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(54) Supply and exhaust air terminal device

(57) A method and a supply and exhaust air terminal device arranged in a chilled beam system. The terminal comprises a supply air chamber into which supply air is led through at last one supply air opening from a supply air duct, wherein the supply air chamber is arranged in the first end of the chilled beam; and an exhaust air chamber through which exhaust air is led from a room space into an exhaust air duct through at least one exhaust air opening, wherein the exhaust air chamber is arranged in the second end of the chilled beam and separated from the supply air chamber. The air terminal device further comprises an adjusting device configured to adjust the at least one supply air opening and the at least one exhaust air opening; and an actuator for displacing the adjusting device, wherein displacing the adjusting device causes the air flow to be obstructed through the at least one supply air opening and through the at least one exhaust air opening.

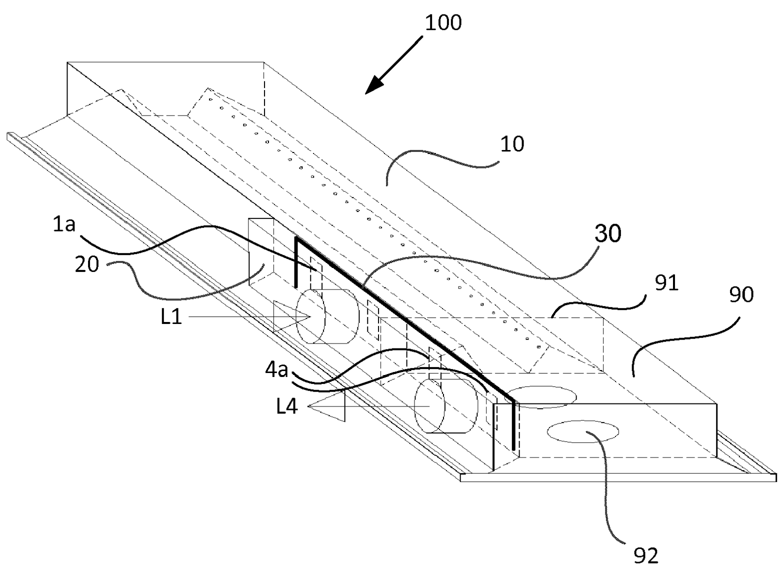

FIG. 9

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a supply and exhaust air terminal device.

BACKGROUND OF THE INVENTION

[0002] Supply air terminal devices or chilled beams usually comprise a supply air chamber, a mixing chamber and a heat exchanger. A supply air flow is guided from the supply air chamber via nozzles to the mixing chamber where the supply air flow induces a circulated air flow to flow from a room being air-conditioned via the heat exchanger to the mixing chamber. A combined air flow formed from the supply air flow and the circulated air flow in the mixing chamber is guided from an output opening of the mixing chamber to the room being air-conditioned. The same supply air terminal device can perform the cooling of indoor air in summer and the heating of indoor air in winter. In summer, the circulated air of the room is cooled and, in winter, it is heated in the heat exchanger of the supply air terminal device.

[0003] Recently, closer attention is being paid to the energy consumption of a building. The chilled beam system has proven to be, as to both its investment and operational costs, a very competitive system which can manage the air-conditioning and cooling and/or heating of a room being air-conditioned. Typically, the chilled beam operates with minimum air flow, in other words, only the air volume, which is required by authorities in the room in question, is guided to the chilled beam.

[0004] The chilled beam system may be modified by adjusting the flow of the supply air and the flow of the exhaust air. The chilled beam system may be connected to a constant pressure duct system, wherein the air flow per room is controlled by air terminals. For example, the amount of supply air may be fixedly modified by separating the nozzle chamber into multiple nozzle chambers, and the air flow resistance may change accordingly. In one embodiment the chilled beam is used in the single room and the exhaust air flow should be adjusted to correspond to the supply air flow. The prior art discloses solutions, wherein the exhaust air and the supply air flow are controlled individually. The supply air flow may be adjusted continuously between 0%...100%. The variable air flow controllers may be inaccurate in the air flow settings below 10%...20%. Such controllers may be expensive and require two electric actuators per air terminal, thus increasing the complexity of the solution.

SUMMARY OF THE INVENTION

[0005] One aspect discloses a supply and exhaust air terminal device arranged in a chilled beam system, comprising a supply air chamber into which supply air is led through at last one supply air opening from a supply air duct, wherein the supply air chamber is arranged in the first end of the chilled beam. In one embodiment the supply and exhaust terminal device is arranged in a VAV system (VAV, Variable Air Volume). The terminal device comprises also an exhaust air chamber through which exhaust air is led from a room space into an exhaust air duct through at least one exhaust air opening, wherein the exhaust air chamber is arranged in the second end of the chilled beam and separated from the supply air chamber. The air terminal comprises an adjusting device configured to adjust the at least one supply air opening and the at least one exhaust air opening; and an actuator for displacing the adjusting device. Displacing the adjusting device causes the air flow to be obstructed through the at least one supply air opening and through the at least one exhaust air opening.

[0006] In one embodiment the adjusting device comprises at least one opening configured to interact with the at least one supply air opening; and at least one opening configured to interact with the at least one exhaust air opening. The form of the at least one opening is configured to cause the air flow through the supply air opening to correspond to the air flow though the exhaust air opening.

[0007] In one embodiment the adjusting device comprises a solid regulating plate. The plate may be moved in the supply air chamber and the exhaust air chamber.

[0008] In one embodiment the air terminal device comprises a distribution chamber, a nozzle chamber comprising nozzles or a nozzle gap, at least one mixing chamber, and at least one heat exchanger. The supply air flow is guided from the distribution chamber to the nozzle chamber, from where the supply air flow is further guided via the nozzles or the nozzle gap to said at least one mixing chamber, where the supply air flow induces a circulated air flow to flow from the room being air-conditioned via said at least one heat exchanger to said at least one mixing chamber, from which the combined air flow composed of the supply air flow and circulated air flow is guided to the room being air-conditioned. The supply air flow is also guided from the distribution chamber to the supply air chamber, from which a separate supply air flow is further guided directly to the room being air-conditioned. The nozzle chamber is divided into at least two partial nozzle chambers. The adjusting device is arranged between the distribution chamber and the first nozzle chamber, the second nozzle chamber and the supply air chamber such that the adjusting device is arranged to open and close the air flow connection from the distribution chamber to the first partial nozzle chamber and/or the second partial nozzle chamber and/or the supply air chamber.

[0009] In an embodiment the first partial nozzle chamber, the second partial nozzle chamber and the supply air chamber each comprise on that surface which is against the distribution chamber an inlet opening. The adjusting device consists of a regulating plate comprising openings, whereby the adjusting device is arranged to open and close the desired connection from the distribution chamber to the first partial nozzle chamber and/or the second partial nozzle chamber and/or the supply air chamber.

[0010] A second aspect discloses a method for a supply and exhaust air terminal device arranged in a chilled beam system. The method comprises adjusting the at least one supply air opening and the at least one exhaust air opening by an adjusting device; and displacing the adjusting device by an actuator, causing obstruction of the air flow through the at least one supply air opening and through the at least one exhaust air opening.

