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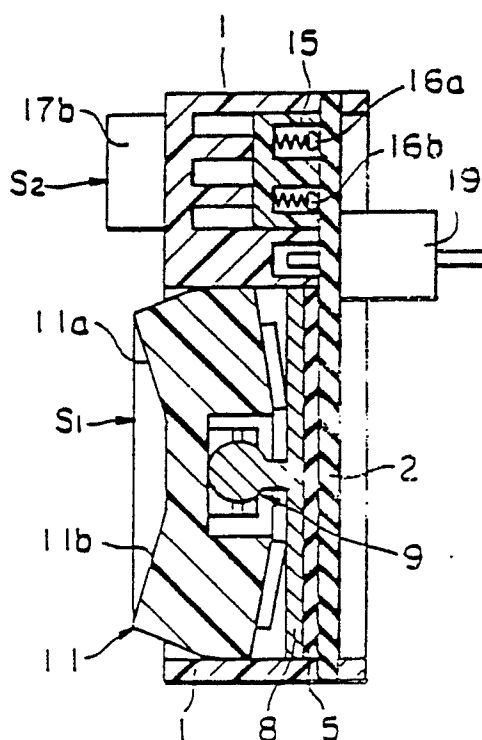
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(54) Multi-position electrical switch.

(57) The present invention relates to a multi-position electrical switch comprising a housing (1), an insulating board (2) provided with a pair of electrodes constituting fixed contacts, a pressure-sensitive electrically conductive rubber sheet (5) extending over said electrodes so as to form switch elements with the latter, a supporting plate (8) disposed on the rubber sheet and having a central ball-and-socket joint (9) and a plurality of openings, and an operating button (11) tiltably mounted on the ball of said joint.

The bottom face of the button (11) has four faces having raised pressing surfaces arranged for engagement with the portions of the rubber sheet corresponding to the switch elements when the button (11) is tilted. The ball of the joint (9) has pins whereas the socket has grooves for receiving respective ones of said pins when the button is tilted, the grooves being elastic and slightly narrower than the diameter of the pins in order to urge the button back from a tilted position to its untilted position.

FIG. 2



EP 0 269 153 A2

MULTI-POSITION ELECTRICAL SWITCH

The present invention relates to a switch suitable for use as a remote control switch for electrically operated rear-view mirrors of a motor vehicle. More particularly, the invention relates to a switch having switch elements comprising a pressure sensitive rubber sheet which becomes conductive only when and where it is pressed (hereinafter referred to as a "pressure-sensitive conductive rubber sheet" or, more briefly a "rubber sheet").

Each of a pair of motor-driven mirrors mounted on a door, a fender or the like, of a motor vehicle has a respective electric motor for driving thereof, said electric motors being controlled by means of a switch inside the vehicle so as to adjust the direction of inclination, horizontal or vertical, of each mirror. The switch for controlling the motor-driven mirrors is required to have the functions of actuating each of said two electric motors of each mirror independently, and reversing the polarity of the electric power supply thereto. Also, the switch should be easy to mount in an instrument panel or the like.

To meet such requirements, the inventors have previously proposed a switch as disclosed in Japanese Utility Model Application No. 56-71428. This previous switch comprises a housing, an operating member disposed within said housing at a predetermined clearance from the inner walls of said housing, said operating member being adapted to rock from its neutral position in mutually perpendicular directions, two switch elements disposed between a pair of plate-form electrodes via a pressure conductive rubber sheet and arranged in pairs at the four intervening positions, and a switch for reversing the polarity of a power supply is constituted by said switch elements.

However, the previous switch has a considerable depth which cannot be reduced because the operating member is rockably disposed within the housing and the switch elements are disposed between the operating member and the four inner walls of the housing. Also the switch is not very easy to mount in an instrument panel or the like. Furthermore, its design does not facilitate assembly thereof and does not provide a satisfying response in use because the operating member has almost no stroke and does not have a click-action.

