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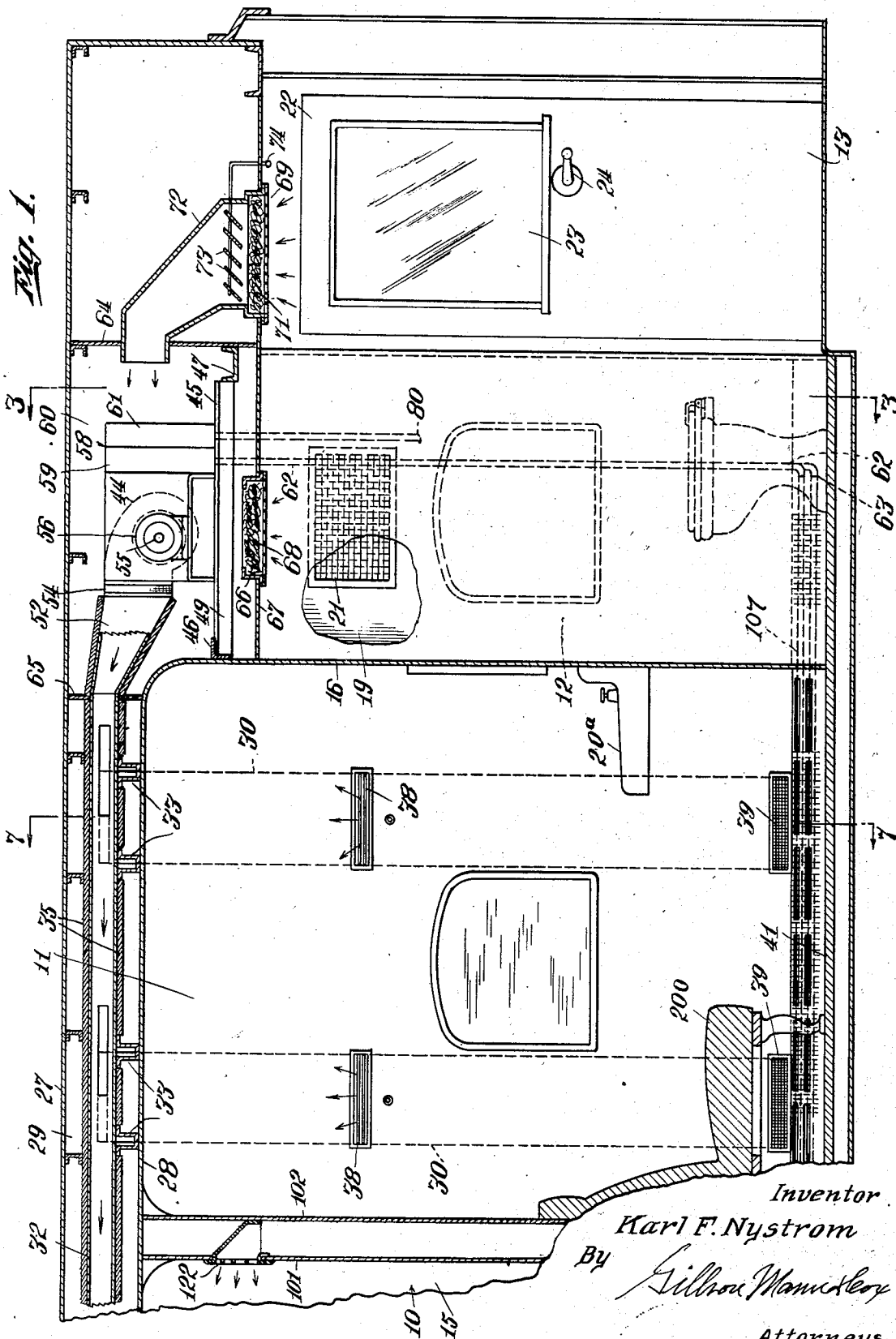
K. F. NYSTROM

