

July 11, 1933.

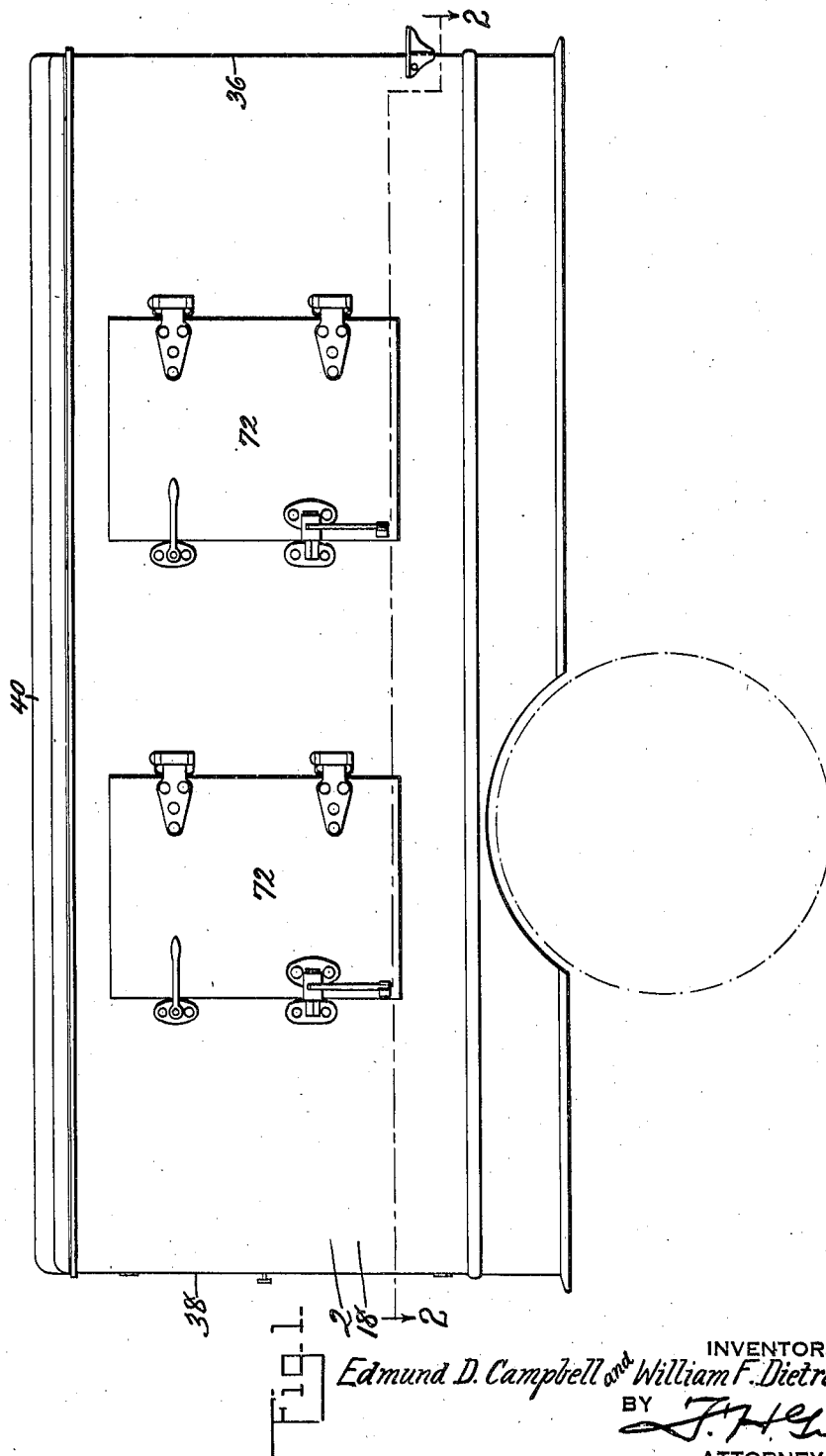
E. D. CAMPBELL ET AL

1,917,873

REFRIGERATOR

Filed March 27, 1930

8 Sheets-Sheet 1



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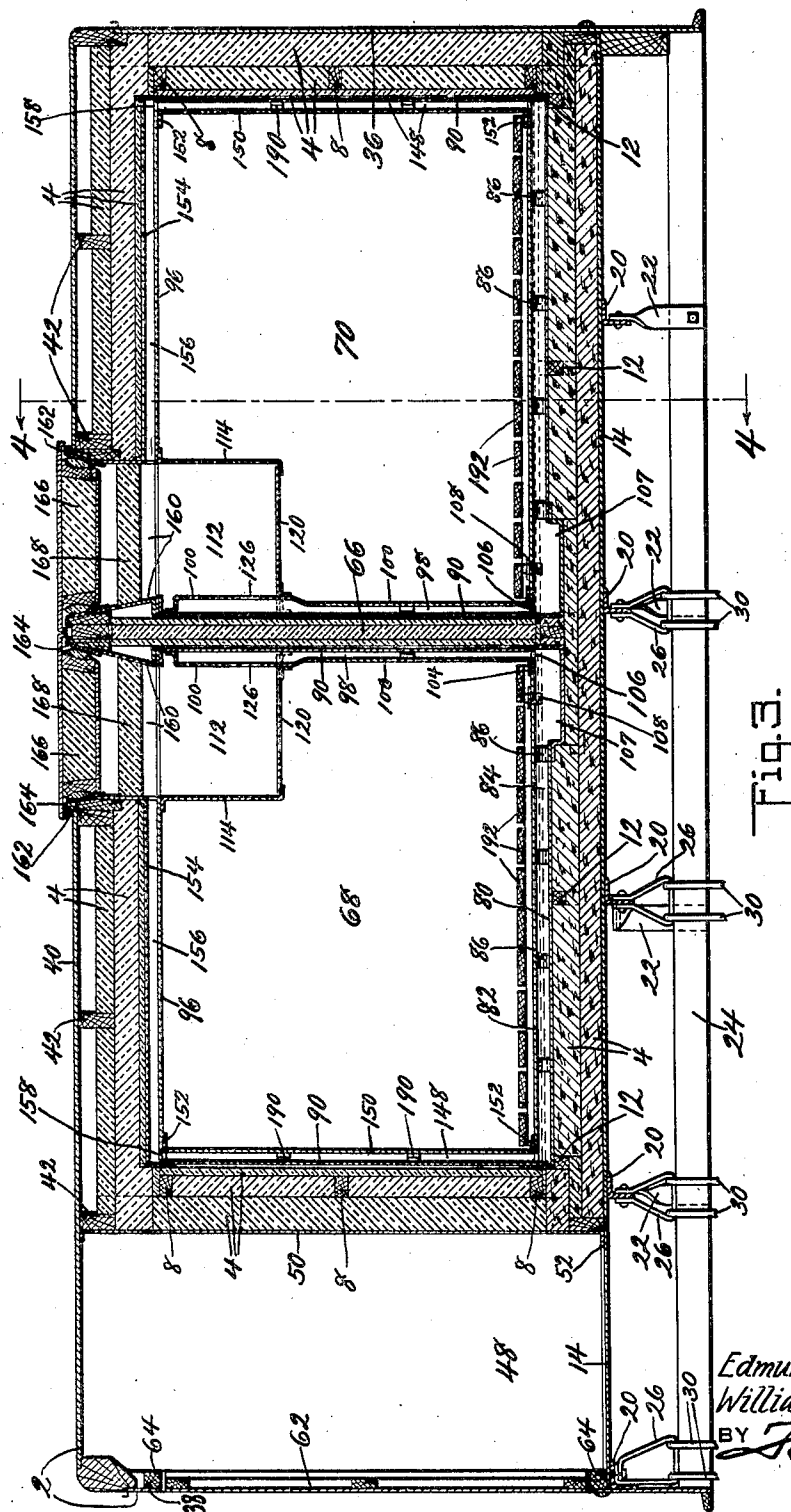
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REFRIGERATOR

