July 19, 1949. E. E. HANS 2,476,295

AIR FRESHENING SYSTEM

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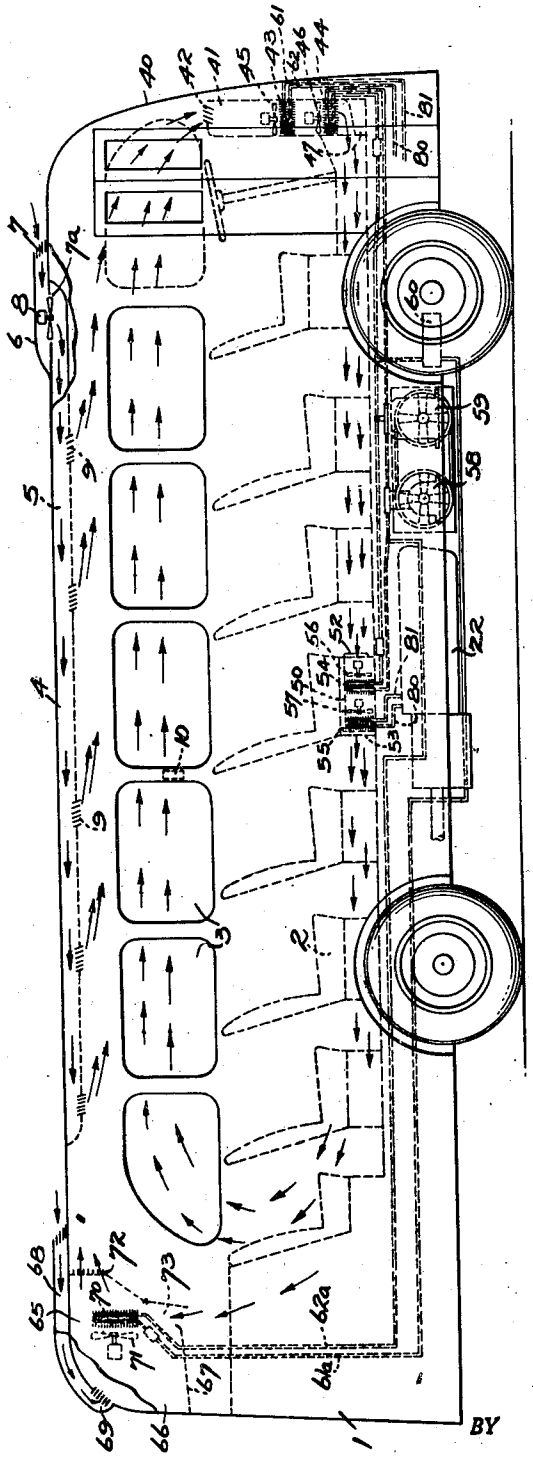

Fig. 1

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AIR FRESHENING SYSTEM

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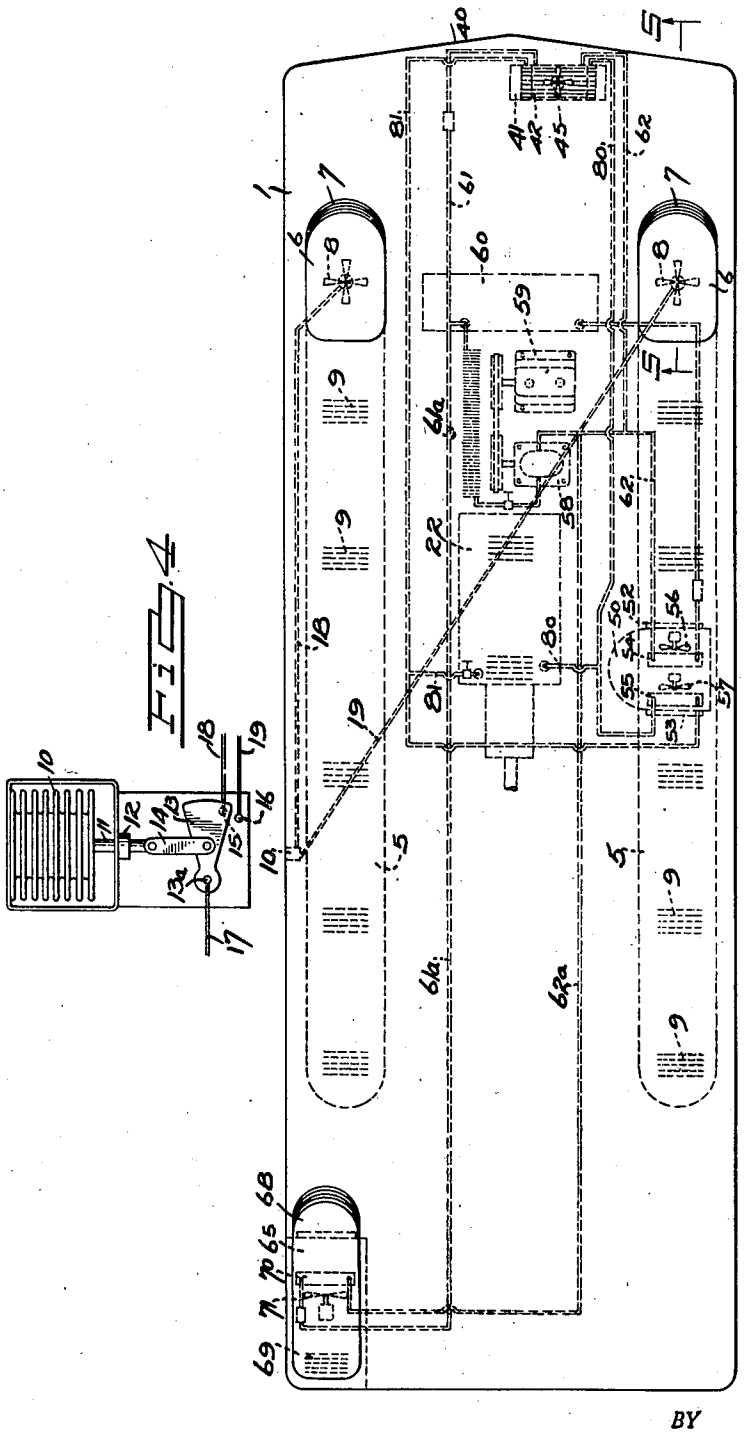

