

MULTI-DIRECTIONAL SWITCH

The present invention relates to a multi-directional push-button switch and more particularly relates to a multi-directional push-button switch in which the operation of multiple switching contact sets is dependent on the direction in which the push-button of the switch is pressed.

The switch of the present invention is particularly though not exclusively adapted for use as a control switch in an electronic game apparatus and Fig. 1 of the accompanying drawings is a perspective view showing an example of a well known hand-held type of game playing apparatus using conventional character moving switches. Referring to Fig. 1, the apparatus has a liquid crystal display panel 2. The liquid crystal panel 2 has a plurality of transparent electrodes which define characters which can be displayed according to the progress of a game or in response to operation of character moving switches 4a to 4d. The characters 3a, 3b, 3c and 3d illustrated in the drawing might for example be selectively displayed by operation of respective ones of character moving

switches 4a, 4b, 4c and 4d. Accordingly, by selectively operating the character moving switches 4a to 4d, the display can be made to appear as though characters 3a to 3d were moving. The apparatus 1 further comprises game selection switches 5 and 6 for selecting between games of different difficulties and a current time switch 7 for operation to indicate the current time.

As described above, in the apparatus of Fig. 1 the character moving switches 4a to 4d correspond to the apparent moving directions of the characters 3a to 3d. The character moving switches 4a to 4b are provided at the left hand end of the apparatus 1, and the character moving switches 4c and 4d are provided at the right hand end of the apparatus 1. Accordingly, if a game is played with the apparatus held in the hands, the character moving switches 4a and 4b must be operated with the left hand and the character moving switches 4c and 4d must be operated with the right hand, and we have found that it is very difficult to operate two switches with one hand and a further two switches with the other hand. As a result, one must take great care in operating the character moving switches 4a and 4d, which makes the game dull. If a larger number of character moving switches are provided to increase the

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character moving directions, then more variety will be given to the game, so that one will not easily get bored with it, but the problem of switch manipulation remains. Thus, in using conventional character moving switches, there is a disadvantage that the provision of variety in the games available runs contrary to the requirements of simplicity in operation.

In order to eliminate the above described disadvantage, the character moving switches 4a to 4d might be disposed collectively in a certain position in the apparatus 1 so that one can operate them with one hand. However, such collective disposition would encounter another problem in that two or more of the character moving switches might often be pressed simultaneously. Conversely, this means that the character moving switches 4a to 4d would have to be spaced apart from each other by a certain distance. Accordingly, the space required for accommodating the character moving switches 4a to 4d would have to be made larger, and consequently restrictions would be placed upon the provision of sufficient space for the liquid crystal display panel 2. As a result, the content of the game organized in the liquid crystal display panel 2 would have to be limited.

In the foregoing, the disadvantages of the type of character moving switches used hitherto in held-held type game playing apparatuses was explained. However, the same disadvantages or problems as described above are also found in various other conventional apparatus where control for selection of modes or moving directions is required to be made by means of switches, if switches are provided corresponding to the modes or moving directions.

Therefore, a primary object of the present invention is to provide a multi-directional switch which can be operated with efficiency and in a simplified manner and does not have to occupy much space.

According to the present invention there is provided a push-button switch which can be operated by finger pressure to selectively operate any one of a plurality of sets of switching contacts, the switch comprising an operating member which is generally pivotally mounted with respect to a base portion of the switch and has a unitary operating portion which projects through an aperture in a housing part of the switch and defines a unitary finger contact surface accessible for switch-operating finger pressure, the said operating portion having a central region and a plurality of limbs disposed about said central region

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and extending therefrom in directions corresponding to predetermined directions for pivotal switch-operating movement of the operating member, the said finger contact surface being depressed at said central region and being elevated relative thereto at said limbs so as to be generally concave overall for accommodating the touch of the fingers, the said operating member further having means defining a plurality of contact pressure surfaces opposed to the switch base portion and arranged to be selectively brought into operation for operating a selected switching contact set in dependence upon the application of finger pressure to said operating portion in the direction of a corresponding one of said limbs and corresponding pivotal movement of the said operating member, and the switch further comprising means for resiliently retaining the switch operating member in a generally median position intermediate the positions to which it can be pivoted for switch operation so long as no finger pressure is applied thereto, and a plurality of sets of normally-open switching contacts, including contacts provided on the base portion of the switch, arranged to be closed by respective ones of said contact pressure surfaces in response to finger pressure on said operating portion in the direction of

respective ones of said limbs and corresponding pivotal movement of the operating member.