[0011] In an embodiment of the method the adjusting device comprises at least one opening interacting with the at least one supply air opening; and the adjusting device comprises at least one opening interacting with the at least one exhaust air opening. The form of the at least one opening is causing the air flow through the supply air opening to correspond to the air flow though the exhaust air opening. In an embodiment the adjusting device comprises a solid regulating plate.

[0012] In an embodiment the method comprises dividing the nozzle chamber into at least two partial nozzle chambers and arranging the adjusting device between the distribution chamber, the first nozzle chamber and the second nozzle chamber and the supply air chamber, arranging the adjusting device to open and close the air flow connection from the distribution chamber to the first partial nozzle chamber and/or the second partial nozzle chamber and/or the supply air chamber.

[0013] The air terminal and the method enable the control of the supply air flow and the exhaust air flow simultaneously. The adjustment is accurate even with lower air flows. The solution may be operated with one actuator, and it is more cost-effective and robust.

[0014] The embodiments described hereinbefore may be used in any combination with each other. Several of the embodiments may be combined together to form a further embodiment. A method, an apparatus, a computer program or a computer program product to which the invention is related may comprise at least one of the embodiments of the invention described hereinbefore. It is to be understood that any of the above embodiments or modifications can be applied singly or in combination to the respective aspects to which they refer, unless they are explicitly stated as excluding alternatives.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

Fig. 1 axonometrically shows a supply air terminal device in which the arrangement according to the invention can be applied,

Fig. 2 axonometrically shows the supply air terminal device shown in Fig. 1 such that its inner parts are visible,

Fig. 3 shows a cross-directional section of the supply air terminal device shown in Figs. 1 and 2,

Fig. 4 shows a cross-directional section of another supply air terminal device in which the arrangement according to the invention can be applied,

Fig. 5 shows a longitudinal cross section of the supply air chamber construction of a supply air terminal device,

Fig. 6 shows the operating principle of the regulation arrangement in Fig. 5,

Fig. 7 shows different modes of the supply air terminal device applying the arrangement according to the invention,

Fig. 8 shows a top plan view of an alternative regulation arrangement according to the invention, and

Fig. 9 axonometrically illustrates the supply and exhaust air terminal with its inner parts visible.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings. The detailed description provided below in connection with the appended drawings is intended as a description of the present examples and is not intended to represent the only forms in which the present example may be constructed or utilized. However, the same or equivalent functions and sequences may be accomplished by different examples.

[0017] Fig. 1 shows a cross-directional section of a supply air terminal device in which the adjusting arrangement and the method can be applied.

[0018] The supply air terminal device 100 shown in Fig. 1 comprises an elongated supply air chamber 10, 11 having a polygonal cross section and an elongated distribution chamber 20 having a rectangular cross section located on a side wall of the supply air chamber 10, 11. A fresh supply air flow L1 is guided from an inlet opening 21 to the distribution chamber 20 from where the supply air flow L1 is further guided to the supply air chamber 10, 11. The supply air flow is guided to the inlet opening 21 of the distribution chamber 20 by a fresh air channel system extending to a room being air-conditioned and by a connected blower which is not shown in the figure.

[0019] Below the supply air chamber 10, 11 is fitted an elongated heat exchanger 12 having a rectangular cross section. Below the heat exchanger 12, there is a bottom plate 18 which includes openings at the point of the heat exchanger 12. A circulated air flow L2 flows from the room being air-conditioned through the heat exchanger 12 within the supply air terminal device where it is mixed with the supply air flow L1. A combined air flow LA, LB composed of the supply air flow L1 and the circulated air flow L2 flows out of the supply air terminal device to the sides.

[0020] Fig. 2 axonometrically shows the supply air terminal device shown in Fig. 1 such that its inner parts are visible. The figure shows that the supply air chamber 10, 11 consists of the nozzle chamber 10 and the supplementary air chamber 11. The nozzle chamber 10 is again divided into a first partial nozzle chamber 10a and a second partial nozzle chamber 10b. The nozzle chamber 10 shows one nozzle bank 15b. The bottom of the distribution chamber 20 also shows openings 1a, 2a, 3a leading to each chamber 10a, 10b, 11. The heat exchanger 12 extends in the longitudinal direction of the device only in the area of the nozzle chamber 10 but not in the area of the supplementary air chamber 11. The supplementary air chamber 11 is an open chamber from the lower part of which a fresh supplementary air flow L3 flows with a low impulse to the room being air-conditioned. The supplementary air chamber 11 does not include nozzles. The lower part of the supplementary air chamber 11 is advantageously covered with a plate with openings, whereby the supplementary air flow L3 flows through the openings in the plate to the room being air-conditioned.

[0021] Fig. 3 shows a cross-directional section of the supply air terminal device shown in Figs. 1 and 2. The cross section shows the nozzle chamber 10 on a vertical side wall of which is fitted the distribution chamber 20. Below the nozzle chamber 10, there is the heat exchanger 12 and, below the heat exchanger 12, the bottom plate 18, the outer edges of which include folds 18a, 18b. The bottom wall of the nozzle chamber 10 is of the shape of a spread letter M and the outer edges of the bottom wall include guide parts 19a, 19b. The bottom wall of the nozzle chamber 10, the guide parts 19a, 19b connected to it and the folds 18a, 18b of the bottom plate 18 form mixing chambers 13a, 13b and output openings 16a, 16b of the supply air terminal device. The supply air terminal device is symmetrical in relation to the vertical central axis Y-Y except for the distribution chamber 20 and the inlet opening 21 leading to it.

[0022] The supply air flow L1 is guided to the inlet opening 21 of the distribution chamber 20 by a fresh air channel system extending to the room being air-conditioned and by a connected blower which is not shown in the figure. From the distribution chamber 20, the supply air flow L1 is further guided to the nozzle chamber 10 from where the supply air flow L1 is guided via a first nozzle bank 15a to the first mixing chamber 13a and via a second nozzle bank 15b to the second mixing chamber 13b. A first supply air flow L1 fed to the first mixing chamber 13a with a relatively high impulse induces a first circulated air flow L2 to flow from the room being air-conditioned via the heat exchanger 12 to the first mixing chamber 13a. A second supply air flow L1 fed to the second mixing chamber 13b with a relatively high impulse induces a second circulated air flow L2 to flow from the room being air-conditioned via the heat exchanger 12 to the second mixing chamber 13a. In each mixing chamber 13a, 13b, the supply air flow L1 and the circulated air flow L2 are mixed, after which the combined air flow LA, LB composed of the supply air flow L1 and the circulated air flow L2 is guided to the room being air-conditioned from the output openings 16a, 16b of the supply air terminal device. The supply air terminal device 100 is advantageously fitted in connection with the ceiling of the room being air-conditioned such that the bottom plate 18 of the supply air terminal device 100 is on the level of the ceiling of the room being air-conditioned, whereby the combined air flow LA, LB is guided on both sides of the supply air terminal device 100 in the direction of the ceiling.

[0023] Fig. 4 shows a cross-directional section of another supply air terminal device in which the arrangement according to the invention can be applied.

[0024] The supply air terminal device 100 shown in Fig. 4 comprises the elongated supply air chamber 20 having a rectangular cross section and, below it, the elongated distribution chamber 10, 11 having a rectangular cross section. The supply air flow is guided to the inlet opening 21 of the distribution chamber 20 by the fresh air channel system extending to the room being air-conditioned and by the connected blower which is not shown in the figure.

