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E. L. BARRETT

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TOGGLE SWITCH CONSTRUCTION

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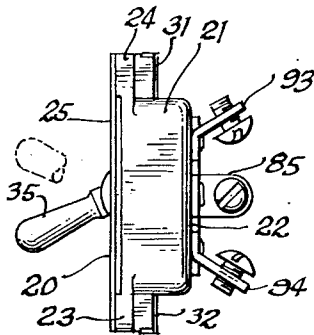


Fig. 1

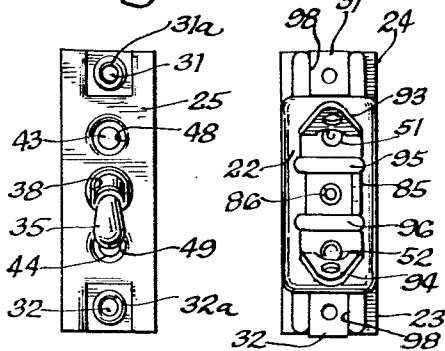


Fig. 2

Fig. 3

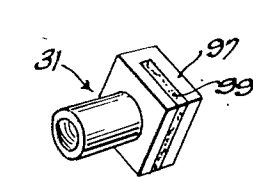


Fig. 8

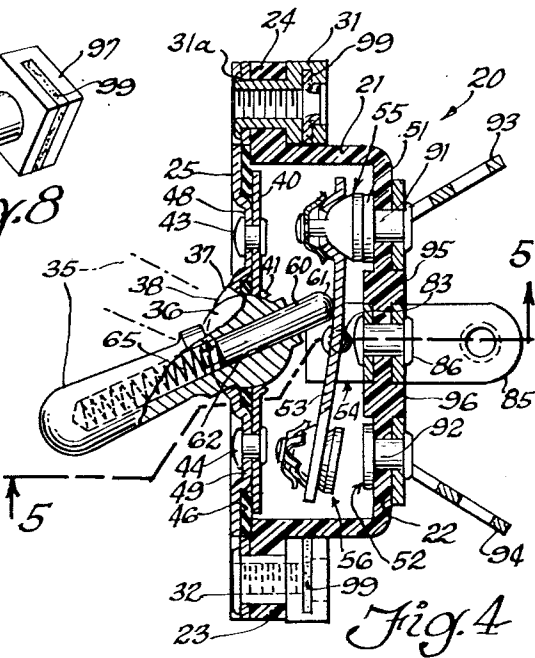


Fig. 4

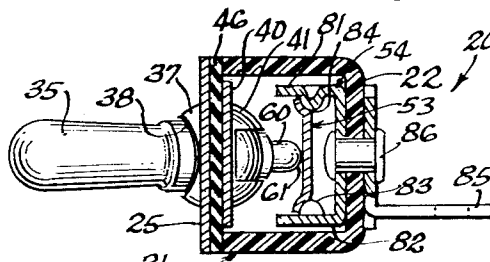


Fig. 5

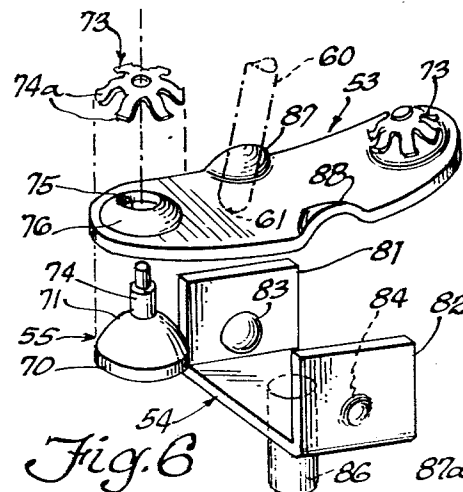


Fig. 6

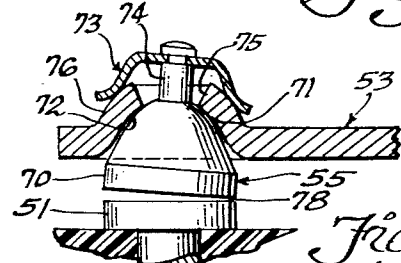


Fig. 7

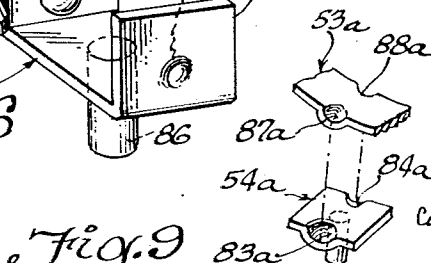


Fig. 9

INVENTOR.
Edward L. Barrett
BY
Carlson, Pitzner, Hubbard & Wolfe
Att'ys

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TOGGLE SWITCH CONSTRUCTION

Edward L. Barrett, La Grange, Ill., assignor to Barrett-Keenan Company, Chicago, Ill., a copartnership

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5 Claims. (Cl. 200—67)

The present invention relates to switches and more particularly to toggle switches for use in aircraft or the like.

It is an object of the present invention to provide a toggle switch which has a high degree of reliability and which is capable of carrying currents which are substantially higher than those carried by ordinary toggle switches of comparable size. It is another object to provide a toggle switch which has extremely low contact, resistance and which maintains such low resistance over a long period of use, even in the face of extreme shock and vibration. It is a further object to provide a toggle switch which has a voltage rating higher than the rating of conventional switches in the same size classification and which is capable of safely cutting off current flow even under short circuit conditions.

It is another object of the invention to provide a toggle switch which is sealed against entry of dirt and moisture but which is nevertheless easily operated and which provides positive detent action.

Finally it is an object to provide a toggle switch which is inexpensive to construct, which may be quickly and securely mounted and which requires no care or maintenance.

Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawing in which:

Figures 1, 2 and 3 are side, front and rear elevations respectively of a toggle switch constructed in accordance with the present invention.

Figure 4 is a vertical section of the toggle switch shown in Figure 1.

Figure 5 is a horizontal section taken along the line 5—5 in Figure 4.

