

Feb. 20, 1962

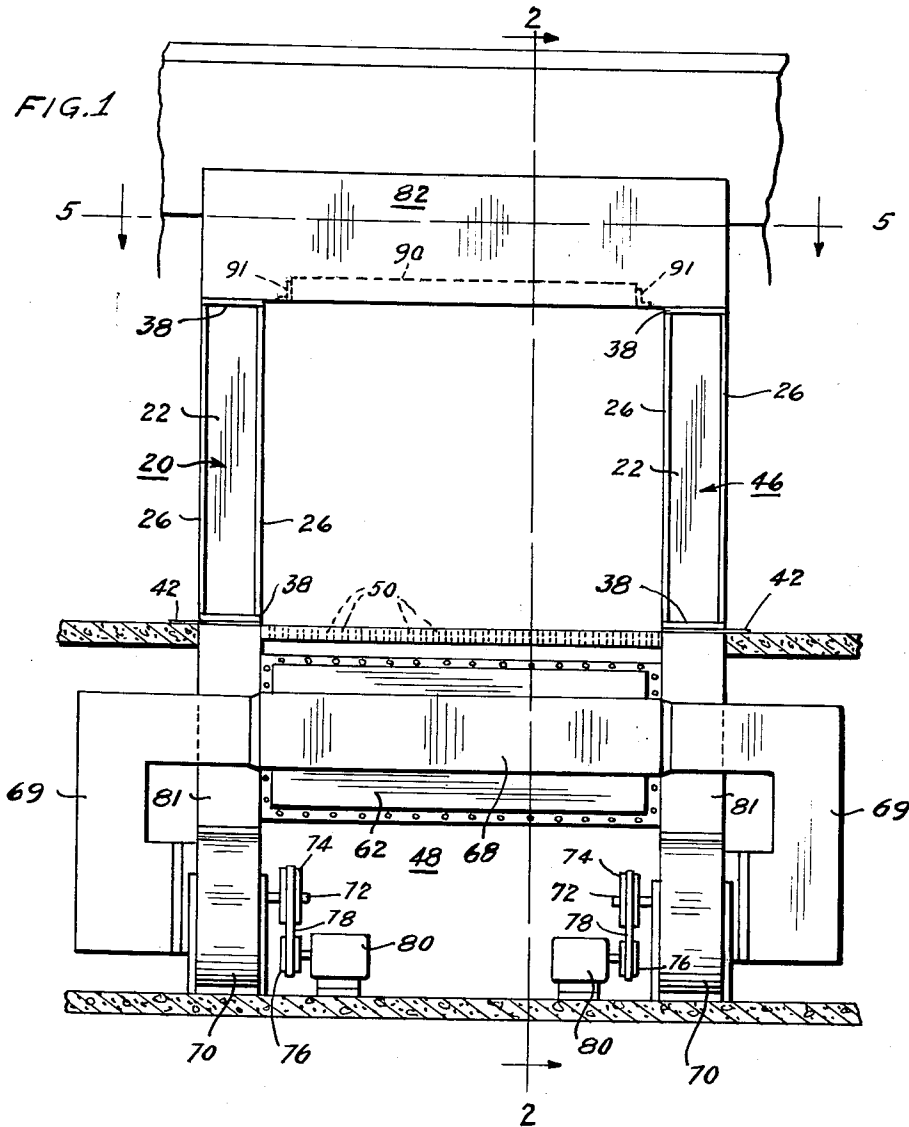
E. F. GYGAX

3,021,775

DEVICES FOR PRODUCING AIR SCREENS

Filed Dec. 10, 1956

6 Sheets-Sheet 1



INVENTOR.

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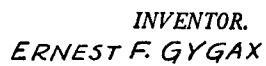
BY

ATT'Y.

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DEVICES FOR PRODUCING AIR SCREENS

6 Sheets-Sheet 2



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DEVICES FOR PRODUCING AIR SCREENS

