Sept. 13, 1932. D. H. KILLEFFER 1,877,181

REFRIGERATIVE APPARATUS

Filed March 2, 1929

Fig. 1.

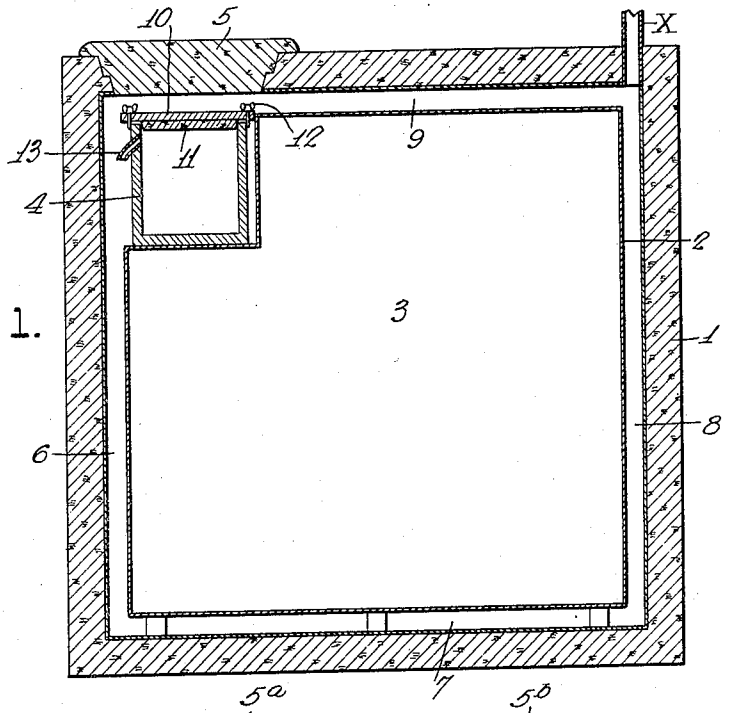
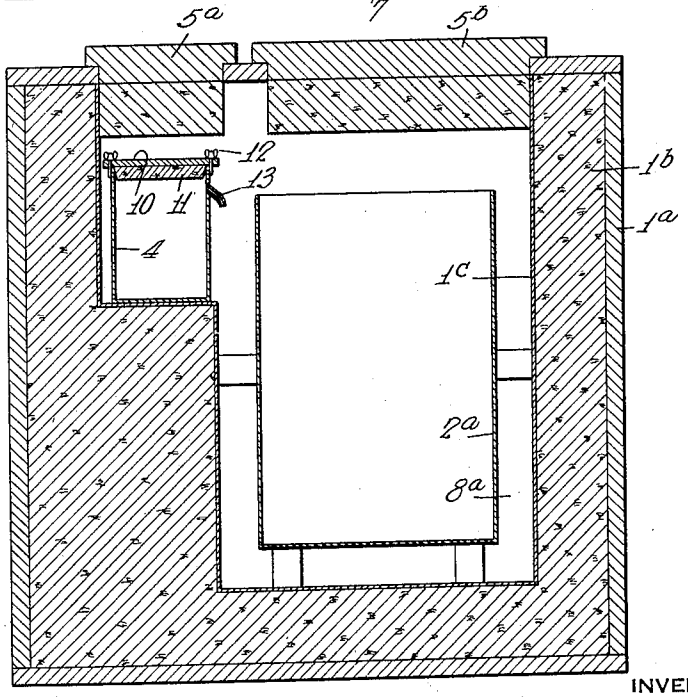


Fig. 2.



INVENTOR
David H. Killeffer
BY
Geo. A. Mead
ATTORNEY

Patented Sept. 13, 1932 1,877,181

UNITED STATES PATENT OFFICE

DAVID H. KILLEFFER, OF YONKERS, NEW YORK, ASSIGNOR TO DRYICE EQUIPMENT CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

REFRIGERATIVE APPARATUS

Application filed March 2, 1929. Serial No. 343,860.

