Nov. 22, 1932. B. H. WESTON 1,888,646

REFRIGERATING APPARATUS

Filed March 20, 1929

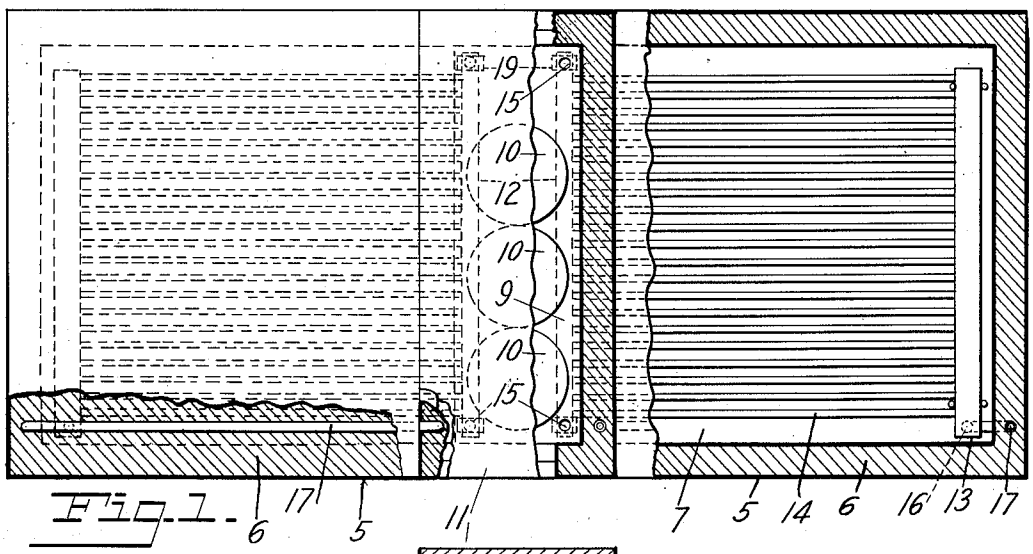


Fig. 1.

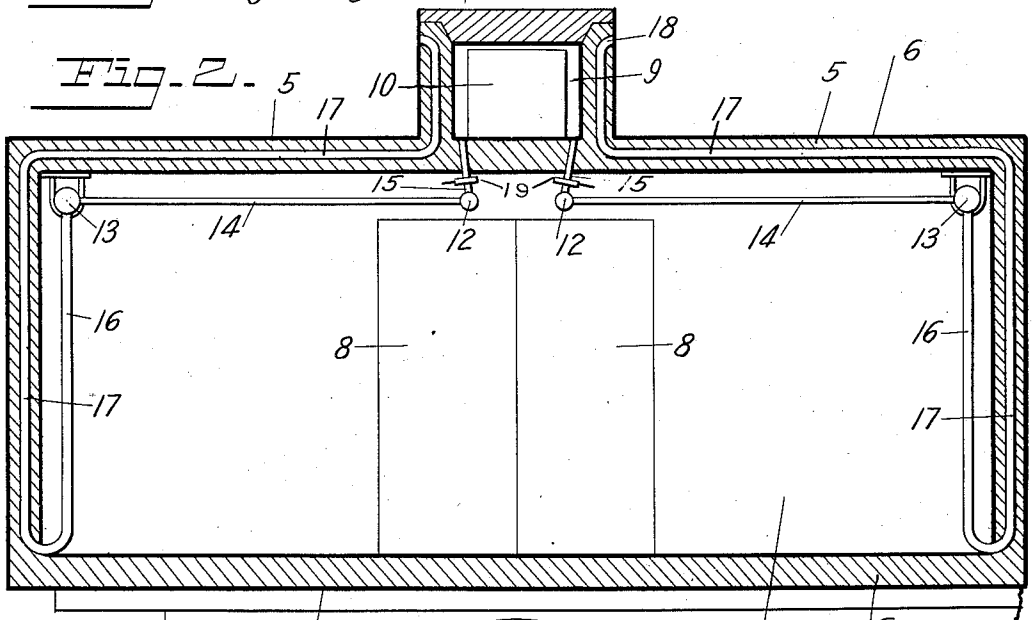


Fig. 2.

