April 12, 1932. E. A. RUSSELL ET AL 1,853,459

AIR CONDITIONING FOR RAILWAY CARS

Filed Jan. 12, 1931 3 Sheets-Sheet 1

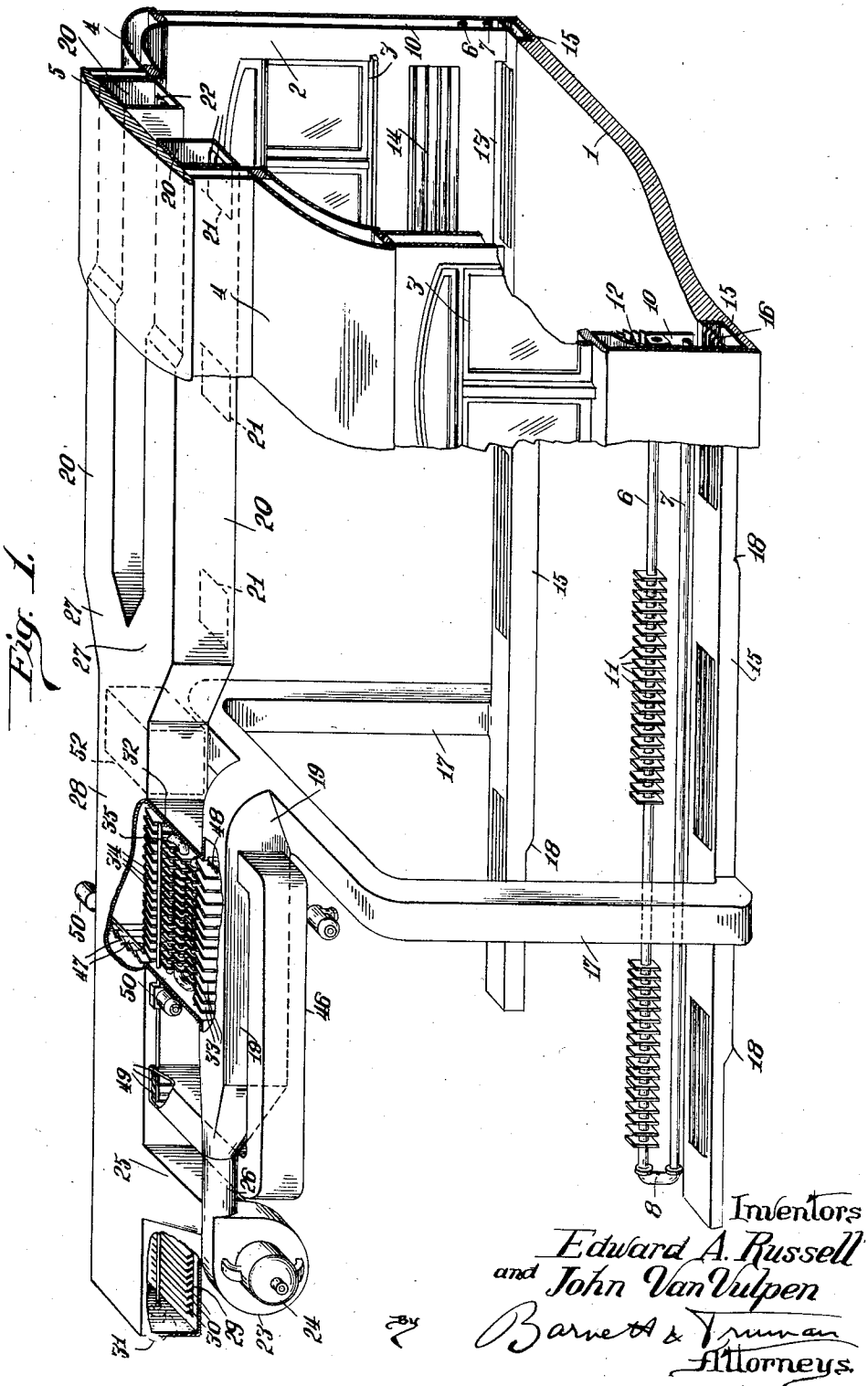


Fig. 1.

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Fig. 3.

