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(71) Applicant : **SEGA ENTERPRISES, LTD.**
2-12 Haneda 1-chome Ohta-ku
Tokyo 144 (JP)

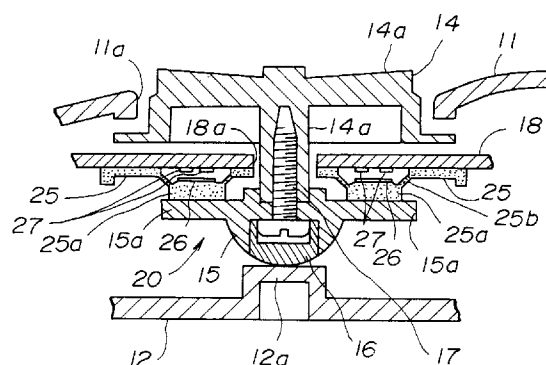
(72) Inventor : **Matsumiya, Hiroshi**
c/o Sega Enterprises, Ltd., 2-12, Haneda
1-chome
Ohta-ku, Tokyo (JP)

(74) Representative : **Luckhurst, Anthony Henry**
William
MARKS & CLERK 57-60 Lincoln's Inn Fields
London WC2A 3LS (GB)

(54) **Directional control-key mechanism.**

(57) A directional control-key mechanism used for a controller of a TV game machine, which mechanism has a long service life. A support member (15) is secured to a key (14) with a circuit board (18) therebetween. A lowermost portion of the support member (15) is in contact with a portion of a bottom case (12) of the controller. The support member (15) has a radially extending portion (15a) under the circuit board (18), a plurality of elastic members (25) are arranged between the circuit board (18) and the radially extending portion (15a). A portion (25a) of each of the elastic members (25) is in a position lifted from the circuit board (18) and a contact material (26) is provided on a top surface of the portion (25a). On a surface of the circuit board (18), there are provided a pair of electrodes at a position directly above the portion (25a).

FIG. 3



The present invention relates to a directional control-key mechanism, and more particularly to a directional control-key mechanism used for a controller such as an input device used for playing TV games.

In a TV game machine and a portable computer game machine, there is often provided a directional control-key. By using such a key, a player of a TV game can move an image on a display of the TV game machine in a desired direction such as up and down or right and left. The size of the directional control-key is relatively larger than that of a key generally used as an input key of computers. When using the directional control-key, a portion of the key is pressed so that operator can input a desired signal corresponding to the pressed position of the key with respect to the center thereof.

A description will now be given, with reference to Fig. 1, of a conventional control-key mechanism of a TV game machine.

As shown in Fig. 1, a conventional directional control-key comprises a key body 2 having a top surface 2a for being handled by an operator (or player) and a bottom plate 5 fixed on a bottom surface of the key body 2. The bottom plate 5 is provided with a hemispherical member 6 at the center thereof. The key body 2 is positioned above a portion of a circuit board 7 provided in a housing which comprises an upper case 1 and a bottom case 2. The key body 2 is inserted into an opening 1a of the upper case 1 so that the top surface 2a of the key body 2 protrudes from a surface of the upper case 1.

A plurality of elastic members 8, made of electrically conductive rubber, are provided between the bottom plate 5 and the circuit board 7 so that the elastic members 8 are radially arranged a predetermined distance apart from the center of the key body 2. Each of the elastic members has a raised portion 8a around the center thereof, and a top surface of the raised portion 8a makes contact with the bottom plate 5. A bottom surface of the raised portion 8a of each of the elastic members 8 is apart from the surface of the circuit board 7 where electrodes are formed. These electrodes are provided so as to generate electric signals when a pair of these electrodes under the raised portion 8a of each of the elastic members 8 are connected by the elastic members 8.

The above-mentioned hemispherical member 6 is positioned on the center of the bottom plate 5 between the bottom plate 5 and the circuit board 7 with a small gap formed between a tip of the hemispherical member and the surface of the circuit board 7. It should be noted that the gap between the tip of the hemispherical member and the circuit board is formed because it is difficult to accurately control the height of the elastic members 8 due to the material, namely due to the electrically conductive rubber, of the elastic member 8.

Usually, four elastic members and four respective

pairs of electrodes are provided on the circuit board so as to generate signals corresponding to up, down, right, and left.

