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(54) **ventilation device**

(57) The invention relates to a ventilation device (1) for the natural supply of air or discharge of air, comprising an air flow channel (4) wherein a first, a second and a third regulating valve (5), (6), (7) are arranged so as to be able to rotate or hinge in series, so that during rotating or hinging of these regulating valves (5), (6), (7) the flow rate of air through this air flow channel (4) is regulated,

at least two regulating valves (5), (6), (7) being mutually mechanically coupled. A ventilation device (1) of this type has high thermal resistance, a high temperature factor and high airtightness, so that said ventilation device is suitable for placing in or on a window, door, roof surface or external wall of a passive house building or a building in regions having low outside temperature during the heating season.

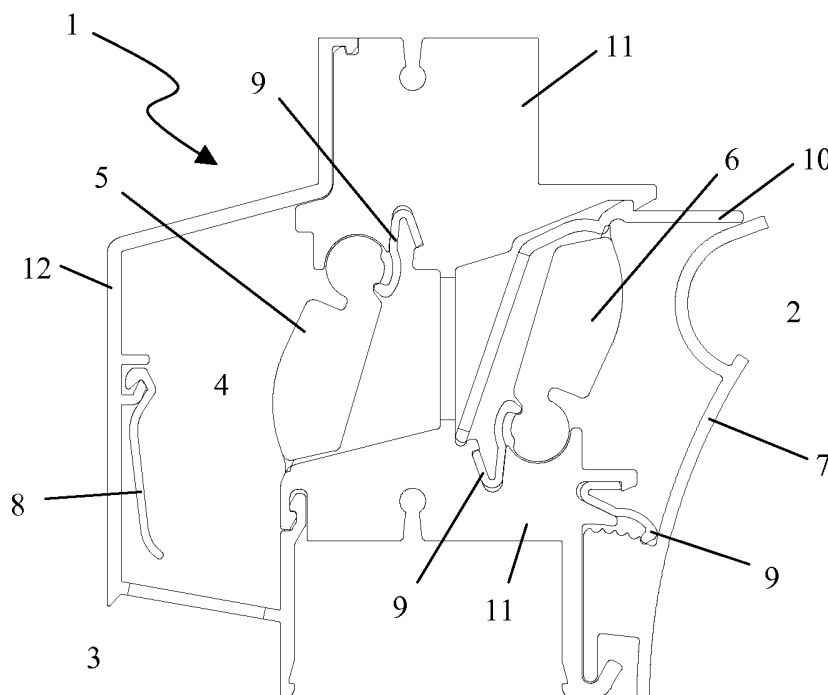


FIG. 1

Description

[0001] This invention relates to a ventilation device for the natural supply of air or discharge of air, comprising an air flow channel wherein a first, a second and a third regulating valve are arranged so as to be able to rotate or hinge in series, in such a way that during rotating or hinging of these regulating valves the flow rate of air through this air flow channel is regulated.

[0002] Regulating valves are arranged in series in an air flow channel when said regulating valves are arranged one after another in a direction of the flow of air through this air flow channel and are each per se provided in order to be able to close off the air flow channel.

[0003] This invention is situated predominantly in the framework of the provision of a ventilation device for the natural supply of air or discharge of air, provided for placing in or on a window, door, roof surface or external wall of a building designed in accordance with what is known as the passive house concept or of a building in regions having low to very low outside temperature during the heating season.

[0004] What are known as passive house buildings usually possess a completely mechanical ventilation system provided with a heat recovery unit. In this way, the losses of energy via ventilation can be limited in the event of low outside temperatures. Because of the high degree of insulation and the high air-tightness of the building shell of buildings of this type, the gains of heat via solar irradiation, internal heat loads et al. are usually higher than the losses of heat via transmission and ventilation. There is therefore a great need to increase ventilation losses via the opening of additional ventilation devices when the outside temperature is lower than the inside temperature. However, existing ventilation devices for the natural supply of air or discharge of air cannot be used for this purpose. That is to say, when losses of energy are higher than gains of energy, it is desirable to limit as much as possible the losses of heat through the building shell because there is only a small amount of heating capacity and to avoid what are known as cold bridges because of the high degree of insulation of the building shell. Losses of heat via the ventilation devices should then also be limited as much as possible. When the ventilation device is closed, a ventilation device of this type should then also possess high thermal resistance (or a low coefficient of heat transmission or U value in W/m^2K), a high temperature factor f and high air-tightness.

