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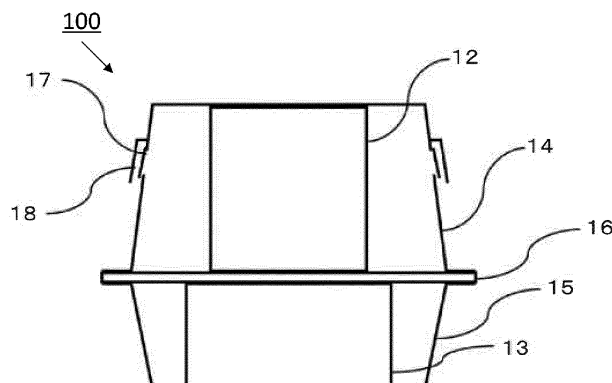
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(54) **AIR CIRCUIT BREAKER**

(57) Provided is an air circuit breaker having a drainage structure that enables water entering through a vent to be drained to outside without entering a current-interruption portion and can prevent water entry from outside. An air circuit breaker (100) includes: a current-interruption portion (13); an arc-extinguishing portion (12); an upper casing (14) having a vent (17) and storing the arc-extinguishing portion; a lower casing (15) storing the current-interruption portion; and an intermediate plate

(16). The intermediate plate has outer and inner peripheral walls (19) and (21) protruding toward the upper casing side. The outer peripheral wall has a slit (20) at least at one location. An outer peripheral side of the outer peripheral wall is covered by an outer edge portion of the upper casing. Inside of the upper casing and outside of the upper casing and the lower casing communicate with each other via the slit.

FIG.2



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to an air circuit breaker.

BACKGROUND ART

[0002] An air circuit breaker includes a current-interruption portion having a fixed element and a movable element for interrupting current, and an arc-extinguishing portion which extinguishes an arc generated between the fixed element and the movable element. The air circuit breaker is placed outdoors and therefore has a casing for preventing rain water, dust, or the like from entering the inside of a device. The casing is composed of an upper casing storing the arc-extinguishing portion, a lower casing storing the current-interruption portion, and an intermediate plate provided between the upper casing and the lower casing. In the air circuit breaker, hot gas is generated at the arc-extinguishing portion by heat of an arc generated between the movable element and the fixed element at the time of current interruption. The intermediate plate is provided for protecting the interruption portion from the hot gas. In addition, the upper casing has a vent for preventing increase in the internal pressure due to the hot gas. For preventing entry of a foreign material such as water or dust through the vent, the vent has a structure such as a labyrinth structure or a flapper structure.

[0003] However, even if the vent has a structure such as a labyrinth structure or a flapper structure, it is impossible to perfectly prevent entry of a foreign material such as water or dust through the vent. Accordingly, such a structure that a drainage hole is provided to an outer wall of a casing and water having entered through a vent is drained through the drainage hole to the outside, is disclosed (see, for example, Patent Document 1). In addition, such a structure that an inside wall is provided inside a vent and water having entered through the vent is drained downward inside a casing through a bottom surface between an outer wall of the casing and the inside wall, is disclosed (see, for example, Patent Document 2).

CITATION LIST

PATENT DOCUMENT

[0004]

Patent Document 1: Japanese Laid-Open Patent Publication No. 2004-129403

Patent Document 2: Japanese Laid-Open Utility Model Publication No. 4-111223

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005] However, in the structure in which the drainage hole is provided to the outer wall of the casing, the drainage hole is exposed to the outside, thus having a problem that a foreign material enters through the drainage hole. Meanwhile, in the structure in which water is drained downward inside the casing, water having entered cannot be drained to the outside, thus having a problem that water enters the current-interruption portion stored inside the lower casing.

[0006] The present disclosure has been made to solve the above problems, and an object of the present disclosure is to provide an air circuit breaker having a drainage structure that enables water having entered through a vent to be drained to the outside without letting the water enter a current-interruption portion, and can prevent entry of water from the outside.

MEANS TO SOLVE THE PROBLEM

[0007] An air circuit breaker according to the present disclosure includes: a current-interruption portion including a fixed element and a movable element; an arc-extinguishing portion which extinguishes an arc generated between the fixed element and the movable element; an upper casing having a vent and storing the arc-extinguishing portion; a lower casing storing the current-interruption portion; and an intermediate plate provided between the upper casing and the lower casing. The intermediate plate has an outer peripheral wall protruding toward the upper casing side, and an inner peripheral wall provided on an inner side of the outer peripheral wall so as to be opposed thereto. The outer peripheral wall has a slit at least at one location thereof. An outer peripheral side of the outer peripheral wall is covered by an outer edge portion of the upper casing. Inside of the upper casing and outside of the upper casing and the lower casing communicate with each other via the slit.

EFFECT OF THE INVENTION

[0008] In the air circuit breaker according to the present disclosure, the intermediate plate has the outer peripheral wall protruding toward the upper casing side and the inner peripheral wall provided on the inner side of the outer peripheral wall so as to be opposed thereto, the outer peripheral wall has the slit at least at one location thereof, the outer peripheral side of the outer peripheral wall is covered by the outer edge portion of the upper casing, and inside of the upper casing and outside of the upper casing and the lower casing communicate with each other via the slit. Thus, it becomes possible to drain water having entered through the vent, to the outside, without letting the water enter the current-interruption portion, and prevent entry of water from the outside.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

[FIG. 1] FIG. 1 is a schematic view showing a major part of an air circuit breaker according to embodiment 1.

[FIG. 2] FIG. 2 is a schematic sectional view showing the configuration of the air circuit breaker according to embodiment 1.

[FIG. 3] FIG. 3 is a perspective view showing an intermediate plate according to embodiment 1.

[FIG. 4] FIG. 4 is an enlarged top view of the intermediate plate according to embodiment 1.

[FIG. 5] FIG. 5 is an enlarged perspective view of the intermediate plate according to embodiment 1.

[FIG. 6] FIG. 6 is a sectional view of the air circuit breaker according to embodiment 1.

