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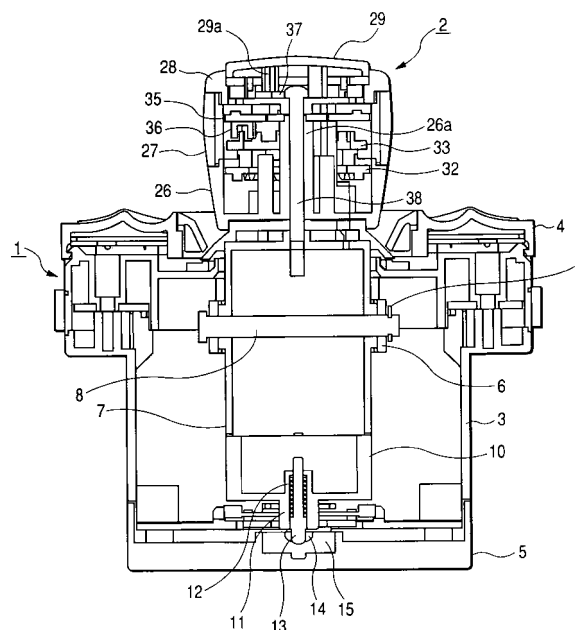
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(54) **Multi-operational input device**

(57) A multi-operational input device includes a press a press knob (29) which is supported on the top surface of an upper knob so as to be press-operated; a circuit board (35) which is disposed on the rear side of the press knob; a push switch (37) which is mounted on the surface of the circuit board; a rotation ring (27) which is supported between the upper knob and a lower knob so as to be rotatably operated; a code plate (33) which is rotated in conjunction with the rotation of the rotation ring; photo interrupters which are mounted on the rear side of the circuit board. The push switch is operated by pressing the press knob and the code plate is rotated in conjunction with the rotating or the rotation ring, so as to operate the photo interrupters mounted on the rear side of the circuit board. At this time, as the rotation ring is continuously disposed over a range from the surface of the circuit board to the rear side thereof, a rotating force of the rotation ring is transmitted to the code plate disposed on the rear side of the circuit board

FIG. 4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a multi-operational input device which is capable of carrying out a predetermined input operation with two different press and rotation operations, and more particularly, to a multi-operational input device which mounts a press detecting element and a rotation detecting element on a common circuit board.

2. Description of the Related Art

[0002] In the related art, as an example of this type of multi-operational input device, there has been known a device in which an operating body is held in a case so as to be rotatable and vertically movable, a code plate is spline-connected to the operating body by a return spring, and a rotation detecting element which detects a rotation operation of the operating body and a press detection element which detects a pressing operation of the operating body are mounted on a circuit board disposed in the case (for example, see JP-A-2004-87307 (pages 4 to 5, Fig. 3)).

[0003] A pair of plungers is slidably held in the operating body, respectively, through a coil spring, and front tips of these plungers protrude from an external edge of the operating body and engage with concavity and convexity formed at an inner peripheral surface of the case. A shaft is provided in the center of the operating body, and a cylindrical portion is provided outside of the shaft. The code plate is spline-connected to the shaft of the center through the return spring. Accordingly, even though the code plate rotates integrally with the operating body, the code plate does not move vertically while the operating body moves vertically. The rotation detecting element is made up of photo interrupters that are mounted inside of the circuit board. When the code plate rotates along with the rotation operation of the operating body, an on-signal and an off-signal are alternately output from the photo interrupters along with the rotation of the code plate. In addition, the press detecting element is made up of separate photo interrupters mounted outside of the circuit board, when the cylindrical portion moves down along with the pressing operation of the operating body, a light path of the photo interrupter is blocked so that an on-signal is output.

[0004] In the multi-operational input device configured in this way, when an operator rotates the operating body, the code plate rotates integrally with the operating body. Therefore, on/off signals are alternately output from the photo interrupters (rotation detecting element) mounted inside on the circuit board, and the operator can detect rotation operation performed by the operator on the basis of these signals. In addition, when the operating body is

rotated, a front end of a plunger is disengaged from the uneven portion of an inner peripheral surface of the case so as to generate a click feeling; therefore, the operator can perceive the rotation amount of the operating body by the click feeling.

[0005] In the meantime, when the operator presses the operating body, the operating body moves downward while pressing against the return spring, the cylindrical portion blocks a light path of a separate photo interrupter (press detecting element) which is mounted outside of the circuit board when the operating body has moved by a predetermined stroke. Therefore, the output from the photo interrupter is converted from ON to OFF, and pressing of the operating body can be detected by the converted signals. However, since the code plate does not move while the operating body moves downward, signals from the photo interrupter (rotation detecting element) inside the circuit board are not converted. Further, when pressing force applied to the operating body is removed, the operating body moves to an initial position by a resilient force of the return spring, the cylindrical portion is deviated from the light path of the outside photo interrupter (press detecting element). Accordingly, the output from the photo interrupter is converted from OFF to ON, and moving of the operating body can be detected on the basis of the converted signal.

[0006] However, in the multi-operational input device according to the related art, since a mounting space of the rotation detecting element and a mounting space of the press detecting element are concentrated on the surface of the circuit board, the entire input device including the circuit board should be made large in a transverse direction; therefore, it is difficult to make the device small in the transverse direction. In addition, the above-mentioned problem is not limited to an input device in which the photo interrupter is used both in the rotation detecting element and the press detecting element. For example, the problem is also found in an input device, in which a push switch is used as the press detecting element, and a photo interrupter is used as the rotation detecting element.

[0007] In addition, in the multi-operational input device according to the related art, the front end of the plunger which protrudes from an outer edge of the operating body is pressure-contacted with the uneven portion of the inner peripheral surface of the case, and the rotation of the operating body makes the plunger disengaged from the uneven portion so as to generate a click feeling. Therefore, the input device is inevitably made large in the transverse direction by the aforementioned click mechanism, and thus it is difficult to make the device small in the transverse direction.

[0008] The present invention has been finalized in view of the inherent drawbacks in the related art, and it is an object of the present invention to provide a multi-operational input device which can be made small in the transverse direction.

SUMMARY OF THE INVENTION

[0009] In order to solve the above-described problems, according to an aspect of the invention, a multi-operational input device includes a press operating member which is supported by a supporting body so as to be press-operated; a circuit board which is disposed in a press-operating direction of the press operating member; a press detecting element which is mounted on the front surface of the circuit board and operated by pressing the press operating member; a rotation operating member which is supported by the supporting body so as to be rotatably operated; and a rotation detecting element which is mounted on the circuit board and operated by rotating the rotating operating member. In this case, the rotation detecting element is mounted on the rear surface of the circuit board, and at least a part of the rotation operating member is allocated at the front side of the circuit board, and a rotating force of the rotation operating member applied from the front side of the circuit board is transmitted to the rear side of the circuit board.

[0010] In the multi-operational input device with this structure, a mounting space of the press detecting elements overlaps with one side of the circuit board, and the rotation detecting elements overlaps with the other side of the circuit board. Accordingly, it is possible to make the entire input device small in a transverse direction.

[0011] With this structure, even though the entire rotation operating member may be disposed on the surface of the circuit board, the rotation operating member is preferably a barrel-shaped rotation ring which surrounds the circuit board. Accordingly, it is possible to make the multi-operational input device small in a lengthwise direction.

[0012] In this case, the supporting body includes an upper knob and a lower knob which hold the rotation ring therebetween, and the circuit board and the upper knob are fixed onto an upper end of a support shaft which is erected at the center of the lower knob. Accordingly, it is possible to improve operability by adjacently disposing the press knob and the rotation ring.

[0013] In addition, with the above structure, rotation detecting elements may be used, such as a hall element, a rotary encoder or the like. However, preferably, the rotation detecting element includes photo interrupters, in which a light emitting element and a light receiving element are disposed to face each other with a concave portion interposed therebetween. Further, a code plate having the light shielding portion and the light transmitting portion is fixed onto an inner peripheral surface of the rotation ring, and the light shielding portion and the light transmitting portion move inside the concave portion in conjunction with the rotation of the rotation ring.

[0014] In this case, an uneven portion is formed on the rear side of the code plate, and a plunger, which is elastically urged toward the code plate, is held by the lower knob so as to move vertically, and the rotation of the rotation ring makes an upper end of the plunger 31 dis-

engaged from the uneven portion, so as to generate a click feeling. Accordingly, the click mechanism can be disposed in a space under the circuit board. Therefore, it is possible to make the entire input device small in the transverse direction by the click mechanism, and to prevent rattling of the rotation ring by using the urging force of the plunger provided in the click mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a perspective view of a control unit according to an embodiment of the invention;

Fig. 2 is a plan view of the control unit;

Fig. 3 is a cross-sectional view taken along the line III-III of Fig. 2;

Fig. 4 is a cross-sectional view taken along the line IV-IV of Fig. 2;

Fig. 5 is an exploded perspective view of a multi-operational input device provided in the control unit;

Fig. 6 is an exploded perspective view of a multi-directional input device provided in the control unit;

Fig. 7 is a cross-sectional view showing main components of the multi-directional input device;

Fig. 8 is a plan view showing main components of the multi-directional input device;

Fig. 9 is a perspective view showing main components of the multi-directional input device;

Fig. 10 is an exploded perspective view showing main components of the multi-directional input device;

Fig. 11 is a plan view showing an arrangement relationship of a guide member and an engaging protrusion provided in the multi-directional input device;

Fig. 12 is an explanatory view showing an operation of the engaging protrusion;

Fig. 13 is a plan view of a circuit board provided in the multi-operational input device of Fig. 5;

Fig. 14 is a side view of the circuit board; and

Fig. 15 is a rear view of the circuit board.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] Hereinafter, a preferred embodiment of the invention will be described with reference to the accompanying drawings. Fig. 1 is a perspective view of a control unit according to an embodiment of the invention, Fig. 2 is a plan view of the control unit, Fig. 3 is a cross-sectional view taken along the line III-III of Fig. 2, Fig. 4 is a cross-sectional view taken along the line IV-IV of Fig. 2, Fig. 5 is an exploded perspective view of a composite operation input device provided in the control unit, Fig. 6 is an exploded perspective view of a multi-directional input device provided in the control unit, Fig. 7 is a cross-sectional view showing the multi-directional input device, Fig. 8 is a plan view showing main components of the multi-directional input device, Fig. 9 is a perspective view showing

main components of the multi-directional input device, Fig. 10 is an exploded perspective view showing main components of the multi-directional input device, Fig. 11 is a plan view showing an arrangement relationship of a guide member and an engaging protrusion provided in the multi-directional input device, Fig. 12 is an explanatory view showing an operation of the engaging protrusion, Fig. 13 is a plan view of a circuit board provided in the multi-operational input device of Fig. 5, Fig. 14 is a side view of the circuit board, and Fig. 15 is a rear view of the circuit board.

