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(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

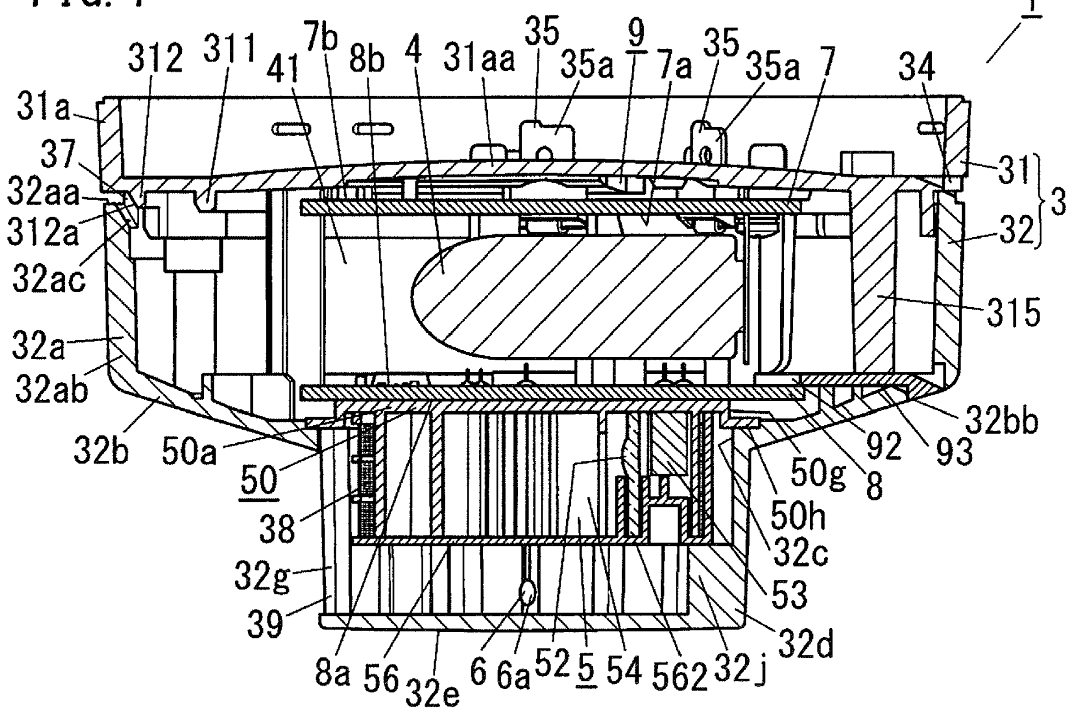
(72) Inventor: **Yoshitsuru, Tomohiro**
Osaka-shi, Osaka 540-6207 (JP)

(74) Representative: **Müller-Boré & Partner Patentanwälte PartG mbB**
Friedenheimer Brücke 21
80639 München (DE)

(54) **Composite fire detector**

(57) A composite fire detector (1) includes: a housing (3); a carbon monoxide detector (4) configured to detect carbon monoxide; a smoke detector (5) configured to detect smoke; and a heat detector (6) configured to detect heat. The carbon monoxide detector (4), the smoke detector (5) and the heat detector (6) are arranged at different heights in the housing (3). A periphery of the housing (3) is shaped like a circle. The housing (3) is formed with: carbon monoxide inlets (37) arranged at regular intervals in a peripheral direction of the housing (3); smoke inlets (38) arranged at regular intervals in the peripheral direction of the housing (3); and heat inlets (39) arranged at regular intervals in the peripheral direction of the housing (3).

FIG. 1



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Description

Technical Field

[0001] The invention relates to a composite fire detector configured to detect the presence of fire based on respective changes of carbon monoxide concentration, smoke density and temperature.

Background Art

[0002] Conventionally, there is proposed a composite fire detector of that sort, which is configured to sense smoke density, temperature and carbon monoxide (for example, JP Pub. No. H7-254096 (hereinafter referred to as "Document 1")).

[0003] The composite fire detector described in Document 1 has configuration in which a scattered light type smoke detector, a heat detector and a carbon monoxide detector are provided in one detector body.

[0004] Concrete structure of the composite fire detector is not described in Document 1.

Summary of Invention

[0005] The present invention has been achieved in view of the above circumstances, and an object thereof is to provide a composite fire detector having a detection area which can cover a wide range by simple structure.

[0006] A composite fire detector of the present invention includes a housing (3), a carbon monoxide detector (4) configured to detect carbon monoxide, a smoke detector (5) configured to detect smoke, and a heat detector (6) configured to detect heat. The carbon monoxide detector (4), the smoke detector (5) and the heat detector (6) are arranged at different heights in the housing (3). A periphery of the housing (3) is shaped like a circle. The housing (3) is formed with carbon monoxide inlets (37) arranged at regular intervals in a peripheral direction of the housing (3). The housing (3) is also formed with smoke inlets (38) arranged at regular intervals in the peripheral direction of the housing (3), and with heat inlets (39) arranged at regular intervals in the peripheral direction of the housing (3).

[0007] The composite fire detector of the present invention can have a detection area which can cover a wide range by simple structure.

Brief Description of Drawings

[0008] Preferred embodiments of the invention will now be described in further details. Other features and advantages of the present invention will become better understood with regard to the following detailed description and accompanying drawings where:

FIG. 1 is a sectional view of a composite fire detector in accordance with an embodiment of the invention;
FIG. 2 is a side view of the composite fire detector;
FIG. 3 is a perspective view of the composite fire detector;
FIG. 4 is a plan view of the composite fire detector;
FIG. 5 is a bottom view of the composite fire detector;
FIG. 6 is a sectional view taken along an X-X line of FIG. 5;
FIG. 7 is a sectional view taken along a B-B line of FIG. 2;
FIG. 8 is a sectional view taken along a C-C line of FIG. 2;
FIG. 9 is a sectional view taken along a D-D line of FIG. 2;
FIG. 10A is a perspective view of an attaching base of the composite fire detector, as viewed from an upper side thereof, and FIG. 10B is a perspective view of the attaching base, as viewed from a lower side thereof;
FIG. 11 is a perspective view of the composite fire detector with a cover thereof removed;
FIG. 12 is a plan view of the cover; and
FIG. 13 is a bottom view of main parts of the composite fire detector.

Description of Embodiments

[0009] A composite fire detector 1 of an embodiment is hereinafter explained with FIGS. 1 to 13. Note that FIG. 1 is a sectional view taken along a Y-Y line of FIG. 5.

[0010] The composite fire detector 1 includes a housing 3, a carbon monoxide detector 4 configured to detect carbon monoxide, a smoke detector 5 configured to detect smoke, and a heat detector 6 configured to detect heat. The carbon monoxide detector 4, the smoke detector 5 and the heat detector 6 are respectively arranged at different heights in the housing 3. A periphery of the housing 3 is shaped like a circle. The housing 3 is formed with carbon monoxide inlets 37 arranged at regular (even) intervals in a peripheral direction of the housing 3. The housing 3 is also formed with smoke inlets 38 arranged at regular intervals in the peripheral direction of the housing 3, and with heat inlets 39 arranged at regular intervals in the peripheral direction of the housing 3. Therefore, the composite fire detector 1 can have a detection area which can cover a wide range by simple structure.

[0011] In an example, the carbon monoxide detector 4 is configured to detect presence of carbon monoxide, and configured to output a signal that varies according to a level of carbon monoxide concentration, for example. The smoke detector 5 is configured to detect presence of smoke, and configured to output a signal that varies according to a level of smoke concentration, for example. The heat detector 6 is configured to detect changes in heat (temperature), and configured to output a signal that varies according to a level of ambient heat (ambient temperature), for example.

[0012] In an example, the carbon monoxide inlets 37 are arranged at regular intervals in a peripheral direction at a first height position of the housing 3. The smoke inlets 38 are arranged at regular intervals in the peripheral direction at a second height position lower than the first height position of the housing 3. The heat inlets 39 are arranged at regular intervals in the peripheral direction at a third height position lower than the second height position of the housing 3.

[0013] Each component of the composite fire detector 1 is hereinafter explained.

[0014] The composite fire detector 1 is of a type that exposes the housing 3, and may be provided with an attaching base 2 (see FIGS. 3 and 10) configured to be fixed to a ceiling member or the like in a building by two first screws (not shown). The housing 3 is configured to be detachably attached to the attaching base 2.

[0015] As shown in FIGS. 10A and 10B, the attaching base 2 includes an attaching base body 20 shaped like a disk. For example, the attaching base body 20 is made from synthetic resin. A first hole 21 is formed in center part of the attaching base body 20, which allows wires led out from a through-hole cut in the ceiling member or the like to pass through.

[0016] The attaching base 2 integrally includes a frame member 20b which is shaped like a ring and protrudes downward from a periphery of a lower surface 20a of the attaching base body 20. An external diameter of the frame member 20b is set to be smaller than an external diameter of the attaching base body 20.

[0017] First and second terminal blocks 23a and 23b are arranged on the lower surface 20a of the attaching base body 20 of the attaching base 2. Two quick connection terminals (not shown) to be connected with respective wires are housed in the first terminal block 23a. Two quick connection terminals to be connected with respective wires are housed in the second terminal block 23b. The first and second terminal blocks 23a and 23b are arranged with the first hole 21 intervened between them.

[0018] Four contact members 25 are arranged on the lower surface 20a of the attaching base body 20 of the attaching base 2, and configured to be respectively connected to first connection parts 35a of four connection plates 35 (see FIGS. 1 and 4) provided in the housing 3. Each contact member 25 is formed of a conductive plate. Two contact members 25 of the four contact members 25 are electrically connected to the two quick connection terminals of the first terminal block 23a, and remaining two contact members 25 are electrically connected to the two quick connection terminals of the second terminal block 23b. Each contact member 25 includes two plate springs 26 and 26 and is configured to be electrically and mechanically connected with a first connection part 35a inserted between the two plate springs 26 and 26.

[0019] The attaching base body 20 of the attaching base 2 is formed with two insertion holes 22 which allows the two first screws to be respectively inserted into. Each insertion hole 22 is formed of an opening 22a which is shaped like a circle and allows a head of a first screw to pass through, and a slit 22b which is shaped like an arc continuously extending from the opening 22a and allows a thread of the first screw to pass through and prohibits a head thereof from passing through.

[0020] As shown in FIGS. 1 to 3 and 6, the housing 3 includes a base 31, and a cover 32 which is disposed at a lower side of the base 31 and covers the carbon monoxide detector 4, the smoke detector 5 and the heat detector 6.