[FIG. 7] FIG. 7 is an enlarged sectional view of the air circuit breaker according to embodiment 1.

[FIG. 8] FIG. 8 illustrates drainage in the air circuit breaker according to embodiment 1.

[FIG. 9] FIG. 9 is an enlarged sectional view of an air circuit breaker according to embodiment 2.

[FIG. 10] FIG. 10 is an enlarged sectional view of an air circuit breaker according to embodiment 3.

DESCRIPTION OF EMBODIMENTS

[0010] Hereinafter, an air circuit breaker according to embodiments for carrying out the present disclosure will be described in detail with reference to the drawings. In the drawings, the same reference characters denote the same or corresponding parts.

Embodiment 1

[0011] FIG. 1 is a schematic view showing a major part of an air circuit breaker according to embodiment 1. FIG. 1 shows a state in which contacts of an air circuit breaker 100 are closed. The air circuit breaker 100 includes a fixed element 3 composed of a fixed contact 1 and a fixed-contact metal base 2, and a movable element 6 composed of a movable contact 4 and a movable-contact metal base 5. An upper conductor 8 is electrically connected to the fixed element 3, and a lower conductor 9 is electrically connected to the movable element 6. In a closed state, the movable element 6 is moved to the fixed element 3 side by an actuator 7 so that the movable contact 4 is in contact with the fixed contact 1. Current is flowing through the upper conductor 8, the fixed element 3, the movable element 6, and the lower conductor 9.

[0012] A current detector 10 is provided to the lower conductor 9. When fault current exceeding the rated current flows in the air circuit breaker 100, the current detector 10 detects the fault current. When the fault current is detected by the current detector, a latch 11 holding the movable element 6 is released, so that the movable el-

ement 6 is separated from the fixed element 3. Thus, opening operation is executed in the air circuit breaker 100. The fixed element 3, the movable element 6, the actuator 7, the upper conductor 8, the lower conductor 9, the current detector 10, and the latch 11 compose a current-interruption portion 13.

[0013] When opening operation is performed in the air circuit breaker 100, an arc is generated between the fixed contact 1 and the movable contact 4. The arc is elongated toward an arc-extinguishing portion 12. The arc-extinguishing portion 12 includes a plurality of arc-extinguishing plates 12a, and the arc elongated to the inside of the arc-extinguishing portion 12 is divided by the plurality of arc-extinguishing plates 12a, so that the arc voltage increases. In the air circuit breaker 100, when the arc voltage increases to power supply voltage of the circuit or higher, the current is interrupted.

[0014] FIG. 2 is a schematic sectional showing the configuration of the air circuit breaker according to the present embodiment. In FIG. 2, the detailed configurations of the arc-extinguishing portion 12 and the current-interruption portion 13, which are a major part of the air circuit breaker 100, are not shown. In the air circuit breaker 100, for preventing entry of a foreign material such as rain or dust, the arc-extinguishing portion 12 and the current-interruption portion 13 are stored inside a casing. The air circuit breaker 100 of the present embodiment includes an upper casing 14 storing the arc-extinguishing portion 12, a lower casing 15 storing the current-interruption portion 13, and an intermediate plate 16 provided between the upper casing 14 and the lower casing 15. The upper casing 14 is located vertically above the lower casing 15. The upper casing 14, the lower casing 15, and the intermediate plate 16 are made of materials such as resin having an insulation property, for example. Since an arc generated between the fixed contact 1 and the movable contact 4 has a high temperature, metal, resin, and the like forming the arc-extinguishing portion 12 are melted and vaporized to generate hot gas. Due to generation of hot gas, the gas pressure in the upper casing 14 increases. For preventing damage to the upper casing 14 or the like due to increase in the gas pressure, a vent 17 is provided at a side surface of the upper casing 14. For preventing entry of rain, dust, or the like from the outside, a flapper 18 is provided on the outer side of the vent 17. The flapper 18 is formed by a flexible insulation sheet, for example. The flapper 18 normally closes the vent 17 and serves as a pressure relief device that opens the vent 17 only when the gas pressure inside the upper casing 14 increases. The intermediate plate 16 is provided for protecting the current-interruption portion 13 from hot gas.

[0015] However, the flapper 18 cannot perfectly prevent entry of a foreign material from the outside. For example, entry of water through a gap at a connection part of the flapper 18 or entry of rain, mist, or the like by wind blowing up from a lower side, cannot be perfectly prevented. The air circuit breaker of the present embodiment

enables water having entered through the vent to be drained to the outside without letting the water enter the current-interruption portion.

[0016] FIG. 3 is a perspective view of the intermediate plate of the air circuit breaker according to the present embodiment. The intermediate plate 16 of the present embodiment has a rectangular shape of which the short-side length is about 40 cm and the long-side length is about 70 cm. The intermediate plate 16 has an outer peripheral wall 19 protruding from the outer peripheral edge toward the upper casing side, and an inner peripheral wall 21 provided on the inner side of the outer peripheral wall 19 so as to be opposed to the outer peripheral wall 19. The wall thicknesses of the outer peripheral wall 19 and the inner peripheral wall 21 are about 6 mm, the wall height of the outer peripheral wall 19 is about 5 mm, and the wall height of the inner peripheral wall 21 is about 15 mm. The outer peripheral wall 19 has slits 20 provided at two locations on each side. FIG. 4 is an enlarged top view of the intermediate plate at a part where the slit is provided. FIG. 5 is an enlarged perspective view of the intermediate plate at the part where the slit is provided. As shown in FIG. 4 and FIG. 5, the outer peripheral wall 19 has the slit 20 formed by cutting a part of the outer peripheral wall 19. The slit 20 is formed such that an upper part of the outer peripheral wall 19 and a side wall on the outer peripheral side are cut. In the air circuit breaker of the present embodiment, a transverse width 22 of the slit 20 is about 8 mm and a depth 23 on the outer peripheral side of the slit 20 is about 3 mm. The sizes of the outer peripheral wall 19 and the inner peripheral wall 21, and the number and the sizes of the slits 20 can be arbitrarily set in accordance with the size of the casing, an assumed amount of entering water, and the like.

