

May 10, 1960

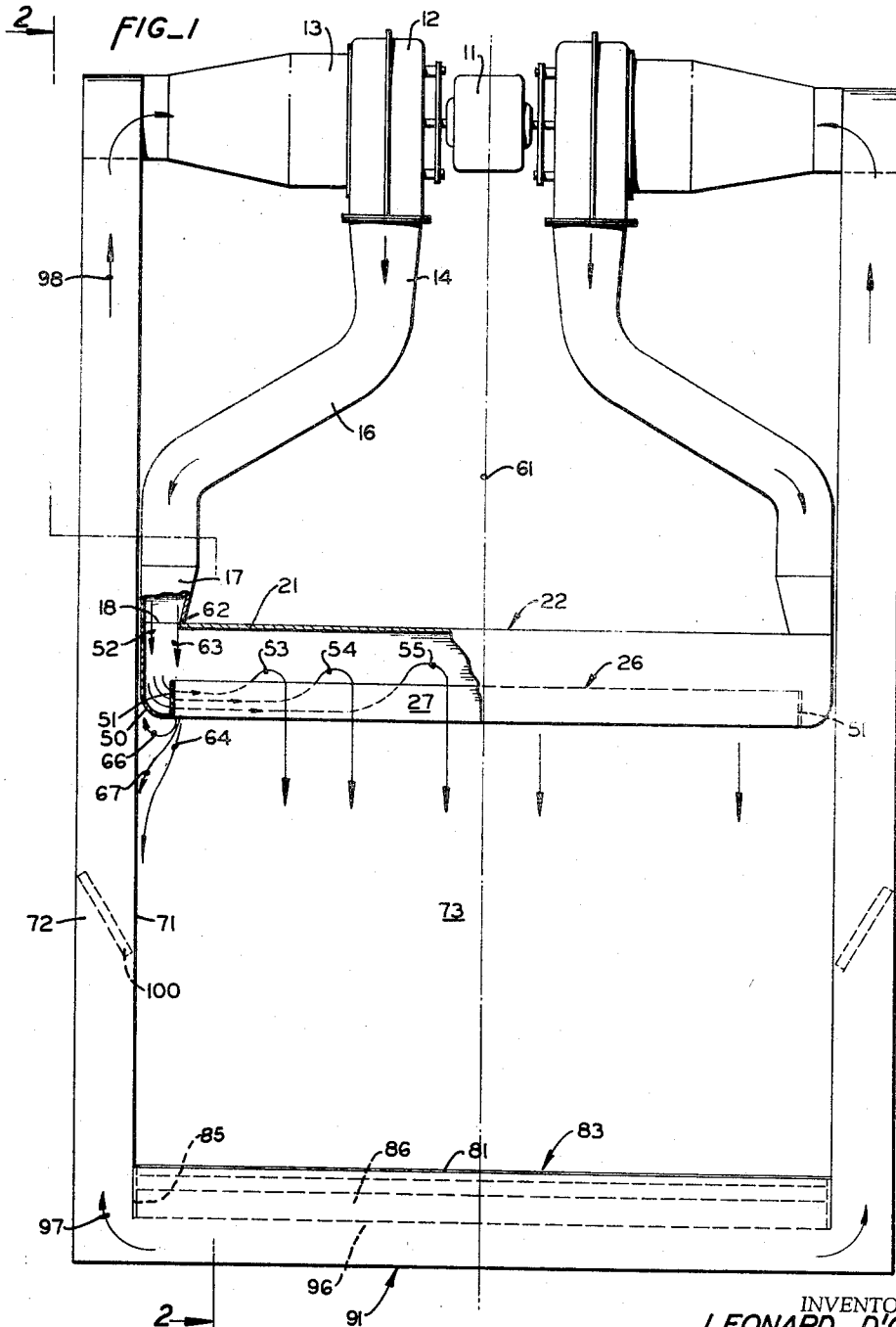
L. D'OOGÉ

2,935,925

AIRSEAL CLOSURE DEVICE

Filed April 22, 1957

4 Sheets-Sheet 1



INVENTOR
LEONARD D'OOGÉ

BY *Lothrop & West*

ATTORNEYS

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L. D'OOGÉ

