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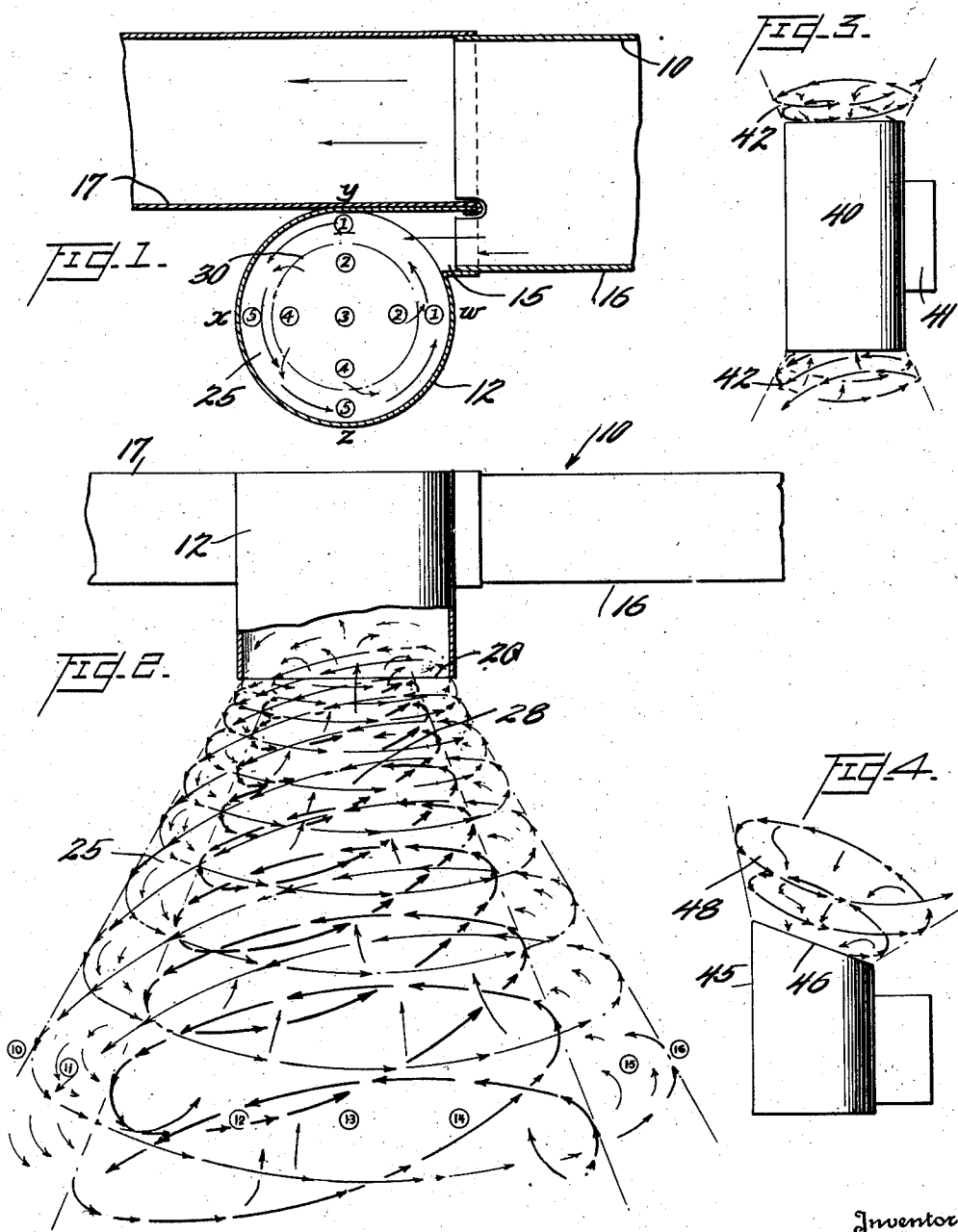
F. L. SLADE

