Jan. 1, 1957 B. V. KORRY 2,776,348

ELECTRICAL SWITCHES

Filed April 26, 1952 2 Sheets-Sheet 1

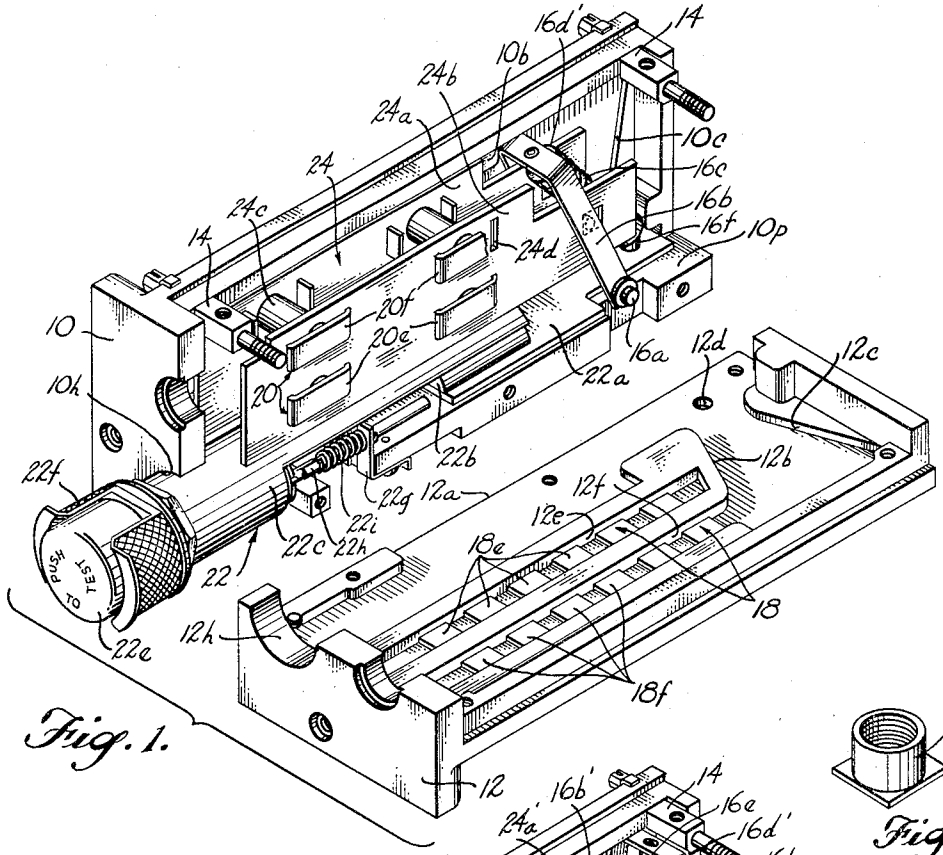


Fig. 1.

Fig. 11.

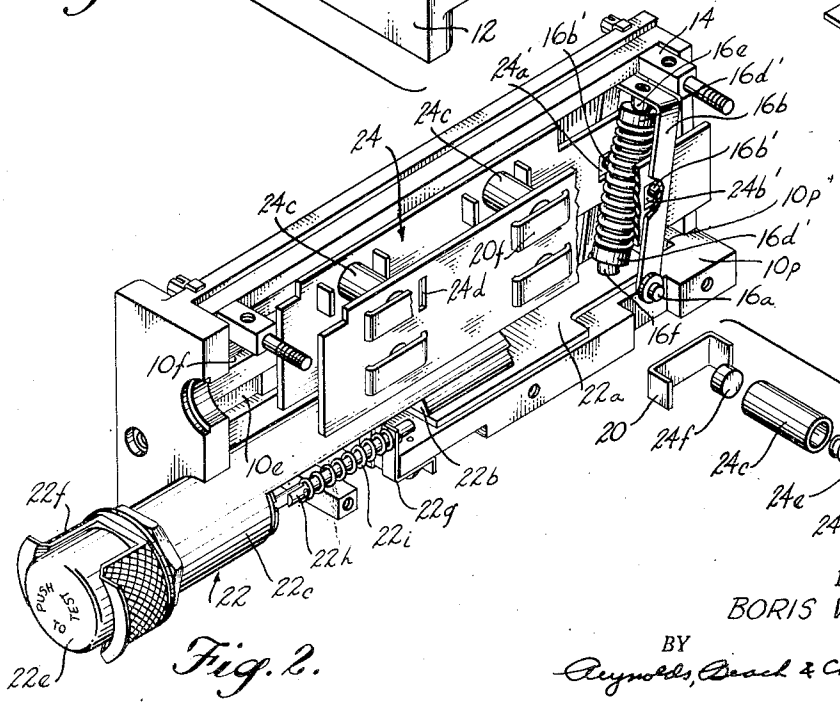


Fig. 2.

