Aug. 18, 1942. H. Y. STEBBINS 2,293,316

METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURES

Filed June 29, 1936 5 Sheets-Sheet 1

Fig. 1.

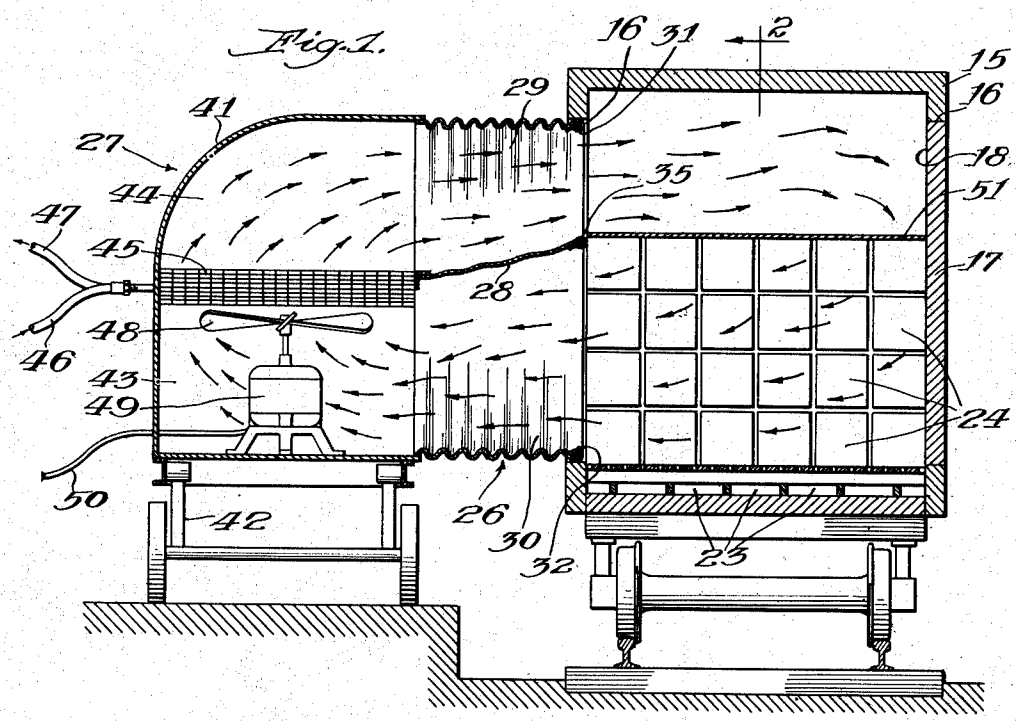
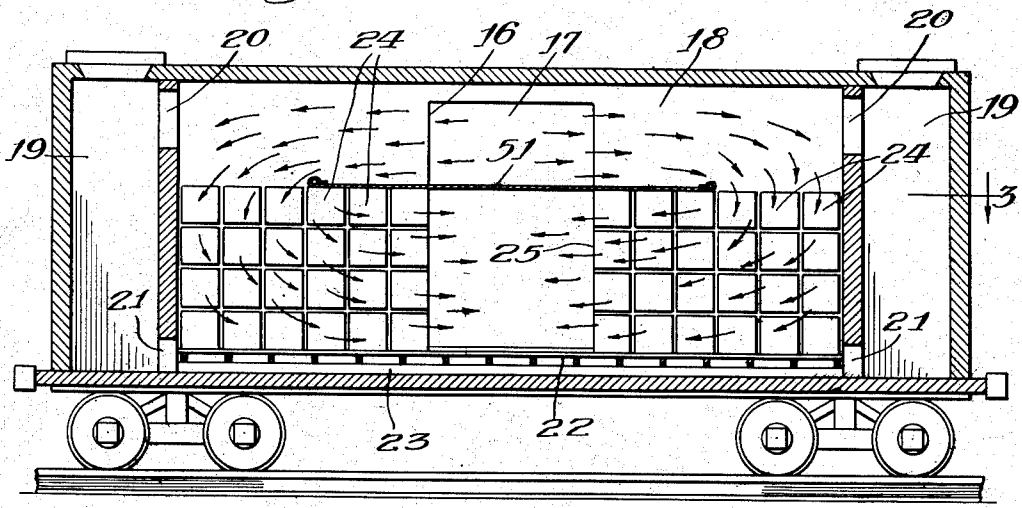


Fig. 2.



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METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURES

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Fig. 3.

