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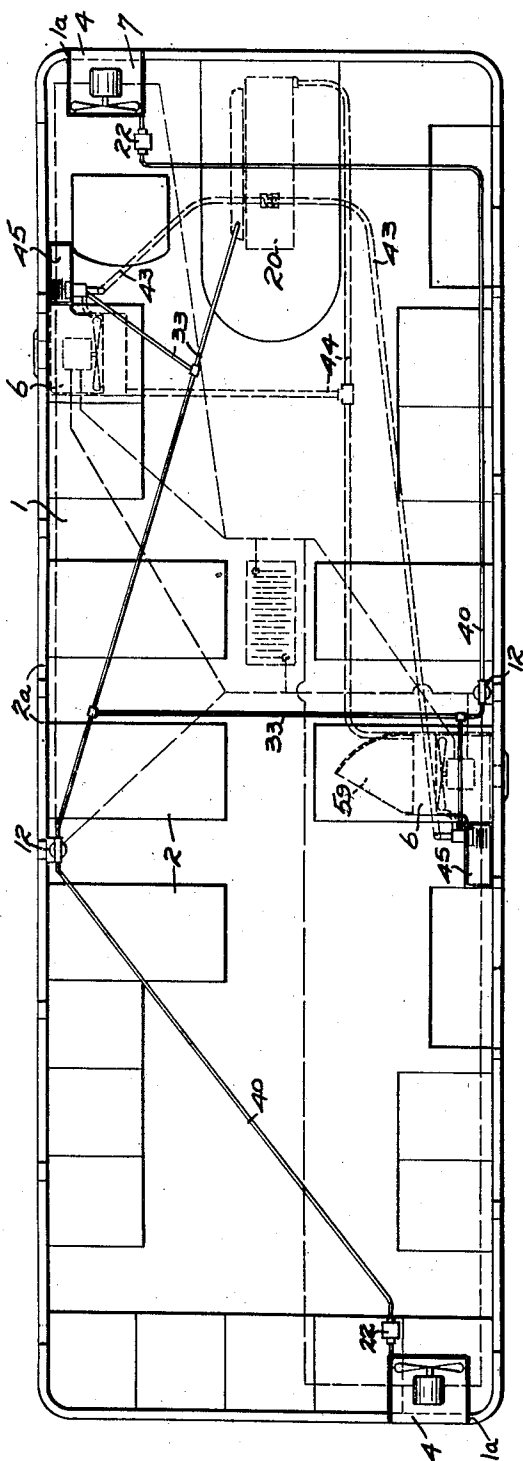
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2,273,000