My present invention relates to refrigerators, dispensing cabinets, containers, etc., in which solid carbon dioxide is used as a refrigerant, and the carbon dioxide gas sublimated therefrom is circulated in operative relation to the device or materials to be refrigerated. The functioning of most apparatus of this kind depends on how the circulation of the gas is managed and the primary object of my present invention is to accelerate the circulation by utilizing pressures that may be generated by the sublimated gas in a closed container. The pressure is utilized by directing the outflow of the gas which is discharged in the direction in which acceleration or disturbance of the main body or current of gas in the refrigerated space, or in heat exchange relation to said space, is desired. A scarcely perceptible throttling of the outflow of the gas will give it velocities sufficient to profoundly affect circulation of the stagnant gas enclosed in the refrigerative casing, but it will be obvious that relatively high pressures and high velocities may be easily afforded by my present method.

An important feature of the invention, particularly where the throttling is slight, is the increase and decrease of the pressure and the resulting velocity of the outflow in accordance with the refrigerant requirements. That is to say, when the container for the solid carbon dioxide is absorbing heat at a rapid rate, the velocity of the discharged gas as well as its volume will increase and vice versa, as the interior space cools down, the volume and velocity will be decreased.

The above and other features of my invention may be more fully understood from the following description in connection with the accompanying drawing, in which

Fig. 1 is a characteristic vertical section through one form of refrigerative container to which my invention is applied; and

Fig. 2 is a similar view of another form.

It will be understood that the two forms shown are merely illustrative of two of the many refrigerative systems to which my invention may be applied. Fig. 1 illustrates a system of the type in which the refrigerant gas has a closed orderly circuit of travel, whereas in Fig. 2 there is simply a unitary volume or pool of the gas in which there is relatively slow, relatively unguided thermo circulation.

In Fig. 1, the insulating container 1 may be of any desired construction. It is shown as enclosing a gas-tight container 2, preferably of metal, spaced apart from the outer container 1, thus affording a refrigerant space 3 with exterior passages for circulation of the gas discharged from a high level container 4 which may be inserted or may be charged with solid carbon dioxide by removing the manhole cover 5. Gas liberated at this point being of much greater specific gravity than air and being very cold, tends to flow downward in the interspace 6 across the bottom 7, up at 8 and back at 9 to the refrigeraant container 4. The cause of the up circulation is of course the gradual warming up of the gas, and the effect of the arrangement is to cause the warmest gas to return to and warm the container 4, thereby causing the solid carbon dioxide therein to sublimate and generate gas at a greater or less rate according as the temperature of the return gas increases and decreases, that is, in accordance with the needs of the refrigerator under the varying conditions of use. As applied to such a system, my invention contemplates closing in the top of the container by a suitable cover which may consist of an upper member 10 of any material having ordinary structural strength, preferably provided with means whereby it may afford a more or less tight seal for the top or mouth of the container 4. As shown, this may consist merely of a dependent wedge shape member 11 of balsa wood or the like, but a gasket may be used if desired. The mere weight of such a cover may be quite sufficient to afford a desired amount of pressure in the container 4, but I have shown stud bolts and nuts as at 12, whereby pressure may be applied to make the seal as tight as may be desired.

An internal pressure of gas being thus assured, so far as concerns the container, I provide an outlet 13 through which all of the gas will be discharged under normal operative conditions, it being understood that

in a special case where this outlet is small enough to present a possibility of clogging, the cover closure will be insecure enough so that it may afford leaks under any pressure which would be dangerous, thus serving as a safety valve.

It is obvious that the outlet 13 may be arranged to discharge in any direction desired and for maximum acceleration of the circulation shown in Fig. 1, this direction will be downward in the direction of the natural gravity downflow of the cold gas in the space 6. As the natural thermo circulation is relatively slow, even a low velocity discharge from the outlet 13, exerting a continuous injector effort, may effect relatively great changes in the rate of the circulation, particularly as the flow paths of this circuit are of very low resistance.

From the above description of my invention as applied in Fig. 1, the operation in Fig. 2 will be readily understood. In this case there is an outer casing 1*a*, which may be of hard wood having a thick insulating lining 1*b* of cellular insulating material, cork, kapok or the like, and it may also have an inner lining 1*c* which may be of metal or wood. In this instance, the outer casing is provided with a manhole 5*a* for access to the refrigerant container 4 and another manhole 5*b* for access to the inner container 2*a* which is shown as positioned by spacer blocks or cleats arranged so as not to interfere with free flow of gas. The container 2*a* may be a can of ice cream to be dispensed through the manhole 5*b*, or it may be merely a storage space for parcels or materials that may be packed therein, the top being shown as open so that the gas has access to the interior thereof.

