

J. F. PLACE.

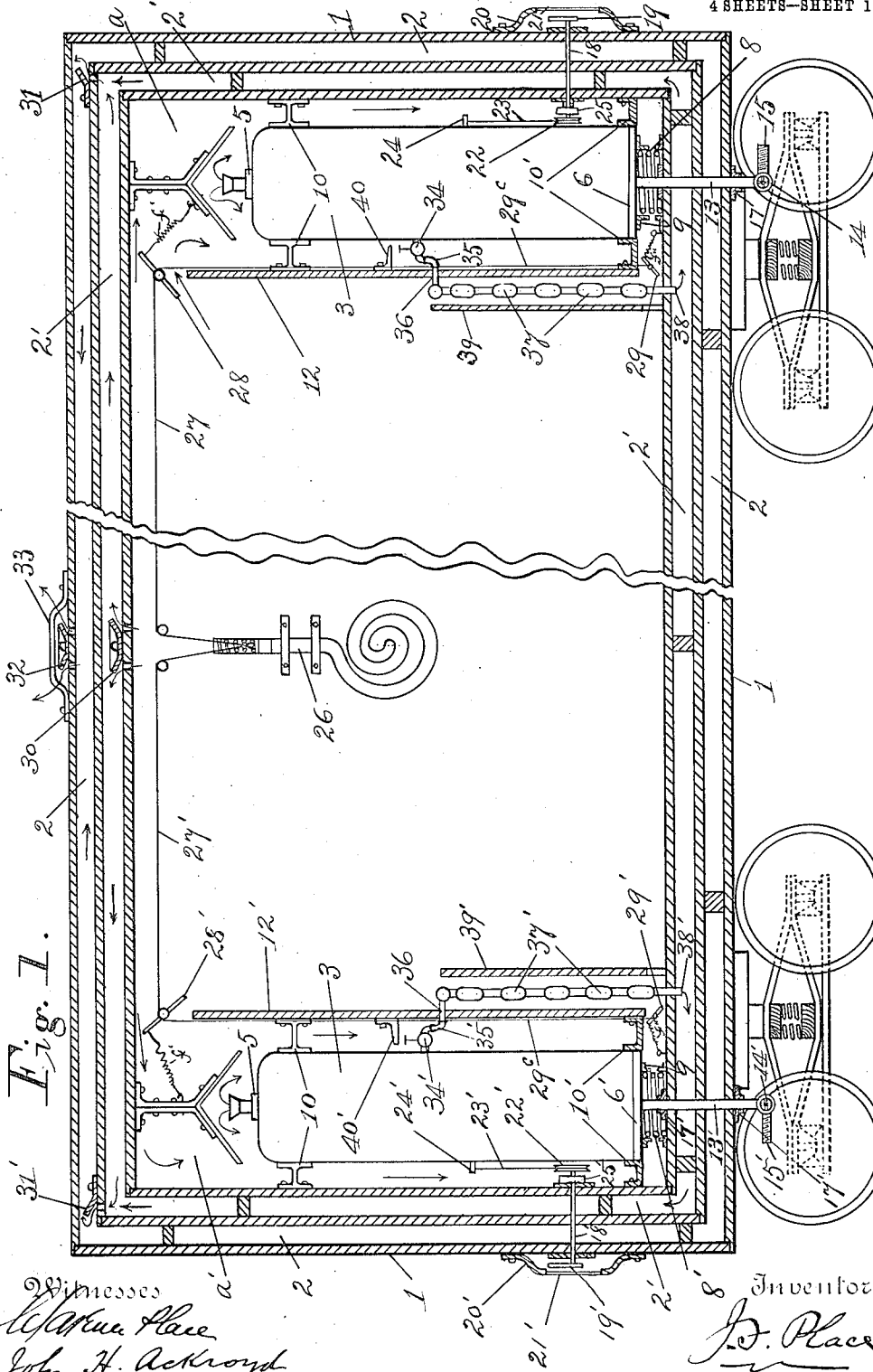
APPARATUS FOR COOLING AND PRESERVING FOODS, &c., BY LIQUID AIR.

APPLICATION FILED NOV. 20, 1906.

927,595.

Patented July 13, 1909.

