(No Model.)

4 Sheets—Sheet 1.

W. E. EASTMAN.

AUTOMATIC REFRIGERATOR.

No. 469,296. Patented Feb. 23, 1892.

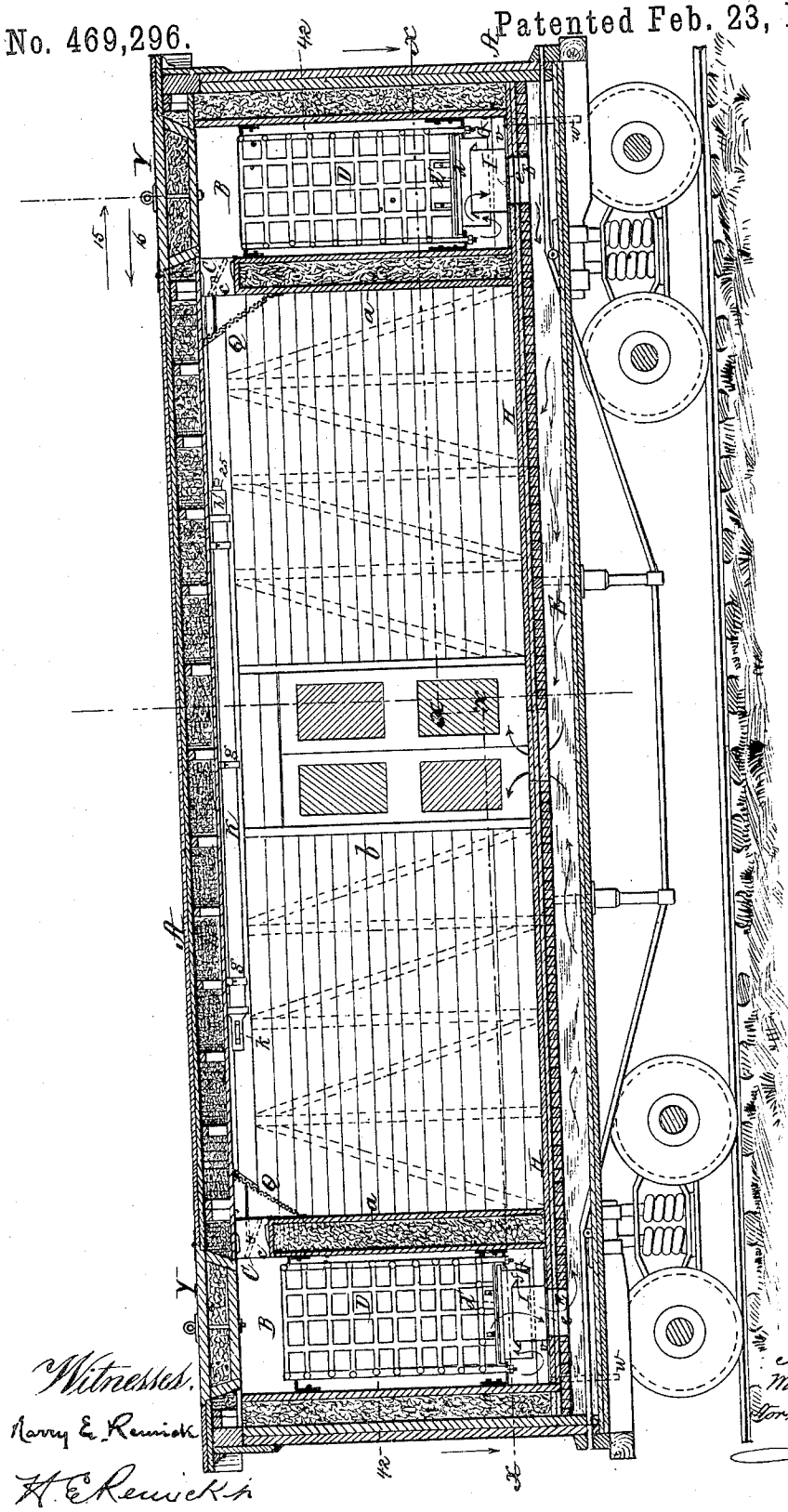

Fig. 1.