2,296,314

DIFFUSER

Filed Aug. 3, 1940

5 Sheets-Sheet 1



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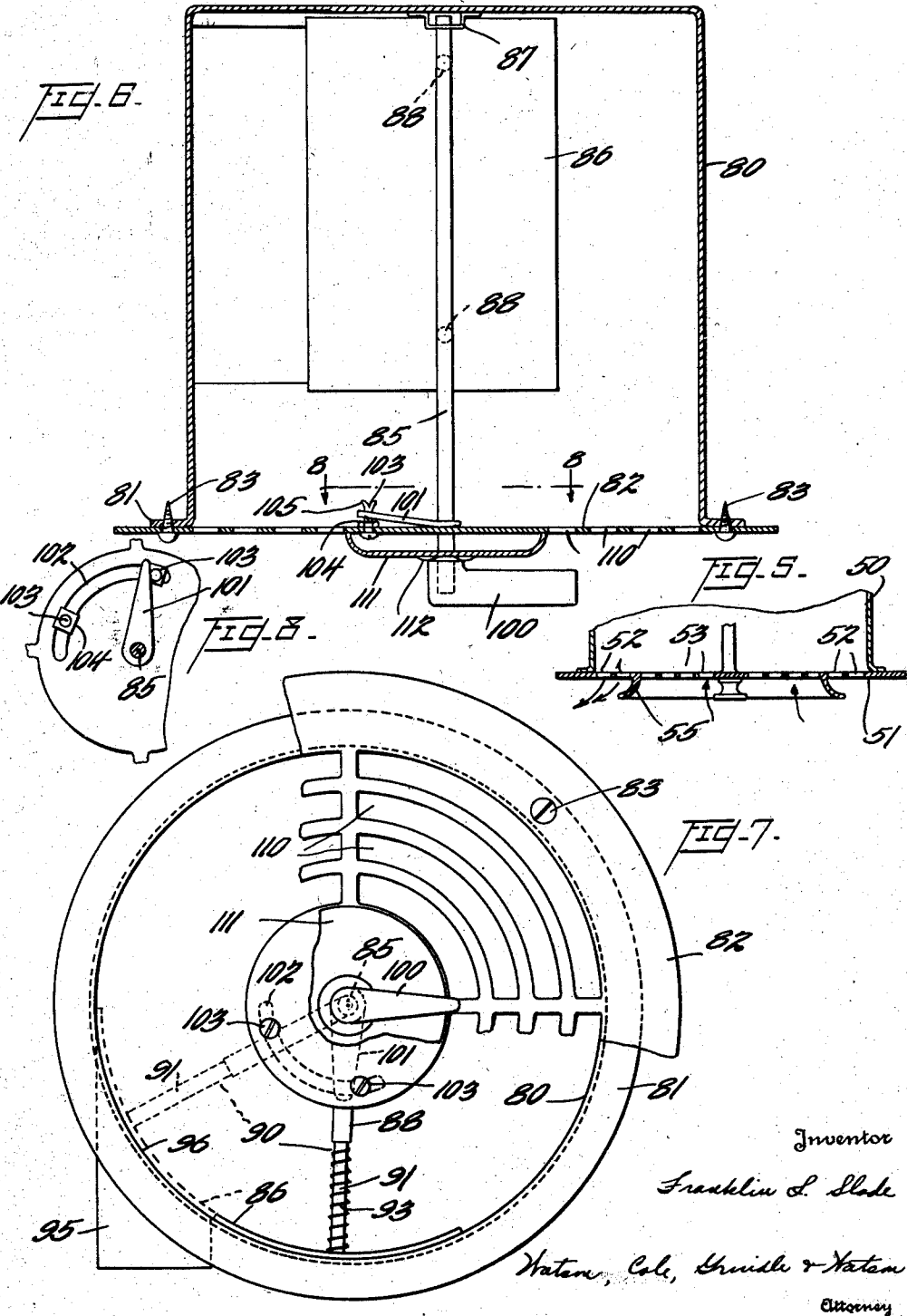
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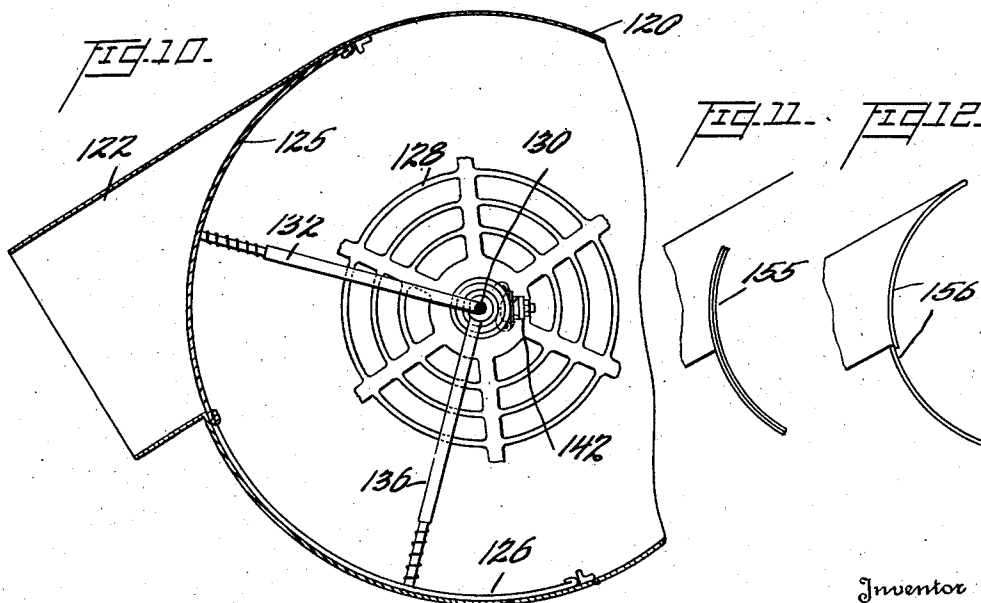
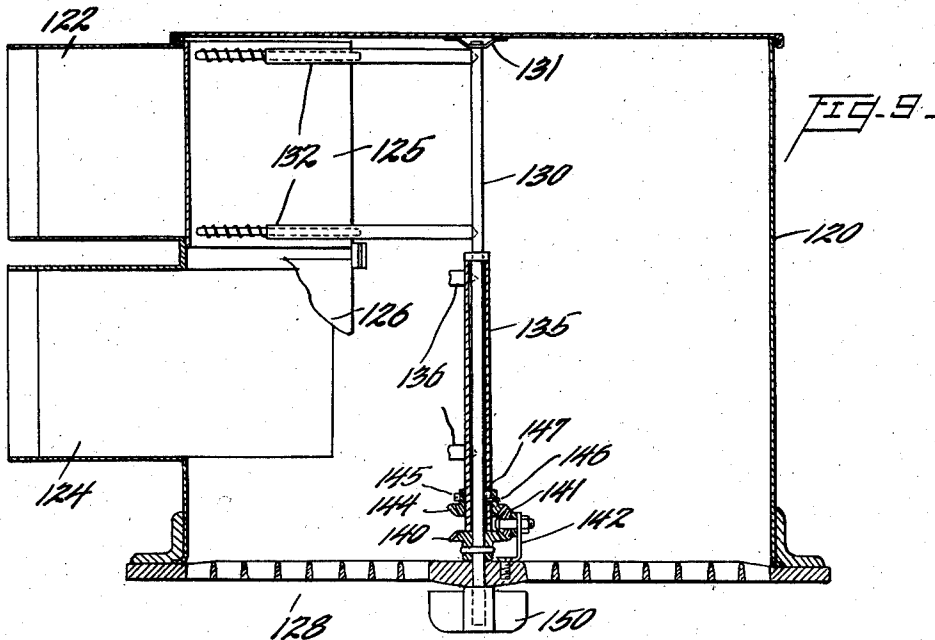
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5 Sheets-Sheet 3



