United States Patent

[11] 3,614,346

[72] Inventors **Bernard Vincent Gudaitis**
Wilkes-Barre;
Winfield Warren Loose, Harrisburg, both of Pa.

[21] Appl. No. **2,291**
[22] Filed **Jan. 12, 1970**
[45] Patented **Oct. 19, 1971**

[73] Assignee **AMP Incorporated**
Harrisburg, Pa.

---

[54] **RECTILINEARLY MOVABLE SWITCH ASSEMBLY WITH PARTICULAR PIVOTAL ACTUATOR AND FLANGE MEANS**
8 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** ..... **200/16 R,** 200/153 K, 200/166 SD, 200/172 R, 74/543
[51] **Int. Cl.** **H01h 21/24,** H01h 21/68
[50] **Field of Search** ..... 200/16 R, 153 K, 166 PC, 166 SD, 76, 172 R, 166 BH, 168 G; 74/543

[56] **References Cited**

UNITED STATES PATENTS

1,853,358	4/1932	Hubbell, Jr.	200/165
2,508,692	5/1950	Souza	200/16
2,742,548	4/1956	Cole	200/168 G
3,146,330	8/1964	Miller	200/172
3,299,227	1/1967	Schaad et al.	200/16
3,500,003	3/1970	Schink	200/16
3,525,828	8/1970	Eckhart et al.	200/16

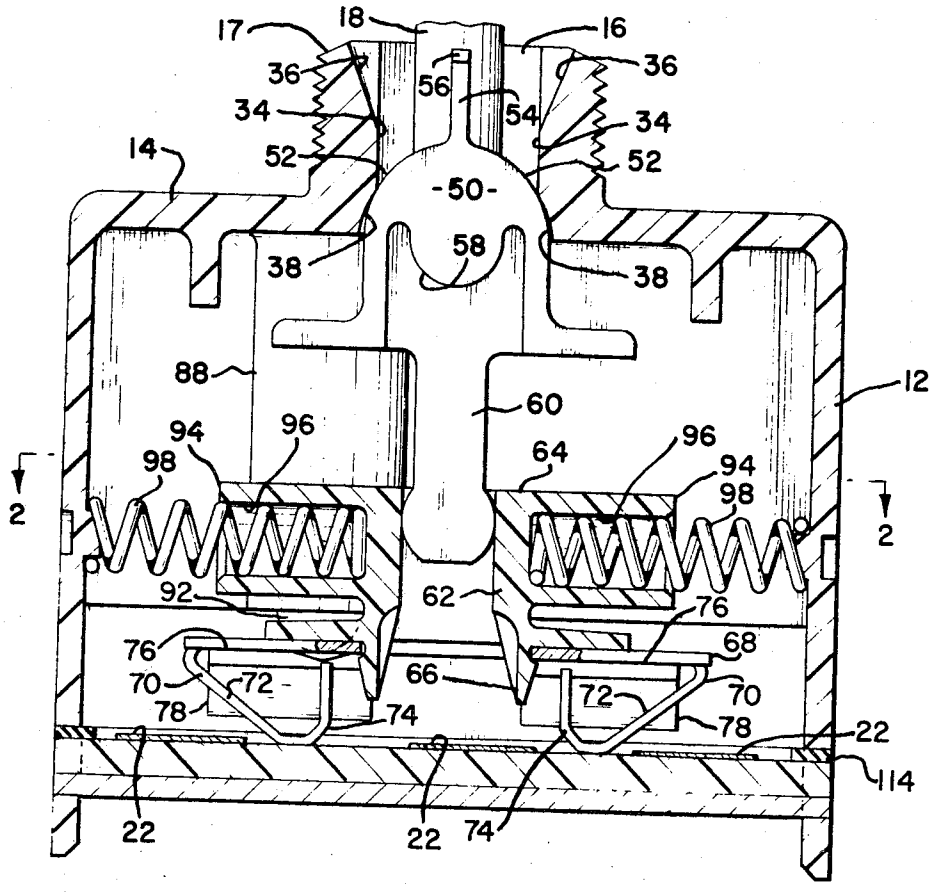
FOREIGN PATENTS

1,259,436	1/1968	Germany	200/16
1,287,185	1/1969	Germany	200/166 (CPC)

Primary Examiner—David Smith, Jr.
Assistant Examiner—Robert A. Vanderhye
Attorneys—Curtis, Morris and Safford, William J. Keating, Ronald D. Grefe, William Hintze, Adrian J. La Rue, Frederick W. Raring, Jay L. Seitchik and John P. Vandenburg

---

ABSTRACT: Disclosed is an electrical actuator of the toggle switch variety having contained therein electrical contacts which are reciprocably movable and adapted to slidingly engage the surface of a printed circuit board having circuitry thereon. The circuit board is clamped to the base of the housing, and upon movement of the actuator, the contacts will slidingly engage various circuitry on the printed circuit board surface. The actuator has two pairs of shoulder portions engaging the casing, which restrain the actuator from undesired movement while pivotally mounting it.