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8 Sheets-Sheet 3



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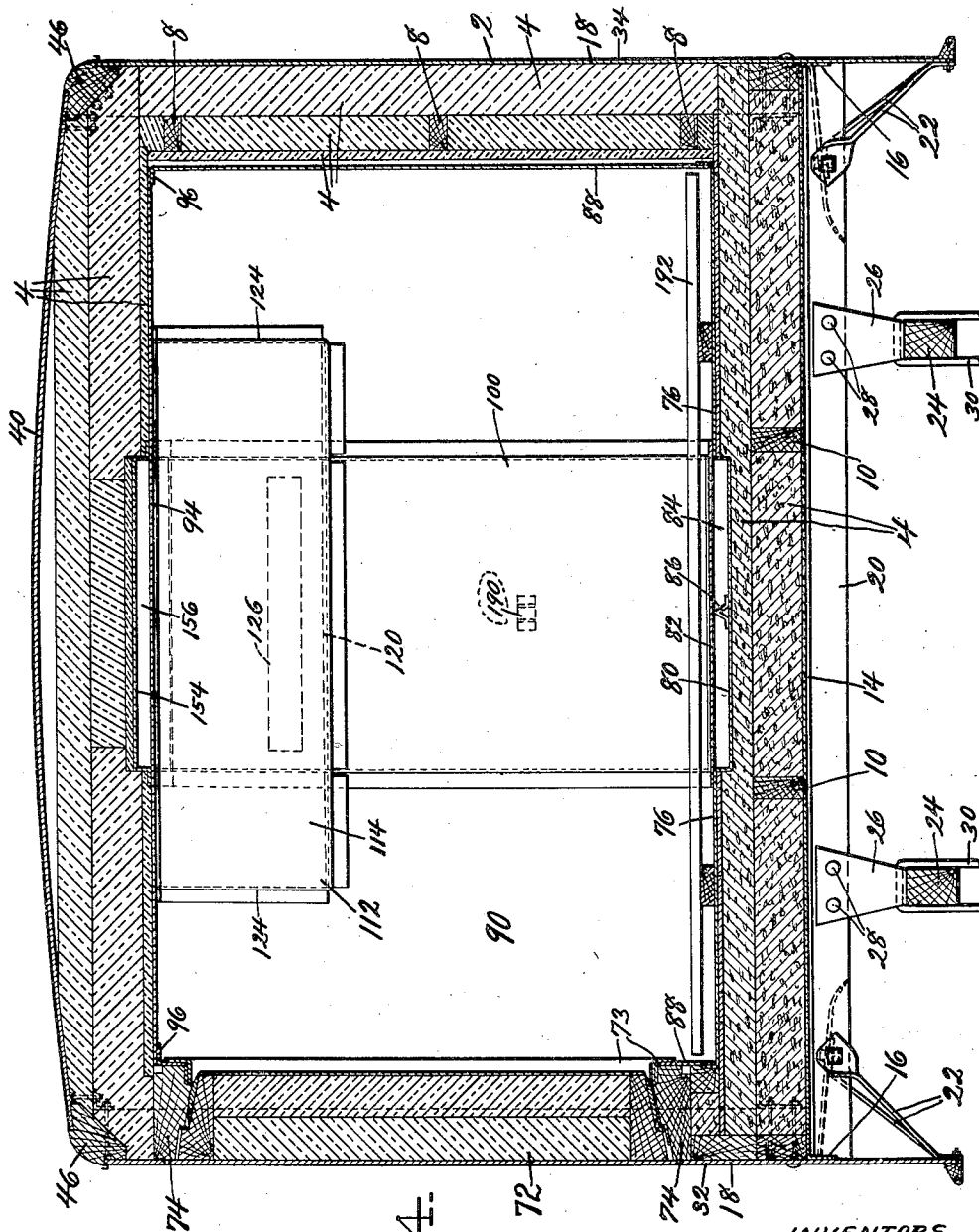
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8 Sheets-Sheet 4