4 SHEETS—SHEET 1.

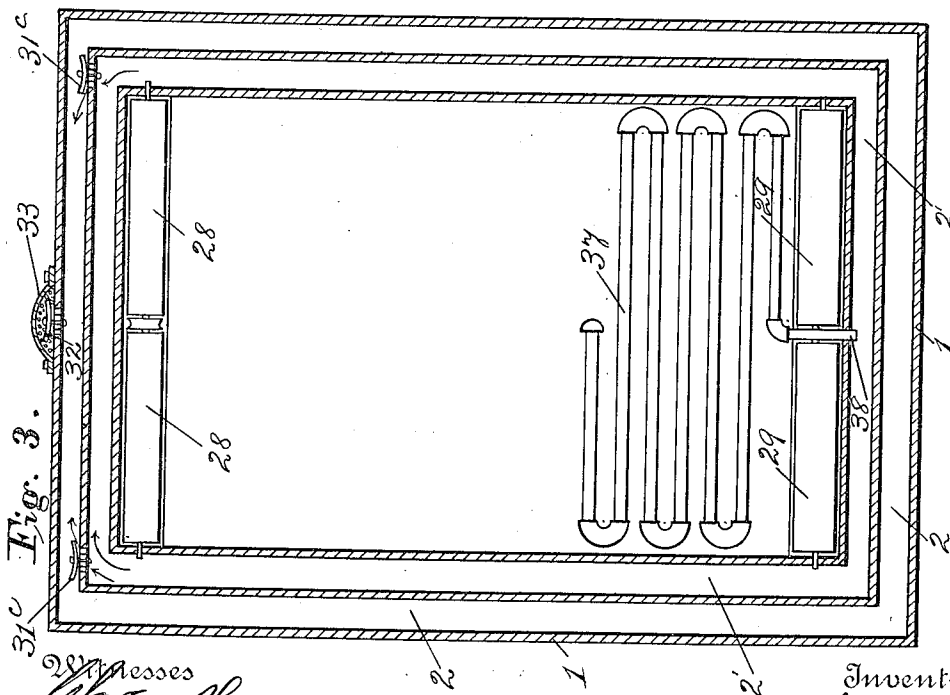
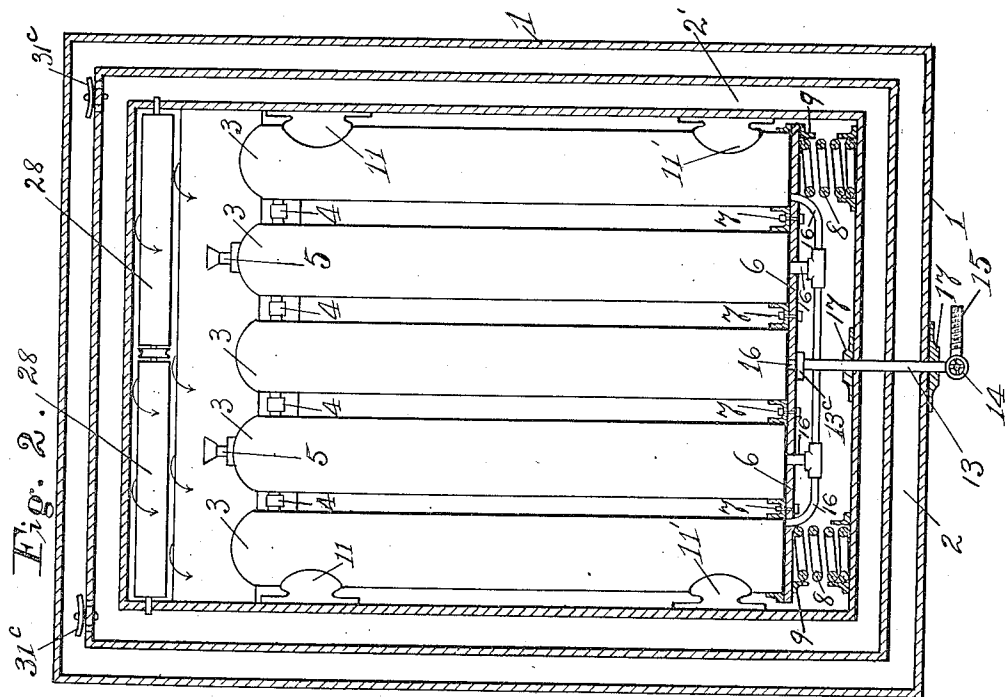


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4 SHEETS—SHEET 2.



Witnesses
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4 SHEETS—SHEET 3.

Fig. 6.

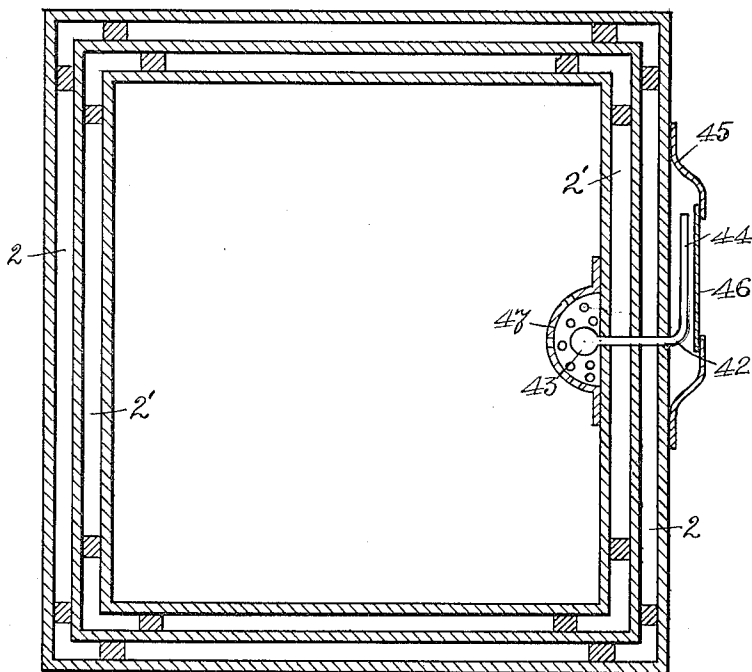


Fig. 4.

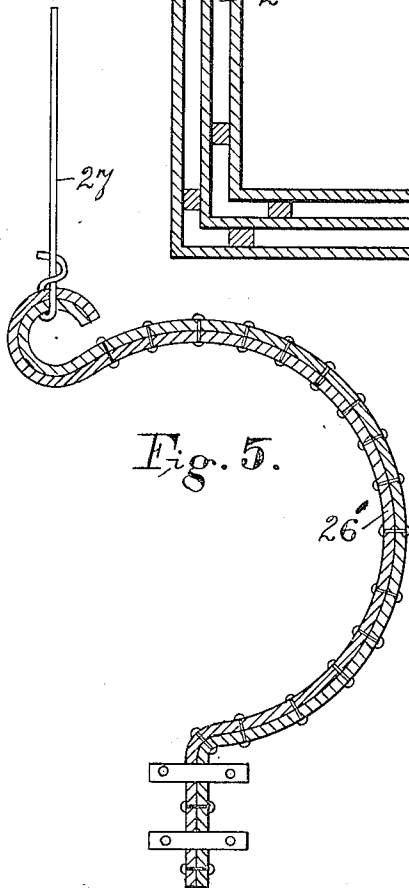
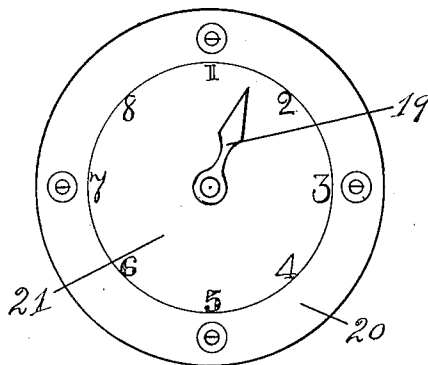


Fig. 5.



