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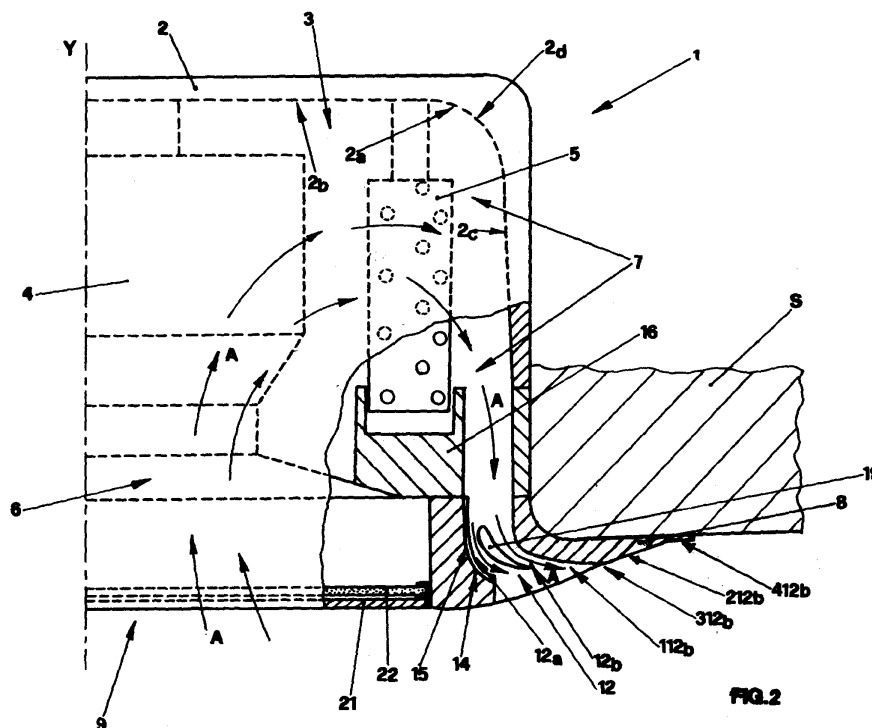
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AL HR LT LV MK(71) Applicant: **Xiang Srl****36030 S. Vito di Leguzzano (IT)**(72) Inventor: **Tonin, Maurizio Enrico****36030, S. VITO DI LEGUZZANO (VI) (IT)**(30) Priority: **23.04.2003 IT VI20030021**(74) Representative: **Bonini, Ercole et al****Corso Fogazzaro, 8****36100 Vicenza (IT)**(54) **Ceiling type air-conditioner**

(57) A ceiling (S) type air-conditioner (1) comprising a container (2) inserted in a cavity made in the ceiling (S) according to a vertical axis (Y), an air-conditioning unit (3) comprising a fan (4) and a heat exchanger (5), both placed in the container (2), where they form a central suction conduit (6) of the air (A) from the room to be air-conditioned and a peripheral delivery conduit (7) of the conditioned air (A) to the room to be air-conditioned, and a covering rim (8) of the container (2), abutting against the ceiling (S), provided with an air (A) inlet hole

(9) coaxial with the central suction conduit (6), and four outlet holes (10, 11, 12, 13), disposed on the surface of the peripheral delivery conduit (7), bounded by two mutually facing longitudinal surfaces (12a, 12b), one concave and the other convex, able to send the conditioned air (A) in the direction diverging from the vertical axis (Y). A portion of the length (L) of the longitudinal surfaces (12a, 12b) comprises protuberances (14) fan-divergent to the room to be air-conditioned to mutually define directional conveying channels (15) of the conditioned air (A).

**FIG. 2****EP 1 471 311 A1**

Description

[0001] The present invention is about a ceiling type air-conditioner, suitable for being installed both on concrete walls and on the inspectable panels of a false ceiling.

[0002] It is known that the air-conditioning systems mounted on the ceiling of rooms are disposed according to a vertical direction in a cavity made in the ceiling.

[0003] This kind of air-conditioning systems comprises a mainly parallelepipedal container, inserted upside down in said cavity, for instance by pressure insertion, a fan and a heat exchanger placed inside said container.

[0004] The fan is closed at its bottom by a rim of substantially plane and square shape, having a central opening through which, in operation condition, passes the air taken from the room to be air-conditioned.

[0005] In fact the fan, for example of centrifugal or axial kind, sucks up the air from the room below, subsequently sending it to the heat exchanger, for example of coil kind, where the thermal exchange with the fluid circulating therein, either refrigerant fluid or water, is performed.

[0006] The heat exchanger, being interposed between the fan and the container, usually surrounds the fan so that the thermal exchange is uniformly distributed around said fan.

