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REFRIGERATION

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Fig. 1.

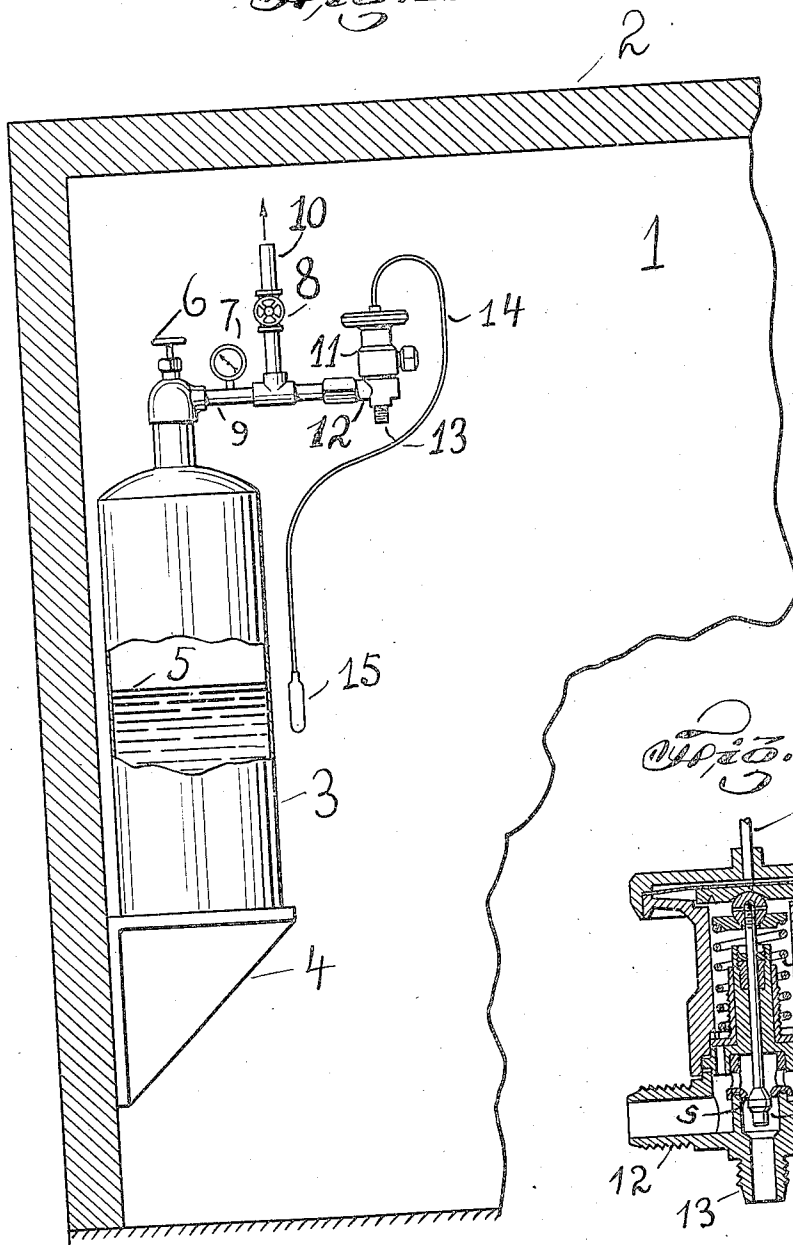
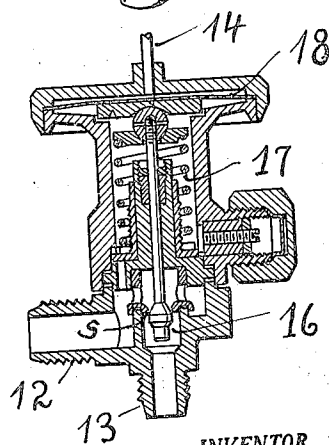


Fig. 2.



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REFRIGERATION

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2 Claims. (Cl. 62-92)

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The present invention refers to refrigeration and more specifically to temperature control.

The invention is illustrated in the accompanying drawing, and is applied to the specific task of maintaining the temperature of a walled space constant at a predetermined level.

The invention makes it possible to control the storage temperature in portable, heat-insulated, so-called containers, as used for railway and truck shipments of less than carload size. Such containers do not allow much dead weight for the insulation of refrigeration equipment. It has not been possible to equip them with the power-driven complete condensing unit and evaporator. Dry Ice, brine hold over tanks or eutectic ice have been the only practical means for cooling such less-than-carload containers. Each of these means has its disadvantage.

The invention allows a temperature control as exact as the one perfected in complete condensing units; yet, no powered condensing unit is required in connection with the invention.

In the accompanying drawings Fig. 1 illustrates the apparatus installed in a walled space.

Fig. 2 shows a cross-section of a thermal expansion valve which is a detail of Fig. 1.