Witnesses.
Harry E. Renwick
H. E. Renwick Jr.

Inventor,
William E. Eastman
by Norman W. Stearns
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(No Model.) 4 Sheets—Sheet 2.

W. E. EASTMAN.

AUTOMATIC REFRIGERATOR.

No. 469,296. Patented Feb. 23, 1892.

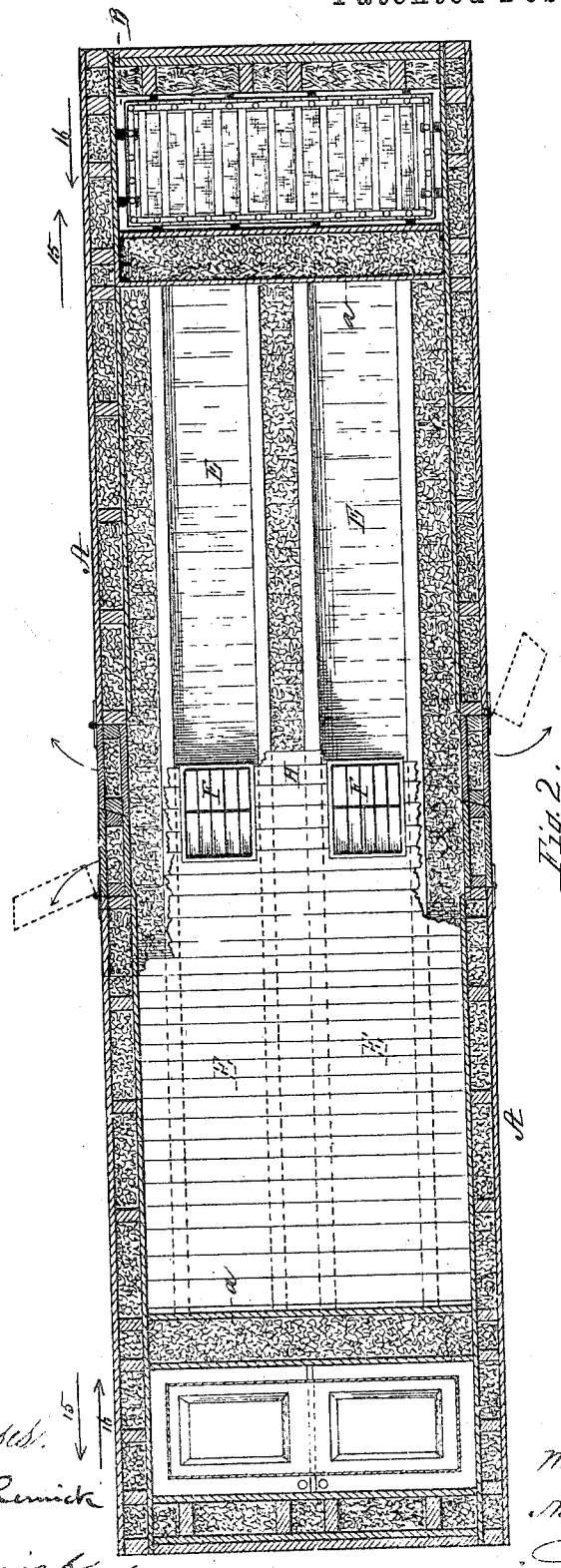

Fig 2.

Witnesses:
Harry E. Renick
H. E. Renick Jr.

Inventor:
William E. Eastman
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Norman W. Stearns
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(No Model.) 4 Sheets—Sheet 3.

W. E. EASTMAN.

AUTOMATIC REFRIGERATOR.

No. 469,296. Patented Feb. 23, 1892.

