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ANTISMUDGING AIR DIFFUSERS

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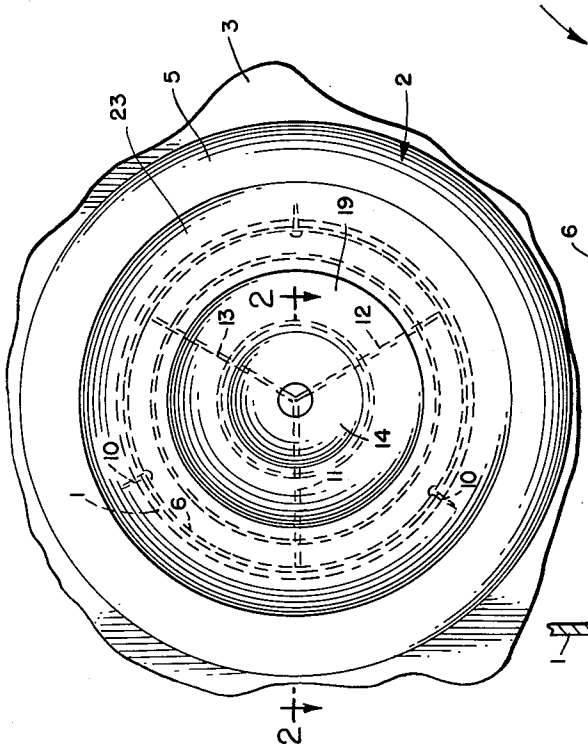


FIG. 1

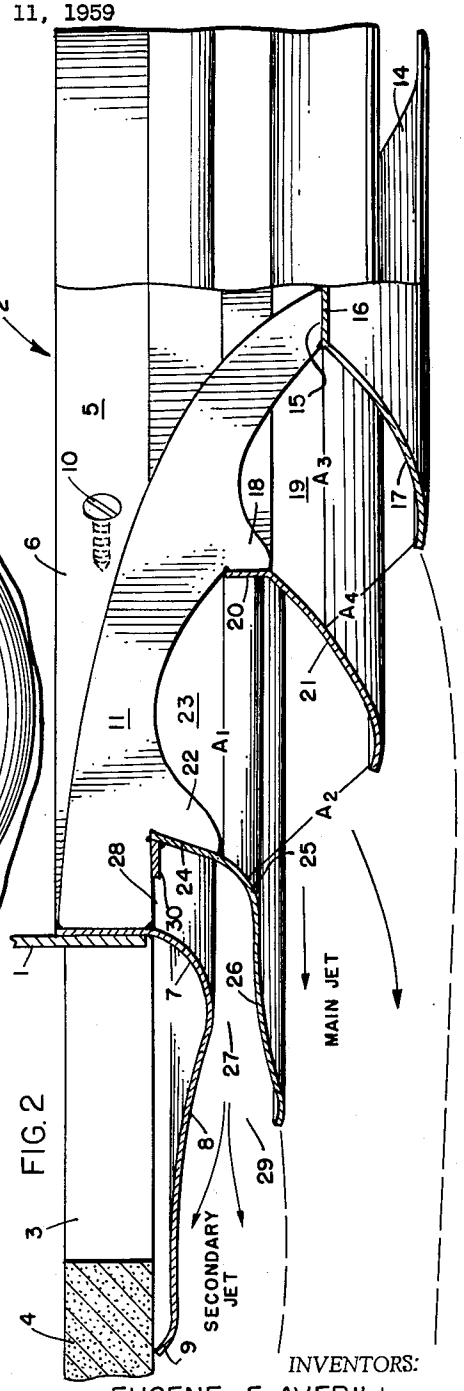


FIG. 2

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ANTISMUDGING AIR DIFFUSERS

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This invention, in general, relates to improvements in ceiling and wall diffuser outlets and, more particularly, to improvements for the purpose of minimizing the deposit of dirt and the like on ceilings and walls surrounding the diffuser outlet.