Fig. 10.

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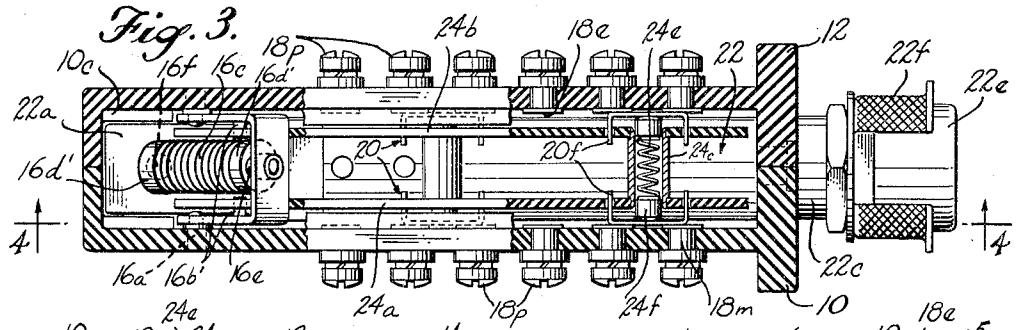
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Jan. 1, 1957 B. V. KORRY 2,776,348

ELECTRICAL SWITCHES

Filed April 26, 1952 2 Sheets-Sheet 2



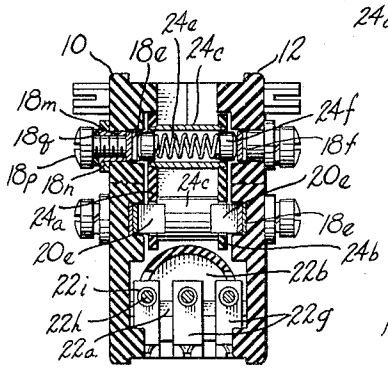


Fig. 5.

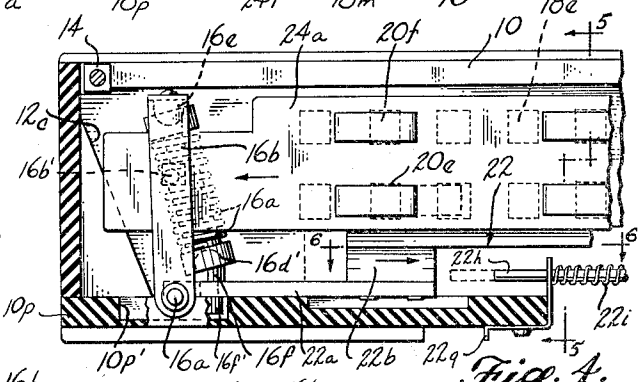


Fig. 4.

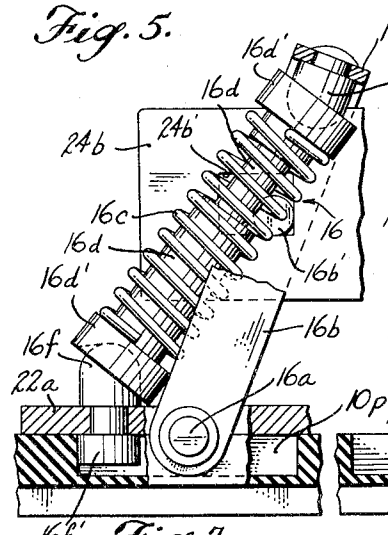


Fig. 7.

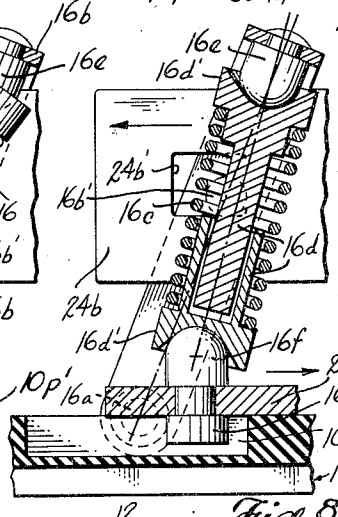


Fig. 8.

