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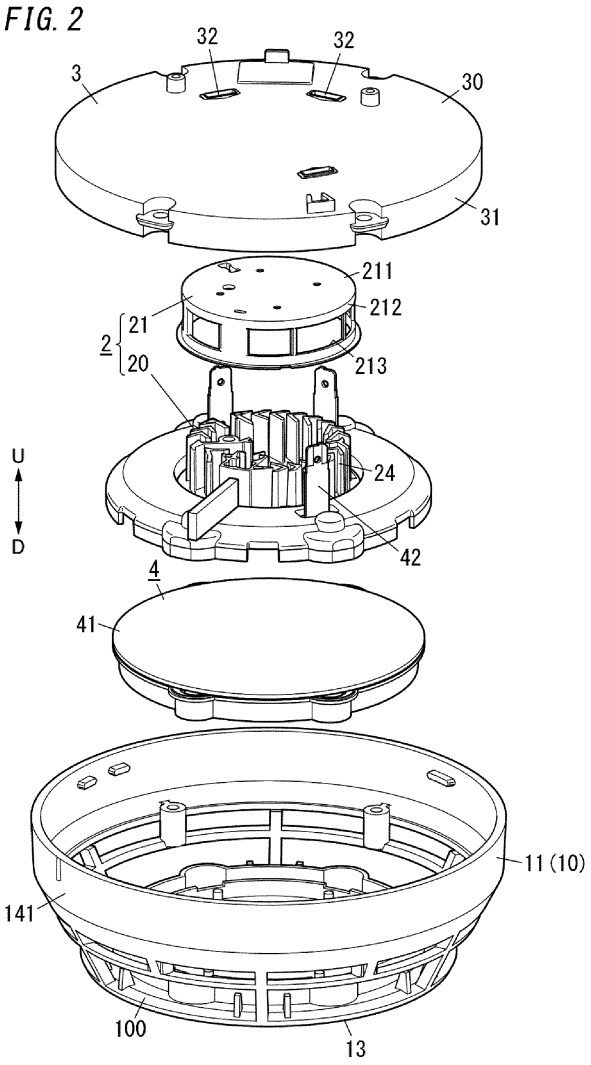
(54) **SMOKE SENSOR**

(57) An object of the present disclosure is to provide a smoke sensor that allows a photodetector unit thereof to detect smoke smoothly. A smoke sensor (1) according to the present disclosure includes: a sensor case (21) surrounding a sensing space (Sp1); a light-emitting unit (22) that emits light toward the sensing space (Sp1); and a photodetector unit (23) disposed at a position where the light emitted from the light-emitting unit (22) is not incident directly and where scattered light that has been scattered by smoke in the sensing space (Sp1) is incident. The sensor case (21) has a wall structure (labyrinth structure 24) that lets the smoke pass through and reduces transmission of incident light. The sensor case (21) also has a blocking region (25) provided locally along a circumference, surrounding the sensing space (Sp1), of the sensor case (21) to prevent the smoke from passing through. The sensor case (21) further has a first region (26) and a second region (27) provided on both sides of the blocking region (25) along the circumference of the sensor case (21) to let the smoke pass through. The sensor case (21) further includes an inhibiting wall (5) reducing inflow of the smoke from either the first region (26) or the second region (27) and arranged to extend outwardly from the sensor case (21).

FIG. 2



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Description

Technical Field

[0001] The present disclosure generally relates to a smoke sensor. More particularly, the present disclosure relates to a smoke sensor including a smoke sensing space and a detection unit for detecting smoke in the smoke sensing space inside.

Background Art

[0002] JP 2010-257258 A discloses a smoke sensor. The smoke sensor includes: a smoke sensing unit for detecting smoke optically by using a light-emitting unit and a photodetector unit; and an optical base that houses the light-emitting unit and the photodetector unit.

Summary of Invention

[0003] In the smoke sensor of JP 2010-257258 A, the smoke sensing unit may fail to detect smoke smoothly depending on how the smoke flows into the optical base.

[0004] It is therefore an object of the present disclosure to provide a smoke sensor that allows a photodetector unit thereof to detect smoke smoothly.

[0005] A smoke sensor according to an aspect of the present disclosure includes: a sensor case surrounding a sensing space; a light-emitting unit that emits light toward the sensing space; and a photodetector unit disposed at a position where the light emitted from the light-emitting unit is not incident directly and where scattered light that has been scattered by smoke in the sensing space is incident. The sensor case has a wall structure that lets the smoke pass through and reduces transmission of incident light. The sensor case also has a blocking region provided locally along a circumference, surrounding the sensing space, of the sensor case to prevent the smoke from passing through. The sensor case further has a first region and a second region provided on both sides of the blocking region along the circumference of the sensor case to let the smoke pass through. The sensor case further includes an inhibiting wall reducing inflow of the smoke from either the first region or the second region and arranged to extend outwardly from the sensor case.

Brief Description of Drawings

[0006]

FIG. 1 is an exploded perspective view of a smoke sensor according to a first embodiment of the present disclosure as viewed from obliquely below the smoke sensor;

FIG. 2 is an exploded perspective view of a lower unit of the smoke sensor as viewed from obliquely above the lower unit;

FIG. 3 is a plan view of the rest of the lower unit other than a partition and sensor case thereof;

FIG. 4 is a plan view of the rest of a lower unit of a smoke sensor according to a second embodiment of the present disclosure other than a partition and sensor case thereof;

FIG. 5 is a plan view of the rest of a lower unit of a smoke sensor according to a third embodiment of the present disclosure other than a partition and sensor case thereof;

FIG. 6 is a plan view of the rest of a lower unit of a smoke sensor according to a fourth embodiment of the present disclosure other than a partition and sensor case thereof; and

FIG. 7 is a plan view of the rest of a lower unit of a smoke sensor according to a fifth embodiment of the present disclosure other than a partition and sensor case thereof;

Description of Embodiments

[0007] A smoke sensor according to the present disclosure will now be described with reference to the accompanying drawings. Note that the drawings to be referred to in the following description of embodiments are all schematic representations. Thus, the ratio of the dimensions (including thicknesses) of respective constituent elements illustrated on the drawings does not always reflect their actual dimensional ratio.

(1) Overview

[0008] An overview of a smoke sensor 1 according to the present disclosure will be described with reference to FIGS. 1-3.

[0009] A smoke sensor 1 (see FIG. 1) according to the present disclosure is a type of disaster prevention equipment for alerting, when sensing any smoke involved with a fire, for example, people to the outbreak of the fire. That is to say, when smoke is present due to the outbreak of a disaster such as a fire, the smoke sensor 1 senses the smoke and alerts people to the outbreak of the disaster by either sounding an alarm or activating other devices via instant communication with those devices. As used herein, the "disaster prevention equipment" refers to a type of equipment installed in various types of facilities for the purpose of preventing a disaster such as a fire, preventing the spread of damage caused by the disaster, or recovering from the damage caused by the disaster.

[0010] The smoke sensor 1 is installed and used in any of various types of facilities. Examples of those facilities in which the smoke sensor 1 according to the present disclosure may be installed include non-dwelling houses such as hotels, office buildings, schools, welfare facilities, commercial facilities, theme parks, hospitals, and factories. However, this is only an example of the present disclosure and should not be construed as limiting. The smoke sensor 1 may naturally be used in dwelling houses

including multi-family dwelling houses and single-family dwelling houses. In any case, the smoke sensor 1 may be installed in any of these various facilities to be mounted on the ceiling, a wall, or any other building component in, for example, a room, a hallway, or stairs of the facility.

