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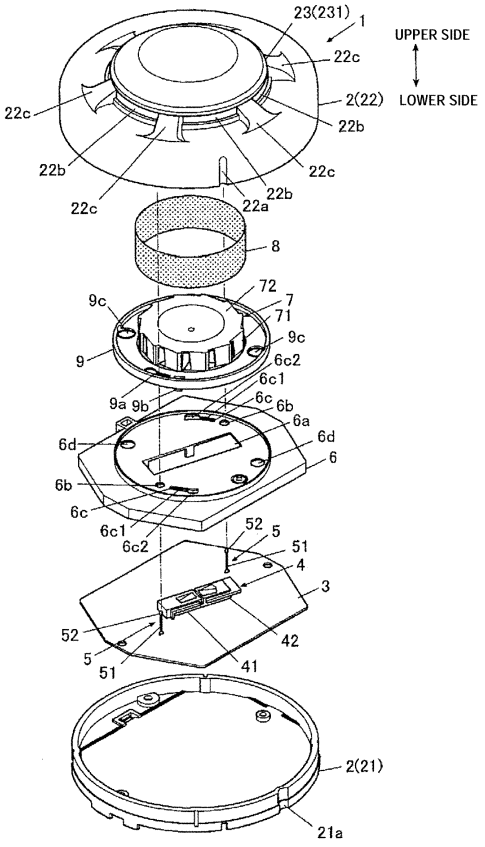
(54) Combined heat and smoke detector

(57) A combined heat and smoke detector is provided. A housing is comprised of a body base and a body case covering an entire upper side of the body base. A circuit substrate is mounted on a top surface of the body base and disposed inside the housing. A smoke detecting portion configured to detect smoke flowing into a dark chamber and a plurality of heat detecting means for detecting heat are disposed inside the housing. The heat detecting means are arranged lateral to the dark chamber.

FIG.1



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Description

BACKGROUND

[0001] The present invention relates to a combined heat and smoke detector capable of detecting fire through heat and smoke.

[0002] A combined heat and smoke detector is capable of detecting heat by means of a heat sensitive element such as thermistor and is capable of detecting smoke by means of a light emitting device for emitting light and a light receiving device for receiving the light emitted from the light emitting device when the light is scattered by the smoke. With using the combined heat and smoke detector, it is possible to early detect all types of fire, e.g., fire simply generating smoke (white smoke) without increasing temperature (smoldering fire), fire simply increasing temperature without generating smoke, and fire increasing temperature and generating smoke (black smoke).

[0003] In the combined heat and smoke detector, in order to enable the heat sensitive element to detect an ascending air current that occurs due to fire with good sensitivity, the heat sensitive element is disposed at the top of a head portion of the detector (at the bottom side of the detector, in a state where the detector is mounted on the ceiling). Specifically, in order to enable the heat sensitive element to detect the ascending air current at the time of fire with good sensitivity, a heat detecting means including the heat sensitive element at the leading end thereof penetrates a dark chamber (a smoke detecting box; a labyrinth portion), such that the leading end of the heat detecting means is projected from the top surface of the dark chamber (for example, refer to JP-A-2001-14570 and JP-A-2001-266265).

[0004] However, since the heat detecting means penetrates the dark chamber such that the leading end of the heat detecting means is projected from the top surface of the dark chamber, the detector becomes thick as much as the projected leading end of the heat detecting means. It prevents reduction in thickness of the detector.

SUMMARY

[0005] It is therefore an object of the present invention to provide a combined heat and smoke detector capable of reducing the thickness thereof while maintaining good sensitivity for detecting heat.

[0006] In order to achieve the above described object, according to an aspect of the present invention, there is provided a combined heat and smoke detector, comprising: a housing comprised of a body base and a body case covering an entire upper side of the body base; a circuit substrate mounted on a top surface of the body base and disposed inside the housing; a smoke detecting portion configured to detect smoke flowing into a dark chamber and disposed inside the housing; and a plurality of heat detecting means for detecting heat, the plurality of heat detecting means disposed inside the housing, wherein the plurality of heat detecting means are arranged lateral to the dark chamber.

[0007] With this configuration, since the heat detecting means are arranged lateral to the dark chamber, it is possible to reduce the thickness of the detector.

[0008] In addition, since a plurality of heat detecting means are provided, the detector does not have a specific directionality in the heat detecting sensitivity. Accordingly, it is possible to detect heat with good sensitivity.

[0009] Since the heat detecting means are arranged lateral to the dark chamber, manufacturing costs can be reduced, and design improvement can be expected.

[0010] In addition to the combined heat and smoke detector, there is a smoke detector as a type of a detector. The smoke detector does not include the heat detecting means. Since the heat detecting means penetrates the dark chamber such that the leading end thereof is projected from the top surface of the dark chamber in the conventional combined heat and smoke detector, a body case of the smoke detector may not be used for the body case of the combined heat and smoke detector. Thus, in order to provide the body case of the combined heat and smoke detector, it is necessary to modify the design of the body case of the smoke detector so as to enable the heat detecting means with the leading end projected from the top surface of the dark chamber to detect heat with good sensitivity. In the combined heat and smoke detector according to the present invention, to the contrary, since the heat detecting means do not penetrate the dark chamber and are arranged lateral to the dark chamber, the body case of the smoke detector which does not have the heat detecting means may be used for the body case of the combined heat and smoke detector. Further, components of the smoke detector other than the body case, with or without a simple modification, may also be used for components of the combined heat and smoke detector according to the present invention. Thus, manufacturing processes can be simplified, thereby reducing manufacturing costs. Since the design of the combined heat and smoke detector according to the present invention can be unified with the design of the smoke detector, design improvement can be expected.

[0011] In the combined heat and smoke detector, the plurality of heat detecting means may be connected to the circuit substrate and upwardly projected from the circuit substrate such that a leading end of each of the plurality of heat detecting means is positioned below a top surface of the dark chamber.

[0012] With this configuration, since the leading end of the heat detecting means is positioned below the top surface of the dark chamber, it is possible to reduce the thickness of the detector.

[0013] In the combined heat and smoke detector, the body case may be formed with a smoke intake at a position facing a lateral surface of the dark chamber, and one of the heat detecting means may be disposed between the dark chamber and the smoke intake.

[0014] With this configuration, since the one of the heat detecting means is disposed between the dark chamber and the smoke intake, a thermal air current flowing through the smoke intake can easily reach the heat detecting means directly, thereby detecting heat with good sensitivity.

[0015] In the combined heat and smoke detector, the smoke intake may have a shape for protecting the heat detecting means.

[0016] With this configuration, it is possible to prevent problems such as destruction of the heat detecting means.

[0017] In the combined heat and smoke detector, each of the plurality of heat detecting means may include a leg portion connected to the circuit substrate and upwardly projected from the circuit substrate and a heat sensitive element provided at a leading end of the leg portion, and the heat sensitive element may be disposed at a position higher than a center of the smoke intake in a vertical direction.

[0018] With this configuration, since the heat sensitive element is disposed at a position higher than the center of the smoke intake in the vertical direction, a proportion of a portion of the leg portion, which comes into contact with the thermal air current flowing into the housing increases compared to a case where the heat sensitive element is disposed at a position lower than the center of the smoke intake in the vertical direction. Thus, the entire heat detecting means is easily warmed so that it is possible to detect heat with good sensitivity.

[0019] In the combined heat and smoke detector, an interior space of the housing between an inner wall of the body case and an outer wall of the dark chamber may have a smoothly curved shape so as not to interrupt a thermal air current flowing into the interior space of the housing.

[0020] With this configuration, since a thermal air current or smoke smoothly flows in the interior space of the housing, it is possible to detect heat or smoke with good sensitivity.

[0021] In the combined heat and smoke detector, the body case may be provided with a smoke intake fin configured to guide smoke into an interior space of the housing, and the smoke intake fin may function as a rectifying fin configured to converge a thermal air current into the interior space of the housing.

[0022] With this configuration, since smoke and a thermal air current can effectively flow into the interior space of the housing with a smoke intake fin, it is possible to detect heat or smoke with good sensitivity.

