

[54] **TWO FACED, MULTIPLE THUMBWHEEL-TYPE SWITCH ASSEMBLY HAVING PLURAL ACTUATORS AND LINEARLY MOUNTING STRUCTURE**

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[52] U.S. Cl. **200/11 TW; 200/11 G; 200/291; 200/307; 200/308**

[51] Int. Cl. **H01h 21/50**

[58] Field of Search..... **200/11 D, 11 DA, 11 TW, 200/17 R, 292, 307, 308, 11 G, 11 K, 291**

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[57]

ABSTRACT

A multiple switch suited for mounting on printed circuit cards in which the switch units are placed side-by-side in an elongated frame. Each unit may have a unique printed circuit held by a rotor. Multiple stationary fingers make contact with the circuit on the rotor and also provide an axial mechanical bias to accomplish detenting in coaction with an axial cam. Two modes of actuation are possible; by a shaft or by a serrated periphery of the rotor. Dual indication of the position of the rotor is supplied by indicia on the disk of the rotor and on a cylindrical portion of the rotor. The structure enables easy assembly and disassembly, either before or after mounting on a circuit card.

11 Claims, 13 Drawing Figures

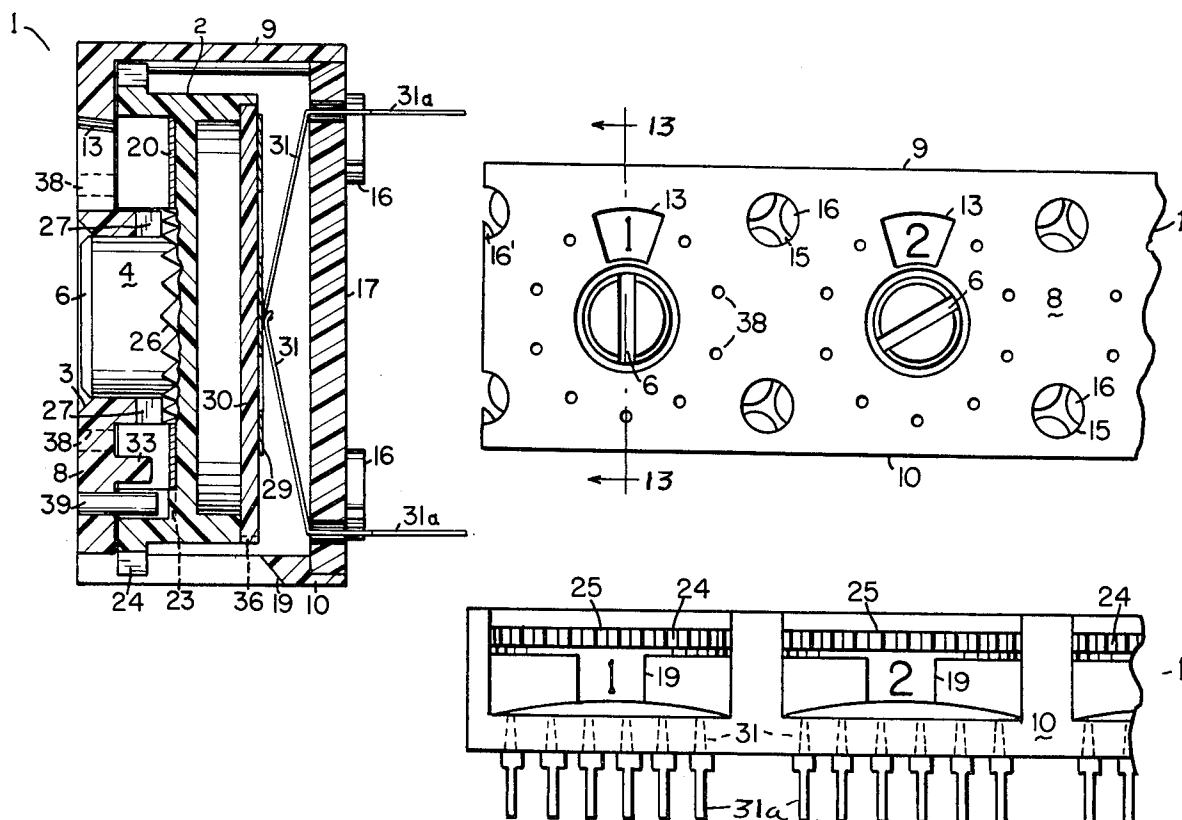


FIG. 1.