[0017] FIG. 6 is a sectional view of the air circuit breaker according to the present embodiment. In FIG. 6, the arc-extinguishing portion and the current-interruption portion, which are a major part of the air circuit breaker 100, are not shown. Also, the flapper is not shown. FIG. 7 is an enlarged sectional view of a slit part of the intermediate plate. As shown in FIG. 7, the outer peripheral side of the outer peripheral wall 19 of the intermediate plate 16 is covered by an outer edge portion at a lower part of the upper casing 14. Thus, a space enclosed by the upper casing 14 and the intermediate plate 16 is sealed by the outer edge portion at the lower part of the upper casing 14 and the outer peripheral wall 19, but the inside of the upper casing 14 and the outside of the upper casing 14 and the lower casing 15 communicate with each other via the slit 20. The outer size of an outer edge portion at an upper part of the lower casing 15 is approximately equal to the outer size of the outer edge portion at the lower part of the upper casing 14. The outer edge portion at the upper part of the lower casing 15 has a cutout 24. The cutout 24 further ensures communication between the inside and the outside of the upper casing 14 via the slit 20.

[0018] Next, drainage in the air circuit breaker of the

present embodiment will be described. FIG. 8 illustrates an action of drainage. Water having entered through the vent of the upper casing 14 drops to the intermediate plate 16 along the inner side of the upper casing 14 as shown by an arrow 25. The water dropped to the intermediate plate 16 is temporarily accumulated in a water-receiving portion 26 on a surface of the intermediate plate 16 between the outer peripheral wall 19 and the inner peripheral wall 21 of the intermediate plate 16. The water accumulated in the water-receiving portion 26 is drained through the slit 20 and the cutout 24 to the outside of the upper casing 14 and the lower casing 15, as shown by an arrow 27.

[0019] The air circuit breaker configured as described above enables water having entered from the vent to be drained to the outside without letting the water enter the current-interruption portion. In addition, since the outer peripheral side of the outer peripheral wall of the intermediate plate where the slit is provided is covered by the outer edge portion of the upper casing, entry of water into the slit from the outside can be prevented.

[0020] In the air circuit breaker of the present embodiment, the outer size of the outer edge portion at the upper part of the lower casing is approximately equal to the outer size of the outer edge portion at the lower part of the upper casing, and the outer edge portion at the upper part of the lower casing has the cutout. If the outer size of the outer edge portion at the upper part of the lower casing is set to be smaller than the outer size of the outer edge portion at the lower part of the upper casing, water accumulated in the water-receiving portion is drained through the slit to the outside without the cutout.

Embodiment 2

[0021] FIG. 9 is an enlarged sectional view of an air circuit breaker according to embodiment 2. The configuration of the air circuit breaker in the present embodiment is the same as the configuration of the air circuit breaker in embodiment 1. In the present embodiment, the structure of the intermediate plate is different from that in embodiment 1.

[0022] As shown in FIG. 9, the intermediate plate 16 in the present embodiment is formed with the surface of the water-receiving portion 26 sloped. The water-receiving portion 26 descends toward the outer peripheral wall 19 side.

[0023] In the air circuit breaker configured as described above, water temporarily accumulated in the water-receiving portion 26 moves to the slit side along the slope, whereby the water can be efficiently drained. Thus, the air circuit breaker has improved reliability even in a case where a large amount of water enters.

Embodiment 3

[0024] FIG. 10 is an enlarged sectional view of an air circuit breaker according to embodiment 3. The config-

uration of the air circuit breaker in the present embodiment is the same as the configuration of the air circuit breaker in embodiment 1. In the present embodiment, the structure of the lower casing is different from that in embodiment 1.

[0025] As shown in FIG. 10, the lower casing 15 in the present embodiment has a protrusion 28 protruding toward the intermediate plate 16 side, on the inner side of the outer edge portion at the upper part. A distal end of the protrusion 28 contacts with a surface of the intermediate plate 16.

[0026] In the air circuit breaker configured as described above, even if water drained through the slit to the outside enters the inside of the lower casing 15 through a gap between connection surfaces of the intermediate plate 16 and the lower casing 15, the entry of water can be prevented by the protrusion 28. Thus, entry of water into the current-interruption portion stored inside the lower casing can be prevented, whereby reliability of the air circuit breaker is improved.

[0027] Although the disclosure is described above in terms of various exemplary embodiments and implementations, it should be understood that the various features, aspects, and functionality described in one or more of the individual embodiments are not limited in their applicability to the particular embodiment with which they are described, but instead can be applied, alone or in various combinations to one or more of the embodiments of the disclosure.

[0028] It is therefore understood that numerous modifications which have not been exemplified can be devised without departing from the scope of the present disclosure. For example, at least one of the constituent components may be modified, added, or eliminated. At least one of the constituent components mentioned in at least one of the preferred embodiments may be selected and combined with the constituent components mentioned in another preferred embodiment.

DESCRIPTION OF THE REFERENCE CHARACTERS

[0029]

- 1 fixed contact
- 2 fixed-contact metal base
- 3 fixed element
- 4 movable contact
- 5 movable-contact metal base
- 6 movable element
- 7 actuator
- 8 upper conductor
- 9 lower conductor
- 10 current detector
- 11 latch
- 12 arc-extinguishing portion
- 12a arc-extinguishing plate
- 13 current-interruption portion
- 14 upper casing

- 15 lower casing
- 16 intermediate plate
- 17 vent
- 18 flapper
- 5 19 outer peripheral wall
- 20 slit
- 21 inner peripheral wall
- 24 cutout
- 26 water-receiving portion
- 10 28 protrusion