Witnesses
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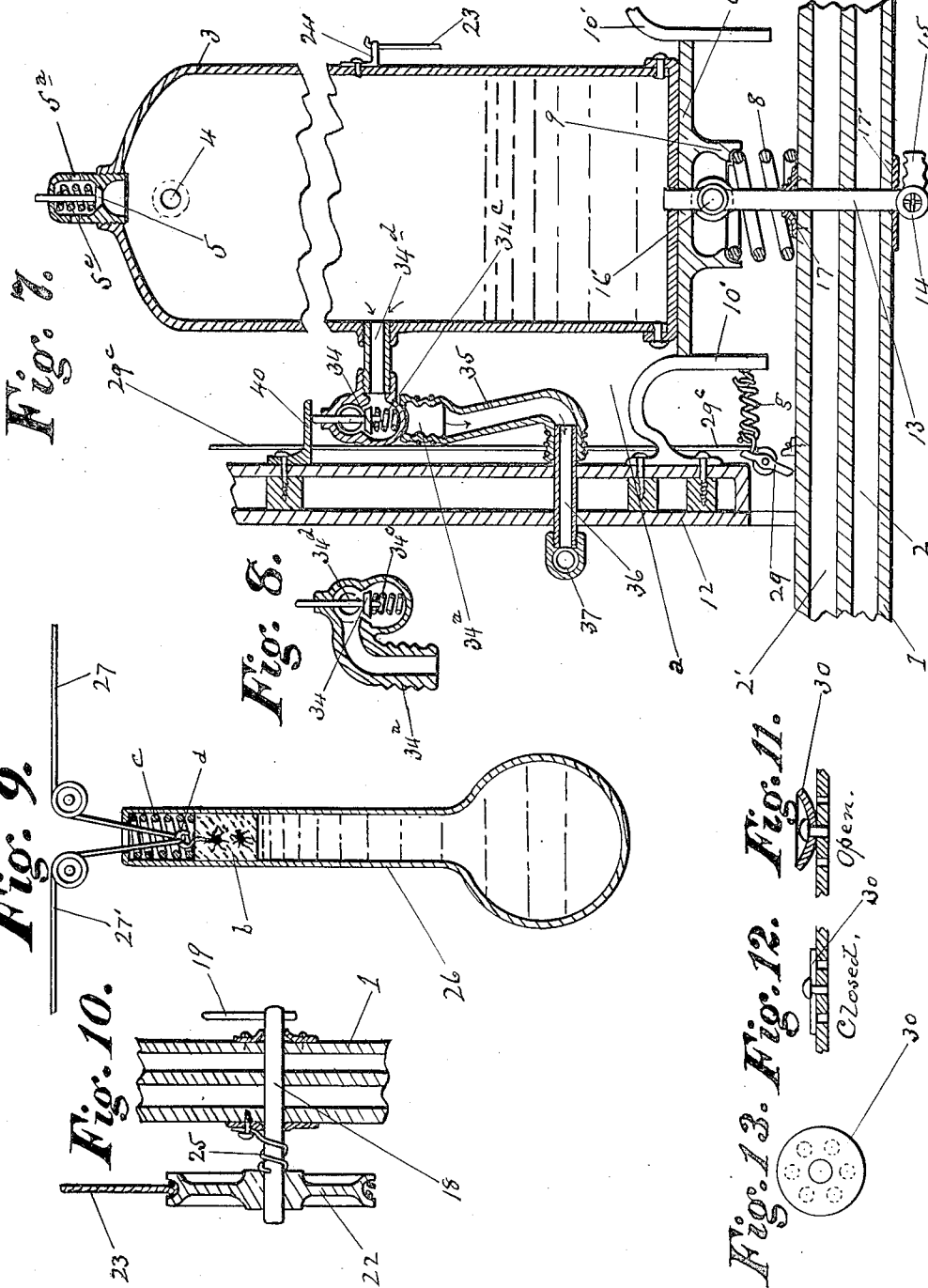
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4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

JAMES F. PLACE, OF GLENRIDGE, NEW JERSEY, ASSIGNOR TO AMERICAN AIR LIQUEFYING CO., A CORPORATION OF NEW YORK.

APPARATUS FOR COOLING AND PRESERVING FOODS, &c., BY LIQUID AIR.

No. 927,595.

Specification of Letters Patent.

Patented July 13, 1909.

Application filed November 20, 1906. Serial No. 344,250.

To all whom it may concern:

Be it known that I, JAMES F. PLACE, a citizen of the United States, and a resident of Glenridge, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Apparatus for Cooling and Preserving Foods, &c., by Liquid Air, of which the following is a specification.

This invention relates to apparatus for cooling railway cars, especially for so called "refrigerator cars;" but it may also be used for cooling and keeping cool cold storage rooms anywhere or wherever fruits, meats or food products are sought to be preserved.

The invention is especially applicable, also, for maintaining relatively low temperatures in cold storage rooms on steamships, and preserving the perishable products during transportation therein.

The object of the invention is to not only maintain a uniformly cool temperature, but to keep the car or storage room dry and pure; to save a large part of the space taken by ice; to reduce the weight of the refrigerant carried by refrigerator cars; and to preserve the perishable products better and at much less cost. I attain these objects by the use of liquid air or liquid nitrogen as the refrigerant and preserver; and by means of the mechanism or apparatus herein described.

In order that those skilled in the art may understand and make use of my invention, I have illustrated it, as used in an ordinary refrigerator car, by the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of such refrigerator car, with the ice bunkers removed, and my apparatus shown located therein. Fig. 2 is a transverse section of the car, or the end removed, showing my apparatus in elevation. Fig. 3 is a similar transverse section, or view from the middle of the car looking toward one of the ends. Fig. 4 shows in elevation a plan or front view of the outside gage or indicator, which indicates to the attendant outside the quantity at all times of liquid air in the containers, holders or tanks inside the car or refrigerating room. Fig. 5 is a modified form of thermostat for use in the car or refrigerating room. Fig. 6 shows a mercury thermometer for indicating outside the car or refrigerating room the temperature therein—the same

being protected by a glass case outside, and the bulb protected by a perforated box inside. Fig. 7 is a longitudinal vertical section of one of the liquid air evaporating holders, showing in detail the safety relief valve and the oxygen automatic discharging valve; Fig. 8 is a transverse view in vertical section of this automatic discharging valve; Fig. 9 shows the mercury thermostat, in vertical section on an enlarged scale; and Fig. 10 is a vertical sectional view of the liquid indicator V wheel and stem, showing details. Figs. 11, 12 and 13 are detail views of the leather or rubber outlet check or flap valve in top of the car or inclosure—the first two being in vertical section, and the other a plan view.

Similar reference marks refer to similar parts throughout the several drawings.