[0023] The combined heat and smoke detector may further comprise: a shield case mounted on the body base, the shield case covering an entire top surface of the circuit substrate; and an extension portion integrally formed with the dark chamber, the extension portion laterally extending from a bottom end of the dark chamber. One of the heat detecting means may be upwardly projected to be inserted into a penetration hole portion formed in the shield case and an inserted portion formed in the extension portion. The dark chamber may be mounted on the shield case by rotation of the dark chamber relative to the shield case in a state where the one of the heat detecting means is inserted into the inserted portion. The inserted portion may have such a shape that one portion thereof, into which the one of the heat detecting means is inserted after the rotation and the other portion thereof, into which the one of the heat detecting means is inserted prior to the rotation are continued to each other. The one portion into which the one of the heat detecting means is inserted after the rotation may be narrower than the other portion into which the one of the heat detecting means is inserted prior to the rotation, and the penetration hole portion may be wider than the one portion into which the one of the heat detecting means is inserted after the rotation.

[0024] With this configuration, since one portion of an inserted portion, into which the one of the heat detecting means is inserted after the rotation of the dark chamber, is narrower than the other portion of the inserted portion, into which the one of the heat detecting means is inserted prior to the rotation of the dark chamber, the dark chamber can be easily mounted on the shield case. Thus, at the time of manufacturing, the detector can be easily assembled. In addition, since the one portion of the inserted portion of the extension portion, into which the one of the heat detecting means is inserted after the rotation of the dark chamber is narrower than the penetration hole portion of the shield case, the most part of the penetration hole portion is blocked by the extension portion, and thus dust or the like is unlikely to enter into the inside of the shield case.

[0025] According to the present invention, since the heat detecting means are arranged lateral to the dark chamber, it is possible to reduce the thickness of the detector.

[0026] In addition, since a plurality of heat detecting means are provided, it is possible to detect heat with good sensitivity even though the leading end of the heat detecting means is not projected from the top surface of the dark chamber.

[0027] Since the heat detecting means are arranged lateral to the dark chamber, components of the smoke detector, with or without a simple modification, can be used for components of the combined heat and smoke detector according to the present invention. Accordingly, manufacturing processes can be simplified, thereby reducing manufacturing costs.

[0028] Since the design of the combined heat and smoke detector according to the present invention can be unified with the design of the smoke detector, design improvement can be expected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] In the accompanying drawings:

Fig. 1 is an exploded perspective view of a combined heat and smoke detector according to an embodiment of the present invention;
Fig. 2 is a side view of the combined heat and smoke detector illustrated in Fig. 1;
Fig. 3 is a top plan view of the combined heat and smoke detector illustrated in Fig. 1;
Fig. 4 is a cross-sectional view taken along a line A-A illustrated in Fig.3;
Fig. 5 is a cross-sectional view taken along a line B-B illustrated in Fig. 3;
Fig. 6 is a cross-sectional view taken along a line C-C illustrated in Fig. 3;
Fig. 7 is a bottom view of a dark chamber and an extension portion integrally formed with the dark chamber of the combined heat and smoke detector illustrated in Fig. 1;
Fig. 8 is a top plan view of the combined heat and smoke detector illustrated in Fig. 1 in a state where a body case is detached; and
Fig. 9 is a perspective view of a combined heat and smoke detector according to a modified embodiment of the present invention in a state where a housing is detached.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0030] Hereinafter, an embodiment of the present invention will be described with reference to the accompanying drawings. The scope of the present invention is not limited to the embodiment illustrated in the drawings.

[0031] A combined heat and smoke detector 1 (hereinafter referred to as the "detector 1") according to an embodiment of the present invention is a fire detector capable of detecting heat generated due to the fire and smoke generated due to the fire. The detector 1 is configured to be installed on a ceiling surface of a building.

[0032] In the descriptions below, a side attached to the ceiling surface when the detector 1 is installed on the ceiling surface of the building is referred to as a lower side, and a side opposite to the side attached to the ceiling surface when the detector 1 is installed on the ceiling surface of the building is referred to as an upper side.

[0033] As illustrated in Fig. 1, the detector 1 includes a body base 21, a circuit substrate 3, an optical element portion 4, heat detecting means 5, a shield case 6, a dark chamber 7, an insect screen 8, and a body case 22.

[0034] Specifically, as illustrated in Fig. 1 or 2, a housing 2 of the detector 1 is comprised of the body base 21 and the body case 22 covering the entire upper side of the body base 21. The housing of the detector 1 has a substantially circular shape.

[0035] The circuit substrate 3, the optical element portion 4, the heat detecting means 5, the shield case 6, the dark chamber 7, and the insect screen 8 are disposed inside the housing 2.

[0036] The body base 21 constitutes the lower side of the housing 2 of the detector 1. The bottom surface of the body base 21 has an engagement piece to be connected to an attachment base (not illustrated) which is pre-installed on the ceiling surface to fix the detector 1 onto the ceiling surface. As illustrated in Fig. 1, the outer periphery of the body base 21 has a predetermined number of concaves 21a (one concave in the embodiment) to position the body case 22 to the body base 21.

[0037] As illustrated in Fig. 1, 4, or 5, the circuit substrate 3 is mounted on the top surface of the body base 21. The circuit substrate 3 is fixed to the body base with screws.

[0038] Predetermined electronic circuits (not illustrated) to control the operation of the detector 1 are mounted on the circuit substrate 3.

[0039] As illustrated in Fig. 1, 4, or 5, the optical element portion 4 is mounted at a position on the circuit substrate 3, which corresponds to the interior side (bottom interior side) of the dark chamber 7.

[0040] Specifically, the optical element portion 4 includes light emitting means 42 and light receiving means 41, which are disposed on the top surface of the circuit substrate 3 to detect smoke.

[0041] The light emitting means 42 is a light emitting device which is connected to the circuit substrate 3 and periodically generates light under the control by the circuit substrate 3.

[0042] The light receiving means 41 is a light receiving device which is connected to the circuit substrate 3 and transmits a reception signal to the circuit substrate 3.

[0043] As illustrated in Fig. 5, the light emitting device 42 is configured to emit light traveling in an obliquely upward direction. The light receiving means 41 is configured to receive the light traveling in an obliquely downward direction. With this configuration, the light emitted from the light emitting means 42 is not directly received by the light receiving means 41.

[0044] The heat detecting means 5 detect heat. As illustrated in Fig. 1, the heat detecting means 5 are arranged lateral to the dark chamber 7. The heat detecting means 5 are connected to the circuit substrate 3 so as to face each other across the optical element portion 4. The heat detecting means 5 are upwardly projected from the circuit substrate 3. The leading end of each heat detecting means 5 is positioned below the top surface of the dark chamber 7.

[0045] Specifically, each of the heat detecting means 5 includes a leg portion 51 which is connected to the circuit substrate 3 and upwardly projected from the circuit substrate 3, and a heat sensitive element 52 such as a thermistor provided at the leading end of the leg portion 51. The leg portion 51 is an electric wire coated with insulating material. The leg portion 51 supports the heat sensitive element 52 and electrically connects the heat sensitive element 52 to the circuit substrate 3.

[0046] Two heat detecting means 5 are provided in the embodiment. However, the present invention is not limited to the embodiment. Three or more heat detecting means 5 may be provided.

[0047] As illustrated in Fig. 1, 4 or 5, the shield case 6 is mounted on the body base 21 with claws (not illustrated) and covers the entire top surface of the circuit substrate 3.

[0048] Substantially the center of the shield case 6 has an exposure hole portion 6a for exposing the top surface of the optical element portion 4.

[0049] The shield case 6 has a predetermined number of penetration hole portions 6b (two in the embodiment) at positions corresponding to the heat detecting means 5. The penetration hole portions 6b are configured to insert the heat detecting means 5 therethrough.

[0050] The shield case 6 has a predetermined number of engagement hole portions 6c (two in the embodiment) at positions corresponding to claw portions 9b (described later) provided in an extension portion 9 integrally formed with the dark chamber 7. The engagement hole portions 6c are configured to engage with the claw portions 9b.