When a pressing force is applied to the surface 2a of the key body 2, the key body 2 starts to move downward against an elastic force exerted by the elastic members 8, until the tip of the hemisphere member 6 makes contact with the surface of the circuit board 7. Supposing that the pressing force is applied on the right side, in Fig. 1, of the top surface 2a from the center thereof, the key body then starts to pivot about the tip of the hemispherical member 6. Accordingly, after the tip of the hemispherical member 6 is in contact with the circuit board 7, only the elastic member 8 on the right side in Fig. 1 is continued to be pressed down. Eventually, the bottom surface of the raised portion 8a of the elastic member 8 on the right side makes contact with a pair of the electrodes positioned under the raised portion 8a. Thereby, the pair of electrodes are electrically connected, resulting in a generation of a signal corresponding to a direction of the position of the top surface 2a to which the pressing force is applied, in this case a signal representing "right".

According to the operation of the conventional control-key mechanism, the tip of the hemispherical member 6 hits every time the key body 2 is pressed. The impact of these hits results in wear of the tip of the hemispherical member or the surface of the circuit board 7. If a wear amount becomes large after considerable use of the control-key, then, before the tip of the hemispherical member 6 makes contact with the circuit board 7, the elastic members 8 positioned on opposite sides of the center of the key body 2 are simultaneously pressed against the position where the pair of electrodes located in each of the elastic members are connected by the elastic members 8. This results in malfunctioning of the TV game machine, or difficulty in controlling movement of an image on a display of the TV game machine.

It is a general object of the present invention to provide an improved and useful directional control-key mechanism used for TV game machines and the like, in which directional control-key mechanism the above-mentioned problems are eliminated.

A more specific object of the present invention is to provide a directional control-key mechanism which has a long service life without malfunctioning due to wear of a part thereof.

In order to achieve the above mentioned object, a directional control-key mechanism according to the present invention comprises a key and pairs of electrodes, a given pair of electrodes being momentarily connected by means of an elastic member pressed by the key in accordance with a portion of the key being pressed, the directional control-key being characterized in that;

the key is connected with a support member

having a radially extending portion, the support member having a generally round shaped tip portion being in contact with a base;

a plate is provided between the key and the support member so that the radially extending portion is a predetermined distance apart from a bottom surface of the plate;

a plurality of elastic members are provided between the plate and the support member, each of the elastic members having a portion attached to the plate and having a lifted portion in a position lifted from a surface of the plate and elastically movable against the surface of the plate;

a contact material is attached on a top surface of each of the lifted portions and a pair of electrodes are provided at a position directly above each of the contact materials on the plate; and

when a pressing force is applied onto a portion of the key, the support member is inclined about a point where the tip portion of the support member is in contact with the base, the contact material provided on an opposite side with regard to the center of the key on the radially extending portion making contact with a corresponding pair of electrodes.

According to the present invention, the tip portion of the support member is always in contact with the base and thereby there is no impact force applied to a contacting point. Accordingly, wear of the contact point is less than that of the conventional mechanism. Further, even if the contact point has been worn in the mechanism according to the present invention, there are no undesired influences on the operation of the mechanism because wear of the contact point merely makes a gap between the electrodes and the contact material slightly larger. This gives a completely different effect as compared to the conventional mechanism in which two pairs of electrodes are connected simultaneously when the contact point has been worn. Therefore, no malfunction of the TV game machine occurs due to wear of the contact point.

Other objects, features and advantages of the present invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings.

Fig.1 is a cross sectional view of a conventional directional control-key mechanism;

Fig.2 is a plan view of a portion of a controller used for playing TV games in which an embodiment of the present invention is incorporated;

Fig.3 is a cross sectional view of a directional control-key mechanism according to the present invention; and

Fig.4 is a cross sectional view of a variation of the directional control-key mechanism shown in Fig.3.

A description will now be given, with reference to Figs.2 and 3, of an embodiment of a directional control-key mechanism according to the present inven-

tion.

Fig.2 shows a portion of a controller of a TV game machine in which a directional control-key mechanism is incorporated. The controller has a plastic upper case 11, and from a top surface of the upper case 11, a top portion of a directional control-key 14 protrudes. An operator (or a player of the TV game) can control a moving direction of an image on a display of the TV game machine by pressing a portion of the control key 14. For example, if the operator presses a right side portion of the control key 14, an image (the image may be a character) moves to the right on the display.