Fig. 4

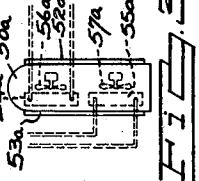

Fig. 2



Fig. 5

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AIR FRESHENING SYSTEM

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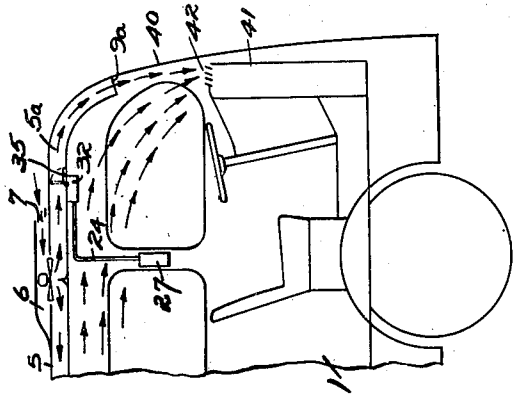


FIG. 5

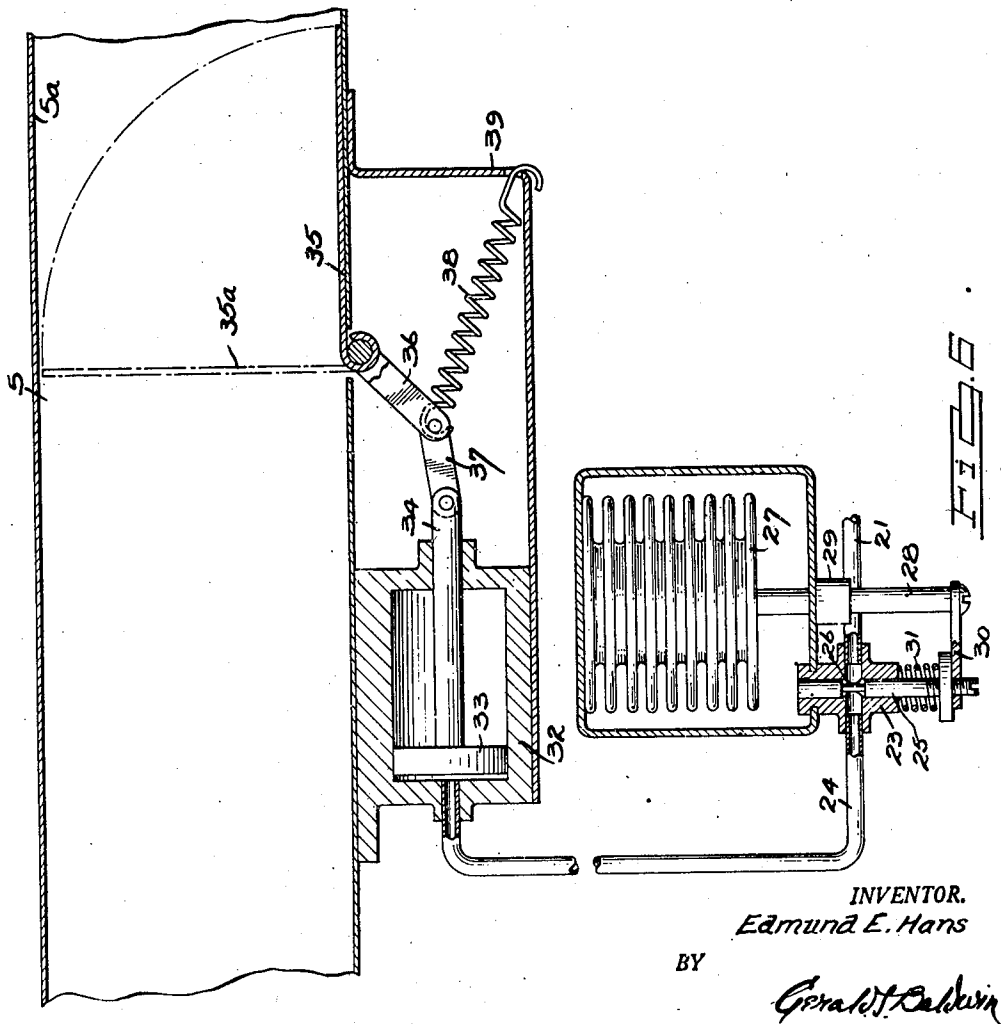


FIG. 6

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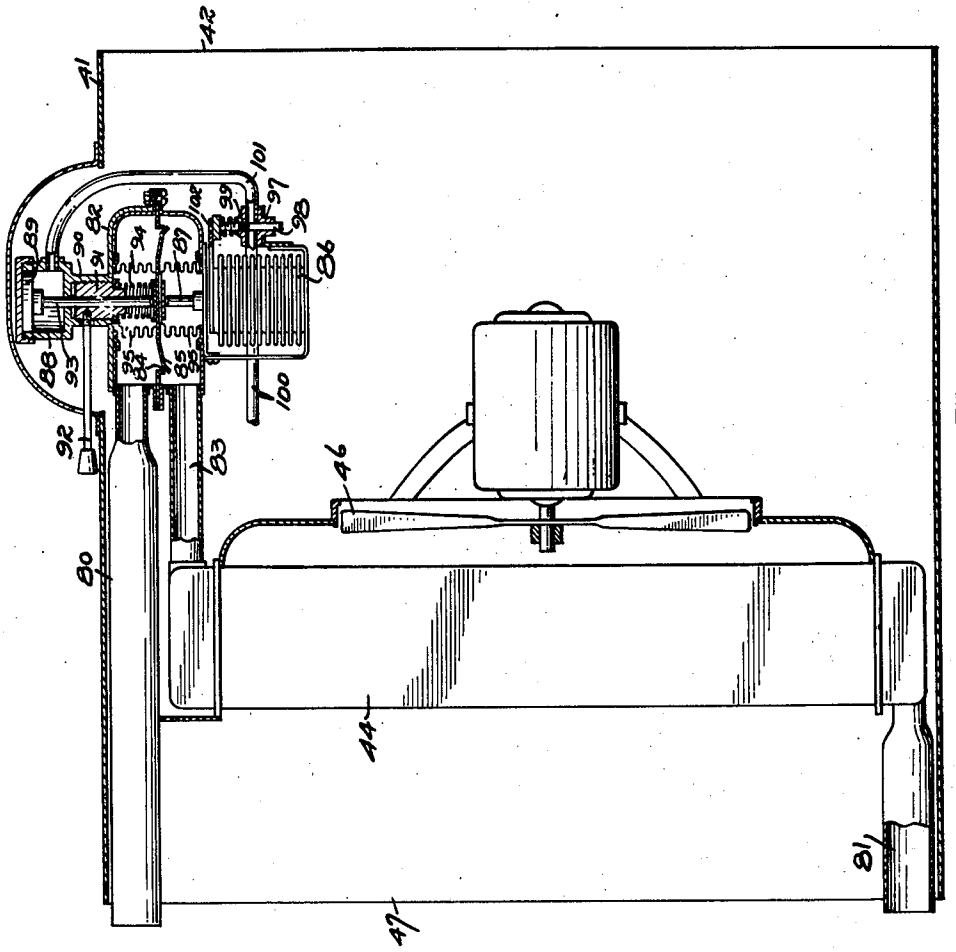


FIG 7

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Patented July 19, 1949 2,476,295

# UNITED STATES PATENT OFFICE

2,476,295

## AIR FRESHENING SYSTEM

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Application November 6, 1946, Serial No. 708,162

18 Claims. (Cl. 257—3)

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This invention relates to improvements in air freshening systems, and refers to an air circulating system for use either in summer or winter adaptable both to closed vehicle bodies and to rooms of buildings.