[0051] The shield case 6 has a predetermined number of hole portions 6d (two in the embodiment) at positions corresponding to light incidence portions 232 (described later). The hole portions 6d are configured to insert the light incidence portions 232 therethrough.

[0052] The circular portion substantially in the center of the shield case 6 is projected in an upward direction.

[0053] A diameter of the projected circular portion is substantially the same as a diameter of the extension portion 9 (described later) integrally formed with the dark chamber 7. This configuration facilitates positioning the dark chamber 7 to the shield case 6 when mounting the dark chamber 7 on the shield case 6.

[0054] The projected circular portion has the exposure hole portion 6a, the penetration hole portions 6b, the engagement hole portions 6c, and the hole portions 6d.

[0055] As illustrated in Figs. 1, 4 and 5, the dark chamber 7 is mounted substantially in the center of the shield case 6 with the extension portion 9 integrally formed with the dark chamber 7 and laterally extending from the bottom end of the dark chamber 7.

[0056] Specifically, as illustrated in Figs. 1 and 7, the dark chamber 7 includes a labyrinth portion 71 comprised of a plurality of shielding walls 711 with L-shaped cross-sections and having a substantially cylindrical shape, and a cover portion 72 covering the top surface of the labyrinth portion 71. The region in the dark chamber 7 surrounded by the shielding walls 711 and the cover portion 72 is a smoke detecting region.

[0057] In the embodiment, in consideration of enabling smoke to effectively flow into the dark chamber 7, the labyrinth portion 71 has a substantially cylindrical shape. However, the present invention is not limited to the embodiment. For example, the labyrinth portion 71 may have a substantially square container shape.

[0058] The wall portion of the dark chamber 7 is formed by the labyrinth portion 71. Accordingly, in a state where the dark chamber 7 is mounted on the shield case 6, smoke flowing into the interior space of the housing 2 is introduced into the inside of the dark chamber 7 along the shielding wall 711, while exterior light cannot be introduced into the inside of the dark chamber 7. The light emitting means 42 of the optical element portion 4 is configured to emit light traveling in an obliquely upward direction. The light receiving means 41 is configured to receive light traveling in an obliquely downward direction. The top surfaces of the light emitting means 42 and the light receiving means 41 are exposed through the exposure hole portions 6a of the shield case 6. With this configuration, the light generated from the light emitting means 42 enters into the inside of the dark chamber 7. When the light is scattered by smoke flowing into the dark chamber 7, the light receiving means 41 can receive the scattered light.

[0059] In other word, the dark chamber 7, and the light emitting means 42 and the light receiving means 41 which are disposed inside the dark chamber 7 constitute a smoke detecting portion for detecting smoke flowing into the dark chamber 7. When the light generated from the light emitting means 42 is scattered by smoke flowing into the dark chamber 7, the light receiving means 41 receives the scattered light, thereby detecting smoke.

[0060] The extension portion 9 has a predetermined number of inserted portions 9a (two in the embodiment) at positions corresponding to the heat detecting means. The inserted portions 9a are configured to insert the heat detecting means 5 therethrough.

[0061] The extension portion 9 has a predetermined number of claw portions 9b (two in the embodiment) at positions corresponding to the engagement hole portions 6c formed in the shield case 6. The claw portions 9b are downwardly projected.

[0062] The extension portion 9 has a predetermined number of hole portions 9c (two in the embodiment) at positions corresponding to the light incidence portions 232 (described later) of the guide member 23. The hole portions 9c are configured to insert the light incidence portions 232 therethrough.

[0063] The dark chamber 7 is configured to be mounted on the shield case 6 in the manner that in the state that the heat detecting means 5 are inserted into the inserted portions 9a formed in the extension portion 9, and the claw portions 9b formed in the extension portion 9 are inserted into the engagement hole portions 6c formed in the shield case 6, the dark chamber 7 (or the extension portion 9) is rotated relative to the shield case 6 around a rotation axis in a vertical direction until the claw portions 9b are engaged into the engagement hole portions 6c.

[0064] Specifically, each of the claw portions 9b has a substantial L shape such that the leading end thereof is projected toward the outside.

[0065] For example, as illustrated in Fig. 1, the engagement hole portion 6c of the shield case 6 has such a shape that an engagement portion 6c1 into which the base end section of the claw portion 9b can be inserted but the leading end section of the claw portion 9b cannot be inserted and an insertion portion 6c2 into which the leading end section of the claw portion 9b can be inserted

are connected to each other in the direction of the rotation of the dark chamber 7.

[0066] When the dark chamber 7 is mounted on the shield case 6, the claw portions 9b are inserted into the insertion portions 6c2 of the engagement hole portions 6c. In that state, the dark chamber 7 is rotated until the claw portions 9b are engaged into the engagement hole portions 6c (i.e., until the claw portions 9b reach the engagement portions 6c1 of the engagement hole portions 6c), such that the dark chamber 7 is mounted on the shield case 6.

[0067] As illustrated in Figs. 7 and 8, the inserted portion 9a has such a shape that a small diameter portion 9a1 which has a slightly larger diameter than the leg portion 51 of the heat detecting means 5 and a large diameter portion 9a2 which has a larger diameter than the small diameter portion 9a1 are continued to each other in the direction of the rotation of the dark chamber 7 to form a substantial gourd shape.

[0068] In the state prior to the rotation of the dark chamber 7, the heat detecting means 5 are inserted into the large diameter portions 9a2. In the state after the rotation of the dark chamber 7 (i.e., the state that the claw portions 9b of the extension portion 9 are engaged into the engagement hole portions 6c of the shield case 6 such that the dark chamber 7 is mounted on the shield case 6), the heat detecting means 5 are inserted into the small diameter portions 9a1. In other words, when the dark chamber 7 is mounted on the shield case 6, the heat detecting means 5 are inserted into the large diameter portions 9a2 of the inserted portions 9a. In that state, the dark chamber 7 is rotated such that the dark chamber 7 is mounted on the shield case 6. With this configuration, the heat detecting means 5 can be easily inserted into the inserted portions 9a so that when manufacturing the detector, the detector can be easily assembled.

[0069] The small diameter portion 9a1 has a smaller diameter than a diameter of the penetration hole portion 6b of the shield case 6. With this configuration, as illustrated in Fig. 8, the most part of the penetration hole portion 6b of the shield case 6 is blocked by the extension portion 6 in the state that the dark chamber 7 is mounted on the shield case 6. Accordingly, dust or the like is unlikely to enter into the inside of the shield case 6.

[0070] The shape of the inserted portion 9a is not limited to the substantial gourd shape. The inserted portion 9a may have any shape as long as a portion of the inserted portion 9a, into which the heat detecting means 5 is inserted after the rotation of the dark chamber 7 (corresponding to the small diameter portion 9a1 in the embodiment) and a portion of the inserted portion 9a, into which the heat detecting means 5 is inserted prior to the rotation of the dark chamber 7 (corresponding to the large diameter portion 9a2 in the embodiment) are continued to each other, the portion of the inserted portion 9a, into which the heat detecting means 5 is inserted after the rotation of the dark chamber 7 is narrower than the portion of the inserted portion 9a, into which the heat detecting means 5 is inserted prior to the rotation of the dark chamber 7, and the penetration hole portion 6b of the shield case 6 is wider than the portion of the inserted portion 9a, into which the heat detecting means 5 is inserted after the rotation of the dark chamber 7. For example, the portion of the inserted portion 9a, into which the heat detecting means 5 is inserted prior to the rotation of the dark chamber 7 may be formed by notching the end section of the extension portion 9.

[0071] The insect screen 8 has small meshes and covers the circumference of the labyrinth portion 71 of the dark chamber 7. With this configuration, insects or dust is unlikely to enter into the inside of the dark chamber 7.

[0072] The body case 22 constitutes the upper side of the housing 2 of the detector 1, covers the entire upper side of the body base 21. The body case 22 has a substantially dome shape.

[0073] For example, as illustrated in Fig. 1, the inner periphery of the body case 22 has a predetermined number of positioning portions 22a (one in the embodiment) at positions corresponding to the concaves 21a formed in the body base 21. The positioning portions 22a are configured to fit into the concaves 21a.