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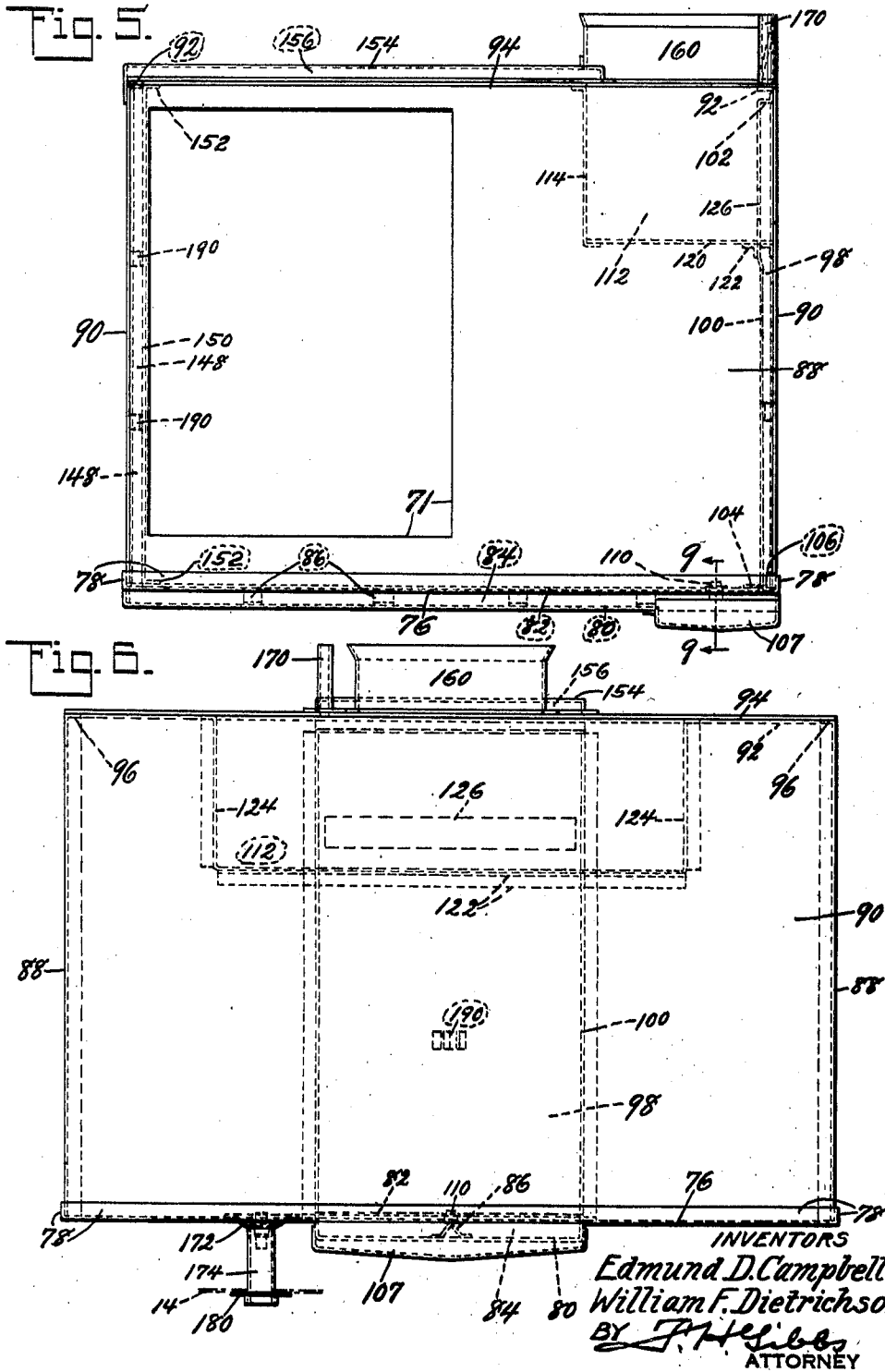
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Fig. 7.

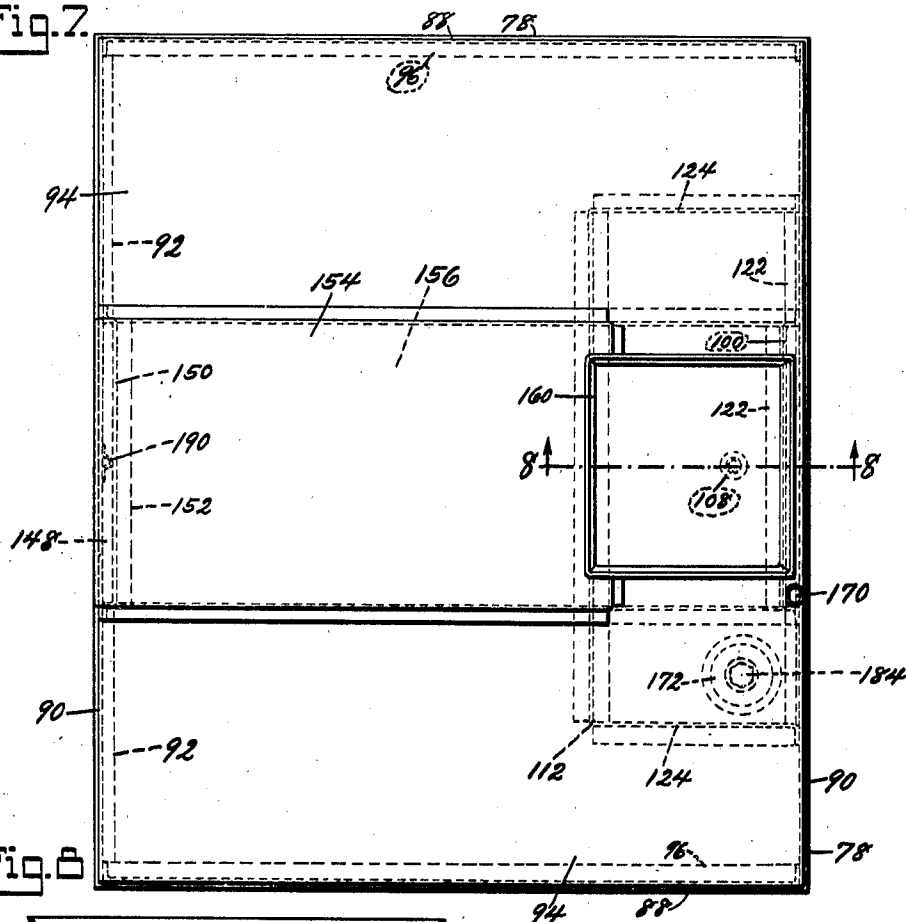


Fig. 8

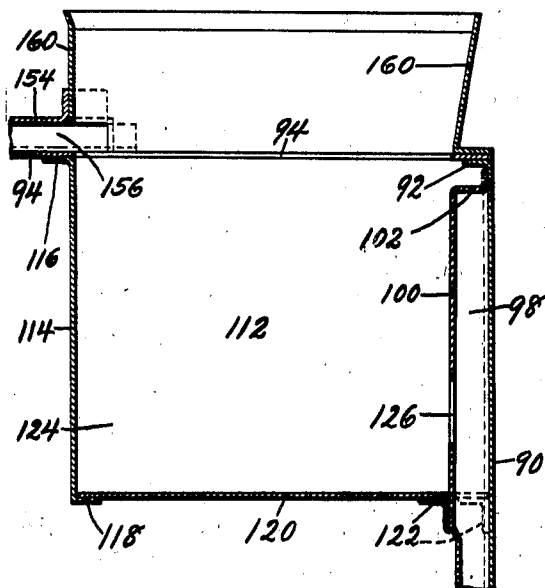
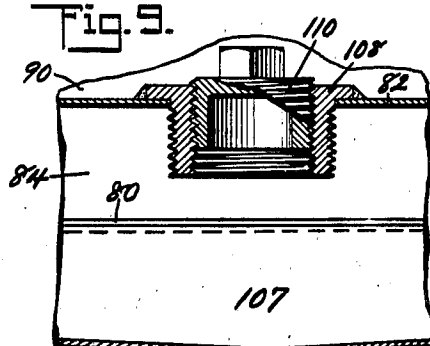


Fig. 9.