Claims

- 15 1. An air circuit breaker comprising:
 - a current-interruption portion including a fixed element and a movable element;
 - an arc-extinguishing portion which extinguishes an arc generated between the fixed element and the movable element;
 - an upper casing having a vent and storing the arc-extinguishing portion;
 - a lower casing storing the current-interruption portion; and
 - 25 an intermediate plate provided between the upper casing and the lower casing, wherein the intermediate plate has an outer peripheral wall protruding toward the upper casing side, and an inner peripheral wall provided on an inner side of the outer peripheral wall so as to be opposed thereto,
 - 30 the outer peripheral wall has a slit at least at one location thereof,
 - 35 an outer peripheral side of the outer peripheral wall is covered by an outer edge portion of the upper casing, and
 - inside of the upper casing and outside of the upper casing and the lower casing communicate with each other via the slit.
- 40 2. The air circuit breaker according to claim 1, wherein
 - 45 a surface of the intermediate plate between the outer peripheral wall and the inner peripheral wall descends toward the outer peripheral wall side.
- 50 3. The air circuit breaker according to claim 1 or 2, wherein
 - the lower casing has, on an inner side of an outer edge portion thereof, a protrusion protruding toward the intermediate plate side, and
 - 55 a distal end of the protrusion contacts with a surface of the intermediate plate.