As will be appreciated from the following description of a preferred embodiment a plurality of conductive members are disposed to be opposed to a plurality of electrodes formed on a base plate and, by pressing in a selected direction a key top switch operating member having predetermined multiple pressing directions provided in an identified manner, a corresponding electrically conductive member is brought into contact with associated electrodes, and thus the pressing direction of the key top serves as an important factor. The present invention enables switching on and off of multiple contacts composed of a plurality of electrodes formed on a base plate to be performed with one hand and as a result, operation can be made much more easily as compared with the conventional switches hereinbefore described. Furthermore, since only a single key top is provided for obtaining multiple switching, it need take up only little space for its fixing.

Other features of the present invention are set forth with particularity in the appended claims and will become more apparent from the following detailed descriptions when taken in conjunction with the accompanying drawings, wherein:

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Fig. 1 is a perspective view showing an example of a hand-held type game playing apparatus using conventional character moving switches which constitute the background of the present invention;

Fig. 2 is a perspective view showing an example of a hand-held type game playing apparatus using a character moving switch in which the present invention is embodied;

Fig. 3 is a sectional view showing installation of a character moving switch 8;

Fig. 4 is a front view showing a key top 10;

Fig. 5A is a sectional view of a sustaining member 20; and

Fig. 5B is a bottom view of a sustaining member 20.

Referring to Fig. 2, the hand-held type game playing apparatus is the same as the apparatus shown in Fig. 1, except for the matters described hereinafter. Therefore, the same reference numerals denote like components, and the description of the same is omitted. The apparatus 1 is provided with a character moving switch 8 which is an embodiment of the present invention. The character moving switch 8 is formed in the shape of a cross and is arranged so that characters 9a to 9d can be selectively displayed responsive to the

pressing directions in which the switch is pressed. More particularly, if a protrusion 11a is pressed, the character 9a is displayed; if a protrusion 11b is pressed, the character 9b is displayed; if a protrusion 11c is pressed, the character 9c is displayed; and if a protrusion 11d is pressed, the character 9d is displayed.

Fig. 3 is a sectional view showing installation of the character moving switch 8. Referring to Fig. 3, the components except for operating member 10 are sectionally illustrated. Fig. 4 is a front view showing the operating member 10. Fig. 5A is a sectional view of a member 20 for resiliently retaining the switch operating member 10 in a generally median position so long as no finger pressure is applied thereto and Fig. 5B is a bottom view of the member 20. In the following, a detailed description will be given of the structure of the character moving switch 8 with reference to Figs. 2 to 5.

The character moving switch 8 as described is composed of the operating member or key top 10, the sustaining member 20 and a base plate 40. First, the formation of a key top 10 will be described. The key top 10 comprises a disk 12 having limbs or protrusions 11a to 11d in the shape of a cross formed on the upper

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surface thereof and defining an operating portion of the key top 10. An opening is formed in a housing part of the apparatus 1, so that the protrusions 11a to 11d in the shape of a cross may fit into it. The key top 10 is inserted into the opening from the inside of the apparatus 1. As a result, the protrusions 11a to 11d in the shape of a cross are accessible for switch-operating finger pressure outside the apparatus 1, while the disk 12 is retained by the opening in the apparatus 1. The operational finger contact surfaces 14 of the protrusions 11a to 11d are formed with inclinations so that the finger contact surface of the switch is generally concave with a depressed center. With these inclinations, the operational finger contact surface 14 is generally concave overall and fitted perfectly for the touch of the fingers, which makes operations of the switch easier.