[0011] The smoke sensor 1 includes: a sensor case 21 surrounding a sensing space Sp1; a light-emitting unit 22 that emits light toward the sensing space Sp 1; and a photodetector unit 23 disposed at a position where the light emitted from the light-emitting unit 22 is not incident directly and where scattered light that has been scattered by smoke in the sensing space Sp1 is incident. The sensor case 21 has a labyrinth structure 24 (wall structure) that lets the smoke pass through and reduces transmission of incident light. The sensor case 21 also has a blocking region 25 provided locally along a circumference, surrounding the sensing space Sp1, of the sensor case 21 to prevent the smoke from passing through. The sensor case 21 further has a first region 26 and a second region 27 provided on both sides of the blocking region 25 along the circumference of the sensor case 21 to let the smoke pass through. An inhibiting wall 5 that reduces inflow of the smoke from either the first region 26 or the second region 27 is arranged to extend outwardly from the sensor case 21.

[0012] The smoke sensor 1 according to the present disclosure allows the photodetector unit 23 thereof to detect smoke smoothly.

(2) First embodiment

(2-1) Overall configuration

[0013] A detailed configuration for the smoke sensor 1 according to a first embodiment will be described with reference to FIGS. 1-3.

[0014] The smoke sensor 1 is supposed to be mounted on the ceiling of the facility as an example. In a state where the smoke sensor 1 is mounted on the ceiling, a direction perpendicular to (i.e., that intersects at right angles with) the (lower) surface of the ceiling is herein supposed to be an "upward/downward direction." Note that the double-headed arrow indicating the upward/downward direction on the drawings is shown there for illustrative purposes only and is an insubstantial one. Note that these directions should not be construed as limiting the directions in which the smoke sensor 1 is supposed to be used (or mounted).

[0015] The smoke sensor 1 includes a housing 10 (refer to FIGS. 1 and 2), a detection block 2 (refer to FIG. 2), a partition 3 (refer to FIG. 2), and a circuit block 4 (refer to FIG. 2). Optionally, in the first embodiment, the smoke sensor 1 may further include a battery. Note that the battery is not an essential constituent element for the smoke sensor 1. That is to say, the battery may be counted out of the constituent elements of the smoke sensor 1.

(2-2) Housing

[0016] The housing 10 houses the detection block 2 and the circuit block 4 therein. The housing 10 has a disklike shape, which is circular when viewed in plan. The housing 10 is molded product made of a resin.

[0017] The housing 10 includes a first cover 11 and a second cover 12. The housing 10 is formed by combining the first cover 11 that forms the lower part thereof with the second cover 12 that forms the upper part thereof. The housing 10 is fixed onto an installation surface (e.g., the ceiling surface in this embodiment). Strictly speaking, however, the housing 10 is not directly fixed onto the installation surface. Actually, the housing 10 is fixed onto a mounting base (not shown) fixed on the installation surface to be indirectly fixed onto the installation surface.

[0018] Note that the housing 10 does not have to have a circular shape when viewed in plan. In addition, the housing 10 does not have to be a molded product made of a resin. That is to say, the material for the housing 10 does not have to be a resin but may also be a metal, for example.

(2-2-1) First cover

[0019] The first cover 11 has a bottom wall 13 and a sidewall 141. The bottom wall 13 is a plate which is circular when viewed in plan. The sidewall 141 has the shape of a (circular) cylinder which extends upward from the peripheral edge portion of the bottom wall 13. The bottom wall 13 and the sidewall 141 are formed integrally with each other. The bottom wall 13 forms a bottom wall of the housing 10 (smoke sensor 1). In the following description, the "bottom wall 13" will herein refer to not only the bottom wall of the first cover 11 but also the bottom wall of the housing 10 as well.

(2-2-2) Second cover

[0020] As shown in FIG. 1, the second cover 12 has an upper wall 15 and a sidewall 142. The upper wall 15 is a plate which is circular when viewed in plan. The upper wall 15 has an opening (not shown) as a center hole. That is to say, the upper wall 15 according to the first embodiment is a plate, which is annular when viewed in plan.

[0021] The sidewall 142 has the shape of a circular cylinder which extends upward and downward from the peripheral edge portion of the upper wall 15. The upper wall 15 and the sidewall 142 are formed integrally with each other. The upper wall 15 forms an upper wall of the housing 10 (smoke sensor 1). In the following description, the "upper wall 15" herein refers to not only the upper wall of the second cover 12 but also the upper wall of the housing 10 as well.

[0022] Also, the sidewall 141 of the first cover 11 and the sidewall 142 of the second cover 12 together form the peripheral wall 14 of the housing 10 (smoke sensor 1).

[0023] The peripheral wall 14 has at least one window 100. The window 100 is a window that lets smoke flow into the smoke sensor 1. In the first embodiment, the window 100 includes a plurality of windows, which are arranged side by side along the circumference of the peripheral wall 14. Each of the plurality of windows 100 has the shape of a rectangle which is elongate along the circumference of the peripheral wall 14 and penetrates through the peripheral wall 14 in the thickness direction (i.e., in the radial direction). Each of the plurality of windows 100 allows the inside of the housing 10 to communicate with the outside of the housing 10. Thus, smoke is allowed to flow from the outside of the housing 10 into the inside of the housing 10 through each of the plurality of windows 100. In the first embodiment, each of the plurality of windows 100 is provided through the peripheral wall 14 to be located below the partition 3.

(2-2-3) Partition

[0024] The partition 3 partitions the internal space of the housing 10 in the upward/downward direction. More specifically, the partition 3 partitions, in the upward/downward direction, the internal space of the housing 10 into a lower space interposed between the first cover 11 and the partition 3 and an upper space interposed between the second cover 12 and the partition 3.

[0025] As shown in FIG. 2, the partition 3 includes a body 30 and a cylindrical portion 31. The partition 3, as well as the housing 10, is a molded product made of a resin. The partition 3 is preferably, but does not have to be, made of the same material as the housing 10.

[0026] The body 30 is a disklike member. Through holes 32 are provided to penetrate through the (body 30 of the) partition 3 in the upward/downward direction.

[0027] The cylindrical portion 31 has the shape of a (circular) cylinder extending downward from the peripheral edge portion of the body 30. The cylindrical portion 31 serves as an attachment to the housing 10. Specifically, the cylindrical portion 31 is fitted into the (first cover 11 of the) housing 10 such that the outer surface of the cylindrical portion 31 faces the inner surface of the lower sidewall 141 of the peripheral wall 14 of the housing 10.

[0028] Fitting the partition 3 into the first cover 11 allows the lower unit of the smoke sensor 1, including the first cover 11, the partition 3, the detection block 2, and the circuit block 4, to be formed.

[0029] Note that the body 30 of the partition 3 does not have to be circular when viewed in plan. In addition, the partition 3 does not have to be a molded product made of a resin. That is to say, the material for the partition 3 does not have to be a resin but may also be a metal, for example.

(2-2-4) Lower space and upper space

[0030] The lower space under the partition 3 inside the housing 10 includes a sensing space Sp1. The windows 100 are provided through respective parts, facing the lower space, of the peripheral wall 14. The smoke in the space outside of the housing 10 flows through the windows 100 into the lower space to reach the sensing space Sp1.

[0031] The lower space communicates with the indoor space through the windows 100.

[0032] In the upper space over the partition 3 inside the housing 10, disposed is an electrical component, to which one end of an external cable is connected. The external cable may be, for example, a signal cable. The rest of the external cable, other than the one end thereof, is extended in the rafters over the ceiling. The external cable is introduced into the space (upper space) inside the housing 10 through a ceiling window provided through the ceiling and the opening provided through the upper wall 15 of the second cover 12. One end of the external cable is connected to the electrical component. The electrical component may be, for example, a board (circuit board). In addition, terminals are electrically connected to a conductor portion of the board as the electrical component.

[0033] An upper unit of the smoke sensor 1 is formed by the second cover 12 including the electrical component and the terminals. The upper unit serves as a sensor base, which is mounted onto the mounting base provided on the ceiling. In addition, the lower unit is removably attached, from under the upper unit, onto the upper unit serving as the sensor base.

[0034] The upper space communicates with the space in the rafters through the ceiling window and the opening provided through the upper wall 15 of the second cover 12.

(2-3) Detection block

[0035] As shown in FIG. 2, the detection block 2 includes a detection unit 20 and a sensor case 21.

