

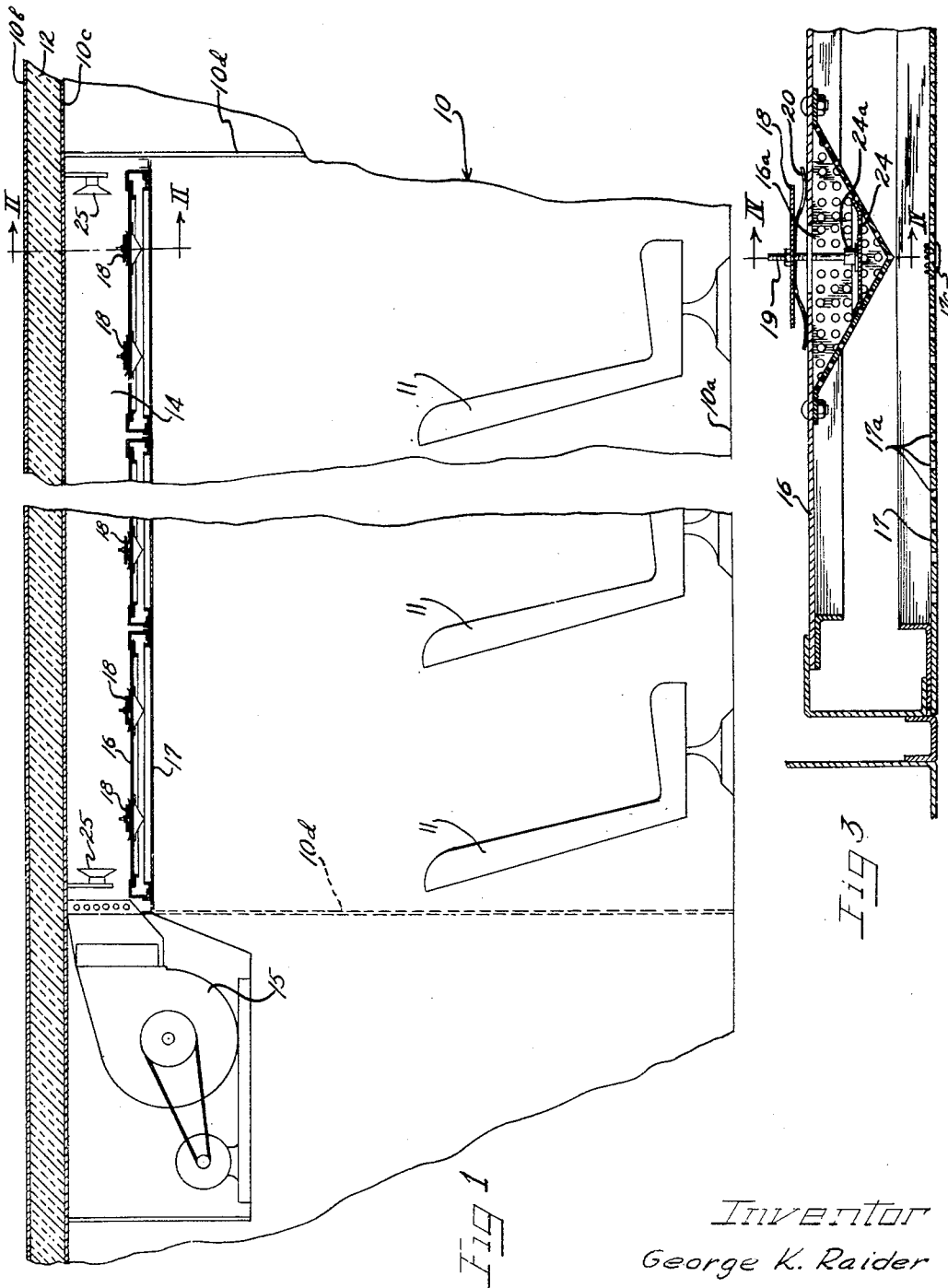
Jan. 1, 1952

G. K. RAIDER
SYSTEM FOR UNIFORM DISTRIBUTION OF
VENTILATING AIR AND SOUND ENERGY

2,580,835

Filed Jan. 26, 1948

2 SHEETS—SHEET 1



Inventor
George K. Raider

by The Firm of Charlesworths Attys

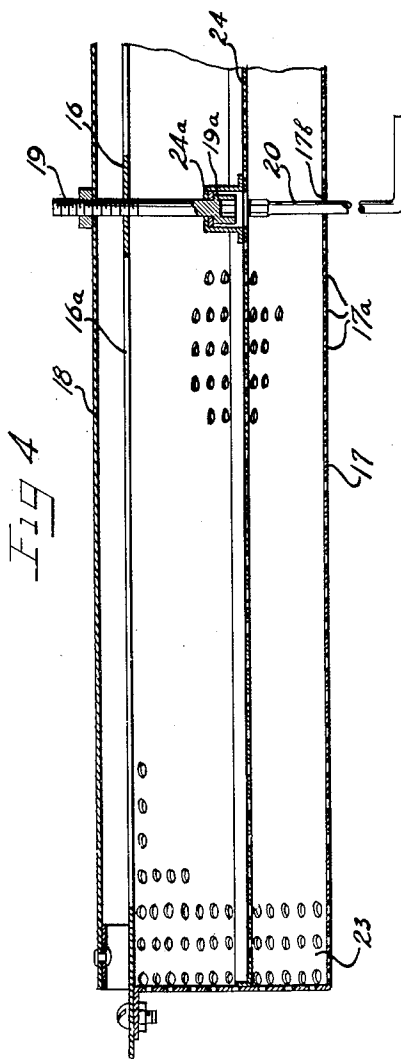
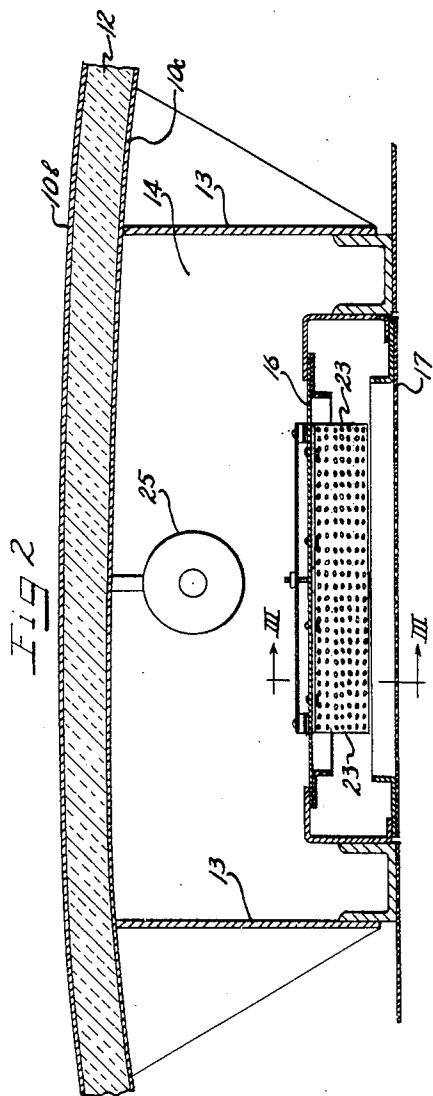
Jan. 1, 1952

G. K. RAIDER
SYSTEM FOR UNIFORM DISTRIBUTION OF
VENTILATING AIR AND SOUND ENERGY

2,580,835

Filed Jan. 26, 1948

2 SHEETS—SHEET 2



Inventor
George K. Raider

by The Firm of Characut & Co. Attys

UNITED STATES PATENT OFFICE

2,580,835

SYSTEM FOR UNIFORM DISTRIBUTION OF
VENTILATING AIR AND SOUND ENERGY

George K. Raider, Chicago, Ill., assignor to The
Pyle-National Company, Chicago, Ill., a corpo-
ration of New Jersey

Application January 26, 1948, Serial No. 4,368

1 Claim. (Cl. 181—30)

1

This invention relates to an improved acoustical arrangement for ventilated spaces, and particularly to a loudspeaker arrangement for a railway car or the like by which the uniform distribution of sound energy throughout the entire length of the car may be obtained with a minimum number of loudspeaker units.

