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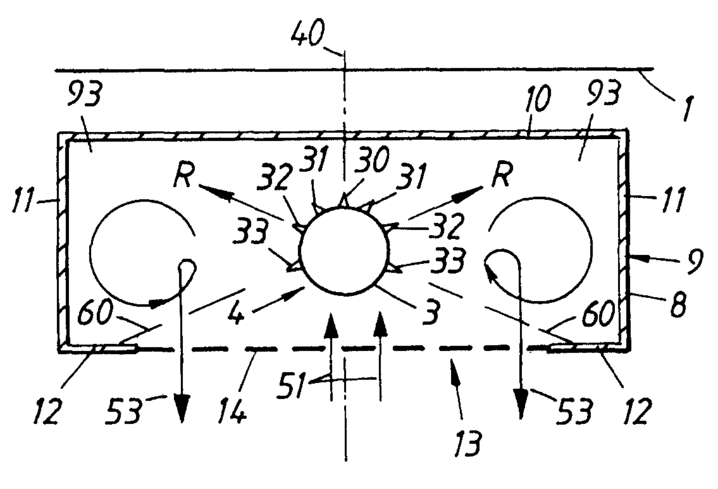
(54) **Supply air terminal device**

(57) A supply air terminal device intended for a room and comprising a supply air chamber (4) to which supply air is delivered, and a number of air outlet nozzles (30-33) which are distributed along a length direction of the chamber, wherein the nozzles are adapted to provide a drop in pressure of at least 70 Pascal, and an air flow rate of at least 8 metres per second, wherein the nozzles are formed to provide but a low noise build-up during the throughflow of supply air, in a known manner. The supply air chamber (4) is surrounded by a housing (8) that includes an opening (13), which extends along that part of the chamber (4) equipped with said nozzles. The opening (13) is screened or shielded by an air-permeable grating (14) and extends around at least 20 percent of the housing periphery, transversely to the long direction of the chamber (4). The nozzles (30-33) are directed so that the air jets issuing from said nozzles will impinge on the housing walls at a distance from the housing opening (13).

Fig. 2



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Description

[0001] The present invention relates to a supply air terminal device for use in a room and being of the kind defined in the preamble of Claim 1.

[0002] Air for delivery to a group of rooms in a building is transported from a fan centre via a duct network, which includes branches that extend into the rooms concerned. These duct branches are connected to a respective supply air terminal device by means of which air is introduced into a room. This supply device is required to fulfil a number of demands.

[0003] First, the noise generated by the device must be very low. Second, air must be introduced into the room in a manner which will ensure that movement of the air in the room will be sufficiently low as to prevent movement of the air from being experienced as a "draft" by persons present in the room.

[0004] The air led out from the fan centre must have a relatively high pressure, in order to prevent the pattern of air flow through the ducting system from being significantly affected by a change in the air flows delivered to one or more of the other rooms. Moreover, many supply air terminal devices used at present are of such character as to only provide a small drop in air pressure before the drop in pressure across the terminal device results in troublesome noise levels. As a result, the supply line which delivers supply air to the supply air terminal device in the room is equipped with a pressure reducing means, which, in turn, has a tendency to generate noise, wherein the level of noise development is reduced with the aid of sound damping constructions, for instance with the aid of sound damping material, such as mineral wool, etc. It is normal practice to include sound damping material in such supply air terminal devices. In addition, it is necessary to set accurately the pressure drops across the terminal device, so as to avoid the build-up of noise.

[0005] It has been proposed in recent times (SE 00 00517-3) that supply air is delivered to a room with the aid of an air supply chamber which includes a number of air outlet nozzles that generally taper conically in a direction away from the interior of the chamber, wherewith the nozzle inner walls connect with the chamber inner wall via continuous smooth curves, and wherewith the nozzle inner walls typically include continuous and smooth surfaces so as to minimise the risk of the occurrence of noise-generating turbulence. These nozzles have a diameter in the order of 6 mm. Such nozzles can achieve a pressure drop of at least 70 Pascal, for instance about 100 Pascal, without generating troublesome noise levels. The exiting jets of air therewith have a velocity of at least 8 m/sec., preferably at least 10 m/sec. The nozzles have a gently rounded funnel shape up to the nozzle exit orifice, which may, for example, have a free diameter of about 6 mm. The nozzle will then have a height of about 15 mm.