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6 Sheets-Sheet 3

FIG. 3

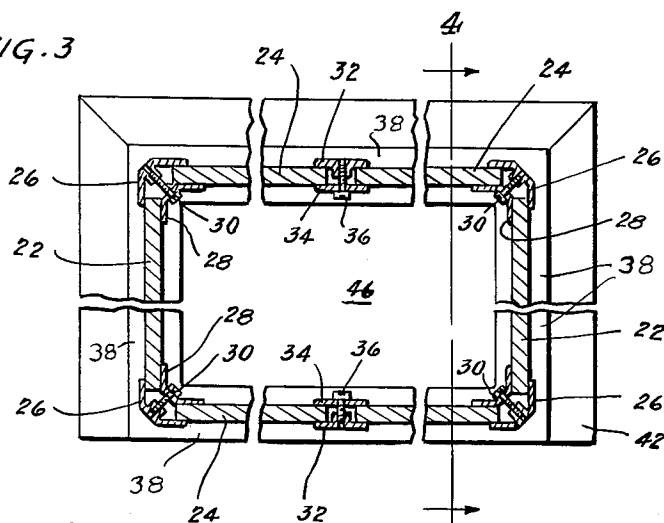


FIG. 4

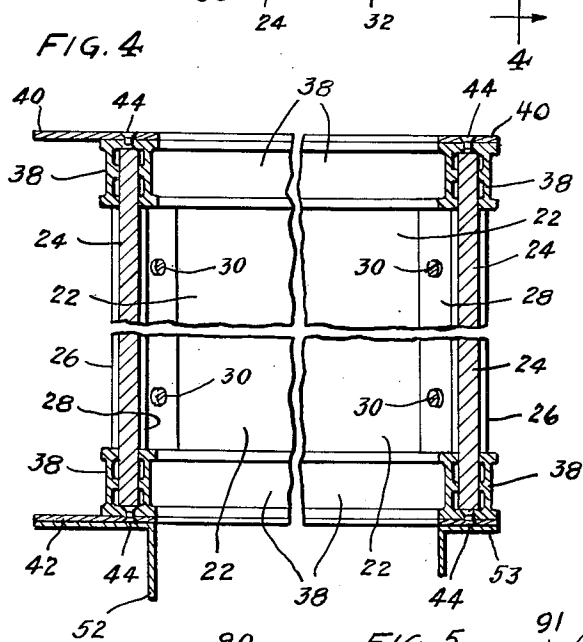


FIG. 6

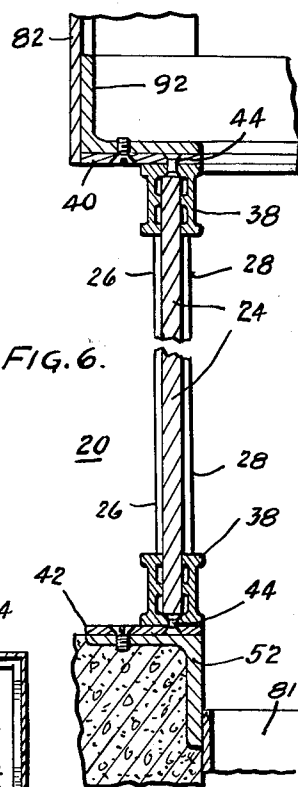
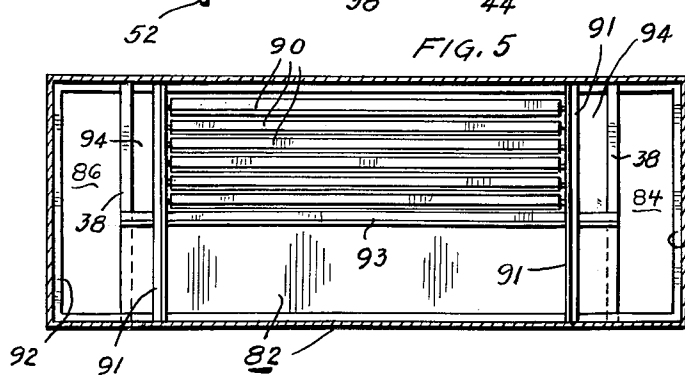


FIG. 5



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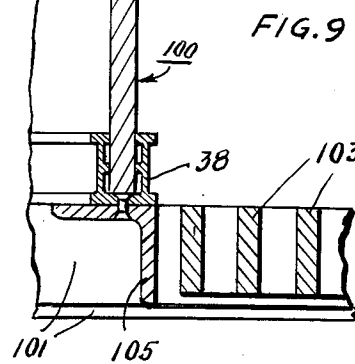
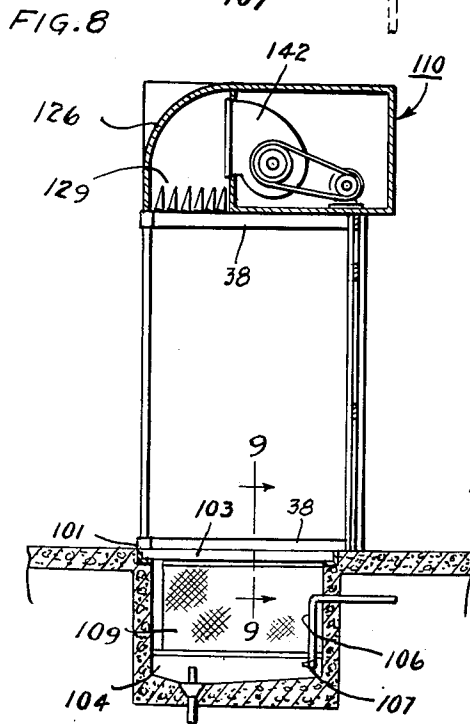
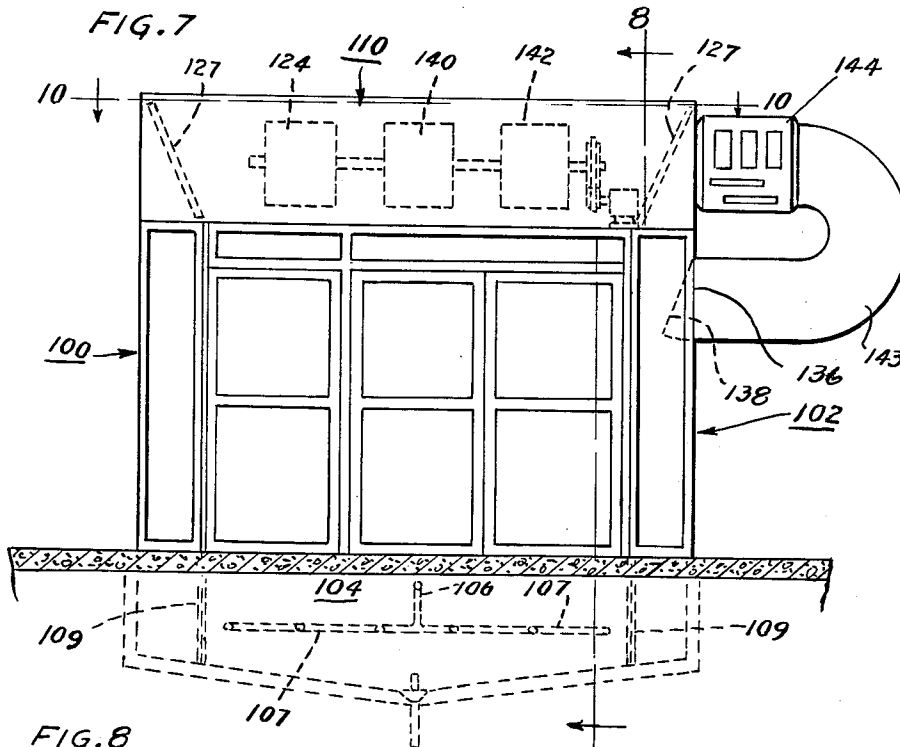
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DEVICES FOR PRODUCING AIR SCREENS