[0021] The base 31 includes a base body 31a which is made from synthetic resin and shaped like a cylinder having a bottom (see FIGS. 1 to 4 and 6 to 11). The cover 32 is made from synthetic resin. As shown in FIGS. 1 to 3, 5 and 6, the cover 32 includes an upper cover 32a which is shaped like a cylinder having a bottom, and a lower cover 32d which is shaped like a cylinder having a bottom and protrudes downward from a periphery of an opening 32c in center part of a bottom wall 32b of the upper cover 32a. The cover 32 integrally includes spacers 321 which protrude upward from an upper edge 32aa of the upper cover 32a so that a distance between a bottom wall 31aa of the base body 31a and the upper edge 32aa becomes a prescribed distance. The spacers 321 are arranged at regular intervals in a circumferential direction of the upper edge 32aa of the upper cover 32a. Each carbon monoxide inlet 37 of the composite fire detector 1 corresponds to a space surrounded by the upper edge 32aa of the upper cover 32a, the bottom wall 31aa of the base body 31a, and two spacers 321, adjoining in the peripheral direction of the housing 3, of the spacers 321. In the composite fire detector 1, it is therefore unnecessary to provide first and second molding dies with complicated structure such as slide structure including a slide core in order to form the carbon monoxide inlets 37, wherein the first molding die is for molding the base body 31a and the second molding die is for molding the cover 32. It is accordingly possible to make the composite fire detector 1 less costly. The carbon monoxide inlets 37 are inlets through which carbon monoxide can enter the composite fire detector 1, but function as outlets through which carbon monoxide can flow out.

[0022] An external diameter of the upper edge 32aa of the upper cover 32a in the cover 32 is substantially the same as an external diameter of the base body 31a.

[0023] The base 31 and the cover 32 constituting the housing 3 are coupled together with two second screws 33 (see FIG. 4).

[0024] Insertion holes 317 (see FIG. 11) each of which allows a thread of a second screw 33 to pass through are formed in bottom walls of first bosses 316 (see FIGS. 7 and 11) each of which is shaped like a cylinder having a bottom and protrudes downward from the bottom wall 31aa of the base body 31a. An internal diameter of each first boss 316 is set to be larger than a head of each second screw 33. As shown in FIG. 12, the cover 32 is provided with second bosses 325 each of which is shaped like a protruding cylinder formed with a screw hole 326 into which a thread of a second screw 33 fits. Each second boss 325 is formed integrally with a coupling piece 327 which is extended from a peripheral wall 32ab of the upper cover 32a of the cover 32 in a radial direction of the peripheral wall 32ab.

[0025] The base 31 is provided with the aforementioned four connection plates 35 held on the base body 31a. The four connection plates 35 are provided so as to pierce through the bottom wall 31aa of the base body 31a, and the connection parts 35a correspond to parts of the four connection plates 35, protruding upward from the bottom wall 31aa of the base body 31a. Each connection plate 35 is made of a conductive plate.

[0026] An internal diameter of the base body 31a is slightly larger than the external diameter of the frame member 20b of the attaching base 2. Preferably, the external diameter of the base body 31a is substantially the same as an external diameter of the attaching base body 20 of the attaching base 2.

[0027] The bottom wall 31aa of the base body 31a is formed to swell upward. The base body 31a is formed with second holes 34 across the bottom wall 31aa and a lower end of a peripheral wall 31ab of the base body 31a (see FIGS. 1, 4 and 8). The second holes 34 are spaced at regular intervals in a circumferential direction of the base body 31a. The second holes 34 are provided as discharge holes through which liquid, gas or the like in an interior space of the base body 31a can flow out.

[0028] As shown in FIG. 4, a first projection 301, two second projections 302 and three third projections 303 are provided on an inner face of the peripheral wall 31ab of the base body 31a in the base 31 in order to detachably attach the housing 3 to the attaching base 2. The first, second and third projections 301, 302 and 303 each have different lengths in a circumferential direction of the peripheral wall 31ab of the base body 31a.

[0029] On the other hand, as shown in FIGS. 10A and 10B, a first depression 201 which allows the first projection 301 to be inserted into from below is formed in an outer peripheral face of the frame member 20b of the attaching base 2. Two second depressions 202 which each allow the second projections 302 to be inserted into from below are also formed in the outer peripheral face of the frame member 20b of the attaching base 2. Three third depressions 203 which each allow the third projections 303 to be inserted into from below is also formed in the outer peripheral face of the frame member 20b of the attaching base 2. A first groove 211 having an arc cross section is formed to communicate with the first depression 201 at an upper side of the first depression 201 in the outer peripheral face of the frame member 20b of the attaching base 2 and allows the first projection 301 to move along a circumferential direction of the frame member 20b. A second groove 212 having an arc cross section is formed to communicate with the two second depressions 202 at upper sides of the second depressions 202 in the outer peripheral face of the frame member 20b of the attaching base 2 and allows the second projections 302 to move along the circumferential direction of the frame member 20b. A third groove (not shown) having an arc cross section is formed to communicate with the three third depressions 203 at upper sides of the third depressions 203 in the outer peripheral face of the frame member 20b of the attaching base 2 and allows the third projections 303 to move along the circumferential direction of the frame member 20b.

[0030] When attaching the housing 3 to the attaching base 2, a worker first fits the first projection 301, the second projections 302 and the third projections 303 into the first depression 201, the second depressions 202 and the third depressions 203 and then into the first groove 211, the second groove 212 and the third groove 213, respectively. The worker then rotates the housing 3 clockwise as seen from the worker (below). As a result, the housing 3 can be attached to the attaching base 2.

[0031] In the composite fire detector 1, as shown in FIG. 1, a circuit module 9 includes the carbon monoxide detector 4, the smoke detector 5 and the heat detector 6, and is put in the housing 3.

[0032] The circuit module 9 includes a fire detector circuit (not shown) configured to detect presence or absence of fire breakout based on respective outputs of the carbon monoxide detector 4, the smoke detector 5 and the heat detector 6.

[0033] The circuit module 9 includes a first printed circuit board 7 and a second printed circuit board 8 which are spaced in a vertical direction. The second printed circuit board 8 is disposed below the first printed circuit board 7. The first printed circuit board 7 is fixed to the base 31. The first printed circuit board 7 and the second printed circuit board 8 are electrically connected with each other via lead wires 10 (see FIG. 7). Each of the first printed circuit board 7 and the second printed circuit board 8 is a double printed circuit board. Each color of a lower surface 7a of the first printed circuit board 7 and a lower surface 8a of the second printed circuit board 8 is, for example, black.

[0034] As shown in FIGS. 1, 7, 9 and 11, a first rib 311 and a second rib 312 protrude from the bottom wall 31aa of the base body 31a in the base 31. The first rib 311 is shaped like a ring. The second rib 312 is shaped like a ring of which internal diameter is larger than the first rib 311. The first printed circuit board 7 is disposed inside the first rib 311. The base 31 is formed with a fourth projection 313 for determining the position of the first printed circuit board 7, which protrudes from a lower surface of the bottom wall 31aa of the base body 31a. A cut 72 into which the fourth projection 313 fits is formed in an edge side of the first printed circuit board 7.

[0035] The base 31 is provided with two first posts 319 and two second posts 318 which protrude from the lower surface of the bottom wall 31aa of the base body 31a and are in contact with the second printed circuit board 8. The two first posts 319 are in contact with both ends of the second printed circuit board 8 in a longitudinal direction thereof (a vertical direction in FIG. 13). The two second posts 318 are in contact with both ends of the second printed circuit board 8 in a short direction thereof (a horizontal direction in FIG. 13). Parts of the first posts 319 are each inserted into through holes 82 of the second printed circuit board 8 (see FIG. 11).

[0036] As shown in FIGS. 6 and 12, the cover 32 is integrally formed with a third rib 323 which is shaped like a ring and protrudes upward from an upper surface of the bottom wall 32b of the upper cover 32a. The second printed circuit board 8 is disposed inside the third rib 323.

[0037] The cover 32 is integrally formed with two positioning lugs 324 for determining the position of the second printed circuit board 8, which protrude upward from the upper surface of the bottom wall 32b of the upper cover 32a. Two cuts 83 (see FIG. 11) into which the positioning lugs 324 each fit are formed in edge sides of the second printed circuit board 8.

[0038] The first printed circuit board 7 is electrically connected with the four connection plates 35. Each of the four connection plates 35 integrally includes a first connection part 35a, a second connection part 35b, and an intermediate part 35c between the first and second connection parts 35a and 35b. Each second connection part 35b is disposed between the bottom wall 31aa of the base body 31a and an upper surface 7b of the first printed circuit board 7. The first printed circuit board 7 and the second connection parts 35b are attached to the bottom wall 31aa of the base body 31a with four third screws 36 (see FIG. 7). The third screws 36 are each provided for the second connection parts 35b. Therefore, the first printed circuit board 7 is electrically connected with each second connection part 35b. The intermediate parts 35c of the connection plates 35 are bent in a U-shape, and each inserted into through holes 7c of the first printed circuit board 7.

[0039] The carbon monoxide detector 4 is mounted on the first printed circuit board 7, and disposed at a side of the lower surface 7a of the first printed circuit board 7. The carbon monoxide inlets 37 of the housing 3 communicate with a first space 41 surrounding the carbon monoxide detector 4 between the first and second printed circuit boards 7 and 8 in the housing 3.

[0040] The carbon monoxide detector 4 is formed of an electrochemical CO sensor. Preferably, the electrochemical CO sensor has a characteristic of an output current increasing in proportion to carbon monoxide concentration. For example, TGS5042 (Model No.) made by FIGARO Engineering inc. may be employed as that sort of electrochemical CO sensor.

[0041] The smoke detector 5 and the heat detector 6 are mounted on the second printed circuit board 8 and disposed at a side of the lower surface 8a of the second printed circuit board 8.

[0042] As shown in FIGS. 1 and 13, the smoke detector 5 includes an optical substrate 50, a light emitting device 51, a lens 52 and a photodetector 53 which are disposed at the side of the lower surface 8a of the first printed circuit board 8.

[0043] Preferably, the light emitting device 51 is formed of a shell type LED (light emitting diode), and the photodetector 53 is formed of a photodiode.