[0017] The control unit according to the present embodiment controls an electric mechanism for a vehicle, such as an air conditioner, an acoustic device, a navigation system, etc., in a concentrated manner, the control unit includes a chassis 1 mounted in, for example, a center console inside a vehicle, and an operating body 2 which protrudes from the chassis 1. The chassis 1 is composed of a case 3 having a hollow structure whose top and bottom are open, an upper cover 4 which covers an upper opening end of the case 3, and a lower cover 5 which covers a lower opening end of the case 3, and all of these components are molded of synthetic resin.

[0018] A circular ring body 6 is disposed inside the case 3, a pair of spindles 6a and a pair of through-holes 6b are alternately formed at every 90-degree interval. Both spindles 6a are inserted into shaft holes 3a formed at upper inner walls of the case 3 facing each other, and the ring body 6 is rotatably held in the case 3 about a line connecting both shaft holes 3a as the central axis. A cylindrical holder 7 is inserted into the ring body 6, and a protrusion 7a having a pair of stepped portions is formed at an outer peripheral surface of the holder 7. In addition, the holder 7 is provided with a through-hole 7b which penetrates the central axis and the protrusion 7a having the pair of stepped portions, and a pin 8 is inserted through the through hole 7b and both through holes 6b of the ring body 6. The pin 8 is prevented from falling off the ring body 6 by an engaging ring 9, and the holder 7 is rotatably held in the ring body 6 about an axis line connecting both through-holes 6b as the central axis. That is, the holder 7 is rotatably supported so as to rock in a direction orthogonal to the case 3 through the ring body 6. In the following description, a rocking direction (X1-X2 direction) of the holder 7 which rocks about both spindles 6 of the ring body 6 as a fulcrum is referred to as a first direction, a rocking direction (Y1-Y2 direction) of the holder 7 which rocks about the pin 8 as a fulcrum is referred to as a second direction.

[0019] The holder 7 forms some constituent parts of the operating body 2, a pair of protrusions 7d is disposed to be erected on a top surface of the holder 7 with a screw hole 7c interposed between the pair, and a connection body 10 is integrated with a lower end of the holder 7 by using a fixed means, such as snap-fitting. In addition, in the present embodiment, even though the connection body 10 is used for a driving motor or the like to be accommodated in the holder 7. However, when such a

space for accommodation is unnecessary, the holder 7 and the connection body 10 may be formed of an integrated molding. A barrel-shaped engaging protrusion 11 is protrudingly disposed at the center of a bottom surface of the connection body 10, and an accommodation hole 11a is formed in the engaging protrusion 11 so as to extend vertically (See Fig. 10). Four convex portions 11b are protrudingly disposed at an outer wall surface of the engaging protrusion 11 so as to serve as guided portions, and these convex portions 11b extend in first and second directions from the center of each side of a square. As shown in Fig. 7, a coil spring 12 and a driving rod 13 are inserted into the accommodation hole 11a of the engaging protrusion 11, a leading end (bottom end) of the driving rod 13 is pressure-contacted with an inner bottom surface of a cam groove 14 by resilient force of the coil spring 12. The cam groove 14 is a conical dented portion formed on a top surface of a support body 15 made of synthetic resin material, and a click protrusion 14a is formed along the same periphery about the innermost of the dented portion. The support body 15 is pressure-fixed in a concave portion 5a which is formed in the center of the inner bottom surface of the lower cover 5, and four upper corners of the support body 15 are provided with protrusions 15a and screw holes 15b formed thereon.

[0020] A guide member 16 made of synthetic resin is disposed on the support body 15, and four circular holes 16a are formed on four corners of the guide member 16. Two of the circular holes 16a function as a positioning hole so as to be engaged with the protrusions 15a of the support body 15, and a screw 17 is inserted through the rest two circular holes 16a and further inserted into the screw holes 15b. Thus, the guide member 16 is fixed on the support body 15. An aperture 18 is formed in a central portion of the guide member 16, as shown in Fig. 11, and the engaging protrusion 11 which protrudes from the bottom surface of the connection body 10 is positioned inside the aperture 18, and the leading end of the driving rod 13 held in the engaging protrusion 11 is pressure-contacted with the cam groove 14 which is exposed through the central position of the aperture 18. Four notch portions 18a are formed at an inner wall surface of the aperture 18 so as to function as guide portions, and these notch portions extend in first and second directions toward the outside from the center of each side of a square. Each convex portion 11b of the engaging protrusion 11 faces the entrance of each notch portion 18a. When a length between opposite inner wall surfaces of the aperture 18 is set to L1, and a length between opposite convex portions 11b is set to L2, L2 is set to be slightly shorter than L1.

[0021] In addition, a pair of first guide protrusions 16b and a pair of second guide protrusions 16c are formed on an outer edge so as to erect thereon, the respective guide protrusions 16b and 16c are positioned so as to extend from the notch portions 18a. The first and second guide protrusions 16b and 16c are formed to be divided into two directions, and a height dimension of the first

guide protrusion 16b is set smaller than that of the second guide protrusion 16c. A first slider 19 is slidably supported in a first direction (X1-X2 direction) by both of the first guide protrusions 16b, and a second slider 20 is slidably supported in a second direction (Y1-Y2 direction) by both of the second guide protrusion 16c. The first slider 19 includes a rectangular frame 19a, a pair of arm portions 19b which extends outward from the center of longer sides of the frame 19a facing to each other, and light shielding portions 19c which are formed on leading ends of both of the arm portions 19b to protrude in a direction orthogonal to the plate surface of the arm portions 19b. Further, an elongated hole 19d is formed in the frame 19a to extend in the second direction. The second slider 20 includes a rectangular frame 20a, a pair of arm portions 20b which extends outward from the center of longer sides of the frame 20a facing to each other, and light shielding portions 20c which are formed on leading ends of both of the arm portions 20b so as to protrude in a direction orthogonal to the plate surface of the arm portions 20b. Further, an elongated hole 20d is formed in the frame 20a to extend in the first direction. The first and second sliders 19 and 20 are the common components that are molded of synthetic resin in the same shape, but these sliders are built in the guide member 16 in a state opposite to each other vertically when used, and the frame 19a of the first slider 19 overlaps with the frame 20a of the second slider 20 in a planar direction so as to form a laminated arrangement.

[0022] In other words, as shown in Figs. 8 and 9, the first slider 19 is disposed in an upward direction in which the light shielding portion 19c protrudes from the plate surface of the arm portion 19b, and as the arm portions 19b are held between the corresponding first guide protrusions 16b. Accordingly, the first slider 19 is slidably supported by both of the first guide protrusions 16b that are shorter sides of the guide member 16. In the meantime, the second slider 20 is disposed in an opposite direction in which the light shielding portion 20c protrudes downward from the plate surface of the arm portion 20b, and as the arm portion 20b is held between the corresponding second guide protrusions 16c, whereby the second slider 20 is slidably supported by both of the second guide protrusions 16c that are the longer sides of the guide member 16. In this way, since the first slider 19 and the second slider 20 are disposed in a state opposite to each other to form the laminated arrangement, both of the light shielding portions 19c of the first slider 19 and both of the shielding portions 20c of the second slider 20 are positioned on the same plane, and the elongated hole 19d formed in the frame 19a of the first slider 19 overlaps with the elongated hole 20d formed in the frame 20a of the second slider 20 in a state orthogonal to each other. The aforementioned engaging protrusion 11 is inserted through both of the elongated holes 19d and 20d (see Fig. 8). When the first slider 19 is pressed by an external force from the engaging protrusion 11 and moves in the first direction (X1-X2 direction), the second

slider 20 does not move because the engaging protrusion 11 relatively moves only inside the elongated hole 20d. When the second slider 20 is pressed by an external force from the engaging protrusion 11 and moves in the second direction (Y1-Y2 direction), the first slider 19 does not move because the engaging protrusion 11 relatively moves only inside the elongated hole 19d.

[0023] A printed board 21 is fixed on the lower cover 5, and the guide member 16 is exposed through an aperture 21a formed in a central portion of the printed board 21. Four photo interrupters 22 are mounted on the printed board 21, and each photo interrupter 22 is disposed in X1-X2 and Y1-Y2 directions on the printed board 21. The photo interrupter 22 is a light detecting element in which a light emitting element 22b and a light receiving element 22c are disposed to face each other and integrated with each other with a recessed portion 22a interposed therebetween. As shown in Fig. 8, when the first slider 19 and the second slider 20 are in neutral positions in the first and second directions, each light shielding portion 19c and 20c remain at insensitive areas at the entrances of the recessed portion 22a of each photo interrupter 22.

[0024] As shown in Figs. 1 to 5, a circular aperture 4a is formed in a central portion of the upper cover 4, and a plurality of operation keys 23 is provided around the aperture 4a. A plurality of push switches (not shown) is disposed inside the upper cover 4 so as to correspond to each operation key 23, and these push switches are operated when the operation keys 23 are pressed. In addition, a circular decoration ring 24 is fitted and fixed to the aperture 4a of the upper cover 4 by a fixation means, such as a snap-in relationship, and the components of the operating body 2, such as a base 25, a lower knob 26, a rotation ring 27, an upper knob 28, and a press knob 29, protrude from the decoration ring 24.

[0025] The base 25 is disposed on the aforementioned holder 7, a through hole 25a and a pair of positioning holes 25b are formed in the base 25, and these positioning holes 25b are engaged with both of the protrusions 7d of the holder 7. The lower knob 26 is disposed on the base 25, and a cylindrical support shaft 26a is disposed in a central portion of the lower knob 26 so as to be erected thereon. In addition, a pair of accommodation holes 26b is disposed in the lower knob 26, other portions of the lower knob 26 than the accommodation holes 26b and the support shaft 26a are vertically hollow. Coil springs 30 and plungers 31 are inserted into both of the accommodation holes 26b, respectively, and these plungers 31 are pressure-contacted with the bottom surface of a click plate 32 by the resilient force of the coil springs 30. An uneven portion 32a is formed in a circumferential direction on the bottom surface of the click plate 32, and four engaging portions 32b are protrudingly formed at an outer periphery of the click plate 32 at every 90-degree interval. Each engaging portion 32b is locked in and fixed to a notch portion 27a formed at a lower end of an inner peripheral surface of the rotation ring 27, and a code plate 33 is fixed onto the click plate 32 by screws

34. A plurality of light shielding portions 33a and a plurality of light transmitting portions 33b are alternately formed in a circumferential direction, and a circuit board 35 is disposed on the code plate 33.

[0026] As shown in Figs. 13 to 15, two photo interrupters 36, serving as rotation detecting elements, are mounted on the rear side of the circuit board 35, and a pair of push switches 37, serving as press detecting elements, is mounted on the surface of the circuit board 35. The photo interrupter 35 is a light detecting elements in which a light emitting element (not shown) and a light receiving element (not shown) are disposed to face each other and integrated with each other with a concave portion 36a interposed therebetween, and the light shielding portion 33a and the light transmitting portion 33b of the code plate 33 are designed to move inside the concave portion 36a of the photo interrupter 36. In addition, the push switch 37 is called a tack switch having a stem 37a, the stem 37a is urged upward by a resilient force of a tack spring (not shown) built therein. Further, a pair of through holes 35b is formed in the circuit board 35 with an oval engaging hole 35a interposed therebetween, and the engaging hole 35a is engaged with an upper end of the support shaft 26a of the lower knob 26. Further, although not shown, a wiring pattern is formed on the circuit board 35 to allow current to flow to the photo interrupters 36 and the push switches 37, and a lead wire connected to the wiring pattern is connected to the aforementioned printed board 21 through a central hole of the code plate 33 or the click plate 32 and a hollow portion of the lower knob 26.

