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W. E. RAPP

1,990,753

AIR CONDITIONING

Filed April 6, 1932

4 Sheets-Sheet 1

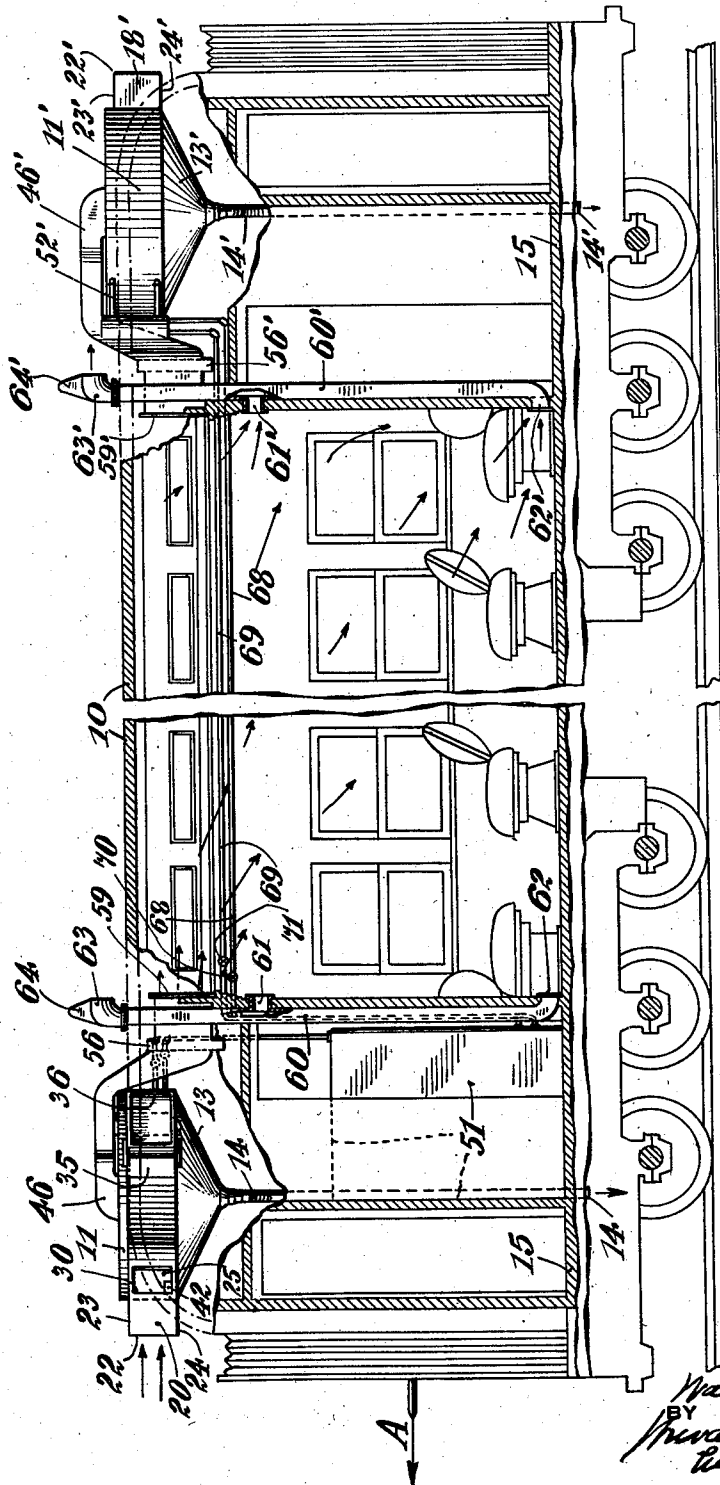


Fig. 1.

