July 3, 1956 J. W. ANDERSON 2,753,413

QUICK BREAK ELECTRIC SWITCHES

Filed Sept. 28, 1953

Fig. 3.

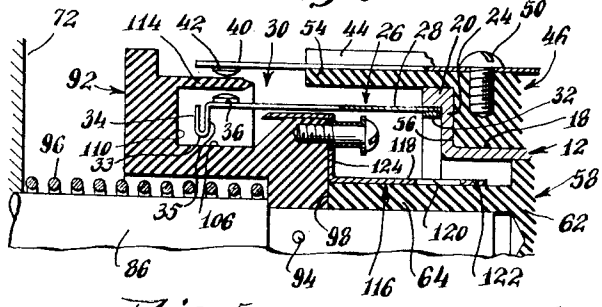


Fig. 4.

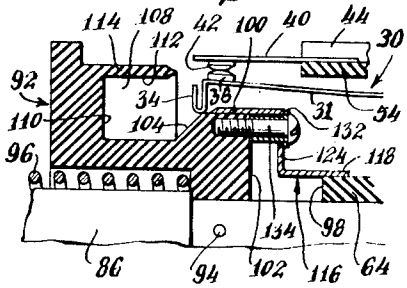


Fig. 5.

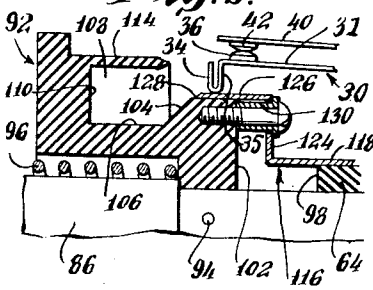


Fig. 6.

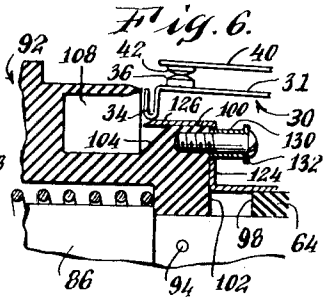
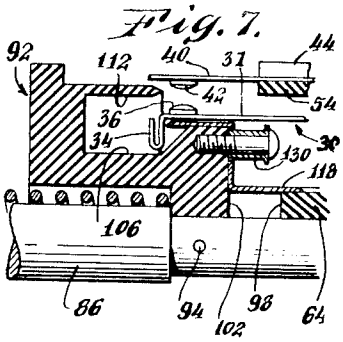


Fig. 7.



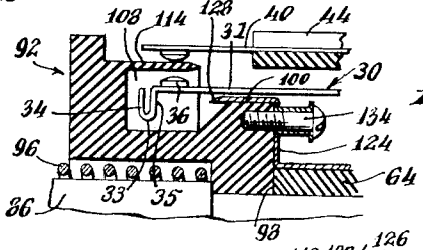
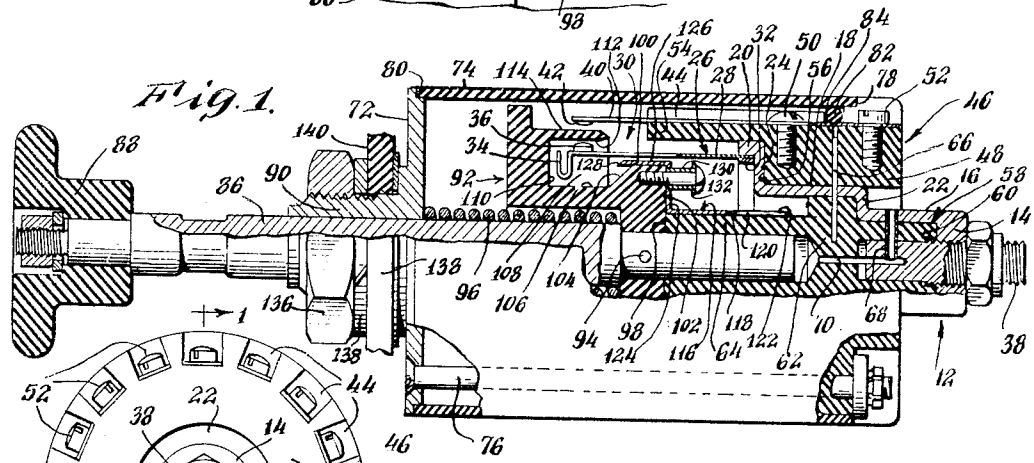


Fig. 8.

