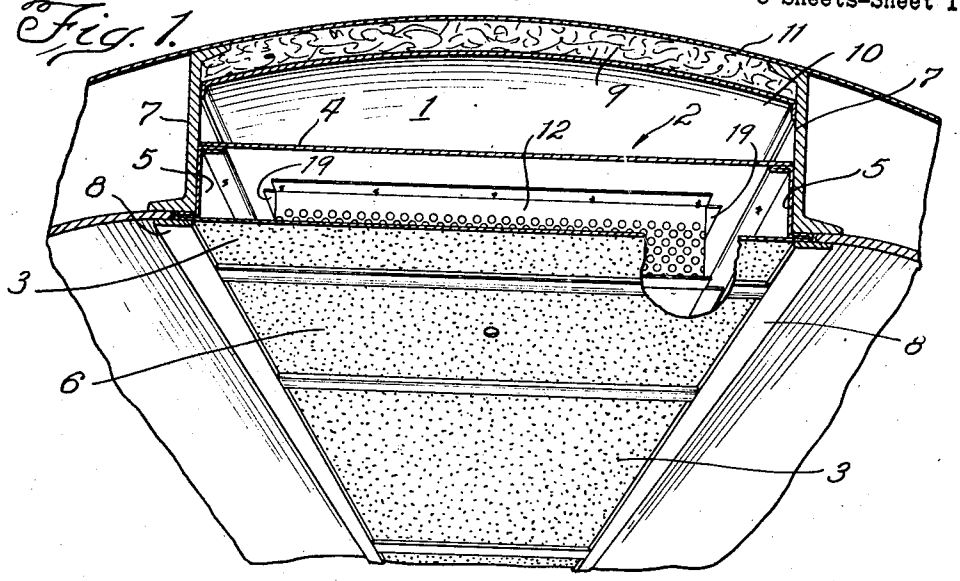
Aug. 5, 1941. H. H. DARBO 2,251,663

VENTILATING CONSTRUCTION

Filed May 2, 1938 3 Sheets-Sheet 1

Fig. 1.



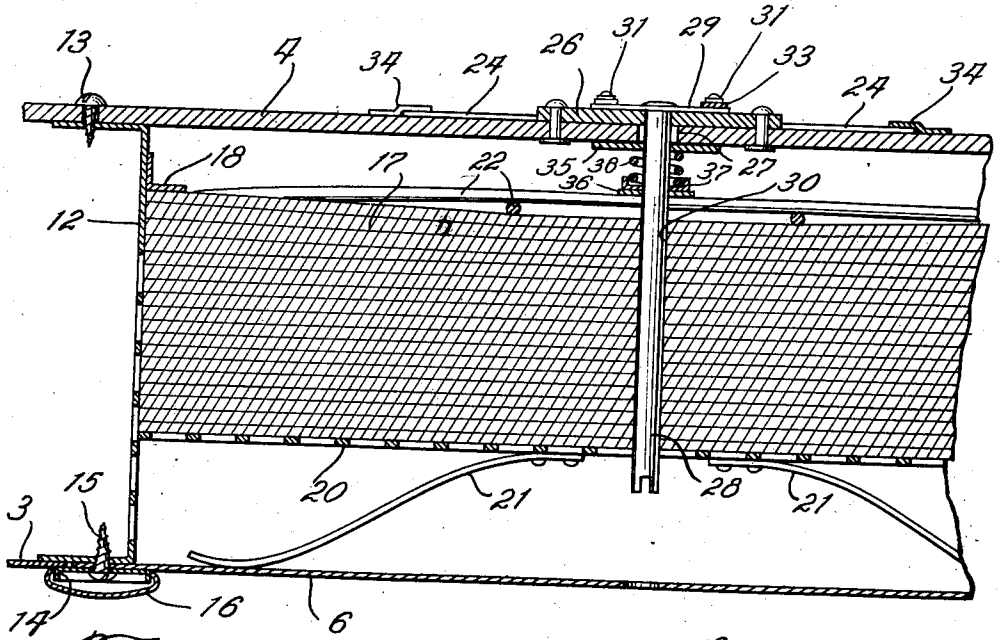


Fig. 4.