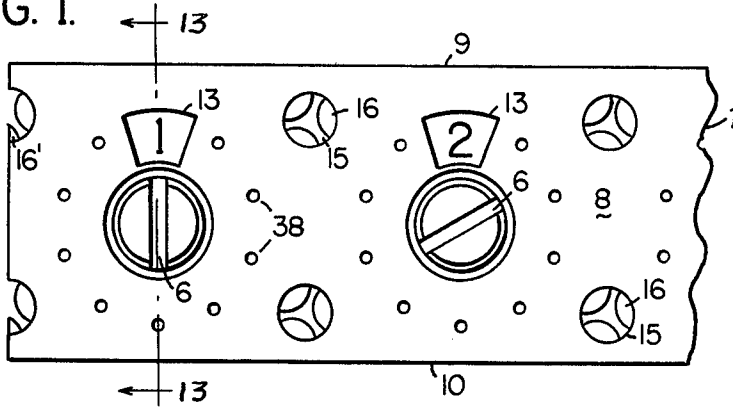


FIG. 4.

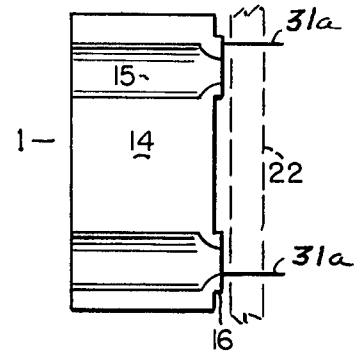


FIG. 2.

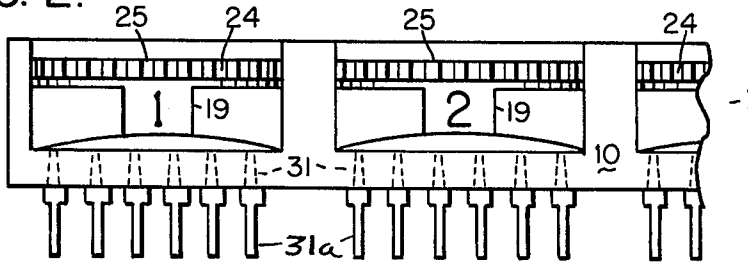


FIG. 3.

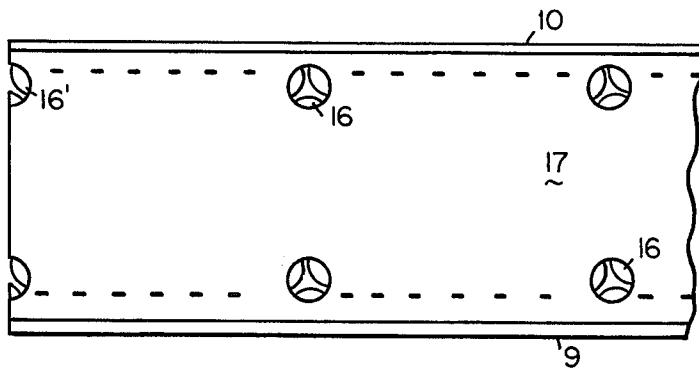


FIG. 5.

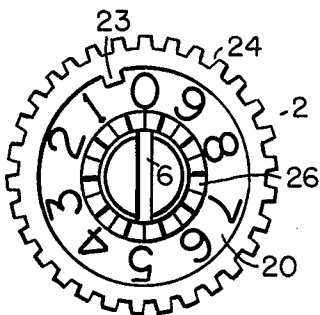


FIG. 6.

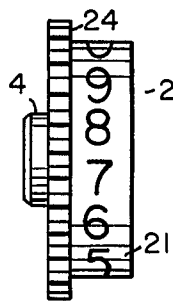


FIG. 7.

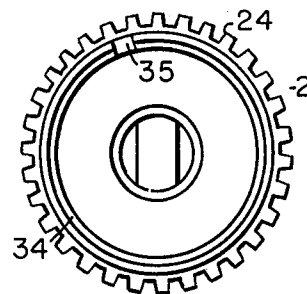


FIG. 9.