[0006] In the case of room-located supply air terminal devices, it is often of interest to supply conditioned air, for instance cooled supply air, so as to correspondingly adjust the room air temperature. However, should the temperature of the supply air differ from the temperature of the air already present in the room, there is a danger of persons present in the room from experiencing some degree of discomfort if there has not been time to mix the supply air with the air present in the room to an acceptable extent, prior to the air contacting the persons involved. Consequently, there is a need for a supply air terminal device of simple design that will achieve an effective mixture of supply air and room air, preferably in the absence of fans or the like.

[0007] Accordingly, the object of the present invention is to provide a supply air terminal device of simple design that generates but a low noise level despite a large pressure drop, and also achieves effective mixture of the supply air and the room air prior to releasing the mixture into said room.

[0008] This object is achieved by means of the present invention.

[0009] The invention is defined in Claim 1.

[0010] Further embodiments of the invention are apparent from the accompanying dependent Claims.

[0011] The invention is based on the concept of using a supply air chamber that may have the form of an end-section of the supply air duct with nozzles of the aforesaid kind disposed along the duct. The chamber is enclosed by a housing that has an outlet opening, which is preferably shielded by an air-permeable grating that functions to somewhat limit the flow of air through the opening. The housing surrounding the chamber may have a generally rectangular configuration in a section at right angles to said chamber, which is in the form of a circular conduit or pipe. An upper housing wall is normally disposed adjacent to and in the proximity of the ceiling of the room, said opening being provided in the bottom wall of the housing. The nozzles are directed towards the inner surface of the housing/the walls, in spaced relationship with said opening.

[0012] The invention utilises the fact that the air jets exiting from the nozzles will generate an ejector effect. Consequently, air present in the proximity of the outer surface of the chamber will be entrained by said air jets, as a result of the ejector effect. The air entrained by the jets of supply air will be replaced by room air that flows up through the housing opening towards the surface of the chamber/the conduit, i.e. its underside, and follow the outer surface of the conduit up to the region of respective nozzles where, as before mentioned, the air is entrained by said ejector effect and circulates around the housing, therewith thoroughly mixing together supply air and room air. If it is assumed that the supply air terminal device is mounted adjacent a ceiling and that the housing is parallelepipedic with the opening facing downwards, the supply air nozzles will be disposed so that the resultant to the air jets exiting from the nozzles will first impinge on the upper wall of the housing and then on its side walls and finally on the opening-defining edge on the lower wall. The air mixture may, of course, continue to circulate in the housing, generally in the indicated circulating direction, before leaving through the opening in a region thereof other than the nearest opening region beneath the chamber where room air is sucked into the housing. This room air then moves in a gap between the outer surface of the chamber and a surface which is "pitched" by the tops of the nozzles. The nozzles extend outwards from the chamber wall.

[0013] In the case of embodiments in which the supply air terminal device has essentially a mirror-symmetrical design relative to a symmetry plane and where the chamber is spaced from the inner walls of the housing, the nozzles may, of course, be disposed symmetrically in relation to this plane, therewith establishing two circulation areas that need not be separated physically in the chamber, since their pressures will essentially balance each other out in the region between the chamber and the upper wall of the housing.

[0014] In one particularly preferred embodiment of the invention, the grating that shields the opening may be comprised of extended metal. The extended metal structure includes a number of lamellae that are generally parallel and directed at an angle to the extension plane of the extended metal structure, whereby the air exiting from (and entering) the housing moves in a corresponding direction.