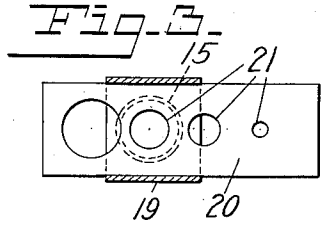


Fig. 3.

INVENTOR.
BURT H. WESTON.
By Edward L. Reed
ATTORNEY.

Patented Nov. 22, 1932 1,888,646

UNITED STATES PATENT OFFICE

BURT H. WESTON, OF WOOD RIVER, ILLINOIS

REFRIGERATING APPARATUS

Application filed March 20, 1929. Serial No. 348,634.

This invention relates to refrigerating apparatus and is designed more particularly for use with solid carbon dioxid as the refrigerating medium.

Carbon dioxid gas has an extremely low temperature and unless properly controlled will freeze or otherwise injuriously affect substances, such as food, within the refrigerator. While the gas is not poisonous it will, if brought into direct contact with foods, modify the taste thereof in an objectionable manner and it is therefore important that the gas should not enter the food compartment.

One object of the invention is to provide a simple and efficient means for utilizing solid carbon dioxid as a refrigerant and for controlling the application or distribution of the gases given off thereby in such a manner as to maintain the desired temperature in the compartment to be cooled.

A further object of the invention is to provide such an apparatus having means for automatically controlling the application of the carbon dioxid gas to the compartment to be cooled in accordance with the temperature in said compartment.

A further object of the invention is to provide such an apparatus having means for predetermining the temperature which is to be maintained in the compartment to be cooled.

A further object of the invention is to provide such an apparatus with means for preventing or retarding the evaporation or sublimation of the solid carbon dioxid when the compartment to be cooled is at the desired temperature.

A further object of the invention is to provide in such an apparatus a circulation system for carbon dioxid gas which will be independent of the structure in which the compartment to be cooled is located, thus avoiding the breaking of joints or leakage which frequently results when the circulation channels are built into the structure itself, especially when said structure is embodied in a refrigerator car or truck.

A further object of the invention is to provide a circulation system of such a character that the carbon dioxid gas may be caused to circulate therethrough, and the circulation controlled, without the use of pumps or other mechanical devices.

Other objects of the invention will appear as the apparatus is described in detail.

In the accompanying drawing Fig. 1 is a top plan view, partly in section, of a refrigerating apparatus embodying my invention; Fig. 2 is a longitudinal vertical section taken through such an apparatus; and Fig. 3 is a detail view of the regulating valve.

In the drawing I have illustrated one embodiment of my invention and have shown the same as applied to a refrigerator truck but it will be understood that this particular embodiment has been chosen for the purposes of illustration only and that the apparatus may take various forms and may be applied to refrigerators of various kinds, either stationary or portable, without departing from the spirit of the invention.

In that embodiment of the invention here illustrated the refrigerator is mounted on and forms the body of a truck and comprises a main body portion or structure 5 having a lining 6 of insulating material, within which is formed the compartment to be cooled, 7. The body structure is provided in one side thereof with doors 8 to permit access thereto. Mounted adjacent to, and preferably above, the top of the compartment 7 is a refrigerant chamber 9 adapted to receive blocks or cakes of solid carbon dioxid, as shown at 10. This refrigerant chamber has a removable top wall or closure 11 to permit access thereto and the closure is of such a character as to tightly seal the chamber when in closing position. The refrigerant chamber is wholly separate from the compartment 7 and is insulated both from that compartment and from the atmosphere.

