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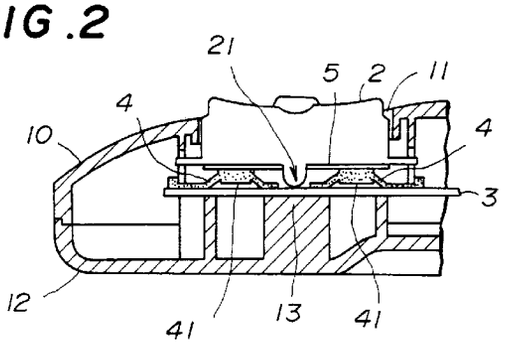
(54) Control key mechanism.

(57) A control key mechanism includes a circuit board (3) having contact points, each contact point used to indicate one of predetermined directions of movement of a character ; a key top member (2, 32) arranged within an opening of a housing of the circuit board, the key top member having a plurality of direction portions each of which can be depressed to indicate one of the predetermined directions of movement of the character, the key top member having a downwardly projecting hemispherical portion (21) at the center of the bottom thereof ; and a flexible member (4) having a plurality of flexible portions arranged on the circuit board for supporting the key top member, each flexible portion having a depressing portion (41), the depressing portion subjecting the circuit to electrical conduction at the corresponding contact point when the corresponding direction portion of the key top member is depressed, wherein the hemispherical portion of the key top member is in contact with the circuit board, and wherein peripheral portions of the bottom surface of the key top member are supported by the flexible portions.

FIG.2



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The present invention generally relates to a control key mechanism, and more particularly to a control key mechanism for a simulation game system or the like which is used to control the direction of movement of a character displayed when a simulation game is running on the system.

A known control key device is used in a television game system or a portable electronic game system to control the direction of movement of a character displayed when a game such as a simulation game or a roll playing game is running on the system. This control key device is made up of a printed circuit board, a key top member having a portion depressed by an operator, and a flexible holding member for supporting the key top member on the printed circuit board.

The key top member has four direction portions on its top surface. One of the four direction portions is depressed by an operator to indicate the direction of movement of a displayed character. The key top member is formed with a disk portion on its bottom surface, and with a downwardly projecting portion at the center of the bottom thereof. Four conductive rubber elements are arranged on the bottom of the disk portion at locations corresponding to the four direction portion.

When one of the four direction portions of the key top member is depressed, the downwardly projecting portion is brought into contact with the printed circuit board and the corresponding conductive rubber element on the disk portion is brought into contact with one of contact points of a circuit on the printed circuit board, so that the circuit is made conductive to indicate one of the four directions of movement of the displayed character.

However, in the known control key device, the disk portion of the bottom of the key top member is supported by the holding member on the printed circuit board such that the edge of the downwardly projecting portion is maintained at a distance from the printed circuit board when the key top member is not depressed. Therefore, each time the key top member is depressed by an operator, the downwardly projecting portion hits the printed circuit board. An excessively great impact force may sometimes exert on the printed circuit board.

In the known control key mechanism, it is likely that the contact points of the printed circuit board will wear due to repeated key operation. Also, the impact force by the downwardly projecting portion will damage the printed circuit board, and the control key device may sometimes malfunction. Also, in the known control key device, it is likely that erroneous key operation will occur since a couple of the conductive rubber elements are simultaneously brought in contact with the printed circuit board when the key top member is depressed.

Accordingly, it is a general object of the present invention to provide an improved control key mechanism in which the above described problems are eliminated.

Another, more specific object of the present invention is to provide a control key mechanism which enables smooth and exact key operation for an operator to control the direction of movement of a character, and reduces the wear of the contact points of the printed circuit board due to the repeated key operation.