Dirt deposit on surrounding wall and ceiling areas is a problem common to all air distribution systems. These dirt deposits cause streaking or graying of the wall areas and, after prolonged operation of the air distribution system, these dirty areas become unsightly. The primary source of the dirt deposited on the ceiling areas is not, as one might expect, from the air discharged from the air distribution system, wherein it is usually filtered or otherwise cleaned, but rather the major source of the dirt is in room air. The room air is picked up by the air stream flowing out of the diffuser outlet, and the dirt in the room air is carried outwardly along the ceiling or wall areas with the primary air stream of the diffuser outlet. A portion of the dirt picked up from the mixing of the room air with the primary air stream of the diffuser eventually is deposited on the ceiling and the wall area surrounding the diffuser outlet.

Therefore, it will be seen that the installation of efficient filtering or other air cleaning systems in the air distribution system will not completely solve the dirt deposit problem. The alleviation of dirt deposit on wall areas surrounding the diffuser outlet must be solved by something other than filtering of the air stream of the air distribution system inasmuch as the presence of dust particles, smoke and the like are inevitable in room air.

The mixing of the room air from the diffuser outlet with the discharged air stream, which mixing will hereinafter be referred to as induction of the room air by the discharged air stream, is much greater when the velocity of the air stream emitted from the diffuser outlet is high than when said velocity is low. This phenomenon is believed to be due to the fact that the faster moving air stream has a lower pressure than the slower moving air stream whereby the pressure differential in the former case is greater between the diffuser discharged air stream and the room air—thereby inducing more mixing of the room air with the discharged air stream of the diffuser. Also, the faster moving discharged air stream creates more turbulence with the room air, thereby increasing the amount of induction of the room air into the discharged air stream.

The primary object of our invention is to reduce smudging around the diffuser outlet with dirt particles such as dust, smoke and the like from the room air by providing a small, nonturbulent air jet having a lower air velocity than the main jet of the diffuser in the area between the ceiling and the main air jet. This result is achieved by providing as the radially outermost annular passage in the diffuser a passage whereby the air flow of the supply air stream supplied through the duct connected with the diffuser is emitted substantially radially outwardly and parallel with the wall or ceiling at substantially right angles to the axis of the diffuser, from which passage the discharged air stream is caused to take a lower velocity than the air speed of the main jet emitted from the remaining, more radially central portion of the diffuser. In this manner the lower velocity secondary air jet adjacent the ceiling serves to isolate the ceiling area surrounding the diffuser from the main jet and the room air mixed therewith by induction.

A preferred embodiment of the invention is illustrated in the drawing wherein:

FIG. 1 constitutes a bottom plan view of a ceiling diffuser mounted in a ceiling; and

FIG. 2 is a partial side elevation of the diffuser of FIG. 1, with a portion thereof being shown in section taken along lines 2—2 of FIG. 1.

In the drawing, the numeral 1 designates the vertical take-off duct of an air distribution system which supplies supply air to the ceiling diffuser or outlet designated generally at 2. The diffuser 2 is mounted in a hole 3 cut in plastered ceiling 4. The ceiling air diffuser comprises an outer ring 5, which may be a stamped metal or the like, having a cylindrical portion 6 forming a neck at the upstream side of the diffuser. Forwardly of the neck portion 6 is a radially outwardly flaring portion 7 of a trumpet shape and forming a convex front face. The trumpet shaped, radially outwardly flaring portion 7 merges with a radially outwardly extending portion 8 forming a concave forward face, and the radially outwardly extending portion 8 terminates in a rearwardly directed peripheral portion 9 which abuts with the ceiling 4.

The ceiling diffuser 2 is rigidly mounted by means of sheet metal screws 10. The neck portion 5 of the diffuser has spot welded thereto three radially inwardly extending spider arms 11, 12, 13, equally spaced and extending radially inwardly toward the center of the diffuser. The remaining portion of the diffuser constitutes a center deflector cone 14 which is spot welded to the lower end 15 of the spider arm on the rear of disc 16 of the center deflector cone 14. The remainder of the center deflector cone constitutes a trumpet shaped flaring portion 17 which forms an air deflector surface for deflecting the supply air stream supplied to the diffuser in a radially outward direction.