[0015] The housing limits the linear propagation of the air jets and also possible propagation of noise from the nozzles, and also provides a mixing chamber that ensures that the air mixture departing from the housing has only a small temperature deviation from the room air. Because of the housing and the orientation of the nozzles in said housing, the aforesaid advantages are also obtained with supply air terminal devices of small heights, therewith enabling the device to be mounted in a small vertical space beneath the ceiling of the room concerned.

[0016] The use of the special nozzles obviates the need for sound damping material and also the use of further pressure reducing means other than said nozzles.

[0017] The grating shielding the opening also functions to stabilise the flow pattern established through the opening.

[0018] The invention will now be described by way of example, with reference to the accompanying drawing, in which

Fig. 1 is a view towards the ceiling of a room, showing a number of supply air terminal devices in accordance with the invention;

Fig. 2 is a schematic cross-sectional view of a first embodiment of a supply air terminal device;

Fig. 3 is a cross-sectional view of a second embodiment of a supply air terminal device;

Fig. 4 is a schematic illustration of the flow pattern in the supply air chamber of said device;

Fig. 5 is a schematic illustration of another embodiment of an inventive supply air terminal device; and

Fig. 6 is a schematic sectional view of a grid or grating that shields the outflow opening of said device.

[0019] Fig. 1 shows a ceiling 1 and supply air ducting 2, including branch pipes 3 connecting said ducting with respective supply air terminal devices 9. Although not shown, the ducting can extend to, and into, further supply air terminal devices 9. The devices 9 include a respective housing 8, which is shown to be orthogonally parallelepipedic and includes an upper wall 10, which extends parallel with the ceiling 1, side walls 11 and a bottom wall 12. The bottom wall 12 includes an opening 13, which is covered by a grating 14. In the case of a preferred embodiment (Fig. 6), the grating is comprised of extended metal. As is well known, extended metal includes a relatively large number of lamellae 61, which are generally parallel and which define an angle with the extension plane of the grating and include openings 62 therebetween. The direction in which the lamellae 61 are inclined defines a corresponding air throughflow direction 68, said direction defining an acute angle with the extension plane of the grating 14.

[0020] Fig. 2 can be considered to show a cross-section of an inventive supply air terminal device at right angles to a branch pipe 3, said pipe having a circular cross-section and forming a supply air chamber 4 centrally in respective housings 8. The chamber 4 is formed by distributing nozzles 30-33 around and along a longitudinal section of the branch pipe 3. It can be seen from Figs. 2 and 5 that the supply air terminal device 9 has a construction that is mirror-symmetrical relative to a plane 40. The nozzles 30-33 project out from the outer surface of the pipe. The nozzles are preferably identical and have the form of gently rounded funnels which connect with respective pipes 3 in the absence of sharp edges. The nozzles are typically configured to establish the minimum of noise build-up as supply air passes out in to the interior of the housing 8. A resultant R to the nozzle air jets is shown on each side of the symmetry plane 40 and it will be seen that the direction of the resultant defines an angle above a plane parallel with the wall 10. It can be assumed that supply air will flow in through the pipe 3 at a pressure greater than 70 Pascal, for example a pressure of 100-200 Pascal, and that it will exit through the nozzles with the minimum of noise build-up. The air jets exiting from the nozzles have an effective front rake angle of about 24°. The distance between the top of a nozzle and its adjacent housing wall will preferably be at least 85 mm, at least when the wall is perpendicular to the air jet. It will be evident from Fig. 2 that the resultant of the supply air jets is directed at an acute angle to the wall 10, and then deflected by the wall 11 and thereafter by the wall 12, so as to follow a circulation path that is counter-clockwise to the left chamber 93 of the housing and that is clockwise in the right circulation chamber 93 of said housing. Room air flows up in the region beneath the chamber 4, through the grating 14 and into contact with the underside of said chamber 4, and follows the outer surface of said chamber in a gap that is delimited by the outer surface of the chamber 4 and a surface which is "pitched" by the tops of respective nozzles 30-33. Supply air, which exits from the nozzles at a velocity of at least 10 m per second, normally at least 13.5 m per second, at a drop in pressure of100 Pascal, establishes an ejector effect and thereby entrains room air from said surface layer. Supply air and room air are thus mixed together, and the mixture is augmented as the mixture circulates, as illustrated by the circulation patterns shown in Fig. 2. As a result of the wall 12, i.e. an edge screen in the region nearest the lower part of the side walls 11 and surrounding the opening 13, the circulating mixture is prevented from exiting from the housing directly after being deflected by the wall 11, and thus establishes additional thorough mixing of room air and supply air prior to said mixture departing in the peripheral parts of the opening 13, as illustrated by the arrows 53. In the case of the regular symmetrical embodiments (Fig. 2, Fig. 5), the room air 51 entering the housing 8 flows into the central parts of the opening 13.