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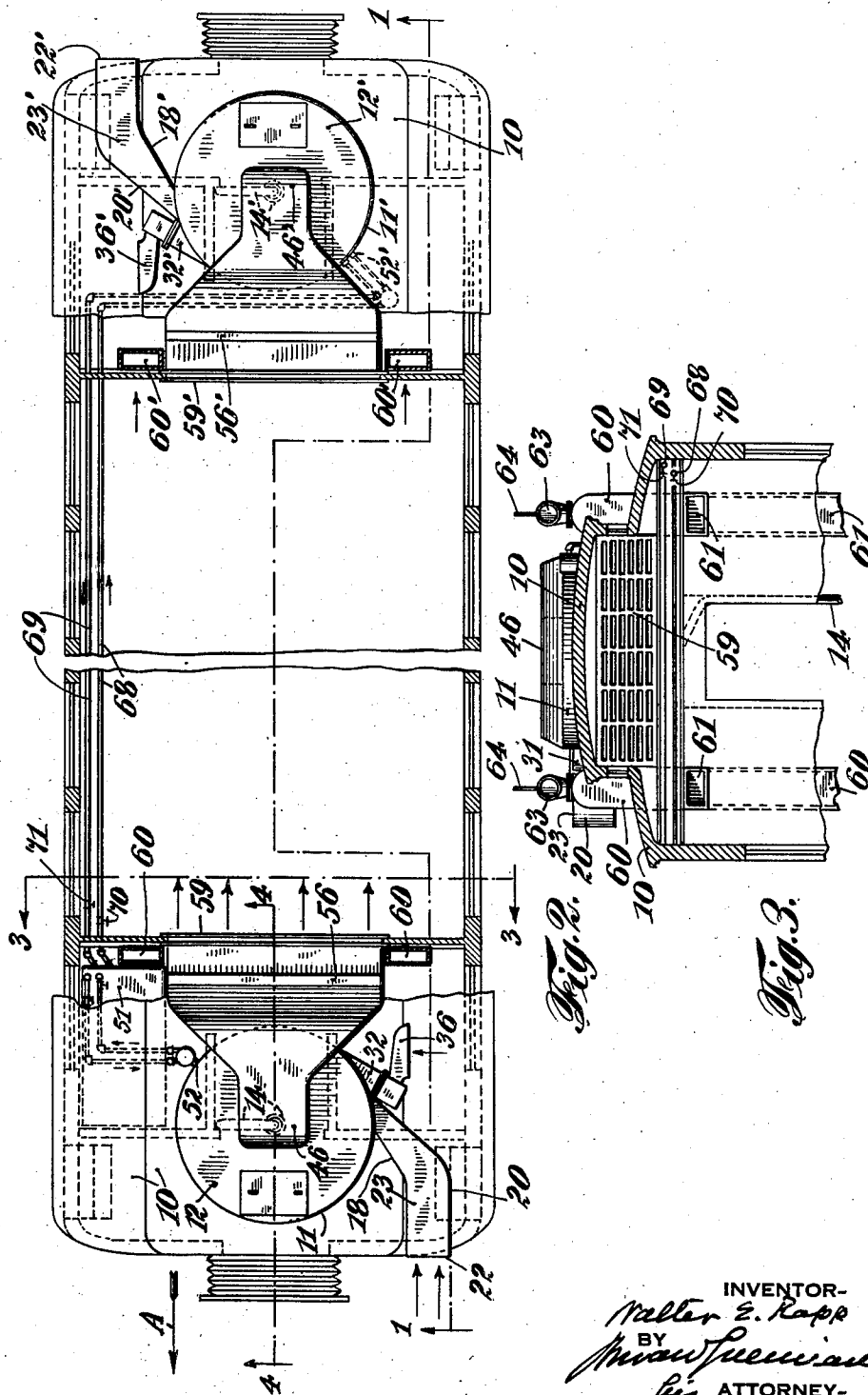
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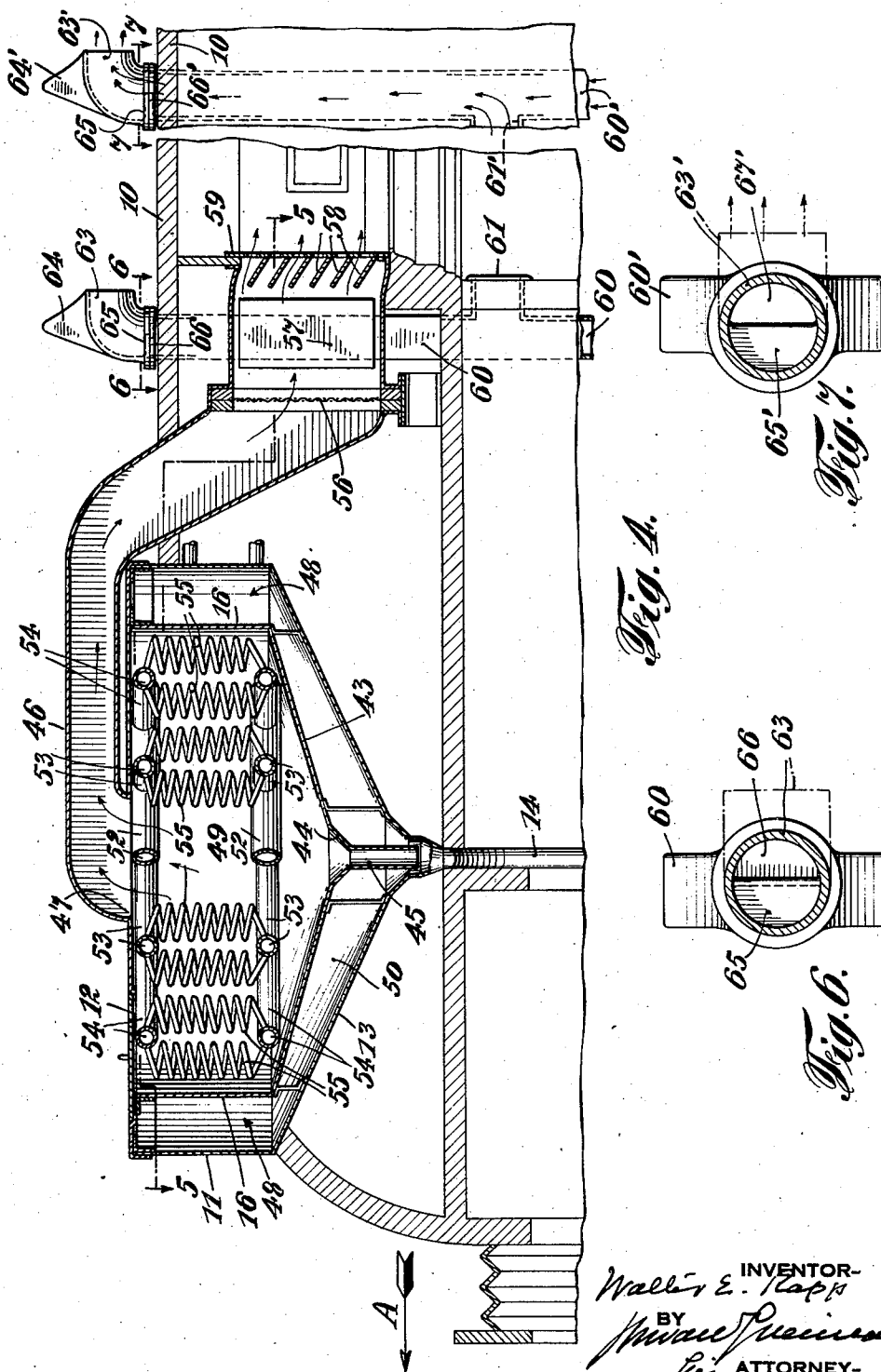