It has only been in recent years that public address, radio and inter-car communication systems were introduced in railroad operations. Such systems necessarily required the incorporation of one or more loudspeakers in the railway car to transmit sound energy to the occupants of the car.

Due to the fact that this was a new innovation in railway passenger car travel, not too much thought was given to the matter of proper sound distribution and the first installation in passenger cars consisted of locating the speakers within the main body of the car, generally utilizing a speaker at each end of the car. With such an arrangement, an extremely poor distribution of sound energy throughout the car resulted. Those passengers seated near the ends of the car were subjected to discomfort due to excessive noise while the sound energy reaching those at the center of the car was barely at the audible level. In attempts to overcome this condition, additional speakers have been added at intermediate locations throughout the car length but always such speakers have been disposed within the body of the car and delivered their output to the car interior directly. For satisfactory sound energy distribution, it was found necessary to use, in general, from four to eight loudspeakers, depending on the quality of distribution desired. Such large number of loudspeakers not only substantially increased the installation cost but naturally the servicing costs also increased in direct proportion to the number of speakers used. Furthermore, by virtue of the fact that each of the speakers was mounted directly within the interior of the car, a modification of the interior walls of the car had to be accomplished to provide a recess for mounting such speakers, so as to maintain a uniform and attractive interior appearance.

While the above problem of proper sound distribution became particularly acute in railway car installations, those skilled in the art will recognize that the same problem has existed for many years in any large room area, such as auditoriums or assembly halls. In fact, in any room area sufficiently large to dispose one or more persons at substantially greater distances from a loudspeaker than the remainder of the occupants

2

of the room, the problem of proper sound distribution immediately arises.

In accordance with this invention, the problem of adequate sound distribution in railway cars or other large room areas has been very satisfactorily and economically solved by utilizing a certain form of ventilating arrangement for distributing the sound energy from one or more loudspeakers throughout the room area supplied by the ventilating system. In particular, this invention provides unusually desirable results when employed in conjunction with ventilating systems of the type disclosed in U. S. Patents Nos. 2,172,771 to Norris, 2,251,682 to Leadbetter and 2,304,628 to Damerel. In all of the ventilating arrangements disclosed in the above mentioned patents, the distribution of ventilating air throughout a room area, such as the interior of a railway car, is accomplished in such manner as to provide a substantially uniform flow of ventilating air throughout the entire room area and without producing any detectable drafts. By incorporating a loudspeaker in the path of the ventilating air stream, yet located exteriorly of the room area serviced by the ventilating system, this invention accomplishes a uniform distribution of sound energy throughout the room area and provides an adequate sound energy level throughout the entire room area with a much smaller number of loudspeaker units than has been heretofore possible.

Accordingly, it is an object of this invention to provide an improved loudspeaker arrangement for ventilated spaces, particularly for railway cars or similar room areas having ventilating arrangements for producing a uniform flow of ventilating air throughout the entire interior of the room area.

A particular object of this invention is to provide an improved loudspeaker arrangement for a railway car wherein the entire interior of the car may be supplied with a substantially uniform level of sound energy through the utilization of not more than two loudspeakers located in the plenum chamber of the ventilating system of the railway car.

The specific nature of this invention, as well as other objects and advantages thereof, will become apparent to those skilled in the art from the following detailed description, taken in conjunction with the annexed sheets of drawings which, by way of preferred example only, illustrate a preferred embodiment of the invention.

On the drawings:

Figure 1 is a partial, longitudinal vertical sec-

tional view of a railway car incorporating a loud-speaker arrangement embodying this invention.

Figure 2 is an enlarged scale transverse sectional view taken on the plane II—II of Figure 1.

Figure 3 is a still further enlarged sectional view taken on the plane III—III of Figure 2.

Figure 4 is a sectional view taken on the plane IV—IV of Figure 3.

