Sept. 8, 1936. H. H. DODGE 2,053,395

APPARATUS FOR CONDITIONING AIR

Filed March 23, 1934 3 Sheets-Sheet 1

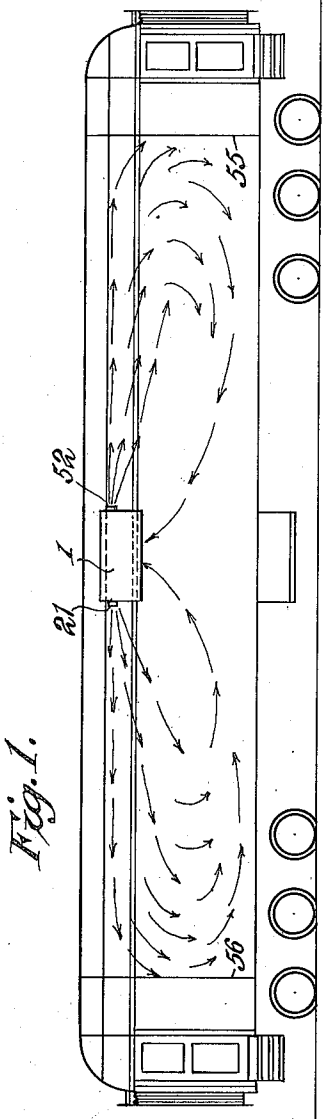

Fig. 1.

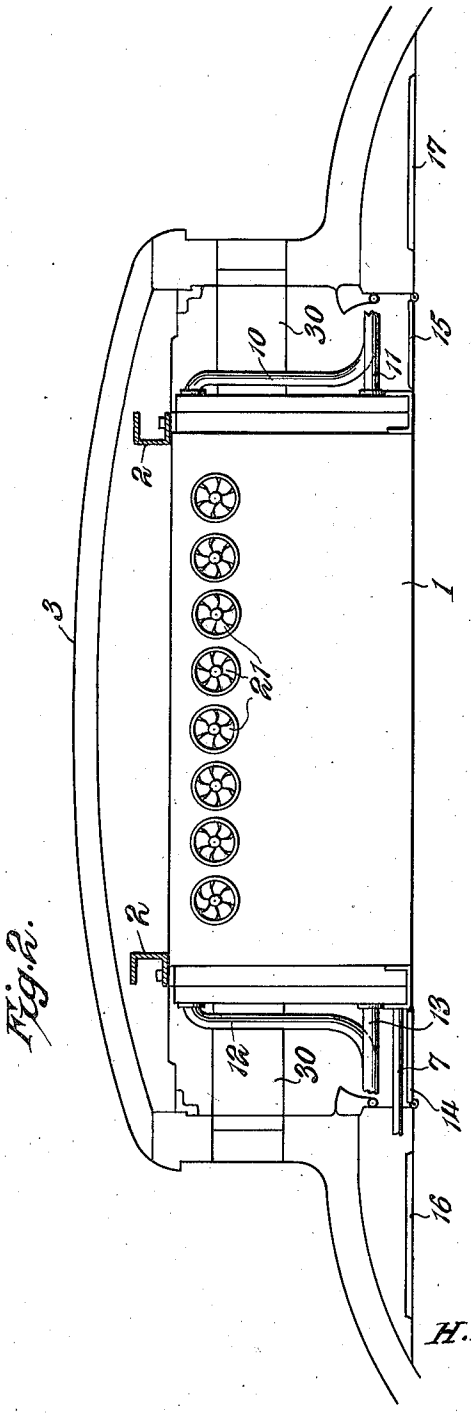

Fig. 2.