2,935,925

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FIG-2

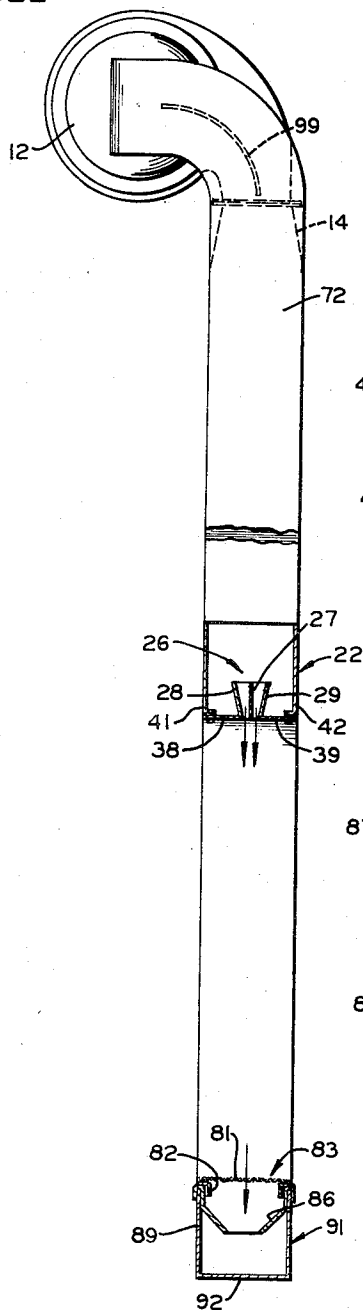


FIG-3

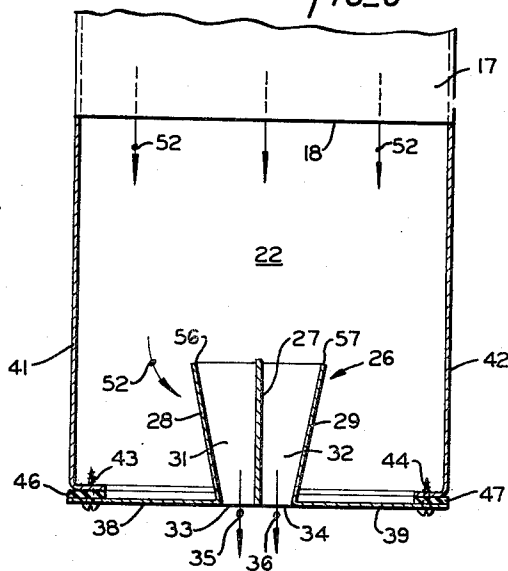
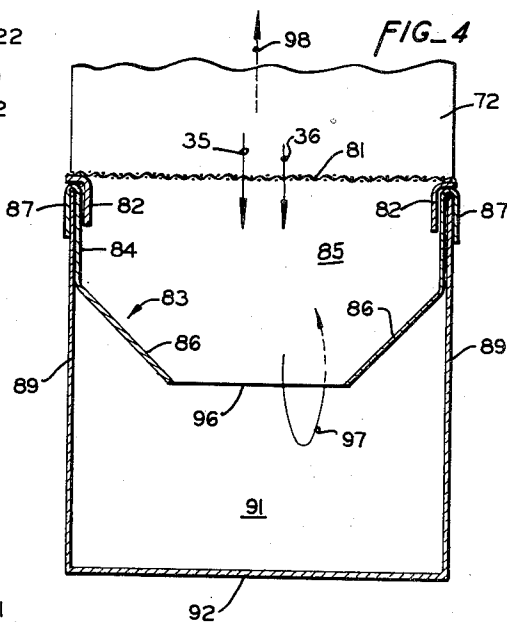