U.S. Patent No. 4,029,915 discloses a switch comprising an insulating board arranged in a housing, and a plurality of stationary contact elements. Each of these elements are formed of a pair of film electrodes and arranged around a specific central position on the insulating board. A conductive rubber sheet forms switch elements together with the

stationary contact elements. A key arranged tiltably to the rubber sheet drives the switch elements by means of pressing surfaces. Furthermore, a spring provides a resettable trend at the button.

The present invention provides a multi-position electrical switch comprising a housing, an electrically insulating base board disposed in the bottom of said housing, printed circuit electrodes formed on said base board to provide a pair of electrodes constituting fixed contacts of a respective switch means at each side of a rectangle, a pressure-sensitive electrically conductive rubber sheet extending over said printed circuit electrodes so as to form switch elements for making and breaking electrical connections between the fixed contacts of the respective switch means upon application and release of pressure thereto respectively, a supporting plate disposed over said rubber sheet, having a ball of a ball-and-socket joint disposed generally centrally with respect to said rectangle and having a plurality of openings therein, an operating button tiltably mounted on said ball, the section of said operating button facing said supporting plate being formed in the shape of a frustum of a pyramid having its vertex on the vertical axis of said ball-and-socket joint and having four faces having raised pressing surfaces formed and arranged for engagement with selected portions of said rubber sheet by protruding through corresponding openings in said supporting plate when said operating button is tilted, the ball of said joint having pins extending transversely of the vertical axis of said ball and socket joint, and the socket of said joint having grooves for receiving respective ones of said pins therein when said operating button is tilted, said grooves being elastic and slightly narrower than the diameter of said pins, said pins and grooves being formed and arranged for urging said operating button back from a tilted position thereof, towards its untilted position.

The switch of the present invention has a relatively flat, thin and shallow depth form which can be readily secured in a relatively small space such as in an instrument panel of a motor vehicle.

In addition to the abovementioned advantages, the use of a tiltable operating button having projections for preventing the simultaneous closing of switch elements other than the desired ones at any given moment with the operating button being displaced against the biasing of elastic portions and returned to its original position thereby, provides a more positive feel in use and ensures smooth operation even after use for a considerable period of time.

In the accompanying drawings: Figs. 1 to 11

show a switch according to the present invention ;

Fig. 1 is a plan view of the switch;

Fig. 2 is a sectional view taken on line II-II of Fig. 1;

Fig. 3 is a plan view of a supporting plate removed from Fig. 2;

Fig. 4 is a bottom view of an operating button;

Fig. 5 is a sectional view taken on line V-V of Fig. 1;

Fig. 6 is a bottom view of a slide block removed from Fig. 5;

Fig. 7 is an enlarged plan view of a printed circuit board removed from Fig. 2;

Fig. 8 is a schematic plan view showing the relative disposition of the various switch elements on the printed circuit board;

Fig. 9 is a circuit diagram showing the relation between the various switch elements;

Fig. 10 is an enlarged sectional view showing a ball and socket bearing removed from Fig. 2; and

Fig. 11 is a sectional view showing the operating state of the ball and socket bearing.

The present invention will now be described in detail, with reference to the embodiment illustrated in Figs. 1 to 11 in which the invention is applied to a switch for controlling a motor driven mirrors of a motor vehicle.

Figs. 1 to 11 show a switch according to the present invention comprising a housing, 1 an electrically insulating base board 2 (a printed circuit board) which also serves as the base plate of the housing 1. Disposed within the housing 1 is a power supply polarity reversing switch S_1 and another switch SS_2 for changing over between right hand mirror R operation and left hand mirror L operation.

The switch S_1 comprises, for example, eight switch elements A to F' as shown in Fig. 9. Several pairs of generally film-form electrodes $3a$ and $4a$ to $3f'$ to $4f'$, serving as fixed contact elements of the switch elements A to F' , are printed around a specific central position 7 on the printed circuit board 2 in a pectinated shape. The film electrodes $3a$ and $4a$ to $3f'$ and $4f'$ are disposed to occupy substantially the whole of the upper and lower, right and left areas of the printed circuit board 2.