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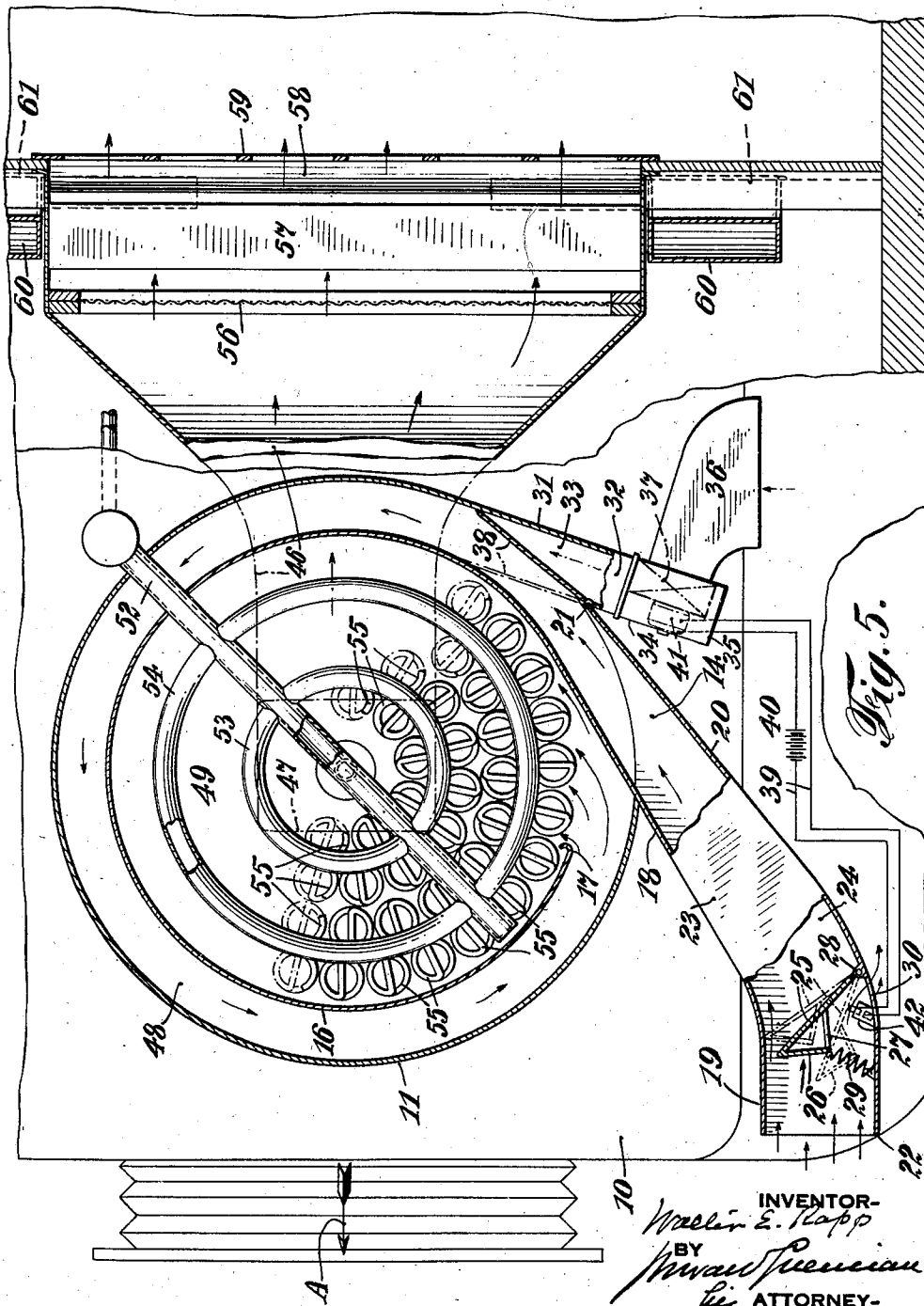
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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