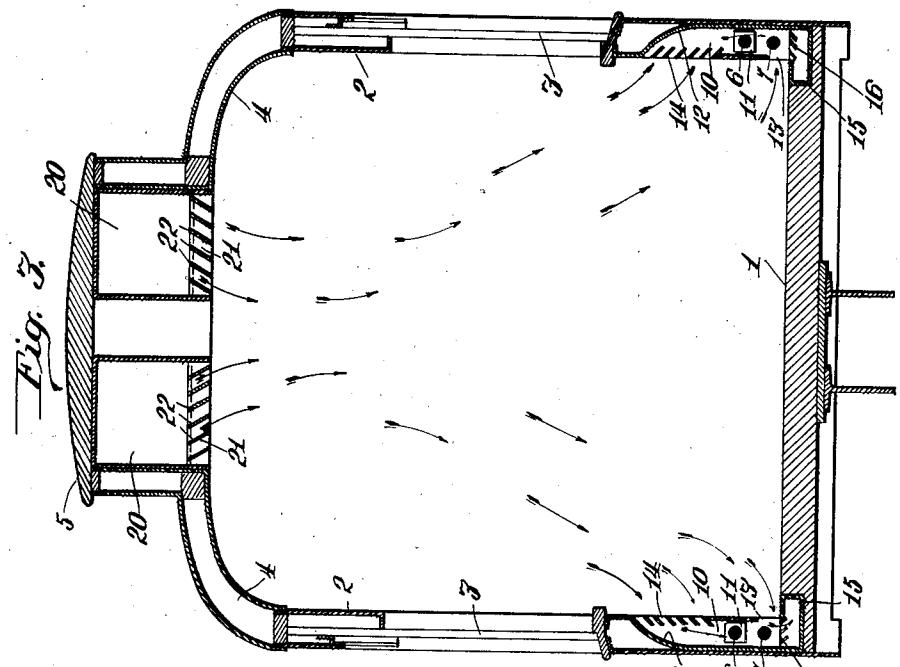
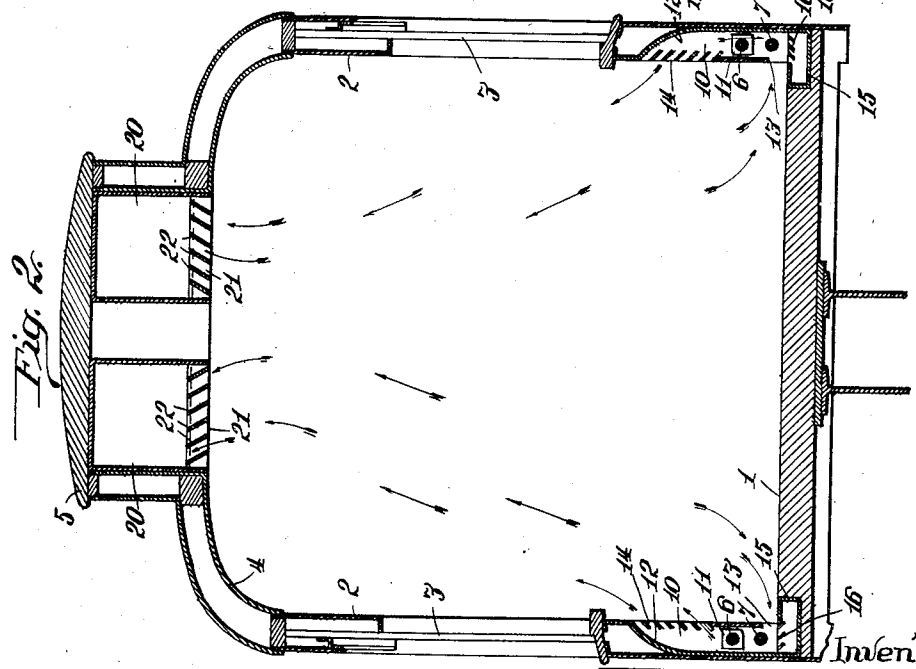


Fig. 2.