The container 4 may have the cover 10, 11, holding means 12, for optional use, and the downwardly directed constricted outlet 13, as in Fig. 1.

Where the container 2*a* is a can of ice cream kept at a very low temperature, it is sometimes found in practice that the lower part of the can will tend to be overfrozen, while the upper part of the can from which ice cream is being dispensed will be relatively soft because of the frequent introduction of heat and air by opening of the manhole 5*b*, whereas the relatively heavy stagnant gas in the bottom of the space 8*a* is not much affected by such operation. In other words, the use of the device as a dispensing container causes the main source of heat to be at the top rather than at the sides or bottom, and of course any warming up that can occur at 8*a* will have almost negligible effect in causing upflow of gas from the bottom because of the very much higher temperatures and lighter air of the air gas mixture at the top. In such connection, the pressure discharge and injector effect of the fresh gas from 13 will be highly effective in reducing the tendency to overfreezing at the bottom and insufficient freezing at the top.

It will be understood that in the arrangement shown in Fig. 2, the excess gas generated within the device easily finds a path of escape through relatively loose fit of the manhole covers 5*b*. In Fig. 1, the manhole 5 is supposed to be tighter and a vent *x* is provided for escape of the gas.

While I have shown my container unit with its cover and velocity discharge nozzle arranged at a high level, as concerns the circulation, and while I prefer small throttling effects at the nozzle 13, so that the velocities will be slow, it will be evident that the method permits of a substantially forced circulation in any desired direction and that in a special case this would make it possible to have a container at a low level and the nozzle discharging upward, if desired.

Many other variations are possible. The nozzle may be connected with the solid carbon dioxide container by a conduit of any desired length and caused to discharge in any desired direction within the refrigerated space. When my invention is embodied in a shipping container or carton likely to be turned upside-down, the conduit may discharge in the part of a circulatory space directly opposite the one in which the solid carbon dioxide container is located, so that if the container is at the top, the discharge will be at the bottom and vice versa. The container may be in the form of a long bag having the solid carbon dioxide at the bottom and its mouth folded around to the other side of the container.

A very important characteristic of my invention, for shipping packages or in fact any container that may be turned upside-down, is that an outlet or outlets restricted enough to maintain relatively slight pressure within the solid carbon dioxide container will render the rate of gas discharge from the container independent of which side up it happens to be. Even if there are a number of outlets in different walls of the container, this will be true provided only that the internal pressure is substantially greater than the depth pressure of the heavy gas in the container. There will be a slight preponderance of flow downward in the direction where the pressure is assisted by gravity, but the gravity effect may be easily made negligible as compared with the pressure effect.

The greater the normal rate of gas evolution in any given container 4, the larger may be the flow section of the outlets that may be used for given internal pressures and outflow velocities; also that for any given rate of gas evolution, predetermined flow resistances and back pressures may be attained with several or even a large number of proportionally smaller outlets, in place of one large outlet. Such outlets may be distributed

in the bottom, side or top walls of the container. In general, the larger the container 4 and the more it is exposed to heat, the greater will be the rate of the gas evolution and the greater may be the number or larger the size of the individual outlets.

I claim:—

1. A refrigerative apparatus including an outer container for enclosing products to be refrigerated, means wthin said container affording a restricted path for thermo circulation of a refrigerant atmosphere in combination with a container of solid carbon dioxide in heat absorbing relation to said atmosphere, and having gas outlet means of cross sectional area and flow resistance suitable for maintaining substantiallv internal pressure to impart substantial velocity to the escaping gas and means for directing said escaping gas into said refrigerant atmosphere, in a region and in a direction of natural thermo flow thereof.

2. A refrigerative apparatus including an outer container for enclosing products to be refrigerated, means within said container affording a restricted path for thermo circulation of a refrigerant atmosphere, in combination with a container of solid carbon dioxide in heat absorbing relation to said atmosphere, at a high level thereof, and having gas outlet means of cross sectional area and flow resistance suitable for maintaining substantially internal pressure to impart substantial velocity to the escaping gas and means for directing said escaping gas into said refrigerant atmosphere in a region and in a direction of natural thermo flow thereof.

Signed at New York, in the county of New York, and State of New York, this 28th day of February, A. D. 1929.

DAVID H. KILLEFFER.