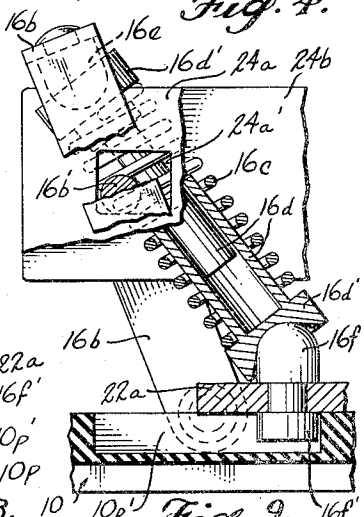


Fig. 9.

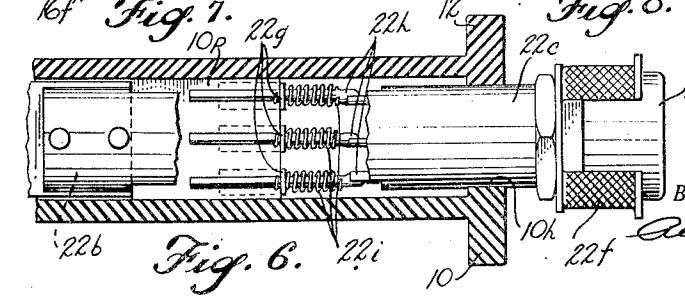


Fig. 6.

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ELECTRICAL SWITCHES

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Application April 26, 1952, Serial No. 284,527

11 Claims. (Cl. 200—76)

This invention relates to electrical switches and more particularly concerns an improved gang switch of the double-throw, multiple-pole, snap-action type.

A general object of this invention is to provide such a switch in which greater compactness and simplified internal construction are achieved while external contact terminals are arranged accessibly and in a manner best suited for convenient circuit-wiring purposes. Preferably, and as herein described, such terminals and the corresponding internal switch contacts are arranged in straight parallel rows for greater accessibility, convenience and orderliness in the placement and arrangement of wires connected to the switch.

Additional objects concerning such a switch include a rugged and durable construction, reliable snap-action operation of the movable shuttle carrying the slidable contact shoes, snap movement of the shuttle effected near the end of a toggle actuator movement, and reduction of manufacturing costs through integration of parts and minimizing the necessity of close tolerances and critical relationships in the switch construction.

A more specific object of the invention is a self-accommodating or adjusting shuttle and contact shoe arrangement tending to equalize contact pressure of the switch contact shoes, and thereby equalize wear and insure longer and more satisfactory service of the switch.

In accordance with this invention a shuttle member guided for free lineal reciprocative movement in a switch casing is actuated between opposite limit positions by means of a spring-toggle mechanism including a slidable actuating unit guided for movement in the housing parallel to the shuttle member and interconnected therewith by an over-centering toggle spring and yoke assembly, the yoke ends swinging on fixed pivots in the housing and being coupled by a slot-and-pin connection to the shuttle member. Rows of insulated switch contacts mounted in opposite inner walls of the switch housing extend parallel to the line of movement of the shuttle member and are engaged in a selective manner by slidable contact shoes carried by such shuttle member as it is actuated between its limit positions through manual shifting of the reciprocative actuating unit one way or the other. Such slidable contact shoes are retained on the shuttle member for free movement laterally thereof, although, of course, constrained to follow the correct row of contacts to which they individually appertain. For each contact shoe engaging contacts on one side of the switch housing there is a corresponding shoe engaging similar contacts on the opposite side of such housing, with a common contact pressure spring interposed between and pressing such opposed contact shoes oppositely against their respective stationary switch contacts. In effect, therefore, the pair of contact shoes and pressure spring "float" between opposite rows of stationary switch contacts, resulting in a tendency for the contact pressures to be equalized.