Figure 6 is an exploded perspective showing the rocker and associated parts.

Figure 7 is a fragmentary section taken through one of the rocker arms and showing the contact construction.

Figure 8 shows in perspective a mounting ferrule prior to assembly of the switch.

Figure 9 is an exploded fragmentary perspective of a modified rocker and carrier.

While I have described in the attached specification and shown in the drawing only certain preferred forms of the present invention, it will be understood that I do not intend to limit myself thereto but intend to cover all other modifications and alternative constructions falling within the spirit and scope of the appended claims.

Turning now to the drawing, the switch indicated generally at 20 has a body 21 which is formed of molded plastic material having high strength and dielectric properties. The body is of hollow, rectangular construction having a "bottom" wall 22 and having integral end portions 23, 24. The body is closed by a face plate 25 which has a rectangular outline as shown in Figure 2 and which is secured permanently to the body 21 by means of hollow threaded ferrules 31, 32. Such ferrules are

spun over at their ends as indicated at 31a, 32a, respectively.

Mounted in the face plate 25 for rocking movement is a switch lever or handle 35 having a ball enlargement 36 at its inner end. For the purpose of mounting such ball for rocking movement, the face plate 25 has a socket 37 integrally formed therein and which has an elongated slot 38. Fastened to the face plate 25 is a backup plate 40 having a corresponding socket 41 integrally formed therein so that the ball enlargement on the operating handle is held captive between them. The face plate 25 and the backup plate 40 are permanently fastened together by rivets 43, 44. Sandwiched between the two plates is a rubber gasket 46. Such gasket serves several functions, the edge portion serving to seal the joint between the face plate 25 and the body 21 while the center portion thereof snugly embraces the ball 36 on the switch handle as shown in Fig. 4. This is accomplished by making the clearance hole at the center of the gasket slightly smaller in nominal diameter than the diameter of the ball 36. Preferably the face plate has integrally formed bosses 48, 49 which not only recess the heads of the rivets 43, 44 but which also insure that the plates 25, 40 are accurately spaced relative to one another, insuring free pivoting movement at the ball and socket joint.