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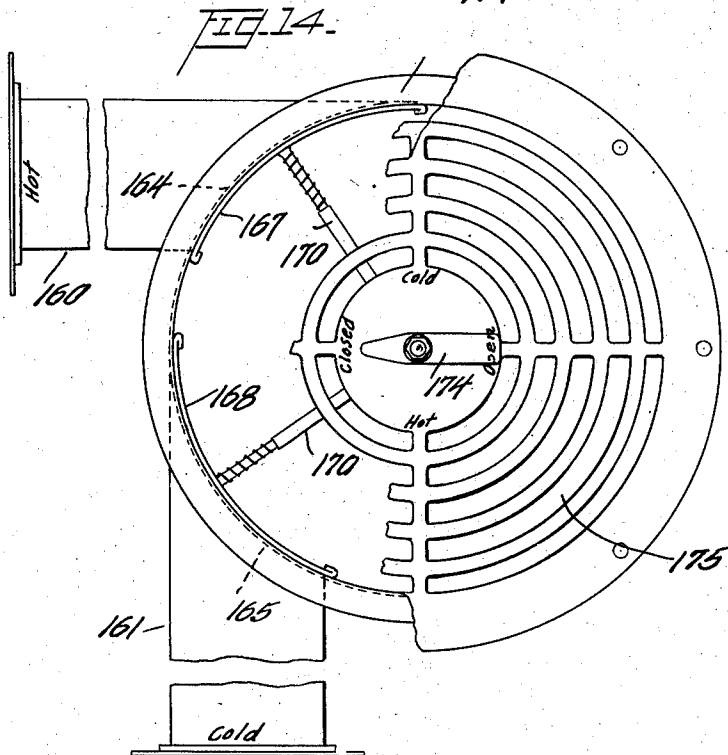
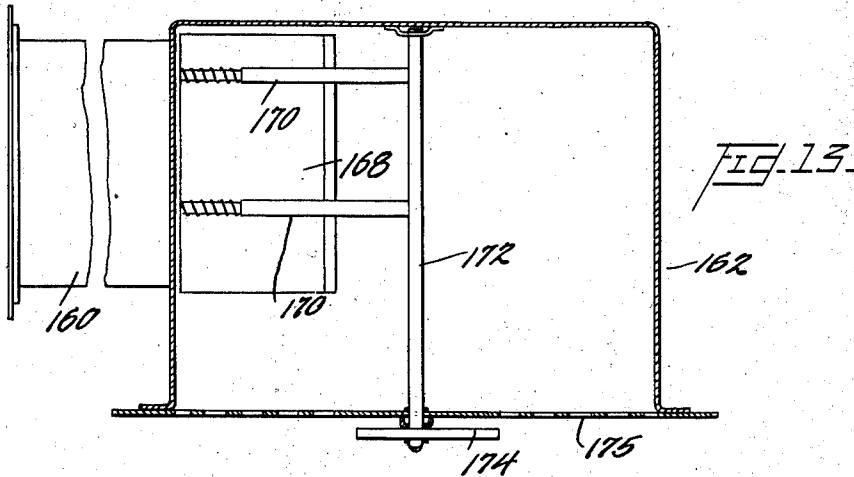
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5 Sheets-Sheet 4



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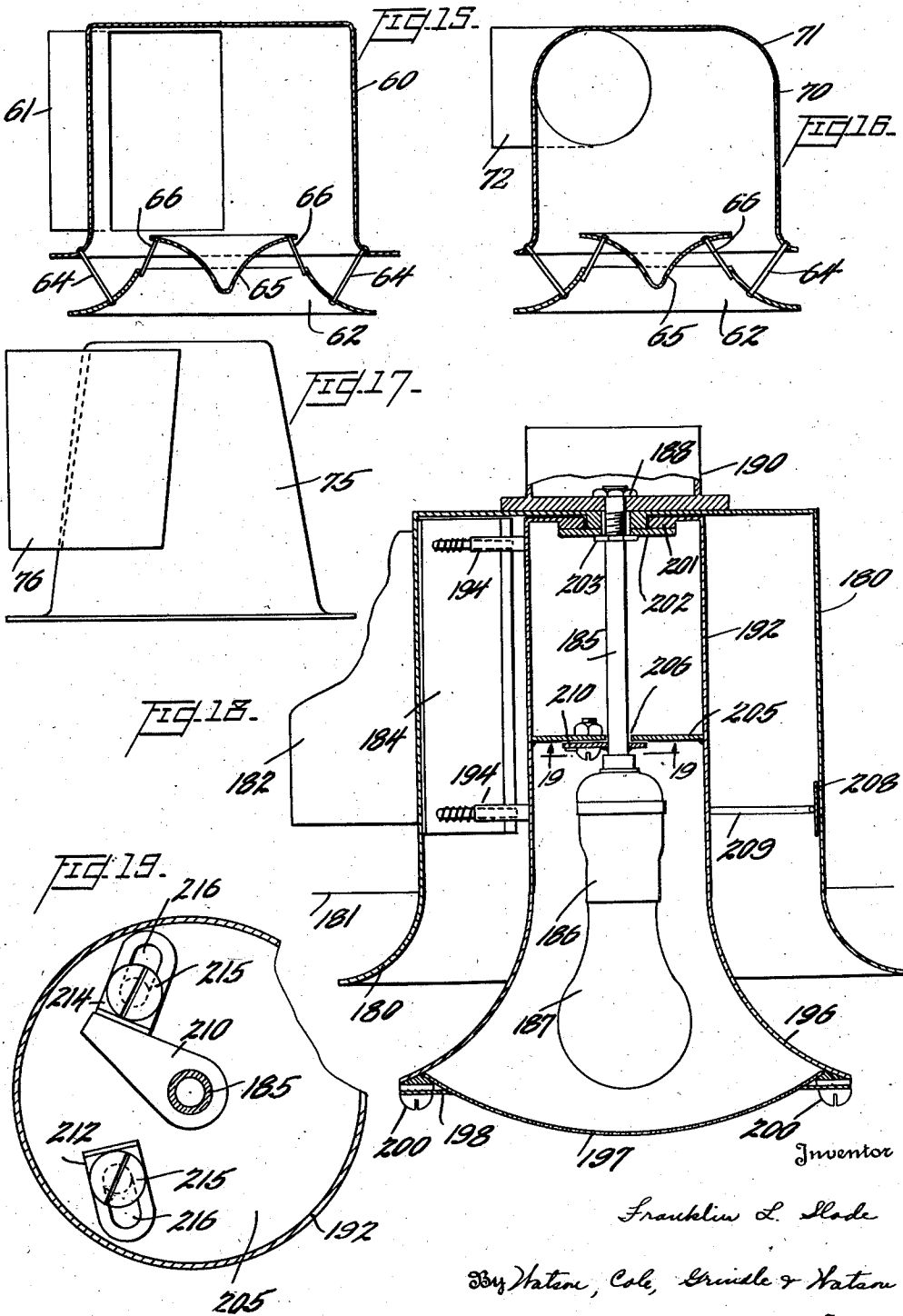
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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,296,314

DIFFUSER

Franklin L. Slade, Washington, D. C.

Application August 3, 1940, Serial No. 350,953

13 Claims. (Cl. 98—40)

The invention described herein may be manufactured and used by and for the United States Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to the art of ventilation and has more particularly to do with methods and apparatus for discharging or diffusing air or other conditioning gases or vapors into the ambient atmosphere of an enclosure, such as a marine vessel, a vehicle, or a room of a building.