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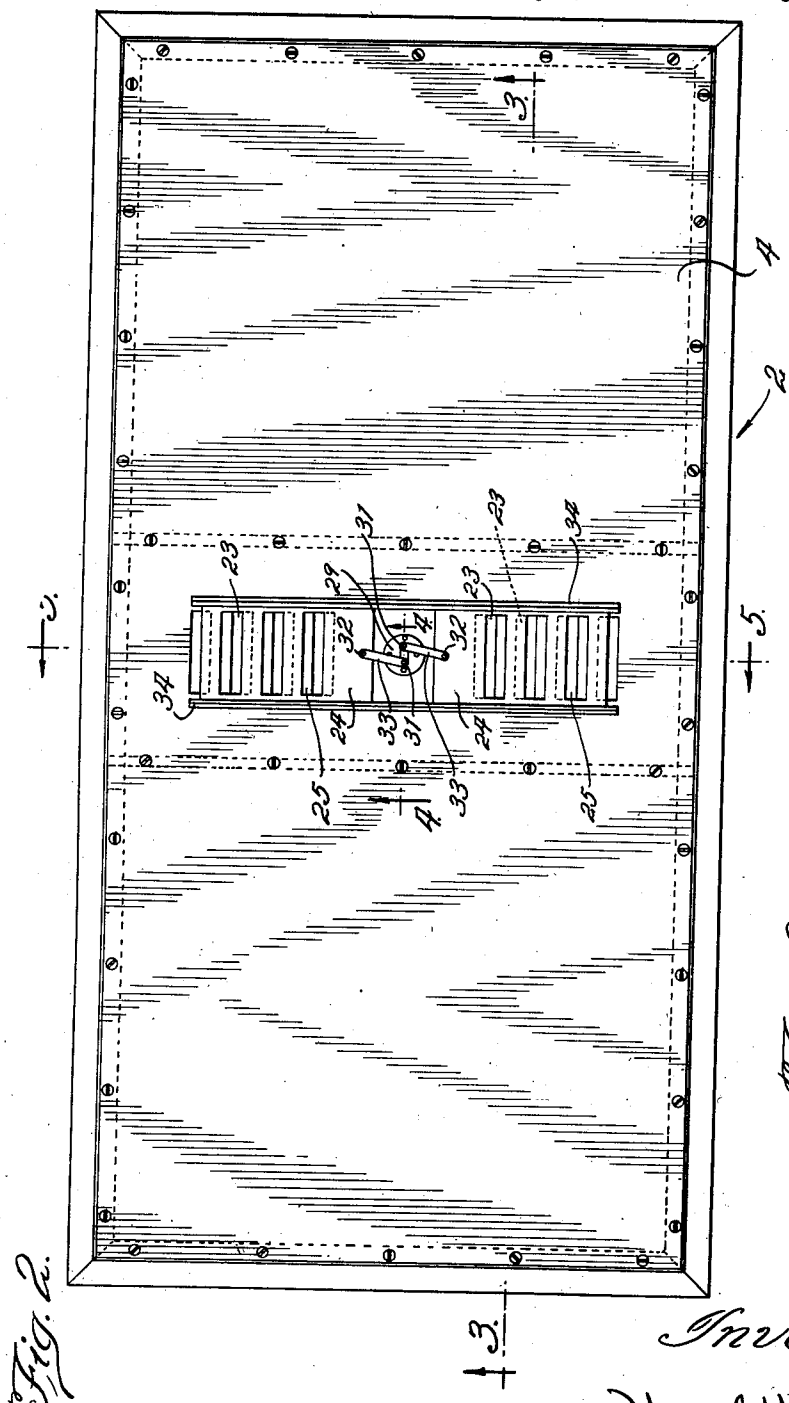

Fig. 2.