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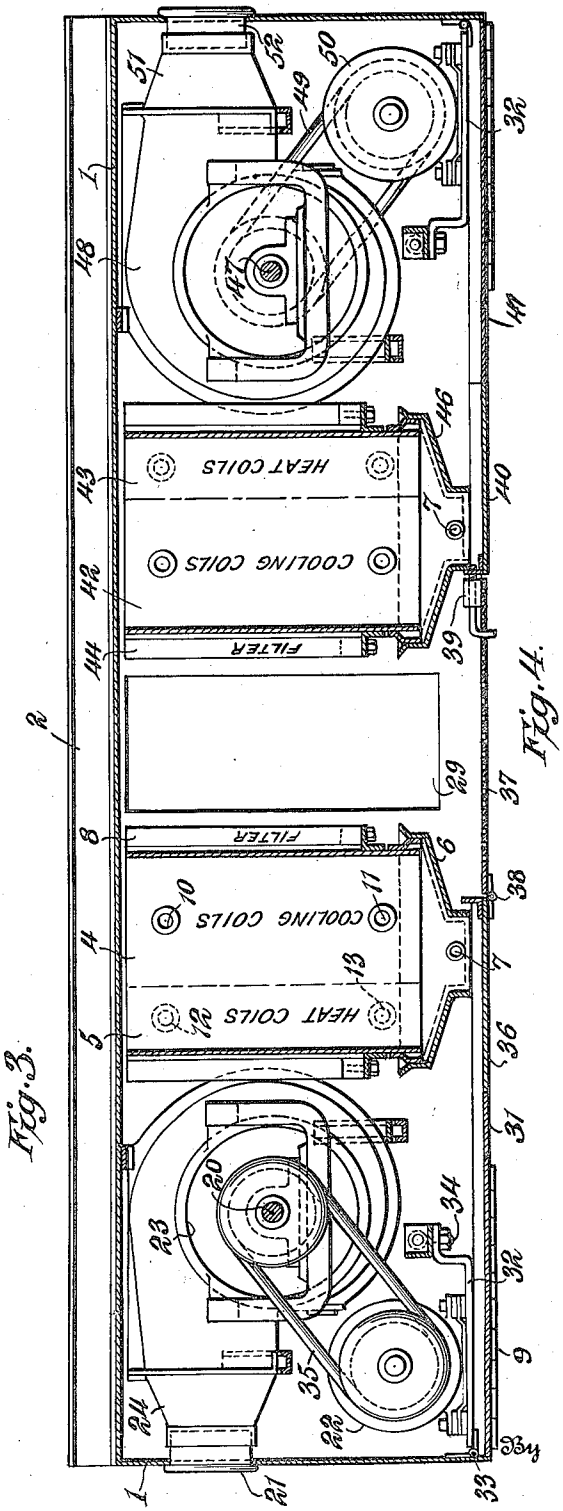

Fig. 3.

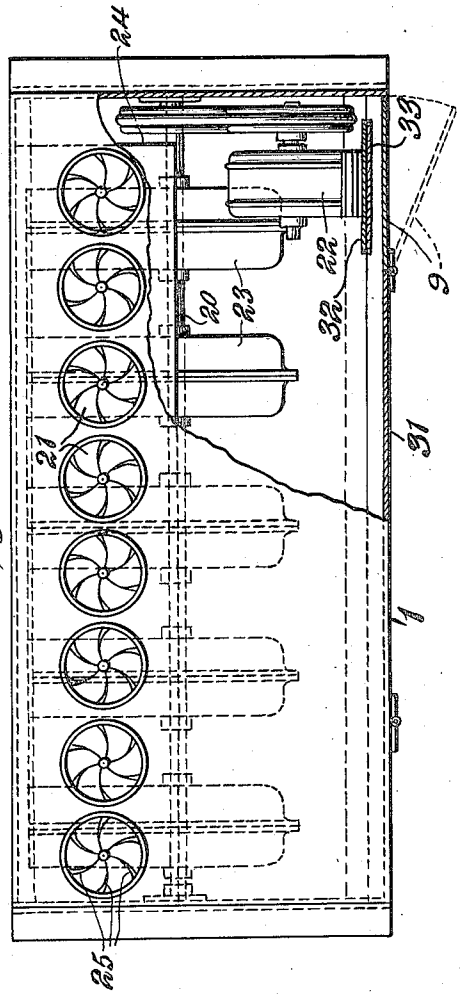

Fig. 4.