A pressure-sensitive electrically conductive rubber sheet 5, corresponding to a movable contact element of a conventional switch element, is laid over said fixed contact elements $3a$ and $4a$ to $3f'$ and $4f'$. The single rubber sheet 5 is common to all the fixed contact elements. The pressure-sensitive conductive rubber sheet 5 is, for example, made of silicone rubber and metal particles. It is normally non-conductive and becomes conductive upon pressure being applied thereto.

Thus, according to the present invention, the eight switch elements A to F' are disposed on the surface of the base board 2 and these switch elements A to F' are connected by printed conductors 6 so as to form two switch means for reversing the polarity of electric power source. That is, in Fig. 9, the four switch elements A , B , E and F form one switch means (switch means for vertical adjustment) and the four switch elements C , D , E' and F' form the other switch means (switch means for horizontal adjustment). The arrangement of the switch elements A to F' on the base board 2 is illustrated in Fig. 8.

An operating means disposed over said above-described switch elements A to F' will now be described in detail.

First, a supporting plate 8 as shown in Fig. 3, is disposed on top of the rubber sheet 5. The supporting plate 8 is fixed at its periphery to the housing 1. And an operating button 11 is supported on a ball-and-socket joint 9 provided approximately in the centre of the supporting plate 8 so that the operating button 11 can be tilted with respect to the rubber sheet 5. The operating button 11 has a square shape, for example as seen in the plan view shown in Fig. 1, and is adapted to apply localised pressure to the rubber sheet 5 when any of four operating portions thereof comprising: an upper portion $11a$, a lower portion $11b$, a left-hand portion $11c$ and a right-hand portion $11d$ as viewed in Fig. 1, is pushed. As shown in Figs. 2 to 4, the section of the operating button 11 facing the pressure-sensitive conductive rubber sheet 5, that is, the lower part of the button, has the shape of a frustum of a pyramid having its vertex on the vertical axis of said ball-and-socket joint 9 which serves as a point of support, and has four faces $11e$, $11f$, $11g$ and $11h$, as well as four intersection lines where adjacent faces meet. Each of the four sloping faces $11e$ to $11h$ of said frustum has two pressing surfaces $12a$ and $12b$, $12c$ and $12d$, etc. slightly protruding therefrom. These pressing surfaces $12a$ to $12h$ correspond to said switch elements A to F' as follows: The pressing surface $12a$ corresponds to the switch element A , the pressing surface $12b$ to the switch element F , the pressing surface $12c$ to the switch element E , the pressing surface $12d$ to the switch element B , the pressing surface $12e$ to the switch element F' , the pressing surface $12f$ to the switch element C , the pressing surface $12g$ to the switch element D and the pressing surface $12h$ to the switch element E' . Thus, each of the four sloping faces $11e$ to $11h$ of said frustum of a pyramid corresponds to two switch elements.

A plurality of generally complementary through holes $8a$ is provided in the supporting plate 8 opposite respective ones of the pressing surfaces

12a to 12h.

The ball and socket bearing mounting 9 supporting the button 11 consists of a sphere 10 provided at the side of the plate 8 and a sphere retainer 13 provided at the button 11 side. The sphere 10 has a plurality of radially projecting pins 10a in a cruciform arrangement extending towards respective ones of sloping faces 11e to 11h of the frustrations of the button 11. Split grooves 13a each having a narrow width slightly smaller than the diameter of the pin 10a and elastically deformable to receive said pins 10a are formed at the side of the retainer 13. The button 11 is thus subject to a resilient return biasing force for always returning it to its central neutral position by means of the interaction of the split grooves 13a and the pin 10a.