Fig. 1.



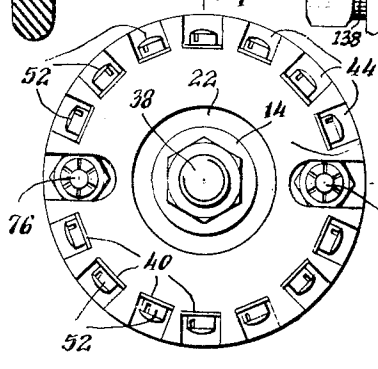


Fig. 2.

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QUICK BREAK ELECTRIC SWITCHES

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Application September 28, 1953, Serial No. 382,635

19 Claims. (Cl. 200—73)

This invention relates to electric switches wherein provision is made for the instantaneous, complete or substantial separation of contact members to minimize or obviate objectionable arcing.

An important object of this invention is the provision, in such a switch, of improved means by which one contact of a pair of contacts therein may be wedged into and held in firm engagement with the other contact of the pair while, nevertheless, being capable of instantaneous separation from said other contact by a reverse operation.

Another important object is the provision, in such a switch, of a wedge which closes switch contacts as a result of operation in one direction but automatically becomes covered and nullified insofar as wedge action is concerned, by a sheer-drop, contact holding platform which permits instantaneous, substantial separation of the contacts upon reverse operation of the wedge.

Another important object is the provision, in such a switch in which at least one of such contacts is resiliently supported, of means for preventing accidental inter-engagement of the switch contacts.

Another important object is the provision of an improved multiple switch structure wherein plural switch assemblies have common operating means.

The foregoing and other more or less obvious objects are accomplished by the present invention, of which, for illustrative purposes and without limiting the invention thereto, a preferred embodiment is illustrated in the accompanying drawing in which:

Figure 1 is a longitudinal partly sectional view of one form of switch structure in which the principles of this invention are advantageously employed; the section being substantially on the angularly extending line 1—1 of Fig. 2.

Fig. 2 is an end elevational view of said switch structure, looking toward the right end of Fig. 1.

Figs. 3, 4 and 5 are fragmentary, enlarged views of a portion of the switch structure of Fig. 2 showing, sequentially, the coaction of certain parts of the device to close the switch.

Figs. 6, 7 and 8 are views of the same character as Figs. 3, 4 and 5, showing, however, the sequential coaction of the same parts to open the switch.

The switch structure illustrated in Figs. 1 and 2 preferably comprises a generally cup-shaped central terminal 12 of conductive metal having a flat circular bottom or end wall 14 and stepped cylindrical side wall portions 16, 18 and 20 with intervening shoulders 22 and 24. A single, cylindrical, inner contact element 26, preferably of relatively thin, flexible, conductive metal, having a circumferentially continuous base or mounting portion 28 and a circumferential series of integral, flexible contact fingers 30, is suitably, conductively mounted upon the terminal 12 as by having its mounting portion 28 soldered within and to the terminal's wall 20, preferably in abutment with the shoulder 24, or, as shown in the drawing, said mounting portion may be secured within the wall 20 by an internal clamping or presusre ring 32. If desired,

of course, both soldering and the clamping ring may be employed to assure a firm mounting of the contact element 26 and good conductivity between the latter and the terminal 12. Each of the contact fingers 30 has the elongated body portion 31 extending substantially parallel to the common axis of symmetry of the switch and is reversely bent at its free end to form a radially inwardly extending cam follower 34 preferably having the semi-cylindrical bottom or radially innermost surface 33 and the rear side surface 35, the latter extending from surface 33 to the elongate body portion 31 and substantially perpendicularly to the latter; and the finger also has a radially outwardly facing contact point 36 welded, soldered, or otherwise suitably fixed to its free end. A connection post in the form of a metal stud 38 is threaded into the end wall 14 of the terminal.

In use, the plural contact fingers 30 are connected through terminal 12 and connection post 38 to a common wire or lead (not shown) of plural electric circuits. Each of the fingers 30, thus, is an inner member of a pair of switch fingers which is radially aligned with and coacts, for switching purposes, with one of a plurality of separate, similar radially outer, longitudinally extending, flexible contact fingers 40, each of which is in the form of a strip of suitable, flexible, conductive metal provided with a suitably mounted, radially inwardly facing contact point 42 in opposition to a contact point 36 of a mating inner contact finger.