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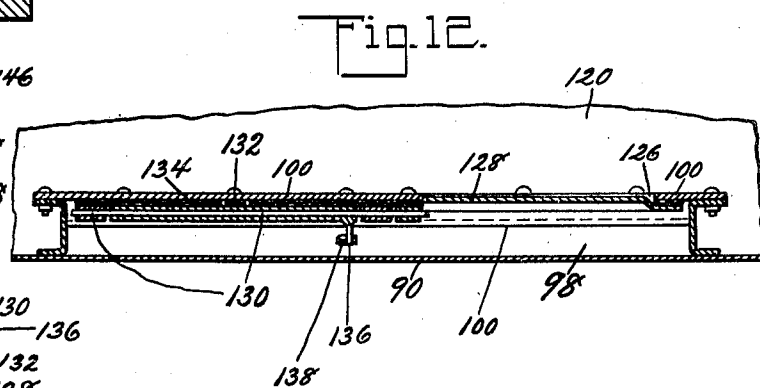
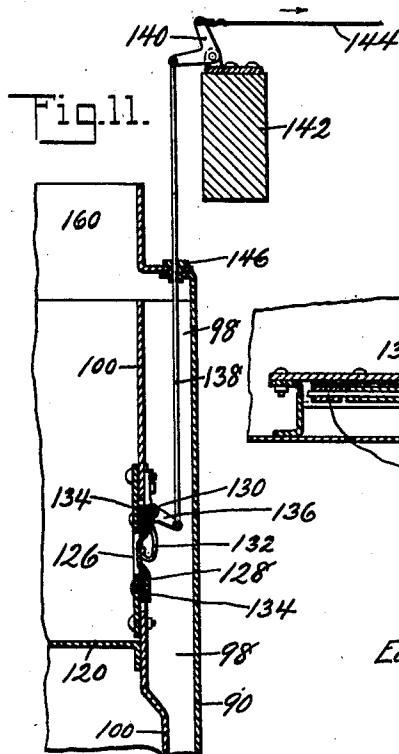
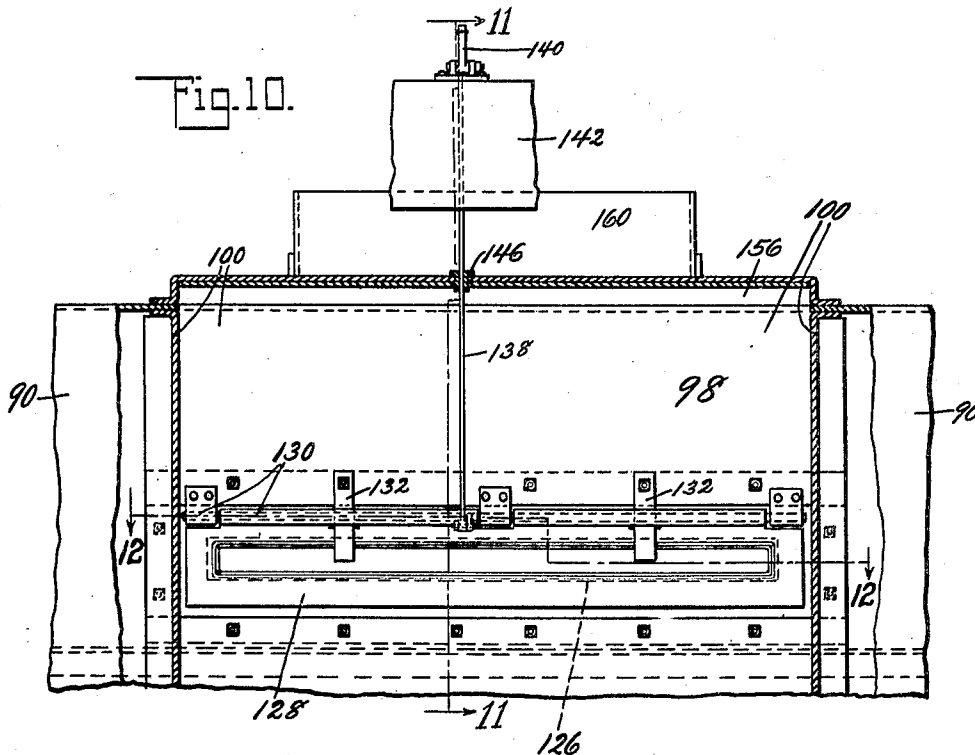
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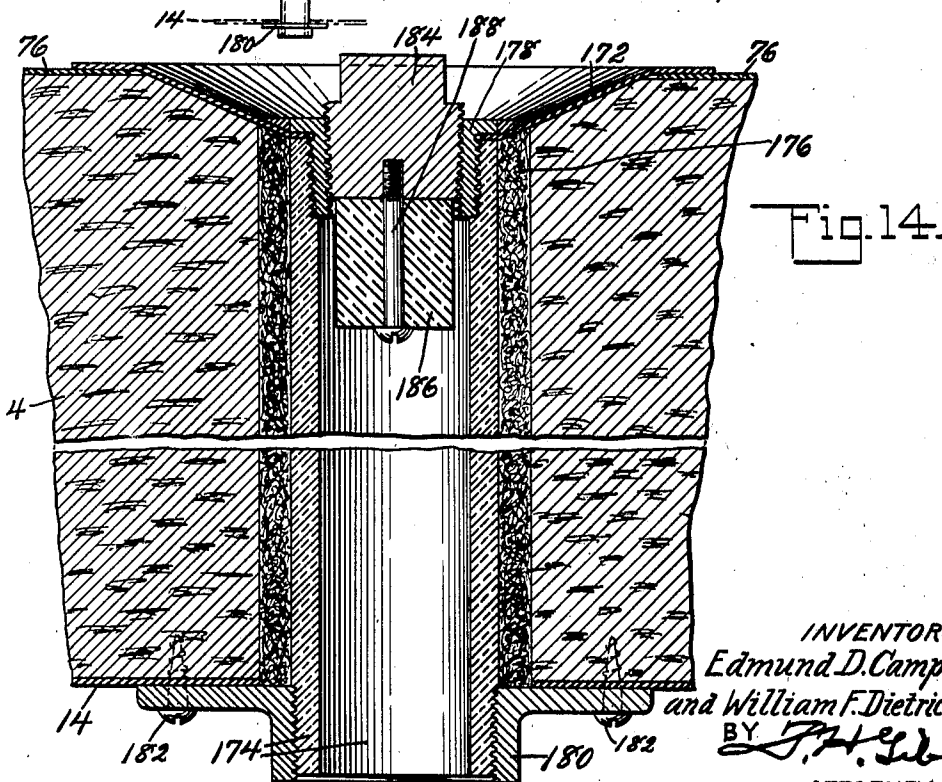
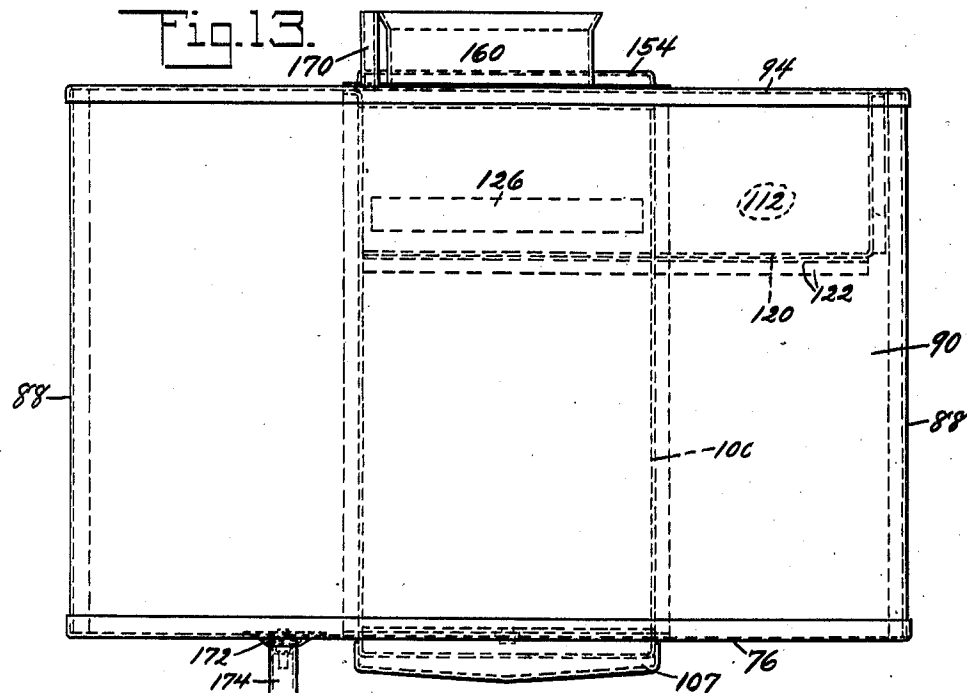
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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE