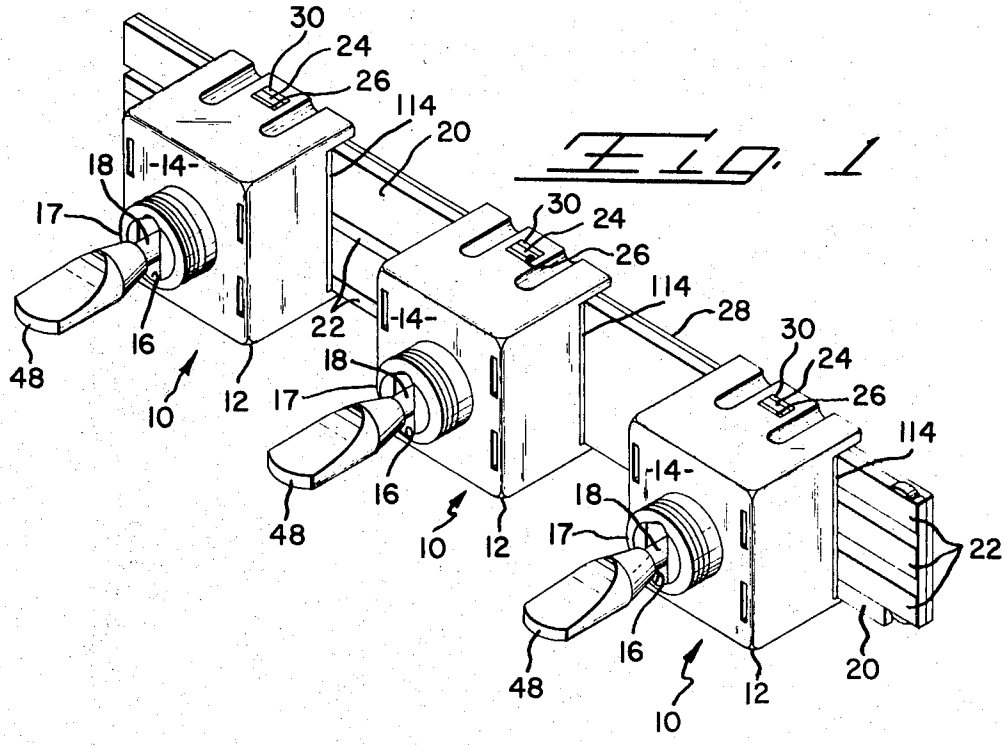

30
24
26
114
20
18
-14-
17
48
16
10
12
22
28

FIG. 1

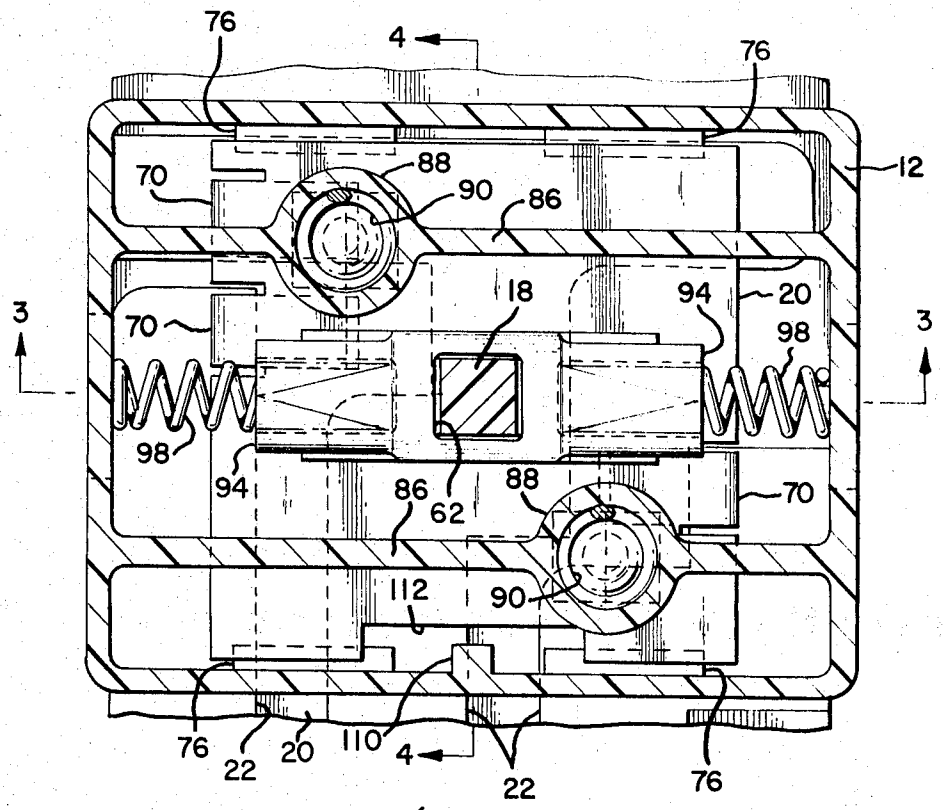

76
4
70
88
90
86
12
18
94
20
98
3
62
112
110
22

