

[54] **KEYBOARD SWITCH AND UNITIZED
MULTIPLE SWITCH CONFIGURATION**

[75] Inventor: **John F. Brady**, Clifton, N.J.

[73] Assignee: **Universal Technology, Inc.**, Verona, N.J.

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[51] Int. Cl. **H01h 13/52**

[58] Field of Search **200/5 R, 5 A, 6 BB,
200/159 R, 159 A, 159 B, 166 CT, 11 G, 166
BH**

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Attorney—Willis H. Taylor, Jr. et al.

[57] **ABSTRACT**

A unitized configuration including plurality of key top switches. A single unit shell overlies and is secured to a circuit board upon which the contact leafs for the various switches are so mounted as to be cantilevered over their respective printed contacts. The plungers associated with the several key tops pass through openings in the shell and are biased out of contact with the underlying cantilevered leafs by spring means. Depressing of the key tops drives the plungers downward to deflect the respective contact leafs and close the associated circuits.

21 Claims, 5 Drawing Figures

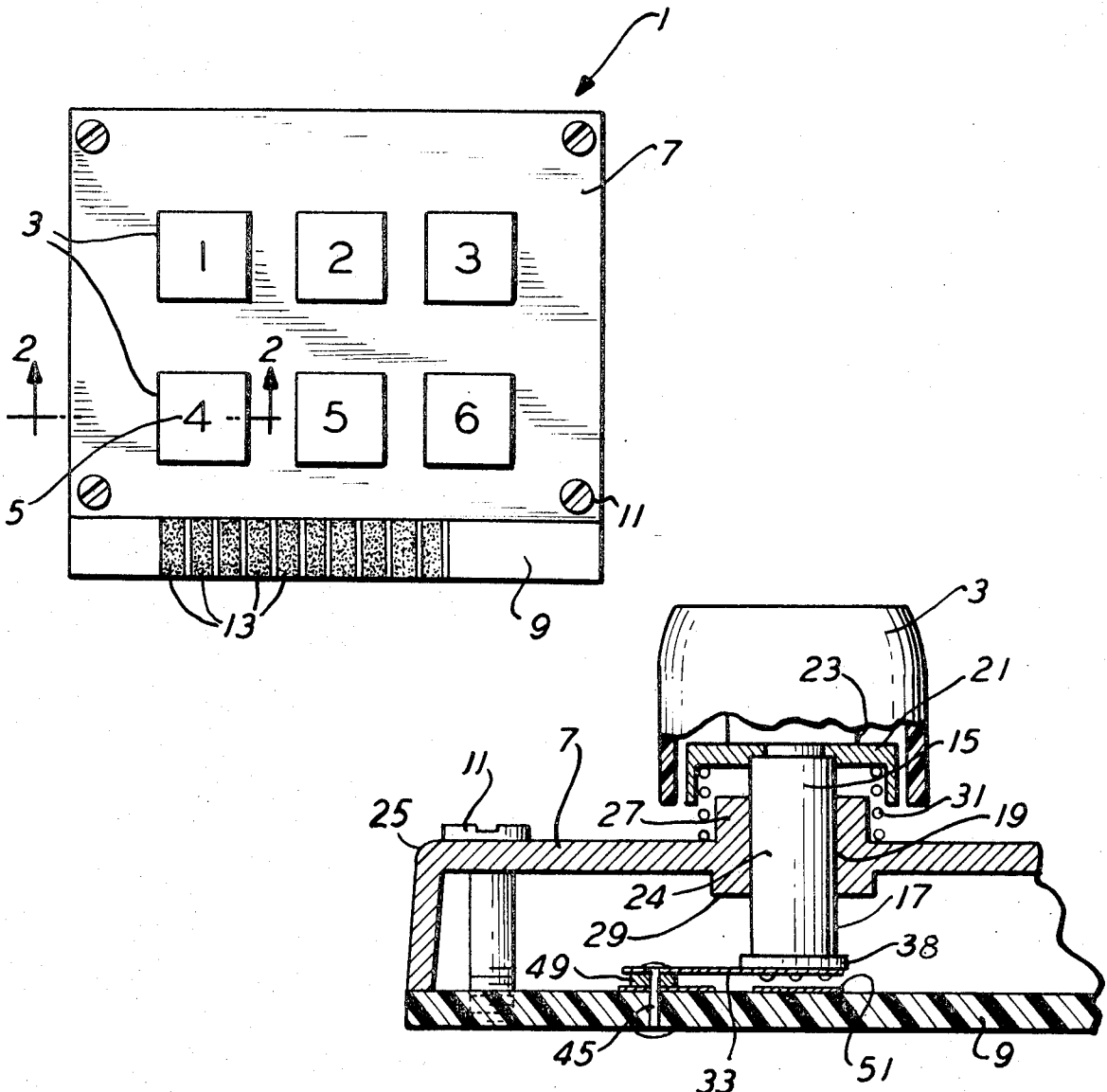


FIG. 1

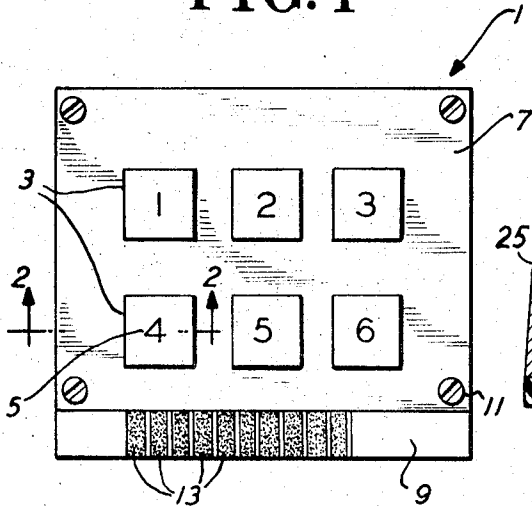


FIG. 2

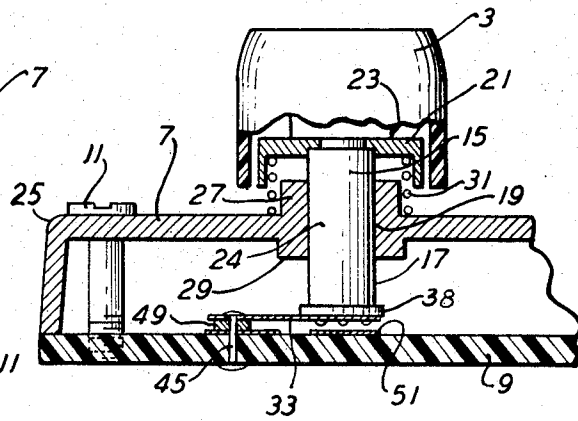


FIG. 3

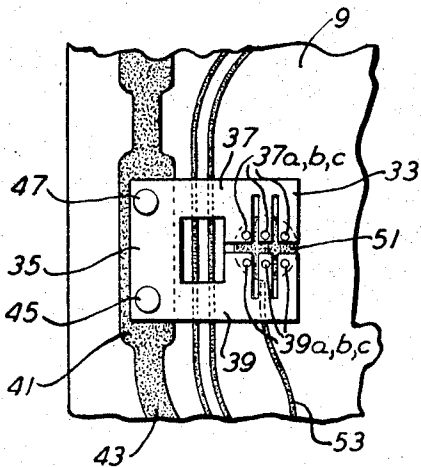


FIG. 4

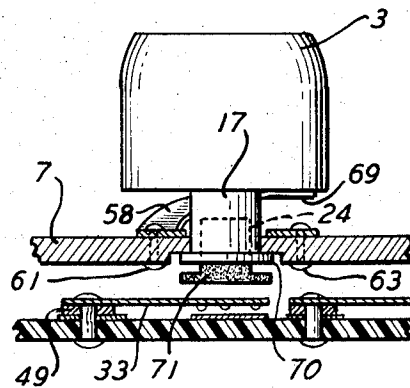
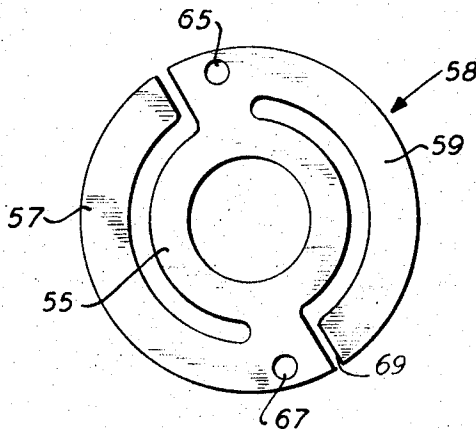


FIG. 5



INVENTOR
JOHN F. BRADY

BY *Styan J. Klaber*
ATTORNEY

KEYBOARD SWITCH AND UNITIZED MULTIPLE SWITCH CONFIGURATION

BACKGROUND OF INVENTION

This application is a continuation in part of my copending application entitled "Control Keyboard," Ser. No. 144,606 filed May 18, 1971 and assigned to the assignee of the present application. A related application, the disclosure of which is substantially contained in application Serial No. 144,606, is my copending application entitled "Pushbutton Cantilevered Leaf Spring Contact Switch Assembly for Keyboard Type Switch Arrays", Serial No. 144,605, also filed May 18, 1971 and assigned to the assignee of the present application.