The principal object of the invention is to provide new and improved devices and methods for the introduction and diffusion of ventilating or conditioning gases into the ambient medium, with such a control of the velocity and direction of flow of the introduced gas as to substantially reduce or eliminate noise and to obtain a thorough and rapid mixing and scrubbing effect without giving rise to undesirable drafts in the habitable portions of the enclosure being ventilated or conditioned.

Basically, the invention involves the discharging of a gaseous fluid into the ambient medium in such a way as to set up a return flow in the resulting mixture of ambient and introduced gases, whereby a proportion of these gases is returned into or adjacent the outlet orifice of the discharging or diffusing member or nozzle, and then re-discharged and recirculated in the enclosure, thus effecting a very efficient mixing or scrubbing action between the two fluids.

Prior proposals looking toward the attainment of similar effects have been made, but these have necessitated the provision of mechanical means such as a plurality of overlapped or perforated walls or vanes to provide a kind of injector device, and these expedients have not proved to be as efficient or as free from noise and drafts as the comparatively simple arrangements which characterize the present invention.

The fundamental provisions of the invention include a substantially cylindrical discharge or diffuser member into which the incoming ventilating or conditioning medium is introduced tangentially from the supply duct which traverses the building or other structure carrying the installation. This tangential introduction of the gas creates a whirling, constantly expanding, hollow, conical jet of fluid, which, due to the novel arrangement and proportioning of the device under the principles of the invention, sets up a vortex movement which of itself induces the efficient return flow and scrubbing action, with a substantial reduction in noise and draft, and

without the necessity of employing mechanical injector structure of any kind.

It is of course well known that certain fluids have been introduced into other ambient fluids by means of a whirling or rotary spray, notably by the means of sprinkling or spraying nozzles whereby a fluid in the liquid phase is discharged into an ambient gaseous fluid such as the atmosphere, as, for example, in the case of lawn sprinklers and the like. It has also been proposed to discharge a rotating stream of air into the atmosphere of an enclosure through a narrow elongated cylindrical outlet member, either at a relatively constant high velocity or at an increasing velocity through a continually contracting system; the only objective being to force the air into the chamber or enclosure in the form of an ordinary rotary jet, which is obviously of some slight advantage over a straight line introduction of the fluid. Such a proposal, however, indicates no conception of the principles of the present invention, nor does it involve the novel qualifications and structural limitations which the applicant has determined by much experimentation as being necessary in producing the effects described.

As will be developed in detail as the description proceeds, it is necessary in order to attain the return flow scrubbing effect by means of the whirling jet and the vortex produced thereby, that the outlet or distributor member, or diffuser be of a substantially continually expanding capacity, whereby the velocity of the jet diminishes from the main duct to the furthest point of travel of the cone of fluid projected into the chamber. This requires that the ratio of the height or length of the discharge cylinder to its diameter fall within a certain range; and preferably that the cross-sectional area of the inlet of the diffuser member bear a ratio to that of the outlet orifice thereof which will fall within certain limits. If the discharge cylinder is too long with respect to its diameter, the desired vortex will disappear (as, indeed, will the rotary flow itself if the length is inordinately increased) and if the length of the diffuser is too short, the air will "spill" over the rim of the diffuser before the whirling is effectively initiated.

If the normal outflow is unobstructed, the vortex will be formed within the mouth of the outlet orifice of the discharge member or diffuser, and the velocity of the air as measured across any diameter of the orifice will be at a maximum adjacent the periphery where an annular outflow section is observed; then at the inner margin of

this annular section, a point of zero velocity is found; and within this circle of zero velocity, the velocity of air within the plane of the orifice is found to be negative, i. e., an aspiration of air from the enclosure is taking place. This inwardly moving air is mixed with the treating air from the supply duct and is again discharged through the annular peripheral portion of the orifice.

The invention in its preferred form contemplates the provision of a cylindrical discharge element having an inlet connection of either constant or increasing rectangular cross section; but within the broad scope of the invention may be included discharge elements of somewhat frusto-conical shape, or those having round bottom portions; and the inlet sections may also be of circular or elliptical cross section.

By positioning certain diverting elements at the circle of zero velocity adjacent the plane of the orifice, certain variant effects in the direction of flow of the introduced air may be attained without destroying the vortex and aspirated return flow, and these features are also comprised within the scope of the invention.

Another object of the invention is to provide in the diffuser members, novel control dampers and operating means therefor, certain embodiments employing two or more dampers permitting the mixing of a plurality of different treating media in a single diffuser.

Other objects of the invention include the provision of diffusers having inclined outlet orifices, and others having outlet orifices at both ends of the cylinder; and also various combinations of the diffuser members with lighting fixtures whereby not only an improved ornamental effect is attained, but also certain structural, functional, and utilitarian features result.

Other objects and features of novelty will be apparent from the following specification when read in connection with the accompanying drawings in which certain embodiments of the invention are illustrated by way of example.

The present application is a continuation-in-part of my copending application Serial No. 204,636, filed April 27, 1938.

In the drawings:

Figure 1 is a view in horizontal cross-section of a portion of a ventilating duct with a simple form of outlet member or diffuser embodying the principles of the invention, attached thereto;

Figure 2 is a view in side elevation of the same structure;

Figure 3 is a view in side elevation of a double-ended diffuser;

Figure 4 is a similar view of a diffuser having an inclined outlet orifice;

Figure 5 is a fragmentary view in vertical section of the outlet end of a diffuser showing a grille having a diverting blade attached thereto;

Figure 6 is a view in vertical section of a diffuser of the practical commercial form having a damper of novel type applied thereto;

Figure 7 is a bottom plan view of the diffuser shown in Figure 6, with a portion of the outlet grille broken away;

Figure 8 is a fragmentary sectional view taken substantially on line 2-2 of Figure 6;

Figure 9 is a vertical sectional view through a diffuser member having two inlets and associated damper controls;

Figure 10 is a fragmentary horizontal sectional view of the diffuser shown in Figure 9;

Figures 11 and 12 are diagrammatic fragmen-

tary views similar to Figure 10 but showing adjusted positions of the two dampers;

Figure 13 is a vertical sectional view of a diffuser having a plurality of inlets occupying different planes;

Figure 14 is a bottom plan view of the same device with a portion of the outlet grille broken away;

Figures 15 and 16 are vertical sectional views showing modified forms of diffuser cylinder, and outlet vanes;

Figure 17 is a view in side elevation of a diffuser having a frusto-conical body portion;

Figure 18 is a vertical sectional view showing a diffuser in which a lighting fixture and damper control are combined; and

Figure 19 is a fragmentary sectional view taken on line 19-19 of Figure 18.