[0044] Preferably, the optical substrate 50 is made of black synthetic resin. The optical substrate 50 includes a pedestal member 50a shaped like a disk, and a labyrinth unit 50b which protrudes downward from the pedestal member 50a. The pedestal member 50a of the optical substrate 50 is formed with a first opening (not shown) which allows the light emitting device 51 to pass through, a second opening (not shown) which allows the photodetector 53 to pass through, and a third opening (not shown) which allows the heat detector 6 to pass through. The optical substrate 50 includes a first wall 50c which protrudes downward from the pedestal member 50a and is shaped like a U surrounding a back and sides of the light emitting device 51. The optical substrate 50 includes a second wall 50e which protrudes downward from the pedestal member 50a and is shaped like a U surrounding a back of the photodetector 53 and sides of the lens 52 and the photodetector 53. The optical substrate 50 also includes a hollow cylinder part 50f which protrudes downward from the pedestal member 50a and allows the heat detector 6 to be inserted into.

[0045] As shown in FIGS. 1 and 11, the optical substrate 50 includes a peripheral wall 50g which is extended downward from a periphery of the pedestal member 50a, and a flange 50h which is extended sideway from a lower edge of the peripheral wall 50g.

[0046] The optical substrate 50 is detachably attached to the second printed circuit board 8. Two first hooks 50i (see FIG. 11) protruding upward from the flange 50h engage with two cuts 81 (see FIG. 11) formed in edge sides of the second printed circuit board 8, respectively. As a result, the optical substrate 50 is attached to the second printed circuit board 8.

[0047] The smoke detector 5 includes a cap 56 detachably attached to the optical substrate 50. The cap 56 is shaped like a cylinder having a bottom. The cap 56 is attached to the optical substrate 50 so as to cover the labyrinth unit 50b, the first wall 50c, the light emitting device 51, the second wall 50e, the lens 52, the photodetector 53 and hollow cylinder part 50f.

[0048] Preferably, the cap 56 is formed of black synthetic resin. The cap 56 includes a bottom wall 56a which faces the pedestal member 50a of the optical substrate 50, and a lattice peripheral wall 56b surrounding the labyrinth unit 50b.

[0049] The cap 56 is provided with a locking projection 56d (see FIG. 6) which protrudes sideway from an upper end of the peripheral wall 56b and is configured to engage with a second hook 50j (see FIG. 6) protruding downward from the flange 50h of the optical substrate 50. Accordingly, the cap 56 can be detachably attached to the optical substrate 50.

[0050] The cap 56 is provided with a first projecting support (not shown) for determining the position of the light emitting device 51, and a second projecting support

562 (see FIG. 1) for determining the positions of the lens 52 and the photodetector 53. The first and second projecting supports protrude upward from an upper surface of the bottom wall 56a.

[0051] As shown in FIG. 11, the peripheral wall 56b of the cap 56 is shaped like a lattice, and includes openings 57. The openings 57 are arranged at regular intervals in each of circumferential and vertical directions of the peripheral wall 56b. The openings 57 constitute the smoke inlets 38 through which smoke can enter the cap 56. The openings 57 function as outlets through which smoke can flow out.

[0052] A second space 54 surrounded by the pedestal member 50a of the optical substrate 50, the labyrinth unit 50b, and the bottom wall 56a of the cap 56 corresponds to a smoke detection chamber in the composite fire detector 1.

[0053] The light emitting device 51 and the photodetector 53 are arranged so that the light emitting device 51 does not face the photodetector 53. The optical substrate 50 and the cap 56 in the composite fire detector 1 determine the positions of the light emitting device 51, the lens 52 and the photodetector 53 so that an optical axis of the light emitting device 51 intersects with a common optical axis of the lens 52 and photodetector 53 in the smoke detection chamber.

[0054] The labyrinth unit 50b is configured to allow smoke to enter the second space 54 from an outside of the housing 3 and to prevent light to enter the second space 54 from lateral sides of the housing 3. Specifically, as shown in FIG. 13, the labyrinth unit 50b is formed by projecting walls 50bb arranged side by side in a circumferential direction of the pedestal member 50a. The projecting walls 50bb are almost shaped like a V.

[0055] The smoke detector 5 has smoke passages each of which corresponds to a space surrounded by the pedestal member 50a of the optical substrate 50, the bottom wall 56a of the cap 56, and two projecting walls 50bb adjoining in the circumferential direction of the pedestal member 50a. First ends of the smoke passages correspond to inlets, and second ends of the smoke passages communicate with the smoke detection chamber. Therefore, the inlets of the smoke detector 5 are substantially arranged at regular intervals in a peripheral direction of the housing 3.

[0056] Preferably, a net 58 is provided for the openings 57 in the peripheral wall 56b of the cap 56. For example, color of the net 58 is black. Preferably, the net 58 has mesh size so as to prevent insects, dust and the like from passing through.

[0057] The flange 50h of the optical substrate 50 is mounted on an upper edge of the lower cover 32d (see FIG. 1). A peripheral part of the cap 56 is put on a support part 32j protruding upward from a bottom wall 32e of the lower cover 32d.

[0058] The light emitting device 51 in the smoke detector 5 emits light in the smoke detection chamber. In the composite fire detector 1, if smoke enters the smoke detection chamber, the light is scattered by smoke particles and the scattered light may enter the photodetector 53 via the lens 52, thereby increasing an output (an output level) of the photodetector 53.

[0059] The bottom wall 56a of the cap 56 is formed with a hole 56aa (see FIG. 11) which allows the heat detector 6 to pass through. For example, the heat detector 6 is formed of a Thermistor.

[0060] The heat detector 6 may be configured to detect (measure) temperature (ambient temperature) by a detecting element 6a disposed between the bottom wall 56a of the cap 56 and the bottom wall 32e of the lower cover 32d (see FIG. 1).

[0061] Openings (Slits) 32g are formed in a peripheral wall 32f of the lower cover 32d (see FIG. 2). Preferably, the openings 32g are formed at regular intervals in a circumferential direction of the lower cover 32d. The openings 32g in the composite fire detector 1 correspond to the heat inlets 39. The heat inlets 39 are inlets through which heat can enter a heat detection chamber, but functions as outlets through which heat can flow out. A space surrounded by the bottom wall 32e and the peripheral wall 32f of the lower cover 32d of the cover 30 and the bottom wall 56a of the cap 56 corresponds to the heat detection chamber.

[0062] Therefore, a measured value of temperature by the heat detector 6 will change according to change in ambient temperature. It is preferable that the number of the openings 32g of the lower cover 32d arranged in a peripheral direction of the housing 3 be the same as the number of the openings 57 of the cap 56 arranged in a peripheral direction of the housing 3, and that the openings 32g and the openings 57 be arranged in radial directions of the housing 3. In other words, it is preferable that the openings 32g and the heat inlets 39 be arranged in radial directions of the housing 3, and that the peripheral wall 32f of the lower cover 32d be prevented from blocking off heat into the heat inlets 39.

[0063] Circuit components of the fire detector circuit are mounted on a side of an upper surface 8b of the second printed circuit board 8. The fire detector circuit includes a first current-voltage converter circuit, a first A/D converter circuit, a second current-voltage converter circuit, a second A/D converter circuit and a third A/D converter circuit. The first current-voltage converter circuit is configured to convert an output signal of the carbon monoxide detector 4 as an input signal (an input current) into a voltage signal by current-to-voltage conversion to output the voltage signal as an output signal. The first A/D converter circuit is configured to convert the output signal of the first current- voltage converter as an input signal (an analog signal) into a digital signal by analog-to-digital conversion to output the digital signal as an output signal. The second current-voltage converter circuit is configured to convert an output signal of the photodetector 53 of the smoke detector 5 as an input signal (an input current) into a voltage signal by current-to-voltage conversion to output the voltage signal as an output signal. The second A/D converter circuit is configured to convert the output signal of the second current-voltage converter as an input signal (an analog signal) into a digital signal by analog-to-digital conversion to output the digital signal as an output signal. The third A/D converter circuit is configured to convert the output signal of the heat detector 6 as an input signal (an analog signal) into a digital signal by analog-to-digital conversion to output the digital signal as an output signal. The fire detector circuit is configured to detect presence or absence of fire breakout based on the output signals of the first to third A/D converters.

[0064] The circuit module 9 includes two LEDs 92 for display, configured to light when the fire detector circuit detects the presence of fire breakout (see FIG. 6). The two LEDs 92 are mounted on the upper surface 8b of the second printed circuit board 8. The composite fire detector 1 includes two light guide members 93 for light guide with respect to the LEDs 92. A first end of each light guide member 93 faces a light emission face of an LED 92, and a second end thereof is exposed from an opening-hole 32bb formed in a peripheral part of the bottom wall 32b of the upper cover 32a. Each light guide member 93 is made of transparent synthetic resin. The two light guide members 93 are aligned in a straight line. Color of each LED 92 is, but not limited to, red. Each LED 92 is to be lit or unlit by the fire detector circuit. The composite fire detector 1 is not limited to the configuration in which each LED 92 is lit when the fire detector circuit detects the presence of fire breakout. For example, it may be configured to blink the LEDs 92 on and off.

[0065] It is preferable that the circuit module 9 include a communication circuit (not shown) configured, when the fire detector circuit detects the presence of fire breakout, to transmit a signal for fire breakout notification to a fire alarm (not shown) or to receive a signal from the fire alarm. Preferably, the composite fire detector 1 includes an address setting device for setting a unique address of the composite fire detector.

[0066] For example, the fire detector circuit may be formed of a microcomputer or the like, to which an appropriate program is installed.

[0067] In the aforementioned composite fire detector 1, the carbon monoxide inlets 37 are formed in the housing 3 attached to the attaching base 2 at regular intervals in the peripheral direction of the housing 3. In addition, the smoke inlets 38 are formed in the housing 3 at regular intervals in the peripheral direction of the housing 3, and the heat inlets 39 are formed in the housing 3 at regular intervals in the peripheral direction of the housing 3. The composite fire detector 1 can therefore have a detection area which can cover a wide range by simple structure. The composite fire detector 1 can detect the presence of carbon monoxide and smoke and to measure heat by the simple structure of the housing 3 regardless of a mounting direction of the composite fire detector 1, and also detect the presence of fire breakout regardless of the mounting direction. The composite fire detector 1 can satisfy requirements prescribed in European Standard (prEN54-31), which international standard draft is based on and which put a directionality test requiring non-directivity with respect to respective detection targets. In short, the composite fire detector 1 can prevent, by the simple structure of the housing 3, the occurrence of directional dependency which may affect detection properties of carbon monoxide and smoke and a measurement property of heat.