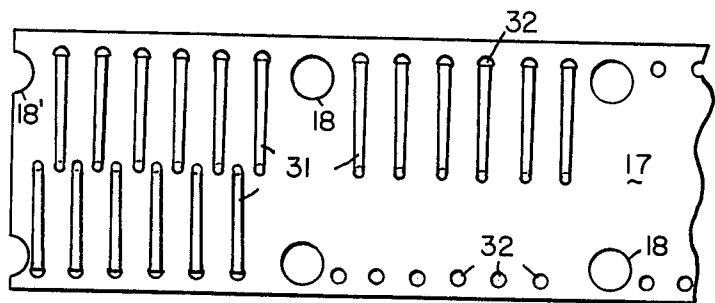


FIG. 10.

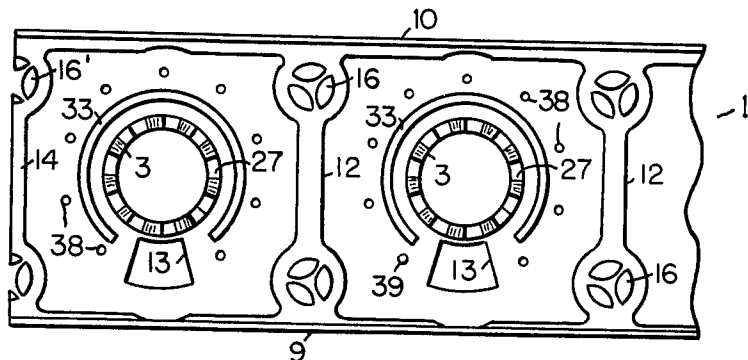


FIG. 8.

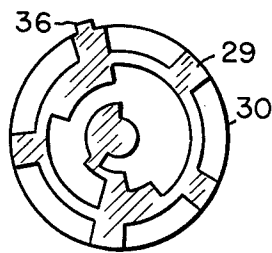


FIG. 11.

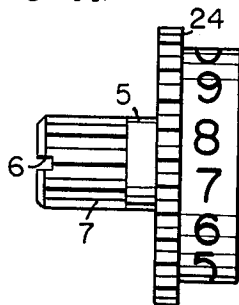


FIG. 12.

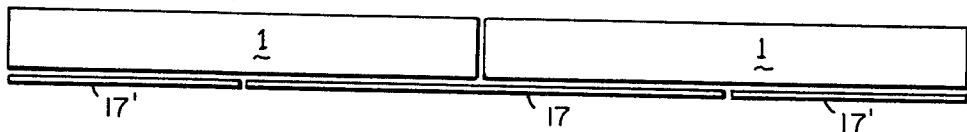
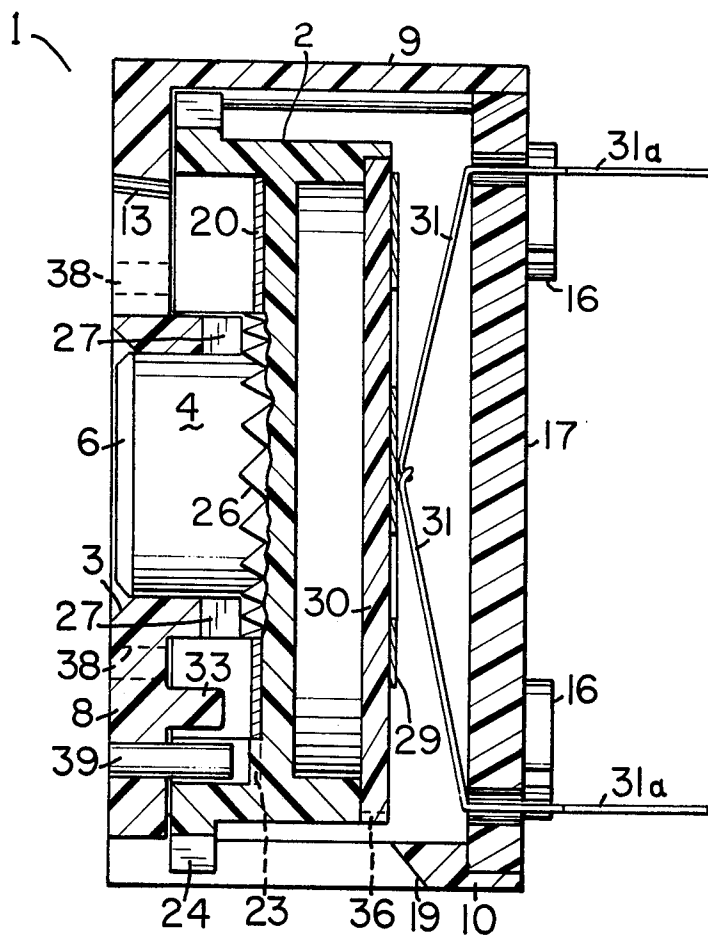


FIG. 13.