FIG-4



INVENTOR.
LEONARD D'OOGÉ

BY

Lothrop & West

ATTORNEYS

May 10, 1960

L. D'OOGHE

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FIG-5

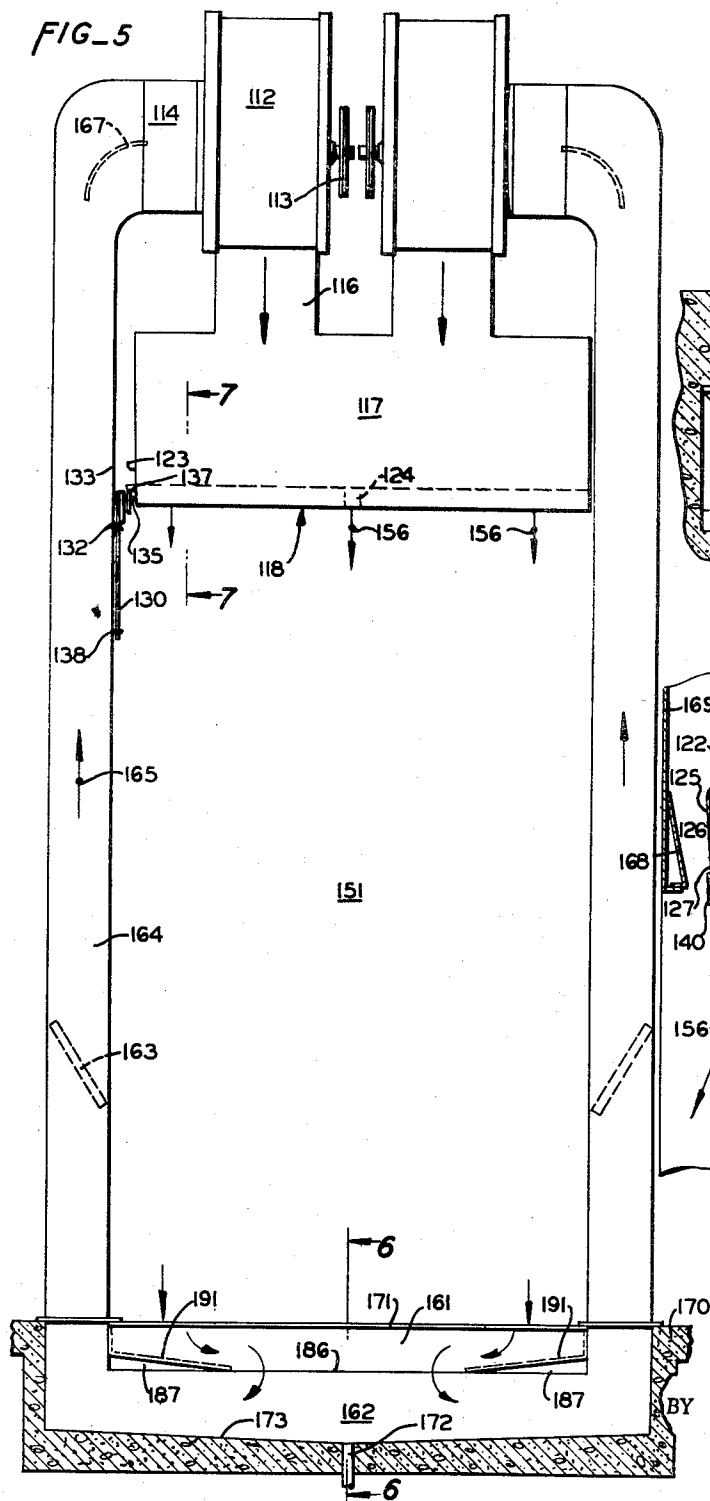


FIG-6

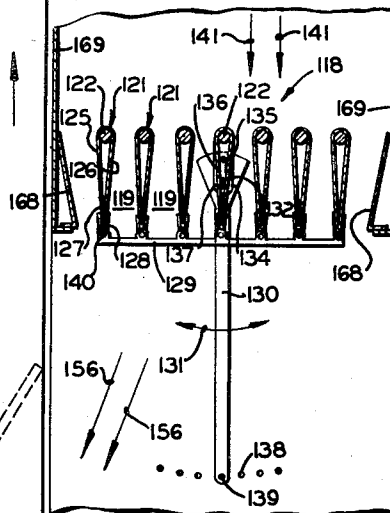
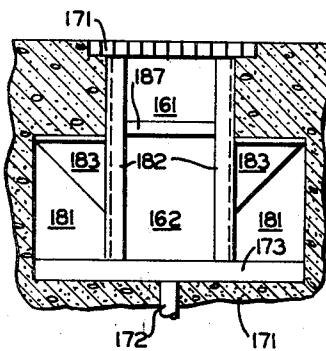