Fig.3 is a cross sectional view of the controller shown in Fig.2 taken along a line III-III. The directional control-key mechanism according to the present invention comprises a key body 20 and a plurality of elastic members 25. The key body 20 comprises the key 14 and support member 15 secured to a stem 14a of the key 14 by a screw 17. The support member has a radially extending portion 15a, and in an opening of the support member 15 in which opening the screw 17 is inserted is provided with a tip portion 16 having a convex shape directing downward. The tip portion 16 is press fitted into the opening of the support member 15. The stem 14a of the key 14 extends through a hole 18a provided on a circuit board 18 in the upper case 11. The tip portion 16 is placed on a protrusion 12a of a bottom case 12 of the controller.

A top portion of the key 14 is protrudes from an opening 11a of the upper case 11 so that the operator can press a desired portion of a top surface 14a of the key 14. Under the key 14 and between the key 14 and the support member 15, there is provided a circuit board 18 on which a circuit necessary for the controller is formed. The circuit board 18 is fixed to the bottom case 12. The stem 14a extends through a hole 18a formed on the circuit board 18.

Between the radially extending portion 15a of the support member 15, a plurality of elastic members 25 are provided. Each of the elastic members 25 is attached to a bottom surface of the circuit board 18 so that they are arranged on a circumference. Each of the elastic members 25 has a portion 25a having a relatively large thickness and being in a portion lifted from the surface of the circuit board 18. Accordingly, there is formed a gap between the top surface of the portion 25a and the bottom surface of the circuit board 18. The portion 25a is supported by a relatively thin portion 25b and thereby the top portion 25a is allowed to elastically move up and down. A bottom surface of the portion 25a is in contact with a top surface of the radially extending portion 15a and the support member 15 is thereby always pressed to the protrusion 12a of the bottom case 12.

On a top surface of the portion 15a of each of the elastic members 25, a contact material 16 is attached and a pair of electrodes 27 are provided on the bottom

surface of the circuit board 18 at a position directly above the contact material 16. The electrodes 27 are part of an electrical circuit formed on the circuit board and the electrical circuit is so formed to generate a signal used for moving an image on the display when the pair of electrodes is electrically connected.

A description will now be given, with reference to Fig.3, of an operation of the above-mentioned directional control-key mechanism. When a pressing force is applied to a portion of the right side of the top surface 14a, it means an operator desires to move an image on the display to the right, the key body 20 is then inclined to the right side about a point where the tip portion 16 is in contact with the protrusion 12a of the bottom case 12. Accordingly, the radially extending portion 15a of the support member 15, on the left side in the figure, is lifted up. As the key body 20 inclines, the portion 25a of the elastic member 25 positioned on the lifted radially extending portion 15a comes closer to the circuit board. Finally, the contact material 26 on the portion 25a makes contact with a pair of electrodes 27 on the left side of the figure, resulting in connection of the pair of electrodes 27.

When the pressing force is released, the key body 20 returns to its original position due to an elastic force exerted by the elastic members 25. Similarly to the above-mentioned operation, if a force is applied on the left side of the key 14, the electrodes on the right side are connected.

In the above-mentioned mechanism, the tip portion 16 is always in contact with the surface of the protrusion 12a and thereby there is no impact force applied to a contacting point. Accordingly, wear of the contact point is less than that of the conventional mechanism. Further, even if the contact point has worn in the mechanism according to the present invention, there is no influences to the operation of the mechanism because wear of the contact point merely makes a gap between the electrodes 27 and the contact material 26 slightly larger. This gives a completely different effect as compared to the conventional mechanism in which two pairs of electrodes are connected simultaneously when the contact point has worn. Therefore, in the mechanism according to the present invention, no malfunction of the TV game machine occurs due to wear of the contact point.

It should be noted that, similarly to the conventional mechanism, the elastic member 25 may be made of electrically conductive rubber instead of providing the contact material on the top surface of the portion 25a of each of the elastic material 25.

Fig.4 is a variation of the embodiment according to the present invention shown in Fig.3. In this Fig.4, parts that are the same as those shown in Fig.3 are given the same reference numerals as previously, and descriptions thereof will be omitted.

In the variation shown in Fig.4, a key body 30 comprises a key 14 and support member 35 which is

press fitted to a hole formed on a stem 14a of the key 14. A tip portion 35c is formed as a part of the support member 35. A radially extending portion 35a corresponds to the radially extending portion 15a shown in Fig.3.

According to this variation the key body 30 comprises fewer parts than the key body 20 shown in Fig.3. Additionally, assembly of the key body 30 is simply performed by press fitting without using tools such as a screw driver. Thus this variation can reduce manufacturing costs while having the same advantages as those in the embodiment shown in Fig.3.