TWO FACED, MULTIPLE THUMBWHEEL-TYPE SWITCH ASSEMBLY HAVING PLURAL ACTUATORS AND LINEARLY MOUNTING STRUCTURE

BACKGROUND OF THE INVENTION

This invention pertains to multiple circuit control of, typically, printed circuits.

Much of the prior art has disclosed multiple switches with sections axially joined rather than framed side-by side.

One embodiment is a single unit automobile type switch having circumferentially disposed rotatable protuberance solid contacts that coact with conventionally disposed circumferential contacts mounted upon a stationary disk. It is key operated and is embodied in a maximum of four positions. All rotatable contacts are in a common shorting configuration. Plural spring fingers mechanically associated with the contacts provide axial mechanical bias for detenting action but do not act in any way as electrical contacts. Detenting undulations are peripheral. Indicia are not provided.

Another prior art embodiment has plural axially related switch elements and uses only a peripherally serrated thumbwheel for actuation. A single contact therein selectively contacts a plurality of circumferentially arranged common bus-bar stationary contacts. Detenting is by a leaf spring bearing upon the thumbwheel serrations. Indicia are viewed upon a drum of the thumbwheel.

Two other embodiments have thumbwheel rotatable contacts with circumferential drum indicia and leaf spring detent members bearing upon the indentations of the thumbwheels. Etched-circuit stationary contacts are coactive with the rotatable contacts. The multiple switch arrangement is axial, with one switch unit flat against the next, like a sandwich.

BRIEF SUMMARY OF THE INVENTION

The side-by-side configuration of the multiple switch of this invention allows dual manual actuation and dual exhibition of indicia. Actuation may be by shaft, with indicia visible adjacent thereto, or actuation may be by serrated periphery of the rotor element, with indicia visible adjacent thereto.

The rotor carries a pattern of contacts, which may have any configuration, and which may be conveniently formed by printed circuit - etch techniques.

Aligned cantilever spring contacts bear upon the rotor pattern and exert an axial mechanical bias on the rotor.

A serrated axial cam immediately surrounds the shaft of the rotor. The multiple section side-by-side stationary frame nests each rotor-shaft assembly and includes a stationary serrated axial cam aligned to coact with the rotor cam.

The spring contacts provide mechanical bias for the functioning of the axial cam structure as well as acting as electrical contacts.

The frame includes a bearing for each shaft and an aperture for observing an indicum of the rotor indicia at a time. This aperture is on the face of the frame through which the shaft is journaled. The frame also includes an aperture for each rotor on one side, or edge, through which the serrated periphery extends and through which indicia on the cylindrical drum portion

of the rotor may be observed, typically an indicum at a time.

Each rotor may be provided with a removable disk carrying the pattern of contacts, so that the pattern can be exchanged at will.

The enclosing rear of the frame carries the stationary spring contacts. It is removably fastened in place by plural semi-spring compression-pin protuberances on the main part of the frame.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of the assembled multiple switch.

FIG. 2 is a side view of the same.

FIG. 3 is a bottom view of the same.

FIG. 4 is an end view of the same.

FIG. 5 is a front view of a rotor element.

FIG. 6 is an edge view of the same.

FIG. 7 is a rear view of the same.

FIG. 8 is a front view of a typical contact pattern disk.

FIG. 9 is an interior view of the contact-carrying board, showing illustrative contact combinations.

FIG. 10 is a rear, interior, view of the multiple frame.

FIG. 11 is an edge view of an alternate embodiment of the rotor element, showing an extended shaft.

FIG. 12 is a nearly assembled edge view of plural switch parts for providing a multiple switch of extended length.