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REFRIGERATOR

Application filed March 27, 1930. Serial No. 439,374.

This invention relates to refrigerated vehicles, and pertains more particularly to vehicle bodies having compartments therein for the reception of goods such as ice cream or the like to be transported and which must be maintained at a relatively low temperature.

One object of the present invention is to provide a refrigerated vehicle body.

Another object of this invention is the provision of a vehicle body having a plurality of compartments therein, certain of which are to be refrigerated and others of which are adapted to hold empty cans or the like.

Still another object of this invention is the provision of a vehicle body which is suitably insulated and which is provided with storage compartments.

A further object of the invention is the provision of a vehicle body to be refrigerated by a refrigerating gas.

The invention further contemplates the provision of a refrigerating system for vehicle bodies.

Still another object of the present invention is the provision of a vehicle body having compartments to be refrigerated, and means for permitting the circulation of a refrigerating gas around the compartments for the purpose of maintaining the desired low temperature in the compartments.

A further object of this invention is the provision of a refrigerator having a metal container the interior of which constitutes the chamber to be refrigerated, and a closed metal container for holding solid carbon dioxide in thermal conductive relation to the metal container whereby heat units from the interior of the container or from the chamber to be refrigerated are conducted to the solid carbon dioxide.

Another object of the invention is to provide a refrigerating gas circulating system whereby the gas does not come into contact with the insulating material of the refrigerated compartment.

A further object of the invention is to provide a refrigerating gas circulating system so arranged that no moisture prevalent in

the ducts can possibly seep into the insulation of the refrigerated body.

Still another object of the present invention is to provide a compartment lined with metal so as to prevent condensation which will collect on the walls of the compartment when doors are opened from entering into the insulation.

A further object of the invention is the provision of a new and improved compartment to be refrigerated.

Refrigerated vehicles are well known in the art, but this invention contemplates the use with carbon dioxide in solid form, which, as is well known, evaporates or sublimates direct to a gas without an intermediate liquid stage.

Carbon dioxide gas is much heavier than air; it has a very low temperature as it evaporates and, as is well known, carbon dioxide gas absorbs heat rapidly and hence it is very suitable for use as a refrigerating medium in certain instances an example of which is described herein. Carbon dioxide gas being heavier than air will displace air, and when permitted to evaporate into a closed duct will completely fill the latter and exclude the air; the gas as it becomes warmer, rising and being supplanted by other cold gas. In other words, with the use of carbon dioxide gas there obtains what might be termed a cycle which commences at the vaporization or sublimation of the solid carbon dioxide, the gas traveling first downwardly because it is heavier than air, and then as it becomes warmer, rising until it is permitted to escape from the closed duct.

Advantage has been taken of the known properties of carbon dioxide gas in providing, in the present invention, a compartment or container which is provided with a closed duct which extends completely around the container and which is adapted to receive carbon dioxide gas for refrigerating or cooling the interior of the container; the carbon dioxide gas evaporating from a cake of solid carbon dioxide held adjacent the upper wall of the container and said gas being admitted into a closed duct, the place of admission be-

ing adjacent the upper portion of the container. The gas being heavy obviously drops in the duct and absorbs heat and travels around the container in the duct until it escapes from the duct at the top of the container.