1,990,753

AIR CONDITIONING

Walter E. Rapp, New York, N. Y.

Application April 6, 1932, Serial No. 603,673

15 Claims. (Cl. 257-7)

My invention relates to processes and devices for the conditioning and circulating of air, and refers particularly, but not exclusively, to processes and devices adapted for the conditioning of air and its circulation through cars and similar movable conveyances and containers.

The annoyance, inconvenience and danger to health incident to the direct introduction of exterior air into and through moving passenger cars has long been recognized, and numerous attempts have been made to eliminate, or diminish, these objectionable and dangerous conditions.

Among the conditions necessary for the proper maintenance of health and comfort of human beings, confined in a room, or chamber, the following may be mentioned:—The air must be free from obnoxious odors and injurious gaseous contents, it must be clean, that is, free from dust and other solid materials in order that they may not be inhaled; the supply of fresh air must be of continued consistent quality in order to maintain health and comfort giving properties; the velocity of the air current must be of reasonable motion in order to avoid draughts; the quantity of air supplied for consumption must be sufficient to supply the health needs of the passengers, the air must be withdrawn at a velocity and in quantity corresponding to the velocity and quantity of supplied air; the means for the supply of fresh air and those for the withdrawal of the vitiated air must be such that there is as little intermixture of the two air masses as is possible; the air must be of proper humidity content for the comfort of the passengers and the protection of their respiratory tracts; and the air must be of reasonable temperature for the comfort and health of the passengers.

While it is physically and mechanically impossible to respond to all of the aforementioned conditions with absolute perfectness, I believe that the process and devices of my invention accomplish them more accurately, practically, economically and with more practical automatic control than any of the processes and devices previously proposed for the accomplishment of the described desirable results.

In the accompanying description of my process for air conditioning and circulation and of my devices particularly adapted therefor, I refer specifically to their application to passenger cars, but I do not by any means limit myself to such conveyances, as it is evident that my invention has much broader applications and

can be applied successfully to many other uses.

In the accompanying drawings, illustrating one form of the device of my invention installed within a railway passenger car, similar parts are designated by similar numerals.

