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(54) Title: FACADE ELEMENT

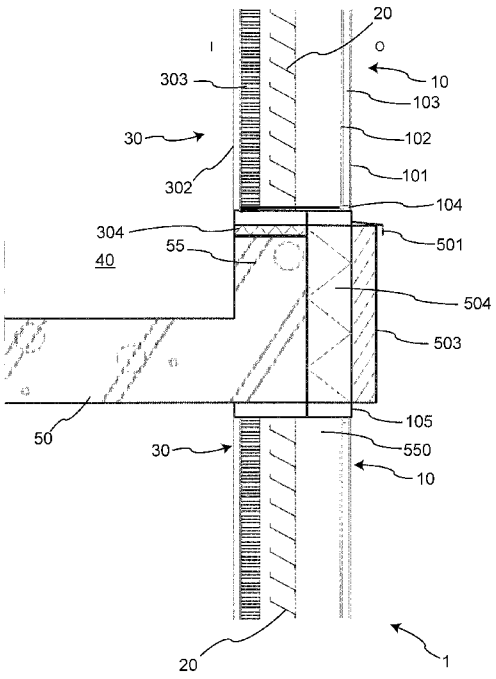

Fig. 1

(57) Abstract: The invention relates to a façade element (1) enabling an air exchange between at least one inside (I) room (40) and an outside (0) of a building having at least one wall (55), comprising a wall opening being arranged in the wall, a filter element (30) being arranged in at least a part of the wall opening, at least one movable shutter (10), being arranged at the outside of the building and being movable between at least an open position and a closed position, wherein the shutter (10) is arranged between the filter element (30) and the outside of the building in the closed position, and the shutter (10) is arranged beside the filter element (30) in the open position.

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Façade element

BACKGROUND OF THE INVENTION

The invention relates to a façade element being adapted to allow an air exchange between at least one inside room and an outside of a building having at least one wall, the façade element comprising a wall opening being arranged in the wall and a filter element being arranged in at least a part of the wall opening.

From a plurality of residential buildings, small air inlet systems being arranged on a window frame or on a wall are known. These openings can provide a required minimum air exchange rate between an inside room of the building and the outside. This minimum air exchange rate can be sufficient to prevent mould risk and to avoid too high indoor carbon dioxide concentration. These known air inlet systems may include a filter element providing filtering of air pollution or dust. However, a comfortable air quality is not guaranteed.

A disadvantage of these known air inlet systems lies in the fact that the airflow is limited and therefore, the air inlet systems are not suitable to guarantee thermal comfort and inside air quality under all conditions, e.g. in summer. Therefore, additional air conditioning or ventilation systems are needed. Central ventilation systems can deliver mixed air, thereby providing ventilation, heating and cooling. However, these systems generally have a low user acceptance due to the fact that an individual control of the airflow is very limited. A simple ventilation system is constituted by a window which can be opened and closed by user interaction. However, high-rise buildings are subject to very high wind loads on the façade. Hence, window ventilation is very limited in these buildings.

Therefore, it is an object of the invention to provide a ventilation system being unaffected by outside weather

conditions, guaranteeing thermal comfort and inside air quality, and having a high user acceptance.

SUMMARY OF THE INVENTION

The present invention is limited only by the scope of the claims as ultimately allowed in this application, and in no way limited by the prior versions of the claims.

According to the invention, a façade element is disclosed being adapted to enable an air exchange between at least one inside room and an outside of a building having at least one wall, the façade element comprising a wall opening being arranged in the wall, a filter element being arranged at least partly in at least a part of the wall opening, at least one moveable shutter, being arranged at the outside of the building and being moveable between at least an open position and a closed position, wherein the shutter is arranged between the filter element and the outside of the building in the closed position and the shutter is arranged beside the filter element in the open position.

In this embodiment of the invention, a façade element for use in conjunction with a building is disclosed which allows an airflow from outside into a room or vice versa. The façade element comprises a filter element, which may be adapted to provide any of a sound attenuation, filtering of air pollution, filtering of odours, or filtering of dust. In some embodiments, the filter element may provide increased comfort to the users inside the room.

The optional filter element is arranged at least partly in at least a part of a wall opening. The wall opening can be formed in the wall during the construction of the building. In other embodiments of the invention, a part of the wall of an existing building can be removed in order to form a wall opening. In still another embodiment of the invention, the wall opening can be a window opening, which is used partly for

the filter element and the air duct and partly for a conventional window with a fixed or moveable glazing.