[0027] The upper knob 28 is disposed on the circuit board 35, a recess 28a is formed on the top surface of the upper knob 28. A through hole 28b is formed in the center of an inner bottom surface of the recess 28a, a fixation screw 38 inserted into the through hole 28b is inserted into the screw hole 7c of the holder 7 through the support shaft 26a of the lower knob 26 and the through hole 25a of the base 25. Accordingly, the lower knob 26 is fixed above the holder 7 with the base 25 interposed therebetween, and the circuit board 35 and the upper knob 28 are fixed on an upper end of the support shaft 26a which is disposed to be erected on the lower knob 26, and the rotation ring 27 is held between the lower knob 26 and the upper knob 28. That is, the rotation ring 27, serving as a rotation operation member, is rotatably supported between the lower knob 26 and the upper knob 28 which forms a supporting body, and the rotation ring 27 is continuously disposed over a range from the top surface of the circuit board 35 to the rear side thereof. Further, since the click plate 32 and the code plate 33 are locked in the inner peripheral surface of the rotation ring 27 and fixed therein, the click plate 32 and the code plate 33 can integrally rotate in conjunction with the rotation of the rotation ring 27. At this time, the plunger 31 is pressure-contacted with the bottom surface of the click plate 32 by a resilient force of the coil spring 30. Furthermore, since a pressing force of the plunger 31 is applied

upward to the rotation ring 27 through the click plate 32, the rotation ring 27 is held between the lower knob 26 and the upper knob 28 without rattling. In addition, a pair of relief holes 28c and a pair of guide holes 28d are formed in the inner bottom surface of the recess 28a of the upper knob 28 with the through hole 28b interposed therebetween, both of the push switches 37 mounted on the top surface of the circuit board 35 are exposed through the relief holes 28c to protrude inside the recess 28a. Further, guide pieces 28e are formed to the upper knob 28 to extend downward from outer edges of both of the guide holes 28d, and these guide pieces 28e are inserted through the through holes 35b of the circuit board 35 to reach the lower knob 26.

[0028] The press knob 29, serving as a press operation member, is disposed in the recess 28a of the upper knob 28 so as to move vertically. As a pair of protrusions 29a formed on the bottom surface of the press knob 29 are brought in contact with the stem 37a of the push switches 37, respectively, the press knob 29 is urged upward by a resilient force of the tack switch built in both of the push switches 37. In addition, only one of the two push switches 37 involves in a converting operation of a contact, and the other push switch 37 is used as a resilience applying means which urges upward the press knob 29 in fine balance. Since a plurality of hooks 29a is formed on an edge of a lower end of the press knob 29, and by locking these hooks 29a in an outer edge of the recess 28a so as to be fixed therein, the press knob 29 is prevented from falling off from the upper knob 28. In addition, a pair of guide rods 29b is suspended from the press knob 29, and these guide rods 29b reach the inside of the guide pieces 28e through the guide holes 28d of the upper knob 28.

[0029] Hereinafter, the operation of a multi-directional input device and the multi-operational input device, both of which are provided in the control unit constructed as described above, will be described.

[0030] First, the operation of the multi-directional input device will be described. Figs. 1, 3 and 4 show a non-operating state, in which an external force is not applied to the operating body 2; therefore, the components of the operating body 2, such as the holder 7, the base 25, the lower knob 26, the rotation ring 27, and the upper knob 28, stand vertically (in Z1-Z2 direction in Fig. 1). In the non-operating state, the lower end of the driving rod 13 is pressure-contacted with the center (innermost portion) of the inner bottom surface of the cam groove 14 by the resilient force of the coil spring 12. Further, as shown in Fig. 11, the engaging protrusion 11 which holds the driving rod 13 is located in the center of the aperture 18 of the guide member 16. In addition, as shown in Fig. 8, since the engaging protrusion 11 is located at the center of the elongated holes 19d and 20d in a longitudinal direction, the first and second sliders 19 and 20 are located in the neutral position of the first and second directions, and the light shielding portions 19c and 20c remain at the insensitive areas at the entrances of the recesses

22a of the photo interrupters 22. As a result, the light path between the light emitting element 22b and the light receiving element 22c of the photo interrupter 22 is not blocked, and thus all of the photo interrupters 22 output high-level signals.

[0031] When an operator rocks the operating body 2 in either first or second direction from the above non-operating state, since the holder 7 rocks in the above direction with the supporting points at either spindles 6a or the pin 8 of the ring body 6, the lower end of the driving rod 13 held by the engaging protrusion 11 slides outward from the center at the inner bottom surface of the cam groove 14, and a click feeling generated when the driving rod 13 surmounts the click protrusion 14a is fed back to the operator through the operating body 2. At this time, the engaging protrusion 11 moves outward in either first or second direction from the center of the aperture 18, and then the engaging protrusion 11 is prevented from moving further when one convex portion 11b intrudes into and engages with the corresponding notch portion 18a.

[0032] That is, when the convex portions 11b and the notch portions 18a, which face each other in the first and second directions, are denoted as follows for convenience: 11b-1 for the convex portion and 18a-1 for the notch portion in the X1 direction; 11b-2 for the convex portion and 18a-2 for the notch portion in the X2 direction; 11b-3 for the convex portion and 18a-3 for the notch portion in the Y1 direction; 11b-4 for the convex portion and 18a-4 for the notch portion in the Y2 direction, as shown in Fig. 11, in a non-operating state, the convex portions 11b-1, 2, 3, 4 face the entrances of the notch portions 18a-1, 2, 3, 4. If the engaging protrusion 11 moves in, for example, the X1 direction from the neutral position, as shown in Fig. 12A, the front ends of the convex portions 11b-3 and 11b-4 are guided by the facing inner wall surfaces of the aperture 18; the convex portion 11b-1 intrudes into the notch portion 18a-1; and the engaging protrusion 11 is prevented from moving in the X1 direction more than a position where the outer wall surface of the engaging protrusion 11 located in the X1 direction is in contact with the inner wall surface of the aperture 18. Therefore, at the limited moving positions, the engaging protrusion 11 are restricted within the aperture 18 by three parts, that is, the convex portions 11b-1, 11b-3, and 11b-4; therefore, the operating body 2 moving in the X1 direction is prevented from moving in either the Y1 or Y2 direction by mistakes. Likewise, if the engaging protrusion 11 moves in, for example, the Y1 direction, as shown in Fig. 12B, the front ends of the convex portions 11b-1 and 11b-2 slide on the facing inner wall surfaces of the aperture 18, and the convex portion 11b-3 intrudes into the notch portion 18a-3; therefore, the engaging protrusion 11 is prevented from moving in the Y1 direction more than a location where the outer wall surface of the engaging protrusion 11 located in the Y1 direction is in contact with the inner wall surface of the aperture 18. In this case, at the limited moving positions, the engaging pro-

trusion 11 are restricted within the aperture 18 by three parts, that is, the convex portions 11b-1, 11b-2, and 11b-3; therefore, the operating body 2 moving in the Y1 direction is prevented from moving in either the X1 or X2 direction by mistakes.

[0033] In addition, if the engaging protrusion 11 moves in either the first or second direction within the aperture 18 in conjunction with the rocking operation of the operating body 2, either the first or second slider 19 or 20 slides while being guided by the guide member 16, and then one of the photo interrupters 22 is turned on selectively. For example, when the engaging protrusion 11 moves in the X1 direction from the neutral position shown in Fig. 8, since the engaging protrusion 11 moves only within the elongated hole 20d elongated in the first direction (X1-X2 direction), the second slider 20 does not receive an external force (a driving force in the moving direction) through the engaging protrusion 11 so as to remain in the neutral position. However, the first slider 19 receives an external force through the engaging protrusion 11 so as to move in the X1 direction. In this case, the arm portion 19b is guided by the first guide protrusion 16b of the guide member 16, and the first slider 19 moves in the X1 direction; therefore, the light shielding portion 19c moves in the recessed portion 22a of the photo interrupter 22 located in the X1 direction. Furthermore, when the engaging protrusion 11 reaches the limited moving position in the X1 direction, since the light path between the light emitting element 22b and the light receiving element 22c of the photo interrupter 22 is blocked by the light shielding portion 19c, the photo interrupter 22 outputs a low-level signal. At this time, since the second slider 20 does not receive an external force through the engaging protrusion 11 so as to remain in the neutral position, the signals output from the rest three photo interrupters located in the Y1-Y2 direction and the X2 direction are maintained at a high-level. The same operation can be found when the engaging protrusion 11 moves in the X2 direction from the neutral position, and, in this case, the first slider 19 receives an external force through the engaging protrusion 11 so as to move in the X2 direction; therefore, the photo interrupter 22 located in the X2 direction outputs a low-level signal, and the signals output from the rest three photo interrupters 22 remain at a high-level.

[0034] On the other hand, if the engaging protrusion 11 moves in the Y1 direction from the neutral position shown in Fig. 8, since the engaging protrusion 11 relatively moves only within the elongated hole 19d elongated in the second direction (Y1-Y2 direction), the first slider 19 does not receive an external force through the engaging protrusion 11 so as to remain in the neutral position. However, the second slider 20 receives an external force through the engaging protrusion 11 so as to move in the Y1 direction. In this case, the arm portion 20b is guided by the second guide protrusion 16c of the guide member 16, and the second slider 20 moves in the Y1 direction; therefore, the light shielding portion 20c moves in the

recessed portion 22a of the photo interrupter 22 located in the Y1 direction. In addition, when the engaging protrusion 11 reaches the limited moving position in the Y1 direction, since the light path between the light emitting element 22b and the light receiving element 22c of the photo interrupter 22 is blocked by the light shielding portion 20c, the photo interrupter 22 outputs a low-level signal. At this time, since the first slider 19 does not receive an external force through the engaging protrusion 11 so as to remain in the neutral position, the signals output from the rest three photo interrupters 22 located in the X1-X2 direction and the Y2 direction are maintained at a high-level. The same operation can be found when the engaging protrusion 11 moves in the Y2 direction from the neutral position, and, in this case, the second slider 20 receives an external force through the engaging protrusion 11 so as to move in the Y2 direction; therefore, the photo interrupter 22 located in the Y2 direction outputs a low-level signal, and the signals output from the rest three photo interrupters 22 remain at a high-level.

[0035] If the operating body 2 is selectively operated to rock in either of the first and second directions, which are perpendicular to each other, since only the signal output from the photo interrupter 22 located in the operating direction is changed from high-level to low-level, it is possible to identify the operating direction of the operating body 2 on the basis of the signals output from the four photo interrupters 22. Meanwhile, when the rocking-operating force on the operating body 2 is removed, the lower end of the driving rod 13 receives the resilient force of the coil spring 12 so as to return to the center of the inner bottom surface of the cam groove 14; therefore, the entire operating body 2 including the holder 7 stands upright, and the engaging protrusion 11 or the first and second sliders 19 and 20 return to the neutral position automatically.

