

[54] **ELECTRICAL SWITCH**

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**Related U.S. Application Data**

[63] Continuation of Ser. No. 74,582, Sept. 23, 1970, abandoned.

[52] **U.S. Cl.**..... **335/207, 200/76, 200/181**

[51] **Int. Cl.**..... **H01h 13/00, H01h 5/02**

[58] **Field of Search**..... **200/76, 77, 67 F, 200/181, 172; 335/205, 206, 207; 310/8.3, 8.7; 317/144**

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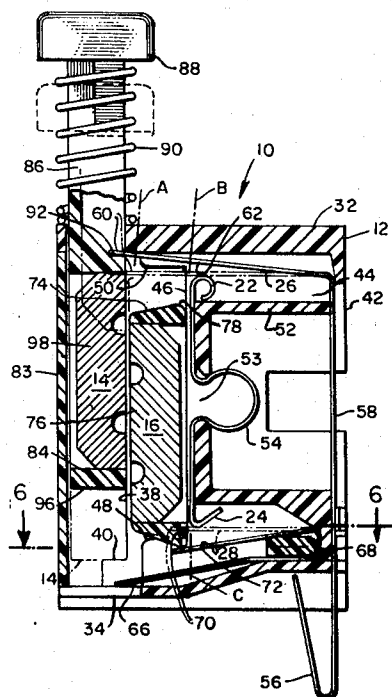
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[57] **ABSTRACT**

A magnetically operated electrical switch having a housing supporting a manually operable push slide and a freely movable shuttle. A magnet carried by the push slide cooperates with another magnet carried by the shuttle to effect movement of the shuttle in one direction in response to movement of the push slide in an opposite direction and to a critical position relative to the shuttle. A plurality of sets of electrical contacts are conditioned by the push slide and/or the shuttle. Each contact set includes a pair of elongated movable contacts mounted in cantilever position in the housing and having free end portions which extend into the path of either the shuttle or both the push slide and the shuttle. Operational characteristics of the switch are determined by the length of the free end portions of the various movable contacts. In accordance with one embodiment of the invention, at least one of the contact sets includes an electro-mechanical transducer or piezo-electric crystal which serves both as a stationary contact and a source of electromotive force.

**33 Claims, 13 Drawing Figures**





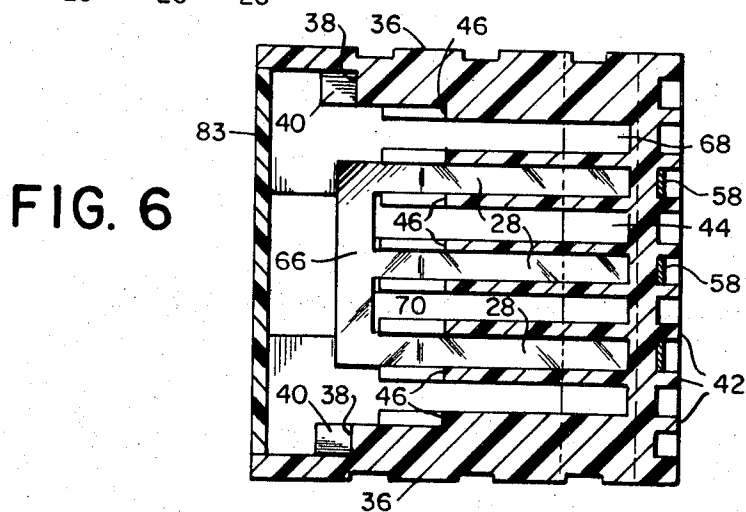
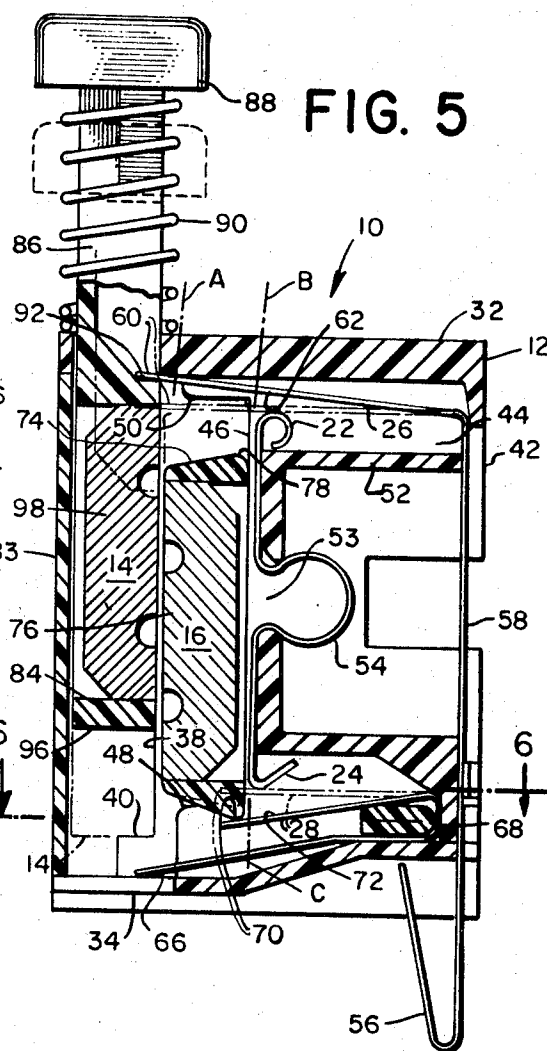
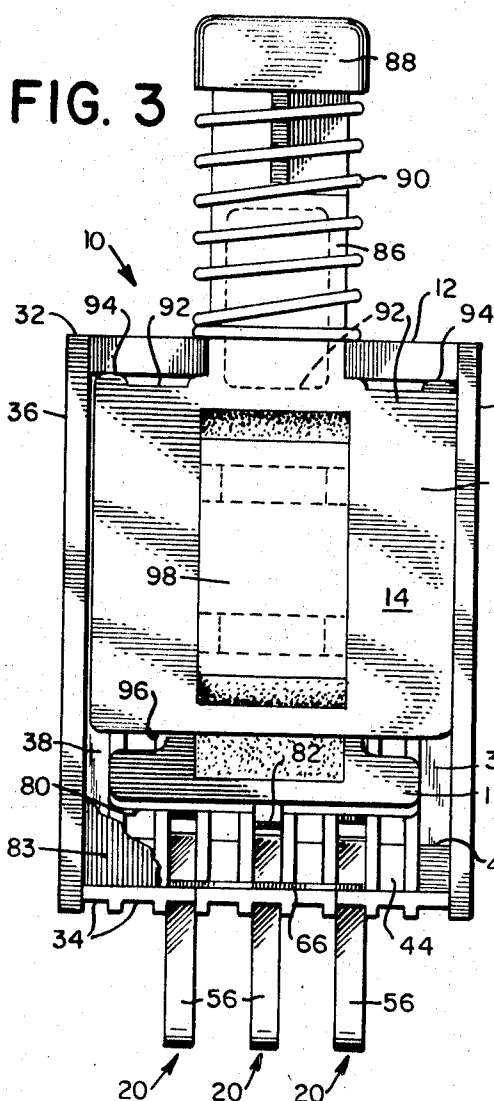


