March 14, 1933. F. W. RABE 1,901,190

REFRIGERATING APPARATUS

Filed Feb. 3, 1930

FIG. 1

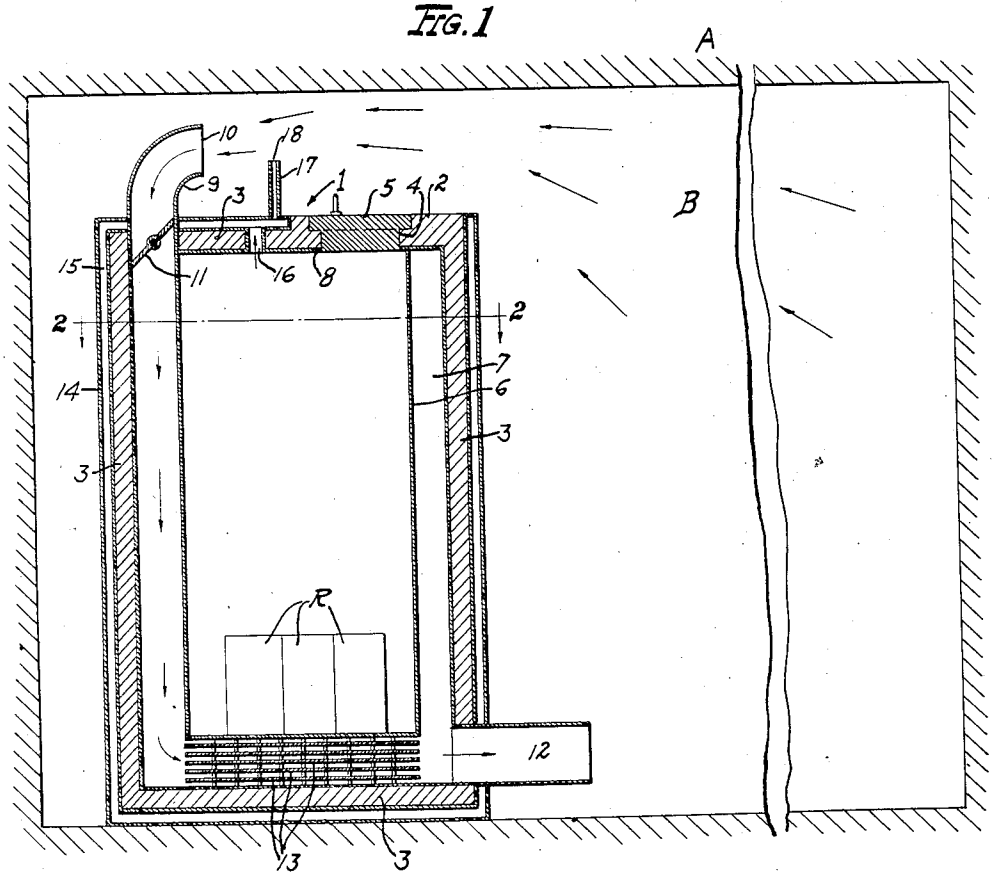
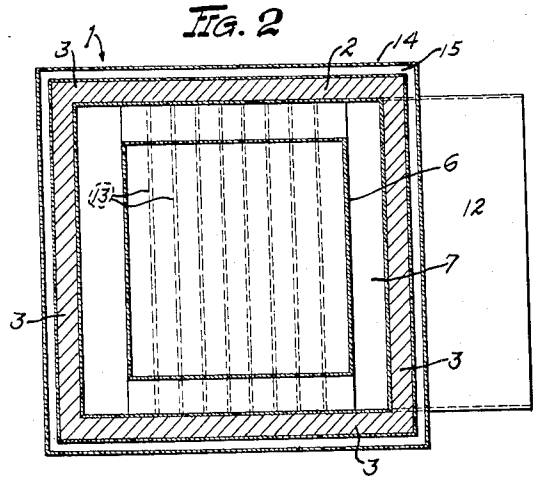


FIG. 2



INVENTOR
F. W. RABE
BY J. H. Cook
ATTORNEY

Patented Mar. 14, 1933 1,901,190

UNITED STATES PATENT OFFICE

FREDERICK W. RABE, OF ST. LOUIS, MISSOURI

REFRIGERATING APPARATUS

Application filed February 3, 1930. Serial No. 425,425.

This invention relates generally to refrigerating apparatus, and more specifically to an improved refrigerating apparatus adapted for use with solid carbon dioxide (CO_2), or other solidified gas, as the refrigerant thereof, the predominant object of the invention being to provide a refrigerating apparatus of the class described, which is so constructed and arranged that the temperature of the refrigerated compartment thereof may be regulated and controlled so as to prevent the extremely low temperature of the refrigerant from reducing the temperature of the refrigerated compartment to an undesirable extent.