[0025] On the left of the distribution chamber 20 is fitted an elongated first heat exchanger 12a having a rectangular cross section and on the right of the distribution chamber 20 is fitted an elongated second heat exchanger 12b having a rectangular cross section. Below the supply air chamber 10, 11 is fitted a guide piece 17 of a trapezoidal shape. Below a vertical exterior side wall of the first heat exchanger 12a is fitted a vertical first side wall 14a and below a vertical exterior side wall of the second heat exchanger 12b is fitted a second vertical side wall 14b.

[0026] A space defined by the first side wall 14a, the bottom surface of the first heat exchanger 12a, the left side wall of the supply air chamber 10, 11, and the left oblique side surface of the guide piece 17 forms the first mixing chamber 13a. A space defined by the second side wall 14b, the bottom surface of the second heat exchanger 12b, the right side wall of the supply air chamber 10, 11, and the right oblique side surface of the guide piece 17 forms the second mixing chamber 13b.

[0027] On the left side wall of the supply air chamber 10, 11, there is the first nozzle bank 15a via which the supply air flow L1 is guided from the supply air chamber 10, 11 to the first mixing chamber 13a. On the right side wall of the supply air chamber 10, 11, there is the second nozzle bank 15b via which the supply air flow L1 is guided from the supply air chamber 10, 11 to the second mixing chamber 13b. The supply air flow L1 directed vertically downwards from the nozzles 15a, 15b to each mixing chamber 13a, 13b induces the circulated air flow L2 to run from the room being air-conditioned via the equivalent heat exchanger 12a, 12b to the equivalent mixing chamber 13a, 13b.

[0028] The lower part of the first mixing chamber 13a includes the first output opening 16a from which the combined air flow LA composed in the first mixing chamber 13a of the supply air flow L1 and the circulated air flow L2 is guided to the left in the room being air-conditioned. The lower part of the second mixing chamber 13b includes the second output opening 16b from which the combined air flow LB composed in the second mixing chamber 13b of the supply air flow L1 and the circulated air flow L2 is guided to the right in the room being air-conditioned. The supply air terminal device 100 is advantageously fitted in connection with the ceiling of the room being air-conditioned at a distance from the ceiling, whereby the combined air flows LA, LB are guided on the side in the direction of the ceiling.

[0029] Fig. 5 shows a longitudinal cross section of the supply air chamber construction of a supply air terminal device.

[0030] Fig. 5 shows the nozzle chamber 10 and the supplementary air chamber 11 being its extension. The nozzle chamber 10 is further divided into two parts, i.e. the first partial nozzle chamber 10a and the second partial nozzle chamber 10b. The supply air chamber 10, 11 can thus be formed of one elongated chamber which is divided into three parts air-tightly separated from each other. The distribution chamber 20 extends to the partial nozzle chambers 10a, 10b and the supplementary air chamber 11. Between the distribution chamber 20, the partial nozzle chambers 10a, 10b and the supplementary air chamber 11, there is an adjusting device 30 which here consists of a regulating plate 30 of a rectangular shape. The regulating plate 30 is connected with an arm 41 to an actuator 40, whereby the regulating plate can be moved by the actuator 40 in question. The actuator 40 can be e.g. an arrangement based on an electric motor or a hydraulic cylinder. The actuator 40 can again be controlled by a control unit 60 including a programmable processor which controls the actuator 40 according to a specific control algorithm. Input signals of the control unit 60 can be e.g. a measurement signal of a temperature sensor 61 located in the room being air-conditioned and/or a control device 62 located in connection with the user's desk in the room being air-conditioned. The control device 62 enables the manual regulation of the regulating plate 30 directly by the user. The control device 62 can also be connected such that it controls the regulating plate 30 together with the automatic regulation based on the measurement signal of the temperature sensor 61.

[0031] Fig. 6 shows the operating principle of the regulation arrangement shown in Fig. 5. The figure shows the inlet opening 1a of the first nozzle chamber 10a, the inlet opening 2a of the second nozzle chamber 10b and the inlet opening 3a of the supplementary air chamber 11 and equivalently the openings 1b, 2b, 3b in the regulating plate 30. The regulating plate 40 can be moved in opposite directions S1 and S2 by the actuator 40 such that the desired inlet openings 1a, 2a, 3a and the openings 1b, 2b, 3b of the regulating plate 30 are set on top of each other. The inlet openings 1a, 2a, 3a of the partial nozzle chambers 10a, 10b and the supplementary air chamber 11 are located on that wall of the air chambers 10a, 10b, 11 in question which sets against the distribution chamber 20. The inlet openings 1a, 2a, 3a of the partial nozzle chambers 10a, 10b and the supplementary air chamber 11 are thus in the embodiment shown in Fig. 1 on the side wall of the chambers in question and in the embodiment shown in Fig. 4 they are on the ceiling of the chambers in question. The figure shows a mode where the regulating plate 30 closes the connection to both partial nozzle chambers 10a, 10b and the supplementary air chamber 11.

[0032] Fig. 7 shows different modes A1, A2, A3, A4 and A5 of the supply air terminal device applying the arrangement according to the invention. In each mode A1, A2, A3, A4 and A5, the inlet openings 1a, 2a, 3a of the partial nozzle chambers 10a, 10b and the supplementary air chamber 11 and the equivalent openings 1b, 2b and 3b in the regulating plate 30 are shown as being adjacent, even though they are on top of each other in reality. By showing the openings adjacently, the figure is more illustrative.

[0033] In the first mode A1, the supply air flow flowing from the partial nozzle chambers 10a, 10b and the supplementary air chamber 11 to the room being air-conditioned is totally closed, i.e. the regulating plate 30 covers the inlet opening 1a of the first partial nozzle chamber 10a, the inlet opening 2a of the second partial nozzle chamber 10b and the inlet opening 3a of the supplementary air chamber 11. Thus, air cannot flow from the distribution chamber 20 to the partial nozzle chambers 10a, 10b or to the supplementary air chamber 11. Indeed, no inlet air flows to the room being air-conditioned from the supply air terminal device 100. This is the so-called power saving mode which can be employed e.g. when the room being air-conditioned is temporarily unused. This mode operates in the same way in an air-conditioning system based on constant air flow as well as in one based on constant pressure.

[0034] In the second mode A2, the first, i.e. longer, nozzle chamber 10a is in use, i.e. the inlet opening 1a leading to the first partial nozzle chamber 10a and the first opening 1b of the regulating plate 30 are on top of each other, but the nozzle plate 30 covers the inlet opening 2a of the second partial nozzle chamber 10b and the inlet opening 3a of the supplementary air chamber 11. Then, supply air flows from the distribution chamber 20 solely to the first partial nozzle chamber 10a. When the supply air terminal device 100 is connected to a constant air flow system and only a part of the nozzles 15, i.e. the nozzles 15 in the first partial nozzle chamber 10a, are in use, the pressure in the first partial nozzle chamber 10a tends to increase, because the constant air flow system tends to keep the air flow constant. For this reason, the air discharging from the nozzles 15 of the first partial nozzle chamber 10a has a higher speed/impulse. The higher speed can be utilized e.g. in a heating situation whereby warm air blown from the supply air terminal device 100 to the room being air-conditioned mixes better to the air of the room being air-conditioned. When the supply air terminal device 100 is connected to a constant pressure system and only a part of the nozzles 15, i.e. the nozzles 15 in the first partial nozzle chamber 10a, are in use, the air flow from the supply air terminal device 100 to the room being air-conditioned decreases in relation to the dimensions of the partial nozzle chambers 10a, 10b. This mode producing a smaller air volume can be employed e.g. in a situation where the room being air-conditioned is temporarily empty, thus improving energy efficiency.

