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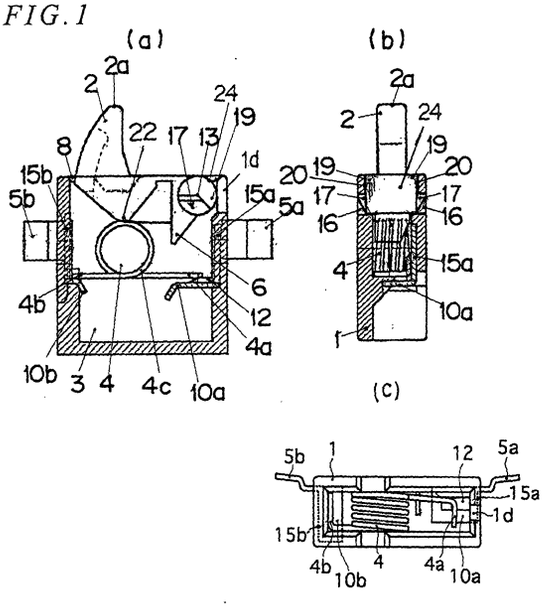
(54) SMALL SWITCH

(57) A small-size switch is provided where a push-button (2) is lengthened in the stroke and can thus be positioned at higher accuracy, hence improving the utility and lowering the production cost. The push-button (2) has a first projection or fan shaped pivot pin (17) and a second projection (19) of a circular shape over the first projection (17) provided on each of two sides thereof. As the first projections (17) are fitted into two semi-circular holes (16) respectively provided in both side walls of a body (1), the second projections (19) engage directly with their corresponding recesses 20 provided in the inner surfaces of the side walls of the body (1) as well as the corresponding holes (16). The push-button (2) is pivotably movable about the pivot center (13) of its pivot pins (17) until the wall surface (17a) of each pivot pin (17) touches the edge of the semi-circular hole (16). Since the push-button (2) is supported at its pivot center by one end close to the opening of the body (1), no extra member for retaining the push-button (2) can be needed. Also, as the pivot pins (17) of the push-button (2) are fitted into the corresponding semi-circular holes (16) of the body (1) and their opening angle is sized smaller, the stroke of the push-button (2) can be lengthened.

FIG. 1



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Description

Field of the Invention

[0001] The present invention relates to a small-size switch for closing and opening electrical contacts.

Background of the Invention

[0002] A conventional small-size switch, e.g. two-way micro switch, is commonly designed in which a push-button is mounted at its pivotal point to a body as a housing and when is operated and turned about the pivotal point, drives a coil or spring provided in the body for closing and opening between two switch contacts (for example, as disclosed in Japanese Patent Laid-open Publication No.10-188726).

[0003] Such a small-size switch, if its size remains unchanged, may easily be operated when its push-button stroke (the travel of one contact from its start on position to the other contact) is longer. Hence, the pivotal point of the push-button is located at the furthest end of the body while the operating (press-down) portion of the push-button is at the opposite side. As the push-button is installed in the body, the position of its pivotal point is determined. the positioning may be made by arresting its pivotal point portion in a recess provided in the edge at the opening of the body and holding the push-button for no slipping off with a retainer mounted at the opening on the body (the first positioning method). Alternatively, the pivotal point portion of the push-button may be fitted into holes provided in both sides of the body (the second positioning method).

[0004] The structure of a small-size switch employing the first positioning method will be explained in more detail referring to Figs. 15a, 15b, and 15c. This small-size switch comprises a body 1 serving as a housing, a push-button 2 accommodated in an accommodating chamber 3 as the inner space from the opening 8 of the body 1, a coil spring 4, and a pair of first and second conductors 10a and 10b shaped integral with terminals 5a and 5b respectively. The push-button 2 has a pivot pin 26 thereof turnably mounted in a pivot bearing 25a provided in the edge at the opening of the body 1 while a retaining cover member 21 is provided across the opening 8. The cover member 21 is fitted into recesses 21a provided in both outer sides of the body 1 to determine its position.

[0005] The first conductor 10a and the second conductor 10b are located along two opposite inner walls at the accommodating changer 3 of the body 1 and their respective terminals 5a and 5b project outwardly from the body 1. The distal end of each of the conductors 10a and 10b is bent downwardly in the accommodating chamber 3. The proximal end of the first conductor 10a is protected with an insulator 12.

[0006] The coil spring 4 comprises a coil portion 4c and a pair of first and second movable contact portions 4a and 4b provided at both ends of spring material extending from the coil portion 4c and folded axially of the coil portion 4c. When the push-button 2 remains not depressed in the normal state, the first movable contact portion 4a is rested directly on the insulator 12 as isolated from the first conductor 10a. On the other hand, the second movable contact portion 4b stays in direct contact with the second conductor 10b. At the normal state, the small-size switch is turned off as its terminals 5a and 5b are disconnected.

[0007] When the press-down portion 2a of the push-button 2 is depressed, it turns about the pivot pin 26 and comes into direct contact with the coil portion 4c of the coil spring 4. As its coil portion 4c is urged downwardly in the accommodating chamber 3, the coil spring 4 twists and moves towards the bottom of the accommodating chamber 3. More particularly, when the push-button 2 is turned to its lower position 2', the first movable contact portion 4a of the coil spring 4 departs from the insulator 12 and is pressed against the bent end of the first conductor 10a by the spring-back yielding force of the coil spring 4. Simultaneously, the second movable contact portion 4b of the coil spring 4 is pressed against the bend end of the second conductor 10b by the yielding force of the coil spring 4. The pressing down of the push-button 2 produces conduction between the two terminals 5a and 5b by the coil spring 4, hence shifting the small-size switch to the turn-on state.

[0008] When the pressing down of the push-button 2 is released, the yielding force of the coil spring 4 lifts up the push-button 2 until its press-down portion 2a projects out from the body 1. The first movable contact portion 4a of the coil spring 4 is then sprung back to rest directly on the insulator 12. Simultaneously, the second movable contact portion 4b of the coil spring 4 returns back to its original position on (the flat portion of) the conductor 10b.

[0009] The structure of a small-size switch employing the second positioning method will be explained referring to Figs. 16a, 16b, and 16c. This small-size switch has the pivot pin 26 of a push-button 2 thereof fitted into pivot holes 25 provided in both sides of the body 1. The push-button 2 is positioned with its stopper 6 provided adjacent to the pivot pin 26 coming into directly contact with a body stopper 7 of the body 1. As the other arrangements and actions are substantially identical to those shown in Figs. 15a, 15b, and 15c, like components are denoted by like numerals as those of the previous switch and will be explained in no more detail.

[0010] Referring back to Figs. 15a, 15b, and 15c, the push-button 2 is installed in the body 1, held with the cover member 21, and supported by the pivot bearing 25a which serves as the pivot point on the furthest end of the body 1. Accordingly, the distance h1 from the pivot bearing 25a to the bottom at the accommodating chamber 3 of the body 1 can be lengthened. As shown in Fig. 17, the stroke of the push-button 2 is thus increased to s1 while the distance between the pivot bearing 25a and the bottom of the body 1 is h1. However, this requires

the cover member 21 for holding and will unfavorably increase the overall cost and the number of production steps.

[0011] Also, when the push-button 2 is installed with its pivot pin 26 fitted into the pivot holes 25 in the body 1 as shown in Figs 16a, 16b, and 16c, its position has to be lowered because the pivot holes 25 are provided lower than the edge at the opening of the body 1. As the pivot pin 26 of the push-button 2 is lower than that of the previous arrangement, the distance between the pivot pin 26 and the bottom of the body 1 will be as small as h2. Subsequently, the stoke of the push-button 2 (denoted by 2' at its lower position) is decreased to s2 while the distance between the pivot pin 26 (denoted by 26' at its lower position) and the bottom of the body 1 is h2, as shown in Fig. 17. As a result, the switch will be hardly favorable for most of applications.

[0012] Moreover, when the body stopper 7 of the body 1 is provided adjacent to the pivot holes 25 as shown in Fig 16, the distance between the pivot holes 25 and the body stopper 7 has to be minimized because the pivot holes 25 are provided adjacent to the edge of the body 1 for generously lengthening the stroke of the push-button 2. This may decline the positioning accuracy of the push-button 2 at the normal state. Also, as the torque of a counter force against the yielding force of the coil spring 4 increases, it may produce an overload in the opposite direction of the switching movement of the push-button 2. The body stopper 7 and the push-button stopper 6 may however be inferior in the physical strength to the overload.

[0013] The present invention has been developed for eliminating the above drawbacks and its object is to provide a small-size switch adapted in which the stroke of its push-button is long enough for ease of the operation while the overall cost is low.