FIG.1

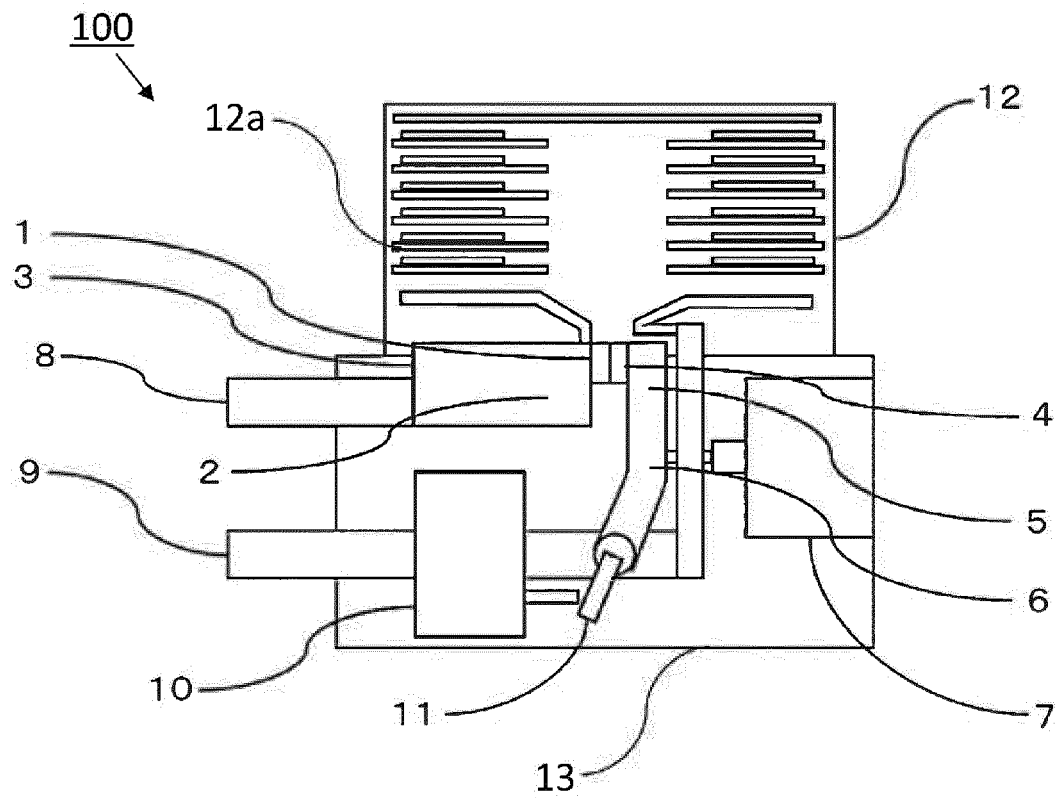


FIG.2

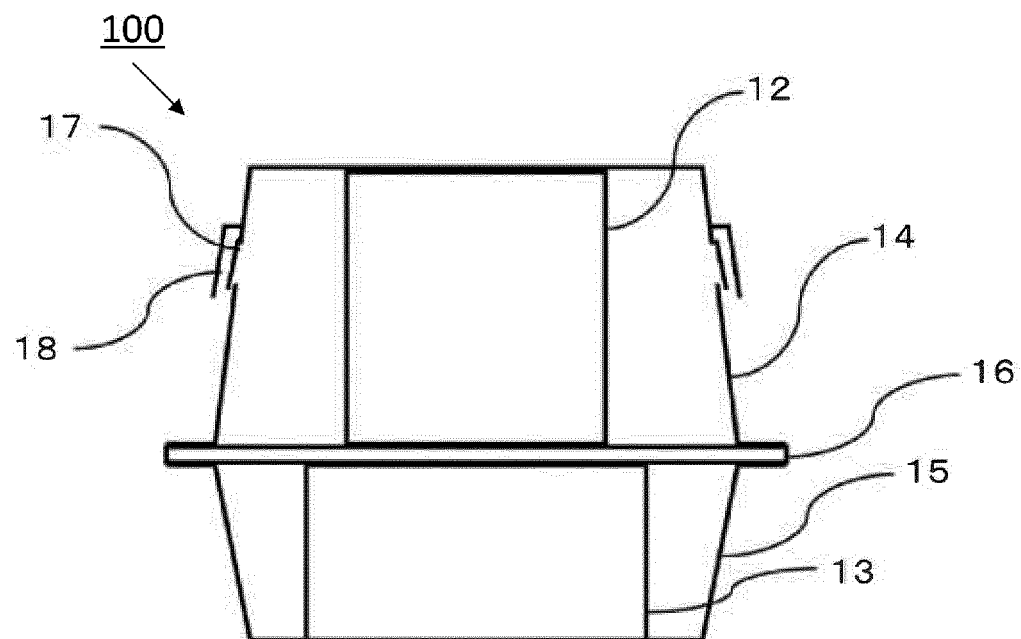


FIG.3

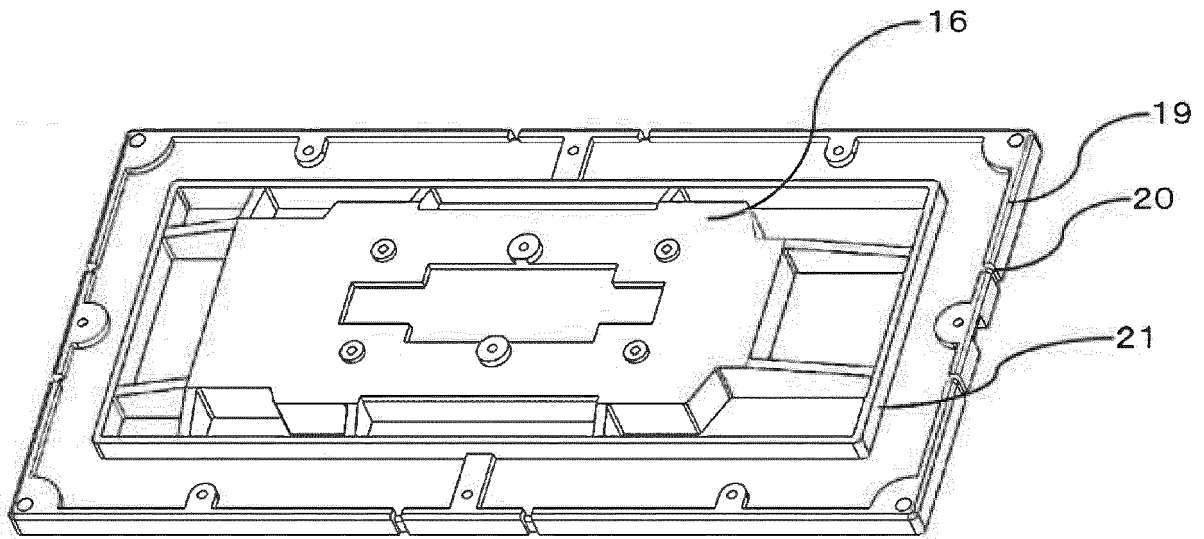


FIG.4