[0035] In the third mode A3, both partial nozzle chambers 10a, 10b are is use, i.e. the inlet opening 1a of the first partial nozzle chamber 10a and the inlet opening 2a of the second partial nozzle chamber 10b and equivalently the first opening 1b and the second opening 2b of the nozzle plate are on top of each other and the nozzle plate 30 covers the inlet opening 3a of the supplementary air chamber 11. In this mode, the cooling capacity (water capacity) of the supply air terminal device 100 is at its highest, the opening effective length of the heat exchangers 12, 12a, 12b is employed and the chamber pressure of the partial nozzle chambers 10a, 10b is on a normal, designed level. This mode operates in the same way in an air-conditioning system based on constant air flow as well as in one based on constant pressure.

[0036] In the fourth mode A4, both partial nozzle chambers 10a, 10b are opened and additionally the supplementary air chamber 11 is totally or partially opened, i.e. the inlet opening 1a of the first partial nozzle chamber 10a, the inlet opening 2a of the second partial nozzle chamber 10b and the inlet opening 3a of the supplementary air chamber and equivalently the first opening 1b, the second opening 2b and the third opening 3b of the regulating plate 30 are on top of each other. In the system based on constant air flow, the air flow flowing through the nozzles decreases compared to the third mode A3 when the total air flow stays constant. As the nozzle air flow decreases, the circulated air flow induced from the room being air-conditioned also decreases, whereby the flow speeds of the room being air-conditioned equivalently decrease and the conditions in the room being air-conditioned are improved in this sense. In the system based on constant pressure, this mode achieves the maximum total air volume. The magnitude of the opening of the supplementary air chamber 11 depends on the amount of supplementary air required. This enables changing the intended use of the room being air-conditioned easily from an office to a conference room.

[0037] In the fifth mode A5, the air flow from the distribution chamber 20 to the partial nozzle chambers 10a, 10b is closed and the air flow from the distribution chamber 20 to the supplementary air chamber 11 is totally opened and the inlet opening 3a of the supplementary air chamber and the third opening 3b of the regulating plate 30 are on top of each other and the nozzle plate 30 closes the inlet opening 1a of the first partial nozzle chamber 10a and the inlet opening 2a of the second partial nozzle chamber. In this mode, the supplementary air volume guided to the room being air-conditioned is at its maximum. This mode can be employed e.g. at night, whereby solely cool outdoor air is used for cooling the room being air-conditioned. This mode operates in the same way in an air-conditioning system based on constant air flow as well as in one based on constant pressure.

[0038] Fig. 8 shows a top plan view of an alternative regulation arrangement according to the invention. The adjusting device in this embodiment is, instead of the rectangular regulating plate, a circular regulating plate 50. The outer circle radius of the circular regulating plate 50 is R1. On the periphery of a circle R2 drawn inside the outer circle of the circular regulating plate 50 are composed openings 1a, 2a, 3a equivalent to the ones of the rectangular regulating plate. The figure also shows the inlet openings 1b, 2b, 3b from which there are led channels to the equivalent chambers, i.e. the first nozzle chamber 10a, the second nozzle chamber 10b and the supplementary air chamber 11. The circular regulating plate 50 is rotatably supported from its center C, whereby the circular regulating plate 50 can be rotated around the center C clockwise S1 and counter clockwise S2. When the circular regulating plate 50 is rotated around its center C clockwise S1 from the position shown in the figure, the five modes shown in Fig. 5 are provided. The rotation of the circular regulating plate 50 can be done manually or by the actuator 40 as in the embodiment shown in Fig. 4. The actuator 40 can be e.g. an electric motor. The figure shows a mode where the regulating plate 30 closes the connection to both nozzle chambers 10a, 10b and the supplementary air chamber 11. The use of the circular regulating plate 50 requires a larger area in relation to the rectangular regulating plate 30 in order to have equal areas for the openings. The height of the side wall of the supply air chamber 10, 11 does not usually enable installing of the circular regulating plate 50 on the side wall, but the width of the ceiling surface of the supply air chamber 10, 11 can enable installing of the circular regulating plate 50 on the ceiling surface.

[0039] The supply air terminal device shown in Fig. 3 includes only one nozzle chamber 10 where there are two nozzle banks 15a, 15b which both feed their own mixing chambers 13a, 13b. The arrangement also includes only one heat exchanger 12 via which the circulated air flow L2 is guided to both mixing chambers 13a, 13b. Part of the heat exchanger 12 serves the first mixing chamber 13a and part of the heat exchanger 12 serves the second mixing chamber 13b.

[0040] The embodiment shown in Fig. 4 also includes only one nozzle chamber 10 where there are two nozzle banks 15a, 15b which both feed their own mixing chambers 13a, 13b. In this arrangement, each mixing chamber 13a, 13b is connected to its own heat exchanger 12a, 12b via which the circulated air flow L2 is guided to the mixing chamber 13a, 13b in question.

[0041] The embodiment shown in Fig. 4 can e.g. be modified such that in place of each heat exchanger 12a, 12b are located the supply air chamber 10, 11 and the distribution chamber 20. In place of the supply air chamber 10, 11 and the distribution chamber 20 is again located the heat exchanger 12. Each supply air chamber 10, 11 further consists of the nozzle chamber 10 and the supplementary air chamber 11 and each nozzle chamber 10 is again divided into at least two partial nozzle chambers 10a, 10b. The nozzles 15 are now located on the bottom wall of each partial nozzle chamber 10a, 10b from where the supply air flow L1 is directed to each mixing chamber 13a, 13b. Such an embodiment can employ a separate regulating plate 30 between each unit being formed of the distribution chamber 20 and the supply air chamber 10, 11, whereby the regulation occurs in each unit controlled by its own regulating plate. On the other hand, the regulating plates of each unit can be connected mechanically together, whereby the regulation occurs in both units simultaneously with one and the same adjusting device.

[0042] The embodiment shown in Fig. 4 can also be modified e.g. such that the second heat exchanger 12b, the second mixing chamber 13b and the second nozzle bank 15b are totally omitted. The remainder is a supply air terminal device provided with one mixing chamber 13a, one heat exchanger 12a, one nozzle bank 15a. The distribution chamber 20 and the supply air chamber 10, 11 remain as above.

[0043] In the supply air terminal devices shown in the figures, the cross sections of different chambers are rectangular but, from the viewpoint of the invention, the cross sections of the chambers can naturally be of some other shape, e.g. circular, triangular, trapezoidal or polygonal.

[0044] The embodiments shown in the figures employ the nozzles 15, 15a, 15b in the nozzle chambers 10a, 10b, but the nozzles 15, 15a, 15b can also be replaced by a nozzle gap.

[0045] In the embodiments shown in the figures, the nozzle chamber 10 consists of two partial nozzle chambers 10a, 10b, but the arrangement according to the invention can naturally be applied in a situation where the nozzle chamber 10 is divided into more than two parts. Then, the device provides even more modes.