Summary of the Invention

[0014] In accordance with claim 1 of the present invention, a small-size switch comprises: a housing body having an accommodating chamber provided therein; a coil spring provided between two opposite end walls at the accommodating chamber of the body and having a coil portion and a pair of first and second movable contact portions extending from both ends of the coil portion; a push-button pivotably supported at its pivot point by the body and having one end thereof in the accommodating chamber arranged to seat directly on the coil portion so that while the one end of the push-button is urged upwardly by the yielding force of the coil spring, the other end projects from the opening of the body and stays outside the body at the non operating state and serves as an operating portion for switching actions at the switch operating state; and a pair of terminals having a first and a second conductor thereof respectively extending inwardly from the two opposite end walls at the accommodating chamber of the body, the first conductor staying in no contact with the first movable contact portion of the coil spring at the non operating state and when the operating portion of the push-button is pressed down to lower the coil spring, coming into direct contact with the first movable contact portion, and the second conductor remaining constantly in contact with the second movable contact portion of the coil spring, wherein the body has a substantially semi-circular hole provided in each of two side walls thereof as defined by an arcuate edge and a straight edge for accepting pivotably corresponding one of two pivot pins of the push-button, the straight edge of the hole located closer to the uppermost end at the opening of the body while the arcuate edge located further from the uppermost end, and the pivot pins are provided on both sides of the push-button to extend coaxial with the substantially semi-circular holes of the body, each the pin having a first projection of a fan shape of which the opening angle is smaller than that of the substantially semi-circular hole so that the fan shaped projection fits into the substantially semi-circular hole.

[0015] Accordingly, as the push-button is pivotably supported by one end wall close to the semi-circular holes at the opening of the body, no use of an extra retaining member can be ensured thus decreasing the production cost. Also, since the pivot pins of the push-button are provided with the fan shaped first projection fitted into the corresponding semi-circular holes of the body and the opening angle of the first projection is sized smaller, the stroke of the push-button can favorably be lengthened.

[0016] In accordance with claim 2 of the present invention, in a small-size switch according to claim 1, the push-button has a second projection of a circular shape provided on each side thereof to extend coaxial with the substantially semi-circular hole of the body so that the first projection of a fan shape is located on the corresponding second projection at each side, and the body has a recess provided in the inner surface of each side wall thereof next to the semi-circular hole for accepting the corresponding second projection of the push-button at each side.

[0017] Accordingly, the second projections of the push-button are fitted into the corresponding recesses of the body which can thus serve as the stoppers for inhibiting the push-button from being dislocated at right angles to the pivot pins. Also, as its second projections of a circular shape are engaged directly with the arcuate edges of the corresponding substantially semi-circular holes of the body, the push-button can stably be operated for the pivotal movement.

[0018] In accordance with claim 3 of the present invention, in a small-size switch according to claim 1, the first projection of each pivot pin has a lower side thereof beveled so that while the pivot pins of the push-button are inserted into the opening of the body to fit into the corresponding substantially semi-circular holes of the body, their first projections expand the opening of the

body with the beveled sides. Accordingly, the push-button can be easily inserted into the body from the opening.

[0019] In accordance with claim 4 of the present invention, in a small-size switch according to claim 1, the push-button has a first stopper provided thereon extending from the pivot pins for positioning the push-button at a location distanced from the pivot pins, and the body has a second stopper provided thereon for engaging directly with the first stopper turned in a switch-off direction by the yielding force of the coil spring thus to determine the position of the push-button at its non operating state. Accordingly, as the first stopper of the push-button extending from the pivot pins engages directly with the second stopper of the body, the stopper mechanism can be improved in the physical strength. In addition, since the push-button is positioned while protected from being slipped off, its positioning accuracy can much be enhanced.

[0020] In accordance with claim 5 of the present invention, in a small-size switch according to claim 4, the first stopper is an arm extending from the pivot pins of the push-button, and the second stopper stands upright in the accommodating chamber of the body for engaging directly with the arm of the first stopper. Accordingly, as the distance from the pivot pins to the distal end of the arm of the push-button is longer than that of the prior art, the positioning accuracy of the push-button can be improved in its non operating state, The stopper mechanism is increased in the physical strength thus contributing to the thinning or the size reduction of the small-size switch.

[0021] In accordance with claim 6 of the present invention, in a small-size switch according to claim 4, the first stopper is a projection extending from one end opposite to the pivot center of the push-button, and the second stopper is located on one end wall of the body for engaging directly with the projection of the first stopper. Accordingly, as the distance from the pivot center to the first stopper is increased, the positioning accuracy of the push-button can further be improved at the non operating state.

[0022] In accordance with claim 7 of the present invention, in a small-size switch according to claim 4, either the first stopper or the second stopper is adapted to has a degree of elasticity. Accordingly, the push-button can be installed into the body by a known snap-fit method.

[0023] In accordance with claim 8 of the present invention, in a small-size switch according to claim 4, the first stopper incorporates a pair of recesses provided in both sides at a substantially center region of the push-button so as to open to the opening of the body, and the second stopper incorporates a pair of projections provided on the inner surfaces of the two side walls of the body for fitting into the corresponding recesses of the push-button. Accordingly, as the push-button needs to have no projections as the stopper members, it can be simple in the shape and less in the cost.

[0024] In accordance with claim 9 of the present invention, in a small-size switch according to claim 4, the first stopper incorporates a pair of projections provided on both sides at a substantially center region of the push-button so as to extend towards the inner surfaces of the two side walls of the body, and the second stopper incorporates a pair of slit recesses provided in the inner surfaces of the two side walls of the body for accepting the corresponding projections of the push-button which engage with the upper ends of the slit recesses of the body. Accordingly, the arrangement of the body requires no undercuts in the molds and its production can be easy.

[0025] In accordance with claim 10 of the present invention, a small-size switch comprises: a housing body having an accommodating chamber provided therein; a coil spring provided between two opposite end walls at the accommodating chamber of the body and having a coil portion and a pair of first and second movable contact portions extending from both ends of the coil portion; a push-button pivotably supported at its pivot point by the body and having one end thereof in the accommodating chamber arranged to seat directly on the coil portion so that while the one end of the push-button is urged upwardly by the yielding force of the coil spring, the other end projects from the opening of the body and stays outside the body at the non operating state and serves as an operating portion for switching actions at the switch operating state; and a pair of terminals having a first and a second conductor thereof respectively extending inwardly from the two opposite end walls at the accommodating chamber of the body, the first conductor staying in no contact with the first movable contact portion of the coil spring at the non operating state and when the operating portion of the push-button is pressed down to lower the coil spring, coming into direct contact with the first movable contact portion, and the second conductor remaining constantly in contact with the second movable contact portion of the coil spring, wherein the push-button has a first stopper provided thereon extending from its pivot pin for positioning the push-button at a location distanced from the pivot pin, and the body has a second stopper provided thereon for engaging directly with the first stopper turned in a switch-off direction by the yielding force of the coil spring thus to determine the position of the push-button at its non operating state. Accordingly, the push-button can be improved in the positioning accuracy and the stopper mechanism can be increased in the physical strength.

Brief Description of the Drawings

[0026]

Figs. 1a,1b, and 1c are a cross sectional view, seen from front, a side sectional view, and an upper view without a push-button of a small-size switch respec-

tively showing a first embodiment of the present invention;
Fig. 2 is a cross sectional view seen from front of the switch at its turn on state;
Figs. 3a and 3b are a front view and an upper view of the switch respectively;
Figs. 4a, 4b, and 4c are a perspective view, a front view, and a cross sectional view seen from one end of a body of the switch respectively;
Fig. 5 is an upper view of a push-button support of the body;
Fig. 6 is a three-dimensional view of the push-button support of the body;
Fig. 7 is a perspective view of the push-button of the switch;
Figs. 8a, 8b, and 8c are a front view, a side view, and an upper view of the push-button respectively;
Figs. 9a, 9b, 9c, and 9d are a cross sectional view seen from front, a cross sectional view seen from left end, a cross sectional view seen from right end, and an upper view without a push-button of a small-size switch respectively showing a second embodiment of the present invention;
Fig. 10 is a cross sectional view seen from front, of the switch at its turn on state;
Figs. 11a, 11b, and 11c are a front view, a right side view, and an upper view of a small-size switch respectively showing a third embodiment of the present invention;
Fig. 12 is a cross sectional view seen from front of a small-size switch showing a fourth embodiment of the present invention;
Figs. 13a, 13b, and 13c are a cross sectional view seen from front, an upper view, and a partial perspective view at a body of the switch showing a fifth embodiment of the present invention;
Figs. 14a, 14b, 14c, and 14d are a cross sectional view seen from front, a perspective view at a push-button, an upper view, and a partial perspective view at a body of a small-size switch showing a sixth embodiment of the present invention;
Figs. 15a, 15b, and 15c are a front view, an upper view, and a cross sectional view seen from front of a conventional small-size switch;
Figs. 16a, 16b, and 16c are a front view, an upper view, and a cross sectional view seen from front of a precursor small-size switch; and
Fig. 17 is a view explaining the actions of the conventional and precursor small-size switches.

Detailed Description of the Preferred Embodiments

(First Embodiment)

[0027] Figs. 1 to 8 illustrate a small-size switch according to the first embodiment of the present invention. As shown, this small-size switch comprises a body 1 serving as a box-shaped housing, a coil spring 4 provided in an accommodating chamber 3 of the body 1 and having a pair of first and second movable contact portions 4a and 4b, a push-button 2 pivotably supported on the body 1, and a pair of terminals 5a and 5b arranged integral with a first 10a and a second conductor 10b respectively which extend from opposite inner walls at the accommodating chamber 3 of the body 1.

[0028] The body 1 is made of a box like resin molded form having an opening 8 at the top and an inner space thereof provided as the accommodating chamber 3. When the push-button 2 is moved down and up, the movable contact portion 4a comes into contact with and is isolated from the first conductor 10a. Accordingly, conduction between the two terminals 5a and 5b is switched on and off, i.e. the switch is turned on and off.

