

Masuda et al.

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

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[58] **Field of Search** ...338/32; 324/45, 46; 323/94 H;
317/235 H; 335/1; 307/309

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[57] **ABSTRACT**

A push-button type switching apparatus is provided comprised of a base having a concave space at the center and guide holes at both sides of the concave space, a push-button cap which caps said base, a magnetic path, which is arranged in the concave space of the base, and a galvano-magnetron effect device which is positioned in said magnetic path. The magnetic path is formed with a U-shaped magnetic frame, both ends of which project upward and a moving yoke which turns around one end of the magnetic frame as the fulcrum. The push-button cap is provided with guide bars which vertically slide in the guide holes and an actuating means which causes the moving yoke to vary the density of magnetic flux applied to the galvano-magnetron effect device.

8 Claims, 8 Drawing Figures

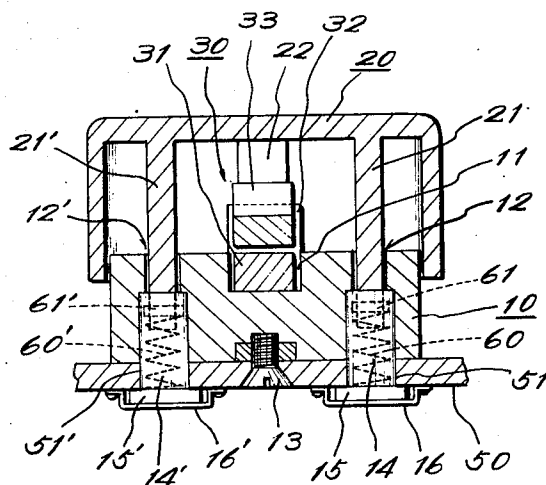


FIG. 1

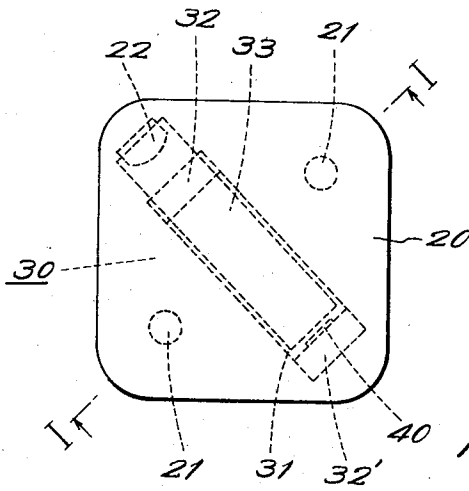


FIG. 3

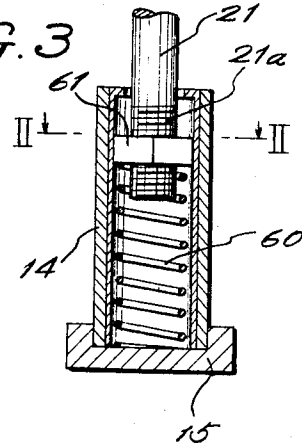


FIG. 4

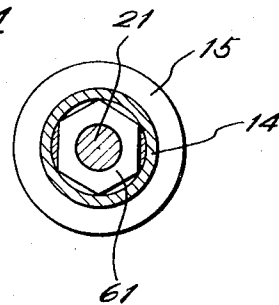


FIG. 2

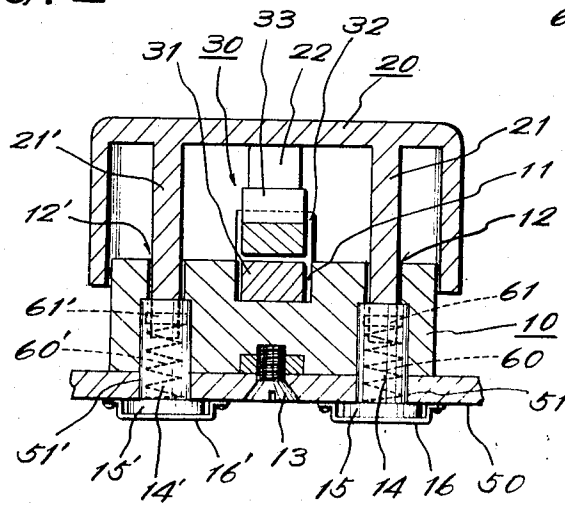


FIG. 5

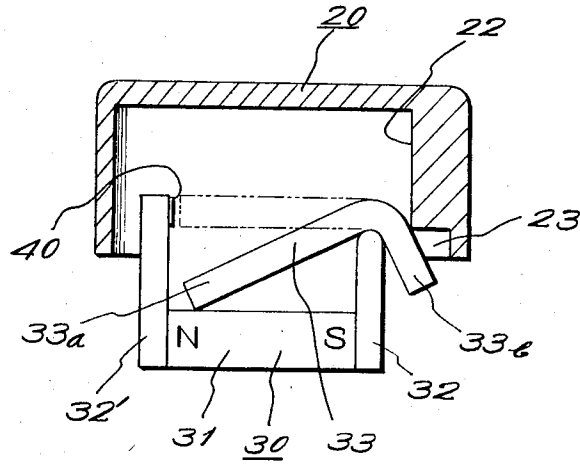


FIG. 6

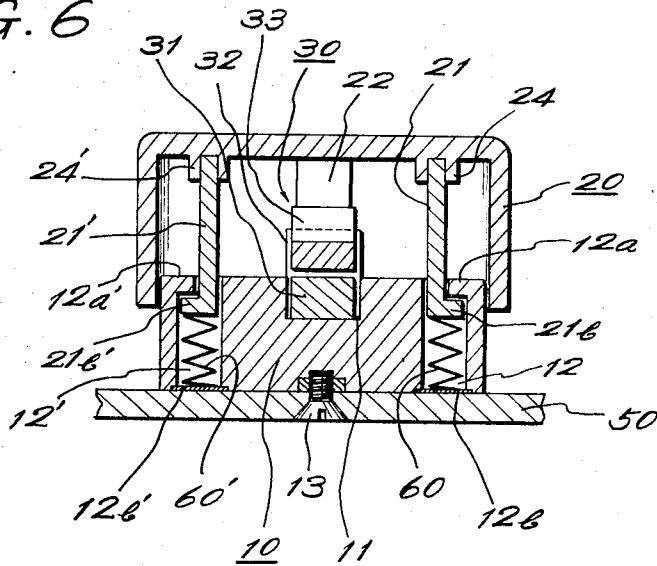


FIG. 7

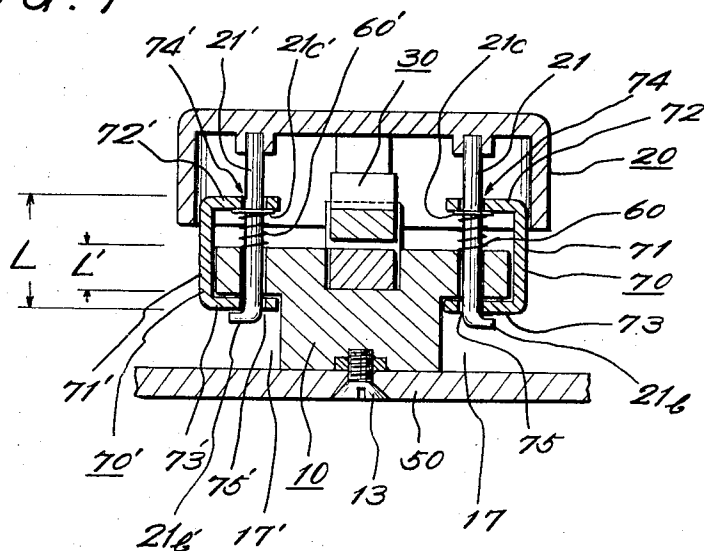
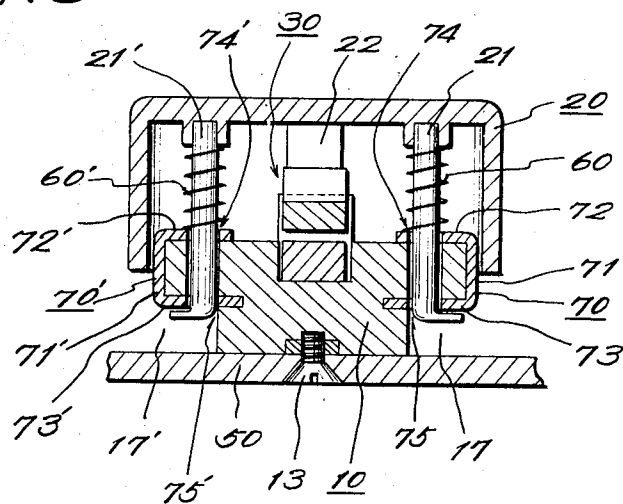


FIG. 8



PUSH-BUTTON TYPE SWITCHING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a contactless switching apparatus which employs a galvano-magnetro effect device such as, for example, a Hall effect device or a magneto-resistance device.