[0005] As a reference, it may be stated that a ventilation device of this type attains preferably at least thermal resistance and a temperature factor which are obtained by window profiles.

Plastics material PVC windows made up of five chambers are to have in accordance with Belgian standard NBN B62-002 at most a U value of $1.6 W/(m^2K)$. This value is also obtained by highly insulated aluminium window profiles. In accordance with this same standard, a wooden

frame made of hardwood must already have a thickness of 120 mm in order to obtain a U value of $1.6 W/(m^2K)$.

[0006] In accordance with NBN B25.002-1, in houses in accordance with indoor climate class 2, at a minimum monthly average temperature of $-8^\circ C$, a temperature factor of at least 0.61 must be obtained for windows.

[0007] When providing ventilation devices for the natural supply of air or discharge of air in passive house buildings, it should be possible to switch off one or two fans of the mechanical ventilation system present when the ventilation devices are in use. This entails a not inconsiderable additional gain in energy for passive house buildings of this type.

[0008] Ventilation devices having high thermal resistance, a high temperature factor and high air-tightness are desirable also in buildings in regions having low to very low outside temperature during the heating season. That is to say, in such regions it is desirable to have ventilation devices which allow the ventilation device to be temporarily closed off while losing as little energy as possible, while at the same time avoiding condensation or the formation of ice in or on the ventilation device.

[0009] However, in existing ventilation devices, it is not possible to limit losses of heat to such a degree that said ventilation devices can be used in a passive house building without having to make the air flow channel undesirably long. That is to say, the total length of the air flow channel should be limited as much as possible in order to limit material costs, to allow placement on glazing, etc.

[0010] In sliding grates it is not possible to sufficiently limit losses of heat, since in that case at least one displaceable valve has at all times to be able to be displaced with respect to a grate with punched holes. In this case, although insulation is currently attached between the displaceable valves and the grate with punched holes, this insulation has to be provided in such a way that the valves remain displaceable, so that substantial losses of heat occur at all times because of limited air-tightness. These losses of heat are in this case, viewed relatively, also greater than in comparable ventilation devices, since a sliding grate of this type has a much more limited ventilation flow rate than ventilation devices with regulating valves of comparable dimensions and it is thus necessary to provide a larger surface area on sliding grates in order to obtain the same ventilation flow rate and, as a result, greater losses of heat occur for the same ventilation flow rate.

[0011] Also in the case of ventilation devices with two rotating regulating valves which form part of the circumference of a hollow drum which is rotatably provided in the air flow channel of this ventilation device (what are known as drum grates), it is not possible to sufficiently limit losses of heat. It is possible to provide between the rotatable drum and the air flow channel insulation which ensures as effectively as possible that the air flow channel can be closed off with the aid of the regulating valves and this insulation, when the rotating regulating valves are closed, these regulating valves closing off the air flow

channel at two different locations. Nevertheless, this insulation should be provided in such a way that the drum remains rotatable in the air flow channel, so that a ventilation device of this type is in practice not very air-tight when closed.

[0012] An air flow channel can be closed off more effectively with the aid of hingeable regulating valves in the air flow channel. However, a major drawback of ventilation devices of this type is the fact that the position of regulating valves of this type changes in an unintended manner in the event of the occurrence of gusts of wind.

[0013] WO 89/02970 describes a ventilation device of this type with a hingeable regulating valve which can close off the air flow channel at two locations. In this way, during closing-off of the air flow channel a volume of air is retained by this hingeable regulating valve. A somewhat improved thermal resistance, temperature factor and air-tightness are thus obtained. However, as a result of the fact that the position of this regulating valve can change in an unintended manner in the event of the occurrence of sudden gusts of wind, this ventilation device does not meet the stipulated objectives.

[0014] DE 299 10 662 describes a ventilation device wherein three regulating valves are arranged in series in such a way that during rotating and/or hinging thereof the flow rate of air through the air flow channel is regulated. When the air flow channel is closed off with the aid of the outermost regulating valves, a volume of air can be retained by these regulating valves. In this way too, somewhat improved thermal resistance, a higher temperature factor and air-tightness are obtained. However, as stated hereinbefore, a major drawback of this is the fact that the position of regulating valves of this type changes in an unintended manner in the event of the occurrence of gusts of wind. This entails not inconsiderable, and thus undesired, losses of heat.