[0029] As the first conductor 10a and the second conductor 10b are located at both, right and left (in Fig. 1), sides of the accommodating chamber 3, they are linked by two strips 15a and 15b to be formed integral with their corresponding terminals 5a and 5b which project outwardly from the body 1. The distal end of each of the conductors 10a and 10b in the accommodating chamber 3 is bent downwardly. The other end of the first conductor 10a proximal to the body 1 is protected with an insulator 12 formed integral with the body 1. The insulator 12 is tapered at a distal end thereof apart from the body 1 side so that the first movable contact portion 4a of the coil spring 4 can slide between the insulator 12 and the first conductor 10a.

[0030] The coil spring 4 comprises a coil portion 4c and the first 4a and the second movable contact portion 4b which extend from both ends of the coil portion 4c of a spring material and are bent axially of the coil portion 4c. As the coil spring 4 is mounted between two inner walls in the accommodating chamber 3 of the body 1, its second movable contact portion 4b remains in direct contact with the second conductor 10b and its first movable contact portion 4a is isolated and rest directly on the insulator 12 when the switch is at the switch-off state. Fig. 1a illustrates the switch-off state where the two terminals 5a and 5b are electrically isolated from each other.

[0031] A support mechanism for the push-button 2 is now explained. The push-button 2 has pivot pins 17 provided on both side thereof and movably fitted into two substantially semi-circular holes 16 respectively (referred to as holes hereinafter) provided in both sides of the body 1. More specifically, the push-button 2 is pivotably supported by the body 1. The shape of the hole 16 has an arcuate edge and a straight edge. The straight edge is closer to the uppermost end at the opening 8 of the body 1 while the arcuate edge is distanced from. Each pivot pin 17 of the push-button 2 incorporates a first projection of a fan-like shape of which the opening angle is smaller than that of a semi-circle. The pivot pin 17 is arranged integral with a second projection 19 of a circular shape provided on either side of the push-button 2. The pivot pins 17 (the first projections) and the second

projections 19 are aligned coaxially. The push-button 2 is installed in the body 1 with its pivot pins 17 extending coaxially of the holes 16. As the push-button 2 is assembled with the body 1, its pivot pins 17 fit into the corresponding holes 16. At the time, the second projections 19 of the push-button 2 are accepted in two substantially rectangular recesses 20 provided in both sides of the body 1 respectively and the holes 16 (See Figs. 5 and 6).

[0032] The construction of the push-button 2 is now explained. The push-button 2 comprises a press-down portion 2a for operation, a coil press-down portion 22 of a substantially triangle shape accommodated in the accommodating chamber 3 for pressing down the coil portion 4c, a bar portion 23 joining the press-down portion 2a and the coil press-down portion 22 to a pivot center 13 (See Fig. 7), a circular column portion 24 linked to one end of the bar portion 23 and arranged of which the axis extends vertical to the radius of the pivotal movement of the push-button 2, the second circular projections 19 extending from the circular column portion 24 outwardly of the bar portion 23, the pivot pins 17 provided on the second projections 19, and a stopper arm portion 6 (a first stopper) extending from the pivot center 13 towards the accommodating chamber 3. It is noted as shown in Fig. 8 that e>f>g is established when the distance between the two pivot pins 17 is e, the distance between the two second projections 19 is f, and the width of the bar portion 23 is g.

[0033] When the push-button 2 is pressed down, its fan-shaped pivot pins 17 are turned and guided by the arcuate edges of the holes 16 until the wall surface 17a of each the pivot pin 17 comes into direct contact with the straight edge of the hole 16 with the pivot center 13 sustained by the straight edge of the hole 16. While the push-button 2 remains not depressed, its coil press-down portion 22 engaging the coil portion 4c of the coil spring 4 is urged upwardly by the yielding force of the coil spring 4 so that the press-down portion 2a projects outwardly from the opening 8 of the body 1.

[0034] Each of the pivot pins 17 of the push-button 2 has a beveled surface 17b thereof provided for allowing the pivot pin 17 to fit into the hole 16 of the body 1 with much ease during the assembly process. As the body 1 is elastic, its opening 8 can expand during the assembly process. For assisting the expansion, the body 1 has a U-shaped notch 1d provided in one side thereof.

[0035] The stopper arm 6 of the push-button 2 remains rested directly on a body side stopper (a second stopper, not shown) when the push-button 2 is not operated. This determines the location of the push-button 2 at its non-operating state. The switch of this embodiment is of a right action type where the push-button 2 when pressed down is turned in a counterclockwise direction.

[0036] The switch on and off states of the switch is explained. Fig. 1a illustrates the switch off state while Fig. 2 illustrates the switch on state. When its press-down portion 2a is pressed down, the push-button 2 turns counter-clockwisely about the pivot center 13 thus to lower the coil portion 4c with its coil press-down portion 22 in the accommodating chamber 3. As its coil portion 4c is lowered, the coil spring 4 is twisted and its first movable contact portion 4a departs from the insulator 12 and comes into direct contact with the first conductor 10a. Finally, the first movable contact portion 4a is pressed against the bend end of the first conductor 10a by the yielding force of the coil spring 4. Also, the second movable contact portion 4b is pressed against the bend end of the second conductor 10b by the yielding force of the coil spring 4. As a result, the two terminals 5a and 5b are connected to each other and the switch is turned to the switch on state. In reverse, when the pressing of the push-button 2 is canceled, the coil press-down portion 22 is lifted up by the yielding force of the coil spring 4. Then, the press-down portion 2a of the push-button 2 projects from the body 1 and the first movable contact portion 4a of the coil spring 4 returns back to sit directly on the insulator 12. Simultaneously, the second movable contact portion 4b returns back to its original position on (the flat portion of) the second conductor 10b.

[0037] The body 1 of the switch of this embodiment has a stepped recess 18 provided on each side thereof as defined by the inner wall of the recess 20 and the extension of the arcuate edge of the hole 16 (See Fig. 6). The stepped recess 18 acts as a guide for leading the pivot pin 17 and the second projection 19 during the installation of the push-button 2 to the body 1. Also, as its second projections 19 engaged with the corresponding stepped recesses 18 which serve as stoppers, the push-button 2 is protected from jogging to left and right. Accordingly, the positioning error of the push-button 2 can be avoided.

[0038] When the angle of the fan shape of the pivot pin 17 is set to a small degree as shown in Fig. 7, the stroke of the push-button 2 can be lengthened. This may cause the contact area between the wall surface 17a of the pivot pin 17 and the semi-circular edge at the hole 16 of the body 1 to be reduced thus making the pivotal movement less stable. Since the second projections 19 of a circular shape are arranged with their wall surfaces engaging directly with the arcuate edge of the corresponding holes 16, this embodiment will ensure no unstableness of the pivotal movement. Even if the semi-circular shape of the hole 16 is modified to a 1/4 circular (fan like) shape by decreasing the angle, the pivotal movement can remain stable. The holes 16 may be replaced by recesses not through the body 1. The substantially semi-circular shape holes defined in the claims may be implemented by such an arrangement.

[0039] As shown in Fig. 5, the relationship between the width c of the stepped recess 18 acting as the stopper for preventing the leftward and rightward jogging and the clearance d between the body 1 and the second projection 19 is expressed by a sum of the left side and right side widths c > a sum of the left side and right side clearances d. This permits the wall surface of the sec-

ond projection 19 stays in direct engagement with the stepped recess 18. Accordingly, the pivotal movement of the push-button 2 can be improved. Fig. 5 illustrates a cross section of the push-button 2. In a common switching application, the press-down portion 2a of the push-button 2 may be actuated directly by an actuating member (not shown) of an object to be examined. For inhibiting the interruption between the actuating member and the body 1 at the opening 8, the body 1 has a pair of notches 1c provided at the opening 8 in the uppermost ends of two side thereof (See Fig. 3a). As a result, the movement of the push-button 2 can be utilized throughout the stroke.

(Second Embodiment)

[0040] Figs. 9 and 10 illustrate a small-size switch according to the second embodiment of the present invention. This switch like that of the first embodiment comprises a body 1 acting as a housing, a coil spring 4 having a pair of first and second movable contact portions 4a and 4b, a push-button 2 pivotably supported by the body 1, and a pair of terminals 5a and 5b linked with a first 10a and a second conductor 10b respectively. As the construction of this embodiment is substantially identical to that of the first embodiment, except a stopper mechanism between the body 1 and the push-button 2, like components are denoted by like numerals and will be described in no more detail. (This is applicable to other embodiments.) The body 1 has a stopper 7a (a second stopper) thereof provided extending upwardly from the bottom. The push-button 2 has the stopper arm 6a (the first stopper) provided extending downwardly from the pivot pins 17. As its stopper arm 6a engages directly with the second stopper 7a of the body 1, the push-button 2 is precisely positioned at the non operating state. The push-button 2 also has a thin portion 25 thereof provided between the bar portion 23 and the stopper arm 6a for clearing the second stopper 7a of the body 1.

[0041] The body 1 has a pair of spring guide portions 11a and 11b thereof provided extending upwardly from the bottom. At the time when the push-button 2 is pressed down, the first 4a and the second movable contact portion 4b of the coil spring 4 are controlled in the positioning by the two spring guides 11a and 11b so that they are pressed by adequate forces against the first 10a and the second conductor 10b respectively. The second stopper 7a of the body 1 in this embodiment is arranged integral with the spring guides 11a.

