

March 11, 1958

H. F. MASON

2,826,657

SNAP SWITCH

Filed April 12, 1954

4 Sheets-Sheet 1

FIG. 1.

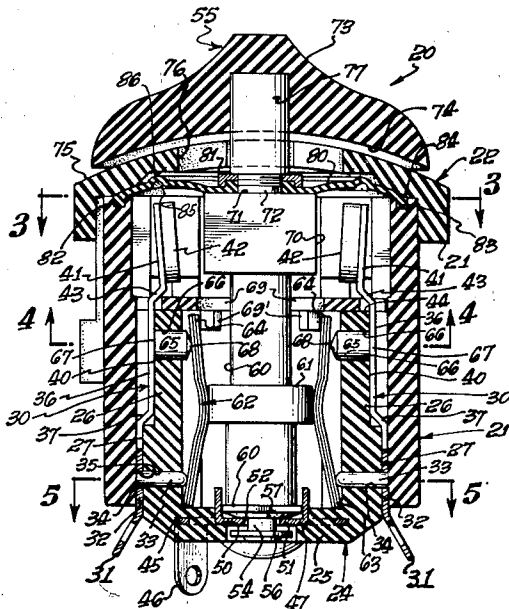


FIG. 4.

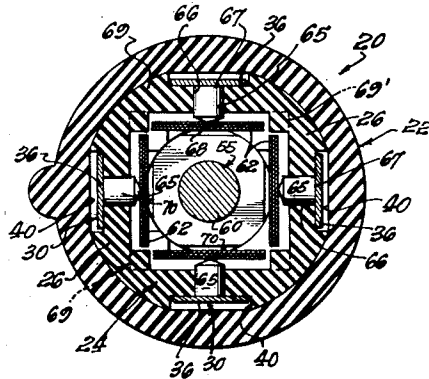


FIG. 5.

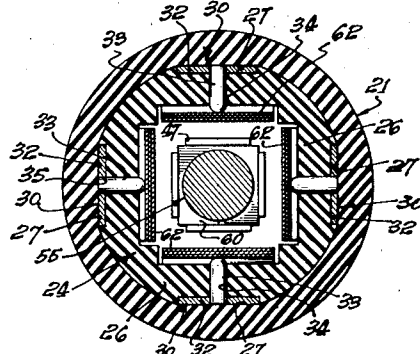


FIG. 3.

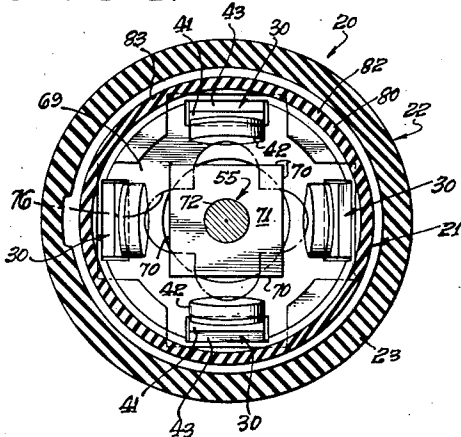
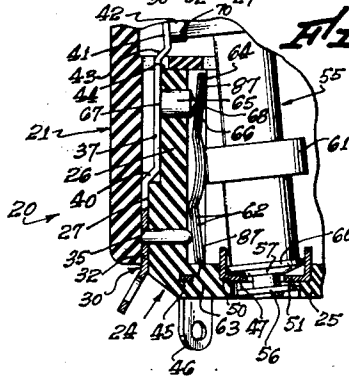


FIG. 2.



INVENTOR.

HOWARD F. MASON,

By His ATTORNEYS.

HARRIS, KIECH, FOSTER & HARRIS.