FIG. 7

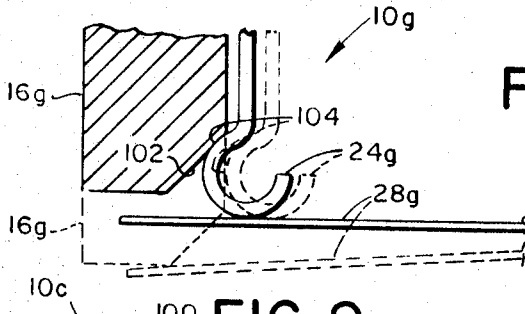


FIG. 8

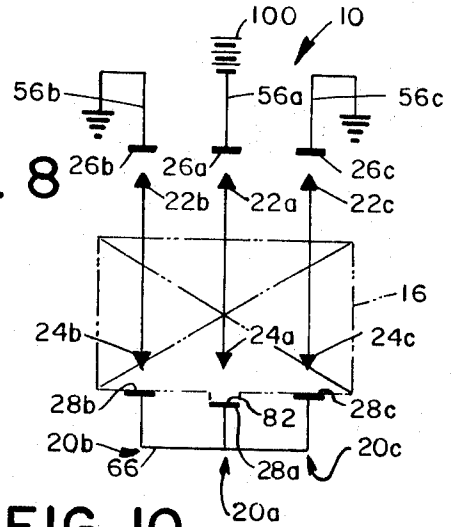


FIG. 9

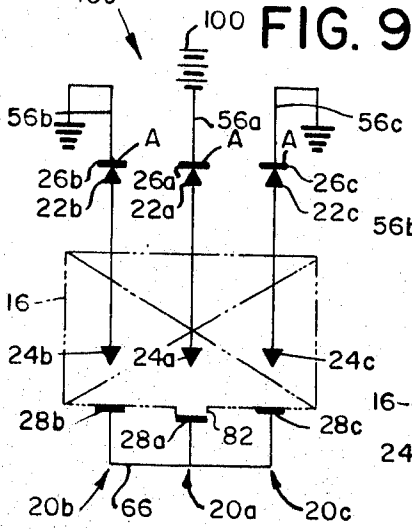


FIG. 10

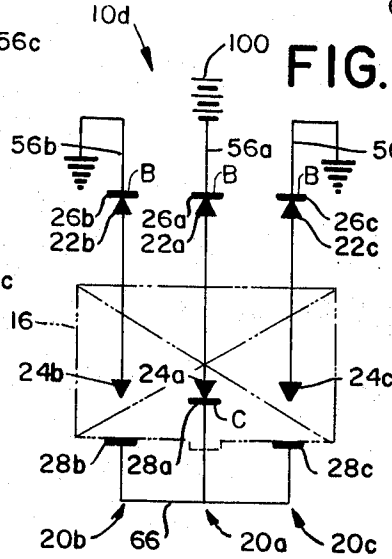


FIG. 11

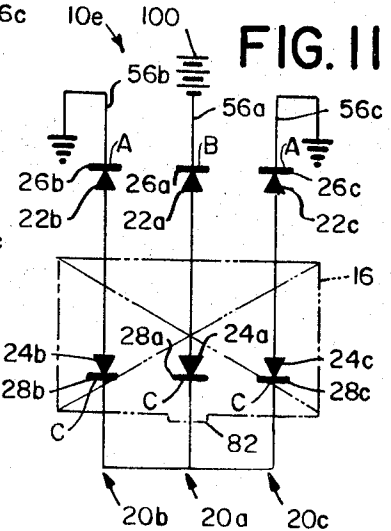


FIG. 12

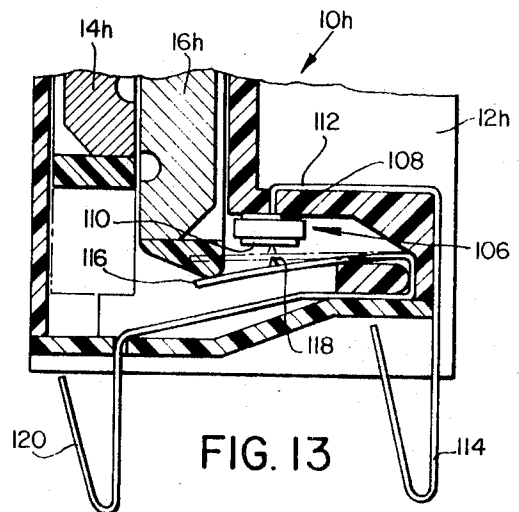
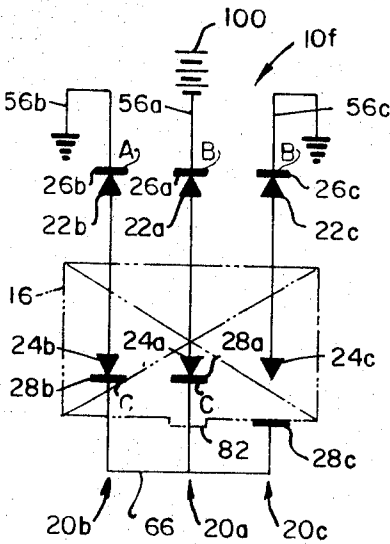


FIG. 13

## ELECTRICAL SWITCH

## CROSS REFERENCE TO RELATED APPLICATION

This application is a Continuation of application Ser. No. 74,582, filed on Sept. 23, 1970 now abandoned.

## BACKGROUND OF THE INVENTION

This invention relates in general to electrical switches and deals more particularly with electrical switches of a type wherein electrical contacts are conditioned by a freely movable body or shuttle.

The switch of the present invention is particularly adapted for use as a keyboard switch in an electrically operated business machine, computer or the like and has full code capability for such application. However, it may also be adapted to function as a pulse relay or as a Form A, B or C switch or may be constructed and arranged to provide various combinations of the afore-said switching characteristics.

## SUMMARY OF THE INVENTION

In accordance with the present invention, an electrical switch is provided which includes a freely movable shuttle element supported for movement between first and second switching positions and an actuating means which includes an operating element supported for movement relative to the path of the shuttle and operable upon movement to a predetermined critical position relative to the shuttle in either of its switching positions to release the shuttle from the latter position and urge it to and retain it in its other switching position. The switch has at least one set of contacts conditioned by movement of the shuttle. Each set of contacts includes a pair of elongated movable contact members or blades mounted in cantilever position relative to the shuttle element and the operating element. At least some of the movable contact members have free end portions disposed in the path of at least one of the movable elements.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of an electrical switch embodying the present invention.