2,256,350

AIR CONDITIONING SYSTEM FOR RAILWAY CARS

Original Filed Feb. 23, 1934

5 Sheets-Sheet 1



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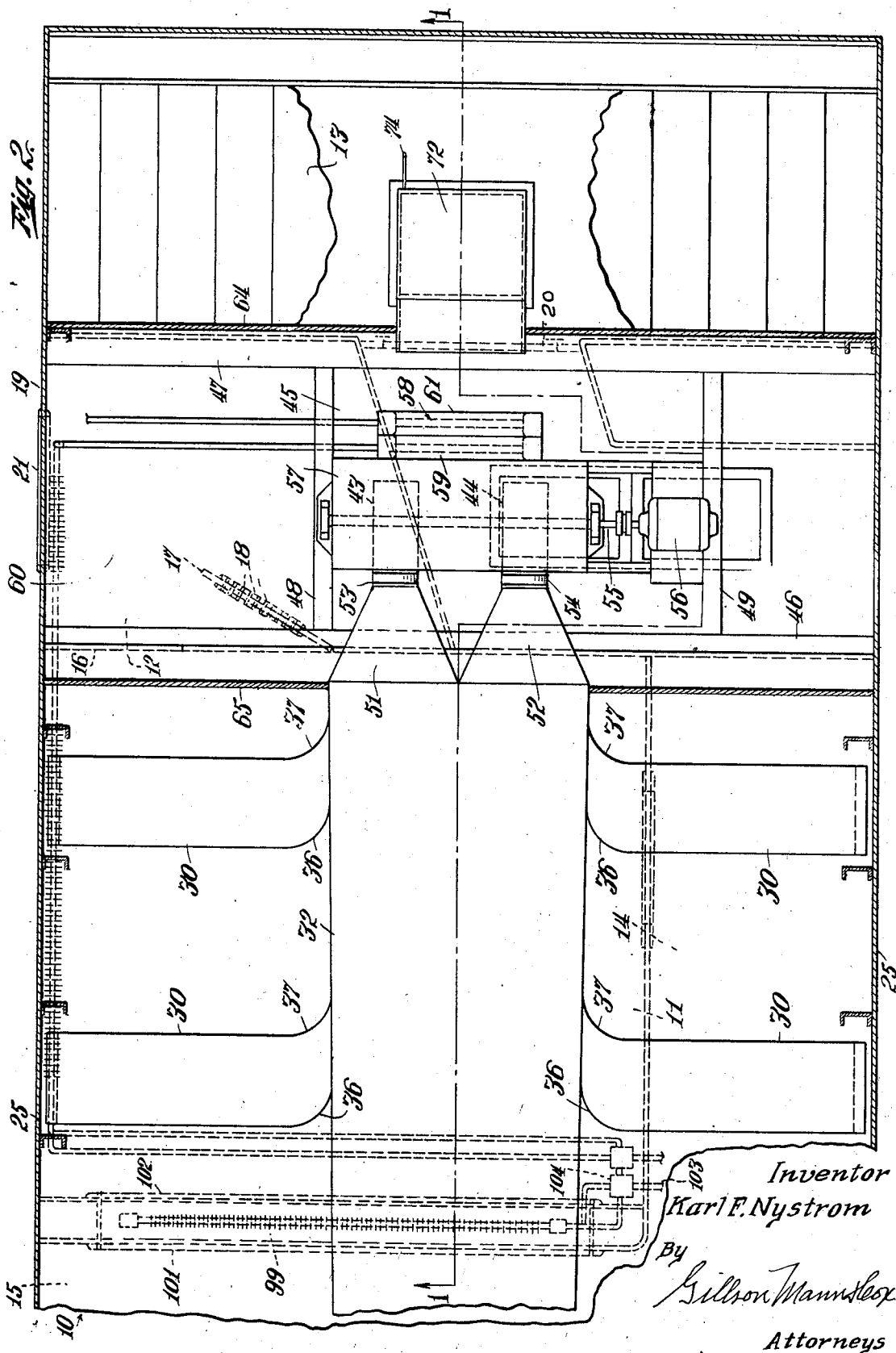
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Fig. 3.

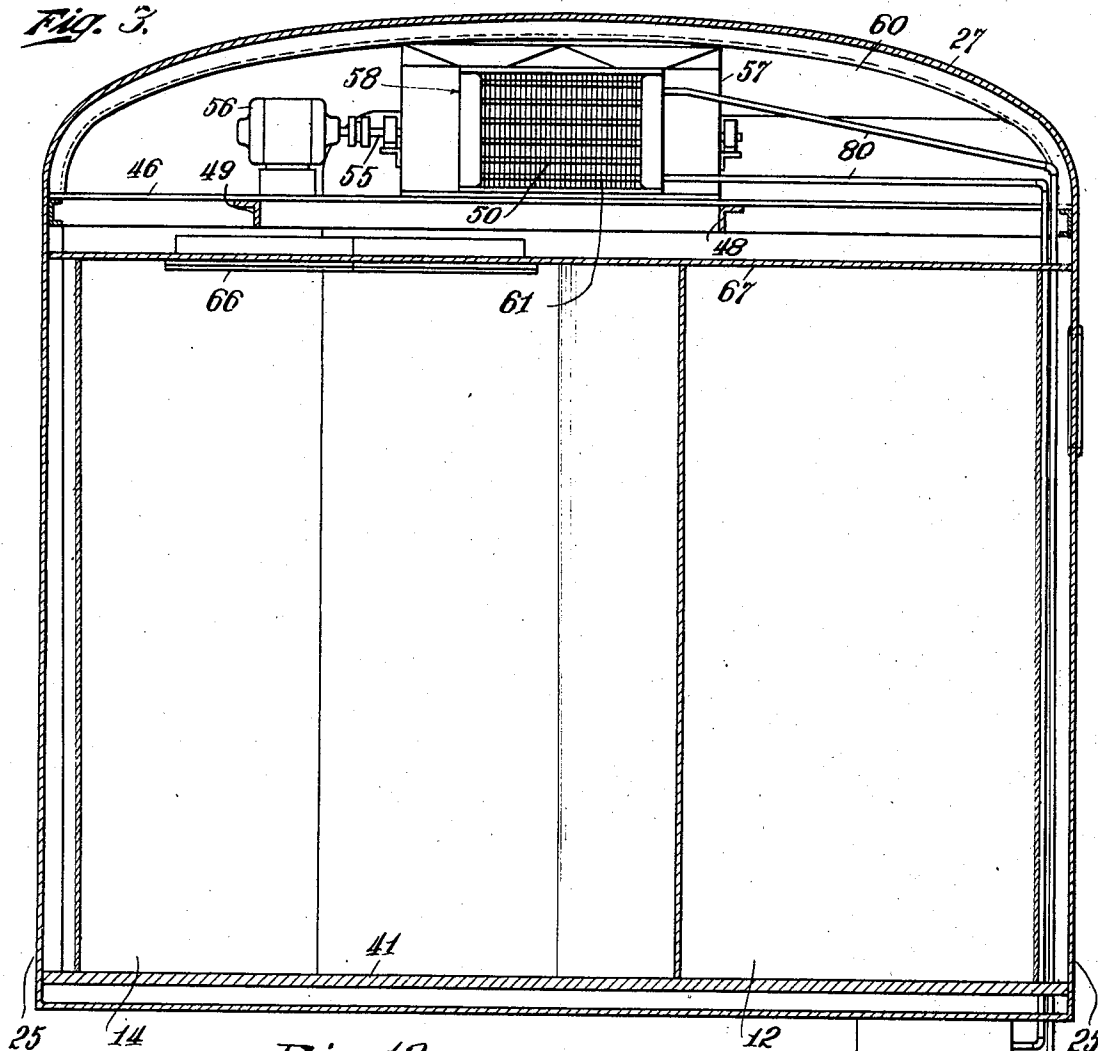


Fig. 12.

