ABSTRACT

A modular floor terminal mounted in the floor of an occupied space for delivering air from an underfloor air plenum to the occupied space. The modular floor terminal includes a square or rectangular housing with an air inlet at the bottom and an air outlet at the top. A rotating damper is positioned in the housing between the air inlet and the air outlet. The position of the damper is controlled by an actuator which is in turn controlled by a thermostat/controller in the occupied space above the floor.
MODULAR FLOOR TERMINAL WITH DAMPER

RELATED APPLICATION

[0001] This application claims the benefit of priority of U.S. provisional application Ser. No. 60/575,108, filed May 27, 2004, which is relied on and incorporated herein by reference.

FIELD OF THE INVENTION

[0002] This invention relates to a modular floor terminal with a downwardly facing air inlet and a rotating damper. The modular floor terminal is used in connection with an underfloor plenum air conditioning system.

BACKGROUND OF THE INVENTION

[0003] In an underfloor plenum air conditioning system, cool air is supplied to the plenum below the floor of an occupied space to be cooled. In order to cool the occupied space above the floor, terminals are mounted in the floor at predetermined locations to allow the cool air in the plenum to flow into the occupied space above the floor. The terminals are located and oriented to accommodate the configuration of the occupied space to be cooled.

[0004] Prior art configurations for modular floor terminals include simple boxlike structures with side openings. The side openings allow the terminals to be rotated in order to control air flow through the terminal based on the relative position of the housing’s air inlet to the flow of air in the plenum. Such side air inlet terminals have further included sliding dampers for further control of airflow by closing off a portion of the face of the diffuser grilles used in connection with the floor terminals.

SUMMARY OF THE INVENTION

[0005] The module floor terminal of the present invention includes a round floor boot terminal and a linear floor grille terminal. The round floor boot terminal consists of a square housing with a downwardly facing air inlet at the bottom and an upwardly facing air outlet at the top. The linear floor grille terminal consists of a rectangular housing with a downwardly facing air inlet at the bottom and an upwardly facing air outlet at the top. Both modular floor terminals have a rotating damper within the housing between the air inlet and the air outlet that is controlled by a floating point actuator that opens and closes the damper to vary the volume of air delivered through the air outlet to a diffuser grille and thereby to the occupied space above the floor.

[0006] The bottom location of the air inlet in the housing of the modular floor terminal allows the modular floor terminal of the present invention to be mounted in any orientation without the terminal’s performance being influenced by air movement in the underfloor plenum. While there is limited air movement in the underfloor plenum, the air movement is generally horizontal and depends on the location of the air source for the plenum. Any air movement in the plenum directed toward a terminal’s air inlet, such as the side terminal air inlet of the prior art, could cause an unexpected pressure rise within the housing of the terminal. This rise in pressure could lead to unpredictable and uncontrollable performance due to uneven loading of the terminals. If the terminal’s air inlet is not in line with the direction of airflow, the effects of air currents in the plenum are even harder to predict and will vary with the terminal’s distance from the plenum inlets. With the terminal air inlet located on the bottom of the terminal housing, air inlet is always subject to the same ambient pressure (uniform static pressure at any location in the plenum) i.e., there is no pressure contribution due to horizontal air movement. No matter the installed orientation of the terminal, the air flow direction will be perpendicular to the air inlet of the terminal.

[0007] The damper within the terminal is rotated perpendicular to the air flow direction within the terminal to control the pressure inside the terminal. This pressure will determine the amount of air that can be delivered by the terminal to the occupied space above the floor. By having the damper rotate, as opposed to sliding as shown in the prior art, the entire air outlet area of the diffuser grille remains active no matter what the terminal pressure might be. Consequently the terminal delivers a predictable air pattern from the diffuser grille under any conditions of open damper orientation.

[0008] The actuator control signal is supplied through a signal converter which allows for convenient and easy plug and play installation. A modular control cable can be plugged into the control interface at the actuator. The interface also includes an output for the signal to be carried to the next terminal if installed in a daisy-chain manner.

[0009] A perforated plate located in the air outlet of the terminal serves as an equalization baffle, ensuring consistent flow from the air outlet to the diffuser grille. This plate also serves to catch debris that may fall into the terminal from the occupied space through the diffuser grille.

[0010] Therefore, it is an object of the present invention to provide a modular floor terminal with a downwardly facing air inlet and a rotating damper that will provide consistent control of the air flow from the underfloor plenum, through the diffuser grille, to the occupied space above the floor.