The invention aims, among other things, to provide an air freshening system wherein a vertical unit is arranged in a closed body adjacent the front thereof to receive air in the top, that is intermediately of the height of the body, and discharge it at high velocity after treatment (either heating or cooling) parallel with and adjacent the floor toward the rear of the body; wherein a horizontal unit arranged on floor level is utilized for receiving some of the treated air, re-treating it (either by heating or cooling), and again discharging it at high velocity toward the back of the closed body so that the treated air reaches the rear at sufficiently high velocity to turn upward and then return to the front of the body; and wherein ducts are provided through which air from outside is discharged into the returning air so that the temperature of this air which extends across breathing level is reduced, say about ten to fifteen degrees in winter, and raised a somewhat lesser amount in summer. Thus I aim to maintain the lower extremities of persons within the closed body warmer in winter and cooler in summer, than the air at breathing level which is refreshing at all times. The fresh air entering the flow of air returning to the vertical unit for re-treatment compensates for the air continuously lost through leakage around doors and windows. The flow of fresh air through the ducts is thermostatically controlled so that too much of it is at no time admitted, and one of the ducts may be provided with a forward extension terminating above and adjacent the vertical unit to decrease the drag on the fans in the latter so that a maximum amount of treated air may be discharged therefrom; moreover it is preferable that a high percentage of fresh air be introduced into the unit as it is found that fresh air heats more quickly than vitiated moisture-laden air from which some of the oxygen has been extracted by the breathing of the occupants of the closed body. The use of a maximum amount of fresh air in the units is also particularly desirable in winter for the reason that all the available heat from the engine is necessary to sufficiently heat the lower portion of the closed vehicle.

In my Patent No. 2,273,000 I provided an arrangement including two vertical units one adjacent the front and the other intermediately of

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the length of a closed body; both units were arranged to withdraw air from an intermediate level and discharge it rearwardly at floor level so that at the rear this air turned and flowed back at an intermediate height; meanwhile a supply of fresh air was discharged rearwardly immediately beneath the ceiling which also turned at the rear of the closed body and flowed back and mixed at an intermediate level with the previously treated air. In actual practice it has been found and established that the air followed the paths above outlined, but in so doing created unlooked-for drawbacks. Firstly, outside air discharged rearwardly in sufficient volume to maintain the desired balance resulted at times in too cool a temperature at breathing level for the comfort of passengers, and also tended to create a draft which I now overcome by injecting a plurality of forwardly and downwardly directed streams of fresh air into the returning and previously treated air. Secondly, the pull of the intermediate vertical unit drawing air into the top thereof from the intermediate level caused an objectionable draft upon the shoulders of persons seated in its vicinity. This I now overcome by placing the intermediate unit horizontally so that air treated by it is drawn from floor level and the rearward travel of the air is thus expedited. My present arrangement simplifies the entire flow arrangement and permits sufficient fresh air to be added to provide refreshing air at breathing level without fear of creating a draft at all outside temperatures. The air discharged by the two units as now arranged after reaching the rear turns and flows forward not merely at an intermediate level but throughout the upper part of the closed body where it picks up the fresh air injected into it, thus a large volume of air extending over a large proportion of the entire cross section of the body interior flows forward uniformly and at a speed insufficient to create a draft.

A further object of the invention is to provide an air freshening system which, when installed in a bus, includes a centrally located front unit to discharge air substantially uniformly over the entire width of the body; and wherein the intermediate unit is positioned so that its discharge is also well distributed over the entire body width; consequently crowding of the vehicle does not interfere with the successful operation of the system.

Another object of the invention is to provide an air freshening system wherein sufficient fresh air is added to the forwardly flowing air, and the

front vertical unit is so located, that under all normal operating conditions a sufficient supply of this fresh air flows down in contact with the windshield to render the use of defrosters superfluous.

Another object of the invention is to provide an air freshening system including units in each of which both a heater core and a cooling coil are provided, and separate means are arranged for discharging air through the core and the coil both of which are normally in operation when either the core or the coil is in operation, thereby discharging a large volume of air at high velocity from the units.

Another object of the invention is to provide an air freshening system including a plurality of ducts which extend along the ceiling from which streams of fresh air are forwardly and downwardly discharged into the closed body, a fan to discharge air into and through each duct, and a thermostat within the body to control the operation of the fans, and an additional thermostatic control for regulating the flow of air from one of the ducts through a forward extension in cases where such an extension is employed, so that if the temperature of the air travelling within the body to the forward unit is too cool no additional fresh air passes through the extension. However if the air returning to the forward unit for retempering (cooling) is too warm, a flow of fresh air from the extension reduces the temperature of the returning air, and consequently the temperature of treated air from the forward unit is correspondingly lowered.

Another object of the invention is to provide a specially constructed form of thermostatic control for regulating the flow of hot water to the heater core in each unit according to the temperature of the air entering that unit.

Another object of the invention is to provide an air freshening system which may include an additional cooling unit positioned immediately beneath the ceiling, preferably at the rear for introducing additional cool air into the upper portion of the vehicle body.