FIG. 13 is an assembled view, in section along line 13 — 13 in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 numeral 1 indicates the multiple side-by-side frame. While this can be fabricated to hold one rotor unit it is typically fabricated to hold plural such units, as from two to eleven. By assembling the frames and the contact-carrying boards in a staggered manner a longer strip of switches can be fabricated than the extent of any one frame.

Plural rotors 2, of FIGS. 5, 6 & 7, are individually housed in each unit or section of the frame. The rotors are journaled in central apertures 3, of FIG. 10. These receive rotor shaft 4 of FIG. 6, or the modification 5 of FIG. 11. This shaft is provided with screwdriver slot 6 in the basic embodiment, and may be also provided in the alternate embodiment of FIG. 11, although in the latter the knurled portion 7 of the shaft is provided for basic manual actuation.

Frame 1 is cast with three surfaces integral; the top 8 and two sides 9 and 10. Each section of the frame has a rib 12, and at the ends of a frame a half-rib, either so cast or sawn. The half-rib 14 enables a full rib with full holes, etc. to be formed when two frames are fastened together to extend the total switch. The half-ribs also enclose the frame so that the switch is relatively immune to external ambient influences.

The rib area also includes a cylindrical hole 15, which extends largely through the extent of the frame and is surmounted by an integrally cast compression-pin 16 in each instance. The holes are provided to allow fasteners to be used for additionally securing the frame to a printed circuit board, and also to maintain relatively uniform thickness of material according to known plastic casting practice. Pins 16 are used to removably fasten the contact-carrying board 17. The lat-

ter has apertures 18, mating with pins 16, and half diameter apertures 18' mating with half pins 16'.

While the composition of the plastic material used to cast the frame, preferably by injection molding, is subject to variation, a polyester resin is preferred. This may be the General Electric material "Valox," which has a low coefficient of friction and a degree of self-lubrication. These characteristics are desirable in the functioning of the axial cam and the journal for the shaft in this switch structure; also, in making compression-pins 16 suited for removing contact-carrying board 17. These pins are typically formed in three lobes, as shown, with a slight ridge of increased diameter near the ends in order to seat the board. The resin material has sufficient inherent elasticity to cause a slight deformation of the pins for holding the board.

The apertures on the top 8 of frame 1 are identified as 13 and are fan-shaped. Normally, these are dimensioned to exhibit only one indicum of the plural indicia to be found on rotor 2. In FIG. 1 the numerals "1" and "2" are exhibited.

The apertures on side 10 of frame 1 are identified as 19 and are rectilinear. Indicia 1 and 2 are also exhibited in FIG. 2.

The indicia per se are carried by front disk 20 of rotor 2, of FIG. 5, and on cylindrical surface 21, of FIG. 6. The disk indicia are normally arranged radially. The drum indicia may stand vertically, as seen in FIG. 2, or circumferentially, as seen in FIG. 6. The latter arrangement is convenient should the printed-circuit board 22, shown dotted in FIG. 4, be mounted vertically in such a way that the switch stands vertically. One of the principal uses of the switch of this invention is for mounting on such printed circuit (P.C.) boards.

The disk indicia 20 may be printed on a thin disk, usually white letters on a black background, or on a colored background for coding the circuit involved. The front face of rotor 2 is provided with an inward projection 23 at one point of the circumference and disk 20 is provided with a mating recess. This fixes the circumferential position of the disk with respect to the rotor so that the indicia will correctly signify the switch contact pattern orientation as the switch rotor is rotated.

In addition to the screw-driver or knurled shaft means of rotating shaft 4 of the rotors, each rotor is also provided with a serrated periphery 24. This is externally accessible through a laterally elongated aperture 25, of FIG. 2. The rotor may thus be rotated by frictional engagement of any finger of the operator.

Injection molding of a polyester resin is also preferred for fabricating the rotor bodies.

A compact, internal detent mechanism is formed by serrated axial cam 26 on rotor 2 (FIG. 5), and a companion stationary serrated axial cam 27 (FIG. 10). These have sawtooth peaks and valleys at the same pitch as the desired stationary circumferential positions of rotor 2. Typically, a valley on cam 27 is aligned with indicia aperture 13.

In the illustrative embodiment shown in the drawings the rotor has ten positions. This is a desired number, but by understandable modification of proportions this may be altered; such as to be eight, twelve or sixteen.