Preferably the switch casing or housing is of generally rectangular cross-sectional form, and the shuttle member

is composed of spaced parallel insulating plates having guide apertures therein slidably receiving the legs or bent ends of U-shaped contact slide shoes. The spacer elements maintaining predetermined separation of the insulating plates preferably comprise tubes in which the slide-shoe pressure springs are housed, the rows of stationary contacts engaged by the slide shoes being inset in the opposite inner side walls of the housing, in the base of channel grooves constituting guides for such U-shaped slide shoes.

As a result of the arrangement, the stationary contact terminals of the switch lie in straight parallel rows on opposite outer sides of the switch housing and are therefore readily accessible for wiring purposes and may simply comprise machine screws threaded in the backs of the switch contacts.

The foregoing and other features, objects and advantages of the improved switch will become more fully evident from the following detailed description of the presently preferred form thereof based upon the accompanying drawings. It will be understood, however, that certain and basic features of the improved switch construction may assume different physical forms and vary somewhat as to arrangement and detail within the scope of the invention and that the advancement which the invention affords is not necessarily limited to the illustrative form.

Figure 1 is a perspective view of the improved switch with one side of the switch housing removed from the other, and with certain minor parts removed, the actuating plunger or unit of the switch being shown in one limit position.

Figure 2 is a perspective view of the switch with one section of the housing removed from view and the actuating plunger in its opposite limit position relative to that in Figure 1.

Figure 3 is a top view of the switch with parts broken away in sectional manner to illustrate interior details.

Figure 4 is a longitudinal section taken on line 4—4 in Figure 3 with the right-hand portion thereof broken away, and with parts about to snap over into the opposite limit position.

Figure 5 is a transverse sectional view taken on line 5—5 in Figure 4.

Figure 6 is a longitudinal section taken on a line which corresponds in location to the line 6—6 in Figure 4, but which extends through the right-hand portion of the switch as shown in Figure 3, to illustrate certain details of the switch actuating unit not appearing in Figure 4.

Figures 7, 8 and 9 are operational side views of the spring-toggle mechanism in the switch and illustrate the principle of snap action involved.

Figure 10 is an exploded perspective view of an assemblage including a shuttle-carried contact shoe pressure spring and a pair of contact shoes acted upon in common by this spring to engage oppositely located stationary contacts in the switch housing.

Figure 11 is a perspective view of a switch contact element.

The switch housing is preferably formed in three parts, a first side section **10** (Figure 1), a bottom section **10***p* shown connected to the side section **10**, and a second side section **12**, and is generally of rectangular elongated form on all sides. These housing parts are made of Bakelite or other strong and durable insulating material preferably capable of being machined and of being molded readily in the desired configuration illustrated. Metal screws, not shown, and special fastener bolts **14** are employed to secure the housing parts together with the edge **12***a* in Figure 1 being the lower edge of the removable section **12** as it fits together with the remaining sections **10** and **10***p*.

In the molding of the plastic housing section 12 suitable ribs and bosses are formed on its inside wall to provide various stops, guides and locating elements for the switch parts. For instance the convergingly oriented rib edges 12*b* and 12*c* form the sides of a toggle-yoke well and constitute stops establishing the opposite limits of swing of the toggle yoke 16*b*. Similar edges 10*b* and 10*c* are formed in identical locations on the inner wall of the complemental housing section 10, both housing sections having journal holes 12*d* receiving the respective pivot pins 16*a* carried by the ends of the swingable U-shaped yoke 16*b*.

In the illustrated case two parallel grooves 12*e* and 12*f* are formed by ribs on the inside wall of the housing section 12 and similar grooves 10*e* and 10*f* in corresponding locations on the opposite inner wall of the main housing section 10 (Figures 1 and 2). Two rows of spaced electrical contacts 18 are set into the bases of the respective grooves and the groove side walls serve as guides for the slide shoes 20 engageable with such contacts, as will be more fully explained hereinafter.

As part of an actuating unit 22, a slide plate 22*a* is adapted to slide freely lengthwise of the housing upon its flat inside bottom wall, formed by the bottom section 10*p* (Figures 1 and 4). This slide plate is riveted or otherwise fastened to a cylindrical segment 22*b* carried by the inner end of a tubular actuating plunger 22*c*. The plunger is guided for longitudinal reciprocation in the housing through a front-end aperture therein formed by complemental semi-circular molded concavities 10*h* and 12*h* in the respective housing parts. The maximum width of the slide plate 22*a* between opposite longitudinal edges is only slightly less than the internal width of the housing, so that these edges receive a measure of lateral guidance from the housing side walls during longitudinal reciprocation of the actuating unit 22, the type of movement by which the switch is actuated between opposite switching positions, as will more fully appear hereinafter.