The present invention is not limited to the specifically disclosed embodiments, and variations and modifications may be made without departing from the scope of the present invention.

Claims

1. A directional control-key mechanism comprising a key and pairs of electrodes, a given pair of electrodes being momentarily connected by means of an elastic member pressed by the key in accordance with a portion of the key being pressed, the directional control-key mechanism being characterized in that:

said key (14) is connected with a support member (15) having a radially extending portion (15a), said support member (15) having a generally round shaped tip portion being in contact with a base (12a);

a plate (18) is provided between said key (14) and said support member (15) so that said radially extending portion is a predetermined distance apart from a bottom surface of said plate (18);

a plurality of elastic members (25) are provided between said plate (18) and said support member (15), each of said elastic members (15) having a portion attached to said plate (18) and having a lifted portion (25a) in a position lifted from a surface of said plate (18) and elastically movable against the surface of said plate (18);

a contact material (26) is attached on a top surface of said lifted portion (25a) and a pair of electrodes are provided at a position directly above said contact material (26) on said plate (18); and

when a pressing force is applied onto a portion of said key (14), said support member (15) is inclined about a point where said tip portion of said support member (15) is in contact with said base (12a), said contact material (26) provided on an opposite side of the portion where the pressing force is applied with regard to the center of said key (14) on said radially extending portion (15a) making contact with said corresponding

pair of electrodes (27).

2. The directional control-key mechanism as claimed in claim 1, characterized in that:

said key (14) has a stem (14a) extending 5
through an opening (18a) of said plate (18), and
said support member (15) is secured to said stem
(14a).

3. The directional control-key mechanism as 10
claimed in claim 2, characterized in that:

said stem (14a) has a hole (35c) and said
support member (35) is press fitted into said hole
(35c).

4. The directional control-key mechanism as 15
claimed in claim 1, characterized in that:

said plate (18) is comprised of a circuit
board on which an electric circuit is formed, and
said circuit board is secured to a housing (12), 20
said base (12a) being formed as a part of said
housing (12).

5. The directional control-key mechanism as 25
claimed in claim 1, characterized in that:

each of said elastic members (15) is made
of electrically conductive rubber instead of pro-
viding said contact material (26) on said lifted
portion (15a) of each of said elastic members 30
(15).