The cross-section of the filter element and/or the air duct may be designed according to the projected air exchange rate. In some embodiments, the cross-sectional area of the filter element may amount between 0.25 m^2 and 4 m^2. In some embodiments, each room is assigned a single wall opening and a single corresponding filter element. In other embodiments of the invention, a plurality of wall openings with corresponding filter elements contributes to the air exchange of a single room. In some embodiments, the number of filter elements and wall openings can amount 1 to 10 per room.

The air exchange rate, and thus the maximum airspeed inside the room, can be regulated by the user by means of a moveable shutter. In some embodiments of the invention, the shutter may be arranged inside the room, within the filter element, within an optional air duct coupling an outside orifice to the filter element, or at the outside of the building. The shutter is moveable between at least an open position and a closed position. In the closed position, the shutter restricts the air exchange by increasing the flow resistance of the air through the filter element. In some embodiments of the invention, the shutter can be arranged adjacent to the filter element in order to obstruct the air passage through the filter element into the room.

In other embodiments of the invention, the shutter can be spaced apart from the filter element in its closed position, thereby restricting the airflow through the filter element inside the room without blocking the airflow completely.

In the open position, the shutter is arranged beside the filter element so that airflow from the outside into the room is not less restricted by the shutter or, in some embodiments, even unrestricted.

In some embodiments of the invention, the façade element can provide high air exchange rates and therefore high elevated air speed inside the room. A high elevated air speed may be used to increase the maximum acceptable temperature. Therefore, the façade element may provide a positive effect on thermal comfort even in hot humid climates. Due to the filter element, air pollution and noise inside the building may be reduced compared to normal window ventilation in some embodiments of the invention. As the maximum acceptable temperature is increased, cooling energy might be saved in some embodiments. As outside air may be transported through the façade element into the room by gradient winds, the energy consumption used for ventilation may be minimized.

In some embodiments, the façade element comprises further a rain protection device which is permeable to air and which is adapted to prevent the filter element from being soaked by rain water. The rain protection device may comprise in some embodiments at least one louver. In other embodiments of the invention, the rain protection device may comprise a grid or a protruding porch. The rain protection device may be adapted to allow high air exchange rates even in heavy rain without rainwater affecting the filter element or entering the room. Therefore, high air exchange rates and increased thermal comfort may be achieved even in bad weather conditions. In some embodiments of the invention, the rain protection device may be adapted to allow for an esthetically appealing look of the building.

In some embodiments of the invention, the rain protection device is moveable between at least an open position and a closed position. In this context, the open position of the rain protection device may allow a higher air exchange rate. In the open position, a small amount of rain water, drizzle or snow might enter the air duct and reach the filter element and/or the inside of the room. The closed position of the rain protection device will prevent rain from entering the air duct, the filter element or the room but still allow some air

exchange between the inside room and the outside of the building so that the user of the building or the inmate of the room is still feeling an increased comfort.

In some embodiments of the invention, the shutter may comprise at least one window pane. Such a window pane may allow for an appearance of modern glazing architecture of the building. Furthermore, the shutter may be moved in front of a window in the open position without obstructing the user's view. Hence, the percentage of the total surface area of the façade which can be used for building ventilation may be maximized.

In some embodiments of the invention, the shutter is slidably mounted on at least one track. The track may be arranged horizontally or vertically at the façade. This embodiment may allow for smooth operation and small area exposed to wind. Therefore, this embodiment might be in particular useful for the upper floors of a high-rise building, without being limited to this application.

In some embodiments of the invention, the shutter is swiveling about pivots being arranged at the outside of the façade. In this embodiment, the shutter can swing from an open to a closed position. In the open position, the shutter can be stowed away flat on the façade, which means that the open and the closed position are spaced apart approximately 180°. In other embodiments of the invention, the shutter may protrude from the façade in the open position and thereby form an air duct or an airflow deflection vane.

In some embodiments of the invention, the façade element comprises further at least one window and a sun protection device being located in front of this window. In this configuration, the shutter can be used in its open position to cover the sun protection device, so that the sun protection device is shielded from wind. This allows the inside of the building to be shaded from direct sunlight even in bad weather

conditions with strong winds, which usually affects the life time or the usability of known sun protection devices.