Referring now more particularly to Figures 1 and 2 of the drawings, in which an elementary form of the invention is illustrated, it will be seen that the supply duct is indicated generally by the reference numeral 10. The discharge or diffuser member attached to the duct is designated 12 and is provided with the short, tangentially disposed inlet conduit 15. In this embodiment the inlet conduit is of a rectangular cross-section and is secured to the supply conduit 10 at the junction of the larger portion 16 and the continuing portion 17 of diminished section and capacity. The duct 10 is of the velocity type, but a plenum type of supply duct may be employed if desired. The inlet section 15 is attached to the duct and aligned with the duct in such a manner that a portion of the air flowing through the duct is cut off from the main flow of air and caused to flow in a direction parallel to the main flow in the duct and thereby diverted into the cylindrical part of the diffuser tangentially thereto so as to set up a spiral whirling or rotation of the air within the diffuser. The remaining air flowing through the supply duct 10 continues through the section 17 to the next point of take-off whereupon another portion of the delivered gas is passed tangentially into the next diffuser along the line, with a corresponding diminution of dimensions of the supply duct.

The delivered air or gas rotates helically about the interior of the diffuser 12 and passes outwardly of the circular orifice 20 of the diffuser in the form of a constantly expanding cone of rotating gas of continually diminishing velocity. The outgoing cone of gas is indicated diagrammatically at 25 in Figure 2 of the drawings and the section of the diffusing jet of gas is indicated by the same reference numeral in Figure 1.

The whirling cone of delivered gas sets up a vortex within the interior thereof which results in the creation of an aspirating effect which causes a return flow of the ambient medium of the enclosure into the central portion of the orifice 20. This central area of return flow is indicated generally by the reference numeral 25.

As indicated in Figure 1, there is formed between the annular outflow jet 25 and the central section of reverse flow, a neutral circle 30 at which the gases are at substantially zero velocity. Outwardly of this circle the newly introduced gases and the recirculated gases are being discharged in the expanding hollow cone, and within this neutral circle the introduced gases and aspirated portions of the surrounding medium are being returned toward the outflow orifice.

Although the general direction of flow of the

various currents of gas set up by the diffuser are diagrammatically indicated in the drawings, possibly a clearer understanding of the novel effect of this mode of discharge or diffusion may be obtained from the following tabulation of velocity readings which are referable to certain numbered points on the figures of drawing, this tabulation representing a test of one commercial form of the invention selected at random. Along the diameter WX at the orifice plane 20 of the diffuser 12, are the stations 1, 2, 3, 4, and 5. Similarly, along the diameter YZ are correspondingly disposed stations 1, 2, 3, 4, and 5; station 3 being common to both diameters. The tabulation shows the velometer readings at different points, a positive reading indicating outflow of gas and a negative reading the inflow. The values given are in feet per minute.

Velometer readings at terminal face of diffuser; inlet velocity 1890 F. P. M.

Stations	Diameter WX	Diameter YZ
1-----	+1750	+1750
2-----	-600	-550
3-----	-550	-500
4-----	-600	-600
5-----	+1850	+1800

The condition of the gases within the room or enclosure adjacent the diffuser may be determined from the following tabulation in which similar average velometer readings are given for the test stations 10-16 inclusive as shown in Figure 2 of the drawings. The test stations were selected at approximately two and one-half feet from the orifice 20, stations 12 and 14 being directly below the margins of the diffuser; stations 11 and 15 being at somewhat less than 30° angles from the adjacent stations 12 and 14 respectively; and stations 10 and 16 being just outside of the 30° line.

Average velometer readings at points spaced from outlet of diffuser

10-----	0
11-----	+150
12-----	-45
13-----	-50
14-----	-45
15-----	+150
16-----	0

As indicated, these values represent average readings and may fluctuate between reasonable limits, but they clearly follow the pattern suggested by the description and the illustrations.

It has been found by extensive experimentation that in order to attain this return flow effect and its consequent valuable scrubbing action between the introduced gas and the ambient fluid, with a minimum of noise and draft, the entire discharge system from the mouth of the inlet member 15 to the point of furthest movement of the introduced air should be of expanding "taper," that is, the velocity of the fluid should diminish continually with a corresponding expansion in the volume or capacity of the system. It has been determined that the physical characteristics of the diffuser, in order to attain this result, should fall within the following limits. The optimum ratios of outlet area of the cylinder orifice 20 to the area of the inlet section 15 should be between 3:1 and 5:1. Also, the optimum ratio of length of the diffuser 12

to its diameter should lie between 0.75:1 and 2:1, and this ratio should never exceed 3:1.

The deleterious effects of exceeding the upper and lower limits of these ratios may be explained as follows. When the proper "taper" of the diffuser system is upset by the provision of a too shallow cylinder, the tangentially introduced gas will "spill" over the margins of the outlet orifice 20 between the points Y and Z, in the counterclockwise direction as viewed in Figure 1, before the proper whirl or helical rotation within the diffuser is attained. This, of course, will destroy the vortex and aspirating effect. If the ratio of the outlet area to the inlet area is too small, the outlet velocity will be too high, and the only result will be the introduction of the gas into the ambient fluid in the form of a narrow whirling substantially solid cone; and if the height or length of the diffuser is too great with respect to the diameter, the whirling effect will be lessened and if the length were continued to an excessive degree, this effect would finally disappear and a straight longitudinal flow of air would result.

The principles of the invention which involve the mixing effect just described, may be embodied in various modifications, one of which is shown in a somewhat elementary form in Figure 3 of the drawings in which the diffuser cylinder 40, fed by the inlet section 41, is open at both ends in order to provide two discharge cones 42 at either end of the device. It will be immediately apparent that in the case of this double-orificed cylinder, the best ratios of length to diameter will be approximately double those already stated in connection with the single outlet embodiments. It is obvious that in all of the embodiments illustrated and described, the direction of discharge may be upwardly, downwardly, or horizontally in any direction, according to the nature of the enclosure and the particular effect desired.

In Figure 4 of the drawings, there is illustrated a diffuser cylinder 45 in which the orifice plane 46 is inclined with respect to the axis of the diffuser, with the result that an inclined discharge cone and vortex indicated at 48 is formed.