[0011] Further objects, features and advantages will become apparent upon consideration of the following detailed description of the invention when taken in conjunction with the drawing and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a perspective view of a round floor boot with a damper in accordance with the present invention.

[0013] FIG. 2 is a front elevation view of a round floor boot with a damper in accordance with the present invention.

[0014] FIG. 3 is a top plan view of a round floor boot with a damper in accordance with the present invention.

[0015] FIG. 4 is a perspective view of a linear floor grille with a damper in accordance with the present invention.

[0016] FIG. 5 is a side elevation view of a linear floor grille with a damper in accordance with the present invention.

[0017] FIG. 6 is a front elevation view of a linear floor grille with a damper in accordance with the present invention.

[0018] FIG. 7 is a top plan view of a linear floor grille with a damper in accordance with the present invention.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] With reference to FIGS. 1-3, a round floor boot terminal 10 in accordance with the present invention is illustrated. The round floor boot terminal 10 consists of a square housing 12, an air inlet 20, an air outlet 22, a damper 16, and a floating point damper actuator 18. The square housing 12 consists of four sheet-metal sides. Extending mounting flanges 14 are located at the top of the housing 12 adjacent the air outlet 22. The air inlet 20 is downwardly facing at the bottom of the housing 12. A set of baffles 21 surround the air inlet 20 to restrict the size of the air inlet 20 to accommodate the size of the damper 16 (FIG. 2).

[0020] The rotating damper 16 is connected to a shaft 17 extending horizontally between two opposite sides of the housing 12. The floating point actuator 18 is mounted onto the housing 12 with a mounting plate 15 and connected to the shaft 17. The floating point actuator 18 rotates the shaft 17 through about a 90 degree range of motion to open and close the damper 16. The floating point actuator 18 is controlled by a thermostat/controller located in the space above the floor. The thermostat/controller provides a damper open signal and a damper close signal to the actuator 18. As long as the damper open signal is present, the actuator 18 continues rotating the damper 16 toward its open position. Therefore, the position of the damper 16 depends on the time that the damper open signal is connected from the thermostat/controller to the actuator 18. Similarly, the damper close signal rotates the damper 16 toward the close position. In one embodiment, the actuator 18 is a Siemens OpenAir Electric Damper Actuator, GDE/GB Series.

[0021] With reference to FIG. 1, an interface board 19 mounted on the housing 12 accommodates the signal from the thermostat/controller to the signal required by the actuator 18. The interface board 19 is configured to accept a modular control cable 11 using an interface, such as an RJ12 interface, for ease of installation. The interface board 19 may also include an output so that additional terminals may be controlled by the control signal in a daisy-chained fashion.

[0022] The damper 16 rotates about a pair of bushings 23 (FIG. 3) located on opposite sides of the housing 12. With reference to FIG. 2, the damper 16 is constructed of two retaining plates 26a and 26b and two damper seal gaskets 28a and 28b. The damper seal gaskets 28a and 28b are supported between the retaining plates 26a and 26b. The retaining plates 26a and 26b also support the shaft 17. The damper seal gaskets 28a and 28b extend beyond the retaining plates 26a and 26b and make contact with the sides of the housing 12 and with the baffles 21 when the damper 16 is in its closed position, thereby sealing the air inlet 20 of the housing 12.

[0023] The round floor boot terminal 10 is installed by fastening the flanges 14 on the housing 12 to the underside of a floor tile (not shown). The floor tile has a round hole in which a round diffuser grille (not shown) is installed. When the round floor boot terminal 10 is mounted to the underside of the floor tile, the air outlet 22 of the housing 12 aligns with the round hole in the floor tile. Consequently, the round floor boot terminal 10 can be oriented in any direction with respect to the floor tile and the occupied space above the floor as long as the air outlet 22 and the round hole in the floor tile align. In cases where the round floor boot terminal 10 is fastened to a contoured floor tile, the round floor boot terminal 10 is fastened to a gasket which bridges the contours and ensures a sealed installation to the tile. This flexibility in orientation and tile selection eliminates the complexity of exact placement of the round floor boot terminal 10 and decreases installation time and cost.