In some embodiments of the invention, the sun protection device is moveable between at least an open position and a closed position. If the user wants to restrict the airflow inside the room and closes the shutter, the sun protection device is affected by gradient winds. In this case, the sun protection device can be rolled or folded to an open position which protects the sun protection device from being destroyed. On the other hand, the sun protection device can be removed from the window in cloudy weather conditions when the inside of the room is not heated by directed sunlight.

In some embodiments of the invention, the filter layer comprises any of activated carbon, paper, non-woven fabric or at least one expanded-metal grid. The filter element may be made of at least one flat layer or from at least one folded layer, which may provide a higher surface area. The filter element may comprise a plurality of filter layers. The filter element may remove dust or gaseous pollutants such as carbon monoxide or strong odours from the air entering the room.

In some embodiments of the invention, the façade element comprises further an inner cover, being permeable to air and being arranged between the filter element and the inside of the room. This feature allows the filter element to be hidden from the user's view inside the room, so that the inside wall of the room can be designed according to the user's preferences. The cover may be adapted to protect the filter layer from being touched or destroyed by user interaction.

In some embodiments of the invention, the inner cover comprises any of at least one gypsum plaster board, at least one woven fabric, at least one metal sheet or wood. In some embodiments, the inner cover comprises a plurality of ventilation bores. The ventilation bores may be covered by fabric in some embodiments. This allows a sufficient airflow

through the inner cover into the room and a plurality of design options, so that the façade element or parts of it are hidden from the user's view, i.e. the inside wall of the room has a conventional appearance.

In some embodiments of the invention, a fan or exhauster may operate inside the building in order to draw outside air into the room. This feature ensures a constant airflow independent from atmospheric winds.

In some embodiments of the invention, the façade element may comprise further a control device being adapted to control the position of at least one shutter and/or the position of the optional rain protection device. In some embodiments, the control device allows for a fully automatic operation of the façade element. In other embodiments, the façade element may be brought into a save operational state in high wind speeds or high precipitation. A control device may comprise any of a fuzzy logic, a neural network, or a characteristic map.

Brief description of the drawings

Figure 1 illustrates a vertical cross-sectional view through one embodiment of the invention.

Figure 2 shows a horizontal cross-sectional view through an embodiment of the invention with the shutters in closed position.

Figure 3 shows a horizontal cross-sectional view through the embodiment from Figure 2 with the shutters in open position.

Detailed description

The following is a detailed exemplary description of embodiments of the invention, in a number of its various aspects. Those skilled in the art will understand that the

specificity provided herein is intended for illustrative purposes with respect to an exemplary embodiment, only, and is not to be interpreted as limiting the scope of the invention or claims.

Figure 1 shows a vertical cross-sectional view of an embodiment of the invention. In the central part of figure 1, a slab 50 of a building is shown. The slab 50 may be made from steel-reinforced concrete, steel, or wood. The slab 50 is coupled to inside and/or outside walls 55 to form the main structure of the building.

At the inside I of the building, at least one room 40 is provided. The room is bounded at least by the wall 55 and the slab 50. The wall 55 comprises at least one wall opening 550, which couples the inside I of the building with the outside O of the building. The façade element 1 according to the invention is at least partly arranged inside the wall opening 550.

The façade element 1 comprises at least one filter element 30. The filter element 30 may have a width ranging from approximately 20 cm about 500 cm and a height of approximately 20 cm up to 2.5 m. The filter element may have a surface area from 0.25 m^2 up 3 m^2. The room 40 may be equipped with one or more filter elements 30. The filter elements 30 are adapted to guide outside air inside the room 40 at high air exchange rates and high elevated air speed to increase the maximum acceptable temperature inside the room and to provide a comfortable inside climate to the users, especially in hot humid climates.

The filter element 30 comprises at least one filter layer 303, which may comprise any of activated carbon, paper, non-woven fabric or an expanded-metal grid. The filter layer 303 may comprise a single layer or a plurality of layers being arranged parallel and adjacent to each other. A plurality of layers may be composed of the same material or may be made

from different materials. Each layer may be flat or folded in order to increase its surface area.

The filter layer 303 may be adapted to filter any of outside noise, air pollution, dust, or odors.