[0046] Fig. 9 illustrates axonometrically the supply and exhaust air terminal device 100 with visible inner parts. The supply air chamber 10 comprises the nozzle chamber and the supplementary air chamber. The nozzle chamber may be divided into a first partial nozzle chamber and a second partial nozzle chamber as described hereinbefore; the division into multiple nozzle chambers is not illustrated in Fig. 9. Openings 1a lead to the supply air chamber 10. The elongated distribution chamber 20 having a rectangular cross section is located on a side wall of the supply air chamber 10. The supply air flow L1 goes from the distribution chamber 20 to the supply air chamber 10.

[0047] The exhaust air flow enters the terminal 100 and passes through the opening 92 to the exhaust air chamber 90. The exhaust air flow is guided through the at least one opening 4a to the exhaust air duct as the exhaust air flow L4. The duct system may be a constant pressure system.

[0048] A separating plate 91 divides the air terminal 100 into two segments, wherein the first end is purposed for the supply air chamber 10 and a first portion of the distribution chamber 20. The second end of the air terminal 100 is purposed for the exhaust air, comprising the exhaust air chamber 90 and a second portion of the distribution chamber 20.

[0049] In this example the adjusting device 30 is a regulating plate 30 configured to move simultaneously in the supply air chamber 10 and the exhaust air chamber 90 or in the distribution chamber 20. The adjusting device 30 blocks the supply air flow L1 and the exhaust air flow L4 by applying equal air flow resistance to both flows L1, L4. The adjusting device 30 may alternatively comprise a circular regulating plate. The adjusting device 30 is displaced with the actuator as described hereinbefore.

[0050] The openings 1a on the supply side and the openings 4a on the exhaust side may be formed to allow accurate adjustment of the air flow on both sides. The air flow adjustment may be set linear or it may result in a similar function on both sides according to the percentage of opening, such as the position of the adjusting device 30 in relation to the openings 1a, 4a. The air flow resistance may be simulated on both sides or it may be measured; thereby, the air flow rate as a function of the adjusting device 30 position, between the fully open and the fully closed position, may be obtained. When the supply air flow resistance function from the supply side is known, a similar air flow resistance function may be applied on the exhaust side. The adjusting device 30 may be a plate that may be modified according to predefined settings. The plate may comprise precut positions that are removed from the plate according to the position of the separating plate 91.

[0051] If desired, the different functions discussed herein may be performed in a different order and/or concurrently with each other. Furthermore, if desired, one or more of the above-described functions may be optional or may be combined. Although various aspects of the invention are set out in the independent claims, other aspects of the invention comprise other combinations of features from the described embodiments and/or the dependent claims with the features of the independent claims, and not solely the combinations explicitly set out in the claims.

[0052] It is obvious to a person skilled in the art that with the advancement of technology, the basic idea of the invention may be implemented in various ways. The invention and its embodiments are thus not limited to the examples described above; instead they may vary within the scope of the claims.

Claims

1. A supply and exhaust air terminal device arranged in a chilled beam system, comprising:

   a supply air chamber into which supply air is led through at last one supply air opening from a supply air duct, wherein the supply air chamber is arranged in the first end of the chilled beam; and
   an exhaust air chamber through which exhaust air is led from a room space into an exhaust air duct through at least one exhaust air opening, wherein the exhaust air chamber is arranged in the second end of the chilled beam and separated from the supply air chamber;

   characterized in that the air terminal device further comprises:

   an adjusting device configured to adjust the at least one supply air opening and the at least one exhaust air opening; and an actuator for displacing the adjusting device, wherein
   displacing the adjusting device causes the air flow to be obstructed through the at least one supply air opening and through the at least one exhaust air opening.

2. The air terminal device according to claim 1, **characterized** by the adjusting device comprising:

   at least one opening configured to interact with the at least one supply air opening; and
   at least one opening configured to interact with the at least one exhaust air opening,
   wherein the form of the at least one opening is configured to cause the air flow through the supply air opening to correspond to the air flow though the exhaust air opening.

3. The air terminal device according to claim 1 or 2, **characterized by** the adjusting device comprising a solid regulating plate.

4. The air terminal device according to any of the claims 1 to 3, **characterized by** the air terminal device comprising:

   a distribution chamber (20),
   a nozzle chamber (10) comprising nozzles (15, 15a, 15b) or a nozzle gap,
   at least one mixing chamber (13, 13a, 13b), and
   at least one heat exchanger (12, 12a, 12b),

   whereby the supply air flow (L1) is guided from the distribution chamber (20):

   to the nozzle chamber (10), from where the supply air flow (L1) is further guided via the nozzles (15, 15a, 15b) or the nozzle gap to said at least one mixing chamber (13, 13a, 13b), where the supply air flow (L1) induces a circulated air flow (L2) to flow from the room being air-conditioned via said at least one heat exchanger (12, 12a, 12b) to said at least one mixing chamber (13, 13a, 13b), from which the combined air flow (LA, LB) composed of the supply air flow (L1) and circulated air flow (L2) is guided to the room being air-conditioned, and
   to the supply air chamber (11), from which a separate supply air flow (L3) is further guided directly to the room being air-conditioned,
   wherein the nozzle chamber (10) is divided into at least two partial nozzle chambers (10a, 10b), and
   the adjusting device (30, 50) is arranged between the distribution chamber (20) and the first nozzle chamber (10a), the second nozzle chamber (10b) and the supply air chamber (11) such that the adjusting device (30, 50) is arranged to open and close the air flow connection from the distribution chamber (20) to the first partial nozzle chamber (10a) and/or the second partial nozzle chamber (10b) and/or the supply air chamber (11).

5. The air terminal device according to claim 4, **characterized in that** the first partial nozzle chamber (10a), the second partial nozzle chamber (10b) and the supply air chamber (11) each comprise on that surface which is against the distribution chamber (20) an inlet opening (1a, 2a, 3a), and that the adjusting device (30, 50) consists of a regulating plate (30, 50) comprising openings (1b, 2b, 3b), whereby the adjusting device (30, 50) is arranged to open and close the desired connection from the distribution chamber (20) to the first partial nozzle chamber (10a) and/or the second partial nozzle chamber (10b) and/or the supply air chamber (11).

6. A method for a supply and exhaust air terminal device arranged in a chilled beam system, the air terminal comprising:

   a supply air chamber into which supply air is led through at least one supply air opening from a supply air duct, wherein the supply air chamber is arranged in the first end of the chilled beam; and
   an exhaust air chamber through which exhaust air is led from a room space into an exhaust air duct through at least one exhaust air opening, wherein the exhaust air chamber is arranged in the second end of the chilled beam and separated from the supply air chamber;

characterized by:

adjusting the at least one supply air opening and the at least one exhaust air opening by an adjusting device; and
displacing the adjusting device by an actuator, causing obstruction of the air flow through the at least one supply air opening and through the at least one exhaust air opening.

7. The method according to claim 6, **charact e r i z e d** by comprising:

the adjusting device comprising at least one opening interacting with the at least one supply air opening; and
the adjusting device comprising at least one opening interacting with the at least one exhaust air opening;
wherein the form of the at least one opening causes the air flow through the supply air opening to correspond to the air flow though the exhaust air opening.