The contact fingers 40 are similarly mounted, separately, within a circumferential series of longitudinally extending, external grooves or slots 44 formed in an annular contact holder 46 formed, preferably, of a single piece of rigid, dielectric material. The fingers 40 are secured, toward their outer ends, to a relatively thick outer end portion 48 of the contact holder 46 by means of inner screws 50 and outer screws 52, the latter of which are accessible exteriorly of the device to serve as binding posts by means of which separate wires (not shown) are connected to the contact fingers 40.

The inner end of the contact holder 46 is in the nature of an integral, sleeve-like extension 54 within which accurately fits the cylindrical wall 20 of the terminal 12 with the latter's shoulder 24 abutting a shoulder or inner end 56 of the portion 48 of the contact holder 46.

Within the terminal cup 12 is disposed an annular bearing element 58, preferably of rigid, dielectric material, having a nose 60 at its outer end seating accurately within cylindrical wall 16 of the terminal 12 and abutting the inside of said terminal's end wall 14, an enlarged intermediate portion 62 seating accurately within cylindrical wall 18 of said terminal and abutting the latter's shoulder 22, and an inner cylindrical extension or bearing sleeve 64. The contact holder 46, terminal cup 12 and bearing element 58 are all held firmly together against any relative movement as, for example, by one or more tight-fitting pins 66 extending radially within aligned radial bores in the three mentioned parts. These pins, if of conductive material, should be clear of contact with any of the contact fingers 40. To partially augment the effect of the pins 66, one or more pin-like metal tubes 68 may extend radially with a tight fit within aligned radial bores in cylindrical wall 16 of the terminal cup, the nose 60 of bearing element 58 and the inner end of stud 38, the bore in the latter communicating with an axial bore 70 in said inner stud and in the intermediate portion 62 of the bearing element. Thus, the tube or tubes 68 may serve to prevent relative movement of the said terminal cup, bearing element and connection stud and, if said tubes, as shown in the drawing, are arranged to terminate outwardly of the bore 70, a vent is provided from the area within the bearing sleeve 64, through bore 70 and tube or tubes 68 to ambient atmosphere.

With the parts arranged and fixed together as aforesaid, the contact holder 46 and the terminal cup 12 form a rear end wall of the device. Substantially coaxial with said rear end wall is a circular, front end wall 72 of suitable metal, the two said end walls being spaced by a cylindrical wall or cover 74, preferably of rigid dielectric material, these parts being held together by tie rods or long bolts 76. The ends of the cylindrical wall 74 seat and are held tightly within annular rabbets 78 and 80 formed, respectively, in the contact holder 46 and the front end wall 72. An O ring 82 of rubber, or other suitable rubber-like material, is radially compressed by the cover 74 within an outer annular groove 84 provided for said ring in the contact holder 46 to prevent ingress of dirt or other foreign matter through the grooves 44 to the interior of the device.

It should be observed that the series of inner contact fingers 30 and the series of outer contact fingers 40, when in normal or non-flexed or open condition, are in two concentric circles and spaced from each other. The principal features of this invention reside in operating means by which the fingers of one series or set are simultaneously flexed radially into contact with the fingers of the other series or set and by which they may be instantaneously disengaged, with a snap action, to obviate or minimize arcing.

The switch operating means, as illustrated in the accompanying drawing, include a manually reciprocable operating plunger 86 which has a handle 88 fixed upon its outer end and extends with a close sliding fit through an axially enlarged bearing portion 90 of front wall 72 and into the bearing sleeve 64. An annular actuator 92, preferably of rigid dielectric material, is fixed by pin 94 to the plunger 86, the plunger and actuator being normally urged rightwardly or rearwardly by a coil spring 96 which extends about the plunger and is compressed between the front wall 72 and the actuator 92 to hold the latter normally in abutment with the outer end 98 of bearing sleeve 64.