Figure 1 is a longitudinal section through the line 1—1 of Figure 2.

Figure 2 is a top view of a railway car installed with my device partly broken away for clearness of description.

Figure 3 is a section on the line 3—3 of Figure 2.

Figure 4 is a section on the line 4—4 of Figure 2.

Figure 5 is an enlarged section on the line 5—5 of Figure 4.

Figure 6 is a section through the line 6—6 of Figure 4.

Figure 7 is a section through the line 7—7 of Figure 4.

The accompanying illustrations show two units of the device of my invention, the units being positioned at the two ends of the car, and for clearness of description and to prevent confusion, I will describe one of the units, the corresponding elements of the other unit being indicated by corresponding prime numerals.

The car which is shown diagrammatically, as it is no part of my invention, is supposed to be moving in the direction of the arrow A.

Positioned partly above and partly below the roof 10 of the car, as shown specifically in Figure 1 is an air collecting and dust and water eliminating device consisting of a chamber formed by the annular wall 11, the cover 12 and the downwardly and inwardly sloping conical bottom 13. A conduit 14 is connected with an opening in the bottom 13 and extends downwardly through the body of the car and outwardly through the car bottom 15.

An interior wall 16, spaced from the outer wall 11, commences at the line 17, extends somewhat more than three-quarters around the chamber and then extends outwardly as at 18, the extremity 19 being positioned toward the end of the car and above the car vestibule. An air entrance conduit is formed by the wall 18, the wall 20 which extends from the point 21 to its extremity 22, a top or cover 23 and a bottom member 24. It will be noted that this air entrance conduit has an inwardly decreasing cross-section area.

A pressure controlled valve consisting of the closure element 25, the angularly positioned plate 26 and the supporting member 27, is pivot-

ally attached to the wall 20 at 28. A spring 29 of predetermined resiliency is attached to the plate 26 and the wall 20. An opening 30 is positioned in the wall 20 between the pivotal point 28 and the entrance of the air entrance conduit.

A subsidiary air entrance conduit is formed by the extension 31 of the wall 11, the top 32, the bottom 33, the wall 34 extending outwardly from the point 21 and the end 35. A funnel-like air catching device 36, open at both ends, admits air into the subsidiary air entrance above described. An electrically controlled suction fan, or blower 37, operates to draw air into and through the subsidiary air entrance conduit.

An air controlled valve 38 is pivotally attached at 21 and is capable of completely closing either the air entrance conduit or the subsidiary air entrance conduit.

An electric circuit 39 energized by the battery 40 is connected to the motor 41, operating the fan 37, and to the switch 42 which is operated by the closure element 25.

A downwardly directed conical-shaped false bottom 43 is connected to the wall 16 and has an opening 44 in its bottom portion connected to the pipe 45, the lower end of which is within the upper portion of the pipe 14.

A conduit 46 is connected to an opening 47 in the central portion of the top 12.

The operation of the above described element of the device of my invention is as follows:—

The spring 29 is of such tension that the valve 25, 26, 27 is in the position shown in dotted lines in Figure 5 and not in contact with the switch 42 when the desired amount of air per minute is admitted to the air entrance conduit. For purposes of explanation, it is assumed that the desired amount of air is admitted when the car is moving at the rate of 15 miles per hour. It is evident, therefore, that as long as the speed is thus maintained the opening in the air entrance conduit will be positioned for the admission of the desired amount of air per minute. If the speed of the car increases, the increased amount of air thus forced into the entrance of air entrance conduit will be impinged upon the member 26 of the valve, overcoming the natural tension of the spring 29 and causing the valve to move, reducing the area of the entrance, for instance into the position shown in full lines in Figure 5, thus maintaining a constant amount of air admission. If, however, the speed of the car is decreased below 15 miles per hour, the spring 29 will draw the valve downwardly against the switch 42 energizing the electric circuit 39, causing the operation of the fan 37 through the action of the motor 41. The revolution of the fan 37 will draw air into and through the subsidiary air entrance conduit, causing the flap valve 38 to open until it is in a position where the amount of air admitted through the subsidiary air entrance conduit supplies the deficiency of air admitted through the air entrance conduit, thus maintaining a constant supply of air.

The subsidiary air entrance conduit is so constructed that when the car is stationary and no air is supplied by the air entrance conduit, the required amount will be supplied by the subsidiary air entrance conduit.