A switch shuttle member 24 carrying the slide contact shoes 20 selectively engageable with the stationary contacts 18 is likewise guided in the housing for longitudinal reciprocation parallel to that of the actuating unit 22. This contact shoe carrier or shuttle member is formed of two insulating plates 24*a* and 24*b*, maintained in parallel spaced relationship by the short spacer tubes 24*c* extending between the insulating plates at the locations of contact shoe pairs. The ends or legs of the U-shaped contact shoes 20 slide in rectangular apertures 24*d* in the insulating plates and by their sliding fit in such apertures permit lateral movement of the contact shoes toward and from the sides of the shuttle member 24, that is in a direction normal to their respective planes of engagement with the rows of stationary contacts 18. A spring 24*e* is received in each of the tubular spacers 24*c*, with insulating disks 24*f* (Figure 10) interposed between the respective ends of the spring and the back sides of paired contact shoes 20 associated therewith. The arrangement is such that pressure of such paired opposite contact shoes against their respective stationary contacts 20 in any position of the shuttle member 24 longitudinally of the housing is established by a single spring 24*e* and is therefore equalized on opposite contacts. This is true because of the fact that the paired slide shoes 20, the spring 24*e* and the insulating disks 24*f* (Figure 10) are all slidably movable in and relative to the shuttle member at right angles to the plane of contact of the stationary contacts 18. In effect, therefore, the pairs of spring-urged contact shoes float between opposite sides of the housing and their carrier or shuttle member 24 serves merely as a positioner of the slide contact shoes 20 with relation to each other and to the stationary contacts 18 lengthwise of the housing.

Guidance of the shuttle member 24 for longitudinal movement in turn is effected largely by the lateral constraint which it receives from the slide shoes 20 as the latter are constrained to travel in their respective housing wall grooves 10*e*, 10*f*, 12*e* and 12*f*. However, the upper edges of the insulating plates 24*a* and 24*b* are adapted to slide along the inside upper wall of the housing and their sides against the faces of housing wall ribs forming grooves 10*e*, 10*f*, 12*e*, and 12*f*, for additional guidance purposes.

A spring-toggle mechanism 16 including the yoke 16*b* swingable on fixed pivots 16*a* as already mentioned, operatively connects the actuating unit 22 to the shuttle member 24 to impart the desired snap action and detaining spring effect in the operation of the switch. This spring-toggle mechanism additionally includes (Figures 7 to 9) the compression spring 16*c*, an extensible spring bushing 16*d* of a telescoping nature with enlarged ends 16*d'* flanged to constitute spring seats with outer end faces recessed, and convexly rounded toggle bearings 16*e* and 16*f*, one fixed to the transverse or upper side of the yoke 16*b* and the other to the upper face of the slide plate 22*a* near the latter's inner end (Figures 1 and 7). Pressure of the preloaded spring 16*c* continuously urges the extensible bushing ends 16*d'* oppositely and into firm retaining contact with the opposed bearings 16*e* and 16*f*, carried by the yoke and slide plate, respectively. The bearing 16*e* carried by the slide plate (Figure 7) is secured thereto by a rivet having the large cylindrical head 16*f'* below the slide plate 22*a* and slidable in a longitudinal slot 10*p'* in the housing extension 10*p*. The length of the slot is such, and its ends are so located, that such ends constitute stops, limiting travel of the slide plate 22*a* in desired extreme positions of the actuating unit 22. On the other hand, the limit positions of swing of the yoke 16*b* are established by the raised edges 10*b*, 10*c*, 12*b* and 12*c*, as previously mentioned (Figure 1).

As shown best in Figure 2, the yoke 16*b* straddles the shuttle member 24 as well as the spring assemblage 16*c*, etc., which is accommodated between the opposite insulating plates 24*a* and 24*b* near the inner end of such shuttle member. Linkage pins 16*b'*, carried by the yoke sides, project inwardly therefrom through slots or openings 24*a'* and 24*b'* in the respective insulating shuttle member plates. Thus arcuate swinging of the yoke between limit positions is converted into longitudinal movement of the shuttle member, the slots being of such shape as to permit this transformation of movement. Accordingly, the snap-action spring-detaining effect of the toggle applies to the shuttle member and gives the switch as a whole the desired positive snap action and spring-detention effect in the limit positions of the switch parts.

