

[54] CEILING AIR TERMINAL

[72] Inventor: August W. Gutheim, Chittenango, N.Y.

[73] Assignee: Carrier Corporation, Syracuse, N.Y.

[22] Filed: Jan. 20, 1971

[21] Appl. No.: 107,965

[52] U.S. Cl. 98/40 D, 251/61.1

[51] Int. Cl. F24f 13/06

[58] Field of Search 251/61.1; 98/40 D, 40 B, 41;
236/49

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Primary Examiner—William E. Wayner

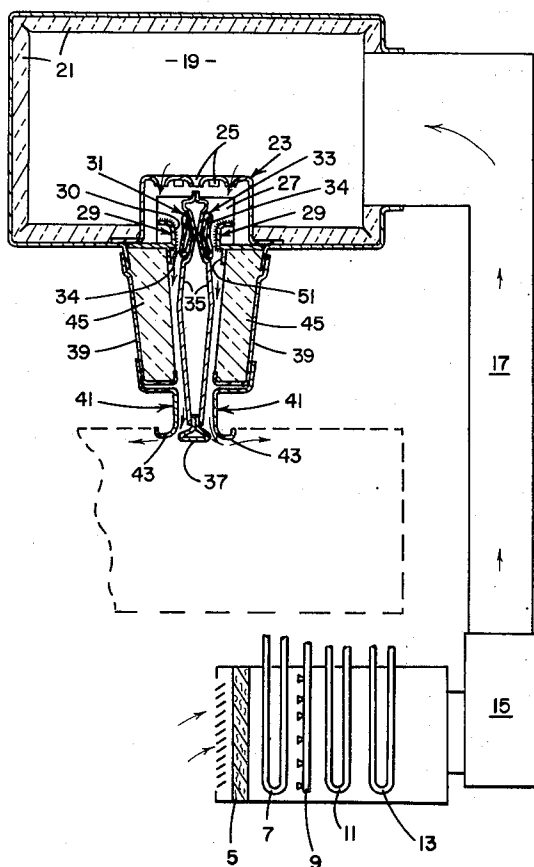
Attorney—Harry G. Martin, Jr. and J. Raymond Curtin

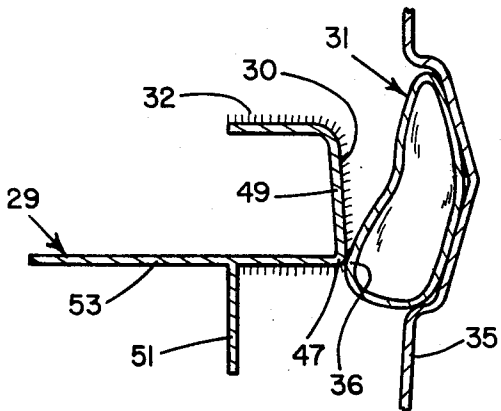
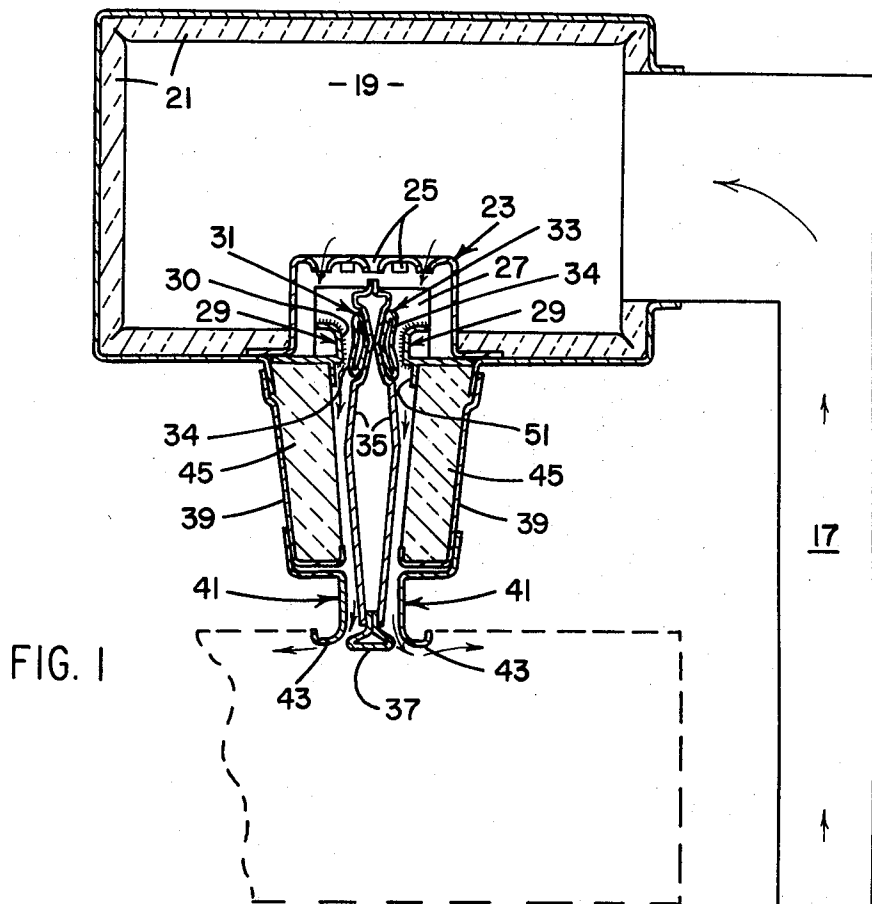
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ABSTRACT