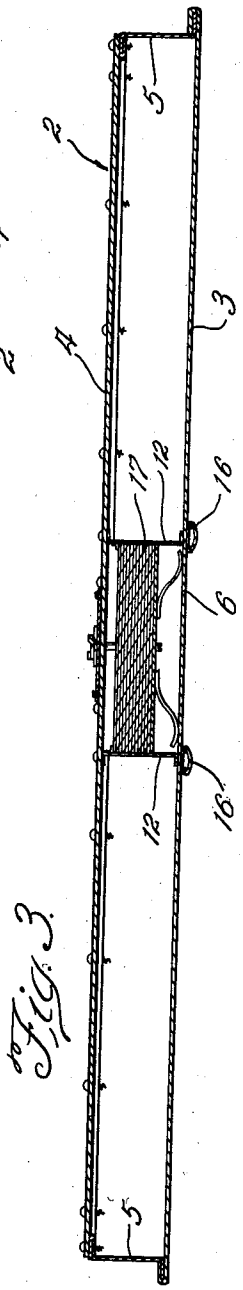

Fig. 3.

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Fig. 5.

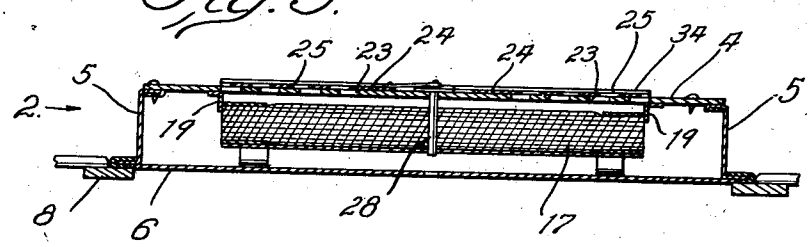


Fig. 9.

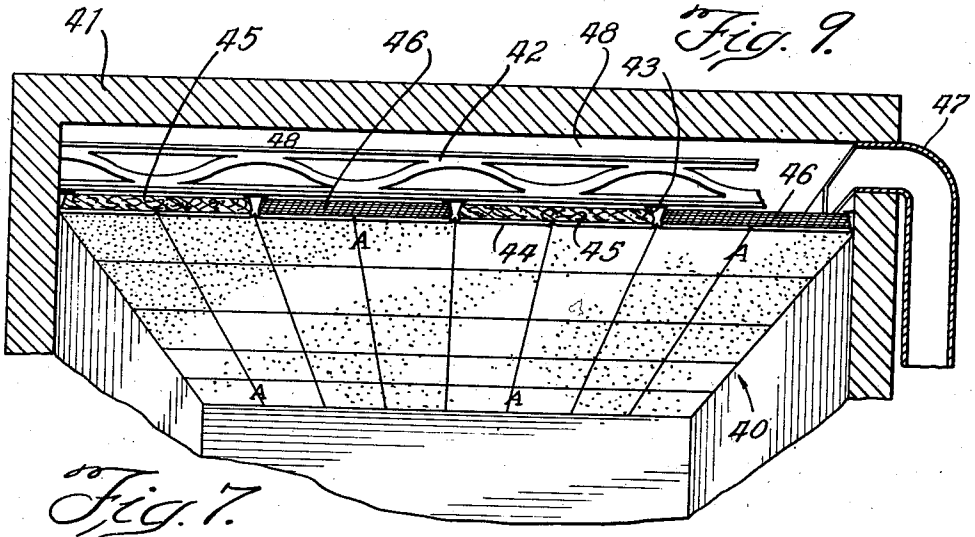
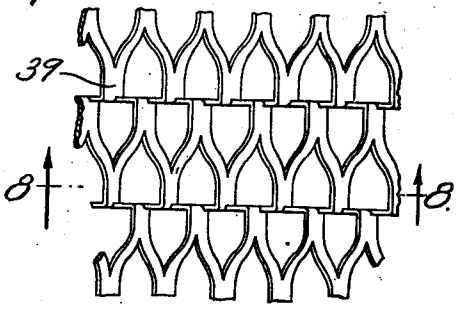


Fig. 7.



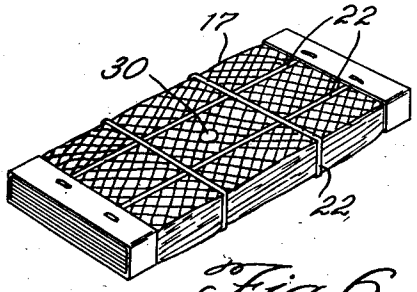
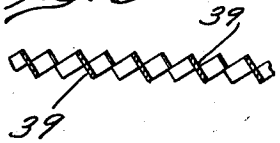


Fig. 6.