[0036] The sensor case 21 houses the detection unit 20. The sensor case 21 has the shape of a bottomed cylinder and has a bottom wall 211 and a peripheral wall 212. The bottom wall 211 is a plate member, which is generally circular when viewed in plan. That is to say, the sensor case 21 has a bottomed cylindrical shape. The peripheral wall 212 protrudes downward from the peripheral edge portion of the bottom wall 211.

[0037] The sensing space Sp1 is a space surrounded with the sensor case 21 inside the housing 10 as shown in FIG. 3.

[0038] The detection unit 20 is arranged in the lower space inside the housing 10 to detect smoke in the sensing space Sp1. The detection unit 20 may be disposed either inside or outside the sensing space Sp1, whichever is appropriate. The detection unit 20 is made up of a light-emitting unit 22 and a photodetector unit 23 and is a photoelectric type. As used herein, the adjective "photoelectric" refers to a scheme for sensing, using the light-emitting unit 22 and the photodetector unit 23, smoke based

on a variation in the quantity of either light reflected from the smoke in the sensing space Sp1 or light transmitted through the sensing space Sp1. In the first embodiment, the light-emitting unit 22 emits light toward the sensing space Sp1. The photodetector unit 23 is disposed at a position where the light emitted from the light-emitting unit 22 is not incident directly but the light scattered by the smoke in the sensing space Sp1 is incident. Thus, when no smoke is present in the sensing space Sp1, the photodetector unit 23 does not receive the light emitted from the light-emitting unit 22. On the other hand, when any smoke is present in the sensing space Sp1, the photodetector unit 23 receives the light emitted from the light-emitting unit 22 and scattered by the smoke (i.e., receives the scattered light). This allows the smoke sensor 1 to sense the presence of smoke in the sensing space Sp1 depending on whether or not the photodetector unit 23 receives any light. In addition, the quantity of light received by the photodetector unit 23 also varies according to the concentration of the smoke in the sensing space Sp1 and the type of the smoke (i.e., whether the smoke is white smoke or black smoke). The photodetector unit 23 supplies an output signal, representing the quantity of the light received, to the circuit block 4.

[0039] As shown in FIG. 2, the peripheral wall 212 of the sensor case 21 is provided with a plurality of window holes 213, each of which lets the smoke flow into the internal space of the sensor case 21 (i.e., into the sensing space Sp1). This allows the smoke to flow through the plurality of window holes 213 into the sensing space Sp1 from outside of the sensor case 21. Each of the plurality of window holes 213 has a rectangular shape in front view and penetrates through the peripheral wall 212 in the thickness direction (i.e., in the radial direction).

[0040] In the first embodiment, a labyrinth structure 24 is provided inside the sensor case 21 as shown in FIG. 3. The labyrinth structure 24 is a set of small pieces which are arranged inside the sensor case 21 in an annular pattern along the circumference of the sensor case 21 so as to surround the sensing space Sp1. The labyrinth structure 24 allows smoke to be taken in the sensing space Sp1 from the outside of the sensor case 21 and through the gaps between the plurality of small pieces.

[0041] The sensor case 21 also has a blocking region 25 provided locally along the circumference thereof surrounding the sensing space Sp1 to prevent the smoke from passing through. The blocking region 25 is located at a position corresponding to the photodetector unit 23 along the circumference of the sensor case 21. The photodetector unit 23 prevents the air located at such a position corresponding to the photodetector unit 23 along the circumference of the sensor case 21 from flowing into the sensing space Sp1.

[0042] The sensor case 21 further has a first region 26 and a second region 27, which are provided on both sides of the blocking region 25 along the circumference thereof to let the smoke pass through. Although there is the labyrinth structure 24 in the first region 26 and the second region 27, the air may flow into the sensing space Sp1 through the gaps between the small pieces of the labyrinth structure 24.

(2-4) Circuit block

[0043] As shown in FIG. 2, the circuit block 4 includes a board (circuit board) 41 and a plurality of electronic components including switches. The plurality of electronic components are assembled together on the board 41. To an electrical conductor portion of the board 41, electrically connected is the detection unit 20 of the detection block 2.

[0044] The board 41 is disposed under the detection block 2, i.e., between the detection block 2 and the first cover 11. The detection block 2 is mounted on one surface (i.e., upper surface) of the board 41 in the thickness direction (upward/downward direction). That is to say, the detection unit 20 and the sensor case 21 are arranged on the one surface of the board 41 in the thickness direction. In other words, the detection unit 20 and the sensor case 21 are mounted on the one surface of the board 41 in the thickness direction.

[0045] A plurality of terminals 42 are electrically connected to the conductor portion of the board 41. The plurality of terminals 42 are extended upward from the board 41. The plurality of terminals 42 are passed through the through holes 32 provided through the body 30 of the partition 3 to be connected to the terminals of the second cover 12. This allows the conductor portion of the board 41 to be electrically connected to the conductor portion of the electrical component via the terminals 42 and the terminal of the second cover 12 so that communication may be established with other devices (such as other smoke sensors) via the external cable.

[0046] In addition, the circuit block 4 further includes a control circuit (not shown) made up of a plurality of electronic components. The control circuit is a circuit provided for the board 41 to control the light-emitting unit 22, the photodetector unit 23, and other units, drives at least the light-emitting unit 22, and performs signal processing on the output signal of the photodetector unit 23. When performing the signal processing, the circuit block 4 compares the quantity of light received by the photodetector unit 23 (i.e., the magnitude of its output signal) with a threshold value, thereby determining whether or not any smoke is present in the sensing space Sp1. When finding the quantity of light received by the photodetector unit 23 equal to or greater than a threshold value, the circuit block 4 determines that smoke, of which the concentration is equal to or higher than a certain value, should be present in the sensing space Sp1. On determining that smoke, of which the concentration is equal to or higher than the certain value, should be present in the sensing space Sp1, the circuit block 4 outputs an electrical signal for driving an emission unit (not shown) which is electrically connected to the conductor portion of the board 41 to the emission unit.

[0047] The emission unit may be, for example, a sound emission unit. On receiving the electrical signal from the circuit block 4, the emission unit emits a sound (as a sound wave). That is to say, when finding the quantity of the light received by the photodetector unit 23 equal to or greater than a threshold value, the smoke sensor 1 makes the sound emission unit 5 emit a sound. The sound emission unit may be implemented as, for example, a loudspeaker or buzzer for converting the electrical signal into the sound.

[0048] Note that the emission unit does not have to be a sound emission unit but may also be a light-emitting unit for emitting light, for example.

(2-5) Inhibiting wall

[0049] As shown in FIG. 3, an inhibiting wall 5 for inhibiting smoke from flowing in from either the first region 26 or the second region 27 is extended outwardly from the sensor case 21. The inhibiting wall 5 is provided to reduce the chances of the air flowing in substantially equal amounts into the sensing space Sp1 from the first region 26 and the second region 27.

[0050] Suppose the air including smoke flows in substantially equal amounts into the sensing space Sp1 from the first region 26 and the second region 27. For example, suppose that the air including smoke at least at a predetermined concentration has flowed earlier from the first region 26 into the sensing space Sp1 and then the air including smoke at least at the predetermined concentration flows a little while later from the second region 27 into the sensing space Sp1. In that case, first, the air including the smoke which has flowed from the first region 26 into the sensing space Sp1 earlier reaches a smoke detection range defined by the light-emitting unit 22 and the photodetector unit 23 to cause an increase in the concentration of the smoke detected by the detection unit 20. Next, the air including the smoke flows from the second region 27 into the sensing space Sp1 a little while later than the inflow of the air from the first region 26. At this time, the air including no smoke which has been present around the smoke detection range in the sensing space Sp1 since a point in time prior to the inflow of the air including the smoke would be expelled by the air that has flowed in from the second region 27 to move to the smoke detection range, thus causing a decrease in the concentration of the smoke detected by the detection unit 20. That is why in the smoke sensor 1 according to the present disclosure in which the blocking region 25 is provided locally along the circumference of the sensor case 21, letting the smoke flow in substantially equal amounts into the sensing space Sp1 from both the first region 26 and the second region 27 would cause a detection error. Specifically, in that case, the concentration of the smoke detected by the detection unit 20 would once increase and then decrease erroneously.

