Nov. 2, 1965 G. A. M. ANDERSON 3,215,058

AIR CURTAIN APPARATUS

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FIG. 1

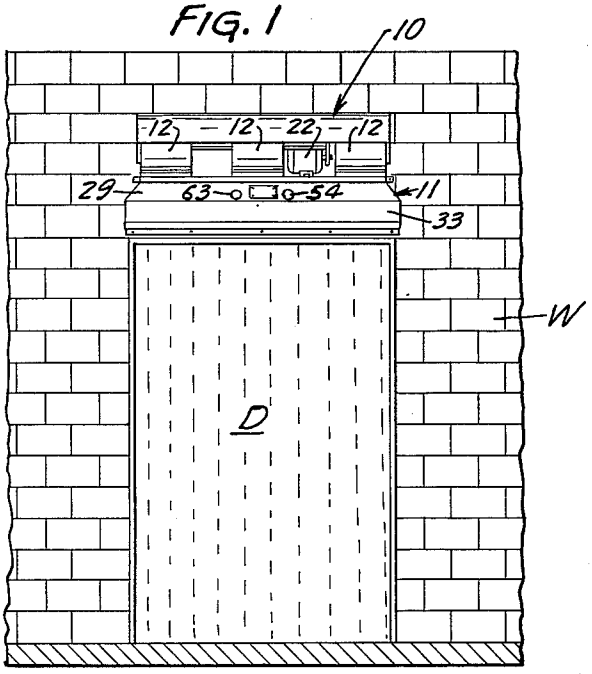

FIG. 2

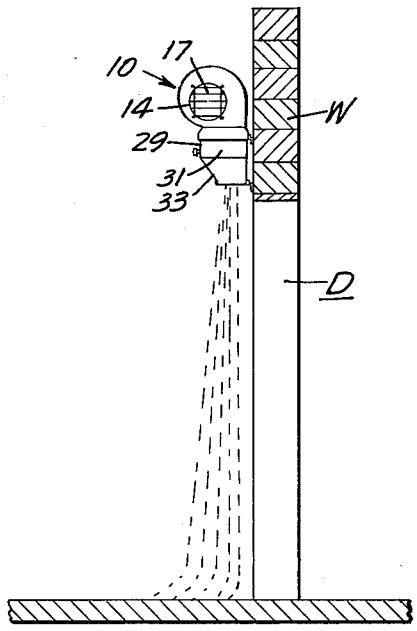

FIG. 6

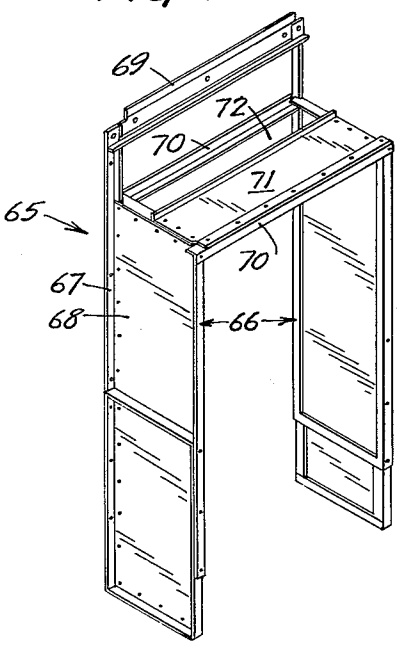

FIG. 7

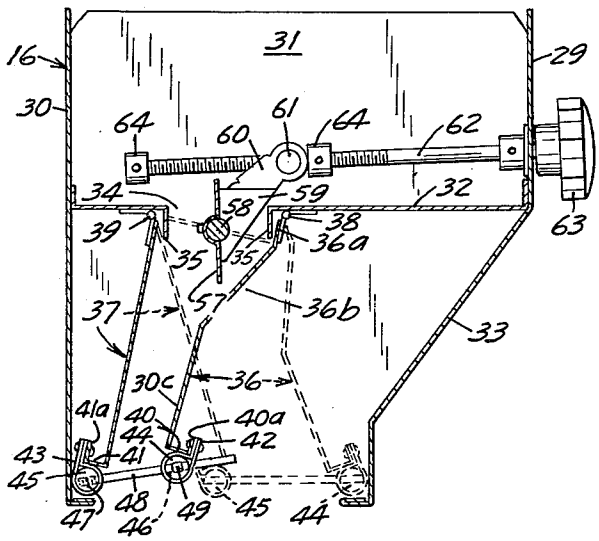

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FIG. 3

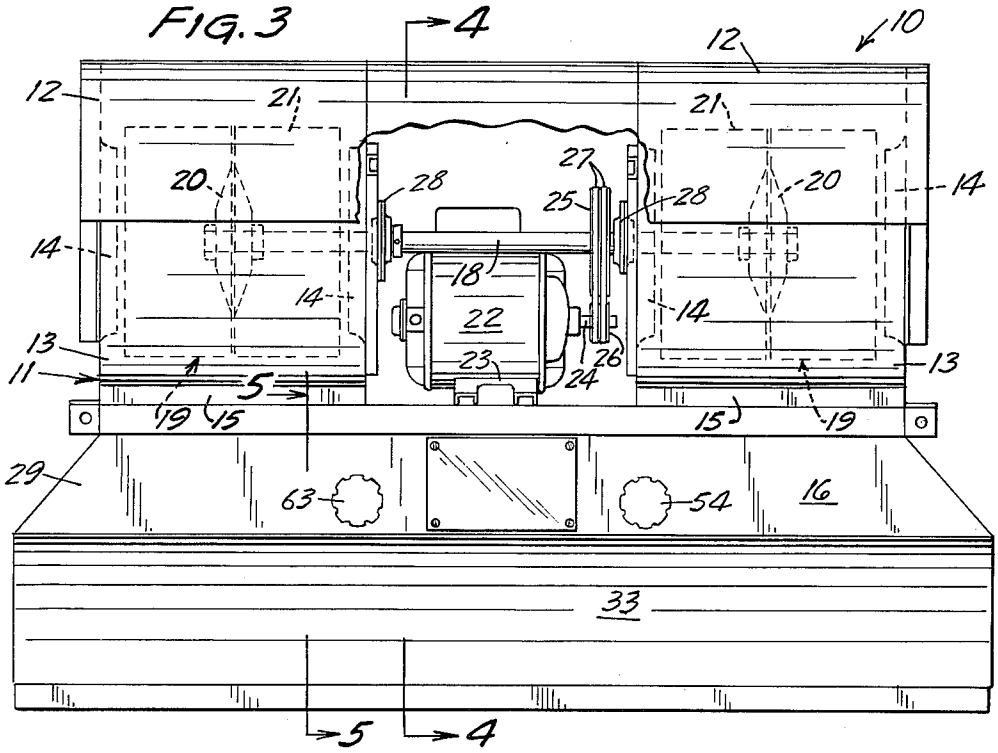


FIG. 4

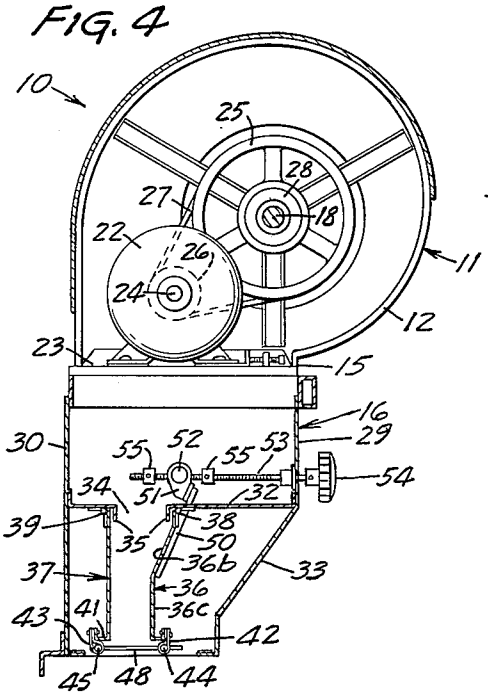
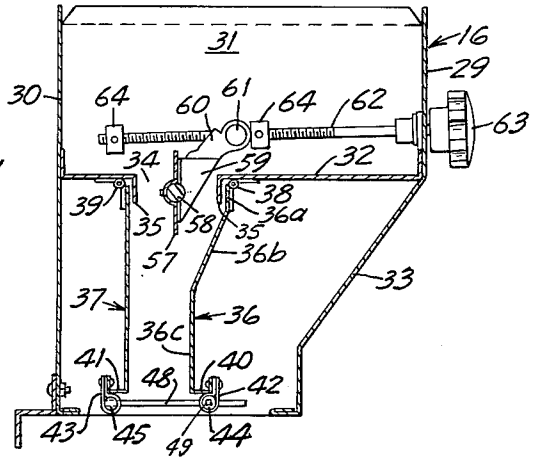


FIG. 5



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AIR CURTAIN APPARATUS

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Filed Oct. 15, 1962, Ser. No. 230,574
5 Claims. (Cl. 98—36)

This invention relates to apparatus for use in producing an air curtain across the doorway in a building wall structure to form thermal and decontamination barriers thereat.

An object of this invention is to provide a highly effective apparatus, of simple and inexpensive construction, for producing an air curtain across a doorway in a building wall structure to form a thermal barrier thereat separating areas of varying temperatures, or to form a decontamination barrier at such a doorway to prevent the intrusion of insects, dust and other air-born contaminates therethrough.

Another object of this invention is to provide a novel and improved apparatus for producing an air curtain across a building doorway, and which includes multiple control means for readily controlling and adjusting the flow characteristics and design of the air curtain such as the angle of deflection of the air curtain with respect to the vertical plane of the doorway, the thickness and cross-sectional configuration of the air curtain, and volume and the velocity of the air stream forming the air curtain, thereby permitting the air curtain to selectively function as highly effective thermal and decontamination barriers.

A more specific object of this invention is to provide a novel and improved air curtain producing apparatus including a housing structure which is readily mountable adjacent the top of a doorway in a building wall structure, and having mechanism associated therewith for producing a stream of air and directing the same downwardly through an orifice in the housing structure, the stream of air passing between depending partitions hingedly mounted in predetermined spaced-apart relation on opposite sides of the housing orifice to cause the air flowing therebetween to form an air curtain across the door way, and means for swinging the partitions in unison while maintaining the predetermined spacing therebetween whereby the median plane of the air curtain may be deflected on both sides of the vertical to form acute angles therewith thereby permitting the most effective application of the air curtain with regard to the ambient air conditions on either side of the curtain to be obtained so that the air curtain is readily and ideally applicable for use as thermal and decontamination barriers.