FIG. 2 is a rear elevational view of the switch of FIG. 1.

FIG. 3 is a front elevational view of the switch of FIGS. 1, a portion of the switch cover shown broken away to reveal structure therebehind.

FIG. 4 is a front elevational view of the switch of FIG. 1 shown with the cover and push slide removed therefrom.

FIG. 5 is a somewhat enlarged sectional view taken along the line 5-5 of FIG. 2.

FIG. 6 is a sectional view taken generally along the line 6-6 of FIG. 5.

FIG. 7 is a fragmentary sectional view similar to FIG. 5, but shows another switch embodying the present invention.

FIGS. 8-12 are schematic diagrams of switch contacts and illustrate various modified forms of the switch of the present invention.

FIG. 13 is a fragmentary sectional view similar to FIG. 5, but shows another switch embodying the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings and referring particularly to FIGS. 1-6, an electrical switch embodying the present invention is indicated generally by the numeral 10. The switch 10 is particularly adapted for use as a keyboard switch for an electrically operated typewriter, computer or the like and comprises a housing 12 which supports a drive element or push slide 14, a driven element or shuttle 16 and at least one set of electrical contacts conditioned by movement of the shuttle 16 and the push slide 14. The number of contact sets provided may vary and will be determined by the desired operational characteristics of the switch. However, for clarity of illustration three substantially identical sets of contacts are shown and indicated generally at 20, 20. Each set 20 includes a stationary upper contact 22 and a stationary lower contact 24 electrically connected to the contact 22, as shown in FIG. 5. Each set also includes a movable upper contact member or blade 26 supported for movement between an open and a closed position relative to the contact 22 and a movable lower contact member or blade 28, supported for movement between an open and a closed position relative to the contact 24. The various contacts are supported and arranged in the housing 12 to cooperate with the operating element or a push slide 14 and the shuttle 16 in a manner hereinafter more fully described.