[0068] In the composite fire detector 1, it is preferable that a projecting dimension of the second rib 312 be the same as each projecting dimension of the spacers. The composite fire detector 1 can prevent a space inside the second rib 312 from being seen in a cross direction of the housing 3, thereby improving appearance of the composite fire detector 1. Preferably, as shown on FIG. 1, the second rib 312 has an outer peripheral surface which is a slope 312a of which external diameter gradually increases as separating from the bottom wall 31aa of the base body 31a. Preferably, a slope substantially parallel with the slope 312a of the second rib 312 is formed in the upper edge 32aa of the peripheral wall 32ab of the upper cover 32a. Thus, in the composite fire detector 1, it is easy to guide carbon monoxide from the carbon monoxide inlets 37 into the first space 41.

[0069] In the base 31, the two first bosses 316 constitute a reinforcement structure which reinforces the base body 31a. The first bosses 316 are integrally formed with the base body 31a. As shown in FIG. 9, the base 31 is provided with four first projections 314 and two second projections 315, which are formed integrally with the second rib 312 and protrude downward from the bottom wall 31aa of the base body 31a. Each projecting dimension of the second projections 315 is larger than each projecting dimension of the first projections 314, and lower edges of the second projections 315 are each in contact with the light guide members 93.

[0070] The first projections 314 and the second projections 315 are arranged in close proximity to and overlap with the spacers 321 in one-to-one correspondence. Conversely, some of the spacers 321 are arranged in close proximity to and overlap with the first projections 314 in one-to-one correspondence, and the others are arranged in close proximity to and overlap with the second projections 315 in one-to-one correspondence. In the base 31, the first projections 314 and the second projections 315 constitute the reinforcement structure which reinforces the base body 31a. In the housing 3, two spacers 321 in a vertical direction of FIG. 9 of eight spacers 321 engage with the second projections 315, and two spacers 321 in a horizontal direction in FIG. 9 of the eight spacers 321 engage with the first projections 314. The housing 3 can accordingly enhance relative positional accuracy between the base 31 and the cover 32.

[0071] It is preferable that the base 31 include reinforcement structures which reinforce the base body 31a and which are arranged in a radial pattern. The composite fire detector 1 can therefore reinforce the housing 3.

[0072] In the composite fire detector 1, it is preferable that the total number of the carbon monoxide inlets 37 is eight. Preferably, as shown in FIG. 9, the composite fire detector 1 has reinforcement structures which are each arranged in eight sector regions (eight parts of the base body 31) each of which is surrounded by a center O of the housing 3 and both ends of a spacer 321 between carbon monoxide inlets 37 adjacent to each other in a horizontal section, including the carbon monoxide inlets 37, of the housing 3. Thus, in the composite fire detector 1, each reinforcement structure can also function as a guide wall for guiding carbon monoxide into the first space 41, thereby further preventing the occurrence of directional dependency which may affect the detection property of carbon monoxide. FIG. 9 schematically illustrates just two sector regions of the eight sector regions by dot and dash lines.

[0073] The figures in the aforementioned embodiments are schematic diagrams. Respective ratios of size or thickness of each component do not necessarily reflect actual ratios. Materials, numerical values and the like in the embodiments are just preferable examples and not limited to these examples.

[0074] While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications may be made therein and that the subject matter disclosed herein may be implemented in various forms and examples, and that they may be applied in numerous applications, only some of which have been described herein. It is intended by the following claims to claim any and all modifications and variations that fall within the true scope of the present teachings.

Claims

1. A composite fire detector (1), comprising:

a housing (3);
a carbon monoxide detector (4) configured to detect carbon monoxide:

a smoke detector (5) configured to detect smoke, and
a heat detector (6) configured to detect heat, wherein
the carbon monoxide detector (4), the smoke detector (5) and the heat detector (6) are arranged at different heights in the housing (3),
a periphery of the housing (3) is shaped like a circle, and
the housing (3) is formed with
carbon monoxide inlets (37) arranged at regular intervals in a peripheral direction of the housing (3),
smoke inlets (38) arranged at regular intervals in the peripheral direction of the housing (3), and
heat inlets (39) arranged at regular intervals in the peripheral direction of the housing (3).

2. The composite fire detector (1) of claim 1, wherein the housing (3) comprises:

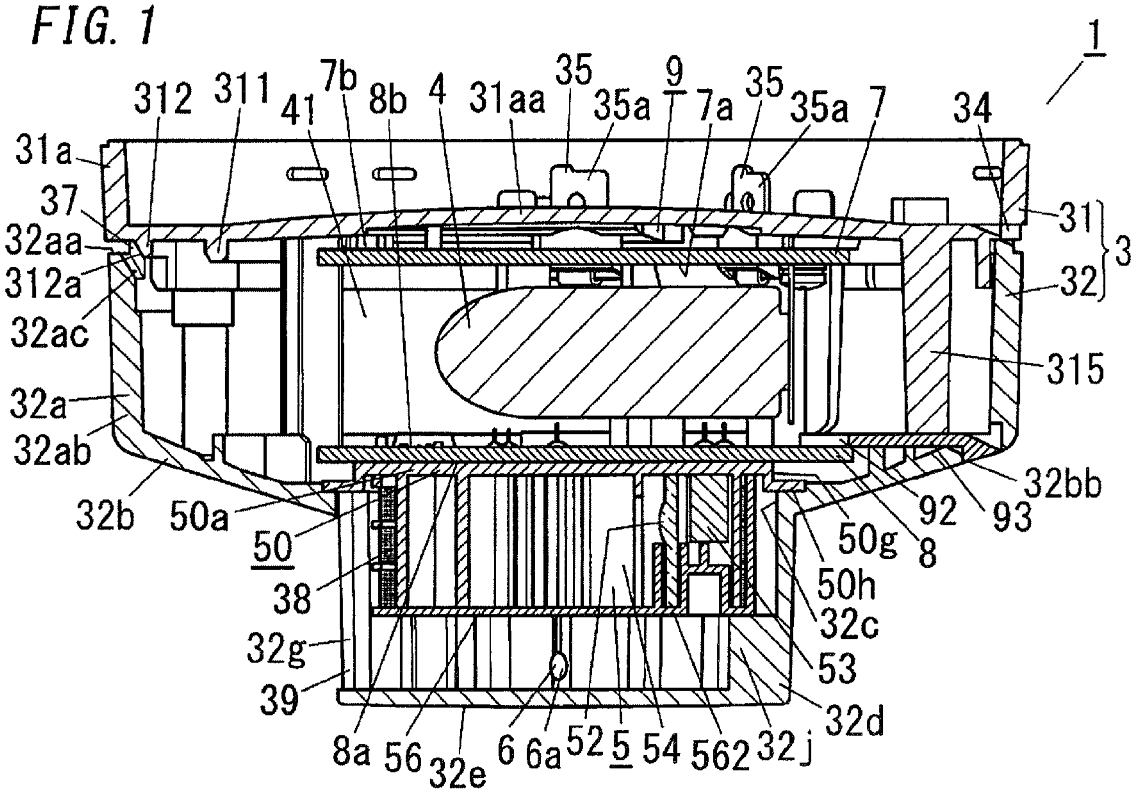
a base (31) comprising a base body (31a) which is made from synthetic resin and shaped like a cylinder having a bottom: and
a cover (32) which disposed at a lower side of the base (31) to cover the carbon monoxide detector (4), the smoke detector (5) and the heat detector (6), the cover (32) being made from synthetic resin, the cover (32) comprising an upper cover (32a) which is shaped like a cylinder having a bottom, and a lower cover (32d) which is shaped like a cylinder having a bottom and protrudes downward from a peripheral part of an opening (32c) in center part of a bottom wall (32b) of the upper cover (32a), the cover (32) integrally comprising spacers (321) which protrude upward from an upper edge (32aa) of the upper cover (32a) so that a distance between a bottom wall (31aa) of the base body (31a) and the upper edge (32aa) becomes a prescribed distance,

the spacers (321) are arranged at regular intervals in a circumferential direction of the upper edge (32aa) of the upper cover (32a),
each carbon monoxide inlet (37) corresponds to a space surrounded by the upper edge (32aa) of the upper cover (32a), the bottom wall (31aa) of the base body (31a), and two spacers (321), adjoining in the peripheral direction of the housing (3), of the spacers (321).

3. The composite fire detector (1) of claim 2, wherein the base (31) comprises reinforcement structures which reinforce the base body (31a) arranged in a radial pattern.

4. The composite fire detector (1) of claim 3, wherein a total number of the carbon monoxide inlets (37) is eight, and
the reinforcement structures are each arranged in eight sector regions each of which is surrounded by a center (O) of the housing (3) and both ends of a spacer (321) between carbon monoxide inlets (37) adjacent to each other in a horizontal section, including the carbon monoxide inlets (37), of the housing (3).

FIG. 1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32ac
32a
32ab
32b
50a
50
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32g
39
8a
56
32e
6
6a
52
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50g
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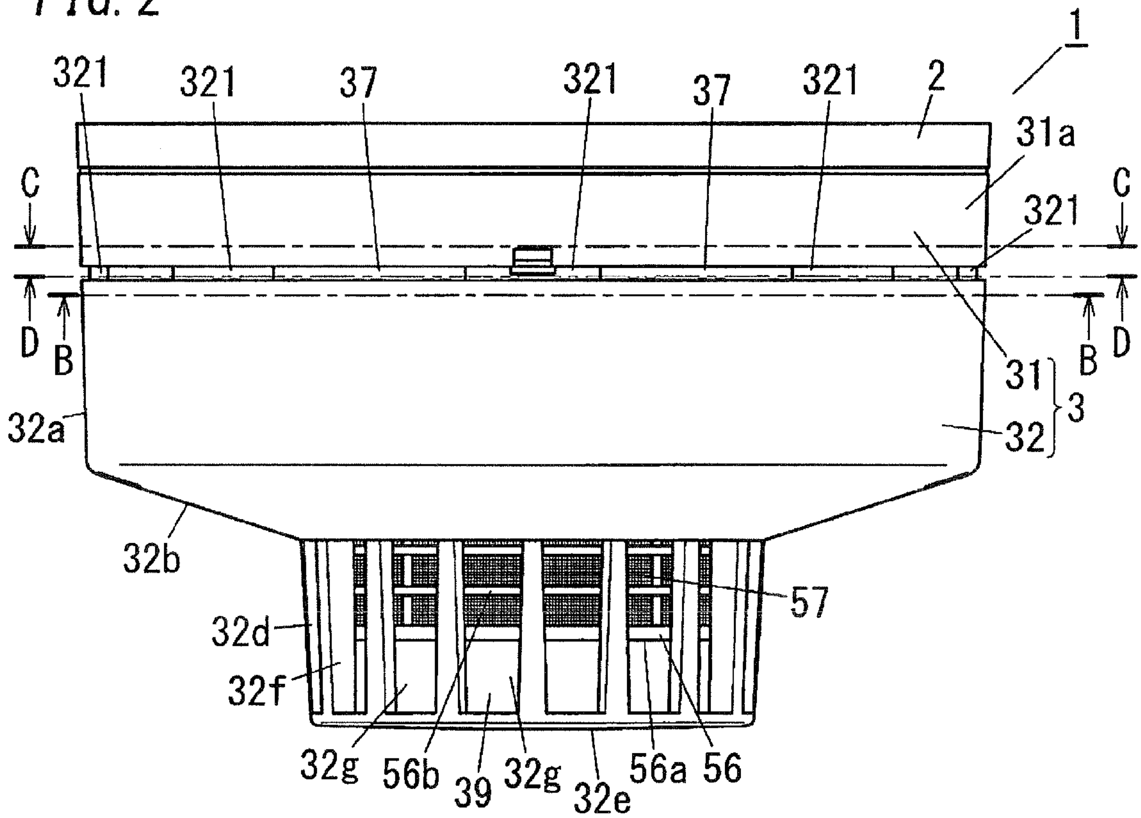
32
3