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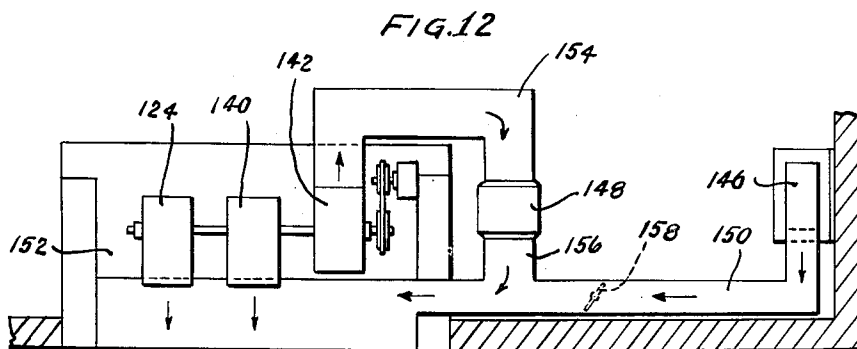
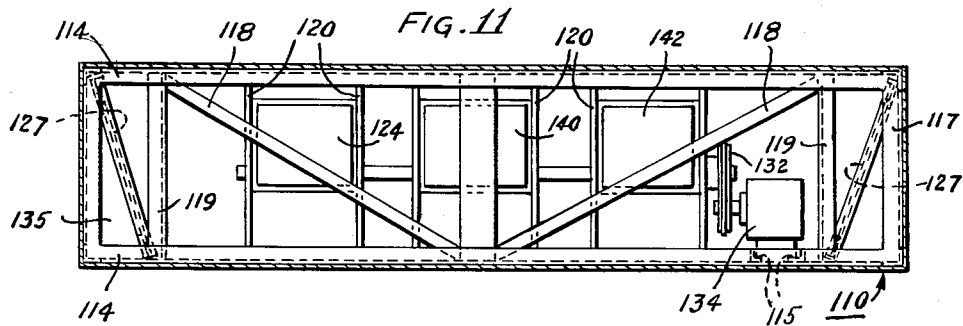
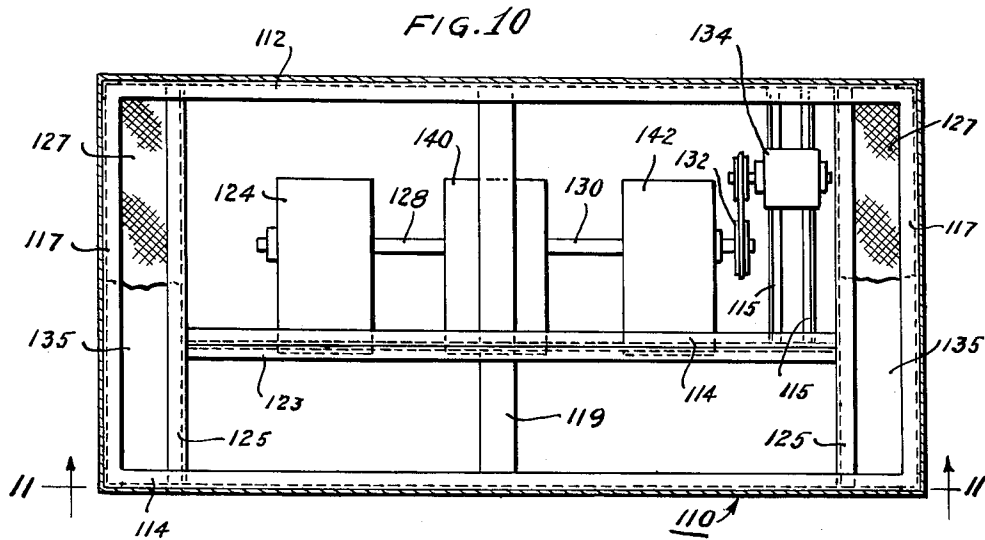
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DEVICES FOR PRODUCING AIR SCREENS