The housing 12 is molded from electrical insulating material and has a generally rectangular form. It includes a top wall 32, a bottom wall 34, and side walls 36, 36. Each side wall is inwardly relieved or cut away along its forward edge to define a generally vertically extending and forwardly facing slide surface 38 and an upwardly facing abutment surface 40 spaced upwardly from the bottom wall 34. A plurality of relatively thin transversely spaced and vertically disposed partitions or ribs 42, 42 extend between the top and bottom walls 32 and 34, respectively, to define a plurality of narrow compartments 44, 44 in the rear of the housing 12. Each rib 42 defines a forwardly facing slide surface 46, an upwardly facing abutment surface 48, and a downwardly facing abutment surface 50 best shown in FIG. 5. A generally U-shaped rearwardly opening wall 52 extends transversely between each adjacent pair of ribs 42, 42 and between the outermost ribs and the side walls 36, 36 to support the various electrical contacts. Each wall 52 has a central opening 53 extending therethrough, as shown in FIG. 5. Each compartment 44 is adapted to receive and retain an associated set of contacts 20. The switch housing may be formed with any number of compartments, the number of compartments corresponding to the number of sets of contacts to be accommodated. The illustrated housing 12 has seven compartments 44, 44. Accordingly, the switch 10 may, if desired, be provided with seven sets of contacts. It will be evident from the description which follows that a switch constructed in accordance with the present invention and having nine sets of contacts will have full code capability, when used as a keyboard switch in a computer installation or the like.

The stationary contacts 22 and 24 are preferably formed at opposite ends of an elongated bus member or contact spring 54. The central portion of the contact spring 54 has a parti-cylindrical configuration and is re-

ceived and retained in snap engagement in an associated opening 53, as shown in FIG. 5. A typical upper contact member 26, best shown in FIG. 5 is formed from an elongated strip of spring metal and is held in the housing by heat sealed portions of the housing adjacent the contact. It has a terminal 56 formed at the lower end thereof, a vertically extending central portion 58 disposed in an associated compartment 44 at the rear of the housing 12 and an upper or free end portion 60 bent forwardly to a cantilevered position with respect to the portion 58. The free end portion 60 extends forwardly for some distance beyond the slide surfaces 38, 38 and has an area or contact point 62 thereon for engaging the contact 22 in closed position. The contact member 26, shown in its open position in FIG. 5, is spring biased toward its closed position, the latter position being indicated by broken lines. When the contact member 26 is in its closed position the free end portion 60 is disposed below the abutment surface 50.

All of the lower contact members 28, 28 are preferably cut or blanked from a single piece of spring metal so that the contact 28 in each contact set 20 is electrically connected to the contacts 28, 28 in the other of the sets by a transversely extending connecting portion 66, best shown in FIG. 6. The contact members 28, 28 have a generally U-shaped configuration as viewed in FIG. 5 and are retained in the housing 12 by a locking bar 68 which extends transversely through the housing and cooperates with the wall 52. Each contact member 28 has a free end portion 70 which extends forwardly beyond the slide surfaces 46, 46. Each contact member 28 is spring biased toward an associated stationary contact 24 and has an area or contact point 72 thereon for engaging the latter stationary contact in a closed position. When the contacts 28, 28 are in closed position, the free end portion 70 of each contact is disposed above the abutment surface 48, as shown in FIG. 5, the closed position being indicated by broken lines.

The shuttle 16 is adapted for free vertical sliding movement in the housing in engagement with the slide surfaces 46, 46 between first and second positions respectively indicated by full and broken lines in FIG. 5. The shuttle may take various forms but preferably, and as shown, it comprises a frame 74 made from a suitable non-magnetic electrical insulating material such as nylon. The shuttle has a permanent magnet 76 centrally mounted therein. Abutment surfaces 78 and 80 respectively formed along the upper and lower edges of the frame 74 are provided for engaging corresponding abutment surfaces 50 and 48 to limit the travel of the shuttle and for engaging the free end portions 60 and 70 of the movable contact members 26 and 28. The frame 74 has a central projection or nose 82 formed on the lower edge thereof extending below the abutment surface 80 and adapted to be received between a pair of ribs 42, 42 when the shuttle is in its first position. The nose 82 engages the free end portion of the contact members 28 in the center set 20 for a purpose which will be hereinafter further evident.

The push slide 14 is supported in the housing forwardly of the shuttle 16 and retained therein by a cover 33 which provides a closure for the housing. The slide 14 is arranged for sliding movement in engagement with the slide surfaces 38, 38 between first and second operating positions respectively indicated in full and broken lines in FIG. 5. It includes a generally rectangu-

lar frame 34 disposed within the housing. The frame 34 has an integral upwardly extending shank 36 formed thereon and projects from the housing through an opening in the upper wall 32. An operating button 38 is mounted on the upper end of the shank 36. When the switch of the present invention is used in a keyboard installation a means is provided to bias the push slide to its first position. In the illustrated case a coil spring 90 surrounds the shank 86 and acts between the operating button 83 and the top wall 32 to bias the slide 14 to and retain it in its first position. Upwardly facing abutment surfaces 92, 92 at the upper end of the frame 84 engage the free end portions 60, 60 when the push slide 14 is in its first position to retain the contact members 26, 26 in open position. Shoulders 94, 94 spaced upwardly from the abutment surfaces 92, 92 and located at opposite sides of the frame engage the upper wall 32 when the slide 14 is in its first position, as shown in FIG. 3. The lower surface of the frame 84 has a downwardly facing abutment surface 96 which engages the abutment surfaces 40, 40 when the slide is in its second position. A permanent magnet 98 retained in a central recess in the frame 84 is arranged to coact with the magnet 76 carried by the shuttle so that movement of the push slide 14 in one direction and toward one of its operating positions and to a critical cross-over point with respect to the magnet 76 causes movement of the shuttle 16 in an opposite direction and toward a corresponding one of its switching positions. More specifically, the polarity of the magnet 98 is arranged with respect to the polarity of the magnet 76 to provide magnetic repulsion therebetween. Thus, the magnet 98 exerts a repelling force on the magnet 76 when the push slide 14 is in its first position tending to bias the shuttle 16 toward and retain it in its first position. Conversely, when the push slide 14 is in its second position, the shuttle 16 is biased to and retained in its second position by magnetic repulsion. Since the push slide 14 and the shuttle 16 are confined within the housing 12 the magnetic forces operate to hold the shuttle 16 in one of its two switching positions when the push slide 14 is at rest in a corresponding one of its two positions.