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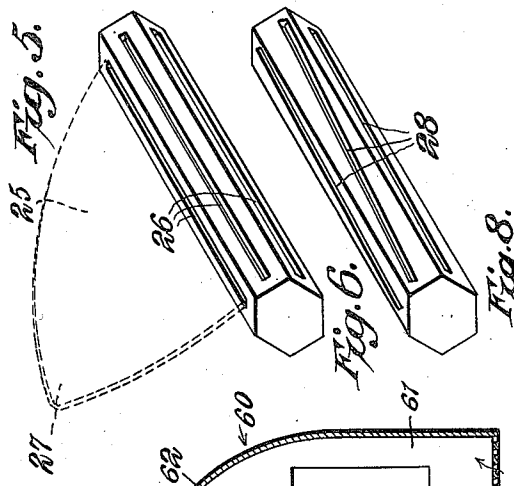

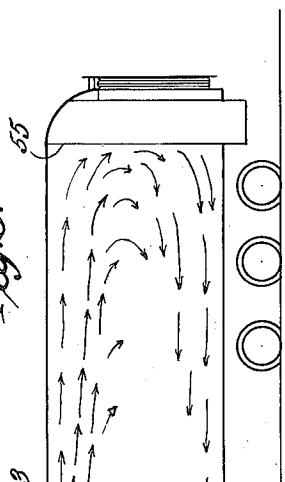

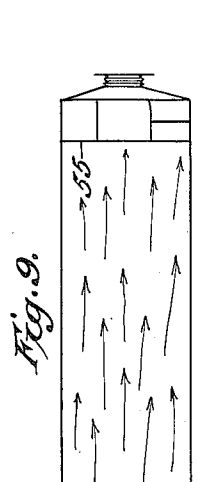

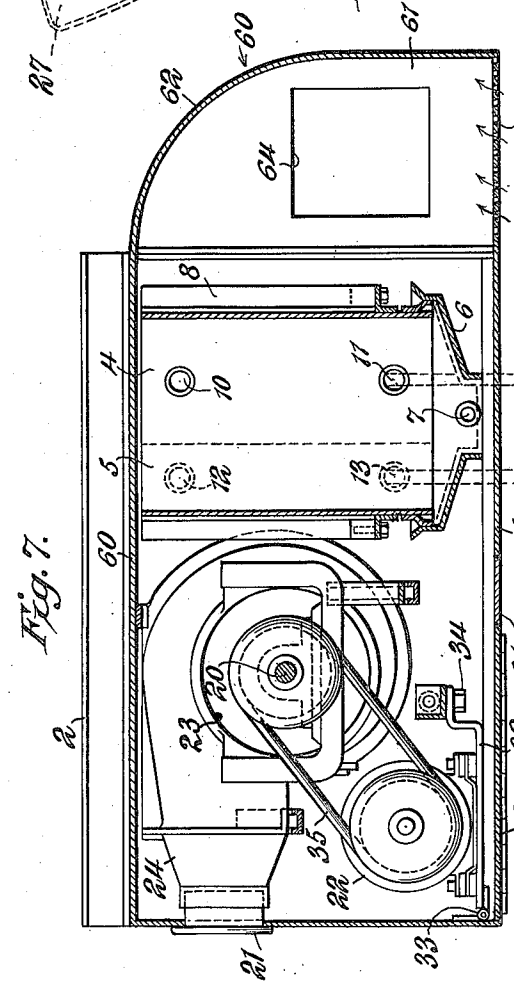

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UNITED STATES PATENT OFFICE

2,053,395

APPARATUS FOR CONDITIONING AIR

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Application March 23, 1934, Serial No. 717,087

6 Claims. (Cl. 98—10)

This invention relates to the conditioning of air in spaces and more particularly to the treatment of the air in a railway passenger car including the heating and/or cooling thereof.