[0074] The body case 22 is formed with a plurality of smoke intakes 22b (six in the embodiment) at positions facing the lateral surface of the dark chamber 7 (i.e., the outer surface of the labyrinth portion 71), which are arranged along the circumferential direction of the body case 22. The heat sensitive element 52 of the heat detecting means 5 is disposed in a region of the housing 2 surrounded by the smoke intakes 22b. The region is a heat detecting region.

[0075] Each of the smoke intakes 22b has a shape for protecting the heat detecting means 5. Specifically, the smoke intakes 22b meet the EN standard or the IEC standard to prevent a finger or the like from entering into the interior space of the housing 2 through the smoke intakes 22b. With this configuration, it is possible to prevent problems such as destruction of the heat detecting means 5 due to contact by a finger or the like with the heat detecting means 5.

[0076] The body case is provided with a plurality of smoke intake fins 22c which are configured to guide smoke into the interior space of the housing 2. A smoke intake fin 22c is provided between adjacent smoke intakes 22b. The smoke intake fin 22c also functions as a rectifying fin for converge a thermal air current into the interior space of the housing 2.

[0077] Specifically, the smoke intake fin 22c has curved lateral surfaces so as to gradually narrow its width toward the inside of the body case 22.

[0078] As illustrated in Fig. 5, the body case 22 includes a light guide member 23.

[0079] A predetermined number of light emitting diodes 31 (two in the embodiment) are surface-mounted as a light source on the circuit substrate 3. For example, when the detector 1 is in operation, the LEDs 31 are turned on.

[0080] The light guide member 23 includes a ring shaped portion 231 having a ring shape and a light incidence portion 232 having a rod shape extending from the ring shaped portion 231 in a downward direction. Both the ring shaped portion 231 and the light incidence portion 232 are made of light permeable material.

[0081] Two light incidence portions 232 are provided in the embodiment. However, the present invention is not limited to the embodiment. Only one light incidence portion 232 may be provided. Three or more light incidence portions 232 may also be provided.

[0082] The lower end portion of the light incidence portion 232 is inserted into the hole portion 9c of the extension portion 9 and the hole portion 6d of the shield case 6, such that light from the LEDs 31 enters from the lower end of the light incidence portion 232. The light entering into the light incidence portion 232 goes toward the ring shaped portion 231 in the light incidence portion 232.

[0083] The ring shaped portion 231 is configured to emit the light from the light incidence portion 232 toward the outside of the detector 1. As illustrated in Fig. 3, a plurality of fine grooves 231a having hair line shape are formed on the bottom surface of the ring shaped portion 231, uniformly. With this configuration, the light sent from the light incidence portion 232 into the inside of the ring shaped portion 231 is reflected in various directions through the fine grooves 231 a.

[0084] Next, a method for assembling the detector 1 will be described.

[0085] First, the circuit substrate 3, on which the optical element portion 4 and the heat detecting means 5 are installed, is mounted on the top surface of the body base 21.

[0086] Subsequently, the shield case 6 is positioned with respect to the body base 21 such that the top surface of the optical element portion 4 is exposed through the exposure hole portions 6a of the shield case 6, and the heat detecting means 5 are inserted and penetrated into the penetration hole portions 6b of the shield case 6. In that state, the shield case 6 is mounted on the top surface of the body base 21.

[0087] Subsequently, the dark chamber 7 is positioned with respect to the shield case 6 such that the heat detecting means 5 are inserted into the large diameter portions 9a2 of the inserted portions 9a of the extension portion 9 which is integrally formed with the dark chamber 7, and the claw portions 9b of the extension portion 9 are inserted into the insertion portions 6c2 of the engagement hole portions 6c of the shield case 6. Consequently, the dark chamber 7 and the extension portion 9 are placed on the top surface of the shield case 6. In that state, the dark chamber 7 is rotated until the claw portions 9b engage with the engagement hole portions 6c (i.e., until the claw portions 9b reach the engagement portions 6c1 of the engagement hole portions 6c). Consequently, the dark chamber 7 and the extension portion 9 are mounted on the shield case 6.

[0088] Subsequently, the lateral surface of the dark chamber 7 (i.e., the circumstance of the labyrinth portion 71 of the dark chamber 7) is covered with the insect screen 8.

[0089] Subsequently, the body case 22 is positioned with respect to the body base 21 such that the light incidence portions 232 of the light guide member 23 attached to the body case 22 are inserted into the hole portions 9c of the extension portion 9 and the hole portions 6d of the shield case 6, and the positioning portions 22a of the body case 22 fit into the concaves 21a of the body base 21. Consequently, the body case 22 is mounted on the body base 21.

[0090] In this way, the detector 1 is assembled.

[0091] The detector 1 is installed on the ceiling with the body case 22 facing downward. When heat is generated from fire and flows into the interior space of the housing 2, the detector 1 detects the heat with the heat detecting means 5 thereby detecting fire.

[0092] The light emitting means 42 periodically emits light. Light emitted from the light emitting means 42 is usually not received by the light receiving means 41. When smoke is generated due to fire and flows into the inside of the dark chamber 7, the light emitted from the light emitting means 42 is scattered and the light receiving means 41 can receive the scattered light. In other words, the detector 1 detects fire in the manner that when the light emitted from the light emitting means 42 is scattered by smoke flowing into the inside of the dark chamber 7, the detector 1 receives the scattered light with the light receiving means 41 thereby detecting the smoke.

[0093] In this way, the detector 1 detects both heat and smoke to detect fire.

[0094] For example, as illustrated in Figs. 2 and 6, the heat sensitive element 52 of the heat detecting means 5 in the detector 1 is disposed at a position higher than the center X of the smoke intake 22b in a vertical direction (a short side direction of the smoke intake 22b). And the leg portion 51 and the heat sensitive element 52 of the detecting means 5 are positioned so as not to come into contact with other members. With this configuration, it is possible to detect heat with good sensitivity. The heat detecting means 5 is configured to detect heat when the heat sensitive element 52 is warmed due to heat flowing into the interior space of the housing 2. When the heat warming up the heat sensitive element 52 is lost by the leg portion 51, it is impossible to detect heat with good sensitivity. For example, if the heat sensitive element 52 is disposed at a position lower than the center X of the smoke intake 22b in the vertical direction, the proportion of the portion of the leg portion 51, which is projected from the top surface of the extension portion 9 (i.e., the proportion of the portion of the leg portion 51, which comes into contact with heat flowing into the interior space of the housing 2), is relatively reduced, compared to the configuration in the embodiment (i.e., the configuration in which the heat sensitive element 52 is disposed at a position higher than the center X of the smoke intake 22b in the vertical direction). If the proportion of the por-

tion of the leg portion 51, which comes into contact with heat flowing into the interior space of the housing 2 is reduced, the entire leg portion 51 is not easily warmed by heat flowing into the interior space of the housing 2. Further, the heat warming up the heat sensitive element 52 may be easily lost by the leg portion 51. Accordingly, it is impossible to detect heat with good sensitivity. As in the embodiment, if the heat sensitive element 52 is disposed at a position higher than the center X of the smoke intake 22b in the vertical direction, the proportion of the portion of the leg portion 51, which comes into contact with heat flowing into the interior space of the housing 2 relatively increases to enable the entire heat detecting means 5 to be easily warmed, and thus it is possible to detect heat with good sensitivity.

[0095] If the leg portion 51 or the heat sensitive element 52 comes into contact with other members, heat for warming up the leg portion 51 or the heat sensitive element 52 may be easily lost by the other members. Accordingly, it is impossible to detect heat with good sensitivity. In the embodiment, the leg portion 51 and the heat sensitive element 52 are disposed without contacting with the other members whereby it is possible to detect heat with good sensitivity.

[0096] For example, as illustrated in Fig. 2, the heat detecting means 5 is disposed at a position facing a substantial center of the smoke intake 22b in a direction orthogonal to the vertical direction (longitudinal direction of the smoke intake 22b). With this configuration, it is possible to detect heat with good sensitivity.