Considering now the operation of the switch 10 and referring to the schematic diagram of FIG. 8, three sets of contacts are shown and are oriented to correspond to the contact sets 20, 20 of the switch 10 as shown in FIGS. 3 and 4. In FIG. 8 the contact sets are respectively designated at 20a, 20b, and 20c. The terminal 56a is shown connected to a power source or battery 100 and is designated the input terminal whereas the terminals 56b and 56c are designated output terminals. When the shuttle 16 is in its first position, as shown, the contacts 20a-20c are held open by the shuttle and the contacts 26a-26c are held open by the push slide (not shown) which is also in its first position. When the operating button 38 is depressed, initial downward movement of the push slide 14 causes the contacts 26a-c to close. However, no movement of the shuttle 16 occurs until the push slide 14 reaches a critical position or cross-over point relative to the shuttle. When the latter condition is attained, the shuttle 16 moves upwardly toward its second position permitting the contacts 28a-28c to close. As the shuttle 16 approaches its second position, it simultaneously engages and opens the upper contacts 26a-c. It will now be evident that in the interval during which the shuttle moves from its first to

its second position, all of the movable contacts are closed so that a pulse output occurs at the terminals 26b and 26c. The duration of the output pulse is determined by the mass of the shuttle and its vertical dimension. Thus, the duration of the output pulse may be altered by varying the aforesaid shuttle characteristics. Further referring to FIG. 8, it will be noted that as the shuttle 16 moves from its first to its second position, the nose 82 holds the contact 28a open until after the contacts 28b and 28c have closed. This arrangement assures a simultaneous pulse output at the terminals 56b and 56c when the contact 28a closes.

When the operating button 88 is released the push slide 14 is biased toward its second position by the spring 90. During the initial upward movement of the push slide the shuttle 16 remains in its second position and holds the contacts 26a-c open. The shuttle 16 remains at rest in its second position until the push slide 14 reaches a critical cross-over point with respect to the shuttle at which time the shuttle 16 moves downwardly toward its first position. The abutment surfaces 92, 92 engage the free end portions of the upper contacts 26a-c before the shuttle 16 starts its downward movement. Thus, the upper contacts 26a-c are held open at all times during the return movement of the push slide to its first position. Accordingly, the switch 10 delivers a single output pulse at the terminals 56b and 56c during one complete operating cycle of the push slide 14.

The switch 10 may be modified to alter its switching characteristics by reducing the lengths of the free end portions of selected movable contacts in various contact sets to remove the selected contacts from the influence of either or both the push slide 14 and the shuttle 16. Referring now to the upper contact 26 as it appears in FIG. 5, it will be noted that if the free end portion 60 terminates at the line indicated at A and rearwardly of the slide surfaces 38, 38 the contact member 26 will no longer extend into the path of push slide 14. Further, if the free end portion 60 terminates at the line B rearwardly of the slide surfaces 46, 46 the contact member 26 will no longer be in the path of the shuttle and will remain in its closed position at all times. Referring now to the contact member 28, if the free end portion 70 terminates at the line C, it will remain in closed position at all times free of the influence of the shuttle 16. In the schematic diagrams which follow, various modified forms of the switch 10 are illustrated, the points at which the free end portions of the various movable contacts terminate being designated by the letters A, B and C.

Referring now to FIG. 9, a modified form of the switch 10 is illustrated and designated generally at 10c. The switch 10c is similar to the switch 10 except that the free end portions of upper contact members 26a-c terminate at A and are not engaged by the push slide 14. When the shuttle is in its first position, the contacts 26a-c are closed and the contacts 28a-c are held open by the shuttle 16. Depressing the operating button 88 causes the shuttle 16 to move to its second position allowing the contact members 28a-c to close. As the shuttle 16 approaches its second position, it engages and opens the upper contact members 26a-c. Thus, a pulse output occurs at the terminals 56b and 56c during the interval of shuttle movement when all of the contacts are closed. The lower contact members 28a-28c remain in closed position while the shuttle remains in

its second position. Return movement of the push slide 14 to its first position causes the shuttle 16 to return to its first position, thereby permitting the contact members 26a-c to close. All of the contact members are closed in the interval during which the shuttle travels downwardly to its first position. The lower contact members 28a-c are opened by return movement of the shuttle 16 to its first position. Thus, the switch 10 provides two output pulses at the terminals 56b and 56c during one complete switching cycle.

In FIG. 10, a form A modification of the switch 10 is illustrated and designated by the reference numeral 10d. The switch 10d is normally open when the push slide 16 is in its first position, so that no output occurs at the terminals 56b and 56c. Contact members which are closed at all times are designated by the letters B and C, respectively. The contact members 28b and 28c are held open by the shuttle 16 when it is in its first position. When the operating button 88 is depressed, the shuttle 16 moves to its second position permitting the contact members 28b and 28c to close. The latter contact members remain closed to provide constant output at the terminals 56b and 56c until the shuttle is returned to its first position by reverse movement of the push slide. In the illustrated embodiment 10 the biasing spring 90 acts to return the depressed push slide to its first position. However, in the modified form of the switch designated 10d and in the other modified forms hereinafter described it may be desirable to eliminate the spring 90 and the operating button 88 so that the push slide is adapted for push-pull operation.

