

DESCRIPTION

VENTILATION DEVICE FOR SWITCH GEAR

5 TECHNICAL FIELD

[0001] An embodiment of the present invention relates generally to a ventilation device for a switchgear.

BACKGROUND ART

10 [0002] Conventionally, switchgear ventilation devices including support members and louvers supported by the support member are known.

CITATION LIST

15 Patent Literature

[0003] Patent Document 1: JP 2016-116429 A

SUMMARY OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

20 [0004] It is preferable to provide a switchgear ventilation device with a novel structure easy to assemble, for example.

MEANS FOR SOLVING PROBLEM

25 [0005] According to one embodiment, in general, a ventilation device for a switchgear includes a pair of support members and a louver. The support member pair is aligned with spacing and is joined to a housing. The louver is located between the support member pair, to open
30 and close an opening in the housing. One of the support member pair and both ends of the louver in an aligning direction of the support members is provided with protrusions that protrude in the aligning direction. The

other of the support member pair and both the ends is provided with holes into which the protrusions are fitted, and tubular faces facing the holes. The support member pair supports the louver while the protrusions and the
5 tubular faces are engaged with each other.

BRIEF DESCRIPTION OF DRAWINGS

[0006] FIG. 1 is an exemplary and schematic perspective view of a switchgear in an embodiment;

10 FIG. 2 is an exemplary and schematic front view of a ventilation device of a switchgear in the embodiment;

FIG. 3 is an exemplary and schematic plan view of the ventilation device of the switchgear in the embodiment;

FIG. 4 is an exemplary and schematic cross-sectional
15 view of part of a housing of the switchgear and the ventilation device in the embodiment, with louvers placed in an open posture;

FIG. 5 is an exemplary and schematic cross-sectional
view of part of the housing of the switchgear and the
20 ventilation device in the embodiment, with the louvers placed in a closed posture;

FIG. 6 is an exemplary and schematic perspective view of one of a support member pair in the embodiment;

FIG. 7 is an exemplary and schematic perspective view
25 of the other support member in an embodiment;

FIG. 8 is an exemplary and schematic front view of a louver in the embodiment; and

FIG. 9 is an exemplary and schematic plan view of the louver in the embodiment.

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DESCRIPTION OF EMBODIMENTS

[0007] Hereinafter, an exemplary embodiment of the present invention will be described. Configurations of the

embodiment described below and actions and results (effects) achieved by the configurations are merely exemplary. In the accompanying drawings, for convenience sake, three mutually orthogonal directions are defined. An X direction is along the length of a housing 2, a Y direction is along the width of the housing 2, and a Z direction is along the height of the housing 2.

[0008] As illustrated in FIG. 1, a switchgear 1 includes the housing 2 and a ventilation device 3. The switchgear 1 is referred to as a metal-enclosed switchgear including the housing 2 made from metal and a breaker and a protective relay housed in the housing 2. The housing 2 contains, for example, an incoming panel including a breaker and an instrument transformer to mainly receive power, a feeder panel from which a load supply cable is drawn via the breaker, a current transformer, and a zero-phase current transformer, and a bus tie that isolates a main busbar for each route with the breaker. The switchgear 1 is installed in, for example, an electric room of a building, for example. The housing 2 can also be referred to as a panel or an enclosed box, for example.

[0009] The housing 2 has, for example, a flat rectangular parallelepiped box shape having a short side in the Y direction. The housing 2 includes walls 2a to 2f. The wall 2a and the wall 2b both extend in a direction orthogonal to the Z direction (XY plane) and are spaced apart from each other in parallel in the Z direction. The wall 2a can also be referred to as a top wall or upper wall, and the wall 2b can also be referred to as a bottom wall or lower wall, for instance.

[0010] The wall 2c and the wall 2e both extend in a direction orthogonal to the X direction (YZ plane) and are spaced apart from each other in parallel in the X direction.

The wall 2d and the wall 2f both extend in a direction orthogonal to the Y direction (XZ plane) and are spaced apart from each other in parallel in the Y direction. The wall 2c can also be referred to as a front wall, and the wall 2e can also be referred to as a back wall. The walls 2c to 2f can also be referred to as side walls or surrounding walls.

