Title: ROOF WINDOW, IN PARTICULAR A SMOKE EXTRACTION WINDOW, WITH A PIVOT SASH

Abstract: Roof window has a lower sash (3) mounted in the common window frame (1) with the main pivot sash (2), situated in the upper part of this window frame, in addition the lower sash is opened as a tilt window turning around its horizontal axis of rotation situated at its bottom and the window is fitted with side shields (4, 6) filling the space between the lower sash (3) and the window frame (1) in all stages of this window opening.
Roof window, in particular a smoke extraction window, with a pivot sash

The invention concerns a roof window with a pivot sash, to be installed in an inclined roof slope. The window has two functions. In its regular operation the window is used for providing daylight and ventilation to passageways in buildings, in particular staircases. However in the circumstances defined as emergency, mainly in case of fire, the window performs a function of taking away smoke from inside of the building.

Smoke flaps in buildings are known, they are installed usually at flat roofs, being opened in case of fire upon a signal from the alarm installation, in particular from fire sensors including smoke sensors. Also roof windows installed in inclined roof slopes may be used as smoke flaps, however in this case there is a danger that wind, in particular blowing crosswise to the roof slope, will hamper smoke removal, forcing the smoke coming out of the roof window back into the building. Shields recommended to be used in windows of some producers, mounted permanently in the roof below the window and at its sides, prevent disadvantageous effect of wind. Permanent shields lower the aesthetics qualities of a building, therefore customers often, contrary to manufacturer's recommendations, do not install these shields in the roof, so the windows do not have the declared smoke extraction capacity.

The essence of the solution by the invention is that a roof window having a window frame and a main sash, being a pivot sash, has also a lower sash mounted in the common window frame with the pivot sash located in the upper part of this frame. The lower sash is opened as a tilt window, turning around a horizontal axis situated at its bottom, and equipped with side shields filling the space between the lower sash and the window frame in all stages of this sash opening. The side shields are advantageously made of a heat-resistant material. The lower sash is a window-type sash, or has a glass pane mounted in the sash frame. Another variant is also possible - where the lower sash has the form of non-transparent panel, and the glass pane is only in the main, pivot sash, situated in the upper part of the window.
Both roof window sashes are situated so that when the window is closed the pivot sash overlaps the lower sash. In this position of sashes, the lower cross-bar of the pivot sash frame leans against the upper part of the lower sash, adjacent to it with its rebate surfaces fitted with known seals. Thanks to this position of sashes, the window frame has no backup cross-bar for the pivot sash. When the window is closed, overlapping of the pivot sash with the lower sash provides a free run-off of rainwater on both roof window sashes. However, no cross-bar in the window frame causes that there is no obstacle to the air flow when the window is open, which in particular increases smoke extraction efficiency.

In the first invention variant, the side shield of the lower sash consists of a set of segments, for instance in the form of metal sheet strips, overlapping each other like a fan, unfolding while opening the lower sash. The segments are joined at one end by mounting them on a common axle, whereas at the other end they have slidable connections, with a stop limiting unfolding. When the lower sash is closed, the side shield segments are let inside the window frame and situated close to each other, perpendicular to the main surface of the window frame. Advantageously, in the closed position of the lower sash, the side shield segments are placed in a cassette adjacent to the inner side of the window frame, covering these segments from inside of the room and from the side, and open at the lower sash side.

In the second invention variant, the side shield consists of a set of segments connected in an articulated way and unfolding as a concertina while the lower sash is being opened. The segments have the form of metal sheet strips of a trapezoid shape of a slight edge convergence, which are connected to the adjacent segments. When the lower sash is closed, the side shield segments are let inside the window frame and folded next to each other, approximately parallel to the main surface of the window frame. Advantageously, when folded, the side shield segments are placed in a cassette adjoining the inner side of the window frame, covering these segments from the inside of the room and from the side, and open at the lower sash side.
In the third invention variant, the side shield has the form of a uniform mobile wall, secured perpendicularly to the lower window sash. When the lower sash is closed, the side shield is let inside the room through the window frame. The window frame has stops, installed at its inner side surfaces, which hold the lower sash side shield in the direct vicinity of the side sections of the window frame, preventing bending the shield out as a result of cross wind force towards the window centre.

In the fourth invention variant, the side shield comprises a small number of segments, in particular three to five. When the lower sash is closed, these side shield segments are let inside the room through the inside of window frame, however to a lower depth than in the third variant. The window frame, as in the third invention variant, has stops holding the lower sash side shield segments in the direct vicinity of the window frame side segments.