The actuator 92 is so designed that when it with the plunger 86 is manually pulled forwardly (leftwardly as viewed in the drawing), portions of the actuator function as a cam or wedge to flex the free ends of all the inner contact fingers 30 radially outwardly into switching or closing engagement with the free ends of the outer contact fingers 40, the engagement of these fingers of course being through their respective contact points 36, 42. This flexing is of such magnitude that the outer contact fingers 40 are forced to flex radially outwardly to some extent so that the reaction set up therein causes them to maintain a firm or positive switching engagement with the inner contact fingers while the latter are not bent beyond their flexing limits by the camming or wedging action applied thereto.

To permit functioning as generally recited in the preceding paragraph, and to yield a further or additional function hereinafter described, the actuator 92 is formed with an outwardly directed cylindrical surface 100 which extends from a flat, back end surface 102 of said actuator to the outer circumferential limits of a frusto-conical wedging surface 104 which tapers inwardly to adjoin another cylindrical surface 106. The latter surface constitutes an inner side wall of an axially directed annular recess 108 the outer walls or surfaces of which are a flat, annular, bottom surface 110 and another cylindrical surface 112 which constitutes the outer side wall or surface of the recess 108. The surface 112 is part of a cylindrical, rearwardly extending tongue 114, of the actuator, which, when the latter is in its normal or switch-open position, extends between contact points 36 and 42 to prevent accidental closing of the switch from vibration or other causes.

The actuator 92 is shown in Fig. 1 in its normal or full, switch-open position, abutting the outer end 98 of bearing sleeve 64. The contact fingers 30 and 40, likewise, are in their normal or open positions, the showing thereof in Fig. 1 being illustrative of the condition of the entire circumferential series of fingers 30 and 40; and the relationships of all such fingers to the actuator 92 are similar because the detailed parts of the actuator are circumferentially continuous and annular or circular. When the switch is fully open, the tongue 114 extends between and clear of the contact points 36, 42 and the free or contact ends of contact fingers 30 extend into the annular recess 108 with the cam follower 34 extending radially inwardly into axial alignment with the wedging surface 104.

There is associated with the actuator 92 and bearing sleeve 64 an annular element 116 preferably of sheet metal and hereinafter referred to for convenience as a "slider." This slider is formed with an inner cylindrical back-end flange 118 which encircles and engages the outer cylindrical surface of bearing sleeve 64 with a rather tight but nevertheless a sliding fit. If desired, this fit may be an easy sliding fit but may be frictionally accentuated by providing longitudinal slots 120 opening at the free edge of the flange 118 to form spring fingers 122 which, but for the presence of sleeve 64, would bend inwardly, but are held to cylindrical form aggregatively by said sleeve to react thereagainst as springs and thereby oppose sliding of the slider 116 except in response to positively applied forces. The criterion of the sliding coaction of the slider with the bearing sleeve 64 is that the slider preferably will not slide relatively to said sleeve except as compelled to do so by its hereinafter described relationship to the actuator 92.

The slider 116 has a radial, annular web 124 which integrates flange 118 with an outer cylindrical flange 126. The latter flange intimately surrounds cylindrical surface 100 of the actuator 92 in spaced relationship to the inner contact fingers 30 and preferably is circumferentially beveled at its free edge as at 128 to the same angularity as the wedging surface 104.

The slider 116 is linked to the actuator 92 for limited longitudinal movement therewith, but some lost motion therebetween is provided by the linkage means which, as illustrated, comprise preferably at least three similar circumferentally equidistant linkage assemblies each comprising an elongate grommet 130 having a rear end radial flange 132. Each grommet extends slidably through a hole provided therefor in the slider's web 124 with its unflanged forward end held close to or embedded in the back end surface 102 of the actuator 92 by a headed screw 134 which extends through the grommet and is threaded into the actuator 92. The grommet hole in the web 124 is smaller than the grommet's flange 132, so that the lost relative motion between the actuator and the slider corresponds to the distance between the actuator surface 102 and the opposed or facing side surface of the grommet's flange 132.

The enlarged bearing portion 90 of the front wall 72 of the device may be externally threaded to receive a mounting nut 136 which, with a related lock washer 138, may serve to secure the device upon an instrument panel fragmentarily shown at 140. The bearing portion 90 and the within plunger 86 extend through a hole in the panel so that the switching parts of the device are at the back of the panel while the handle 88 is readily accessible at the front of the panel for convenient manual operation of the device. It should be understood that the device, as illustrated in the accompanying drawing, has fourteen similar switches which function simultaneously in response to manual reciprocation of the plunger.