[0042] When the pressing of the push-button 2 is canceled, the push-button 2 is lifted up and turned in a clockwise direction by the yielding force of the coil spring 4 until its stopper arm 6a touches the second stopper 7a of the body 1. Then, the push-button 2 is positioned at its non operating state.

[0043] In this embodiment, the distance A from the pivot center 13 of the pivot pins 17 to the distal end of the stopper arm 6a of the push-button 2 is greater than that of the prior art from the pivot point to the push-button stopper. Accordingly, the push-button 2 can be improved in the production accuracy and also in the positioning accuracy at the non operating state. Also, as the counter torque of the coil spring 4 is reduced by the action of the stopper arm 6a, the physical strength of the stopper mechanism can be ensured thus contributing to the thinning and the size reduction of the small-size switch.

(Third Embodiment)

[0044] Fig. 11 illustrates a small-size switch according to the third embodiment of the present invention. The small-size switch of this embodiment is of a left action type where a push-button 2 is turned in a clockwise direction when pressed down. As the other arrangements and actions are identical to those of the previous embodiment, like components are denoted by like numerals and will be explained in no more detail.

(Fourth Embodiment)

[0045] Fig. 12 illustrates a small-size switch according to the fourth embodiment of the present invention. The small-size switch of this embodiment has a push-button 2 thereof provided with a stopper hook 6b (a first stopper) which extends from one end opposite to a pivotal center 13 towards one inner wall of the body 1. More particularly, the stopper hook 6b is formed by having a slit 14 in the push-button 2. Its body 1 also has a stopper 7b (a second stopper) provided on the upper edge of one inner wall thereof extending inwardly for engagement with the stopper hook 6b.

[0046] Accordingly, when the push-button 2 remains not pressed down, it is held upward by the yielding force of a coil spring 4 with its stopper hook 6b turned clockwisely and engaged directly with the lower side of the stopper 7b of the body 1. This defines the positioning of the push-button 2 at its non operating state. The slit 14 provides such an elasticity of the stopper hook 6b that the push-button 2 can thus be installed to the body 1 using a common snap-fit technique. As the distance from the pivot center 13 to the distal end of the stopper hook 6b of the push-button 2 of this embodiment is set greater, the positioning accuracy of the push-button 2 at its non operating state can be improved. Although the push-button 2 has the slit 14 in this embodiment, the body 1 may have a slit for providing the elasticity.

(Fifth Embodiment)

[0047] Fig. 13 illustrates a small-size switch according to the fifth embodiment of the present invention. The small-size switch of this embodiment has a push-button 2 thereof provided with a pair of stoppers 6c (first stoppers) which are two recesses provided in both sides at a substantially center region of the push-button 2. Its

body 1 also has a pair of stoppers 7c (second stoppers) provided on the inner surfaces of two sides at a substantially center region thereof extending inwardly as shown in Figs. 13b and 13c. Each the stopper 7c has an upper side thereof beveled. The beveled sides of the stoppers 7c allow the push-button 2 to be easily inserted into the body 1 from the opening 8 for installation.

[0048] Accordingly, when the push-button 2 remains not pressed down, it is held upward by the yielding force of a coil spring 4 with its stopper recesses 6c turned clockwisely and engaged directly with the corresponding stoppers 7c of the body 1. This defines the positioning of the push-button 2 at its non operating state. Since the switch of this embodiment has the push-button 2 provided with no projection acting as the stopper, its construction can thus be made simple and favorably reduced in the production cost.

(Sixth Embodiment)

[0049] Fig. 14 illustrates a small-size switch according to the sixth embodiment of the present invention. The small-size switch of this embodiment has a push-button 2 provided with a pair of push-button stoppers 6d (first stoppers) which extend from both sides at a substantially center region of the push-button 2 towards the inner wall of a body 1. Each of the push-button stoppers 6d has a lower side thereof beveled as best shown in Fig. 14b. The beveled lower sides of the stoppers 6d allow the push-button 2 to be easily inserted into the body 1 as expanding its opening 8. Also, a pair of body stoppers 7d (second stoppers) are provided in the form of recesses in the inner wall of the body 1 as shown in Figs. 14c and 14d. More particularly, the body stopper 7d is implemented by the upper end of an arcuate recess which is shaped to match the pivotal movement of the push-button stoppers 6d.

[0050] Accordingly, when the push-button 2 remains not pressed down, it is held upward by the yielding force of a coil spring 4 with its stoppers 6d turned clockwisely and engaged directly with the corresponding stoppers 7d of the body 1. This defines the positioning of the push-button 2 at its non operating state. Because the body 1 of this embodiment requires no undercuts in its molds to be used in the production, the stopper mechanism can be improved in the dimensional accuracy.

Industrial Applications

[0051] The small-size switches of the embodiments of the present invention are designed for closing and opening between the electrical contacts with the stroke of the push-button significantly increased for ease of the operation and thus favorable for use in mobile telephones and other commercial appliances.

Claims

1. A small-size switch comprising:

a housing body having an accommodating chamber provided therein;
a coil spring provided between two opposite end walls at the accommodating chamber of the body and having a coil portion and a pair of first and second movable contact portions extending from both ends of the coil portion;
a push-button pivotably supported at its pivot point by the body and having one end thereof in the accommodating chamber arranged to seat directly on the coil portion so that while the one end of the push-button is urged upwardly by the yielding force of the coil spring, the other end projects from the opening of the body and stays outside the body at the non operating state and serves as an operating portion for switching actions at the switch operating state; and
a pair of terminals having a first and a second conductor thereof respectively extending inwardly from the two opposite end walls at the accommodating chamber of the body, the first conductor staying in no contact with the first movable contact portion of the coil spring at the non operating state and when the operating portion of the push-button is pressed down to lower the coil spring, coming into direct contact with the first movable contact portion, and the second conductor remaining constantly in contact with the second movable contact portion of the coil spring, wherein
the body has a substantially semi-circular hole provided in each of two side walls thereof as defined by an arcuate edge and a straight edge for accepting pivotably corresponding one of two pivot pins of the push-button, the straight edge of the hole located closer to the uppermost end at the opening of the body while the arcuate edge located further from the uppermost end, and
the pivot pins are provided on both sides of the push-button to extend coaxial with the substantially semi-circular holes of the body, each the pin having a first projection of a fan shape of which the opening angle is smaller than that of the substantially semi-circular hole so that the fan shaped projection fits into the substantially semi-circular hole.

2. A small-size switch according to claim 1, wherein
the push-button has a second projection of a circular shape provided on each side thereof to extend coaxial with the substantially semi-circular hole of the body so that the first projection of a fan

shape is located on the corresponding second projection at each side, and

the body has a recess provided in the inner surface of each side wall thereof next to the semicircular hole for accepting the corresponding second projection of the push-button at each side.

3. A small-size switch according to claim 1, wherein the first projection of each pivot pin has a lower side thereof beveled so that while the pivot pins of the push-button are inserted into the opening of the body to fit into the corresponding substantially semicircular holes of the body, their first projections expand the opening of the body with the beveled sides.

4. A small-size switch according to claim 1, wherein

the push-button has a first stopper provided thereon extending from the pivot pins for positioning the push-button at a location distanced from the pivot pins, and

the body has a second stopper provided thereon for engaging directly with the first stopper turned in a switch-off direction by the yielding force of the coil spring thus to determine the position of the push-button at its non operating state.

5. A small-size switch according to claim 4, wherein

the first stopper is an arm extending from the pivot pins of the push-button, and

the second stopper stands upright in the accommodating chamber of the body for engaging directly with the arm of the first stopper.

6. A small-size switch according to claim 4, wherein

the first stopper is a projection extending from one end opposite to the pivot center of the push-button, and

the second stopper is located on one end wall of the body for engaging directly with the projection of the first stopper.

7. A small-size switch according to claim 4, wherein either the first stopper or the second stopper is adapted to has a degree of elasticity.

8. A small-size switch according to claim 4, wherein

the first stopper incorporates a pair of recesses provided in both sides at a substantially center region of the push-button so as to open to the opening of the body, and

the second stopper incorporates a pair of projections provided on the inner surfaces of the two side walls of the body for fitting into the corresponding recesses of the push-button.

9. A small-size switch according to claim 4, wherein

the first stopper incorporates a pair of projections provided on both sides at a substantially center region of the push-button so as to extend towards the inner surfaces of the two side walls of the body, and

the second stopper incorporates a pair of slit recesses provided in the inner surfaces of the two side walls of the body for accepting the corresponding projections of the push-button which engage with the upper ends of the slit recesses of the body.