This invention relates generally to electrical switches, and more specifically relates to switch constructions for use in the keyboards commonly employed at computer terminals or similar environments whereat operator communication with an electronic system occurs.

Electric keyboards featuring an array of individual key switches have been in use for many years. Such keyboards, have, for example, long been utilized in electric typewriters, where activation of the individual keys effects striking of the type-face-bearing elements against the typewriter platen. In still more recent years, in consequence of the enormous proliferation in data processing and communications systems, increased interest in keyboards—and particularly in the switches utilized therewith—has been evident. This has occurred by virtue of the fact that communication with the cited systems is commonly effected through a manually operated keyboard.

Because of the aforementioned intense interest, an enormous number of key top switches have been proposed and very many are currently in commercial use. Although lines of classification tend to merge, a useful distinction may be based upon the characterization of the switch as in the nature of a solid state device or of an electromechanical device. The former, based for example on the well-known Hall effect, tend to be technologically quite complex, and in consequence, are very expensive in comparison to a functionally similar electromechanical device.

In my aforementioned copending applications Ser. Nos. 144,605 and 144,606, there is disclosed an electromechanical switch construction which is particularly advantageous with respect, among other things, to compactness, low profile of design, cost of production and length and dependability of operating life. While the design set forth therein incorporates numerous distinct features, that feature of interest for present purposes is the contact element arrangement and the manner in which switch closing is effected. In particular, a contact leaf is supported in cantilevered fashion in a switch housing so that operator movement of a plunger into the housing causes a foot to bear against the cantilevered portion of the leaf and thereby deflect such portion against an underlying contact plate to close an associated circuit. The significant point for present purposes is that the said design, as is the case for numerous electromechanical key switches, is predicated on use of distinct and separate switch housings for each and every switch utilized in a key board. Clearly, the presence of such individual housings for each switch represents not only an item of cost which

ideally one would like to eliminate, but moreover a source of bulk limiting the compactness of a keyboard installation and contributing to the profile height thereof.

In accordance with the foregoing, it may be regarded as an object of the present invention, to provide a key top switch arrangement, wherein a plurality of key top switches are combined into a unitized construction eliminating the need for distinct housings for individual switches.

It is a further object of the invention to provide an electromechanical key top switch arrangement for a plurality of key top switches, wherein individual switch housings are eliminated and wherein the switches and associated contact leaves are so integrated with a printed circuit board as to yield a unitized structure of exceptional compactness and of very low profile.