Reference will now be made to the switch S₂. The switch S₂ is for selectively connecting the above-mentioned switch S₁ with either the right-hand mirror R or the left-hand mirror L and is constructed as follows: The switch S₂ comprises two circuits and six contacts. Contact patterns l, m and 14a to 14d, corresponding to the six contacts, are printed near one end (upper portion as viewed in Fig. 7) of the board 2. A slide block 15, slidable right and left in Fig. 5 (or Fig. 6), is disposed over the contact patterns l, m and 14a to 14d. The slide block 15 is provided with movable contacts 16a and 16b corresponding the contact patterns l, m and 14a to 14d. A pair of push buttons 17a and 17b respectively corresponding to the right-hand mirror R and the left-hand mirror L are disposed on both sides of the slide block 15 in the direction of its slide. The driving end of each push button is engaged with each of taper portions 15a and 15b formed on both ends of the slide block 15. Numerals 18a and 18b represent balls for positioning the push buttons 17a and 17b.

Thus, the embodiment illustrated in Figs. 1 to 11 is a hybrid switch comprising said switch S₁ including the eight switch elements A to F and said changeover switch S₂.

A connector 19 shown in Fig. 2 for externally leading the contacts l, m and 14a to 14d in the changeover switch S₂ to the exterior (the mirrors R and L). Referring to Fig. 9, electric motors M₁, M₂ are provided for horizontally and vertically driving the right-handed mirror R, and electric motors M₃, M₄ for vertically and horizontally driving the left-handed mirror L.

The operation of the switch will now be described with reference to Fig. 9.

Reference will be made to the case of controlling the right-handed mirror R by pushing the push button 17a of the changeover switch S₂. When the push button 17a is pushed, the slide block 15 is slid toward the left in Fig. 5 and its movable

contacts 16a and 16b respectively close the contacts l and 14a together and the contacts m and 14c together so that the switch S₁ is connected with the right-hand mirror R. (See the condition illustrated in Fig. 9.)

When the portion 11a of the operating button 11 is pushed through a predetermined tilting stroke, the switch elements A and F are closed. Then, the electric motor M₁ rotates in such a direction as to change the angle of the right-hand mirror R upwardly. The pin 10a corresponding to the ball and socket bearing 9 is engaged within the split groove 13a as shown in Fig. 11 at this stage. When the pressing force is released, the pin 10a is elastically ejected and returned to its neutral position as shown in Fig. 10. The positive click-operation feeling is produced during operation by the elastic operation of the bearing 9 in this manner.

Similarly, when the portion 11b of the button 11 is pressed, the switch elements B, E, are closed and the electric motor M₁ rotates in a reverse direction so as to change the angle of the right-hand mirror R downward.

When the portion 11c is pushed, the switch elements C and F are closed and the electric motor M₂ rotates in such a direction to change the angle of the right-handed mirror R towards the left.

When the portion 11d is pushed, the switch elements D and E are closed in the same way as mentioned above. Then, the electric motor M₂ rotates in a reverse direction so as to change the angle of the right-hand mirror R toward the right.

The operations of the bearing 9 when the portions 11b, 11c, 11d are pressed are similar to the pressing of the position 11a.

When the push button 17b of the changeover switch S₂ is pushed, the left-handed mirror L is controlled in the same way as described above.

Claims

1. A multi-position electrical switch comprising a housing (1), an electrically insulating base board (2) disposed in the bottom of said housing, printed circuit electrodes formed and arranged on said base board to provide a pair of electrodes constituting fixed contacts (3a-3f, 4a-4f) of a respective switch means at each side of a rectangle, a pressure-sensitive electrically conductive rubber sheet (5) extending over said printed circuit electrodes so as to form switch elements (A-F) for making and breaking electrical connections between the fixed contacts of the respective switch means upon application and release of pressure thereto respectively, a supporting plate (8) disposed over said rubber sheet, having a ball of a ball-and-socket joint (9) disposed generally cen-

trally with respect to said rectangle and having a plurality of openings therein (8a), and operating button (11) tiltably mounted on the ball (10) of said joint (9), the face of said operating button facing said supporting plate being formed in the shape of a frustum of a pyramid having its vertex on the vertical axis of said ball-and-socket joint and having four faces (11e-11h) having raised pressing surfaces (12a-12h) formed and arranged for engagement with selected portions of said rubber sheet by protruding through corresponding openings (8a) in said supporting plate when said operating button is tilted, the ball (10) of said joint (9) having pins (10a) extending transversely of the vertical axis of said ball and socket joint, and the socket (13) of said joint having grooves (13a) for receiving respective ones of said pins therein when said operating button is tilted, said grooves (13a) being elastic and slightly narrower than the diameter of said pins (10a), said pins and grooves being formed and arranged for urging said operating button back from a tilted position thereof, towards its untilted position.