[0015] The object of this invention is therefore also, as stated hereinbefore, to provide a ventilation device for the natural supply of air or discharge of air, provided for placing in or on a window, door, roof surface or external wall of a building designed in accordance with what is known as the passive house concept or of a building in regions having low to very low outside temperature during the heating season, this ventilation device having high air-tightness, a maximum U value of 1.6 W/(m²K) and a minimum temperature factor of 0.61 at a minimum monthly average temperature of -8 °C.

[0016] This object of the invention is achieved by providing a ventilation device for the natural supply of air or discharge of air, comprising an air flow channel wherein a first, a second and a third regulating valve are arranged so as to be able to rotate or hinge in series, in such a way that during rotating or hinging of these regulating valves the flow rate of air through this air flow channel is regulated, the hinging movement of at least two of the regulating valves being mutually mechanically coupled.

[0017] Mutually mechanically coupling the movement of at least two regulating valves greatly reduces the risk

of unexpected changes of the position of the regulating valves.

[0018] When closed, it is possible to create between these two regulating valves placed in series at least two volumes of air which are screened off from the inside and outside air. The air movement in these volumes of air is minimal, as a result of which the thermal resistance is substantially increased.

[0019] In the case of at least one hinging regulating valve, said regulating valve can connect exceedingly well in the known manners, such as for example with the aid of a resilient part at the end of this regulating valve, when closed, to the air flow channel, as a result of which, together with the other regulating valves, especially high air-tightness of the ventilation device as a whole is obtained.

[0020] If two rotating regulating valves are provided, which form part of the circumference of a hollow drum which is rotatably provided in the air flow channel of this ventilation device (what are known as drum grates), then it is possible either to provide as the third regulating valve a hinging regulating valve, which can ensure high air-tightness when closed, or to provide as the third regulating valve a rotating regulating valve which, together with a fourth rotating regulating valve, forms part of a second hollow drum which is rotatably provided in the air flow channel. Thus, with two drums, three volumes of air are screened off from the inside and outside air, as a result of which the thermal resistance is increased still further, but as a result of which even better air-tightness of the ventilation device is obtained between the inside air and the outside air.

[0021] Of course, in addition to the first, the second and the third regulating valve, still further regulating valves can be provided in series with these regulating valves in the air flow channel. However, further regulating valves will merely entail smaller gains in thermal resistance, temperature factor and air-tightness.

[0022] Preferably, in a ventilation device of this type according to the invention, the movement of the aforementioned at least two regulating valves is mutually mechanically coupled in such a way that during hinging or rotating of one of both regulating valves in a first direction with respect to the air flow channel the other of both regulating valves hinges or rotates in the opposite direction to this first direction with respect to the air flow channel.

[0023] A coupling of this type produces, in the event of a difference in pressure over the ventilation device, opposite forces, that is to say, on the one hand, a force which seeks to open one of both regulating valves and, on the other hand, a force which seeks to open the other of both regulating valves. Owing to the coupling of the movement of both regulating valves, both forces which occur (substantially) cancel each other out, thus stabilizing the entity formed by both regulating valves. The position of these regulating valves will therefore also (substantially) not change in an unintended manner in the event of the occurrence of gusts of wind.

[0024] In a specific embodiment of a ventilation device of this type, the movement of the aforementioned at least two regulating valves is mutually mechanically coupled with the aid of a rod mechanism.

[0025] Alternatively or additionally to the coupling with the aid of a rod mechanism, the movement of these aforementioned two regulating valves can be mutually mechanically coupled with the aid of a drum.

[0026] In the case of coupling with the aid of a drum, in a further specific embodiment, the movement of the aforementioned at least two regulating valves can also be mutually mechanically coupled as a result of the fact that the two regulating valves form part of the circumference of a hollow drum which is arranged so as to be able to rotate in the ventilation channel. This specific embodiment therefore corresponds to the specific embodiment cited hereinbefore wherein what is known as a drum grate is provided with one or more additional regulating valves.

[0027] Even more preferably, in a ventilation device according to this invention, the movement of the first, the second and the third regulating valve is mutually mechanically coupled.