[0007] After the thermal exchange, the processed air is driven by the fan to the internal wall of the container, being shaped in order to create an air flow delivery conduit to four opposite and parallel in pairs outlet holes, externally obtained near each lateral edge of the rim.

[0008] Said outlet holes allow the return of the conditioned air to the room in which it has been sucked up, at the desired and proper temperature for air-conditioning the room.

[0009] The air-conditioning system is completed by a grid and an air filter placed above the grid, both applied on the rim at the central opening, a tank for collecting the condensate produced by the heat exchanger, placed below it, and proper deflecting blades placed along each of the aforesaid outlet holes.

[0010] These deflecting blades have the function of guiding the air flow direction inside the room according to the temperature of the air, set on the basis of the external and internal climatic conditions.

[0011] So, for example, the deflecting blades are oriented in a substantially vertical direction in winter, when the conveyance of hot air into the room is required, while they are oriented in a substantially horizontal direction in summer for sending cold air in the room.

[0012] The prior art provides for outlet holes connected to the conditioned air delivery conduit according to different configurations.

[0013] A first embodiment is shown in the US patent No. 5,577,958, in which the conditioned air delivery conduit, placed between the heat exchanger and the internal side wall of the container, has a substantially con-

stant cross section.

[0014] The air is slightly deflected to the air-conditioner vertical axis direction immediately before entering in the outlet hole, which has a cross sectional curved profile in the opposite direction, that is according a diverging direction from said vertical axis.

[0015] Therefore, the conditioned air is forced to make two deflections in its way to the room below, with the outlet hole maintaining constant its cross section anyway, and consequently the air volume which flows therein from the air delivery conduit.

[0016] The inconvenience of this embodiment is related to the fact that the air outgoing from the air-conditioner is merged with the incoming air sucked up by the fan because the conditioned air outlet holes are near to the air to be conditioned inlet holes, with evident disadvantages in terms of efficiency of the system.

[0017] This inconvenience was solved by another ceiling type air-conditioner of known type, object of the EP patent application No. 0 926 451, in which the delivery conduit, even placed between the heat exchanger and the internal side wall of the container, has a cross section which gradually increases from the bottom of the container to the outlet holes of the rim, in view of the inclination of the internal side wall of the container.

[0018] Each outlet hole is completely smooth and it is placed on the longitudinal surface of the conditioned air delivery conduit, so that said conditioned air is forced to make a single deflection, determined by the curved profile of the outlet hole, to a diverging direction from the vertical axis of the container.

[0019] This allows to send the conditioned air in the room to be air-conditioned, being sufficiently separated from the air entering the air-conditioner.

[0020] However, also this kind of ceiling type air-conditioner has a limitation related to the fact that the air flow is not completely distributed in a uniform way in the room to be air-conditioned, although the outlet holes are fairly distributed on the rim.

[0021] The object of the present invention is to overcome the aforesaid limitation.

[0022] In particular, it is an object of the present invention to provide for a ceiling type air-conditioner which allows to distribute more uniformly the conditioned air in the room below with respect to equivalent devices of known type.

[0023] The above mentioned object is attained by a ceiling type air-conditioner which, according to the contents of the main claim, comprises:

- a container inserted in a cavity made in said ceiling according to a vertical axis Y;
- an air-conditioning unit comprising a fan and a heat exchanger, both placed in said container, where they form a central suction conduit of the air from the room to be air-conditioned and a peripheral delivery conduit of said conditioned air to said room to be air-conditioned;

- a covering rim of said container, abutting against said ceiling, provided with a said air inlet hole coaxial with said central suction conduit, and at least an outlet hole, disposed on the surface of said peripheral delivery conduit, bounded by two mutually facing longitudinal surfaces, one concave and the other convex, able to send said conditioned air in the direction diverging from said vertical axis Y

and is characterized in that at least a portion of the length of at least one of said longitudinal surfaces comprises protuberances fan-divergent to said room to be air-conditioned to mutually define directional conveying channels of said conditioned air.

[0024] Advantageously, the air-conditioner of the invention allows to distribute the conditioned air in the rooms in a more uniform way with respect of the air-conditioners of known type.

[0025] More advantageously, the invention maintains separate the outlet air flow from the inlet air flow in the air-conditioner, granting optimal use conditions and high efficiencies.

[0026] Further objects and characteristics will be better highlighted in the description of a preferred embodiment of the invention given in an explanatory but not limiting way, with reference to the figures of the annexed drawings, wherein:

- Figure 1 shows the air-conditioner of the invention installed on the ceiling;
- Figure 2 is a longitudinal section of the air-conditioner of Figure 1;
- Figure 3 is an axonometric view of an enlarged detail of the air-conditioner of Figure 1;
- Figure 4 is a cross section of the detail of Figure 3; and
- Figure 5 shows an enlarged detail of Figure 4.