By the provision of suitably shaped and positioned baffles or vanes, the expanding discharge cone may be altered in order to widen it and flare the stream of introduced fluid toward a plane parallel with the outlet plane. For example, it may be desirable, when the diffuser is positioned in the ceiling of a room and directed downwardly, to prevent too great a penetration of the habitable portions of the room by the discharge cone or air. In Figure 5 of the drawings the outlet end of a diffuser 50 is shown provided with a perforated grille 51 having marginal openings 52 through which the delivery cone passes and a plurality of inner openings 53 for the return flow of gases. At the circle of zero velocity between the discharging and returning gases, an outwardly flared vane or baffle 55 is secured to the grille 51, or made integral therewith. This curved baffle tends to flare or widen the cone of discharging gases as indicated by the arrows, without disturbing the aspirating effect of the arrangement at all. It will be understood that the arrows in Figure 5, and also in certain of the other figures, indicate the general direction of flow of the bodies of fluid which, however, have a rotating or circular movement within themselves.

In Figures 15 and 16 of the drawings, other

modifications of the diffuser are shown which also employ baffles such as indicated in Figure 5. In Figure 15, a cylindrical diffuser body 60 is illustrated, having an inlet passageway 61 of rectangular cross-section. The flared vane 62 has the same general effect on the flow of introduced fluid as the vane 55 in Figure 5. This device is not provided with a grille, however, and the vane 62 is secured to the body 60 of the diffuser as by means of the rods or bolts 64. Conical baffle 65 is secured to the baffle 62 as by means of the supports 66 and is so shaped as to conform approximately to the natural lines of flow of the returning or aspirated fluid. The baffle 65 is designed, however, to aid in streamlining the return flow and prevent the accidental formation of eddy currents, and may also be so positioned as to prevent the return of the fluids to a very great extent into the mouth of the diffuser.

In Figure 16 of the drawings the cylindrical shape of the diffuser 70 is modified to some extent to form a bowl like or rounded bottom portion 71, and the inlet connection 72 is of circular cross-section conforming generally to the curvature of the portion 71. Otherwise the outlet structure is exactly the same as that shown in Figure 15.

As heretofore suggested, the shape of the diffuser body need not be exactly cylindrical, and the frusto-conical shape of the diffuser shown at 75 in Figure 17 of the drawings conforms more nearly to the theoretical, constant expansion or "taper" of the diffusing system. This diffuser is fed by an inlet connection 76 which is, of course, shaped to conform to the surface of the diffuser body.

In order to control the flow of gas introduced into the diffuser, suitable damper arrangements are provided. One eminently satisfactory embodiment of this control means is illustrated in Figures 6, 7, and 8 of the drawings. The diffuser body in this case is indicated by the numeral 80, and, for convenience in manufacture, may be pressed from a single sheet of metal. The margin of the diffuser is flanged as at 81 and a stamped grille 82 may be secured thereto as by means of the screws 83. Centrally of the grille 83 there is provided an opening through which the control shaft 85 for the arcuate damper plate 86 may pass. The inner end of the shaft 85 is rotatably secured within the perforated saddle bearing strip 87. Extending from spaced points along the inner portion of the shaft 85 are the tubular portions 88 of the telescoping strut members 90. These members also include the rods 91 which are received within the tubes 88 and have their outer ends rigidly secured to the damper plate 86. A coil spring 93 extends between the damper and the end of the tubular member 88 in order to urge the struts 90 toward extended position and press the damper plate 86 firmly against the inner surface of the diffuser. The inlet section 95 of the diffuser is arranged tangentially and forms with the surface of the member 80 a rectangular opening 96. The area of the damper 86 is, of course, sufficient to overlap the margins of this opening.

Upon the outer end of the control shaft 85 there is secured a handle 100 for rotating the damper element. Within the confines of the grille 82 there is rigidly secured to the shaft 85 a radial arm 101 which is designed to cooperate with stop elements secured to the grille 82 in order to limit the movement of the damper in 75

either direction. The central portion of the grille 82 is provided with an arcuate slot 102 as most clearly shown in Figure 8 of the drawings, and at the proper points along this slot are secured the bolts 103 as by means of the nuts 104. The inwardly extending shanks 105 of the bolts extend across the plane of rotation of the arm 101 and prevent its movement beyond the points at which the stops are secured. The stop members are so positioned as to permit the damper to swing from the open position shown in solid lines in Figure 7 of the drawings to the closed position indicated in dotted lines.

The grille 82 in this embodiment is provided with a plurality of openings 110 through which the fluids may pass in their inward and outward directions as heretofore described. The central solid portion of the grille is provided with a cover plate or a cap 111 and a spring washer 112 is disposed between this cap and the handle portion 100. By means of this damper element, the flow of fluid may be entirely cut off, or any degree of opening provided.

In some cases it is desirable to supply a plurality of fluids to an enclosure, these fluids having different properties as relate to temperature, humidity, etc., and in Figures 9-14 of the drawings there are illustrated certain embodiments of the invention including provisions for the introduction of gases from two different sources and having different properties, into a single diffuser or outlet arrangement.

In the embodiment illustrated in Figures 9-12 inclusive an outlet structure is provided for attachment to superposed ducts, the diffuser body 120 being provided with tangential inlet connections 122 and 124, both having openings upon the same side of the diffuser body and being provided with dampers designated, respectively, by the numerals 125 and 126. A grille 128 is applied to the outlet orifice of the diffuser 120 and passing axially therethrough is the control shaft 130 which has a bearing 131 for its inner end. A pair of struts 132, corresponding exactly in construction and function to those illustrated at 90 in Figures 6 and 7 of the drawings, are provided adjacent the inner end of the control shaft 130. Surrounding the shaft 130 is the tubular shaft 135 which extends for approximately half the length of shaft 130. Struts 136 similar to those shown at 132 extend from this tubular shaft 135 to the damper 126.

Pinned to the shaft 130 adjacent its outer end, is the bevel gear 140 which is continually in mesh with the bevel pinion 141 which is carried by the bracket 142 secured to the grille 128. Another bevel gear 144 is adjustably secured to the tubular shaft 135 as by means of the set screw 145. Relative rotation of the tubular member 135 and the gear 144 is prevented, by means of the pin 146 secured to the gear 144 and working in the slot provided in the tubular shaft 135, when the set screw 145 is released for the purpose of sliding the gear 144 along the tubular shaft 135 in order to adjust the relative positions of gears 140, 141, and 144. Any desired initial relative setting of the two dampers 125 and 126 may be attained by the adjustment of the gear 144 with relation to the stationarily supported gear 141 by means of the adjusting devices just described, and it is obvious, by manipulation of the handle 150 secured to the end of the operating shaft 130, that the two dampers will be moved in opposite directions relative to each other so that when one damper is fully opened the other damper

will be completely closed, and any intermediate proportioning of flow through the two inlet ducts between these extreme positions can be attained. In Figure 10 of the drawings the damper 126 is shown in its open position and the other damper 125 is closing the inlet conduit 122. In the somewhat diagrammatic Figure 11 of the drawings, both dampers are at an intermediate position 155 in which the flow may occur through both of the inlet conduits. Figure 12 illustrates a position 156 in which both dampers are closed. This position may be attained by a suitable relative adjustment of the controlling shafts.