It will thus be seen that a constant amount of air is supplied irrespective of the speed of movement of the car as well as when it is stationary.

The air thus forced into the device passes

in the direction of the arrow with centrifugal movement through the conduit 48 between the walls 11 and 16, through the opening beyond the wall extremity 17 into the central chamber 49 and thence outwardly through the conduit 46.

This centrifugal movement of the air throws out the heavier particles of dirt and impurities which pass through the space 50 between the bottom 13 and the false bottom 43 and thence outwardly through the pipe 14.

The air as it passes through the central chamber 49 is cooled and de-humidified by means of a refrigerating device, which consists of a refrigerating plant 51, of any suitable character, the refrigerating liquid passing through the supply pipe 52 into the annular headers 53 and 54, which in turn are connected to a plurality of worm pipes 55, 55 and thence to the plant 51.

The air flowing through the conduit 46 passes through a cloth screen 56, to remove the finer dust and solid impurities, thence through the heating device 57 and thence over the deflectors 58, 58 and through the grill 59, positioned in the upper portion of the car, into the car proper. The desired temperature of the air may be obtained and retained by themostatic control for cooling or heating.

The moisture removed from the air by the cooling device falls downwardly through the pipes 45 and 14.

It will thus be seen that a constant quantity of air is cleansed of all dust and solid impurities, is de-humidified, cooled or heated to a desired temperature before introduction into the car proper and that these conditions are maintained irrespective of the speed of motion of the car.

Positioned at each end of the car are two exhaust pipes 60, 60 extending from above the car roof 10 to the lower portion of the car proper, and having openings 61 and 62 therein.

The exhaust pipe 60 has a revoluble funnel 63 carried by its upper extremity, said funnel having a wing 64 whereby the opening of the funnel will always be in a reverse direction to the movement of the car. The pipes 60 and 60' have automatically controlled valves whereby the pipe at the rearward end of the car is open and the pipe at the forward end of the car is closed. This is accomplished by means of two semi-circular closure members, one attached to the pipe and the other to the funnel, so positioned that they may be operated by the movement of the funnel to either open or close the pipe. This is shown particularly in Figures 6 and 7. Figure 6 illustrates the position of these elements in the forward end of the car and in which the shutter 65 is carried by the funnel, and the shutter 66 is carried by the pipe and the pipe is closed. In Figure 7, the shutter 65' is positioned above the shutter 66', as shown in Figure 4 and the pipe is open at the space 67'.

The air, therefore, entering the car through the grill 59 passes the length of the car through the openings 61' and 62' and outwardly through the pipe 60', a suction being caused by the funnel 63'.

The pipes 68 and 69, Figure 2, illustrate the movement of the refrigerating liquid from the plant 51 to the device in the other end of the car, the flow being controlled by the valves 70 and 71.

It is to be noted that a novel and valuable feature of my invention is that the air is auto-

5 matically introduced into the forward portion of the car and withdrawn from the rearward portion of the car irrespective of the direction of movement of the car and that the amount of air introduced per unit of time is the same when the car is moving in either direction and when it is stationary, a most necessary and advantageous attribute of devices adapted for the health and comfort of the passengers.

10 By "conditioned air", I mean air which has been submitted to any or all of the processes of removing solid contents, producing a desired degree of humidity and producing a desired degree of temperature.

15 I do not limit myself to the particular size, shape, number, arrangement, construction or application of the elements of my invention or the number or order of steps of procedure as particularly shown and described, as these are given simply as a means for clearly describing my invention.

What I claim is:—

1. In a device adapted for the ventilation of a moving chamber, in combination, pressure valve means adapted for automatically introducing a definite quantity of conditioned air into the forward portion of said chamber by means of the movement of said chamber, during both the forward and backward direction of movement of said chamber; and means adapted for automatically withdrawing air from the rearward portion of said chamber by means of the movement of said chamber, during both the forward and backward movement of said chamber.

2. In a device adapted for the ventilation of a moving chamber, in combination, pressure valve means adapted for automatically introducing a definite quantity of conditioned air into the forward portion of said chamber by means of the movement of said chamber, during both the forward and backward direction of movement of said chamber; means adapted for automatically withdrawing air from the rearward portion of said chamber by means of the movement of said chamber, during both the forward and backward movement of said chamber, and independent automatically acting means adapted for the introduction of air into the forward portion of said chamber irrespective of movement of said chamber.