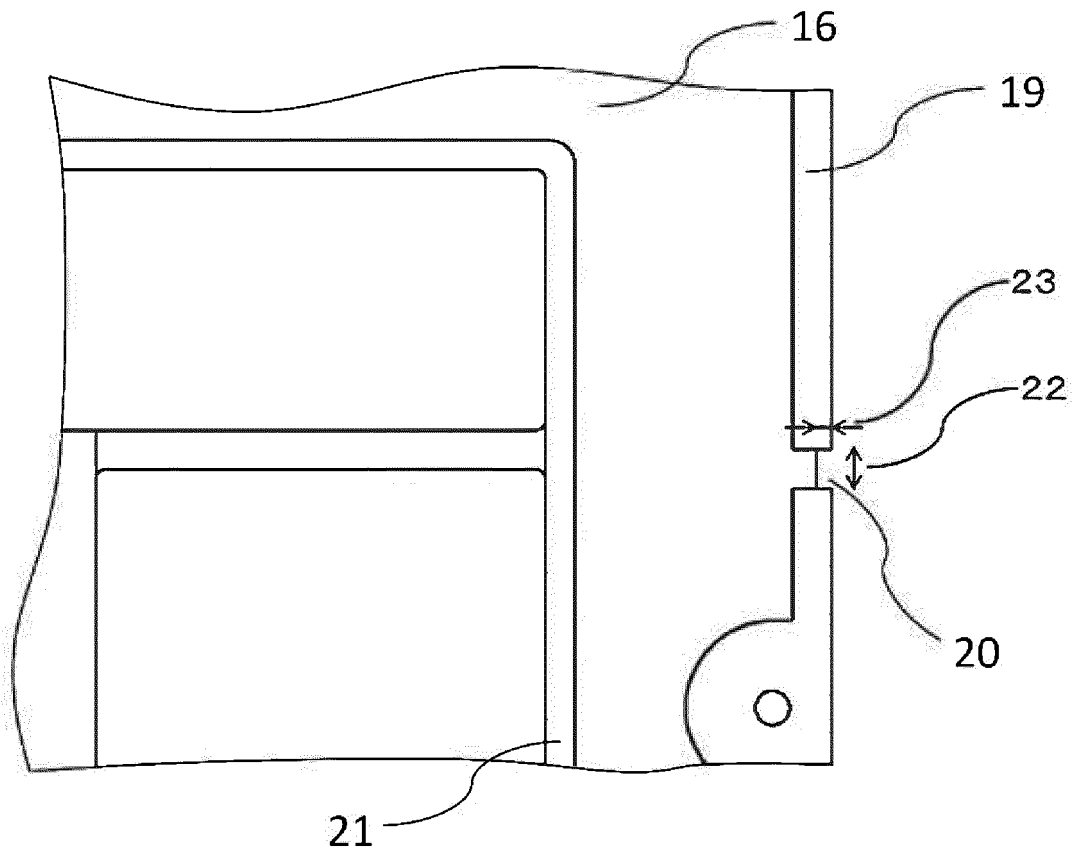


FIG.5

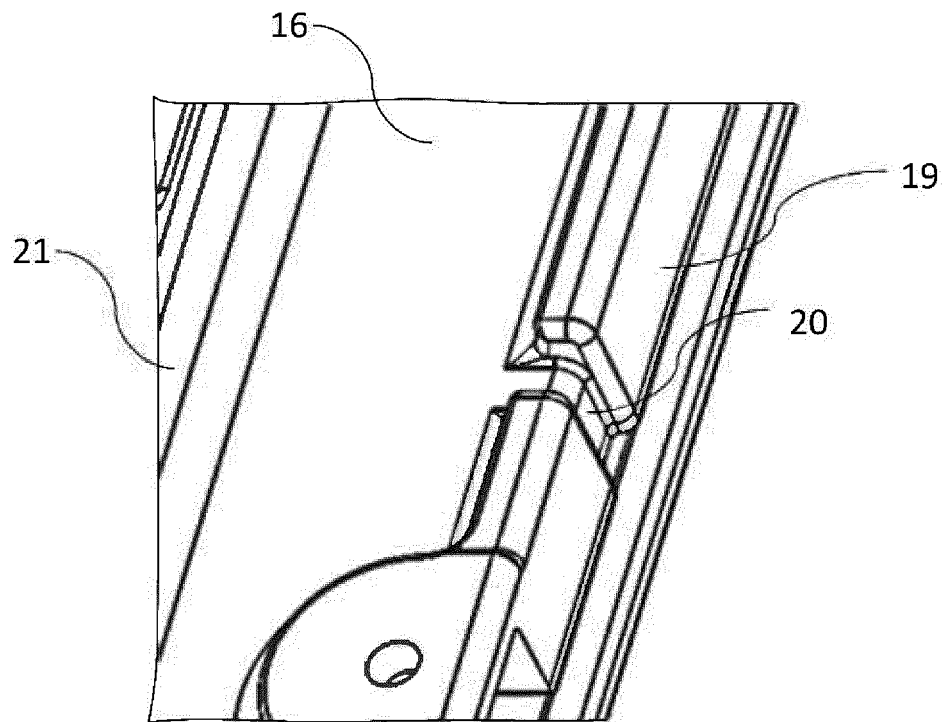


FIG.6

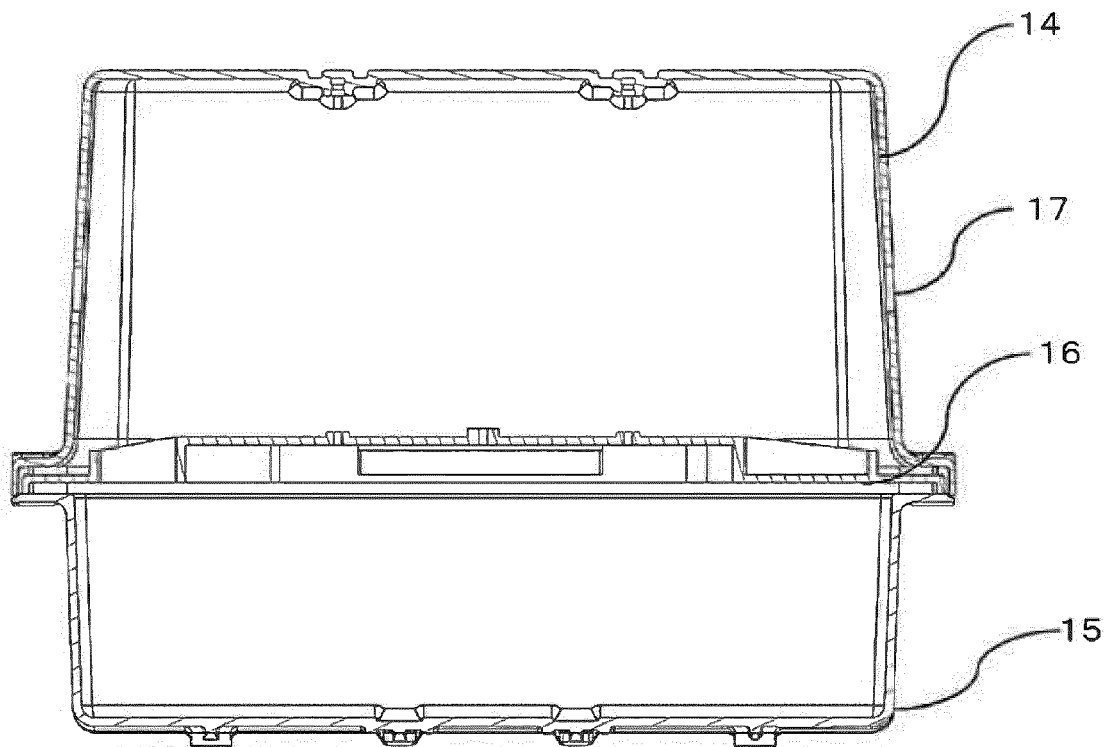


FIG.7