A ceiling air terminal including inflatable bladders that cooperate with cut-off plates to regulate the volume of treated air discharged from the terminal into the area being served. The cut-off plates have a first curved portion which defines the extremity of each plate closest to each inflatable bladder and a planar portion immediately adjacent to the curved portion. The planar portion is at an angle of substantially 5° relative to a vertical tangent line to the curved portion, the planar portion being inclined away from the inflatable bladder.

1 Claim, 2 Drawing Figures





INVENTOR.
AUGUST W. GUTHEIM
BY *Barry E. Deutsch*
ATTORNEY

CEILING AIR TERMINAL

BACKGROUND OF THE INVENTION

In providing treated air to an area being treated, ceiling air terminals of the type including inflatable bladders have proven to be highly successful and desirable. The inflatable bladders cooperate with a cut-off plate disposed opposite each bladder to regulate the volume of air discharged from the terminal into the area.

The configuration of the cut-off plate is extremely important for efficient operation of the terminals. It is essential for the cut-off plate to define a portion of a nozzle at the inlet or "upstream" portion thereof so as to minimize the pressure loss through the restricted flow area formed between the plate and cooperating bladder. In addition, the nozzle portion will create less turbulence so as to maintain a lower sound level for the terminal by generating less noise.

To prevent instability and to thereby maintain the sound at a desirable level, it is essential that the extremity of the cut-off plate opposite the inflatable bladder be maintained directly opposite the extreme point of expansion of the bladder.

It is therefor an object of this invention to provide an air terminal including an improved cut-off plate so as to obtain the desired results.

SUMMARY OF THE INVENTION

This invention relates to a ceiling type air terminal provided for supplying treated air from a central source thereof to an enclosure. More particularly, this invention relates to such a terminal including selectively inflatable bladders operable to regulate the volume of treated air discharged from the terminal. Each bladder cooperates with a cut-off plate to obtain the desired volumetric regulation.