[0051] Thus, to avoid such an error, the inhibiting wall 5 (5A) is provided in this embodiment to reduce the chances of the air including the smoke flowing in substantially equal amounts into the sensing space Sp1 from both the first region 26 and the second region 27.

[0052] In the first embodiment, the inhibiting wall 5A is arranged to extend outwardly from a part, corresponding to the blocking region 25, of the sensor case 21. Providing the inhibiting wall 5A reduces, even when the air including the smoke flows in the direction indicated by the arrow 71, the inflow of the air from the second region 27 into the sensing space Sp1, although the air flows easily from the first region 26 into the sensing space Sp1. This reduces the chances of the air including no smoke being expelled by the air flowing in from the second region 27 to move into the smoke detection range and thereby cause such a detection error. Likewise, even when the air including the smoke flows in the direction indicated by the arrow 72, the air easily flows from the second region 27 into the sensing space Sp1 but does not flow in easily from the first region 26, thus reducing the chances of causing such a detection error.

(3) Second embodiment

[0053] Next, a smoke sensor 1 according to a second embodiment will be described with reference to FIG. 4. The smoke sensor 1 according to the second embodiment is mostly the same as the smoke sensor 1 according to the first embodiment. Thus, in the following description, any constituent element of the smoke sensor 1 according to this second embodiment, having the same function as a counterpart of the smoke sensor 1 according to the first embodiment described above, will be designated by the same reference numeral as that counterpart's, and a detailed description thereof will be omitted herein.

[0054] An inhibiting wall 5B according to the second embodiment is arranged to extend outwardly from an end portion, adjacent to the second region 27, of the blocking region 25 of the sensor case 21.

[0055] The inhibiting wall 5B has a first part 51 and a second part 52. The first part 51 is arranged to extend from the sensor case 21 in a first direction 61. The first direction 61 is a predetermined direction pointing outward from the sensor case 21.

[0056] The second part 52 is arranged to extend from an outer end portion of the first part 51 in a second direction 62. The second direction 62 is tilted toward the second region 27 with respect to the first direction 61.

[0057] Providing the inhibiting wall 5B reduces, even when the air including the smoke flows in the direction indicated by the arrow 71, the inflow of the air from the second region 27 into the sensing space Sp1, although the air flows easily from the first region 26 into the sensing space Sp1. This reduces the chances of causing a detection error. In particular, the second part 52 is located, along the circumference of the sensor case 21, in the second region 27 with respect to the first part 51, thus further reducing the inflow of the air from the second region 27 compared to the first embodiment.

(4) Third embodiment

[0058] Next, a smoke sensor 1 according to a third embodiment will be described with reference to FIG. 5. The smoke sensor 1 according to the third embodiment is mostly the same as the smoke sensor 1 according to the second embodiment. Thus, in the following description, any constituent element of the smoke sensor 1 according to this third embodiment, having the same function as a counterpart of the smoke sensor 1 according to the second embodiment described above, will be designated by the same reference numeral as that counterpart's, and a detailed description thereof will be omitted herein.

[0059] An inhibiting wall 5C according to the third embodiment is arranged to extend outwardly from an end portion, adjacent to the first region 26, of the blocking region 25 of the sensor case 21.

[0060] The second part 52 is arranged to extend from an outer end portion of the first part 51 in a third direction 63. The third direction 63 is tilted toward the first region 26 with respect to the first direction 61.

[0061] Providing the inhibiting wall 5C reduces, even when the air including the smoke flows in the direction indicated by the arrow 72, the inflow of the air from the first region 26 into the sensing space Sp1, although the air flows easily from the second region 27 into the sensing space Sp1. This reduces the chances of causing a detection error. In particular, the second part 52 is located, along the circumference of the sensor case 21, in the first region 26 with respect to the first part 51, thus further reducing the inflow of the air from the first region 26 compared to the first embodiment.

(5) Fourth embodiment

[0062] Next, a smoke sensor 1 according to a fourth embodiment will be described with reference to FIG. 6. The smoke sensor 1 according to the fourth embodiment is mostly the same as the smoke sensor 1 according to the second embodiment. Thus, in the following description, any constituent element of the smoke sensor 1 according to this fourth embodiment, having the same function as a counterpart of the smoke sensor 1 according to the second embodiment described above, will be designated by the same reference numeral as that counterpart's, and a detailed description thereof will be omitted herein.

[0063] An inhibiting wall 5D according to the fourth embodiment is arranged to extend outwardly from either a middle portion of the blocking region 25 of the sensor case 21 or an end portion, adjacent to the first region 26, of the blocking region 25 of the sensor case 21.

[0064] The second part 52 is arranged to extend from an outer end portion of the first part 51 in a second direction 62. The second direction 62 is tilted toward the second region 27 with respect to the first direction 61.

[0065] Providing the inhibiting wall 5D reduces, even when the air including the smoke flows in the direction indicated by the arrow 71, the inflow of the air from the second region 27 into the sensing space Sp1, although the air flows easily from the first region 26 into the sensing space Sp1. This reduces the chances of causing a detection error. In particular, the second part 52 is located, along the circumference of the sensor case 21, in the second region 27 with respect to the first part 51, thus further reducing the inflow of the air from the second region 27 compared to the first embodiment.

(6) Fifth embodiment

[0066] Next, a smoke sensor 1 according to a fifth embodiment will be described with reference to FIG. 7. The smoke sensor 1 according to the fifth embodiment is mostly the same as the smoke sensor 1 according to the first embodiment. Thus, in the following description, any constituent element of the smoke sensor 1 according to this fifth embodiment, having the same function as a counterpart of the smoke sensor 1 according to the first embodiment described above, will be designated by the same reference numeral as that counterpart's, and a detailed description thereof will be omitted herein.

[0067] An inhibiting wall 5E according to the fifth embodiment includes the first part 51 and a third part 53. The first part 51 is arranged to extend from the sensor case 21 in the first direction 61. The first direction 61 is a predetermined direction pointing outward from the sensor case 21.

[0068] The third part 53 is arranged to extend from an outer end portion of the first part 51 in a third direction 63. The third direction 63 is tilted toward the first region 26 with respect to the first direction 61.

[0069] Providing the inhibiting wall 5E reduces, even when the air including the smoke flows in the direction indicated by the arrow 72, the inflow of the air from the first region 26 into the sensing space Sp1, although the air flows easily from the second region 27 into the sensing space Sp1. This reduces the chances of causing a detection error. In particular, the third part 53 is located, along the circumference of the sensor case 21, in the first region 26 with respect to the first part 51, thus further reducing the inflow of the air from the first region 26 compared to the first embodiment.

(Recapitulation)

[0070] The exemplary embodiments and their variations described above are specific implementations of the following aspects of the present disclosure.

[0071] A smoke sensor (1) according to a first aspect includes: a sensor case (21) surrounding a sensing space (Sp1); a light-emitting unit (22) that emits light toward the sensing space (Sp1); and a photodetector unit (23) disposed at a position where the light emitted from the light-emitting unit (22) is not incident directly and where scattered light that has been scattered by smoke in the sensing space (Sp1) is incident. The sensor case

(21) has a wall structure (labyrinth structure 24) that lets the smoke pass through and reduces transmission of incident light. The sensor case (21) also has a blocking region (25) provided locally along a circumference, surrounding the sensing space (Sp1), of the sensor case (21) to prevent the smoke from passing through. The sensor case (21) further has a first region (26) and a second region (27) provided on both sides of the blocking region (25) along the circumference of the sensor case (21) to let the smoke pass through. The sensor case (21) further includes an inhibiting wall (5) reducing inflow of the smoke from either the first region (26) or the second region (27) and arranged to extend outwardly from the sensor case (21).