In order to provide a neat and tidy inside view of the filter element 30, the filter element 30 may comprise an optional inner cover 302. The inner cover is permeable to air and is arranged between the filter layer 303 and the inside I of the room. The cover 302 may be designed according to the preferences of the user or inhabitants of the room 40. This means, the cover 302 may be designed in different colors, from different materials or may be covered with canvas. In some embodiments, the inside cover 302 is made from any of a gypsum plaster board, an expanded metal grid, a woven fabric, or wood. If the inside cover 302 is made from a naturally airtight material, it may comprise a plurality of ventilation bores which allow the air leaving the filter layer 303 to enter the inside I of the room 40 or vice versa.

The filter element 30 may comprise in some embodiments an additional rain protection device 20. The rain protection device 20 may comprise a plurality of louvers, with allow air from the outside to pass through the rain protection device 20. In some embodiments, the rain protection device 20 is adapted to protect the filter layer 303 at least partly from rainwater, drizzle or snow, so that the filter layer 303 is prevented from being soaked by water. This feature may prevent the filter layer 303 to be affected by mildew.

In some embodiments of the invention, the rain protection device 20 is moveable, so that the louver can be brought at least from an open position into a closed position to provide a better protection from rain and snow at the price of reduced airflow or allowing for increased airflow at the price of lesser rain protection. The rain protection device 20 may be user-operated or may be controlled automatically without user

interaction, e.g. dependent on the weather report or measured precipitation.

In some embodiments, the filter element 30 is fixed to the wall opening 550 by means of an coupling element 304, which may provide an airtight seal and/or a thermal insulation between the wall 55 and the filter element 30. Furthermore, the coupling element 304 may include a quick release to allow an easy exchange of the filter layer 303, so that maintenance of the façade element is simplified.

At the outside O of the filter element 30, a moveable shutter 10 is provided which may be used to regulate the amount of air entering the room 40. In the embodiment shown, the shutter 10 comprises a first window pane 101 and a second window pane 102 which are spaced apart and confine a gap 103. Such an arrangement may provide increased heat isolation and therefore lower energy consumption in winter.

The shutter 10 is guided in a lower rail 104 and an upper rail 105, which are arranged substantially horizontally at the outside O of the building. Therefore, the shutter is slidably mounted and can be moved from an open position beside the filter element to a closed position in front of the filter element.

Furthermore, figure 1 shows an optional isolation element 504 which may comprise rigid expanded plastic like polyurethane foam and which is adapted to reduce heat losses through the slab 50. Furthermore, the façade may comprise decorative elements 503 which give the façade a modern glazing look. To prevent the isolation element 504 and the decorative element 503 from being affected by precipitation, a sealed base 501 may be provided which can be made from a sheet metal, e.g. an aluminum alloy.

Figure 2 and figure 3 show the horizontal cross-sectional view through an embodiment of the present invention. The figures

show a part of the wall 55 which separates the inside I from the outside O of a building. The wall 55 comprises a wall opening 550. Inside this wall opening 550, a window 15 is arranged which allows the user to look outside of the room and which allows natural sunlight to enter the room, e.g. for natural illumination. The window may comprise a fixed glazing in some embodiments. In other embodiments, the window may be movable so that it may be opened by the user.

Adjacent to the window 15 and adjacent to the wall 55, a first filter element 30a and a second filter element 30b is arranged. The inside structure of the filter elements 30 has been described in greater detail with respect to figure 1.

As can be seen from figure 2, a first shutter 10a is arranged in front of and spaced apart of the first filter element 30a and a second shutter 10b is arranged in front of and spaced apart from the second filter element 30b. The filter elements 30 and the shutters 10 confine a gap 11. If the venting element 70 is in an open position, outside air may enter the gap 11 and is heated due to solar radiation passing through the shutter 10, which comprises at least one window pane. This heated air 60 can enter the room through the filter element 30. Thus, the configuration shown in figure 2 allows moderate air exchange between the inside and the outside of the building and using solar energy to raise the inside temperature on cold days with moderate or cold outside temperatures.

In hot and humid climate, e.g. in summer, the shutters 10a and 10b can slide in an open position as shown in figure 3. This allows a higher flow of outside air 60 to enter the room through the filter elements 30a and 30b. This high elevated air speed may cool down the room or increase the maximum acceptable temperature inside the room. If the indoor air temperature is higher than the outdoor temperature due to a high heat load indoors or during the night, the high air exchange rate may improve the energy efficiency and cool down

the inside of the building without the need of energy-consuming air conditioning systems.