[0097] If the heat detecting means 5 is not disposed at a position facing the substantial center of the smoke intake 22b in the direction orthogonal to the vertical direction (for example, if the heat detecting means 5 is disposed between the dark chamber 7 and the smoke intake fin 22c), heat flowing into the interior space of the housing 2 cannot directly reach the heat detecting means 5 due to the interruption by the smoke intake fin 22c. Thus, it is impossible to detect heat with good sensitivity. As in the embodiment, if the heat detecting means 5 is disposed at a position facing the substantial center of the smoke intake 22b in the direction orthogonal to the vertical direction, heat flowing through the smoke intake 22b into the interior space of the housing 2 can easily reach the heat detecting means 5. Thus, it is possible to detect heat with good sensitivity.

[0098] In the embodiment, the heat detecting means 5 is disposed at a position facing the substantial center of the smoke intake 22b in a direction orthogonal to the vertical direction. However, the present invention is not limited to the embodiment. As long as the heat detecting means 5 is disposed between the dark chamber 7 and the smoke intake 22b without being shielded by the smoke intake fin 22c, the heat detecting means 5 may be disposed at any position with respect to the smoke intake 22b (aperture).

[0099] In the embodiment, both of two heat detecting means 5 are disposed between the dark chamber 7 and the smoke intake 22b. However, the present invention is not limited to the embodiment. In a case where a plurality of heat detecting means 5 are provided, one of the heat detecting means 5 should be disposed between the dark chamber 7 and the smoke intake fin 22c but the other of the heat detecting means 5 may not be disposed between the dark chamber 7 and the smoke intake 22b. If only one heat detecting means 5 is provided, the heat detecting means is preferably disposed between the dark chamber 7 and the smoke intake 22b.

[0100] For example, as illustrated in Fig. 6, the heat detecting means 5 is disposed in a substantial center between the interior surface of the body case 22 and the lateral surface of the dark chamber 7 (the exterior surface of the labyrinth portion 71). With this configuration, it is possible to detect heat or smoke with good sensitivity.

[0101] If the heat detecting means 5 is disposed at a side of the body case 22 or a side of the dark chamber 7, a thermal air current may not easily reach the heat detecting means 5 or smoke may not easily flow into the dark chamber 7. As a result, it may be impossible to detect heat or smoke with good sensitivity. As in the embodiment, if the heat detecting means 5 is disposed in a substantial center between the interior surface of the body case 22 and the lateral surface of the dark chamber 7, it facilitates a thermal air current to reach the heat detecting means 5 and smoke to flow into the dark chamber 7, and thus it is possible to detect heat or smoke with good sensitivity.

[0102] The interior space of the housing 2 has such a shape that a thermal air current flowing into the interior space of the housing 2 is not interrupted. With this configuration, it is possible to detect heat or smoke with good sensitivity.

[0103] If the interior space of the housing 2 is not formed into a smoothly curved shape, a thermal air current or smoke flowing into the interior space of the housing 2 is interrupted by the inner wall of the body case or the outer wall of the dark chamber. As a result, it may be impossible to detect heat or smoke with good sensitivity. In the embodiment, the doughnut-shaped interior space of the housing 2 between the inner wall of the body case 22 and the outer wall of the dark chamber 7 is formed into a smoothly curved shape so as not to interrupt the thermal air current or smoke flowing into the interior space of the housing 2. Since the interior space of the housing 2 has the smoothly curved shape so as not to interrupt the thermal air current or smoke flowing into the interior space of the housing 2, it is possible to detect heat or smoke with good sensitivity.

[0104] For example, if the inner wall of the body case is formed with wing portions which are projected toward the interior space of the housing 2, a thermal air current or smoke flowing into the interior space of the housing 2 is interrupted by the wing portions. As a result, it may be impossible to detect heat or smoke with good sensitivity. In the embodiment, no wing portions are provided in the interior space of the housing 2, and the interior space of

the housing 2 has a shape so as not to interrupt a thermal air current or smoke flowing into the interior space of the housing 2. As a result, it is possible to detect heat or smoke with good sensitivity.

[0105] According to the above-described embodiment, the detector 1 includes: the housing 2 comprised of the body base 21 and the body case 22 covering an entire upper side of the body base 21; the circuit substrate 3 mounted on a top surface of the body base 21 and disposed inside the housing 2; the smoke detecting portion (the dark chamber 7, the light emitting means 42 and the light receiving means 41) configured to detect smoke flowing into the dark chamber 7 and disposed inside the housing 2; and the plurality of heat detecting means 5 for detecting heat, disposed inside the housing 2, wherein the plurality of heat detecting means 5 are arranged lateral to the dark chamber 7.

[0106] Since the heat detecting means 5 are arranged lateral to the dark chamber 7, it is possible to reduce the thickness of the detector.

[0107] In addition, since a plurality of heat detecting means 5 are provided, the detector 1 does not have a specific directionality in the heat detecting sensitivity. Accordingly, it is possible to detect heat with good sensitivity. If only one heat detecting means which is arranged lateral to the dark chamber 7 is provided, it is difficult to detect heat in a region near a position facing the heat detecting means 5 across the dark chamber 7. In the present invention, to the contrary, even when the heat detecting means 5 are arranged lateral to the dark chamber 7, there is no region where the heat detecting is difficult because the plurality of heat detecting means 5 are provided. As a result, it is possible to detect heat with good sensitivity.

[0108] Since the heat detecting means 5 are arranged lateral to the dark chamber 7, manufacturing costs can be reduced, and design improvement can be expected.

[0109] In addition to the combined heat and smoke detector, there is a smoke detector as a type of a detector. The smoke detector does not include the heat detecting means. Since the heat detecting means penetrates the dark chamber such that the leading end thereof is projected from the top surface of the dark chamber in the conventional combined heat and smoke detector, a body case of the smoke detector may not be used for the body case of the combined heat and smoke detector. Thus, in order to provide the body case of the combined heat and smoke detector, it is necessary to modify the design of the body case of the smoke detector so as to enable the heat detecting means with the leading end projected from the top surface of the dark chamber to detect heat with good sensitivity. In the detector 1 according to the embodiment, to the contrary, since the heat detecting means 5 do not penetrate the dark chamber 7 and are arranged lateral to the dark chamber 7, the body case of the smoke detector which does not have the heat detecting means 5 may be used for the body case 22 of the detector 1. Further, components of the smoke detector other than the body case, with or without a simple modification, may also be used for components of the detector 1 according to the embodiment. Thus, manufacturing processes can be simplified, thereby reducing manufacturing costs. Since the design of the detector 1 according to the embodiment can be unified with the design of the smoke detector, design improvement can be expected.

[0110] According to the detector 1 of the embodiment, the plurality of heat detecting means 5 are connected to the circuit substrate 3 and upwardly projected from the circuit substrate 3 such that the leading end of each of the heat detecting means 5 is positioned below the top surface of the dark chamber 7.

[0111] Since the leading end of the heat detecting means 5 is positioned below the top surface of the dark chamber 7, it is possible to reduce the thickness of the detector 1.

[0112] According to the detector 1 of the embodiment, the body case 22 is formed with a smoke intake 22b at a position facing the lateral surface of the dark chamber 7, and one of the heat detecting means 5 is disposed between the dark chamber 7 and the smoke intake 22b.

[0113] Since the one of the heat detecting means 5 is disposed between the dark chamber 7 and the smoke intake 22b, a thermal air current flowing through the smoke intake 22b can easily reach the heat detecting means 5 directly, thereby detecting heat with good sensitivity.

[0114] In the embodiment, the body case 22 includes the smoke intakes 22 only at positions facing the lateral surface of the dark chamber 7. The present invention, however, is not limited to the embodiment. As long as the body case 22 has at least one smoke intake 22b at a position facing the lateral surface of the dark chamber 7, the other smoke intake 22b may be provided at a position other than the position facing the lateral surface of the dark chamber 7.

[0115] According to the detector 1 of the embodiment, the smoke intake 22b may have a shape for protecting the heat detecting means 5. Specifically, the smoke intake 22b meets the EN standard or the IEC standard, such that a finger or the like cannot enter into the housing through the smoke intake 22b.