Having thus broadly outlined some of the objects and advantages of the invention I will now describe preferred embodiment thereof with the aid of the accompanying drawings, in which:

Figure 1 is a side elevation of a bus equipped with my invention, and Figure 2 is a plan view thereof.

Figure 3 is a detail showing a modification of the intermediate horizontal unit.

Figure 4 is an enlarged view showing a detail of the thermostatic control for the duct fans.

Figure 5 shows a modification including a forward duct extension.

Figure 6 is a thermostatic control for the shutter in the duct extension.

Figure 7 is a detail showing the thermostatic control for the water inlet to the heater cores.

Referring to the drawings, 1 designates a closed body, in the present instance the body of a bus, having seats 2 therein, windows 3 and a roof 4. Formed longitudinally in the latter on each side and extending throughout the major portion of the length of the bus are fresh air ducts 5 the front extremity of each of which terminates beneath a raised chamber 6 projecting upwardly from the roof 4 and having suitable openings 7 in front for the admission of outside air. Formed through the base of each chamber 6 is an opening 7a in which an electrically operated fan 8 is mounted to discharge air downwardly into the



duct 5 beneath. It will be noted that in Figure 1 these ducts only extend rearwardly from beneath the chambers 6 and are provided with a series of spaced outlets 9, preferably in the form of louvres so arranged that air passing therethrough flows into the top of the bus in a downward and forward direction. In the modification shown in Figure 5 one of the ducts 5, usually the one on the right side, has a forward extension 5a which terminates in a downwardly directed outlet 9a positioned adjacent the front of the vehicle.

Mounted in the body 1 substantially at normal breathing level therein is a thermostat 10 which controls the operation of the fans 8 in such manner that if the temperature is low both fans are inoperative; if the temperature is somewhat warmer one fan is automatically set in motion thereby; and if the temperature is still higher both fans are operated. The operation of the fans is controlled in the following manner:

The thermostat 10 (Figure 4) is of the bellows type and expands downwardly when subjected to heat. Extending downward from the thermostat is a rod 11 which passes through a suitable bearing 12, and pivotally mounted at 13a beneath the latter is an arm 13 connected by a link 14 to the lower extremity of the rod 11. Suitably mounted adjacent one side of the arm for contact therewith as the arm is moved pivotally downward are two contact members 15 and 16. 17 denotes a feed wire connected to the said arm, and 18 and 19 are leads which extend from the contact members 15 and 16 respectively each to one of the fans 8. Thus as the arm 13 is swung downward by expansion of the thermostat 10 first one fan and then the other is set in motion.

In the event that one of the ducts 5 is provided with a forward extension 5a I provide automatic means for preventing air flowing through the extension when the temperature in the front part of the bus is below a predetermined minimum. A preferred method of so doing is shown in Figure 6 wherein a shutter 20 is pivoted in the duct 5 which, when closed, prevents air flowing forward into the extension 5a. 21 is a suction line extending from the main vehicle motor 22 and terminates in a valve housing 23; extending from the opposite side of the housing and in alignment with the line 21 is a pipe 24. Mounted for movement in the housing 23 at right angles to the axis of the suction line 21 and pipe 24 is a valve stem 25 having an annular groove 26 formed around it intermediately of its length to connect the suction line and pipe at a certain position of the valve stem. A thermostat 27 of the bellows type has a rod 28 extending therefrom which is adapted to move through a bearing 29 as the thermostat expands or contracts. Secured to the lower extremity of the rod 28 and in threaded engagement with the lower extremity of the valve stem 25 is an arm 30 so that movement of the rod imparts like movement to the valve stem, and the annular groove 26 is so located that upon sufficient downward movement of the rod 28 the suction line 21 and pipe 24 are connected. 31 denotes a helical spring around the valve stem between the underside of the housing 23 and the arm 30 which tends to move the said stem downwardly. Mounted adjacent the duct 5, in the present instance upon the underside of the latter, is a cylinder 32 having a piston 33 therein from which a rod 34 extends. The shutter 35 is pivoted in the duct 5 adjacent its junction with the forward extension 5a and forwardly of the fan 8. Projecting

from the shutter is an arm 36 which is connected to the rod 34 by a link 37 so that movement of the piston to the left (Figure 6) opens the shutter. The pipe 24 is connected to the extremity of the cylinder 32 remote from that through which the rod 34 projects so that suction exerted through the pipe causes the shutter to open. When suction is no longer exerted on the piston 32 the latter is pulled toward the opposite extremity of the cylinder and the shutter is turned to its closed position indicated at 35a by a helical spring 38 secured at one extremity to the arm 36 and at its opposite extremity to a suitable fixed member, such as the member 39 extending downwardly from the duct extension 5a.