The shutters 10a and 10b are arranged in front of the window 15 in their open position. As the shutters 10 comprise at least one window pane, the view through the window 15 remains unobstructed. If the user wants to shade the room from direct sunlight, an optional sun protection device 25 is arranged in the gap between the window 15 and the shutter 10. The sun protection device may comprise a sheet of fabric or louvers made from wood or metal in order to reflect direct sunlight and let scattered light enter the room for illumination purposes. As the sun protection device 25 is protected by the shutters 10a and 10b, the sun protection device 25 is not affected by high wind speeds. Therefore, even the upper floors of a high-rise building may be shaded.

The invention has been described in the form of functional elements. Those elements are known to those skilled in the art and may be realized in different embodiments. These elements can be combined with one another in different ways. In some embodiments, parts of the proposed control device may also be integrated, for example in a single component, a single subassembly or a program for a data processing device. The invention does not rely on the strict realization of a certain embodiment.

While the invention has been described in terms of several embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments described, but can be practiced with modification and alteration within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of limiting. Therefore, it is intended that this invention be limited only by the claims and the equivalents thereof.

Claims

1. Façade element (1) being adapted to allow an air exchange between at least one inside room (40) and an outside (O) of a building having at least one wall (55), comprising

a wall opening (550) being arranged in the wall,

a filter element (30) being arranged in at least a part of the wall opening (550),

at least one movable shutter (10), being arranged at the outside (O) of the building and being movable between at least an open position and a closed position, wherein

the shutter (10) is arranged between the filter element (30) and the outside (O) of the building in the closed position, and

the shutter (10) is arranged beside the filter element (30) in the open position.

2. Façade element according to claim 1, comprising further a rain protection device (20) which is permeable to air (60) and which is adapted to prevent the filter element from being soaked by rain water.

3. Façade element according to claim 2, wherein the rain protection device (20) comprises at least one louver.

4. Façade element according to any of claims 2 or 3, wherein the rain protection device (20) is movable between at least an open position and a closed position.

5. Façade element according to any of claims 1 to 4, wherein the shutter (10) comprises a window pane.

6. Façade element according to any of claims 1 to 5, wherein the shutter is slidably mounted on at least one track (104, 105).

7. Façade element according to any of claims 1 to 5, wherein the shutter is swivelling about pivots being aranged at the outside (O) of the façade.

8. Façade element according to any of claims 1 to 7, comprising further at least one window (15) being arranged in a part of the wall opening (550).

9. Façade element according to claim 8, wherein the shutter (10) is at least partly arranged between the window (15) and the outside (O) of the building in its open position.

10. Façade element according to any of claims 8 or 9, comprising further a sun protection device being located in front of the window.

11. Façade element according to claim 10, wherein the sun protection device is arranged between the window (15) and the shutter (10), if the shutter () is in its open position.

12. Façade element according to any of claims 10 or 11, wherein the sun protection device is movable between at least an open position and a closed position.

13. Façade element according to any of claims 1 to 12, wherein the filter element comprises any of activated carbon, paper, non-woven fabric or an expanded-metal grid.

14. Façade element according to any of claims 1 to 13, comprising further an inner cover (302), being permeable to air (60) and being arranged between the filter layer (303) and the inside (I) of the room.

15. Façade element according to claim 14, wherein the inner cover (302) comprises any of gypsum plaster board, a metal sheet, an expanded-metal grid, woven fabric, or wood.

16. Façade element according to any of claims 14 or 15, wherein the inner cover (302) comprises a plurality of ventilation bores.