[0116] Accordingly, it is possible to prevent problems such as destruction of the heat detecting means 5.

[0117] According to the detector 1 of the embodiment, each of the heat detecting means 5 includes a leg portion 51 connected to the circuit substrate 3 and upwardly projected from the circuit substrate 3 and a heat sensitive element 52 provided at the leading end of the leg portion 51, and the heat sensitive element 52 is disposed at a position higher than the center X of the smoke intake 22b in the vertical direction.

[0118] Since the heat sensitive element 52 is disposed at a position higher than the center X of the smoke intake 22b in the vertical direction, the proportion of the portion of the leg portion 51, which comes into contact with the thermal air current flowing into the interior space of the

housing 2 increases compared to a case where the heat sensitive element 52 is disposed at a position lower than the center X of the smoke intake 22b in the vertical direction. Thus, the entire heat detecting means 5 is easily warmed so that it is possible to detect heat with good sensitivity.

[0119] According to the detector 1 of the embodiment, the interior space of the housing 2 between the inner wall of the body case 22 and the outer wall of the dark chamber 7 has a smoothly curved shape so as not to interrupt the thermal air current flowing into the interior space of the housing 2.

[0120] Since the thermal air current or smoke smoothly flows in the interior space of the housing 2, it is possible to detect heat or smoke with good sensitivity.

[0121] According to the detector 1 of the embodiment, the body case 22 is provided with the smoke intake fin 22c configured to guide smoke into the interior space of the housing 2, and the smoke intake fin 22c also functions as a rectifying fin configured to converge the thermal air current into the interior space of the housing 2.

[0122] Since smoke and the thermal air current can effectively flow into the interior space of the housing 2 with the smoke intake fin 22c, it is possible to detect heat or smoke with good sensitivity.

[0123] The detector 1 of the embodiment includes: the shield case 6 mounted on the body base 21, the shield case 6 covering an entire top surface of the circuit substrate 3; and the extension portion 9 integrally formed with the dark chamber 7, the extension portion 9 laterally extending from the bottom end of the dark chamber 7. One of the heat detecting means 5 is upwardly projected to be inserted into the penetration hole portion 6b formed in the shield case 6 and the inserted portion 9a formed in the extension portion 9. The dark chamber 7 is mounted on the shield case 6 by rotation of the dark chamber 7 relative to the shield case 6 in a state where the one of the heat detecting means 5 is inserted into the inserted portion 9a. The inserted portion 9a has such a shape that one portion thereof, into which the one of the heat detecting means 5 is inserted after the rotation (the small diameter portion 9a1) and the other portion thereof, into which the one of the heat detecting means 5 is inserted prior to the rotation (the large diameter portion 9a2) are continued to each other. The one portion into which the one of the heat detecting means 5 is inserted after the rotation (the small diameter portion 9a1) may be narrower than the other portion into which the one of the heat detecting means 5 is inserted prior to the rotation (the large diameter portion 9a2), and the penetration hole portion 6b is wider than the one portion into which the one of the heat detecting means 5 is inserted after the rotation (the small diameter portion 9a1).

[0124] Since the one portion of the inserted portion 9a, into which the one of the heat detecting means 5 is inserted after the rotation of the dark chamber 7 (the small diameter portion 9a1), is narrower than the other portion of the inserted portion 9a, into which the one of the heat detecting means 5 is inserted prior to the rotation of the dark chamber 7 (the large diameter portion 9a2), the dark chamber 7 can be easily mounted on the shield case 6. Thus, at the time of manufacturing, the detector 1 can be easily assembled. In addition, since the one portion of the inserted portion 9a of the extension portion 9, into which the one of the heat detecting means 5 is inserted after the rotation of the dark chamber 7 (the small diameter portion 9a1) is narrower than the penetration hole portion 6b of the shield case 6, the most part of the penetration hole portion 6b is blocked by the extension portion 9, and thus dust or the like is unlikely to enter into the inside of the shield case 6.

[0125] The present invention is not limited to the above-described embodiment. The embodiment may be properly modified without deviating from the scope of the present invention.

[0126] In the above-described embodiment, the heat detecting means 5 is configured to penetrate both the shield case 6 and the extension portion 9. However, the present invention is not limited to the embodiment. The heat detecting means 5 may be configured to penetrate only the shield case 6.

[0127] Specifically, the heat detecting means 5 may be configured to penetrate only the shield case 6 by reducing the diameter of the extension portion 9 or disposing the heat detecting means 5 at a relatively outer position.

[0128] In the above-described embodiment, the shield case 6 is provided on the tope surface of the circuit substrate 3. However, the present invention is not limited to the embodiment. The shield case 6 may not be provided on the top surface of the circuit substrate 3.

[0129] For example, as illustrated in Fig. 9, a dark chamber plate 11 fixed to the circuit substrate 3 and a dark chamber 12 mounted on the top surface of the dark chamber plate 11 may be provided, instead of the shield case 6, the dark chamber 7, and the extension portion 9 in the above-described embodiment. The light emitting means 42 and the light receiving means 41 are fixed on the dark chamber plate 11. The light emitting means 42 and the light receiving means 41 are connected to the circuit substrate 3 through the dark chamber plate 11. The dark chamber 12 includes a labyrinth portion capable of containing the light emitting means 42 and the light receiving means 41, and a cover portion for covering the top surface of the labyrinth portion. In a state where the body case 22 is mounted on the body base 21, a portion of the dark chamber plate 11, which is not covered by the dark chamber 12, blocks various circuits installed on the circuit substrate 3, so that the various circuits is spatially blocked from the outside of the detector.

[0130] In that case, as illustrated in Fig. 9, the heat detecting means 5 may be configured to penetrate the dark chamber plate 11. Otherwise, the heat detecting means 5 may be configured to be disposed at an outer position from the dark chamber plate 11, such that the heat detecting means 5 does not penetrate other mem-

bers such as the dark chamber plate 11.

[0131] In that case, a circuit which can be easily affected by noise (for example, an amplification circuit) may be mounted on a bottom surface of the circuit substrate 3. The shield case may be provided on the bottom surface of the circuit substrate 3 to cover the circuit. Otherwise, a dark chamber having a shielding function may be adopted as the dark chamber 12, and the circuit which can be easily affected by noise may be mounted on the top surface of the circuit substrate 3, as in the above-described embodiment, such that the circuit is covered by the dark chamber 12.

[0132] In the above-described embodiment, the light emitting means 42 is configured to emit light traveling in the obliquely upward direction, and the light receiving means 41 is configured to receive the light traveling in the obliquely downward direction. However, the present invention is not limited to the embodiment. As long as the light emitted from the light emitting means 42 is not directly received by the light receiving means 41, the light emitting means 42 may not be configured to emit the light traveling in the obliquely upward direction, and the light receiving means 41 may not be configured to receive the light traveling in the obliquely downward direction.

Claims

1. A combined heat and smoke detector, comprising:

a housing comprised of a body base and a body case covering an entire upper side of the body base;
a circuit substrate mounted on a top surface of the body base and disposed inside the housing;
a smoke detecting portion configured to detect smoke flowing into a dark chamber and disposed inside the housing; and
a plurality of heat detecting means for detecting heat, the plurality of heat detecting means disposed inside the housing,
wherein the plurality of heat detecting means are arranged lateral to the dark chamber.

2. The combined heat and smoke detector as set forth in claim 1, wherein the plurality of heat detecting means are connected to the circuit substrate and upwardly projected from the circuit substrate such that a leading end of each of the plurality of heat detecting means is positioned below a top surface of the dark chamber.

3. The combined heat and smoke detector as set forth in claim 1 or 2,
wherein the body case is formed with a smoke intake at a position facing a lateral surface of the dark chamber, and
wherein one of the heat detecting means is disposed between the dark chamber and the smoke intake.

4. The combined heat and smoke detector as set forth in claim 3, wherein the smoke intake has a shape for protecting the heat detecting means.