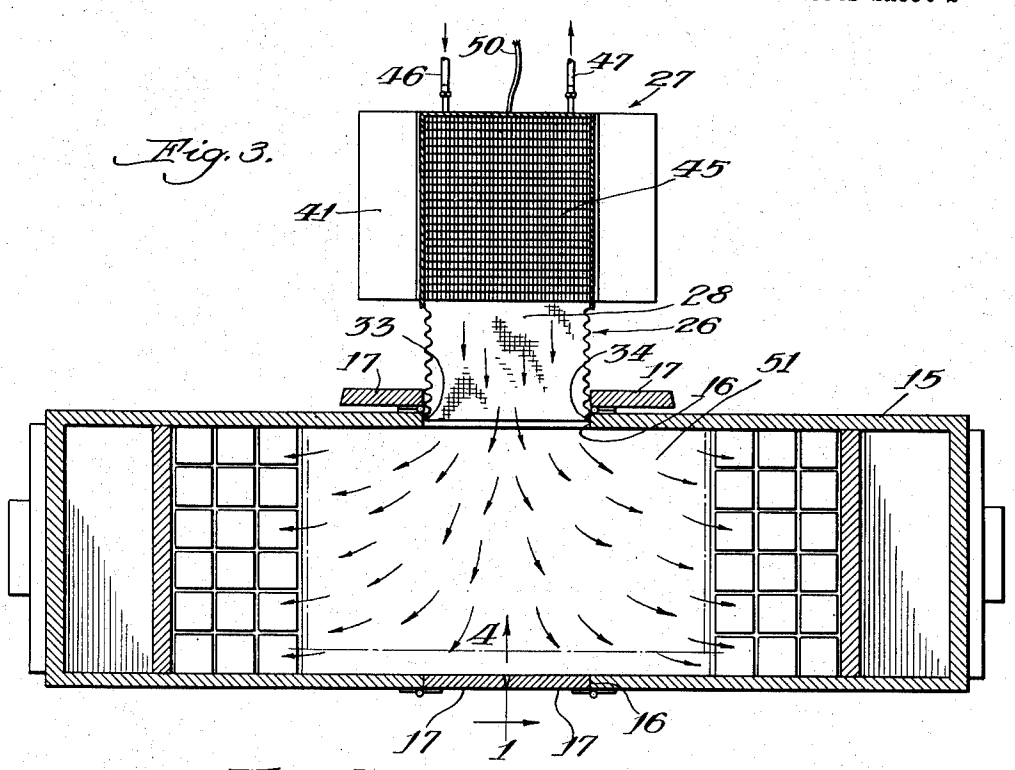


Fig. 4.

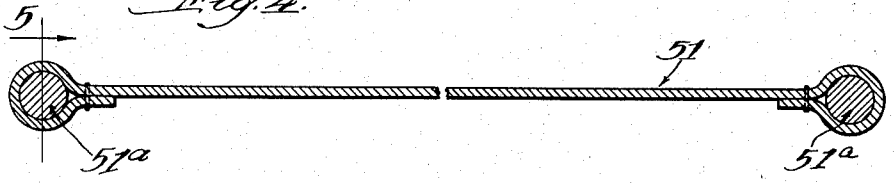


Fig. 5.

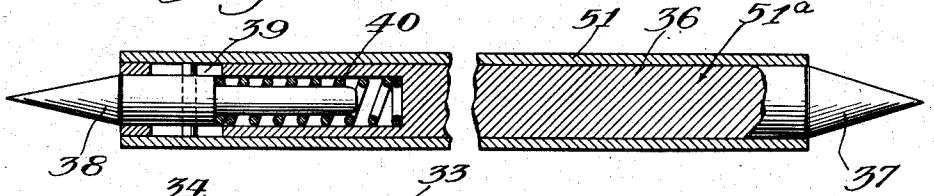
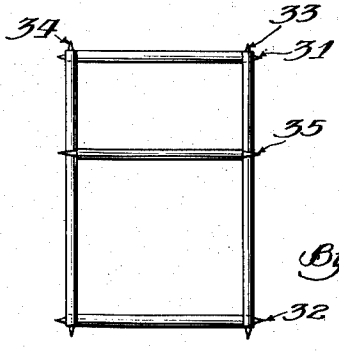


Fig. 6.



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METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURES

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Fig. 8.

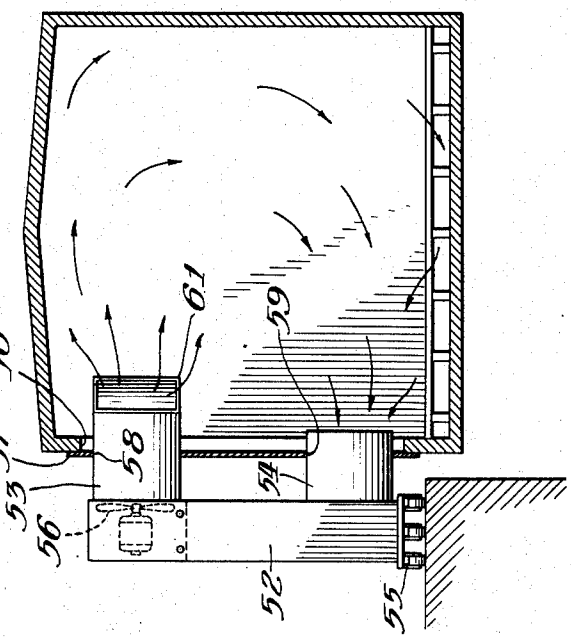
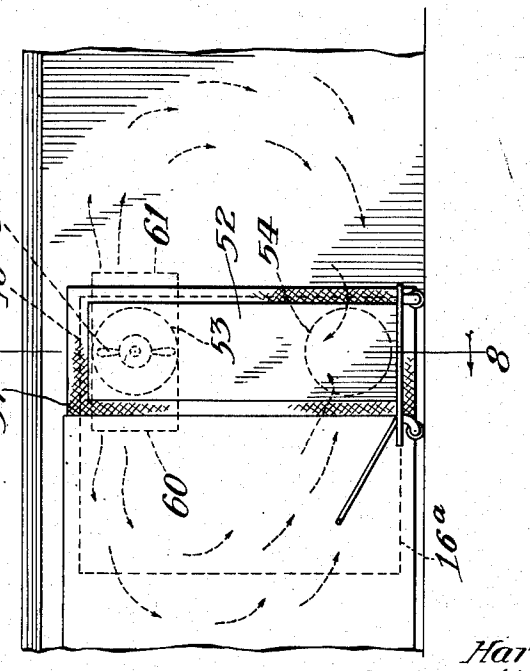


Fig. 7.



