

United States Patent

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[54] **CONTACTLESS PUSH-BUTTON TYPE SWITCHING APPARATUS**

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[58] Field of Search.....338/32 R; 324/45, 46;
323/94 H; 335/1

[56]

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[57]

ABSTRACT

A contactless push-button type switching apparatus comprised of a box type base with the opening facing upward, a push-button cap which caps the box type base so as to cover the opening, a closed magnetic path including an elastic yoke which is provided in the base to retain the push-button cap at the home position and at least one galvano-magnetro effect device which is arranged in the magnetic path so that the density of magnetic flux applied to the galvano-magnetro effect device varies with bending of the elastic yoke when the push-button cap is pressed down.

8 Claims, 4 Drawing Figures

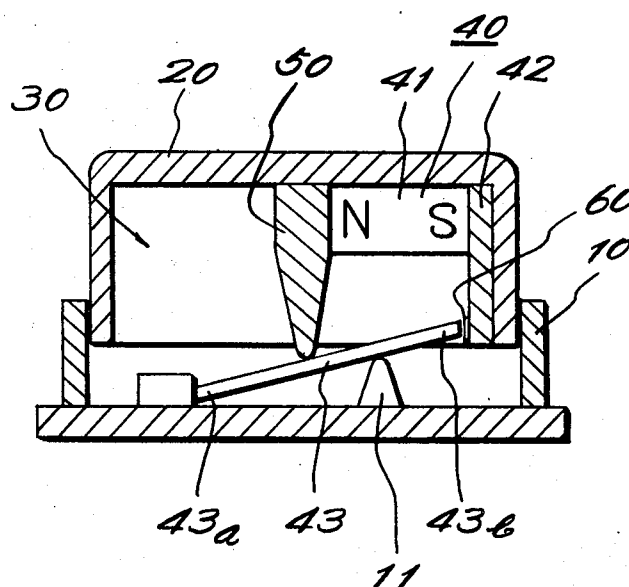


FIG. 1

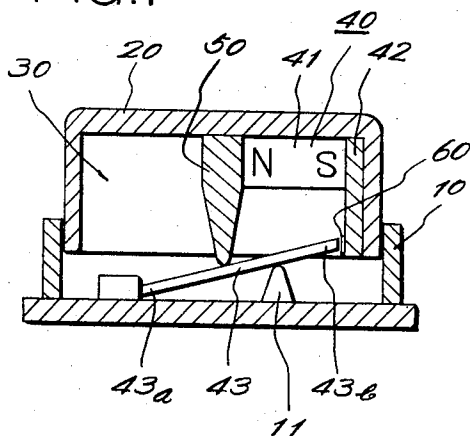


FIG. 2

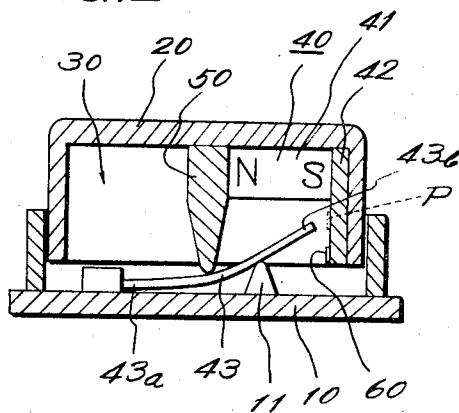


FIG. 3

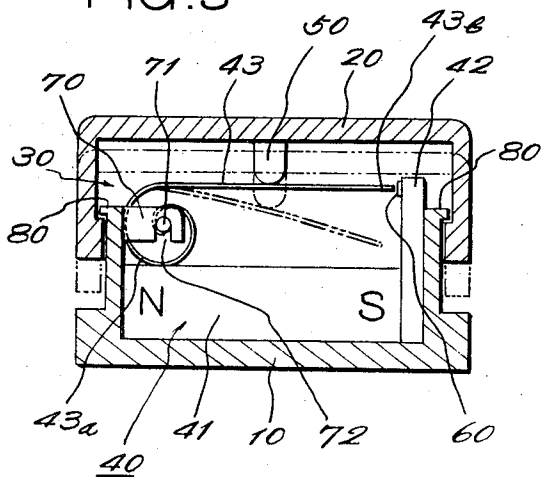
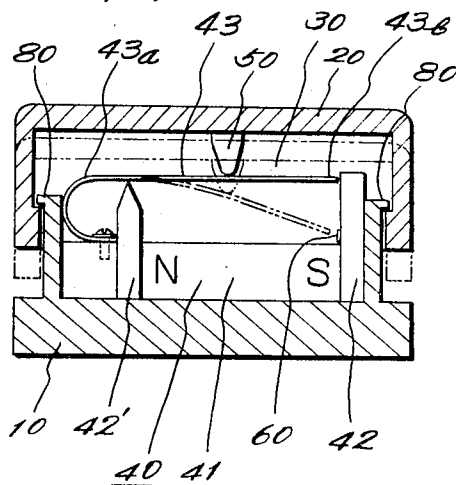


FIG. 4



CONTACTLESS PUSH-BUTTON TYPE SWITCHING APPARATUS

BACKGROUND OF THE INVENTION

Conventional contact push-button type switching apparatuses have suffered from deficiencies such as poor contact due to wear of contacts and generation of chattering noise in contacting. Furthermore, since conventional apparatuses require a separate resetting means such as, for example, a spring, they are disadvantageous in the point that they require additional parts for each separate resetting means and extra cost and manpower for production result.

The present invention provides a contactless push-button type switching apparatus which eliminates the deficiency mentioned above.

SUMMARY

The present invention provides a contactless push-button type switching apparatus comprised of a box type base made of non-magnetic material with an opening facing upward, a push-button cap made of non-magnetic material which slides on to cap the base, a magnetic or non-magnetic projection which is provided at the inside top of the push-button cap toward the base, a magnetic path which is