The cut-off plate includes a first curved portion which defines the extremity of the plate closest to the inflatable bladder, and a planar portion immediately adjacent to and "upstream" from the curved portion, the planar portion being at an angle of substantially 5° relative to a vertical tangent line to the curved portion, the planar portion being inclined away from the inflatable bladder. Inflation of the bladder reduces the area between the curved portion and the bladder so as to obtain the desired regulation of the air being discharged into the enclosure being served by the terminal.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic view of a portion of an air conditioning system illustrating the air terminal of the present invention in section, with the bladder being shown as deflated; and

FIG. 2 is an enlarged view of a cut-off plate and cooperating bladder shown in FIG. 1 illustrating the invention, the bladder being shown in its inflated position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawings, there is illustrated a central air conditioning apparatus including a filter 5, precooling coil 7, spray means 9, cooling coil 11, heating coil 13 and a fan 15, for heating, cooling, humidifying and filtering the air as desired, to pro-

vide treated air for passage to the area being served by the terminal.

A supply air duct 17 is illustrative of the plurality of ducts provided to supply treated air to ceiling air terminals throughout a building. The ceiling terminal includes a primary chamber 19 lined with a sound absorbing material 21 such as a glass fiber blanket. The primary chamber is ordinarily open at both ends for connecting a series of terminals end to end to provide a complete air discharge system. Suitable end pieces, not shown, are utilized to cap the end terminals in the series. An air supply distribution plate 23 having a plurality of collared openings 25 therein is provided to evenly distribute the supply air from primary chamber 19 into the distribution chamber 27, which is defined by the top and side walls of distribution plate 23.

To provide an optimum air discharge pattern, the air supplied to the distribution chamber from the primary chamber should have minimal nonvertical velocity components. Since the air supplied to the ceiling terminal is ordinarily introduced horizontally into the end or side of the terminal, there is a large horizontal velocity component to the air stream within the conduit section. The distribution plate employing a large number of collared openings is very effective in providing an efficient, nonturbulent vertical diversion of the air stream from primary chamber 19 into distribution chamber 27. This minimizes noise generation within the terminal. The collars divert the horizontal velocity component of the air stream so that the velocity components of the air stream within distribution chamber 27 are vertical. For an optimum air discharge pattern from the plate, the depth of the collar should approximate the diameter of the collared opening. The depth of each collar is constant throughout the entire circumference thereof to provide a discharge opening parallel to the plane of the distribution plate. In discharging air from an opening, the geometry of the opening itself may have a tendency to effect an attachment of the air stream to a portion of the wall forming the opening. This attachment can cause the air stream to be diverted in a direction away from the axis of the opening. By providing a collar having a constant depth throughout its circumference, an abrupt detachment of the air stream therefrom is obtained which minimizes the tendency of the airstream to flow in a nonvertical direction within the distribution chamber.

The bottom of distribution chamber 27 includes aligned cut-off plates 29. Referring particularly to FIG. 2, an enlarged view of one plate 29 is illustrated. The plates cooperate with selectively inflatable bladders 31 and 33 to form a damper. Bladders 31 and 33, when fully inflated, form a pear shaped configuration having an extreme point 36 on the outer surface thereof. Surface 30 of the plates may be covered with felt to minimize noise. The plates have a first curved portion 47 which defines the extreme point of the plate closest to the cooperating inflatable bladder. Immediately adjacent curved portion 47 and "upstream" therefrom is planar portion 49. Portion 49 is inclined at a substantially 5° angle relative to a vertical tangent line to curved portion 47. Inclined portion 49 slopes away from the inflatable bladder. Downwardly extending flange member 51 is formed integrally with horizontal member 53 of plate 29; the function of member 51 is to

be more fully explained hereinafter. By sloping planar portion 49 at an angle of 5°, the benefits of providing a nozzle type inlet to the flow restricting means is obtained. In addition thereto, the extreme point on curved portion 47 may be accurately maintained in its required location. If the angle of inclination were too large, an abrupt alteration in the air flow would occur rather than the gradual change provided by portion 49.