Figures 7, 8 and 9 illustrate more particularly the action of the spring toggle slide actuating mechanism. In each position of rest, as shown in Figures 7 and 9, the spring 16*c* reacts between the swinging yoke 16*b* and slide plate 22*a* to urge the yoke into one extreme position and the slide plate into the opposite extreme position. To reverse the positions of these parts from those shown in Figure 7 to those shown in Figure 9, the slide plate is shifted toward the right to the position of Figure 8 through almost its entire possible travel, moving spring 16*c* past its dead center position in which a line joining the centers of its hemispherical bearings 16*e* and 16*f* crosses the yoke 16*b* an appreciable amount. Immediately the force of spring 16*c* swings the yoke 16*b* counterclockwise from the position of Figure 8 to the position of Figure 9. This action throws the pins 16*b'* to the opposite side of the rectangular shuttle apertures 24*b'*, whereupon they strike forcibly such opposite side and drive the shuttle 24 abruptly into its opposite extreme position of Figure 9. The spring force also completes the small additional travel of the slide plate 22*a* into its other limit position shown in Figure 9 so that again the shuttle and slide plate occupy opposite limit positions. Thus positive snap action movement of the shuttle is accom-

plished only after the control knob 22*f* has been moved through almost its entire possible travel.

The limit positions of the yoke 16*b* and the shuttle member 24 are such that in one such position each of the slide shoes 20 bridges between two adjacent contacts in one of the rows of contacts 18*e* or 18*f*, whereas in the opposite limit position these shoes bridge between a different pair of contacts including one of those previously engaged. In other words the shuttle member travels approximately the distance between succeeding contacts in moving between its limit positions. During longitudinal shifting of the shuttle member effected by the snap-action toggle mechanism 16, the shoes having rounded corners, slide smoothly and uniformly over the contacts and provide the desired guidance of the shuttle unit as a whole inside the housing, as previously mentioned.

As shown best in Figure 5, each stationary contact 18 is separately mounted in a housing wall and its terminal for exterior electrical connection is simply an outward extension or integral part of the contact unit, being through a sleeve 18*m* and terminal screw 18*p*, so that the electrical continuity between the contact surface engaged by the slide shoe and the corresponding external terminal to which an electrical conductor will be fastened, is exceptionally good. Moreover the arrangement of contact terminals in straight parallel rows outside the housing corresponds directly to the arrangement of contacts inside the housing. As shown in Figure 11, the contact itself is a flat plate preferably of silver, and is silver soldered to the inner end of a tapped brass sleeve 18*m*. The contact sleeve is held in position in the housing by spinning to a brass washer 18*n*, an operation which, with the washer and sleeve in place, flanges the outer edge of the sleeve over the inside edge of the washer to prevent the sleeve slipping inwardly of its housing bore. A terminal screw 18*p* threads into the sleeve 18*m* and is provided with a lock washer 18*q*.

An incidental feature of the illustrated form of the switch is an indicator arrangement including a lamp unit in the translucent head 22*e* adapted to light up when external circuit conditions call for a reversal of the switch position. In case of fire in an airplane engine, for example, the engine ignition circuit should be opened and a fire extinguisher circuit closed by reversing the switch actuator unit 22. The pilot or engineer would effect this switching operation in response to illumination of the head 22*e* energized by an engine thermostat, for example.

To permit testing of a lamp bulb (not shown) suitably mounted inside the translucent switch actuator knob or head 22*e*, the translucent button 22*e* fits slidably inside a collar 22*f* which is threaded upon the outer end of the slide tube 22*c*. By a suitable internal construction not illustrated in detail in these drawings, inward pressure against the button 22*e* relative to the collar 22*f*, causing relative movement therebetween, effects corresponding movement of a switch contact element inside the tube 22*c* and causes illumination of the lamp bulb inside the hollow button 22*e*. Energization of the lamp bulb to indicate an emergency condition takes place through terminals 22*g* suitably wired in an external circuit and slide rod conductors 22*h* slidably engageable with such terminals to permit longitudinal reciprocation of the unit 22 in the housing while the terminals 22*g* are fixed on the housing. Return springs 22*i* encircling the rods 22*h* and soldered at their opposite ends to the rods and terminals 22*g* respectively, serve also as conductors insuring electrical continuity in the energizing circuit for the indicator lamp.