FIG-7

INVENTOR.
LEONARD D'OOGHE

BY
Lothrop & West

ATTORNEYS

May 10, 1960

L. D'OOGHE

2,935,925

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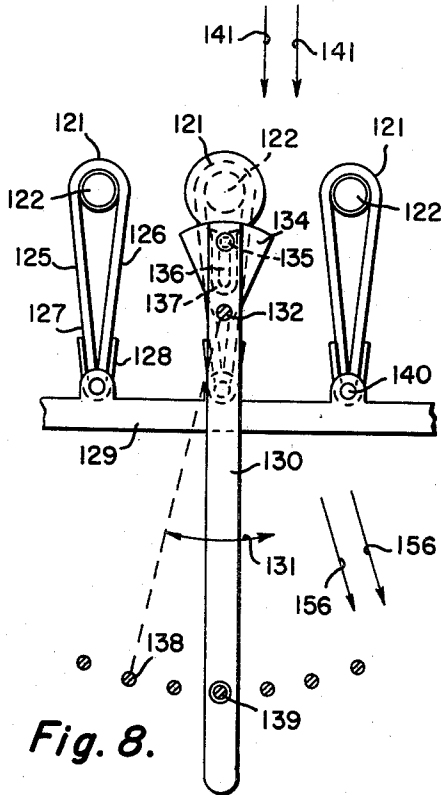


Fig. 8.

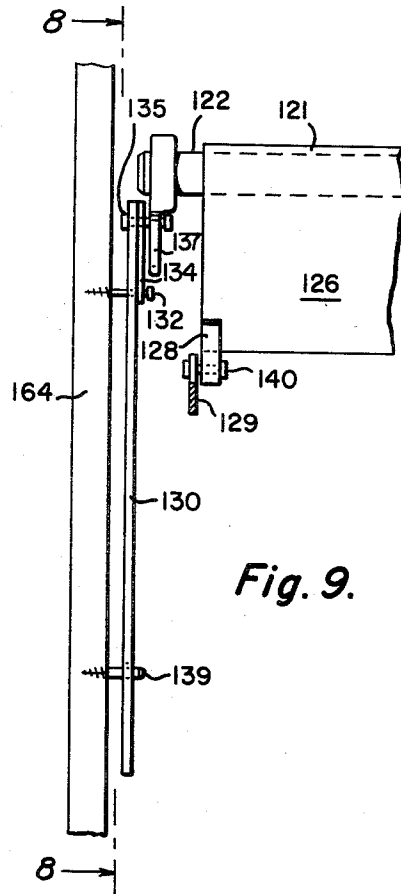


Fig. 9.

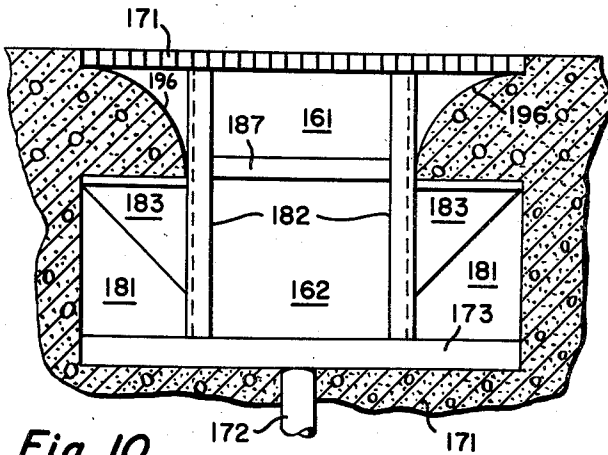


Fig. 10.

INVENTOR.
LEONARD D'OOGHE

BY *Lothrop & West*
ATTORNEYS

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2,935,925

AIRSEAL CLOSURE DEVICE

Leonard D'Ooge, Sacramento, Calif.

Application April 22, 1957, Serial No. 654,375

4 Claims. (Cl. 98—36)

The invention relates to improvements in airflow closures, and, more particularly, to devices providing a shielding or screening effect to an aperture as a consequence of a sheetlike current of air flowing, usually downwardly, across the aperture.

In recent years vast numbers of buildings, especially shops, stores, theaters and other buildings frequented by the public, have had air conditioning systems installed therein. These air conditioning systems not only provide the interior of the building with suitable heat and moisture conditions during the winter but also with a cooling atmosphere in the summer. In either case, it has been found that one of the major losses of hot air in winter and cool air in the summer, within these public edifices, has resulted from the frequent opening and closing of the doors leading into and out of the buildings. In the summer time, an open door in an air conditioned building permits great quantities of cold air to pour outwardly in an invisible stream. In comparable fashion, in the winter time, an open door permits large volumes of cold air to flow into the heated interior, thereby increasing the heating load.

It is therefore an object of the invention to provide an airseal closure device which is capable of increasing the over-all efficiency of an air conditioning system when the doors are left open.