FIG. 2

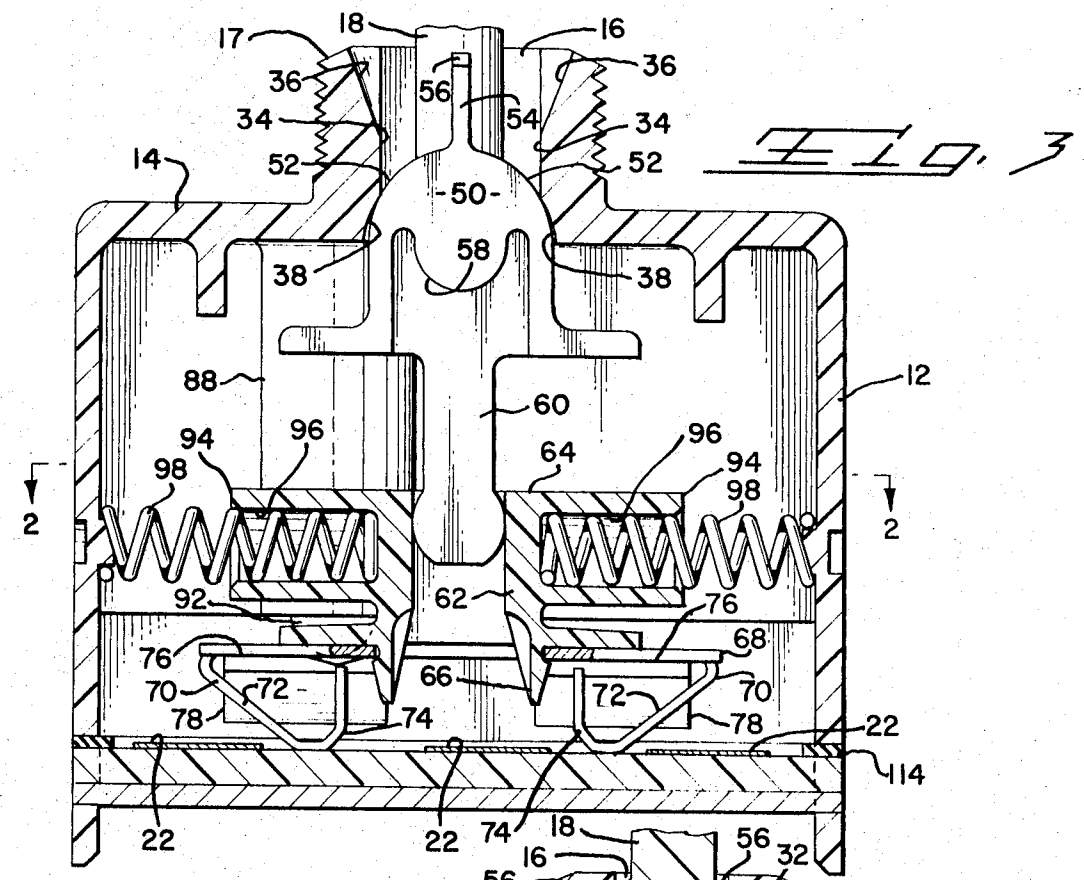

17
18
16
36
36
56
54
34
34
52
52
14
50
38
58
38
88
12
60
94
96
64
96
94
98
98
2
2
92
62
76
76
68
70
72
66
72
70
78
74
78
22
114
22
22
74