provided in the internal chamber formed by the base and push-button cap and at least one galvano-magnetro effect device such as, for example, a Hall effect device or magnetro-resistance device, which is provided in the magnetic path, wherein the magnetic path is constructed so that part of the magnetic path which is made a spring yoke contacts the lower end of the projection provided at the inside top of the push-button cap and the push-button cap is biased at the home position by the spring yoke one end of which is made free, and the galvano-magnetro effect device is arranged at a position of the magnetic path so that the density of magnetic flux to which the galvano-magnetro effect device is exposed varies when the spring yoke is pushed down by the push button cap.

BRIEF DESCRIPTION OF DRAWINGS

The present invention is illustrated in detail in the accompanying drawings whereof:

FIG. 1 is a cross-sectional front view of one embodiment of the present invention;

FIG. 2 is a cross-sectional front view of the apparatus shown in FIG. 1 when the push-button cap is pushed down; and

FIGS. 3 and 4 are cross-sectional front views of other embodiments of the present invention.

DETAILED DESCRIPTION

Referring to FIGS. 1 and 2, there is shown a contactless push-button type switching apparatus comprised of a box type base 10 made of non-magnetic material with an opening facing upward, a push-button cap 20 which slides on and caps the base so as to cover the opening, a magnetic path arranged in internal chamber 30 formed with said push-button cap 20 and base 10, a projection 50 made of magnetic material provided at the inside top of push-button cap 20 and at least one galvano-magnetro effect device 60 which is provided at said magnetic path 40 and is connected to an external input power supply and external load.

Magnetic path 40 is comprised of magnet 41 pole N of which contacts projection 50 at the inside top of push-button cap, fixed yoke 42 which is coupled to other pole S of the magnet so as to be opposite to projection 50 and spring yoke 43 the base portion 43a of which is fixed at the bottom of base 10 and the free end 43b of which is arranged to closely approach the internal surface of fixed yoke 42.