AIR CONDITIONING SYSTEM

Filed June 14, 1940

4 Sheets-Sheet 1



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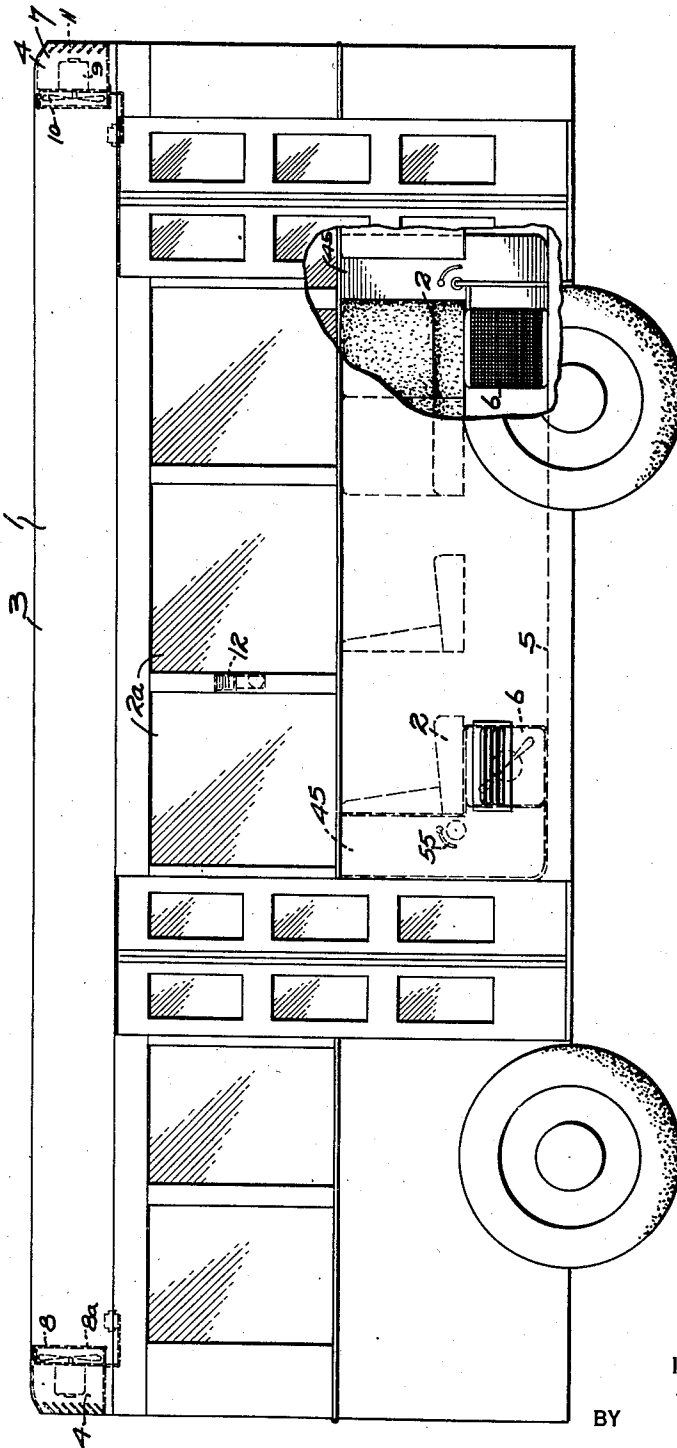
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AIR CONDITIONING SYSTEM

