G. A. BOBRICK.

REFRIGERATING APPARATUS.

APPLICATION FILED SEPT. 20, 1905.

966,076. Patented Aug. 2, 1910.

Fig. 1.

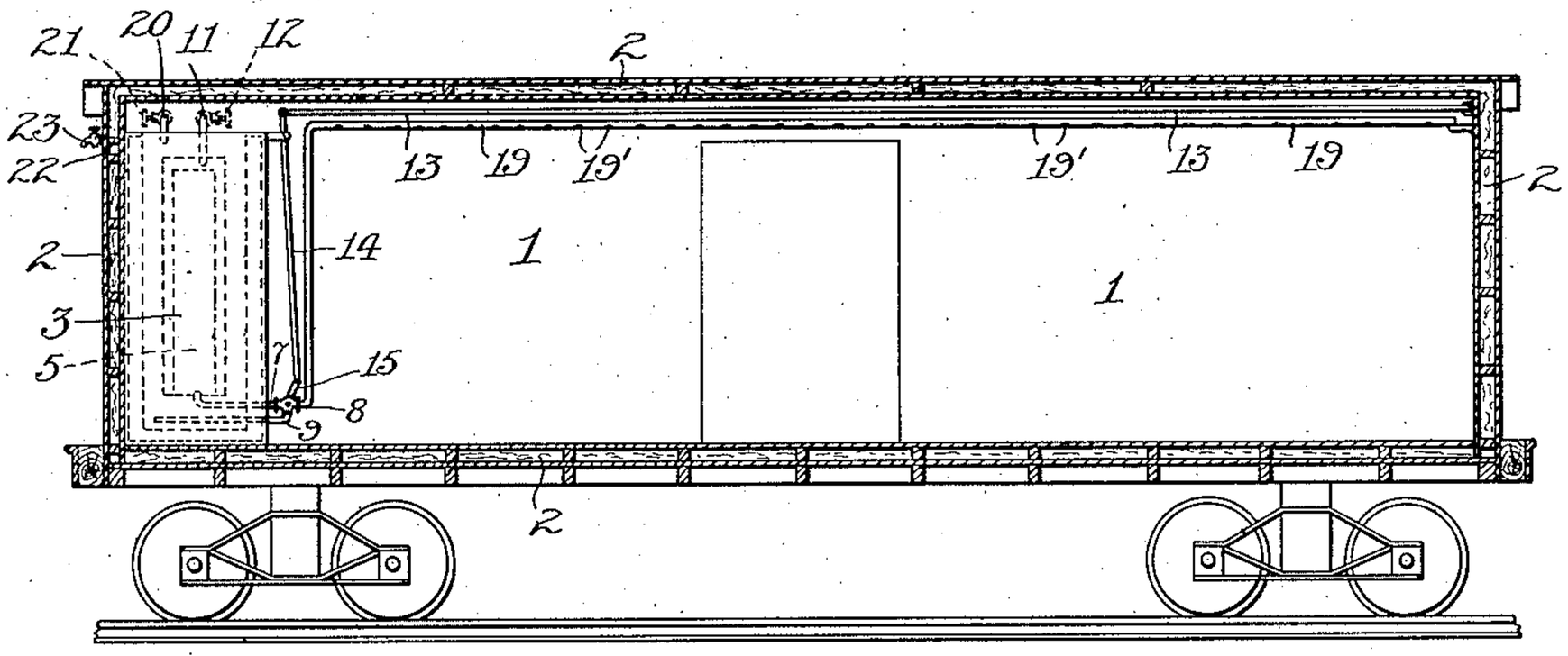


Fig. 4.