Conventional switching apparatus of this kind are comprised of a moving yoke which turns on a U-shaped magnetic frame with the free end of the yoke as the fulcrum and a galvano-magnetro effect device, which is provided at the internal surface of the other yoke of the magnetic frame opposite to the moving end of the yoke. The density of magnetic flux applied to the galvano-magnetro effect device is varied by approaching and separating the moving end of the moving yoke to and from the galvano-magnetro effect device, which occurs during movement of the moving yoke.

In the conventional switching apparatus an actuating lever is connected to the external end of the moving yoke opposite to the moving end as the actuating means to move the yoke. Accordingly, such switching apparatus is deficient because if the apparatus is required to be compact, it is difficult or troublesome to attach the actuating means and, in addition, the operation of the switching apparatus is inconvenient because of the compact size of the actuating means.

The present invention provides a switching apparatus which eliminates this deficiency. It can be produced at low cost with simple construction.

SUMMARY

The present invention provides a push-button type switching apparatus comprised of a non-magnetic base, at the center of which is a long concavity with two vertical guide holes at both sides, a non-magnetic push-button cap which slides to cap said base and which has guide bars that are located at the inside top of the push-button cap so as to vertically slide in the guide holes and an actuating projection that is provided at the internal surface opposite to one lengthwise end of the long concavity, a resetting spring associated with the guide bars to keep the pushbutton cap at the home position under normal conditions or whenever the push-button cap is not pressed, a magnetic path arranged in the long concavity of the base, a galvano-magnetro effect device which is positioned in the magnetic path, and an input power supply and load circuit which are connected to the galvano-magnetro effect device. The magnetic path is composed of a magnet which is fixed in the long concavity so that both poles of the magnet are positioned respectively at both lengthwise ends of the long concavity, a pair of fixed yokes which are arranged in parallel at both pole ends of the magnet so that said fixed yokes are projected from the base and a L-shaped moving yoke, the internal moving end of which approaches the oppositely positioned fixed yoke (in reference to one free end of a fixed yoke serving as a fulcrum) and the external end of which is bent downward from the support point. The galvano-magnetro effect device is arranged in the magnetic path so that the density of magnetic flux to which the galvano-magnetro effect device is exposed varies when the moving end of said moving yoke turns and the

actuating projection of the push-button cap presses and tilts the external end of the moving end toward the external surface of a fixed yoke when the push-button cap is pressed down by making the actuating projection of the push-button cap contact the external end of the moving yoke.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a plan view of a push-button type switching apparatus of the present invention;

FIG. 2 is a cross-sectional front view of the switching apparatus along the I—I line in FIG. 1;

FIG. 3 is a cross-sectional front view of the guide cylinder of the switching apparatus shown in FIG. 2;

FIG. 4 is a lateral-sectional top view of the guide cylinder along the II—II line in FIG. 3;

FIG. 5 is an explanatory side view illustrating the action of the switching apparatus according to the present invention; and

FIG. 6 to 8 are cross-sectional front views of other embodiments of the present invention.

DETAILED DESCRIPTION

Referring to FIGS. 1 to 5, there is shown a push-button type switching apparatus comprised of a non-magnetic base 10 which is provided with long narrow and shallow concavity 11 in the direction of a diagonal line at the center of the top and vertical guide holes 12 and 12' that are positioned at both sides of said concavity, a non-magnetic push-button cap 20 which slidably caps said base, a magnetic path 30 which is arranged on the base, and a galvano-magnetro effect device 40 which is inserted in magnetic path 30.