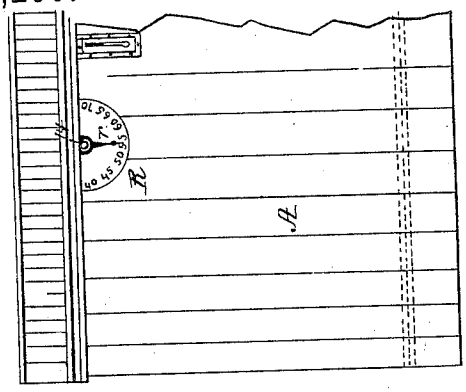

Fig. 5.

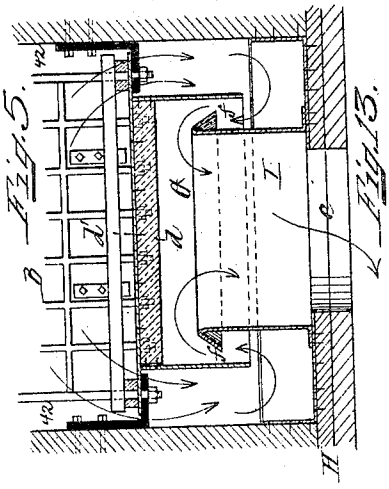

Fig. 1.

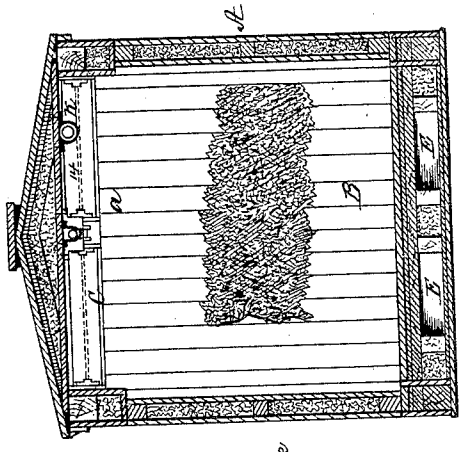

Fig. 4.

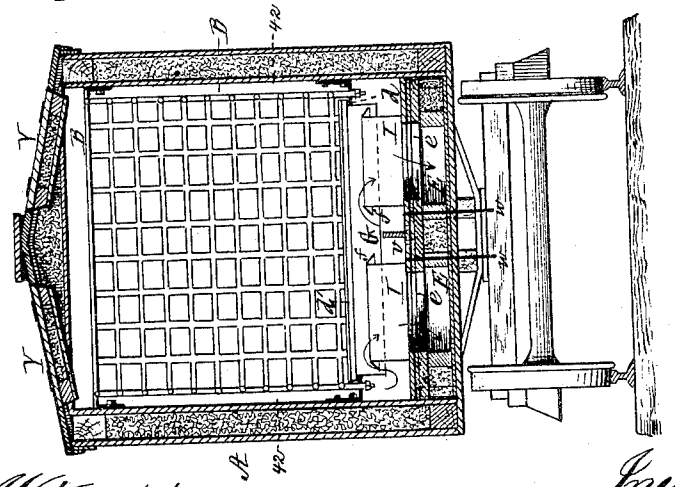

Fig. 3.

Witnesses.

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Inventor.

William B. Eastman

per

Norman W. Stearns

Atty.

(No Model.)

4 Sheets—Sheet 4.

W. E. EASTMAN.

AUTOMATIC REFRIGERATOR.

No. 469,296. Patented Feb. 23, 1892.