Mounted in the body 1 substantially centrally of its width and immediately behind the windshield 40 is an enclosed vertical unit 41 having an air inlet 42 extending over its upper face. Mounted horizontally in the unit is a horizontal cooling coil 43 and spaced beneath it is a horizontal heater core 44. Fans 45 and 46 are mounted above the coil 43 and core 44 respectively to discharge air therethrough. An outlet 47 is formed through the lower extremity of the rear wall of the unit and is so shaped that air discharged therethrough flows rearwardly along the floor of the body throughout its entire width.

An intermediate, horizontal, closed unit 50 is mounted on the floor of the closed body beneath one of the seats 2. An air inlet 52 is formed through the front wall of the unit 50 and through its rear wall an air outlet 53 is provided, the latter is so shaped that air discharged therethrough flows in a rearward direction across the entire width of the body. Mounted in the unit 50 is a vertical cooling coil 54 and spaced in front of it is a vertical heater core 55. 56 and 57 denote fans mounted adjacent the coil and core respectively to discharge air through them. Due to the location of the intermediate unit rearwardly flowing air passes directly through it and its velocity is so increased that air reaches the back of the body at such high velocity that it is diverted upwardly and then forwardly at a higher level. During its forward passage some of the fresh air from the outlets or louvres 9 mixes with it, and the fresh air from the louvres and the treated and returning air passes to the vertical unit 41 for retreatment and recirculation.

Figure 3 shows a modified form of horizontal unit 50 for use under narrow seats beneath which there is not sufficient room to mount a unit wherein the cooling coil and heater core with their respective fans are positioned one in front of the other. In that case the cooling coil 54a and the heater core 55a are arranged side by side in the unit 50a with their respective fans 56a and 57a behind them to draw air in through the inlet 52a and discharge it through the outlet 53a.

Any conventional refrigerating means may be employed for furnishing a refrigerant to the cooling coils 43, 54 or 54a. In the present instance a compressor 58 is shown beneath the body 1 driven by a gasoline engine 59. 60 is a condenser tank and 61 and 62 denote flow and return pipes respectively to the coils 43 and 54, or 54a. The operation of the cooling coils is controlled in the present instance by starting or stopping the engine 59 though obviously other means may be substituted if desired.

In the rear of the closed body 1 a supplemental cooling unit 65 may be provided. This includes a chamber 66 usually formed in part by the underside of the roof 4 and by a casing 67 attached thereto. Mounted upon the roof is a longitudinal air receiving tube 68 open at its front extremity and having its rear extremity in communication with the interior of the chamber 66 through inlet passages 69. Mounted in the chamber is a vertical cooling coil 70 suitably connected to the refrigerating system by piping 61a and 62a. A fan 71 is arranged for discharging air forward from the inlet passage 69 through the coil 70 and through openings 72 formed through the front vertical wall of the casing 67. In order that some air from within the closed body may enter the chamber 66 for mixing with the fresh air therein the underside of the casing 67 may also be apertured as shown at 73. It is however understood that this supplemental cooling unit is only employed in cases where quite excessively high temperatures are encountered.

From the water cooling system for the main bus motor 22 feed and returns lines 80 and 81 extend to the heater cores 44 and 55, or 55a. The flow of water through the feed line may be controlled in each unit 41 and 50 by thermostatic means so that if the air entering the unit is above a predetermined temperature no water flows into the core. In the present instance the arrangement is as follows: A valve housing 82 is connected both to the feed line 80 and to a connection 83 the opposite extremity of which is secured to the heater core 44. Provided in this housing is an annular valve seat 84 the opening through which is adapted to be closed by a diaphragm 85. Mounted on one side of the housing 82 is a bellows-type thermostat 86 from the expanding extremity of which a spindle 87 projects which is adapted to bear against one side of the diaphragm and force it against its seat. Mounted on the opposite side of the housing is a cylinder 88 having a plunger 89, and spaced between the cylinder and the housing, extending into the latter, and integral with the said cylinder is an internally threaded sleeve 90 having an annular nut 91 therein. Extending radially through a slot formed through the sleeve 90 and secured to the nut 91 is an operating handle 92 for turning the nut and varying the spacing between it and the diaphragm 85. Extending from the plunger 89 through the nut 91 is a rod 93 the outer extremity of which is adapted to move the diaphragm off its seat. 94 denotes a helical spring mounted around the rod 93 and extending between the nut 91 and the diaphragm 85 thereby tending to move the latter to open position. Extending between each side of the housing 82 and the adjacent side of the diaphragm, and secured at each extremity to one of the latter is an annular bellows-like expansible sleeve 95; one of the sleeves encloses the plunger rod 93 and the spring 94 and prevents water reaching these parts, and the other sleeve similarly encircles and protects the spindle 87 and the thermostat 86. Mounted on the housing 82 is a valve body 97 having a spindle 98 axially movable therethrough around which latter an annular groove 99 is formed intermediately of its length. Extending through opposite sides of the body 97 are aligned openings one of which receives one extremity of a suction line 100 the opposite end of which is connected to the water cooling system of the main bus motor 22, and in the other opening a pipe 101 is secured the opposite end of which is connected to the cylinder 88. The plunger 89 in the latter is adapted to be moved by suction exerted through the line 100 and the pipe 101.