On the under surface of the disk 12, a hemispherical supporting member 13 is provided which is spaced slightly apart from the base plate 40 of the switch when the switch is not present. When the key top 10 is pressed, it moves downwardly until contact between the support member 13 and the base plate 40 which then serves as a fulcrum for pivotal switch-operating movement of the key top 10. The support mem-

ber 13 could be provided on the base plate 40. The disk 12 is formed with its thickness in the center larger than that at its periphery and is arranged so that, as shown in Fig. 3, when the key top 10 is not pressed, the under surface of the disk 12, which constitutes a contact pressure surface of the switch, has a certain angle of inclination with respect to the base plate 40, but when any one of protrusion of the key top 10 is pressed, a corresponding portion on the under surface of the disk 12 under the pressed protrusion becomes approximately parallel to the base plate 40. As a result, any one of electrically conductive rubbers 30a to 30d to be described below can be brought into contact with corresponding ones of the electrodes 41a to 41d and 42a to 42d in a parallel state, which serves to establish a good contact between the conductive rubber and the corresponding electrodes.

Next, the sustaining member 20 will be described. The sustaining member 20 is made of elastic material such as rubber and comprises a mat which is disposed between the under surface of the disk 12 and the base plate 40. In a central portion of the sustaining member 20, an opening 21 is formed into which the support member 13 locates. The member 20 has four raised portions 22a, 22b, 22c and 22d arranged around the

opening 21 disposed respectively beneath the protrusions 11a to 11d. When the sustaining member 20 is placed on the base plate 40, the portions 22a to 22d form cavities between themselves and the base plate 40 and electrically conductive rubbers 30a, 30b, 30c and 30d are attached to the upper inner surfaces of the cavities of the portions 22a, 22b, 22c and 22d, respectively. Grooves 23 to 26 are formed between the portions 22a to 22d. In addition, a groove 27 is formed from the sustainer 22b to the outer side. These grooves 23 to 27 serve for ventilation and prevent the sustaining member 20 from being held by suction to the base plate 40 when the sustaining member 20 is pressed, so that the sustaining member 20 can return to its original state.

Now, description will be made of the formation of the base plate 40. Electrodes to be turned on and off by operation of the key top 10 are formed on the base plate 40. More particularly, as shown in Fig. 5B, electrodes 41a and 42a are formed opposing to the conductive rubber 30a. In the same manner, electrodes 41b and 42b are formed opposing to the conductive rubber 30b; electrodes 41c to 42c are formed opposing to the conductive rubber 30c; and electrodes 41d and 42d are formed opposing to the conductive rubber 30d.

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Operation in a state where the above described key top 10, sustaining member 20 and base plate 40 are incorporated in the apparatus 1 will be described in the following. First, description is made of a case where the key top 10 is not pressed. In this case, the sustaining member 20 pushes up the under surface of the disk 12 by its elastic force so that the upper surface of the disk 12 is pressed against the housing part of the apparatus 1.

When the key top 10 is pressed, the support member is brought into contact with the base plate 40 to form a fulcrum. In this case, even if the central portion of the key top 10 is pressed vertically downward, none of the conductive rubbers 30a to 30d will be in contact with their corresponding electrodes. Furthermore, even if two or more than two protrusions are simultaneously pressed by mistake, two or more than two conductive rubbers will not be simultaneously brought into contact with the corresponding electrodes. For this purpose, the height d1 of the support member 13, the height d2 of the sustaining member 20 and the height (stroke) d3 from the bottom of the sustaining member 20 to the conductive rubbers 30a to 30d must be predetermined.

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When any one of the protrusions 11a to 11d of the key top 10 is pressed, the disk 12 is inclined in the pressing direction with a fulcrum formed by the support member 13 as a center. For example, assuming that the protrusion 11d is pressed, the sustainer portion 22d under the protrusion 11d is pushed down toward the base plate 40 against its elastic force. Consequently, the conductive rubber 30d is also pushed down so as to be in contact with the electrodes 41 d and 42d. As a result, the electrodes 41d and 42d are short-circuited to turn on a predetermined circuit, not shown in the drawings. In response thereto, a segment 9d is displayed. Also, when any of other protrusions 11a, 11b and 11c is pressed, almost the same operation as described above is performed.

The above described embodiment is arranged such that no two or more of the conductive rubbers can simultaneously be in contact with their corresponding electrodes. However, the invention could provide an embodiment in which two conductive rubbers are desired to be simultaneously in contact with their corresponding electrodes. In such a case, while the conductive rubbers 30a to 30d and the electrodes 41a to 41d and 42a to 42d, for example, might be disposed in the same positions as in the above described embodiments, the

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cruciform key top 10 would have to be turned by an angle of 45° .