Fig. 3

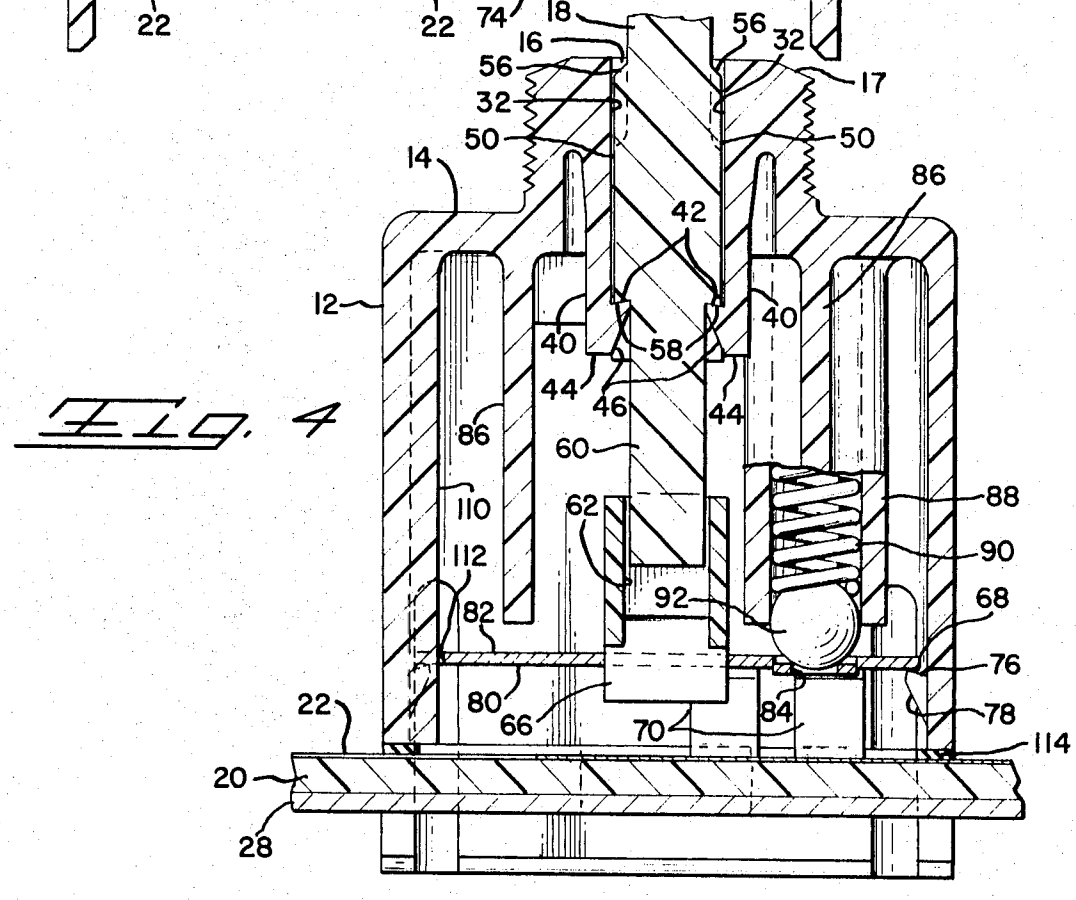

18
56
32
16
17
56
32
50
50
14
86
42
12
40
40
58
44
46
44
86
60
110
62
88
112
90
92
82
68
76
80
66
84
70
78
114
22
20
28