The pivot sash is opened and closed by a turn around its horizontal axis, located in the central zone of this sash. This sash is mounted in the roof window frame with two hinges, each of them joins a side segment of the pivot sash frame to a side segment of the window frame. Advantageously, each hinge of the pivot sash comprises two components, where one component, secured with its fastening plate to the window sash, has an arched guide, and the other one, secured with its fastening plate to the sash frame, has an arched slide placed in this guide. The centres of curvature of the guide and the slide are points on the theoretical axis of revolution of the hinge, located at the inner side of the window glass pane surface.

The arched slide is connected to the fastening plate with an axle, enabling additional movement of the window after the maximum come out of the slide from the guide. It extends the range of pivot sash opening angles and allows to set the pivot sash in the vertical position or even open it by a slightly wider angle, inclining this sash towards the roof slope. It is useful in an emergency (fire), when the window functions as a smoke opening, in this case placing the window pivot sash in a position close to vertical provides large cross-section area of outflow through the smoke opening, whereas inclining the pivot sash towards the roof slope results in guiding the wind stream pressing against this sash upwards, causing the effect of exhausting the smoke out of the building.
The pivot hinge in its another variant is a hinge with a constant, true axis of revolution. It is mounted in extension arms installed in the window frame and in the pivot sash, protruding over the outer side of the glazing surface from the both window units.

At least one pivot sash is motorized, advantageously remote controlled, in particular with fire signaling sensors, especially smoke sensors. In particular, an actuator, especially electric one, is an executive member of the drive, cooperating directly with the window sash, advantageously there are two actuators at both side sections of the sash frame.

In the first variant of the window sash drive, also the lower sash is motorized, in particular with an actuator, especially an electric one, or more advantageously with two such actuators. If a hazard signal is obtained from the fire alarm installation, in particular a signal from a smoke sensor, drive actuators set the pivot sash in an approximately vertical position, possibly inclined towards the roof slope, and the lower sash is set by its drive actuators in the position of the maximum opening.

The window sash drive control system, apart from automatic activation in emergencies, allows also to set in motion at least the pivot sash in the regular window operation, to provide ventilation in the rooms where the window is installed. Electric terminals are used for control, they are situated in a place convenient to access for everybody or for authorised persons only.

When in regular operation of the roof window both sashes are being opened, the actuators of the pivot sash and the lower sash are controlled independently, with the option of setting these sashes in any positions in the range of their opening angles. The control system is fitted with interlocks, preventing the sashes from being put in a disadvantageous set of positions. One of the interlocks in the control system prevents the lower sash from being put in motion when the pivot sash is in a position overlapping with its overlap part the movement zone of the lower sash. Only opening of the pivot sash by a wider angle enables the lower sash drive to be turned on. This interlock prevents overloading of the lower sash drive, which could occur if this drive put both sashes in motion. The other interlock prevents closing
of the pivot sash when the lower sash is open, even by a small angle. It ensures correct closing of the window, thus preventing it from being left in a position, which could allow rainwater to penetrate through a not fully closed window inside the room.

When the lower sash is used only for smoke extraction in an emergency, and in the regular operation only the pivot sash of roof window opens, only the actuator(s) of the sash windows is started. This control enables the pivot sash motion to be stopped in any position within its opening angles. This control variant is simpler as it does not require interlocks as in the case of both sashes movement in the regular window operation.

In the second roof window sash drive variant, to open the window for smoke removal, during emergency opening the lower sash is driven by accumulated potential energy, advantageously in a spring. The lower sash is kept in the closed position with a bolt, release of which is tripped by a signal from fire sensors, in particular smoke sensors. In this window drive variant only the pivot sash is opened with electric actuators, both for smoke removal and regular operation.

An advantageous effect of application of the invention is ensuring of smoke extraction efficiency in an emergency, and at the same time maintaining the regular roof window function for room illumination and ventilation.

The subject matter of the invention is shown in the embodiment example in the picture, where the individual figures present:
Fig. 1 - window with segment side shields, fully open - in an axonomethc view;
Fig. 2 - window of figure 1 - in a side view;
Fig. 3 - fragment of the segment side shield - in an axonomethc view;
Fig. 4 - detail (from fig. 3) of the side shield upper segment end;
Fig. 5 - detail (from fig. 3) of the side shield segment connection;
Fig. 6 - window with uniform side shields, partially open - in the side view, with partial longitudinal section.
Example 1.