Filed Dec. 10, 1956

6 Sheets-Sheet 5



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3,021,775

DEVICES FOR PRODUCING AIR SCREENS

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6 Sheets-Sheet 6

FIG. 13

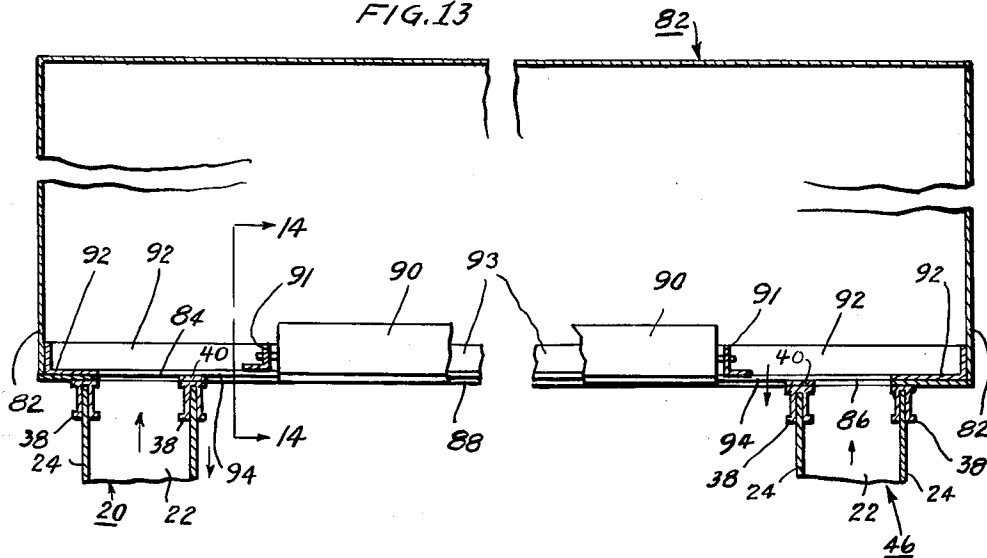


FIG. 14

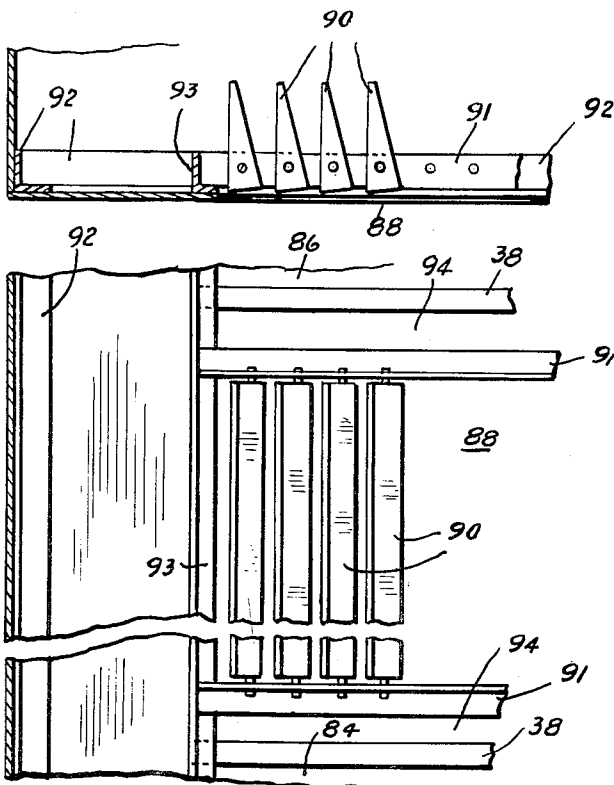


FIG. 15

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3,021,775

DEVICES FOR PRODUCING AIR SCREENS

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Filed Dec. 10, 1956, Ser. No. 627,303

4 Claims. (Cl. 98—36)

This invention relates to improvements in devices for producing air screens. More particularly, this invention relates to improvements in readily assembled devices for producing air screens.

It is therefore an object of the present invention to provide a readily assembled device for producing air screens.

This invention is an improvement on the invention disclosed and described in Ernst Steiner patent application Serial Number 465,680 which was filed October 29, 1954 for Device for Producing a Room-Closing Air Curtain and which was granted December 8, 1958 as Letters Patent No. 2,863,373. The said Steiner application discloses a very useful and important concept in the formation of air screens adjacent doorways and other openings; and that concept includes the generation of a number of rapidly moving, closely spaced air walls that coact to constitute an air screen. The use of the plurality of air walls and the provision of spaces between those air walls makes the air screen so deep that any solid object, such as a person, can pass through it without forming a "hole" all the way through the air screen. That object will naturally form a "hole" in one or more of the walls of the air screen as it passes through the air screen, but the air screen will be deep enough that one or more of the walls will always remain intact. In this way, air screens generated in accordance with the teachings of the said Steiner application make it possible to maintain different temperatures, pressures and humidities for the atmospheres at the opposite sides of those air screens.

To make the structures, needed to generate air screens, commercially available to a large number of users, it is necessary to produce those structures as inexpensively as possible. If all the doorways of all buildings were standard in design and size, it would be a simple matter to make one standard structure for the generation of air screens and to manufacture it on a production line basis. Unfortunately, the configuration and size of doorways often varies with the architect selected by the builder, contractor or owner, and hence doorways and other openings vary widely. Furthermore, doorways vary as architectural tastes and concepts change during the years. Consequently, it is impractical to try and establish just one structure for the generation of air screens and to try to use that structure in all installations. Instead, it has been the practice in the past to design and custom-build each structure, for the generation of air screens, for each particular installation. This practice is expensive and time consuming, and hence is objectionable. The present invention largely obviates these objections by making it possible to develop certain basic structural components which can be made in the factory on a production basis as pre-fabricated sections and then assembled on the job. In this way, it is possible to reduce the cost of building and installing structures to generate air screens. It is therefore an object of the present invention to provide a structure for producing air screens that can be made of standard elements and which can be pre-fabricated for installation on the job.

The structure provided by the present invention can be produced and shipped as a number of individual sections. Those sections can then be assembled on the job to provide the overall screen-generating structure. This structure is desirable because it makes possible the economies

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attainable through the use of standard parts and of factory production of sub-assemblies. Further, this structure is advantageous because it makes possible full fitting and testing of the component sections in the shop and thus before they are installed on the job.

Other and further objects and advantages of the present invention should become apparent from an examination of the drawing and accompanying description.

In the drawing and accompanying description several preferred embodiments of the present invention are shown and described but it is to be understood that the drawing and accompanying description are for the purpose of illustration only and do not limit the invention and that the invention will be defined by the appended claims.

In the drawings, FIG. 1 is a front sectional view of one form of structure that can be used to generate air screens,

FIG. 2 is a cross sectional view of the structure of FIG. 1, and it is taken along the plane indicated by the line 2—2 in FIG. 1,

FIG. 3 is a broken, sectional view in plan of a portion of the structure shown in FIGS. 1 and 2, and it is taken along the plane indicated by the line 3—3 in FIG. 2,

FIG. 4 is a sectional rear view through the portion of the structure shown in FIG. 3, and it is taken along the plane indicated by the line 4—4 in FIG. 3,

FIG. 5 is a sectional plan view of the top section of the structure shown in FIGS. 1 and 2, as that section would appear when rotated one hundred and eighty degrees about a vertical axis, and it is taken along the plane indicated by the line 5—5 in FIG. 1,

FIG. 6 is a view in section of portions of the joints between one of the vertical sections and the top and bottom sections of the structure,

FIG. 7 is a partially sectioned front elevational view of another form of screen-generating structure provided by the present invention,

FIG. 8 is a sectional side view of the structure shown in FIG. 7, and it is taken along the plane indicated by the line 8—8 in FIG. 7,

FIG. 9 is a sectional view on a larger scale showing a portion of the joint between the bottom section and one of the vertical sections of the said structure, and it is taken along the plane indicated by the line 9—9 in FIG. 8,

FIG. 10 is a sectional plan view of a portion of the structure in FIG. 7 and it is taken along the plane indicated by the line 10—10 in FIG. 7, but the arcuate deflector is not shown,

FIG. 11 is a sectional view in elevation of the structure shown in FIG. 10, and it is taken along the plane indicated by the line 11—11 in FIG. 10,

FIG. 12 is a schematic view of the overall relationship of a structure like FIGS. 7—11 to a refrigeration unit,

FIG. 13 is a sectional view, on a larger scale, through the top section of the structure shown in FIG. 2, and it is taken along the plane indicated by the line 13—13 in FIG. 2,

FIG. 14 is a sectional view, on a still larger scale, through part of the structure shown in FIG. 13, and it is taken along the plane indicated by the line 14—14 in FIG. 13, and

FIG. 15 is a plan view of the part of the structure shown in FIG. 14.