[0028] In a further preferred embodiment of a ventilation device according to this invention, at least two of the regulating valves are embodied identically to one another. This provides, in the case of regulating valves which do not form part of a drum, a major advantage in terms of production as a result of the fact that producing one type of regulating valve allows a plurality of regulating valves to be provided from this ventilation device. In the case of coupled regulating valves on which opposite forces act in the event of gusts of wind, it is also simpler to further design the ventilation device in such a way that these opposite forces can cancel each other out almost completely.

[0029] Furthermore, in order to be able to easily clean and maintain the ventilation device, preferably at least one of the regulating valves is releasably arranged.

[0030] A further specific embodiment of a ventilation device according to this invention is provided with an actuator which can be used to activate the movement of the regulating valves.

[0031] Furthermore, in order to automatically adapt the flow rate of air through the ventilation device as a function of the difference in pressure between the inlet and the outlet of the air flow channel, in a ventilation device according to this invention, a fourth regulating valve is preferably arranged in series with the first, the second and the third regulating valve, in such a way that during rotating and/or hinging of this first, second, third and fourth regulating valve the flow rate of air through the air flow channel is regulated, this fourth regulating valve being a self-regulating valve.

[0032] A self-regulating valve of this type is a valve which can automatically adapt the flow rate of air through a ventilation device, without being activated with the aid of a sensor or a motor.

[0033] This invention will now be commented on in

greater depth based on the subsequent detailed description of a preferred embodiment of a ventilation device according to this invention. The purpose of this description is exclusively to provide illustrative examples and to indicate further advantages and particularities of this embodiment, and may thus in no way be interpreted as a restriction of the scope of the invention or of the intellectual property rights sought in the claims.

[0034] This detailed description refers by means of reference numerals to the appended drawings, in which:

- **Figure 1** is a cross section of an embodiment of a ventilation device according to this invention, the first, second and third regulating valve each being in the position in which they close off the ventilation channel;
- **Figure 2** is a cross section of the embodiment of a ventilation device from Figure 1, the first, second and third regulating valve each being in the position in which they allow a maximum flow rate of air through the ventilation channel;
- **Figure 3** schematically illustrates the operating principle of the coupled first and second regulating valves; and
- **Figure 4** schematically illustrates an alternative operating principle for coupled first and second regulating valves.

[0035] The ventilation device (1) as depicted in Figures 1 and 2 is a ventilation device (1) for the natural supply of air from the outside (3) to an internal space (2) or for the discharge of air from the internal space (2) to the exterior (3). In Figure 2 the dot-dash arrow indicates the direction of the supply of air through the air flow channel (4) of this ventilation device (1).

[0036] This ventilation device (1) further comprises a first, a second, a third and a fourth regulating valve (5), (6), (7), (8) which are arranged so as to be able to rotate or hinge in series, in such a way that during rotating or hinging of these regulating valves (5), (6), (7), (8) the flow rate of air through the air flow channel (4) of the ventilation device (1) is regulated.

[0037] The first and the second of these regulating valves (5), (6) are in this case mutually mechanically coupled in such a way that during hinging or rotating of one of both regulating valves (5) in a first direction with respect to the air flow channel (4) the other of both regulating valves (6) hinges or rotates in the opposite direction to this first direction with respect to the air flow channel (4).

[0038] The movement of these first and second regulating valves (5), (6) can for example be mutually mechanically coupled by rotatingly connecting these regulating valves (5), (6), at the level of a front plate of this ventilation device, to a drum which is in turn rotatably arranged at the level of this front plate.

[0039] Other mechanical coupling mechanisms are conceivable. Coupling mechanisms of this type can be implemented by a person skilled in the art and are not

depicted in the present document.

[0040] Figure 3 schematically presents the operating principle of these coupled regulating valves (5), (6). The regulating valves (5), (6) from the embodiment of a ventilation device according to this invention (1) from Figures 1 and 2 are represented by the dot-dash line. The solid line presents regulating valves (5'), (6') which open and close in the opposite direction. Figure 4 shows further possible arrangements of coupled regulating valves (5''), (6'') and (5'''), (6''') of this type. In each case the dashed line presents the corresponding regulating valve in the closed position, while the arrow in this regulating valve indicates the direction of opening thereof.