Projecting laterally from the movable extremity of the thermostat 86 is a plate 102 to which one end of the spindle 98 is secured for movement with the said movable extremity. The annular groove 99 is so positioned that the suction line 100 and the pipe 101 are connected thereby when the thermostat is contracted so that then suction is exerted in the cylinder 88 to move the rod 93 farther into the housing 82 and expedite the movement of the diaphragm 85 off its seat 84. Thus the thermostat moves the diaphragm against its seat when expanded, and when contracted the diaphragm is moved off its seat by the spring 94, and the latter movement is hastened by operation of the plunger 89 and rod 93.

While in the foregoing the preferred embodiments of the invention have been described and shown, it is understood that alterations and modifications may be made thereto provided they fall within the scope of the appended claims.

What I claim is:

1. A method of freshening air in the interior of a closed body including the steps of withdrawing air from within the body both adjacent the front thereof intermediately of its height and also intermediately of the length of the body substantially at floor level, treating the withdrawn air at both locations and discharging it horizontally substantially at floor level in a rearward direction whereby it flows toward the rear of the body, rises, and returns to the front at a higher elevation for retreatment and recirculation, and discharging fresh air at spaced intervals throughout the length of the body into the top of the latter in a substantially forward direction whereby it mixes with the returning air.

2. The method as set forth in claim 1, including controlling the volume of fresh air discharged into the returning air substantially in accordance with the temperature of the returning air.

3. The method as set forth in claim 1, including discharging fresh air directly adjacent and toward the forward point of withdrawal of air for treatment, and controlling the volume of fresh air so discharged substantially in accordance with the temperature of the air substantially at the point of withdrawal.

4. A method of freshening air in the interior of a closed body including the steps of withdrawing air from within the body both adjacent the front thereof intermediately of its height and also intermediately of the length of the body substantially at floor level, heating the withdrawn air at both locations and discharging it horizontally substantially at floor level in a rearward direction whereby it travels toward the rear of the body, rises, and returns to the front at a higher elevation for reheating and recirculation, and discharging fresh air at spaced intervals throughout the length of the body into the top of the latter in a substantially downward direction whereby it mixes with the returning air.

5. A method of freshening air in the interior of a closed body including the steps of withdrawing air from within the body both adjacent the front end thereof intermediately of its height and also intermediately of the length of said body substantially at floor level, cooling the withdrawn air at both locations and discharging it horizontally substantially at floor level whereby it travels toward the rear of the body, rises, and returns to the front at a higher elevation for recooling and recirculation, and discharging fresh air at spaced intervals throughout the length of the body into the top of the latter in a substantially downward direction whereby it mixes with the returning air.



6. The method as set forth in claim 5, including the additional step of admitting fresh air into the upper rear portion of the body, cooling it and discharging it into the returning air in a substantially horizontal, forward direction.

7. A method of freshening air in the interior of a closed vehicle body including the steps of admitting fresh air into the upper portion of the body and discharging it in a forward and downward direction, withdrawing air within the body at an intermediate level at the front of the body and also substantially at floor level intermediately of the length of said body, tempering the withdrawn air at both locations and discharging it substantially rearwardly and horizontally adjacent floor level whereby this air travels to the rear of the body, rises, and returns to the front for retempering and recirculation at a higher level and mixes with the fresh air during its return flow.

8. An air freshening system for closed vehicle bodies, including means for discharging fresh air in a substantially forward direction through the top of the body at intervals throughout its length, a vertical air tempering unit having an air inlet at its upper extremity positioned within and adjacent the front of said body, said unit having an air outlet adjacent the bottom, means in the unit for drawing air thereinto and discharging it in a substantially rearward horizontal direction, a horizontal air tempering unit substantially on floor level intermediately of the length of the body, said horizontal unit having a front inlet and a rear outlet, means for drawing air through the latter inlet and discharging it in a substantially rearward horizontal direction through the latter outlet, the discharged air from both units being adapted to travel rearwardly at relatively high velocity, rise at the back of the body and return at a higher level for retempering and recirculation and to mix with the fresh air during its return flow, and means in each unit for tempering the air passing therethrough.

9. The combination in claim 8, including thermostatic means for controlling the means for discharging fresh air through the top of the body.

10. The combination in claim 8, wherein the tempering means in each unit includes both a heater core and a cooling coil.

11. The combination in claim 8, including a housing mounted in the upper rear portion of the body, a cooling coil therein, means for admitting fresh air into the housing, and means for discharging this air through the cooling coil and in a substantially horizontal forward direction through an opening in the housing into the returning air.