5. The combined heat and smoke detector as set forth in claim 3 or 4,
wherein each of the plurality of heat detecting means includes a leg portion connected to the circuit substrate and upwardly projected from the circuit substrate and a heat sensitive element provided at a leading end of the leg portion, and
wherein the heat sensitive element is disposed at a position higher than a center of the smoke intake in a vertical direction.

6. The combined heat and smoke detector as set forth in any of claims 1 to 5, wherein an interior space of the housing between an inner wall of the body case and an outer wall of the dark chamber has a smoothly curved shape so as not to interrupt a thermal air current flowing into the interior space of the housing.

7. The combined heat and smoke detector as set forth in any of claims 1 to 6,
wherein the body case is provided with a smoke intake fin configured to guide smoke into an interior space of the housing, and
wherein the smoke intake fin functions as a rectifying fin configured to converge a thermal air current into the interior space of the housing.

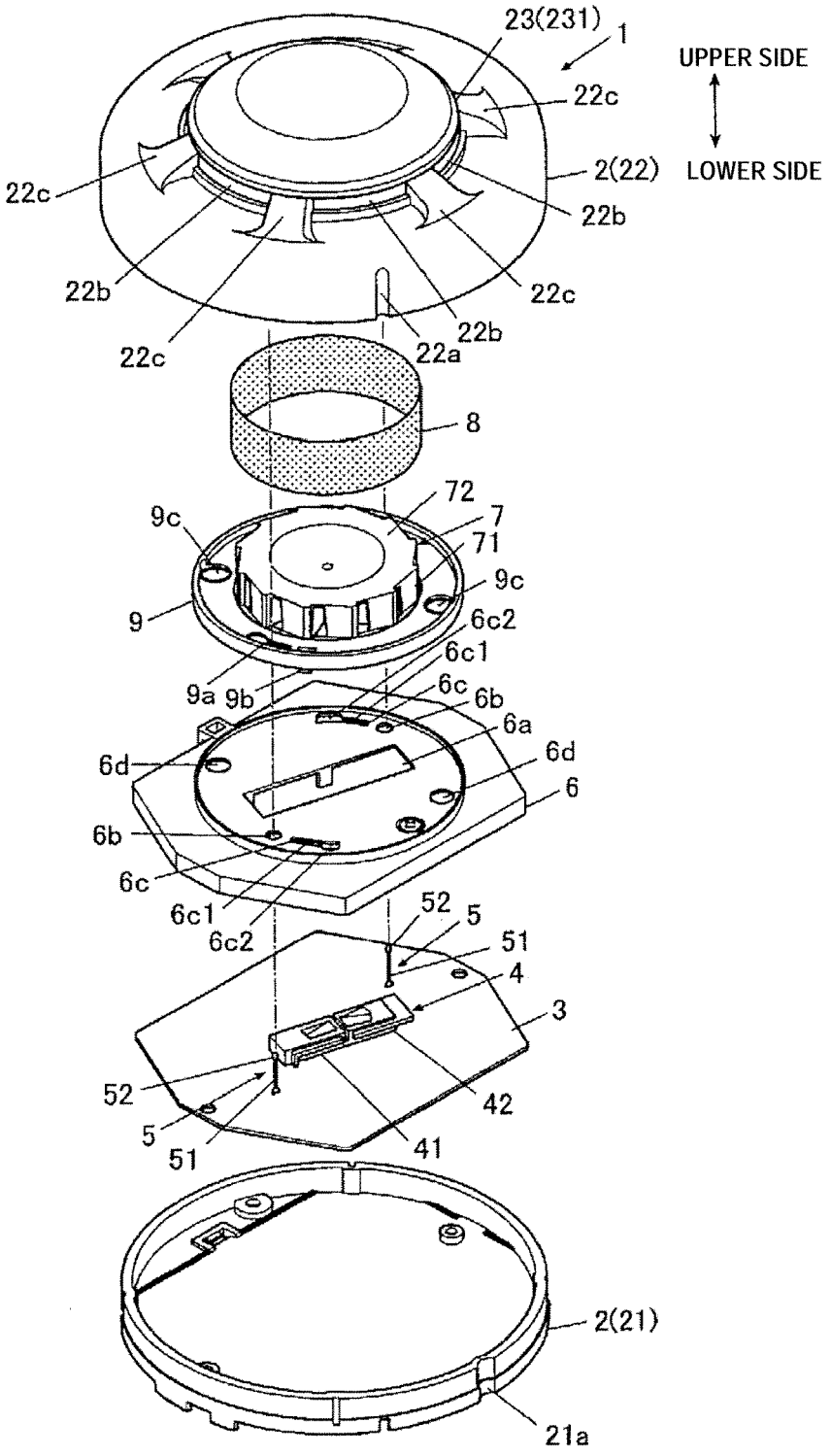
8. The combined heat and smoke detector as set forth in any of claims 1 to 7, further comprising:

a shield case mounted on the body base, the shield case covering an entire top surface of the circuit substrate; and
an extension portion integrally formed with the dark chamber, the extension portion laterally extending from a bottom end of the dark chamber,
wherein one of the heat detecting means is upwardly projected to be inserted into a penetration hole portion formed in the shield case and an inserted portion formed in the extension portion,
wherein the dark chamber is mounted on the shield case by rotation of the dark chamber relative to the shield case in a state where the one of the heat detecting means is inserted into the inserted portion,
wherein the inserted portion has such a shape that one portion thereof, into which the one of the heat detecting means is inserted after the rotation and the other portion thereof, into which the one of the heat detecting means is inserted prior to the rotation are continued to each other,
wherein the one portion into which the one of

the heat detecting means is inserted after the rotation is narrower than the other portion into which the one of the heat detecting means is inserted prior to the rotation, and

wherein the penetration hole portion is wider than the one portion into which the one of the heat detecting means is inserted after the rotation.

FIG.1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LOWER SIDE
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9c
7
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9c
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6c1
9a
9b
6c
6b
6a
6d
6d
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21a