[0036] Hereinafter, the operation of the multi-operational input device will be described with reference to Figs. 3 to 5. As shown in Figs. 3 and 4, the components of the operating body 2, such as the base 25, the lower knob 26, the rotation ring 27, the upper knob 28, the press knob 29, protrude from the upper cover 4 of the chassis 1, and, if an operator rotates the rotation ring 27 clockwise or counter-clockwise, the click plate 32 and the code plate 33 are integrally rotated in conjunction with the rotation ring 27. In addition, since the light shielding portion 33a and the light transmitting portion 33b rotate in the concave portion 36a of each photo interrupter 36, mounted on the rear surface of the circuit board 35, in conjunction with the rotation of the code plate 33, the photo interrupter 36 outputs pulse signals corresponding to the rotation of the code plate 33. In addition, since the rotation of the click plate 32 makes the upper ends of the plungers 31, which are elastically urged by the coil springs 30, disengaged from the uneven portion 32a, a click feeling generated at this time is fed back to the operator through the operating body 2. In this way, if the rotation ring 27 is rotatably operated, since the photo interrupter 36 outputs

signals corresponding to the rotating direction and the amount of the rotation of the rotation ring 27, it is possible to obtain the information on the rotation of the rotation ring 27 along with click feelings on the basis of the signals.

[0037] On the other hand, if the operator presses the press knob 29 downward (Z2 direction in Fig. 1), since the stems 37a of the push switches 37 mounted on the top surface of the circuit plate 35 are pressed down by the protrusions 29a of the press knob 29, the contacts of the push switches 37 are switched to ON from OFF. In addition, if such pressing force is removed, the press knob 29 returns to the original position by the resilient force of the tact spring built in the push switches 37, and the contacts of the push switches 37 are also converted to OFF from ON. At this time, since the guide rods 29b suspended from the bottom surface of the press knob 29 are guided by the guide pieces 28e of the upper knob 28 and move vertically, the press knob 29 can be press-operated smoothly without rattling.

[0038] As described above, the multi-operational input device according to the embodiment includes the press knob 29 supported on the top surface of the upper knob 28 so as to be press-operated, the circuit board 35 disposed in a press-operating direction of the press knob 29, a push switch 37 mounted on the front surface of the circuit board 35, the rotation ring 27 which is supported between the lower knob 26 and the upper knob 28 so as to be rotatably operated, the code plate 33 which rotates in conjunction with the rotation ring 27, and the photo interrupters 36 mounted on the rear surface of the circuit board 35. With this structure, since the push switches 37 mounted on the front surface of the circuit board 35 are operated by pressing the press knob 29, and the code plate 33 is rotated in conjunction with the rotation of the rotation ring 27, the photo interrupters 36 mounted on the rear surface of the circuit board 35 are operated. Therefore, a mounting space of the push switches 37, serving as press detecting elements, overlaps with one side of the circuit board 35, and a mounting space of the photo interrupters 36, serving as rotation detecting elements, overlaps with the other side of the circuit board 35. Accordingly, it is possible to make the entire input device small in a transverse direction. Moreover, the rotation ring 27, serving as the rotation operating member, is continuously disposed over a range from the front side of the circuit board 35 to the rear side thereof, and the rotating force of the rotation ring 27 received at the front side of the circuit board 35 is transmitted to the rear side of the circuit board 35. Therefore, the press knob 29 and the rotation ring 27 can be arranged close to each other in the front side of the circuit board 35, and thus the operator can easily press-operate the press knob 29 and rotatably operate the rotation ring 27.

[0039] In addition, the uneven portion 32a is formed on the bottom surface of the click plate 32 which integrally rotates with the code plate 33, the plungers 31 are held in the accommodation holes 26b of the lower knob 26 through the coil springs 30 so as to move vertically, and

the rotation of the rotation ring 27 makes the upper ends of the plungers 31 disengaged from the uneven portion 32a, so as to generate a click feeling. Therefore, a space under the circuit board 35 can be effectively used to dispose a click mechanism. In this respect, it is possible to make the entire input device small in the transverse direction. Moreover, since an upward pressing force applied to the uneven portion 32a through the plunger 31 is also applied to the rotation ring 27 through the click plate 32, the rotation ring 27 can be reliably prevented from rattling by using the pressing force through the plunger 31 provided in the click mechanism.

[0040] In addition, even though the embodiment describes the input device, in which the push switch 37 is used as the press detecting element mounted on the surface of the circuit board 35, any press detecting element may be used as the press detecting element as long as it is operated by pressing the press knob 29 serving as the press operating member. For example, a magnetic detecting element and an optical detecting element or the like may be used as the press detecting element.

[0041] Further, even though the embodiment describes the input device, in which the code plate 33 is integrated with the click plate 32 and the uneven portions 32a is formed on the bottom surface of the click plate 32, an uneven portion may be formed on the bottom surface of the code plate 33 and the click plate 32 may be omitted.

[0042] Furthermore, even though the embodiment describes the control unit including both of the multi-directional input device and the multi-operational input device, the invention may be applied to a control unit including only the multi-operational input device.

[0043] In the multi-operational input device of the invention, the pressing detecting element is mounted on the surface of the circuit board and the rotation detecting element is mounted on the rear side of the circuit board, and at least some portion of the rotation operating member is disposed on the surface of the circuit board, and the rotating force of the rotation operating member applied from the surface of the circuit board is transmitted to the rear side of the circuit board. Therefore, the mounting space of the press detecting elements overlaps with one side of the circuit board, and the rotation detecting elements overlaps with the other side of the circuit board. Accordingly, it is possible to make the entire input device small in the transverse direction.

Claims

1. A multi-operational input device comprising:

a press operating member (29) which is supported by a supporting body (28, 26) so as to be press-operated;
a circuit board (35) which is disposed in a press-operating direction of the press operating member (29);

a press detecting element (37) which is mounted on the front surface of the circuit board (35) and operated by pressing the press operating member (29);

a rotation operating member (27) which is supported by the supporting body (28, 26) so as to be rotatably operated; and

a rotation detecting element (36) which is mounted on the circuit board (35) and operated by rotating the rotating operating member (27),

characterized in that the rotation detecting element (36) is mounted on the rear surface of the circuit board (35), and at least a part of the rotation operating member (27) is allocated at the front side of the circuit board (35), and a rotating force of the rotation operating member (27) applied from the front side of the circuit board (35) is transmitted to the rear side of the circuit board (35).

2. The multi-operational input device according to claim 1,

characterized in that the rotation operating member (27) is a barrel-shaped rotation ring (27) which surrounds the circuit board (35).

3. The multi-operational input device according to Claim 2,

characterized in that the supporting body (28, 26) includes an upper knob (28) and a lower knob (26) with the rotation ring (27) therebetween, and the circuit board (35) and the upper knob (28) are fixed onto an upper end of a support shaft (26a) which is erected at the center of the lower knob (26).

4. The multi-operational input device according to claim 2 or 3,

characterized in that the rotation detecting element (36) includes photo interrupters (36), in which a light emitting element and a light receiving element are disposed to face each other with a concave portion (36a) interposed therebetween, and a code plate (33) having the light shielding portion (33a) and the light transmitting portion (33b) is fixed onto an inner peripheral surface of the rotation ring (27), and the light shielding portion (33a) and the light transmitting portion (33b) move inside the concave portion (36a) in conjunction with the rotation of the rotation ring (27).

5. The multi-operational input device according to claim 4,

characterized in that an uneven portion (32a) is formed on the rear side of the code plate (33), and a plunger (31), which is elastically urged toward the code plate (33), is held by the lower knob (26) so as to move vertically, and the rotation of the rotation ring (27) makes an upper end of the plunger (31)

disengaged from the uneven portion (32a), so as to generate a click feeling.