Referring to the drawing in detail, the numeral 20 generally denotes a vertically directed, hollow, four-sided column that is one section of a structure for generating an air screen. This column stands adjacent the side frame of the door or opening which the air screen is to protect. Section 20 includes a pair of vertical plates 22 which are located at two of the opposite sides of that section, and also includes a pair of vertical plates 24

which are disposed at the other two opposite sides of that section. The plates 22 and 24 may be made of a number of different materials, but one material that has been found to be very useful is a fabricated plate of metal and wood sold commercially as "Met-l-wood." The "Met-l-wood" plates have appreciable structural strength and also have smooth faces to minimize the frictional air losses in the section. They can be obtained in various widths and lengths, and they lend themselves well to the construction of sections 20 of different cross sections and lengths. Where the sides of the section 20 are to be narrow, as is usually the case where they are parallel to the plane of the doorway, one vertical plate will usually suffice at each side. Where the sides are to be wide, as is usually the case where they are perpendicular to the plane of the doorway, two or more plates can be used in edge-to-edge relation, as shown in FIG. 3. The edge-to-edge plates 24 of the section 20 in FIG. 3 are rigidly secured together by external elongated connectors 32 and by internal elongated connectors 34. The connectors are held in assembled relation with each other and in assembled relation with the plates 24 by fasteners 36 which are shown in the form of machine screws. When the four plates 24 and the connectors 32 and 34 are assembled together, they form a pair of sturdy and rigid sides for section 20. Those sides are interconnected with the sides 22 by external elongated corner connectors 26 and internal elongated corner connectors 28. The corner connectors 26 and 28 are rigidly held to each other and to the sides 22 and 24 by fasteners shown in the form of machine screws 30. When the plates 22 and 24 are assembled together by means of the connectors 26, 28, 32 and 34, they coact to form a sturdy and rigid hollow column that is substantially air-tight. That column acts both as a structural member and as an air duct.

The upper and lower ends of this column extend into an oblong cap 38 and an oblong base 38. The exteriors of that cap and that base are ornamental in design, and that cap and base are slotted to accommodate the upper and lower edges of the walls 22 and 24. As indicated particularly in FIG. 4, the connectors 26 and angles 28 are cut short so they do not extend the full length of the plates 22 and 24. Instead, the upper and lower ends of those connectors abut the confronting faces of the cap 38 and the base 38. Similarly, the connectors 32 and 34 are cut short so they do not extend the full lengths of the plates 22 and 24; and instead, those connectors abut the confronting faces of the cap 38 and the base 38.

A securing plate 40 that is oblong in configuration is rigidly secured to the cap 38 by a number of fasteners 44 shown in the form of rivets. A generally similar securing plate 42 is rigidly secured to the base 38 by a number of fasteners 44, shown in the form of rivets. Section 20 includes the above described vertical plates, internal and external connectors and fasteners, slotted cap and base, securing plates and rivets.

The numeral 46 generally denotes a second section which can be made identical to the first section 20 in all respects. In the particular form shown in the drawing, the sections 20 and 46 are identical in height, breadth and depth; and they use the same vertical plates and the same connectors. However, if desired, the second section 46 could be made larger or smaller than the section 20. In fact, in some instances, where space limitations require it, either section 46 or 20 could be eliminated and the other section enlarged to provide the required capacity.

The numeral 48 generally denotes a third section of the structure for producing air screens. This section is positioned below the level of the door which the air screen is to protect, and this section includes a sturdy and rigid oblong frame 52 made of angle irons. As indicated particularly in FIG. 2, the frame 52 rests upon the floor of the building adjacent the door which the air screen is to protect. The frame is recessed into the floor

so that the top of the frame is flush with the floor and no hazard is presented to pedestrian traffic. The rest of section 48 is supported by and suspended below frame 52, and it is in register with an opening in the floor. The frame 52 has an inwardly directed ledge which supports a grid 50; and that grid spans the opening in the floor. The grid 50 must be strong enough to bear all the traffic through the door, and it will preferably be made in sections to decrease its cost and to lessen the difficulty of installation and removal. The frame 52 must be very sturdy because it must support the grid, the weight of the persons and objects moved and moving across the grid, and the rest of section 48.

Depending downwardly from the inner faces of the angle iron frame 52, and suitably attached thereto by bolts or the like, are sheet metal walls which coact to define a generally air-tight chamber 56. That chamber is elongated in the horizontal direction, and it is generally trapezoidal in end elevation. The left side of housing 56, as that housing is viewed in FIG. 2, is imperforate while the right side of that housing is open. A baffle or deflector 54 is mounted adjacent the open right side of the housing 56, and a screen 58 is removably supported between the lower end of that deflector and the bottom of the housing 56. This screen will intercept and hold particles of paper, particles of dirt, cigarettes and the like which may fall downwardly or be drawn downwardly through the grid 50. A water spray 57 is mounted in the housing 56, and that water spray is shown in the form of an elongated pipe with a number of short nipples projecting therefrom. This spray is adjacent the bottom of the housing 56 and it directs a number of sprays of water along that bottom. Those sprays will extinguish any lighted cigarettes which might be dropped or drawn into the grid and will also tend to wash any debris down to the low point of the housing 56. A drain connection 60 is provided at the low point of the housing and debris will be washed to that drain connection and exhausted from the housing at that point.