[0027] The air-conditioner of the invention is shown in Figures 1 and 2, where it is generally indicated with numeral **1**, in installation condition, mounted on the ceiling **S**.

[0028] In Figure 2 it is noticed in particular that it comprises a container **2**, inserted in a cavity (not visible) made in the ceiling **S** according to a vertical axis **Y**, and an air-conditioning unit, generally indicated with numeral **3**, which comprises a fan **4** and a heat exchanger **5**.

[0029] Both the heat exchanger **5**, of coil kind in this case, and the fan **4**, for example of axial kind, are placed inside the container **2**, with the heat exchanger **5** surrounding the fan **4**, forming a central suction conduit, generally indicated with numeral **6**, of the air **A** from the room to be air-conditioned, and a peripheral delivery conduit, generally indicated with numeral **7** and defined by the space comprised between the heat exchanger **5** and the side wall **2a** of the container **2**, of the conditioned air **A** to the room to be air-conditioned.

[0030] The air-conditioner **1** then comprises a cover-

ing rim **8** for the container **2**, abutting against the ceiling **S**, provided with an air **A** inlet hole **9** coaxial with the central suction conduit **6** and preferably but not necessarily with four outlet holes, visible in Figure 1 and generally indicated with numerals **10**, **11**, **12**, **13**, each of them disposed on the surface of the peripheral delivery conduit **7** of the air **A**.

[0031] Each of the outlet holes **10**, **11**, **12**, **13** is bounded by a couple of mutually facing longitudinal surfaces, one concave and the other convex, visible in Figure 2 for the outlet hole **12** only and indicated with numerals **12a** and **12b**, which send the conditioned air **A** in the direction diverging from the vertical axis **Y**.

[0032] According to the invention, the entire length **L** of each concave longitudinal surface, of the kind indicated with numeral **12a**, comprises protuberances **14**, better highlighted in Figure 1, fan-divergent to the room to be air-conditioned to mutually define directional conveying channels **15** of the conditioned air **A**.

[0033] According to other embodiments of the air-conditioner of the invention, said protuberances could be present on some, for instance two or three, of the outlet holes only.

[0034] It is evident as well that in further executive embodiments said protuberances could be placed along a portion of the length of each outlet hole only.

[0035] According to a further executive embodiment of the invention, the protuberances could be obtained on the convex longitudinal surface of each outlet hole instead of on the concave longitudinal surface.

[0036] Furthermore, in another executive embodiment both the longitudinal surfaces of the outlet holes could have the aforesaid protuberances.

[0037] With reference to the embodiment described hereby, in particular in Figure 2, the internal wall **2a** of the container **2** has a connection curvature **2d** between the bottom **2b** and the side wall **2c**, which is inclined so that the peripheral delivery conduit **7** has a width progressively increasing from the bottom **2b** to each of the outlet holes **10**, **11**, **12**, **13**.

[0038] Also in Figures 1 and 2 is shown that the air-conditioner **1** comprises a grid **21** and a filter **22** of the air **A** to be air-conditioned, applied to the rim **8** at the inlet hole **9**, with the filter **22** placed above the grid **21**.

[0039] The air-conditioner **1** of the invention is furthermore provided by a collecting sump **16**, shown in Figure 2, placed below the heat exchanger **5** and used for containing the condensate produced during the thermal exchange between the air **A** and the thermal exchange fluid circulating in the heat exchanger **5**.

[0040] In Figure 2 it is clearly shown that the convex longitudinal surface **12b** has a mixtilinear profile formed by a curved portion **112b** following the side wall **2c** of the container **2**, a subsequent first rectilinear segment **212b** inclined toward the ceiling **S** and joined to a second rectilinear segment **412b** substantially parallel to the same ceiling **S**.

[0041] With this constructive measure, an edge **312b**

on the external wall of the rim **8** is obtained, whose function, together with the second rectilinear segment **412b**, is to avoid the conditioned air **A** outgoing from the air-conditioner **1** to be directly sent against the ceiling **S**, condition that causes the well known formation of evident stains on the same ceiling **S**.

[0042] In the aforesaid Figures, more particularly in Figure 3, it is shown that the air-conditioner **1** comprises four rotating blades **17, 18, 19, 20** each of them placed in the respective outlet hole **10, 11, 12, 13** parallel to the longitudinal surfaces which bound said outlet holes, mechanically or manually operable to deviate the outlet flow of the conditioned air **A**, as it will be better explained as follows.