2. A switch as claimed in claim 1, wherein each of said four faces (11e-11h) has a pair of generally trapezoidal projections (12a-12h) formed and arranged for engagement of a respective pair of portions of said rubber sheet (5) through a similarly shaped pair of openings (8a) in said supporting plate (8), which pair of portions constitutes switch elements of a respective pair of switch means.

3. A switch as claimed in claim 1 or claim 2, wherein is provided a two button push-button type slide switch (S2) for alternatively connecting said switch means to two different pairs of a output connections.

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FIG. 1

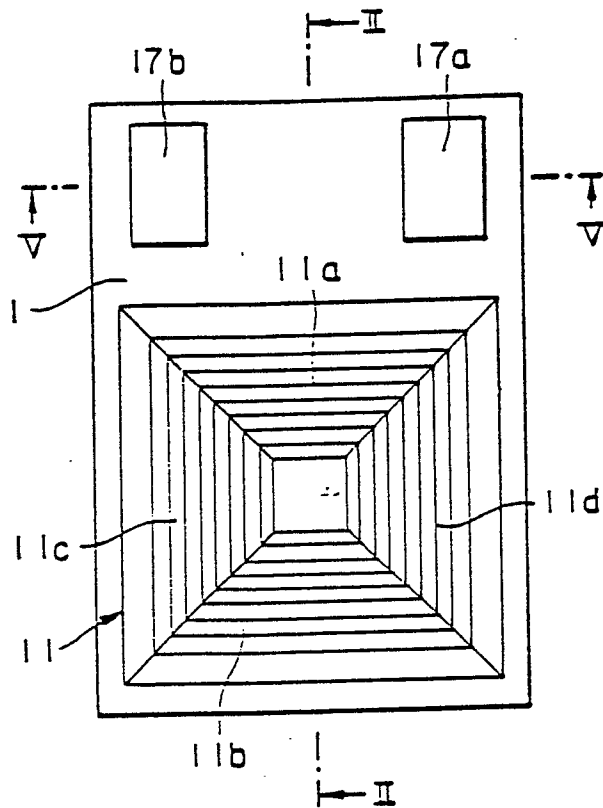
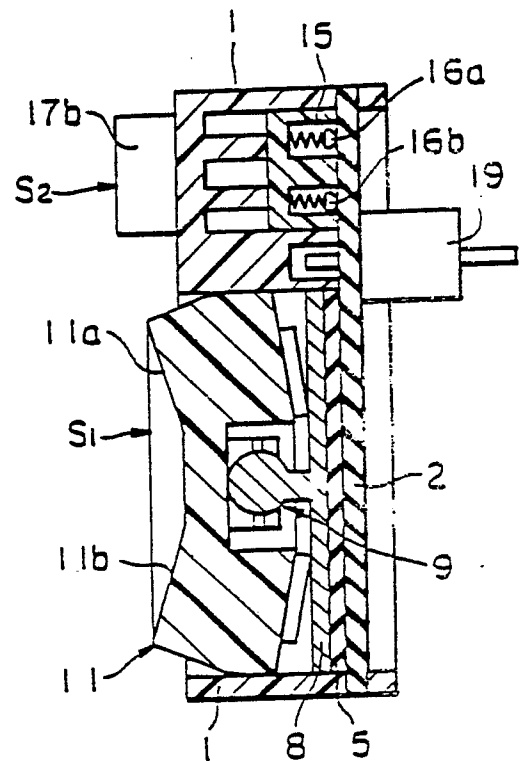