A coil and filter housing 62 is bolted to the housing 56. In that coil and filter housing a number of supports 64 are provided to releasably hold filters 66. Different filters can be mounted in the supports 64, and any convenient filter can be selected for use in the housing 62. In the particular modification shown, an open-work, metal filter is provided. The filter 66 can be readily removed for cleaning or replacement through a detachable panel, not shown, of housing 62. Screen 58 can be removed by lifting the side portions of grid 50.

Behind the filters 66 a coil 93 is mounted; and that coil can be selectively connected to a source of heat and to a source of cooling effect, as desired. If it is desired to use direct expansion of a refrigerant for cooling, two or more coils may be provided; one or more for heating and the other coils for cooling. If steam or hot water is to be used for heating and chilled water is to be used for cooling, the same coil or coils can be used for both heating and cooling.

Openings 68 are provided at both ends of the coil and filter housing 62, and generally J-shaped ducts 69 are connected to that housing to communicate with those openings. Those ducts extend downwardly from the openings 68 to the inlets of multi-vane blowers 70. The rotors of the blowers 70 are mounted on shafts 72 and those shafts support pulleys 74 that are belted to motor pulleys 76 by belts 78. The motor pulleys are mounted on the shafts of motors 80. Preferably the motors 80 will be variable speed motors so the velocity of the air in the various walls of the air screen can be adjusted at will. From the outlets of blowers 70, two generally trapezoidal ducts 81 extend upwardly through the floor to abut the hollow columns 20 and 46. The upper ends of the ducts 81 are in register with and connected to the lower ends of the columns 20 and 46 as illustrated in FIG. 6. The securing plate 42 of the column 20 is

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supported by and bolted to the rigid angle iron frame 52; that frame having outer dimensions corresponding to the outer dimensions of the plate 42. The plate 42 of the column 46 will be similarly secured to the frame 52 at the opposite side of the doorway; and in this way the two columns are secured to and supported by the bottom section. The connections between the ducts 81 and the lower ends of the columns 20 and 46 will be substantially air-tight. The frame 52 will preferably define an opening that is as long as the distance from the left-hand plate 22 of column 20 to the right-hand plate 22 of column 46; and that frame will preferably have transversely directed angles 53 to help support the confronting faces of the ducts 81.

The numeral 82 generally denotes a fourth section of the structure for producing air screens. The section 82 is located above the door which the air-screen is to protect, and that section is elongated in the horizontal direction and it is substantially rectangular in end elevation. As shown in FIG. 5, section 82 has three openings in the bottom thereof. One of those openings, namely opening 84, is in register with the column 20, the opening 86 is in register with the column or section 46 and the opening 88 is disposed between the openings 84 and 86. The opening 88 is much longer than the total width of the other two openings, and it is substantially as long as the space between the columns or sections 20 and 46.

A set of air directing vanes 90 receives part of its support from a frame 92 that extends beyond the ends of the vanes 90 to bound the bottom of the section 82. Transversely extending angles 91 are secured to the longitudinally extending angles of the frame 92, and these angles are spaced inwardly from the angles which define the opposite ends of the frame 92. These inwardly spaced angles are disposed inwardly short distances from the ends of the opening 88, thereby forming two narrow and elongated openings 94 that are transverse of the plane of the doorway which the air screen is to protect. These openings are desirable because they permit thin films of air to be forced downwardly immediately adjacent the confronting faces of the sections 20 and 46. The angles 91 support a longitudinally extending angle 93 that helps support the vanes 90. Those vanes are held in the opening 88 and form the series of spaced walls that constitute the air screen. The films at the opposite ends of the opening 88 coast with the spaced walls of air defined by the vanes 90 to prevent breakthroughs at the ends of the air screen.

The sections 20 and 46 are firmly supported by having their securing plates 42 bolted to the rigid angle iron frame 52 that is mounted on the floor; and those sections have their upper ends firmly connected to the section 82 by having their securing plates 40 bolted to the frame 92 of that section. In this way the four sections are rigidly connected and the sections 20 and 46 support the top section 82. In other words, the four sections 20, 46, 48 and 82 are integrated into a sturdy and self-supporting frame around the doorway.

The four sections 20, 46, 48 and 82 can be prefabricated at the shop and then shipped to the job in prefabricated form or in "knocked down" form ready for re-assembly on the job. In either event, the fabrication at the shop takes full advantage of shop practices and shop tools for the initial assembly, and it also makes certain that the parts fit together properly. As a result, the final assembly at the job is quick and certain.

When the sections have been assembled, the blowers 70 will force air upwardly through the generally trapezoidal ducts 81, which are between the outlets of the blowers 70 and the bottoms of the sections 20 and 46, will force the air upwardly through the sections 20 and 46 into the top section 82, which serves as a plenum chamber, and will force the air outwardly between the air-directing vanes 90 and also out through the narrow

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elongated openings 94. That air will move downwardly as a series of closely spaced walls of air plus two films of air that move adjacent the confronting faces of the sections 20 and 46. Where it has been necessary to eliminate either section 20 or section 46, only one blower will be used. That blower must then have sufficient capacity to maintain the proper air velocity and air volume in the air screen. The air of the air walls and of the two films of air will be drawn into the bottom section through the grid 50 and will then be forced downwardly adjacent the bottom of the pit before it passes through the screen 58. Having passed through the screen, the air is filtered by passing through the filters 66 and is heated or cooled, as the case may be, by passing through the coil or coils 98.

The bottom of the section 48 will be sprayed on the average of one minute for every ten minutes during the operation of the structure. This makes it possible to extinguish any lighted cigarettes that are dropped or drawn down through the grid. Further, it washes any debris down to the drain so that the debris can not clog up the screen and reduce the air flow materially.