Fig. 8



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Patented Aug. 5, 1941 2,251,663

UNITED STATES PATENT OFFICE

2,251,663

VENTILATING CONSTRUCTION

Howard H. Darbo, Berwyn, Ill., assignor, by mesne assignments, to Burgess Battery Company, Chicago, Ill., a corporation of Delaware

Application May 2, 1938, Serial No. 205,439

15 Claims. (Cl. 98—13)

This invention relates to improvements in air-distributing apparatus for ventilating systems, and pertains particularly to that type of air-distributing apparatus in which the ventilating air is introduced into an enclosure through a perforated or otherwise apertured panel of large area in comparison with the ordinary ventilating grille.

Air-distributing apparatus of the above type in which a plenum chamber is separated from the enclosure to be ventilated by a double panel of sheet-like apertured members in spaced parallel relation with each other has recently been commercially adopted and is now widely used for distributing conditioned air in closed vehicles, especially in railway coaches and motor buses. The construction is equally useful in architectural installations and has been used in this environment. The plenum chamber is generally located overhead and the double panel air distributor forms at least a portion of the ceiling of the enclosure. The upper panel, which is not visible from below, is usually provided with a relatively small number of holes and is known as the control panel since it functions, due to the limited proportion of open area, to restrict the flow of air from the plenum chamber into the enclosure below, thus maintaining an appreciable superatmospheric pressure substantially uniform throughout the volume of the plenum chamber. Under such conditions it is possible to distribute the air from the plenum chamber into the enclosure in accordance with predetermined specifications by selectively varying the number and/or size of openings in the different zones of the control panel. A perforated facing member, generally referred to as the distributing panel, forms the ceiling of the enclosure as well as the final outlet of the air distributor, serving to screen the control panel which is generally unsightly.

It is desirable to cause the air to diffuse slowly through the distributing panel into the room. Experience has shown that air passing through the openings in the control panel does not spread sufficiently to prevent impingement of the air stream against the perforated facing member at high velocity with the result that there is a tendency of draft formation at localized areas and foreign materials carried by the ventilating air quickly build up in the said localized high velocity areas. The result is an unsightly ceiling since these accumulations are visible from below and aggravate the generally unclean condition of the exposed surface of the distributing panel. Some of the material may sift through the perforations of the distributing panel to the annoyance of persons below. Experience has also shown that air filters ordinarily provided to clean the ventilating air are incapable of removing more than a fraction of the air-borne particles. This is primarily because the space available for conditioning equipment is generally so limited as to provide insufficient area for adequate air filters and the air passes through the filters at a relatively high velocity, carrying dirt particles which would, at lower velocities, be removed. The air available at ventilating intakes in railway vehicles is always heavily laden with particles of soot, cinders and tiny tar droplets. The combination of these materials forms a sticky mass which accumulates rapidly and is removed with difficulty.

It is desirable, for the above reasons, to diffuse the air passing through the control panel as thoroughly as possible to reduce its velocity before it reaches the distributing panel for final distribution, and to increase the efficiency of the air-filtering equipment by the provision of secondary filters operating at low air velocity to remove substantially all foreign materials from the ventilating air.

The object of this invention is, accordingly, to provide effective means for diffusing the air passing through the control panel openings and to provide efficient means for filtering the ventilating air at low velocity. Thus, the ultimate aim is to provide apparatus capable of delivering clean air to an enclosure without concomitant draft formation. A further object is to combine the diffusing means and the filter means in a single dual purpose element.

In the accompanying drawings:

Fig. 1 is a perspective view, partly in section, of the filter-diffuser assembly of this invention;

Fig. 2 is a plan view of an air-distributing unit;

Fig. 3 is a sectional view taken at 3—3 of Fig. 2;

Fig. 4 is an enlarged sectional view taken at 4—4 of Fig. 2;

Fig. 5 is a sectional view taken at 5—5 of Fig. 2;

Fig. 6 is a perspective view of the preferred form of the filter-diffuser element;

Fig. 7 is a fragmentary plan view of the material used in the preferred embodiment of the filter-diffuser;

Fig. 8 is a fragmentary sectional view of the preferred filter-diffuser material, and

Fig. 9 is a perspective view, partly in section,

of a combined acoustical treatment and air-distributing and air-filtering construction.