3. In a device adapted for the ventilation of a moving chamber, in combination, an entrance conduit positioned in an end portion of said chamber connecting conditioning means with the exterior air; conditioning means; a funnel fixedly attached to the exterior end of said conduit, said funnel being fixedly directed toward said chamber end; means for automatically controlling and regulating the amount of air per unit of time introduced into said entrance conduit; and an exit conduit positioned in and connecting the other end portion of said chamber with the exterior air.

4. In a device adapted for the ventilation of a moving chamber, in combination, an entrance conduit positioned in each end portion of said chamber connecting conditioning means with the exterior air; conditioning means; a funnel fixedly attached to the exterior end of said conduit, said funnel being fixedly directed toward said chamber end; an exit conduit positioned in each said chamber end portions connecting said chamber with the exterior air; a revoluble funnel carried by the exterior portion of each said exit conduits, and means

whereby the revolution of said exit funnel will open and close said exit conduit.

5. In a device adapted for the ventilation of a moving chamber, in combination, an entrance conduit positioned in each end portion of said chamber connecting conditioning means with the exterior air; conditioning means; a funnel fixedly attached to the exterior end of said conduit, said funnel being fixedly directed toward said chamber end; means for automatically controlling and regulating the amount of air per unit of time introduced into said entrance conduit; an exit conduit positioned in each said chamber end portions connecting said chamber with the exterior air; a revoluble funnel carried by the exterior portion of each said exit conduits, and means whereby the revolution of said exit funnel will open and close said exit conduit.

6. In a device adapted for the ventilation of a moving chamber, in combination, an entrance conduit connecting an auxiliary chamber in each end of said chamber with the exterior air; an auxiliary chamber; means within said auxiliary chamber adapted to remove the heavier solid particles from introduced air; means for conducting the thus purified air into said chamber; a funnel fixedly attached to the exterior portion of said entrance conduit, said funnel being fixedly directed toward said chamber end; an exit conduit connecting each said end portions of said chamber with the exterior air, a revoluble funnel carried by the exterior portion of each said exit conduits, means whereby said exit conduit will be open when said exit funnel is directed in the same direction as is the chamber end upon which it is positioned and means whereby said exit conduit will be closed when said exit funnel is directed in the same direction as is the chamber end other than that upon which it is positioned.

7. In a device adapted for the ventilation of a moving chamber, in combination, an entrance conduit connecting an auxiliary chamber in each end of said chamber with the exterior air; an auxiliary chamber; means within said auxiliary chamber adapted to remove the heavier solid particles from introduced air; means adapted for otherwise conditioning said introduced air; means for conducting the thus purified air into said chamber; a funnel fixedly attached to the exterior portion of said entrance conduit, said funnel being fixedly directed toward said chamber end; an exit conduit connecting each said end portions of said chamber with the exterior air, a revoluble funnel carried by the exterior portion of each said exit conduits, means whereby said exit conduit will be open when said exit funnel is directed in the same direction as is the chamber end upon which it is positioned and means whereby said exit conduit will be closed when said exit funnel is directed in the same direction as is the chamber and other than that upon which it is positioned.

8. In a device adapted for the ventilation of a moving chamber, in combination, an entrance conduit connecting an auxiliary chamber in an end of said chamber with the exterior air; an auxiliary chamber; means within said auxiliary chamber adapted to remove the heavier solid particles from introduced air; means for conducting the thus purified air into said chamber; a funnel fixedly attached to the exterior portion of said entrance conduit, said funnel being fixedly directed toward said chamber end; means for automatically controlling and regulating the

continuous introduction of a definite amount of air per unit of time; and an exit conduit connecting said end portion of said chamber with the exterior air.

9. In a device adapted for the ventilation of a movable chamber, in combination, an entrance conduit positioned in an end portion of said chamber connecting conditioning means with the exterior air; conditioning means, a funnel fixedly attached to the exterior end of said conduit; said funnel being fixedly directed toward said chamber end; means for automatically controlling and regulating the amount of air per unit of time introduced into said entrance conduit; an exit conduit positioned in and connecting the other end portion of said chamber with the exterior air; and independent automatically acting means adapted for the introduction of air into the forward portion of said chamber irrespective of movement of said chamber.