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4 Sheets-Sheet 2



2. 11

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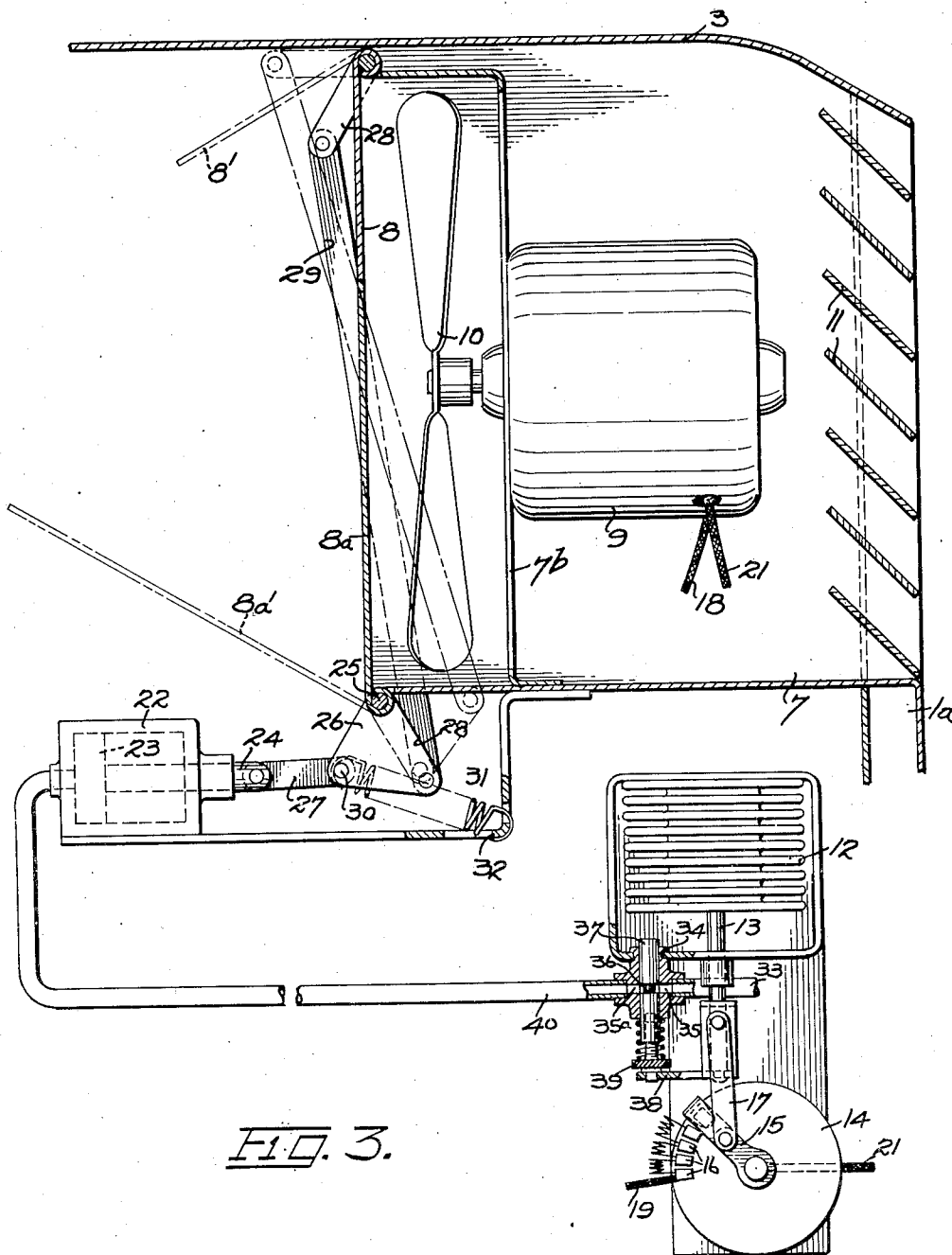
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AIR CONDITIONING SYSTEM