The diffuser may have additional deflector members mounted concentrically with the center deflector cone. In the embodiment illustrated in the drawing, one additional deflector member for deflecting the supply air stream is shown, although additional deflector members may be employed where needed. In the embodiment illustrated, there is mounted on depending wing 18 of the spider arm 11 a hollow deflector cone 19 having a rear cylindrical portion 20 forming a hollow passage. The deflector cone 19 is mounted in the diffuser by spot welding the inner surface of the cylindrical portion 20 to the outer edge of the depending wing 18 of the spider arm 11, as well as to similar wings on spider arms 12 and 13 (not shown). The remainder of the deflector cone 19 constitutes a trumpet shaped flaring portion 21 forming a deflector surface for deflecting the supply air radially outwardly in a manner similar to the center cone 14.

Deflector cones 14 and 23 constitute the deflector members for forming the main or primary, radially outwardly directed air jet of the ceiling diffuser. The air deflected radially outwardly therefrom constitutes the main air jet of the diffuser. The secondary air jet, which flows between the main air jet and the ceiling, results from the provision of an additional, radially outermost deflector member spot welded to the depending wing 22 on the spider arm 11, as well as spider arms 12 and 13 in a similar manner (not shown). This deflector member 23, which is concentric with cones 14 and 19 and the ring 5, is composed of a frusto-conical, axially forwardly ex-

tending rear collar 24, which may be cylindrical instead of frust-conical, followed by a trumpet shaped flaring portion 25 and a radially outwardly extending portion 26. The outwardly extending portion 26 forms a convex upper surface opposite the convex surface of the radially outwardly flaring portion 7 on the outer ring 5. This arrangement provides an annular Venturi throat 27—forming an annular restriction in the air passage space between the outer ring 5 and deflector member 23. The cross-section of the Venturi throat 27 is perpendicular to the horizontal flow through the outermost air passage of the diffuser. It is the preferred form of restriction because it is the best form for providing a smooth, uniform flow in a horizontal plane. Also, the cross-sectional area of the neck opening 28 at the upstream side of the Venturi throat is substantially less than the cross-section of the annular discharge opening 29 between the radially outer edge of the deflector member 23 and segment 8 of ring 5 at the downstream or discharge side of the Venturi throat.

While the annular Venturi passage above described will provide adequate reduction of the flow velocity of the secondary air stream in most cases, it is also within the contemplation of our invention to use other means to reduce said velocity. For example, an annular ring 30 may be welded about the upper edge of segment 24 to block off a portion of the cross-sectional area 28 to further reduce the secondary air jet velocity. Where possible, we prefer however, to avoid protruding devices of this type because they create turbulence and interfere with the smooth air flow. Little or no turbulence in the secondary air jet is desirable to give the secondary air jet its greatest throw (distance of travel along the ceiling or wall) and minimize turbulent mixing thereof with the main air jet.

The employment of a Venturi throat passage in the manner indicated thus provides a velocity decrease in air flow at the downstream side of the outer annular passage. It also has the advantage over other means for reducing flow through the radially outermost, annular passage of providing a uniform, nonturbulent expansion of the secondary air jet on the exit side of the Venturi throat to provide a secondary air jet of reduced velocity in a horizontal plane parallel and adjacent to the ceiling surface.

As a general guide, the velocity of the secondary air jet parallel and adjacent to the ceiling surface in the area immediately surrounding the ceiling diffuser should fall within the range of 50% to 80% of the velocity of the main jet of the diffuser. The reduction is flow velocity through the outermost annular passage of the diffuser can normally be provided by the greater cross-sectional area of the annular opening 29 over the cross-sectional area of opening 28, but in some instances it may be necessary to or desirable to block off a portion of the opening 28 in the neck portion to provide additional restriction of the entering air flow.

The invention herein described is most efficiently employed in round ceiling diffusers where the radially outwardly directed emitted air flow jets are substantially uniform in all directions. However, the invention is also applicable, though with lesser degrees of success as to uniformity of the antismudging in the ceiling areas surrounding the diffuser with rectangular or square diffusers. In the event an adjustable diffuser is desired, the cones 14 and 19 may be mounted so as to be adjustable axially inwardly and outwardly of the ring 5 by means now well known in the art.

The main jet and the secondary jet are figuratively outlined in FIG. 2 of the drawing. The smaller velocity, relative to the velocity of the main jet, of the secondary jet is achieved by virtue of the larger cross-sectional area at the discharge end 29 of the radially outermost annular passage 27 than the cross-sectional area of the inlet opening 28 to the passage 27, into which opening

28 the radially outermost portion of the axially forwardly flowing supply air stream enters.