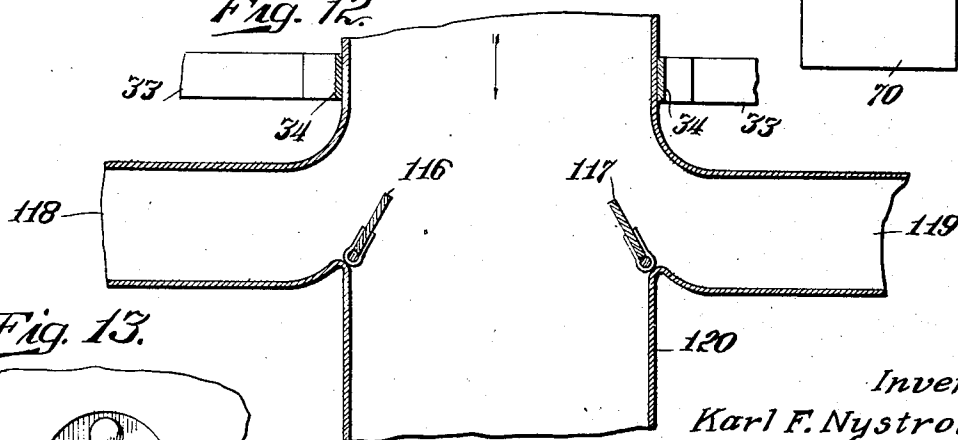
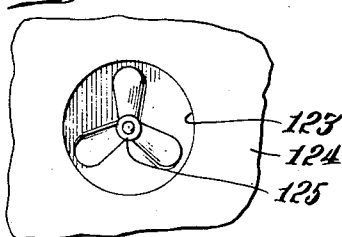


Fig. 13.



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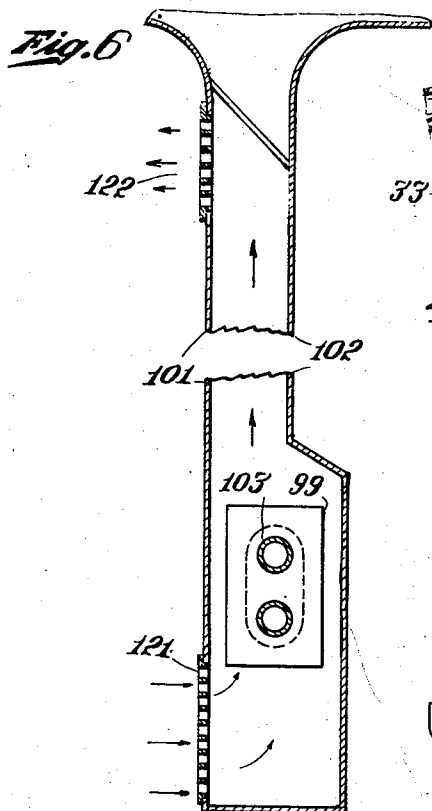
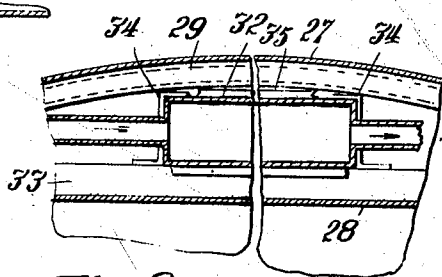


Fig. 8

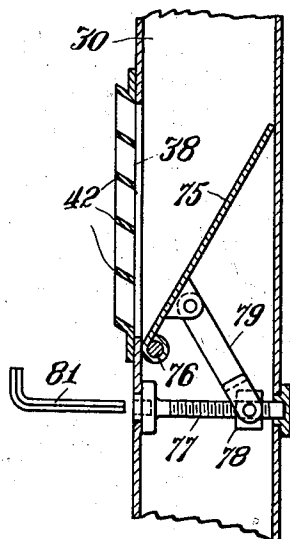
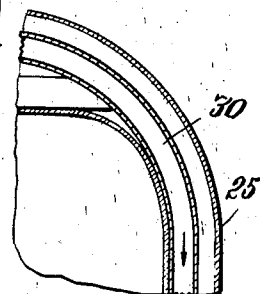
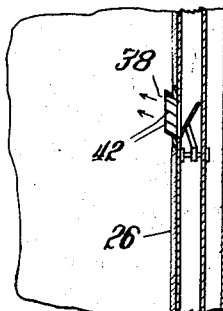
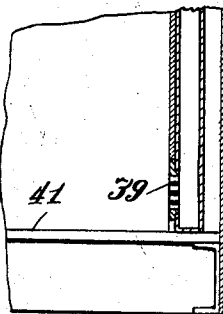


Fig. 4

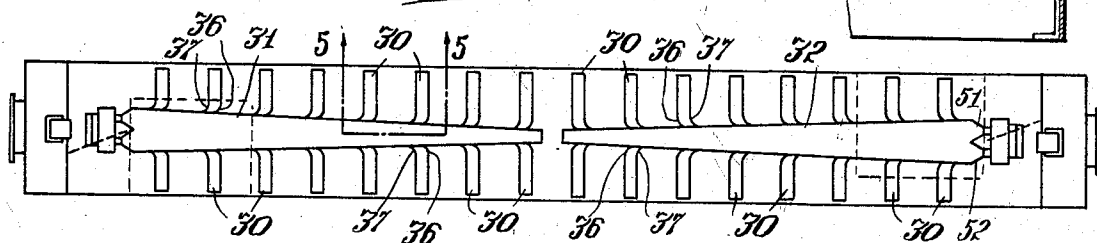
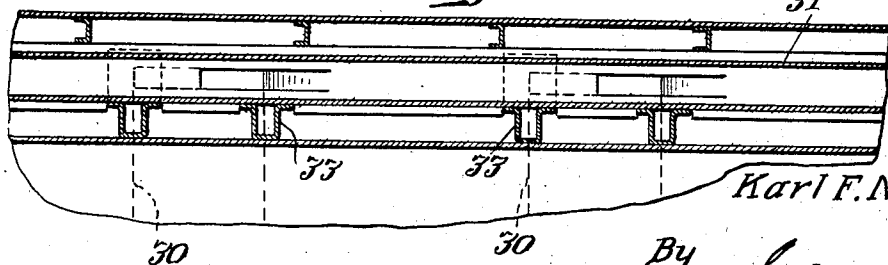