Another form of structure provided by the present invention is shown in FIGS. 7-11. The section 104 below the doorway will be different from the section below the doorway in FIGS. 1-6, because the modification shown in the latter views was adapted for mounting in a basement underneath the doorway. As a result that section could be pre-fabricated of metal; and the motors, blowers, filters and coils could be mounted below it or in it. The structure shown in FIGS. 7-11 is adapted for use adjacent doorways that do not have basements beneath them. The section 104 is smaller and it is not prefabricated of metal; instead it is formed of concrete poured in a suitable excavation below the doorway. The pit has a sturdy angle iron frame 101 around it and that frame is generally comparable to the frame 52 of section 48. The frame 101 supports a heavy grid 103 which spans the pit and which supports the traffic through the doorway. Transversely directed angles 105 extend between the longitudinally directed angles of the frame 101, and these angles and the ends of the frame 101 define small rectangles.

Expanded metal screens 109 or other similar screens are suitably mounted in supports adjacent the angles 105. Those supports hold these screens in position to intercept debris drawn into the pit, and yet they make it possible to remove the screens, as by pulling upwardly on those screens. The screens 109 perform the same functions that are performed by the screens 58 of FIGS. 1-6.

A water pipe 106 projects from one side of the pit and extends vertically downward to a T. Perforated pipes 107, with spray nozzles mounted thereon, are connected to each of the horizontally directed arms of the T, and those spray nozzles are directed horizontally across the bottom of the pit. The spray from those nozzles will wash the air passing through the pit, will extinguish lighted cigarettes, and will drive any debris to the drain, much in the manner in which the spray from nozzle 57 of FIG. 2 does.

The section of the structure shown in FIGS. 7-11, denoted by the numeral 110, differs from the section 82 mounted above the doorway in FIGS. 1-6. Section 110 has a number of heavy structural elements which are needed because this section not only serves as a plenum chamber, as did section 82, but it also houses the motors; blowers and filters. In particular, a number of angles 112 and 114 extend longitudinally of the section 110 and parallel to the plane of the doorway. Those angles are interconnected by angles 117 at the ends of that section, and by plates 119 intermediate those ends. In addition, that section is reinforced by diagonal braces 118.

Three multi-vane blowers 124, 140 and 142 are supported in the section 110 by means of vertical brackets 120 which are secured to longerons 123 that are secured

to angles 125. Those angles, in turn, are rigidly mounted on the angles 112 and 114 of the section 110. The blowers 124, 140 and 142 are thus afforded full support. The rotors of the multi-vane blowers are interconnected by stub shafts 128 and 130 and suitable couplings and hence all of those rotors move together. A pulley 132 is mounted to drive the rotor of blower 142, and a belt extends over that pulley and over the pulley on the shaft of the motor 134. In this way, the rotors of the various multi-vane blowers are held for conjoint and simultaneous rotation by the motor 134. That motor is preferably a multi-speed motor so the desired air velocity and volume can be obtained. The motor is mounted on transversely extending angles 115 which are between and are secured to the lower angles 112 and to the lower longerons 123.

Openings 135 are provided in the bottom of the section 110 at the opposite ends of that section, and filters 127 are removably mounted in that section above those openings. As shown in FIG. 11, those filters are set at an angle to the vertical. The blowers 124, 140 and 142 will draw air upwardly through the openings 135 and through the filters 127, and will then discharge that air toward an arcuate deflector 126 that will direct that air downwardly between the air-directing vanes. Those vanes are suitably supported by the lower angles 114 and by the lower longerons 123. The vanes are shorter than the distance between the angles 125, and therefore thin films of air will be formed at the ends of the vanes 129, and those films will be perpendicular to the walls in the air screen.

There are two vertical sections 100 and 102 which will be made so they are similar in structure to the sections 20 and 46 of FIGS. 1-6. The section 102 has, however, an opening 136 at the right-hand side thereof, and it has a damper 138 mounted in it adjacent that opening. The opening 136 and the damper 138 are intended to bypass the air from the upper part of that section into a heating unit when the weather is cold. When the weather is warm, the baffle 138 can be set vertical, and unheated air will pass to the blowers. In the particular modification shown, the heating unit 144 burns gas and it has a finned heat exchange surface to transfer heat to the air passing through it. The air to be heated will be drawn upwardly through the section 102 and through the J-shaped duct 143 by the action of the blowers 124, 140 and 142, and particularly by the action of the blower 142; and it will then be drawn over the finned heat exchange surfaces in the heater housing 144. The capacity of the heater in the housing 144 will be great enough to provide all of the heat required for the maintenance of the desired temperature for the air being discharged through the air-directing vanes 129. A thermostat will usually be provided to maintain the desired temperature for that air. A good part of that air will be recirculated, and hence the air moving upwardly through the section 100 will also be warm. The temperature of the air issuing across the full area of the section 110 will be approximately the same.

The four sections of the structure shown in FIG. 7-11 can be bolted together to provide a sturdy, self-supporting structure adjacent a doorway. Those sections will be pre-fabricated in the shop and then shipped to the job in that form or in "knocked down" form. The sections 100 and 102 can be secured to the angles 105 by passing screws through the bases 38 and seating those screws in those angles; much in the manner of "toe nailing."

If it is desired to use refrigerated air in the air screen, an air-conditioning unit 146 can be connected to the upper section, as indicated in FIG. 12, by a duct 150. That section is denoted by the numeral 152, and it is generally similar to the section 110 of FIGS. 7-11. However, the blower 142 in the section 152 has been set so it discharges its air toward the rear of the section 152 while the other two blowers discharge their air toward the front of that section. The blower 142 will, therefore, force its air

through the duct 154, through the unit heater 148 and then through the duct 156 into the front portion of the section 152. When that heater is operating, it will heat the air, and that air will mix with and warm the air issuing from the blowers 124 and 140; and hence the air that is forced downwardly across the area of the doorway will be warm. In summer, the air from the blower 142 will pass through the unheated unit 148 and will mix with refrigerated air that is forced up to the duct 156 by blowers in the air conditioning unit 146. The resulting cooled air will enter the plenum chamber defined by section 152 and will mix with the air from the blowers 124 and 140 to cool the air used in forming the air screen. The air from the blower 142 will help draw the air out of the duct 150, as by aspiration. A damper 158 is provided in the duct 150 and will be used to block that duct when warm, rather than cooled, air is desired.