[0011] The housing 2 is provided with a work opening (not illustrated) in the X direction. The opening is covered by a door 8 illustrated in FIG. 1 to be openable and closable. The door 8 forms at least part of the wall 2c. Hereinafter, directions of the elements of the switchgear 1 are the ones while the door 8 is closed, unless otherwise stated. The door 8 is rotatably supported by the housing 2 via a hinge having a rotary shaft extending along an end 8a (Z direction) of the door 8 in the opposite direction of the Y direction. The door 8 rotates around the rotary shaft and is therefore movable between a closed position to close the opening (FIG. 1) and an open position to open the opening (not illustrated).

[0012] The housing 2 includes an operation unit 9 at a Y-directional end 8b of the door 8. The operation unit 9 includes a lever 9a rotatable around a rotary shaft extending in the X direction. For example, the lever 9a faces downward in the Z direction at the closed position (FIG. 1) and faces laterally in the Y direction at the open position. The lever 9a can also be referred to as a handle, doorknob, or grip.

[0013] The door 8 is also provided with an opening 8c. The opening 8c is a through hole penetrating the door 8 in the X direction. The opening 8c has a rectangular shape, as viewed in the X direction. The opening 8c communicates with, for example, a chamber in which instruments serving

as main circuitry of the switchgear 1 such as a breaker is placed. The opening 8c can also be referred to as a ventilation hole.

[0014] The ventilation device 3 is housed in the housing 2 and is attached to an inner surface 8d (FIG. 4) of the door 8 while covering the opening 8c in openable and closable manner.

[0015] As illustrated in FIGS. 2 to 5, the ventilation device 3 includes a pair of support members 11, a plurality of louvers 12, and a pair of occluding members 13.

[0016] As illustrated in FIG. 2, the support member pair 11 are aligned with spacing in the Z direction. The support member pair 11 is joined (fixed) to the inner surface 8d (FIG. 4) of the door 8 with fasteners such as screws. In the following, an upper support member 11 (one) of the support member pair 11 may be referred to as support member 11A, and a lower support member (the other) of the support members pair 11 may be referred to as support member 11B. The support member 11A is placed at the top edge of the opening 8c of the door 8, while the support member 11B is placed at the bottom edge of the opening 8c of the door 8. The support member 11A and the support member 11B are symmetric to the XY plane (not illustrated) located in-between them.

[0017] As illustrated in FIGS. 6 and 7, each of the support members 11 includes two walls 11a and 11b and has a substantially L-shape, as viewed in the Y direction. The walls 11a and 11b can also be referred to as plates.

[0018] The walls 11a and 11b are in a strip form with a long side extending in an aligning direction D1 (FIG. 2) of the support member pair 11. Specifically, the walls 11a and 11b both have a strip shape with a long side extending along the width of the housing 2, i.e., in the Y direction.

The wall 11a extends along the inner surface 8d of the door 8. The wall 11a is placed on the inner surface 8d of the door 8 and joined to the door 8. The wall 11b extends from an end of the wall 11a in a direction away from the inner
5 surface 8d of the door 8, i.e., toward inside of the housing 2. Specifically, in the support member 11A, the wall 11b extends from the bottom end of the wall 11a while in the support member 11B, the wall 11b extends from the top end of the wall 11a.

10 [0019] The wall 11b is provided with a plurality of holes 11c. The holes 11c is aligned with spacing in a cross direction D2 crossing the aligning direction D1 of the support member pair 11. In this embodiment, the cross direction D2 is along the length of the wall 11b, i.e., in
15 the Y direction. Each hole 11c is a through hole penetrating the wall 11b along the thickness, i.e., in the Z direction. The holes 11c have a rectangular (polygonal) cross section orthogonal to the axis of the holes. That is, the holes 11c have a rectangular shape, as viewed in the
20 aligning direction D1. In the wall 11b, each hole 11c is provided with a tubular face 11d facing the hole 11c. Thus, the tubular faces 11d are arranged with spacing in the cross direction D2 crossing the aligning direction D1 of the support member pair 11. Each tubular face 11d has a
25 rectangular (polygonal) cross section orthogonal to the axis of the tube. That is, the tubular face 11d has a rectangular shape, as viewed in the aligning direction D1. The hole 11c and the tubular face 11d are provided for each louver 12. The hole 11c and the tubular face 11d may have
30 another shape. For example, the hole 11c and the tubular face 11d may have a polygonal shape other than a rectangular shape, as viewed in the aligning direction D1.
[0020] As illustrated in FIGS. 2, 4, and 5, the louvers

12 are juxtaposed to each other in the cross direction D2 crossing the aligning direction D1 of the support member pair 11. The louvers 12 are located between the support member pair 11 to open and close the opening 8c of the housing 2. The respective louvers 12 are supported by the support member pair 11 to be changeable in posture between an open posture (FIG. 4) to open the opening 8c and a closed posture (FIG. 5) to close (cover) the opening 8c.