FIG. 2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37
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37
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C
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321
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32g
32e
56a
56

FIG. 3

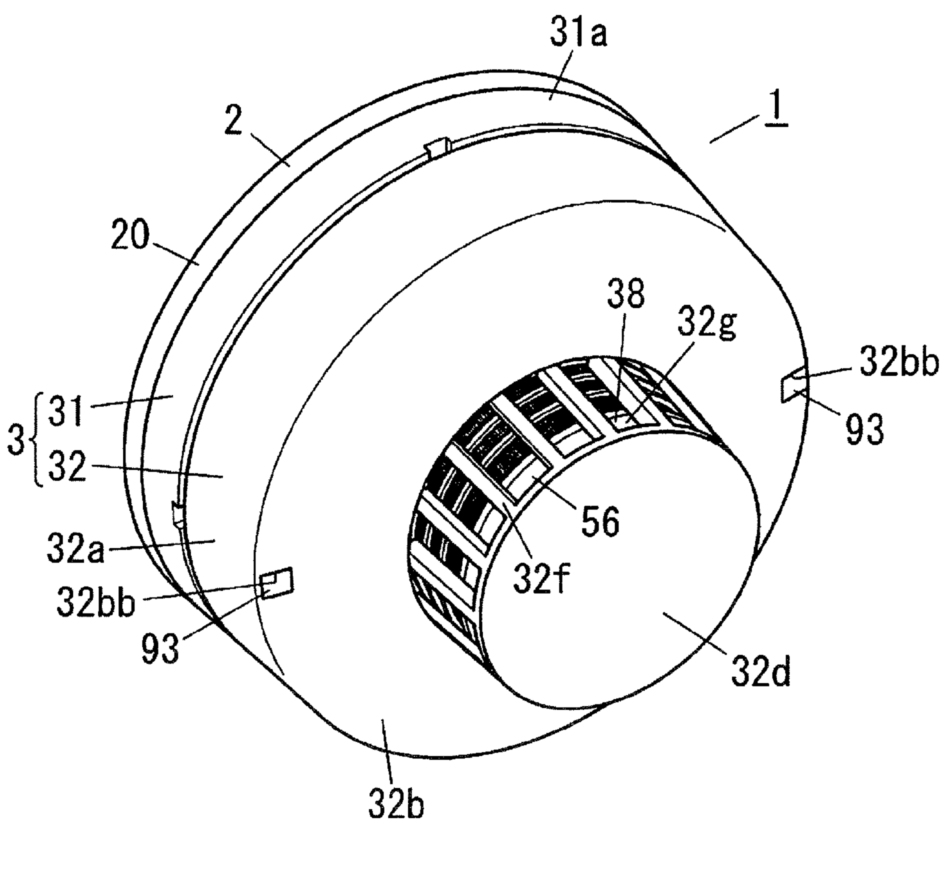
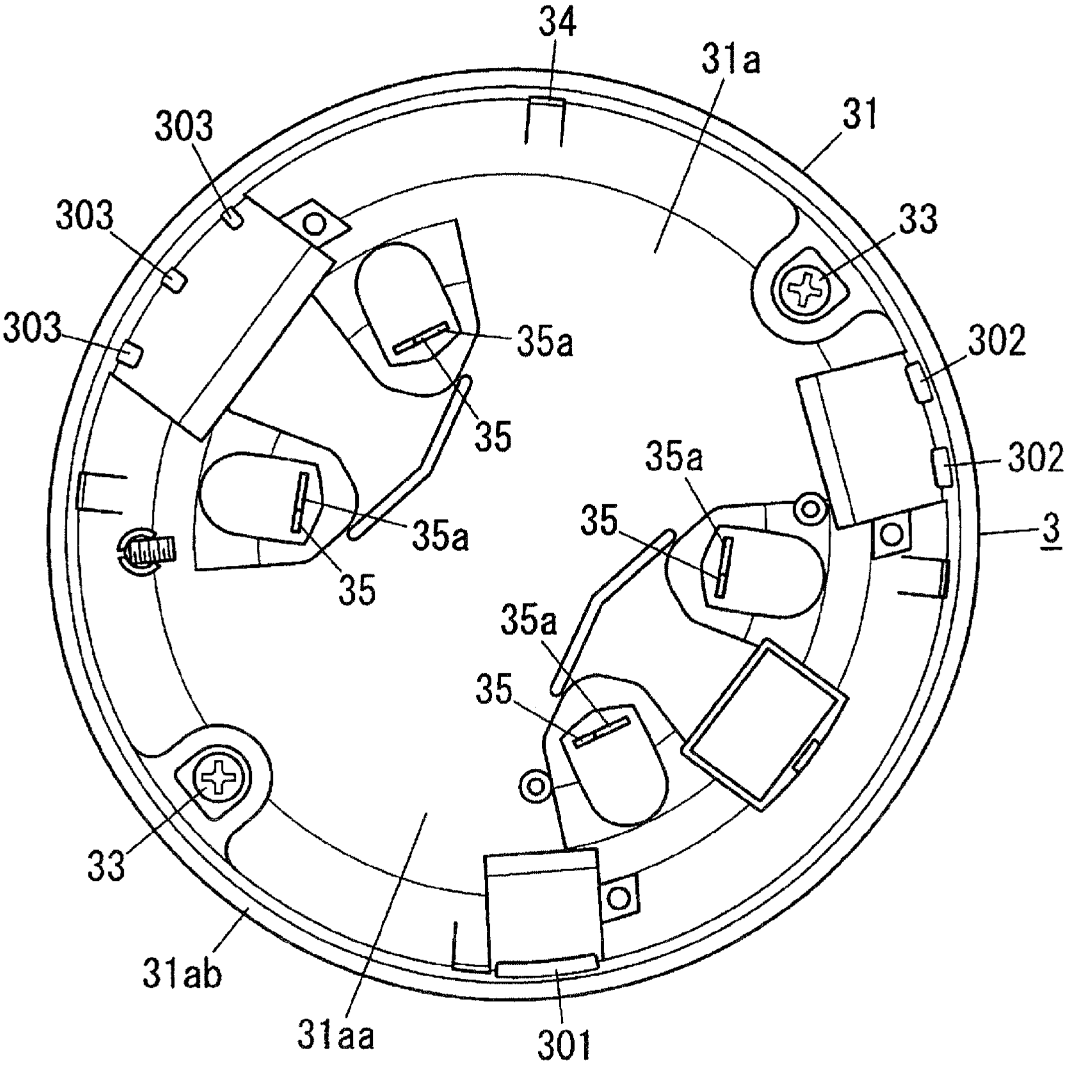