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4 Sheets-Sheet 3



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AIR CONDITIONING SYSTEM

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4 Sheets-Sheet 4

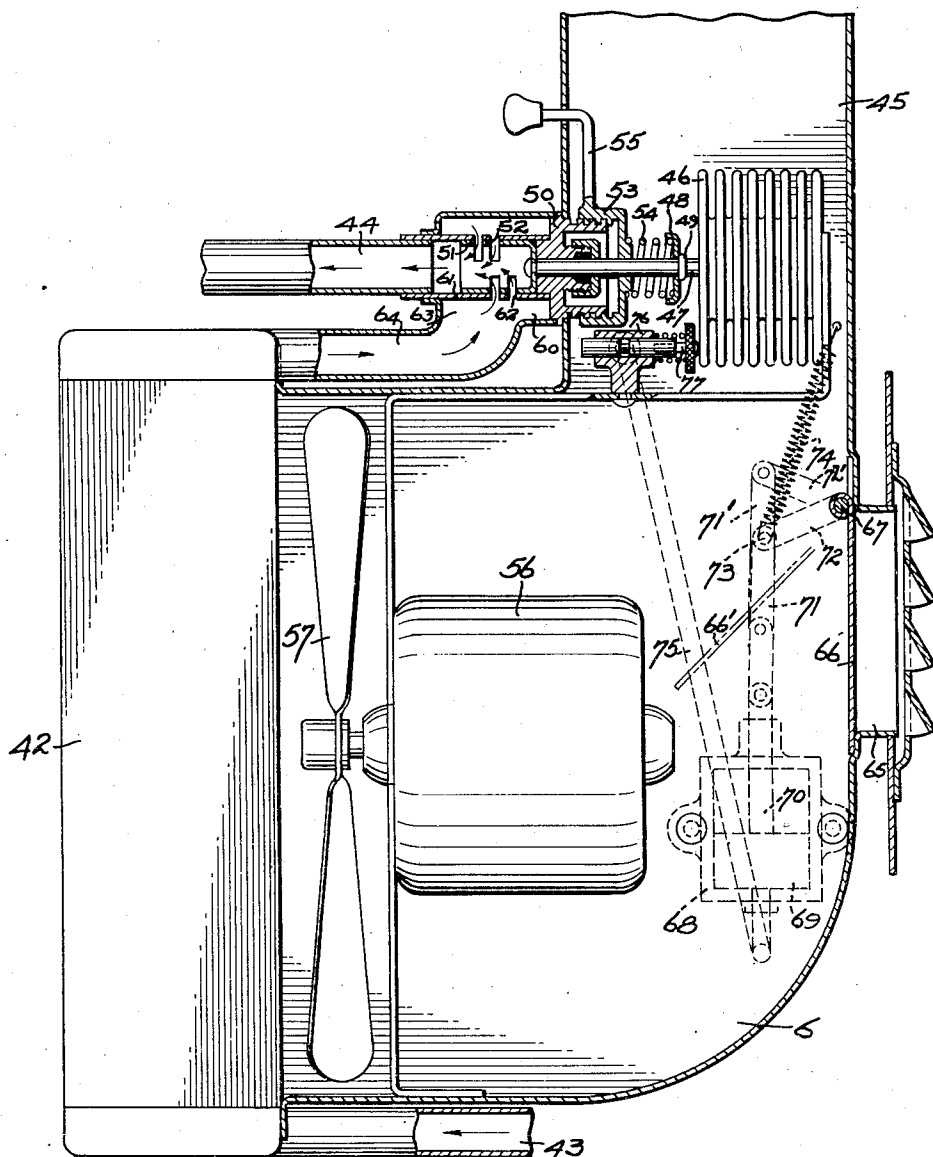


FIG. 4.

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UNITED STATES PATENT OFFICE

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AIR CONDITIONING SYSTEM

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12 Claims. (Cl. 237—2)

This invention relates to improvements in air conditioning systems, and refers to a system which is adaptable either to vehicles or rooms of buildings. The invention aims, among other things, to provide such a system wherein cold air units are provided for delivering fresh, cool air into the upper portion of a vehicle or room, which circulates therein down to an intermediate level slightly below normal breathing level therein; wherein heated air units are provided for discharging heated air into the lower portion of the vehicle or room; and wherein means are provided for maintaining a marked differential between the air temperatures in the said upper and lower portions in such a manner that air currents of sufficient intensity to cause drafts are not created.

Another object of the invention is to provide such an air conditioning system including means for delivering fresh, cool air into the upper portion of a vehicle or room, means for delivering heated air into the lower portion thereof, and means for withdrawing air from within the vehicle or room for re-heating and re-circulating at an intermediate elevation, so that a marked differential in the temperatures of the top and bottom air is maintained.

A further object of the invention is to provide such an air conditioning system wherein the heated air units (through which air is withdrawn for re-heating, and discharged again into the lower portion of the vehicle or room) are also provided with fresh air inlets through which air from outside passes and is mixed with the air to be re-heated. Thus I materially lessen the volume of air withdrawn for re-heating, and so eliminate the formation of air currents within the vehicle or room of sufficient intensity to cause drafts, and at the same time I maintain an ample flow of heated air into the said vehicle or room substantially at floor level. By this arrangement leakage of heated air through doors, windows, and the like is compensated for, and re-circulation of vitiated air prevented.

Another object of the invention is to provide such an air conditioning system wherein the temperature of the air withdrawn from the vehicle or room for re-heating controls the flow of the heating medium through the heater core by which the air is re-heated so that the temperature of the heated air discharged into the vehicle or room remains substantially constant; and wherein the temperature of this air withdrawn from the room or vehicle also controls

the admission of fresh air from outside which mixes with the air to be re-heated.

Yet another object of the invention is to provide such an air conditioning system wherein a cold air unit is utilized which includes a thermostat to control the rotation of a fan to introduce fresh air, and also to control the opening and closing of shutters to admit, or prevent the admission of, the fresh air discharged by the fan.