[0021] As illustrated in FIGS. 8 and 9, the louver 12 includes both ends 12a and 12b in the cross direction D2, a plate-like part 12c, extensions 12d and 12e, and protrusions 12f and 12g.

[0022] The plate-like part 12c is located between both ends 12a and 12b, extending in the aligning direction D1 (Z direction). That is, the plate-like part 12c includes at least part of both ends 12a and 12b. The plate-like part 12c also extends in the cross direction D2 (Y direction). The plate-like part 12c has a folded shape. The plate-like part 12c has a thickness of, for example, approximately 2 mm. The respective parts of the louver 12 may have a thickness of approximately 2 mm. The plate-like part 12c and the louver 12 may have a different thickness.

[0023] The extensions 12d and 12e are located at both ends 12a and 12b. The extensions 12d and 12e extend from the end of the plate-like part 12c in the opposite direction of the Y direction.

[0024] The protrusions 12f and 12g are located at both ends 12a and 12b. The protrusions 12f and 12g protrude from the extensions 12d and 12e in the aligning direction D1. Specifically, the protrusion 12f protrudes in the Z direction from an end of the extension 12d in the opposite direction of the Y direction. The protrusion 12g protrudes in an opposite direction of the Z direction from an end of

the extension 12e in the opposite direction of the Y direction. The protrusions 12f and 12g have rectangular (polygonal) cross sections orthogonal to the protruding directions. That is, the protrusions 12f and 12g have a rectangular shape, as viewed in the aligning direction D1.

5 [0025] The protrusions 12f and 12g are fitted into the holes 11c of the support member pair 11. Specifically, the protrusion 12f is fitted into the hole 11c of the support member 11A (FIG. 4) while the protrusion 12g is fitted into
10 the hole 11c of the support member 11B. The protrusions 12f and 12g and the tubular faces 11d are engaged with each other. In this state, the tubular faces 11d work to lock the rotation of the protrusions 12f and 12g and the louver 12 with respect to the support member pair 11. Then, the
15 louver 12 is supported by the support member pair 11A and 11B in this state.

[0026] As is seen from FIGS. 2 to 5, the occluding member pair 13 is located between two of the louvers 12 at ends (both ends) in the cross direction D2 and the door 8
20 (housing 2) to close the spaces between the louvers 12 and the door 8. The occluding members 13 have a plate shape. Each occluding member 13 includes a plurality of plate members 13a placed on top of each other and joined together. The occluding members 13 are joined (fixed) to the inner
25 surface 8d of the door 8 with fasteners such as screws.

[0027] In the above structure, while the switchgear 1 is in normal operation, each louver 12 of the ventilation device 3 is in an open posture (FIG. 4). A gap S
(ventiduct) between the adjacent louvers 12 communicates
30 with the opening 8c of the door 8. In this state, air is ventilated in the housing 2 or heat is emitted to the outside of the housing 2 through the gap S between the adjacent louvers 12. Meanwhile, along with increase in

pressure inside the housing 2 due to a high temperature or high-pressure gas caused by occurrence of anomaly, the plate-like parts 12c of the louvers 12 are deformed to eliminate the gap S, i.e., approaching the opening 8c. By the deformation, each louver 12 comes in contact with the adjacent louver 12 or the occluding member 13 and overlaps the adjacent louver 12 or the occluding member 13 (FIG. 5). Thereby, the opening 8c is closed by all the louvers 12. As described above, according to this embodiment, the two adjacent louvers 12 are deformed along with an increase in the pressure in the housing 2 and contact and overlap with each other (FIG. 5). This restrains generated gas from being emitted through the opening 8c to outside the housing 2.

[0028] Next, an assembling method (attaching method) of the ventilation device 3 will be described. First, an operator inserts the protrusions 12f and 12g of the louvers 12 into the holes c in the support member pair 11 to hold the louvers 12 in-between the support member pair 11. Then, the support member pair 11 holding the louvers 12 is joined to the door 8 with fasteners. The occluding members 13 are joined to the door 8 with fasteners. The support member pair 11 may be joined to the door 8 with fasteners after the occluding members 13 are joined to the door 8. Such an assembling method requires no welding work, for example.