It is an additional object of the invention, to provide a unitized construction wherein a plurality of electromechanical key top switches are incorporated under a single shell and functionally integrated with an associated circuit board, to provide a low cost but exceptionally effective structure for use in keyboard applications.

SUMMARY OF INVENTION

Now in accordance with the present invention, the foregoing objects, and others as will become apparent in the course of the ensuing specification, are achieved in a unitized configuration including a plurality of key top switches. A single unit shell, which is typically a casting, overlies and is secured to a circuit board upon which the contact leaves for the several switches are so mounted as to be cantilevered over their respective printed contacts. The plungers associated with the several key tops pass through openings in the shell and are biased out of contact with the underlying cantilevered leaves by spring means. Depressing of the key tops drives the plungers downward to deflect the respective contact leaves and close the associated circuits.

BRIEF DESCRIPTION OF DRAWINGS

The invention is diagrammatically illustrated, by way of example, in the drawings appended hereto, in which:

FIG. 1 is a plan view of a unitized switch configuration in accordance with the present invention;

FIG. 2 is a cross sectional view through a portion of the FIG. 1 construction, taken along the line 2—2 of FIG. 1;

FIG. 3 is plan view of part of the circuit board appearing in FIG. 2, and illustrates the mounting arrangement and functioning of the contact leaves utilized in the invention;

FIG. 4 is a cross sectional view similar to FIG. 2, but illustrating an alternate embodiment for the shell and associated switch elements passing there through; and

FIG. 5 is a plan view of the spring element utilized in connection with the FIG. 4 embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

In FIG. 1 a unitized multiple switch configuration 1 in accordance with the invention appears. Configuration 1, for purposes of concrete illustration, is shown as including six key tops 3, which key tops include indicia

5, typically alpha-numeric symbols or so forth indicative of the operation to be rendered by depressing of the so-identified key top. The key tops 3 could, of course, be of greater or lesser number depending upon the function to be performed by the unit. The key tops are seen to overlie a shell 7 which in turn is secured to an underlying circuit board 9 by threaded fasteners 11.

Circuit board 9 is in general terms of conventional construction and is manufactured by any of the numerous techniques well-known to those skilled in the electronic arts. In accordance with the present application, the shell 7 and circuit board 9 are so proportioned that an end of board 9 protrudes beyond the edge of shell 7, thereby enabling one to readily make connections to the "printed" conductors 13 thereat.

In FIG. 2 a cross-sectional view, taken along the line 2-2 of FIG. 1 appears. The operation and mode of functioning of but a single of the switches is shown therein, it being understood that all of the switches of the configuration 1 function in an identical manner. It is thus seen that a key top 3 engages a plunger means 15 which includes a cylindrical portion 17 passing through a bearing 19 formed in shell 7. Plunger means 15 as well as key top 3 are molded or otherwise formed of a non-conducting plastic or the like. Means 15 may include a pair of cross pieces at its upper end which extend into and are frictionally engaged in recesses formed in a block on the underside of key top 3. A collar 21 is positioned about the top of plunger means 15 and bears against the said block the edge of which is seen at 23.

Bearing 19 in which cylindrical portion 17 is vertically slideable, is defined by circular opening 24 formed in shell 7, which opening is but one of a plurality of similar openings through which the plunger means associated with the several switches pass. The shell 7 is a unit structure which may, for example, comprise a zinc or other metallic casting or similarly may comprise a single molded structure. The openings such as 24 referred to may be formed during the casting process, or can be produced by drilling or the like subsequent to casting. Along these lines, it is also possible to form shell 7 from flat stock which is appropriately drilled or punched, and turned down at the corners 25. Bushing inserts may, if desired, be inserted to line the openings 24. While not explicitly shown in the Figure, a slotted keyway extends longitudinally along bearing 19 and is engaged by a rib extending lengthwise along cylindrical portion 17, such combination acting as an anti-rotational device preventing rotation of the keytop 3.