Fig. 4

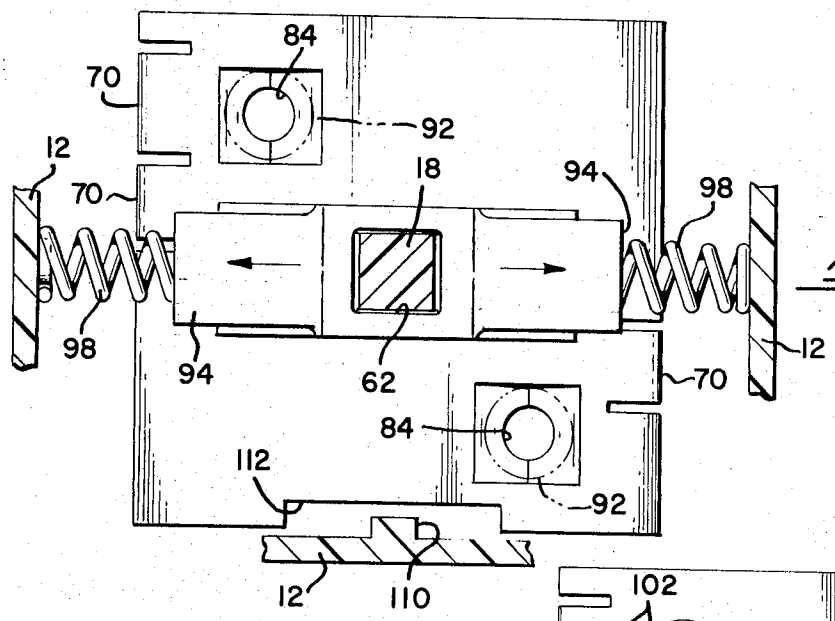


FIG. 5

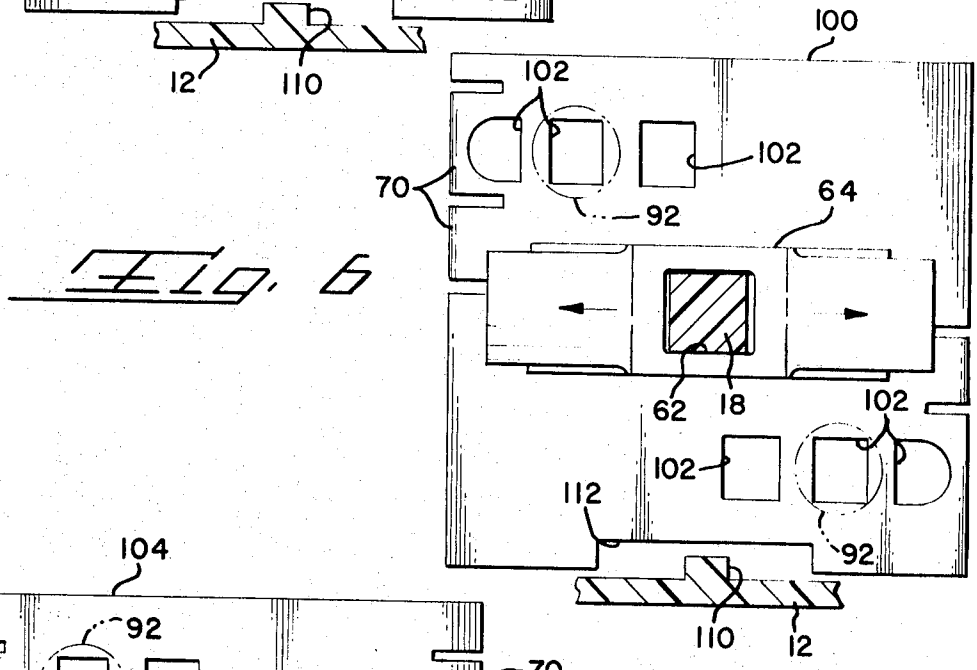


FIG. 6

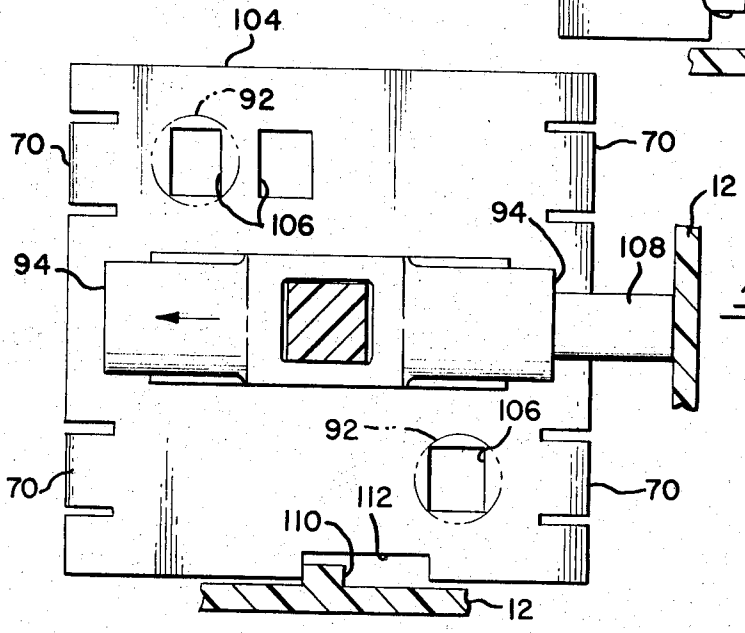


FIG. 7

RECTILINEARLY MOVABLE SWITCH ASSEMBLY WITH PARTICULAR PIVOTAL ACTUATOR AND FLANGE MEANS

BACKGROUND OF THE INVENTION

In the past, various actuators and switch assemblies of the toggle switch variety have adequately satisfied many different modes of applications in the electrical or electronics fields. However, such switches have not kept pace with modern technology in that connections are still made to such switches with the use of wire conductors. With the advent of printed circuit board technology, such switches have become outdated and do not satisfy the needs of modern electrical applications.