It is yet another object of the invention to provide an airseal closure device in which the occupants or customers in air-conditioned buildings can be kept more comfortable with respect to temperature and humidity although the doors are left open.

It is still another object of the invention to provide an air shield device which is relatively inexpensive to build and install.

It is yet a further object of the invention to provide an air shield device which can, without major structural changes in a building, be installed in addition to presently functioning doors so that during working hours the doors can be left open to permit ready entrance to and egress from the building.

It is a further object of the invention to provide an airseal closure device which has but few moving parts to get out of order and which is therefore durable and long-lived.

It is still a further object of the invention to provide an airseal closure device which can be regulated to operate at maximum efficiency despite the vagaries of outside atmospheric conditions, such as winds.

It is another object of the invention to provide an airseal closure device which involves but a small amount of operating or upkeep expenditure.

It is a further object of the invention to provide an airseal closure device which can readily be installed in a pass-through type of window such as that found in a cashier's booth or in a drive-in or other restaurant having a window opening directly to the outside and through which the food and orders are transferred.

It is a still further object of the invention to provide a

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pass-through type of airseal in which insects are effectively prevented from entering into the interior through the shielded opening.

It is another object of the invention to provide a shield of air whose flow velocity does not cause discomfort or annoyance to a person passing through the shielded opening, there being, for example no tendency of the air current to dislodge a person's hat or blow one's hair.

It is a still further object of the invention to provide an airseal type of closure in which the wind curtain or wind stream passing across the airseal aperture is maintained at a substantially constant value across the entire width of the aperture.

It is yet a further object of the invention to provide a generally improved airseal closure device.

Other objects together with the foregoing are attained in the embodiment described in the following description and shown in the accompanying drawings in which:

Figure 1 is a front elevation, partially in section, of a pass-window type of closure.

Figure 2 is a side elevation, partially in section, of the device shown in Figure 1, the plane of section being indicated by the line 2—2 in Figure 1.

Figure 3 is a section, to an enlarged scale, of the discharge plenum and nozzle structure of the pass-window type of closure shown in Figure 2.

Figure 4 is a section to an enlarged scale of the return air trough and return air plenum structure of the device shown in Figure 2.

Figure 5 is a front elevation, partially in section, of a typical foot traffic, or doorway, type of closure.

Figure 6 is a section of the base structure of the doorway type, to an enlarged scale, the plane of section being indicated by the lines 6—6 of Figure 5.

Figure 7 is a section of a nozzle structure, the plane of section being indicated by the line 7—7 in Figure 5.

Figure 8 is an end view, to an enlarged scale, of the nozzle control mechanism.

Figure 9 is a side view of the mechanism shown in Figure 8, a portion of the figure being broken away to reduce the extent of the figure and to clarify the showing.

Figure 10 is a variant form of the base structure shown in Figure 6.

While the airseal closure of my invention is susceptible of numerous physical embodiments, depending upon the environmental requirements and upon the particular installation needs, a substantial number of both of the herein shown and described embodiments have been made and installed and have performed in an eminently satisfactory manner.

It is believed that one of the several unique features incorporated within the device of the invention is the co-planar or flat relation of the majority of the elements, as can be seen most clearly by reference to Figure 2. Not only does this construction greatly simplify installation but it also lends a neatness of appearance to the finished job and, as well tends to minimize the frictional losses of the fluid flow in the system.

Preferably, the device comprises, in the majority of situations, a symmetrically disposed pair of units, each of the units being in mirror relation with respect to the other. Consequently a description of one side only, with the exceptions as noted, will serve equally to describe the other side. An energy source such as an electrical motor 11 serves to rotate a blower (not shown) encased within a blower housing 12. The blower receives air from an intake pipe 13, or intake plenum, and discharges through a suitable transition duct 14, and air duct 16, to an air duct outlet 17, the air duct outlet 17 converging in the fashion shown most clearly in Figure 1 so as to discharge through an aperture 18. The air discharging

through the aperture 18 enters the upper side 21 of a transverse elongated member 22, termed a discharge plenum, the aperture 18 being preferably adjacent one end of the plenum.