As shown on the drawings:

While the drawings and the following description will refer to the installation of this invention in a railway car, it is to be distinctly understood that the invention is in no way limited to such specific application but may be equally well applied to any room area supplied by a ventilating system having certain characteristics as hereinafter set forth. Hence, the principle of this invention may be applied to auditoriums, assembly halls, theaters, private and commercial building structures, street cars, motor buses, etc.

Referring to Figure 1, there is shown a portion of a railway car 10 having a floor 10a and a roof 10b. A plurality of passenger seats 11 are arranged along the length of the car in conventional manner. The car 10 is provided with a well-known form of ventilating air distributing apparatus which forms the interior ceiling of the car illustrated. The car roof is of conventional double walled construction, having an inner wall 10c spaced from the exterior wall 10b and the space therebetween is filled with a suitable heat insulating material 12. A pair of transversely spaced, vertically disposed walls 13 are provided which cooperate with the interior roof wall 10c to define a ventilating distributing duct or plenum chamber 14 extending lengthwise of the car, just under the roof. If the car is provided with a clerestory, the duct 14 may be disposed in it. As is more fully described in the above referred to patent to Damerel, No. 2,304,628, the duct 14 defines a plenum chamber for a ventilating system for the interior of the car. Any suitable form of air pressuring means, such as a motor-driven blower 15, is mounted in the car with the outlet end thereof in communication with the duct or plenum chamber 14. Hence, the air in the plenum chamber is maintained at a slightly higher pressure than that existing in the interior of the car and tends to flow from the plenum chamber 14 into the interior of the car. It will be understood that the air supplied to the plenum chamber 14 may be heated or cooled by conventional apparatus according to the requirements of the outdoor temperature.

To uniformly distribute the ventilating air from the plenum chamber into the interior of the entire car, an air distributing unit is provided consisting essentially of a control panel 16 and distributing panel 17. The control panel 16 in effect defines the bottom wall of the duct or plenum chamber 14 and is provided with a plurality of longitudinally spaced transversely extending openings 16a through which air may flow downwardly from the distributing duct or plenum chamber 14 into the space between the panels 16 and 17. The rate of air flow is controlled by a valve plate or shutter 18, adjustable in vertical position relative to each opening 16a by means of a threaded shaft 19. Cradles 20 are provided on each end of the valve plates 19 and maintain a tension on the threaded spindle and prevent rattling of the valve plate 18. The bottom end of the spindle 19 is provided with an enlarged head 19a defining a socket-like recess which is accessible from the interior of the car

through a suitable aperture 17b in the distributing panel 17 to receive a correspondingly shaped head of an adjusting tool 20. Hence, each of the valve plates 18 along the length of the car may be adjusted in vertical position so as to provide a substantially uniform flow of air into the interior of the car along the entire length thereof, irrespective of the location of the motor-driven blower 15. Obviously, those openings 16a which are located closer to the discharge end of the motor of the blower 15 will have their effective passage area more reduced by the valve plates 18 than the openings 16a which are more remotely disposed.

Immediately beneath each of the openings 16a, a baffle device 23 is provided which operates to diffuse the stream of air passing downwardly from the distributing duct 14 through the opening 16a. The baffle 23 is of perforated construction having a plurality of apertures 23a therein, and is of triangular configuration in vertical cross-section. A perforated support plate 24 is supported horizontally within each baffle 23 and in turn mounts a bracket 24a through which the control rod 19 passes and against which the control rod head 19a abuts. The air distributing panels 17 are mounted in any convenient manner immediately beneath the control panels 16 and the baffles 23. The air distributing panels 17 are of perforated, sheet-like construction being provided with a large number of spaced perforations 17a. In addition, a large aperture 17a is provided in alignment with each control shaft 19 for access thereto and this opening is normally closed by a removable plug 17c (Figure 3). Hence, the controlled rate of flow of ventilating air through each of the openings 16a in the control panel 16 is further diffused by passage through the perforations 17a of the distributing panel 17.