[0043] As to the protuberances **14**, in Figure 4 it is evidenced that they are preferably but non necessarily symmetrically disposed with respect to the axis of symmetry **Z** of the outlet hole **12**, perpendicular to the development direction **X** of the longitudinal surfaces **12a, 12b**.

[0044] According to the preferred embodiment of the invention described hereby, each protuberance **14** comprises a linear portion **14a**, disposed on the upper part **112a** of the concave longitudinal surface **12a** parallel to the axis of symmetry **Z**, and a portion **14b** curved toward the corresponding side wall **12c, 12d** of the outlet hole **12**, placed on the end portion **212a** of the concave longitudinal surface **12a**, as it is evidenced in Figure 5.

[0045] It is evident that what previously explained about the outlet hole **12** is valid for the other outlet holes **10, 11, 13** obtained on the covering rim **8** as well.

[0046] Operatively, the fan **4** sucks up the air **A** from the room to be air-conditioned and sends it to the heat exchanger **5**, where the thermal exchange with the fluid circulating therein, for example refrigerant fluid of well known type or water, takes place.

[0047] The fan **4** subsequently drives the air **A** to the peripheral delivery conduit **7** which sends it to the outlet holes **10, 11, 12, 13** and then to the room below to be air-conditioned.

[0048] In winter, the air **A** absorbs heat from the thermal exchange fluid, brought to a proper temperature, of the heat exchanger **5**.

[0049] In this case, the rotating blades **17, 18, 19, 20** are oriented downward, in a substantially vertical position so that the air **A** heated by the thermal exchange fluid is rapidly sent to the room below.

[0050] In summer, the air **A** transfers instead the heat to the thermal exchange fluid of the heat exchanger **5** and the rotating blades **17, 18, 19, 20** are oriented according to a substantially horizontal position, so that the cold air **A** is sent to the room to be air-conditioned according to a direction which is not harmful and not causes physical inconveniences to the persons present in the room.

[0051] In any case, the presence of the grooves **14** on the concave longitudinal surface of each of the outlet holes **10, 11, 12, 13** allows to distribute in a more uniform

way the conditioned air **A** in the room below with respect to the air-conditioners of the prior art.

[0052] In fact, said protuberances form directional conveying channels **15** fan-divergent to the room to be air-conditioned so that the air is spread out in said room in a more homogeneous way.

[0053] This is of not negligible importance especially in summer, when the cold conditioned air has not to cause particular physical inconveniences to the persons, at the same time having the function of making more pleasant and comfortable their stay in the rooms.

[0054] The particular configuration of the internal wall **2a** of the container **2**, inclined toward each of the outlet holes **10, 11, 12, 13** starting from the bottom **2b**, allows to rapidly send the air **A**, just conditioned by the heat exchanger **5**, to the room below thus increasing the efficiency of the air-conditioning system of the invention.

[0055] On the basis of this disclosure, it is thus evident that the ceiling type air-conditioner of the invention achieves the object and realizes the previously mentioned advantages.

[0056] In the executive step, modifications to the air-conditioner of the invention can be provided, consisting for instance in a different shape of the protuberances on the longitudinal surfaces delimiting each of the outlet holes obtained on the covering rim.

[0057] All the described and cited embodiments, but not shown in the annexed drawings, should be intended as protected by the present patent if they fall in scope of protection of the following claims.

Claims

1. A ceiling (S) type air-conditioner (1) comprising:
 - a container (2) inserted in a cavity made in said ceiling (S) according to a vertical axis (Y);
 - an air-conditioning unit (3) comprising a fan (4) and a heat exchanger (5), both placed in said container (2), where they form a central suction conduit (6) of the air (A) from the room to be air-conditioned and a peripheral delivery conduit (7) of said conditioned air (A) to said room to be air-conditioned;
 - a covering rim (8) of said container (2), abutting against said ceiling (S), provided with a said air (A) inlet hole (9) coaxial with said central suction conduit (6), and at least an outlet hole (10, 11, 12, 13), disposed on the surface of said peripheral delivery conduit (7), bounded by two mutually facing longitudinal surfaces (12a, 12b), one concave and the other convex, able to send said conditioned air (A) in the direction diverging from said vertical axis (Y),

characterized in that at least a portion of the length (L) of at least one of said longitudinal surfaces (12a,

12b) comprises protuberances (14) fan-divergent to said room to be air-conditioned to mutually define directional conveying channels (15) of said conditioned air (A).