Fig. 5



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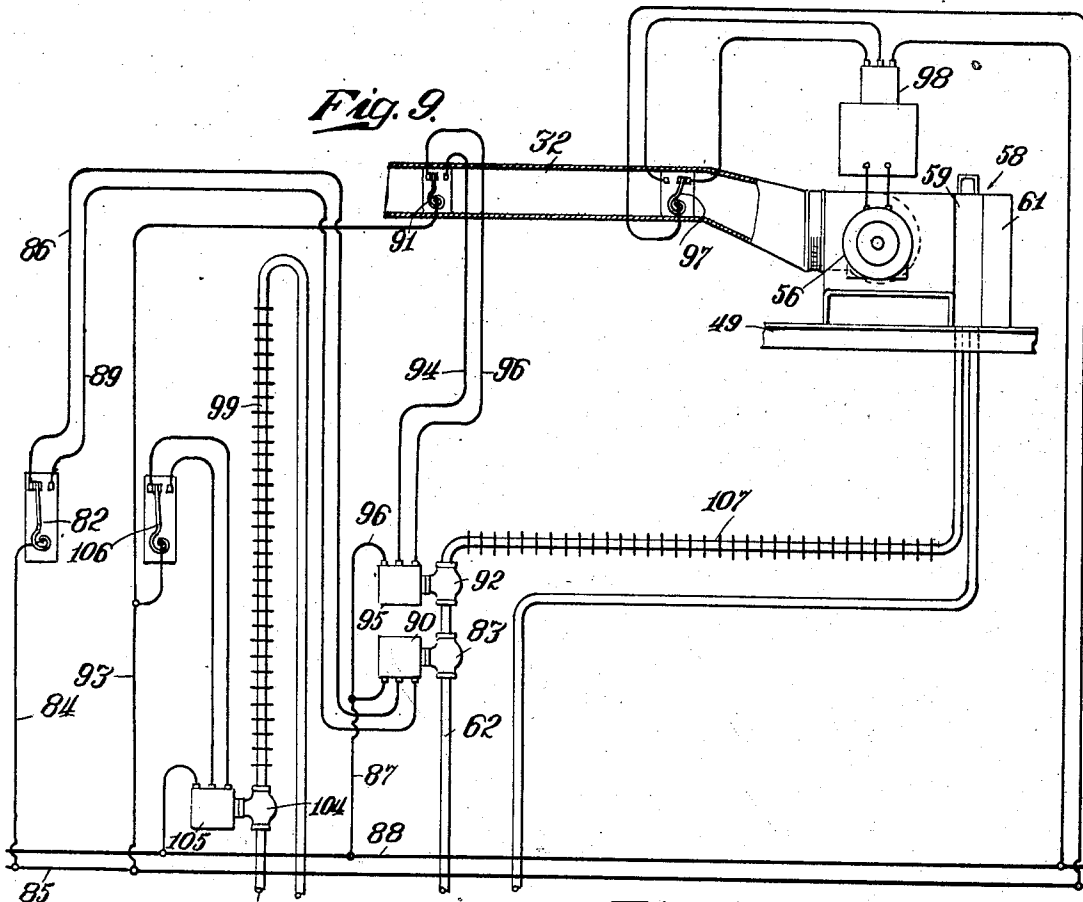
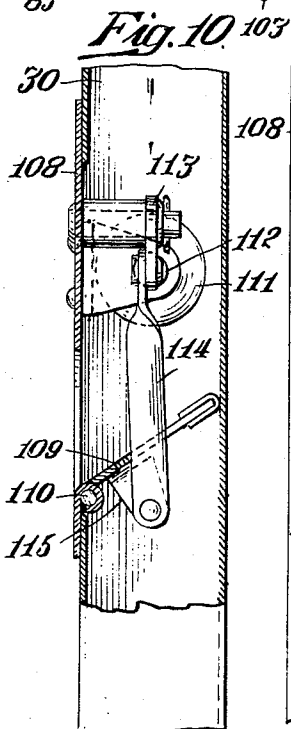
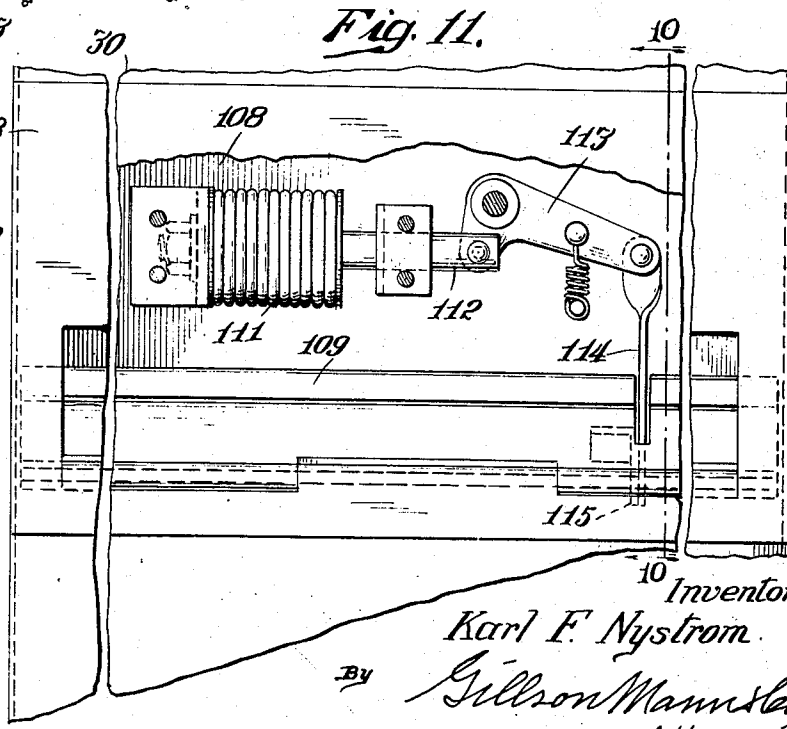
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UNITED STATES PATENT OFFICE

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AIR CONDITIONING SYSTEM FOR RAILWAY CARS

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Continuation of application Serial No. 712,449,
February 23, 1934. This application December
8, 1937, Serial No. 178,821

11 Claims. (Cl. 98—10)

This invention relates to air conditioning systems for passenger vehicles, such as railway cars, busses and the like.