The velocity of the main jet is greater than the velocity of the supply air stream. This may be achieved by making the areas at the downstream discharge side of the passages 23 and 19 smaller than the areas at the upstream entry side of said passages. For example, referring to FIG. 2, the annular discharge areas, which are frusto cones formed by the lines A_2 and A_4 around the entire periphery of the passages 23 and 19 and are designated in FIG. 2 by the letters "A_2" and "A_4," are less than the areas of the rings formed by rotating the lines A_1 and A_3 about the axis of the diffuser, the latter giving the total area of the upstream, entry side of the passages 23 and 19. By this area relationship, the velocity of the main jet is increased above the velocity of the supply stream as the air flows through the passages 23 and 19.

The invention is hereby claimed as follows:

1. A process for reducing smudging on a surface surrounding an air diffuser outlet which comprises supplying to the upstream side of a diffuser a supply stream of air, deflecting said air stream in said diffuser, discharging the major portion of the deflected air stream as a main jet from said diffuser in a radially outward direction generally parallel with said surface at a velocity greater than the velocity of said supply stream, and discharging the remaining portion of the deflected air as a secondary air jet flowing radially outwardly from said diffuser between said surface and said main jet at a velocity of said secondary jet substantially less than the velocity of said main jet and supply stream.

2. A process as claimed in claim 1 wherein said velocity of said secondary jet is 50–80% of the velocity of said main air jet.

3. An antismudging air diffuser for outlets of distribution systems comprising a hollow, radially outermost, radially outwardly flaring air flow directing member, means mounted radially inwardly of said hollow, radially outermost member and having a wall forming with said hollow member a radially outermost annular passage having an entry, upstream cross-sectional area materially smaller than the cross-section area of the downstream, discharge area of said annular passage, said means deflecting only the radially outermost portion of a supply stream of air fed to the upstream side of said diffuser into a radially outwardly flowing secondary discharge jet, and deflecting means comprising at least one air deflecting member mounted radially inwardly of said first-mentioned means and having an air deflecting surface for intercepting the remaining, radially inner portion of said supply stream and deflecting said inner portion of said supply stream radially outwardly into a discharge main air jet, said deflecting means having a downstream, air flow discharge area which is smaller than the upstream entry area of said deflecting means whereby the flow velocity of the discharged main jet is greater than the flow velocity of said supply stream and the flow velocity of the discharged secondary jet is less than the flow velocity of said supply stream and, correspondingly, less than the flow velocity of said main jet.

4. An antismudging air diffuser for outlets of air distribution systems comprising a radially outermost, hollow, first ring member which flares radially outwardly from a radially central opening in the upstream side of said ring member, a second, hollow ring member concentrically positioned in said first ring member, said second ring member having an opening in the upstream side and flaring radially outwardly in a downstream direction from said opening in said second ring member, said first and second ring members defining an annular, radially outwardly extending air flow passage therebetween, said second ring member having in said radially outwardly extending passage an annular convex surface, said radially outermost, first ring member having in said ra-

dially outwardly extending passage an annular, convex surface opposite said first-mentioned annular convex surface, said convex surfaces defining in said radially outwardly extending passage an annular Venturi throat therebetween, the upstream, entry side of said passage having a cross-sectional area substantially smaller than the cross-sectional area of the downstream, discharge side of said passage to intercept and discharge radially outwardly the radially outer portion of a supply air stream supplied to the axially rearward side of said diffuser as a radially outwardly flowing secondary jet of discharge air having a velocity substantially less than the velocity of said supply air stream, and air-deflecting, air-passage means spaced radially inwardly of said second ring member and positioned axially forwardly of said opening in the upstream side of said second ring member for intercepting and deflecting radially outwardly the remaining

portion of said supply stream as a radially outwardly flowing main jet of discharge air, the total cross-sectional area of said air-passage means at the upstream, entry side of said passage means being greater than the total cross-sectional area of said passage means at the downstream, discharge side of said passage means, whereby said main jet of discharge air has a velocity greater than the velocity of said supply air stream.

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