I claim as my invention:

1. An electrical switch comprising an elongated switch casing, a series of switch contacts arranged in rows extending longitudinally of and in corresponding locations at opposite sides of said casing, a shuttle member guided for reciprocation longitudinally within said casing between the opposite rows of switch contacts, switch-closing contact elements carried by and extending transversely of said shuttle member to slidably engage corresponding opposite contacts selectively by reciprocation of said shuttle member, a switch-actuating member guided in said casing for longitudinal movement relative to said shuttle member, stop means interengageable between said actuating member and the casing to limit movement of the actuating member in each sense, a toggle lever having one end fixedly pivoted in the casing to swing about an axis transverse to the direction of reciprocation of the shuttle member and of the actuating member, stop means interengageable between said toggle lever and the casing to limit swinging of the toggle lever in each sense, lost-motion means operatively connecting said toggle lever to said shuttle member to effect reciprocation of the latter as the toggle lever completes its swinging from each limit position to the other, and a preloaded compression spring strut having one end pivotally engaging said actuating member and its opposite end pivotally engaging the swinging end of said toggle lever, and reacting between the actuating member and the toggle lever to urge the same mutually apart and into opposite limit positions as the toggle lever swings past dead-center position in either sense, and through the lost-motion means urging the shuttle member sharply in the sense opposite to the sense of movement of the actuating member.

2. An electrical switch comprising an elongated switch casing, a series of switch contacts arranged in a row longitudinally of said casing, a shuttle member guided for reciprocation longitudinally within said casing parallel to the row of switch contacts, a switch-closing contact element carried by said shuttle member to slidably engage contacts selectively by reciprocation of said shuttle member, a switch-actuating member guided in said casing for longitudinal movement relative to said shuttle member, a toggle lever having one end fixedly pivoted in the casing to swing about an axis transverse to the direction of reciproocation of the shuttle member, stop means interengageable between said toggle lever and the casing to limit swinging of the toggle lever in each sense, lost-motion means operatively connecting said toggle lever to said shuttle member to effect reciprocation of the latter as the toggle lever completes its swinging from each limit position to the other, and a preloaded compression spring strut having one end pivotally engaging said actuating member and its opposite end pivotally engaging the swinging end of said toggle lever, and reacting between the actuating member and the toggle lever to urge the same mutually apart and into opposite limit positions as the toggle lever swings past dead-center position in either sense, and through the lost-motion means urging the shuttle member sharply in the sense opposite to the sense of movement of the actuating member.

3. The electrical switch defined in claim 2, wherein the toggle lever comprises a generally U-shaped yoke, the legs of which are pivoted in the casing, and the crossbar whereof is at its swinging end, said spring strut being mounted between such legs of the yoke to swing in a longitudinal plane of the casing therebetween.

4. The electrical switch defined in claim 3, wherein the actuating member comprises an element slidable directly along an inner wall of the casing, a bearing element thereon constituting the pivot for one end of the spring strut, and a like bearing element on the crossbar of the toggle lever, constituting the pivot for the other end of the spring strut, pressure of such spring means maintaining said slidable element in contact with said inner casing wall.

5. The electrical switch defined in claim 2, wherein the spring strut comprises an elongated coil spring encircling an extensible spring bushing having enlarged opposite ends constituting spring-end seats, at least one of said enlarged bushing ends having a recessed outer end

face constituting a pivot-bearing socket, and a pivot-bearing element comprising a pin with a rounded end engaged in said socket for pivoting movement therebetween but unconnected thereto, pressure of said coil spring maintaining such engagement.

6. An electrical switch comprising a switch casing having parallel opposite sides, grooves in the inner faces of said sides disposed in a plane perpendicular to said switch casing sides, a switch contact mounted in each of said sides in the bottom of its respective groove and said contacts being located directly oppositely, a floating shuttle member received between said switch casing sides, reciprocable parallel thereto between opposite limit positions and having apertures in its opposite sides spaced lengthwise of and in registry with such grooves in said switch casing sides, a pair of U-shaped guide contact shoes having their ends received in said shuttle member apertures in opposite sides of said shuttle member, respectively, holding said contact shoes and said shuttle member against appreciable relative turning, and having rectangular webs snugly received respectively in said grooves in said switch casing sides holding said shoes and said grooves against appreciable relative turning and guiding said shuttle member for substantially nonrotative movement lengthwise of said grooves by such engagement therein, and spring means urging said contact shoes away from said shuttle member and into engagement with said switch contacts in the bottoms of said grooves.