10. A small-size switch comprising:

a housing body having an accommodating chamber provided therein;

a coil spring provided between two opposite end walls at the accommodating chamber of the body and having a coil portion and a pair of first and second movable contact portions extending from both ends of the coil portion;

a push-button pivotably supported at its pivot point by the body and having one end thereof in the accommodating chamber arranged to seat directly on the coil portion so that while the one end of the push-button is urged upwardly by the yielding force of the coil spring, the other end projects from the opening of the body and stays outside the body at the non operating state and serves as an operating portion for switching actions at the switch operating state; and

a pair of terminals having a first and a second conductor thereof respectively extending inwardly from the two opposite end walls at the accommodating chamber of the body, the first conductor staying in no contact with the first movable contact portion of the coil spring at the non operating state and when the operating portion of the push-button is pressed down to lower the coil spring, coming into direct contact with the first movable contact portion, and the second conductor remaining constantly in contact with the second movable contact portion of the coil spring, wherein

the push-button has a first stopper provided thereon extending from its pivot pin for positioning the push-button at a location distanced from the pivot pin, and

the body has a second stopper provided thereon for engaging directly with the first stopper turned in a switch-off direction by the yielding force of the coil spring thus to determine the position of the push-button at its non operating state.

FIG. 1

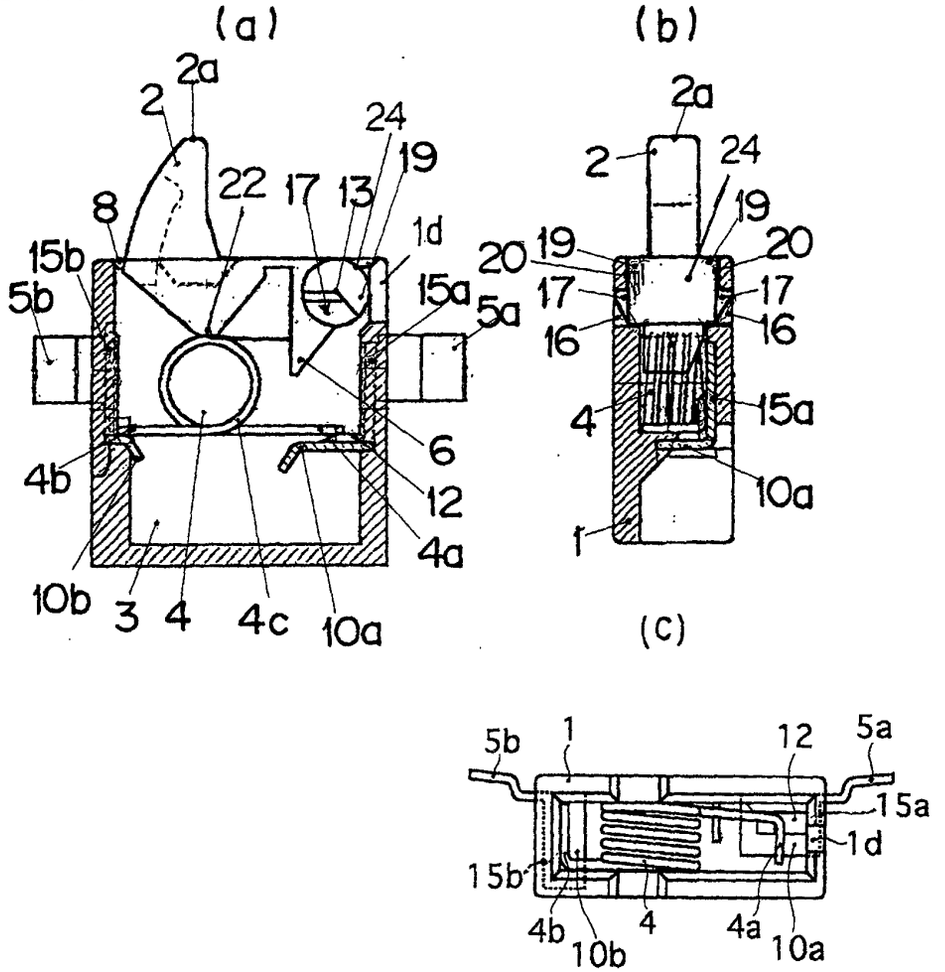
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FIG. 2

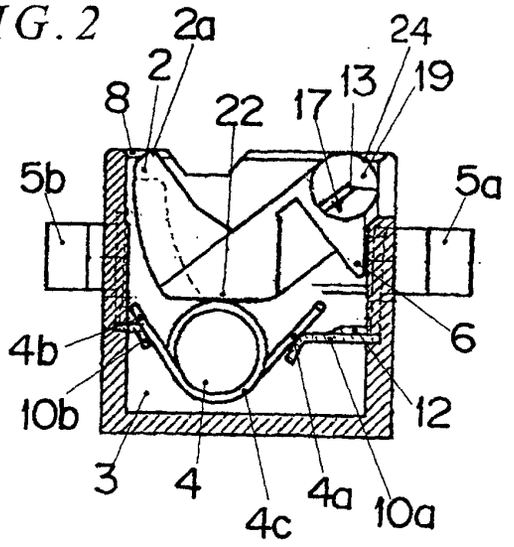
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FIG. 3

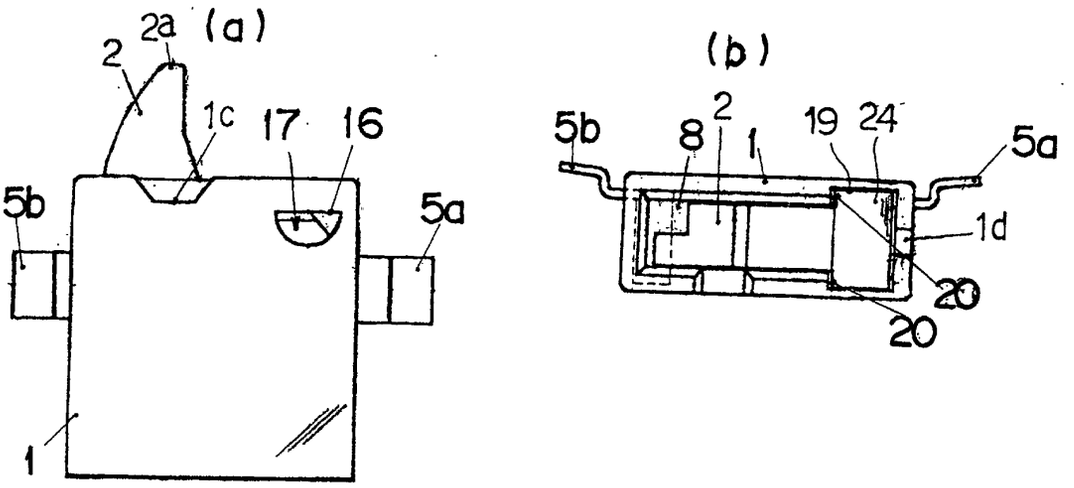
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FIG. 4

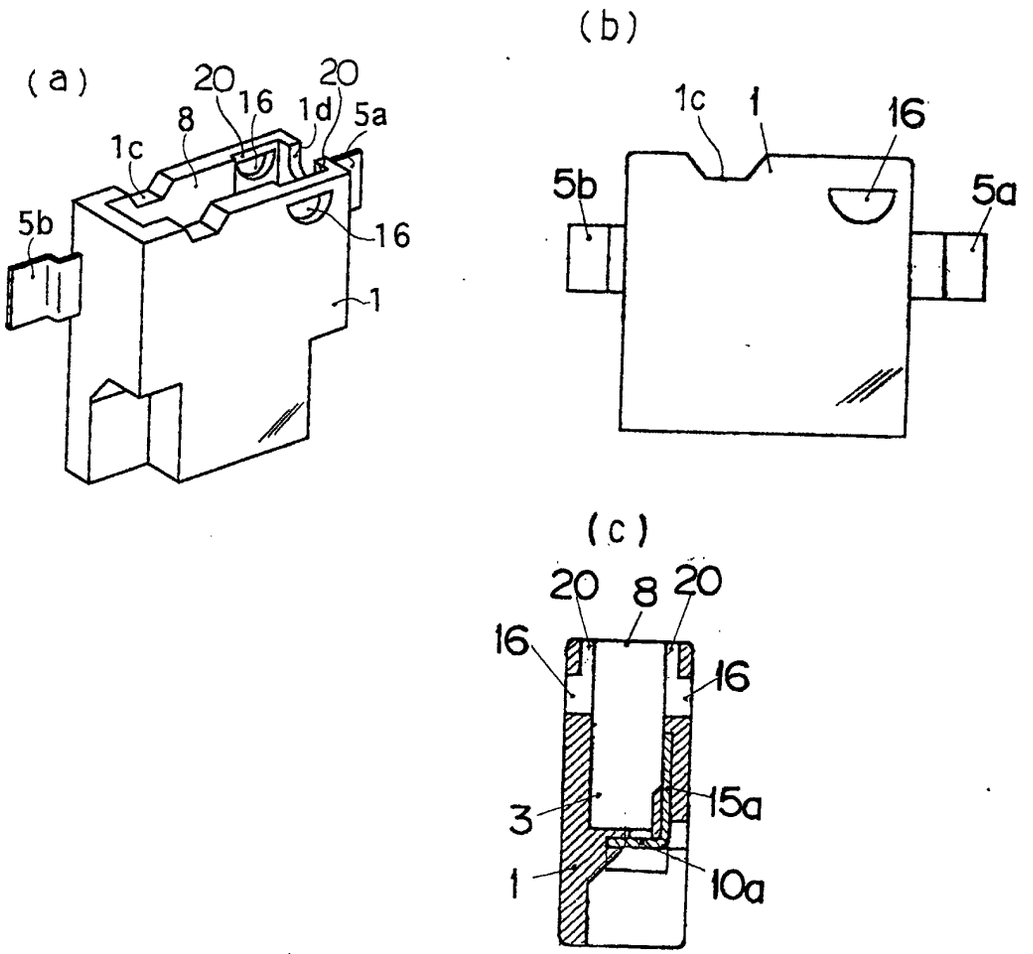
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FIG. 5