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Aug. 18, 1942. H. Y. STEBBINS 2,293,316

METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURES

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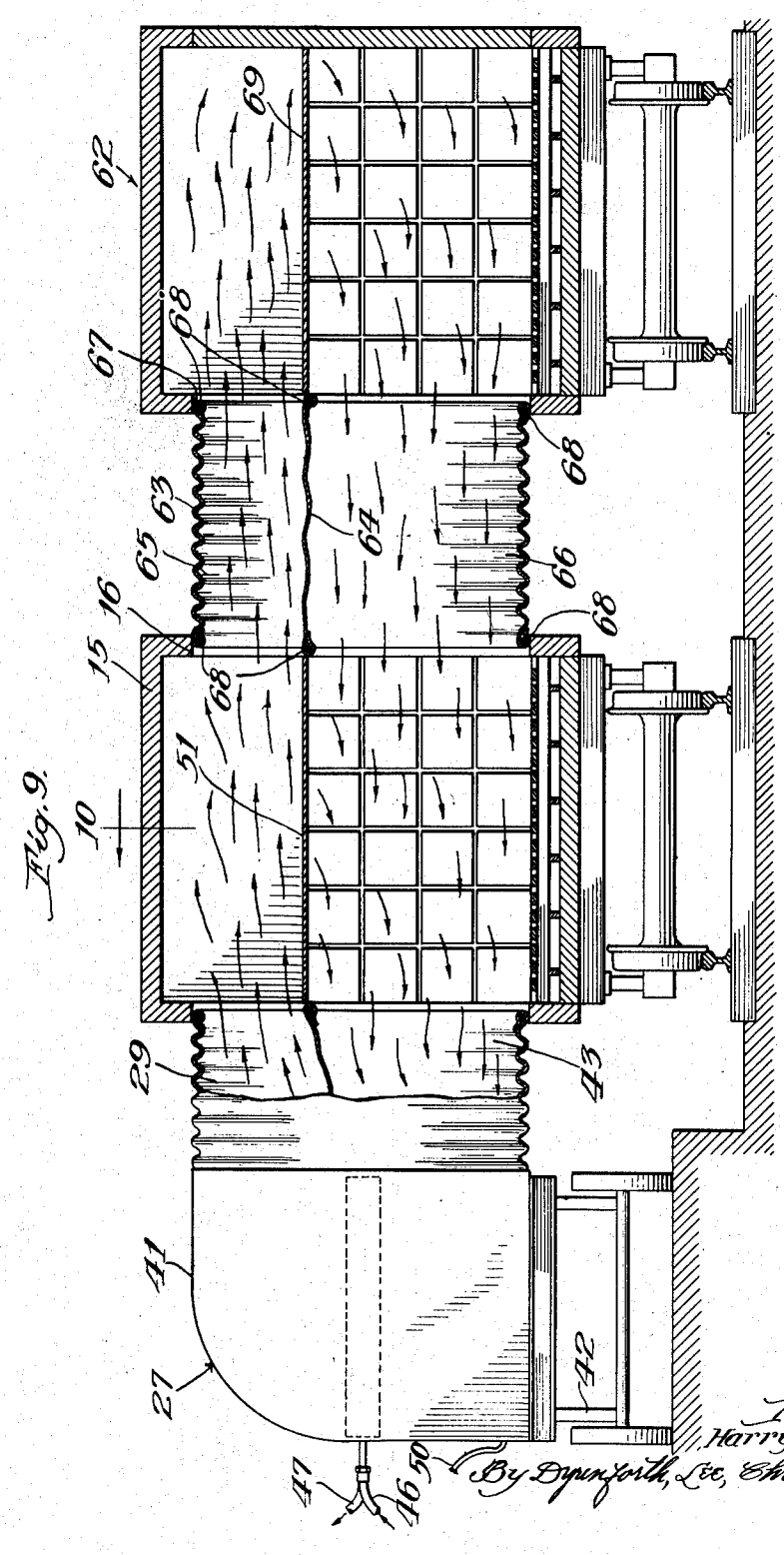


Fig. 9.

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Aug. 18, 1942. H. Y. STEBBINS 2,293,316

METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURES

Filed June 29, 1936 5 Sheets-Sheet 5

Fig. 10.