17. Façade element according to claim 17, wherein the ventilation bores are covered by fabric.

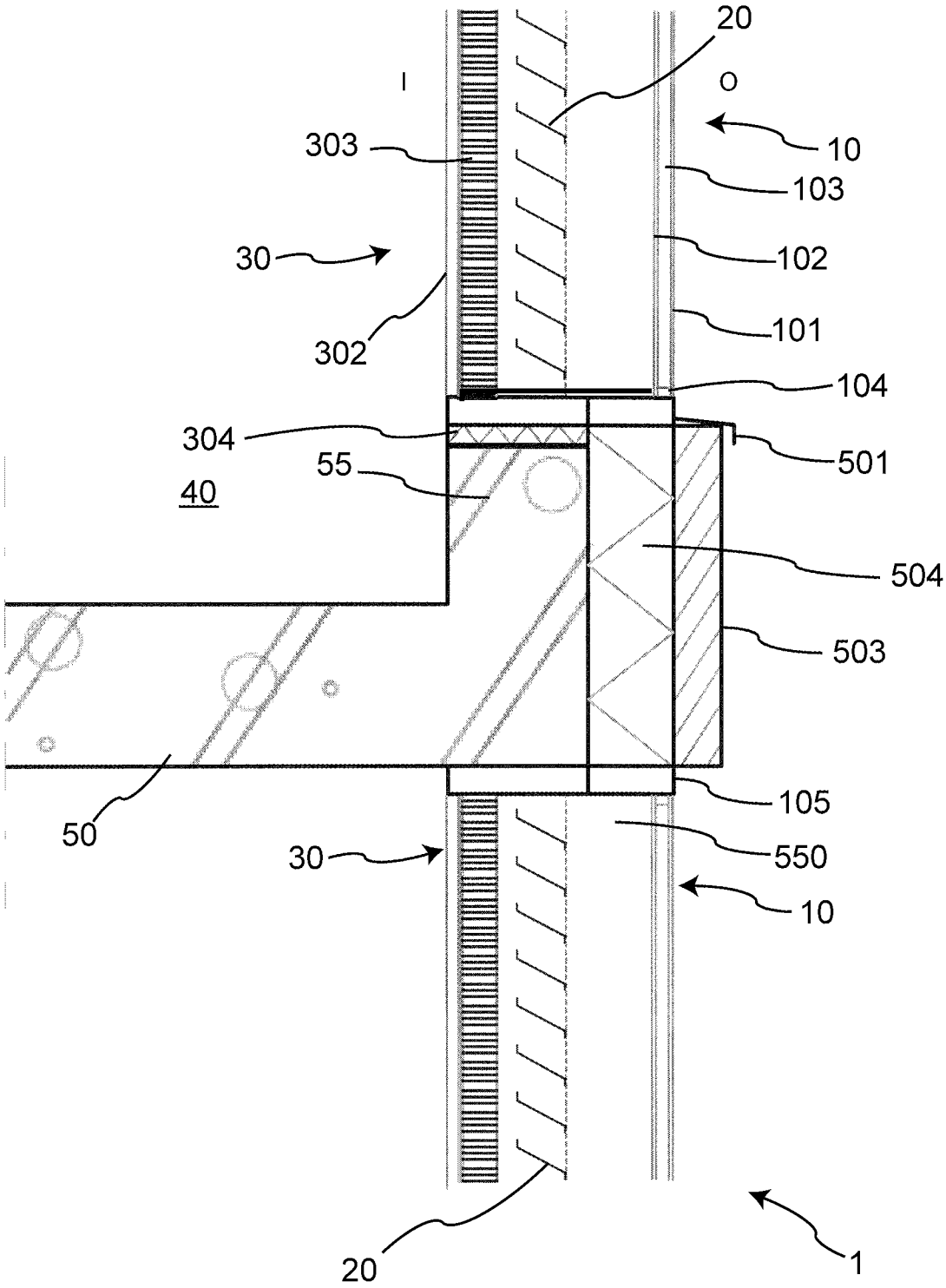
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Fig. 1

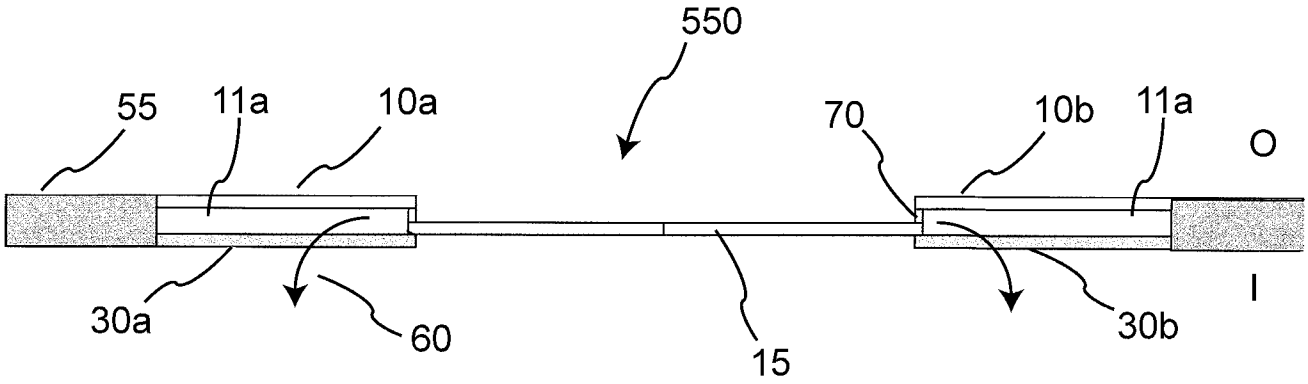
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Fig. 2