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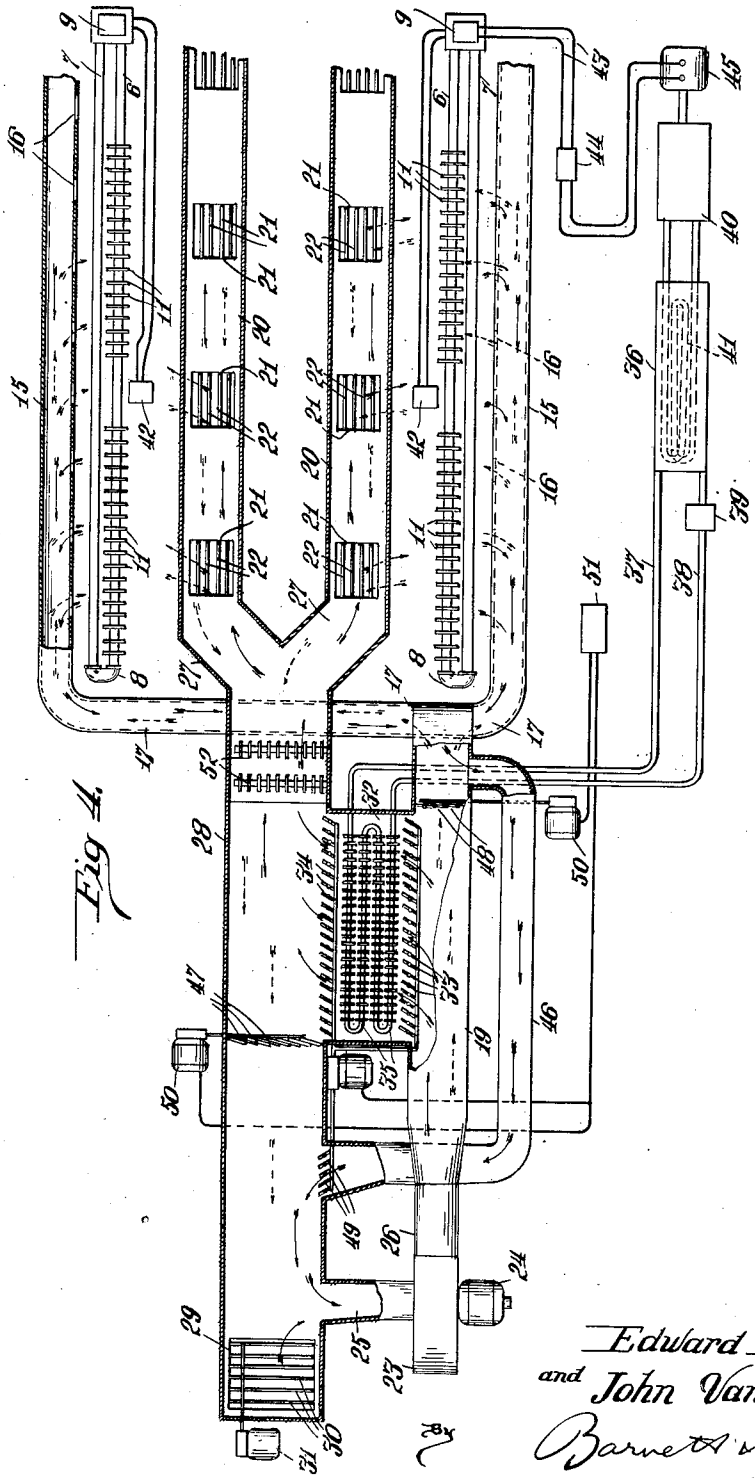


Fig 4.

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UNITED STATES PATENT OFFICE

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AIR CONDITIONING FOR RAILWAY CARS

Application filed January 12, 1931. Serial No. 508,116.

This invention relates to certain new and useful improvements in a temperature controlling and air circulating system for railway cars, especially adapted for passenger carrying cars of all types.

This invention contemplates a unitary system, by means of which air is continuously circulated through the car, fresh air from outside the car added as required, and the air stream is either heated or cooled as the temperature conditions prevailing both inside and outside the car may necessitate. Briefly described, the system embodies a close system of air conduits, of which the space within the passenger compartment of the car forms a part, this system including conduits in open communication with the upper portion of the car and conduits in open communication with the lower portion of the car. A heating means is so positioned in or adjacent the lower side portions of the car that the air stream flowing from the lower conduits will pass over this heating means and be heated thereby. A refrigerating means is so positioned that the air stream delivered through the upper conduits may be passed thereover and cooled. A single blower or air-circulating means is adapted to maintain a continuous flow of air through the conduit system, and suitable valves and cross connections between the conduits are operated thermostatically so that the air stream will either flow from the pressure side of the fan over the refrigerating means and be delivered through the upper conduits into the upper portion of the passenger compartment of the car, air being simultaneously withdrawn through the lower conduit to the suction side of the blower, or alternatively, air may be delivered from the blower to the lower conduit and over the heating means into the lower portion of the passenger compartment and withdrawn through the upper conduit to the suction side of the fan or blower. Means is provided for adding additional fresh air from outside the car to the suction side of the blower, and a humidifier is included in the circuit to add the necessary moisture to the air stream. The heating system and the refrigerating system may be controlled thermostatically in accordance with temperature changes within the passenger compartment of the car.