Mounted within the discharge plenum 22 on the lower or bottom side thereof is a nozzle structure 26 comprising a plurality of elongated plates including a vertical central plate 27 straddled by a pair of oppositely inclined plates 28 and 29, the angle of inclination being approximately 12° from the vertical. The sloping side plates 28 and 29 form with the central plate 27 a pair of nozzle cavities 31 and 32 each having an opening 33 and 34, respectively, adjacent the bottom end thereof through which air is discharged in a pair of discrete sheets or layers as indicated by the arrows 35 and 36. Each of the inclined plates 28 and 29 is conveniently formed by appropriate bending of the material forming the bottom boundary walls 38 and 39 of the plenum 22, the boundary walls being, in turn, mounted on the vertical side walls 41 and 42 of the plenum as by suitable fastenings 43 and 44, the wall corners being made air tight by interposition of a pair of gaskets 46 and 47.

The opposite ends of the elongated nozzle 26 are blocked off by a pair of end plates 51, the end plates 51 serving in conjunction with the arcuate end wall portion 50 laterally to deflect entrant air, indicated by the numeral 52, along the outer sides of the plates 28 and 29, thence over into the nozzles in the fashion indicated schematically by the arrows 53, 54 and 55. In other words, the major portion of the entrant air stream 52 is not permitted to flow directly downwardly through the nozzle cavities 31 and 32, but instead is forced to pass laterally or transversely inwardly in the channels between the plate 28 and the side wall 41 and between the plate 29 and the side wall 42 and to flow over the upper ends 56 and 57 of the plates 28 and 29, respectively, and thence downwardly through the cavities and into the discrete layers diagrammatically indicated by the numerals 35 and 36. In this fashion, and with appropriate dimensioning of the aperture 18 and the nozzle 26 to the approximate sizes shown in Figures 1 and 2 it will be found that there is a substantially constant pressure drop from the opposite ends of the discharge plenum to the central vertical axis 61 thereof. In other words, the amount of air flow and the velocity thereof is substantially equal over the entire length of the nozzle.

It is especially to be noted, however, that the end plate 51 does not deflect, and cause to flow in a transverse pattern, all of the air discharging downwardly through the aperture 18. With especial reference to Figure 1 it will be noted that the end plate 51 is displaced laterally to the left to some extent from the right hand margin 62 of the aperture 18; that is to say, the aperture margin 62 overlaps the end plate 51. Consequently, a portion of the air adjacent the margin 62, the air portion being designated by the numeral 63, discharges directly or vertically downwardly and passes on the right hand side of the left hand end plate 51 and assumes substantially the flow pattern indicated by the arrow designated 64. The arrow 64 is shown as dividing into a plurality of branches, thus schematically illustrating the fact that as the air passes directly downwardly in unhindered fashion through the nozzle portion on the right hand side of the end plate 51, a fraction of the air eddies sharply upwardly and into the pattern generally indicated by the numeral 66, whereas still another portion follows the path indicated by the arrow 67. As will be appreciated, the air passing directly downwardly through the nozzle moves at a considerably higher velocity than that encountered in the air pattern which is deflected transversely inwardly along the length of the nozzle. This unhindered high velocity stream tends to deflect laterally somewhat and flows along the inner margin 71 of a vertical return air conduit 72, later to be described. Since the air flowing along the boundary 71 has substantial velocity it serves as an ef-

fective barrier to insects such as flies which might otherwise gain entry by walking inwardly across the vertical wall 71. Therefore, even though the vertical sheets of air passing over the aperture, generally designated by the numeral 73, are not of a velocity sufficient to dislodge crawling insects, it is found that the high velocity existing at the lateral boundary walls 71 is adequate to prevent unwanted entry thereof. Nevertheless, the velocity of the air sheets is entirely adequate to discourage the entry through the aperture 73 of insects on the wing.

As the air sheets, indicated by the numerals 35 and 36, traverse the opening 73 of the pass-through window, but a minimum amount of eddying of the air takes place in a direction normal to the direction of flow. The relatively stream-lined flow of the two layers, or two sheets, tends largely to maintain itself across the entire aperture and, therefore, even at the end of its travel the sheets are still in a relatively compact and undissipated condition. Therefore, the air currents, still forming a relatively planar imaginary envelope, can pass easily through an elongated bottom screen 81 mounted horizontally on a pair of flanges 82 supported on the top side of a trough, generally designated 83, the screen being readily removable for cleaning. The trough 83 includes a pair of vertical side walls 84 and end walls as well as a corresponding but oppositely inclined pair of sloping walls 86. At the upper end of the vertical walls 84 the trough material is recurved to form an overhanging lip 87 adapted to engage in frictional relation for ease of removal with the side walls 89 of a return air plenum 91 bounded on its lowermost portion by a boundary wall 92.