A further object of this invention is the provision of a novel air curtain producing apparatus of the class described wherein the partitions present inner opposed surfaces one of which is planar and the other being convex so that a venturi effect is produced on the air flowing between the partitions whereby the air flow of at least one of the faces of the air curtain is of non-turbulent nature and wherein very little diffusion occurs between ambient air and the air curtain so that the latter functions as highly effective thermal and decontamination barriers.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawings where like character references refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a front elevational view of my invention illustrated in cooperating relation with a doorway in a building wall structure;

FIG. 2 is a side elevational view thereof;

FIG. 3 is a front elevational view of my invention on an enlarged scale with parts thereof broken away for clarity;

FIG. 4 is a vertical cross-sectional view taken approximately along line 4—4 of FIG. 3 and looking in the direction of the arrows;

FIG. 5 is a vertical cross-sectional view on an enlarged scale taken approximately along line 5—5 and looking in the direction of the arrows;

FIG. 6 is a perspective view of the mounting means and air curtain confining structure which may be advantageously employed with the present invention when the same is used to produce a thermal barrier; and

FIG. 7 is a cross-sectional view similar to FIG. 4 and on a larger scale, illustrating the partitions in different positions of adjustment.

Referring now to the drawings it will be seen that one embodiment of my novel apparatus for producing an air curtain and designated generally by the reference numeral **10** is shown mounted at the top of a doorway D in a building wall structure W. My apparatus **10** includes a housing structure **11** which is comprised of a blower assembly housing **12**. It will be noted that the blower assembly housing **12** is of generally cylindrical configuration having a tangential downwardly facing outlet through which the air produced by the blower assembly is discharged.

The interior of the blower assembly housing **12** at opposite end portions thereof defines a pair of blower chambers **13** each having a bladed blower mechanism positioned therein. It will be seen that each of the blower chambers **13** has an axially opening air inlet **14** through which the air is drawn and that the air is discharged downwardly through the tangential outlet **15** and into a plenum chamber structure **16**. Thus it will be seen that the housing structure **11** not only includes the blower assembly housing but also a plenum chamber structure **16**. Referring again to FIG. 1 it will be noted that the plenum chamber structure **16** extend transversely of and above the doorway D throughout the width thereof.

The air inlet **14** for each of the blower chambers **13** is provided with a suitable grill type guard member **17**, each guard member being detachably secured to its associated end wall of the blower assembly housing **12**. The blower assembly also includes an elongate shaft positioned within the blower assembly housing **12** in longitudinally extending relation thereto and having its opposite ends projecting into the blower chambers **13** as best seen in FIG. 3. Each end of the blower shaft **18** suitably supports one of the bladed blower mechanisms **19**, the latter including a hub **20** keyed to the shaft **18** and having blades **21** affixed thereto. Thus it will be seen that when the blower shaft **18** is revolved, the blower mechanisms **19** and the blower chambers **13** will also be revolved and will produce a stream of air which will be directed downwardly and into the plenum chamber structure **16**. These blower mechanisms or units are commonly referred to in the trade as squirrel cage blower units.

The means for revolving the blower mechanisms **19** include an electric motor **22** positioned within the blower assembly housing **12** and mounted upon suitable support frame elements **23**, the latter extending transversely of the blower assembly housing **12**. Referring now to FIG. 4 it will be seen that the drive shaft **24** of the electric motor **22** is disposed in substantially parallel relation with respect to the blower shaft **18**. It will also be seen that the blower shaft **18** is provided with a relatively large driven pulley **25** which is affixed thereto for rotation therewith. The output or drive shaft **24** of the electric motor **22** is provided with a smaller drive pulley **26** keyed thereto and an endless V-type drive belt **27** is trained around the pulleys **25** and **26** whereby the rotary drive

of the output shaft is transmitted to the blower shaft **18** so that the blower mechanisms are revolved and a stream of air is directed downwardly from the respective blower chambers **13** and into the plenum chamber **16**.

Referring again to FIGS. 3 and 4 it will be seen that the blower shaft **18** is supported intermediate its ends by suitable bearing units **28** whereby the ends of the rotary shaft are free to permit mounting of the blower mechanisms **19** thereon. It is also pointed out that the motor **22** is preferably a one-horse power motor which operates at approximately 3450 r.p.m. It will also be noted that because of the differential in size of the drive pulley **26** and the driven pulley **25**, a speed reduction takes place through this drive connection.

Referring now to FIGS. 4 and 5 it will be seen that the blower chambers **13** at tangential outlets **15** communicate directly with chamber structure **16** so that the air stream produced by the blower mechanisms **19** is directed into this plenum chamber structure **16**. The plenum chamber structure is preferably constructed of a rigid material such as metal or the like and includes a front wall **29**, a rear wall **30**, opposed end walls **31** and a bottom wall **32**. The respective upper portions of the rear wall **30**, the front wall **29**, end walls **31** and bottom wall **32** cooperate with each other to define a plenum chamber. It will be noted that the bottom wall **32** has an elongate discharge orifice **34** formed therein through which the air is discharged from the plenum chamber structure **16**. It is pointed out that it is preferred that the discharge orifice **34** extend transversely of the doorway D a distance substantially at least the width of the doorway and preferably a distance slightly in excess of the width of the doorway. With this arrangement, the curtain of air produced will flow completely across the doorway at which the air barrier is formed. It will also be noted that the edges of the bottom wall **32** surrounding the orifice **34** are provided with downturned flanges **35** as best seen in FIGS. 4 and 5.