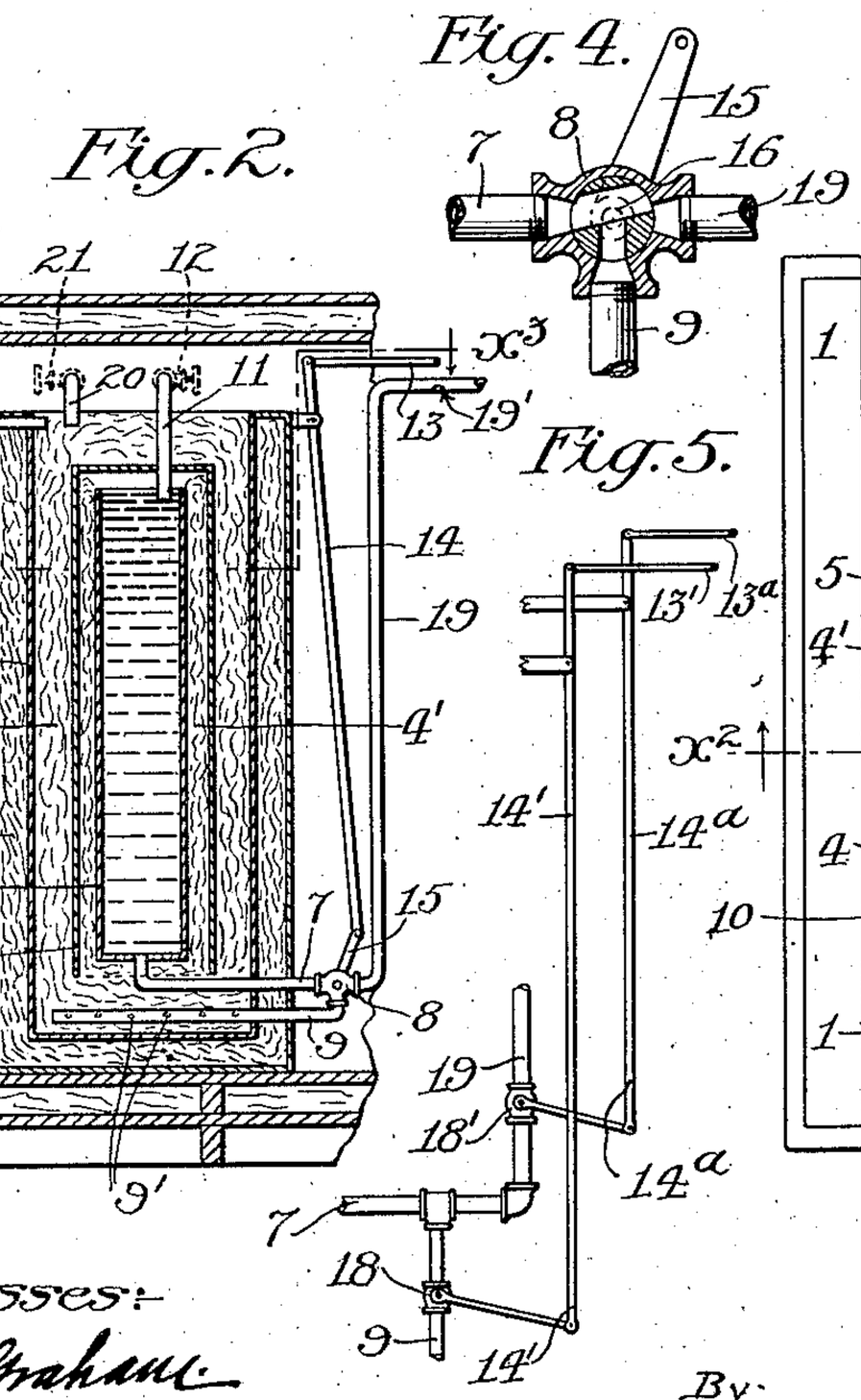


Fig. 2.