FIG.2

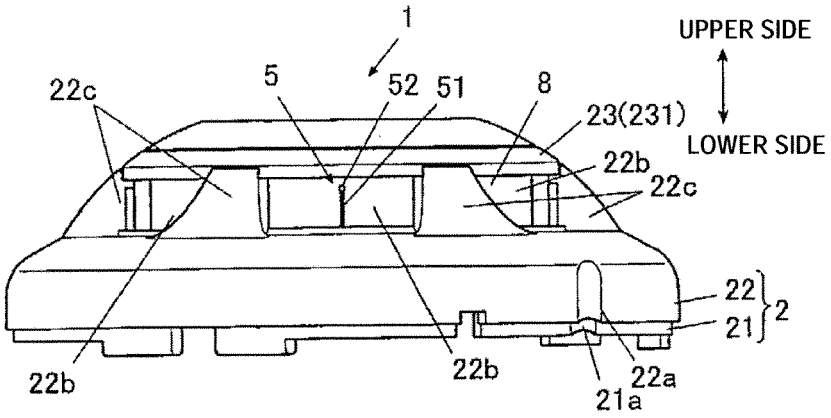
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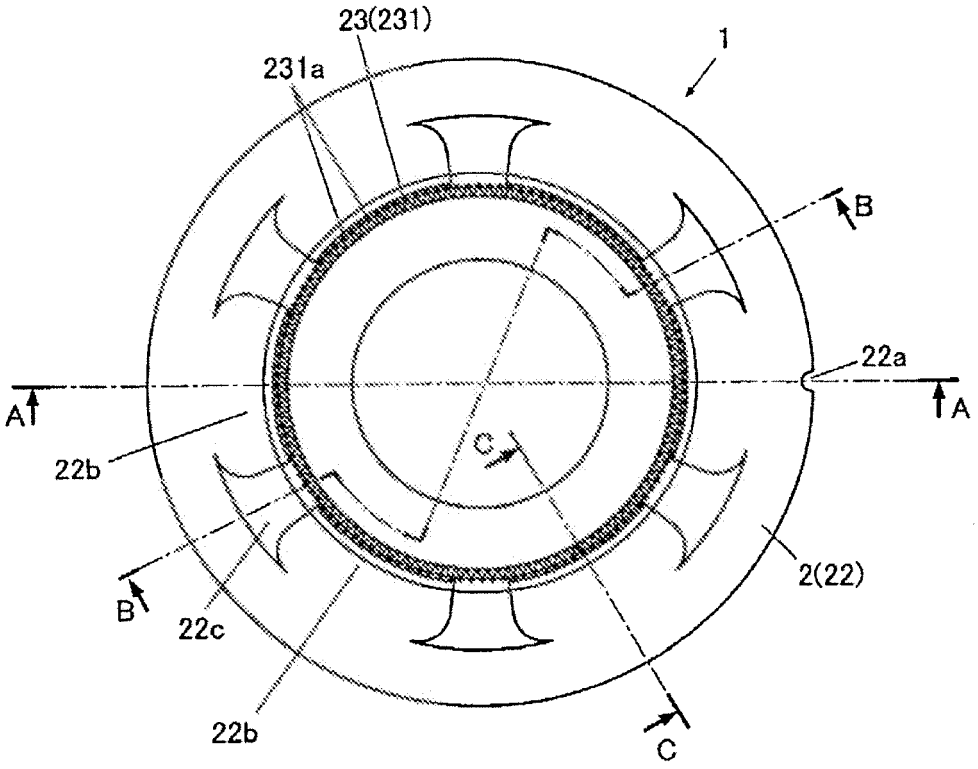
FIG.3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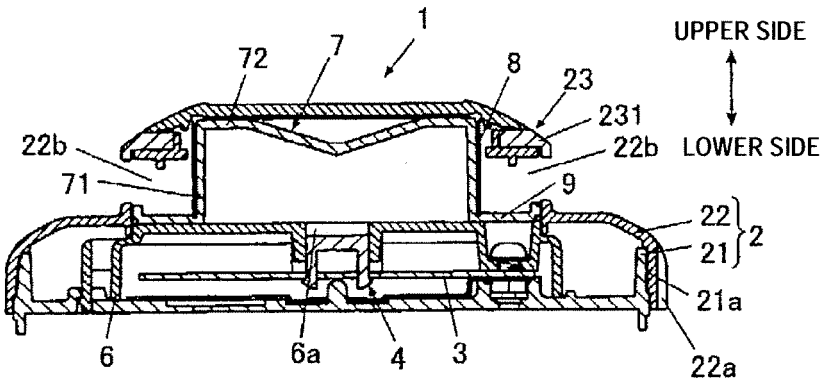
22b
C

FIG.4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22a

FIG.5

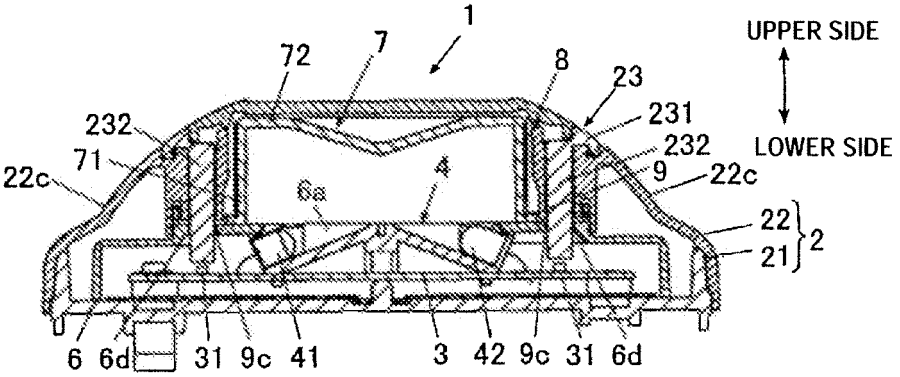


FIG.6

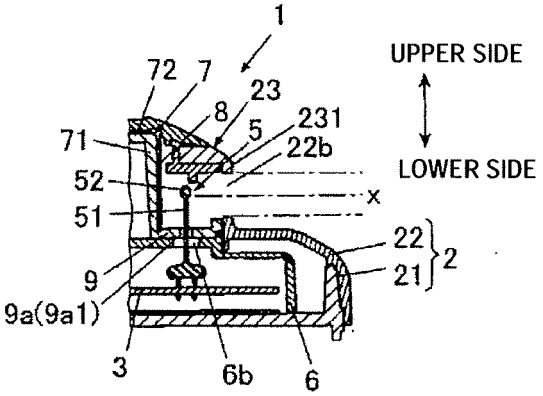


FIG.7

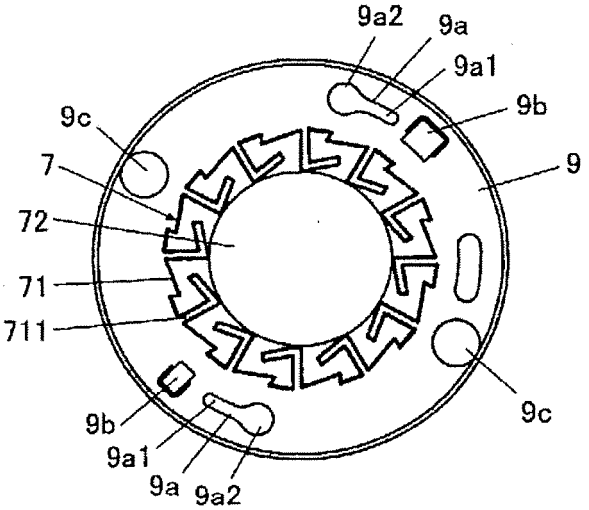


FIG.8

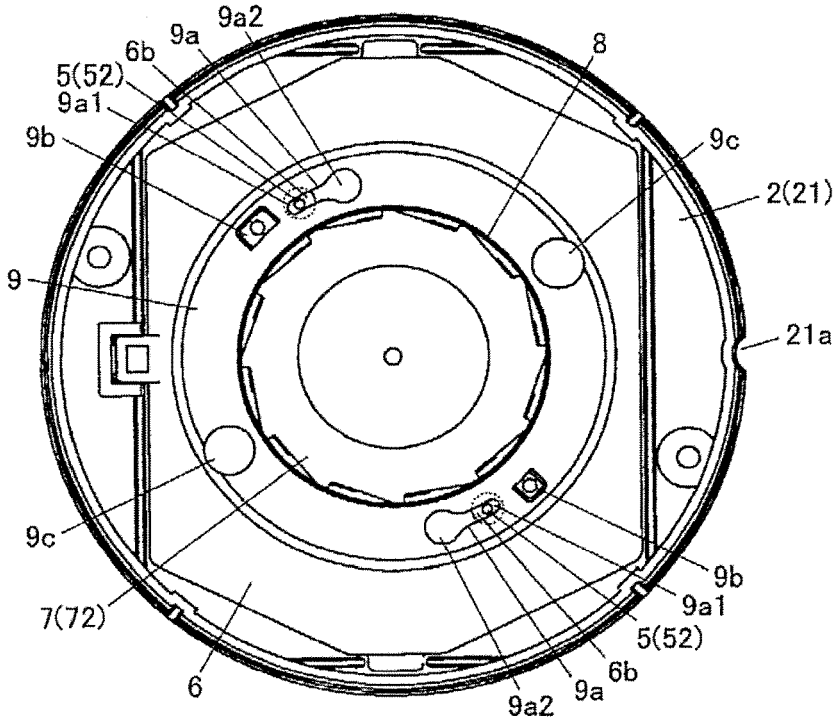
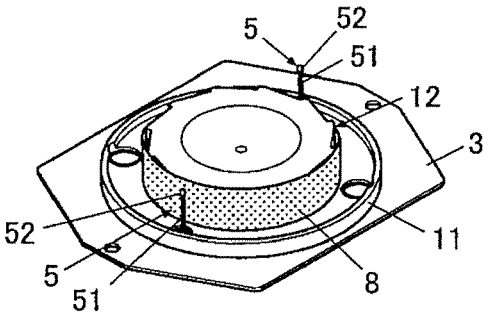


FIG.9



UPPER SIDE

LOWER SIDE

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- JP 2001014570 A **[0003]**
- JP 2001266265 A **[0003]**