In the embodiment illustrated in Figure 13 of the drawings, the two supply ducts for the different introduced fluids are disposed in the same plane and the inlet conduits 160 and 161 are applied to the diffuser 162 at different angles as shown in Figure 14. The openings 164 and 165 from these conduits into the diffuser 162 are spaced peripherally of the surface of the diffuser and are controlled by the dampers 167 and 168 which are fixed in their relative positions since the telescoping spring pressed struts 170 are rigidly secured to the control shaft 172. The control shaft is operated by means of a handle 174 and passes through the outlet grille 175 in the usual way. Both dampers are shown in closed position in Figure 14 and it is obvious that by rotating the handle 174 in a clockwise direction as seen in Figure 14, the opening 165 from the duct 161 will be uncovered and the damper 167 will move from the opening 164 in the duct 160. When the rotation is continued so that the damper 168 closes the duct 160, flow will occur from the duct 161. Further rotation of the combined dampers will open both ducts for an equal mixture of the two fluids. Still further movement in the same direction will cause the damper 167 to close the duct 161 and the duct 160 will be supplying the fluid to the diffuser. By adjustment to suitable intermediate positions a desired proportion of the two fluids may be attained.

Certain embodiments of the invention may be combined with lighting fixtures and novel adaptations of the control means for the diffuser for this purpose may be arranged. In Figures 18 and 19 of the drawings, an embodiment is illustrated in which the diffuser 180 is set into the ceiling of an enclosure which is indicated at 181. An inlet duct 182 supplies fluid to the diffuser and the inlet opening is controlled by means of the damper 184. Disposed centrally of the diffuser is a tubular rod or pipe 185 upon the outer end of which is carried an electrical socket 186 into which a light bulb 187 may be placed. The pipe 185 is rigidly secured to the base of the diffuser 180 as by means of the nut 188, and may also serve to hold the diffuser 180 in its position by securing it to the outlet box 190. A tubular member 192 is disposed axially of the diffuser 180 and carries the spring pressed extensible struts 194 which support and operate the damper 184. This tubular member is flared at its outer end as shown at 196 and is provided with a translucent globe 197 which is secured in position as by means of a bezel or ring 198 held in place by the screws 200. The inner end of the member 192 is provided with an inwardly directed flange 201 which is supported by means of the washer 202 held in place by the nut 203 which is applied to the rod 185. The member 192 is centered with respect to the rod or shaft 185 by means of the disc 205 which is provided with an opening 206 through which the rod passes. The mem-

ber 192 may be further centered with respect to the diffuser body 180 by means of the shoe 208 carried by the rod 209. This shoe moves along the inner surface of the member 180 and serves to balance the pressure of the damper 184.

Obviously the rotation of the light casing 192, 196, 197, serves to adjust the damper 184 and a limiting device is provided for stopping the rotation at its fully opened and closed positions. As more clearly shown in Figure 19 of the drawings, an arm 210 is secured to and extends radially from the rod 185, and adjustably secured to the disc 205 carried by the member 186 are the angle brackets 212 and 214, which are fastened to the disc 205 by means of the bolts 215. The slots 216 permit of a limited adjustment of these stop brackets 212 and 214 for determining the fully open and fully closed positions of rotation of the combined light fixture and damper control.

It is understood that various changes and alterations may be made in the embodiments illustrated and described herein without departing from the scope of the invention as defined in the following claims. It is also understood that the terms "gas," "air," and "gaseous medium" are used interchangeably and are intended to include vapors within their scope.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a ventilation system, an outlet structure for distributing air or other gaseous fluid into an enclosure with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a cylindrical member having a free and unobstructed open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the perimeter of said cylindrical member, and communicating therewith, said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, all whereby the fluid is caused to swirl within said cylindrical member and to flow from said discharge orifice in a spirally conical form for a predetermined distance, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to again join the continued substantially conical flow of introduced fluid.

2. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a hollow substantially cylindrical member having an open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter, said cylindrical member being of a length equal to from three-quarters to two times its diameter, and the cross-sectional area of the said outlet orifice being from three to five times that of the inlet end of the inlet conduit, and there being no diminution of cross-section within the structure from the last named point toward the outlet orifice, all whereby the fluid is caused to swirl within the substantially cylindrical member and to flow from said discharge orifice in an expanding spirally conical form for a distance from said orifice, and a portion of said flow and of the ambient medium being automatically diverted inwardly toward the

center of the cone and back toward said discharge orifice to again join the continued substantially conical flow of introduced fluid.

3. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a hollow substantially cylindrical member having open ends comprising the discharge orifices of the structure, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter, the double-orificed cylindrical discharge member being of a length equal to from one and one-half to four times its diameter, and there being no diminution of cross-section within the structure from the last named point toward the outlet orifices, all whereby the fluid is caused to swirl within the substantially cylindrical member and to flow from said discharge orifices in an expanding spirally conical form for a distance from said orifices, and a portion of said flow and of the ambient medium being automatically diverted inwardly toward the center of each cone and back toward the corresponding discharge orifice to again join the continued substantially conical flow of introduced fluid.

4. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, said inlet conduit being of circular cross-section, a hollow substantially cylindrical member having a closed end, and an open end comprising the discharge orifice of the structure, the corners adjacent the closed ends of said substantially cylindrical member being rounded to correspond to the radius of curvature of said inlet conduit, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter at said rounded corner, said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, and there being no diminution of cross-section within the structure from said inlet end toward the outlet orifice, all whereby the fluid is caused to swirl within the substantially cylindrical member and to flow from said discharge orifice in an expanding spirally conical form for a distance from said orifice, and a portion of said flow and of the ambient medium being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to again join the continued substantially conical flow of introduced fluid.

5. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a hollow substantially cylindrical member having an open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter, said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, and there being no diminution of cross-section within the structure from said inlet end point toward the outlet orifice, all whereby the

fluid is caused to swirl within the substantially cylindrical member and to flow from said discharge orifice in an expanding spirally conical form having an annular cross-section lying adjacent the periphery of the outlet orifice, and a portion of said flow and of the ambient medium being automatically aspirated inwardly of said orifice within the discharge cone to rejoin the outward substantially conical flow of introduced fluid, thus providing a circle of zero velocity between the discharge and aspiration zones of said orifice, and an outwardly flared annular vane carried by said cylindrical member and disposed at said circle of zero velocity for flattening and broadening said cone of discharged fluid without interfering with the described aspiration phenomenon.

6. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a hollow substantially cylindrical member having an open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter, said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, and there being no diminution of cross-section within the structure from the last named point toward the outlet orifice, all whereby the fluid is caused to swirl within the substantially cylindrical member and to flow from said discharge orifice in an expanding spirally conical form having an annular cross-section lying adjacent the periphery of the outlet orifice, and a portion of said flow and of the ambient medium being automatically aspirated inwardly of said orifice within the discharge cone, thus providing a circle of zero velocity between the discharge and aspiration zones of said orifice, an outwardly flared annular vane carried by said cylindrical member and disposed at said circle of zero velocity for flattening and broadening said cone of discharged fluid without interfering with the described aspiration phenomenon, and a conical baffle also carried by the cylindrical member and disposed adjacent the central portion of the plane of the outlet orifice and having its apex directed outwardly toward the center of the aspiration zone.

7. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a hollow substantially cylindrical member having an open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter, said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, whereby the fluid is caused to swirl within said cylindrical member and to flow from said discharge orifice in a spirally conical form, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to rejoin the outward substantially conical flow of introduced fluid, and means for controlling the flow of fluid from said inlet conduit to said substantially cylindrical member, said means comprising an arcu-

ate damper of an area sufficient to cover the opening between said members, and disposed within said substantially cylindrical member for sliding movement against the inner surface of the wall thereof, operating means for said damper, and spring pressed means for urging said damper radially outwardly against the wall of said member.

8. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a hollow substantially cylindrical member having an open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter, said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, whereby the fluid is caused to swirl within said cylindrical member and to flow from said discharge orifice in a spirally conical form, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to rejoin the outward substantially conical flow of introduced fluid, and means for controlling the flow of fluid from said inlet conduit to said substantially cylindrical member, said means comprising an arcuate damper of an area sufficient to cover the opening between said members, and disposed within said substantially cylindrical member for sliding movement against the inner surface of the wall thereof, an axially disposed rotatable operating shaft, an extensible and contractible strut projecting radially from said shaft and supporting said damper on its outer end, and means for resiliently urging said damper radially outwardly against the surface of the wall of said member.

9. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising a substantially cylindrical member having an open end comprising the discharge orifice of the structure, a plurality of inlet passageways leading into said member tangentially thereto through spaced openings in the wall thereof said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, whereby the fluids are caused to swirl within the substantially cylindrical member and to flow from said discharge orifice in an expanding spirally conical form, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to rejoin the outward substantially conical flow of introduced fluid, arcuate dampers for controlling the flow of fluid through said openings, operating means for moving said dampers about the inner surface of the wall of said member to open, close, and adjust said openings for the desired proportioning of fluid entering said member and discharged therefrom, and means for resiliently pressing said damper against said wall surface.

10. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising a substantially cylindrical member having an open end

comprising the discharge orifice of the structure, a plurality of inlet passageways leading into said member tangentially thereto through openings in the wall thereof which are spaced longitudinally of the member said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, whereby the fluids are caused to swirl within the substantially cylindrical member and to flow from said discharge orifice in an expanding spirally conical form, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to rejoin the outward substantially conical flow of introduced fluid, arcuate dampers for controlling the flow of fluid through said openings, operating means for moving said dampers about the inner surface of the wall of said member to open, close, and adjust said openings for the desired proportioning of fluid entering said member and discharged therefrom, and means for resiliently pressing said damper against said wall surface, said operating means including a rotatable actuating element and gearing connecting said element with each of said dampers for movement in opposite directions.

11. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising a substantially cylindrical member having an open end comprising the discharge orifice of the structure, a plurality of inlet passageways leading into said member tangentially thereto through openings in the wall thereof which are spaced peripherally of the member said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, whereby the fluids are caused to swirl within the substantially cylindrical member and to flow from said discharge orifice in an expanding spirally conical form, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to rejoin the outward substantially conical flow of introduced fluid, arcuate dampers for controlling the flow of fluid through said openings, operating means for moving said dampers about the inner surface of the wall of said member to open, close, and adjust said openings for the desired proportioning of fluid entering said member and discharged therefrom, and means for resiliently pressing said damper against said wall surface.

12. In a ventilation system or the like, an outlet and diffusing structure for introducing a gaseous fluid into an ambient gaseous medium and mixing the same, with the substantial elimination of noise and draft, said structure comprising an unobstructed inlet conduit, a hollow substantially cylindrical member having an open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the periphery of the cylindrical member and opening into the latter, said cylindrical member being of a length equal to from about three-quarters to not over three times its diameter, whereby the fluid is caused to swirl within said cylindrical member and to flow from said discharge orifice in a spirally conical form, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to rejoin the outward substantially conical flow of introduced fluid, and means for controlling the flow of fluid

from said inlet conduit to said substantially cylindrical member, said means comprising an arcuate damper of an area sufficient to cover the opening between said members, and disposed within said substantially cylindrical member for sliding movement against the inner surface of the wall thereof, a hollow casing containing a source of light disposed axially within said cylindrical member and rotatable with respect thereto, an extensible and contractible strut projecting radially from said casing and supporting said damper on its outer end, and means for resiliently urging said damper outwardly against the surface of the wall of said member.

13. In a ventilation system, an outlet structure for distributing air or other gaseous fluid into an enclosure with the substantial elimination of noise and draft, said structure comprising an unob-

structed inlet conduit, a cylindrical member having an open end comprising the discharge orifice of the structure, said inlet conduit being disposed tangentially with respect to the perimeter of said cylindrical member, and communicating therewith, said cylindrical member being of a length equal to from about three-quarters to about one times its diameter, all whereby the fluid is caused to swirl within said cylindrical member and to flow from said discharge orifice in a spirally conical form for a predetermined distance, and a portion of said flow being automatically diverted inwardly toward the center of the cone and back toward said discharge orifice to again join the continued substantially conical flow of introduced fluid.

FRANKLIN L. SLADE.