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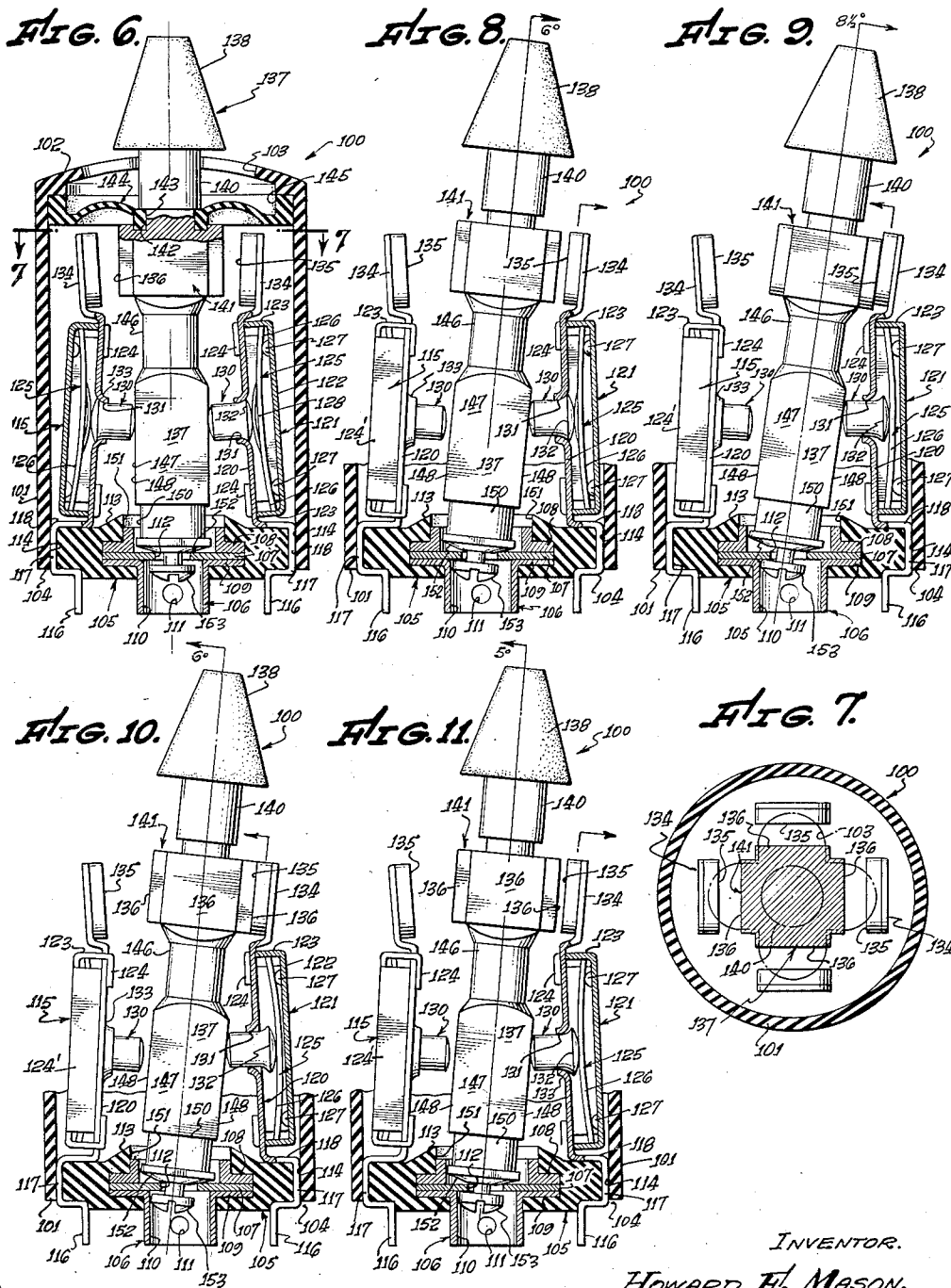
H. F. MASON

2,826,657

SNAP SWITCH

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4 Sheets-Sheet 2



INVENTOR.

HOWARD H. MASON,

By His Attorneys.

HARRIS, KIECH, FOSTER & HARRIS.