OBJECTS OF THE INVENTION

It is therefore an object of the present invention to provide an electrical actuator adaptable to make electrical contact between the various printed circuits on the surface of a printed circuit board.

It is a further object of the invention to provide an electrical actuator to mate in locking engagement with a printed circuit board to form a switch assembly.

It is still a further object of the present invention to provide an electrical actuator and switch assembly whereby the use of external wire conductors and connections are eliminated.

SUMMARY OF THE INVENTION

The above objects of the present invention are achieved by providing a rectangular housing containing a pivotable actuator in engagement with a carriage member having attached thereto a slidable bus bar member. The housing also receives in locking engagement a printed circuit board or the like, with the bus bar having electrical contacts thereon, which slidingly engage the surface of the printed circuit board containing the printed circuitry. Ball and detent means are provided to indicate various switch positions.

BRIEF DESCRIPTIONS OF THE DRAWINGS

FIG. 1 is a perspective view showing three electrical actuators of the instant invention positioned on a printed circuit to comprise a ganged switch assembly;

FIG. 2 is a top section view of one electrical actuator assembly taken along lines 2—2 of FIG. 3;

FIG. 3 is a side section view of an electrical actuator assembly taken along lines 3—3 of FIG. 2;

FIG. 4 is a side section view of an electrical actuator assembly taken along lines 4—4 of FIG. 2;

FIG. 5 shows one embodiment of a bus bar arrangement for three-position use with spring-return to center-off position;

FIG. 6 shows a different embodiment of a bus bar member adapted for three-position use;

FIG. 7 is yet another embodiment of a bus bar adapted for two-position use.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there are shown and described illustrative embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention, but are given for purpose of illustration in order that others skilled in the art may fully understand the invention and the principles thereof, and the manner of applying it in practical use so that they may modify it in various forms each as may be best suited to the condition of a particular use.

With reference to FIG. 1, there is shown three electrical actuators of the present invention as generally indicated by the numeral 10. Each actuator is comprised of a rectangular body 12, a wall 14 having an opening 16 located in projection 17 of

wall 14, the opening 16 containing therein a mechanical actuator member 18. Each rectangular housing has locked to it on a side opposite wall 14, a printed circuit board or the like 20, such board 20 containing printed circuitry 22 on a first surface thereof. The board 20 has projections 24 on the edges thereof, such projections adapted to matingly lock into slots 26 in sidewall of rectangular member 12. For purposes of reinforcing the printed circuit board 20, a reinforcing plate 28, generally of metallic structure, has located thereon projections 30 which are adapted to be received by slots 26 in housing member 12. Protection is thereby afforded to printed circuit board 20 against inadvertent breakage or bending.

Shown in FIGS. 2, 3, 4, and 5, is one embodiment of the invention, which is designed for momentary on, center-off, with spring bias to the off position. FIGS. 3 and 4 show additional section views of the embodiment of FIG. 2. With reference to these figures, the opening 16 has a first two opposed surfaces 32, 32, and a second two opposed surfaces 34, 34. Each surface 34 has an outer end portion 36, which extends from surface 34 at an angle thereto, and is normal to the first two opposed surfaces 32, 32. Located at the other end of each surface 34, are cylindrically relieved inner end portions 38. Integral with projection 17 and extending inwardly thereof, are a pair of opposed flexible retaining fingers 40, each having arcuate lips 42 located thereon. Each retaining finger 40 has in facing relationship, and adjacent the end portion 44 thereof, a flat camming surface 46.