In carrying out the present invention, contacts 51, 52 are provided in the bottom wall of the switch body co-operating with a pivoted rocker or rocker plate 53 which extends longitudinally within the body having contact assemblies 55, 56 mounted thereon. The rocker is mounted upon a rocker carrier 54 which engages the center of the rocker 53 for limited tilting movement of the latter. Prior to discussing the details of construction of the rocker carrier 54, more specific reference will be made to the means for tilting the rocker back and forth. This function is provided in the present instance by a detent plunger 60 having a spherical end 61 which rides along a longitudinal path on the back of the rocker 53. The detent plunger 60 is received in a bore 62 in the switch handle. To press the plunger outwardly a coil spring 65 is used bottomed in the bore 62. It will be apparent that the spring pressed plunger 60 performs a detenting function as the end 61 thereof moves from one side to the other of the central pivot on the rocker 53.

In accordance with the present invention a novel self-leveling contact assembly is employed at each end of the rocker 53 for engaging the stationary contacts 51, 52. The contact assembly 55 will be taken as representative, being detailed in Figures 6 and 7. The movable contact, indicated at 70, has a spherical surface 71 which is received in a spherical socket 72 to provide a ball and socket joint. For the purpose of retaining the contact in the socket and for resiliently clamping it to the end of the rocker, a spring retaining washer 73 is used which is mounted at the end of an integral shank 74 which extends rearwardly from the contact 70 and through a clearance opening 75 formed in the center of the spherical socket. The spring washer 73 is preferably of spider shape, having resilient downwardly bent legs 74a, each of which is reversely bent to ride smoothly on the outer surface of the socket 72. The upper surface of the socket, indicated at 76, is concentric with the socket surface 72 so that the spring washer 73 may ride through a relatively large arc in any direction without binding and with no tendency to depart from any given position of adjustment. Preferably, the washer 73 is in tight engagement electrically and mechanically with the contact 70, the washer being held in place by spinning over the tip of the shank 74 as shown. The legs of the washer 73 may be "preloaded" by bending them downwardly be-

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fore the contact assembly is put together in order to establish adequate squeezing pressure on both the inner and outer surfaces of the socket 72. With the contact assembled as described, it is found that the contact-to-rocker resistance is maintained at an extremely low value independently of the pressure which may be exerted by the cooperating stationary contact 51 and independently of its orientation.

The self-leveling action of the above structure is clearly shown in Figure 7 which illustrates the initial closure. The first time that the contacts are snapped together by the switch handle, the movable contact 70 is in a random position resulting in edge engagement as shown at 78. However, because of the downward pressure on the rocker exerted by the spring 65 and because of the inertia of the rocker 53 the movable contact moves in its socket, adjusting itself precisely to the upper surface on the fixed contact 51. The friction produced by the spring washer 73 is sufficient to hold the movable contact in such position so that flat face-to-face contact occurs during all subsequent switch operations.

It will be apparent that if either contact surface is eroded as a result of severe use, constant equalization of the contact 70 will occur, always insuring that the maximum available contact area is used and insuring that the resistance will continue to be low over the life of the switch. In the event that the movable contact is jarred from its optimum position by shock or severe vibration, it will be restored to such condition when it is closed the next time. While the above discussion has been restricted to the contact assembly 55 it will be understood that it is equally applicable to the identical contact assembly 56 at the other end of the rocker.

Having understood that contact structure afforded in the present switch more specific attention may be given to the novel means for pivoting the rocker 53. In accordance with the present invention pivoting of the rocker and lateral centering thereof is accomplished by using opposed ball and socket joints laterally spaced at the center of the rocker. As illustrated in Figures 5 and 6 the ball and socket are formed integrally on the rocker carrier 54 and rocker 53 respectively. The rocker carrier 54 is of U-shape having upwardly extending arms 81, 82 which are located adjacent the side walls of the switch body. Each of the arms is inwardly dimpled or deformed to provide opposed balls 83, 84 respectively.

For the purpose of accurately locating the rocker carrier 54 a recess is provided in the bottom wall of the switch body (see section Figure 4). A corresponding recess is formed on the outside wall for receiving a terminal 85, the carrier 54 and terminal 85 being engaged by a rivet 86 which extends through both of them and which secures them together electrically and mechanically.