10. In a device adapted for the ventilation of a forwardly moving chamber, in combination, an entrance conduit opening into an end portion of said chamber connecting conditioning means with the exterior air; conditioning means; a funnel fixedly attached to the exterior end of said conduit, said funnel being fixedly directed forwardly of said chamber; an exit conduit connecting the other end portion of said chamber with the exterior air; a revoluble exit funnel carried by the exterior portion of said exit conduit, and means whereby the revolution of said exit funnel will open said exit conduit when said chamber moves forwardly and will close said exit conduit upon backward movement of said chamber.

11. In a device adapted for the ventilation of a forwardly moving chamber, in combination, an entrance conduit connecting an auxiliary chamber opening into the forward end portion of said chamber with the exterior air; an auxiliary chamber; means within said auxiliary chamber adapted to remove the heavier solid particles from introduced air; means for conducting the thus purified air into the forward end of said chamber; a funnel fixedly attached to the exterior portion of said entrance conduit, said funnel being fixedly directed forwardly of said chamber; an exit conduit connecting the rear end portion of said chamber with the exterior air, a revoluble exit funnel carried by the exterior portion of said exit conduit, means whereby said exit conduit will be open when said exit funnel is directed rearwardly of said chamber, and means whereby said exit conduit will be closed when said exit funnel is directed forwardly of said chamber.

12. In a device adapted for the ventilation of a forwardly moving chamber, in combination, an entrance conduit connecting an auxiliary chamber opening into the forward end portion of said chamber with the exterior air; an auxiliary chamber; means within said auxiliary chamber adapted to remove the heavier solid particles from introduced air; means adapted for otherwise conditioning said introduced air; means for conducting the thus purified air into the forward end of said chamber; a funnel fixedly attached to the exterior portion of said entrance conduit, said funnel being fixedly directed forwardly of said chamber; an exit conduit connecting the rear end portion of said chamber with the exterior air, a revoluble exit funnel carried by the exterior portion of said exit conduit, means whereby said exit conduit will be open when

said exit funnel is directed rearwardly of said chamber, and means whereby said exit conduit will be closed when said exit funnel is directed forwardly of said chamber.

13. In a device adapted for the ventilation of a movable chamber, in combination, an entrance conduit opening into the forward end portion of said chamber connecting conditioning means with the exterior air; conditioning means; a funnel fixedly attached to the exterior end of said conduit, said funnel being fixedly directed forwardly of said chamber; an exit conduit positioned in and connecting the rear end portion of said chamber with the exterior air; a revoluble exit funnel carried by the exterior portion of said exit conduit, means whereby the revolution of said exit funnel will open said exit conduit when said chamber moves forwardly and will close said exit conduit upon rearward movement of said chamber, and independent automatically acting means adapted for the introduction of air into the forward portion of said chamber irrespective of movement of said chamber.

14. In a device adapted for the ventilation of a forwardly moving chamber, in combination, an entrance conduit connecting an auxiliary chamber opening into the forward end portion of said chamber with the exterior air; an auxiliary chamber; means within said auxiliary chamber adapted to remove the heavier solid particles from introduced air; means for conducting the thus purified air into the forward end of said chamber; a funnel fixedly attached to the exterior portion of said entrance conduit, said funnel being fixedly directed forwardly of said chamber; an exit conduit connecting the rear end portion of said chamber with the exterior air; a revoluble exit funnel carried by the exterior portion of said exit conduit, means whereby said exit conduit will be open when said exit funnel is directed rearwardly of said chamber, means whereby said exit conduit will be closed when said exit funnel is directed forwardly of said chamber, and independent automatically acting means adapted for the introduction of air into the forward portion of said chamber irrespective of movement of said chamber.

15. In a device adapted for the ventilation of a forwardly moving chamber, in combination, an entrance conduit connecting an auxiliary chamber opening into the forward end portion of said chamber with the exterior air; an auxiliary chamber; means within said auxiliary chamber adapted to remove the heavier solid particles from introduced air; means adapted for otherwise conditioning said introduced air; means for conducting the thus purified air into the forward end of said chamber; a funnel fixedly attached to the exterior portion of said entrance conduit, said funnel being fixedly directed forwardly of said chamber; an exit conduit connecting the rear end portion of said chamber with the exterior air; a revoluble exit funnel carried by the exterior portion of said exit conduit, means whereby said exit conduit will be open when said exit funnel is directed rearwardly of said chamber, means whereby said exit conduit will be closed when said exit funnel is directed forwardly of said chamber, and independent automatically acting means adapted for the introduction of air into the forward portion of said chamber irrespective of movement of said chamber.

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