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FIG. 1

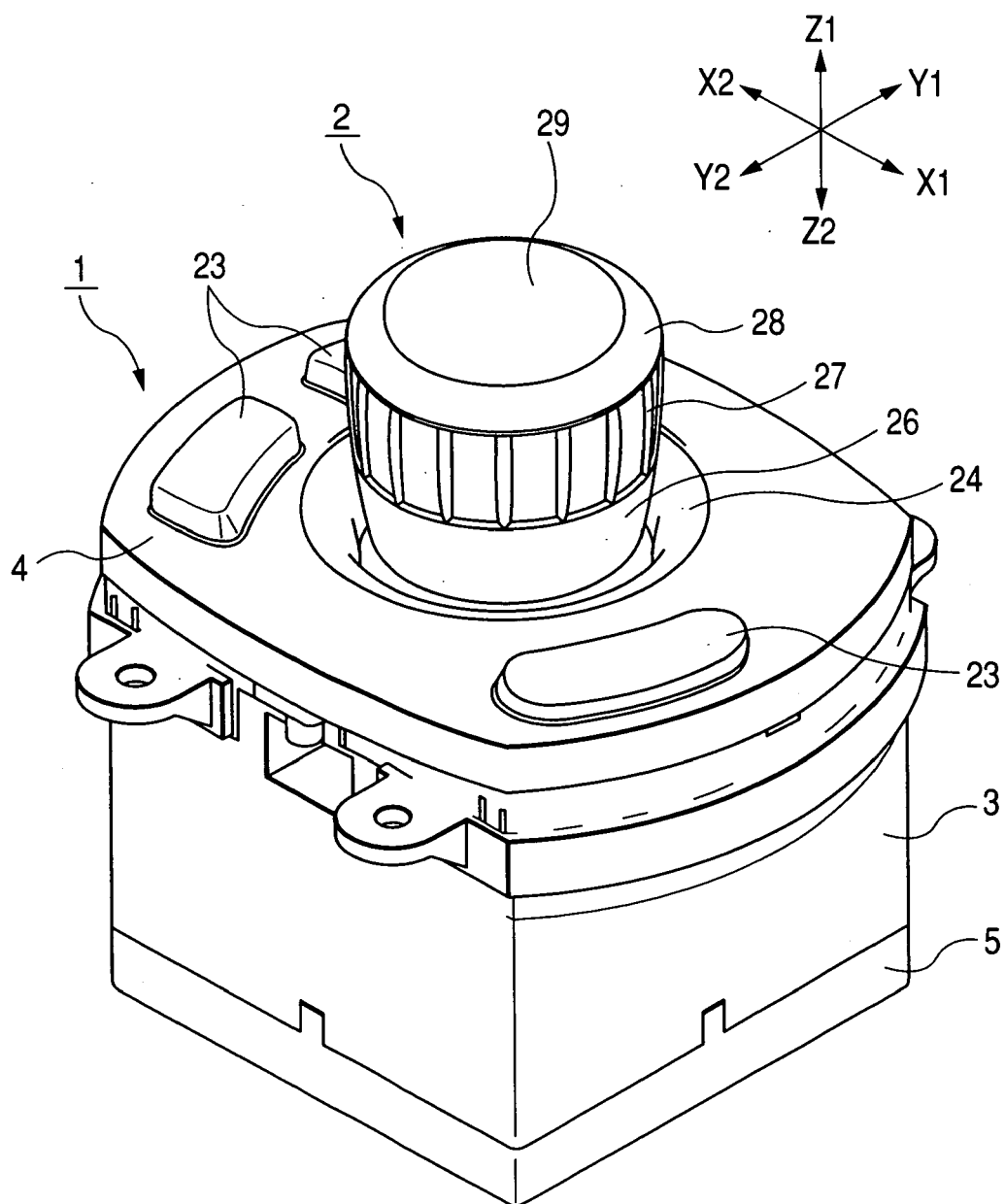


FIG. 2

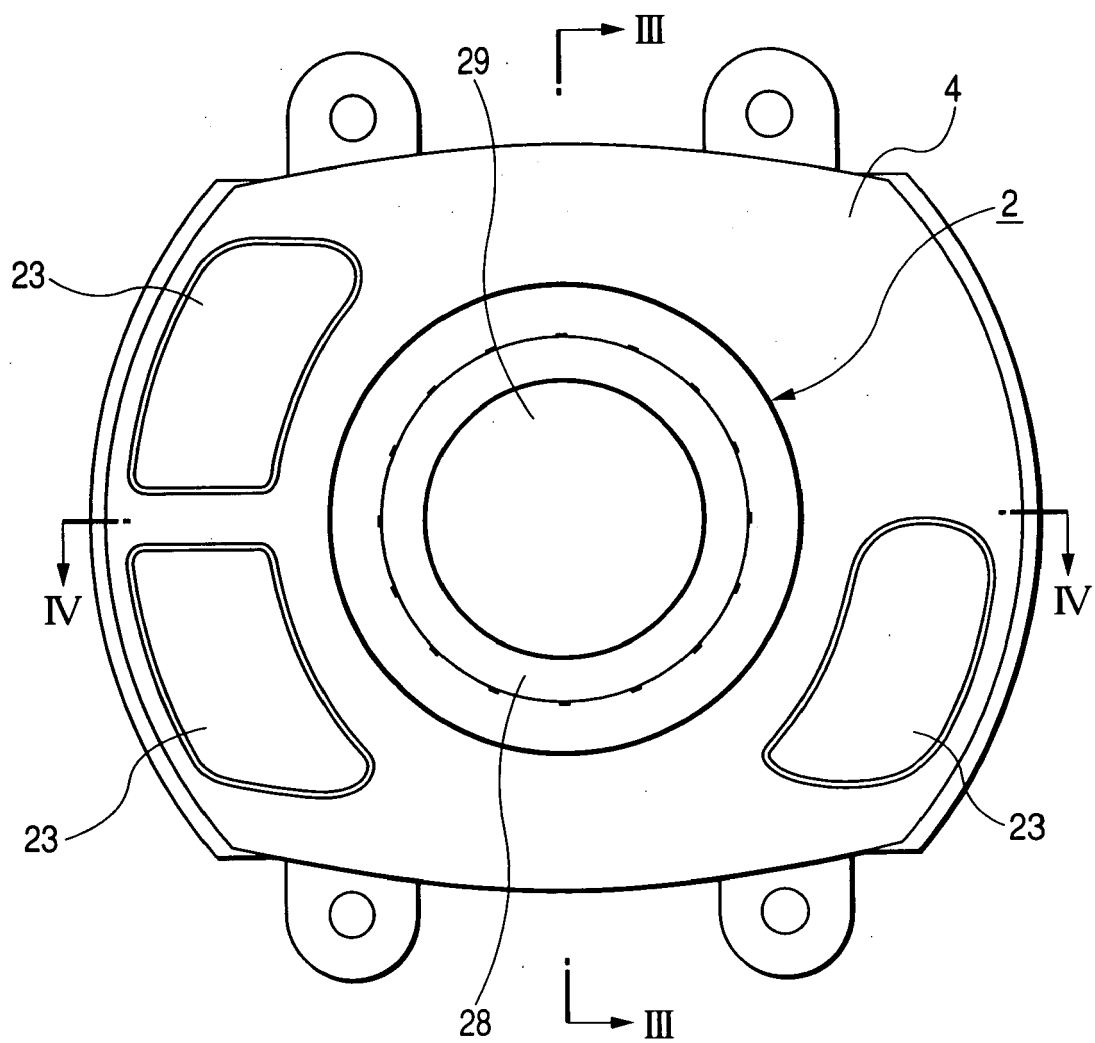


FIG. 3

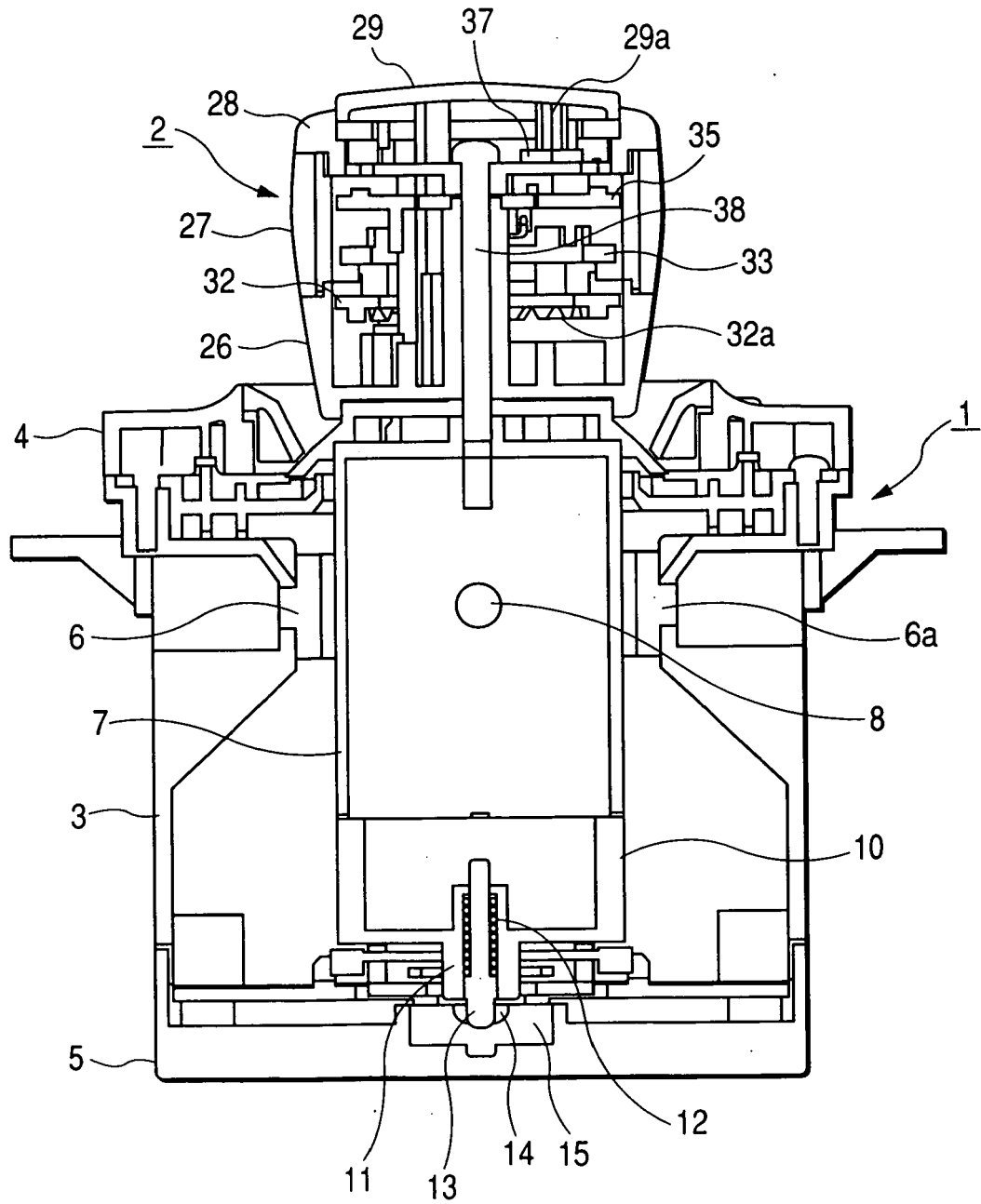


FIG. 4

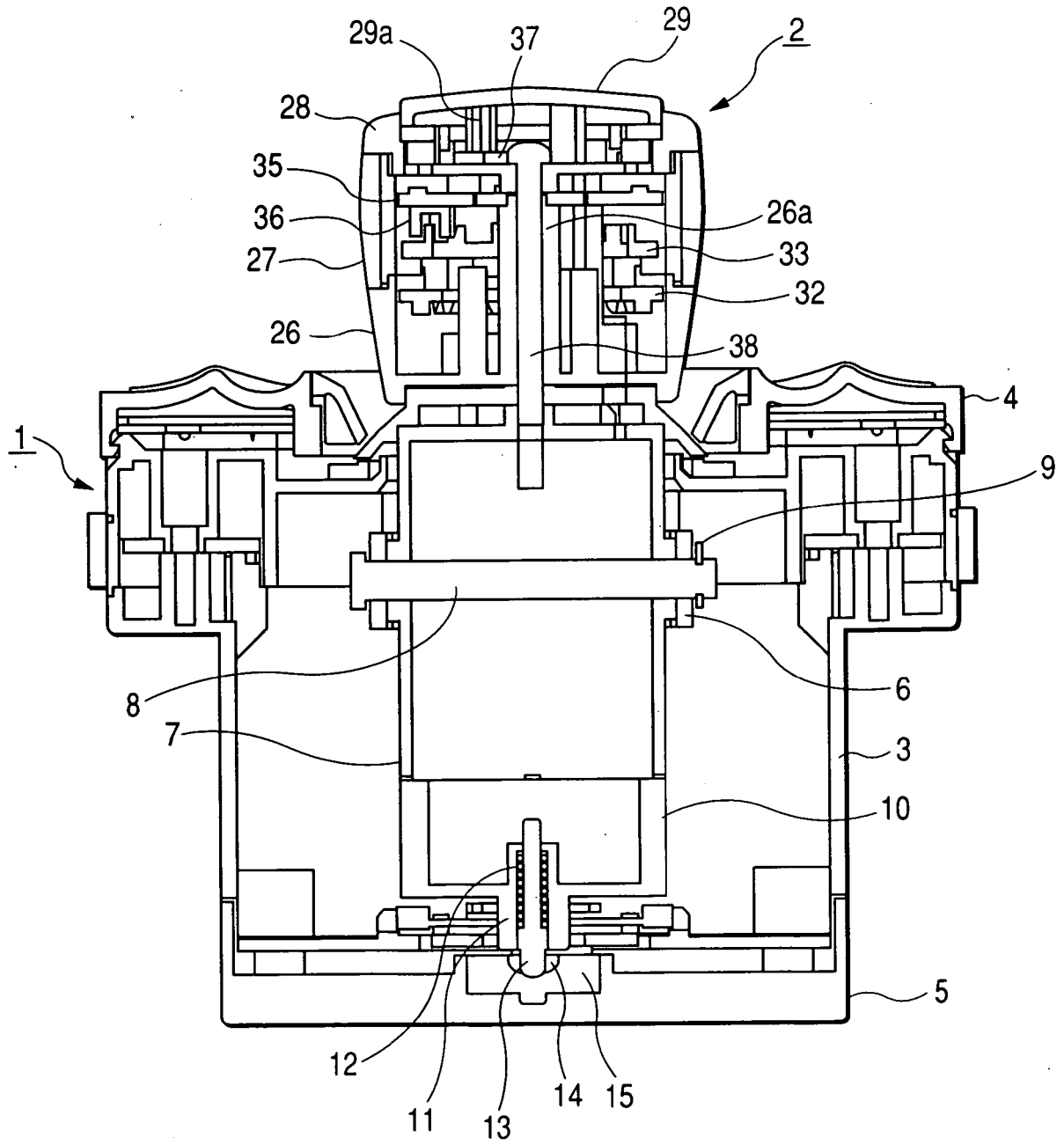


FIG. 5

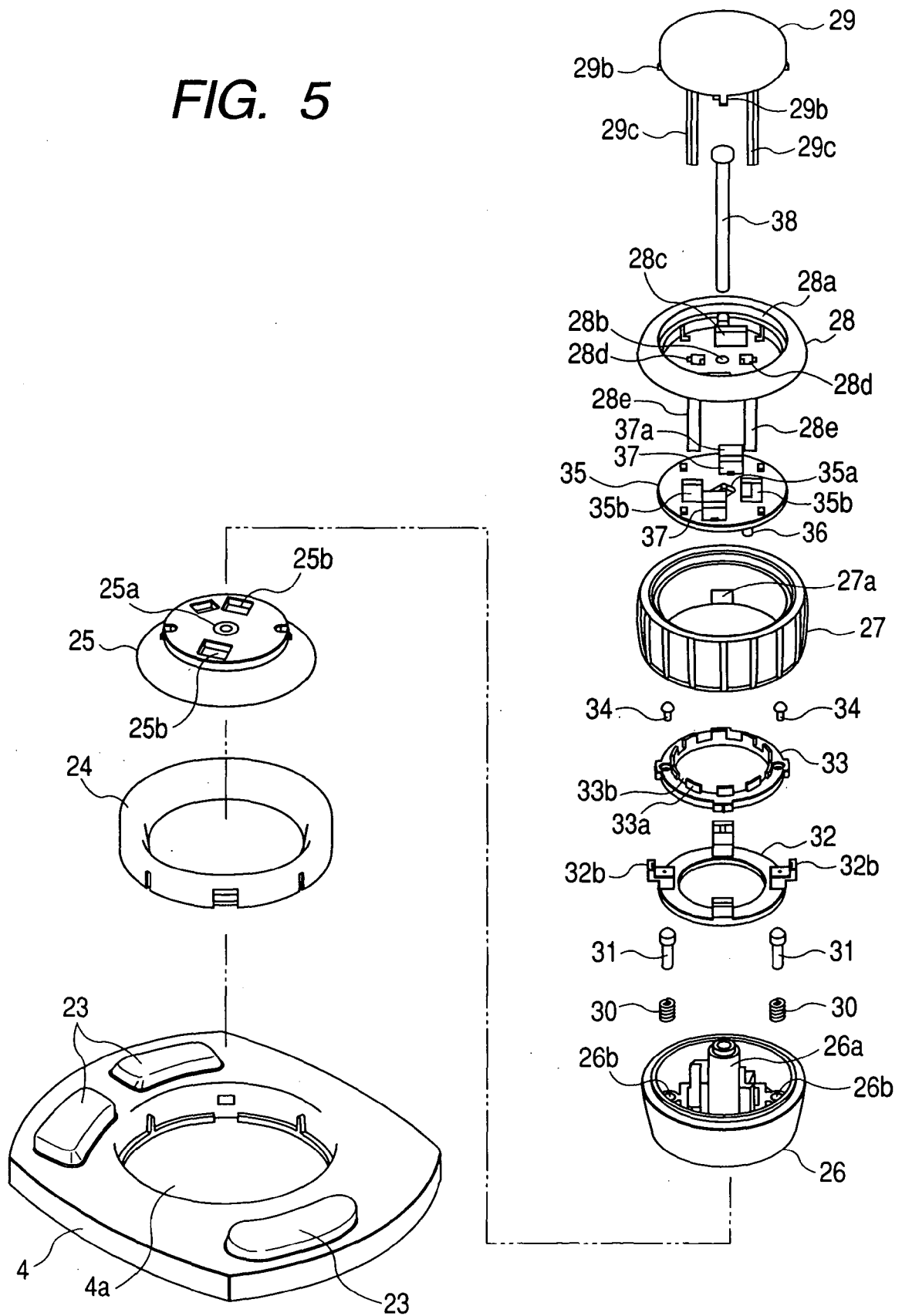


FIG. 6

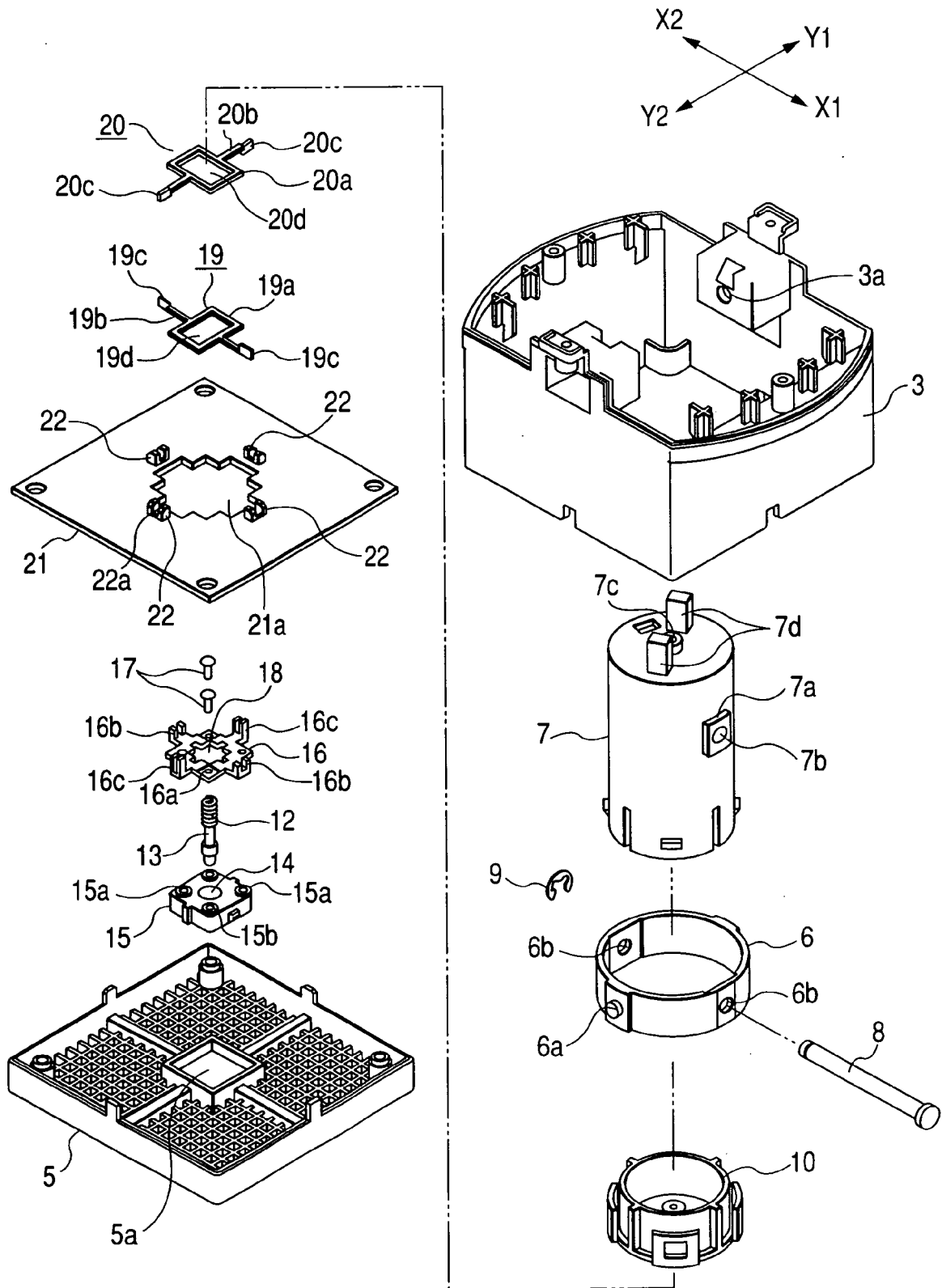