Figs. 3–8 more or less diagrammatically show the working parts of the fourteen switches and should afford an understanding of the manner in which the switches function. In considering these figures it should be noted that the principal stationary parts are the bearing sleeve 64, the cupshaped central terminal 12 which supports the

inner contact fingers **30**, and the annular contact holder **46** which supports the outer contact fingers **40**.

Fig. 3 shows the parts as when the device is dormant with the switch open. To close the switch, the operator grasps handle **88** (Fig. 1) and pulls plunger **86** forwardly (leftwardly) against the yielding compressive force of spring **96**. In a first part of this forward plunger movement, actuator **92** moves forwardly with the plunger but slider **116**, due to its frictional engagement with sleeve **64**, remains stationary until flange **132** of the grommet engages the slider's web **124**, whereafter the actuator and the slider, with continued forward movement of the plunger, move forwardly in unison first to their positions shown in Fig. 4 and finally to their positions shown in Fig. 5.

At the point of operation shown in Fig. 4, the cam follower **34** has ridden up the wedging surface **104** to bring contact point **36** into initial contact with contact point **42**; the tongue **114**, meanwhile, having moved from its protective position between said contact points.

At the point of operation shown in Fig. 5, the cam follower **34** has ridden up the beveled edge **128** of the slider and has come to rest upon the slider's outer cylindrical flange **126** to fully close the switch, the flange **126** then being interposed between the cam follower **34** and the actuator **92**. The resultant additional lift imparted to the contact point **36** has served to flex the inner contact arm **30** further and to flex outer contact arm **40** radially outwardly to set up in the latter an inwardly directed reaction which assures a positive interconnection between the two contact fingers through their related contact points.

The operator may maintain the closed switch condition by holding the plunger **86** in its extreme forward position, but switch structures of the type described herein are used mostly where the switch need be held closed only for a short or momentary period of time. After the switch has been closed for the desired time period, the operator merely release his grip on the handle **88**, thereby permitting spring **96** to force the actuator **92** rearwardly.

During the first part of such rearward movement of the actuator, the slider **116** remains stationary until its web **124** is engaged by the back end surface **102** of the actuator, as shown in Fig. 6, at which instant the cam follower **34** is still resting upon the slider's flange **126** and the free margin of the latter substantially overhangs the wedging surface **104** of the actuator.

Thereafter, the actuator and the slider move rearwardly in unison until, as shown in Fig. 7, the cam follower has dropped, radially inwardly, off the free edge of the slider's flange **126**, this drop constituting an instantaneous movement of the contact finger **30** from its fully closed or flexed position to its fully open or unflexed position. There is no relatively gradual opening movement because the wedging surface **104**, the only structure which conceivably could cause any gradual opening movement of the contact finger **30**, is at that time ineffective because it is underneath the slider's flange **126**.

Simultaneously with the described opening movement of inner contact finger **30**, the outer contact finger **40** assumes its normal or unflexed position. Although these instantaneous opening movements of the two contact fingers might tend to cause them to vibrate and thereby cause their contact points to contact or approach each other, this possibility is avoided because the continued rearward movement of the actuator **92** causes its tongue **114** to project itself between said contact points as soon as the described opening movement of the contact fingers has occurred. Final rearward movement of the actuator **92** brings all the switch parts to their normal or open positions as shown in Fig. 8, the same as in Figs. 1 and 3.

The described, unimpeded, instantaneous opening of the switch's contact points prevents arcing upon the breaking of an electric circuit therethrough and the tongue **114** gives positive assurance against accidental closing of the switch and against objectionable vibration of the switch fingers at the instant of their opening movement.

It should be obvious that the present inventive concept may be embodied in other switch and switch operating arrangements and, without attempting to recite all such possible arrangements, it may be noted that switch operation, somewhat similar to that hereinbefore described, may be derived from rotary reciprocatory actuator movement. Therefore, the present invention is not limited to the structure shown in the accompanying drawing but should be limited only to the extent indicated in the following claims.