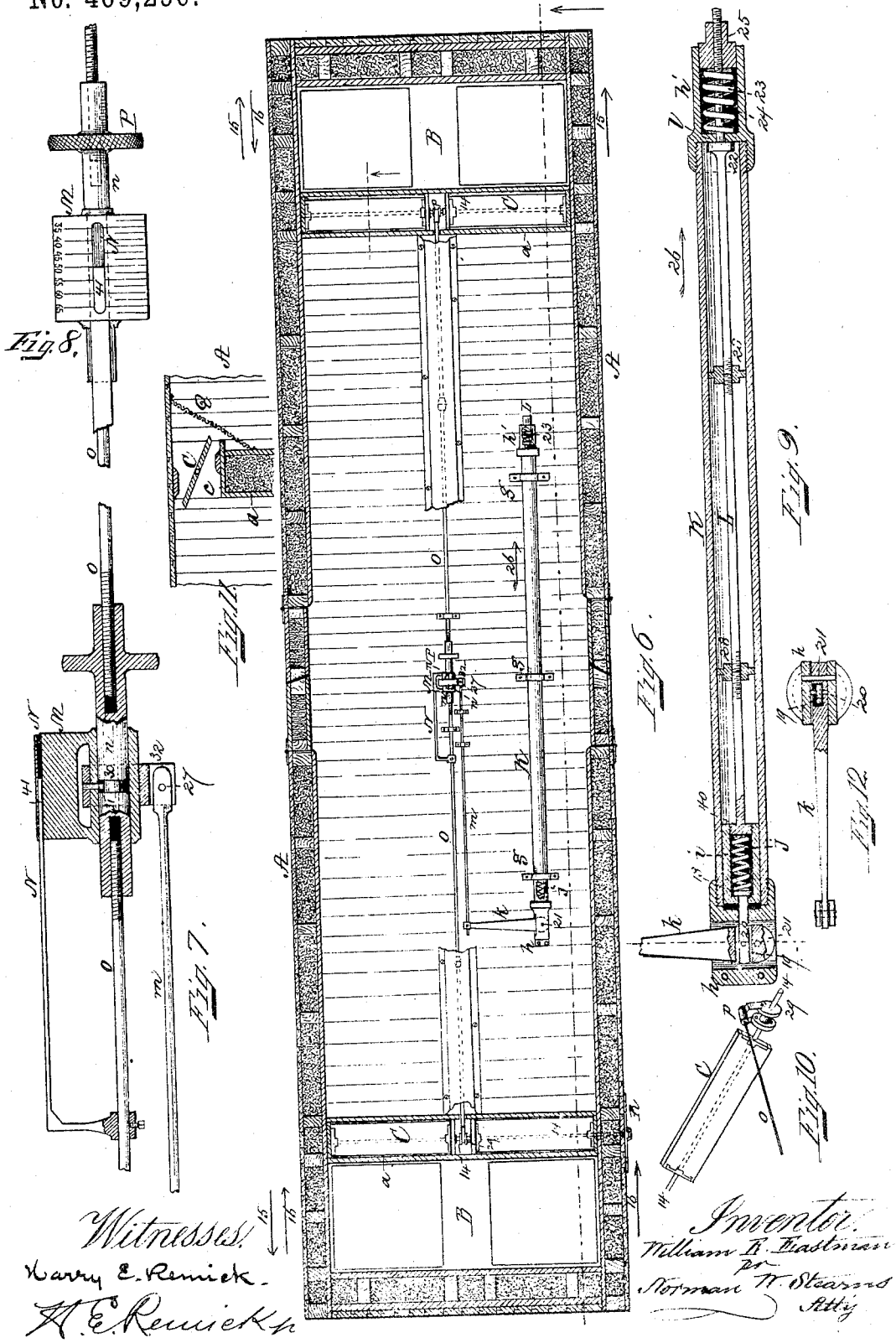

Fig. 8.

Fig. 11.

Fig. 7.

Fig. 6.

Fig. 9.

Fig. 12.

Fig. 10.

Witnesses.
Harry E. Remick.
H. E. Remick Jr.

Inventor.
William E. Eastman
per
Norman W. Stearns
Atty

UNITED STATES PATENT OFFICE.

WILLIAM E. EASTMAN, OF BOSTON, MASSACHUSETTS.

AUTOMATIC REFRIGERATOR.

SPECIFICATION forming part of Letters Patent No. 469,296, dated February 23, 1892.