The switch sections may be arranged to accomplish various electrical switching functions. In its simplest form each section is a single-pole multiple-throw (such as ten) switch. However, by appropriately disposing

etched pattern 29 on glass-based epoxy board 30, in conjunction with the maximum of 12 spring contacts 31 per section, it is seen that numerous open and close circuit functions may be accomplished at the different circumferential positions of the rotor.

A basic use for the switch is to convert a digital number into binary coded logic for the electronic circuit to which it is connected. This may be considered as converting human language into electronic language.

The pattern shown at 29 in FIG. 8 accomplishes a coded output by distributing a voltage from a common input on the center pad of the pattern to none or to several outputs depending upon the rotor position.

Another pattern makes simple contact with a different finger at each rotational position and the pattern appears as a "lightning flash," progressing from a common terminal at the center of rotation outwardly to the periphery.

The switch may be used to program microcomputer chips, to set timing in traffic signal timing, for testing printed circuit (p.c.) boards, or for changing circuits on printed circuit boards or logic.

Often all rotors of the multiple switch have the same pattern 29 on each, but this is not required. Each rotor may have a different pattern, or there may be any combination of similarity and dissimilarity.

Contacts 31 are preferably punched out of beryllium-copper sheet approximately seven-thousandths of an inch thick and are gold over nickel plated.

The contacts are formed to have essentially three parts.

Looking at FIG. 2 the bottom part 31a is formed as a lug for a printed circuit board or an equivalent, which lug may be wave-soldered. The spatial relation between the lugs and a circuit board 22 is shown in FIG. 4.

The intermediate part of the lug is wide and provides a seat to uniformly position each contact through aligned holes 32 in contact-carrying board 17.

The contact part of each contact is shown dotted in FIG. 3 and in full lines in FIG. 9. These are given an upward mechanical bias when installed, so that they press firmly against the underside of each rotor 2, upon a pattern 29, thereby to make good electrical contact and also to press the rotors firmly upward against fixed axial cam 27 of FIG. 10. This causes shaft 4 to properly journal in aperture 3.

The contacts thus serve a triple purpose; to provide external terminals, to make electrical contact with rotors, and to maintain a mechanical bias upon the axial cam of the rotor-frame parts of the cam.

As seen in FIG. 9, two opposed rows of contacts 31 have been mounted in the contact-carrying board 17 for the left-hand section. These are staggered so that each contact occupies a unique position at the adjacent contact ends. One or two contacts at the center of each section contact the central portion of the pattern, as in FIG. 8, and the other contacts progressively contact parts of the pattern at greater radii as these parts of the pattern are located away from the center.

The right-hand section in FIG. 9 shows contacts in only one row. This is the configuration that is used for the pattern 29 of FIG. 8.

In FIG. 10 ring 33 is molded into the material of the frame. The ring has a curved cross-section and extends away from the body of frame 1. The ring provides a restriction to the front face of indicia ring 20 to prevent disengagement of indicia ring 20 with key 23.

These contacts are typically installed in each section of the switch in groups of six or twelve, to provide adequate axial bias.

Other rotor pattern configurations may require utilizing only two contacts, electrically. In this case the outer two contacts, at essentially maximum radius, would be used. Depending upon the switching required, two to twelve of the available stationary contacts may be utilized.

Epoxy board 30 of FIG. 8 fits into the step-like depression 34 in the bottom of rotor 2, as seen in FIG. 7. An extra-circumferential keyway 35 is formed in the rotor body. A corresponding key 36 is formed in board 30, so that the circumferential integrity of the assembly will be maintained and a given circumferential position of the rotor will always give a known switching circuit configuration.

A group of small holes 38 is arranged in a circumference that is concentric with shaft aperture 3. See FIG. 10. These are in the frame and just inside of the rim of each rotor at the same radius as inward projection 23; FIG. 5. These holes are for the insertion of a pin, such as 39, in FIG. 10. This is inserted sufficiently far down in the frame to engage projection 23. Thus, the rotor cannot be rotated more than 360°.

By inserting two pins at selected holes 38 the arc of switching may be restricted as may be desired; to two switch positions as a practical minimum. Restriction is desirable in circuit use where less than the full number of possible switch positions are used. This prevents non-operation of the circuits involved, or an undesired switching in certain instances. Pins 39 may be inserted or removed as desired throughout the life of the switch.