[0041] In the case of a difference in pressure over the air flow channel (4) from left to right or vice versa, there will in each case be exerted on one of both regulating valves a force which seeks to close this one regulating valve, while on the other of both regulating valves there is exerted a force which seeks to open this other regulating valve. As a result of the fact that the movement of both regulating valves (5), (6) is mutually mechanically coupled, these opposite forces cancel each other out and these regulating valves (5), (6) stabilize each other.

[0042] In the embodiment of a ventilation device (1) which was depicted in Figures 1 and 2, the movement of the third regulating valve (7) is furthermore also mechanically coupled to the movement of these first and second regulating valves (5), (6). Coupling mechanisms which may be used for this purpose have equally not been depicted in the present document. The movement of this third regulating valve (7) could for example be mechanically coupled to the movement of these first and second regulating valves (5), (6) by connecting this third regulating valve (7), with the aid of a rod mechanism, to the drum to which the first and second regulating valves (5), (6) are rotatably fastened. This rod mechanism can also be incorporated into this ventilation device (1) at the level of a front plate of the ventilation device (1). Other possible implementations of the mechanical coupling of these three valves (5), (6), (7) are conceivable.

[0043] Furthermore, these first, second and third regulating valves (5), (6), (7) are hingeably and releasably arranged with respect to the air flow channel (4) with the aid of clamps (9). In order to releasably provide said regulating valves in the ventilation device (1), for example for simple maintenance and/or cleaning of the ventilation device (1), these regulating valves (5), (6), (7) should therefore furthermore be releasably connected to the coupling mechanisms which mutually connect these regulating valves (5), (6), (7).

[0044] The fourth regulating valve (8), which is hingeably and/or rotatably and/or plially arranged in the air flow channel (4), is a self-regulating valve which can adapt the flow rate of air through the ventilation device (1) automatically (i.e. without activation with the aid of a sensor or motor) on the basis of the difference in pressure over the air flow channel (4). This fourth regulating valve (8) could equally be rotatably or plially arranged in the

air flow channel (4). A combination of hingeable, rotatable or pliable arrangement is also possible. Self-regulating valves (8) of this type are already known in the art.

[0045] Furthermore, the ventilation device (1) from Figures 1 and 2 is provided with a removable mosquito gauze (10), provided to prevent undesired insects from entering the space (2).

[0046] Tests with the depicted ventilation device (1) from Figures 1 and 2, the profiles (11) being made of PVC, the outer cap (12) being made of aluminium, the first and second regulating valves (5), (6) being made of PVC and the third regulating valve (7) being made of aluminium, indicate that this ventilation device has, at a difference in temperature of 20 °C between the internal space (2) and the external space (3), a U value of 1.5 W/(m²K) and a temperature factor of 0.65.

[0047] A comparable ventilation device (1), the third regulating valve (7) being omitted, resulted in a U value of 1.7 W/(m²K).

[0048] Standard ventilation grates equipped with one regulating valve have a U value of at least 3.0 W/(m²K) and a temperature factor of less than 0.6.

[0049] Because of the three possibilities for closing-off using the first, second and third regulating valve (5), (6), (7), the air-tightness of this ventilation device (1) is also much better than a conventional ventilation device (1).

[0050] The embodiment provided hereinbefore of the ventilation device (1) does not form any restriction. A large number of materials, designs, etc. may be considered for producing ventilation devices (1) according to this invention. The profiles (11) may equally be made of partially encasing aluminium profile parts between which insulating material is attached. The first and second regulating valves (5), (6) can for example be made completely from polyurethane in cases in which said regulating valves have to be resistant to temperatures as low as -40 °C.

Claims

1. Ventilation device (1) for the natural supply of air or discharge of air, comprising an air flow channel (4) wherein a first, a second and a third regulating valve (5), (6), (7) are arranged so as to be able to rotate or hinge in series, in such a way that during rotating or hinging of these regulating valves (5), (6) the flow rate of air through this air flow channel (4) is regulated, **characterized in that** the hinging or rotating movement of at least two of the regulating valves (5), (6) is mutually mechanically coupled.
2. Ventilation device (1) according to Claim 1, **characterized in that** the movement of the aforementioned at least two regulating valves (5), (6) is mutually mechanically coupled in such a way that during hinging or rotating of one of both regulating valves (5) in a first direction with respect to the air flow channel (4)

the other of both regulating valves (6) hinges or rotates in the opposite direction to this first direction with respect to the air flow channel (4).