With these and other objects in view the invention resides in the novel details of construction and combinations of parts constituting the apparatus, as well as in the novel steps and combinations of steps constituting the method of treatment, all as will be disclosed more fully hereinafter and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification and in which like numerals designate like parts in all the views,—

Fig. 1 is a diagrammatic representation of a railway passenger car to which this invention has been applied;

Fig. 2 is a diagrammatic representation of one end of this device particularly showing its position in the clerestory of the passenger car, said view being taken transversely of said car;

Fig. 3 is a longitudinal vertical sectional view taken through the device;

Fig. 4 is an end view of the device with portions broken away to show some of the interior structure;

Fig. 5 is a perspective view of a vane cluster employed in the air discharge nozzles;

Fig. 6 is a detail view indicating a modification of the mounting of a vane upon its supporting hub;

Fig. 7 is a view similar to Fig. 3 but illustrating a single unit device such as may be used in a particular type of railway passenger car;

Fig. 8 is a diagrammatic longitudinal representation of a passenger car of the type to which the single unit shown in Fig. 7 may be particularly adapted; and

Fig. 9 is a diagrammatic top plan view of the car shown in Fig. 8.

In heretofore known air conditioning installations the apparatus has been located in valuable and usable space, and therefore one of the important features of this invention is to locate the apparatus in a portion of the car space where it will never interfere with the passengers or other equipment incident to such cars; in other words it is placed in an absolutely unoccupied portion of the car space. In addition, its position is peculiarly advantageous to the distribution of the conditioned air under extremely high velocity whereby said air is not positively directed at any time directly upon any passenger of the car, and neither are any objectionable drafts created. Still another object of importance is the provision of an apparatus which will create a circulation of the air in the passenger space of the car without the necessity of any additional or auxiliary equipment such as booster fans.

The air placed in circulation by this apparatus is delivered at high velocity, sufficient to cause said air to travel to the end of the passenger space, this delivery in present installations having a maximum velocity of 1800 F. P. M. with a consequent volume of 2500 cubic feet per minute. Lastly, the apparatus is supplied with electrical switches, thermostats, and valves so that the air of the passenger space may be properly conditioned by either heating or cooling without the necessity of manual changes, which is a distinct advantage when the car is routed through from a far southern city where the temperature is high to a northern city where the temperature is low.

Referring to Figs. 1 to 4 of the drawings, 1 indicates generally a metallic cabinet adapted to be secured centrally of the clerestory of a passenger car to the longitudinally extending channel members 2 attached to the roof 3 of the car, the cabinet being of a depth to lie entirely within said clerestory. Within the cabinet is mounted an air cooling unit 4 and an air heating unit 5 with a drip pan 6 extending therebeneath for collecting the condensation which later may escape to the road bed, or any other suitable point, as through the drain pipe 7. Each unit comprises a plurality of spaced pipe coils for conveying therethrough the cooling or heating medium, with heat conducting fins on said coils, as well understood for accelerating the heat transfer to and from the air passing through the spaces between the coils. These air conditioning units are preferably arranged in juxtaposition and the cooling coil unit is flanked by an air filter or screen as indicated at 8.

10 and 11 indicate respectively the inlet and outlet of the cooling coil unit 4, and 12 and 13 indicate respectively the inlet and outlet steam pipes for the heating coil 5, Fig. 2 being a left end view of the construction shown in Fig. 3, from which it will be clearly seen that these pipes are hidden from view as by the horizontal filler plates 14 and 15 closing the lateral spaces between the cabinet 1 and the bottom plates 16 and 17 of the half-deck of the car, it being understood that said pipes will pass into the space between the double walls of the car sides and lead to appropriate supplies of cooling and heating fluids. Portions of the

plates 14 and 15 are hinged as indicated, providing means to gain access to said pipes.

Between the air conditioning units 4 and 5 and one end of the cabinet, is a battery of blowers acting in unison and fixed upon a horizontal transverse shaft 20, for forcing the air from said units to and through the air discharge nozzles 21 located in the end wall of the cabinet, said shaft being driven by an electric motor 22 disposed in one of the lower corners of the cabinet 1 through suitable belt and pulley drive, the circuit to said motor being controlled thermostatically in accordance with the temperature of the passenger space.