FIG. 4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31aa
301

FIG. 5

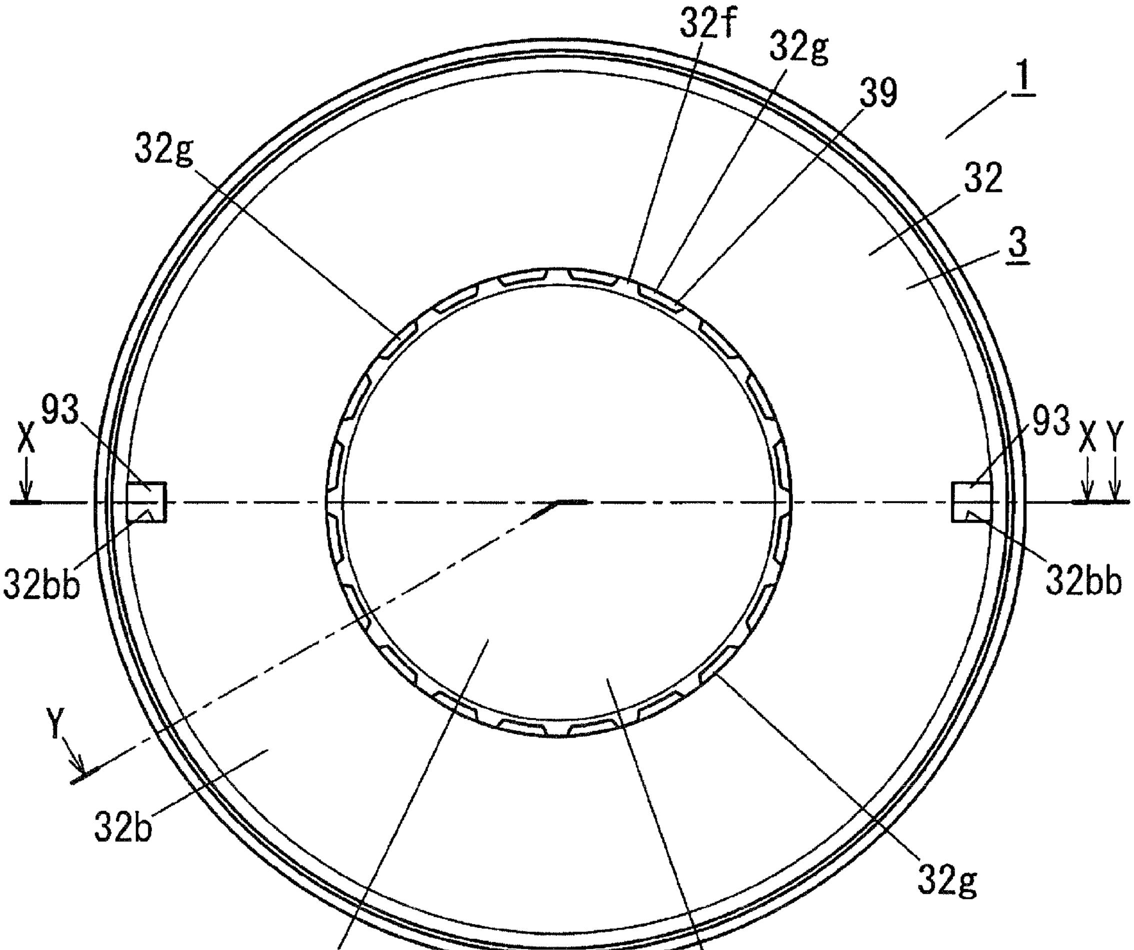
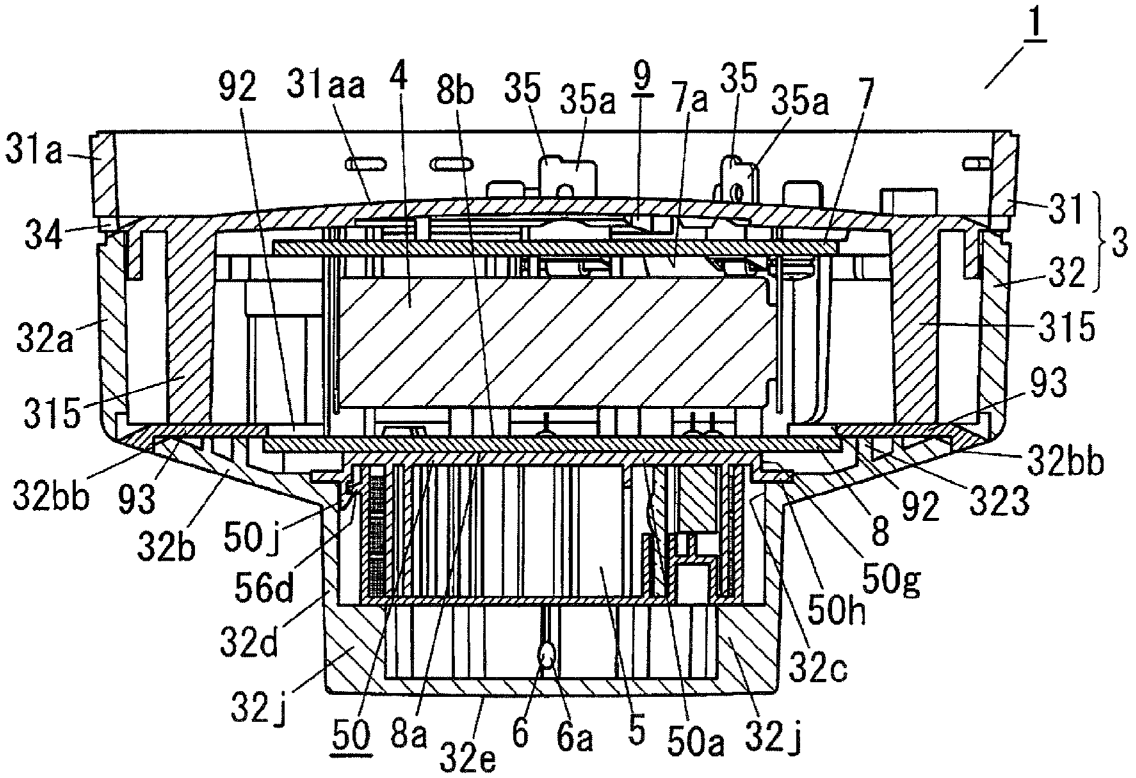


FIG. 6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50j
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6a
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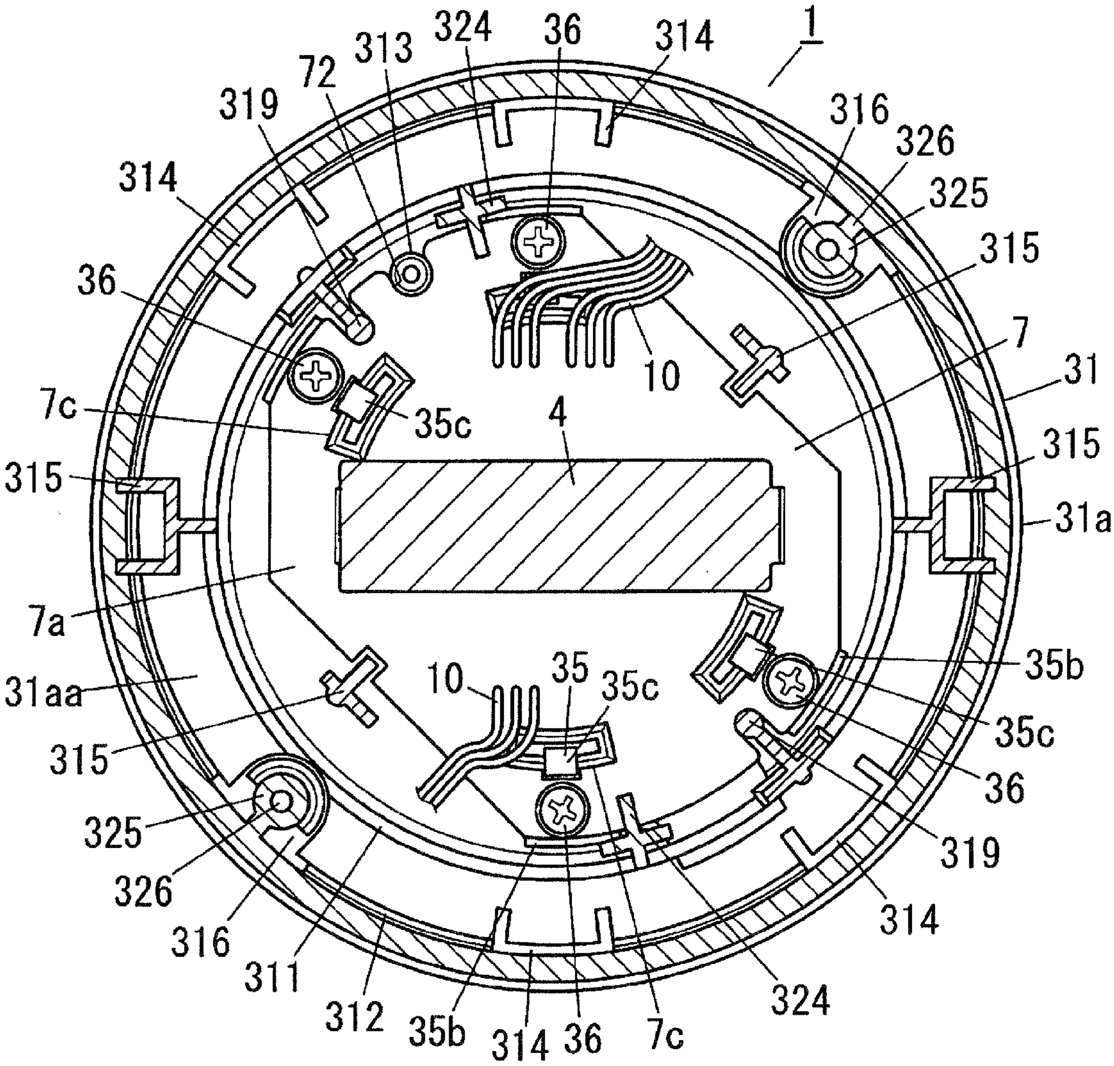
32j

FIG. 7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7a
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31aa
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35b
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FIG. 8