The general object of this invention is to provide a combined temperature-controlling and air circulating system of the type briefly described hereinabove and disclosed more in detail in the specifications which follow.

Another object is to provide an improved air circulating system for railway cars.

Another object is to provide an improved air heating and circulating system for railway cars.

Another object is to provide an improved cooling system for railway cars.

Another object is to provide an improved means for continuously circulating air through a railway car, regulating the temperature thereof, and replenishing the air supply in such proportions as may be desirable.

Another object is to provide improved means for humidifying the air within the railway car.

Another object is to provide an improved system of air circulating conduits within a railway car, through which the flow of air may be reversed so as to form part of either a heating or cooling system.

Other objects and advantages of this invention will be more apparent from the following detailed description of one approved form of apparatus embodying the principles of this invention.

In the accompanying drawings:

Fig. 1 is a partial perspective view, partially broken away, showing a railway passenger car to which this invention has been applied.

Fig. 2 is a transverse vertical section through the car when the heating system is in operation.

Fig. 3 is a view similar to Fig. 2, illustrating the operation when the refrigerating or cooling system is being used.

Fig. 4 is a diagrammatic view of the entire system.

The application of the system to the railway car as shown in Figs. 1, 2 and 3 will first be described, and then Fig. 4 will be referred

to in order to more clearly explain the co-operation of the several parts of the system, and describe some features which could not readily be disclosed in Figs. 1 to 3.

The railway car to which this invention is applied may be of substantially any of the well known types, such as a coach, Pullman car, or dining car, and is preferably provided with heat-insulated walls. As shown in the drawings, the body portion of the car is indicated more or less diagrammatically, the floor being shown at 1, the side walls at 2, the windows at 3, the roof at 4, and the clearstory at 5. The under-frame, trucks and other running gear are not shown.

Various types of heating systems may be used, but preferably a vapor or steam heating system of suitable form will be incorporated in this combined system. As here shown, a continuous series of radiators are mounted in and concealed by the lower portion of each side wall of the car, adjacent the floor of the car. Each heating circuit comprises an upper supply pipe 6 and a lower return pipe 7 connected at the far end by a loop 8 and both pipes connected at the supply end to a distributing valve which is indicated diagrammatically at 9 in Fig. 4. In the heating space or compartment 10 beneath each window or pair of windows 3, a plurality of radiating fins 11 are positioned on the respective pipes 6 and 7 so as to increase the radiating surface at these locations. An insulating and heat reflecting wall 12 is positioned behind the radiating unit in each compartment 10, and the front wall of the compartment is provided with a lower air inlet 13 adjacent the floor and an upper air outlet 14, preferably covered by an open grille or screen. An air duct or conduit 15 is positioned in or below the floor 1 of the car adjacent the side of the car, this duct being provided with a series of upper grilled outlets 16, one outlet being positioned beneath each radiator housing compartment 10, so that air discharged through the conduit outlet 16 will pass upwardly through the radiator compartment and be heated by the radiating units mounted therein. An upwardly extending air conduit 17 communicates with the lower horizontal conduit 15 at some convenient location, and preferably the horizontal distributing conduit 15 is stepped down at intervals or decreased in cross-section, as indicated at 18, so as to provide a more equal distribution of air delivered through the outlets 16. It is to be understood that a duplicate heating system is provided at each side of the car, and the two supply or return vertically extending conduits 17 may be both connected in the upper portion of the car to a common supply or return conduit 19 which communicates with the air-distributing system hereinafter described.

A pair of similar air conduits or ducts 20 are built into the roof or clearstory of the car, these conduits being provided at intervals with lower outlets 21 communicating with the upper portion of the space within the car. Preferably a plurality of vanes or louvers 22 are positioned in each outlet 21 so as to direct the air stream delivered through these outlets downwardly and inwardly, as indicated in Fig. 3. This is particularly desirable in sleeping cars, so as to avoid forcing streams of cooled air into the upper berths.

When the heating system is being used, the direction of air flow will be as indicated by the arrows in Fig. 2. Air will be forced under pressure through the conduits 15 and discharged upwardly through the heating chambers 10. This air will be heated by the radiator units positioned in these chambers and will be discharged through the grilled outlets 14 into the passenger compartment of the car. A portion of the air will circulate within the car and re-enter the heating compartments through the lower inlets 13, but the greater portion of the air will be drawn into the upper conduits 20 which are now connected with the suction side of the blower or air-circulating means, hereinafter described.