[0024] The rotating damper 16 insures consistent performance by the diffuser grille in communication with the air outlet 22 of the round floor boot terminal 10. Unlike a horizontal sliding damper that obstructs a portion of the face of the diffuser grille, the rotating damper 16 of the present invention assures that the entire face of the diffuser grille remains unobstructed so that the entire pattern of the diffuser grille is operational in connection with delivering air to the occupied space above the floor. In one embodiment, a perforated plate 24 is located between the damper 16 and the air outlet 22 of the housing 12. The perforated plate 24 is supported by retaining angles 29 that are mounted to opposite sides of the housing 12. The perforated plate 24 equalizes the pressure across the air outlet 22 thereby ensuring a consistent and perpendicular flow of air to the diffuser grille (not shown) and into the occupied space above the floor even when the damper 16 is partially open at an angle to the vertical. The perforated plate 24 also serves to catch debris that may fall into the housing 12 from the occupied space through the diffuser grille.

[0025] With reference to FIGS. 4-7, a linear floor grille (LFG) terminal 40 in accordance with the present invention is illustrated. The linear floor grille terminal 40 consists of a rectangular housing 42, an air inlet 52, an air outlet 54, a grille 56, a damper 46, and a floating point actuator 50. The rectangular housing 42 consists of four sheet-metal sides. Extending mounting flanges 44 are located at the top of the housing 42 adjacent the air outlet 54. The air inlet 52 is downwardly facing at the bottom of the housing 42.

[0026] The rotating damper 46 is connected to a shaft 47 extending horizontally between two opposite sides of the housing 42. The floating point actuator 50 is mounted onto the housing 42 with a mounting plate (not shown) and connected to the shaft 47. The floating point actuator 50 rotates the shaft 47 through about a 90 degree range of motion to open and close the damper 46. The floating point actuator 50 is controlled by a thermostat/controller located in the occupied space above the floor. The thermostat/controller provides a damper open signal and a damper close signal to the actuator. As long as the damper open signal is present, the actuator 50 continues rotating the damper 46 toward its open position. Therefore, the position of the damper 46 depends on the time that the damper open signal is connected from the thermostat/controller to the actuator 50. Similarly, the damper close signal rotates the damper 46 toward the close position. In one embodiment, the actuator 50 is a Siemens OpenAir Electric Damper Actuator, GDE/GB Series.

[0027] With reference to FIG. 4, an interface board 41 mounted on the housing 42 accommodates the signal from the thermostat/controller to the signal required by the actuator 50. The interface board 41 is configured to accept a modular control cable 43 using an interface, such as an RJ12 interface, for ease of installation. The interface board 41 may also include an output so that additional terminals may be controlled by the control signal in a daisy-chained fashion.
The damper 46 rotates about a pair of bushings (not shown) located on opposite sides of the housing 42. With reference to FIG. 6, the damper 46 is constructed of two retaining plates 58a and 58b and two damper seal gaskets 60a and 60b. The damper seal gaskets 60a and 60b are supported between the retaining plates 58a and 58b. The retaining plates 58a and 58b also support the shaft 47. The damper seal gaskets 60a and 60b extend beyond the retaining plates 58a and 58b and make contact with the sides of the housing 42 when the damper 46 is in its closed position, thereby sealing the air inlet 52 of the housing 42.

With reference to FIGS. 5 and 6, the linear floor grille terminal 40 is installed by fitting it into a rectangular hole cut into the floor tile 70. The rectangular hole in the floor tile 70 is sized to accommodate the dimensions of the air outlet 54 of the housing 42. The flanges 44 around the air outlet 54 extend beyond the dimensions of the rectangular hole in the floor tile 70 and thereby support the linear floor grille terminal 40. In addition, the housing 42 has an actuator offset 48 and a side offset 49 so that the portion of the housing 42 that accommodates the damper 46 is dimensionally smaller than the rectangular hole cut in the floor tile 70. The smaller dimension of the portion of the housing 42 that accommodates the damper 46 allows the linear floor grille terminal 40 to be dropped vertically into place without the necessity of maneuvering the linear floor grille terminal 40 to accommodate any protrusions. The offset design of the housing 42 and the flanges 44 thereby eliminates installation complexity and decreases installation time and cost.