Application filed October 23, 1890. Serial No. 369,097. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM E. EASTMAN, of Boston, in the county of Suffolk and State of Massachusetts, have invented an Automatic Refrigerator, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a vertical longitudinal section taken near the center of a refrigerator-car constructed in accordance with my present invention. Fig. 2 is a horizontal longitudinal section on the line $x\ x$ of Fig. 1. Fig. 3 is a vertical transverse section showing an ice-receptacle at one end of the car, looking in the direction of the arrows 15, Figs. 1 and 2. Fig. 4 is a vertical transverse section through the air-space between an ice-receptacle and the freight-compartment, looking in the direction of the arrows 16, Figs. 1 and 2. Fig. 5 represents a portion of the outside of the car and showing a thermometer located on the inside of the car and seen through a window, and also showing a dial and its index or pointer connected with the shaft of the air-valves and by which the degree of temperature inside is known. Fig. 6 is a horizontal longitudinal section taken a little below the top of the inside of the car inverted and having attached to its ceiling an automatic-valve-operating mechanism and an interposed index mechanism for controlling the degree of temperature and excess of expansion of the automatic valve-operating device, said automatic and controlling mechanism forming the subject-matter of another application soon to be filed by me. Figs. 7, 8, 9, 10, 11, 12, and 13 are details of the regulating mechanism, to be fully referred to hereinafter.

To preserve fruit, vegetables, fish, fowl, meat, &c., in a sweet, fresh, and marketable condition, it is necessary to ascertain by observation and experiment what is the particular degree of temperature of the surrounding air required for the proper preservation of each, respectively, and then to maintain such temperature without variation.

The object of this invention is to produce a refrigerator so constructed that any desired predetermined degree of temperature may be maintained therein for a considerable period of time by automatic means—for instance, in a car for conveying fruit a long distance; and my present invention consists in a refrigerator having peculiarities of construction and certain thermostatic features applied thereto, to be hereinafter described and claimed.

In the said drawings, A represents my improved ice-refrigerating car for the transportation of fruit, &c., having insulated sides, top, and floor, an ice-compartment B being formed at each end having a thick insulated partition a interposed between it and the freight-compartment b, whereby moisture is prevented from depositing thereon, and but slight radiation of heat is experienced. These partitions a do not extend up to the ceiling of the car, thereby leaving a transverse opening, which is divided into two air-passages c at each end of the freight-compartment b, each pair of said air-passages being controlled by a pair of valves C, which are free to swing on a common anti-corrosive shaft 14, the ends and middle portions of which rest within anti-corrosive bearings secured to the opposite sides of the car and to the insulated partition, these valves being operated automatically so as to open and close the air-passages c by mechanism connected with expansion and contraction devices (to control the air-currents and temperature inside the freight-compartment) to be but generally described hereinafter in the present application, as they will form the subject-matter of another application to be filed by me.

In the top of each end of the car are preferably located two openings leading to each ice-compartment, said openings being closed by tightly-fitting insulated trap-doors Y.

Within each compartment B is located an ice rack or receptacle D, formed of galvanized-iron slats at its sides and with a bottom d, of wood, having its under side varnished with shellac to prevent condensation and dripping of water into cold-air passages e thereunder, the upper side d' of the wooden bottom d being covered with galvanized iron to prevent leakage and corrosion. (See Fig. 13.)

There are two cold-air passages or flues E, extending longitudinally under the insulated floor of the freight-compartment, leading from the air-passages e under each ice-compartment to a register placed in an opening E, cut in the insulated floor—*i. e.*, four passages or

flues E in all, two on each side of the middle sill or sills of the car-bottom.

Each ice-rack has an air-space 42 (two and one-half inches wide) surrounding its four sides, which, together with its open top, affords access for the air to come into contact with the ice and become rapidly cooled, after which, owing to its specific gravity, it descends around outside of apron G, smaller in area than the bottom of the ice-rack to which it is secured, said box G extending down nearly to the floor of the ice-compartment in order to insure the descent of the cold air to or nearly thereto before it can enter the cold-air conductors I, which are smaller than and located centrally within the bottomless box G.

Each cold-air conductor I is of galvanized iron and of greater area than the passage *e* in the floor, Fig. 2, leading to the air passage or flue E thereunder, the edge of the open bottom of each conductor surrounding the passage *e*, while the upper edge of said conductor I is turned down so as to form an outwardly-flaring lip *f*, which prevents the water from the melted ice from swashing over and flowing into the cold-air flues E under the floor.