When the cooling system is in operation, the direction of air flow is reversed, as indicated by the arrows in Fig. 3. Cooled air is now forced under pressure through the conduits 20 and discharged downwardly through outlet 21. This cooled air will flow downwardly and be withdrawn from the car through outlets 14, 13 and 16 into conduits 15 which are now connected with the suction side of the air circulating means.

Referring now more particularly to the diagram shown in Fig. 4, taken in connection with Fig. 1, the means for maintaining the air circulation and determining the direction of air flow will be described. A suitable blower 23 driven by motor 24 is adapted to suck or draw in air through conduit 25 and discharge this air under pressure through conduit 26. It is to be understood that the term "blower" as here used and as used in the claims which follow is intended to cover any form of air pumping means or fan suitable for maintaining a continuance circulation of air through the conduit system.

The delivery conduit 26 from blower 23 connects directly with the conduit 19, which, as already described, connects with the upper ends of the distributing conduits 17 which extend to the lower horizontal conduits 15 beneath the heating means. The two upper air conduits 20 are connected together by the forked conduit 27 which joins with air conduit 28 extending back substantially parallel with conduit 19 and connecting with the conduit 25 leading to the suction side of blower 23. At 29 in conduit 28 is positioned an air inlet communicating with the air outside the

car, this inlet being closed or regulated by a plurality of shutters or louvers 30 which may be moved to open or closed or some intermediate position by means of a time-controlled motor 31. The control mechanism 31 may be so regulated as to admit a measured quantity of fresh air at intervals to the air-circulating system.

A refrigerating chamber 32 is positioned intermediate the conduits 19 and 28 and is connected at its respective sides with these two conduits by passages that may be closed or opened as desired, by means of shutters or other suitable closures 33 and 34, respectively. A suitable refrigerating means is positioned in the chamber 32, this refrigerating element preferably being a brine circulating coil 35, this coil being connected with a brine supply tank 36 by pipes 37 and 38, in one of which pipes may be positioned a pumping mechanism 39 for enforcing a circulation of the brine. At 40 is indicated diagrammatically any suitable mechanical refrigeration system having a refrigerating coil 41 positioned in brine tank 36. A single thermostat 42 positioned within the passenger compartment of the car may be connected to control the distributing valve 9 of the heating system, and also through wires 43 and relay 44 control the actuating motor 45 of refrigerating apparatus 40. Either the heating system or the refrigerating system, if required, will be put in operation automatically by thermostat 42 in accordance with temperature conditions in the car.

A return air conduit 46 is shunted around the refrigerating chamber 32, conduit 46 being connected at its inlet end to the conduit 19 and at its discharge end to the conduit 28. A cut-off gate or closure 47 is positioned in conduit 28 between the valved opening 34 and the suction side of the blower, and a similar valve or closure 48 is positioned in conduit 19 between the valved opening 33 to the refrigerating chamber and the inlet to shunt conduit 46. A similar closure or valve 49 is located at the outlet end of shunt conduit 46. The series of valves or closures 33, 34, 47, 48 and 49 are automatically operated by a series of motors 50 controlled by a thermostat 51, preferably positioned outside of the car so as to respond to outside temperature conditions. When the outside temperature is such that heat should be required within the car, the valves or closures 33, 34 and 49 will automatically be closed and the valves 47 and 48 opened. Air from the pressure side of the blower 23 will now be delivered through conduits 26, 19 and 17 into the blower distributing conduits 15, from which it will be discharged through heating chamber 10 into the passenger compartment of the car. If the temperature within the car has fallen to such a point that heat is required, the interior thermostat 42 will have operated distributing valve 9 to deliver vapor or steam to the radiators, and the air forced through the chambers 10 will be heated before it passes into the car through outlets 14. Air from the upper portion of the car will be withdrawn through conduits 20, 27 and 28 and delivered to the suction side of the blower at 25. Fresh air in measured quantities is admitted through inlet 29, and the excess air within the car will escape through the doors, windows or other openings or leaks in the usual manner. The required moisture may be added to the circulating air stream by means of a humidifier 52 positioned in conduit 28. This humidifier may be of any suitable form, and may be provided with a heating coil or vaporizer formed as a branch of the car heating system.