Reference to Figure 4 will show that the air current sheets 35 and 36 pass downwardly through the screen 81 and, upon traversing the trough cavity, pass outwardly through a trough aperture 96 and flow laterally in the direction indicated by the arrow 97, and shown most clearly in Figure 1, thence upwardly in the direction shown by the arrow 98, through the return conduit 72. Upon reaching the upper end of the return air conduit 72 the air is deflected by a suitable curved vane 99 and thence inwardly into the intake plenum 13 where recycling is commenced. It is to be realized, of course, that the arrows 35 and 36 as they appear in Figure 4 are largely schematic since a certain amount of air entrainment in the twin streams exiting from the nozzles does in fact take place; as a result the actual air currents are considerably wider than that indicated by the numerals. Indeed, at the bottom of the aperture 73 the currents have spread approximately to or even in excess of the width of the screen 81, the trough's sloping walls 86 serving aptly to suck or to funnel most of the currents into the return air plenum 91.

Since the system is substantially a closed one, except for the exposure to the atmosphere while the streams are traversing the aperture 73, it is found that the interposition within the system of suitable filter 100 is advisable.

Figures 5 through 7 show a modified form of the device, and one which is especially suitable for walk-through or comparable use.

The modified form of closure comprises numerous elements resembling their counterparts in the form heretofore described. In mirror symmetry, and on each side of the apparatus, there is provided a blower 112 driven by a suitable energy source (not shown) through a V-belt 113. Connecting to the intake side of the blower is appropriate intake piping 114, the blower air passing through a discharge duct 116 into a discharge plenum 117. At the lower or discharge side of the plenum 117 is a nozzle generally designated 118 comprising a plurality of individual nozzle cavities 119 defined by a plurality of tear-shaped members 121, or vanes, capable of being inclined in unison, as will now be described.

Each of the tear-shaped elements 121 includes a rod 122 secured at opposite ends to the side walls 123 of the plenum and supported at a central location by an appro-

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priate bearing member 124. Encompassing the rod 122 and extending downwardly therefrom on opposite sides in converging style is a pair of boundary plates 125 and 126 secured adjacent their lower ends 127 and affixed to a pair of ears 128 mounted on a pin 140 in a cross bar 129, the ears projecting upwardly from the bar whose lateral motion is controlled by a crank handle 130 swingable in the directions shown by the arrow 131. The handle 130 pivots about a pin 132 mounted on a suitable adjacent vertical surface 133. Projecting from a triangular plate 134 mounted on the upper end of the handle is a pin 135 disposed in a vertical slot 136 in a link 137 secured at its upper end to the rod 122 of the central vane, the rod extending beyond the plenum wall 123, as appears in Figure 5. Thus as the crank handle 130 is swung either clockwise or counter clockwise about the pivot 132, the link 137 and the rod 122 of the central vane is oppositely rotated. As the central vane is rotated the cross bar 129 is laterally moved, carrying with it the rest of the vanes in unison. The handle is lockable in desired position owing to the provision of a plurality of pins 138 adapted to fit in an aperture 139 in the handle. The nozzle boundary plates, when in canted attitude, serve to deflect the air flowing downwardly in the direction indicated by the arrows 141 either to a right hand or to a left hand direction.

It is believed that this air deflection feature is another one of the novel and unique aspects of the closure of the invention and enables the operator to deflect the discrete sheets or layers of air emerging from the nozzles either to a direction inwardly or outwardly with respect to the central aperture 151. Consequently, if it be assumed upon reference to Figure 5 that the viewer is looking inwardly through the aperture 151 into the interior of a store or a public building, and that the outside wind is blowing in a direction toward the interior of the store, then it is only necessary for the operator to deflect the vanes to a direction such that the airflow 141 leaves the vanes with a left hand directional flow pattern as indicated by the arrows 156, and which is obtained by swinging the handle 130, in Figure 7, in a right hand direction. The outward component of the airflow 156 is countered by the opposing flow of the atmospheric wind, the vanes being sufficiently deflected by the operator so that substantial neutrality is obtained and so that the vertically flowing sheets of air enter in the proper fashion into a return air pickup or floor slot 161 leading into a return air plenum 162 and thence upwardly through suitable filters 163 in a return air conduit 164 in the direction indicated by the arrow 165. The air thereupon is deflected inwardly by a suitable vane 167 and back to the intake plenum 114 and to the blower 112 for recycling.