Although one form of the invention is illustrated and will be described as embodied in a railway car, it will be clear that the construction is equally well adapted for use architecturally. The most severe conditions are encountered in railway car and vehicular ventilation generally and it is for this reason that the invention has been developed and embodied in this particular environment.

The general air-distributing construction to which the invention is adapted is illustrated and described in Norris Patent 2,172,944 dated September 12, 1939, and Reynolds Patent 2,172,851 dated September 12, 1939. A plenum chamber 1 is formed in the clerestory of a railway car, the upper portion of which is shown in Fig. 1, the air-distributing construction being installed between the plenum chamber and the passenger space. This construction is conveniently made up of a number of distributor units 2 which may be fabricated in a shop and installed as a unit in the railway car framework. Each distributor unit comprises a perforated distributing panel 3, the imperforate control panel 4, side frame members 5 and the filter-diffuser and air flow control apparatus located between the distributing and control panels. The distributing and control panels may be sheet metal, pressed wood board, or other self-sustaining sheet material. Distributing panel 3 includes a removable section 6 which provides access to the filter-diffuser apparatus for inspection and replacement of the filter element. This section is slightly shorter in width than the main part of the distributing panel as shown in Fig. 5, to permit shifting slightly to remove the edges from under moldings 8 in removing the section. The distributor unit is secured to carlines 7 in any suitable manner, moldings 8 serving to conceal the joints with the half-deck portions of the railway car. A thickness of insulating material 9, preferably provided with an air-impervious lining 10, is disposed subjacent top 11 of the railway car.

Channel members 12 extend transversely of the car and span the space between the control panel and the distributing panel. The upper flanges of these members are secured to control panel 4, as by screws 13, or by welding if the control panel is metallic. The lower flanges overlap the edges of distributing panel 3 adjacent the removable section 6 as shown in Fig. 4. This arrangement offers supporting means for the removable distributing panel section, as by channel 14 and screws 15, snap-on moldings 16 being used to conceal the screws. As shown in Figs. 1 and 4, the lower portions of the webs of channels 12 are generously perforated. The perforations should be at least ¼ inch in diameter and sufficient in number to render this portion of the channel at least 80% open. The filter-diffuser element 17 is retained in position between channels 12. This element is in the form of an interstitial body which has unbound edges which permit flow of air entering the face of the cartridge laterally from the edges as well as downwardly through the element. The multiplicity of passageways through this body are omnidirectional, that is, they extend in haphazard manner in every direction. Stops 18 limit upward movement of the filter-diffuser element. Stops 19 prevent sidewise movement and prevent by-passing of air around the element 17. The filter body is supported by apertured plate 20 which, in turn, is supported by removable section 6 by means of leaf springs 21. A suitable grid 22 of metal rods may be provided either as a part of the filter or as a permanent part of the apparatus to prevent bulging of the filter body upwardly. Where only small openings are provided in the control panel 4, it is necessary to maintain a space between the control panel and the filter-diffuser element, as shown, so that the air may enter the filter at all points upon the exposed surface thereof. Such spacing would not be required if the control panel opening area approaches that of the exposed face of the element.

Openings 23, Fig. 5, are provided in the control panel to permit passage of air from plenum chamber 1 downwardly into the filter-diffuser and means are provided for regulating the rate of flow of air through these openings. This control means may assume a variety of forms, the particular structure shown being of the sliding shutter type. Shutter plates 24 are provided with openings 25 corresponding to openings 23 in the control panel. A friction washer 26 is fastened to the control panel in register with a small central opening 27. Stem 28 of lever 29 passes through opening 27 and hole 30 in filter 17, the slotted lower end of stem 28 being available for adjustment from below. A screw driver may be inserted through a perforation of the distributing panel for this purpose. Pins 31 and 32 and links 33 cooperate with rotatable lever member 29 to slide shutters 24 in guides 34 to thereby control the flow of air through openings 23. Washers 35 and 36, spring retainer 37 and spring 38, all held in position on stem 28, operate to urge the cross portion of lever 29 against friction washer 26. The lever is thereby prevented from turning after adjustment of the shutters has been completed.