FIG. 7

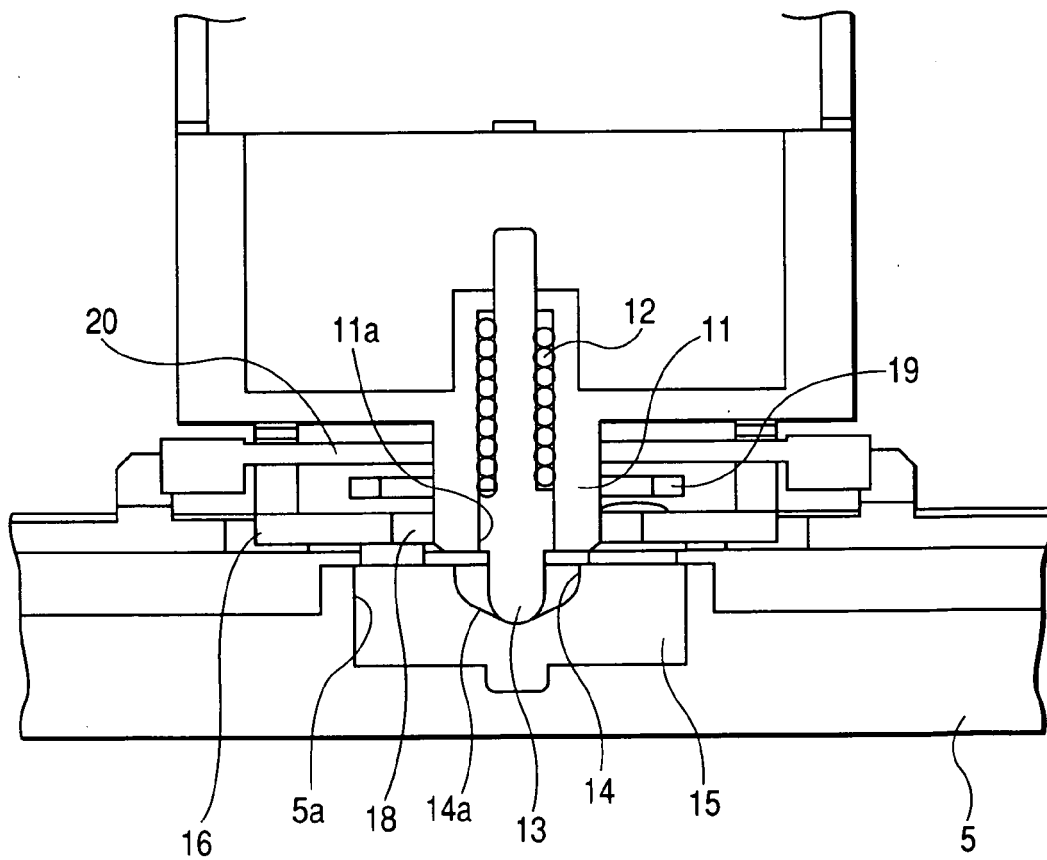


FIG. 8

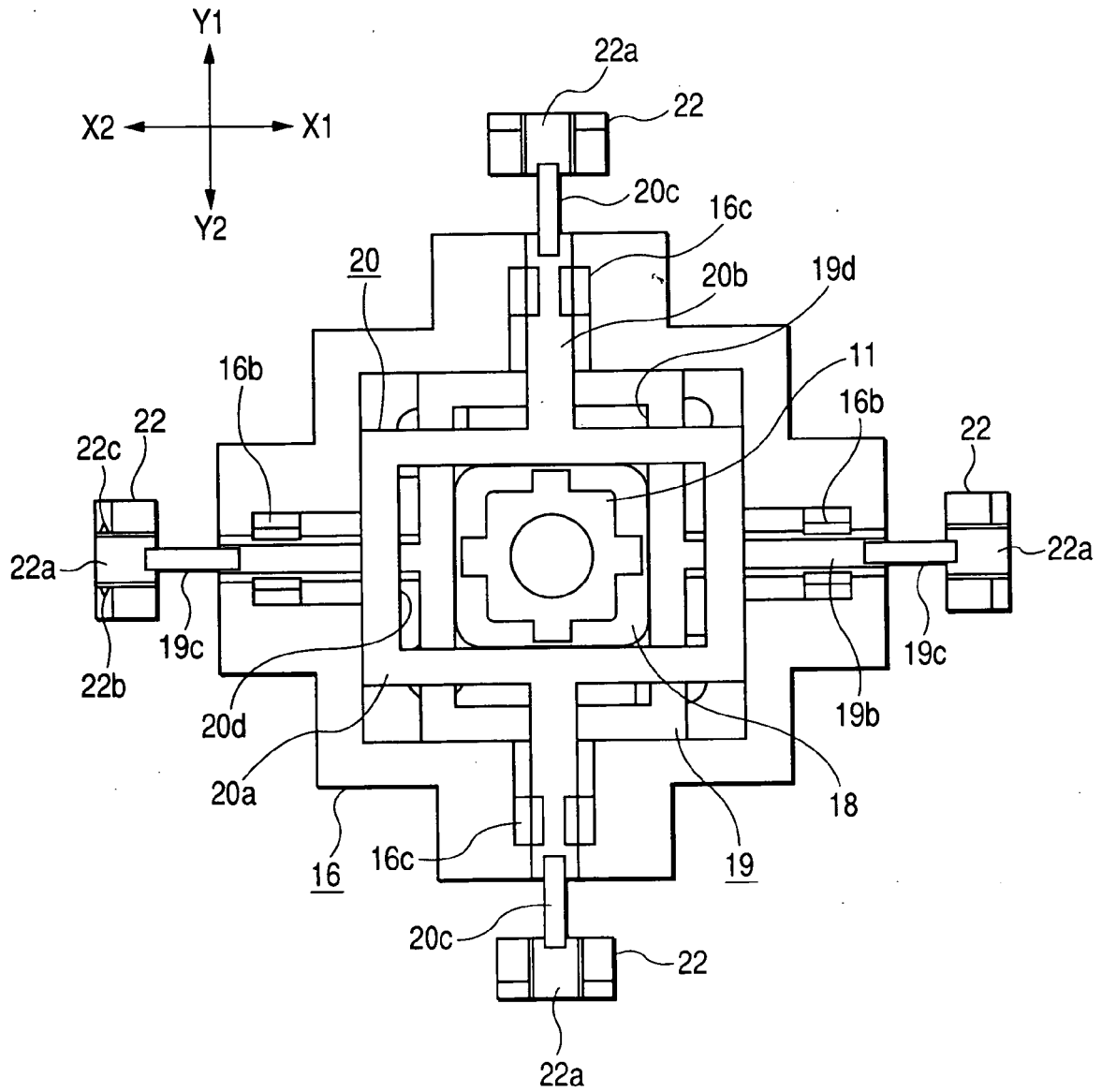


FIG. 9

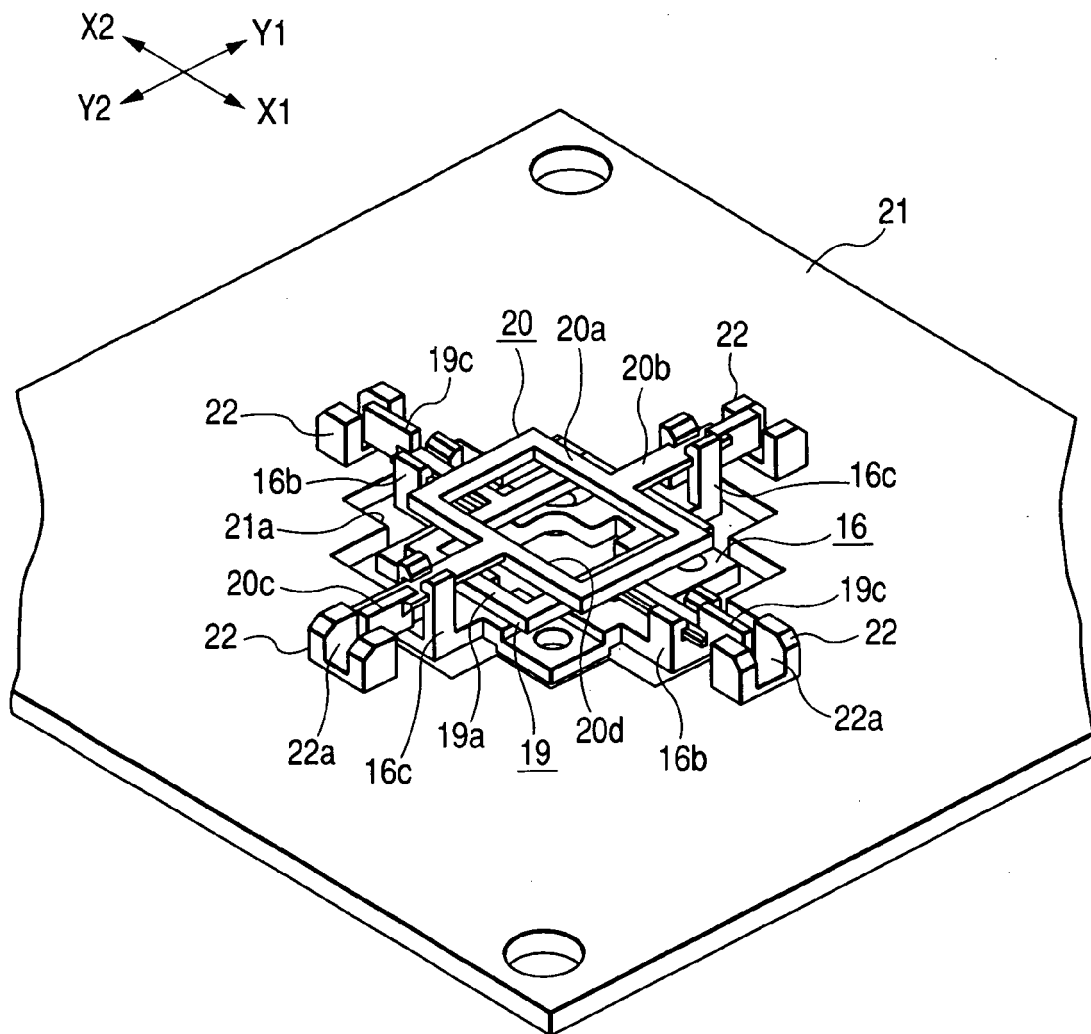


FIG. 10

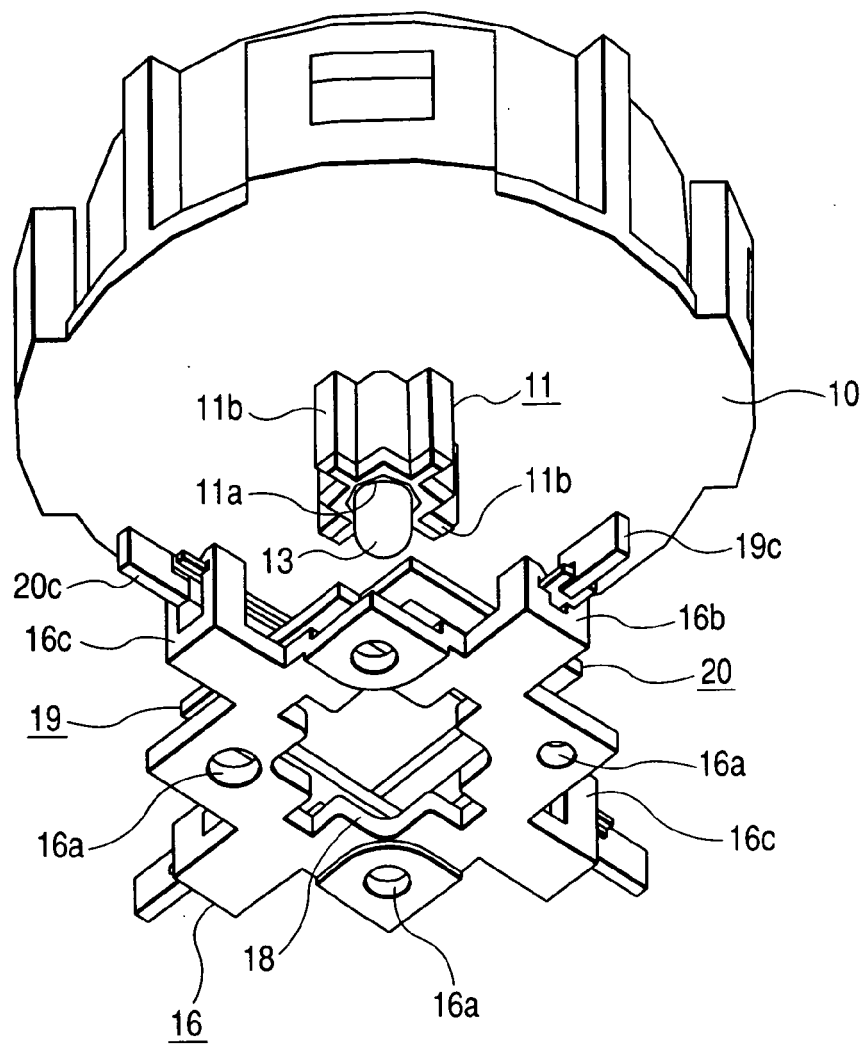


FIG. 11

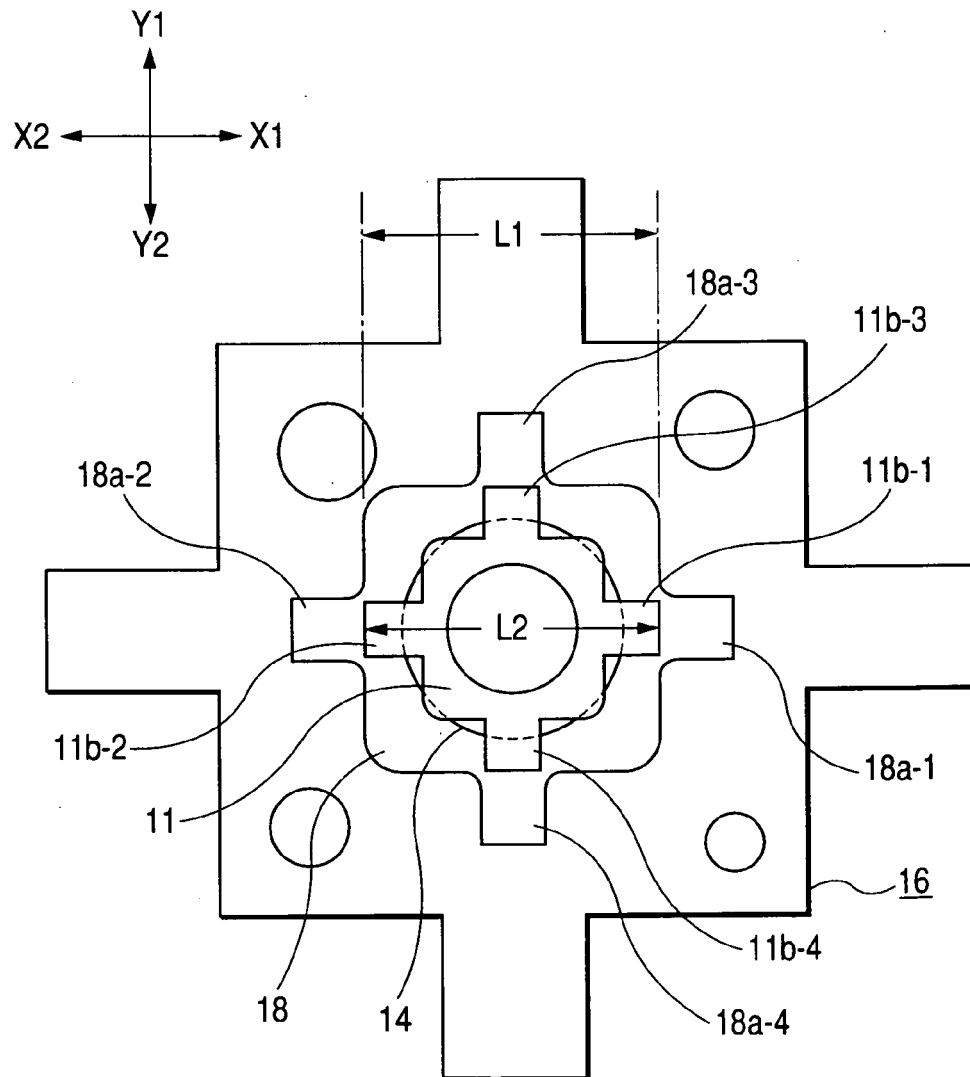


FIG. 12A

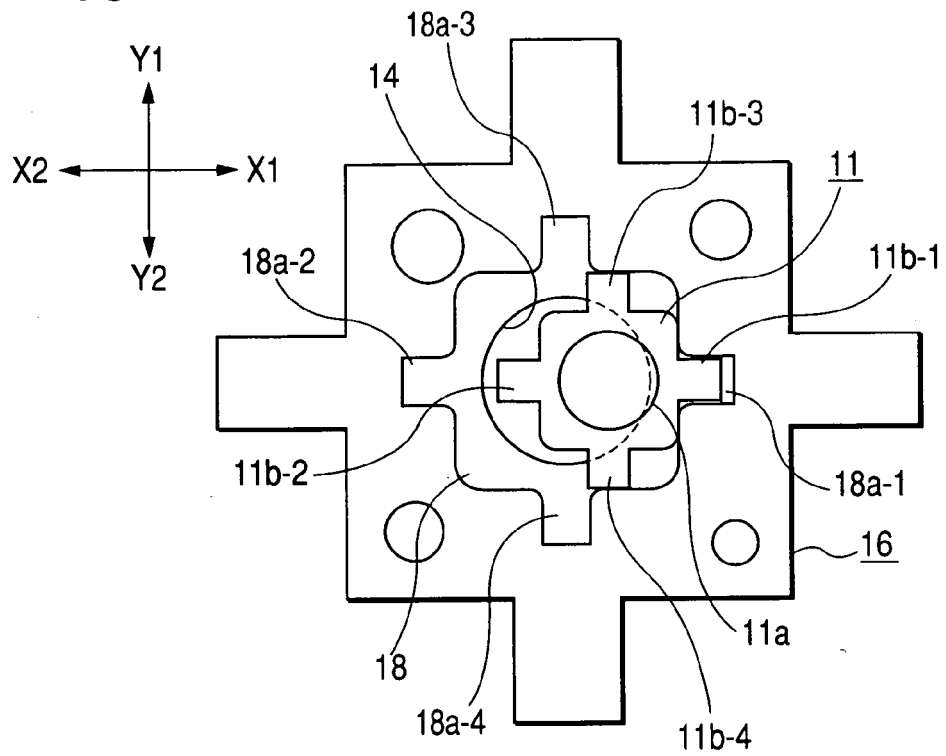


FIG. 12B