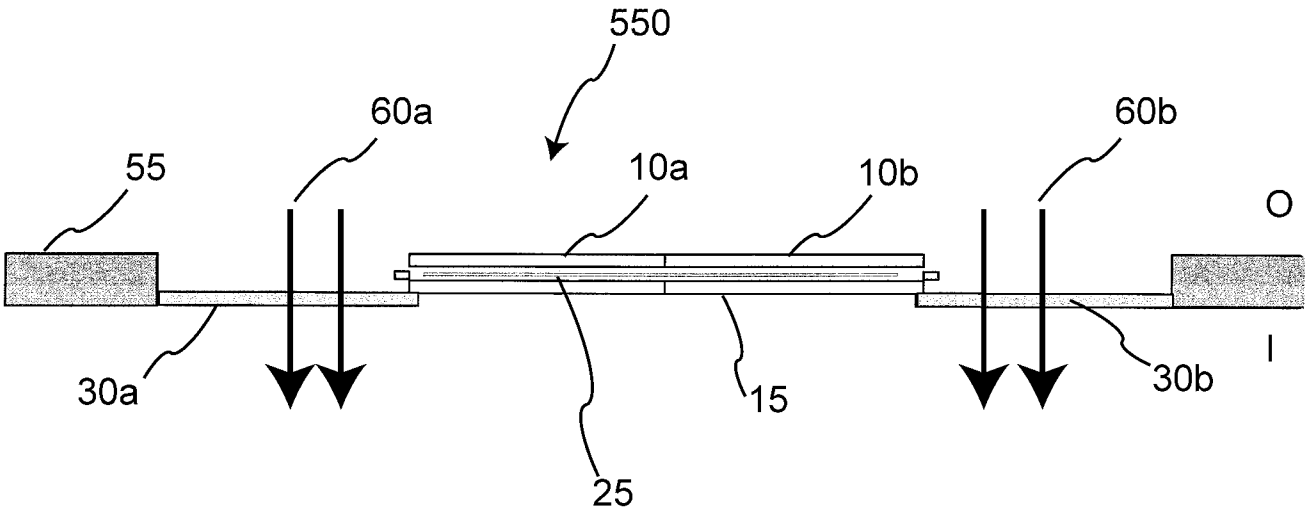
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Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2011/052393

A. CLASSIFICATION OF SUBJECT MATTER

E06B 7/02(2006.01)i, E06B 7/10(2006.01)i, F24F 13/08(2006.01)i, B01D 39/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E06B 7/02; E04B 2/96; E04B 1/70; B01D 39/16; E06B 7/04; B60H 3/06; E06B 9/52; B60J 1/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: window, facade, filter, shutter, cover, slidable, movable, ventilate, air

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2001-311372 A (KASURU CO., LTD.) 09 November 2001 See abstract, paragraph [0021], and figures 1-3.	1,5-6,8 7 2-4,9-17
Y A	JP 2010-196293 A (SANKYO TATEYAMA ALUMINIUM INC.) 09 September 2010 See paragraph [0011], and figure 2.	7 1-6,8-17
A	KR 10-1995-0008905 A (KIM, HAN-JOO) 19 April 1995 See claims 1-7, and figures 2-3.	1-17
A	US 7320637 B2 (LACK, NICHOLAS L.) 22 January 2008 See columns 4-5, and figure 6.	1-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
27 FEBRUARY 2012 (27.02.2012)	**27 FEBRUARY 2012 (27.02.2012)**

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/IB2011/052393

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