When temperature conditions are such that it is desirable to cool the circulating air stream, the motors 50 will be automatically operated to open the shutters or valves 33, 34 and 49 and close the valves 47 and 48. The air delivered from the blower will now be forced through the refrigerating chamber 32 where it is cooled by refrigerating element 35, and will then be delivered through conduits 28, 27 and 20 and discharged into the upper portion of the passenger space in the car. Air will now be exhausted from the lower portion of the car through conduits 15, 17 and 19, and through shunt conduit 46 to the end of conduit 28 beyond closure 47 and thence through conduit 25 to the suction side of blower 23.

It will now be apparent that an air circulation system is provided through which air may be continuously circulated through a closed system of conduits, including the space within the passenger compartment of the car. Means are provided for automatically regulating the temperature of this air so that it may be maintained at either a higher or a lower temperature than the outside air, as prevailing temperature conditions may require. Means are also provided for admitting to the circulation such additional fresh air from outside the car as may be necessary, and for humidifying the air stream circulated through the conduits.

In the case of relatively short passenger compartments, such as dining cars or cars of special type having similar short compartments, a single system of the type here diagrammatically illustrated may be sufficient. In the case of longer cars, such as coaches, two such systems may be used, one operating from each end of the car to a point mid-way thereof.

While closures or gates in the form of swinging shutters of louvers have here been illustrated for directing the air streams through the several conduits, it will be understood that any other suitable form of closures or valves may be used, and the terms "valves" or "valved conduits" as herein-

after used in the claims are intended to cover any suitable form of means for opening or closing a conduit to the flow of air therethrough.

It will be understood that any suitable form of refrigerating means may be used in refrigerating chamber 32 to cool the air stream flowing therethrough. While ice might be used for this purpose, a mechanical refrigerating system is preferable, and it is preferred to use a brine coil in this chamber and locate the refrigerating means outside of chamber 32 so as to avoid the possibility of ammonia or other refrigerating medium escaping into the air stream. By adding fins on the brine coils 35, as illustrated in Figs. 1 and 4, an extended heat absorbing surface is provided so as to effectively and rapidly chill the air stream flowing through compartment 32.

We claim:

1. In combination with a railway car, a blower, valved conduits communicating with the pressure and suction sides of said blower and the upper and lower portions of the car, a refrigerating means and a heating means each in circuit with said conduits, and means for controlling the valve conduits whereby cooled air may be continuously circulated from top to bottom of the space within the car, or alternatively heated air may be continuously circulated from bottom to top of this space, and means for admitting outside air in measured quantities to the circulating air stream.

2. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including in the circuit the space within the passenger compartment of the car, a blower in the circuit, a heating means, a refrigerating means, and valve means in the circuit for diverting the air flow either in contact with the refrigerating means and downwardly through the compartment, or in contact with the heating means and upwardly through the compartment.

3. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including in the circuit the space within the passenger compartment of the car, a blower in the circuit, a heating means, a refrigerating means, and thermostatically controlled valve means in the circuit for diverting the air flow either in contact with the refrigerating means and downwardly through the compartment, or in contact with the heating means and upwardly through the compartment.

4. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including in the circuit the space within the passenger compartment of the car, a blower in the circuit, a heating means, a refrigerating means, valve means in the circuit for diverting the air flow either in contact with the refrigerating means and downwardly through the compartment, or in contact with the heating means and upwardly through the compartment, and automatic means for actuating the valve means including a thermostat positioned exteriorly of the car.

5. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including the space within the passenger compartment of the car, conduits communicating with the upper portion of this space, and conduits communicating with the lower portion of this space, a blower for maintaining a flow of air through the system, a heating means and a cooling means in said conduit system, valve means for reversing the direction of flow of air through the compartment, and directing the air flow alternatively in contact with either the heating or cooling means and automatic means for actuating the valves comprising a thermostat positioned exteriorly of the car.

6. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including the space within the passenger compartment of the car, conduits communicating with the upper portion of this space, and conduits communicating with the lower portion of this space, heating means in contact with which air is discharged from the lower conduits, a refrigerating means, a blower, and valved passages in said circuit whereby the air discharged from the blower may be directed in contact with the refrigerating means and into the upper conduits, the lower conduits being connected with the suction side of the blower, or alternatively the air from the blower may be directed through the lower conduits, and the upper conduits connected directly with the suction side of the blower.

7. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including the space within the passenger compartment of the car, conduits communicating with the upper portion of this space, and conduits communicating with the lower portion of this space, heating means in contact with which air is discharged from the lower conduits, a refrigerating means, a blower, and valved passages in said circuit whereby the air discharged from the blower may be directed in contact with the refrigerating means and into the upper conduits, the lower conduits being connected with the suction side of the blower, or alternatively the air from the blower may be directed through the lower conduits, and the upper conduits connected directly with the suction side of the blower, an inlet from the air outside the car to the suction side of the blower, and means for controlling the per-

centage of air added to the circulating air stream through this inlet.

8. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including in the circuit the space within the passenger compartment of the car, a blower in the circuit, a heating means, a refrigerating means, and valve means in the circuit for diverting the air flow either in contact with the refrigerating means and downwardly through the compartment, or in contact with the heating means and upwardly through the compartment, an inlet from the air outside the car to the suction side of the blower, and means for controlling the percentage of air added to the circulating air stream through this inlet.

9. In a temperature controlling and air circulating system for railway cars, a closed system of air-circulating conduits including the space within the passenger compartment of the car, conduits communicating with the upper portion of this space, and conduits communicating with the lower portion of this space, heating means in contact with which air is discharged from the lower conduits, a refrigerating means, a blower, and valved passages in said circuit whereby the air discharged from the blower may be directed in contact with the refrigerating means and into the upper conduits, the lower conduits being connected with the suction side of the blower, or alternatively the air from the blower may be directed through the lower conduits, and the upper conduits connected directly with the suction side of the blower and thermostatic means for automatically controlling the valved passages.

10. In a cooling and ventilating system for railway cars, conduits communicating with the upper portion of the space within the car, conduits communicating with the lower portion of the space within the car, a refrigerating means, a blower, and valved conduits for directing air from the pressure side of the blower through the refrigerating means and the upper conduits into the car, and at the same time connecting the lower conduits with the suction side of the blower, or for alternatively connecting the pressure side of the blower directly with the lower conduits, and connecting the upper conduits with the suction side of the blower.

11. In a cooling and ventilating system for railway cars, conduits communicating with the upper portion of the space within the car, conduits communicating with the lower portion of the space within the car, a refrigerating means, a blower, and thermostatically controlled valved conduits for directing air from the pressure side of the blower through the refrigerating means and the upper conduits into the car, and at the same time connecting the lower conduits with the suction side of the blower, or for alternatively connecting the pressure side of the blower directly with the lower conduits, and connecting the upper conduits with the suction side of the blower.

12. In a cooling and ventilating system for railway cars, conduits communicating with the upper portion of the space within the car, conduits communicating with the lower portion of the space within the car, a refrigerating means, a blower, and valved conduits for directing air from the pressure side of the blower through the refrigerating means and the upper conduits into the car, and at the same time connecting the lower conduits with the suction side of the blower, or for alternatively connecting the pressure side of the blower directly with the lower conduits, and connecting the upper conduits with the suction side of the blower, and means including a thermostat positioned exteriorly of the car for regulating the valved conduits and controlling the direction of air flow through the space within the car.

13. In a cooling and ventilating system for railway cars, conduits communicating with the upper portion of the space within the car, conduits communicating with the lower portion of the space within the car, a refrigerating chamber, a brine coil therein, a mechanical refrigerating system for cooling the brine, thermostatic means in the car for controlling the refrigerating system, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and the upper conduits into the car, and at the same time connecting the lower conduits with the suction side of the blower, or for alternatively connecting the pressure side of the blower directly with the lower conduits and connecting the upper conduits with the suction side of the blower, and thermostatic means for regulating the valved conduits.

14. In a cooling and ventilating system for railway cars, conduits communicating with the upper portion of the space within the car, conduits communicating with the lower portion of the space within the car, a refrigerating chamber, a brine coil therein, a mechanical refrigerating system for cooling the brine, thermostatic means in the car for controlling the refrigerating system, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and the upper conduits into the car, and at the same time connecting the lower conduits with the suction side of the blower, or for alternatively connecting the pressure side of the blower directly with the lower conduits and connecting the upper conduits with the suction side of the blower, and means including a thermostat positioned exteriorly of the car for regulating the valved conduits to control the direction of flow of air within the car.