Having thus briefly and broadly stated some of the objects and advantages of the invention I will now proceed to describe an embodiment of the invention applied to a vehicle, though it is of course understood that this system may be installed with equally satisfactory results in the room of a building.

In the drawings:

Figure 1 is a diagrammatic plan view of a vehicle equipped with my air conditioning system, and

Figure 2 is a side view thereof.

Figure 3 is an enlarged side view showing one of the cold air units, and

Figure 4 is an enlarged view showing one of the heated air units.

Referring to the drawings, 1 designates a vehicle having seats 2 and windows 2a provided therein. Adjacent the roof 3 and within the vehicle one or more fresh or cold air units 4 are provided, and in the lower portion of the vehicle, and usually arranged upon the floor 5 beneath the seats 2, and one or more heated air units 6. In the installation shown in Figures 1 and 2 two fresh air units 4, which are identical, and two heated air units 6, which are the same in construction, are utilized. I will now describe one of each of these units.

Referring first to the fresh air unit 4, shown in detail in Figure 3, 7 denotes an air duct terminating at one extremity through an apertured wall 1a of the vehicle substantially flush with the outside thereof, and having shutters 8 and 8a adapted to close its opposite, inner extremity. This duct is mounted in the upper portion of the vehicle and, in the present instance, a portion of the roof 3 forms the top thereof. Suitably supported within the duct 7, as by a narrow vertical strap 7b, and between its inner and outer extremities is a motor 9 having a fan 10 thereon which is adapted to draw air through the apertured wall 1a and discharge it through the inner end of the duct when the shutters 8 and 8a are open. To prevent rain

and snow entering the duct suitable baffles 11 are provided therein.

Mounted in the upper portion of the vehicle, usually between two adjacent windows 2a intermediately of their height, is a thermostat or bellows 12 having a spindle 13 connected thereto which is moved downward by expansion of the bellows when the latter is subjected to heat. Mounted in spaced relation to the bellows 12 is a rheostat 14 having a rotary contact arm 15 which progressively engages fixed contacts 16 thereby starting and progressively increasing the speed of the motor 9 as the spindle 13 travels downward. In the present instance this spindle 13 is shown connected to the rotary contact arm 15 by a link 17; leads 18 and 19 from the motor 9 and rheostat 14 respectively are connected to a source of power (not shown), and another lead 21 extends from the said rheostat directly to the motor. Thus as the spindle 13 is moved down the motor 9 is started and its speed is progressively increased.

The shutters 8 and 8a, which are pivoted adjacent the top and bottom of the duct 7 respectively, are preferably of unequal length, the upper shutter 8 being the shorter, so that when they are open as indicated at 8' and 8a' most of the air discharged by the fan 10 strikes the lower shutter and is deflected upward towards the roof 3. Mounted adjacent one of the shutters, in the present instance the lower shutter 8a, is a cylinder 22 having a piston 23 therein from which a rod 24 extends. Mounted for pivotal movement with the lower shutter 8a on a pin 25 is an element 26 which is pivotally connected to the piston rod 24 by a link 27, and also through links 28 and a reach rod 29 to the upper shutter 8. Connected to the pin 30 by which the link 27 is pivoted to the element 26 is a spring 31 the opposite extremity of which is secured to a projection 32 extending from the duct 7 and by which the cylinder 22 is supported.

A suitable suction line 33 extends in this instance from the motor 20 of the vehicle, and is connected to a passage 35 of a valve 34. Opposite this passage 35 in the said valve and spaced therefrom is a second passage 35a which is adapted to be connected to the former by a port 36 formed through an axially movable plunger 37. Extending laterally from the spindle 13 is an arm 38 carrying a screw 39 which is in threaded engagement with the bottom of the plunger 37, so that by rotation of the screw the spacing of the plunger from the said arm may be adjusted. Vertical movement of the plunger 37 is therefore caused by movement of the spindle 13 and arm 38, so that as the latter is moved downward the plunger is also moved down to gradually sever the connection through the port 36 between the passages 35 and 35a. Thus when the bellows 12 is fully expanded no suction is exerted through the passage 35a and pipe 40 connected thereto. The opposite end of this pipe 40 is connected to one extremity of the cylinder 22.