[0029] As described above, in this embodiment, the ventilation device 3 includes the support member pair 11 that is aligned with spacing and is joined to the housing 2, and the louvers 12 located between the support member pair 11 to open and close the opening 8c in the housing 2. One of the support member pair 11 and both ends 12a and 12b of the louvers 12 in the aligning direction D1 (e.g., both ends 12a and 12b of the louver 12) are provided with the

protrusions 12f and 12g. The other of the support member pair 11 and both ends 12a and 12b of the louvers 12 (e.g., the support member pair 11A and 11B) are provided with the holes 11c into which the protrusions 12f and 12g are fitted
5 and the tubular faces 11d facing the holes 11c. The support member pair 11A and 11B supports the louvers 12 while the protrusions 12f and 12g and the tubular faces 11d are being engaged with each other. Thus, according to this embodiment, for example, the louvers 12 are held in-between
10 the support member pair 11 with the protrusions 12f and 12g fitted into the holes 11c, so that the louvers 12 are supported by the support member pair 11 and prevented from falling from the support member pair 11. This facilitates the assembly of the ventilation device 3.

15 [0030] According to this embodiment, the protrusions 12f and 12g are fitted into the holes 11c, which enables accurate alignment of the louvers 12 with respect to the support member pair 11. This can make position adjustment of the louver 12 with respect to the support member pair 11
20 unnecessary.

[0031] According to this embodiment, the ventilation device 3 includes the louvers 12 aligned in the cross direction D2 crossing the aligning direction D1, and the occluding members 13 that occlude the space between the
25 housing 2 and the louvers 12 located at both ends in the cross direction D2. Thus, according to this embodiment, the occluding members 13 can work to restrain gas from flowing out through the space between the housing 2 and the louvers 12 at the ends in the cross direction D2, for
30 example.

[0032] According to this embodiment, the two adjacent louvers 12 are deformed along with increased pressure in the housing 2 to come in contact and overlap with each

other. Thus, according to this embodiment, for example, at the time of increase in the pressure inside the housing 2, it is possible to restrain gas from outflowing through the space between the adjacent louvers 12.

5 [0033] According to this embodiment, the thickness of the plate-like part 12c is set to, for example, approximately 2 mm. Thus, the plate-like part 12c is easily deformable along with an increase in pressure inside the housing 2.

10 [0034] This embodiment has described the example that each of the support member pair 11A and 11B is provided with the holes 11c and the tubular faces 11d and the louvers 12 are provided at both ends 12a and 12b with the protrusions 12f and 12g. However, the present invention is
15 not limited to such an example. That is, each of the support member pair 11A and 11B may be provided with the protrusions 12f and 12g, and the louvers 12 may be provided at both ends 12a and 12b with the holes 11c and the tubular faces 11d.

20 [0035] This embodiment has described the example that the ventilation device 3 is placed in the door 8, but the present invention is not limited to such an example. For example, the ventilation device 3 may be placed in another part of the housing 2 except for the door 8.

25 [0036] While certain embodiments of the present invention have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. These novel embodiments may be embodied in a variety of other forms, and various
30 omissions, substitutions and changes may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover these embodiments or modifications thereof as would

fall within the scope and spirit of the inventions. The present invention can also be implemented by configurations other than those disclosed in the embodiment and can attain various effects (including derivative effects) attainable
5 by the basic configurations (technical features). The specifications of each component (structure, type, direction, shape, size, length, width, thickness, height, number, arrangement, position, material, and the like) can be appropriately modified for implementation.

CLAIMS

1. A ventilation device for a switchgear, comprising:
a pair of support members that is aligned with spacing
and joined to a housing; and
5 a louver that is located between the support member
pair, to open and close an opening in the housing, wherein
one of the support member pair and both ends of the
louver in an aligning direction of the support members is
provided with protrusions that protrude in the aligning
10 direction;
the other of the support member pair and both the ends
is provided with holes into which the protrusions are
fitted, and tubular faces facing the holes; and
the support member pair supports the louver while the
15 protrusions and the tubular faces are engaged with each
other.
2. The ventilation device for a switchgear according to
claim 1, wherein
20 the louver comprises a plurality of louvers juxtaposed
in a cross direction crossing the aligning direction, the
ventilation device further comprising
an occluding member that occludes a space between one
of the louvers and the housing, the one of the louvers
25 located at an end in the cross direction.
3. The ventilation device for a switchgear according to
claim 1 or 2, wherein
the louver comprises a plurality of louvers juxtaposed
30 in a cross direction crossing the aligning direction; and
the two adjacent louvers are deformed along with an
increase in pressure inside the housing, to come in contact
and overlap with each other.