[0021] Fig. 4 shows that the room air 51 is able to flow up into contact with the outer surface of the chamber 4 and along said surface in a layer that is delimited by a surface that is pitched by the tips of the nozzles 32. The jets 38 of supply air exiting from the nozzles generate an ejector effect, which entrains room air from said layer.

[0022] Fig. 4 also shows that a nozzle 30 may be directed at right angles to the wall 10 in the embodiment according to Fig. 2, said air jets 38 being divided into two equal parts, whereby the flow patterns in the chambers 93 will be essentially identical although in mutually opposite directions.

[0023] In the case of a cross-section corresponding to that in Fig. 2, the opening 13 extends around at least 20 percent of the housing perimeter.

[0024] A supply air terminal device of the illustrated kind is extremely effective in that it can achieve with supply air an admixture of room air in the housing 8 in a volume that is three times greater than a typical room air flow at a pressure drop across the nozzles of about 100 Pascal, in the absence of any significant sound build-up and with an area of 60 x 60 cm (Fig. 1) and with a supply air flow rate of 60 litres per second at a temperature that is 6° beneath room temperature. The resulting outflow of this air mixture will be extremely uniform and thus of uniform temperature. This means that the air flowing out through the grating 14 will be an effective mixture with but a small temperature difference with regard to the temperature of the room air, and at a relatively low velocity. If the drop in pressure across the nozzles 30-34 increases to 200 Pascal, the supply air terminal device will provide an effective mixture of 4.5 parts of room air and one part of supply air, where the temperature of the supply air is 6°C beneath that of the room air.

[0025] As shown in Fig. 5, the supply air chamber 4 may include a number of nozzles 30 that are directed towards the wall 10 in the plane 40, so as to establish two identical mixing chambers 93.

[0026] When seen against the background of the preferred embodiments of the supply air terminal devices that include a symmetry plane 40, it will be realised that another possible embodiment may include generally one-half of a supply air terminal device according to Fig. 2, as illustrated in Fig. 3 where it can be seen that the supply air chamber 4 is integrated in a side wall 11 that lies on the site of the symmetry plane 40 in the Fig. 2 embodiment. It will be understood that in the case of the Fig. 3 embodiment, no nozzle need lie in the right wall 11, although the same conditions will apply in other respects. However, room air 51 will flow in on one side of the opening, for natural reasons, and the air mixture 53 will exit on the opposite side of the opening.

[0027] The nozzles 30-33 in Fig. 2 are directed so that their respective air jets will impinge on the walls of the housing 8 outside the opening 30. Accordingly, the Fig. 2 embodiment includes jet direction limitations 60 that prevent the air jets exiting from the nozzles from passing directly out through the opening 13.

[0028] The directional effect of the expanded metal grating can be utilised to obtain a desired direction relative to the housing, by rotating the grating in its plane and securing the grating in a chosen rotational orientation. When the grating is rectangular/square and fitted in a corresponding opening 13, two or four different flow directions are provided respectively in the grating plane for the flows entering and departing through the grating.