A roof window, installed in an inclined roof slope, has a window frame 1 and the main pivot sash 2, mounted in the upper window frame part. It has also additional lower sash 3 with two segment-type side shields 4, placed at the both sides of the lower sash. The pivot sash 2, having a frame 21, in which a glass pane 22 is mounted, is connected to the window frame 1 with hinges 23, situated in the central zone of pivot sash frame 21 side segments. The hinges are known from applications in pivot roof windows, where one subassembly of the hinge is equipped with an arched guide, secured with its fastening plate to the window frame inner surface, and the second hinge subassembly with an arched slide coming into the guide is secured with its fastening plate to the side segment of the sash frame.

The arched slide is connected to the fastening plate with an axle, which enables additional turn of the plate, and the pivot sash along, after the maximum come out of the slide from the guide. In the position of pivot sash 2, shown in the picture - fig. 1 and 2, in which the pivot sash 2, after passing by the vertical plane "V" is inclined towards the window slope, the maximum come out of the slide and an additional turn of the hinge around its axle are utilized. In this position, the pivot sash part that in the closed window cooperates with the lower sash is up. This part of the pivot sash is fitted with a cover plate 24, which in the closed window overlaps the lower sash 3 and rain water from the pivot sash falls down onto the lower sash over this cover plate.

The lower sash 3 of the roof window, having sash frame 31, in which a glass pane 32 is mounted, connected with hinges to the lower section of the window frame 1, is opened as a turn window. Following the lower sash opening the fan-type side shields 4 unfold. Each shield consists of overlapping segments 41. The top segments are secured to the side sections of the lower sash frame 31.

Segments 41 of the side shield 4, being narrow metal strips situated in a vertical plane, are mounted on a common axle 42, near the hinges of the window lower sash 3. Each segment on its whole length has a bending of its lower edge forming a shelf 43, perpendicular to the main surface of the segment 41. On the opposite
side to the axle 42, each segment is ended with a reinforcing bend 44, which in the upper part of the segment 41 is extended parallel to the longer side of this segment and bent out twice, resulting in a guiding tongue 45, forming a forked bracket along with the main surface of the segment 41. In the segment set of the side shield 4, each consecutive segment 41 is shorter than the adjusting segment situated below, in addition the difference in length of adjacent segments is slightly larger than the bend 44 width. As a result the guiding tongue 45 of the shield segment located below embraces the bend 44 of the segment located above it. When the fan-type side shield segments are unfolded, the guiding tongue 45 cooperates with the lower section of the reinforcing bend 44 of the segment located above, at the maximum unfolding resting against the shelf 43 of this segment. When the fan-type side shield is folded, the guiding tongue 45 cooperates with the upper section of the bend 44 of the segment located above, and the shelves 43 of the both segments at their maximum folding adjoin. When the lower sash 3 is closed, the segments 41 of the side shield are accommodated in the cassette 46 open from the lower sash side.

The pivot sash 2 and the lower sash 3 of the roof window are driven by electric actuators 5, two for each sash, installed in an articulated way in central holders 51 and lower holders 52, mounted in the window frame 1. In all four actuators 5 pull rods 53 coming out of their cylinders are connected in an articulated way to the side sections of the window sash frames, driven by these actuators. The pitch of actuators driving the lower sash, in connection with the number of segments of the side shields and their range of unfolding is selected so that at the maximum opening of the window lower sash the clearances between the side shield segments are eliminated and the shield is slightly stretched, which makes it more stiff and more resistant to side gusts of wind.

Example 2.
A roof window, installed in an inclined roof slope, has a window frame 1 and the main pivot sash 2, mounted in the upper window frame part, identical as in the first embodiment example. It has also an additional lower sash 3 with two uniform side shields 6, situated on the both sides of the lower sash. The uniform shield 6 has the form of a mobile wall, secured perpendicularly to the lower sash 3, and when
the lower sash is closed or even partially open the shield is let inside the room through the inside of the window frame.