[0072] According to this aspect, the inhibiting wall (5) makes it easier for the air to flow into the sensing space (Sp1) from one of the first region (26) or the second region (27) and makes it less easy for the air to flow into the sensing space (Sp1) from the other of the first region (26) or the second region (27), thus reducing the chances of causing a detection error.

[0073] In a smoke sensor (1) according to a second aspect, which may be implemented in conjunction with the first aspect, the inhibiting wall (5) is arranged to extend outwardly from a part, corresponding to the blocking region (25), of the sensor case (21)

[0074] This aspect enhances the advantage of making it easier for the air to flow into the sensing space (Sp1) from one of the first region (26) or the second region (27) and making it less easy for the air to flow into the sensing space (Sp1) from the other of the first region (26) or the second region (27).

[0075] In a smoke sensor (1) according to a third aspect, which may be implemented in conjunction with the second aspect, the inhibiting wall (5) is arranged to extend outwardly from an end portion, adjacent to the first region (26), of the blocking region (25) of the sensor case (21).

[0076] This aspect may further reduce the chances of causing a detection error.

[0077] In a smoke sensor (1) according to a fourth aspect, which may be implemented in conjunction with the second or third aspect, the inhibiting wall (5) includes a first part (51) and a second part (52). The first part (51) is arranged to extend from the sensor case (21) in a first direction (61). The first direction (61) is a predetermined direction pointing outward from the sensor case (21). The second part (52) is arranged to extend from an outer end portion of the first part (51) in a second direction (62). The second direction (62) is tilted toward the second region (27) with respect to the first direction (61).

[0078] This aspect may further reduce the chances of causing a detection error.

[0079] In a smoke sensor (1) according to a fifth aspect, which may be implemented in conjunction with the second or third aspect, the inhibiting wall (5) includes a first part (51) and a third part (53). The first part (51) is arranged to extend from the sensor case (21) in a first direction (61). The first direction (61) is a predetermined direction pointing outward from the sensor case (21). The third part (53) is arranged to extend from an outer end portion of the first part (51) in a third direction (63). The third direction (63) is tilted toward the first region (26) with respect to the first direction (61).

[0080] This aspect may further reduce the chances of causing a detection error.

Reference Signs List

[0081]

1	Smoke Sensor
Sp1	Sensing Space
21	Sensor Case
22	Light-Emitting Unit
23	Photodetector Unit
24	Labyrinth Structure
25	Blocking Region
26	First Region
27	Second Region
5	Inhibiting Wall
51	First Part
52	Second Part
53	Third Part
61	First Direction
62	Second Direction
63	Third Direction

Claims

1. A smoke sensor (1) comprising:

a sensor case (21) surrounding a sensing space (Sp1);
a light-emitting unit (22) configured to emit light toward the sensing space (Sp1); and
a photodetector unit (23) disposed at a position where the light emitted from the light-emitting unit (22) is not incident directly and where scattered light that has been scattered by smoke in the sensing space (Sp1) is incident,
the sensor case (21) having:

a wall structure (24) configured to let the smoke pass through and reduce transmission of incident light;
a blocking region (25) provided locally along a circumference, surrounding the sensing space (Sp1), of the sensor case (21) to prevent the smoke from passing through;
a first region (26) and a second region (27) provided on both sides of the blocking region (25) along the circumference of the sensor case (21) to let the smoke pass through; and

an inhibiting wall (5) configured to reduce inflow of the smoke from either the first region (26) or the second region (27) and arranged to extend outwardly from the sensor case (21).

2. The smoke sensor (1) of claim 1, wherein
the inhibiting wall (5) is arranged to extend outwardly from a part, corresponding to the blocking region (25), of the sensor case (21).

3. The smoke sensor (1) of claim 1 or 2, wherein
the inhibiting wall (5) is arranged to extend outwardly from an end portion, adjacent to the first region (26), of the blocking region (25) of the sensor case (21).

4. The smoke sensor (1) of any one of claims 1 to 3, wherein
the inhibiting wall (5) includes:

a first part (51) arranged to extend from the sensor case (21) in a first direction (61), the first direction (61) being a predetermined direction pointing outward from the sensor case (21); and
a second part (52) arranged to extend from an outer end portion of the first part (51) in a second direction (62), the second direction (62) being tilted toward the second region (27) with respect to the first direction (61).

5. The smoke sensor (1) of any one of claims 1 to 3, wherein
the inhibiting wall (5) includes:

a first part (51) arranged to extend from the sensor case (21) in a first direction (61), the first direction (61) being a predetermined direction pointing outward from the sensor case (21); and
a third part (53) arranged to extend from an outer end portion of the first part (51) in a third direction (63), the third direction (63) being tilted toward the first region (26) with respect to the first direction (61).