The particular filter-diffuser element 17 shown is composed of a number of superposed layers of expanded fibrous sheet material, coated with a suitable tacky substance, as disclosed in Walton Patent No. 2,070,073, dated February 9, 1937. Although the invention is not limited to the use of this particular form of filter-diffuser and other materials, such as spun glass or hair, serve the purposes of the invention, it is preferred because of its high filtering efficiency and because of the advantageous diffusing effect of the multiplicity of angularly disposed deflecting surfaces. Substantially all of the surfaces shown in the detailed view of the expanded fiber material (Fig. 7) are angularly disposed with respect to the general plane of the individual layers. This is indicated in the sectional view of Fig. 8. The numerous flat surfaces 39 form a multiplicity of baffles against which the air strikes and which tend to turn the air stream from its downward course. Air passing through the openings in the control panel is deflected and caused to flow horizontally through the perforations in channels 12, displacing the air immediately preceding it in the space between control panel 4 and distributing panel 3 and causing the air to move downwardly through the distributing panel evenly throughout the area thereof. A portion of the air is permitted to pass downwardly through the filter-diffuser and into the enclosure through panel section 6. If a filter element of spun glass, hair felt, or other similar material is used, perforation of supporting plate 20 should be restricted to provide an open area of less than about 10% of the total area to create an air cushion just above it in the element and cause the desired

portion of the air stream to turn from vertical to horizontal.

When the filter-diffuser element has trapped sufficient dirt to make its replacement desirable, snap-on moldings 16, screws 15 and channels 14 are dismantled and panel section 6 is lowered. The element may then be removed and cleaned or discarded and a fresh one substituted. The unit is then reassembled.

If air diffusion is desired without the filtering operation, expanded thin sheet metal may be used as well as the fibrous sheet material to form cartridge 17. In such case the expanded material should not be coated with a tacky substance. The mesh of the material should be sufficiently open to prevent clogging of the diffuser with dirt accumulating with extended use. This construction may be suitable where the air delivered to chamber 1 is substantially free of foreign materials. Obviously, frequent replacement is not required where a non-filtering diffuser is employed.

The air-conditioning apparatus used to supply ventilating air to plenum chamber 1 will ordinarily include an air filter. While this is not necessary when my filter-diffusers are used, it is desirable to remove the bulk of the dirt from the air by such primary filters to thereby render it unnecessary to change the filter-diffuser elements installed as part of the air-distributing apparatus as frequently as would be required if these secondary filters were used alone. A filter element approximately 19 inches long by 5 inches wide and 2 inches deep will serve a distributing panel approximately 8 feet long by 2 feet wide under ordinary railway ventilation practice. An opening approximately 3 inches by 17 inches or its equivalent may be provided across this panel and the cartridge arranged under it in the manner described. In architectural installations, where the volume of air per square foot of air distributor required may be less than in the railway car, a single unit of the above dimensions would be capable of serving a greater span. Due to the low resistance characteristics of the expanded sheet material type of filter, it is possible to handle a larger volume of air when this particular material is used than it is when the ordinary fiber filter is employed. Thus the employment of the particular type of filter shown in Figs. 6 to 8 results in efficient distribution of the air over the distributing panel with a minimum number of filter-diffusers for a particular enclosure.

A combined acoustical treatment and air distributor embodying the invention is shown in Fig. 9. The air-distributing construction, designated generally by the numeral 40, is suspended below ceiling 41 of the room by means of expaned web I-beams 42. Furring strips 43 are supported by beams 42 and, in turn, support flanged apertured members 44. These flanged members are conveniently formed from perforated sheet metal to simulate tiles. The flanges on the two ends of the members are adapted to be inserted between the spring legs of furring strips 43, suitable beads being provided to insure gripping of the flange by the furring strip. Sound-absorbing pads 45 are disposed on the apertured members, the edges of the pads abutting the flanges of the member. These pads are impervious to the passage of air. Fibrous sound-absorbing material, such as hair felt or shredded wood fibers having a wrapping of air-impervious, sound-transparent sheet material form suitable pads. Filter elements 46 are arranged on several apertured members instead of the sound-absorbing pad. For example, the apertured members marked "A" may carry filters while the remainder carry sound absorbing pads.