7. An electrical switch comprising a switch casing having parallel opposite sides, a row of switch contacts mounted in one of said sides, a shuttle member received between the opposite sides of said switch casing, reciprocable lengthwise of said switch contact row between opposite limit positions, and including two spaced plates parallel to said switch casing sides and a plurality of spacer tubes extending between said plates and maintaining them in such spaced relationship, a switch contact shoe extending transversely across and beyond one end of one of said tubes and engageable with adjacent switch contacts in said row for bridging therebetween, and a spring received in said spacer tube and urging such shoe away from said shuttle member and into engagement with the switch contacts in such row.

8. An electrical switch comprising a switch casing having parallel opposite sides, a row of switch contacts mounted in each of said sides at corresponding directly opposite locations therein, a shuttle member received between the opposite sides of said switch casing, reciprocable lengthwise of said switch contact rows between opposite limit positions, and including two spaced plates parallel to said switch casing sides and a plurality of spacer tubes extending between said plates and maintaining them in such spaced relationship, a pair of switch contact shoes disposed respectively at opposite ends of one of said spacer tubes and extending transversely across and beyond the ends of said tube and engageable with adjacent switch contacts in said rows for bridging therebetween, and a spring received in said spacer tube, interposed between said contact shoes and urging such shoes away from each other and into engagement with the switch contacts in such respective rows.

9. An electrical switch comprising a switch casing having parallel opposite sides, switch contacts mounted in said sides, a shuttle member received between said switch casing sides and reciprocable parallel thereto between opposite limit positions, a switch contact shoe carried by said shuttle member in a position to slidably engage said switch contacts, and means operable to move said shuttle member selectively between opposite limit positions thereof, including a toggle lever having an end fixedly pivoted in said switch casing and operatively connected to said shuttle member to effect reciprocation thereof accompanying swinging of said toggle lever, a switch-actuating member guided in said casing for movement parallel to the course of movement of said shuttle member, and an elongated preloaded compression spring strut extending transversely of the course of movement of said shuttle member and having one end pivoted on said switch-actuating member and its other end pivoted on said toggle lever adjacent to its swinging end, to urge said actuating member and said toggle lever into opposite limit positions by movement of said switch-actuating member in one direction, and reversible at will by movement of said switch-actuating member in the other direction, thereby effecting swinging of said spring strut through parallelism with said toggle lever and thus rendering it effective to swing said toggle lever and said switch-actuating member each toward its other limit position, producing opposite reciprocation of said shuttle member.

10. The electrical switch defined in claim 9, wherein the rows of switch contacts are located in the bases of housing wall grooves, and the sides of such grooves constitute guides for the contact shoes, defining the paths of reciprocation thereof, and thereby guiding the shuttle member for reciprocative movement in the casing.

11. In a double-throw electrical switch such as includes a base, a shuttle element guided for lineal reciprocation thereof alongside said base between opposite limit positions and cooperative switch contact means carried respectively by said shuttle element and by said base and selectively interengageable by such reciprocation of such shuttle element, the improvement which comprises snap-action mechanism including a movable actuating member guided by the base for reciprocation generally parallel to the line of reciprocation of said shuttle element and likewise between opposite limits, and a toggle lever and a preloaded compression toggle spring strut assembly having an effective line of force extending generally transversely of said movable actuating member line of reciprocation and including an actuating portion connected to and movable with said movable actuating member, and an opposite portion connected to and movable with said shuttle element, said movable actuating member and said shuttle element normally occupying either of correspondingly opposite limit positions respectively, with said toggle lever and spring strut lines of force inclined at either of respectively opposite angles relative to the line of reciprocation of said actuating member, and reciprocation of said movable control member at will in either direction from a given limit position thereof towards its other limit position effecting reversal of the angle of said toggle lever and spring strut, and thereby producing snap-action reversal of position of said shuttle element and of the switch contact means carried thereby.

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