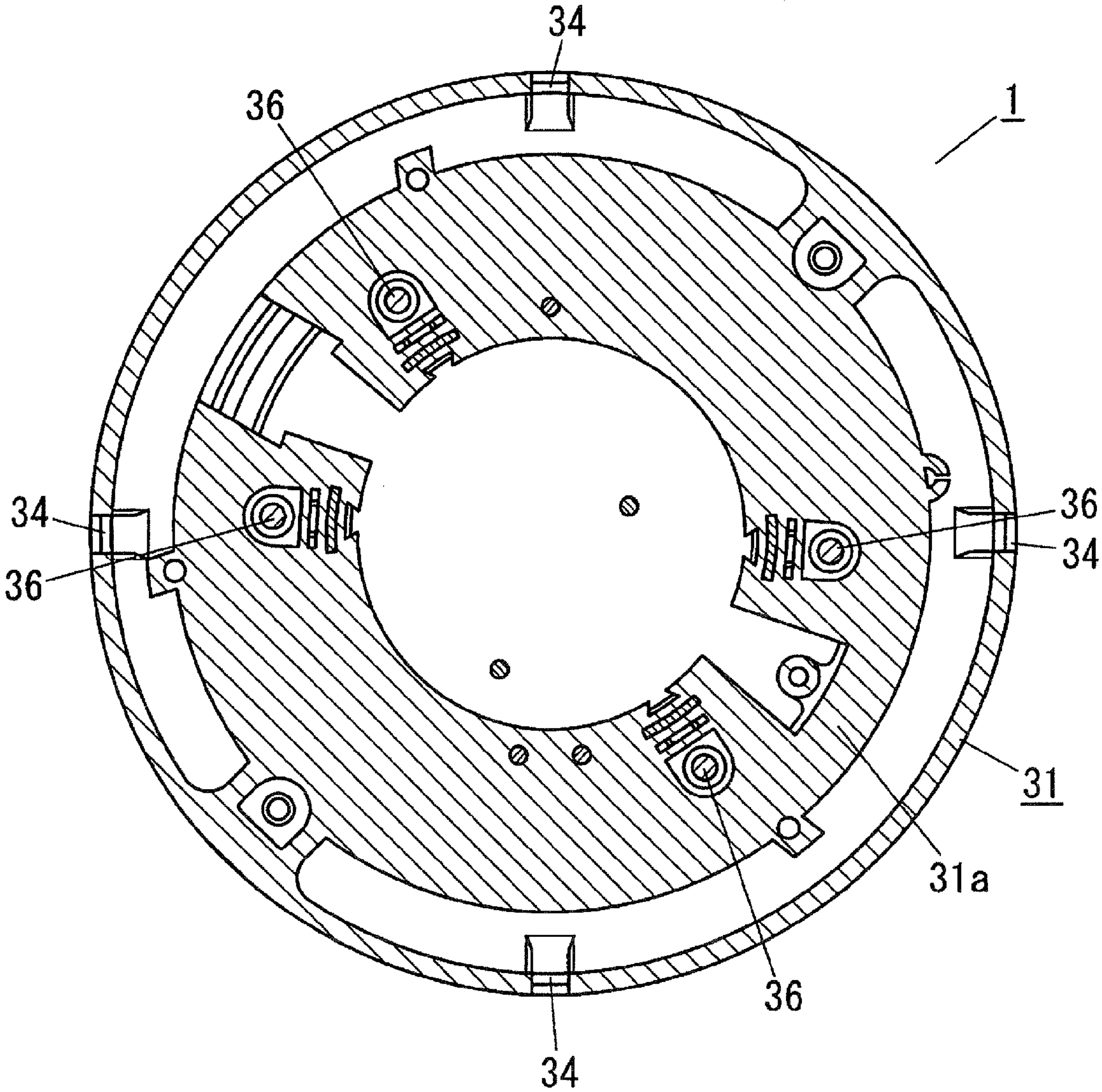
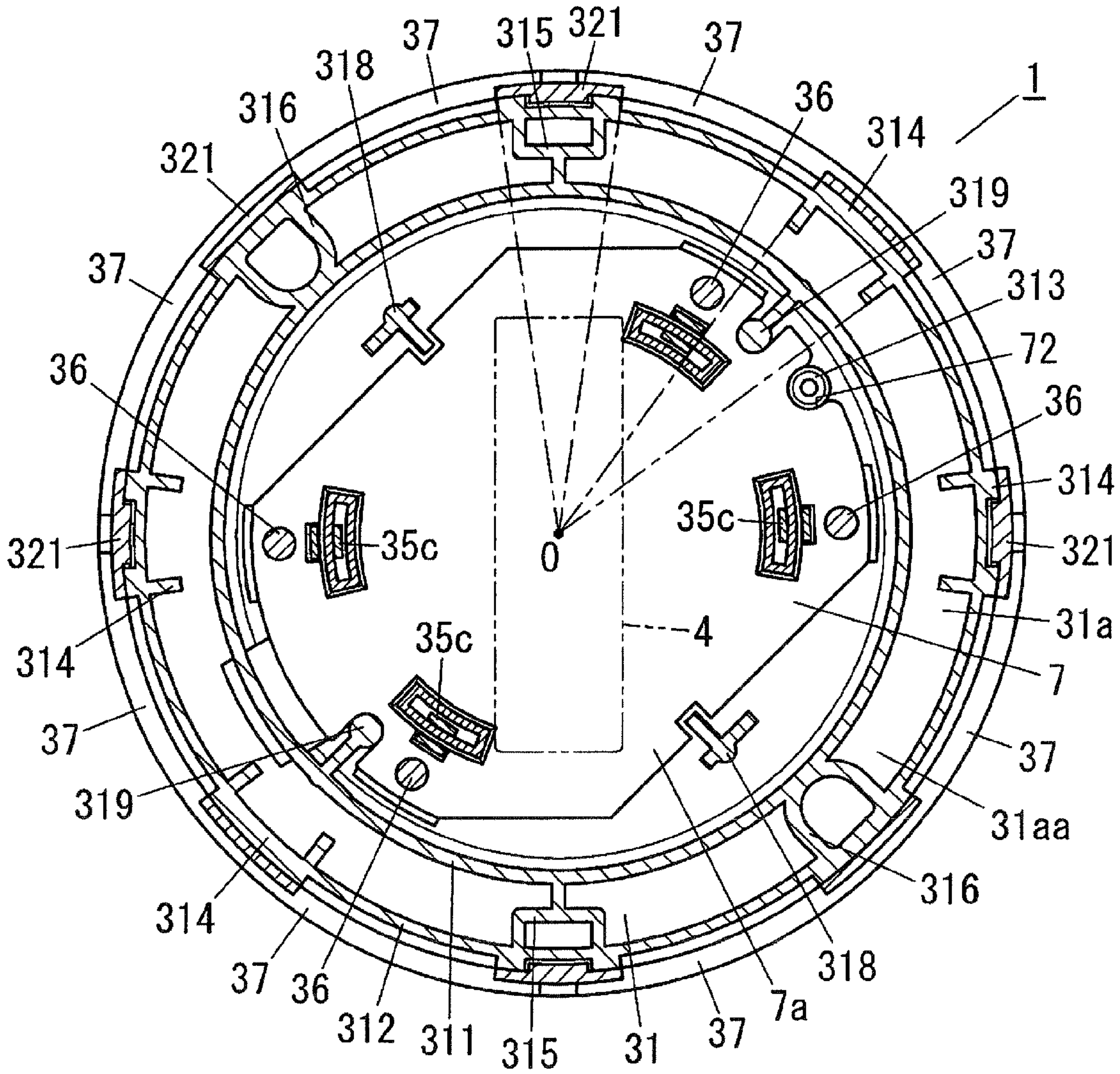


FIG. 9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4
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31
37
7a

FIG. 10A

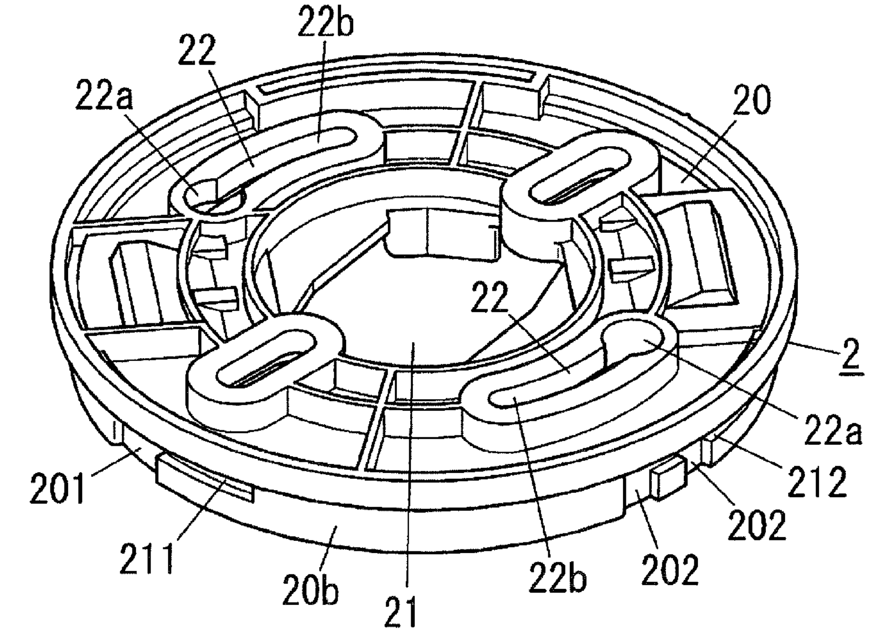


FIG. 10B

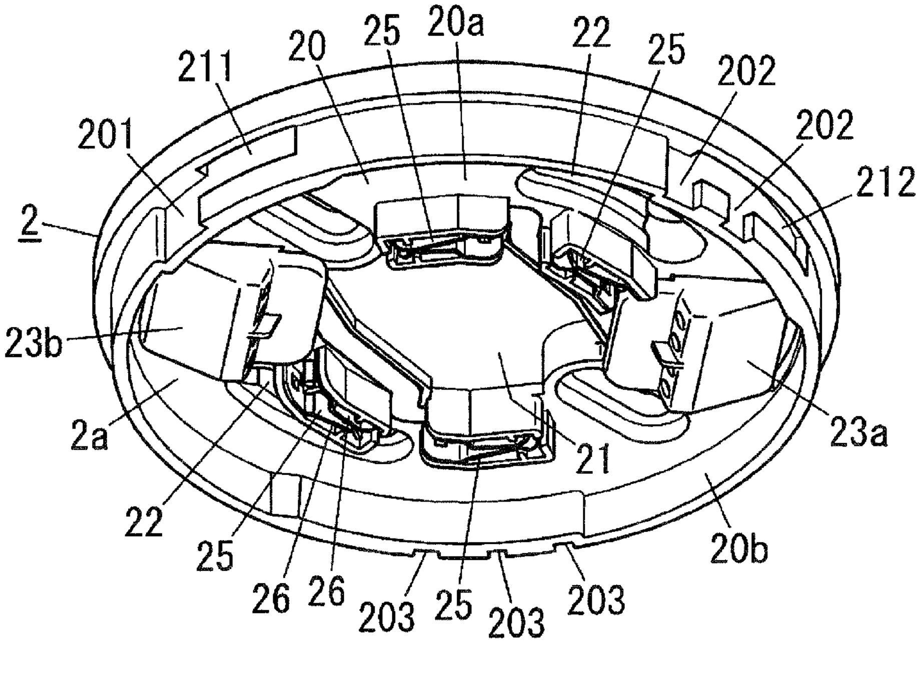
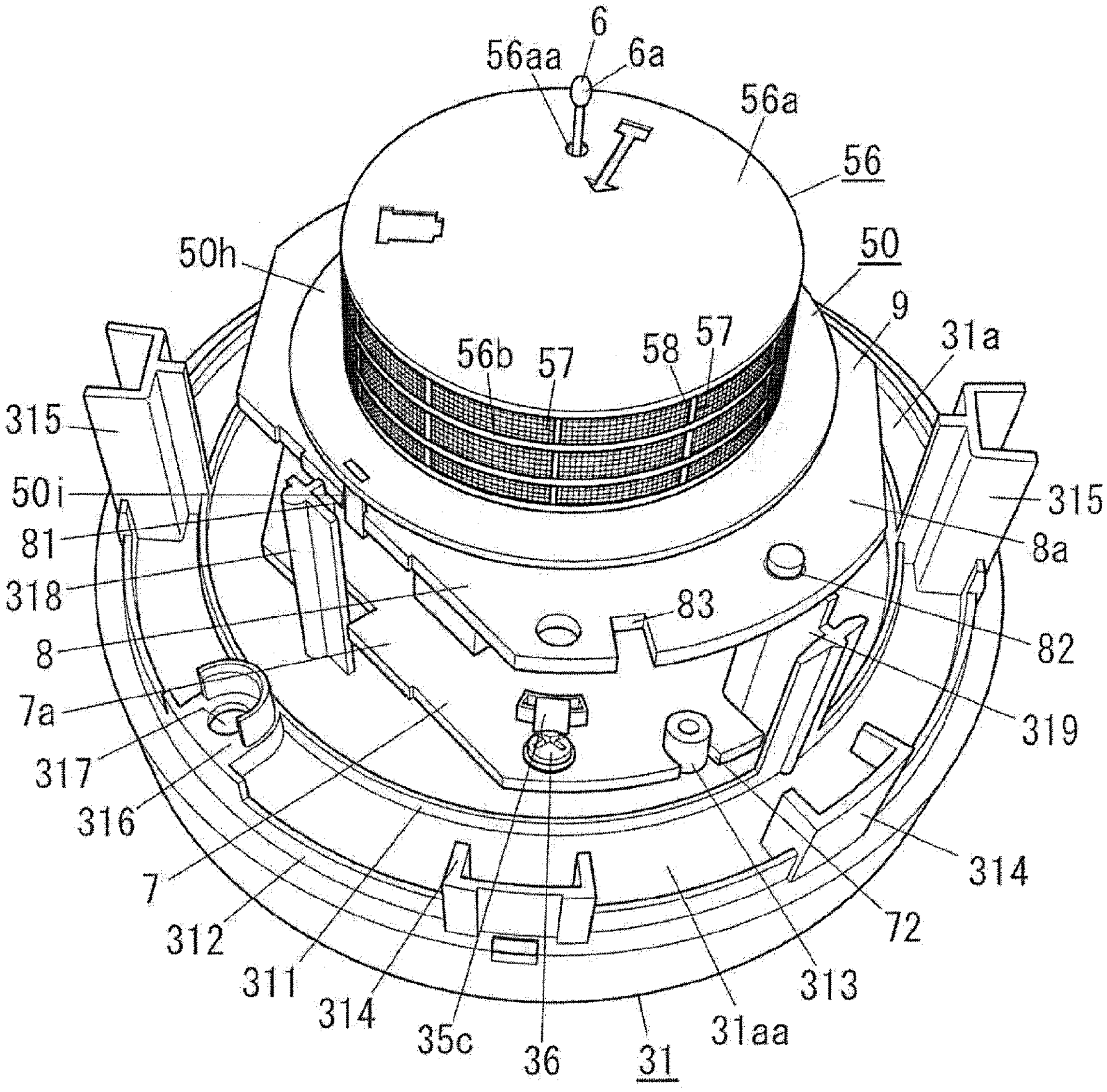