At the numeral 1 I show the car body, which is made with the outer and inner insulating still air spaces 2 and 2', as usually built. Often there are three such still or dead air spaces. At 3 I show a series of light liquid gas tanks, preferably made of thin sheet metal, such as steel or iron. Ten are shown in the drawing, 5 at each end inside of the car, although a larger or less number may be used. These tanks are preferably located on end, and are connected together near the tops by the connecting pipes 4 (see Fig. 2). One or more of these tanks has an escape, or gas discharge, at the top, through suitable safety valves 5 and 5', which safety valves are preferably set so as to discharge at a suitable light pressure, say at from 5 lbs. to 10 lbs. to the square inch inside the tanks. In a detail view (Fig. 7), the preferred construction of these tanks or evaporating liquid air holders, is shown, with also a sectional view of this safety relief or outlet discharging valve 5 or 5'. This valve may be fixed to one holder only, or attached to the connecting pipe 4—in which case only one valve will be required for each series of holders. These tanks (3) are fixed to a common base 6 and 6', by the screws 7 or other suitable fastenings; and these bases are supported by the springs 8 and 8'—preferably of the usual steel wire helical variety; though rubber or any other suitable spring will do. These springs rest on the bottom of the car, and are held in place by any suitable guides, such as shown at 9. These liquid gas tanks are held against lateral motion by the guides 10 and

10' and 11 and 11' respectively, which may be of any suitable construction. These guides are fixed as shown to the car body, and the insulating partitions 12 and 12'.
 5 These insulating partitions 12 and 12' separate the tanks at each end from the interior space of the car, so that the tanks are practically inclosed in a small space a and a' at each end of the car, but are insulated from
 10 the interior loading space. The guides, 10 and 10' and 11 and 11', while preventing the tanks from moving either sidewise or backward and forward, yet allow the tanks on the bases 6 and 6' to freely move up and down as
 15 the resiliency of the springs 8 and 8' allow—or they will move up as the weight in the tanks grows less, or move down whenever they are filled with liquid and the springs are compressed with the increased weight.

20 At the bottom I have charging or discharge pipes 13 and 13' provided with suitable cocks or valves 14 and 14', and hose connections 15 and 15'. These pipes 13 and 13' pass through the car body, preferably at
 25 the bottom, and are fixed to the bases 6 and 6', respectively, as shown at 13^c (Fig. 2). Each pipe 13 and 13' is connected to branch pipes, as shown at 16' in Fig. 7; which connect each with one of the tanks, as shown at 16 in Fig.
 30 2. The pipes 13 and 13' are made so as to readily slide up and down through the bottom of the car, the same being packed with the leather or other suitable packings 17 and 17' respectively, so that no air is allowed to
 35 pass in or out the cars around the pipes. See Fig. 7.

At 18 and 18' I show two small spindles or stems one of which passes through each end of the car, and each of which has fixed to its
 40 outer end, outside the car, an index finger 19 and 19', which are protected by the cases 20 and 20' having the glass face 21 and 21', respectively. On the inner end of these stems 18 and 18' I have fixed suitable grooved pulleys 22 and 22', with a wire or cord 23 and 23', which is attached respectively to the
 45 stud 24 or 24' on one of the tanks 3. The stem is held against this wire or cord by the spiral spring 25 or 25'; so that as the tanks
 50 move up and down on the springs 8 or 8' (as the weight of the liquid gas therein varies), the outside index fingers 21 and 21' will show to the trainman outside exactly how much liquid there is in the series of tanks at
 55 each end of the car. This is an important feature of my invention as will further be explained. In Fig. 4 I show another view of the index gage, showing more clearly some of the details thereof; and in Fig. 10 is shown a
 60 detail view of the V wheel 22 or 22', the stem 18 or 18' and the little helical spring 25 or 25' which holds the wheel 22 or 22' and the index finger 19 or 19' against the cord 23.

At 26 I have a suitable thermostat, made
 65 as shown with a mercury tube. Another

form of thermostat (26') is shown in Fig. 5, consisting of two strips of metal in form of a ring, or horse-shoe, the metal strips being of unequal thermal expansion, such for instance as steel and brass. The mercury thermostat
 70 26 is shown in vertical section on an enlarged scale in Fig. 9. The simplest form of this mercury thermostat (26) is similar to an ordinary mercury thermometer, of a large size, the bulb being extra large, and the glass
 75 tube being open at the top. A cork float b rests on the top of the mercury, and is held to the surface of the mercury by a light spring c ; to this cork may be attached the eye d to which the cords 27 and 27' are fixed.
 80 As the temperature falls the mercury contracts, and helical spring c presses the cork b down as the column of mercury in the tube falls and the cords 27 and 27' pull the gates
 85 28 and 28' and 29 and 29' partially or wholly shut; as the temperature rises in the refrigerating inclosure in which the thermostat 26 is located, the mercury in said thermostat expands and the cork b rises in the tube, and the cords 27 and 27' being loosened, the tension of the springs f and g partially or fully
 90 open the gates 28 and 28' and 29 and 29'.

At 30 I have an escape valve, of leather, or some other suitable material, which opens into the dead air insulating space 2' at the
 95 top of the car. The nitrogen gas, after evaporating in the tanks 3 at each end of the car, and passing up through relief valve 5 or 5', and down out through the gates 29 and 29', and absorbing heat from the car space, finally passes up through this flap
 100 valve 30, and circulating over the top of the car in air-space 2', passes through similar valves 31 and 31' near the end of the car into the insulating air space 2 on top of the car.
 105 From here it passes out into the open through a similar flap valve 32, which is protected by the perforated cover 33. Valves similar to 31 and 31' may be located on the sides near the end, as at 31^c to insure more complete
 110 circulation of the escaping nitrogen gas, (see Fig. 3).

At 34 and 34' (see Figs. 1, 7 and 8) I show check valves connected with one of the liquid air tanks in the series at each end of
 115 the car, and opening the passage in the pipe (34^d) from said tanks into the flexible tubes 35 and 35' respectively. Said flexible tubes are tightly connected with the nipples 36 and 36' respectively, which pass through the insulating partitions 12 and 12' respectively,
 120 and connect with the radiating grillage or pipe loops 37 and 37' (see Figs. 1, 3 and 7). This valve 34 (or 34') as well as the chamber below the same, and the outlet bib 34^a
 125 (which is connected through said valve with the passage in the pipe 34^d) is held firmly in position by the pipe 34^a attached to one of the tanks (see Fig. 7); the valve is kept to its seat by the spring 34^e, until forced open by
 130

the bracket 40. The flexible tube 35 (or 35') at its upper end is slipped over the downwardly projecting hose bib 34^a and made fast thereto, and its lower end is made fast to the pipe 36 in a similar manner, thus forming a connecting passage between the radiating grillage 37, and the tank 3, through the valve 34, whenever said valve is opened by pressure on the bracket 40 when the tank 3 is caused to rise by the spring 8.