It is quite generally known that under atmospheric conditions the temperature of solid carbon dioxide is approximately 110 degrees below zero, Fahrenheit, and while this refrigerant may be used in preserving some products, such, for instance, as ice cream and fish, the temperature thereof is entirely too low to be employed with safety for refrigerating many other products, such as fruits and vegetables, certain kinds of meats, yeast, etc., where accurate temperature control is desirable. The purpose of the present invention, therefore, is to provide an improved apparatus in the use of which the temperature of a refrigerated compartment cooled by solid carbon dioxide, or other solidified gas, may be controlled, so that any desired temperature within a predetermined range may be approximated.

Fig. 1 is a fragmentary longitudinal section through a refrigerating apparatus constructed in accordance with my invention.

Fig. 2 is a cross-section on line 2—2 of Fig. 1.

In the drawing, wherein is shown for the purpose of illustration, merely, one embodiment of the invention, A designates a refrigerated housing of ordinary construction. The refrigerated housing A may be a part of an ordinary refrigerator of common use, or it may be a refrigerated railroad car, but, for the sake of clearness of disclosure of the invention, it will be considered that the drawing illustrates a refrigerated railroad car, and it will be referred to as such. The walls of the refrigerated car A are insulated in the usual manner, and said car is provided with the ordinary doors (not shown), through which access may be gained to the refrigerated compartment B of the car A.

Arranged within the refrigerated compartment B of the refrigerated car A, preferably at one or both ends thereof, is a refrigerant receptacle 1, which comprises a housing 2 formed of walls 3 which are insulated in the manner common to refrigerator walls. The top wall of the housing 2 is provided with an opening 4, which is closed by a suitable closure element 5, and, as will presently appear, said closure element may be removed to permit passage of the refrigerant through the opening 4 and into the interior of the housing 2.

As will be apparent on inspection of Figs. 1 and 2 of the drawing, the housing 3 has arranged therein an inner receptacle 6, the bottom and side walls of which are spaced from the bottom and side walls of the housing 2 to provide a space 7, which surrounds said inner receptacle on all sides thereof except the top. At the top of the housing 2 the top wall of the inner receptacle is in contact with the lower face of the top wall of said housing 2, an aperture 8, formed through said top wall of the inner receptacle, being in coincidence with the opening 4 formed through the top wall of the housing 2. 9 designates an inlet air conduit which communicates with the space 7 and extends upwardly from the top wall of the housing 2, said inlet air conduit being bent so as to present an open end 10 thereof in a direction toward the center of the refrigerated compartment B of the car A. Approximately at a point where the air inlet conduit 9 joins the space 7 I arrange a valve or damper 11 of ordinary construction, by the operation of which the flow of air through the conduit 9 may be regulated..

Extended through the front wall of the housing 2 at a point adjacent to the lower edge thereof is an air discharge conduit 12, said air discharge conduit being open at its outer end, and at its inner end being arranged in communication with the space 7 within the housing 2. Disposed within the space or air duct 7 preferably at the bottom of the hous-

ing 2 is a structure providing a plurality of fins 13. This structure extends entirely across the housing 2 at a point beneath the inner receptacle 6, as suggested by dotted lines in Fig. 2, and serves a function which will be hereinafter clearly described.

Arranged to surround the entire housing 2, except for a portion of the top wall thereof, is a hollow element 14 which provides a gas chamber 15. The gas chamber 15 is arranged in communication with the interior of the inner receptacle 6 by a relatively short duct 16 (Fig. 1), and 17 designates a gas discharge conductor which communicates with the chamber 15 and is provided with an open outer end 18. As will presently appear herein, gas resulting from evaporation of the refrigerant located within the inner receptacle 6 passes through the duct 16 into the chamber 15. This gas chamber is entirely closed except for the discharge conductor 17, and as the gas has a higher specific gravity than air it will pass downwardly into and fill the entire chamber, and will become stagnant therein. When the chamber 15 has been filled with gas, additional gas, which passes through the duct 16 from the interior of the inner receptacle 6, will pass from said chamber through the discharge conductor 17. As in the case of some products this gas is harmless, or in fact is beneficial to said products, the gas will be discharged directly into the refrigerated compartment in which said products are stored, as shown in Fig. 1. In the cases of other products, however, these gases may have a deleterious effect on said products, and therefore in a refrigerator in which the latter products are to be stored, the conductor 17 will pass into a wall of the refrigerated compartment and the gases will be discharged beyond the refrigerated compartment.

