valve 20 from rising sufficiently to prevent the valve from opening by its gravity. Such leak hole will not however be of sufficient size to interfere with the normal operation before described.

The arrangement of the connections to the receptacle 10 through its cap 11 in each unit is not essential, but merely desirable as a matter of convenience in construction and the operation would be practically the same if the pipe leading from each expansion coil opened to the bottom of the receptacle, as indicated in Fig. 4, instead of to the top at one side. That is, as indicated in Fig. 4 the discharge pipe 13 from the expansion coil may be connected to the receptacle 10^a through a passage 12^a in its bottom, instead of through its cap, as shown in Fig. 2. In this form, when the suction action causes the liquid to be drawn from the coil, it will merely flow into the receptacle through the bottom, and will accumulate therein until the cup is lifted so as to close the valve.

I claim:

1. In a refrigerating system, motor operated refrigerant compressing and condensing means having a main supply pipe and a main return pipe connected thereto, pressure operated means for automatically controlling

the motor to maintain a minus pressure in the return pipe between predetermined limits, a series of expansion coils connected at their respective ends to said supply and return pipes at different points, a normally open expansion valve between each coil and the supply pipe arranged to close when the coil pressure is raised to a predetermined point, and an automatic trap device interposed between each coil and the return pipe normally permitting uninterrupted flow of vaporized refrigerant to the return pipe from the coil and having means arranged to intercept liquid refrigerant flowing therefrom and means arranged to be actuated by the intercepted liquid, when a predetermined quantity thereof has been intercepted, to restrict the flow from the coil while vaporized refrigerant is being drawn from other coils.

2. In a refrigerating system, motor operated refrigerant compressing and condensing means having a main supply pipe and a main return pipe connected thereto, pressure operated means for automatically controlling the motor to maintain a minus pressure in the return pipe between predetermined limits, a series of expansion coils connected at their respective ends to said supply and return pipes at different points, a normally open expansion valve between each coil and the supply pipe arranged to close when the coil pressure is raised to a predetermined point, and a trap device interposed between each coil and the return pipe and normally permitting an uninterrupted flow of vaporized refrigerant from the coil, said device having a receptacle arranged to intercept and retain any liquid refrigerant flowing from the coil and a valve arranged to be actuated by the intercepted liquid to close communication between the coil and return pipe and to open the same upon vaporization of the liquid.

3. In a closed circuit compression, expansion refrigerating system having a supply pipe and a return pipe and automatic means to maintain a minus pressure in the return pipe, an expansion coil connected to said supply pipe and having a pressure controlled valve therein arranged to close when the pressure in the coil is raised to a predetermined point, a receptacle between the coil and the return pipe arranged to intercept liquid flowing from the coil, a cup in the receptacle arranged to be lifted by the liquid flowing into the latter, a pipe depending into the cup and opening thereto at its lower end when the cup is unsupported by the liquid, the upper end of said pipe being connected to said return pipe, and a valve in the bottom of the cup arranged to close the lower end of the pipe when the cup is lifted.

4. In a closed circuit compression, expansion refrigerating system having a supply pipe and a return pipe and automatic means to maintain a minus pressure in the return

pipe, an expansion coil connected to said supply pipe and having a pressure controlled valve therein arranged to close when the pressure in the coil is raised to a predetermined point, a receptacle between the coil and the return pipe arranged to intercept liquid flowing from the coil, a cup in the receptacle arranged to be lifted by the liquid flowing into the latter, a pipe depending into the cup and opening thereto at its lower end when the cup is unsupported by the liquid, the upper end of said pipe being connected to said return pipe, a valve in the bottom of the cup arranged to close the lower end of the pipe when the cup is lifted, and said pipe having a constantly open leak passage arranged to permit a relatively small quantity of gas, to that normally drawn from the coil, to pass from the cup into said pipe when entrance thereto is closed by said valve.

In testimony whereof I have signed my name to this specification.

ALBERT F. SAWYER.

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