At 40 and 40' are shown brackets, fixed to the partitions 12 and 12', see Figs. 1 and 7, respectively, at suitable distances above the spring check valves 34 and 34' so that as the liquid air in the tanks 3 evaporates and the charges therein grow lighter in weight and the tanks rise upwardly on the springs 8 or 8', that the stems of the check valves will press against the brackets 40 and 40' and the valves open. These brackets will be placed at such points so that when the nitrogen (which evaporates first) has all (or substantially all) evaporated, the oxygen liquid as it evaporates in the tanks 3 will pass through the check valves 34 and 34' into the radiating pipe grillage 37 and 37', and not into the car space. This is a valuable feature of my invention, as it enables me to supply to the perishable products in the car, or in a cold storage room, pure dry nitrogen gas all the time, and keep the oxygen gas (which is the prime cause of deterioration and decay) away from contact with such perishable products; and yet to avail of the refrigerative or cooling effect of all of the evaporating liquid air.

The operation of the mechanism or apparatus is very simple: The tanks 3 are filled with liquid air, (which is kept at a convenient station under a suitable pressure) through a leather or other suitable flexible hose attached to the nipples 15 and 15'. This liquid air is a mixture of about 80% in volume of liquid nitrogen, and about 20% of liquid oxygen—or practically the same proportions as the atmosphere. The temperature of the car being above that for which the thermostat 26 or 26' is set, the dampers 28 and 28' and 29 and 29' are open. The car is then preferably filled with whatever merchandise is desired to be kept cool and preserved, and is then closed—preferably air-tight. The circulation of the air in the car space commences, and the warmer air passes in at the top through the gates 28 and 28', into the insulated inclosures *a* and *a'* in which are located the liquid air tanks, and down and around the tanks in the said inclosures at the ends of the car. This circulation sets up an evaporation of the liquid air in the tanks at once, and the circulating air around the tanks being cooled, falls by gravity to the bottom, and passes out through the gates 29 and 29' into the car-space, mixed with the nitrogen gas escaping from the safety valves 5 and 5'

—for the nitrogen passes off first as the liquid air evaporates in the tanks. As the car or cold storage room becomes filled with cool nitrogen, the warmer air in the car space is forced out by the accumulating pressure through the valves 30, 31 and 31' and 32. This operation continues until gradually all of the air, practically, in the car-space is replaced by cool nitrogen gas. In many cases 90% of the car-space is occupied by the load of fruit or other perishable food products; so that the car is filled many times each hour with the cool nitrogen gas evaporating from the liquid air charges in the tanks. As the fruit, meats or other products and the car space become cooled to the temperature desired, the thermostat 26 acts, and the gates 28 and 28' and 29 and 29' gradually close, until finally the liquid air tanks are shut off from the circulating air in the car space. The tanks thus being in an insulated inclosure, *a* or *a'*, with little or no circulation around them, evaporation of the liquid air in the same is retarded, and finally reaches such a low stage, that it is just sufficient to neutralize the heat which passes through the walls of the car. Gates 28 and 28' can be arranged to close air-tight, and gates 29 and 29', closed not so tight but that the nitrogen gas escaping from the tanks may pass into the car space. When the bulk of the nitrogen has evaporated from the liquid air charges, the loss of weight will cause the tanks to be lifted up on the springs 8 or 8', and the brackets 40 and 40' will come in contact with valve stems of check valves 34 and 34' respectively and pressing down the spring 34^c, open said valve. The evaporated gas in the tanks, being then relieved from pressure will no longer lift the safety valves 5 and 5' (for the spring 5^c will close the valve), but will pass out through the radiating pipe loops 37 and 37' into the insulating spaces 2' and 2 and out into the open through the flap valve 32. The brackets 40 and 40' may be so adjusted as to open the check valves 34 and 34' when the nitrogen has about all passed off, so the residue or oxygen does not pass into the car space, and does not come in contact with the fruit or other products being cooled or preserved.

If it is desired to save the oxygen, 25% more liquid air may be put into the tanks than ordinarily required for a day's run; and then when the index gages 19 and 19' show that about four-fifths of the charges have evaporated, a hose may be attached to the bibs 15 and 15' and by opening the cocks 14 and 14' successively, the oxygen liquid may be forced out by its own pressure into an insulated storage tank kept for the purpose at the station.

It will be seen that the cold gases as delivered to the spaces 2 and 2' in the car body, whether delivered from the loading space or

from the pipes 38 and 38', will set up and maintain a constant circulation all through said spaces, thereby insulating the interior of the car from the normal heat of the outside atmosphere; the top of the car, which is most exposed to the sun, being doubly insulated in this respect.

In Fig. 6 I show an ordinary mercury thermometer 42, the bulb 43 being located inside the car space or cold storage room, and the stem 44 outside, graduated on the stem and protected by the outside frame 45, and having the glass face 46, so the temperature inside can be readily seen at all times from the outside. The bulb inside is protected by the perforated case 47.

While the drawings illustrate a refrigerator car, with dead or still air insulating spaces around the same, as ordinarily built; yet it may also serve to illustrate the applicability of my invention to any cold storage room, or any inclosure or space to be cooled, or used for the storage and preservation or for cooling or refrigerating of meats, fruits, fish, eggs, or any other perishable foods or food products, whether being preserved in warehouses, markets, hotels or residences, or during transportation in cars or steamships.

The words "insulation," "insulated" or "insulating" used herein; refer to insulation against circumambient heat, or the normal heat of the atmosphere, or the environment of the substance or space sought to be insulated or cooled.

Having thus described my invention what I claim as new and original and desire to secure by Letters Patent, is—

1. In an apparatus for cooling by evaporating liquid air, an insulated inclosure to be cooled having a separate insulated compartment therein, and operating gates connecting said separate compartment with said inclosure; in operative combination with a non-insulated liquid-gas evaporating holder within said separate compartment, having a valved passage in or near its top connecting said holder with and delivering to said compartment, arranged to open at and by a predetermined light pressure; and a thermostat within said inclosure to be cooled, arranged to operate said gates as the temperature in said inclosure changes—whereby the amount of air allowed to circulate in a given time from said inclosure through said compartment and over said holder, and be thus subjected to the cooling action of the evaporating liquid therein, is increased or diminished as the temperature in said inclosure changes, thereby increasing or diminishing the evaporation of the liquid air in said holder and the delivery of the cold evaporated gases therefrom to said compartment and said insulated inclosure.