It has been found in practice that the rate of evaporation or sublimation of solid carbon dioxide maintained in closed containers depends upon the rate of escape of the gas from the solid carbon dioxide container. Suitable openings are preferably formed in the solid carbon dioxide container to permit escape of the carbon dioxide gas and it has been found that the rate of escape of gas and also the rate of sublimation of the solid carbon dioxide depends a great deal upon the location of the opening or slot with respect to the solid carbon dioxide. For instance, in a closed container having solid carbon dioxide therein, vaporization or sublimation occurs, and if the opening or slot is arranged adjacent the bottom of the container the gas will immediately flow out of the container through the slot. If the opening or slot is arranged considerably above the bottom of the container, as for example adjacent the top thereof, the container will substantially fill with gas before the gas escapes through the slot, thus building up in effect an insulating blanket of carbon dioxide gas around the solid carbon dioxide. This obviously tends to retard the rate of sublimation or evaporation of the solid carbon dioxide and from this it can be seen that some control of the rate of evaporation or sublimation of the solid carbon dioxide is obtained by providing for the location of the escape opening for the gas. In other words, the rate of evaporation or sublimation of solid carbon dioxide is dependent upon the rate of escape of the gas from the container for the solid carbon dioxide. Several openings may be provided, any one or more of which may be opened to vary the rate of escape of gas from the container. Further, a single opening or slot may be provided which is controlled by a valve to regulate and control the rate of escape of gas from the solid carbon dioxide container. This valve may be controlled either automatically by means of a thermostat which is set to maintain a desired temperature, or the valve may be manually controlled if desired. All of this is within the scope of the present invention.

Other objects and advantages of this invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a side elevation of the vehicle body of the present invention.

Fig. 2 is a sectional view on the line 2—2, Fig. 1.

Fig. 3 is a sectional view on the line 3—3, Fig. 2.

Fig. 4 is a sectional view on the line 4—4, Fig. 3.

Fig. 5 is a side elevation of one of the refrigerated containers used with the body shown in Figs. 1 to 5 inclusive.

Fig. 6 is an end view of the container shown in Fig. 5.

Fig. 7 is a top plan view of the container shown in Figs. 5 and 6.

Fig. 8 is a sectional view on the line 8—8, Fig. 7.

Fig. 9 is a detail view showing, in section, the siphon plug for the container shown in Fig. 7.

Fig. 10 is a sectional view of a portion of the container to be refrigerated, showing a valve for controlling the gas escape opening.

Fig. 11 is a sectional view on the line 11—11, Fig. 10.

Fig. 12 is a sectional view on the line 12—12, Fig. 10.

Fig. 13 is a side elevation of a modified form of container, and

Fig. 14 is an enlarged detail view, in section, showing the drain means for the refrigerated container.

Referring now more particularly to the drawings the vehicle body of the present invention is shown in side elevation in Fig. 1 and comprises an insulated structure having an outer steel sheathing 2 and insulation 4; the insulation in the present instance being formed in layers though obviously this is merely by way of example. The body is reinforced by vertical posts 6, belts 8, longitudinal floor stringers 10 and transverse floor members 12. As clearly shown in the drawings, the body is provided with a steel bottom sheet 14 (see Figs. 3 and 4) the side edges of which are downwardly flanged as at 16 to lie against and be secured to the inner surface of the body side sheets 18. Extending transversely of the bottom 14 and secured thereto are a plurality of cross-bearers 20 of angle shape. Brackets 22 connect the cross bearers 20 to the side sheets 18 as clearly shown in Fig. 4. The body is further provided with longitudinally extending sills 24 secured to stirrups 26 which latter are connected to cross bearers 20 by suitable fasteners 28. U-bolts 30 are utilized to connect the body to the usual chassis of a vehicle but inasmuch as the chassis forms no part of the present invention the same is not illustrated. With the construction just described it is apparent that the body of the present invention is adapted to be mounted on chassis of varying sizes as the stirrups 26 may be secured to the cross bearers 20 at any point or points between the side sheets of the body.

The body comprises in the main, the sides 32 and 34 respectively, front end 36, rear end 38, and top 40; carlins 42 being em-

bedded in the roof insulation for supporting the roof. The body also includes corner posts 44 and side plates or cant rails 46.

As more clearly shown in Figs. 2 and 3, the insulation does not extend the full length of the body, though obviously it may extend from end to end of the body. In the present instance the insulation terminates short of the rear end of the body and defines, with the rear end of the body, a storage area 48 in which empty cans or the like may be placed, and the insulation at the area 48 is sheathed by a steel sheet 50 having a bottom flange 52 welded or otherwise secured to the bottom sheet 14 of the body. The inner surfaces of the side sheets at the rear end of the body are lined with metal sheets 54 having end and bottom flanges 56 and 58 respectively welded to the sheet 50 and the bottom sheet 14. These metal sheets are extended around to cover the corner posts 44 (see Fig. 2) and the inner surface of the rear end 38 is lined with steel sheets 60 which overlap the inner surfaces of the corner posts and which are welded or otherwise secured to the liner sheets 54. The rear end 38 of the body is provided with a door 62 framed as at 64.

The insulated area of the body is provided with a partition or wall 66 thus dividing the insulated area into compartments 68 and 70 each of which is provided with a door 72 formed in side 32 of the body; the doors being fitted in frames 74, as clearly shown in Fig. 2.

The compartments 68 and 70 are provided for refrigerating purposes and each thereof is lined with a metal container which is a unit in itself and which substantially fits the individual compartments. The container is shown in side elevation in Fig. 5 and is provided with an opening 71 in one side wall thereof which lines up with the door opening in the side 32 to permit access to the interior of the container. The containers are for practical purposes identical, and a description of the one will suffice for both.

The specific construction of the container is more clearly shown in Figs. 4 to 9, inclusive, and now referring to these figures it can be seen that the container comprises a substantially rectangular structure having a base 76 formed of metal (preferably steel) the edges of which are upwardly flanged as at 78. The base 76 is provided with a depressed area or channel 80 extending completely across the base and substantially midway of the sides thereof, which channel is covered by a plate 82 to define a closed duct 84 for the passage of gas as hereinafter more particularly pointed out. The plate 82 is preferably welded to the base 76 and plate supports 86 are arranged in the depressed area for supporting the plate 82.

The container includes sides 88 welded or otherwise secured to the base 76 at the flanges 78, one of the sides being provided with the before mentioned opening 71, aligned with the door opening in the side 32 of the body. In order to seal the joint at the opening 71, the door frame 74 is provided with an edge liner 73 of metal which overlaps the container side 88 at the opening 71 and which is welded or otherwise secured to the container side.

The container further includes ends 90 having their upper and side edges flanged as at 92 to be secured to a top plate 94 and the sides 88; the lower edges of the ends 90 being welded to flanges 78 of the base plate 76. The upper edges of the sides 88 are flanged at 96 and secured to the top plate. From the above description it can be seen that a strong and durable container has been provided.

As before mentioned the body of the present invention is adapted to be refrigerated through the medium of carbon dioxide and initially solid carbon dioxide is used, the gas from which is utilized for refrigerating purposes and directed around the container. In bodies for the purposes heretofore described it has been found practical to provide a closed duct around the container through which carbon dioxide gas circulates, and the base duct 84 heretofore described receives carbon dioxide gas from a vertical duct 98 formed by a flanged channel 100 secured to the inner surface of one end wall 90 and having its upper end offset as at 102 and secured to said end wall by welding or soldering. This construction is more clearly illustrated in Fig. 8.