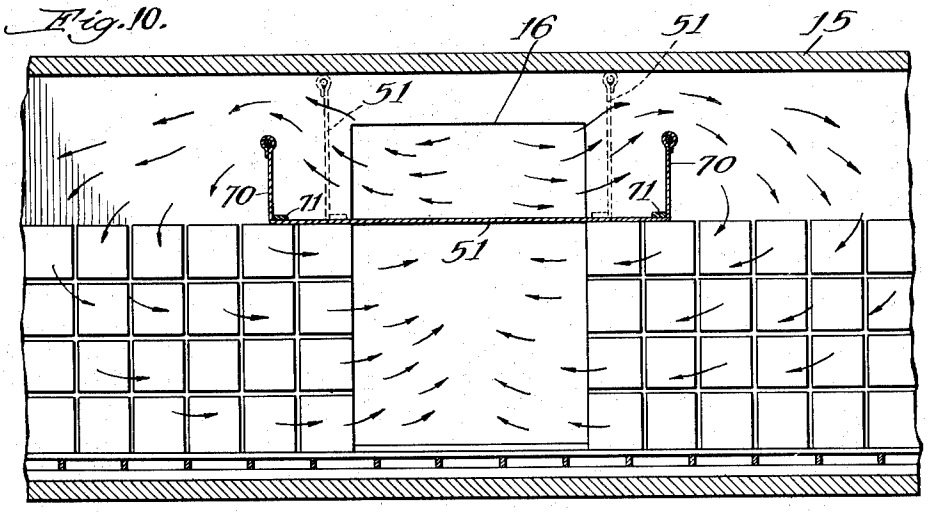


Fig. 11.

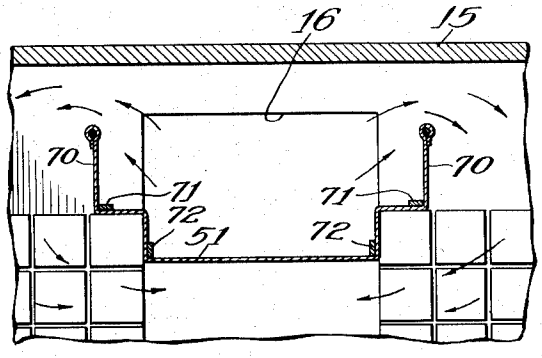
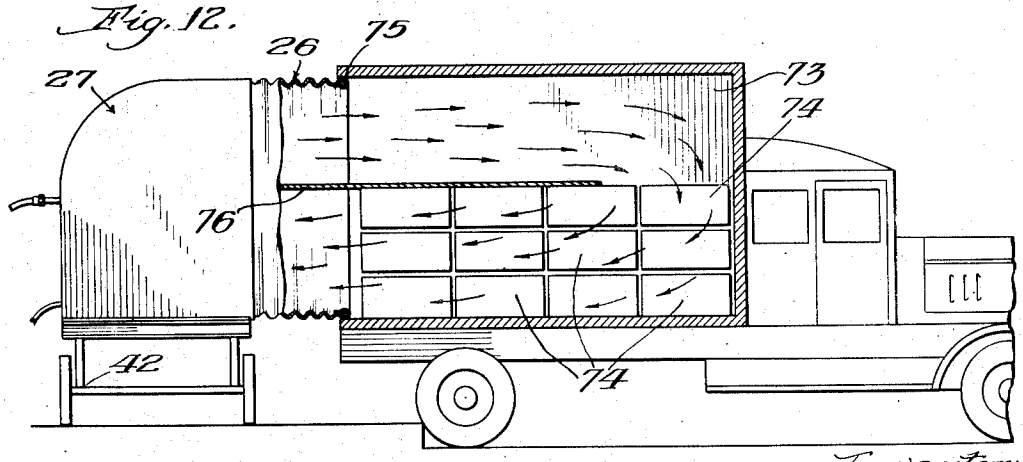


Fig. 12.



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Patented Aug. 18, 1942

2,293,316

UNITED STATES PATENT OFFICE

2,293,316

METHOD OF AND APPARATUS FOR CONTROLLING TEMPERATURES

Harry Y. Stebbins, Chicago, Ill., assignor to General American Precooling Corporation, Chicago, Ill., a corporation of Delaware

Application June 29, 1936, Serial No. 88,050

19 Claims. (Cl. 257—18)

This invention has particular application to the temperature regulation, either the cooling or heating, of loaded or unloaded commercial transportation vehicles, such as for example railway cars the lading in which requires temperature conditioning, or commercial trucks containing similar lading; the invention having been devised more particularly for the temperature conditioning of vehicles either loaded, or unloaded, prior to the commencement of their transport; the present application being a continuation in part of my pending application for United States Letters Patent Serial No. 676,721, filed June 20, 1933, now Patent No. 2,223,581, issued December 3, 1940.

One of my objects is to provide for the economical and quick temperature conditioning of a vehicle and its contents.

Another object is to produce a substantially uniform temperature change throughout the contents of the space to be temperature conditioned and particularly in the case of railway cars serviced with a temperature-conditioning medium through a longitudinal side thereof, and in the case of a truck serviced with such a medium through an end wall of the truck.

Another object is to provide for the temperature conditioning of cars arranged side by side on railway tracks, from a single servicing apparatus at the far side of one of the cars, as for example at the shipping platform, such an arrangement of cars being common at lading-loading and unloading stations, adjacent side-by-side dispesed cars being so positioned on the tracks as to cause their side doors to be in registration and permit, by the use of any suitable bridging means between cars at such doors, the loading or unloading through the car or cars adjacent the shipping platform, of such of the cars as are remote from this platform; and other objects as will be manifest from the following description.

Referring to the accompanying drawings:

Figure 1 is a view in sectional elevation of one embodiment of my improved apparatus and constituting one form of apparatus suitable for the practicing of my novel method of temperature-conditioning vehicles, the section being taken at the line 1 on Fig. 3 and viewed in the direction of the arrow.