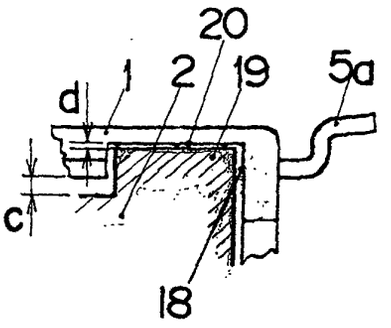
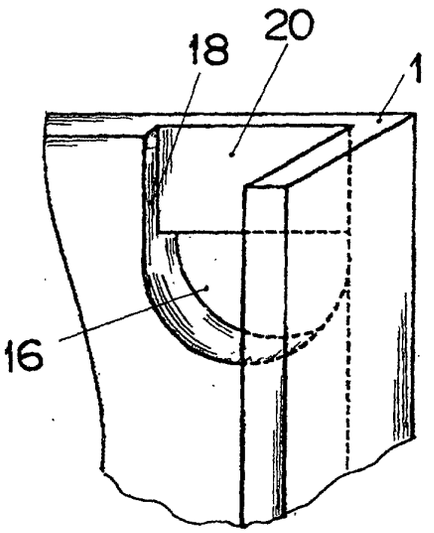


FIG. 6



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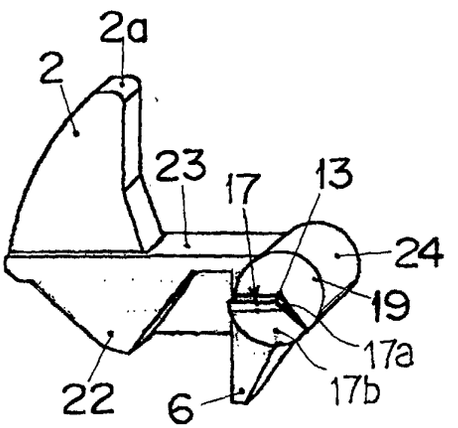


FIG. 8

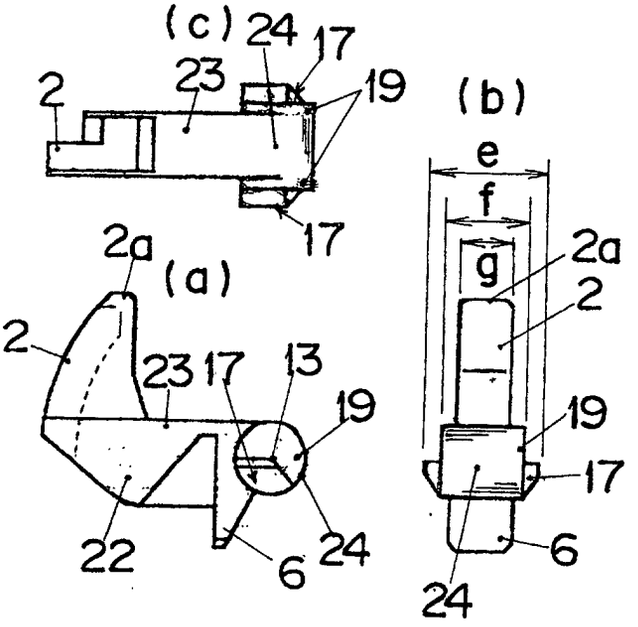


FIG. 9

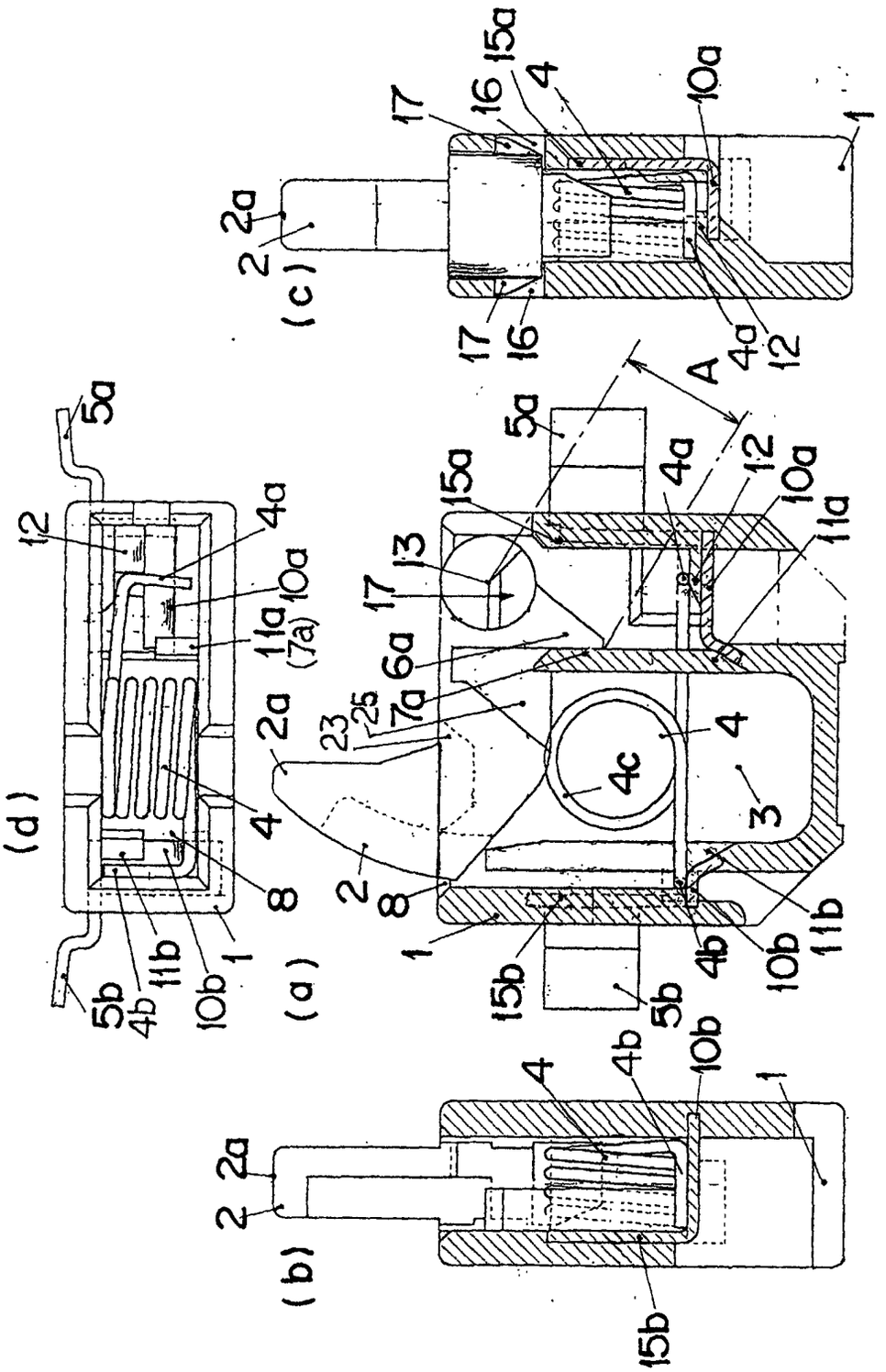
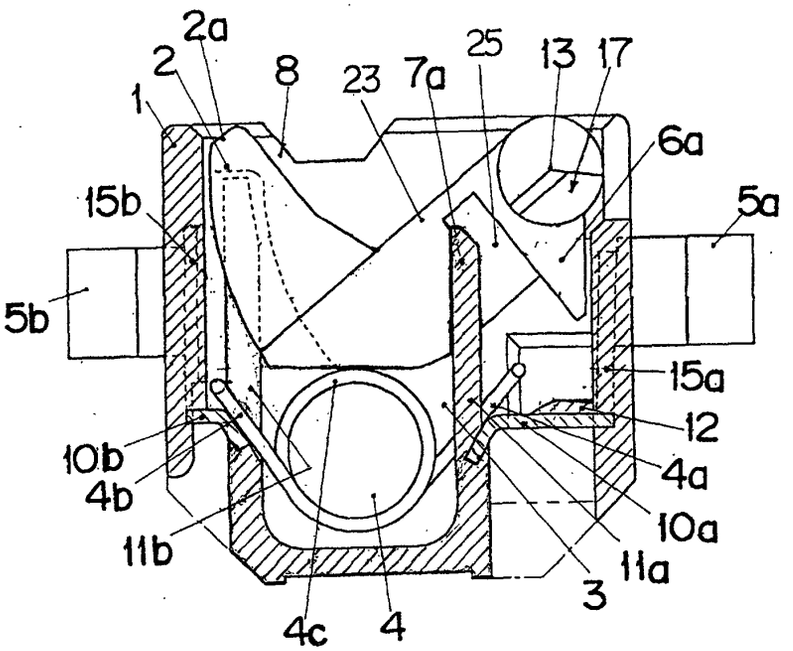