Cooperating sockets are integrally formed on the lateral edges of the rocker 53. Each of the sockets is in the shape of a quarter-sphere having the same curvature as the balls to provide a joint which is largely friction free but which has appreciable area in contact. Since the sockets 87, 88 are relatively deep and since constant spring pressure is applied to the rocker by the plunger 60, there is no risk that the rocker will be moved out of register with the balls even in the face of severe shock. It will be noted, in any event, that the limited endwise clearance of the rocker with respect to the switch body and the limited sidewise clearance between the rocker and the carrier 54 insures that the rocker will always return to a seated position. Use of opposed and laterally spaced ball and socket joints limits the rocker to pure rocking movement in a centered position, and it is impossible for the rocker to skew or to ride up into engagement with one of the arms of the rocker carrier 54. The above construction insures accurate registry between the fixed and movable contacts and therefore maximum use of the available contact area.

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If desired, the arms of the rocker may be bent upwardly on each side of the central pivot to provide a slightly curved track for the end of the plunger 60. Such curvature furthermore increases the distance between the contacts when in open position. However, in order to provide strong detenting action and to reduce the required head room in the switch body, the curvature is preferably kept to a small amount.

For the purpose of positively anchoring the fixed contacts 51, 52, each of them is provided with shanks 91, 92 respectively which are riveted to terminals 93, 94. Such terminals have a base portion which lies flatly against the molded body. Positive location of the terminals as well as electrical isolation is provided by barriers 95, 96.

It will be apparent to one skilled in the art that the invention is not limited to providing sockets on the rocker 53 and if desired the position of the balls and the sockets may be reversed as shown in the modified structure of Figure 9. Here the rocker indicated at 53a is deformed along its lateral edges to provide downwardly extending ball surfaces 87a, 88a. The rocker carrier indicated at 54a is correspondingly deformed along its lateral edges to provide integral spherical sockets 83a, 84a, the surface radius of the balls and sockets as well as the spacing between them, being the same. Such structure enables smooth rocking movement of the rocker 53a, the opposed ball and socket joints serving, as in the previous embodiment, to prevent skewing of the rocker while maintaining the rocker in its desired centered position. The latter embodiment may be preferred where it is desired to reduce the manufacturing cost to a minimum since tolerances are more easily maintained.

In accordance with one of the more detailed aspects of the present device the threaded ferrules 31, 32 which hold the face plate in position on the switch body include a novel means for anchoring on the switch body and for securely locking a machine screw used to hold the switch to a panel. For this purpose the ferrules, 31 being taken as representative, include a rectangular base 97 which is snugly received in a recess 98 formed in the switch body and which is slotted to receive an insert 99 formed of fiber or the like. Such insert is pierced and the free opening provided therein is smaller than the diameter of the machine screw so that the machine screw is jammed in place and cannot work itself loose as a result of continued vibration.

It will be apparent from the foregoing that a switch is provided which is of eminently simple and inexpensive construction but which includes features which are not to be found in conventional toggle switches. It will be noted that when the rocker is in one of its seated positions it is stably supported at three areas which are arranged in triangular formation. Each of such areas comprises a ball and socket in which rubbing friction is low but which, nevertheless, provides a substantial area over which current flow may take place. As a result the contact resistance from terminal to terminal may be reduced to a minimum enabling the switch to operate cool even under rather extreme load conditions. Should the contacts become eroded as a result of continued severe use, automatic and constant self-alignment occurs, each movable switch contact reorienting itself to engage maximum contact area on the fixed contact. It is also found that excess voltages may be successfully interrupted without undue arcing and without damaging the switch. Preferably the switch body is formed of a number of plastics having good arc resisting characteristics. Arcing to the casing, common in switches having metal bodies, is precluded in the present construction. Leakage resistance under humid conditions is reduced to a minimum. As a result of the above features the present toggle switch is ideally suited for use in aircraft or for use for military purposes where high performance and absolute reliability are essential.

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While the invention has been described above as embodied in a toggle switch, it will be apparent to one skilled in the art that certain of the features of construction are not at all limited to use in toggle switches but would have more general utility wherever it is desired to provide self-aligning contacts having extended contact area and wherever the making of contact is brought about by application of force generally perpendicular to the contact faces. By the term "laterally spaced ball and socket joints" is meant joints comprising concave and convex portions in nesting engagement providing a substantial contact area while permitting limited rocking movement and preventing any axial movement or skewing.