2. An apparatus for cooling by liquid air, comprising in operative combination, an in-

ulated inclosure to be cooled, having a separate insulated compartment therein; a liquid-gas evaporating holder within said separate compartment, uninsulated and exposed to the air-currents therein, and arranged to be charged with liquid-air—said holder having a spring-actuated valve connecting the same with said separate compartment, arranged to open at or by a predetermined light pressure; an operating gate connecting said inclosure to be cooled with said separate compartment therein; and a thermostat within said inclosure to be cooled, arranged to open or close said gate as the temperature rises or falls in said inclosure.

3. In an apparatus for cooling by liquid air, the combination with the refrigerating room or inclosure to be cooled, of a separate compartment formed by a partition therein and connected therewith by openings at the top and bottom of the partition wall separating the same; one or more vertically-movable evaporating tanks or liquid-gas holders within said separate compartment adapted to be charged with liquid air, and having one or more springs on which they are supported; a safety relief valve connected with said tank or holders, near the top thereof, and set so as to open only at a pre-determined light pressure; a discharging or pressure-releasing check-valve connected with said tank or holders; and a bracket fixed to the partition wall of said compartment—the parts being so arranged that as said liquid-air charge evaporates and thereby becomes lighter in weight said tank or holders will rise on the spring supports and at a pre-determined point said check valve will come in contact with said bracket and automatically be opened thereby, and the release of the pressure in said tank or holder will permit said safety valve to close.

4. An apparatus for cooling by liquid air, comprising in operative combination a refrigerating room or inclosure to be cooled, having insulated inclosed air spaces around the same; a separate insulated inclosure connected with said refrigerating room; radiating pipes located within said refrigerating room, and connected at the outlet or delivery end thereof with said insulating air-spaces; a vertically movable liquid gas evaporating holder, arranged to be charged with liquid air, located within said separate inclosure—said holder having two spring-actuated check valves, one of which is connected with and delivers to said radiating pipes and the other to said separate inclosure; one or more springs arranged to support said holder—whereby it automatically falls or rises with the increase or decrease of the weight of the liquid-gas charge therein; and means for automatically operating one of said valves by the vertical movement of said evaporating holder.

5. In an apparatus for cooling by liquid

air, the combination with a refrigerating room or inclosure to be cooled, insulated from the normal heat of the atmosphere by inclosed air-spaces around the same, of a separate insulated compartment; radiating pipes within said refrigerating room delivering to the insulating air-spaces around the same; a vertically movable evaporating holder, arranged to be charged with liquid air, within said separate compartment, having two valves—one delivering to said separate compartment and the other to said radiating pipes; one or more springs on which said liquid-air evaporating holder is supported—whereby said holder falls and rises on said spring support as the weight of the liquid charge therein varies, or the tension on said spring support is increased or diminished; and means for automatically operating one of said valves by the vertical movement of said holder.

6. In an apparatus for cooling by liquid gas, the combination with a refrigerating room, or inclosure to be cooled, insulated from the normal heat of the atmosphere, of an insulated liquid-gas evaporating chamber separated from said refrigerating room by an insulating transverse partition having inlet openings to said evaporating chamber from said refrigerating room over or near the top of said partition, and outlet openings from said chamber to said refrigerating room, under or near the bottom of said partition—said inlet and outlet openings being controlled by gates; a liquid-gas uninsulated evaporating container within said evaporating chamber, exposed to the air currents therein, arranged to be charged with liquid gas and having a spring-actuated gas-valve opening therefrom, and means for operating said gates by a thermostat in said refrigerating room, thereby controlling the degree or rapidity of evaporation of the liquid-gas charge in said evaporating container within said separated liquid-gas evaporating chamber.

7. In an apparatus for cooling by liquid air, the combination with a refrigerating room, or inclosure to be cooled, insulated from the normal heat of the atmosphere, of an insulated liquid-air evaporating chamber separated from said refrigerating room by an insulating partition having inlet openings to said evaporating chamber from said refrigerating room over or near the top of said partition, and outlet openings from said chamber to said refrigerating room, under or near the bottom of said partition; a liquid-air evaporating container within said evaporating chamber, exposed to the air-currents therein, and arranged to be charged with liquid air; and means for controlling the size of said inlet and outlet openings by the changes in temperature of said refrigerating room, and thereby regulating the degree or rapidity of evaporation of said liquid-air charge in the

exposed container within said evaporating chamber, and means for automatically delivering the first gaseous products of distillation, or a predetermined part of said liquid-air charge as evaporated, into said refrigerating room, and the later gaseous products of distillation, or the remainder of said liquid-air charge, to the open air without passing into said refrigerating room.

8. In an apparatus for cooling by liquid air, the combination with a refrigerating room, or inclosure to be cooled, insulated from the normal heat of the atmosphere, of a separate insulated liquid-air vaporizing chamber connected therewith; a liquid-gas evaporating container, located in said chamber, arranged to be exposed to the air-currents therein and to be charged with liquid air—said container having an outlet for the gaseous products of distillation therein, delivering to said chamber; means for controlling the air-currents in said liquid-air vaporizing chamber by the changes in temperature of said refrigerating room, and thereby regulating the degree or rapidity of evaporation of the liquid-air charge in said container, and means for vaporizing a predetermined proportion of said liquid-air charge, or only the gases richer in nitrogen, and delivering the same to said chamber and thence to said refrigerating room or inclosure to be cooled.

9. In an apparatus for cooling and preserving perishable food products by liquid air, the combination with a refrigerating room or inclosure to be cooled, insulated from the normal heat of the atmosphere, and having therein a cooling radiating pipe or pipes; of a separate insulated inclosure, and a vessel or evaporating holder therein arranged to be charged with liquid air; means for automatically regulating the evaporation or rapidity of fractional distillation of said liquid-air charge by control of the air circulation in said separate inclosure, and delivering to said refrigerating room or inclosure to be cooled the nitrogen substantially thereof as it evaporates, and means for passing the oxygen substantially through said radiating pipe or pipes—whereby the cooling effect of both gases evaporated from said liquid-air charge is utilized, but only those richer in nitrogen are allowed to come in contact with the perishable products being preserved.