FIG. 1

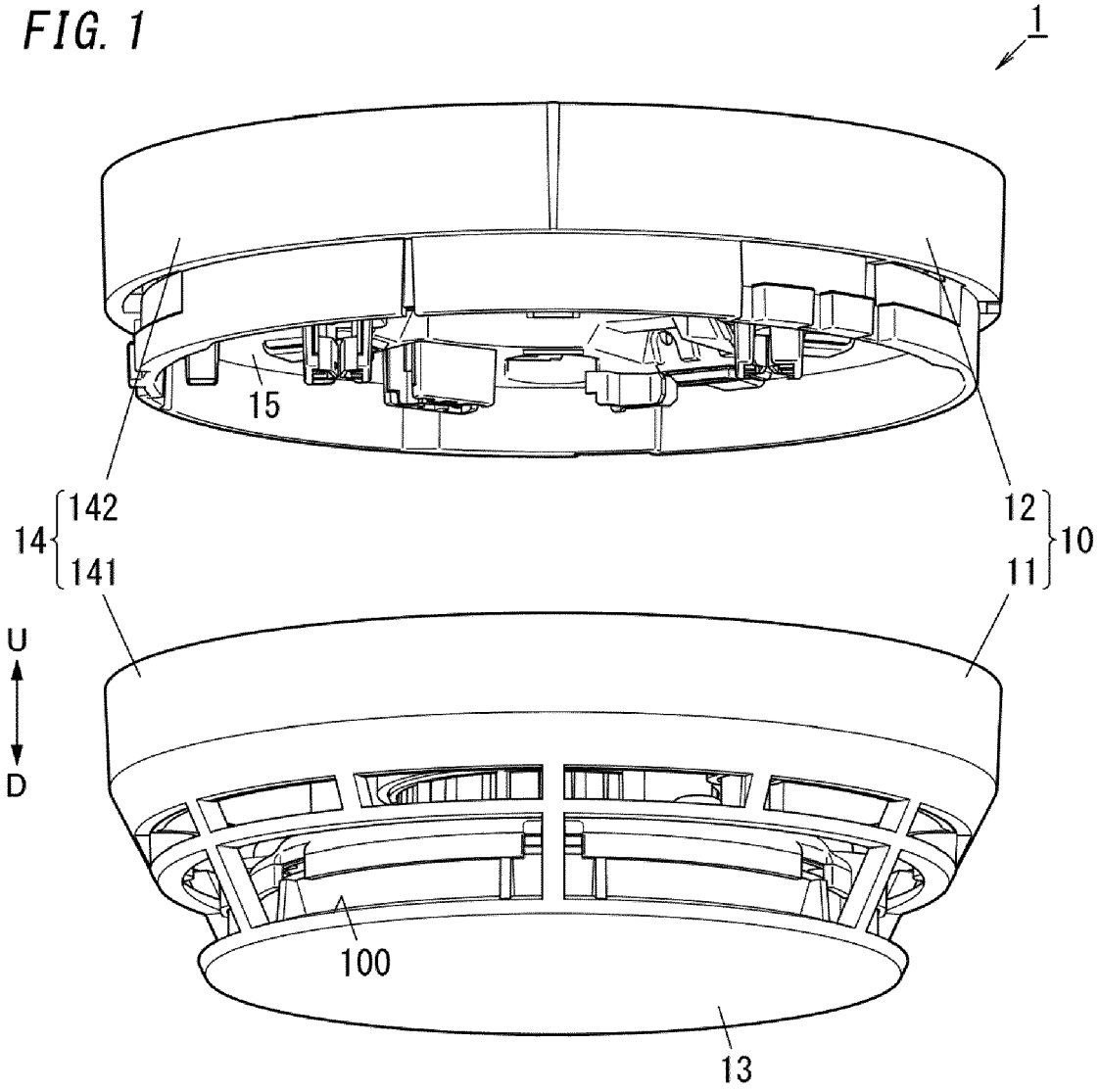


FIG. 2

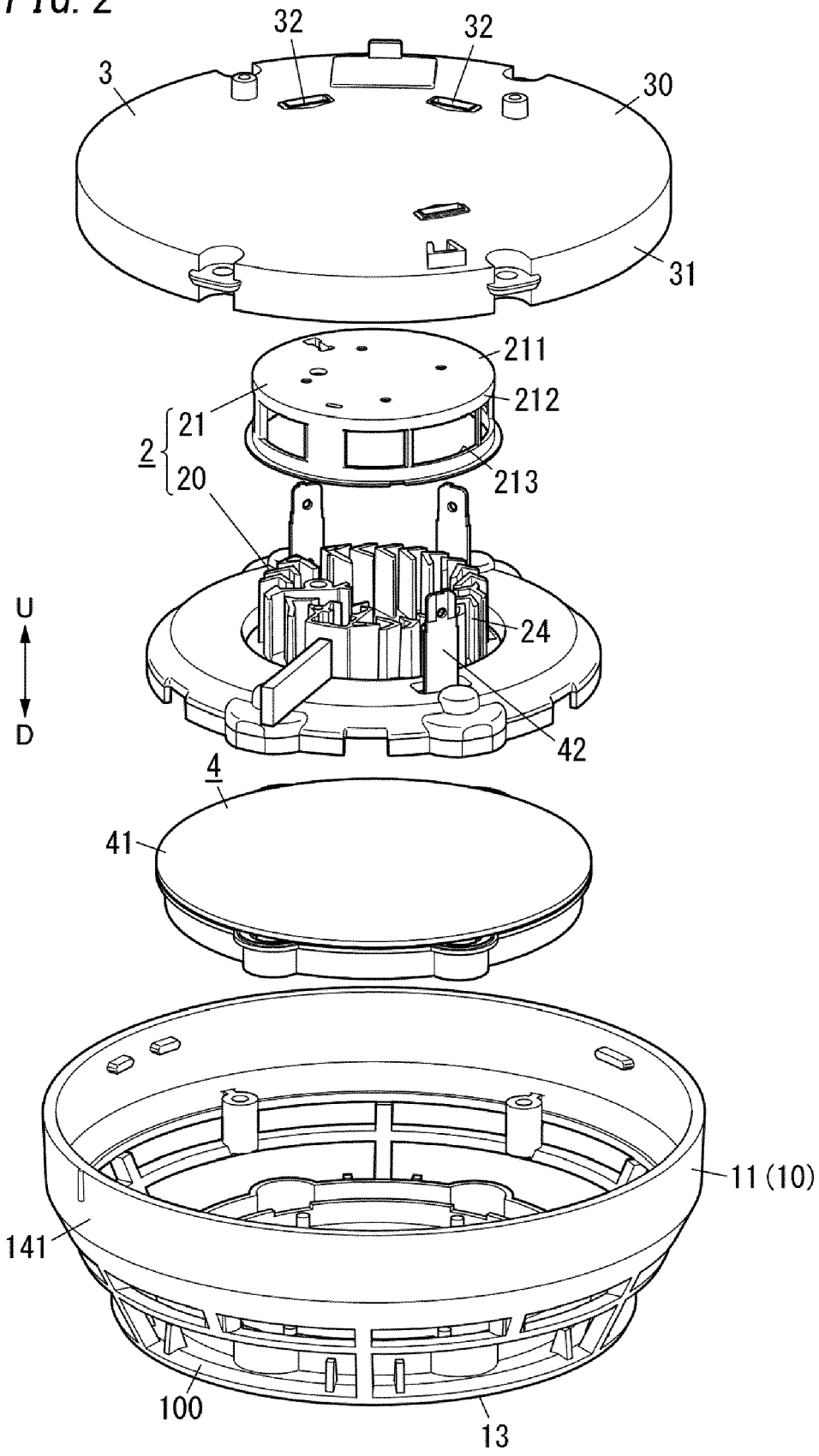


FIG. 3