FIG. 11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314
35c
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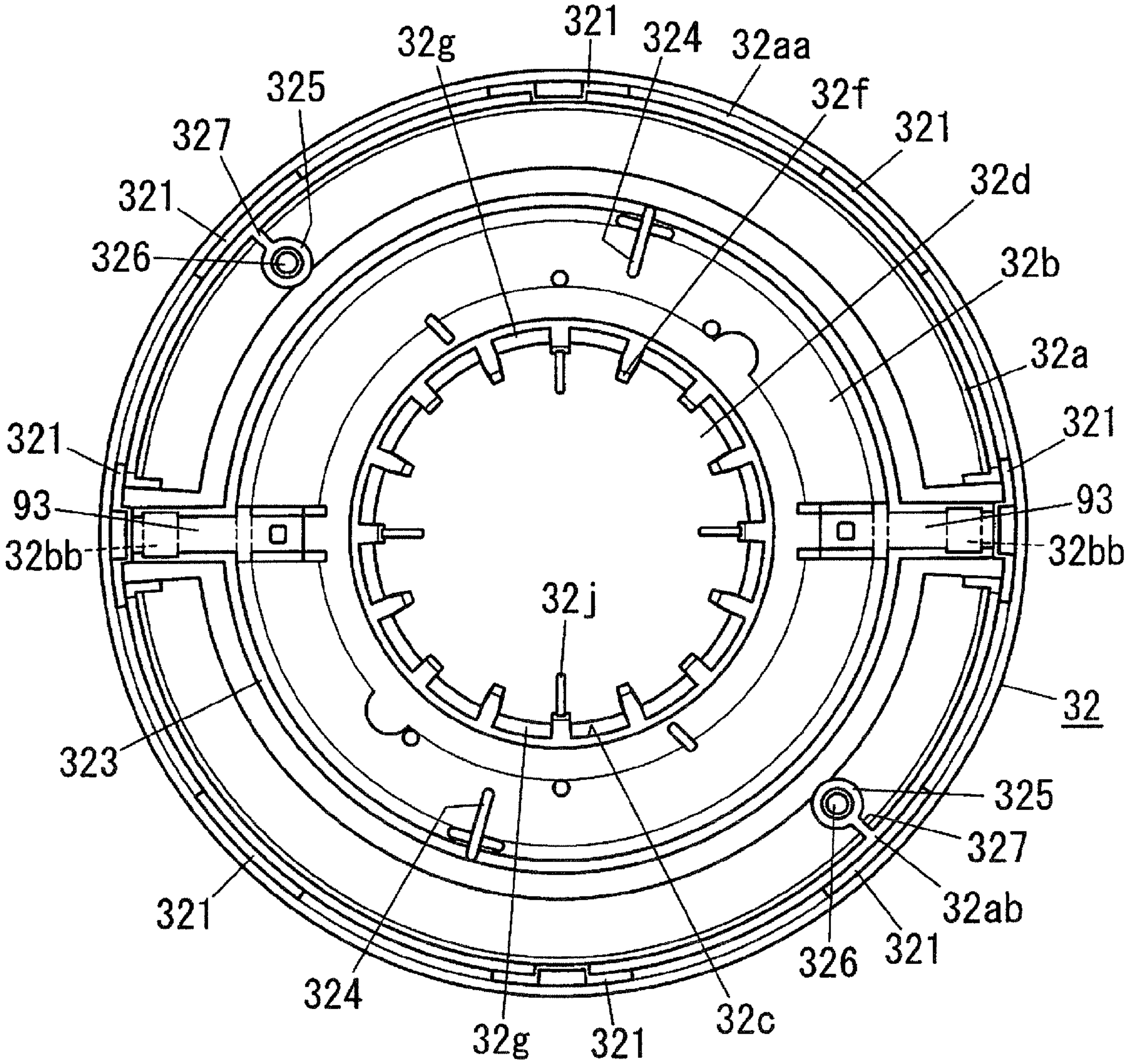
31aa
31

FIG. 12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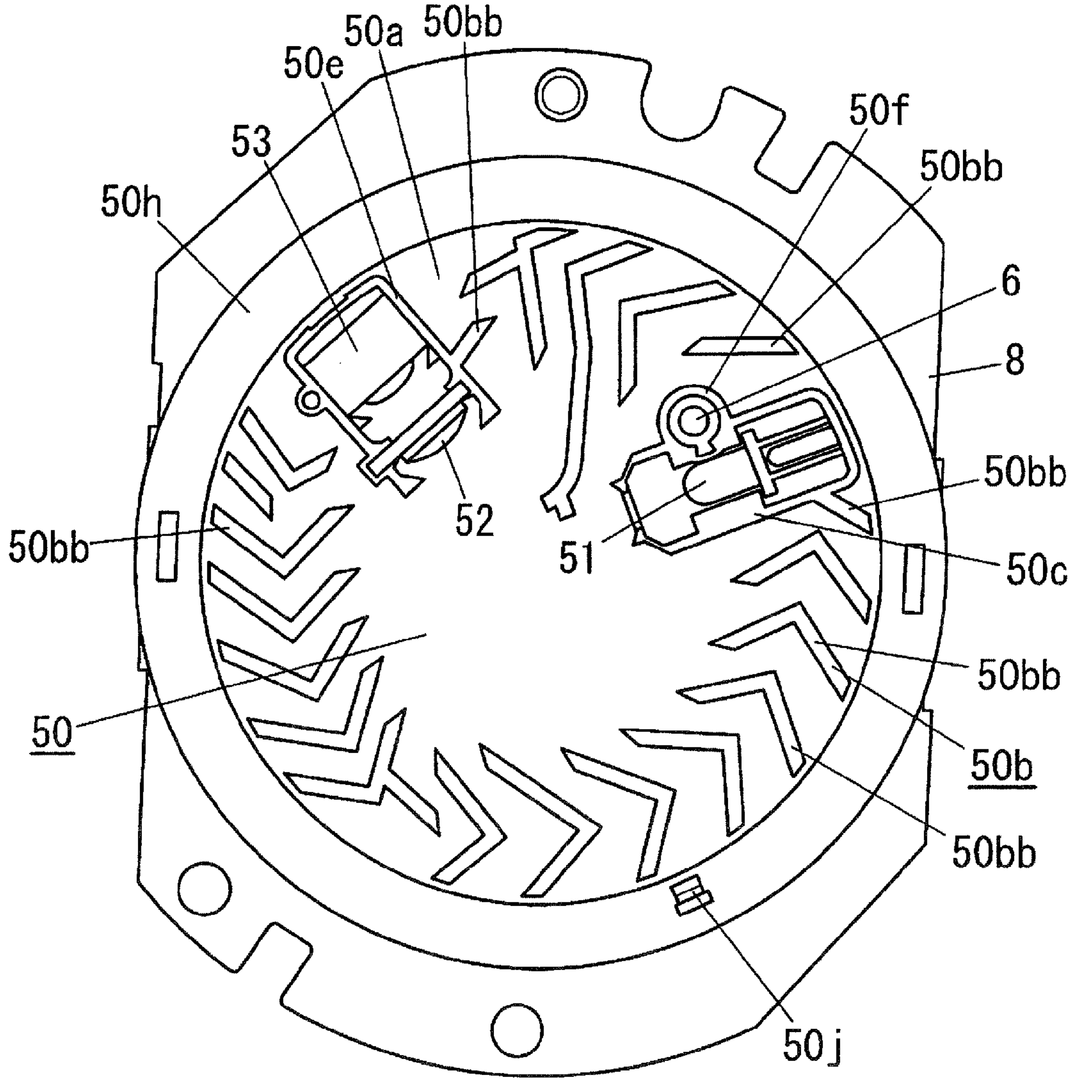
32c

FIG. 13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EUROPEAN SEARCH REPORT

Application Number
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			G08B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	2 July 2015	Fagundes-Peters, D

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