FIG. 2



F. I. G. 3

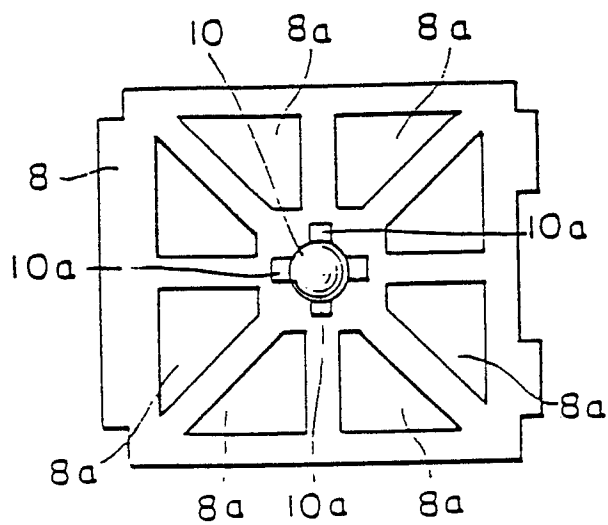


FIG. 4

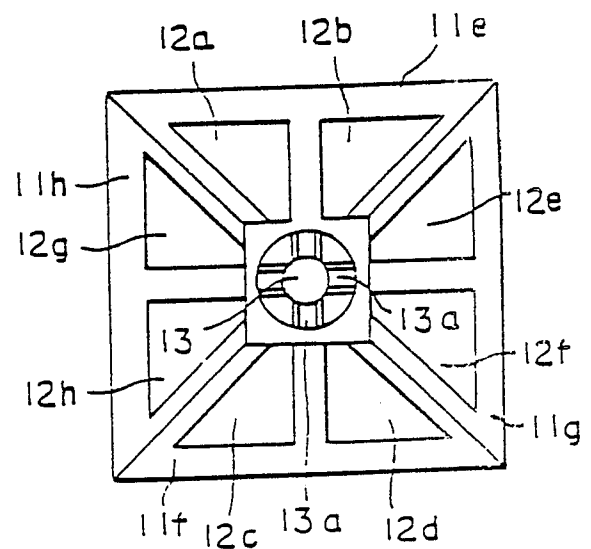


FIG. 5