3. Ventilation device (1) according to Claim 1 or 2, **characterized in that** the movement of the aforementioned at least two regulating valves (5), (6) is mutually mechanically coupled with the aid of a rod mechanism. 5
4. Ventilation device (1) according to Claim 2 or 3, **characterized in that** the movement of the aforementioned at least two regulating valves (5), (6) is mutually mechanically coupled with the aid of a drum. 10
5. Ventilation device (1) according to Claim 4, **characterized in that** the movement of the aforementioned at least two regulating valves (5), (6) is mutually mechanically coupled as a result of the fact that the two regulating valves (5), (6) form part of the circumference of a hollow drum which is arranged so as to be able to rotate in the ventilation channel (4). 15 20
6. Ventilation device (1) according to one of Claims 1 to 5 inclusive, **characterized in that** the movement of the first, the second and the third regulating valve (5), (6), (7) is mutually mechanically coupled. 25
7. Ventilation device (1) according to one of the preceding claims, **characterized in that** at least two of the regulating valves (5), (6), (7) are embodied identically to one another. 30
8. Ventilation device (1) according to one of the preceding claims, **characterized in that** at least one of the regulating valves (5), (6), (7) is releasably arranged. 35
9. Ventilation device (1) according to one of the preceding claims, **characterized in that** said ventilation device is provided with an actuator which can be used to activate the movement of the regulating valves (5), (6), (7). 40
10. Ventilation device (1) according to one of the preceding claims, **characterized in that** at least a fourth regulating valve (8) is arranged in series with the first, the second and the third regulating valve (5), (6), (7), in such a way that during rotating and/or hinging of this first, second, third and fourth regulating valve (5), (6), (7), (8) the flow rate of air through the air flow channel (4) is regulated, this fourth regulating valve (8) being a self-regulating valve. 45 50

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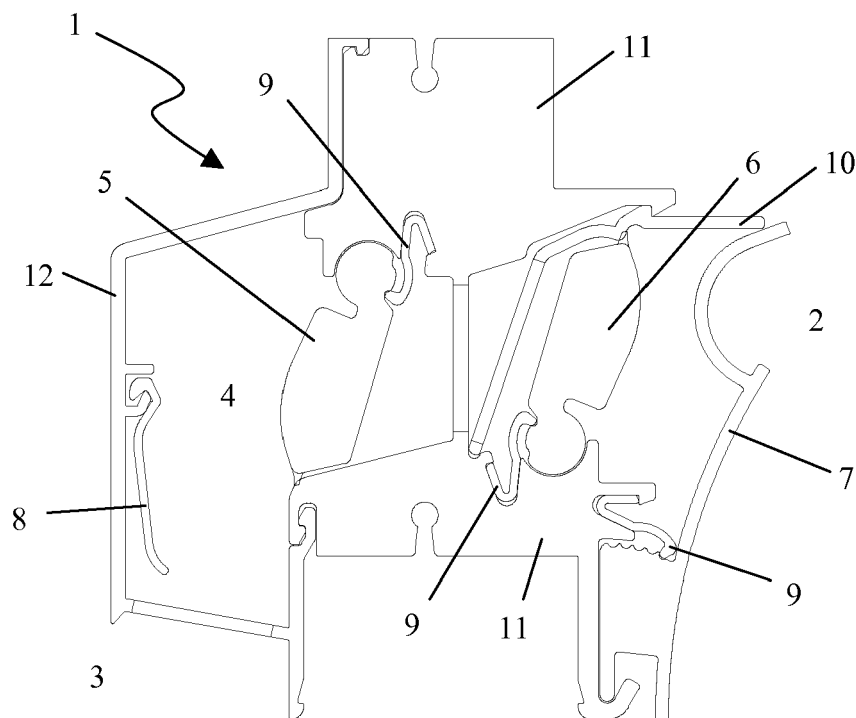