Figure 2 is a section taken at the line 2 on Fig. 1 and viewed in the direction of the arrow.

Figure 3 is a section taken at the line 3 on Fig. 2 and viewed in the direction of the arrow.

Figure 4 is an enlarged, broken, sectional view of a baffle device shown as used in the car for directing the flow of air currents therein, the section being taken at the line 4 on Fig. 3 and viewed in the direction of the arrow.

Figure 5 is a broken view in longitudinal sectional elevation of one of the pair of supporting devices with which the baffle of Fig. 4 is equipped, the section being taken at the line 5 on Fig. 4 and viewed in the direction of the arrow.

Figure 6 is an end view of a conduit structure, with dividing baffle, connecting the vehicle, to be temperature conditioned, with the means for circulating the temperature-controlling medium.

Figure 7 is a fragmentary vertical section illustrating another modification of the invention and constituting another form of apparatus for practicing my novel method.

Figure 8 is a fragmentary cross-section taken substantially along the line 8—8 of Fig. 7 and viewed in the direction of the arrows.

Figure 9 is a broken view in side elevation of still another embodiment of the invention and constituting another form of apparatus suitable for the practicing of my novel method.

Figure 10 is a section taken at the line 10—10 on Fig. 9 and viewed in the direction of the arrow.

Figure 11 is a view like Fig. 10 of still another modification; and

Figure 12, a view in longitudinal sectional elevation of apparatus showing the use of my invention in temperature conditioning a truck through its rear-end charging and delivery door-opening.

Referring to the construction shown in Figs. 1–6, inclusive, 15 represents a refrigerator car such as commonly provided and having the usual side-wall center door-openings 16 with the hinged door-closures 17.

The car shown is of the type comprising a central refrigerating storage space 18 for the articles, with ice bunkers 19 at the ends of the car communicating at their upper and lower ends, through openings 20 and 21, with the storage space 18. The storage space 18 is shown as provided with an open-work false-floor 22 as commonly provided in cars of this type affording longitudinal channels 23 in communication at their ends with the lower openings 21.

In accordance with general practice the lading, particularly when provided in boxes or crates or other similarly shaped packages, as for example in the case of fresh fruits, vegetables or the like and represented at 24, are stacked in the storage space 18 with spacer-means between adjacent packages at different elevations, and with vertical spaces between adjacent side-by-side disposed packages, to provide channels for air circulation

throughout all sides of the packages 24. The lading may occupy the full length of the storage space 18, or as shown in Fig. 2 all of this space except opposite the door openings thereby providing a cross aisle 25 extending from one door-opening 16 to the other, and involving the use of bracing (not shown) in the aisle for preventing shifting of the load in transit.

In accordance with this particular arrangement means are provided for causing the flowing of cooled air into the car for cooling the lading and the flowing from the car of the air heated in the operation of cooling the lading, the cooled air flowing through one portion of the door-opening 16 at one side of the car and into the storage space 18 and the heated air flowing from the storage space 18 through another portion of this door opening, it being preferred that the air flowing from the storage space, in heated condition, be re-cooled and in such condition returned to the lading space and therein again utilized to cool the lading, whereby the air flows through a closed circulatory course including the car, the inflow and outflow conduits and the course in which the air is re-cooled.

The means for conducting cooled air into the car and heated air therefrom may be of any suitable construction, as for example that shown, comprising a conduit structure 26 shown as of accordion form and formed of flexible material, such as for example canvas, or the like, which connects at one end with one of the side door openings, substantially completely filling it and forming therewith a closed joint to prevent leakage of air and at its other end with the inlet and outlet of an air-cooling mechanism represented generally at 27, the conduit structure being provided with a substantially horizontal partition 28 shown as of flexible material, as for example canvas, or the like, dividing the conduit structure into upper and lower conduit sections 29 and 30, respectively, the end of the partition 28 adjacent the car being at substantially the same elevation as the upper surface of the lading as shown in Fig. 1.

As an example of a desirable means for connecting the conduit structure 26 to the car, the upper, lower and side edges of this structure and the end of the partition 28 adjacent the car, may be provided with attaching devices represented at 31 to 35, respectively, each of the same construction and involving a bar 36 to which an end of the sheet material forming the conduit structure, or the partition 28, as the case may be, is attached and wound, one end of the bar 36 being formed to provide a prong 37 and its other end having a separate prong element 38 slidable in a socket 39 in an end of the bar and pressed outwardly by a coiled spring 40, whereby the bars 36 may be releasably embedded at their ends in the casing about the door opening 16 in the desired supported positions, and readily removed therefrom when desired.

The means for cooling the air to be discharged into the storage space may be of any desirable construction and provided as a stationary equipment of any desirable construction or, and preferably as, portable equipment, such as shown at 27 and provided for movement along the sides of cars to be loaded, this portable equipment including, in the particular apparatus shown, the conduit structure 26, constituting a heat transfer unit. The construction of cooling apparatus shown comprises a casing 41 mounted on a wheeled truck frame 42 and divided into air-receiving and air-discharging chambers 43 and 44, respectively, by a refrigerating element represented at 45 and shown in the form of an open-work heat interchanger device through which any suitable refrigerating medium is circulated from any suitable source thereof through inlet and outlet pipes, 46 and 47, respectively, and through which air entering the chamber 43 may flow in contact with the cooled surfaces of the refrigerating element 45, to become refrigerated and thence discharge intc the chamber 44, a fan device 48 shown as driven by an electric motor 49 supplied with current from any suitable source as from a stationary source through wires in a cable shown at 50 being provided in the chamber 43 for effecting such circulation of the air.