As soon as suction is exerted through the line 33, which in the present instance occurs when the engine 20 is started, the passages 35 and 35a being connected by the port 36, suction is exerted through the pipe 40 which retains the piston 23 in its position shown (Figure 3). However as the temperature of the air surrounding the bellows 12 increases and the bellows expands, movement of the plunger 37 results, and communication between the passages 35 and 35a through

the port 36 is gradually cut off. As this occurs the spring 31 gradually moves the plunger 37 towards the opposite end of the cylinder 22, and opens the shutters 8 and 8a, and simultaneously, as already explained, the motor 9 is started and its speed gradually increased.

The heated air units 6 as shown in Figure 1 have radiator cores 42 therein which are connected to a feed line 43 and a return line 44 to provide a circulation of hot water, alcohol vapor or the like therethrough. These lines 43 and 44 are of course connected to a suitable heating medium, in the present instance to the engine 20. I will now describe one of the heated air units 6 in detail with the aid of Figure 4.

45 designates an air conduit which terminates at its open upper extremity substantially level with the bottoms of the windows 2a (see Figure 2) and into which air flows for re-heating and recirculating. Mounted in the duct or conduit 45 intermediately of its height is a thermostatic valve or bellows 46 which expands towards the left when subjected to heat. Extending from one extremity of the bellows 46 is a spindle 47 around which a flange 48 is provided which is held spaced from the said bellows as by an annular enlargement 49 around the said spindle. The latter projects through a casing 50 mounted in one side of the conduit 45 and terminates in an annular plunger 51 closed at one extremity and having peripheral ports 52. The open extremity of the plunger 51 is in communication with one extremity of the return line 44. In engagement with a very coarse thread formed around the outer periphery of the casing 50 is a cap 53 between which and the flange 48 a helical spring 54 is provided. A suitably formed handle 55 integral with the cap 53 projects through a curved aperture formed through one side of the conduit 45 so that by turning this handle the cap may be advanced towards the flange 48 to increase the tension of the spring 54 and thus the resistance to be overcome by the bellows 46.

Mounted in the lower portion of the conduit 45 is a motor 56 having a fan 57 thereon which is positioned adjacent the radiator core 42 to discharge air therethrough and out of the conduit 58, shown in Figure 1. Between the return line 44 and the core 42 a valve 60 is provided having a cylinder 61 therein through which radial slots 62 are formed. This cylinder is located in a chamber 63 into which the return from the core 42 flows through a connection 64. The plunger 51 is axially movable in the cylinder 61 so that its ports 52 register with the slots 62 when the bellows 46 is subjected to only a relatively low temperature and is not expanded. As the temperature of the air influencing the bellows increases the plunger 51 is moved in the cylinder 61 so that the ports 52 no longer register with the slots 62. Then the flow of the heating medium from the core 42 into the return line 44 is interrupted. This interruption persists until the temperature of the air flowing past the bellows or thermostat 46 drops sufficiently for the bellows to contract and move the plunger so that its ports 52 again register with the cylinder slots 62.

Formed through one side of the conduit 45, beneath the thermostat or bellows 46 is a fresh air inlet 65 which is adapted to be closed by a shutter 66 pivotally mounted on a pin 67 supported upon the said conduit. Mounted, preferably outside the conduit and adjacent thereto, is a cylinder 68 having a piston 69 therein from

