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AIR CURTAIN

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2 Claims. (Cl. 98-36)

My invention relates to an air curtain device, and particularly to means for blowing a curtain or screen of air protectively across an opening in a building to retard temperature and moisture exchange between inside and outside air. More particularly, my invention is in a means for compositing both hot and cold air in separate but adjacent sheets or screens as a composite hot and cold air curtain across an open doorway, as an important heat economy to screen the opening adjacent the inside with comparatively warm air and adjacent the outside with comparatively cool air. The invention further includes means for adjusting the direction of the air screen against disrupting outside winds.

According to one aspect of my invention, air picked up by a blower from the inside of a building or the like, as hot air, which optionally may be initially heated or further heated in passage, is conducted to a plenum chamber from which it is emitted as a curtain, screen, or sheath of air directed protectively across an opening in the building, doorway, window, or the like. Simultaneously, ambient cold air from outside the building is passed by a blower through a duct into a separate, adjacent plenum chamber, and emitted therefrom as a sheet of cold air across the same doorway, window or the like. Both sheets of air are separately expelled in layers, lying adjacent to one another as a laminate of air sheets or screens, with the cold air, usually in cold weather, outward of the building opening, and the warm air inward thereof, the composite or laminate of separate sheets being maintained as a continuous blast of air by the separate blowers protectively across the opening. Of course, where the interior of the building is refrigerated, or the air is dried, the cold conditioned air is maintained protectively on the inside of the air screen, and the warmer ambient outside air is then on the outside.

In another aspect of this invention the outlet openings of both hot and cold air can be adjusted to direct the composite air screen sheet vertically downward of the building opening, or forward of the opening at an angle controlled so that in the event there is a wind blowing toward the opening, the protective air curtain will be bent downward but will tend to resist disruption by the interfering air. The angle of the air curtain is adjusted with the disruptive wind velocity so that the curtain will be bent straight downward vertically as a resultant of the forces both propelling the curtain across the opening at the selected angle and the wind velocity or pressure bending it below that expelled angle.

For purposes of securing the control and stability of the sheet of air in the projected direction, the velocity of either the hot or cold portions, preferably the cold portion of the curtain, can be adjusted, increased or decreased, variable with the needs such as the disrupting forces of external winds. The invention is further explained with reference to the drawings wherein:

FIG. 1 is a front elevation of the air screen mounted above and beside a doorway in a building; and

FIG. 2 is a side elevation in section across the wall of the building.

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As shown in the drawings, an air blower 10 is mounted on the outside of a building wall 12. The blower 10 is operated by a motor 14, and draws ambient air from an opening 16, forcing it through a duct 18, the outside air being emitted through an elongated outlet nozzle 20 extending across the open doorway, window, or the like 22 of the building. The outlet nozzle 20 is merely an elongated trough or slot which is narrow in section to compress, exude, or direct the air passed therethrough for emission downward as a thin elongated sheet 21 across the opening 22. The duct 18 preferably communicates with the outlet nozzle 20 through one side of plenum chamber 24.

A second blower 26 is mounted within the building at any convenient place, preferably on the inside of the building wall 12, and draws comparatively warm air through its suction opening 28, passing the air through duct 30 and to another side of plenum 24 and thence out through elongated nozzle 20 in the same way and direction as the cold air sheet. The plenum 24 and nozzle 20 are separated longitudinally into hot and cold air chambers by a partition 32 which maintains air from each blower 10 and 26 separated as separate air streams, so that both hot and cold air are blown as a single composite sheet in distinct layers as a laminate, forming a protective air screen in front of the doorway or opening 22 of the wall 12.

The cold air duct 18 may have mounted therein a damper 34 which can be manually or automatically adjusted to constrict the flow of cold air in the duct 18, allowing cold air to pass therethrough either with the maximum or down to very low velocity, adjusted as desired, by setting of the position of the damper 34, automatically by means known in the art, or by manual rotation of the damper crank handle 36. The damper 34 may also be controlled automatically by a flow motor responsive to the wind velocity, thus controlling the cold air flow velocity responsive to the wind pressure per se.