Referring now to FIG. 11, a form B modification of the switch 10 is illustrated and designated generally at 10e. The switch 10e is normally closed, that is, a constant output occurs at the terminals 56b and 56c in response to constant input at the terminal 56a when the push slide 14 is in its first position. When the operating button 88 is depressed the shuttle 16 moves to its second position allowing the contact members 28b and 28c to open. The latter contact members remain open as long as the shuttle 16 remains in its second position.

A form C modification of the switch is diagrammatically illustrated in FIG. 12 and designated generally at 10f. The contact member 28c is open when the shuttle 16 is in its first position and all other contact members are closed. Accordingly, constant output occurs at the terminal 56b in response to constant input at the terminal 56a. Depressing the operating button 88 causes the contact member 28c to close and the contact member 26b to open resulting in a reversal of output at the terminals 56b and 56c, so that terminal 56c becomes the output terminal.

Various modified switch contact arrangements have been illustrated, however, it should be evident that the switch 10 may be further adapted to attain additional operational characteristics, as, for example, a pulse output at one terminal and a constant output at another terminal upon operation of the push slide. If the switch 10 is provided with additional sets of contacts, still further switching combinations are possible and such modified forms of the switch are contemplated within the scope of the present invention. In practicing the invention it is desirable that the operational characteristic to be attained be chosen before the switch is assembled so that the switch may be assembled using contact members of appropriate length. However, it will be evident that the operational characteristics of an assem-

bled switch may be altered by simply severing the free end portions of selected contact members, as required.

In FIG. 7, another modified form of the switch 10 is shown and designated generally by the reference numeral 10g. The switch 10g is constructed and arranged to provide wiping engagement between its fixed and movable contacts to reduce arcing when the contact points make and break. The switch 10g has a shuttle 16g which includes an inclined cam surface 102 at the lower rear edge thereof. The movable contact 24g has a parti-cylindrical configuration to provide a cam surface 104 for engaging the cam surface 102 and is spring biased into engagement with the shuttle 16g. As the shuttle 16g moves toward its first or full line position, the coengaging cam surfaces 102 and 104 act to bias the movable contact 24g rearwardly to effect wiping engagement between the contact 24g and the contact member 28g to reduce arcing therebetween. The upper contacts may, if desired, be arranged to cooperate with the shuttle in a similar manner.

The switches of the present invention provide substantially bounce-free contact engagement. Since the mass of the movable shuttle is substantially greater than the mass of the movable contact member or members which it controls, substantially all of the energy stored in each movable contact when it is in its open position is dissipated before the contact attains its closed position. Referring to FIG. 5, for example, it will be evident that when the shuttle 16 is released for upward movement by depressing the operating button 38, substantially all of the energy stored in the open contact member 28 will be absorbed or dissipated in aiding the magnetic force to bias the shuttle 16 upwardly toward its second position. Thus, the fixed and movable contacts 24 and 28 make or close with substantially no bounce occurring therebetween. This arrangement is highly desirable in that it facilitates positive switching characteristics. Arcing between the contacts is virtually eliminated, prolonging contact life.

The aforesaid bounce-free contact characteristic is advantageously utilized in a further embodiment of the invention wherein piezoelectric effect is employed to provide a switch having a pulse output. Referring now to FIG. 13, another switch embodying the present invention is indicated generally at 10h. The switch 10h is similar in many respects to switch 10 previously described and includes a housing 12h, a push slide 14h and a shuttle 16h. However, the switch 10h differs from the switch 10 in the general construction and arrangement of its contacts. More specifically, the switch 10h includes an electro-mechanical transducer or piezoelectric crystal indicated generally at 106 which serves both as a stationary contact and a source of electromotive force. Piezoelectric crystals of various types may be used in practicing the invention. However, a CLEVITE High Generating Sensitivity Unit PZT-5, manufactured by Clevite Manufacturing Company has proven particularly suitable for this purpose. The crystal 106 is mounted on the housing 12 and has plates 108 and 110 associated with opposite faces thereof. An electrically conductive member 112 supported on the housing and electrically connected to the plate 108 includes a terminal portion 114 exposed externally of the case 12h. A movable spring contact member 116 mounted in cantilever position in the case and controlled by the movable shuttle 16h moves between opened and closed positions relative to the plate 110

which provides a stationary contact surface. The contact member 116 has a contact point 118 formed thereon and adapted for striking engagement with the plate 110 and a terminal portion 120 exposed externally of the housing 12h. When the shuttle 16h is released for upward movement by a corresponding downwardly movement of the push slide 14h, the contact point 118 moves into striking engagement with the plate 110 to provide an electrical output pulse at one of the terminals in a manner well known in the art. A single pair of lower contacts is shown and described for clarity of illustration. However, it will be evident that the switch 10h may be provided with additional lower contacts and that one or more pairs of upper contacts, constructed and arranged in a manner similar to the lower contact, may also be provided. It will be further evident that this electro-mechanical transducer arrangement may also be used in combination with various other contact arrangements shown and described to produce a further variety of switching characteristics and such arrangements are contemplated within the scope of the present invention.