In the embodiment appearing in FIG. 2, bearing 19 is seen to be bounded by collar portions 27, 29 which are formed upwardly and downwardly in shell 7. Aside from providing an extended bearing support, the collar portion 27 anchors a coil spring 31, the upper edge of which bears against collar 21 and thereby against keytop 23. The function of such spring is to provide a bias which normally maintains foot 38 of plunger means 15 out of contact with the underlying contact leaf 33.

Contact leaf 33 which may be seen both in FIG. 2 and in plan view in FIG. 3, is a thin, flexible, member, preferably formed of a metallic alloy suitable for spring applications, e.g. a copper-beryllium alloy. The said leaf is identical to that disclosed in my copending 144,605 and 144,606 applications, previously alluded to, and is characterized by a base portion 35 which is

bifurcated into the branches 37, 39, the branches in turn being trifurcated at their adjacent but non-contacting end portions into sets of three contact fingers 37 *a, b, c*, and 39 *a, b, c*.

Leaf 33 is seen to be secured to a portion 41 of a conductive track 43 forming part of the printed circuit of board 9, by a pair of fasteners 45, 47 which pass through holes in base portion 35 of the leaf, and through an intervening spacer 49. The latter which typically has a thickness of about 1/32nd of an inch is seen to act as to cause the secured leaf 33 to be cantilevered from its supported base 35, with the contact fingers 37 *a, b, c* and 39 *a, b, c* thereby suspended over a contact zone 51 at the underlying circuit board 9. As will be evident to those skilled in the art, other means are also available for causing the contact fingers to be suspended over the underlying circuit board. For example, contact leaf 33 could simply be bent upward where branches 37, 39 meet base portion 35, in which case spacer 49 need not be used. For convenience, the word "cantilevered" will be used below in its general sense to refer to all structures in which the contact fingers are supported at one end and project over a spaced apart underlying circuit board. Contact zone 51 may typically be an enlarged circular area forming part of a circuit in conjunction with the connecting line 53 leading thereto. Spacer 49 is preferably of a conductive material, such as metal, whereby connection to underlying track 43 is directly achieved.

With the aid of the foregoing, the basic mode of operation of the switches incorporated into configuration 1 may be readily appreciated. In particular, track 43 to which leaf 33 is connected is commonly the ground side of an electrical circuit which is to be completed via the bridge established to contact zone 51 of conductor 53 through leaf 33, the conductor 53 being the other side of the said circuit. Such leaf 33 is, as has been indicated, normally suspended in cantilevered, spaced fashion from the said contact zone 51, and accordingly the circuit is normally open. Upon an operator depressing key top 3, however, foot 23 is brought to bear against the cantilevered portion of leaf 33, displacing fingers 37 *a, b, c* and 39 *a, b, c* into contact with zone 51 to close the said circuit. In this connection, and as is developed in greater length in my alluded-to copending 144,605 and 144,606 applications, the bifurcation of leaf 33 into branches 37, 39, and the trifurcation of such branches into contact fingers 37 *a, b, c*, and 39 *a, b, c*, assures that a very smooth wiping and low bounce contact ensues with zone 51, in consequence of which a contact signal of excellent electrical properties is obtained.

In FIG. 4 a further embodiment of the present invention appears. The view therein is generally similar to FIG. 2, and is thus partially in cross-section. The depicted embodiment principally differs from the FIG. 2 showing in that the shell 7 is now devoid of the collar portions 27 and 29 appearing in FIG. 2, that is to say that shell 7 in FIG. 4 is completely flat. An arrangement of this type is advantageous in that a very low profile configuration is enabled; however, the elimination of the aforesaid collars drastically foreshortens the available bearing surface at hole 24 for support of cylindrical portion 17 of the plunger means. In accordance with a further aspect of the invention, however, a washer spring 58, shown in plan view in FIG. 5, is secured to shell 7 so as to surround cylindrical portion 17 and act,

among other things as, effectively, a collapsable bearing.