Means are provided for causing the air discharged through the discharge orifice **34** to be formed into a curtain to be directed across the doorway D and this means includes a pair of depending partitions arranged in fore and aft spaced-apart relation and being swingably mounted on opposite sides of the discharge orifice **34**. The front partition, designated by the reference numeral **36**, is hingedly connected at its upper end portion to the lower surface of the bottom wall **32** by hinge means **38**. The rear partition, designated generally by the reference numeral **37**, is similarly interconnected at its upper portion to the lower surface of the bottom wall **32** by hinge means **39**. Thus it will be seen by the dotted line configuration of FIGS. 5 and 7 that the partitions **36** and **37** are swingable about transverse axes in both a fore and aft direction with regard to the vertical plane of the doorway D. It is also pointed out that the partitions **36** and **37** extend transversely of the doorway a distance corresponding to substantially the length of the discharge orifice **34** and thereby control and cause the air discharged through the orifice **34** to form an air curtain across the doorway D

Again referring to FIGS. 4 and 5 it will be noted that the inner surface of the rear partition **37** is substantially planar throughout its downward longitudinal extent. The front partition on the other hand includes an uppermost portion **36***a* secured to the associated hinge means **38** and the intermediate portion **36***b* which converges downwardly and towards the rear partition and terminates in a downwardly extending portion **36***c*. Thus it will be seen that the inner surface of the front partition **36** is of convex configuration so that the passage defined between the front and rear partitions normally converges downwardly from adjacent the orifice **34** to a restricted throat and then terminates downwardly in a symmetrical portion. It will therefore be seen that the front and rear partitions cooperate with each other to function as a nozzle and to produce a venturi effect on the air passing therebetween to most efficiently convert the static pressure of the air in the plenum chamber to the maximum velocity pressure at the restricted throat and to create a smooth non-turbulent flow of air with minimum air sound through the lower part of the space defined by the partitions.

Because of the aero-dynamic design of the opposed surfaces of the front and rear partitions **36** and **37**, the air curtain produced across the doorway will have a smooth, non-turbulent face at the rear thereof and will also have a substantially non-turbulent front face. This arrangement is extremely important when the air curtain is functioning as a thermal barrier since there will be little diffusion with ambient air.

It will be appreciated that the spacing between the front partition **36** and the rear partition **37** will determine the thickness of the air curtain thus created. Means are therefore provided for adjustably connecting the front and rear partitions together so that the spacing therebetween may be variously adjusted and thereby permit adjustment of the thickness diverging or converging pattern of the air curtain. This interconnecting means also permits swinging of the front and rear partitions in unison when it is desirable to adjustably deflect the direction of the air curtain with respect to the vertical plane of the doorway to balance the variable ambient pressures caused by wind changes, exhaust systems, and temperature changes in the area adjacent to the air curtain. To this end the front panel **36** as its lower end portion bent forwardly as at **40** and then upwardly as at **40***a* while the rear panel **37** has its lower end portion bent rearwardly at right angles as at **41** and then upwardly as at **41***a*. A pair of elongate adjustable link members each extend between and interconnect the front and rear partitions respectively at their lower ends.

Referring now to FIG. 5 it will be seen that each of these link members includes a pair of clamping elements **42** secured to the upturned portion **40***a* of the front partition **36** and a pair of clamping elements **43** secured to the upturned portion **41***a* of the rear partition **37**. It is pointed out that these clamping elements are preferably secured to the upturned portions or flanges of their associated partition members by suitable securing means such as bolts, rivets or the like and that these clamping elements are of identical construction and are preferably formed of a suitable somewhat resilient material such as nylon or the like. The front pair of clamping elements **42** engages and supports a transversely extending, cylindrically shaped rod-support element **44**. The rear pair of clamping elements **43** support a cylindrically shaped transversely extending rod support element **45**, the latter being disposed in substantially parallel relation with respect to the front rod support element **44**. It is pointed out that the front pair of clamping elements **42** are laterally spaced-apart from each other and that the rear pair of clamping elements **43** are also spaced-apart from each other. Thus the intermediate portion of the associated rod support elements will be positioned between the corresponding pair of clamping elements. The front rod support element **44** is provided with a diametrically extending bore **46** through the intermediate portion thereof and the rear rod support element **45** is also provided with a diametrically extending threaded bore **47** through the intermediate portion thereof.

An elongate link rod **48** extends through the bore **46** of the front rod support element **44** and threadedly engages the threaded bore **47** of the rear rod support element **47**. The front rod support element **44** is also provided with an axially extended threaded bore therein which threadedly receives a set screw **49** therein, the latter engaging the front portion of the link rod **48** to clamp the same in an adjusted position. It will therefore be seen that through use of this pair of longitudinally extensible and retractable link members, the spacing between the

partitions 36 and 37 may be variously adjusted. Therefore the thickness and particular configuration of the air curtain thus produced may be adjusted for the most effective application of the air curtain with respect to its particular function as will be explained more fully hereinbelow.

As pointed out above, the air curtain produced by my novel apparatus may be used as a thermal barrier or it may be used as a contamination barrier to prevent the intrusion of air-borne contaminates through the doorway D. Therefore under certain conditions, and in order to obtain the most effective results of the air curtain for the particular manner in which it is used, it is desirable to change the deflection of the air curtain with respect to the vertical plane of the doorway. Therefore mechanism is provided for shifting the front and rear partitions in unison in a fore and aft direction about their horizontal axes.