Located at the outer end of actuator 18, is a finger-engaging portion 48, adapted to be engaged by the fingers of a hand of a human operator. Located intermediate the ends of the actuator 18 are a pair of flat parallel faces 50, which are adapted to mate or be in engagement with the first two opposed surfaces 32, 32, respectively. To retain the actuator 18 against outward movement of the housing, and to allow for pivotal movement thereof, a first pair of shoulders 52, 52, which are cylindrical, are provided to matingly engage with cylindrically relieved portions 38, 38. Each parallel face 50 has an outward extension 54, having a beveled surface 56 thereon. The outward extension forms a rib which, upon pivotal movement of actuator 18, will come into engagement with the outer end portions 36 of faces 34. These outer face portions 36 respectively act as stop means to limit the travel of the actuator 18. The beveled surface 56 is provided to facilitate insertion or assembly of the actuator from the interior of wall 14, such beveled surface engaging camming surfaces 46, 46, and forcing the retaining fingers apart, thereby allowing insertion of the actuator 18. Upon full insertion of the actuator 18, the retaining fingers, and specifically arcuate lip portions 42, will snappingly engage with a second pair of shoulder portions 58, 58, located on the actuator 18.

The mechanical actuator 18 has an elongated end portion 60, which is adapted to be received in an apertured portion 62 of carriage member 64. In the preferred embodiment, carriage member 64, as is housing 12, are made of a suitable electrically insulating material, such as nylon or polypropelene. However, as long as mechanical actuator 18 is of a suitable insulating material, the housing 12 and the carriage member 64 need not be made of electrically insulating material. Secured to carriage member 64, by any suitable means, such as a resilient collar member 66 allowing a snap fit, is an electrically conductive bus bar 68. Bus bar 68 has integral therewith a plurality of contact portions 70, which are comprised of cantilevered fingers 72 having curved end portions 74 which end a short distance from bus bar 78. As can be seen in FIGS. 2 and 4, bus bar 68 is carried by and rides on, flanges 76, located on opposite walls of housing 12. To facilitate insertion of the bus bar 68 into the housing, camming surfaces 78 are provided integral and spaced from flanges 76. With the built-in resiliency of the sidewalls of housing 12, the edges of bus bar 68 will engage the camming surfaces 78 and force the walls outwardly until the flanges 76 snap into engagement with a first face 80 of bar 68.

The bus bar **68** has located on its upper surface or second face **82**, detents **84** (see FIG. **5**). As seen in FIGS. **2** and **4**, extending downwardly from wall **14** are crossmembers **86**, which extend between two opposite walls of housing **12** with each crossmember having integral therewith a hollow cylindrical projection. Contained within each cylindrical projection **88** is a helical spring **90**, having one end in engagement with the upper wall **14**, and the other end in engagement with a ball **92**, preferably made of a hard material such as steel or the like. Each ball **92** is biased against the first face **82** of bus bar **68** and, upon appropriate sliding motion of bus bar **68**, will cooperate with detents **84** to aid in positioning the bus bar in a predetermined position.

In the particular embodiments of FIGS. **2–5**, the ends **94** of carriage member **64** have cylindrical cavities **96** therein, which cavities receive a helical spring member **98**, the free ends of which springs abut against opposite walls of housing **12**. In this manner, the mechanical actuator **18** is biased to a neutral position which is normal to the wall **14**. Such position is a center-off position, and pivoting the actuator **18** in either direction will place the switch in the on position. Obviously, when the actuator **18** is released, the springs **98** will neutralize their bias, thus returning the actuator to a neutral position.

In FIG. **6**, there is seen a somewhat different embodiment, showing an electrically conductive bus bar **100**, carried by carriage member **64**. In this embodiment are three pairs of detents **102**, which allow for either position to be off with the other two positions being varying degrees of on. It is to be noted in this embodiment, that helical springs **98** have been omitted, thus allowing the switch to remain in any of the three positions in which it is placed. Also in this embodiment, there are four contacts, thus enabling additional circuitry to be engaged.

In the embodiment shown in FIG. **7**, bus bar **104** is adapted for a switch having two positions, on and off. As depicted, with balls **92** shown in phantom, the bar is in a center-off position. The bar can be actuated only in one direction, as shown by the arrow, and movement past the neutral, center-off position, is prohibited by the use of a cylindrical slug **108** which is received in the cylindrical cavity **96** of one end of carriage **64**. With actuator **18** in the center-off position, the end of slug **108** will abut against the appropriate wall of housing **12**. This particular bus bar **104** has four contacts located thereon. As can be seen in FIGS. **2**, and **4–7**, a vertical rib member on one wall of housing **12** cooperates with a cutout portion **112** in each bus bar for purposes of facilitating the correct positioning of the bus bar upon insertion of the bus bar into the housing **12**.

In some uses gasket material, as indicated at **114**, may be employed to prevent ingress of dust and foreign particles into the housing **12**. Such gasket material **114**, of a suitable insulating material, would also be desirable wherein an electrically conductive housing is used to insulate the housing from the circuitry on the board.