Claims

1. A supply air terminal device for a room that comprises a supply air chamber (4) to which supply air is delivered, wherein the supply air chamber includes a number of air outlet nozzles (30-33) which are distributed in the length direction of the chamber, wherein the nozzles are adapted to provide a drop in pressure of at least 70 Pascal and an air flow rate of at least 8 metres per second, and wherein the nozzles are adapted to provide a low noise build-up in response to the throughflow of supply air, in a known manner, **characterised in that** the device includes a housing (8) which surrounds the supply air chamber (4); **in that** the housing includes an opening (13) which extends along that part of the chamber (4) equipped with said nozzles; **in that** the opening (13) is shielded or screened by an air-per-

meable grating (14); **in that** the opening (13) extends around at least 20 percent of the housing periphery transversely to the longitudinal direction of said chamber (4); and **in that** the nozzles (30-33) are directed so that the jets issuing from the nozzles will impinge on the housing walls at a distance from the housing opening (13).

2. A supply air terminal device according to Claim 1, **characterised in that** the supply air chamber (4) has the form of a longitudinal section of a supply air pipe (3) equipped with nozzles (30-33) and extending into said housing so as to deliver supply air to said chamber.

3. A supply air terminal device according to Claim 1 or 2, **characterised in that** the nozzles (30-33) are disposed in one or more rows along the chamber (4).

4. A supply air terminal device according to any one of Claims 1-3, **characterised in that** the grating (14) is an extended metal grating that includes generally parallel lamellae which define an oblique angle with the extension plane of the grating, so as to provide a corresponding oblique direction (68) of air throughflow.

5. A supply air terminal device according to any one of Claims 1-4, **characterised in that** said device has a mirror-symmetrical construction relative to a plane (40).

6. A supply air terminal device according to any one of Claims 1-5, **characterised in that** the nozzles are spaced from the housing walls by a distance of at least 8.5 cm, when the nozzles are directed at right angles to a housing wall (10).

7. A supply air terminal device according to any one of Claims 1-6, **characterised in that** the housing (8) has a generally rectangular cross-section and an orthogonal parallelepipedic shape.

8. A supply air terminal device according to any one of Claims 1-4, 7, **characterised in that** the chamber (4) is integrated in the wall (11) of said housing (8).

9. A supply air terminal device according to any one of Claims 1-8, **characterised in that** the nozzles are directed to establish a flow of supply air that is essentially directed firstly onto the rear wall (10) of the housing, and then deflected by a side wall of the housing, and then impinges on the housing front wall (12) that includes the opening (13).

10. A supply air terminal device according to any one of Claims 1-9, **characterised in that** the chamber has a rounded cross-section with the opening (13) turned generally vertically downwards so as to facilitate the inflow of room air along the rounded surface of the chamber to the region of respective nozzles (30-33), which project out from the outer surface of said chamber.