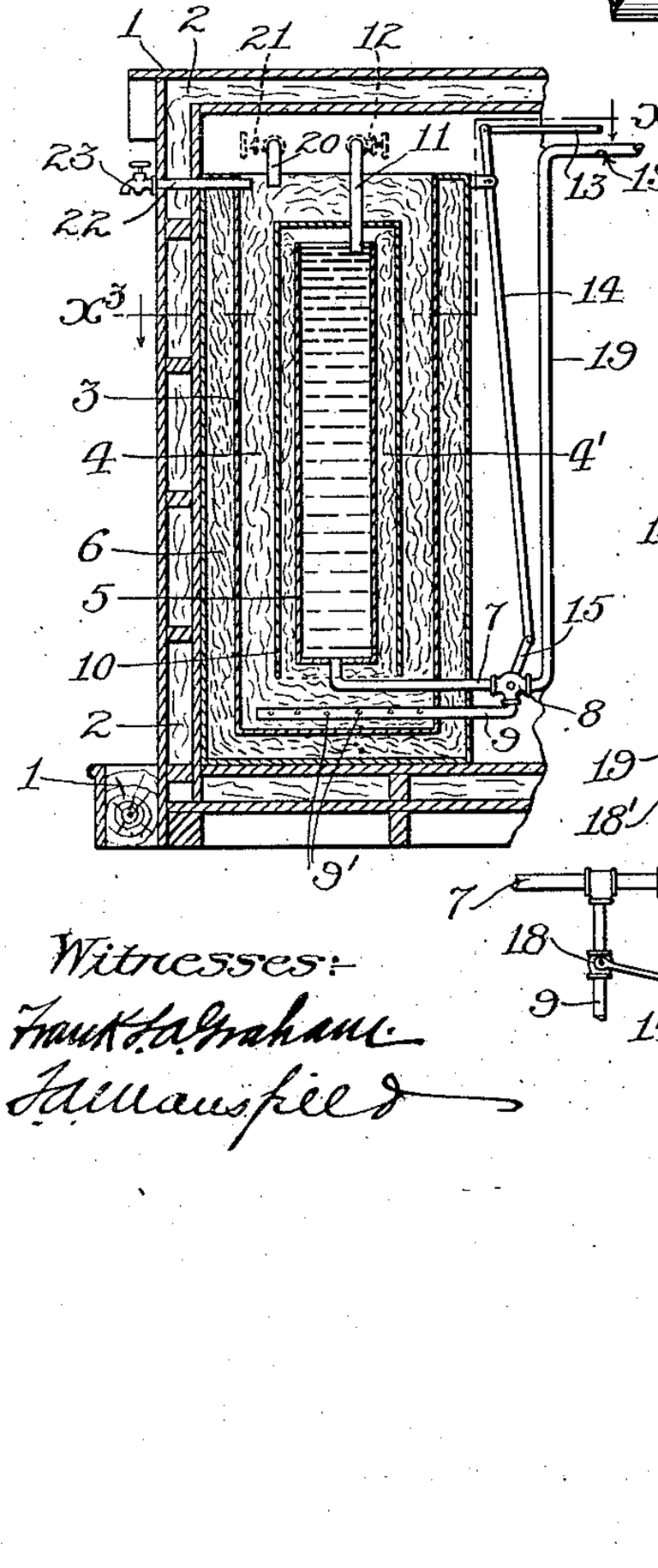


Fig. 5.

Fig. 3.

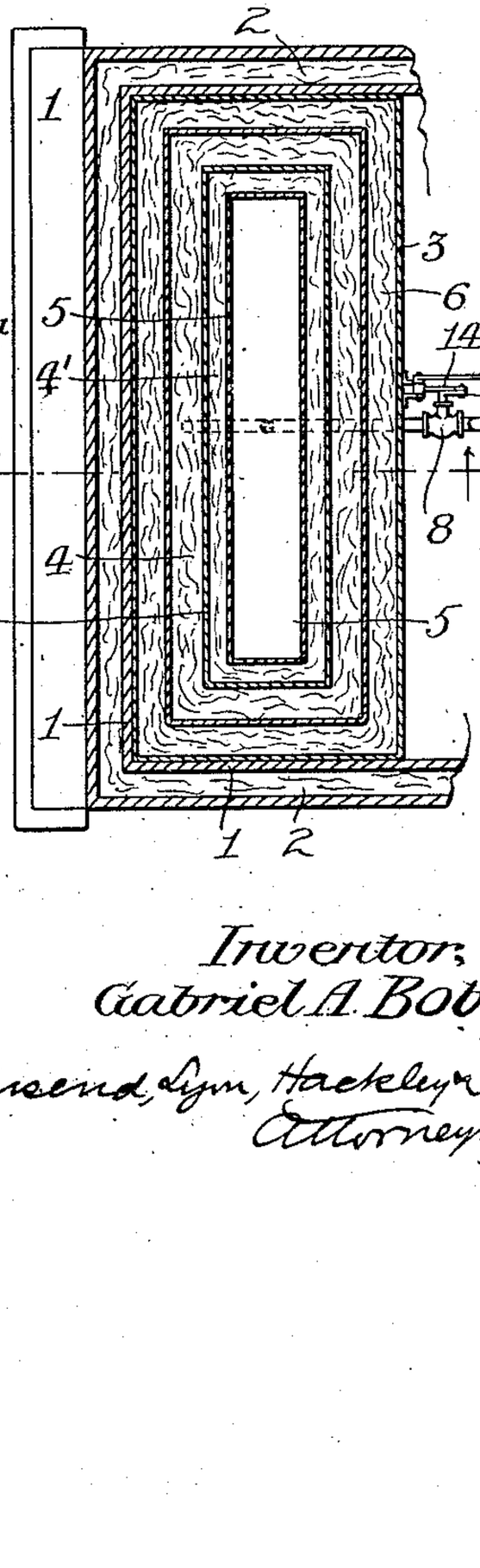
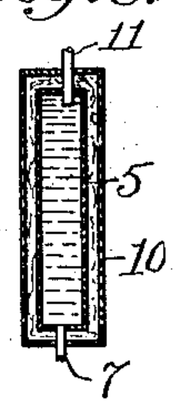