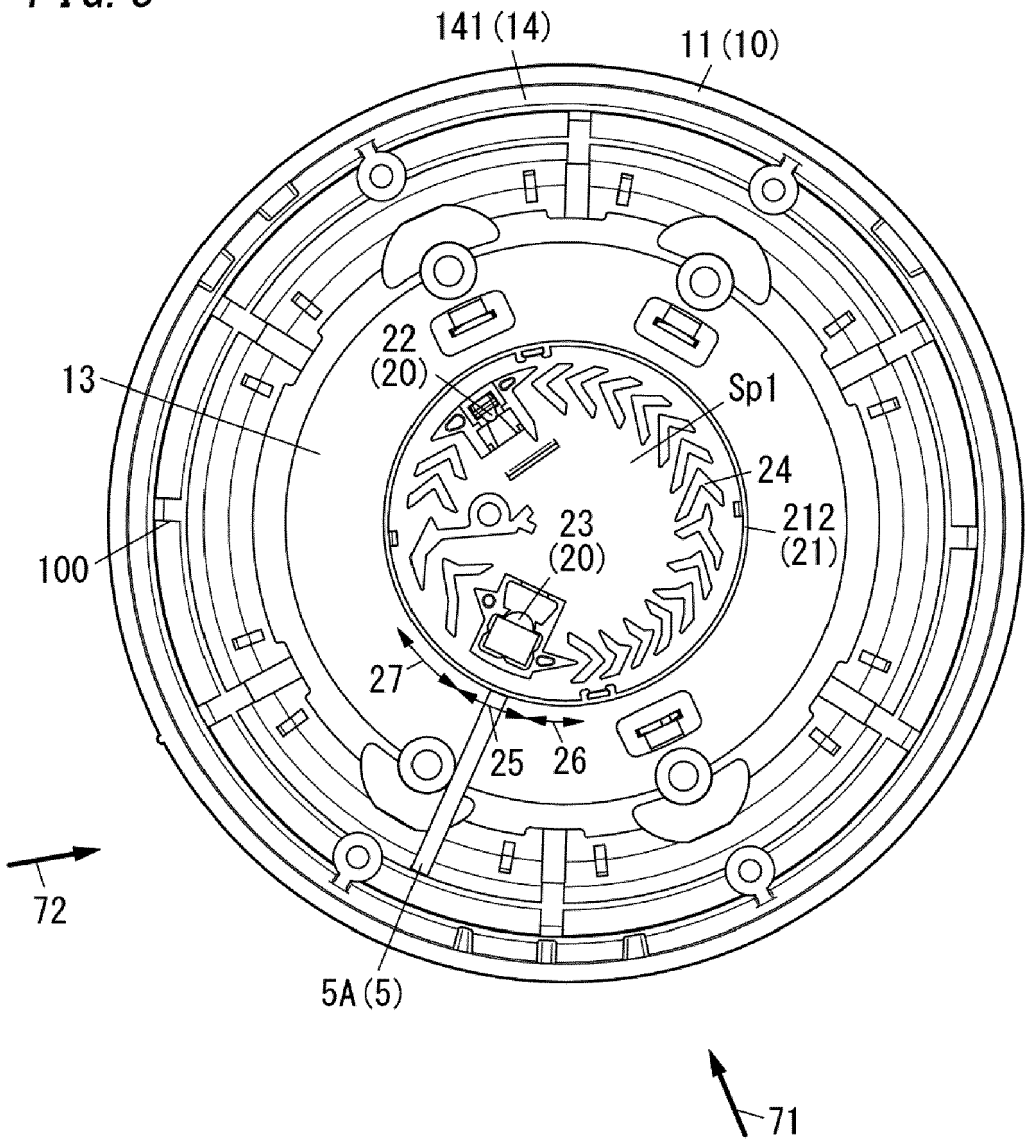


FIG. 4

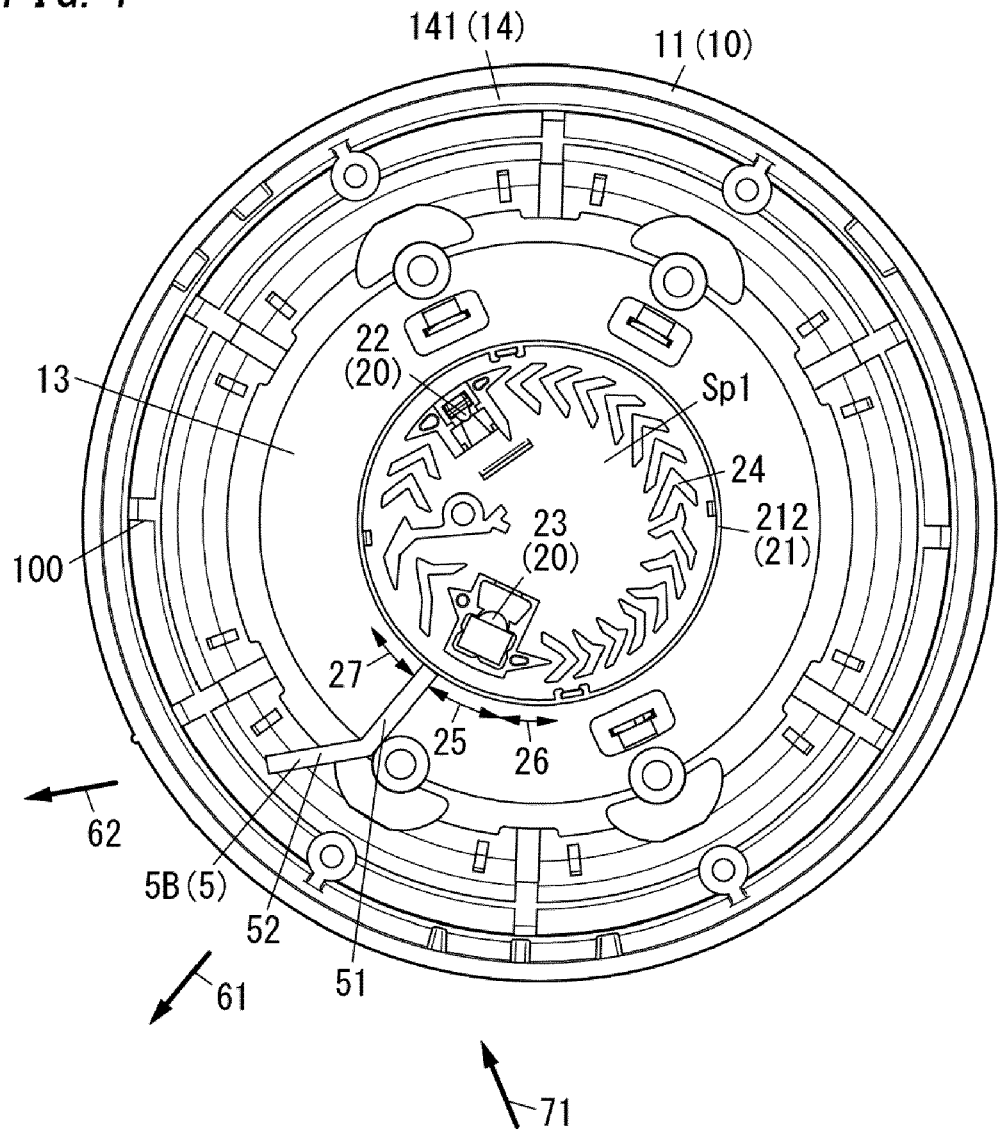
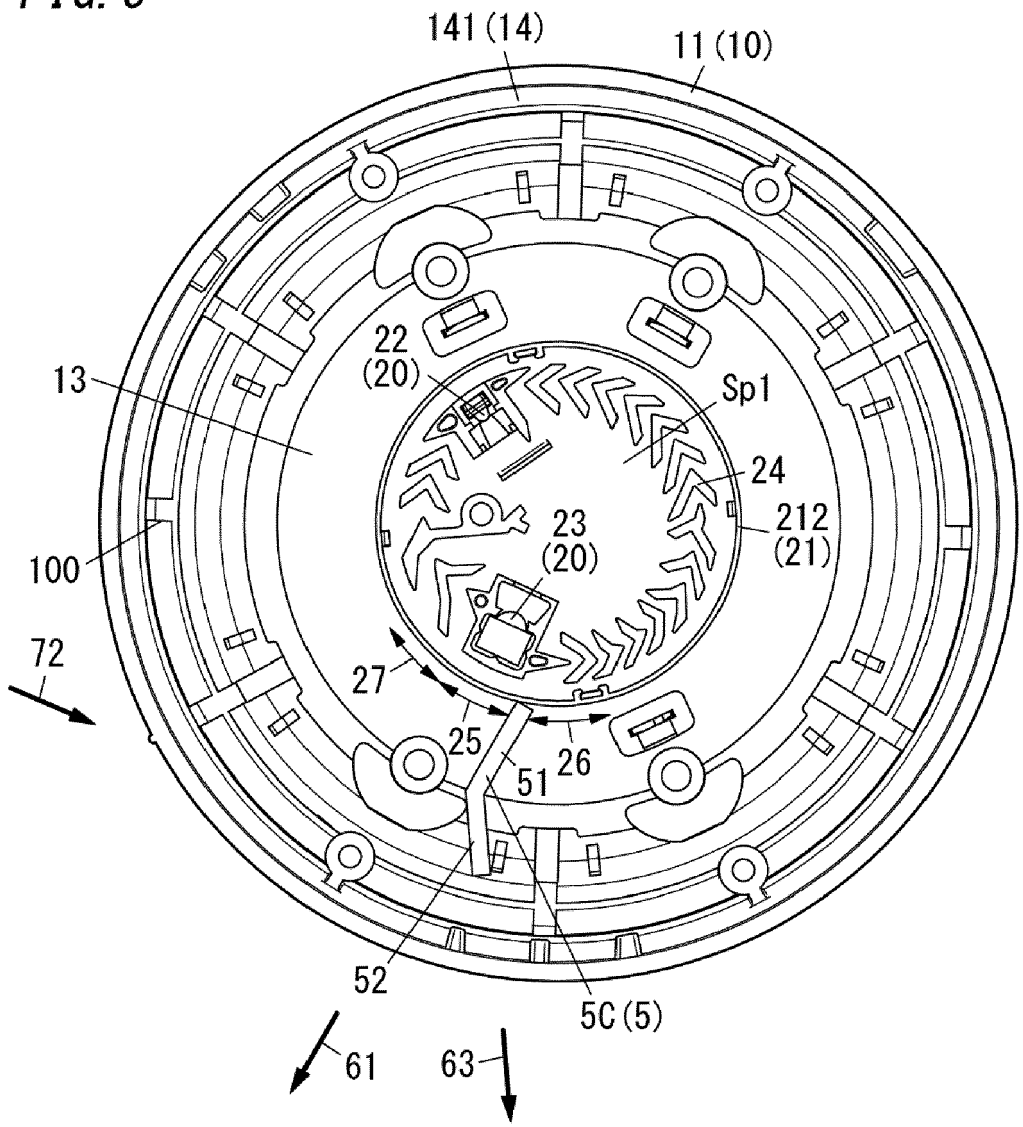