15. In a temperature controlling and air circulating system for railway cars, heating compartments in the lower side walls of the car, air ports between said compartments and the space within the car, heating means in the compartments, conduits in the lower portion of the car communicating with these compartments, conduits in the upper portion of the car provided with ports communicating with the space within the car, a refrigerating chamber, refrigerating means in said chamber, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and thence into the upper conduits, or alternatively for directing the air from the blower directly through the lower conduits, valved conduits for connecting either the upper or the lower conduits with the suction side of the blower, and means for controlling the valves whereby air may be circulated in either direction through the space within the car.

16. In a temperature controlling and air circulating system for railway cars, heating compartments in the lower side walls of the car, air ports between said compartments and the space within the car, heating means in the compartments, conduits in the lower portion of the car communicating with these compartments, conduits in the upper portion of the car provided with ports communicating with the space within the car, a refrigerating chamber, refrigerating means in said chamber, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and thence into the upper conduits, or alternatively for directing the air from the blower directly through the lower conduits, valved conduits for connecting either the upper or the lower conduits with the suction side of the blower, and thermostatic means for controlling the valves.

17. In a temperature controlling and air circulating system for railway cars, heating compartments in the lower side walls of the car, air ports between said compartments and the space within the car, heating means in the compartments, conduits in the lower portion of the car communicating with these compartments, conduits in the upper portion of the car provided with ports communicating with the space within the car, a refrigerating chamber, refrigerating means in said chamber, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and thence into the upper conduits, or alternatively for directing the air from the blower directly through the lower conduits, valved conduits for connecting either the upper or the lower conduits with the suction side of the blower, an inlet to the suction side of the blower from the air outside the car, means for controlling the percentage of air admitted through this inlet, and means for controlling the valves whereby air may be circulated in either direction through the space within the car.

18. In a temperature controlling and air circulating system for railway cars, heating compartments in the lower side walls of the car, air ports between said compartments and the space within the car, heating means in the compartments, conduits in the lower portion of the car communicating with these compartments, conduits in the upper portion of the car provided with ports communicating with the space within the car, a refrigerating chamber, refrigerating means in said chamber, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and thence into the upper conduits, or alternatively for directing the air from the blower directly through the lower conduits, valved conduits for connecting either the upper or the lower conduits with the suction side of the blower, a humidifier positioned in one of the conduits, and means for controlling the valves whereby air may be circulated in either direction through the space within the car.

19. In a temperature controlling and air circulating system for railway cars, heating compartments in the lower side walls of the car, air ports between said compartments and the space within the car, heating means in the compartments, conduits in the lower portion of the car communicating with these compartments, conduits in the upper portion of the car provided with ports communicating with the space within the car, a refrigerating chamber, refrigerating means in said chamber, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and thence into the upper conduits, or alternatively for directing the air from the blower directly through the lower conduits, valved conduits for connecting either the upper or the lower conduits with the suction side of the blower, means including a thermostat positioned exteriorly of the car for controlling the valves, and a thermostat positioned within the car for controlling the heating and the refrigerating means in accordance with temperature changes within the car.

20. In a temperature controlling and air circulating system for railway cars, heating compartments in the lower side walls of the car, air ports between said compartments and the space within the car, heating means in the compartments, conduits in the lower portion of the car communicating with these compartments, conduits in the upper portion of the car provided with ports communicating with the space within the car, a refrigerating chamber, a brine coil in said chamber, a mechanical refrigerating system for cooling the brine, thermostatic means in

the car for controlling the refrigerating and heating means, a blower, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and the upper conduits into the car, and at the same time connecting the lower conduits with the suction side of the blower, or for alternatively connecting the pressure side of the blower directly with the lower conduits and connecting the upper conduits with the suction side of the blower, and thermostatic means for controlling the valved conduits.

21. In a temperature controlling and air circulating system for railway cars, heating compartments in the lower side walls of the car, air ports between said compartments and the space within the car, heating means in the compartments, conduits in the lower portion of the car communicating with these compartments, conduits in the upper portion of the car provided with ports communicating with the space within the car, a refrigerating chamber, a brine coil in said chamber, a mechanical refrigerating system for cooling the brine, thermostatic means in the car for controlling the refrigerating and heating means, a blower, an inlet to the suction side of the blower from the air outside the car, means for controlling the percentage of air admitted through this inlet, valved conduits for directing air from the pressure side of the blower through the refrigerating chamber and the upper conduits into the car, and at the same time connecting the lower conduits with the suction side of the blower, or for alternatively connecting the pressure side of the blower directly with the lower conduits and connecting the upper conduits with the suction side of the blower, and thermostatic means for controlling the valved conduits.

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