Fig. 6.



Witnesses:-

Frank L. Graham.

J. Mansfield

Inventor:

Gabriel A. Bobrick.

By

Townsend, Lyon, Hackley & Knight

Attorneys

UNITED STATES PATENT OFFICE.

GABRIEL A. BOBRICK, OF LOS ANGELES, CALIFORNIA.

REFRIGERATING APPARATUS.

966,076. Specification of Letters Patent. Patented Aug. 2, 1910.

Application filed September 20, 1905. Serial No. 279,233.

To all whom it may concern:

Be it known that I, GABRIEL A. BOBRICK, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Refrigerating Apparatus, of which the following is a specification.

The main object of this invention is to provide a means for efficient and economical cooling of inclosures, such as cold storage rooms, refrigerators, cars or vessels, in which meat, fruit or provisions are stored or shipped.

According to this invention the cooling of the inclosure is effected by the use of liquid air, or other suitable liquid gas, as a refrigerating agent, and the invention relates particularly to a system by which liquid air is supplied automatically to a porous absorbent, also to an automatic distribution of the liquid air through the inclosure and to means for conserving the liquid air as far as possible.

To simplify the description, I will illustrate and describe the invention as applied to a car, using liquid air as a refrigerant.

The accompanying drawings illustrate the invention, and referring thereto Figure 1 is a vertical section of a car, showing the refrigerating apparatus therein. Fig. 2 is a vertical section of the refrigerating apparatus on the line x^2—x^2 in Fig. 3. Fig. 3 is a horizontal section on the line x^3—x^3 in Fig. 2. Fig. 4 is a transverse section of the distributing or controlling valve. Fig. 5 shows a different form of the thermostatic means for controlling the liquid air supply. Fig. 6 shows a different form of the liquid air tank.

1 designates a car, the walls of which are insulated with some well known insulating material, such as hair felt, etc., as shown at 2. In the drawings this chamber is shown as being the body or box of a freight car which is intended for transportation of meat, fruit or other perishable products.

Suitably located in the car, for example, at one end thereof, is the refrigerating apparatus comprising a tank or receptacle 3, and an absorbent packing or filling 4 within said receptacle for holding liquid air, said tank or receptacle being open so as to expose said absorbent packing, and to enable evaporation of the liquid air for cooling the inclosure. The tank 3 has walls formed of insulating material, said walls being preferably double and filled with some suitable insulating material such as hair felt, etc., as shown at 6. The absorbent material 4 within the receptacle 3 may consist of hair felt, wool or other suitable material. Means are provided for automatically replenishing the supply of liquid air to said absorbent material as the liquid evaporates therefrom and the air in the car becomes warmer; said means comprising, for example, a tank or receptacle 5 for holding liquid air and having an outlet pipe 7 leading therefrom at the lower part of the tank, or below the level of the liquid air therein and connected through a valve 8 with a pipe 9 communicating with the tank 3 to supply liquid air to the absorbent material therein. In order to conserve the liquid air as much as possible, the replenishing or supply tank 5 is preferably located within the evaporating tank 3 and completely surrounded by the absorbent material 4 therein. A shell or cylinder 10 extends over and around the inner tank or receptacle 5, said shell having its lower end open as shown in Fig. 2, or perforated as shown in Fig. 6, the space 4′ between said shell and tank being packed with the same absorbent or porous material as receptacle 3, and the said tank having its upper end open as in Fig. 2 or perforated as in Fig. 6, so that the space at the upper end of the inner receptacle communicates through the space within said shell with the lower part of the tank 3 and a liquid seal is thus provided for the internal receptacle 5, raising the pressure in vessel 5 slightly, but the open or perforated top of the vessel 5 and the open or perforated bottom of shell 10 will prevent the possibility of occurrence of dangerously high pressure in the internal receptacle.