Each blower comprises a casing 23 within which is mounted an impeller, the sides of the casing being centrally apertured to provide air inlets, the air discharge being tangential wherefore the blower is of the centrifugal type, the air from all of the blowers being discharged into a manifold or transformation 24 which in turn is provided with discharge openings, one for each nozzle 21, said manifold extending transversely of the cabinet as indicated in Fig. 4 with convergent outlets to the nozzles 21 as shown in Fig. 3, wherefore the pressure of the air delivered by the blowers is increased to pass the nozzles.

Each nozzle comprises a cylindrical nipple supportingly fitted in the end wall of the cabinet and has a tight fit with a circular air discharge opening of the manifold 24. Within each nipple is a cluster of vanes 25 mounted upon a common hub, each vane being longer than the radial distance from said hub to the inner surface of the nipple wherefore, when the vane cluster is located in its nipple, each vane will be arcuately curved as indicated in the drawings. Each vane is made of very thin brass, or other suitable metal, so that it will flex or arcuately bend when the cluster is given a clockwise or counter-clockwise twist when it is manually inserted in said nipple. Further, each vane is substantially triangular in shape with the extreme end so formed that the act of inserting the vane cluster will cause this tip end of the vane to be deflected into a plane oblique to the general plane of the remainder of the vane, wherefore the air in passing from each nozzle will strike these deflected tip portions, resulting in a screw-like directional flow imparted to the air leaving said nozzle, and this angular, circular, rotary or screw flow will be in a direction in accordance with the aforementioned clockwise or counterclockwise arcuate flexing of the vane.

This is an important feature of this invention, for if the plurality of jets from the nozzles were straight there would be a consequent establishment of draft conditions in the passenger space, but by deflecting the vane tips as stated and by alternating the flexing of the vane clusters as clearly shown in Figs. 2 and 4, the adjacent rotary air jets will be given a positive comingling which may be likened to an enmeshed train of gears. It therefore results that a lateral dispersion or centrifugal directional flow is imparted to the air stream discharged from the nozzles. Further the hub 26 of each vane cluster may receive each vane in a slot formed in an axial plane of the hub as indicated in Fig. 5, or said slot may be formed obliquely to the axial plane as indicated at 28 in Fig. 6 in which latter case the tip portion of each vane may or may not be formed so as to give the angular, circular, screw or rotary motion to the air stream passing from the nozzle; the oblique disposition of the main body portion of the vane in this latter case being sufficient to cause said rotary motion.

In inserting a vane cluster the axis of the hub 26 may be made coaxial with the axis of the cylindrical nozzle 21, or the cluster may be slightly cocked to make these axes oblique with respect to each other for changing the parallelism of the issuing air streams as desired. In other words, the axis of the hub may be made at will coincident with or oblique to the axis of the nozzle, thereby controlling the linear directional flow of the air stream issuing from said nozzle. This is possible because the resistance of the thin metal, out of which the vanes 25 are made, is less than the combined frictional contact of the vane tips with the inner surface of the nozzle passage. Further the direction of arcuate flexing of the vanes can be made at will, wherefore other cooperations of adjacent air streams can be established other than the alternate arrangement shown, and this variance in the cooperations of the air stream include the omission of a cluster vane from one or more of the nozzles in accordance with the velocity and pressure of the streams as well as the results desired in a particular car.