With especial reference to the tear-drop shaped vanes it will be noted that the converging boundary walls 125 and 126 of each of the vanes results in an adjacent diverging nozzle cavity, it having been found that such configuration is highly suitable for the creation of discrete streamlined flow sheets which tend to maintain their identity throughout substantially the entire traverse across the door opening 151. Assisting in this pattern and tending to keep the "wall" of air in its original cross sectional shape is a pair of triangular in section deflectors 168 suitably mounted on the plenum walls 169, as appears in Figure 7.

As can be seen by especial reference to Figures 5 and 6, the door or industrial type of closure is ordinarily most conveniently installed in permanent fashion, and thus is customarily set into a foundation structure 170. Since rain water, as well as water used for cleaning the floors or adjacent pavement area, will ordinarily flow downwardly through a floor grate 171 above the floor slot 161, provision is made for appropriate drainage, as by a drain pipe 172 located at the bottom of the sloping walls 173 of the return air plenum 162. To insure adequate volume within the return air plenum 162,

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a pair of side channels 181 is frequently provided, the grate 171 and superposed weight being supported by suitable legs 182 and brackets 183. A throat 186 formed by a pair of opposing guide plates 187 serves to increase the effect of the "vacuum" in the plenum 162 and thus to exert a strong suction influence on the air curtain and entrained air in the space adjacent the floor. For ease of cleaning a sheet metal trough 191 conforming to the outline of the chamber 161 can be inserted therein.

Figure 10 illustrates a variant form of base structure which has been found to be of marked utility in many environments and types of installation. The bell-mouth shape 196 exerts a "suction" influence, it has been discovered, considerably in excess of that obtaining in the straight-walled structure shown in Figure 6. Consequently, not only the air-stream itself, but also the considerable volume of air entrained thereby is "reached" effectively and thus drawn into the return air path.

It can therefore be seen that I have provided an airseal closure, or airshield, which not only prevents the unwanted entry of insects but which also provides a close-coupled, easy to clean and efficient unit which substantially improves the over-all efficacy of an air-conditioning system, even though the customary doors are wide open during business hours.

What is claimed is:

1. An airseal closure device comprising a substantially rectangular structurally rigid vertical framework, said framework having a pair of vertical hollow members, a lower horizontal hollow member connected at opposite ends to said vertical hollow member and including an upwardly facing air-receiving opening, an upper horizontal hollow member including a downwardly facing air-discharge opening, a pair of fans mounted between the upper ends of said vertical hollow members and connecting therewith, and a pair of ducts leading from said fans to the adjacent end of said upper horizontal member, said ducts, said vertical hollow members and said horizontal hollow members lying substantially in a common plane and forming with said fans an integral unit.

2. The device of claim 1 wherein said downwardly facing air-discharge opening in said upper horizontal hollow member is defined by an elongated nozzle including a pair of upwardly diverging walls extending upwardly into said upper member, a pair of end walls, and an elongated center wall interposed between said upwardly diverging walls to form a pair of downwardly facing elongated uninterrupted air passages.

3. The device of claim 2 wherein said end walls of said elongated nozzle are located outwardly from the innermost walls of said ducts adjacent the conjunction of said ducts and said upper horizontal hollow member whereby air from said ducts discharges vertically downwardly through the portions of said nozzle inwardly from said end walls and outwardly of said innermost walls of said ducts.

4. An airseal closure device comprising a lower horizontal hollow member having a perforated upper surface, a pair of vertical hollow members connecting with the ends of said lower horizontal hollow member, a pair of blowers mounted between the upper ends of said vertical hollow members, each blower connecting with the adjacent one of said vertical hollow members, an upper horizontal hollow member having an opening in its lower side and being connected to and located below said pair of blowers, said vertical members, said horizontal members and said blowers lying substantially in a common plane, and a plurality of vanes located in said opening in said upper horizontal hollow member, each of said vanes being rotatably mounted on and extending between the opposite sides of said upper horizontal member to define a plurality of elongated uninterrupted nozzles effective to form and direct a plurality of laminar sheets of air at a predetermined angle with respect to said lower horizontal member, said vanes lying in substantially co-

planar relation with said vertical members, said horizontal members and said blowers.

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