10. In an apparatus for cooling by the evaporation of liquid air, the combination with a refrigerating room or cold-storage inclosure, of a separate vaporizing chamber insulated from said cold-storage room, but connected therewith by regulated openings at or near the top, or ceiling, and at or near the bottom, or floor thereof, respectively; an uninsulated liquid-air evaporating container, located in and having a gaseous outlet delivering to said separate chamber, and exposed to the gaseous currents therein from

said cold-storage inclosure; and means for regulating the size or dimensions of said upper and said lower openings by a thermostat located in said refrigerating room or cold-storage inclosure.

11. An apparatus for cooling and preserving perishable food products by the fractional distillation of liquid air, comprising in operative combination, a cold-storage room or insulated inclosure having a radiating pipe or pipes therein delivering outside thereof; means for automatically delivering substantially the nitrogen only, or first gaseous products of distillation of liquid air, direct to and in contact with said perishable food products in said insulating inclosure; and means for conducting substantially the oxygen, or the later gaseous products of distillation of said liquid air, through said radiating pipe or pipes—thereby utilizing the cooling effect of said later gaseous products of distillation without bringing same in contact with said perishable foods.

12. In an apparatus for cooling and preserving perishable foods by the fractional distillation of liquid air, an insulated inclosure adapted to transport or store therein said perishable foods, in operative combination with means for automatically delivering the first gaseous products of distillation of a liquid-air charge, or substantially the nitrogen only, to and in contact with the perishable foods in said insulated inclosure, and for utilizing the refrigerative effect of the later gaseous products of said distillation, or substantially the oxygen of said liquid-air charge to cool said insulated inclosure, without allowing same in contact with said perishable foods.

13. An apparatus for cooling by liquid gas, railway cars used for the transportation of perishable goods, comprising in combination with an insulated refrigerator car, a separate insulated compartment within said car; an upper and a lower opening and closing gate, connecting said separate compartment with the storage room or inclosure used for transportation of goods in said car; a liquid-gas evaporating holder within said separate compartment; uninsulated and exposed to the air-currents therein, and having an outlet at the upper end thereof; and a thermostat within the storage inclosure used for goods, arranged to operate both of said gates as the temperature changes in said storage inclosure—thereby increasing or diminishing the opening or passage between said storage inclosure and said separate compartment, and correspondingly increasing or diminishing both the circulation of the air or other gases through the same, and the evaporation of the liquid gas in and delivery of the cold evaporated gases from said holder.

14. In an apparatus for cooling by liquid air, railway cars used in the transportation of

perishable goods, the combination with an insulated refrigerator car, of a separate insulated compartment within said car having an operating gate or damper connecting said compartment with the insulated inclosure or space in said car used for the transportation of goods; a liquid-gas evaporating holder within said compartment, uninsulated and exposed to the air-currents therein—arranged to be charged with liquid gas under light pressure, and having a spring-actuated valve in or near its upper end connecting said evaporating holder with and delivering to said separate compartment; and a thermostat within the inclosure used for goods in said car, in operative connection with said gate—the parts being so arranged that as the temperature rises in the inclosure used for goods in said car, the thermostat opens said gate and as the temperature falls therein it closes or partially closes the same.

15. An apparatus for cooling and preserving perishable foods by liquid air during transportation, comprising a refrigerator car having a transverse insulating partition forming a compartment within said car separate from the inclosure used for the transportation of goods; in combination with a vertically-movable tank or liquid-air evaporating container, adapted to be charged with liquid air; a projecting bracket fixed to said partition; one or more springs upon which is supported said evaporating container; and two valves connected with said tank or liquid-air evaporating container—one an outwardly delivering gas check-valve at or near the top of said container, and set so as to open at a pre-determined pressure therein, and the other a pressure-releasing valve, fixed so as to be operated by said bracket—the parts being so arranged that as said liquid-air charge evaporates and thereby becomes lighter in weight, said container will rise on its spring-support, and at a pre-determined point said pressure-releasing valve will come in contact with said bracket and automatically be opened thereby, and by thus releasing the pressure in said container permit the other valve to close.

16. An apparatus for cooling and preserving by liquid air perishable food products during transportation, comprising in operative combination a refrigerator car having insulating air inclosed spaces around the same; a separate insulated inclosure within said car-body; radiating pipes located within the space used for transportation of goods in said car, and connected at the outlet or delivery end thereof with said inclosed insulating air spaces; a vertically-movable liquid-air evaporating holder, arranged to be charged with liquid air located within said separate insulated inclosure—said holder having two escape or outwardly-delivering gas valves, one of which is connected with and delivers

to said radiating pipes, and the other to said separate insulated inclosure; one or more springs on which is supported said liquid-air evaporating holder—whereby said holder rises or falls on said springs as the liquid air charge therein is diminished or increased; and means for actuating said valves, arranged to be brought into operation as the evaporation of the liquid air in said holder proceeds.

17. An apparatus for cooling and preserving perishable food products during transportation in railway cars, comprising in combination with a refrigerator car having insulating air spaces around the same; radiating pipes within the space reserved for transportation of goods, said pipes delivering to the insulating air spaces around said car; a separate inclosure within said car body, and a vertically movable evaporating tank or holder therein arranged to be charged with liquid air, said holder being provided with and supported on one or more springs;—whereby said holder rises and falls on said spring support as the weight of the liquid charge therein varies, and the tension on said spring or springs is increased or diminished; two valves connected with said holder—one delivering to said separate inclosure and the other to said radiating pipes; and means for automatically operating one of said valves by the vertical movement of said holder.

18. In an apparatus for cooling insulated refrigerator cars by liquid air, the combination with a car of a liquid-air evaporating chamber therein separated by an insulating partition from the refrigerated inclosure in said car used for transportation of goods, but connected therewith; a liquid-air evaporating container in said separate chamber, arranged to be charged with liquid air at a tension slightly above atmospheric pressure in operative combination with means for automatically regulating the evaporation of said liquid-air charge operated by the changes in temperature of said refrigerated inclosure for goods; and means for indicating outside of said car during the operation of the apparatus the quantity of liquid air at all times in said container.