The carbon dioxid gas given off by the blocks of solid carbon dioxid in the refrigerant chamber may be circulated or distributed in cooling relation to the compartment 7, which is to be cooled, in any suitable manner but I prefer to utilize a cooling element which is constructed separately from the body structure of the apparatus. This

cooling element is located in such relation to the chamber 7 that the carbon dioxid gas in the cooling element will absorb heat from the chamber to be cooled, and preferably it is located near the top of that chamber. The present apparatus comprises a relatively long body portion and I have therefor located the refrigerant chamber substantially midway between the ends of that structure and have provided two separate cooling elements, one arranged in each end portion of the body structure. It will be understood, however, that the number of cooling elements employed in any given installation will depend to a large extent upon the size and character of the chamber to be cooled.

The two cooling elements are here shown as mounted in the upper part of the chamber to be cooled and below the level of the lowest part of the refrigerant chamber. Each cooling element comprises two manifolds, 12 and 13, spaced apart, the manifold 12 being preferably located directly beneath the refrigerant chamber and the manifold 13 being arranged near the end of the compartment to be cooled. The two manifolds are connected one with the other by a plurality of conduits or pipes 14 which are spaced apart across substantially the full width of the compartment to be cooled. The manifold 12 is connected with the refrigerant chamber 9 by a pipe or conduit 15 which opens into the lower part of the refrigerant chamber so that the carbon dioxid gas given off by the block of solid carbon dioxid, and which is heavier than air, will move by gravity through the conduit 15 into the manifold 12. Any suitable number of conduits may be interposed between the manifold and the refrigerant chamber and, in the present instance, I have shown two. The manifold 13 is provided with a suitable outlet for the gas so that the gas which passes from the refrigerant chamber to the manifold 12 may pass through the conduit or passageways 14 to the manifold 13 and thence to the atmosphere or to a suitable recovery receptacle.

The flow of carbon dioxid gas through the cooling element should be controlled or retarded so as to retain it in the cooling element until it has absorbed as much heat as is practical in the operation of the device, thus reducing the temperature within the compartment to be cooled. It is also desirable that means should be provided for retarding or preventing the evaporation or sublimination of solid carbon dioxid in the refrigerant chamber when the temperature within the compartment to be cooled has been reduced to the desired extent, thus avoiding the waste of the carbon dioxid. Both functions are accomplished by providing the manifold 13 with an outlet conduit having automatically controlled means for regulating the flow of gas through the cooling element. Carbon dioxid gas has a specific gravity greater than that of air and I prefer to control the flow of the gas by providing the outlet conduit with a trap which will prevent the passage of the gas until its specific gravity has, by the absorption of heat, been raised to substantially that of the atmosphere. As here shown, the outlet conduit comprises a portion 16 extending downwardly from the manifold 13, within the compartment to be cooled and to a point near the bottom of that compartment. From this lowest point the conduit extends upwardly, as shown at 17, outside of the compartment to be cooled, and has its discharge end near the top of that compartment. The upwardly extending part of the conduit is preferably insulated both from the compartment to be cooled and from the atmosphere, so as to provide a neutral column of air or heat laden gas. It is preferable that the gas should be discharged from the outlet conduit near the highest point from which gas is delivered to the cooling element and I have therefore arranged the discharge opening of the outlet conduit near the top of the refrigerant chamber. In the present instance, the part 17 of the outlet conduit is arranged within the insulating lining 6 of the body structure and extends through the end and top portions of that lining to the wall of the refrigerant chamber and thence upwardly to the atmosphere, as shown at 18.