I claim:

1. A quick break electric switch comprising a resiliently supported contact element, an actuator movable relatively to said contact element and having a wedging surface adapted, upon such relative movement in one direction, to wedge said element towards its closed position with respect to a related contact element, and a slider associated with said actuator and adapted, during such movement in said one direction, to move between said actuator and said contact element to hold the latter in its closed position, and adapted, during opposite relative movement of the contact element and the actuator, to slide relatively to the latter to bring a portion of the slider to a position covering said wedging surface while still thus holding the contact element; the said slider and actuator, in their last mentioned relative positions, being movable in unison relatively to the contact element, during a portion of said opposite movement, to disengage the slider from the contact element to permit the latter to move to open position independently of said wedging surface.

2. A quick break electric switch comprising a resiliently supported contact element, a reciprocable actuator having a wedging surface adapted, during movement of the actuator in one direction, to engage and wedge said element toward its closed position, a slider slidably associated with said actuator and having a contact-element-holding portion adapted, during such one directional movement, to receive said contact element from said wedging surface and hold said contact element in closed position and being capable of limited lost sliding motion relatively to the actuator during a first part of opposite movement of the contact element and the actuator to enable the said wedging surface to move to a position underneath said contact-element-holding portion while the latter still holds the contact element in closed position and to discharge the latter therefrom independently of said wedging surface during a later part of such opposite movement.

3. A switch according to claim 2, the said actuator having an integral dielectric tongue which constitutes a barrier between said contact element and a related contact element when the former element is in an open position and is in a removed position from the space between said contacts during a period when said actuator and slider are effective to wedge said first-mentioned contact toward its closed position and to hold it in that position.

4. A switch according to claim 2, further including a fixed abutment member coacting with said actuator to limit the latter's switch opening movement, the slider being lost-motionedly linked to said actuator for movement therewith during parts of the actuator's movement and having an integral extension in sliding frictional engagement with a surface of said abutment member to restrain said slider against material movement except as constrained through said linkage to move with the actuator.

5. A switch according to claim 4, wherein said linkage comprises a headed stud extending through a hole, smaller than the stud's head, in said slider and fixed into said actuator.

6. A switch according to claim 2, the said contact element being a first contact element and the device including a second resiliently supported contact element;

the said wedging surface being adapted to wedge said first contact element approximately to initial closing engagement with said second contact element; the contact-element-holding portion of the slider being a thin member adapted to receive said first contact element from said wedging surface and, to the extent of its thickness, to continue the closing movement of said first contact element to the extent of moving the second contact element against the resilience of its support whereby to assure firm closing engagement of the two contact elements.

7. A quick break electric switch comprising a first, circular series of resiliently supported switch contacts, a second, circular series of switch contacts, concentric to and spaced from said first series and its contact members mating, for switching purposes, with the contact members of the first series, an axially reciprocable, annular actuator having circularly arranged contact-actuating portions adapted, in one direction of reciprocating movement of said actuator, to coact with said first series of contacts to urge them toward said second series, an annular slider lost-motionedly linked to said actuator and having circularly arranged holding portions adapted, during movement of the actuator in said one direction, to engage and hold said first series of contacts in closed association with said second series, said holding portions being shiftable relatively to the actuator's said contact-actuating portions to cover the latter, during a first part of opposite movement of said actuator, and adapted, at an intermediate point in such opposite movement, to move from holding association with the said first series of contacts to release them past and out of contact with said contact-actuating portions of the actuator.

8. A switch according to claim 7, the said lost motion linkage comprising plural studs, fixed to said actuator at various circumferential points therearound and extending from an axially facing surface of said actuator through holes in said slider and having heads spaced from said axially facing surface of the actuator and adapted with the latter surface to limit relative movement of the actuator and the slider.

9. A switch according to claim 7, further including an annular dielectric sleeve, movable, with said actuator, between one position in which it extends between said two series of switch contacts and another position in which it is clear of the space between said two series.

10. A switch according to claim 7, further including a reciprocable plunger to which said actuator is fixed for reciprocation therewith, and an abutment sleeve constituting a bearing for said plunger and an abutment for limiting the actuator's said opposite movement and having an outer cylindrical surface; the said slider having a sleeve in sliding frictional engagement with said cylindrical surface, restraining said slider against material movement except as derived from said actuator through the mentioned linkage.

11. A switch according to claim 10, the slider's said sleeve having plural spring fingers in yieldable sliding engagement with the abutment sleeve's said cylindrical surface.