12. An air freshening system for closed vehicle bodies, including longitudinal ducts extending along the ceiling each having a plurality of spaced outlets through which fresh air is discharged in a substantially forward direction, a chamber extending above the closed body over each duct having an inlet for fresh air, means connecting each chamber with the duct beneath it, means for discharging the fresh air from each chamber into its duct, a vertical air tempering unit positioned within and adjacent the front of the body, said unit having an air inlet intermediately of the height of the body and an outlet adjacent the floor thereof, means in the unit for drawing air thereinto and discharging it substantially along the floor in a generally rearward, horizontal di-

rection, a horizontal air tempering unit substantially on floor level intermediately of the length of said body, said horizontal unit having a front inlet and a rear outlet, means for drawing air into the front inlet and discharging it through the rear outlet, the discharged air from both units being adapted to travel rearwardly at a relatively high velocity, rise at the back of the body and return at a higher level to the vertical unit for retempering and recirculation and to mix with the fresh air during its return flow, and means in each unit for tempering the air passing therethrough.

13. The combination in claim 12, including one thermostatic means for controlling the operation of the means for discharging the fresh air from the chambers into the ducts beneath them.

14. The combination in claim 12, including a forward extension on one duct having an outlet adjacent and directed substantially toward the inlet into the vertical unit, and a movable shutter for controlling the flow of air into the extension from its duct.

15. The combination in claim 12, wherein the tempering means in each unit includes both a heater core and a cooling coil, and the means for drawing air into each unit and discharging it therefrom includes a fan adjacent each heater core and another fan adjacent each cooling coil.

16. In an air freshening system for closed bodies, a duct extending longitudinally along the ceiling of a body, said duct having outlets formed at spaced intervals in its underside, an air chamber over the duct having an inlet through which fresh air is adapted to flow, means for discharging the fresh air from the chamber into the duct through an aperture connecting the former with the latter, a forward extension on the duct through which some of the fresh air is adapted to pass and be delivered adjacent the front of the body, means for closing off the extension from the duct, a vertical air treating unit having an air inlet at its upper extremity, said unit being positioned within and adjacent the front of the closed body intermediately of the height of the latter, means in the unit for drawing air thereinto and discharging it through an outlet formed adjacent the bottom of said unit along the floor in a substantially rearward direction, a horizontal air treating unit substantially on floor level intermediately of the length of the body, means for drawing air into an inlet formed in the front of the horizontal unit and discharging it through an outlet formed in the rear of the latter in a substantially horizontal and rearward direction whereby the air discharged from both units travels rearwardly at relatively high velocity, rises at the rear of the body, and returns to the front at a higher elevation for retempering and recirculation and mixes with the fresh air during its return flow, and air treating means in each unit.

17. An air freshening system for closed vehicle bodies including a duct extending longitudinally along the roof of a body, a chamber on the roof open in front for the admission of fresh air, means connecting the chamber with the duct for the passage of the fresh air from the former to the latter and through spaced openings formed in the underside of the duct whereby fresh air



flows into the body substantially throughout the length of the latter, a vertical air tempering unit having an air inlet at its upper extremity positioned within and adjacent the front of said body, said inlet being at an intermediate height in the latter, said unit having an outlet adjacent its underside, means in the unit for drawing air thereinto and discharging it in a substantially rearward direction, a horizontal air tempering unit substantially on floor level intermediately of the length of the body, said latter unit having a front inlet and a rear outlet, means for drawing air through the inlet and discharging it through the outlet in a substantially rearward and horizontal direction, the discharged air from both units being adapted to travel rearwardly to the back of the body at relatively high velocity, rise, and return at a higher level for retempering and recirculation and to mix with the fresh air during its return flow, and means in each unit for tempering the air passing therethrough.

18. An air freshening system for closed vehicle bodies including a chamber on the roof of a body having openings thereinto for the admission of fresh air, a forwardly extending duct, means connecting the latter with the interior of said chamber whereby the fresh air from the latter is discharged through the forwardly extending duct, a vertical air tempering unit having an air inlet within and adjacent the front of the body intermediately of the height of said body, said duct being adapted to discharge its air adjacent and toward said inlet, the unit having an outlet adjacent its underside, means in the unit for drawing air into the inlet and discharging it in a substantially rearward and horizontal direction through the outlet and in proximity to the floor of the body, a horizontal air tempering unit substantially on floor level intermediately of the length of the body having a front inlet and a rear outlet, means for drawing air in through the latter inlet and discharging it through the latter outlet in a substantially rearward and horizontal direction, the discharged air from both units being adapted to travel rearwardly at a relatively high speed, rise at the back of the body and return to the front at a higher elevation for retempering and recirculation and to mix with the fresh air during its return flow, and means in each unit for tempering the air passing therethrough.

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