I claim:

1. An electrical switch comprising a shuttle element supported for free movement along a predetermined path in one and an opposite direction between one and another switching position, switch actuating means including an operating element supported for movement along another predetermined path relative to said shuttle element between one and another operating position and operable upon movement of said operating element toward either of its operating positions and through a critical position relative to said shuttle element to release said shuttle element from one of its switching positions and urge it to the other of its switching positions, and at least one set of electrical contacts, said one set including one stationary contact and one movable contact movable between an open and a closed position relative to said one stationary contact and biased toward its closed position, said one movable contact having a part thereof disposed in the path of said shuttle element, said one set including another stationary contact and another movable contact movable between an open and a closed position relative to said other stationary contact and biased toward said closed position, said other movable contact having a part thereof disposed in the path of at least said shuttle element, said shuttle element during only a portion of its travel in said one direction and toward said one switching position engaging said one movable contact part to move said one movable contact to its open position, said shuttle element in said one switching position maintaining said one movable contact in its open position, said shuttle element during only a portion of its travel in said other direction engaging said other movable contact part to move said other movable contact to its open position, said shuttle element at the end of its travel in said other direction maintaining said other movable contact in its open position, said shuttle element being out of engagement with both of said movable contacts during a portion of its travel between its positions, said one and said other movable contacts being simultaneously in said closed positions during a portion of the travel of said shuttle in at least one of its directions of travel.

2. An electrical switch as set forth in claim 1 including a plurality of sets of electrical contacts and wherein



said other movable contact in at least one of said sets has a part thereof disposed in the path of only said shuttle element and said other movable contact in at least another of said sets has a part thereof disposed in the paths of both said operating element and said shuttle element.

3. An electrical switch as set forth in claim 1 including a plurality of sets of electrical contacts and wherein said one movable contact in each of said sets is electrically connected to said one movable contact in the other of said sets.

4. An electrical switch as set forth in claim 3 including at least three sets of electrical contacts and means for maintaining said one movable contact associated with one of said sets in its open position until each said one movable contact associated with the other of said sets is biased to its closed position when said shuttle element moves from said one to said other switching position.

5. An electrical switch as set forth in claim 4 wherein said means for maintaining said one movable contact in open position comprises a projection on said shuttle element.

6. An electrical switch as set forth in claim 1 wherein said other movable contact part is disposed only in the path of said shuttle element and both said one and said other movable contacts are simultaneously in closed position during a portion of said shuttle element travel between said one and said other switching position.

7. An electrical switch as set forth in claim 1 wherein said other movable contact part is disposed in the path of both of said elements, and said operating element engages said other movable contact part to maintain said other movable contact in its open position when said shuttle element is in said one switching position and during the first portion of the movement of the operating element from its said one to said another operating position.

8. An electrical switch as set forth in claim 1 including a plurality of sets of electrical contacts, said one and said other movable contact in each of said sets comprising an elongated contact member supported in cantilever position relative to said shuttle element and said operating element and having a free end portion extending outwardly beyond an associated one of said stationary contacts and into the path of travel of at least one of said elements, each said free end portion comprising said part of an associated movable contact member, each said contact member being adapted to have said free end portion severed therefrom whereby the operational characteristics of said switch may be altered by severing at least one of said free end portions.

9. An electrical switch as set forth in claim 1 including a housing, said shuttle being supported for movement in said housing, and an elongated bus member supported in said housing near said shuttle and extending in a direction generally parallel to the path of shuttle travel, said one stationary contact and said other stationary contact being respectively formed by opposite end portions of said bus member.

10. An electrical switch as set forth in claim 9 wherein each said movable contact comprises an elongated contact member supported in cantilever position by said housing and relative to said elements and said part comprises a free end portion of said contact member disposed in said housing.

11. An electrical switch as set forth in claim 9 wherein said bus member is retained in snap-engagement in said housing.

12. An electrical switch as set forth in claim 1 including means for biasing said operating element toward one of its operating positions.

13. An electrical switch as set forth in claim 1 wherein each said movable contact comprises an elongated contact member supported in cantilever position relative to said elements and said part thereof comprises a free end portion of said contact member.

14. An electrical switch as set forth in claim 1 including means for effecting wiping engagement between each said movable contact and an associated stationary contact when said movable contact moves between its open and closed position relative to said associated stationary contact.

15. An electrical switch as set forth in claim 14 wherein one of said elements and each said associated stationary contact have coengaging cam surfaces thereon comprising said means for effecting wiping engagement.

16. An electrical switch as set forth in claim 1 wherein said actuating means includes a pair of permanent magnets, one of said magnets carried by said operating element and the other of said magnets carried by said shuttle, the polarity of said one magnet arranged with respect to the polarity of said other magnet to provide magnetic repulsion therebetween whereby movement of said operating element in one direction and operating element "A" through said critical position causes said shuttle element to move from one of its switching positions and in an opposite direction to its opposite switching position.

17. An electrical switch as set forth in claim 1 wherein said stationary contact comprises an electro-mechanical transducer.

18. An electrical switch as set forth in claim 17 wherein said electro-mechanical transducer comprises a piezoelectric crystal.

19. The combination as set forth in claim 1 wherein said electrical switch comprises a keyboard switch including a housing, said shuttle element and said operating element are supported for rectilinear sliding movement in said housing, and said operating element includes a shank which projects from said housing and has a push button thereon.

20. An electrical switch as set forth in claim 19 wherein said actuating means comprises one magnet carried by said operating element and another magnet carried by said shuttle element, said magnets being disposed in closely spaced parallel relation with like poles opposed to each other so that movement of said operating element in either direction will cause said shuttle element to move in the opposite direction.