Base 10 is fixed on base plate 50 with screw 13 and the base plate has holes 51 and 51' which are aligned with guide holes 12 and 12'. Guide bars 21 and 21', which are slid into guide holes 12 and 12', are extended from the inside top of push-button cap 20 toward the base plate. Actuating projection 22 is provided at the internal surface of the push-button cap opposite to one lengthwise end of concavity 11.

Actuating projection 22 is provided at a given position determined in reference to the opening of push-button cap 20 and, accordingly, space 23 is formed between actuating projection 22 and the opening as shown in FIG. 5.

The length of guide bars 21 and 21' is determined so that these guide bars do not exceed the distance to base plate 50 when push-button cap is pressed down; therefore, the guide bars rest at the position at the top of the downward stroke illustrated with dotted lines in FIG. 2 when the push-button cap is not pressed down.

Guide cylinders 14 and 14', which enter into guide holes 12 and 12', are mounted in holes 51 and 51' of base plate 50; stoppers 15 and 15', which are used to couple the guide cylinders to base plate 50, are attached to the lower ends of the guide cylinders; and fixing means 16 and 16', which retain the guide cylinders, are provided at the underside of base plate 50.

Guide cylinders 61', 14 and 14' house guide rings 61 and 61' which are mounted to the lower ends of guide bars 21 and 21'. Spring coils 60 and 60' serve as the

resetting means which push up the guide rings; thus the push-button cap is kept at the home position by spring coils 60 and 60' under normal conditions or whenever the push-button cap is released.

It is desirable to thread the lower ends of guide bars 21 and 21' as shown in FIG. 3 and to mount threaded guide rings 61 and 61' as nuts onto these threaded lower ends. If the lower ends are threaded, it is possible to adjust the home position of the push-button cap by vertically shifting the position of guide rings 61 and 61'.

If guide rings 61 and 61' are threaded, it is desirable to restrain guide rings 61 and 61' so that they cannot be rotated in guide cylinders 14 and 14'; thus, the upward limit of the position of the push-button cap can be adjusted by turning guide cylinders 14 and 14' in guide holes 12 and 12' and, accordingly, the vertical stroke of the push-button cap can be adjusted after the switching apparatus has been assembled.

Magnetic path 30 is comprised of a U-shaped magnetic frame composed of magnet 31 which is fixed in the long concavity so that the N and S pole ends of the magnet are respectively positioned at both lengthwise of long concavity 11, a pair of parallel yokes 32 and 32' with upwardly projected free ends which are fixed to both pole end faces of the magnet and moving yoke 33, which moves at the free end of yoke 32 located at the side of actuating projection 22 of the push-button cap, as the fulcrum.

Moving yoke 33 is L-shaped and has longer and shorter portions. This yoke is mounted on yoke 32 so that end 33a of the longer portion can approach the internal surface of yoke 32'. The moving yoke is supported at its internal surface of the bent portion by the free end of yoke 32; therefore, it is desirable to round the free end of yoke 32 as illustrated in FIG. 5 and to use a material with high wear resistance for the moving yoke and for yoke 32.

End 33b of the shorter portion of moving yoke 33 is projected outside yoke 32 and is positioned in space 23 of push-button cap 20; accordingly, the lower end of actuating projection 22 lightly contacts the upper surface of the end of the shorter portion of moving yoke 33 or remains slightly above the end of the shorter portion of moving yoke 33.

Galvano-magnetron effect device 40 is provided at the internal surface of yoke 32' opposite to end 33a of moving yoke 33 so that end 33a of the longer portion of moving yoke 33 can approach device 40 when moving yoke 33 is turned up.

Galvano-magnetron effect device 40 is connected to a load circuit (not shown) which operates when the output voltage or current of galvano-magnetron effect device 40 varies according to variation of the density of magnetic flux applied to said device 40 and to an input power source (not shown) which supplies the power to the galvano-magnetron effect device.

The push-button type switching apparatus is as described above. When push-button cap 20 is released, the longer portion of moving yoke 33 is lowered by its weight and end 33a of the longer portion moves away from the galvano-magnetron effect device 40 as shown by a solid line in FIG. 5. When push-button cap 20 is pressed down, end 33a of the shorter portion of moving yoke 33 is pushed by actuating projection 22 of the push-button cap and end 33a of the longer portion ap-

proaches galvano-magnetron effect device 40 as shown by a broken line in FIG. 5.