The lower end of the channel 100 is inwardly flanged as at 104 and welded or otherwise secured to the before mentioned plate 82; the latter being provided with an opening 106 to permit gas from the duct 98 to enter the base duct 84. Because of the extreme cold temperature of the carbon dioxide gas, it has been found desirable to provide for collecting water of condensation, and to this end a well 107 is welded to the base of the container adjacent the juncture of the ducts 84 and 98. Secured to the plate 82 is a threaded bushing 108 within which a plug 110 is positioned which, when desired, may be removed to permit siphoning of water of condensation from the well 107.

The channel 100 extends into a box indicated generally at 112 which holds the solid carbon dioxide. As shown more clearly in Fig. 8 the box 112 is formed of a front plate 114 having a top flange 116 welded or otherwise secured to the top plate 94. The plate 114 is further provided with an inwardly extending supporting flange 118 at its lower edge to which is welded a bottom plate 120 the opposite edge of which latter is supported on and welded to one flange of an angle bracket 122. The angle 122 is secured to the

end wall 90 and to the channel 100. The box 112 is further provided with sides 124 thus providing a box having an open top. The channel 100 is provided with a slot 126 (see Fig. 8) for permitting escape of carbon dioxide gas from the box 112 into the vertical duct 98. In the showing in Fig. 8 the slot 126 is open and is arranged adjacent the bottom plate 120 of the box 112. This, it is obvious, permits the carbon dioxide gas, as soon as formed, to escape into the vertical duct 98 and this being the case, there will be a substantially rapid evaporation or sublimation of the solid carbon dioxide. The slot 126 may be arranged at any horizontal level in the channel 100 to permit a retardation of the escape of the gas from the box 112 into the duct 98. Further the slot 126 may be controlled by a valve and now referring to Figs. 10 to 12 inclusive which disclose a valve construction, the slot 126 is shown in Fig. 11 as being completely closed by a valve 128 pivoted at 130. A spring 132 is provided for normally retaining the valve 128 in closed position and canvas 134 is provided for sealing the slot against escape of gas. A lever 136 is provided for operating the valve, the lever being controlled by a rod 138 operated by a bell crank lever 140 pivotally secured to a support 142. In the instance shown the bell crank lever 140 is adapted to be operated from the cab of the vehicle and control line 144 is provided which leads to the cab. Obviously instead of the manual control indicated in Fig. 11, valve 128 may be controlled in its operation by means of a thermostat or other temperature control device which may be positioned within the container to be refrigerated. Such devices are well known in the art at the present time and no illustration thereof is believed to be necessary. With the construction shown in Fig. 11 the offset end of the channel 100 is eliminated because the rod 138 extends upwardly through the duct 98. A suitably packed bushing 146 is provided in the container for preventing leakage of gas from the container at the place where the rod 138 extends through said container.

The gas escaping into vertical duct 98 passes, as just described, into the lower horizontal duct 84 and from the duct 84 the gas passes into a vertical duct 148 formed on the opposite end 90 of the container. This duct 148 is defined by a flanged channel 150 secured to the inner surface of the opposite end 90 and having inturned flanges 152 on its upper and lower edges which are welded or otherwise secured to the under surface of the top plate 96 of the container and to the plate 82 respectively. Secured to the outer surface of the top plate 96 is a flanged channel 154 which defines with the top plate 96 a horizontal duct 156 which communicates with the vertical duct 148 through the medi-

um of an opening 158 formed in the top plate whereby to permit gas from the vertical duct 148 to enter the horizontal duct 156. The flanged channel 154 extends over the top plate 94 and has its opposite end welded or otherwise secured to a metal frame 160 secured to the top plate 94 above the box which receives the solid carbon dioxide. The frame 160 is substantially rectangular in shape and the duct 156 leads into the interior of this frame as shown clearly in Fig. 8. The frame 160 extends through the insulation, as shown in Fig. 3 and into a hatchway formed in the roof of the body. The hatchway is provided with a frame 162 which is lined with metal 164 and is normally closed by a cover 166. A plug 168, formed of suitable insulating material is normally positioned in the frame 160 for an obvious purpose. For convenience in manufacture, the hatchways are arranged side by side in the roof and therefore the containers are arranged in what may be termed a back to back relation as clearly shown in Fig. 3; that is the boxes for the reception of the solid carbon dioxide are arranged adjacent each other on either side of the partition 66.

The carbon dioxide gas when it has made a circuit of the ducts heretofore described has absorbed considerable heat and this carbon dioxide gas is very hard to control and will escape through the smallest openings. In fact the gas may escape from the duct 156 right to the atmosphere through the joint or meeting surfaces of the plug 168 and the frame 160 though of course the escape of the gas is retarded by the plug 168. This retardation of gas escape causes some of the gas to re-enter the solid carbon dioxide box and be re-cooled, and it may then re-enter the vertical duct 98 and be re-cycled as will be apparent. If desired however means may be provided for permitting a free escape of the heated carbon dioxide gas, and to this end a vent 170 may be provided in the top plate 96 adjacent the discharge end of the horizontal duct 156. Such a vent is clearly shown in Figs. 6 and 13.

The interior of the container must at times be washed and to permit drainage of washing fluid from the container, a drain means is provided, the same comprising a sump 172, secured to the bottom of the container. The sump is in effect, a dish shaped annulus to which is secured a tube 174 of insulating material which is surrounded by other insulation such as hair felt or the like 176, the tube 174 extending through the insulation and bottom sheet 14 of the body. The tube 174 is supported by a flanged bushing 178 which serves to clamp the annulus 172 whereby the tube 174 is pendant from said annulus, as clearly shown in Fig. 14. The lower end of the tube is threadedly engaged with a flanged bushing 180 to position the tube; the bush-

ing 180 being secured to the bottom plate 14 by means of suitable fasteners such as the screws 182. The lower end of the tube is open but the upper end of the tube is closed by a plug 184 threaded into the bushing 178. The plug 184 is provided with a squared end for engagement by a suitable tool whereby the plug 184 may be removed from the bushing to permit drainage through the tube 174. Secured to the lower end of the plug 184 is a plug 186 of insulating material in order that the plug 184, which is of metal, may not be exposed to atmospheric air, thus preventing transference of heat from outside the container into the container.

In order to prevent mutilation or deformation of the ducts, spacers 190 are arranged in the ducts as clearly shown in Fig. 3. Platforms 192 are arranged in the containers for supporting cans or the like.