When the apparatus is placed in operation the cooling element and the outlet conduit will contain air at atmospheric pressure. The carbon dioxid gas will pass from the refrigerant chamber 9, and through the conduits 15 to the cooling element and through the several passageways in the cooling element to the outlet conduit, and because of its specific gravity will move downwardly to the lowest point of the outet conduit, dispacing the air as it advances. So long as the carbon dioxid gas retains its normal specific gravity it will not pass upwardly through the part 17 of the outlet conduit but as it absorbs heat from the compartment to be cooled its specific gravity will be gradually raised until it can overcome the pressure of the air in the part 17 of the outlet conduit, and this heat laden gas will then move upwardy through the conduit and will be discharged at the point 18, thereby permitting of the flow of carbon dioxid gas through the cooling element and gradually lowering the temperature within the compartment to be cooled until the gas in the heating element will no longer absorb sufficient heat therefrom to permit it to rise through the upwardly extending part of the outlet conduit. When this takes place the flow of gas through the cooling element is interrupted or retarded. In practice it is probable that there would not be complete interruption of the flow of gas but that the gas would gradually absorb heat and move

slowly through the outlet conduit. By thus interrupting or retarding the flow of gas through the cooling element the temperature within the compartment to be cooled will be maintained at approximately a predetermined temperature. The temperature at which the compartment to be cooled is maintained may be predetermined in any suitable manner but preferably this is accomplished by providing the conduit or conduits 15 with controlling devices to regulate the flow of gas through the same. In the present instance, this regulating device is in the form of a slide valve 19, as shown in detail in Fig. 3, and comprises a slidable plate 20 having a series of openings 21 of different diameters, any one of which may be moved into line with the conduit 15. The quantity of gas which may pass from the refrigerant chamber to the cooling element is, of course, dependent upon the size of the orifice in the plate 20 which is in line with the conduit 15, and the greater the quantity of gas which passes to the cooling element the greater the cooling action. When the flow of gas through the cooling element is interrupted or is very slow the solid carbon dioxid in the refrigerant chamber will be completely surrounded by carbon dioxid gas which insulates the same and prevents the evaporation or sublimation thereof. Consequently the carbon dioxid is conserved and there is no waste thereof, as the solid carbon dioxid will evaporate only when the gas is flowing from the refrigerant chamber through the cooling element.

By means of the very simple apparatus here illustrated and described I am able to maintain in the compartment to be cooled a substantially uniform temperature of a predetermined degree, the flow of carbon dioxid gas through the cooling element being automatically controlled according to the temperature within the compartment, and by adjusting the controlling valve 19 the degree of temperature which is maintained in the compartment to be cooled may be determined. The circulation system for the gas is constructed wholly independently of the body structure of the apparatus and is of such a character that it is not liable to leak, due to the breaking of joints or otherwise. The upwardly extending portion of the outlet conduit is insulated by embedding the same in the insulating lining of the body structure, which can be easily accomplished after the body structure has been built.

While I have shown and described one embodiment of my invention I wish it to be understood that I do not desire to be limited to the details thereof as various modifications may occur to a person skilled in the art.

Having now fully described my invention, what I claim as new and desire to secure by Letters Patents, is:

1. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber adapted to receive solid carbon dioxid, means for conducting carbon dioxid gas from said refrigerant chamber, in cooling relation to said compartment, to a point spaced below the top of said compartment and thence upwardly to a point of discharge, and means for insulating the upwardly extending part of said conducting means.

2. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber adapted to receive solid carbon dioxid, a cooling element arranged in the upper part of said compartment and having a passageway for carbon dioxid gas connected with said refrigerant chamber, and an outlet conduit connected with said passageway and extending downwardly within said compartment to a point near the bottom thereof and then upwardly and exteriorly of said compartment and having a discharge opening near the top of said refrigerant chamber.

3. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber near the top of said compartment and adapted to receive solid carbon dioxid, a cooling element supported within said compartment below said refrigerant chamber and having a passageway for carbon dioxid gas connected with said refrigerant chamber, and an outlet conduit leading downwardly from said passageway and then upwardly.

4. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber near the top of said compartment and adapted to receive solid carbon dioxid, a cooling element supported within said compartment below said refrigerant chamber and having a passageway for carbon dioxid gas connected with said refrigerant chamber, and an outlet conduit leading downwardly from said passageway to a point near the bottom of said compartment and then upwardly to a point above said compartment.

5. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber near the top of said compartment and adapted to receive solid carbon dioxid, a cooling element supported within said compartment below said refrigerant chamber and having a passageway for carbon dioxid gas connected with said refrigerant chamber, and an outlet conduit leading downwardly from said passageway to a point near the bottom of said compartment and then upwardly to a point above said compartment, the upwardly extending part of said outlet conduit being insulated both from said compartment and from the atmosphere.

6. In a refrigerating apparatus compris-

ing a structure having a compartment to be cooled and having a refrigerant chamber near the top of said compartment and adapted to receive solid carbon dioxid, a cooling element arranged near the top of said compartment and below said refrigerant chamber and having a passageway for carbon dioxid gas connected with said refrigerant chamber, and an outlet conduit for said passageway shaped to form a trap which will prevent the passage of carbon dioxid gas until the specific gravity of said gas has been raised by the absorption of heat.

7. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber near the top of said compartment and adapted to receive solid carbon dioxid, a cooling element arranged near the top of said compartment and below said refrigerant chamber and comprising a plurality of passageways connected with said refrigerant chamber, and an outlet conduit connected with said passageways and extending downwardly therefrom and then upwardly.

8. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber adapted to receive solid carbon dioxid, a cooling element for said compartment having a passageway for carbon dioxid gas connected with said refrigerant chamber, means for regulating the flow of carbon dioxid gas from said refrigerant chamber to said cooling element, and means for controlling the flow of carbon dioxid gas through said cooling element in accordance with the temperature in said compartment.

9. In a refrigerating apparatus comprising a structure having a compartment to be cooled and having a refrigerant chamber near the top of said compartment adapted to receive solid carbon dioxid, a cooling element arranged near the top of said compartment and comprising two manifolds spaced apart and a plurality of conduits connecting said manifolds one with the other, means for connecting one of said manifolds with said refrigerant chamber to permit the carbon dioxid gas to flow from said refrigerant chamber to said cooling element, and an outlet conduit connected with the other manifold and shaped to form a trap which will retard the flow of carbon dioxid gas therethrough.

10. In a refrigerating apparatus comprising a structure having a compartment to be cooled and a refrigerant chamber arranged above said compartment and adapted to receive solid carbon dioxid, a cooling element arranged within and near the top of said compartment and comprising spaced manifolds and conduits connecting said manifolds one with the other, means for connecting one of said manifolds with said refrigerant chamber to permit carbon dioxid gas to flow from said refrigerant chamber to said cooling element, an outlet conduit connected with the other of said manifolds, extending downwardly therefrom to a point near the bottom of said compartment and then extending upwardly to a point near the top of said compartment, and means for insulating the upwardly extending part of said outlet conduit.

11. In a refrigerating apparatus comprising a structure having a compartment to be cooled and a refrigerant chamber arranged above said compartment and adapted to receive solid carbon dioxid, a cooling element arranged within and near the top of said compartment and comprising spaced manifolds and conduits connecting said manifolds one with the other, means for connecting one of said manifolds with said refrigerant chamber to permit carbon dioxid gas to flow from said refrigerant chamber to said cooling element, a valve to control said connection, an outlet conduit connected with the other of said manifolds, extending downwardly therefrom to a point near the bottom of said compartment and then extending upwardly to a point near the top of said compartment.

12. In a refrigerating apparatus, a structure having a compartment to be cooled and a refrigerant chamber arranged above said compartment and between the ends thereof and adapted to receive solid carbon dioxid, separate cooling elements arranged within said compartment on opposite sides of said refrigerant chamber, means for connecting the respective cooling devices with said refrigerant chamber, each of said cooling devices comprising passageways through which said carbon dioxid gas may flow, and outlet conduits connected with the passageways of the respective cooling elements, having parts extending downwardly to a point near the bottom of said compartment and other parts extending upwardly from the lowest parts thereof to points near the top of said compartment.

In testimony whereof, I affix my signature hereto.

BURT H. WESTON.