In Fig. 1 the storage space 1 is insulated by a wall 2 of insulating material. A refrigerating evaporator 3 serves as storage vessel for a refrigerant 5 and is arranged in the upper part of the storage room 1, arranged on a stand 4. This storage vessel 3 is preferably an I. C. C. regulation shipping container for compressed gases and is equipped with a shut-off valve 6 and an outlet to receive a conduit 9 of standard refrigeration tubing and fittings. The conduit 9 is equipped with a gauge 7, with a blow-off conduit 10, controlled by a hand valve 8 and with a second blow-off conduit 12, 13 controlled by the thermal valve 11. This thermal valve 11 with its thermal bulb 15 and capillary connection 14 is shown in detail and in vertical cross-section in Fig. 2.

This valve is a standard valve in which the pressure of the bulb 15 acts on the upperside of the diaphragm 18, while the other side of the diaphragm is subjected to the combined pressures of the refrigerant in conduit 12 and a spring 17. If the pressure of the bulb is stronger than those combined two pressures, the valve stem 16 lowers away from the valve seat S and refrigerant can pass from conduit 12 into conduit 13. Opening of the valve 11 is in standard evaporator temperature control effected by exposing the bulb 15 to the temperature of superheated refrigerant vapor which leaves the evaporator, where-

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as in accordance with the instant invention the opening of the valve 11 is as described above.

In this invention such a valve 11 is applied in a new manner. Instead of feeding liquid refrigerant into the evaporator it is used to blow off refrigerant vapor which leaves the evaporator 3. Instead of operating the valve by the difference between the temperature of the liquid refrigerant 5 in the evaporator and superheated refrigerant vapor the valve 11 is in this case actuated by the difference between the temperature of the liquid refrigerant 5 and the temperature of the air in the storage space 1. This difference is a matter of those degrees which are required as TD (TD is the standard expression for Temperature Difference), as general temperature difference for practising heat exchange through a wall which in this case is the wall of the container 3. However, a rather wide range can be effective for actuating valve 11 with this TD, depending on the location of the bulb 15 within the storage space 1 and depending on the availability of stirring, ventilating means to move the air of the storage space 1 to obtain a uniform air temperature throughout the storage space. All these factors are routine refrigeration factors and need not be described in detail. For the chosen TD the valve can be set by operating the set-screw which controls the tension of the spring 17.

One deciding point in this new invention is to make the apparatus operative to the effect of maintaining a predetermined room temperature in the storage space 1 by blowing off new refrigerant 5 if the room temperature rises above the chosen point. Merely placing the apparatus into the storage space 1 and opening the shut-off valve 6 while shut-off valve 8 is closed would be without consequences. Valve 11 would be closed by the spring 17; the refrigerant 5 in the evaporator 3 and the liquid in bulb 15 having the same temperature and compensating their pressures. An important step of the invention, therefore, is to cool down the refrigerant 5 to a temperature which is lower than the predetermined future room temperature which shall be maintained. To give an example, if the room temperature shall be maintained at 20° F., and if conditions require a TD of 10° F. for the heat exchange, the refrigerant 5 must be precooled down to 10° F. to make the apparatus operative. Cooling down the entire mass of the refrigerant 5 may be effected by various known ways: For instance, the container 3 may be refrigerated by independent refrigeration means before or while being installed in the storage

space 1. Or, valve 6 and conduit 9 may be opened to blow off refrigerant until the mass of the refrigerant 5 is cooled down. A gauge 7, a branch conduit 10 and a hand valve 8 may supplement the equipment for this procedure. Or, the bulb 15 may be heated to open the valve and thereby the conduit 9, 12, 13; and in that case the branch conduit 10 is not required to blow off refrigerant.

The system has special merit for mobile refrigeration jobs, such as in trucks. While in the garage, the apparatus and the storage space 1 may be cooled down by stationary refrigeration, and on the road refrigerant 5 may be blown off in the controlled manner as described, to maintain the temperature.

Since non-toxic refrigerants like Freon and— with precautions—carbon dioxide may be blown off into the surrounding air, these refrigerants are especially suitable for this new cooling system.

Having now described the nature of my invention and given an example of the manner in which it may be performed,

I claim as my invention:

1. The method of cooling the air of a storage space by utilizing a vaporizable refrigerant comprising confining the vaporizable refrigerant, pre-cooling the entire mass of vaporizable refrigerant in its liquid phase to a temperature below a predetermined temperature corresponding to the temperature to be maintained in said storage space, releasing refrigerant vapor above the liquid refrigerant to said storage space which refrigerant vapor is formed by the transfer of heat of

the air within said storage space to said liquid refrigerant, controlling the release of said refrigerant vapor in response to the temperature difference between the temperature within said storage space and the temperature of said colder body of liquid refrigerant.

2. Refrigeration apparatus for a walled storage space comprising a refrigerant container arranged within said storage space in the nature of an evaporator adapted to maintain a room temperature higher than the temperature of the refrigerant contained in said evaporator, means for precooling said refrigerant below the predetermined temperature to be maintained later in said storage space, means for alternately opening said container to effect evaporation of refrigerant and closing said container to effect cessation of evaporation of refrigerant, said means being responsive to the temperature difference between the temperature of the storage space and the temperature of the colder refrigerant contained in said evaporator.

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