The construction shown in Fig. 13 is very similar to that disclosed in the other figures but the box for solid carbon dioxide has been placed to one side of the container in order to arrange the same away from the doorway whereby it will not interfere with easy removal of cans or the like from the container.

In use, solid carbon dioxide is placed in the boxes provided for that purpose and the hatchways closed by the plugs 168 and covers 166. The solid carbon dioxide rests directly on the metal of the boxes provided for the reception thereof and it is obvious that the solid carbon dioxide is in direct thermal conductive relation to the interior of the chamber to be refrigerated through the walls of the boxes. The boxes being connected to the walls of the container which defines the chamber to be refrigerated, it is obvious that heat units from the chamber to be refrigerated pass directly to the walls of the container and then are thermally conducted to the solid carbon dioxide. Experiments have proven that a large percentage of the heat units from the interior of the chamber are thermally conducted directly to the solid carbon dioxide within the boxes provided for its reception. The solid carbon dioxide will sublime and the gas evaporating therefrom will first pass into the vertical ducts 98 and, being very cold, will drop in these ducts and pass into the horizontal ducts 84 and then into the vertical ducts 148 and then out through the ducts 156 to the atmosphere; the gases absorbing heat from the walls of the container and refrigerating the containers as will be apparent. With a valve construction such as shown in Figs. 10 to 12 inclusive the rate of sublimation of the solid carbon dioxide may be controlled to suit various conditions or in accordance with the commodities transported in the containers.

With the construction shown and described it will be apparent that the refrigerating gas

is not permitted to enter the space between the container and the insulation of the vehicle body. The gas is passed or permitted to flow in a confined path around the container. It has been found that in a construction in which the carbon dioxide gas is permitted to circulate between a container and insulation, the gas circulates through the insulation. Ostensibly this is for the purpose of providing an insulator, or in other words, to compel the gas to act as an insulator and to dry out the insulation. This idea presents certain disadvantages in that a great quantity of ice is formed in the insulation, and this hinders the insulating effect of the insulation. In the present construction the gas is maintained out of direct contact with the insulation and this arrangement eliminates the formation of ice in the insulation.

The present construction also provides a system which is so arranged that no moisture prevalent in the ducts can seep into the insulation or the insulated body.

It is believed that the construction and operation of the invention disclosed herein will be fully apparent to those skilled in the art without further elaboration, but it is to be understood that the drawings herein are for illustrative purposes only and various changes in the form and proportions of the construction shown in the drawings may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A refrigerator comprising a body having an insulated compartment therein, a metal container fitting said compartment, a closed box secured in the upper part of the container and holding solid carbon dioxide, and a duct extending around the container with portions thereof embedded in the insulation of the compartment whereby to restrain the container against shifting, the ends of said duct opening into said box.

2. A refrigerator comprising a body having an insulated compartment, a metal container fitting said compartment, a closed box in said container for holding solid carbon dioxide, a duct extending around the container and receiving gas evaporating from the solid carbon dioxide, the discharge end of said duct being arranged adjacent the upper portion of the box whereby gas discharged therefrom may be cooled and recycled through the duct and the inlet end of said duct extending a substantial distance into the closed box, certain portions of the duct being externally arranged relative to the container and the remaining portions of the duct being arranged interiorly of the container.

3. In a refrigeration apparatus adapted for and using solid carbon dioxide, an insulated chamber, a metal container fitting the

chamber and comprising top, bottom, sides and ends, said bottom having a recess, a plate covering the recess and defining a bottom horizontal duct, channels secured to the ends of said container and defining vertical ducts the lower ends of which are connected to the bottom horizontal duct, a hatchway in the upper wall of the insulated chamber, a closed box for holding solid carbon dioxide arranged inside the container and into which one of the vertical ducts extends, a duct formed on the top of the container and communicating with the opposite vertical duct and opening into the hatchway; said ducts receiving gas evaporating from the solid carbon dioxide whereby to refrigerate the chamber.

4. In a refrigerating system, a chamber to be refrigerated, enclosing means in the chamber for containing solid carbon dioxide, a vertical duct arranged interiorly of the chamber and extended into the enclosing means for receiving gas evaporating from the solid carbon dioxide, an externally arranged horizontal duct extending across the bottom of the chamber and receiving gas from the vertical duct, second internally arranged vertical duct arranged opposite the first named vertical duct and receiving gas from the horizontal duct, and an externally arranged horizontal duct extending across the top of the chamber and receiving gas from the second vertical duct and discharging it into the enclosing means.

5. In a vehicle body, an insulated compartment to be refrigerated, a metal container in the compartment, a hatchway formed in the body, enclosing means aligned with the hatchway and arranged in the container for holding solid carbon dioxide, a duct extending around the metal container and receiving gas evaporating from the solid carbon dioxide, means closing said hatchway, a condensate well forming part of the duct, means for confining the gas from the body after it has passed through the duct, and drainage means for the container extending through the bottom of the body.

6. A refrigerator comprising a body having an insulated compartment, a metal container closely fitted against the inner walls of the compartment, a closed box in said con-

tainer for holding solid carbon dioxide, and a duct extending around the container and receiving gas evaporating from the solid carbon dioxide, the inlet end of said duct extending a substantial distance into the closed box and having vent means therein for permitting passage of gas from the box to said duct, the position of said vent means being predetermined and variable with respect to the box whereby to control the passage of gas from the box to the duct, the discharge end of said duct being arranged adjacent the upper portion of the box, portions of said duct being externally arranged relative to the container and embedded in the insulation of the compartment to prevent relative movement of the compartment and container.

7. In a refrigerator vehicle, a body having an insulated compartment and an uninsulated compartment, a container fitted against the walls of the insulated compartment and adapted to hold goods to be refrigerated, enclosing means in said container for holding solid carbon dioxide, a channel shaped duct extending around the container with the ends thereof communicating with the interior of the enclosing means, portions of said duct being externally arranged relative to the container and embedded in the insulation of the compartment to restrain the container against shifting, and the remaining portions of the duct being arranged interiorly of the container.

8. A refrigerator vehicle comprising a body having an external sheathing, a plurality of compartments formed in the body, certain of said compartments being insulated and each thereof having a metal container therein closely fitted against the walls thereof, enclosing means for solid carbon dioxide in the containers, channel shaped ducts extending around said containers, upper and lower portions thereof projecting from the walls of the container and being embedded in the insulation to provide holding means for the containers in the compartments, the ducts each having their ends in communication with the interior of the enclosing means.

In witness whereof we have hereunto set our hands.

EDMUND D. CAMPBELL.
WILLIAM F. DIETRICHSON.