Although the present invention has been described and illustrated by reference to a specific embodiment, it is to be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the scope of the present invention being limited only by the terms of the appended claims.

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CLAIMS:

1. A push-button switch which can be operated by finger pressure to selectively operate any one of a plurality of sets of switching contacts, the switch comprising an operating member which is generally pivotally mounted with respect to a base portion of the switch and has a unitary operating portion which projects through an aperture in a housing part of the switch and defines a unitary finger contact surface accessible for switch-operating finger pressure, the said operating portion having a central region and a plurality of limbs disposed about said central region and extending therefrom in directions corresponding to predetermined directions for pivotal switch-operating movement of the operating member, the said finger contact surface being depressed at said central region and being elevated relative thereto at said limbs so as to be generally concave overall for accommodating the touch of the fingers, the said operating member further having means defining a plurality of contact pressure surfaces opposed to the switch base portion and arranged to be selectively brought into operation for operating a selected switching contact set in dependence upon the application of finger pressure to said operating portion in the direction of a



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corresponding one of said limbs and corresponding pivotal movement of the said operating member, and the switch further comprising means for resiliently retaining the switch operating member in a generally median position intermediate the positions to which it can be pivoted for switch operation so long as no finger pressure is applied thereto, and a plurality of sets of normally-open switching contacts, including contacts provided on the base portion of the switch, arranged to be closed by respective ones of said contact pressure surfaces in response to finger pressure on said operating portion in the direction of respective ones of said limbs and corresponding pivotal movement of the operating member.

2. A push-button switch as claimed in claim 1 wherein the said operating portion of the switch has four limbs extending from its central region in a generally cruciform manner.

3. A push-button switch as claimed in claim 1 or 2 wherein the aperture in the housing portion of the switch is shaped similarly to the shape of the operating portion of the switch so that each of said limbs extends between spaced apart edges of the



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aperture, the aperture together with the limbs thereby defining preferring directions for pivotal switch-operating movement of the operating member.

4. A push-button switch as claimed in any of the preceding claims wherein the operating member is arranged so that when no finger pressure is applied thereto it is biased by said resilient retaining means away from the base portion of the switch and a spacing is established between the base portion of the switch and the operating member, such spacing being taken up when finger pressure is applied to the operating member so as to depress the operating member against the action of said resilient retaining means, and a stop is provided for limiting the movement of the operating member towards the base portion of the switch to being such that without pivotal movement of the operating member none of the switching contact sets will be operated.

5. A push-button switch is claimed in claim 4 wherein the stop is provided on the operating member and comprises a projecting part thereof which serves as a fulcrum for pivotal movement of the operating member when the same is depressed under finger pressure.



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6. A push-button switch as claimed in any of the preceding claims wherein said means defining a plurality of contact pressure surfaces comprises an enlarged body portion of the operating member which is received between the base portion of the switch and the housing part of the switch, the said body portion having an upper surface which is biased by said resilient retaining means into contact with an under surface of said housing part around said aperture and a lower surface opposed to the switch base portion and defining said plurality of contact pressure surfaces.

7. A push-button switch as claimed in any of the preceding claims wherein the resilient retaining means comprises a mat of resiliently flexible material interposed between the base portion of the switch and the switch operating member, the said mat having portions with upper surfaces biased into contact with said contact pressure surfaces and lower surfaces opposed to and spaced from the base portion of the switch when the switch operating member is in its median position, said lower surfaces carrying contacts for co-operation with said contacts provided on the base portion of the switch when the switch operating member is subjected to switch-operating pivotal movement.



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8. A push-button switch substantially as herein described with reference to Figures 3, 4, 5A and 5B of the accompanying drawings.

9. An electronic game apparatus incorporating a push-button switch as claimed in any of the preceding claims as a control switch of the game apparatus.

10. An electronic game apparatus as claimed in claim 9 which comprises a character display in which apparent movements of one or more characters are to be controlled in the playing of the game, and wherein the directional orientation of the said limbs of the operating member of the switch correspond to the directions of the apparent movements of said one or more characters resulting from corresponding operation of the switch.