The construction thus far described represents merely a well-known form of ventilating arrangement which has found wide application in railway cars and similar ventilated enclosures. In accordance with this invention, advantage is taken of the uniform air distributing characteristics of the aforescribed ventilating arrangement to produce a uniform distribution of sound energy throughout the interior of the space served by the ventilating arrangement with a minimum number of loudspeakers. In accordance with this invention, one or more loudspeaker units 25 are mounted within the plenum chamber or distributing duct 14 of the ventilating system. By so mounting the loudspeaker units, it has been found that the sound energy generated thereby is more uniformly transmitted throughout the entire area of the enclosure served by the ventilating system. This desirable result is undoubtedly primarily attributable to the fact that the sound energy produced by the loudspeaker is primarily transmitted to the interior of the car through the controlled area passages provided by the ventilating system. Hence, when a loudspeaker unit 25 is mounted adjacent one end of the car, for example adjacent one of the transverse bulkheads 10d customarily provided in railway car construction, there is a relatively small passage area for sound transmission through the control panel openings 16a which are located immediately adjacent that end of the car, as determined by the setting of the plates 18. Further along the length of the car, the effective area of the openings 16a, as determined by the setting of the plates 18, is

gradually increased so that proportionately more sound energy is transmitted through these openings although, of course, the intensity of the sound energy at such point will be reduced as a greater function of the distance from the one loudspeaker 25. But at such point there will also be a contribution in energy from the other loudspeaker. In any event, it will be found that the distribution of sound energy throughout the interior area served by the ventilating system is greatly improved. In the particular application of the loudspeaker arrangement to a railway car, it has been found that the mounting of a speaker at each end of the car, for example on or adjacent each of the two transverse bulkheads 10b, will provide a very satisfactory sound energy level throughout the entire interior of the car, so that all passengers may comfortably receive and comprehend the sound energy produced by the loudspeaker.

It should be further noted that the arrangement of the loudspeaker unit in the manner described has the further advantage of making the location of the loudspeaker practically impossible to detect by ear. This eliminates the normal tendency of the occupants of the car to stretch, strain, and look around in an attempt to locate the source of the sound reaching their ears. Furthermore, no special mounting arrangements are required for the loudspeaker and a much more economical loudspeaker construction may be utilized by virtue of the complete elimination of any fancy trappings or casings which have been heretofore required to conceal the loudspeaker when disposed in the interior of the car.

Accordingly, it will be apparent to those skilled in the art that this invention provides a greatly improved loudspeaker arrangement for ventilated spaces and, in the particular application to a railway car, will not only greatly reduce the initial installation cost of a loudspeaker system but will provide a more uniform distribution of sound energy throughout the car and provide the optimum in listener comfort.

It will, of course, be understood that various details of construction may be modified through a wide range without departing from principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claim.

I claim as my invention:

A system for the uniform distribution of ventilating air and sound energy throughout a space comprising, a space to be ventilated and to receive the transmission of an audible sound signal, a first duct means adjacent said space providing a primary plenum chamber, a second duct means between said first duct means and said space providing a plurality of secondary plenum chambers, blower means at one end of said first duct means providing a supply of pressurized ventilating air to one end of said primary plenum chamber, a first speaker unit in said primary plenum chamber adjacent said blower means to transmit an audible sound signal into the stream of pressurized air flowing from said blower means, adjustable control means between each of said secondary plenum chambers and said primary plenum chamber, each of said control means adjusted to provide an opening between said secondary plenum chambers and said primary plenum chamber of progressively increased relative size in relation to the distance each opening is removed from the blower means to flow air from said primary plenum chamber into said secondary plenum chambers at reduced velocity and pressure, a second speaker unit in said primary plenum chamber at the other end thereof to transmit a supplementary audible sound signal into the stream of pressurized air flowing through said openings, and passageways between each of said secondary plenum chambers and said space to permit air flow therebetween, whereby the supply of ventilating air and sound energy will be concurrently uniformly distributed throughout the space.

GEORGE K. RAIDER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,051,687	Clark	Jan. 28, 1913
1,823,479	Venderbush	Sept. 15, 1931
1,952,514	Selby	Mar. 27, 1934
2,017,153	Kellogg	Oct. 15, 1935
2,172,771	Norris	Sept. 12, 1939
2,218,212	Nassos	Oct. 15, 1940
2,251,682	Leadbetter	Aug. 5, 1941
2,304,628	Damerel	Dec. 8, 1942