As can be seen from the foregoing description of the instant invention, pivotal movement of mechanical actuator **18** will induce appropriate sliding motion of bus bar **68**, as indicated by the arrows in FIGS. **5–7**, and therefore fingers **72** thereon, to slide fingers **72** onto, or off, of the appropriate circuitry **22** on printed board **20**, thus making and breaking electrical contact therewith. In this sense the ends **74** of fingers **72** are slightly spaced from bus bar **68** and, upon assembly of the board **20** to housing **12**, will abut bus bar **68** before overstress of the contacts **70** can occur. The spring pressure of fingers **72** against board **20** will, to some extent, overcome the spring pressure of helical springs **90**, thereby raising bus bar **68** a sufficient distance so as to ride clear of flanges **76**. The instant invention therefore is seen to eliminate the use of wire conductor hookup directly to terminals located on the electrical housing, it being envisioned that connections to the printed circuit board or the like will be made by flat cable connectors or the like. Thus it is seen, that on any printed circuit board it is possible to arrange a number of combinations of electrical actuators to thereby have any number of switches to make up gang switching assemblies.

It will, therefore, be appreciated that the aforementioned and other desirable objects have been achieved; however, it should be emphasized that the particular embodiments of the invention, which are shown and described herein are intended as merely illustrative and not as restrictive of the invention.

What is claimed is:

1. An electrical actuator adapted to connect electrical circuits, said actuator comprising a generally rectangular housing of electrically nonconductive material, said housing having one wall formed with an opening therein, said opening being of generally rectangular configuration and having pivotally located therein a mechanical actuator including an elongated portion extending inwardly of said wall, said actuator having a pair of parallel flat faces thereon in respective engagement with a first two opposed surfaces of said opening, and a first and second pair of shoulder portions, said first pair of shoulder portions being cylindrical and in respective engagement with cylindrically relieved inner end portions of a second two opposed surfaces of said opening, said second pair of shoulder portions being in engagement with inner end flange portions of said first two opposed surfaces, said elongated portion being in engagement with a carriage member, said carriage member being elongated and adapted for reciprocal movement, and in engagement with an electrically conductive bus bar having a plurality of electrical contact portions carried thereon, and flanges extending interiorly from two opposite walls of said rectangular housing, said flanges engaging opposite parallel edges of a first face of said bus bar to allow sliding movement of said bar and said carriage member and to retain said bar within said housing.

2. An electrical actuator as set forth in claim **1** wherein the outer end portions of said second two opposed surfaces extend therefrom at an angle, and act as stops, and wherein an outward extension of each of said parallel flat faces will be engaged by a respective one of said stops upon respective pivotal movement of said actuator away from a position normal to said wall.

3. An electrical actuator as set forth in claim **2** wherein said bus bar has detent means located on a second face thereof parallel to said first face, said faces being on opposite sides of said bus bar and generally parallel with said wall, ball means engaging said second face of said bus bar, and spring means between and in engagement with said wall and ball means to urge said ball means against said second face and said bus bar against said flanges, whereby, upon appropriate sliding movement of said bus bar, said ball means will engage said detent means to accurately locate said bus bar in a desired position.

4. An electrical actuator as set forth in claim **3** wherein said contact portions comprise elongated fingers cantilevered to said bus bar and having curved end portions adapted to slidingly engage electrical circuit means located on the surface of a circuit board.

5. An electrical actuator as set forth in claim **4** wherein two opposite walls of said rectangular housing have slots located therein outwardly of said bus bar, said slots adapted to receive therein mating projecting edge portions of a circuit board whereby said elongated fingers will engage the facing surface of said circuit board upon connection therewith.

6. An electrical actuator as set forth in claim **5** wherein said carriage member has spring means in engagement therewith, said spring means biasing said carriage to a position centrally of said housing whereby said actuator is normal to said one wall.

7. An electrical actuator as set forth in claim **5** wherein said carriage member has abutment means located at one elongated end thereof and laterally from said actuator, said abutment means prohibiting movement of said carriage member in one direction thereby limiting movement of said actuator to only one direction out of a normal position to said one wall.

8. An electrical actuator as set forth in claim **4** wherein a printed circuit board having electrical circuits on a first surface thereof is in locking engagement with said rectangular housing and generally parallel to and spaced from said bus bar, said contact portions being in engagement with said first surface of said board and being adapted to make sliding engagement with said electrical circuits whereby the combination of said electrical actuator and said circuit board comprises an electrical switch.