If desired, a cooling coil could be mounted anywhere adjacent the outlet of the blower 142 or the outlet of the unit heater 148. Refrigerant or some other cooling medium could be conducted to that coil to make the structure self-contained.

Whereas the drawing and accompanying description have shown and described several preferred embodiments of the present invention, it should be apparent to those skilled in the art that various changes may be made in the form of the invention without affecting the scope thereof.

What I claim is:

1. A structure that can be disposed adjacent a doorway to generate an air screen which spans and fills said doorway and that comprises a vertically-directed air duct, a pit that is adjacent the bottom of said doorway and that is in communication with the bottom of said air duct, said pit having a bottom, a drain opening in said bottom of said pit, a water spray in said pit, an opening in the top of said pit, a grid in said opening in the top of said pit, a plenum chamber that is adjacent the top of said doorway and that is in communication with the upper end of said air duct, an opening in the bottom of said plenum chamber, said opening in the bottom of said plenum chamber being above and generally in register with said opening in the top of said pit, a plurality of air-moving devices in said plenum chamber, a plurality of air-directing surfaces in said plenum chamber adjacent said opening in the bottom of said plenum chamber, a heating device, said heating device being mounted exteriorly of said plenum chamber, an air passage that extends from the outlet of one of said air-moving devices to the air inlet of said heating device, and a second air passage that extends from the air outlet of said heating device to a space that is within said plenum chamber and is above said air-directing surfaces, the outlets of other of said air-moving devices communicating directly with said space in said plenum chamber above said air-directing surfaces, whereby the heated air from said heating device can commingle with the air from said other air-moving devices prior to passing downwardly between said air-directing surfaces, said air-moving devices forcing air past said air-directing surfaces and through said opening in the bottom of said plenum chamber to form said air screen, drawing said air screen across said doorway to and through said grid in said opening in the top of said pit, and drawing the air from said pit through said air duct to said plenum chamber, said water spray being operable while said air screen is being maintained.

2. A structure that can be disposed adjacent a doorway to generate an air screen which spans and fills said doorway and that comprises an air duct adjacent one of the sides of said doorway, an air-inlet chamber that is adjacent a second side of said doorway and that is in communication with one end of said air duct, an opening in said air-inlet chamber that is contiguous with said doorway, a plenum chamber that is adjacent that side of said

doorway to which said air-inlet chamber is opposite, said plenum chamber being in communication with the other end of said air duct, an opening in said plenum chamber that is contiguous with said doorway, said opening in said plenum chamber being generally in register with said opening in said air-inlet chamber, a plurality of air-moving devices in said plenum chamber, a plurality of air-directing surfaces in said plenum chamber adjacent said opening in said plenum chamber, a heat-exchanging device that is mounted externally of said plenum chamber, an air passage that extends from the outlet of one of said air-moving devices to the air inlet of said heat-exchanging device, and a second air passage that extends from the air outlet of said heat-exchanging device to a space that is within said plenum chamber and is inwardly of said air-directing surfaces, the outlets of other of said air-moving devices communicating directly with said space in said plenum chamber inwardly of said air-directing surfaces, whereby the conditioned air from said heat-exchanging device can commingle with the air from said other air-moving devices prior to passing between said air-directing surfaces, said air-moving devices forcing air past said air-directing surfaces and through said opening in said plenum chamber to form said air screen, drawing said air screen across said doorway to and through said opening in said air-inlet chamber, and drawing the air from said air-inlet chamber through said air duct to said plenum chamber.

3. A structure that can be disposed adjacent a doorway to generate an air screen for said doorway which spans and fills said doorway and that comprises a pit adjacent the bottom of said doorway, an opening in the top of said pit, a grid in said opening, a plenum chamber disposed above the level of said pit, an opening in the bottom of said plenum chamber that is generally in register with the opening in the top of said pit, a duct that is in communication with and extends between said pit and said plenum chamber, an air-moving device for moving the air in said duct to the plenum chamber from said pit, a plurality of air-directing surfaces, means for mounting said air-directing surfaces adjacent the opening in the bottom of said plenum chamber, said air-directing surfaces extending throughout the major portion of said opening in the bottom of said plenum chamber but terminating short of the opposite ends of said opening in the bottom of said plenum chamber and short of the opposite sides of said doorway to define two narrow openings which are parallel to the direction of pedestrian traffic through said doorway and which are adjacent said opposite sides of said doorway, said narrow openings enabling said air-moving device to direct two thin films of air downwardly adjacent said opposite sides of said doorway, said narrow films

coacting with an air stream provided by the air-directing surfaces to prevent break-throughs of said air screen.

4. A structure that can be disposed adjacent a doorway to generate an air screen for said doorway which spans and fills said doorway and that comprises an air-inlet chamber adjacent one side of said doorway, an opening in said air-inlet chamber that is contiguous with said doorway, a plenum chamber adjacent that side of said doorway which is opposite to the side to which said air-inlet chamber is adjacent, an opening in said plenum chamber that is generally in register with the opening in said air-inlet chamber, said opening in said plenum chamber being adjacent said doorway, a duct that is in communication with and extends between said air-inlet chamber and said plenum chamber, an air-moving device for moving the air in said duct to the plenum chamber from said air-inlet chamber, a plurality of air-directing surfaces, means for mounting said air-directing surfaces adjacent the opening in said plenum chamber, said air-directing surfaces extending throughout the major portion of said opening in said plenum chamber but terminating short of one of the opposite ends of said opening in said plenum chamber and short of the remaining opposed sides of said doorway to define a narrow opening which is parallel to the direction of pedestrian traffic through said doorway and which is adjacent one side of said doorway, said narrow opening enabling said air-moving device to direct a thin film of air adjacent said side of said doorway that extends between said plenum chamber and said air-inlet chamber, said narrow film coacting with said air screen to prevent break-throughs of said air screen.

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