To cause the cooled air supplied to the upper portion of the storage space 18 to be more nearly uniformly distributed throughout the lading and thus to more nearly effect uniform temperature conditioning of the lading, baffle means 51 preferably of a width substantially equal to the width of the car and of a length considerably greater than the cross dimension of the cross-aisle 25 and positioned on top of the lading to span the cross-aisle and lap the lading at opposite sides of the aisle as shown, is provided, this baffle being shown as of sheet form preferably of flexible material, as for example canvas, or the like, connected at its ends with bar-devices 51a of any suitable construction but shown as of the same construction as the devices 31—35.

As will be understood from the foregoing, actuation of the fan 48 will cause air-flow as shown by the arrows, the air cooled by the refrigerating element 45 entering the upper portion of the storage space 18 from the conduit section 29, thence dividing and flowing in opposite directions toward the ends of this space and thence downwardly and through the spaces between the articles to be refrigerated, flowing from opposite directions toward the center of the storage space and thence, in relatively heated condition by contact with the lading, to the lower conduit section 30, for recirculation, by the fan 48, through the refrigerating element 45, the operation above described being continued until the temperature of the contents of the storage space has been reduced to the desired degree; following which the conduit structure 27 is disconnected from the car and the doors of the car quickly closed and sealed.

Any suitable means may be provided for subjecting the contents of the car to a continuing or subsequent refrigerating action, if such is desired, as for example by charging ice into the ice bunkers 19 the melting of which produces by thermo-siphonic action flow of refrigerated air from the bunkers 19 into the storage space 18, or by re-cooling the contents of the storage space 18, en route, at a station providing, as for example, apparatus as above described to circulate cooling currents of air through the storage space from apparatus exterior of the car.

Referring to Figs. 7 and 8, the construction therein shown involves the provision of the heat exchange unit as a structure embodying an upright casing 52 having upper and lower separate and vertically spaced outlet and inlet conduit portions 53 and 54, respectively, and shown as mounted on a hand truck 55, the power fan, which induces the desired circulation of air through the unit and car to which the unit is applied, being represented at 56. The heat exchange element of the unit referred to may be

of any desirable construction as for example that shown in Fig. 1.

In this arrangement a heat insulating blanket 57 is shown as placed over the door opening 16 of the car to provide a substantially sealed closure and the inlet and outlet conduits 54 and 53 of the unit project through openings 58 and 59, respectively, in the blanket, into the interior of the car.

The outlet conduit 53 is provided with two nozzles 60 and 61 extending in opposite directions and when in the position shown in Figs. 7 and 8 they open toward opposite ends of the car.

By operating the fan air is drawn from the car through the conduit 54, circulated through the unit and blown out into the car in opposite directions from the nozzles 60 and 61. As will be understood, the blanket 57 would be drawn tightly about the conduits 53 and 54, or the blanket would be mounted as a part of the heat transfer unit. When the car is being refrigerated the edges of the blanket can be temporarily sealed in the door opening to provide the desired insulation of the vehicle against outside atmosphere. Following the temperature-conditioning operation, the door opening is closed and sealed by the door therefor shown, by way of example, in this particular construction, as of the sliding type, and represented at 16a.

In Figs. 9, 10 and 11 is shown an arrangement whereby refrigerator cars arranged side by side may be temperature conditioned from a single temperature conditioning means located alongside of one of the cars, such conditioning of the cars being effected simultaneously, or in succession, as desired.

In such arrangement I provide between the car 15 and a similar car 62 located alongside it, a conduit structure 63 preferably flexible, as for example formed of canvas or the like, with a horizontal partition 64 of flexible material dividing the conduit structure into two open-ended conduit sections 65 and 66, the ends of the conduit structure fitting the adjacent side-door-openings 16 and 67, respectively, of the cars and, with the partition 64, being held in place in any suitable way as for example by pointed-ended bars represented at 68 as in the case of the conduit structure 26, the ends of the partition 64 preferably being positioned at substantially the same elevation as the tops of the ladings in the cars.

A baffle 69, as explained of the baffle 51 is positioned at the central zone of the car, to span the cross aisle when the car is loaded to provide such an aisle, and to lap at its ends the portion of the lading adjacent the central portion of the car, as explained of the baffle 51 as applied to the car 15.

From the above it will be understood that the spaces in both cars above the lading are in communication with each other through the conduit section 65 and with the cold air supply conduit section 29 whereby cold air will flow as shown of the arrows in the upper part of Fig. 9. Furthermore, the central cross aisles of both cars, separated from the spaces above them by the baffle-means 51 and 69, are in communication with each other through the conduit section 66 and in communication with the conduit-section 43, whereby the air, warmed more or less by contact with the lading, will be drawn from opposite ends of each car to its center aisle and thence pass to the conduit section 43 for re-cooling.