Washer spring 58, as is seen in FIG. 5 is a one piece metal stamping of spring steel or the like, and includes a central washer portion 55 and a pair of spirally directed spring arms 57, 59 extending from said washer portion. Washer spring 58 is secured to shell 7 by fasteners 61, 63 passing through holes 65, 67 therein. The washer portion 55 thereby abounds hole 24, with the arms 57, 59 then being free to press upwardly against the collar 21 (of FIG. 2) and thus against key top 3. The end 69 of arm 59 is seen in FIG. 4, it being evident that as such arm rises to spring bias keytop 3, it also spirals inwardly to thus provide stabilization against horizontal wobble of the plunger means 15.

The foot 70 of said plunger means, is seen in FIG. 4 to be provided with a foot pad insert 71 which is frictionally held within a hollow cavity extending upwardly into cylindrical portion 17 from foot 70. The pad insert 71 comprises a non-conductive resilient material, such as a silicone rubber. Its function is to assist a smooth contact closing operation by providing a degree of allowable overide (due to compressibility of the pad material) as the foot 70 advances upon and is brought to bear on the underlying contact leaf. While the said pad is not explicitly shown in use in the FIG. 2 embodiment, it is equally applicable to the construction shown therein, where it functions in precisely the same manner.

While the present invention has been particularly set forth in terms of specific embodiments thereof, it will be understood in view of the present disclosure, that numerous variations upon the invention are now enabled to those skilled in the art, which variations, in propriety, yet reside within the province of the invention. Accordingly, the present invention is to be broadly construed, and limited only by the scope and spirit of the claims now appended hereto.

I claim:

1. A unitized multiple switch keyboard configuration comprising:

- a printed circuit board carrying a plurality of pairs of complementary conductive elements forming part of circuits to be closed by said switches;
- a plurality of contact leaves one end of each said leaf being electrically connected to one of the pair of conductive elements and the other end of which extends over and is spaced apart from the other of said pair of conductive elements;
- a covering shell overlying said circuit board and having therein a plurality of bearing openings that are bounded by collars formed in said shell;
- individual plunger means mounted in each of said bearing openings and movable toward a contact leaf to displace said leaf into contact with a complementary conductive element to close said associated circuit;
- a keytop connected to the top of each said plunger means; and
- spring means comprising a coil surrounding each said collar and plunger means and biasing the underside of each said keytop away from said shell.

2. A unitized multiple switch keyboard configuration comprising:

a printed circuit board carrying a plurality of pairs of complementary conductive elements forming part of circuits to be closed by said switches;

a plurality of contact leaves one end of each said leaf being electrically connected to one of the pair of conductive elements and the other end of which extends over and is spaced apart from the other of said pair of conductive elements;

a covering shell overlying said circuit board and having therein a plurality of bearing openings;

individual plunger means mounted in each of said bearing openings and movable toward a contact leaf to displace said leaf into contact with a complementary conductive element to close said associated circuit;

a keytop connected to the top of each said plunger means; and

split washer springs that are fastened to said shell at said bearing openings, said washer springs having a washer portion abounding said opening and spring arms biasing the underside of each said keytop.

3. A unitized multiple switch keyboard comprising:

a printed circuit board carrying a plurality of first conductive elements, each forming a part of a circuit that may be closed by one of the switches of the keyboard;

a plurality of contact leaves each of which is electrically connected to a second conductive element and is extended over and spaced apart from one of said first conductive elements;

each leaf comprising a base portion connected to a second conductive element, a branch portion extending from said base portion, and multiple contact fingers integral with said branch portion and extending over a first conductive element;

mounting means overlying said circuit board and being structurally connected thereto, said mounting means having a plurality of bearing openings therein; and

individual plunger means mounted in said bearing openings and adapted to bear upon said contact fingers of the underlying contact leaves and displace said fingers into contact with corresponding first conductive elements.

4. The keyboard of claim 3 wherein:

the bearing openings are bounded by collars formed in said shell;

a keytop is connected to each said plunger means; and

a coil surrounds each said collar and associated plunger means and biases the underside of the keytop connected to said plunger means away from said shell.