8. The method according to claim 6 or 7, **characterized by** the adjusting device comprising a solid regulating plate.

9. The method according to any of the claims 6 to 8, **characterized by** the air terminal device comprising:

a distribution chamber (20),
a nozzle chamber (10) comprising nozzles (15, 15a, 15b) or a nozzle gap,
at least one mixing chamber (13, 13a, 13b), and
at least one heat exchanger (12, 12a, 12b),

whereby the supply air flow (L1) is guided from the distribution chamber (20):

to the nozzle chamber (10), from where the supply air flow (L1) is further guided via the nozzles (15, 15a, 15b) or the nozzle gap to said at least one mixing chamber (13, 13a, 13b), where the supply air flow (L1) induces a circulated air flow (L2) to flow from the room being air-conditioned via said at least one heat exchanger (12, 12a, 12b) to said at least one mixing chamber (13, 13a, 13b), from which the combined air flow (LA, LB) composed of the supply air flow (L1) and circulated air flow (L2) is guided to the room being air-conditioned, and
to the supply air chamber (11), from which a separate supply air flow (L3) is further guided directly to the room being air-conditioned,
dividing the nozzle chamber (10) into at least two partial nozzle chambers (10a, 10b), and
arranging the adjusting device (30, 50) between the distribution chamber (20), the first nozzle chamber (10a) and the second nozzle chamber (10b) and the supply air chamber (11),
arranging the adjusting device (30, 50) to open and close the air flow connection from the distribution chamber (20) to the first partial nozzle chamber (10a) and/or the second partial nozzle chamber (10b) and/or the supply air chamber (11).

10. The method according to claim 9, **charact e r i z e d** in that the first partial nozzle chamber (10a), the second partial nozzle chamber (10b) and the supply air chamber (11) each comprise on that surface which is against the distribution chamber (20) an inlet opening (1a, 2a, 3a), and that the adjusting device (30, 50) consists of a regulating plate (30, 50) comprising openings (1b, 2b, 3b), whereby the adjusting device (30, 50) is arranged to open and close the desired connection from the distribution chamber (20) to the first partial nozzle chamber (10a) and/or the second partial nozzle chamber (10b) and/or the supply air chamber (11).

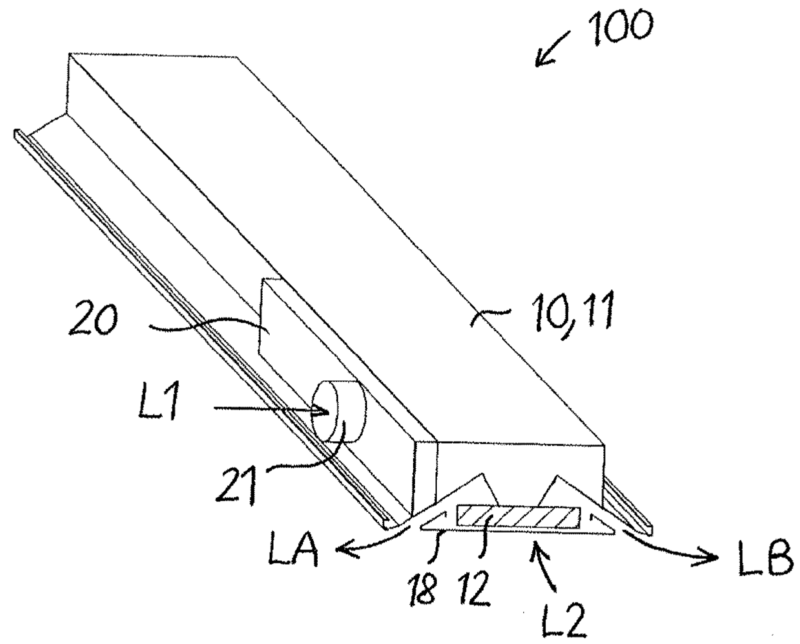
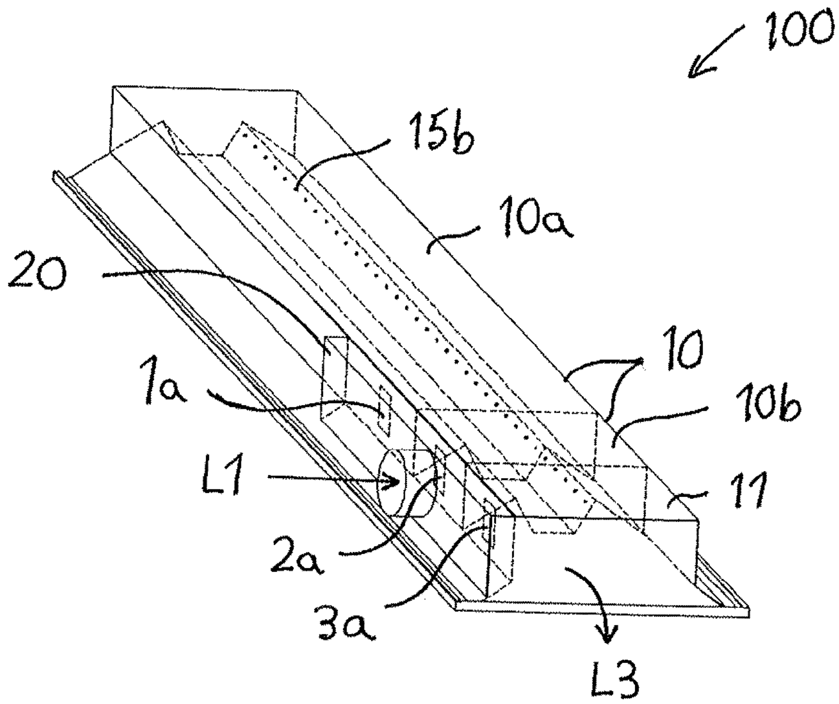

100
20
10,11
L1
21
LA
18
12
L2
LB

FIG. 1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15b
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20
10
1a
10b
L1
11
2a
3a
L3