Running transversely across the center of the bottom of each ice-compartment is a partition *v*, and leading from the bottom at each side of the partition is a waste or drip pipe *w*, which conveys the water from the melted ice out of the car. (See Figs. 1 and 3.) The cold air being of greater weight collects upon the floor of each ice-compartment, and is then driven by the air-currents under the edge of the apron G and up between it and the cold-air conductor I and over the lip *f* of the latter, down therein and into the passage *e* and cold-air passage or flue E under the insulated floor, and up through the opening F into the freight-compartment, (see direction of arrows, Figs. 1, 3, and 13,) this being simply a precaution for preventing the air from taking moisture into the freight-compartment.

I will now briefly describe (in general terms) an automatic expansion and contraction mechanism of my invention, by which the air-valves C are operated to open and close the air-passages *c* above the partitions *a*. (See Figs. 1, 3, 6, and 11.)

K is a brass tube hung loosely within clips *g g*, secured to the ceiling, one end screwing into a plate *h*, also secured to the ceiling, the other end of the tube having a short tubular extension *h'*, by which construction the brass tube is free to expand or lengthen in the direction of the arrow 26, Figs. 6 and 9, and contract or shorten in an opposite direction when under the influence of variations of temperature within the freight-compartment.

Inside the brass tube K is a solid cast-iron rod L, free to slide therein, Fig. 9, a projecting end of this rod being also seen in Fig. 6, the brass of the tube being much more sensitive to changes of temperature than the iron of the rod.

k is a lever pivoted at 21 to the plate *h* and to a pin 19, which slides in the stationary end of the tube K, Fig. 9.

m is a rod connecting the outer end of the lever *k* with an adjustable mechanism *m* for maintaining a uniform temperature and controlling the excess of motion of the unequal expansion pair, said mechanism consisting of a dial M, an index or pointer N, a hand-wheel P, and a cylindrical block *n*, having an opening at each end, Figs. 7 and 8, and provided with a screw-thread, into which is turned the threaded end of a rod *o*, the opposite end of this rod being secured by a bifurcated device *p* to a pair of disks 29, attached to the center of the shaft 14 of the pair of valves C, Fig. 10.

By means of an automatic valve-operating mechanism adapted to the construction of my improved car the air-spaces *c* are opened and closed and the air-currents passing through the ice-compartment are alternately admitted or excluded from the freight-compartment, whereby its temperature is reduced or increased to bring it to a predetermined degree, desired, and by controlling the movement of the unequal expansion pair, resulting from an excess of expansion by an increase of temperature above the predetermined degree or an excess of contraction by a reduction of temperature below the predetermined degree, (which may be readily accomplished by turning the hand-wheel and setting the index opposite the dial-figures expressing the degree desired to be maintained in the freight-compartment,) the effective length of the valve-rod may be nicely regulated, so that when the maximum forward and back movements of the rods are effected to open and close the air-passages *c* the further expansion and contraction of the unequal pair will not continue to exert any further pressure or tension on the rods, (as the case may be,) but will be directed in an opposite direction to compress certain springs *j* 23, (seen in Fig. 9 and broken away, Fig. 6,) connected with the automatic expansion-contraction mechanism, thus avoiding any unnecessary strain on or breakage of the parts or their connections.

A detailed description of the construction and operation of my automatic valve-actuating mechanism and its index-controlling device will be found in another application soon to be filed therefor; but the description contained herein is sufficient for the present purposes, and from it will be understood that the air-valves C will close the air-passages *c* at a degree of temperature indicated by the pointer N on the dial M, and thus prevent further decrease of temperature. If the temperature inside the freight-compartment should rise from lack of ice or for want of sufficient air circulation, the valves C will open and increase the circulating currents until the temperature therein has again fallen to the desired predetermined temperature indicated by the pointer, after which the air-valves will again close the air-passages *c*. Suppose the

air-valves are adjusted to close the air-passages *c* when the temperature in the freight-compartment is at 50° above. They will again open if the temperature rises above 50° and allow the admission of an increase of circulating currents into the freight-compartment until its temperature has again fallen to 50°, simultaneous with which the air-passages *c* will again be closed.