Since the magnetic flux is concentrated onto galvano-magnetron effect device 40 when push-button cap 20 is pressed down, the load circuit connected to device 40 is actuated.

Galvano-magnetron effect device 40 can be located at a lower position on yoke 32' so that the magnetic flux is concentrated onto device 40 when the longer portion of moving yoke 33 is lowered or, two galvano-magnetron effect devices 40 can be respectively provided at upper and lower positions so that the magnetic flux is concentrated onto one of said devices 40 when the longer portion of moving yoke 33 rises and lowers.

Furthermore, galvano-magnetron effect device 40 can be located at any desired position where device 40 can receive the magnetic flux flowing in the magnetic path, because the density of magnetic flux in the magnetic path varies with the upward movement of moving yoke 33 provided that yoke 32' is made short so that end 33a of the longer portion of moving yoke 33 moves away from yoke 32' when the longer portion of moving yoke 33 rises.

The push-button type switching apparatus according to the present invention has the following advantages.

Magnetic path 30 can be completely isolated from an external magnetic field and can be protected from external shock because the magnetic path is covered with non-magnetic base 10 and push-button cap 20. Since guide bars 21 can be made so as not to project downward from base plate 50, the guide bars can be protected from damage during production and use and the space under base plate 50 can be effectively utilized. The operation is easy because the pressing area of push-button cap can be widened even though the magnetic path is small. Moving yoke 33 can move smoothly because push-button cap 20 is accurately moved in the vertical direction by the guide bars.

FIG. 6 illustrates a push-button type switching apparatus provided with resetting springs 60 and 60' which are housed in guide holes 12 and 12'.

In this embodiment, hooks 12a and 12a' are provided at upper openings of guide holes 12 and 12' and the lower ends of guide bars 21 and 21' are made as stoppers 21b and 21b', which are L-shaped. The home position of push-button cap 20 is controlled by engagement of hooks 12a and 12a' of guide holes 12 and 12' and stoppers 21b and 21b' of guide bars 21 and 21'.

In this embodiment, since guide bars 21 and 21' should be inserted into guide holes 12 and 12' from the underside of base 10, the guide bars are made separately from push-button cap 20. Accordingly, push-button cap 20 is fixed to the upper ends of the guide bars after the guide bars have been projected upward through guide holes 12 and 12'. Therefore, guide bar fixing portions 24 and 24' are provided at the inside top of push-button cap.

Resetting springs 60 and 60' are inserted into guide holes 12 and 12' from the underside of base 10 after guide bars 21 and 21' have been inserted into guide holes. It is desirable to fit block plates 12b and 12b' into the lower openings of guide holes 12 and 12' after inserting resetting springs 60 and 60'.

The switching apparatus of this embodiment of the present invention is advantageous because production

costs can be reduced because the number of parts can be decreased.

FIG. 7 illustrates a push-button type switching apparatus provided with spaces 17 and 17' under guide holes 12 and 12' and U-shaped guide frames 70 and 70' attached to guide bars 21 and 21'.

Space 17 and 17' are formed by cutting off part of base 10 corresponding to the lower portions of guide holes 12 and 12' and lower ends of guide bars 21 and 21' rise and lower in spaces 17 and 17'.

Guide frames 70 and 70' are mounted on base 10 so that central portions 71 and 71' can slide along the external surface of base 10 while length L of central portions 71 and 71' is longer than length L' of guide holes 12 and 12'. At the same time, upper and lower free sides 72, 72', 73 and 73' are extended above and under guide holes 12 and 12' and are provided with apertures 74, 74', 75 and 75' which are aligned with the guide holes.

Said guide bars 21 and 21' pass apertures 74, 74', 75 and 75' of guide frames 70 and 70' and the lower ends of the guide bars are projected into spaces 17 and 17' and are L-shaped to form stoppers 21b and 21b'.

Resetting springs 60 and 60' are respectively mounted between the upper surface of base 10 and upper free sides 72 and 72' on guide bars 21 and 21' and flanges 21c and 21c' which contact the lower surface of upper free sides 72 and 72' of the guide frames are mounted on guide bars 21 and 21' so that the guide bars and guide frames 70 and 70' are pushed by by resetting springs 60 and 60'.