This partition shifting mechanism in the embodiment shown includes a rigid shifting arm 50 which is secured to the front surface of the intermediate converging portion of the front partition 36 by suitable fastening means such as bolts, assemblies or the like. This arm 50 projects upwardly through an opening in the bottom wall 32 of the plenum chamber structure 16 as best seen in FIG. 4. The upper end of the shifting arm 50 has a holding bracket 51 secured thereto for movement therewith. This bracket 51 includes upper bifurcated arms 51*a* which are attached to opposite sides of the traveling nut 52 which can rotate in holding bracket 51 to allow for angular changes in the threaded actuator.

The traveling nut 52 is provided with a threaded bore and threadedly engages an elongate revolvable threaded actuator element 53. This elongate threaded actuator element 53 has a revolvable knob 54 secured to the front portion thereof and it will be noted that the knob is revolvably mounted and projects outwardly of the front wall 29 of the plenum chamber structure 16. It will be seen that when the actuating knob 54 is revolved, the traveling nut 52 will be moved axially of the elongate actuating element 53 and thereby cause swinging movement of the front and rear partitions in unison about their hinge axes.

In order to limit the amount of movement of the traveling nut 52 and swinging movement of the partitions 36 and 37, stop collars 55 are adjustably mounted in longitudinally spaced-apart relation on the actuating element 53 and are disposed on opposite sides of the traveling nut 52. The stop collars are preferably of the type having smooth bores therein to permit axial sliding movement along the actuating element 53 and each is provided with a set screw for retaining the same in adjusted relation with respect to the elongate actuating element 53.

It is pointed out that the relative amount of swinging movement of the partitions may be variously adjusted by the adjustment of the stop collars 55 but it is preferred that the partitions be swung in a forward direction through an arc not greater than approximately 19°. It is also preferred that the partitions be swung in a rearward direction through an arc not exceeding 11°. Although this range may be substantially increased, it has been found that in the particular embodiment illustrated, this 30° range of swinging movement suffices for most purposes.

In addition to the control means previously described for controlling the direction of flow of the air curtain with respect to the vertical and for controlling the thickness and configuration of the air curtain thus produced, means are also provided for controlling the volume of air flow forming the air curtain. This volume control means includes an elongate substantially flat damper member extending longitudinally of the orifice 34 and being swingably mounted for movement between orifice closing and orifice open positions. The pivotal or swinging mounting of the damper member 57 includes an elongate substantially cylindrical pivot rod 58 which is attached to the longitudinally extending arcuate intermediate portion of the damper member 57 and which has its opposite end journaled in suitable bearings carried by the end walls 31 of the plenum chamber structure 16. It is pointed out that the damper member 57 is of the length corresponding substantially to the length of the orifice 34 and that the damper member is also variously adjustable between the orifice open and closed positions. It will be noted that the damper member 57 is of the width slightly greater than the width of the orifice 34 so that when the damper member is swung from its vertical or orifice open position, as illustrated in FIG. 5, to a substantially horizontal position, this damper member will be disposed in orifice closed relation to prevent flow of air through the orifice.

Actuating mechanism is also provided for vigorously adjusting the damper member 57 between the orifice open and closed positions and to this end it will be seen that this actuating mechanism includes a bracket member 59 secured to the damper member 57 and having upwardly extending bifurcated arms 60 the latter having a traveling nut 61 extending therebetween and attached thereto. This traveling nut 61 is provided with a threaded bore for threadedly receiving an elongate actuating element 62 therethrough. A revolvable control knob 63 is revolvably mounted and projects outwardly of the front wall 29 of the plenum chamber structure 16 and it will be seen in FIG. 5 that this control knob 63 is secured to the front end of the elongate actuating element 62 for rotation therewith. Thus when the control knob 63 is revolved, the traveling nut 61 will be moved axially along the elongate actuating element 62 to thereby cause swinging movement of the damper member 57 about its pivotal axis.

Means are also provided for limiting swinging movement of the damper member about its pivotal axis and to this end a pair of spaced-apart stop collars 64 are positioned in longitudinally spaced relation along the elongate actuating element 62. These stop collars 64 are of similar construction to the stop collars 55 associated with the control mechanism for controlling swinging movement of the front and rear partitions 36 and 37. It is pointed out that the stop collars 64 are provided with smooth bores therein to permit slidable mounting of the stop collars upon the elongate actuating element 62. Suitable set screws are provided for retaining the stop collars in the pre-set adjusted relation upon the actuating element 62.

As pointed out above, my novel air curtain producing apparatus will produce an air curtain which may be used to serve as a contamination barrier at an opening or doorway in a wall or also may be used as a thermal barrier at such an opening. However, it will be appreciated that the effectiveness of the air curtain to form both decontamination and thermal barriers will be dependent on the varying conditions which affect the air curtain thereby requiring adjustment of the flow characteristics and design of the air curtain.

When the apparatus is used to produce an air curtain to serve as a contamination barrier for the prevention of entrance of insects, dust and other air-borne contaminates, certain factors must be taken into consideration in order to determine the particular flow design and characteristics of the air curtain. Some of these factors to be considered are the shape and size of the air-borne particles, the density of particles based on weight per cubic feet, the velocity of the air-borne particles and the angle of incidence to the plane of the air curtain.

It has been found through tests that the discharge velocity of the air curtain at the throat defined by the front and rear partitions should be between the range of 3500 feet per minute to 4000 feet per minute to form an effective barrier to gnats and drosophila and other small insects. It is pointed out, however, that this velocity is not sufficient to completely overcome the aero-dynamic

flying ability of large flies so as to constitute a positive barrier to the flies This particular discharge velocity (3500 to 4000 feet per minute) is effective to repel a majority of flies.