By forming the cut-off plate so that the air flowing through the damper is first guided by the inclined planar portion, which serves to define a portion of a nozzle, the pressure drop of the treated air flowing through the damper is minimized as is any turbulence produced thereby. Additionally, as noted hereinbefore, to further reduce turbulence to minimize the generation of sound, the extremity of the plate, which is at the point where a tangent line to curved portion 47 would contact the curved surface, is maintained directly opposite the extreme point 36 of the inflatable bladder.

The bladders 31 and 33 are adhesively mounted on a central partition assembly comprised of opposed, generally convex plates 35 and diffuser triangle 37. The plates have a V-shaped recess therein so that the bladders are completely recessed within the plates when deflated. This provides a large area between the active walls 34 of the bladders and the cut-off plates for maximum air flow therebetween. Further, the recessed bladder provides a smooth surface along the plate 35 to minimize air turbulence.

By reference to FIG. 1 of the drawings, it can be seen that the walls 34 of the bladders are normally concave. Therefor, when the bladders are fully deflated, the active walls of the bladders are out of the air stream to minimize the possibility of bladder flutter. By recessing the bladder within plate 35 and providing the bladder with concave wall 34, the distance between the cut-off plate and wall 34 of the bladder is increased. This provides a greater opening between the bladder and the cut-off plate when the bladder is fully deflated for maximum air flow therebetween. Further, a large movement of wall 34 from a concave to a convex position may be obtained without stretching the bladder material.

The damper mechanism is disposed a substantial distance upstream from the discharge openings in the terminal to provide sufficient space therebetween to absorb any noise generated by the damper mechanism. For maximum sound absorption, downwardly extending walls 39 which form air passages in conjunction with plates 35, are lined with a sound absorbing material such as glass fiber blankets 45. Flange member 51 of plates 29 functions to maintain blankets 45 in intimate contact with walls 39. Outlet members 41 having outwardly flared lower portions 43 thereon are affixed, as by welding, to the walls 39.

The convex plates prevent direct, straight-line passage of sound energy waves from the damper into the area being treated. The sound waves generated at

the damper strike the sound absorbing blankets 45 where they are absorbed, to prevent passage of noise from the terminal. The lower portion of the passageway formed between the plate 35 and the wall 39 has a constantly increasing cross-sectional area in the direction of air flow which also aids in the dissipation of sound energy.

For proper air distribution within the treated area, the discharged air stream should attach and remain attached to the ceiling to a location remote from the terminal before diffusing into the area being treated. This assures a supply of treated air to areas remote from the terminal. Another advantage is that room air will be induced by the discharged air stream and will mix therewith to temper the stream so that the air stream temperature is not disproportionate to the room temperature, thereby providing even temperatures throughout the area being treated.

The described ceiling terminal with the novel cut-off plate in accordance with my invention is capable of efficiently discharging a large quantity of treated air at low noise levels and with minimal temperature variations within the area being treated.

While I have described a preferred embodiment of my invention, it is to be understood that the invention is not limited thereto, but may be otherwise embodied within the scope of the following claims.

I claim:

1. An air terminal provided for supplying treated air from a central source thereof to an enclosure comprising:
 - a. means defining a primary chamber adapted for connection to the source of treated air;
 - b. means defining an air distribution chamber associated with said primary chamber;
 - c. a distribution plate disposed between said primary chamber and said distribution chamber, said plate having a plurality of openings formed therein for passage of treated air from said primary chamber into said air distribution chamber;
 - d. selectively inflatable means for regulating the quantity of air discharged from said distribution chamber;
 - e. a cut-off plate disposed opposite said inflatable means for cooperation therewith, said plate having a first curved portion defining the extremity of the plate closest to said inflatable means, and a planar portion immediately adjacent said curved portion, said planar portion being at an angle of substantially 5° relative to a vertical tangent line to said curved portion; said planar portion being inclined away from said inflatable means, inflation of said inflatable means reducing the area between said curved portion and said inflatable means; and
 - f. diffuser means associated with the terminal to provide a substantially horizontal discharge from said terminal into said enclosure.

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