One of the objects of the invention is the provision of a new and improved air conditioning system for railway cars for recirculating the air within the car, supplying the required amount of fresh air to the passenger compartment, properly distributing the same uniformly to all parts of the car, utilizing the circulating air as a medium of heat exchange for maintaining the interior of the car at the desired temperature and controlling the circulation of the air to avoid objectionable drafts.

Another object of the invention is the provision of a new and improved air conditioning system for railway cars having a novel system of control whereby the interior of the car may be automatically maintained at a desired predetermined temperature when the car is in use and when not in use the car may be supplied with sufficient heat to prevent freezing without operating the entire system.

Another object of the invention is the provision of an air conditioning system for passenger cars which will automatically recirculate the air within the car and will introduce the required amount of fresh air and discharge foul air from the ends of the car only, whereby the intermediate or passenger compartment is maintained at slightly super-atmospheric pressure, thereby insuring proper circulation of the air within the car.

A further object of the invention is the provision of a new and improved system for supplying conditioned air to a passenger car that is simple in construction, efficient in operation, and has mechanism for controlling both the volume of air circulated and the direction of flow of the air currents within the car.

Other and further objects and advantages of the invention will appear from the following description taken in connection with the accompanying drawings, in which

Fig. 1 is a vertical section of one end of a railway car, taken on the line 1—1 of Fig. 2;

Fig. 2 is a horizontal section of one end of a railway car, a section being taken above the main duct and air conditioning mechanism of the car, with parts broken away;

Fig. 3 is a section on the line 3—3 of Fig. 1;

Fig. 4 is a top plan view of a railway car with the heating and ventilating system installed and shown diagrammatically;

Fig. 5 is a vertical section of a portion of the

passenger compartment of the car taken substantially on the line 5—5 of Fig. 4;

Fig. 6 is a vertical section of the partition between the lavatory and passenger compartment;

Fig. 7 is a cross-section on the line 7—7 of Fig. 1;

Fig. 8 is a vertical section through one of the air conduits showing the deflector in position therein on an enlarged scale;

Fig. 9 is a diagrammatic view of the heating systems and the controls therefor;

Fig. 10 is a section similar to that shown in Fig. 8 but showing a modified form of deflector on the line 10—10 of Fig. 11;

Fig. 11 is a view at right angles to that shown in Fig. 10, with parts broken away;

Fig. 12 is a horizontal section of a modified form of air duct and conduits; and

Fig. 13 is an elevation of a portion of the outer wall of a toilet showing a modified form of exhaust for the ventilating system.

This application is a continuation of my application, Serial No. 712,449, filed February 23, 1934, for Air conditioning system for railway cars.

Referring now to the drawings, the reference character 10 designates a passenger vehicle which in the embodiment of the invention shown is a railway car or coach having at each end what, for convenience of description, will be termed a lavatory or smoking compartment 11, a toilet 12, a vestibule 13 and a passage or corridor 14 extending from the end of the car alongside the toilet and lavatory compartments into the passenger compartment 15 inwardly of the lavatory. The lavatory compartment contains one or more seats 200 and a wash basin 20a, as is conventional in such structures. The corridor or passage is separated from the vestibule by the usual door and partition 20.

Since the structure at each end of the car is generally similar, it is not thought necessary to describe both in detail.

A partition 16 separates the lavatory compartment from the toilet, and is provided with a door 17, Fig. 2, having grill openings 18 therethrough. The outer wall 19 of the toilet is provided with a grill opening 21 in its upper portion which constitutes a discharge outlet for the ventilating system of the car, as will presently appear.

The vestibule 13 is provided with a door 22 having in its upper portion a movable glass panel or window 23 which is adapted to be raised and lowered by the window operating device 24 of the usual or any well-known construction.

The top and sides of the car comprise the outer wall 25 and the inner wall or trim 26 (see Fig. 7). The outer wall may, and preferably does, extend continuously over the top of the car to form the roof 27. The ceiling 28 is spaced from the roof 27 to form an air space 29 within which the air ducts or conduits for the ventilating and heating system are mounted, as will presently appear.

Suitable means are provided for supplying the car with conditioned air. In the form of construction selected to illustrate one embodiment of the invention, a heating and ventilating system is employed which recirculates air within the car, maintains the car at slightly above atmospheric pressure, admits a limited quantity of fresh air from the vestibules and continuously discharges air from the system through the grill openings located in the toilets at the ends of the car.

In the form of the construction shown, main air ducts or conduits 31 and 32 extend from the ends of the car between the roof and ceiling, as shown in Figs. 1, 4 and 7. Each of the ducts is tapered toward its inner end and is supported by cross members 33 which support the ceiling and is held in position by clamps 34 secured to said cross members and having flanges extending over the upper edges of said ducts (see Fig. 7).

The ducts are spaced from the roof 27, thereby providing air space for insulating the duct from the roof. The ducts are also provided with insulation 35 which extends about the same for further protecting the air flowing therethrough from temperature changes in the external air.