The above mentioned objects of the present invention can be achieved by a control key mechanism which includes a circuit board having a plurality of contact points of a circuit, each contact point used to indicate one of predetermined directions of movement of a character when the contact point is subjected to short circuit; a key top member arranged within an opening of a housing of the circuit board, the key top member having a plurality of direction portions each of which can be depressed to indicate one of the predetermined directions of movement of the character, the key top member having a downwardly projecting hemispherical portion at the center of the bottom of the key top member; and a flexible member having a plurality of flexible portions arranged on the circuit board for supporting the key top member, each flexible portion having a depressing portion, the depressing portion subjecting one of the contact points of the circuit to short circuit when corresponding one of the direction portions of the key top member is depressed, wherein the hemispherical portion of the key top member is in contact with the circuit board, and wherein peripheral portions of the bottom surface of the key top member are supported by the plurality of flexible portions.

The control key mechanism according to the present invention enables smooth key operation for an operator to control the direction of movement of a character, and reduces the wear of the contact points of the printed circuit board due to the key operation.

The above and other objects, features and advantages of the present invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings in which:

FIG.1 is a plan view of a first embodiment of a control key mechanism according to the present invention;

FIG.2 is a sectional view of the control key mechanism taken along a line II-II in FIG.1;

FIG.3 is a plan view showing the inside of a second embodiment of the control key mechanism according to the present invention; and

FIG.4 is an enlarged sectional view of the control key mechanism taken along a line IV-IV in FIG.3.

A description will now be given of a first embodiment of the present invention, with reference to FIGS.1 and 2.

FIGS.1 and 2 show a control key mechanism 1 to

which the present invention is applied. This control key mechanism is made up of a key top member 2, a printed circuit board 3, and a flexible member 4 having four flexible portions arranged on the printed circuit board 3. In the control key mechanism 1, the printed circuit board 3 is covered with an upper housing 10 and a lower case 12.

As shown in FIGS.1 and 2, the upper housing 10 is formed with an opening 11, and the key top member 2 is arranged within the opening 11 of the upper housing 10. The key top member 2 is formed with four direction key portions, and these portions slightly project from the upper housing 10. When one of the four direction key portions of the key top member 2 is depressed by an operator, the corresponding one of four predetermined directions (up, down, right and left) of movement of a displayed character is indicated.

The four flexible portions of the flexible member 4 are arranged on the printed circuit board 3 to support peripheral portions of the bottom surface of the key top member 2. A depressing portion 41 is formed on the bottom surface of each flexible portion of the member 4. When one of the four direction key portions of the key top member 2 is depressed, the corresponding depressing portion 41 is brought into contact with one of four contact points (not shown) of a circuit (not shown) on the printed circuit board 3 so that the circuit is subjected to short circuit at this contact point and made conductive to indicate one of the four directions of movement of a character displayed when a simulation game is running.

An extremely thin sheet 5 is interposed between the bottom of the key top member 2 and the flexible portions of the flexible member 4. Thus, the key top member 2 comes in contact with the thin sheet 5, and is supported on the printed circuit board 3 by the flexible member 4 via the thin sheet 5.

The thin sheet 5 is made of synthetic resin or plastic material, and the surface of this sheet 5 can be formed with a small friction resistance. The thin sheet 5 has a center opening, and the shape thereof is annular. The key top member 2 has a downwardly projecting portion 21 at the bottom of the member 2. The downwardly projecting portion 21 is inserted into the center opening of the thin sheet 5, so that it comes in contact with the printed circuit board 3. A point at which the projecting portion 21 comes into contact with the circuit board 3 serves as a supporting point when one of the direction key portions of the key top member 2 is depressed.

The lower case 12 is formed with a supporting portion 13, and the printed circuit board 3 is secured to the supporting portion 13 of the lower case 12.

Each flexible portion of the flexible member 4 is formed with a slantingly extending leg portion. These leg portions of the flexible member 4 are secured to non-conductive portions of the printed circuit board 3. Thus, the depressing portion 41 on the bottom of each flexible portion 4 is maintained by each leg portion at a distance from the printed circuit board 3 when the corresponding direction portion of the key top member 2 is not depressed, as shown in FIG.2.