It has also been found that when the discharge velocity is between approximately 3500 and 4000 feet per minute at the throat defined by the front and rear partitions, the terminal velocity will be between 1500 and 2000 feet per minute. When the terminal velocity is between the range of 1500 and 2000 feet per minute, it is effective to repel and positively deflect outwardly all particles under 250 microns in size which includes air-borne contaminates such as virus, bacteria, fumes, mold, spores, pollen, fog, smoke, dust, flies, plant spores and yeast cells. It is also pointed out that the terminal velocity of the air curtain will be determined to some degree by the height of the doorway. Thus the discharge velocity at the throat defined by the partitions will require adjustment in accordance with the size of the doorway opening.

It is also desirable when the air curtain is used as a contamination barrier to adjust the curtain to increase the thickness thereof as the air approaches the floor level. This diverging effect of the air stream gives increased exposure or contact between the air-borne particles and the air constituting an air curtain. Since the velocity of the air curtain is reduced as it travels downwardly, this downward thickening of the curtain tends to compensate for the reduction in velocity whereby effective deflection and repulsion of air-borne contaminates is achieved.

This adjustment of the thickness of the air curtain is accomplished or controlled by the adjustment of the link members interconnecting the lower edges of the front and rear partitions. Adjustment of the link members is produced by loosening the set screws **49** for each link rod **48** and sliding the front rod support element **44** in a forward direction to thereby alter the spacing between the partitions so that the spacing between partitions diverges downwardly from the throat or venturi area.

Another variable to be considered with respect to the physical character of the air curtain when the same is used as a contamination barrier is the included angle between the median plane of the air curtain and the vertical plane of the doorway across which the air curtain traverses. It will be appreciated that the downwardly moving stream of air forming the contamination barrier will strike the floor and will thereafter be deflected. It is therefore desirable to allow deflection of the stream of air forming the air curtain away from the vertical plane of the doorway since this allows easy release of the air at the floor and prevents the air from creating undue turbulence at the lower extremities of the curtain by rebounding upon itself. Such a rebounding action of the air curtain upon itself would decrease the effective downward velocity of the intermediate area of the air curtain and would react in some instances with the intruding air-borne contaminates to deflect the same through the doorway. It is therefore desirable when the air curtain is used as a contamination barrier to deflect the median plane of the air curtain so that the same extends downwardly and outwardly whereby to permit easy release of the deflected air away from the door and with a minimum of the portion of the deflected air being rebounded into the plane of the doorway.

It is also pointed out that certain ambient conditions make it desirable to adjust the cross-sectional pattern of the air curtain and also the angle of tilt of the air curtain when the same is used as a decontamination barrier. For example exhaust systems within the protected area, air conditioning or air supply causing a pressure within the protected area, air pressures on the windward side and leeward side, all tend to deflect the plane of the curtain inwardly or outwardly from the vertical plane of the doorway. It will be seen that by merely adjusting the single control knob **54**, the angle of tilt of the median plane of the air curtain with respect to the vertical plane of the doorway may be readily adjusted to meet these varying conditions. Thus it will be seen that my air curtain producing apparatus has a wide range of adjustments to thereby permit the air curtain forming the decontamination barrier to have its physical character readily and easily altered to compensate for the varying changes of conditions when so functioning as a decontamination barrier.

Certain factors must also be considered when the air curtain is used as a thermal barrier at a doorway in a wall structure so that the air curtain separates air in one area or room having a high temperature mass of air and the other area or room having a lower temperature and with a minimum mixing of the air in the two areas or rooms. The physical character and design of the air curtain when used as a thermal barrier will be somewhat different from that of the air curtain when used as a contamination barrier. It is desirable when using the air curtain as a thermal barrier to reduce the volume of air discharged through the orifice and between the partitions and this may be readily accomplished by moving the damper member **57** toward the orifice closing position and restricting the quantity of air passing through the venturi throat of the partitions. In this connection it will be seen that the damper member **57** is positioned above the venturi area defined by the front and rear partitions **36** and **37** respectively. It has been found that the effective discharge velocity of the air curtain when used as a thermal barrier should be approximately 25 to 40% of the velocity of the air curtain when used as a decontamination barrier. It will also be appreciated that adjustments of the discharge velocity will be necessary in accordance with temperature differentials of the two rooms or areas. In this connection it is pointed out that higher terminal velocities are required for extremely cold air, such as —30° air, than for somewhat warmer air such as plus 30° air. Because of the increased density of the extremely cold air, especially at the floor level, the force necessary to prevent escape of this dense cold air must be proportionally increased in proportion to the decrease in the temperature of the air. Furthermore it is necessary to increase the discharge velocity at the throat or venturi defined by the partitions for doorways which are of substantially greater height than the conventional doorways in order to produce the desired terminal velocity adjacent the floor when the air curtain is used as a thermal barrier.

It is also pointed out that when the apparatus is used to produce a thermal barrier for a cold room wherein the temperature varies from approximately 26° to 50° F., it is desirable that the apparatus be mounted within the cold room. However, the apparatus is preferably mounted exteriorly of the cold room if the cold room temperature is substantially below 26° F. In order to obtain the most efficient results of the apparatus to produce a thermal barrier within a refrigerated or cold storage room, I have provided means for mounting the apparatus and for also confining the air curtain thus produced within a predetermined volumetric space. Reference is now made to FIG. 6 wherein the apparatus mounting and air curtain confining means is illustrated and is designated generally by the reference numeral **65**. This apparatus mounting means includes a pair of side frame structures **66** each being comprised of substantially rectangular side frame elements **67** preferably formed of angle iron construction. Each of the side frame structures also include side frame panels **68** for closing the associated side frame member and preferably being formed of aluminum or other suitable metallic material.