Projection 50 contacts the central portion of spring yoke 43 and push-button cap 20 is biased at the home position by virtue of the tension of spring yoke 43.

Galvano-magnetro effect device 60 is arranged at the internal surface of fixed yoke 42 so as to be opposite to free end 43b of spring yoke 43 when no pressure is applied onto the spring yoke.

To accurately position spring yoke 43, bearing projection 11 is provided at the bottom of the base and spring yoke 43 is supported by this bearing projection 11 at its underside.

The contactless push-button type switching apparatus of one embodiment of the present invention is as described above.

When push-button cap 20 is pressed down, spring yoke 43 is bent as illustrated in FIG. 2 and free end 43 moves upward. Accordingly, since free end 43 of the spring yoke shifts away from galvano-magnetro effect device 60, the density of magnetic flux applied to galvano-magnetro effect device 60 varies, the output current or voltage of galvano-magnetro effect device 60 which is applied to the load varies, consequently, the load circuit connected to galvano-magnetro effect device 60 functions.

When push-button cap 20 is released, spring yoke 43 straightens and push-button cap 20 is reset to the home position by the spring yoke. Accordingly, the magnetic flux is concentrated on galvano-magnetro effect device 60 by spring yoke 43 and the load circuit is restored.

Hereupon galvano-magnetro effect device 60 can be arranged at position P shown with a broken line in FIG. 2 so that the magnetic flux is concentrated when button cap 20 is pressed down, or two galvano-magnetro effect devices can be arranged at positions P as indicated with a broken line and that indicated by solid line in FIG. 2 so as to alternately concentrate the magnetic flux on respective galvano-magnetro effect devices when push-button cap 20 is pressed down and released.

In this embodiment according to the present invention, base 10 can be used as the push-button cap by reversing the switching apparatus.

In case of the switching apparatus according to this embodiment, bearing projection 11 can be provided between projection 50 and base portion 43a of spring yoke 43. In this case, free end 43b of spring yoke 43 lowers when push-button cap 20 is pressed down; accordingly, if free end 43b of spring yoke 43 is separated downward from the lower end of fixed yoke 42 by pressing down push-button cap 20, the density of magnetic flux flowing in magnetic path 40 varies.

In this case, galvano-magnetro effect device 60 can be inserted into a desired position, for example, at the coupled portion of fixed yoke 42 and magnet 41.

The contactless push-button type switching apparatus according to the present invention is as described above and is advantageous as follows:

The switching apparatus requires no resetting means because spring yoke 43 is used as the biasing means for push-button cap 20; accordingly, the number of parts to be used can be decreased and manpower and cost of production can be reduced.

Because it is provided with no contact, the switching apparatus according to the present invention can be free from generation of chattering noise and poor contact due to wearing of the contact. Thus it can be used for a long period of time.

The switching apparatus shown in FIG. 3 is comprised of base 10 on which magnet 41 is fixed, fixed yoke 42 directly coupled to one end of the magnet, namely magnetic pole S, and spring yoke 43 magnetically coupled to magnet 41 on the N pole.

Base portion 43a of spring yoke 43 is a coil and spring yoke 43 turns and returns upon expansion and constriction of this coiled portion.

Coiled portion 43a of spring yoke 43 is supported by bearing frame 70. For example, the center of coiled portion 43a is secured at shaft 71 both ends of which are inserted into vertically long holes 72.

In this embodiment, accordingly, coiled portion 43a of spring yoke 43 is forced to contact magnet 41 in reference to shaft 71 which remains at the upper limit position of the long hole when push-button cap 20 is released, thus maintaining magnetic connection. On the contrary, when push-button cap 20 is pressed down, shaft 70 lowers in long hole 72 to cause coiled portion 43a of the spring yoke to contact the magnet, thus also maintaining magnetic connection.