which a rod 70 extends. Pivotaly connected to the outer extremity of the latter is an arm 71 the opposite end of which is connected to a link 72 by a pin 73. The link 72 at its other extremity is pivoted on the pin 67 and is so connected to the shutter 66 that the latter rotates with the said link. Extending from the pin 73 is a helical spring 74 which is secured at its opposite extremity to the conduit 45. Extending from one end of the cylinder 68 is a suction line 75 which terminates at its other extremity in a valve 76 similar in construction to the valve 34 already described in detail. The valve 76 is also connected to the suction line 33. As long as suction is maintained through the valve 76 and suction line 75 the shutter 66 is held closed, but as the suction exerted on the piston 69 diminishes the spring 74 moves the latter towards the other end of its stroke thereby swinging the shutter into its open position indicated at 66', and the arm and link to their respective positions 71' and 72'. In the valve 76 the connecting port through the plunger 77 is so arranged that when the bellows 46 is not expanded suction is exerted through the line 75, and axial movement of the plunger 77 caused by the expansion of the said bellows breaks the communication between the lines 75 and 33, shown in Figure 1, and which is connected to the other side of the valve 76. Owing to the fact that even in the most expensive vehicle bodies there is considerable leakage, particularly around doors and windows, air from within the body is continuously being exhausted to the outside so that space is afforded for the air introduced by the units herein described.

From the foregoing it will be clearly seen that the operation of the heated air unit includes the re-heating and re-circulation of air which enters the open upper extremity of the conduit 45, wherein it may also be mixed with air from outside which enters below the thermostat or bellows 46 and between the latter and the fan 57 by which the air is discharged through the heater or radiator core 42 and through the outlet 59.

In the air conditioning system hereinbefore described it will be noted that the thermostats which control the operation of the cold air units are positioned in the upper portion of the vehicle and above the open upper extremities which constitute the inlets of the conduits that form part of the heated air units. Moreover in this system it is the supply of fresh cool air delivered substantially horizontally into the upper portion of the vehicle which, to a very large extent, prevents the heated air discharged adjacent floor level and substantially parallel thereto rising materially above the conduit inlets. Thus a markedly higher temperature is maintained in the lower portion of the vehicle, that is between the floor level and the said conduit inlets, than in the upper portion. However some heated air does rise therein to somewhat increase the temperature in the upper portion, though I find that a temperature differential in excess of ten degrees Fahrenheit can easily be maintained. In this manner fresh oxygen laden air at about 60 degrees may be maintained down substantially to breathing level, and a supply of heated air at a materially higher temperature, say 70 to 75 degrees, circulated up to substantially the level of the conduit inlet for warming the bodies of passengers. Under certain conditions particularly the introduction of fresh cool air into the heated air units minimizes, or

completely prevents, fogging of the windows. However while this arrangement for introducing fresh air into the conduits for mixing with air to be reheated results in the advantage just referred to and also prevents the re-circulation of vitiated air, compensates for air loss through leakage, and permits a larger delivery volume from the conduit with less air movement toward the conduit inlet, it is here pointed out that the temperature differential in the upper and lower portions of the vehicle may be maintained without its introduction. This differential is primarily dependent upon the operation of the cold air units above breathing level, in conjunction with the operation of the heated air units having their inlets below breathing level but materially above their outlets.

Though throughout the specification reference has been made to the utilization of my system in a vehicle, it is obvious that it may be as conveniently and satisfactorily utilized in a room of a building. In that case however the feed and return lines 43 and 44 respectively and the suction line 33 must be connected to other appropriate sources instead of to the engine 20 of the vehicle.

While the preferred embodiment of the invention has been described and shown, it is understood that alterations and modifications may be made thereto, provided the said alterations and modifications fall within the scope of the appended claims.

What I claim is:

1. An air conditioning system for a closed vehicle body comprising means for discharging fresh cool air substantially horizontally into a body interior adjacent the top thereof, at least one heated air unit including means for withdrawing air from said body interior intermediately of its height and discharging it back thereinto substantially horizontally adjacent floor level therein, and means for re-heating the air during its passage through said heated air unit, whereby the heated air current receiving its initial impetus at floor level in a horizontal direction and drawn back into the impeller at said intermediate height maintains a supply of cool fresh air in the upper portion of said body interior at a temperature markedly lower than that of the air in the lower portion thereof substantially up to the intermediate level of withdrawal.

2. An air conditioning system comprising the combination set forth in claim 1, wherein means are provided for regulating the discharge of fresh cool air into the body interior.