FIG. 2

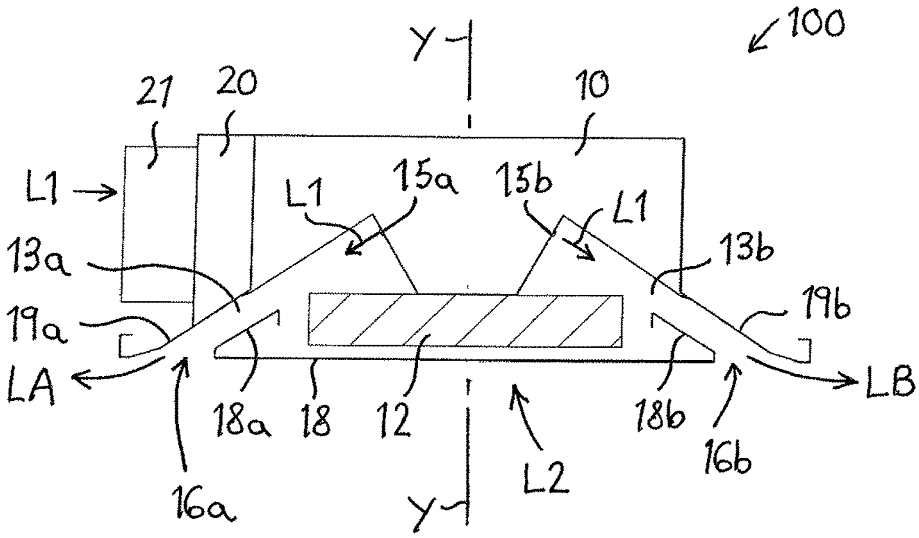
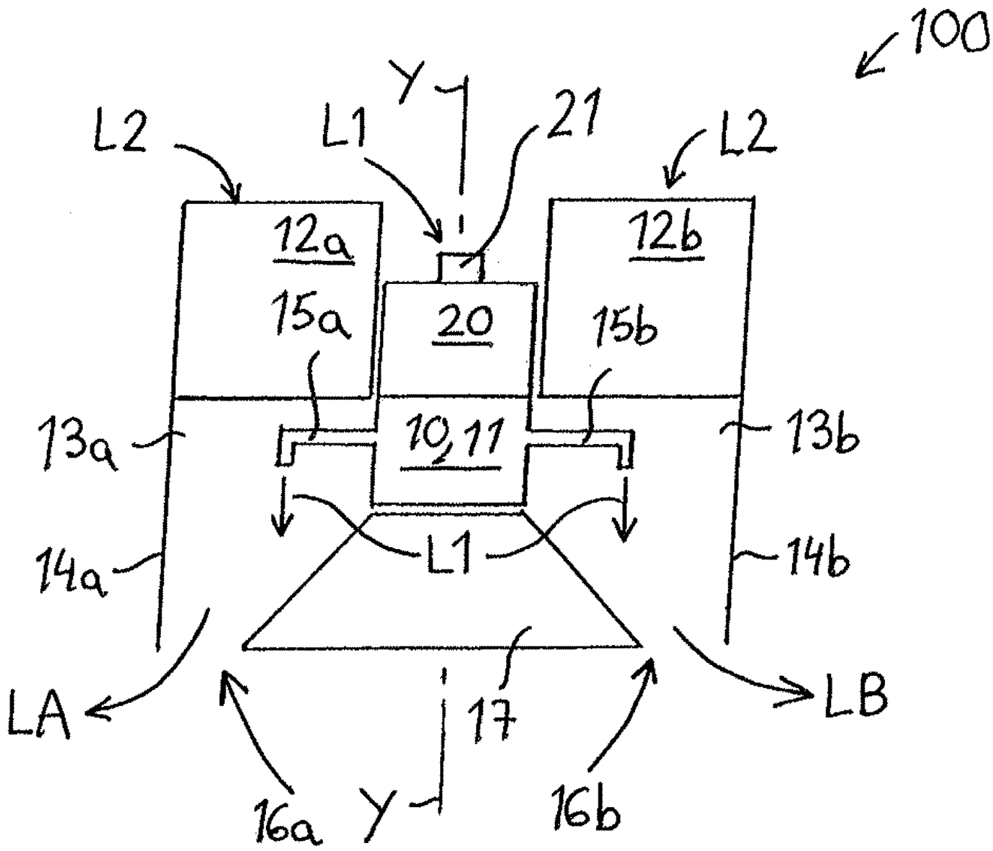

100
Y
21
20
10
L1
L1
15a
15b
L1
13a
13b
19a
19b
LA
LB
18a
18
12
18b
16b
L2
16a
Y

FIG. 3


100
Y
L1
21
L2
L2
12a
12b
20
15a
15b
15a
15b
13a
10,11
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14a
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14b
LA
17
LB
16a
Y
16b

FIG. 4

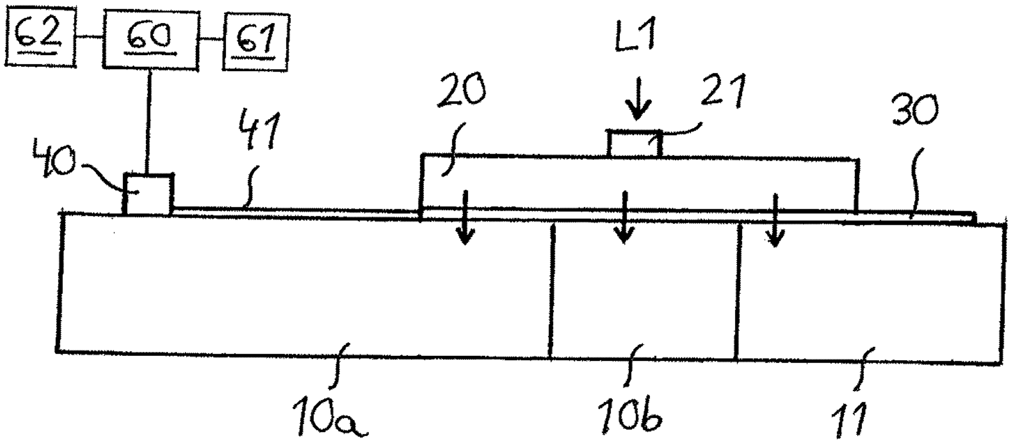
62
60
61
L1
20
21
30
40
41
10a
10b
11

FIG. 5

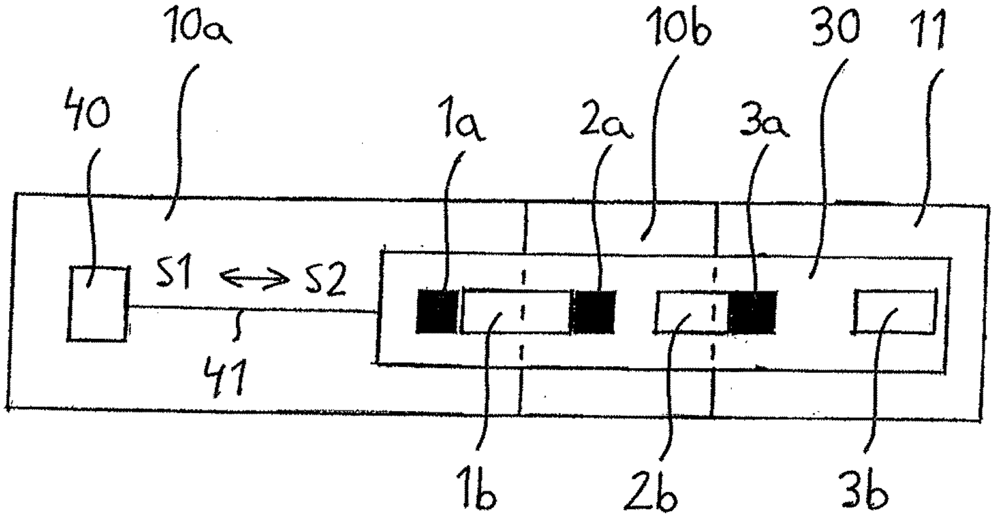
10a
10b
30
11
40
1a
2a
3a
S1 ⟷ S2
41
1b
2b
3b