In the use of a refrigerator constructed in accordance with this invention, the refrigerant R, which will be solid carbon dioxide (CO_2) or some other solidified gas, will be disposed within the inner receptacle 6, as shown in Fig. 1, and as a result thereof the walls of said inner receptacle, which preferably are formed of sheet metal, will become very cold. As soon as the effect of the presence of the refrigerant R is felt within the refrigerated compartment B, the air in said refrigerated compartment will be placed in circulation, with the result that air will pass into the open end of the air inlet conduit 9 and will flow downwardly into the space 7 within the housing 2, where said air will spread so that it moves along the bottom and four side walls of the inner receptacle. In like manner the fins 13 will become very cold due to their proximity to the bottom wall of the inner receptacle 6. The air passing through the space 7 in the manner described above, and particularly while passing in contact with the fins 13, will be very much reduced in temperature, and said air then passes through the air discharge conduit 12 and is discharged into the refrigerated compartment B, wherein it circulates and eventually rises in temperature and again passes through the space 7 within the housing 2. It is obvious that the valve or damper 11 may be adjusted to regulate the volume of air passing through the cooling space 7, hence the temperature of the refrigerated compartment B may be regulated as desired by adjusting said valve or damper 11.

The gas which is given off when solid carbon dioxide or most any other solidified gas is evaporated constitutes a very efficient insulator when maintained in a stagnant condition, and inasmuch as the housing 2 of my apparatus is substantially surrounded by this stagnant insulating gas in the chamber 15, the likelihood of the low temperature of the refrigerant being felt within the compartment B through temperature exchange through the walls of the housing 2 is very greatly reduced.

While the space 7 within the refrigerant receptacle 1 of my improved structure is described as not being present at the top of said receptacle, it is obvious that said space may be extended to the top of the receptacle 1 without departing from the spirit of the invention.

I claim:

1. A refrigerating apparatus including a refrigerated compartment, a refrigerant receptacle, said refrigerant receptacle being provided with an air duct disposed so as to substantially surround a chamber located within the refrigerant receptacle which receives a refrigerant that gives off gas when sublimation thereof takes place, an air inlet element leading to said air duct, an air discharge element leading from said air duct and so arranged as to discharge air passing therethrough into said refrigerated compartment, a gas chamber arranged to substantially surround said refrigerant receptacle and having an outlet opening, and a gas discharge duct leading to said gas chamber from the interior of said refrigerant chamber.

2. A refrigerating apparatus including a refrigerated compartment, a refrigerant receptacle, said refrigerant receptacle being provided with an air duct disposed so as to substantially surround a chamber located within the refrigerant receptacle which receives a refrigerant that gives off gas when sublimation thereof takes place, fins arranged within said air duct, an air inlet element leading to said air duct, an air discharge element leading from said air duct and so arranged as to discharge air passing therethrough into said refrigerated compartment, a gas chamber arranged to substantially surround said refrigerant recep-

tacle and having an outlet opening, and a gas discharge duct leading to said gas chamber from the interior of said refrigerant chamber.

3. A refrigerating apparatus including a refrigerated compartment, a refrigerant receptacle, said refrigerant receptacle comprising an outer housing and an inner container for a refrigerant which gives off gas when sublimation thereof takes place, the bottom and side walls of said inner container being spaced from the bottom and side walls of said outer housing to provide an air duct which substantially surrounds said inner refrigerant container, air inlet means leading to said air duct, air discharge means leading from said air duct, said air discharge means being so arranged as to discharge air passing therethrough into said refrigerated compartment, a gas chamber arranged to substantially surround said refrigerant receptacle and having an outlet opening, and a gas discharge duct leading to said gas chamber from the interior of said refrigerant chamber.

4. A refrigerating apparatus including a refrigerated compartment, a refrigerant receptacle, said refrigerant receptacle comprising an outer housing and an inner container for a refrigerant which gives off gas when sublimation thereof takes place, the bottom and side walls of said inner container being spaced from the bottom and side walls of said outer housing to provide an air duct which substantially surrounds said inner refrigerant container, air inlet means leading to said air duct, means for regulating the passage of air through said air inlet means and into said air duct, and air discharge means leading from said air duct, said air discharge means being so arranged as to discharge air passing therethrough into said refrigerated compartment, a gas chamber arranged to substantially surround said refrigerant receptacle and having an outlet opening, and a gas discharge duct leading to said gas chamber from the interior of said refrigerant chamber.

5. A refrigerating apparatus including a refrigerated compartment, a refrigerant receptacle, said refrigerant receptacle comprising an outer housing and an inner refrigerant container the bottom and side walls of which are spaced from the bottom and side walls of said outer housing to provide an air duct which substantially surrounds said inner refrigerant container, fins arranged within said air duct, air inlet means leading to said air duct, means for regulating the passage of air through said air inlet means and into said air duct, air discharge means leading from said air duct, said air discharge means being so arranged as to discharge air passing therethrough into said refrigerated compartment, a gas chamber arranged to substantially surround said refrigerant receptacle, said gas chamber being provided with a gas discharge opening, and a duct leading from the interior of said refrigerant receptacle to said gas chamber.

In testimony that I claim the foregoing I hereunto affix my signature.

FREDERICK W. RABE.