Size is not a restriction in the embodiment of this invention. A presently useful embodiment may be $\frac{3}{4}$ inch wide by $\frac{3}{8}$ inch thick, with each section 13/16 inch long. Smaller size is attainable with increased precision of fabrication of the parts, and embodiments down to half the stated size could be useful.

The multiple switch of this invention may be extended to include more switching sections than the lateral extent of any molding size of frame 1. This is accomplished by staggering the assembly of the frames with respect to contact-carrying boards 17, employing the compression pins 16 for securing.

For instance, an eight-section switch may be assembled from two four-section frames. A four-section contact board is pressed over the compression pins of two sections of each of the frames; the two sections of each that are adjacent. This binds these three parts into a single composite structure. A two-section board is then pressed upon the compression pins at the two ends of the frames that are otherwise without the same and eight sections of frame are provided with eight sections of contact board.

The above configuration is shown in FIG. 12, in a nearly assembled block structure. The two frames 1 are spanned by the single contact board 17. Two additional half-length contact boards 17' are at the ends. Total assembly is accomplished by pressing all of the contact boards upward upon the compression pins (not shown) at the lower part of the frames.

I claim:

1. A flat, side-by-side, multiple switch structure comprising;

- a. plural separate rotatable members (2), each having a switching pattern of contacts (29),

- a. separate externally accessible shaft (4) surrounded by axial cam protuberances (26), and an externally accessible serrated periphery (24);
 - b. plural separate stationary linearly aligned groups of spring fingers (31) uniformly spaced within the group to electrically contact a said switching pattern of contacts (29), and to also provide an axial mechanical bias upon a said rotatable member; and
 - c. a multiple stationary frame (1), having companion axial cam protuberances (27), whereby said cam elements and the bias of said fingers provides detent functioning.
2. The switch of claim 1, which additionally includes;
- a. a replaceable disk (30) nested in each said rotatable member, and
 - b. a peripheral locking projection (36) formed in said disk; said switching pattern of contacts (29) carried by said disk (30).
3. The switch of claim 1, in which;
- a. said rotatable members (2) have plural identifying indicia circularly disposed upon a removable face (20) locked (23) at substantially right angles to the axis of said externally accessible shaft (4), and
 - b. said frame has corresponding apertures (13) for selective external viewing of one indicum of each said rotatable member that indicates the circumferential position thereof.
4. The switch of claim 3, in which;
- a. said rotor (2) has an inward projection (23),
 - b. said face (20) is a removable disk having a circumferential recess mating with said inward projection,
 - c. said frame (1) has a group of circumferentially arranged holes (38), and
 - d. at least one pin (39) in one of said holes, to mechanically intercept said inward projection and limit the rotation of said rotor.
5. The switch of claim 1, in which;
- a. said rotatable members have a cylindrical surface (21) coaxial with said externally accessible shaft (4),
 - b. plural identifying indicia are disposed upon said cylindrical surface, and
 - c. said frame has corresponding apertures (19) for external viewing of one indicum.
6. The switch of claim 5, in which;
- a. said rotatable members (2) have plural identifying indicia upon both a face (20) at substantially right angles to the axis of said externally accessible shaft, and upon said cylindrical surface (21), and
 - b. said frame has two sets of corresponding apertures (13,19) for external viewing of said indicia.
7. The switch of claim 1, in which;
- a. said externally accessible shaft (5) extends beyond said frame and is circumferentially knurled (7).
8. The switch of claim 1, in which said frame (1) includes;
- a. a removable contact-carrying board (17) having plural apertures (18), and
 - b. plural mating compression-pins (16) to engage said apertures, whereby said frame may be manually removed from said board.
9. The switch of claim 8, in which;

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a. plural contact-carrying boards (17) are assembled upon plural mating compression-pins (16) of plural frames (1) in a staggered manner, in which a said contact-carrying board (17) is attached to more than one said frame, whereby a multiple switch of greater length than the extent of any one said frame is fabricated.

10. The switch of claim 1, in which said spring fingers (31) also include;

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a. a right angle extension external to said frame to act as external terminals to said fingers.

11. The switch of claim 1, in which said frame also includes;

a. a ring (33) circumferentially disposed adjacent to said stationary axial cam (27) to restrict axial displacement of indicia disk (20).

* * * * *