FIG. 6

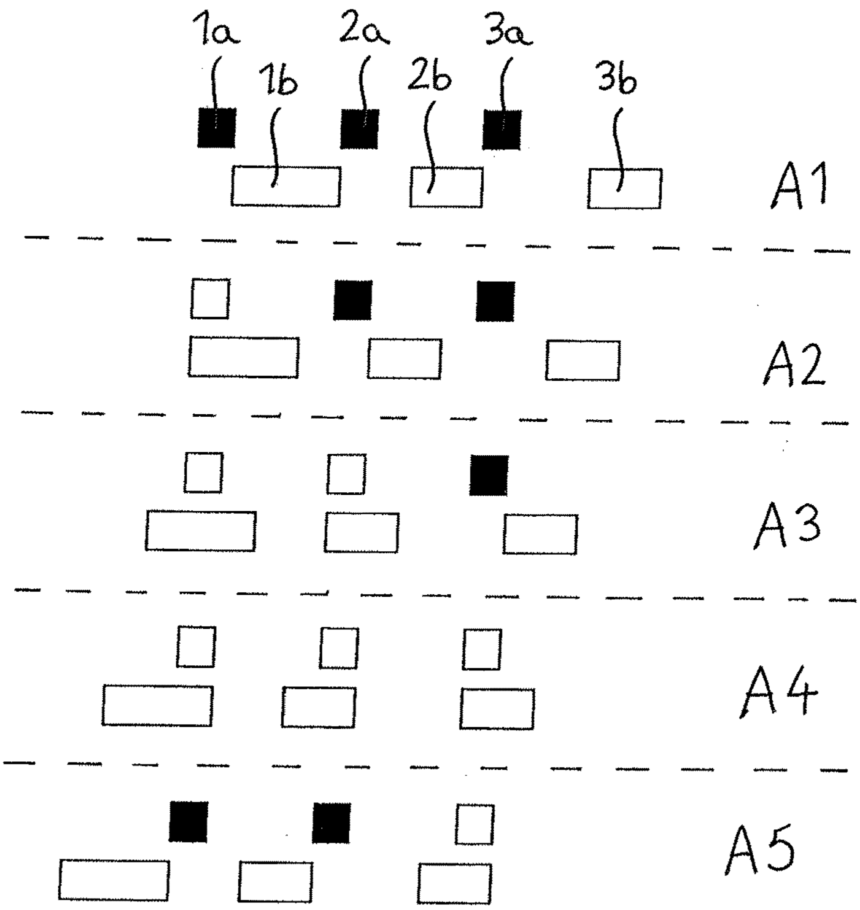

FIG. 7

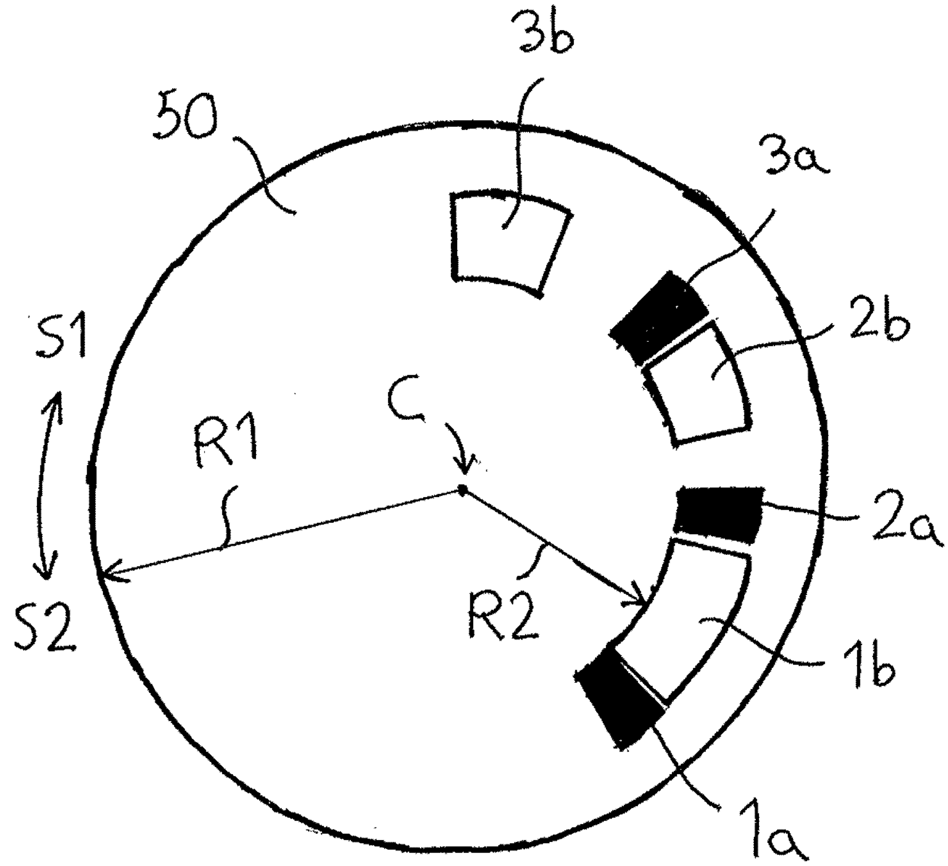

FIG. 8

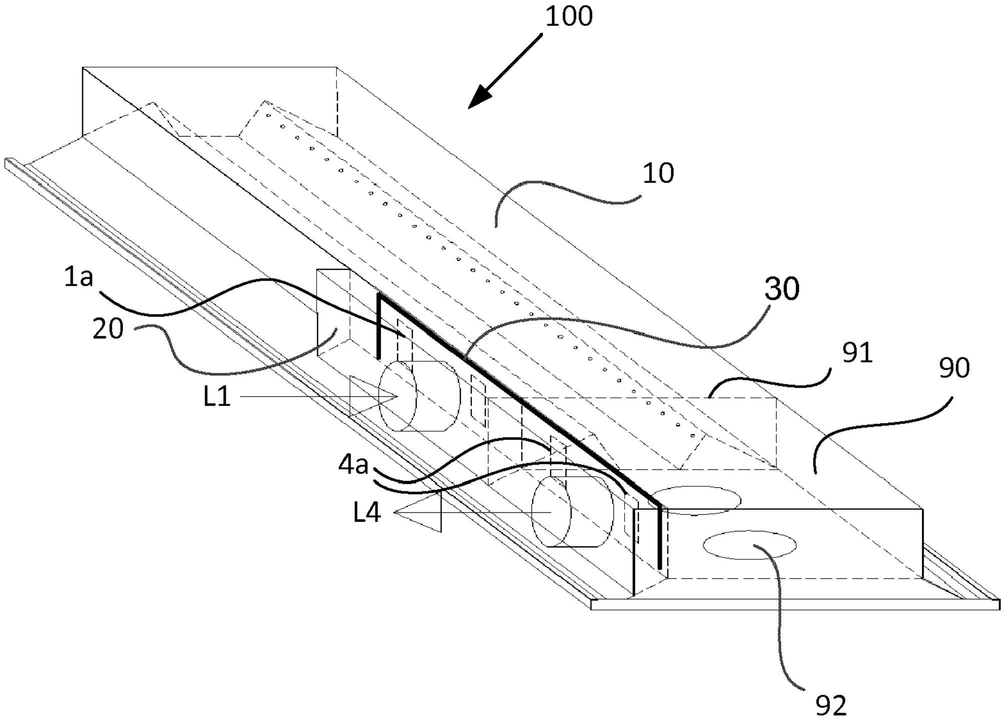

FIG. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 14 19 2288

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	18 May 2015	Mattias Grenbäck

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