3. An air conditioning system comprising the combination set forth in claim 1, including means responsive to the temperature of the withdrawn air for actuating the air re-heating means whereby the temperature of the air discharged from the heated air unit is regulated.

4. An air conditioning system comprising the combination set forth in claim 1, including a thermostat within the heated air unit adapted to be influenced by the temperature of the air passing through said unit for reheating, and means actuated by said thermostat controlling operation of the air reheating means.

5. An air conditioning system for a closed vehicle body comprising at least one cold air unit including means for delivering fresh cool air substantially horizontally into a body interior adjacent the top thereof, a thermostat responsive

to the temperature adjacent the top of the body interior and means operated thereby for controlling operation of the air delivery means, at least one heated air unit having means for withdrawing air for re-heating from the body interior intermediately of its height and below said thermostat and for discharging said withdrawn air into the bottom of said body interior adjacent and substantially parallel with the bottom thereof, and means for re-heating said withdrawn air during its passage through the heated air unit.

6. In an air conditioning system the combination set forth in claim 5 including a second thermostat set to operate at a temperature above that at which the aforesaid thermostat functions and located in the heated air unit between the entry through which the air for re-heating is withdrawn and the air re-heating means, and means actuated by said second thermostat controlling operation of the air re-heating means.

7. An air conditioning system for a closed vehicle body comprising means for discharging fresh cool air substantially horizontally into a body interior adjacent the top thereof, at least one heated air unit including a conduit having an inlet opening into the body interior intermediately of the height of the latter and a horizontally directed outlet adjacent the bottom of said body interior, means for withdrawing air for re-heating through the inlet and discharging it through the outlet, a heating means in said conduit through which said air passes, and said conduit having a fresh air inlet in communication with the outside air connected thereto between the first named inlet and the heating means.

8. In an air conditioning system, the combination set forth in claim 7, including a thermostat in said conduit influenced by the flow of air therethrough for re-heating, and means operated thereby for controlling the entry of fresh air from outside into the conduit, said thermostat being positioned in the latter between the inlet into the conduit for air to be re-heated and the fresh air inlet.

9. In an air conditioning system, for motor propelled vehicles, comprising a cold air unit mounted in the vehicle including a duct open at one extremity to the outside air, movable shutters on the opposite extremity of the duct to close the latter from the vehicle, a motor driven

fan in the duct between said extremities, a thermostat or bellows in the vehicle adapted to expand in one direction under heat, a switch to operate the fan motor, means operated by the bellows for closing the switch, a cylinder having a piston therein, means connecting said piston to said shutters, a suction line from the vehicle motor connected to the cylinder, a valve in the suction line operated by movement of the bellows whereby when the valve is open the position of the piston in its cylinder is such that the shutters are held closed, and a spring adapted to move said piston, connecting means and shutters and bring the latter to open position when the valve is closed.

10. A method of air-conditioning the interior of a closed body including the steps of admitting fresh air into the upper portion of the body and discharging it substantially horizontally adjacent the roof thereof, withdrawing air from within the body intermediately of its height, heating this air to a relatively high temperature, and discharging it for recirculation adjacent and substantially parallel to the floor level whereby this latter air rises to substantially the said intermediate height where it is again withdrawn for reheating and recirculating.

11. A method of air-conditioning the interior of a closed body including the steps of admitting fresh air into the upper portion of the body and discharging it substantially horizontally adjacent the roof thereof, withdrawing air from within the body intermediately of its height, heating this air to a relatively high temperature, discharging it for recirculation adjacent and substantially parallel to the floor level whereby this latter air rises to substantially the said intermediate height where it is again withdrawn for reheating and recirculating, and controlling the temperature of the air so discharged adjacent to the floor level substantially in accordance with the temperature of the air withdrawn for reheating and recirculation.

12. In an air conditioning system, the combination set forth in claim 7, including a thermostat responsive to the temperature of air flowing adjacent thereto positioned above the conduit inlet, and means coacting with said thermostat for controlling the discharge of fresh cool air by the discharge means adjacent the top of the body interior.

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