I claim as my invention:

1. In a toggle switch the combination comprising a switch body having a switch contact located at the bottom thereof, a rocker plate arranged generally parallel to the bottom of the switch body, said rocker plate having a movable contact mounted on an end thereof, a rocker supporting member mounted at the bottom of said switch body and spaced from the fixed contact, the rocker plate and the rocker supporting member being deformed to provide mating curved surface connections at the lateral edges thereof having a substantial area in contact for permitting limited rocking movement of the rocker plate while blocking the rocker plate against axial movement, and switch operating means movable between an on position and an off position and having a spring biased member for exerting downward pressure on said rocker plate when in the on position at a point centered between the pivot axis and the movable contact so that pressure is exerted simultaneously at said contacts and at said connection to minimize the contact resistance thereof.

2. In a toggle switch the combination comprising a switch body having a fixed contact flatly seated therein, a rocker plate in said switch body arranged generally parallel to said fixed contact, said rocker plate having a movable contact at one end thereof arranged opposite said fixed contact, a rocker supporting member seated in said switch body under the central portion of said rocker plate and having lateral edges extending closely adjacent the edges of said rocker plate, the lateral edges of said rocker plate and said rocker carrier being of such shape as to provide laterally spaced ball and socket joints for limiting rocking movement of the rocker plate on the rocker carrier, said switch body having a face plate, a toggle lever mounted in said face plate for rocking movement about an axis parallel to the rocking axis of the rocker plate, said toggle lever having a central bore, a plunger received in said bore, means including a coil spring for urging the plunger outwardly of said bore and into contact with said rocker plate so that when said toggle lever is in one of its limit positions the plunger applies pressure to the rocker plate at a point located between said movable contact and said ball and socket joints thereby to maintain the ball and socket joints in engagement and to minimize the contact resistance thereof.

3. In a toggle switch the combination comprising a switch body, at fixed contact flatly mounted in said switch body, a rocker plate in said switch body arranged generally parallel to the fixed contact, a rocker carrier centrally mounted in said switch body and extending transversely with respect to said rocker plate, said rocker carrier and said rocker plate being deformed to provide mating curved surface connections at the lateral edges

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thereof having a substantial area in contact for permitting limited rocking movement of the rocker plate toward and away from said fixed contact while blocking the rocker plate against axial movement, a movable contact mounted on said rocker plate opposite said fixed contact said movable contact having a ball and socket connection with the rocker plate and having means for resiliently maintaining the movable contact seated on said rocker plate when the contacts are separated from one another, and manually operated means including a biased member for applying resilient pressure to a point on said rocker plate which is centered between the ball and socket connection and the two pivoting connections for simultaneously pressuring the contacts and the pivoting rocker plate supports.

4. In a toggle switch the combination comprising a switch body, a fixed contact in said switch body, a rocker in said switch body arranged opposite the fixed contact, a rocker carrier mounted in said switch body and extending transversely at the central portion of said rocker, said rocker carrier and said rocker being deformed to provide mating ball and socket connections between them which are laterally spaced from one another so that the rocker plate is confined to limited pure rocking movement toward and away from said fixed contact, a movable contact mounted on said rocker opposite said fixed contact, said movable contact having a ball and socket connection with the rocker and having means for maintaining it seated on said rocker when the contacts are separated from one another, and manually operated means for applying resilient pressure to a point on said rocker which is centered between the three ball and socket connection for bringing said contacts into engagement.

5. In a toggle switch, the combination comprising a hollow switch body having one open wall, a rocker carrier recessed in said body, a rocker in said body in said carrier, said rocker and carrier having a pair of laterally spaced ball and socket connections for permitting rocking movement while preventing axial and skewing movement, contacts within said switch body at the ends thereof for cooperating with said rocker, a face plate to cover said open wall and having means permitting it to be secured to said body, a switch lever extending through said face plate and having a ball portion intermediate its ends, a back-up plate secured to said face plate, said plates being apertured and deformed to snugly socket said ball portion and thus pivotally support said lever, and a gasket positioned between said plates to extend between said face plate and body, said gasket being apertured to sealingly engage said ball portion of said lever, the lower end of said lever being in contact with said rocker for over-center rocking movement of the latter.

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