FIG. 1

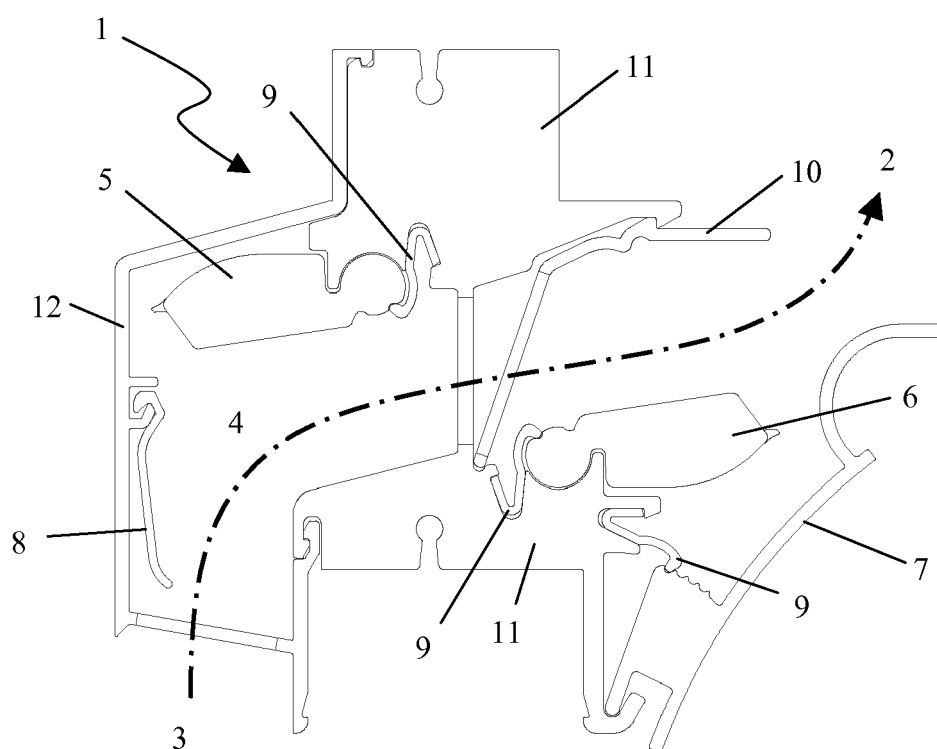


FIG. 2

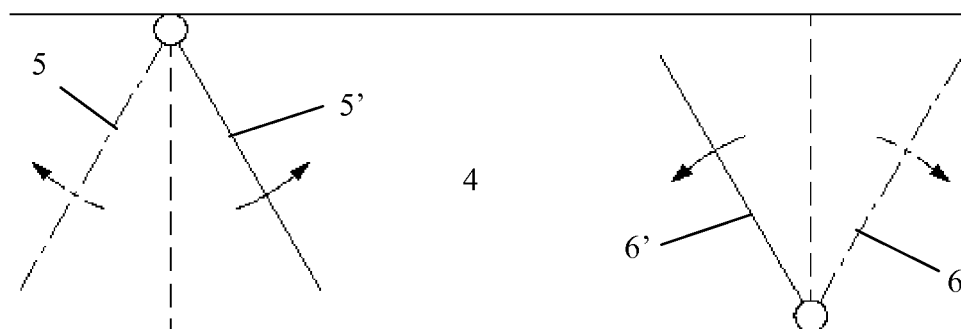


FIG. 3

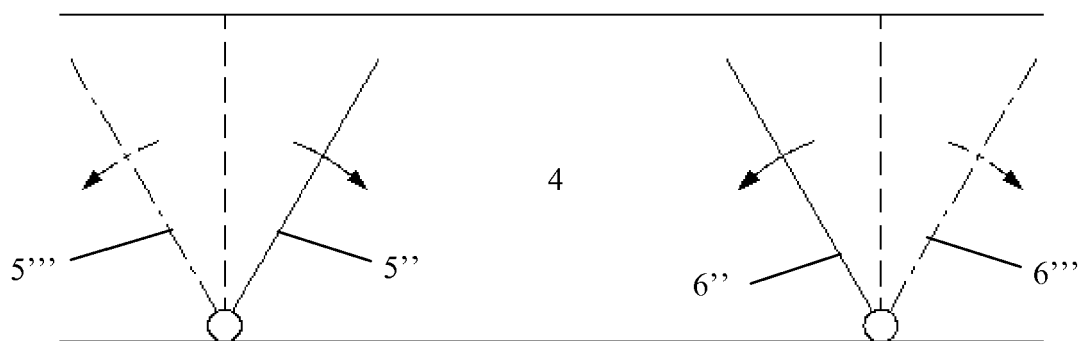


FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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