Q are perforated plates or sheets of wire-netting secured to the ceiling and partitions in such a way as to prevent the possibility of tampering with the valves C.

R is a dial on the outside of the car, Fig. 5, and *r* its index or pointer secured directly to the end of the valve-shaft 14, projecting through the end of the car, the object of this outside dial being to enable the air-valves C to be manipulated from the outside in the event of the automatic mechanism being out of order or disconnected from the air-valves, and the temperature inside the freight-compartment may in this way be regulated to a limited extent.

By having the air-flues E under the floor, together with the ice-compartment at each end of the car and the air-passages *c*, closed automatically and promptly by the valves C, I am readily enabled to obtain and preserve a high degree of temperature in the freight-compartment when so desired, which I believe has not been effected in the previous history of the art for the reason that the air-currents were always in full force, because no suitable means were provided for their regulation to and from the ice. Consequently it will be seen that when by my construction I can diminish the air circulation where a high temperature is to be maintained the supply of ice is more slowly consumed, the result of which is to effect a saving of ice proportionate to the degree of temperature maintained inside the freight-compartment, amounting, perhaps, to a saving of from fifty to sixty per cent. of the ice when a temperature of sixty degrees is maintained inside with an outside temperature of eighty or ninety degrees. The gases generated by the contents of the freight-compartment will be carried through the air-passages *c* into the ice-chambers and be there mixed with and carried away with the moisture as it condenses. Should any ice remain in the ice-compartment after the arrival of the car at the end of the route, it will be preserved for a considerable length of time, owing to the perfect insulation of the floor, walls, and partitions and the capacity of preventing any circulation of air by closing the air-passages *c*.

Another advantage derived from my perfect insulation and arresting the air circulation is that I am enabled to supply ice to my car before the freight-compartment receives its contents, as the temperature inside the freight-compartment will not be reduced to such an extent as to be objectionable to the packers, whereas with cars of the old construction it has been customary, first, to stow the freight and supply the ice thereafter, because the low temperature which would be produced in the freight-compartment if the ice were first received would be detrimental to the health of the packers of the freight. By conducting the cold-air currents to the freight-compartment by flues under the floor and the perfect insulation which I obtain the difference of temperature between the air at the top and that at the bottom of the freight-compartment will usually be scarcely perceptible and will not exceed from one to two degrees, whereas with refrigerator-cars of former construction it is common to find a difference of from seven to twelve degrees between said points.

One of the valuable features of my present invention is the insulated partition *a* and the air-space above it, without which a high temperature in the freight-compartment could not be preserved when the ice-compartments were full of ice.

Instead of an expansion-contraction device consisting of a brass tube and a cast-iron rod, as herein described, I may employ other combinations of metal or liquid—such as copper, zinc, mercury, oil, alcohol, &c.—or both metal and liquid, by the unequal expansion of which the valves may be operated.

During the winter months, in a warm climate, such as is experienced in the southern United States, when my car is iced and loaded with perishable freight, the ice in melting will create a circulation of air inside the car and the moisture therein (while the air is in contact with the ice) will be condensed, and after having been eliminated from the air the capacity of the latter to conduct heat from the contents of the freight-compartment will be much reduced, whereby the temperature inside the freight-compartment will be maintained above the freezing-point for a much longer period of time as the car advances where the temperature outside is gradually lowering—as, for instance, in coming north. When the temperature outside of the car is not higher than 32° above zero, the ice will be prevented from melting, under which conditions the air-passages will be closed by the air-valves and the ice will not have any perceptible effect on the radiation of heat from the freight-compartment and its contents, while at the same time the insulated partitions will furnish double insulation and protection at the ends of the car, and as the circulation of the air will be stopped it is obvious that the ends of the car will be better protected against frost than the sides, whereas in ordinary refrigerator-cars all perishable freight that comes in contact with the ice at the ends of the car (when it is not melted because of a low temperature outside) would be frozen.

When a car is only intended for transporting and preserving corn-fed dressed beef, as said beef requires a given amount of moisture