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FIG. 1

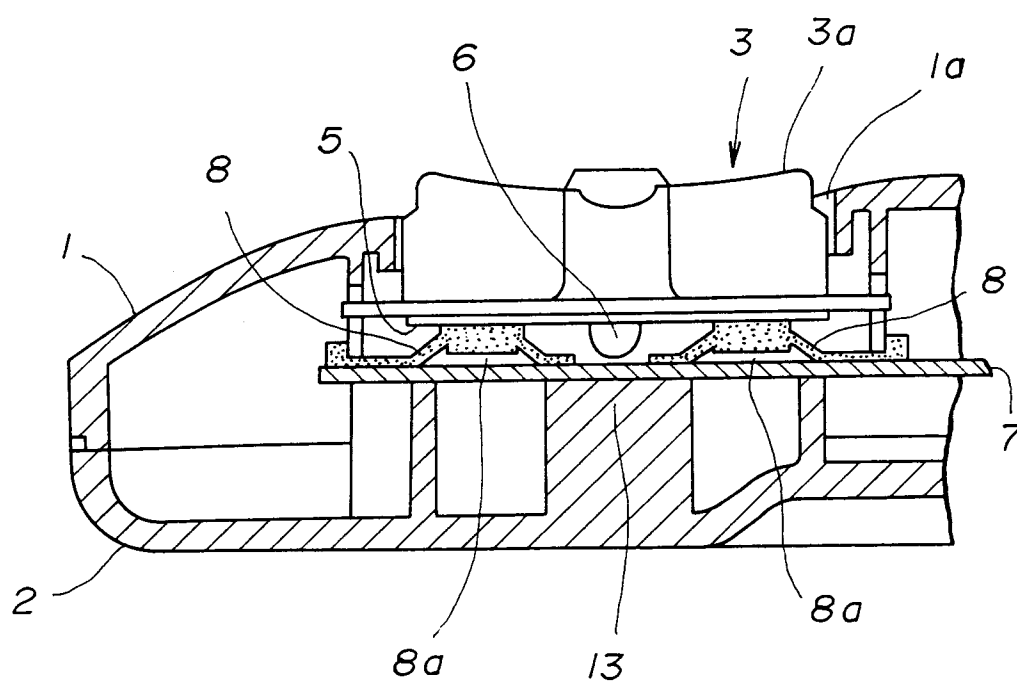


FIG. 2

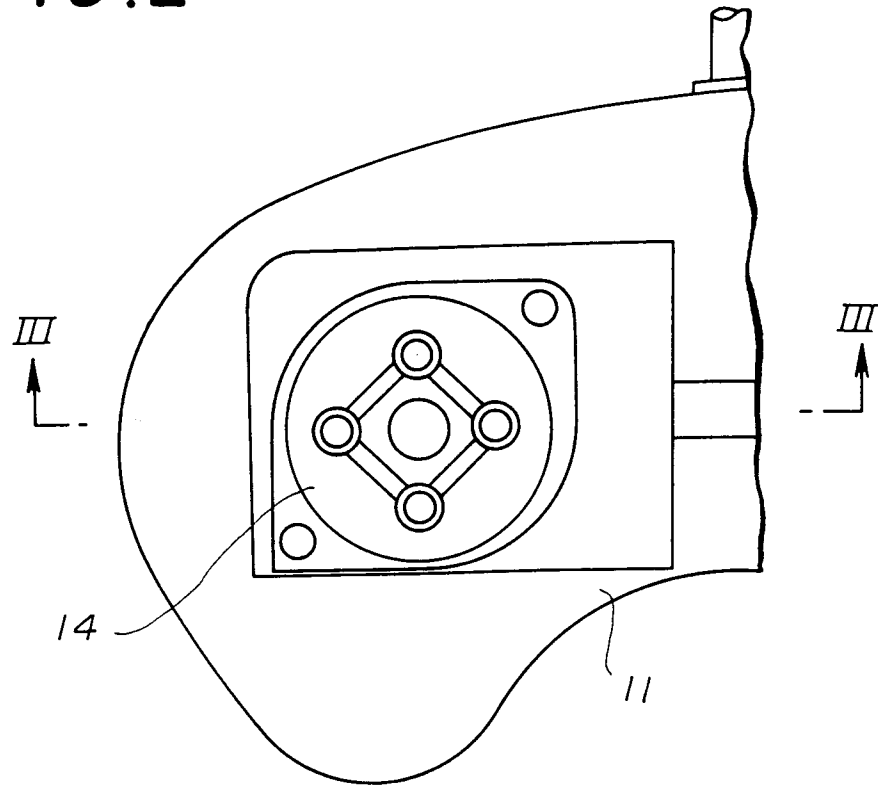


FIG. 3

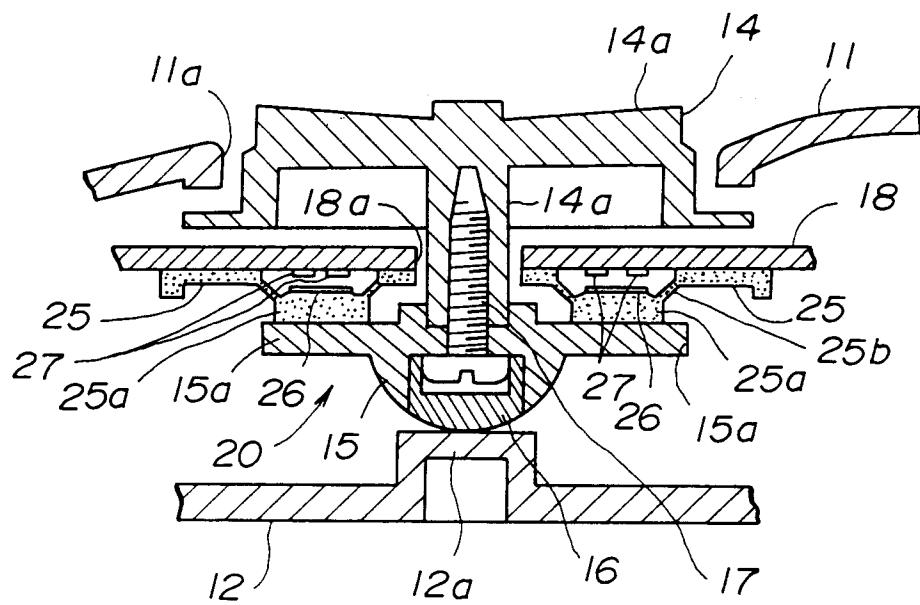


FIG. 4