Furthermore, resetting springs 60 and 60' can be provided in spaces 17 and 17' so that the resetting springs push up the lower ends of guide bars 21 and 21' or resetting springs can be respectively attached to guide bars 21 and 21' and guide frames 70 and 70'.

In this embodiment, the switching apparatus is advantageous because guide bars 21 and 21' can properly lower through the guide holes because guide frames 70 and 70' lower along the external surface of base 10. Thus, the switching apparatus can be used for a long period of time without being affected by rapid wearing of guide holes 12 and 12' because guide frames 70 and 70' can be made of a hard material even through base 10 is made of a relatively soft material such as, for example, synthetic resin.

FIG. 8 illustrates a push-button type switching apparatus provided with U-shaped guide frames 70 and 70' which are mounted on the side of base 10.

In this embodiment, guide frames 70 and 70' are fixed to base 10 which is made the same as that of the switching apparatus shown in FIG. 7 and the tip ends of lower free sides 73 and 73' of the guide frames are buried in base 10.

Resetting springs 60 and 60' are mounted on guide bars 21 and 21' between the upper surface of upper free sides of the guide frames and the inside top of push-button cap 20 and keep the push-button cap at the home position.

Also in this embodiment, resetting springs 60 and 60' can be housed in spaces 17 and 17'.

The switching apparatus of this embodiment of the present invention is advantageous in the same manner as the switching apparatus shown in FIG. 7. In this embodiment, the switching apparatus is advantageous

because guide frames 70 and 70' can be used as the reinforcing frames for the base because the guide frames do not slide and therefore the portions of guide holes 12 and 12' of base 10 can be made thin.

What is claimed is:

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

- a. a non-magnetic base having a long narrow concavity at the center of an upper surface and vertical guide holes at both sides of said concavity;
- b. A non-magnetic push-button cap which slidably caps the base so as to cover the upper surface of the base, said cap being provided with (1) guide bars having upper ends and lower ends, said guide bars being in fixed association with the inside top of the push-button cap and which freely slide through said guide holes and (2) a projection which is provided at an internal surface opposite to one lengthwise side of the long narrow concavity;
- c. a plurality of resetting means which are associated with the guide bars to retain said push-button cap in home position;
- d. a magnetic path in the long narrow concavity of the base, including a moving yoke actuated by the projection when the push-button cap is pressed down; and
- e. at least one galvano-magnetic effect device arranged in said magnetic path so that the density of magnetic flux varies with motion of the moving yoke.

2. A push-button type switching apparatus according to claim 1, wherein guide cylinders are inserted into said guide holes and resetting springs are housed in the guide cylinders to push up the lower ends of the guide bars.

3. A push-button type switching apparatus according to claim 2, wherein the lower ends of guide bars to be inserted into said guide cylinders are threaded, guide rings are mounted on the threaded portions of the guide bars and the guide rings are pushed up by the resetting springs.

4. A push-button type switching apparatus according to claim 3, wherein the guide cylinders, which restrain the guide rings to prevent turning of the rings in said cylinders, are maintained in the guide holes so as to permit the guide cylinders to rotate in the guide holes.

5. A push-button type switching apparatus according to claim 1, wherein hooks are positioned at the upper openings of the guide holes, stoppers which engage said hooks when the push-button cap is released are provided at the lower ends of the guide bars and resetting springs are housed in the guide holes to push up the guide bars.

6. A push-button type switching apparatus according to claim 1, wherein spaces are formed under the guide holes by eliminating portions of the base at its lower end so that the lower ends of the guide bars can project into said spaces.

7. A push-button type switching apparatus according to claim 6, wherein U-shaped guide frames having free sides, the central portions of which are longer than the length of the guide holes, are attached to the base so that said free sides of said guide frames extend above and under the guide holes and the central portions of

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said guide frames lightly contact the sides of the base free sides being provided with apertures which are aligned with the guide holes; the guide bars are inserted through the apertures of the guide frames and the guide holes so that the lower ends of the guide bars are projected into the space below; and resetting springs which simultaneously actuate the guide frames and guide bars are associated with said guide frames and guide bars.

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8. A push-button type switching apparatus according to claim 7, wherein the U-shaped guide frames are mounted to the sides of the base corresponding to the guide holes, and both free sides of the guide frames are forced to contact the upper and lower openings of the guide holes so that the apertures of the guide frames are aligned with the guide holes.

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