2. The air-conditioner (1) according to claim 1), **characterized in that** said protuberances (14) are provided along said longitudinal concave surface (12a) of said outlet hole (10, 11, 12, 13).
3. The air-conditioner (1) according to claim 1), **characterized in that** said protuberances are provided along said longitudinal concave surface and said convex surface of said outlet hole.
4. The air-conditioner (1) according to claim 1), **characterized in that** said protuberances (14) are disposed symmetrically with respect to the axis of symmetry (Z) of said outlet hole (10, 11, 12, 13), perpendicular to the development direction (X) of said longitudinal surfaces (12a, 12b).
5. The air-conditioner (1) according to claim 4), **characterized in that** each of said protuberances (14) comprises a linear portion (14a), disposed on the upper part (112a) of said concave longitudinal surface (12a) parallel to said axis of symmetry (Z), and a portion (14b) curved toward the side wall (12c, 12d) of said outlet hole (10, 11, 12, 13), placed on the end portion (212a) of said concave longitudinal surface (12a).
6. The air-conditioner (1) according to claim 1), **characterized in that** said peripheral delivery conduit (7) is defined by the space comprised between said heat exchanger (5) and the side wall (2a) of said container (2).
7. The air-conditioner (1) according to claim 6), **characterized in that** said internal wall (2a) of said container (2) has a connection curvature (2d) between the bottom (2b) and the side wall (2c).
8. The air-conditioner (1) according to claim 7), **characterized in that** said side wall (2c) is inclined so that said peripheral delivery conduit (7) has a width progressively increasing from said bottom (2b) to said outlet hole (10, 11, 12, 13) of said rim (8).
9. The air-conditioner (1) according to claim 1), **characterized in that** said heat exchanger (5) surrounds said fan (4).
10. The air-conditioner (1) according to claim 1), **characterized by** comprising a collecting sump (16) placed below said heat exchanger (5) for containing the condensate produced during the thermal exchange between said air (A) and the thermal ex-

change fluid circulating in said heat exchanger (5).

11. The air-conditioner (1) according to claim 1), **characterized by** comprising a rotating blade (17, 18, 19, 20) placed in said outlet hole (10, 11, 12, 13) parallel to said longitudinal surfaces (12a, 12b) suitable for deviating the outlet flow of said conditioned air (A).
12. The air-conditioner (1) according to claim 1), **characterized by** comprising a grid (21) applied to said inlet hole (9) of said rim (8).
13. The air-conditioner (1) according to claim 1), **characterized by** comprising a filter (22) of said air (A) to be air-conditioned applied to said inlet hole (9) of said rim (8).
14. The air-conditioner (1) according to claim 7), **characterized in that** said convex longitudinal surface (12b) has, in its longitudinal section, a mixtilinear profile formed by a curved portion (112b) following said side wall (2c) of said container (2), a subsequent first rectilinear segment (212b) inclined toward said ceiling (S) and joined to a second rectilinear segment (412b) substantially parallel to said ceiling (S).