FIG. 10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4c
4

FIG. 11

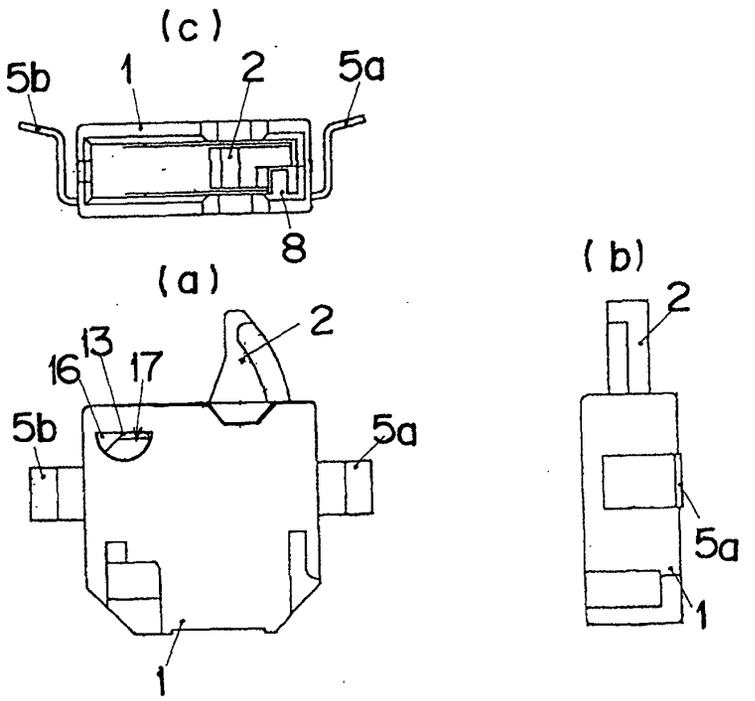
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FIG. 12

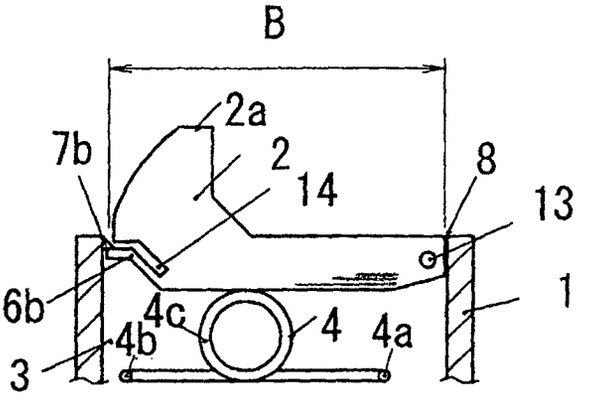
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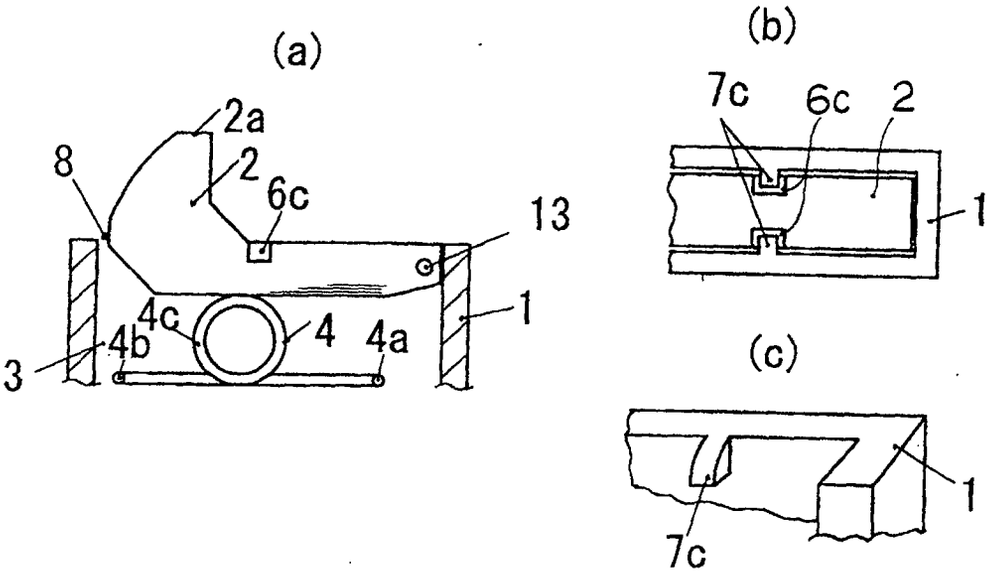
FIG. 13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7c

FIG. 14

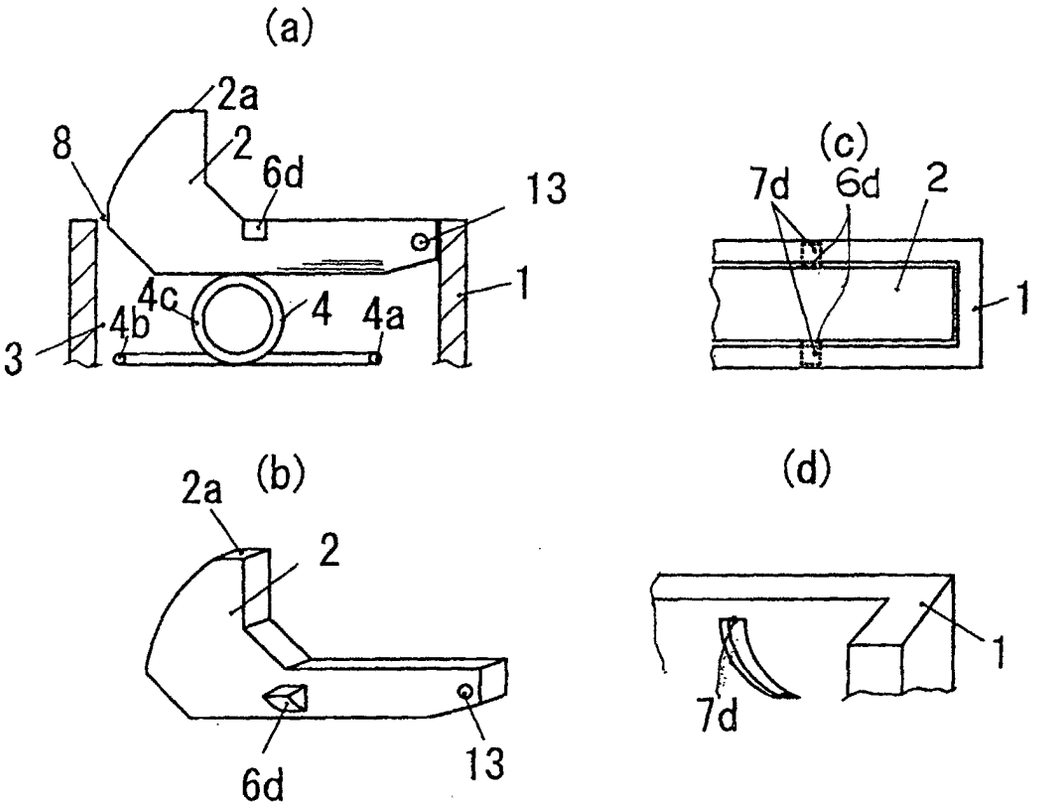
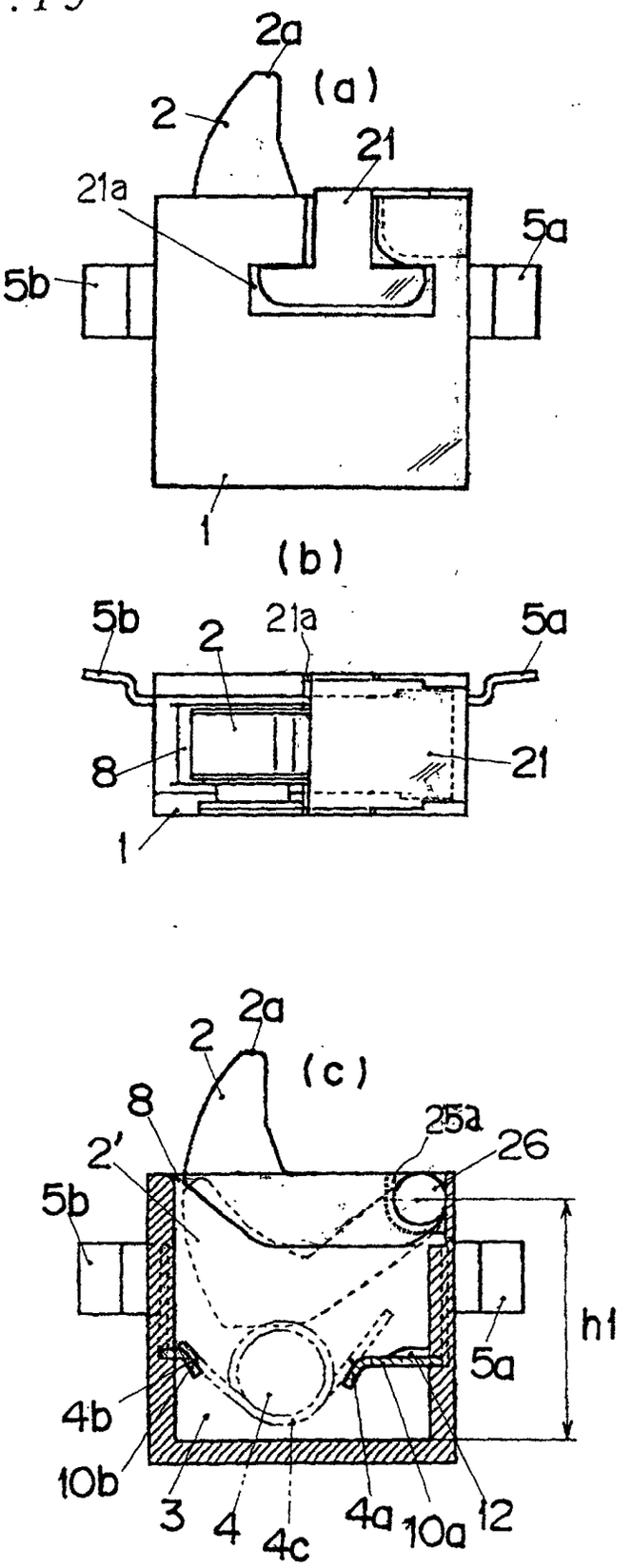