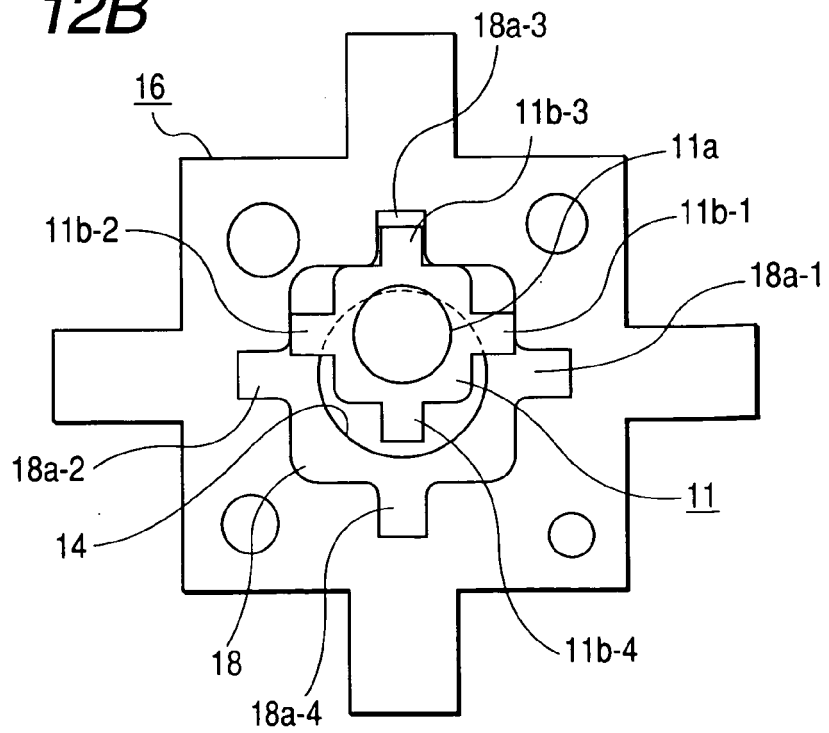


FIG. 13

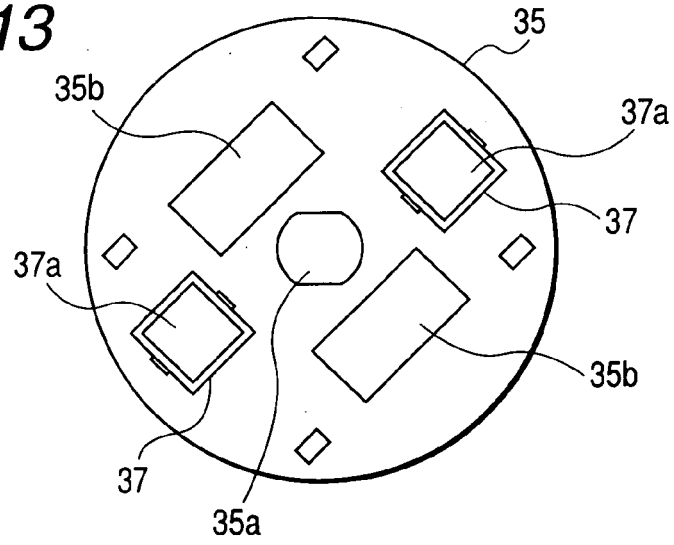


FIG. 14

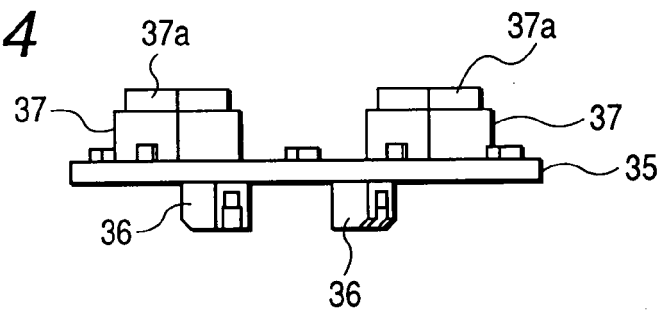
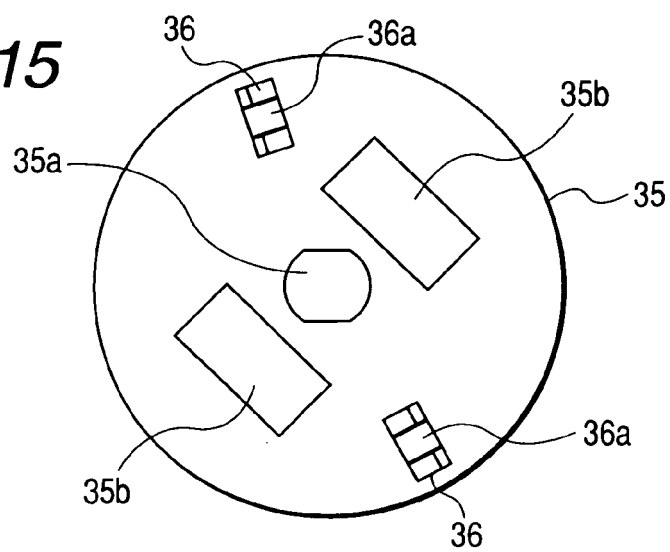


FIG. 15





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A	----- FR 2 785 084 A (SC2N) 28 April 2000 (2000-04-28) * abstract; figures 3,4 *	1,2	
A	----- US 2002/003081 A1 (KAWASE TATSUAKI) 10 January 2002 (2002-01-10) * abstract; figure 3 *	5	

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			H01H G05G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 6 July 2006	Examiner Simonini, S
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06-07-2006

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