As hereinbefore stated, this apparatus is mounted in the cabinet 1 composed of sheet metal walls with structural reinforcing members and suitable sound and heat insulation lining, which latter are not shown in the drawings for the sake of clearness. The cabinet is entirely walled, there being provided in each side wall a fresh air inlet 29 communicating with a suitable duct such as 30 leading to the exterior of the car, the openings 29 in Fig. 3 being located at substantially the middle of the cabinet. The bottom wall of the cabinet comprises several panels, the end panel 31 being of suitable size and removably secured and provided with a hinged door 9 beneath the motor 22 and the plurality of blowers, so that by opening this door or removing this panel ready access may be had to these parts. The motor 22 has a cushioned mounting upon a plate 32 hinged as at 33 and provided with pivotal bolt fastenings 34 so that by loosening the bolts and turning them about their pivots the plate 32 may be swung downwardly, carrying the motor, to permit oiling and other necessary attentions to said motor, it being understood of course that the belt 35 will be slipped out of engagement with the motor pulley previous to this operation.

The next panel 36 extends solidly across the cabinet and is preferably screwed in place so it may be removed if necessary, but the adjacent and central panel 37 is hinged as at 38 and provided with a latch 39 so that said panel may be swung downwardly to give access to the heating and cooling units as well as the drip pan 6. This panel 37 is provided in a substantial area thereof with a grill through which the air from the passenger space of the car may pass to reach the heating and cooling units, the circulation of the air being accomplished by the action of the blowers as is indicated by the arrows in Fig. 1. In similar manner there is provided the adjacent panel 40 stationarily screwed in place like the panel 36, and then at the opposite bottom end of the cabinet is the removable panel 41 similar to the panel 31.

The hereinbefore described apparatus is located in the left half of the cabinet and, as shown in Fig. 3, is duplicated in the other half of the cabinet in reversed order. That is to say next to the open grill 37 and spaced from the cooling unit 4, is a similar cooling coil 42 with an inlet and an outlet, and adjacent one side of this cooling coil is a heating coil 43

exactly similar to the heating coil 5, there being provided adjacent the other or air intake side of the cooling coil a spun glass filter screen 44 similar to the screen 8. A drip pan 46 is disposed below this air conditioning unit which is a duplicate of the pan 6. Beyond this second air conditioning unit is a horizontal transversely disposed shaft 47 having mounted thereon a battery of blowers 48 operated through a belt 49 driven by an electric motor 50 and discharging into a manifold 51 having reduced outlets fitted with nozzles 52 all of which are counterparts of the apparatus located at the opposite end of the cabinet.

Thus it will be understood that when the apparatus is in operation the two batteries of blowers, each acting as a single unit, will draw air from the passenger space through the centrally located grill 37 in the bottom wall of the cabinet 1, which air will be divided, part going to the left and the remainder to the right as seen in Fig. 3, to pass first through the filter screens 8 and 44, thence through the spaces between the coils of the cooling units 4 and 42, thence through the spaces between the coils of the heating units 5 and 43, and then into the space of the cabinet occupied by the battery of blowers. There the air will enter the openings in the sides of the blower casings and be impelled by the rotors, in said casings, to be discharged through the manifolds 24 and 51, into and through the plural nozzles 21 and 52.

The air discharged directly from these nozzles into the car is under high velocity but is mainly travelling in a plurality of adjacent cooperating whirling and constantly expanding streams having opposite rotating motion, all caused by the vane clusters in said nozzles. Further these streams of air are introduced and propelled lengthwise of the car in close proximity to the roof and therefore in the upper portion of the clerestory, well above the heads of the passengers which are located in the breathing or living zone of the car. These streams of air will induce the surrounding air to be carried along with said streams with the result that a great turbulence of air results, which is general throughout the upper portion of the car and hence devoid of any special and confined directional flow. Gradually this impelled air will work downwardly and the bulkheads 55 and 56 at the opposite ends of the car will cause a deflection and reversal of the general directional flow of the myriad air streams.