Provision is made for controlling the relative amounts of cooled air supplied to the cars from the apparatus, this being effected by varying the resistance to flow of the air from the center of the car 15 at its upper portion, toward the ends of this car. This may be provided for in any suitable way, as for example by the provision of the baffle means 51 as formed of a sheet of flexible material with securing means 62 as above described, whereby the end portions of the baffle may be supported in turned-up condition as shown at 70 (Fig. 10), with weight bars 71 applied at the juncture of the portions 70 with the horizontal portion of the baffle to hold down this horizontal portion, and thus afford restrictions to the flow of the cooled air in its passage in opposite directions from the center of the car 15 to the lading therein.

Should it be desired to close off the car 15 to the cooling air supply and cause all of the cooled air to flow through the top portion of car 15 to car 62 for circulation therethrough to cool its lading as above described, the ends of the baffle 51 may be up-turned to the position shown by dotted lines in Fig. 10 and held down at ts horizontal portion as by bars shown by dotted lines thus closing the car against circulation of the cooling air through the lading of this car.

Where the lading in car 15 is so high in the car that the space between the top of the door opening 16 of the car and the baffle 51 (if arranged to extend across the top of the lading as shown in Figs. 1–8) would be too shallow to permit of the desired volumetric flow of air to the car 62 for temperature conditioning it as rapidly as desired, the portion of the baffle means 51 in the cross aisle of car 15 may be positioned to extend at a lower level than the top of the lading as shown in Fig. 11. Where such baffle means are in the form described above, the sheet baffle may be manipulated to depress it within the aisle as shown in Fig. 11 and the same held in such position as by cleats 72.

Fig. 12 illustrates my invention applied to the refrigerating of a commercial truck having its door opening in the back end of the truck, the storage space for the articles comprising the lading, being represented at 73, with the packages, to be refrigerated and shown at 74, spaced apart to provide circulatory spaces.

This arrangement as shown, contemplates the circulation of the air through the storage space and the refrigerating apparatus, shown as a refrigerating unit, to refrigerate the lading, the apparatus shown, by way of example, being the same as the apparatus 27 and connected at its conduit structure 26 with the lading compartment of the car at the opening 75 in the rear end of the latter. In this particular arrangement the partition represented at 76 and corresponding with the partition 28 of Fig. 1, is extended forwardly to become positioned on the top of the lading, from the rear end of the vehicle forwardly to a desirable distance, as represented, whereby the air currents are prevented from short circuiting, as illustrated by the arrows, thus effecting approximately uniform distribution of these cooling air currents through the storage space 73 and consequent approximate uniform refrigeration of the lading.

While I have illustrated and described certain particular constructions constituting embodiments of my invention and have illustrated and described my improved method as practiced in certain particular ways and by certain particular apparatuses, I do not wish to be understood as intending to limit my invention thereto as the invention may be embodied in modified forms of

the construction shown and in other forms of constructions, and my improved method practiced by the use of other apparatus. In this connection it may be stated that while the various constructions illustrated have been described as providing for the refrigerating of lading, it will be readily understood that the invention is not limited to the cooling of lading, but also to the heating of lading, and thus the invention relates broadly to temperature conditioning, it being readily understood that the heat interchanging element may be provided either as one suitable for refrigeration or for heating, though in the case of heating it would probably be desirable to provide for the flow of the air through the storage space and the temperature conditioning apparatus in a direction reverse to that as above described where used for refrigerating purposes.

Furthermore, while I have referred to the circulating of air for effecting the temperature conditioning of the lading it will be understood that when desired any other suitable or desirable gaseous substance may be used, either alone or with air, it being my intention that the word "air" as used in the appended claims include, not only air in the strict sense, but also any other gaseous material alone or mixed with air, that may be used.

Also it is not necessary in the utilization of the horizontal baffles shown and described that the lading be so arranged in the cars as to provide cross-aisles, nor stacked to such low height as shown, as such baffles may be used where no cross aisles are provided and also where, either with or without cross-aisles, the lading extends above the baffles (in which case the baffles would be interposed between layers of the lading) provided the spaces above and below the baffles are of such effective cross-sectional area as to permit of the desired circulation therethrough of the temperature-conditioning medium.

What I claim as new and desire to secure by Letters Patent is:

1. In a refrigerating system, a transportation vehicle having a door-opening for receiving cargo into the vehicle, a heat transfer unit having means for supplying refrigerant thereto, an insulating blanket removably covering said door-opening, said heat transfer unit having intake conduit structure and discharge conduit structure communicating through said blanket into spaced locations inside the vehicle, said blanket providing a substantially atmospheric seal about the conduit structure and door-opening, means for circulating the interior atmosphere of the vehicle through the heat transfer unit and through the vehicle interior, said discharge conduit structure having deflecting surfaces for directing the stream of circulated atmosphere passing therethrough in various directions away from said intake conduit structure, means for transporting said unit away from the vehicle, and means for closing and substantially sealing the door-opening.

2. In a method of conditioning a load in a freight car, circulating conditioned gaseous fluid in the load-receiving space in the car from near the longitudinal center of the car above the load towards an end of the space and through the load and back to the center of the car, then reconditioning the fluid thus circulated and then returning the reconditioned fluid for recirculation through the load.

3. A method of conditioning a load in a freight car comprising circulating conditioned gaseous fluid in the load-receiving space in the car from near the longitudinal center of the car above the load towards opposite ends of the space and through the load and back to the center of the car, then reconditioning the fluid thus circulated and then returning the reconditioned fluid for recirculation through the load.