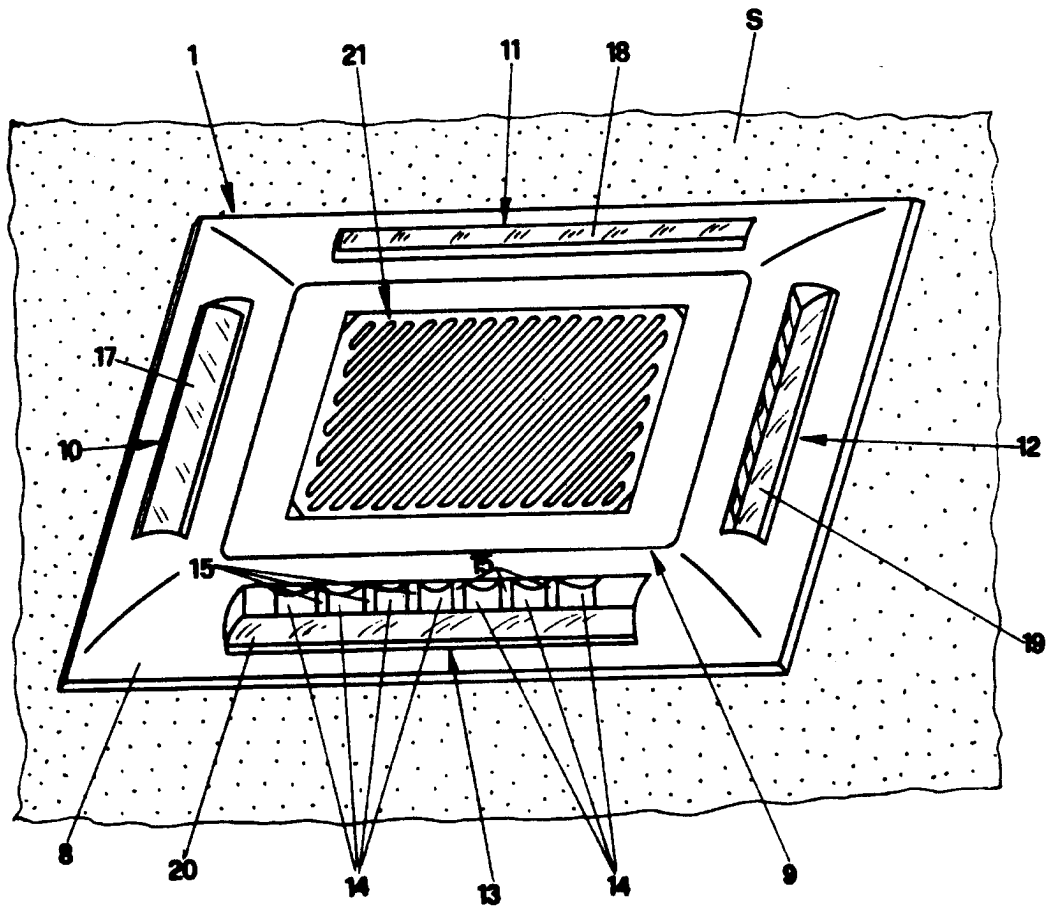
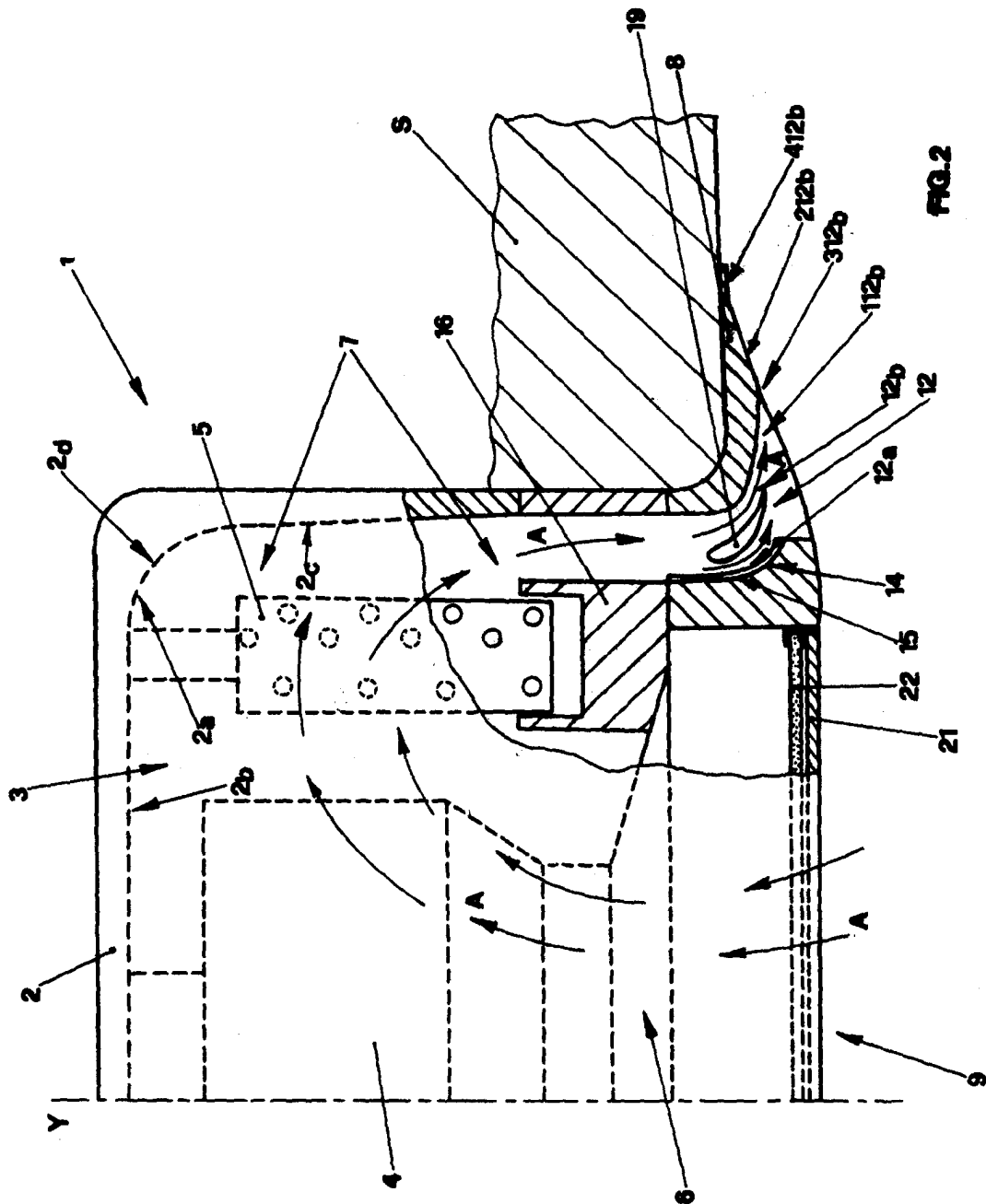