In the first embodiment described above, the downwardly projecting portion 21 of the key top member 2 always comes in contact with the printed circuit board 3, and the key top member 2 is supported by the flexible portions of the flexible member 4 via the thin sheet 5. The thin sheet 5 is made of synthetic resin with a small friction resistance. Thus, the operator can easily depress one of the direction key portions of the key top member 2 to control the direction of movement of a displayed character. The downwardly projecting portion does not hit the printed circuit board as in the conventional device, and it is possible for the present invention to remarkably reduce the wear of the contact points of the printed circuit board 3.

In addition, since the downwardly projecting portion 21 serves as a supporting point of the key top member 2 regardless of whether the key top member is depressed or not, it is possible to prevent the occurrence of erroneous key operation with the control key mechanism. Thus, the control key mechanism of the present invention can be a reliable tool for an operator to indicate the right one out of the four directions of the movement of the displayed character by depressing it at the right time.

Next, a description will be given, with reference to FIGS.3 and 4, of a second embodiment of the control key mechanism according to the present invention. In FIGS.3 and 4, the parts which are the same as the corresponding parts shown in FIGS.1 and 2 are designated by the same reference numerals.

In a control key mechanism 30 in FIGS.3 and 4, the upper housing 10 is formed with the opening 11, and a key top member 32 is arranged within the opening 11 of the upper housing 10. The key top member 32 is formed with four direction key portions (not shown in FIGS.3 and 4) on the top of the member 32, and these portions are slightly and upwardly projecting from the upper housing 10 in a manner similar to that shown in FIG.1. The key top member 32 is formed with four depressing portions 22 on the bottom surface thereof as shown in FIG.4, and the depressing portions 22 are downwardly projecting from the bottom peripheral surface of the key top member 32.

The depressing portions 22 of the key top member 32 are respectively placed on the flexible portions of the flexible member 4, and the flexible member 4 is arranged on the printed circuit board 3. The key top member 32 is formed with a downwardly projecting hemispherical portion 21 at the center of the bottom surface of the key top member 32, and the hemispherical portion 21 is always in contact with the printed circuit board 3. In addition, a depressing portion 41 is

formed on the bottom surface of each flexible portion of the key top member 4. When one of the four direction key portions of the key top member 32 is depressed, the corresponding depressing portion 41 is brought into contact with one of the contact points of the printed circuit board 3 so that the circuit is subjected to short circuit at the contact point and made conductive to indicate the direction of movement of a displayed character.

A connected point 36 at which the hemispherical portion 21 comes into contact with the printed circuit board 3 serves as a supporting point when one of the direction key portions of the key top member 32 is depressed.

The printed circuit board 3 is covered with the upper housing 10 and the lower case 12, and the printed circuit board 3 is secured to the lower case 12. As shown in FIG.4, each flexible portion of the flexible member 4 is formed with a slantingly extending leg portion. These leg portions of the flexible member 4 are secured to non-conductive portions of the printed circuit board 3. Thus, the depressing portion 41 on the bottom of each flexible portion is maintained by each leg portion at a distance from the printed circuit board 3 when the key top member 2 is not depressed.

In the second embodiment described above, the downwardly projecting hemispherical portion 21 of the key top member 32 always comes in contact with the printed circuit board 3, and the key top member 2 is supported by the flexible portions of the flexible member 4. The downwardly projecting portion does not hit the printed circuit board as in the conventional device, and it is possible for the present invention to reduce the wear of the contact points of the printed circuit board 3.

The hemispherical portion 21 serves as a supporting point of the key top member 2 regardless of whether the key top member is depressed or not. When one of the direction key portions of the key top member 2 is depressed by an operator, the hemispherical portion 21 serves as a supporting point while the corresponding depressing portion 41 is brought into contact with the printed circuit board 3 by the corresponding one of the portions 22 of the member 32. It is possible to prevent the occurrence of erroneous key operation with the control key mechanism. Thus, the control key mechanism of the present invention can indicate the right one out of the four directions of the movement of the displayed character by depressing it at the right time.

Further, the present invention is not limited to the above described embodiments, and variations and modifications may be made without departing from the scope of the present invention.