4. In a method of conditioning a load in a freight car, introducing conditioned gaseous fluid into the load-receiving space in the car and circulating the fluid in the space from near the longitudinal center of the car above the load towards an end of the space and through the load and back to the center of the car, reconditioning exteriorly of the space the fluid thus circulated and returning to the space the reconditioned fluid for recirculation through the load.

5. A method of conditioning a load in a freight car comprising introducing conditioned gaseous fluid into the load-receiving space in the car and circulating the fluid in the space from near the longitudinal center of the car above the load towards opposite ends of the space and through the load and back to the center of the car, reconditioning exteriorly of the space the fluid thus circulated and returning to the space the reconditioned fluid for recirculation through the load.

6. A method of conditioning the load of a freight car comprising withdrawing air from the car below the top of the load, conditioning the air exterior of the car, introducing the conditioned air to the car in a stream and directing it against a plane surface substantially at right angles to the stream of air and above the load level in the vicinity of its point of introduction, passing the air into the top of the load at a point remote from its point of withdrawal from the car and then passing the air through the load to said point of withdrawal.

7. In an air-conditioning apparatus for freight cars, a door at the center of the car, an aperture in the upper part of said door to permit the entrance of air to the car interior, a duct within the car communicating with said aperture, and adapted to deflect air toward one end of the car, and an aperture in the lower part of said door to permit the discharge of air from the car.

8. A method of conditioning the load of a freight car comprising withdrawing air from the center of the car and below the load level, conditioning the air, introducing the conditioned air transversely to the center of the car above the load level, deflecting the air so that the major portion thereof passes to the ends of the car, introducing such air to the load near the ends of the car, and passing the air through the load to its point of withdrawal from the car.

9. A method of conditioning the load of a freight car which consists in withdrawing air from the center of the car and below the load level, conditioning the air in a unit exterior of the car, and introducing the conditioned air to the car at the center thereof and above the load level.

10. A method of conditioning the load of a car comprising withdrawing at a point beneath the load level air containing heat extracted from the lading, conditioning the air in a unit exterior of the car, and returning the conditioned air to the car at a point adjacent that at which it is withdrawn from the car but above the load level.

11. A method of conditioning the load of a car which consists in withdrawing from the car air containing heat extracted from the load, conditioning the air in a unit exterior of the car,

introducing the conditioned air to the car above the load and at such a point that it must pass through the load in order that it may be withdrawn from the car, and preventing direct short-circuiting of at least the major part of the air from its point of entrance to its point of exit from the car.

12. A method of conditioning a load in a freight car comprising withdrawing air from the load near the longitudinal center of the load and at a point below the load level, conditioning the air, introducing the conditioned air to the load receiving space of the car at a point above the load level, substantially preventing its introduction into the load through the top thereof substantially immediately above the first-named point, passing the air into the load relatively remote from the first-named point, and then passing the air through the load to the first-named point.

13. A method of conditioning a load in a freight car comprising withdrawing air from the load at a point below the load level, conditioning the air, introducing the conditioned air to the load receiving space of the car at a point above the load level and near the longitudinal center of the load and substantially preventing its introduction into the load through the top thereof substantially immediately below the second-named point, passing the air into the load relatively remote from the first-named point, and then passing the air through the load to the first-named point.

14. A method of conditioning a load in a freight car comprising withdrawing air from the load near the center thereof and at a point below the load level, conditioning the air, introducing the conditioned air to the load receiving space of the car at a point above the load level and near the longitudinal center of the load, substantially preventing its introduction into the load through the top thereof at a point substantially immediately above the first-named point, passing the air into the load relatively remote from the first-named point, and then passing the air through the load to the first-named point.

15. A method of conditioning the load of a freight car in which a space is left between the top of the load and the top of the car comprising withdrawing air from the center of the car at a point beneath the load level, conditioning the air exterior of the car, introducing the conditioned air to the above-mentioned space at the center of the car and through one side thereof, substantially preventing the air from passing from said space into the top of the load adjacent the center of the car while passing the air into the load adjacent the ends of the car, and then passing the air through the load to the first-named point.

16. An apparatus for conditioning the load of a car comprising means to substantially prevent the passage of air into the top of the load at the center of the car, an air-conditioning unit located outside of the car, means for conveying air from the unit to the car and in communication with the interior of the car above the load level, and a means for conveying air from the car to the unit and in communication with the interior of the car below the load level.

17. An apparatus for conditioning the load of a car comprising means to substantially prevent the passage of any air into the top of the load at the center of the car, an air conditioning unit located outside of the car, a conduit adapted to convey air from the unit to the car above the load level, and a conduit to convey air to the unit from the car, said last-mentioned conduit extending from a point in the car below the load level.

18. In an air-conditioning apparatus for the load of a freight car, a door at the center of the car provided with an aperture above the normal load level and an aperture below the normal load level, means to substantially prevent the passage of air into the load at the center of the car, an air-cooling unit located exteriorly of the car, means to convey cooled air from the unit through the upper aperture of the door above the load level, and means to convey air from the car to the unit, said last mentioned means extending from the lower aperture in the door below the load level.

19. The method of temperature-conditioning a vehicle storage space having a center door opening, which consists in directing temperature-conditioned air into, and removing air from, said storage space in separated streams at different elevations through said door opening and maintaining said streams substantially separated within the car at a zone adjacent to said door opening.

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