11 designates a supply pipe through which the receptacle 5 can be charged, said pipe extending, for example, to the exterior of the car and being provided with a valve 12.

Should it be found desirable to charge tank 3 first and then to allow the liquid to overflow into tank 5, a pipe 20 may be provided for that purpose, said pipe having a valve 21. An overflow pipe 22 may also be provided for tank 3, said pipe having a valve 23. The valve 8 preferably operates both to control admission of the liquid air to the packing material in the receptacle 3 and

also, if necessary, to provide for direct passage of the liquid air from the receptacle 5 to the chamber or car 1. Said valve is automatically controlled responsively to the temperature of the air in the car or inclosure 1 by means of a thermostatic device 13, consisting, for example, of a metallic bar or rod extending in the car and connected at one end to a fixed point and pivoted at the other end to a lever 14 operating an arm 15 on the plug 16 of the valve. Said valve is shown as a three-way valve, its several ports being connected respectively to the pipe 7 leading to the bottom of liquid air tank 5, to an outlet pipe, or pipes, 9 leading into the lower portion of the intermediate space between the said tank and the outer casing and to an outlet pipe, pipes or coil 19, extending along the car for distribution of the liquid air directly into the car, said pipe 19 being perforated at 19′ for that purpose. The pipe 9 leading into the packing space 7 is perforated as at 9′ for distribution of liquid air into the said packing. Owing to the liquid air seal, above described, the pressure in vessel 5 is high enough to raise the liquid air in pipe 19 for distribution.

The operation is as follows: Liquid air is allowed to flow into the receptacle 5 through the supply pipe 11 or through pipe 20 until the receptacle is filled, and the liquid overflows and saturates or fills the packing 4′ and 4 inside and outside of the shell 8. The supply is then cut off and valve 12 or 21 is closed. The car having first been packed with the products for transportation and the doors thereof closed, the car is ready for shipment. The outer casing or tank 3 being open at the top, the packing 4 therein saturated with liquid air, is exposed to the air in the car with the consequence that the liquid air contained in said packing evaporates at the exposed surface and reduces the temperature of the air in the car. Owing to the relatively high temperature in the car, the automatic valve 8 has been open during the charging of the vessels with liquid air, and part of it escaping through pipes 19 into the car has assisted in refrigeration of the car. When the refrigeration of the car has reached a certain point, the contraction of thermostatic rod 13 will operate the valve 8 to shut off connection to the pipe 19, still leaving open the connection to pipe 9, so that liquid aid can pass from the tank 5 through pipes 7 and 9 into the bottom of outer tank 3 and thus maintain the packing therein in a more or less saturated condition. The evaporation from the top of the packing in said outer tank will then be sufficient in most cases to maintain the temperature at the desired degree, and if the cooling effect thereby is at any time beyond the amount desired, the thermostatic device will act to further close the valve 4 to cut off communication to pipe 9, thereby stopping the supply of liquid air to packing 4 and reducing the amount of evaporation from said packing. On the other hand, if the temperature rises in the car beyond the desired degree, the valve 8 will be opened by expansion of thermostatic device 13, first to admit liquid air from the tank 5 to the packing 4 in tank 3, thereby increasing the evaporation from said tank and tending to hold the temperature down, and if, by reason of abnormal thermal conditions on the outside of the car, for example, in usually hot weather, the reduction of temperature effected thereby is not sufficient, the valve 8 will be operated by the thermostatic device to open communication into pipe 19 and allow distribution direct from the tank 3 to the car or inclosure 1. It is desirable to have the distributing pipe 19 pass along the upper portion of the car so as to give the best distribution of the liquid air therein, and the pressure within the tank 5 must therefore be sufficient to raise the liquid air through the pipe 19 to the top of the car. This effect is obtained by the liquid air tank and the resisting or obstructing action of the packing 4 which opposes sufficient resistance to the efflux of evaporated air from the tank 3 to maintain liquid air in tank 5 and at the bottom of tank 3 at a pressure sufficient for this purpose. The liquid air permeates the packing from the lower portion upward, and evaporates from the upper portion of the packing.