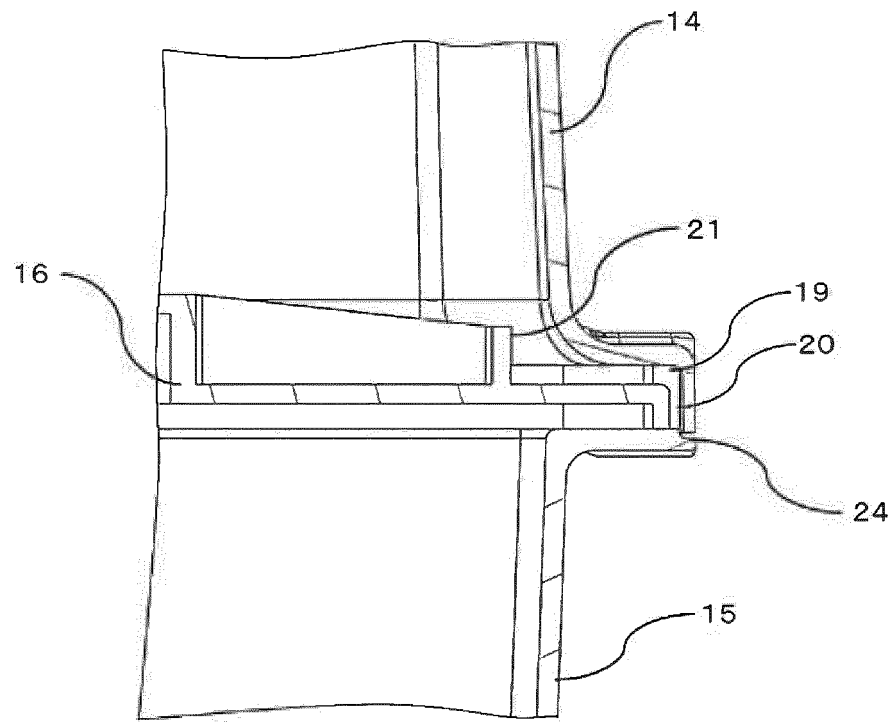


FIG.8

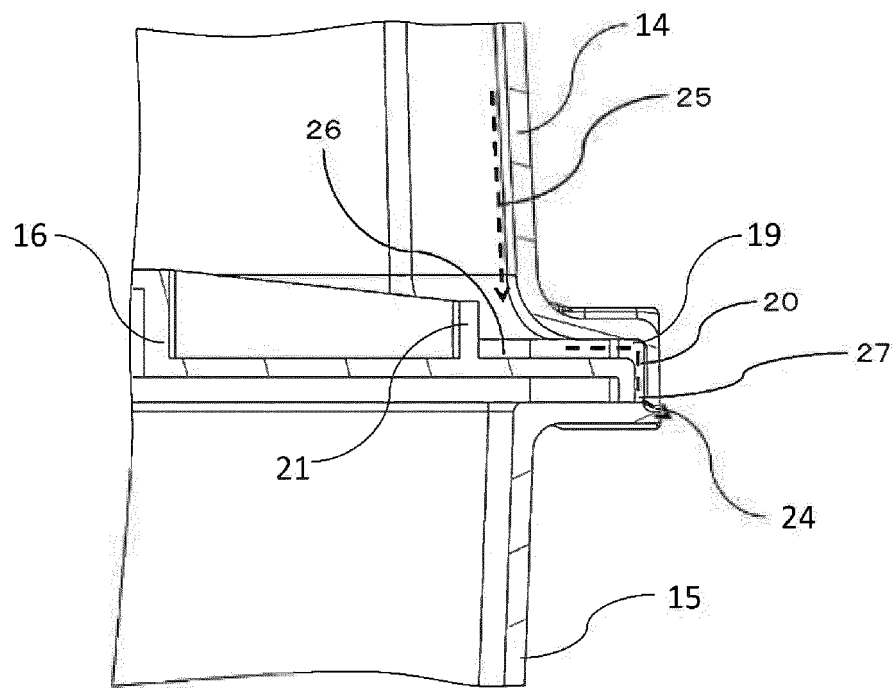


FIG.9

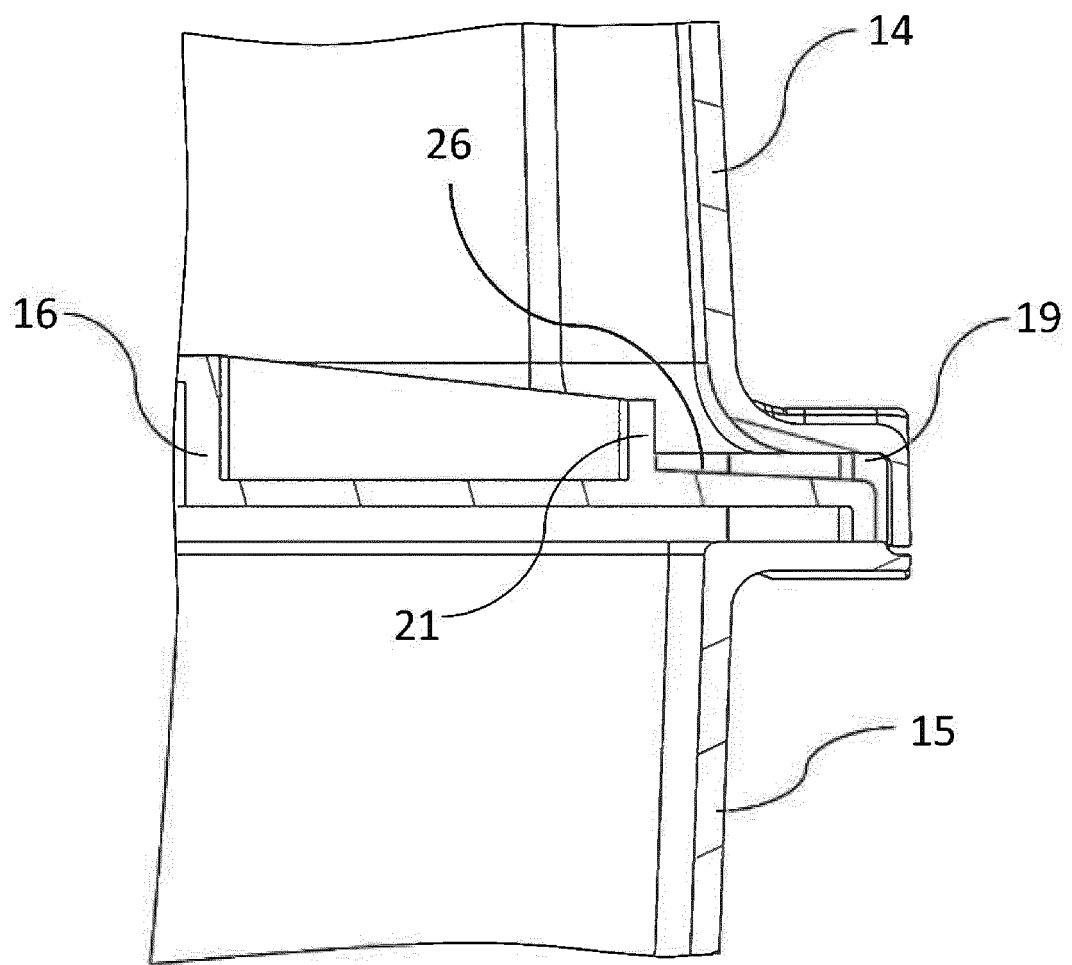
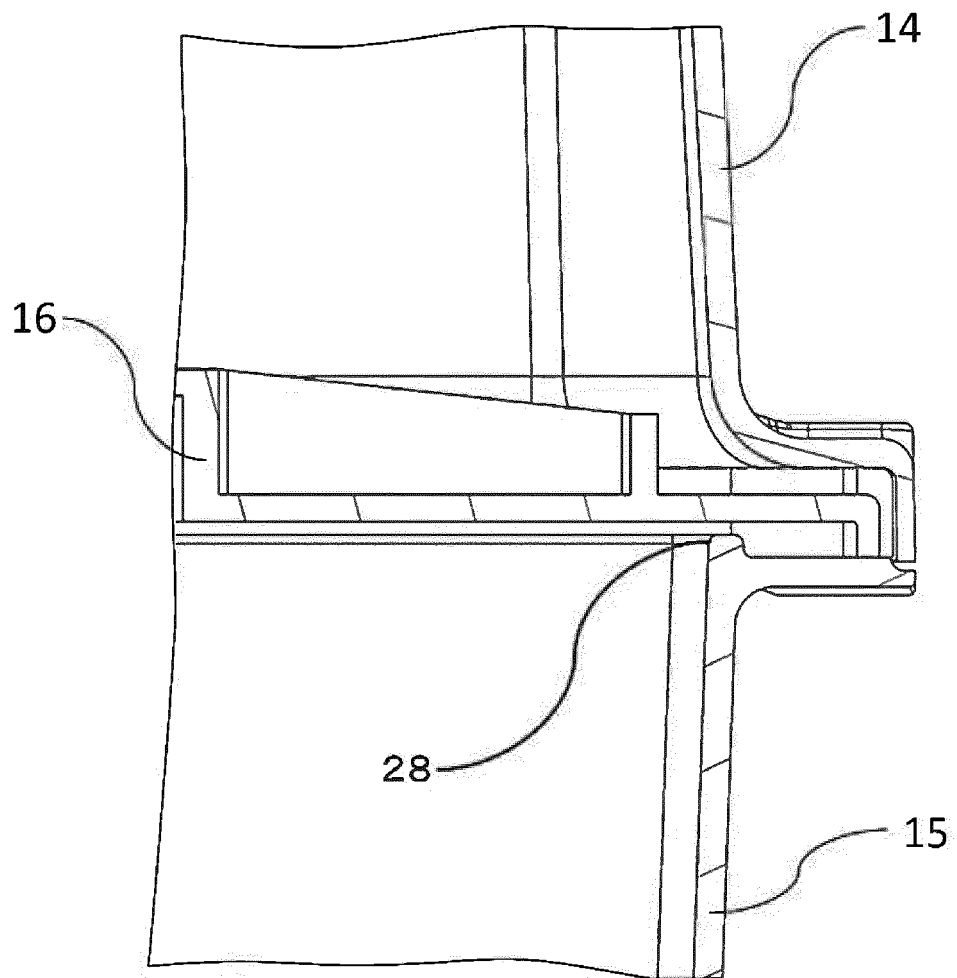