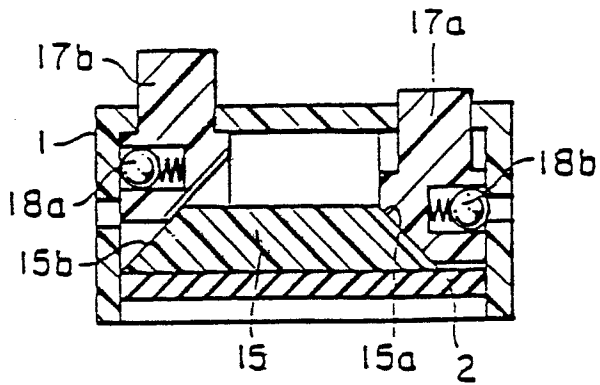


FIG. 6

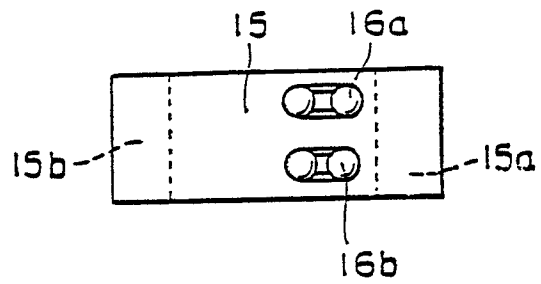


FIG. 7

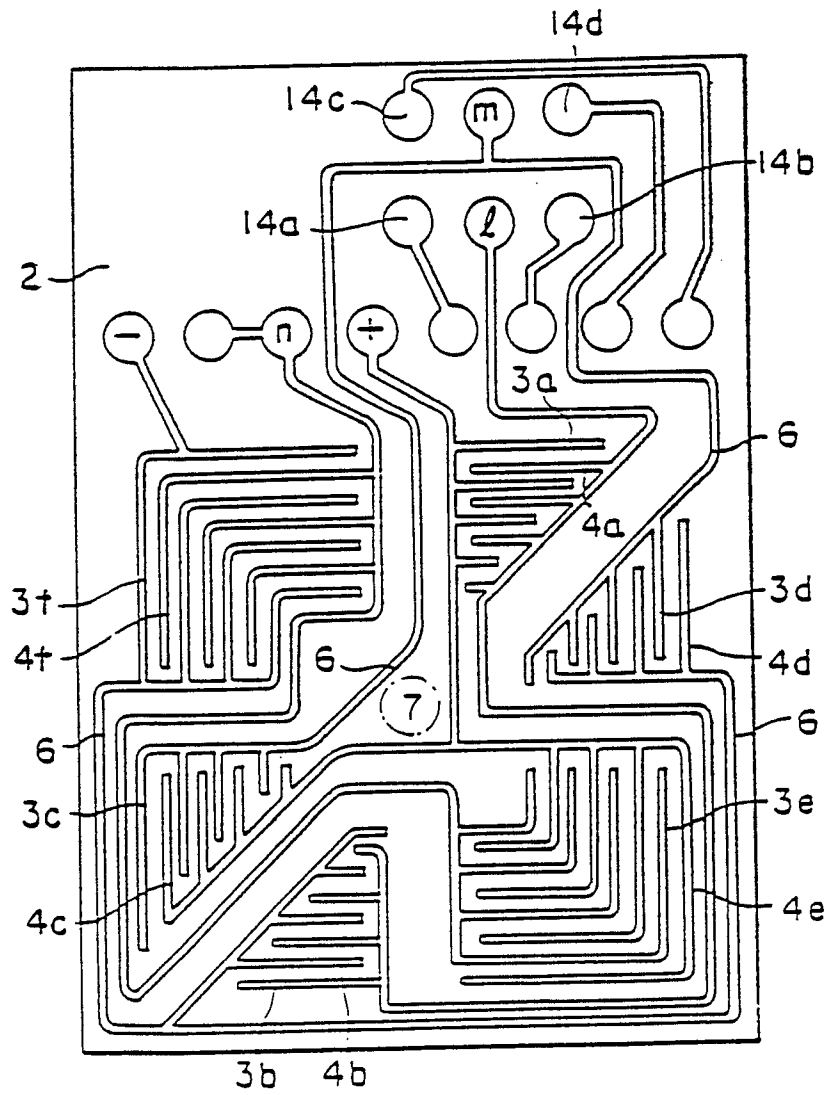


FIG. 8