Ventilating air is supplied to the plenum chamber 48 from duct 47. This air enters the room through the filters and apertured members A. Since a large filter area is used, the ventilating air is thoroughly cleaned before entry into the room. The filters may readily be removed and replaced by drawing the supporting member downwardly and away from legs of the furring strips. The filters may be distributed in accordance with the air requirements within the room, larger volumes of air being supplied adjacent outside walls to compensate for heat losses through the wall and infiltration of air.

I claim:

1. In a ventilating system, an enclosure to be ventilated, means forming a plenum chamber extending superjacent said enclosure, the floor of said chamber having one or more openings therein, means for continuously supplying ventilating air to said chamber, and an interstitial body associated with each said opening in said floor of said chamber without said chamber, said body having connected lateral and vertical passages and being so arranged with respect to said floor of said chamber and so constructed that air from said chamber is caused to flow vertically into said body and at least a substantial portion is caused to pass laterally therefrom.

2. The construction of claim 1 in which said interstitial body comprises a body of filtering material.

3. In a ventilating system, an enclosure to be ventilated, means forming a plenum chamber extending superjacent said enclosure, the floor of said chamber having one or more openings therein, means for continuously supplying ventilating air to said chamber, an interstitial body associated with each said opening in said floor of said chamber without said chamber, said body having connected lateral and vertical passages and being so arranged with respect to said floor of said chamber and so constructed that air from said chamber is caused to flow vertically into said body and at least a substantial portion is caused to pass laterally therefrom, and a foraminous sheet-form member spaced inwardly from said floor of said chamber with respect to said enclosure and covering said interstitial body.

4. In a ventilating system, an enclosure to be ventilated, a partition of air-impervious material spaced from a wall or ceiling of said enclosure to form a chamber between said partition and said wall or ceiling, said partition having one or more openings therein, means for continuously supplying ventilating air to said chamber, a foraminous sheet-form member substantially coextensive with said partition and spaced inwardly thereof with respect to said enclosure, an interstitial body associated with each said opening in said partition and disposed between and spaced from both said partition and said foraminous member, and means for conducting air passing through each opening in said partition from said chamber into the associated interstitial body, said body having connected lateral and vertical passages whereby at least a portion of the air from said chamber flowing vertically into said body is caused to pass laterally therefrom.

5. In a ventilating system, an enclosure to be

ventilated, a partition of air-impervious material spaced from a wall or ceiling of said enclosure to form a chamber between said partition and said wall or ceiling, said partition having one or more openings therein, means for continuously supplying ventilating air to said chamber, means for controlling the rate of flow of air through said openings in said partition, a foraminous sheet-form member substantially coextensive with said partition and spaced inwardly thereof with respect to said enclosure, an interstitial body associated with each said opening in said partition and disposed between and spaced from both said partition and said foraminous member, said body having an area greater than that of the opening with which it is associated but substantially less than the area of said foraminous member, and means for conducting air passing through each opening in said partition from said chamber into the interstitial body associated with said opening, said body having connected lateral and vertical passages whereby at least a portion of the air from said chamber flowing vertically into said body is caused to pass laterally therefrom.

6. The construction of claim 5 in which said interstitial body comprises a body of filtering material.

7. In a ventilating system, an enclosure to be be ventilated, a partition of air-impervious material spaced from a wall or ceiling of said enclosure to form a chamber between said partition and said wall or ceiling, said partition having a plurality of distributed openings therein, means for continuously supplying ventilating air to said chamber, a filter cartridge having a multiplicity of omnidirectional intercommunicating passages therein and disposed without said chamber at each of said openings, means for confining the air from said chamber passing through said openings and conducting it into the contiguous filter cartridge, and a foraminous sheet-form member substantially coextensive with said partition and spaced inwardly therefrom with respect to said enclosure in the direction of air flow through said openings a distance sufficient to accommodate said filter cartridges between said partition and said foraminous member, said filter cartridge being so constructed that air may flow from the interior thereof laterally therefrom into the space between said partition and said foraminous member surrounding said cartridge.