At the same time, the blowers will be receiving air from the passenger space through the grills 37, and this air comes from the lowermost portions of the car, travelling toward the center of the car from each end and thence upwardly to enter said grill. Whereas the arrows in Fig. 1 would more or less indicate positive directional flow yet it is desired distinctly understood that tests have conclusively proved that there is no positive single directional movement of the air body in the car but that, on the other hand, there is a great turbulence of all of the air which however has a general circulatory path as indicated by said arrows all due to the high velocity of the air discharged from the nozzles. Fresh air from outside the car is admitted through the ducts 30 into the cabinet in any desired and controllable amount and this fresh air is immediately entrained with the recirculated air of the car due to the location of the air inlets 29. Any dust, dirt or foreign matter carried by the air will be deposited on and held by the glass filter screens, and any moisture carried by said air in excess quantities will be condensed upon the metal of the air conditioning coils and drip into the pans 6 and 46 which are adapted to drain through the outlet conduits 7. The thermostatic equipment provided in the car will automatically control the temperature conditioning of the circulating air by bringing into action either the cooling coils or the heating coils, or neither. It is understood of course that for the efficient operation of this apparatus, each passenger car will be relatively closed, that is the windows will be kept closed and the doors at the opposite ends will be opened only when occasion demands.

The apparatus as above described is particularly adapted for passenger cars where the occupied space extends substantially the entire length of the car as indicated in Fig. 1. In cars where the air space to be conditioned is materially less than the full length of the car, as for example in dining cars and club cars, the apparatus shown in Figs. 7, 8 and 9 is found to be sufficient. This apparatus is substantially identical to the apparatus shown in Fig. 3, but comprises only one half thereof. Therefore similar reference numerals have been given to like parts in these two views so that additional description will not be necessary. The chief difference is that the cabinet of the single unit shown in Fig. 7 is materially shortened over the cabinet 1 of the double unit and, at the end of the cabinet 60 of the single unit, there is provided a removable box-like chamber 61 the outermost vertical wall of which is curved inwardly and upwardly, as indicated at 62 to positively direct air from the passenger space to and through the air conditioning unit. The bottom wall of this chamber is furnished with a grill 63 through which air may enter from the passenger space, and the inlet 64 for the fresh air from outside the car is furnished in a side wall of the chamber.

In Figs. 8 and 9 there has been diagrammatically shown a car of the diner or club type which clearly shows the installation of this air conditioning apparatus at the middle bulkhead 65, but also disposed in the clerestory of the car. Piping has been diagrammatically shown in Fig. 8 leading from the cooling coil of this air conditioning unit to a receptacle 66 carried beneath the car which may contain any desired means for causing refrigeration and for forcing the refrigerant to and through said cooling coil. The heating coil will be understood as being connected to the steam line of the train.

It is obvious that those skilled in the art may vary the details of construction as well as the steps of the method without departing from the spirit of this invention and therefore it is not desired to be limited to the exact foregoing description except as may be demanded by the claims.

What is claimed is:

1. In an apparatus for conditioning the air of a room the combination of a cabinet disposed in the ceiling area of said room, and comprising a box-like structure having two end walls, two side walls, a bottom, and a top; an intake opening in the bottom wall adjacent one end of the cabinet for admitting air from the room; a second intake opening in a side wall adjacent said room air intake for admitting fresh air from outside the room, the room air and the fresh air freely mixing within the cabinet after passing said intakes; a cooling coil disposed transversely of the cabinet adjacent said intakes and adapted to permit the

air mixture to pass through the spaces between the pipes of said coil; a heating coil disposed transversely of the cabinet in juxtaposition with the cooling coil and adapted to permit the air mixture to pass through the spaces between the pipes of said heating coil; a filter in juxtaposition with one of said coils and through which the mixed air passes; a battery of centrifugal blowers each provided with a casing and mounted upon a common shaft disposed transversely of the cabinet, said blowers being in the upper portion of said cabinet in juxtaposition with one of said coils; means disposed within said cabinet to rotate said blowers; and a plurality of nozzles connected to the blower casings and terminating in the end wall of the cabinet opposite the air intake end, said nozzles disposed next to the top of the cabinet and adapted to discharge the air from the blowers directly into the room under increased pressure.