FIG.1



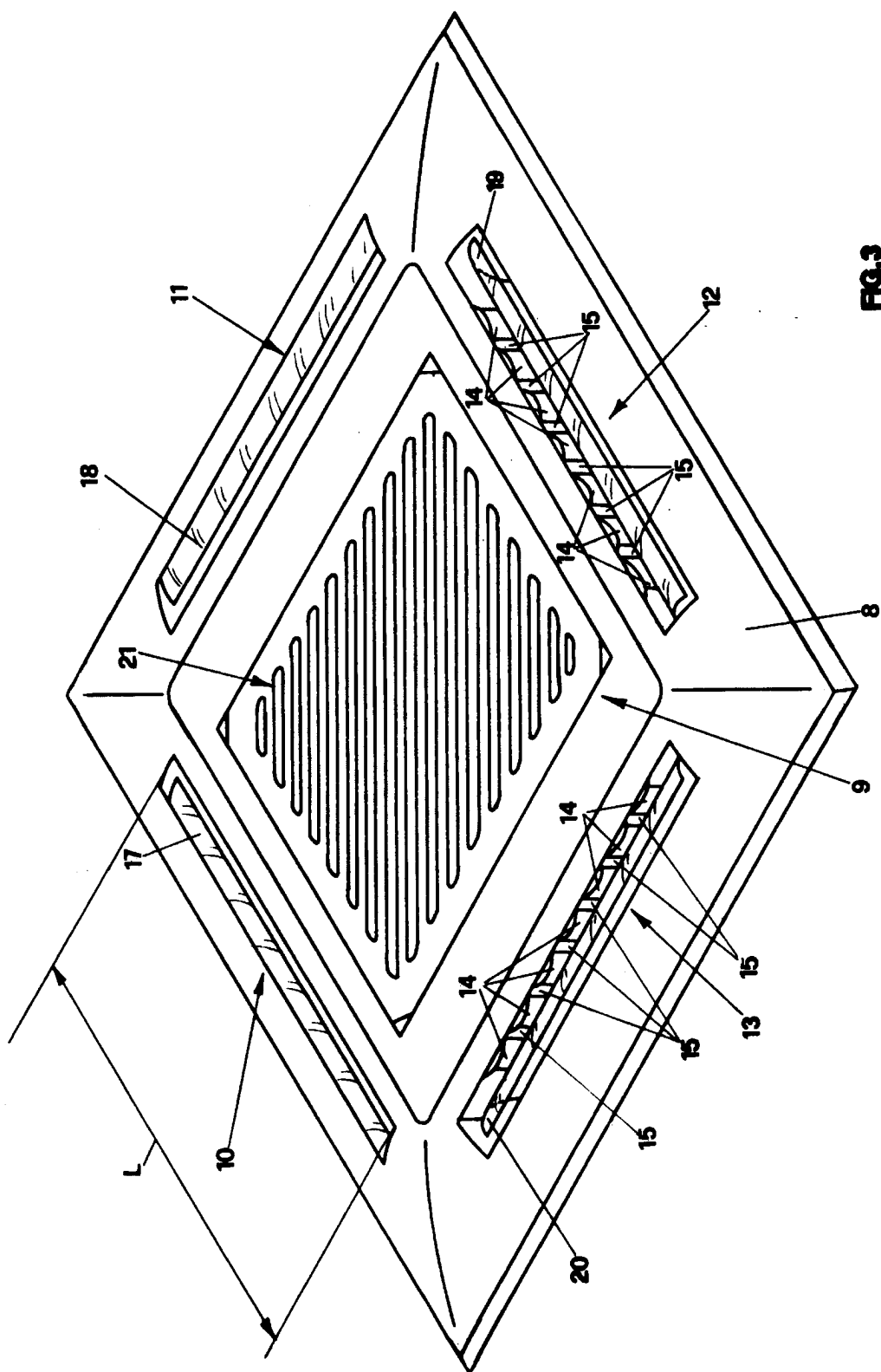
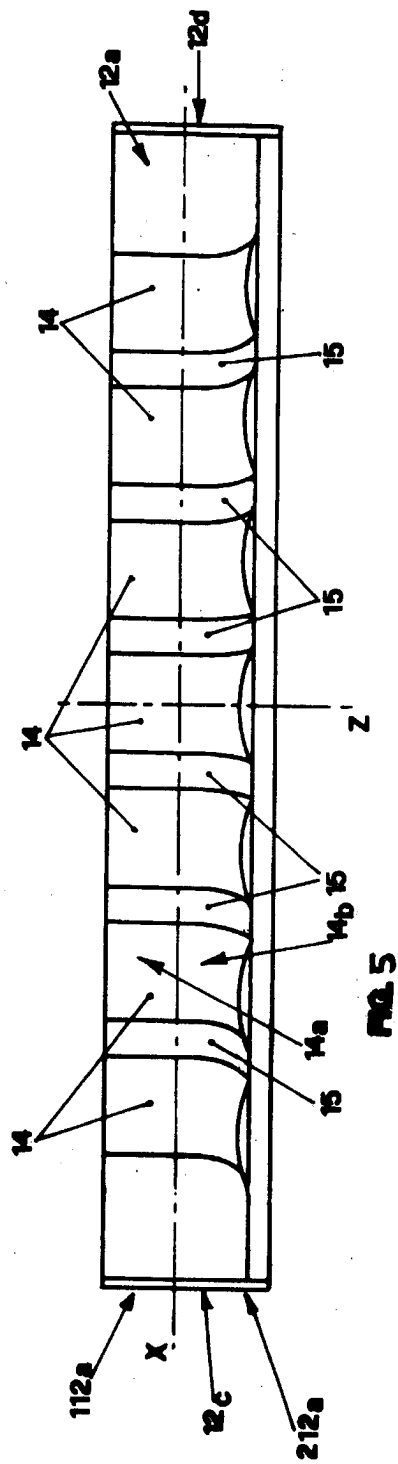
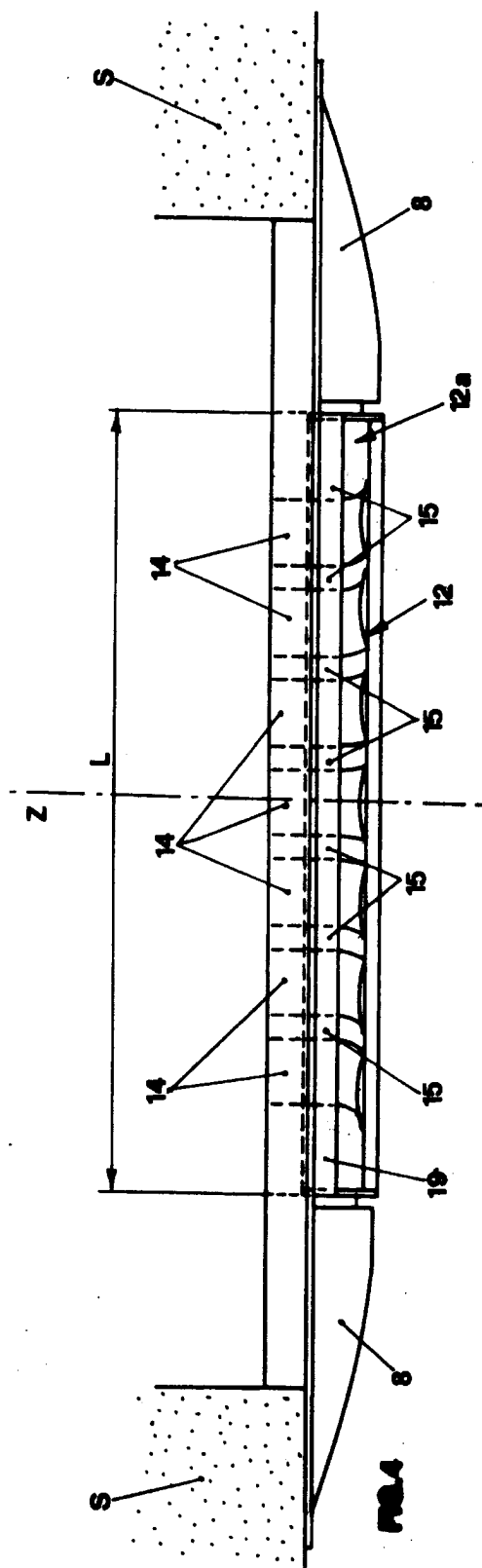


FIG. 3





European Patent
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EUROPEAN SEARCH REPORT

Application Number
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Place of search MUNICH		Date of completion of the search 5 July 2004	Examiner Lienhard, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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