The outlet nozzle 20 is fixed to the partitioned lower portion of the plenum 34 through a lower hopper-shaped neck, through a universal or hinged joint 38, whereby the angle of effluence of the air curtain through the nozzle 20 can be adjusted laterally, whereby the air curtain may be swept or directed forward of the vertical wall opening 22. This nozzle adjustment can be set manually, but is preferably done by a servo means 40 which can be set automatically responsive to wind velocity to adjust the angle  $\alpha$  forward of the air curtain, as shown in the air angle diagram FIG. 2. For instance, there may be a wind blowing in the direction of the arrows with a velocity  $V_1$ . While it would be desirable to have the air curtain extend vertically downward in the direction of the arrow  $V_3$ , to cover the opening 22, it is preferred to set the angle of the nozzle 20 by operation of the servo means 40 to an angle  $\alpha$ ; that is, to set it in the direction of the arrow  $V_2$  so that the resultant direction of the air curtain, bent by the wind moving in the direction of  $V_1$ , will be diverted downward to the direction  $V_3$  as resultant of the projection of the air screen in the direction  $V_2$  to intercept the wind direction and velocity  $V_1$ . At this adjusted angle, despite a wind tending to disrupt the air curtain, the setting of the curtain forward of the vertical to the angle  $\alpha$  is sufficient to maintain the ultimate direction as a substantially vertical screen across the opening 22 of the doorway. Moreover, since the velocity of one or the other,

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preferably the cold air portion of the air curtain, can be varied in velocity by setting of the damper 34, such velocity setting is made for the portion of the screen, providing it with sufficient velocity to offset that of the wind. Thus, the air curtain is maintained as a vertical air curtain at least from the bent central portion downward across the opening 22. Moreover, the servo device 40 will set the nozzle 20 to an angle  $\alpha$ , the right angle in terms of the velocity of the disrupting wind to effect the bending of the air stream to vertical. The angle  $\alpha$  is given the equation

$$\sin \alpha = \frac{V_1}{V_2}$$

where  $\alpha$  is the angle of the nozzle setting,  $V_2$  is the velocity of the gases emitted from the nozzle, and  $V_1$  is the velocity of the disrupting wind.

It is sometimes desirable to further increase the air velocity by making the damper 34 automatically positionable, responsive to the velocity of the wind. For this purpose a wind velocity sensing element 37 which may be a simple transducer whose electrical output is responsively exposed to the wind pressure which in turn activates the circuit crystal to a servomotor 39 which has its armature connected to the damper shaft 36 through a sectional gear 41. In this manner the position of the damper and consequent air velocity is made responsive to the wind velocity.

It is sometimes useful to heat the warm air stream, and for this purpose a heater 42 may be used which will be heated by any warm heat transfer fluid, for instance, steam, entering through line 44 controlled by valve 46 and leaving the heater by line 48.

As thus described, a building opening is protected against rapid cooling or transfer of cold air into and loss of warm air out of the building, by protecting the opening with an air curtain comprising an outer layer of cold air and an inner layer of warm air, each maintained respectively by blowers for circulating air, one blower taking air from inside and the other from the outside of the building. Means is provided to adjust the air flow velocity, preferably of the cold outer air curtain, and, preferably, such velocity is made responsive to the force or velocity of any disruptive winds passing against the air curtain. Moreover, the air curtain is adjustable in direction to offset the disrupting direction of a wind by varying the set of the nozzle angle of the curtain outside of the wall.

While the drawings are more or less diagrammatic, certain modifications will occur to those skilled in the art. For instance, the plenum chamber 24 may draw air alternatively from the top through cold inlet duct 50 and hot inlet duct 52 with blowers mounted elsewhere (not shown). The plenum 24 may be supported above the doorway 22 or opening by brackets 54, and may be mounted lower or closer to the actual opening than is

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shown, and may have connecting shrouds or hoods bridging the space between the air curtain and the wall of the building, protecting the opening from lateral air currents. Moreover, the air curtain laminate of hot and cold air can be reversed in warm weather; or, to protect the opening of a refrigerated room the inner blower then takes cold refrigerated air and the outside blower takes relatively warmer ambient air, thus forming an air curtain in which the warmer air is the outside layer, and the cold air is the inner layer of the air screen.

Accordingly, it is my intention that the description given and illustrated in the drawings be regarded as illustrative and not limiting except as defined in the claims appended hereto.

I claim:

1. Air curtain device adapted for mounting above an opening in a wall and projecting a curtain of air downwardly against said opening, said device comprising an elongated plenum extending entirely across the opening near said wall edge, partitioning means dividing said plenum into individual elongated chambers, an elongated partitioned nozzle movably joined to the lower end of said partitioned plenums with each outlet portion of said partitioned nozzle communicating with one of said partitioned plenums, and means for adjusting the outlet angle of said nozzle with respect to the plane of said wall opening, blower means connected to the outer plenum and having a suction inlet communicating with the ambient air at the outside of said opening, and blower means connected to the inner plenum separated from the outer plenum by the said partition and having a suction inlet communicating with ambient air on the inner side of said wall opening whereby the air evolved from the partitioned nozzle is a laminated sheet comprising layers of air taken from opposite sides of said wall extending downward at an adjusted angle across said wall opening.

2. Air curtain device as defined in claim 1 having means for adjusting the velocity of air flow through the outer portion of the partitioned nozzle affected by wind conditions outside of the wall opening and responsive to changes in the outside wind velocity.

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