The ducts 31 and 32 are provided with branch ducts or conduits 36 which extend downwardly between the inner and outer walls of the car at each side of the windows throughout the length of the car on each side thereof. In order to avoid turbulence in the movement of the air from the ducts into the branch ducts, the inner ends of the branch ducts may, if desired, be curved to extend at an angle of 45° to the axes of the ducts, the side walls of these ducts being curved as at 36 and 37.

Each of the branch ducts or conduits is provided with a grill discharge opening 38 for the cool air and a discharge opening 39 adjacent the floor 41 of the car through which warm air is adapted to be discharged. The opening 38 is provided with deflectors 42 for directing the air discharged through the same upwardly and inwardly, as shown in Fig. 7.

Each of the ducts 31 and 32 is provided with means for causing the air to flow from the outer ends thereof toward the center of the car. In order to conserve space, the mechanism for circulating air and for conditioning same is mounted in the space between the roof and ceiling above the toilets and corridors. This mechanism comprises a pair of blowers 43 and 44 mounted on a platform 45. This platform comprises an angle bar 46 and a U-bar 47 extending from side to side of the car and to which are rigidly connected supporting bars 48 and 49. The blowers 43 and 44 are spaced from each other and have their intakes on their adjacent sides. The discharge outlets of the blowers are connected to diverging conduits 51 and 52 which discharge into the outer end of the corresponding duct. If desired, flexible members 53 and 54 may be employed to connect these conduits and the outlets of the blowers 43 and 44 which will permit a slight variation in alignment of the parts when they are assembled.

The blowers are preferably, though not necessarily, mounted on a single shaft 55 and are operated by an electric motor 56 which is conveniently located over the vestibule between the roof and the ceiling. The power shaft 55 may be connected directly to the armature shaft of the motor.

It is desirable to employ a plurality of blowers in order to reduce turbulence in the movement of the air. Furthermore, by using a plurality of blowers, each is of sufficiently small dimension that they may be mounted in the space between the roof and ceiling of the car. The blowers are provided with a housing 57 having an opening in its side facing the end of the car. Suitable air conditioning mechanism 58 is positioned in front of this opening so that all of the air supplied to the blowers must pass through this mechanism. As shown, this mechanism comprises a heating radiator 59 and an air cooling device 61. The heat radiator 59 is supplied with the heating fluid, such as steam or the like, through the pipes 62 and 63, Fig. 1, which are in communication with the steam pipes of the train. The cooling mechanism 61 comprises a conventional cooling coil 60 through which is circulated cooling fluid from the refrigerator 70 by means of the pipes 80.

The blowers 43 and 44 and air conditioning mechanism 58 are mounted within a compartment 60 formed by the roof and ceiling of the car and by the bulkhead 64 on one side and a partition 65 on the other extending from side to side of the car.

A suitable inlet is provided through which air is withdrawn by the blowers from the car and recirculated. In the construction shown, an inlet 66 is provided in the ceiling 67 above the corridor 14 adjacent the end of the car. An air filter 68 is mounted in the inlet 66. The inlet 66 is preferably located beneath the motor whereby when the filter is removed, access may be had to the motor.

In order to prevent the air within the car from becoming stale, a limited amount of fresh air is supplied to the system either continuously or as is required. Under ordinary circumstances about 25 per cent fresh air or less added to the air passing through the blowers is all that is necessary. This air is supplied to the system through an intake opening 69 located in the roof of the vestibule. This opening is provided with a separate filter 71. A conduit 72 extends upwardly and inwardly from the filter and delivers air through the bulkhead 64 into the air conditioning compartment 60. The conduit 72 is provided with a damper 73 for controlling the amount of air passing through the conduit. This damper comprises a plurality of louvres which are operated by a handle member 74 extending through ceiling 67. The fresh air supplied to the system is taken from the vestibule for the reason that the latter will act as a settling chamber for any dust contained in the air. Ordinarily, sufficient fresh air from the outside will leak into the vestibule to supply the car, but if the parts be so tightly constructed that a sufficient amount of fresh air is not furnished, the window 23 may be lowered to supply the additional air from the outside.

In the operation of the device, air is withdrawn from the passage or corridor through the opening 66 at each end of the car, and this air passes through the air conditioning mechanism 58 and is discharged by the blowers into the ducts 31 and 32 at the ends of the car. From

these ducts, the air passes downwardly along the conduits 30 and if the car is being cooled, the air will be discharged through the opening 38, Fig. 1. If the car is being heated, air will be discharged through the opening 39.

Suitable means are provided for closing the opening 38 for causing the air to be discharged through the grill 39 beneath the seats when it is desired to heat the car. This mechanism comprises a closure 75, Fig. 8, hinged at its lower end, as at 76, and provided with an operating mechanism which comprises a threaded rod 77 having thereon a travelling nut 78 connected by a link 79 to the closure 75. The rod 77 is adapted to be rotated by a removable key 81. When the closure 75 is in the position shown in Fig. 8, air flowing down the conduits 30 will be discharged through the opening 38. During the warm season of the year, the closure is adjusted to the position shown in Fig. 8, and remains in that position. When in this position, no heat is being supplied to the radiator 59 and the coil 50 is being supplied with a cooling fluid from the refrigerator 70 beneath the car. When it is desired to heat the car, the heat is turned on to supply a heating fluid to the radiator 59, cooling coils are turned off and the closure 75 is moved to a position to close the opening 38.

Suitable means are provided for controlling the amount of heat supplied to the car and for controlling the operation of the mechanism. In Fig. 9 is shown diagrammatically a system of electric controls. The diagram shown in this figure is used for illustrative purposes only, since in actual practice any of the standard control systems now on the market may be employed. It is desirable that the temperature within the car shall be maintained between predetermined limits, as, for instance, between 70° F. and 74° F.