The rotating damper 46 insures consistent performance by the grille 56 in communication with the air outlet 54 of the linear floor grille terminal 40. Unlike a horizontal sliding damper that obstructs a portion of the face of the grille 56, the rotating damper 46 of the present invention assures that the entire face of the grille 56 remains unobstructed so that the entire pattern of the grille 56 is operational in connection with delivering air to the occupied space above the floor. In one embodiment, a perforated plate 64 is located between the damper 46 and the air outlet 54 of the housing 42. The perforated plate is supported by retaining angles (not shown) that are mounted to opposite sides of the housing 42. The perforated plate 64 equalizes the pressure across the air outlet 54 thereby ensuring a consistent and perpendicular flow of air to the grille 56 and into the occupied space above the floor even when the damper 46 is partially open at an angle to the vertical. The perforated plate 64 also serves to catch debris that may fall into the housing 42 from the occupied space through the grille 56.

While this invention has been described with reference to preferred embodiments thereof, it is to be understood that variations and modifications can be affected within the spirit and scope of the invention as described herein and as described in the appended claims.

We claim:

1. A modular floor terminal for supplying air from an underfloor air plenum to an occupied space, comprising:
   a. a housing;
   b. an air inlet located adjacent the bottom of the housing and in communication with the underfloor air plenum;
   c. an air outlet located adjacent the top of the housing;
   d. a rotating damper located within the housing between the air outlet and the air inlet; and
   e. an actuator connected to the rotating damper for opening and closing the rotating damper in response to changes in temperature in the occupied space.

2. The modular floor terminal of claim 1, further comprising at least two flanges for installing the terminal to a floor of the occupied space, wherein the at least two flanges are located at the top of the housing adjacent the air outlet.

3. The modular floor terminal of claim 1, further comprising an interface board for accommodating a signal from a controller to the actuator, wherein the interface board includes an output for communicating with additional terminals.

4. The modular floor terminal of claim 1, wherein the damper comprises at least one plate.

5. The modular floor terminal of claim 1, wherein the damper comprises:
   a. two plates; and
   b. at least one gasket located between the two plates;
   wherein the at least one gasket extends beyond an edge of the two plates and contacts a side of the housing when the damper is in a closed position.

6. The modular floor terminal of claim 1, further comprising at least one baffle located adjacent the air inlet.

7. The modular floor terminal of claim 6, wherein the damper comprises at least one plate.

8. The modular floor terminal of claim 6, wherein the damper comprises:
   a. two plates; and
   b. at least one gasket located between the two plates;
   wherein the at least one gasket extends beyond an edge of the two plates and contacts the at least one baffle when the damper is in a closed position.

9. The modular floor terminal of claim 1 further comprising a perforated plate located between the damper and the air outlet.

10. The modular floor terminal of claim 1 further comprising at least one offset for accommodating the terminal for installation in a floor of the occupied space.

11. A modular floor terminal for supplying a flow of air from an underfloor air plenum to an occupied space, comprising:
   a. a housing;
   b. an air inlet on the housing in communication with the underfloor air plenum;
   c. an air outlet on the housing opposite the air inlet;
   d. a damper located within the housing between the air outlet and the air inlet; and
   e. an actuator connected to the damper for opening and closing the damper in response to changes in temperature in the occupied space;

   wherein, upon installing the terminal in a floor of the occupied space, the direction of air flow through the air inlet is generally perpendicular to the direction of air flow in the underfloor plenum.
12. The modular floor terminal of claim 11, wherein the opening and closing of the damper includes rotating the damper.

13. The modular floor terminal of claim 11, further comprising at least two flanges for installing the terminal to a floor of the occupied space, wherein the at least two flanges are located at the top of the housing adjacent the air outlet.

14. The modular floor terminal of claim 11, further comprising an interface board for accommodating a signal from a controller to the actuator, wherein the interface board includes an output for communicating with additional terminals.

15. The modular floor terminal of claim 11, wherein the damper comprises at least one plate.

16. The modular floor terminal of claim 11, wherein the damper comprises:
   a. two plates; and
   b. at least one gasket located between the two plates; wherein the at least one gasket extends beyond an edge of the two plates and contacts a side of the housing when the damper is in a closed position.

17. The modular floor terminal of claim 11, further comprising at least one baffle located adjacent the air inlet.

18. The modular floor terminal of claim 17, wherein the damper comprises at least one plate.

19. The modular floor terminal of claim 17, wherein the damper comprises:
   a. two plates; and
   b. at least one gasket located between the two plates;
   wherein the at least one gasket extends beyond an edge of the two plates and contacts the at least one baffle when the damper is in a closed position.

20. The modular floor terminal of claim 11 further comprising a perforated plate located between the damper and the air outlet.

21. The modular floor terminal of claim 11 further comprising at least one offset for accommodating the terminal for installation in a floor of the occupied space.

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