It is pointed out that the apparatus mounting means **65** is positioned within the cold storage room and with the side frame structure **66** disposed on opposite sides of the doorway. The rearmost angle frame elements of the side frame members **16** project upwardly beyond their associated side frame panels **68** and the transversely extending mounting bracket **69** is secured to the

upper end portions thereof. This mounting bracket **69** serves to support the air curtain producing apparatus **10** thereupon. The side frame structures **66** are interconnected by a pair of transversely extending frame elements **70** adjacent the upper portion thereof for reinforcing and rigidifying the supper portion of the apparatus mounting means **65**. A closure panel **71** extends between and is interconnected to the upper terminal edges of the side frame structures for partially closing the upper end portion of the apparatus mounting means **65**.

It will therefore be seen that when the apparatus mounting means **65** is positioned in abutting flush relationship with the inner wall of the refrigerated or cold storage room, the closure panel **71** cooperates with the side frame structures **66** to define a downwardly opening discharge slot or passage **72** which will be positioned in close proximity to and above the doorway. The apparatus **10** will be mounted so that the lower ends of the partitions will be positioned in close proximity with the passage **72**. It is pointed out that the air curtain producing apparatus **10** will be so mounted on the mounting means **65** so that the rear partition **37** is positioned closest to the wall and with the front partition **36** spaced inwardly of the refrigerated room from the doorway. It is also pointed out that the side frame members and panels thereof of each side frame structure are vertically adjustable thereby permitting accommodation of doorways which vary in height. To this end it will be seen that the side frame member and panels of each side frame structure are telescopically connected for permitting ready vertical extension and retraction of each side frame structure.

When the apparatus mounting means **65** is mounted within the cold storage or refrigerated room, and after the apparatus is mounted thereon the curtain of air will be discharged through the passage **72** and will be confined between the side frame structure **68**. This construction substantially reduces diffusion of the air curtain forming the thermal barrier especially adjacent the floor. When the air curtain is used as a thermal barrier it is desired that the air curtain be easily deflected away from the vertical plane of the doorway so that the median plane of the air curtain is directed into the same area from which air is supplied to the unit. Therefore the control mechanism for controlling swinging movement of the partitions will be adjusted so that the air curtain is deflected downwardly and inwardly into the cold storage room in which it is mounted. The cold air which is supplied to the air curtain will therefore be deflected back into the cold storage room.

Another desirable characteristic of an air curtain when used as a thermal barrier is that of minimizing the diffusion and mixture of the cold air of the air curtain with the warmer air at the outer face of the air curtain. As pointed out above the rear partition while being positioned within the refrigerated cold storage room will also be positioned closely to the doorway and the front partition. Because of the shape of the inner surface of this rear partition, there will be produced a non-turbulent flow of air at the front face of the air curtain, a condition which substantially reduces diffusion and mixture of air along the front face. It will be noted, however, that the configuration of the front partition cooperates with the inner surface of the rear partition so that the partitions function as a converging nozzle so that the air passed through the orifice **34** from the plenum chamber structure will be subjected to a venturi effect to thereby increase the velocity pressure thereof as the air passes through the throat or venturi as defined by the space between the partitions. The configuration of the lower portions of the partitions serves to produce a turbulence which may have been generated at the respective front and rear faces of the air curtain when the same is used as a thermal barrier. The front surface of the curtain, however, will be somewhat of turbulent character when used as a decontamination barrier and adjusted in the preferred manner set forth hereinabove. This slight to moderate turbulent character of the front face of the air curtain when used as a decontamination barrier serves to increase the efficiency of the barrier in preventing the intrusion of air-borne contaminates such as dust, insects and the like.

It will be seen from the foregoing that I have provided a novel air curtain producing device which permits adjustment of the flow characteristics and design of the air curtain of such a wide range that the air curtain may be selectively used as a thermal or contamination barrier. With this arrangement it will be seen that the apparatus can be adjusted to produce an air curtain for use as a contamination barrier during the summer and as a thermal barrier during the winter.

It will also be seen from the foregoing that my uniquely constructed apparatus is also especially adaptable for use in forming a thermal barrier in a doorway of a cold storage or refrigerated room. Thus it will be seen that my apparatus has effective application for use in meat packing plants and other structures wherein refrigerated conditions must be maintained.

It will further be noted that my air curtain producing apparatus has as one of its unique features a pair partitions between which the air flows when the air curtain is formed, these partitions being of adjustable aerodynamic design which permits ready adjustment of the flow characteristics and design of the air curtain such as the deflection of the air curtain with respect to the vertical plane of the doorway, the thickness and cross-sectional configuration of the air curtain, and the velocity of the air comprising the air curtain.

It will also be noted that the partitions which determine the diverging and converging pattern of the air curtain also tend to reduce turbulence of the air stream thereby resulting in a reduction of the noise level.

It will therefore be seen that I have provided a novel air curtain producing apparatus, which is not only of simple and inexpensive construction and operation, but one which functions in a more efficient manner than any heretofore known comparable device.