12. A quick break electric switch comprising, the combination with a first contact point, of a second contact point, a flexible finger supporting the latter and comprising a body portion and a cam follower extending downwardly therefrom, said cam follower having a bottom surface and a rear surface leading from said bottom surface to said body portion and extending substantially perpendicularly thereto, an actuator reciprocable between a rear and a front position, said actuator having a cam surface wedgingly moving said bottom surface to close said second contact point as said actuator moves frontwards, a slider mounted on said actuator for movement therewith and for sliding motion relative thereto between a front and a rear position, said slider in its rear relative position and upon further frontward movement of said actuator, having a portion interposed between said actuator and said flexible finger and means retaining said slider stationary while said actuator begins its rearward movement and until said actuator is at its rear limit of motion relative to said slider, whereby said cam surface in moving under said cam follower is separated therefrom by said interposed portion and when said actuator moves further backward, carrying said slider with it, said bottom surface and said rear surface fall precipitately past the rearward moving front end of said interposed portion and past said cam surface and out of contact with the latter, to quickly break the contact of said contact points.

13. A switch according to claim 12, said actuator further comprising a dielectric tongue extending between said contact points in the rearmost position of said actuator, said tongue having a fixed position relative to said actuator and being withdrawn from between said points as said actuator moves forward.

14. A switch according to claim 12, said slider retaining means comprising a stationary member and friction means comprised by said slider and frictionally engaging said stationary member.

15. A switch according to claim 12, said first contact point further having resilient supporting means and being displaced from its open circuit position by said second contact point upon said further forward motion of said actuator and interposition of said portion of said slider, and against the resilient reaction of said resilient supporting means.

16. A quick break electric switch comprising, in combination, a first circular series of contact points, an elongate flexible contact finger supporting each of said points, a second circular series of contact points located radially inside said first series and mating therewith and an elongate flexible contact finger supporting each point in said second series, said fingers of said second series having elongate body portions and radially inwardly extending cam follower portions, the latter having inmost semi-cylindrical surfaces and rear side surfaces extending from said last mentioned surfaces to said body portions and extending substantially perpendicularly to the latter, all of said fingers extending substantially parallel to a common axis, a stationary bearing sleeve located on said axis, a plunger mounted in said bearing sleeve for axial reciprocation, an annular actuator fixed on said plunger, said actuator having a forward cylindrical surface, a rearward, larger cylindrical surface, and a frusto-conical cam surface joining said two cylindrical surfaces, a slider mounted on said actuator and having a flange portion surrounding and slidably engaging said larger cylindrical surface, means limiting the sliding motion of said slider relative to said actuator, and means tending to maintain said slider stationary while said actuator moves relative thereto within the limits imposed by said limiting means, said slider moving in unison with said actuator when the latter moves past the limits of relative motion between said actuator and said slider, said actuator upon forward motion engaging said cam followers by said cam surface to wedge said second series of contact points into closed position against said first series of points, said actuator upon further forward motion interposing said flange of said slider between said cam followers and said larger cylindrical surface, said cam surface upon rearward motion of said actuator moving into substantial radial alignment with said flange portion and being radially inside the latter while said cam follower rests on the outer surface of said flange, and further rearward motion of said actuator carrying said slider rearward to release said cam followers suddenly past said flange portion and said cam surface and out of contact with the latter.

17. A switch according to claim 16, said motion limiting means comprising a radially extending web comprised by said slider, a rear radial surface of said actuator engaging said web to produce rearward motion of said slider, said web being formed with a plurality of perforations,

and a plurality of parallel, elongate grommets fixed in said actuator and extending rearwardly from said rear radial surface through said perforations and having heads engaging the rear surface of said web to produce forward motion of said slider.

18. A switch according to claim 17, said slider further comprising a plurality of spring fingers extending rearwardly from said radial web and frictionally engaging the outer surface of said bearing sleeve, said fingers and bearing sleeve constituting said means tending to maintain said slider stationary.

19. A switch according to claim 16, said actuator further comprising an annular, rearward extending dielectric

tongue, said tongue constituting the outside wall of an annular recess formed in said actuator, the inside wall of said recess being said forward cylindrical portion, said second series of contact points extending into said recess in the rear position of said actuator and said tongue being interposed between said two series of points to prevent accidental contact therebetween.

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