5. The keyboard of claim 3 further comprising:

a keytop connected to each said plunger means; and

split washer springs fastened to said shell at said bearing openings with a washer portion of each said spring abounding said opening and spring arms of each said spring biasing the underside of the keytop connected to the plunger means in said opening.

6. The keyboard of claim 3 wherein the contact leaves are supported on at least one second conductive element by a spacer means, whereby the multiple contact fingers of each leaf are spaced apart from a corresponding first conductive element.

7. The keyboard of claim 6 wherein said spacer means is a conductive plate.

8. The keyboard of claim 3 wherein said plunger means carries a resilient pad on its lower end and the downward displacement of said plunger compresses said pad against a leaf to effect override during displacement of said leaf into contact with a first conductive element.

9. The keyboard of claim 3 wherein the contact fingers are substantially parallel and extend substantially at right angles to the branch portion in substantially the same plane as the branch portion.

10. The keyboard of claim 3 wherein the leaf comprises a pair of branch portions extending from said base portion and branching into multiple contact fingers.

11. The keyboard of claim 10 wherein the branch portions and finger portions are located in substantially the same plane.

12. The keyboard of claim 11 wherein the base, the branch and finger portions of said leaf surround and define an opening in said leaf.

13. A unitized multiple switch keyboard comprising: a printed circuit board carrying a plurality of first conductive elements, each forming a part of a circuit that may be closed by one of the switches of the keyboard;

a plurality of contact leaves each of which is electrically connected to a second conductive element and is extended over and spaced apart from one of said first conductive elements;

each leaf comprising a base portion connected to a second conductive element, a branch portion extending from said base portion, and multiple contact fingers integral with said branch portion, said branch portion and contact fingers extending over a first conductive element, the contact fingers being substantially parallel to one another, at right angles to the branch portion, and in the plane of the branch portion;

mounting means overlying said circuit board and being structurally connected thereto, said mounting means having a plurality of bearing openings therein; and

individual plunger means mounted in said bearing openings and adapted to displace the leaves into contact with corresponding first conductive elements.

14. The keyboard of claim 13 wherein there are two spaced-apart branch portions extending from the base portion of each leaf and the contact fingers of the two branch portions extend toward one another.

15. The keyboard of claim 13 wherein the plunger means are positioned to engage the contact fingers of said contact leaves when displacing them.

16. A switch comprising:

a first conductive element forming part of a circuit that may be closed by the switch;

a contact leaf electrically connected to a second conductive element and extending over said first conductive element, said leaf comprising a member having a base portion, a branch portion extending from said base portion, and multiple contact fingers integral with said branch portion and extending over said contact plate; and

plunger means adapted to displace said leaf into contact with said first conductive element, said plunger means being positioned to engage the contact fingers of said contact leaf when displacing it.

17. The switch of claim 16 wherein the contact fingers are substantially parallel to one another, are at substantially right angles to the branch portion, and are in substantially the plane of the branch portion.

18. The switch of claim 17 wherein there are two spaced-apart branch portions extending from the base portion of the leaf and the contact fingers of the two branch portions extend toward one another.

19. A switch comprising:

a first conductive element forming part of a circuit that may be closed by the switch;

a contact leaf electrically connected to a second conductive element and extending over said first conductive element, said leaf comprising a base portion, a branch portion extending from said base portion, and multiple contact fingers integral with said branch portion, said branch portion and contact fingers being extended over said contact plate, the contact fingers of said branch being substantially in the plane of the branch portion and extending in a direction significantly different from that of the branch portion so that at least one contact finger is considerably closer to the base portion than at least one other contact finger; and

plunger means adapted to displace the portion of the leaf extending over the first conductive element into contact therewith to close the switch.

20. The switch of claim 19 wherein the contact fingers are substantially parallel to one another and are at substantially right angles to the branch portion.

21. The switch of claim 19 wherein there are two spaced-apart branch portions extending from the base portion of the leaf and the contact fingers of the two branch portions extend toward one another.

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