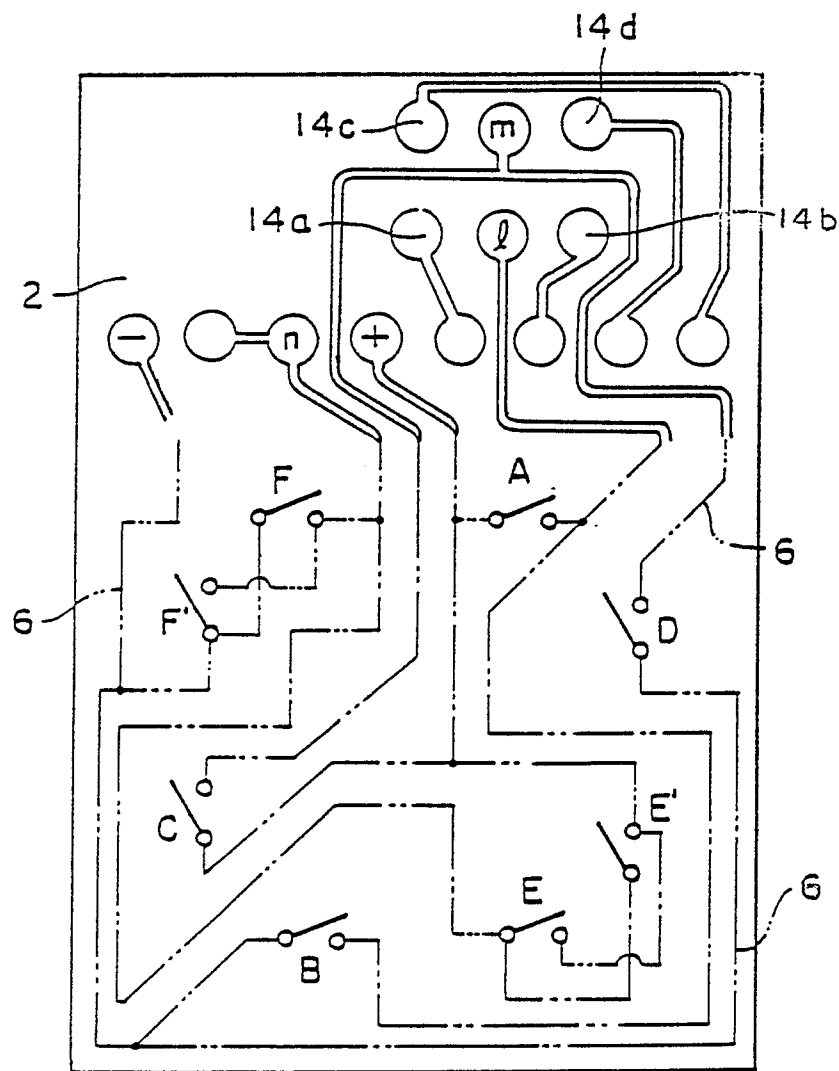


FIG. 9

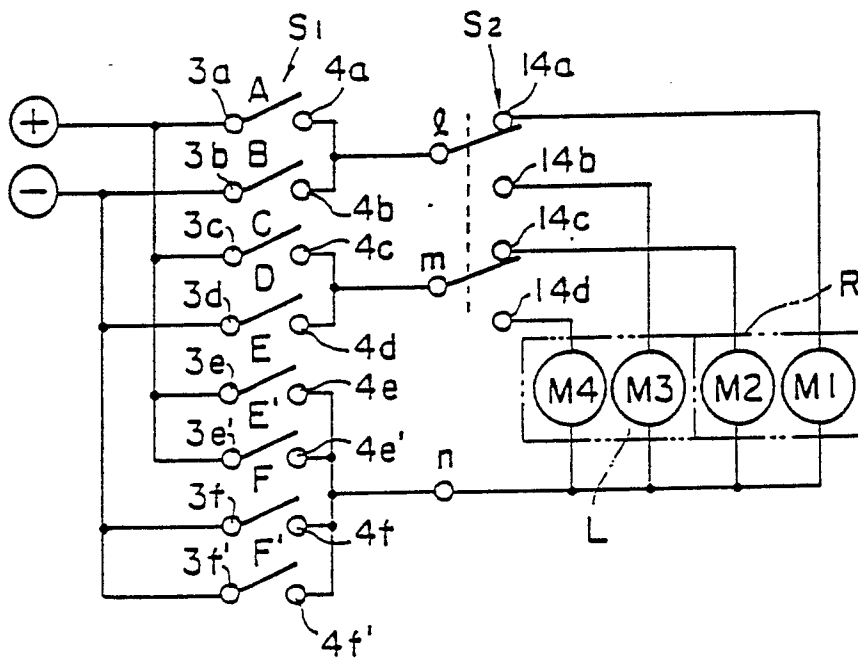


FIG. 10

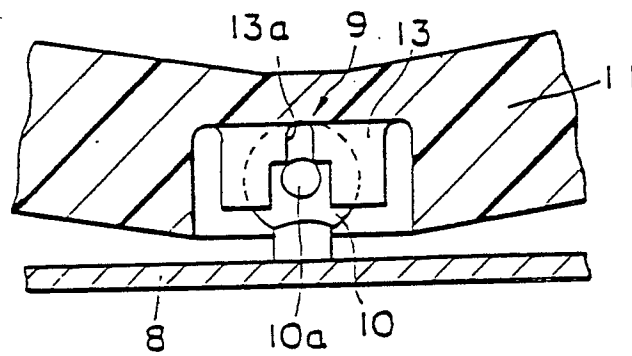


FIG. 11