Claims

1. A control key mechanism for indicating one of a plurality of predetermined directions of movement of a character displayed when a simulation game is running, which includes:

   a circuit board (3) having a plurality of contact points of a circuit, each contact point used to indicate one of the predetermined directions of movement of the character when the circuit is subjected to electrical conduction at the contact point;

   a key top member (2, 32) arranged within an opening of a housing (10) of the circuit board, said key top member having a plurality of direction portions each of which can be depressed to subject the circuit of the circuit board to electrical conduction at the corresponding contact point so that one of the predetermined directions of movement of the character is indicated, said key top member having a downwardly projecting hemispherical portion (21) at the center of the bottom of the key top member; and

   a flexible member (4) having a plurality of flexible portions arranged on the circuit board for supporting the key top member, each flexible portion having a depressing portion (41) on the bottom surface of the flexible portion, the depressing portion subjecting the circuit to electrical conduction at the corresponding contact point when the corresponding direction portion of the key top member is depressed,

   characterized in that said hemispherical portion (21) of said key top member (2, 32) is in contact with the circuit board (3), and that peripheral portions of the bottom surface of said key top member are supported by said flexible portions of the flexible member (4).

2. A control key mechanism according to claim 1, characterized in that an extremely thin sheet (5) made of synthetic resin is arranged between a lower surface portion of the key top member (2) and the flexible portions of the flexible member (4) so as to reduce frictional resistance therebetween.

3. A control key mechanism according to claim 2, characterized in that said hemispherical portion (21) of said key top member (2) is in contact with the circuit board (3), and that the bottom surface portion of the key top member is supported by the flexible portions of the flexible member (4) via said thin sheet (5).

4. A control key mechanism according to claim 1, characterized in that said key top member (32) is formed with a plurality of downwardly projecting

portions (22) respectively connected to the flexible portions of the flexible member (4) such that the hemispherical portion (21) is in contact with the circuit board (3) and that said downwardly projecting portions (22) are supported by the respective flexible portions.

5. A control key mechanism according to claim 1, characterized in that said key top member (2, 32) has four direction portions each of which can be depressed to indicate one of four predetermined directions of movement of the character.

6. A control key mechanism according to claim 1, characterized in that said flexible member (4) is formed with four flexible portions arranged on the circuit board (3) for supporting the key top member (2, 32).

7. A control key mechanism according to claim 1, characterized in that said flexible portions of said flexible member (4) are formed with slantingly extending leg portions, said leg portions being secured to the circuit board (3), each depressing portion (41) of the flexible member (4) being maintained by said leg portions at a distance from the circuit board (3).