141 (14)
11 (10)
22
(20)
13
Sp1
24
212
(21)
23
(20)
100
27
25
26
62
5B (5)
52
51
61
71

FIG. 5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22
(20)
13
Sp1
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(21)
23
(20)
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25
26
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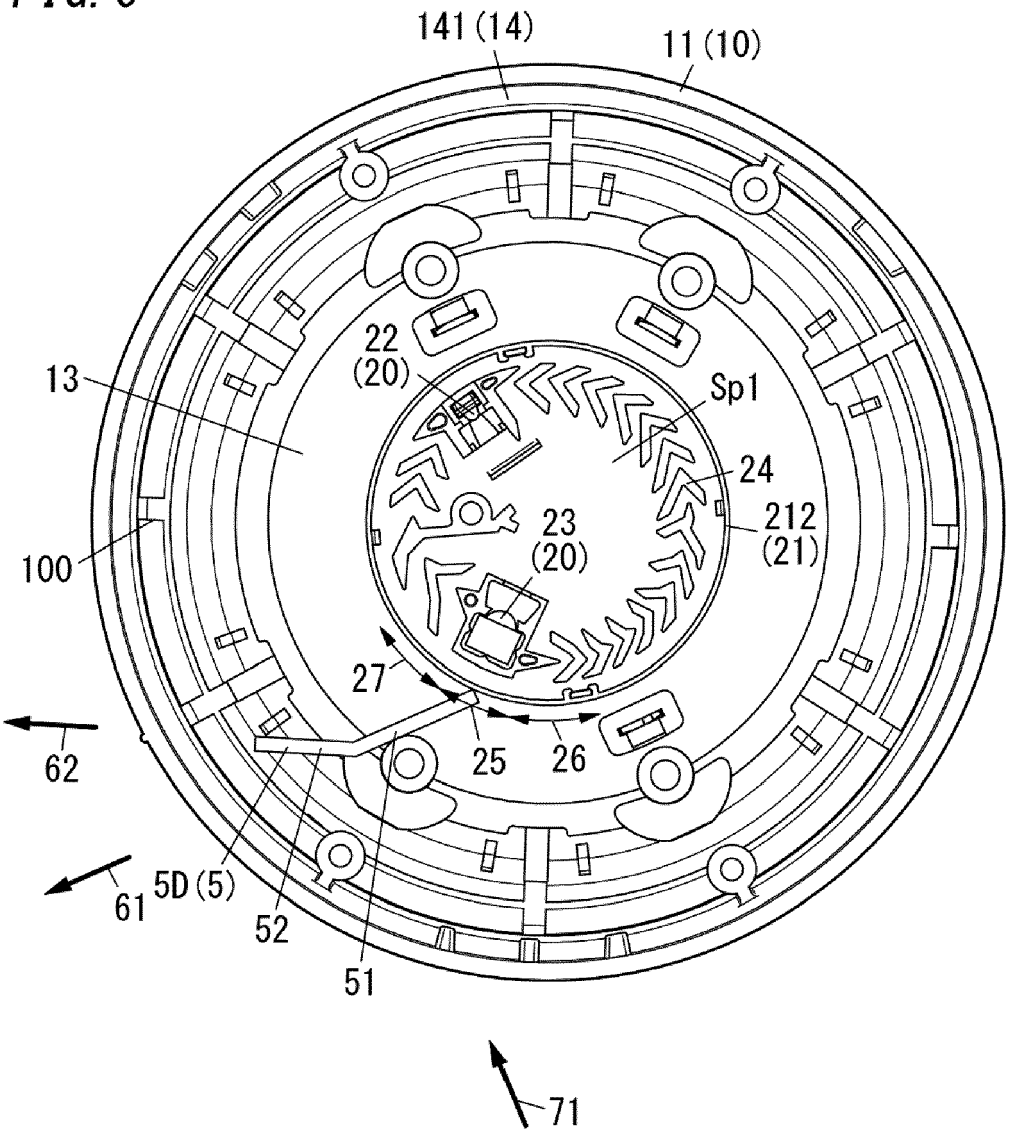
52
5C (5)
61
63

FIG. 6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(20)
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Sp1
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(20)
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25
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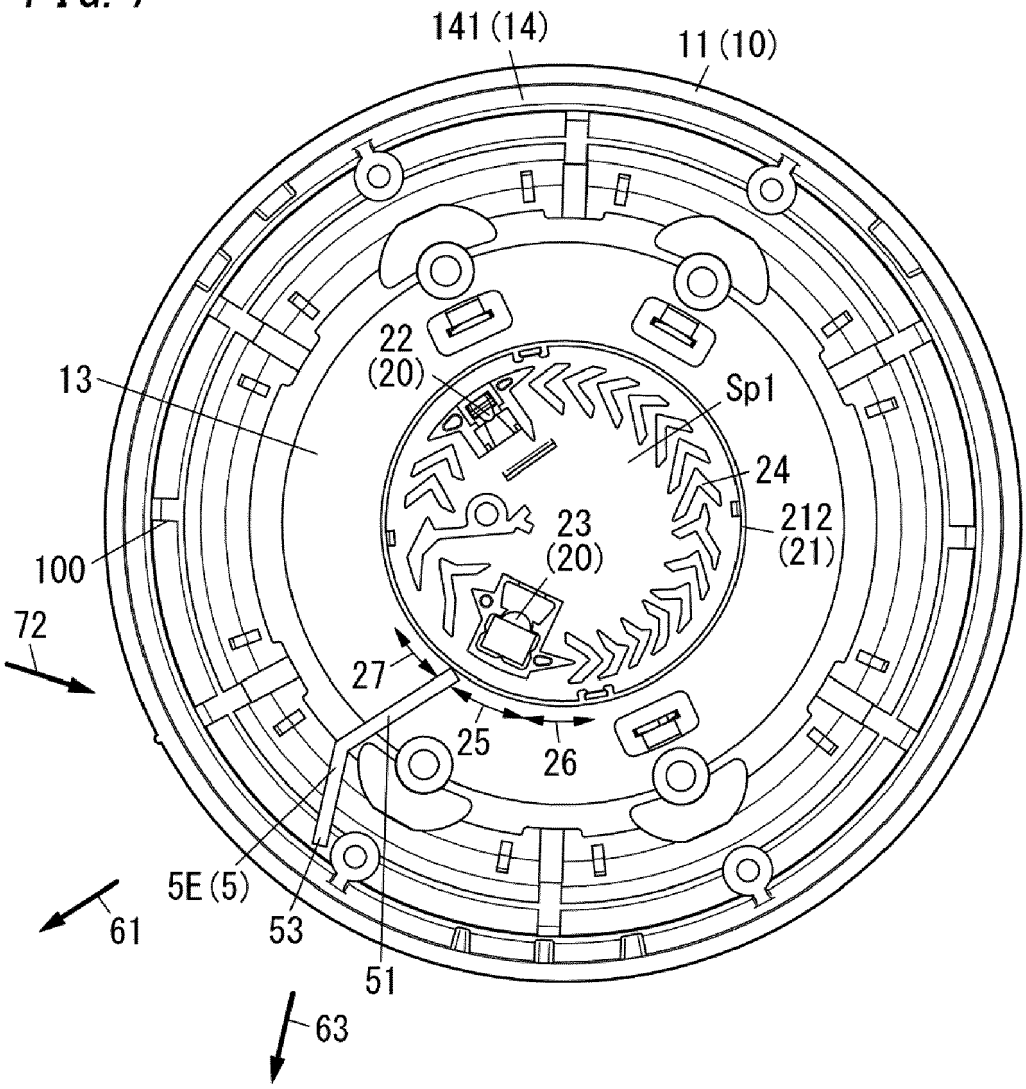
61
5D (5)
52
51
71

FIG. 7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EUROPEAN SEARCH REPORT

Application Number
EP 24 15 9083

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G08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 June 2024	Bilard, Stéphane

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