FIG.10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/035528

A. CLASSIFICATION OF SUBJECT MATTER H01H 33/53 (2006.01)i FI: H01H33/53 B 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) H01H33/53 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2021 Registered utility model specifications of Japan 1996-2021 Published registered utility model applications of Japan 1994-2021 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)												
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>WO 2017/183679 A1 (MITSUBISHI ELECTRIC CORP.) 26 October 2017 (2017-10-26) paragraphs [0019]-[0026], fig. 1, 2</td> <td>1-3</td> </tr> <tr> <td>A</td> <td>JP 2004-129403 A (TOKYO ELECTRIC POWER CO., INC.) 22 April 2004 (2004-04-22) paragraphs [0013]-[0015], [0024]-[0037], fig. 1-4</td> <td>1-3</td> </tr> <tr> <td>A</td> <td>CN 207977285 U (ZHEJIANG CHINT ELECTRIC APPLIANCE CO., LTD.) 16 October 2018 (2018-10-16) paragraphs [0011], [0073]-[0076], fig. 17, 19</td> <td>1-3</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	WO 2017/183679 A1 (MITSUBISHI ELECTRIC CORP.) 26 October 2017 (2017-10-26) paragraphs [0019]-[0026], fig. 1, 2	1-3	A	JP 2004-129403 A (TOKYO ELECTRIC POWER CO., INC.) 22 April 2004 (2004-04-22) paragraphs [0013]-[0015], [0024]-[0037], fig. 1-4	1-3	A	CN 207977285 U (ZHEJIANG CHINT ELECTRIC APPLIANCE CO., LTD.) 16 October 2018 (2018-10-16) paragraphs [0011], [0073]-[0076], fig. 17, 19	1-3
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.										
A	WO 2017/183679 A1 (MITSUBISHI ELECTRIC CORP.) 26 October 2017 (2017-10-26) paragraphs [0019]-[0026], fig. 1, 2	1-3										
A	JP 2004-129403 A (TOKYO ELECTRIC POWER CO., INC.) 22 April 2004 (2004-04-22) paragraphs [0013]-[0015], [0024]-[0037], fig. 1-4	1-3										
A	CN 207977285 U (ZHEJIANG CHINT ELECTRIC APPLIANCE CO., LTD.) 16 October 2018 (2018-10-16) paragraphs [0011], [0073]-[0076], fig. 17, 19	1-3										
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.												
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<table border="1"> <tr> <td>Date of the actual completion of the international search 28 October 2021</td> <td>Date of mailing of the international search report 16 November 2021</td> </tr> </table>	Date of the actual completion of the international search 28 October 2021	Date of mailing of the international search report 16 November 2021										
Date of the actual completion of the international search 28 October 2021	Date of mailing of the international search report 16 November 2021											
<table border="1"> <tr> <td>Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan</td> <td>Authorized officer Telephone No.</td> </tr> </table>	Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan	Authorized officer Telephone No.										
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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/035528

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CN 207977285 U	16 October 2018	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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