It will of course be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What I claim is:

1. Apparatus for producing an air curtain across a doorway in a building structure wall to form thermal and decontamination barriers thereat, said apparatus comprising

a housing structure mounted above the doorway and including a plenum chamber having a downwardly facing elongate discharge orifice positioned adjacent the top of the doorway and extending transversely thereof at least a distance corresponding substantially to the width of the doorway,

mechanism associated with said housing structure for producing a stream of air and directing the same downwardly into said plenum chamber,

a pair of spaced-apart depending elongate partitions hingedly mounted at their respective upper edges on opposite sides of said orifice and being swingable about substantially horizontal axes, said partitions extending transversely of the doorway a distance corresponding substantially to the length of said orifice, said partitions presenting opposed inner faces which cooperate with each other to cause air flowing therebetween to form an air curtain across the doorway,

adjustable linkage means interconnecting said partitions in predetermined spaced relation to thereby cause said partitions to swing in unison while maintaining a predetermined spacing therebetween,

said adjustable linkage means being adjustable for variously adjusting the predetermined spacing between

said partitions to thereby permit the thickness and cross-sectional configuration of the air curtain to be adjusted,

a volume control member shiftably mounted in transversely extending relation with respect to said discharge orifice and being variously adjustable between orifice opened and closed positions for controlling the volume of air flowing through the orifice,

and control mechanism operatively connected with said partitions for swinging said partitions in unison about their hinge axes whereby the median plane of the air curtain may be deflected on both sides of the vertical to form acute angles therewith.

2. Apparatus for producing an air curtain across the doorway in a building wall structure to form thermal and decontamination barriers thereat, said apparatus comprising

a housing structure having a downwardly facing elongate discharge orifice positioned adjacent the top of the doorway and extending transversely thereof a distance corresponding substantially to at least the width of the doorway,

mechanism associated with said housing structure for producing a stream of air and directing the same downwardly through said orifice,

a volume control member shiftably mounted in transversely extending relation with respect to said discharge orifice and being shiftable between orifice open and close positions for controlling the volume of air flowing through the orifice,

actuating mechanism operatively connected with said volume control member and including a single shiftable actuating element for producing shifting movement of said volume control member to variously adjust the same between said orifice closing and open positions,

a pair of spaced-apart depending partitions hingedly mounted on opposite sides of said orifice in predetermined spaced relation with respect to each other and being swingable about substantially horizontal axes, said partitions extending transversely of the doorway a distance corresponding substantially the length of said orifice, one of said partitions having a substantially planar inner face, the other of said partitions having an inner face including a substantially flat upper portion converging downwardly with respect to the inner face of said one partition, and having a substantially flat lower portion which is normally disposed in substantially parallel relation with respect to the inner face of said one partition, said partitions cooperating with each other to cause air flowing therebetween to form an air curtain across the doorway,

linkage means interconnecting said partitions to cause said partitions to swing in unison about their hinge axes while maintaining the predetermined spacing therebetween whereby the median plane of the air curtain may be deflected on both sides of the vertical to form acute angles therewith,

said linkage means being variously adjustable to vary the predetermined spacing between said partitions and thereby permit adjustment of the thickness and configuration of the air curtain,

a control mechanism operatively connected with said partitions comprising a single shiftable actuating element for producing swinging movement of said partitions in unison about their hinged axes.

3. Apparatus for producing an air curtain across a doorway in a building structure wall to form thermal and decontamination barriers thereat, said apparatus comprising

a housing structure mounted above the doorway and including a plenum chamber having a downwardly facing elongate discharge orifice positioned adjacent the top of the doorway and extending transversely thereof at least a distance corresponding substantially to the width of the doorway,

mechanism associated with said housing structure for producing a stream of air and directing the same downwardly into said plenum chamber,

a pair of spaced-apart depending elongate partitions hingedly mounted at their respective upper edges on opposite sides of said orifice and being swingable about substantially horizontal axes, said partitions extending transversely of the doorway a distance corresponding substantially to the length of said orifice and cooperating with each other to present opposed surfaces between which the air is directed to form an air curtain across the doorway,

one of said opposed surfaces being of substantially planar configuration and the other of said opposed surfaces presenting a convex surface whereby the opposed inner surfaces of said partitions produces a venturi effect on the air flowing therebetween,

adjustable linkage means interconnecting said partitions in predetermined spaced relation to thereby cause said partitions to swing in unison while maintaining a predetermined spacing therebetween, said linkage means including an adjustable linkage member having opposite ends thereof adjustably connected through said partitions and being adjustable relative thereto to increase and decrease the thickness of the air curtain, and to vary the cross-sectional configuration of the air curtain,

and control mechanism operatively connected with said partitions including a shiftable control element for producing swinging of said partitions in unison about their hinge axes whereby the median plane of the air curtain may be deflected on both sides of the vertical to form acute angles therewith.

4. The apparatus as defined in claim 3 and a volume control member shiftably mounted in transversely extending relation with said discharge orifice and being shiftable between orifice open and close positions for controlling the volume of air flowing through said orifice,

and an actuating mechanism operatively connected with said volume control member and including a single shiftable actuating element for producing shifting movement of said volume control member to variously adjust the same between said orifice closing and open positions.

5. The apparatus as defined in claim 3 and means for mounting said housing structure above the doorway and including a pair of substantially parallel imperforate panel structures positioned on one side of the building structure wall and on opposite sides of the doorway and supporting the housing structure upon the upper portions thereof,

said panel structures cooperating with each other to confine the air curtain therebetween and thereby reduce the diffusion of the air curtain along the vertical lateral edges thereof when the air curtain is used to form a thermal barrier.

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