21. An electrical switch as set forth in claim 20 wherein said one and other operating positions respectively correspond to released and depressed positions of said push button relative to said housing and said switch includes means for biasing said operating element toward its one operating position.

22. An electrical switch as set forth in claim 1 including a housing having a plurality of partitions defining a plurality of compartments therein and having a plurality of sets of electrical contacts, each of said sets being received and supported in an associated one of said compartments.

23. An electrical switch as set forth in claim 22 wherein said shuttle element and said operating element are supported for rectilinear sliding movement in said housing forwardly of said compartments, each said movable contact comprises an elongated contact member supported in cantilever position in an associated compartment, and each said contact member has a free end portion which projects forwardly from said associated compartment and defines said part thereof.

24. An electrical switch as set forth in claim 1 wherein said other movable contact is disposed in the path of both of said elements, said operating element in said one operating position maintains said other movable contact in said open position, said operating element upon movement from said other to said one operating position engages said other movable contact to maintain it in its open position before it is allowed to move to its closed position by the movement of said shuttle from said other to said one switching position, and said one and said other movable contact are simultaneously in said closed position only during a portion of the travel of said shuttle element from said one to said other switching position.

25. An electrical switch as set forth in claim 1 including a housing and having a plurality of said sets of electrical contacts disposed within said housing and wherein said one and said other stationary contact in each of said sets are electrically connected within said housing, said one movable contact in each of said sets is electrically connected within said housing to said one movable contact of the other of said sets, and each of said other movable contacts includes an associated terminal exposed externally of said housing.

26. An electrical switch as set forth in claim 1 wherein said operating element and said shuttle element are supported to travel in parallel paths.

27. An electrical switch comprising a shuttle element supported for free movement along a predetermined path in one and an opposite direction between first and second switching positions, switch actuating means including an operating element supported for movement along another predetermined path relative to said shuttle element between first and second operating positions and operable upon movement of said operating element toward either of its operating positions and through an intermediate critical position relative to said shuttle element to release said shuttle element from one of its switching positions and urge it to the other of its switching positions, and at least one set of electrical contacts, said one set including a first stationary contact and a first movable contact movable between an open and a closed position relative to said stationary contact and biased toward its closed position, said first movable contact having a part thereof disposed in the path of said shuttle element, said one set of contacts including a second stationary contact and a second movable contact movable between an open and a closed position relative to said second stationary contact and biased toward its closed position, said second movable contact having a part thereof disposed in the paths of both of said elements, said operating ele-

ment in its first position engaging said second movable contact part to hold said second movable contact in its open position while the shuttle element travels to its first position, said shuttle element during only a portion of its travel to its first position engaging said first movable contact part to move said first movable contact to its open position and maintain it there, said shuttle element during only a portion of its travel to its second position as said operating element travels toward its second position engaging said second movable contact part to move said second movable contact to its open position and maintain it there, said first and second movable contacts being simultaneously in closed positions during a portion of the travel of said shuttle element from its first to its second position, said operating element during only the latter portion of its travel back to its first position engaging said second movable contact part while said second movable contact is maintained in its open position by said shuttle element, and said operating element then maintaining said second movable contact in its open position during the entire travel of said shuttle element from its second position back to its first position.

28. An electrical switch as set forth in claim 27 wherein said operating element and said shuttle element are supported to travel in parallel paths.

29. An electrical switch as set forth in claim 28 wherein said actuating means comprises a pair of magnets, one of said magnets being carried by said operating element and the other of said magnets being carried by said shuttle element, said magnets being disposed in closely spaced parallel relation with like poles opposed to each other so that movement of said operating element in either direction will cause said shuttle element to move in the opposite direction.

30. An electrical switch as set forth in claim 29 including means for constantly biasing said operating element toward its first position.

31. The combination as set forth in claim 29 wherein said electrical switch comprises a keyboard switch including a housing, said shuttle element and said operating element are supported for rectilinear sliding movement in said housing and said operating element includes a shank which projects from said housing and has a push button thereon.

32. An electrical switch as set forth in claim 31 wherein said first and second operating positions respectively correspond to released and depressed positions of said push button relative to said housing and said switch includes means for biasing said operating element toward its first operating position.

33. An electrical switch as set forth in claim 27 including a plurality of sets of electrical contacts, one of said first contacts in each of said sets being electrically connected to one of said first contacts in the other of said sets, and means for maintaining said first movable contact associated with one of said sets in its open positions until said first movable contact associated with each of the other of said sets moves to its closed position.

\* \* \* \* \*

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,739,310 Dated June 12, 1973

Inventor(s) Lloyd J. Lapointe

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

- Col. 1, line 50. "Figs." should be --Fig.--
- Col. 2, line 28. Delete "A"
- Col. 3, line 63. Delete "33" and substitute --83--
- Col. 4, line 1. "34" both occurrences should be --84--
- Col. 4, line 2. "36" should be --86--
- Col. 4, line 4. "38" should be --88--
- Col. 4, line 5. "36" should be --86--
- Col. 4, line 10. "83" should be --88--
- Col. 4, line 57. "38" should be --88--
- Col. 4, line 30. "38" should be --88--

Claim 16, Col.

10, line 30. After "and" delete "operating element 'A'"

Signed and sealed this 25th day of December 1973.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

RENE D. TEGTMEYER  
Acting Commissioner of Patents

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