Fig-1

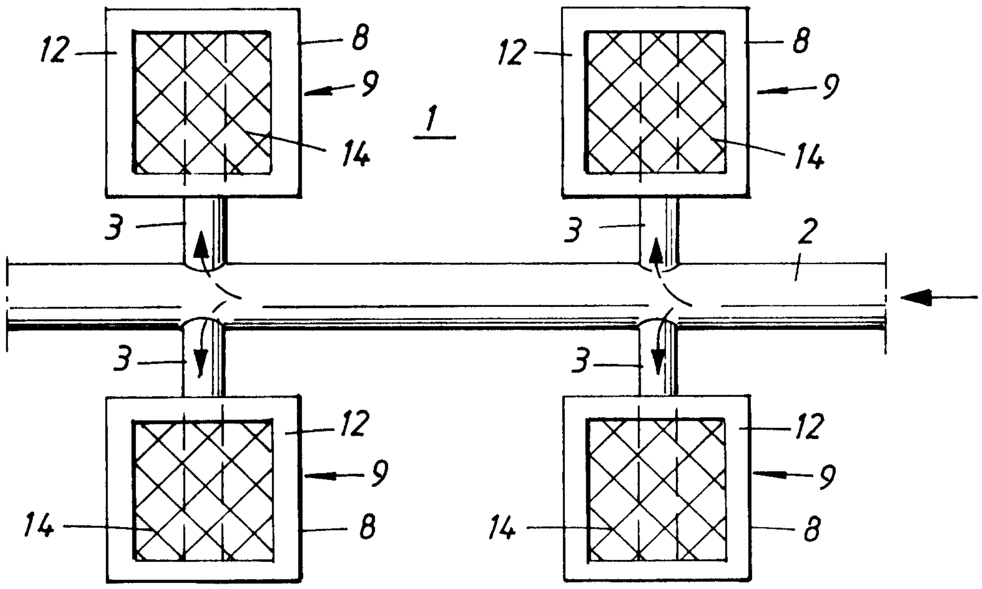

Fig-2

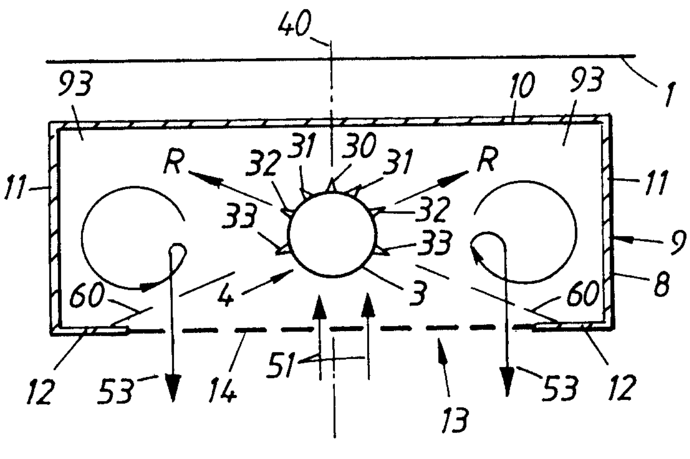

Fig-3

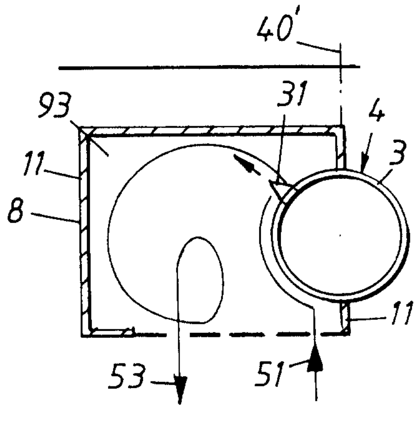

Fig. 4

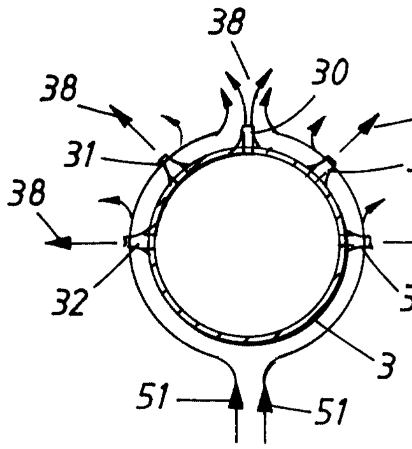

Fig. 5

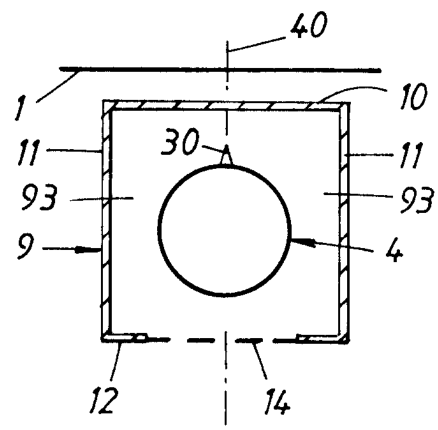

Fig. 6