A thermostat 82 is mounted at a suitable place on the inner wall of the car and is provided with the usual mechanism for setting the same so that it will operate between selected predetermined temperature limits. An electromagnetic valve 83 in the heating pipe 62 is adapted to be operated through the thermostat when the temperature within the car rises above or falls below those limits. The thermostat is supplied with current through the conductor 84 from the train line 85 and when the temperature rises above a predetermined degree, the circuit is closed through the conductor 84, the thermostat 82, a conductor 86, valve operating mechanism 90 and a conductor 87 back to the other train line 88 for closing the valve 83. When the temperature falls below a predetermined degree, the circuit will be closed through the conductor 84, thermostat 82, conductor 89, the member 90 and the conductor 87 for opening the valve 83 and permitting the heating fluid to pass to the radiator.

A thermostat 91 is also provided in the main duct 32 for controlling the flow of heating fluid through the pipe 62. For the purpose of illustrating the invention, a separate valve 92 is shown which is adapted to be operated by the thermostat 91. The thermostat is so constructed that the valve will be closed when the temperature within the main duct 32 rises above a predetermined degree, as for instance 110° F., and will open the valve when the temperature in the duct falls below that degree. Since the heated air is delivered beneath the seats, this control is provided for preventing even temporarily the introduction of air at an uncomfortable, hot tem-

perature into the car. When the temperature rises above 110° F. in the duct, the thermostat operates to close the circuit through the train line 85, conductor 93, thermostat 91, conductor 94 and valve operating mechanism 95, conductors 96 and 87 and train line 88 for closing the valve 92. When the temperature in the duct falls below the predetermined degree, the circuit is closed in like manner through a conductor 96.

In order to prevent the delivery of large quantities of cold air when the heating mechanism fails during the cool season, means are provided for changing the fan to low speed when the temperature in the duct falls below a predetermined amount. In practice, a thermostat 97 mounted in the duct 32 is employed for closing the circuit through a motor control mechanism 98 when the temperature in the duct falls below 40° F. When the temperature rises above that degree, the control mechanism 98 is operated to increase the speed of the fan back to normal. Since the wiring is substantially the same as that already described, it is not thought necessary to repeat the same.

It is desirable that means be provided for preventing the temperature within the car from falling below the freezing point when the car is unoccupied, or when the primary heating system fails for any reason whatever. A secondary heating system is employed for this purpose.

This system comprises a heat radiator 99 (see Figs. 2, 6 and 9) mounted between the walls 101 and 102 of the partition between the lavatory and the passenger compartment (see Fig. 2). The heating radiator is adapted to be supplied by heating fluid from the main steam line through a pipe 103 having a valve 104 adapted to be operated by an electromagnetic device 105. A thermostat 106 is mounted on a wall of the passenger compartment and is set to close a circuit through the valve operating mechanism 105 when the temperature falls below a predetermined degree, as, for example, 40° F., for opening the valve 104. When the temperature rises above 40° F., a circuit is closed through the valve operating mechanism 105 for closing the valve 104. The wall 101 adjacent the passenger compartment is provided adjacent the floor with an inlet grill opening 121 and with a discharge grill outlet opening 122 adjacent its upper portion. In the secondary heating system, air will pass from the passenger car through the inlet 121 upwardly past the radiator and will be discharged outwardly through the upper grill opening 122.

The pipe 62, Fig. 1, of the main heating system is provided with a heat radiator 107 within the outer walls of the lavatory. When it is desired to prevent freezing within the car while it is unoccupied, the fan is turned off and the heat supplied by the radiators 59, 99 and 107, Fig. 9, will warm the car by convection.

In Figs. 10 and 11 is shown a modified form of construction for automatically controlling the operation of the valve 75. In this construction, the valve and its operating mechanism are mounted on a plate 108 which is attached to a conduit 30 over an opening therein. The plate 108 is provided with an opening adapted to be closed by the closure 109, pivoted as at 110 to the plate 108. A thermostat of the bellows type 111 is mounted on the plate 108 and is provided with a plunger 112 which is pivotally connected to one arm of a bell crank 113, the other arm of which is connected to a link 114.

The link 114 is pivotally connected to a lug 115 carried by the closure 109. In the operation of the device, when the temperature within the conduit 30 falls below a predetermined minimum, the thermostat will contract and open the valve to the position shown in Figs. 10 and 11. If desired, a spring attached to the crank arm 113 may be employed for assisting in opening the closure when the bellows contracts. When the air is supplied to the conduits at a temperature above this degree, the thermostat will expand to move the closure 109 to close the opening in the plate 108, whereby the warm air will be discharged through the lower opening in the conduit.

In Fig. 12 is shown a modified form of the duct and conduits. In this form of the construction, a pair of deflectors 116 and 117 are provided at the junction of the conduits 118 and 119 with the main duct 120. These deflectors are positively held in adjusted position and are adapted to be adjusted when the air conditioning system is installed. The adjustment is such that an equal distribution of the air is provided through all of the ducts.

In Fig. 13 is shown a modified form of exhaust for the ventilating system which comprises an opening 123 in the outside wall 124 of the toilet in which is mounted an electric exhaust fan 125. This fan may, if desired, be operated from the lighting circuit of the train.

It is thought from the foregoing taken in connection with the accompanying drawings that the construction and operation of my device will be apparent to those skilled in the art, and that changes in size, shape, proportion and details of construction may be made without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. In an air conditioning system for railroad cars, a pair of main ducts, a plurality of branch ducts extending downwardly from the main ducts to the passenger compartments, means to force air through the main and branch ducts, means to condition the air passing through the ducts, a hot air outlet provided in each branch duct, a cold air outlet provided in each branch duct above each hot air outlet, and temperature controlled means including thermo-sensitive elements provided within each branch duct for directing the conditioned air through either the hot air outlets or the cold air outlets.

2. In an air conditioning system for railroad cars, an air mixing compartment provided in the upper part of the car above the passenger compartment for receiving air from the passenger compartment and fresh air from the exterior of said car, a pair of main ducts centrally positioned end to end, branch ducts extending downwardly from each side of the main ducts to the passenger compartment, means to force air from said mixing compartment through the main and branch ducts, means to condition the air passing through the ducts, a hot air outlet provided in each branch duct, a cold air outlet provided in each branch duct above each hot air outlet, and means including a temperature responsive element within each branch duct for directing the conditioned air through either the hot air outlets or the cold air outlets.