FIG. 15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(c)
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4
4c
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12

FIG. 16

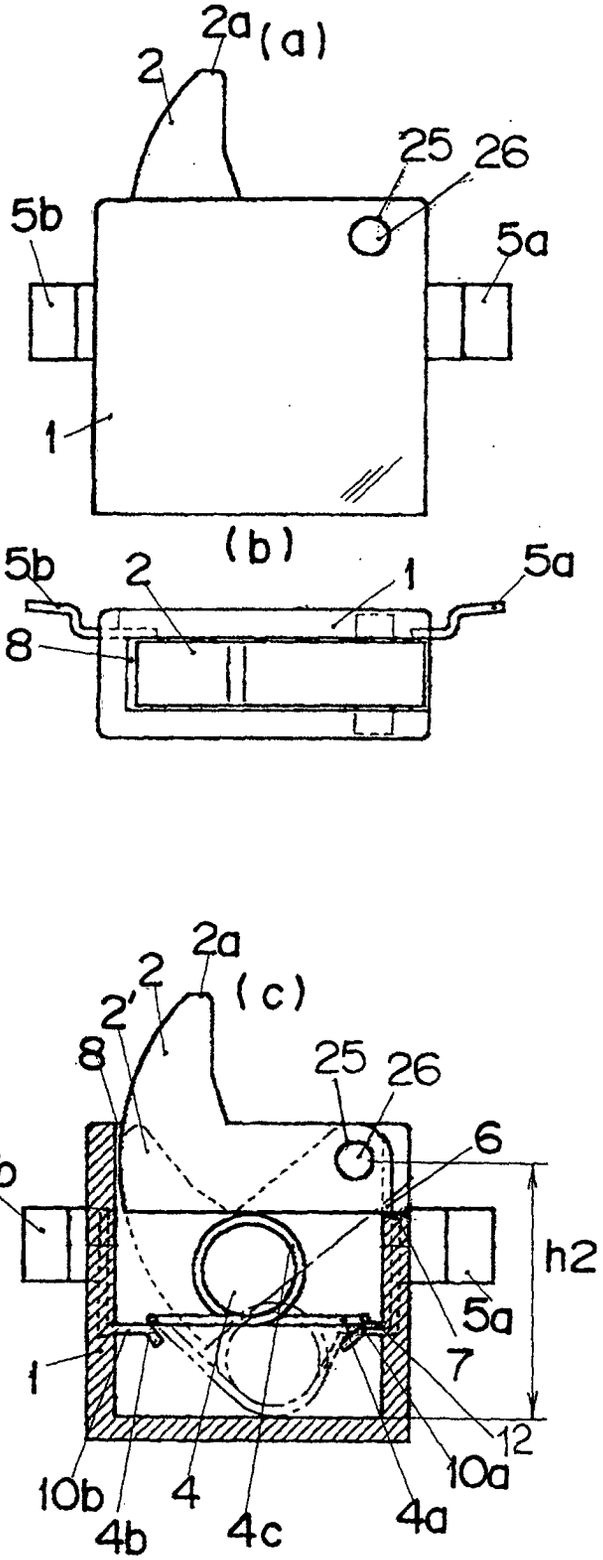
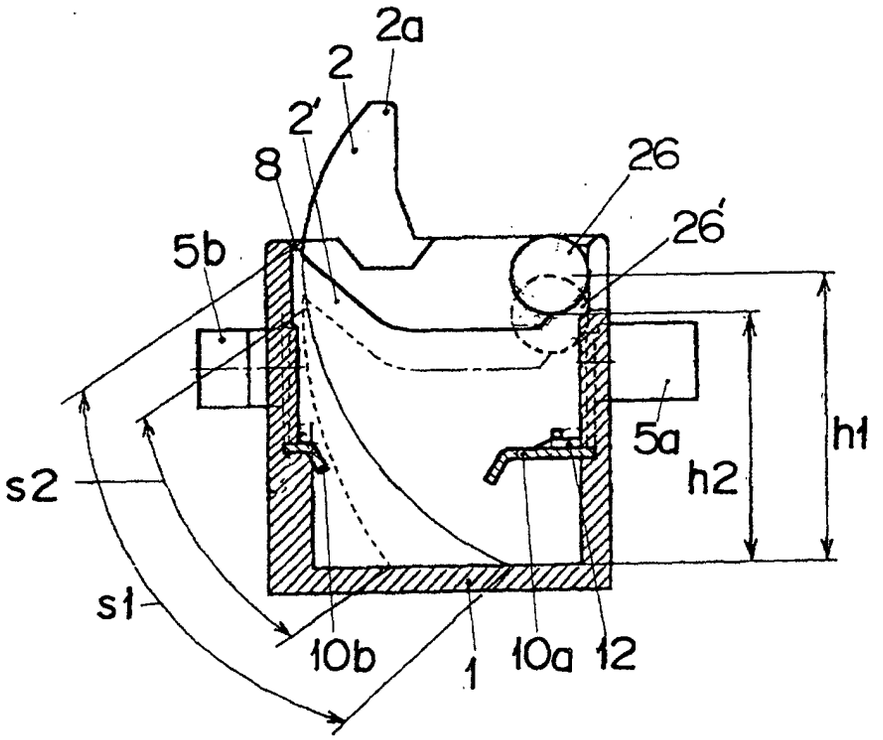


FIG. 17



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/09458

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01H 21/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] H01H 21/00, H01H 21/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1940-1996 Toroku Jitsuyo Shinan Koho 1994-2002
Kokai Jitsuyo Shinan Koho 1971-2002 Jitsuyo Shinan Toroku Koho 1996-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 28056/1993 (Laid-open No. 86240/1994) (Matsushita Electric Ind. Co., Ltd.) 13 December, 1994 (13.12.94), Par. Nos. [0003]-[0005]; Figs. 4-9 (Family: none)	1-10
Y	JP 8-329779 A (Matsushita Electric Ind. Co., Ltd.), 13 December, 1996 (13.12.1996), Par. Nos. [0003] to [0006]; Figs. 20 to 24 (Family: none)	1-10
Y	JP 53-2843 Y2 (Yamatake Honeywell Co., Ltd.), 25 January, 1978 (25.01.1978), Column 2, line 25 to Column 3, line 3; Figs. 1 to 4 (Family: none)	1-10
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 103419/1988 (Laid-open No. 25138/1990) (Yamatake Honeywell Co., Ltd.)	1-10

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 January, 2002 (17.01.02)	29 January, 2002 (29.01.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/09458

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	19 February, 1990 (19.02.90), page 4, line 10 to page 6, line 17; Figs. 1-3 (Family: none)	
Y	JP 9-259703 A (Alps Electric Co., Ltd.), 03 October, 1997 (03.10.1997), Par. Nos. [0012] to [0013]; Figs. 1 to 5 (Family: none)	3
Y	JP 11-3633 A (Matsushita Electric Ind. Co., Ltd.), 06 January, 1999 (06.01.1999), Par. No. [0020]; Fig. 1 (Family: none)	4-7,10
Y	JP 10-21788 A (Matsushita Electric Ind. Co., Ltd.), 23 January, 1998 (23.01.1998), Par. No. [0019]; Fig. 1 (Family: none)	4-7,10
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 30184/1988 (Laid-open No. 134330/1989) (SMK Corporation) 13 September, 1989 (13.09.89), page 5, line 14 to page 6, line 13; Figs. 1-3 (Family: none)	8,9
A	JP 2000-149715 A (Teikoku Tsuushin Kogyo K.K.) 30 May, 2000 (30.05.2000), Par. Nos. [0008]-[0027]; Figs. 1-2 (Family: none)	1-10
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 92849/1977 (Laid-open No. 20371/1979) (Omron Tateishi Electronics Co.) 09 February, 1979 (09.02.1979), page 3, line 4 to page 5, line 9; Figs. 1-2 (Family: none)	1-10
A	JP 6-50918 Y2 (ONKYO CORPORATION), 21 December, 1994 (21.12.1994), Column 4, lines 1 to 20; Figs. 1 to 2 (Family: none)	7

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/09458

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

As shown in column C, Claims 1 to 10 do not avoid a prior art.
Claims 1 to 10 do not so technically relate to each other as to include the technical features to clear the contribution of the inventions to a prior art as a whole.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1992)