2. In an apparatus for conditioning the air of a room the combination of a cabinet disposed in the ceiling area of and substantially midway the ends of said room, and comprising a box-like structure having two end walls, two side walls, a bottom, and a top; an intake opening in the bottom wall substantially equidistant from the end walls of the cabinet for admitting air from the room; a second intake opening in a side wall adjacent said room air intake for admitting fresh air from outside the room, the room air and the fresh air freely mixing within the cabinet after passing said intakes; a cooling coil disposed transversely of the cabinet on each side of and adjacent said intakes and adapted to permit the air mixture to pass through the spaces between the pipes of said coil; a heating coil disposed transversely of the cabinet in juxtaposition with each cooling coil and adapted to permit the air mixture to pass through the spaces between the pipes of said heating coil; a filter in juxtaposition with each set of said coils and through which the mixed air passes; a battery of centrifugal blowers arranged in two sets, each set mounted upon a common shaft disposed transversely of the cabinet, each set of blowers provided with casings and disposed in the upper portion of said cabinet in juxtaposition with one of the sets of said coils; means disposed within said cabinet to rotate said blowers; and a plurality of nozzles at each end of the cabinet connected to the blower casings and terminating in the end walls of the cabinet, said nozzles disposed next to the top of the cabinet and adapted to discharge the air from the blowers directly into the room under increased pressure in opposite lineal directions to equalize the pressures at the ends of the room.

3. In an apparatus of the character described the combination of means for suitably conditioning the air of an occupied space; a cabinet containing said means; means in said cabinet for circulating the conditioned air; and means to discharge the conditioned air from said cabinet into the occupied space, said means comprising a nozzle having therein a cluster of air-deflecting vanes and a hub, each vane joined to the hub obliquely to the axis thereof whereby to impart normally a certain angular rotation to the air stream discharged from said nozzle, said hub tiltable in the nozzle to vary the axial direction of discharge.

4. In an apparatus of the character described the combination of means for suitably conditioning the air of an occupied space; a cabinet containing said means; a battery of blowers disposed in said cabinet for circulating the conditioned air, each blower provided with a casing having an outlet for the circulated air; a chamber interposed between said blowers and an end wall of the cabinet, one wall of said chamber in open communication with all of said outlets, to receive the conditioned air therefrom, another wall of said chamber having a plurality of closely spaced nozzles therein for conducting the conditioned air to and through the end wall of the cabinet; said nozzles discharging the conditioned air directly into the occupied space in plural streams, said streams substantially contacting each other immediately upon being discharged due to the close spacing of said nozzles in the chamber wall.

5. In an apparatus of the character described the combination of means for suitably conditioning the air of an occupied space; a cabinet containing said means; conditioned air circulating means fixedly supported in said cabinet; means hingedly supported within the cabinet to rotate the circulating means; an opening in a wall of the cabinet to permit easy access to the circulating means, said rotating means adapted to swing out of the cabinet through said opening; and means to discharge the conditioned air from the air circulating means into the occupied space.

6. In an apparatus for conditioning the air of a room the combination of a cabinet disposed in the ceiling area of said room, and comprising a box-like structure having an end wall, two side walls, a bottom and a top; an intake opening in a side wall of the cabinet for admitting fresh air from outside the room; a second intake opening in the bottom wall adjacent the fresh air inlet for admitting air from the room, the room air and the fresh air freely mixing within the cabinet after passing said intakes; a cooling coil disposed transversely of the cabinet adjacent said intakes and adapted to permit the air mixture to pass through the spaces between the pipes of said coil; a heating coil disposed transversely of the cabinet in juxtaposition with the cooling coil and adapted to permit the air mixture to pass through the spaces between the pipes of said heating coil; a filter in juxtaposition with one of said coils and through which the mixed air passes; a battery of centrifugal blowers each provided with a casing and mounted upon a common shaft disposed transversely of the cabinet, said blowers being in the upper portion of said cabinet in juxtaposition with one of said coils; means disposed within said cabinet to rotate said blowers; and a plurality of nozzles connected to the blower casings and terminating in the end wall of the cabinet, said nozzles disposed next to the top of the cabinet and adapted to discharge the air from the blowers directly into the room under increased pressure in plural adjacent streams having cooperating opposite rotating motion.

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