To hold the uniform shield 6 close to the side section of the window frame 1, stops 61 in the form of a flat bar parallel to the side section of the window frame are placed inside the shield. The stop is secured with its one end to the lower section 11 of the window frame, whereas the other end of the stop 61 is bent out at a straight angle twice, but towards the opposite direction, forming the end holder 62, which secures the stop 61 to the side section 12 of the window frame. When the lower sash 3 moves, the uniform shield 6 shifts in a gap formed between the stop 61 and the side section 12 of the window frame. The stop 61 has also a pivot 63, which has its axis parallel to the lower section 11 of the window frame and the lever 7 with the spring 71 is mounted on the pivot. The lever drives the lower sash. When the lower sash 3 is closed, it is supported by the bolt 8, which in an emergency is loosened after a fire sensor signal is received, in particular a smoke sensor, enabling opening of the lower sash 3 under the influence of the spring 71.
Claims

1. Roof window, in particular a smoke extraction window, with a pivot sash, to be installed in inclined roof slopes, for providing daylight to passageways in buildings and for their ventilation, including smoke extraction of the building inside in case of fire, having a window frame and a pivot sash installed in the window frame, opened and closed by a turn around a horizontal axis situated in the central zone of the sash that is mounted in the window frame with hinges connecting the side section of the sash frame to the side section of the window frame, with a motor drive of the sash, advantageously remote controlled, in particular with fire signalization sensors, in particular smoke sensors, characterized in that it has a lower sash (3) mounted in the common window frame (1) with the main pivot sash (2), situated in the upper part of this window frame, in addition the lower sash is opened as a tilt window turning around its horizontal axis of rotation situated at its bottom and the window is fitted with side shields (4, 6) filling the space between the lower sash (3) and the window frame (1) in all stages of this window opening.

2. Window as claimed in claim 1 characterized in that the side shield (4) comprises a set of segments (41), advantageously made of a heat resistant material, fan-type overlapping, unfolded when the window lower sash is being opened and let inside the window frame (1) when the lower sash (3) is closed.

3. Window as claimed in claim 1 characterized in that the side shield (4) comprises a set of segments, advantageously made of a heat resistant material, connected to each other in an articulated way and opening out like a concertina when the window lower sash is being opened and let inside the window frame when the lower sash is closed.

4. Window as claimed in claim 1 characterised in that the side shield (4) is a uniform movable wall (6), advantageously made of a heat resistant material, which when the lower sash (3) is closed, is let inside the room through inside of the window frame (1).
5. Window sash as claimed in claim 1 or 2 or 3 or 4 characterized in that when the window is closed, the pivot sash (2) overlaps the lower sash (3), and the lower section of the pivot sash frame (21) rests against the upper part of the lower sash.

6. Window as claimed in claim 1 or 2 or 3 or 4 or 5, characterized in that it has a glass pane (32) in the lower sash (3).

7. Window as claimed in claim 1 or 2 or 3 or 4 or 5 or 6 characterized in that at least the pivot sash (2) while being opened or closed is driven directly by at least one actuator (5), advantageously an electric one, which in emergency is controlled by fire sensors, in particular smoke sensors and in addition in emergency the pivot sash (2) is set in an approximately vertical position, and the lower sash (3) is set in the maximum opening position.

8. Window as claimed in claim 7 characterized in that when opened in emergency, the pivot sash (2) is deviated from the perpendicular ("V") towards the roof slope.

9. Window as claimed in claim 7 or 8 characterized in that the pivot sash (2) as well as the lower sash (3) while being opened or closed are driven directly by actuators (5).

10. Window as claimed in claim 9 characterized in that in its regular operation the actuators (5) of the pivot sash (2) and the lower sash (3) are controlled independently of each other, with a possibility of setting them in any positions of the range of their angles of opening, in addition it is advantageous when the control system of the sash movement has interlocks preventing the lower sash (3) from being opened in these positions of the pivot sash (2) where its members are in the lower sash movement zone, as well as preventing the pivot sash (2) from being closed when the lower sash is open (3).

11. Window as claimed in claim 7 or 8 characterized in that the lower sash (3) during its emergency opening is driven by accumulated potential energy, advantageously in a spring (71), which is tripped by a signal coming from fire sensors, in particular smoke sensors.
12. Window as claimed in claim 7 or 8 or 11 characterized in that in its regular operation only the actuators (5) of the pivot sash (2) are controlled, with a possibility of setting this sash in any position within its range of angles of opening.

13. Window as claimed in claim 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 characterized in that in the hinge (23) of the pivot sash (2), one subassembly of the hinge has an arched guide and the other one, advantageously secured with its fastening plate to the sash frame, has an arched slide placed in this guide, in addition centres of curvature of the guide and the slide are points on the theoretical axis of rotation of the hinge, situated at the outer side of the glazing plane.

14. Window as claimed in claim 13 characterized in that the arched slide is connected to the fastening plate with an axle enabling additional turn of the window after the maximum come out of the slide from the guide.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. E04D13/03 E04D13/035 F24F7/02

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)
E04D F24F

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C

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Date of actual completion of the international search: 23 February 2010
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