3. In a passenger car having inner and outer side walls, a ceiling and a roof, an air duct between the roof and ceiling and having passages extending from said duct downwardly between

the inner and outer side walls of said car, said inner wall being provided with an upper and a lower opening for each of said passages, and means for independently automatically closing the upper openings when the temperatures within the corresponding passages rise above predetermined degrees, respectively.

4. In an air conditioning system for railway cars, a main air duct extending longitudinally of the car from one end thereof above the passenger compartment, branch conduits extending downwardly within the side walls of the car, cold air outlets for said conduits through the upper portions of said walls, warm air outlets for said conduits through the lower portions of said walls, means including temperature responsive mechanism within said conduits for establishing communication between said conduits and said cold air outlets and for closing communication between said conduits and said warm air outlets only when the air within said conduits falls below a predetermined temperature, means for conditioning air supplied to said duct, means for circulating said conditioned air through said duct, means for recirculating air through the air conditioning mechanism, conduits and car, and means responsive to the temperature of the air flowing along said duct for controlling the volume of air flowing through said duct.

5. In a railway car having a roof and a passenger compartment, an air conditioning apparatus, a duct above said compartment extending longitudinally of said car constituting a discharge passage for said apparatus, branch conduits extending from said duct downwardly within the side walls of said car and having upper and lower openings for discharging conditioned air into said passenger compartment from said duct, a fan for circulating air through said duct and conduits at a uniform velocity during the normal operation of said apparatus, a motor driving said fan at a single, uniform, relatively high speed during normal operation, means for closing the upper openings, temperature responsive means within said conduits for operating said closing means when the air in said conduits rises above a predetermined temperature, means within said duct for controlling the temperature of the air flowing along said duct, motor control means including a temperature responsive device within said duct for reducing the velocity of said air by abruptly reducing the speed of said motor and fan to a second, uniform, relatively low speed, said temperature responsive means being operative to reduce said motor and fan speed only when the air in said duct falls below a predetermined temperature, and means within said passenger compartment for controlling the air conditioning apparatus.

6. In a railway car, air conditioning apparatus including blower means for supplying conditioned air to said car, said blower means operating at a uniform speed during the normal operation of the apparatus above a predetermined minimum temperature, conduit means extending throughout the greater portion of the length of the car for conducting conditioned air from said apparatus and for distributing the same in said car, thermally actuated means responsive to the temperature within said car for controlling said air conditioning apparatus, temperature responsive means in said conduit for automatically and promptly reducing the speed of said blower means only when the air discharged from the blower means falls below a predetermined minimum temperature, an auxiliary heating means, and

temperature responsive means within said car for causing the operation of said auxiliary heating means when the air within said car falls below a predetermined minimum temperature.

7. In an air conditioning system for railway cars, an air duct extending inwardly along the center line of the car above the passenger compartment, branch conduits extending downwardly from said duct within the side walls of said car, cool air discharge outlets for said conduits through the upper portions of said walls, warm air outlets in the lower portions of said conduits, means including temperature responsive elements within said conduits for automatically opening said cool air outlets when the temperature of the air within said conduits falls below a predetermined amount, and means responsive to the temperature of the air flowing along said conduit for reducing the volume of cool air discharged through said cool air outlets when the temperature in said duct falls below a predetermined minimum.

8. In an air conditioning system for railway cars, a main air duct, air conduits in communication with said duct, means for recirculating air in the car, each conduit having an upper cool air discharge outlet and a lower warm air discharge outlet, a closure for said upper outlet, and temperature responsive means wholly within said conduits for closing said upper outlets, said closures opening inwardly into said conduits for constituting deflectors for deflecting cool air outwardly through said outlet openings into the passenger compartment of said car.

9. In a railway car having a vestibule, toilet and lavatory compartments at each end of said car, a passenger compartment in the intermediate portion of said car and a corridor at each end of said car between said vestibule and passenger compartment and extending between said lavatory and one side of said car, a door between said toilet and lavatory compartments having a grill opening therethrough, a mixing chamber between the roof and ceiling at each end of the car, an air duct extending inwardly from each end of said car between the roof and ceiling at each end of the car, air conditioning mechanism with-

in said mixing chamber, an air inlet above said corridor at each end of said car opening into said chamber, a pair of blowers for each duct for causing air to be recirculated through said car, air conditioning device and ducts, a fresh air inlet above said vestibule, a conduit for conducting air from said vestibule to said mixing chamber, and means for controlling the amount of fresh air supplied to said mixing chamber and an outlet through the external wall of said toilet for discharging recirculated foul air to the atmosphere without interfering with the mechanism for recirculating said air within the car.

10. In a railway car, an air conditioning system for said car, said system comprising a duct extending longitudinally along the upper portion of the car, a plurality of conduits extending downwardly from said duct between the inner and outer walls at both sides of the car, said walls and conduits having aligned openings through which air may be delivered to the interior of said car from said duct, and temperature controlled means between said walls, said means including temperature responsive members controlled by the temperature of the air in said conduits for automatically opening and closing each of said openings independently of the remainder.

11. In a ventilating system for passenger vehicles having a passenger compartment, a smoking compartment, a corridor and a vestibule at each end of the car, main ducts extending longitudinally of said car from each end thereof above said passenger compartment, said ducts tapering inwardly from the ends of the car, branch conduits extending downwardly from said ducts within the side walls of said car, means for causing air to recirculate through said ducts, conduits, passenger compartment and corridors, means for discharging air through the side wall of said car into the atmosphere after the same has passed through said smoking compartment from said passenger compartment, means for introducing fresh air from said vestibules into said main ducts, and means for controlling the amount of external air introduced into said vestibules.

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