Since the cost of manufacturing liquid air is now reduced to about one cent per gallon, effectual refrigeration of the car can be maintained by the use of a refrigerating apparatus of this character for long distances at a reasonable cost, and the space necessary in the car for the refrigerant is less than that which is taken up by the usual ice compartments.

It will be understood that the invention as above described is applicable to refrigeration of inclosures of any kind, for example, refrigerators and cold storage rooms, whether stationary or movable.

Various modifications may be made in the construction; for example, instead of a single valve to control connections to the respective pipes 9 and 19, separate valves, indicated at 18, 18′ may be provided, as shown in Fig. 5, operated by separate levers 14′, 14ª, controlled by thermostatic devices 13′, 13ª. The rod 13 of the thermostatic device may be located at any suitable place in the car.

What I claim is:—

1. A refrigerating apparatus, comprising a receptacle, a packing of absorbent material within the receptacle for holding liquid air and exposed for evaporation thereof, and a tank for holding liquid air inclosed within

said packing and having an outlet from its lower portion communicating with the packing.

2. A refrigerating apparatus, comprising a receptacle, an absorbent packing therein for holding liquid air and exposed for evaporation thereof, a tank inclosed within said packing and having an outlet connecting with the lower part of the tank to discharge liquid air into the packing and a valve controlling said outlet.

3. A refrigerating apparatus for an inclosure, comprising a receptacle in open communication with the inclosure, an absorbent packing within the receptacle for holding liquid air and exposed for evaporation thereof, a liquid air tank inclosed within said packing and having an outlet communicating with said packing, a valve controlling said outlet and a thermostatic device in the inclosure controlling said valve.

4. A refrigerating apparatus for an inclosure, comprising a receptacle in open communication with said inclosure, an absorbent packing within the receptacle for holding liquid air and exposed for evaporation thereof, a liquid air tank inclosed within said packing and having an outlet communicating with said packing and a shell surrounding said liquid air tank and communicating at its upper end with the tank and at its lower end with the packing.

5. A refrigerating apparatus for an inclosure, comprising a receptacle in open communication with said inclosure, an absorbent packing within the receptacle for holding liquid air and exposed for evaporation thereof, a liquid air tank inclosed within said packing and having an outlet communicating with said packing, and a shell surrounding said liquid air tank and communicating at its upper end with the tank and at its lower end with the packing, and a packing in the space between said shell and tank.

6. A refrigerating apparatus for an inclosure, comprising a receptacle in open communication with the inclosure, an absorbent packing therein for holding liquid air and exposed for evaporation thereof, a liquid air tank inclosed within said packing and having an outlet communicating with said packing, outlet means communicating with said tank and the inclosure, valve means for said outlets and thermostatic means controlling said valve means responsively to the temperature in the inclosure to open communication from the tank successively to the packing in the receptacle and to the inclosure.

7. A refrigerating apparatus for inclosures, comprising a receptacle having insulated walls, an absorbent packing in said receptacle for holding liquid air and exposed at its upper portion for evaporation thereof, a tank for containing liquid air, and a pipe communicating with the lower part of said tank to receive liquid air therefrom and having a connection with the packing in the receptacle to supply liquid air to the packing.

8. A receptacle, a liquid air tank therein, a packing for holding liquid air, filling the space between the tank and receptacle and exposed for evaporation solely at its upper part, said tank having an outlet for liquid air communicating with the lower part of the tank and the lower part of said space.

9. A receptacle, a liquid air tank therein, a packing for holding liquid air, filling the space between the tank and receptacle and exposed for evaporation solely at its upper part, said tank having an outlet for liquid communicating with the lower part of the tank and the lower part of said packing space.

10. A receptacle, a liquid air tank therein, a packing for holding liquid air, filling the space between the tank and receptacle and exposed for evaporation solely at its upper part, said tank having an outlet for liquid communicating with the lower part of the tank and the lower part of said packing space, and a valve controlling said outlet.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 14th day of September, 1905.

GABRIEL A. BOBRICK.

In presence of—

ARTHUR P. KNIGHT,

VERNA A. TALBERT.