FIG.1

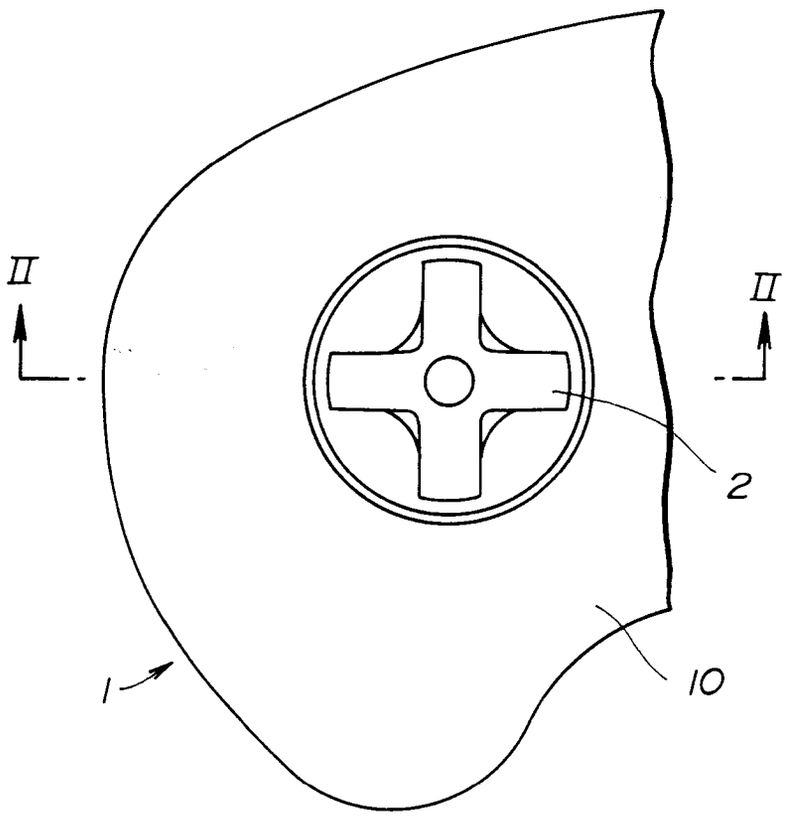

FIG.2

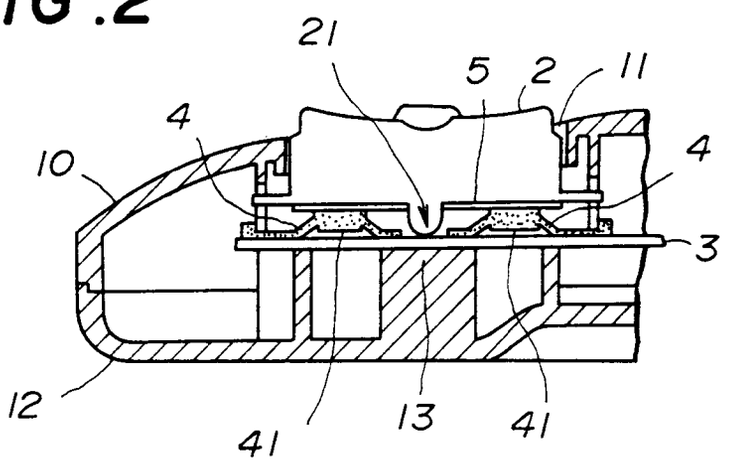

FIG.3

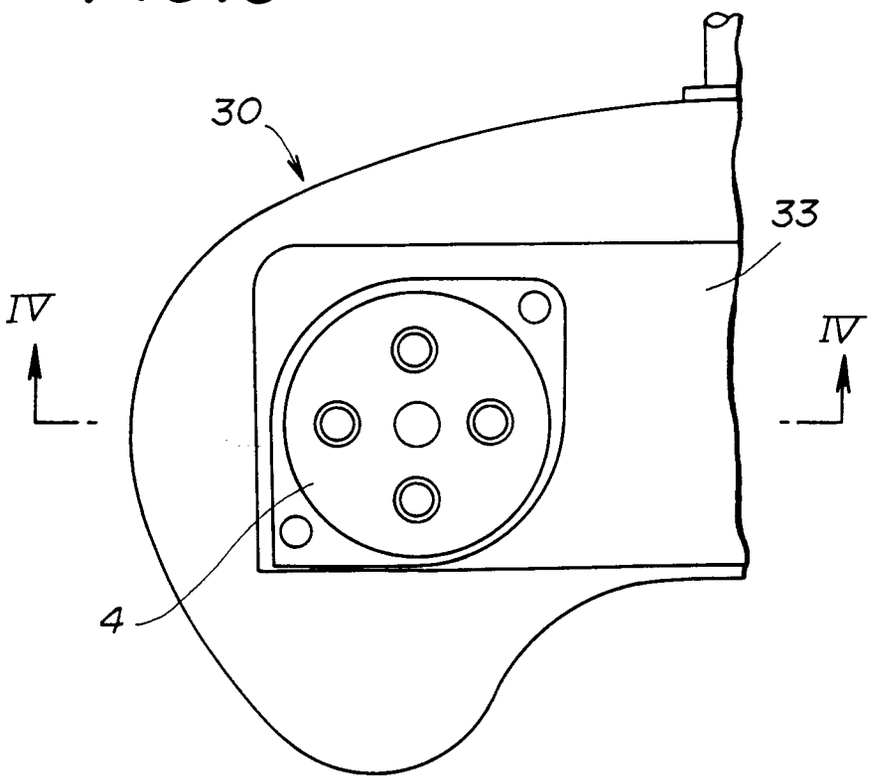

FIG.4