8. In a ventilating system, an enclosure to be ventilated, a perforated distributing panel having an opening therein, said distributing panel being spaced below the ceiling of said enclosure, a control panel of air-impervious material spaced between said distributing panel and said ceiling, said control panel having an opening therein in register with said opening in said distributing panel, means for continuously supplying ventilating air to the space between said control panel and said ceiling, a panel section removably mounted in said opening in said distributing panel, a filter cartridge having a multiplicity of omnidirectional intercommunicating passages therein and disposed subjacent said opening in said control panel, air-pervious supporting means adapted to retain said cartridge in position and permit air entering said cartridge to pass laterally and downwardly from said cartridge, and means for confining the air passing through said opening in said control panel and causing it to enter said filter cartridge, said panel section and said supporting means being arranged to provide ready access to said filter cartridge whereby said cartridge is readily removable.

9. The construction of claim 8 in which the removable panel section is perforated.

10. The construction of claim 8 and including means associated with said opening in said control panel for regulating the rate of flow of air therethrough.

11. In a ventilating system for an enclosure having a ceiling, air-distributing apparatus comprising a plenum chamber extending subjacent said ceiling, a plurality of air-distributing units arranged in a plane to form at least a portion of the floor of said plenum chamber, and means for continuously supplying ventilating air to said plenum chamber, each of said units comprising a sheet-like control member having one or more openings therein, and adjustable valve means for controlling the rate of flow of air through said opening or openings in said control member, a perforated sheet-like distributing member spaced interiorly of said control member, a body of filtering material having a multiplicity of omnidirectional intercommunicating passages therein and arranged between said control member and said distributing member for diffusing and filtering the air passing from said plenum chamber through said opening or openings in said control member, said body of filtering material extending over only a portion of the area of said control member whereby air entering said body may flow from the interior thereof laterally therefrom into the space surrounding said filtering material, said valve means being adapted to be manipulated from within said enclosure.

12. In a ventilating system, an enclosure to be ventilated, a perforated distributing panel spaced interiorly from the ceiling of said enclosure, a control panel of air-impervious material spaced between said distributing panel and said ceiling, said control panel having an opening therein, means for continuously supplying ventilating air to the space between said control panel and said ceiling, means for controlling the rate of flow of air through said opening from said space between said control panel and said ceiling, and means for diffusing the air passing through said opening, said diffusing means comprising guide members depending from said control panel on opposed sides of said opening and having the lower portions thereof pervious to flowing air, and a body of superposed layers of expanded sheet material between said guide members and spaced below said control panel, said guide members and said body of expanded sheet material being so arranged that air passing through said opening is caused to pass into said body of expanded sheet material.

13. The construction of claim 12 in which said expanded sheet material is of fibrous composition and is coated with a tacky substance.

14. In a ventilating system, an enclosure to be ventilated, a partition of air-impervious material spaced from a wall or ceiling of said enclosure to form a chamber between said partition and said wall or ceiling, said partition having an opening therein, means for continuously supplying ventilating air to said chamber, a perforated panel substantially coextensive with said partition and spaced therefrom in the direction of air flow through said opening, and air-diffusing means associated with said opening and arranged between said partition and said perforated panel, said air-diffusing means compris-

ing a body composed of a plurality of layers of uncoated expanded sheet metal.

15. In a ventilating system for a railway car, air-distributing apparatus comprising a plurality of panel units arranged in a plane extending between the half deck portions of the car to form a plenum chamber within the clerestory thereof, and means for continuously supplying ventilating air to said plenum chamber, each of said units comprising a sheet-like control member having an opening therein, adjustable valve means for controlling the rate of flow of air through said opening in said control member, a perforated sheet-like distributing member spaced below said control member, means for filtering and diffusing air passing from said plenum chamber through said opening in said control member, said last-mentioned means being arranged between said control member and said distributing member and comprising a body composed of a plurality of layers of expanded sheet material associated with said opening in said control member.

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