19. In an apparatus for cooling and preserving perishable food products by the fractional distillation of liquid air, the combination with an insulated inclosure adapted to store or transport therein said perishable products; of means for automatically delivering substantially the nitrogen only, or first gaseous products of distillation of liquid air, to and in contact with the perishable foods in said inclosure; and means for separating the later product of evaporation and conducting the same in proximity to the compartment for perishable products for cooling the same.

20. In an apparatus for cooling and pre-

serving perishable food products by the fractional distillation of liquid air, the combination with an insulated inclosure adapted to store or transport therein said perishable products, of a liquid-air evaporating container; means for allowing the warmer gases in said insulated inclosure to be delivered in surface contact with said container, and thereby evaporating the liquid-air charge therein; a thermostat in said inclosure, arranged to regulate the flow or delivery of said warmer gases from said inclosure by the changes of temperature therein; and means for delivering the first gaseous products of said distillation, or substantially the nitrogen only to and in contact with said perishable products.

21. In an apparatus for cooling and preserving by liquid air, perishable foods or food products during transportation in refrigerator cars insulated from the normal heat of the atmosphere, the combination of a refrigerator car having a separate compartment therein communicating with the car-body space; a receptacle or liquid-air evaporating holder in said compartment, arranged to be charged with liquid air; radiating pipes in the refrigerating storage inclosure, or car-space used for the perishable products, delivering outside thereof; means for automatically regulating the evaporation or rapidity of fractional distillation of said liquid-air charge; and means for automatically delivering to the separate compartment and from thence to the car-space used for goods the nitrogen, substantially, of said liquid-air charge as it evaporates, and for passing the oxygen, substantially, of said evaporating liquid charge through said radiating pipes—whereby the cooling effect of both gases from said liquid-air charge is utilized, but only those gases richer in nitrogen are allowed to come in contact with the perishable foods or food products being transported in said car.

22. In an apparatus for cooling by liquid air refrigerator cars insulated from the normal heat of the atmosphere, the combination of a liquid gas evaporating chamber in said car, separated from the inclosure for storage of goods by an insulating partition, but connected therewith; a liquid gas evaporating container in said separate chamber, arranged to be charged with liquid gas at a tension slightly above atmospheric pressure; and means for automatically regulating the degree or rapidity of evaporation of the liquid-air charge in said container by a thermostat located in the inclosure for transportation of goods in said refrigerator car; and means for allowing the products of distillation of a predetermined proportion of said liquid-air charge to be delivered to said storage inclosure.

23. An apparatus for cooling and preserv-

ing by fractional distillation of liquid air the perishable food products being transported in refrigerator cars, comprising in operative combination, an insulated refrigerator car 5 having radiating pipes therein, delivering outside thereof; a liquid air holder; means for automatically delivering substantially nitrogen only, or the first gaseous products of distillation of liquid air, to and in contact with the 10 perishable products in said car; and means for passing the oxygen or the later gaseous products of said distillation, through said radiating pipes and delivering same outside of said car—whereby the cooling effect of 15 said oxygen or the later gaseous products of distillation, is utilized without bringing same in contact with said perishable goods.

24. An apparatus for cooling and preserving by fractional distillation of liquid air the 20 perishable foods or food products being transported in refrigerator cars, comprising in operative combination a refrigerator car having an inclosure therein for storage of the perishable products—said inclosure being 25 insulated by air spaces around the same, having an outlet or means of egress only to the open air; a liquid-air holder; means for automatically delivering substantially nitrogen only or the first gaseous products of 30 distillation of liquid air, to said storage inclosure; and means for passing the oxygen substantially or the later gaseous products of said distillation through said air spaces around the car—thereby utilizing the cooling 35 effect of said later gaseous products of said distillation without bringing same in contact with said perishable goods or admitting same to said storage inclosure.

25. In a liquid-air cooled steamship refrigerating room or insulated cold-storage inclosure, the combination of a separate compartment having therein a liquid-air container or evaporating holder; and means for 40 regulating the evaporation of the liquefied air in said holder by a thermostat in said refrigerating inclosure; and means for delivering to said refrigerating room a pre-determined proportion of the liquid charge as distilled in said evaporating container.

50 26. In an apparatus for cooling and preserving perishable foods by the fractional distillation of liquid air, an insulated inclosure adapted to transport or store therein such perishable foods, and a liquid-air 55 holder in operative combination with means for automatically controlling the evaporation, of all the gaseous products of distillation, of a liquid-air charge, by the temperature of said insulated inclosure; and means 60 for delivering the first gaseous products of said distillation, or substantially the nitrogen only, to and in contact with said perishable

foods and for preventing the later gaseous products of said distillation, or substantially the oxygen, from coming in contact with said 65 perishable foods.

27. In a liquid-air cooled railway refrigerator car, a separate compartment having a liquid-air container or evaporating holder therein, in operative combination with 70 means for regulating the evaporation of the liquefied gas in said holder, by a thermostat in said car; and means for delivering to said car a pre-determined proportion of the liquid charge as distilled in said evaporating 75 container.

28. In an apparatus for cooling and preserving perishable foods, by the fractional distillation of liquid air, a liquid-air holder and means for utilizing the refrigerative and 80 preservative effect of the first gaseous products of distillation of a liquid-air charge, or substantially the nitrogen only, by delivering the same to and in contact with said perishable foods; in operative combination with 85 means for utilizing the refrigerative effect of the later gaseous products of said distillation, or substantially the oxygen to cool said perishable foods, without permitting same 90 in contact therewith.

29. An apparatus for cooling and preserving perishable goods during transportation, comprising in operative combination a railway refrigerator car, having therein a liquid-air container or evaporating holder; means 95 for delivering the warmer gases in said car to and controlling the circulation thereof over or around said holder—whereby the evaporation or fractional distillation of the liquid air in said holder is increased or diminished; 100 and means for causing a pre-determined proportion of said products of distillation to be delivered to the inclosure used for transportation of goods in said car.

30. In an apparatus for cooling and preserving perishable foods by the evaporation 105 of liquid gas, the combination with an insulated inclosure adapted to store or transport therein said perishable foods, of a liquid-gas evaporating holder, and means for 110 automatically controlling the evaporation of the liquid-gas charge in said holder according to the temperature of said insulated inclosure, and automatically regulating the delivery of the gaseous products of said distillation to said car. 115

Signed at New York, in the county of New York and State of New York this 25th day of October A. D. 1906.

JAMES F. PLACE.

Witnesses:

CLARENCE PLACE,
JOHN H. ACKROYD.