FIG. 4 illustrates a contactless push-button type switching apparatus comprised of magnet 41 fixed on base 10, a pair of fixed yokes 42 and 42' which in the same direction project from opposite ends of magnet 41 each one being fixed to a magnetic pole of magnet 41, and spring yoke 43 which is extended so that free end 43b approaches yoke 42 in reference to the end of yoke 42' of said fixed yoke.

In this embodiment, one end portion of spring yoke 43 is U-shaped and base portion 43a is fixed to the outside of fixed yoke 42'. Accordingly this type of the switching apparatus has the simplest construction.

The switching apparatus shown in FIGS. 3 and 4 is advantageous in the point that projection 50 can be formed integral with cap 20 whereby it can be made at the same time push-button cap 20 is formed because projection 50 can be made of non-magnetic material.

In any of the above embodiments, it is desirable to provide stoppers 80 as shown in FIGS. 3 and 4 to determine the upward limit position of the push-button cap.

In case of the switching apparatus shown in FIGS. 3 and 4, galvano-magnetro effect device 60 is generally provided at fixed yoke 42 opposite to free end 43b of spring yoke 43; however spring yoke 43 can be positioned above the end of fixed yoke 42 when push-button cap 20 is released, by shortening the length of fixed yoke 42. In this case, therefore, galvano-magnetro effect device 60 can be inserted into a desired position in the magnetic path. Furthermore, galvano-magnetro effect device 60 can be provided at the upper portion of fixed yoke 42 as shown in FIG. 3 or at the lower portion as shown in FIG. 4.

What is claimed is:

1. A contactless push-button type switching apparatus comprised of

- a. a base made of non-magnetic material and having an opening facing upward;
- b. a push-button cap made of non-magnetic material which slides to cap the base so as to cover the opening;
- c. projection means extending downwardly towards the base from the inside of the push-button cap;
- d. a magnetic path comprising a magnet, a spring yoke having a free end and a fixed end which spring yoke free end is arranged to closely approach a fixed yoke in contact with said magnet and said spring yoke contacting the lower portion of the projection means and is arranged so that it remains at a home position when the push-button cap is not pressed and so that its free end moves when the push-button is pressed down; and
- e. at least one galvano-magnetro effect device arranged in the magnetic path so that the density of magnetic flux to which said device is exposed varies with movement of the spring yoke.

2. A contactless push-button type switching apparatus, according to claim 1, wherein the projection means is made of magnetic material and forms part of the magnetic path.

3. A contactless push-button type switching apparatus, according to claim 2, wherein the magnet is fixed at the inside top of the push-button cap and wherein one magnetic pole of said magnet is coupled to the projection and the other magnetic pole is coupled to a fixed yoke, and the base portion of the spring yoke is fixed to said base in its opening so that the free end of said spring yoke can approach said fixed yoke.

4. A contactless push-button type switching apparatus, according to claim 1, wherein a fixed yoke is coupled to one magnetic pole of the magnet and a free end of the spring yoke is arranged to closely approach the internal surface of the fixed yoke.

5. A contactless push-button type switching apparatus, according to claim 4, wherein two galvano-magnetro effect devices are arranged at the internal surface of the fixed yoke so that one of said devices is positioned to be opposite to the free end of the spring yoke when the push-button cap is released and the other of said devices is positioned to be opposite to the free end of the spring yoke when the push-button cap is pressed down.

6. A contactless push-button type switching apparatus, according to claim 4, wherein the magnet is fixed in said base, and the base portion of the spring yoke is magnetically connected to the other magnetic pole of the magnet.

7. A contactless push-button type switching apparatus, according to claim 4, wherein the base portion of the spring yoke is coiled.

8. A contactless push-button type switching apparatus, according to claim 4, wherein the magnet is fixed in said base, a pair of fixed yokes are arranged on opposite sides of the magnetic poles of the magnet, and one of said fixed yokes serves as a fulcrum for the spring yoke and contacts the spring yoke, the free end of said spring yoke being positioned to closely approach the other fixed yoke.