March 11, 1958

H. F. MASON

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SNAP SWITCH

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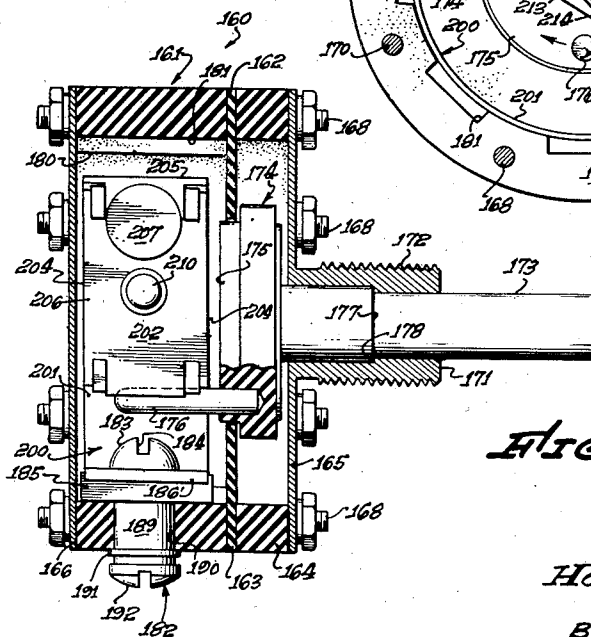
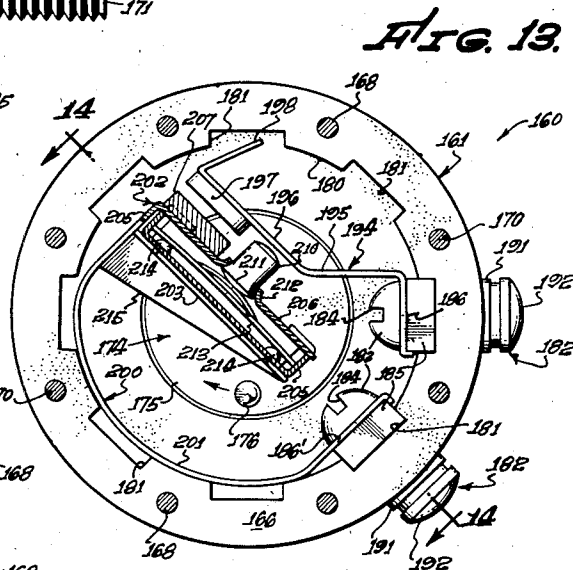
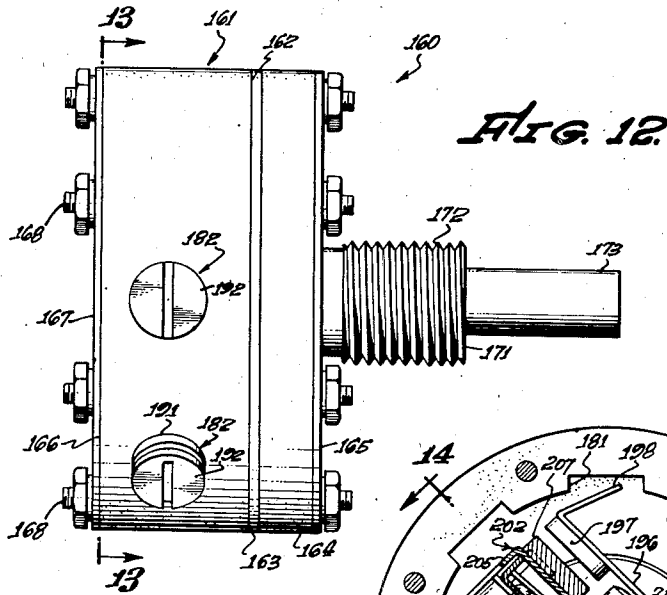


FIG. 14.

INVENTOR.

HOWARD F. MASON,

By His Attorneys.

HARRIS, KIECH, FOSTER & HARRIS.

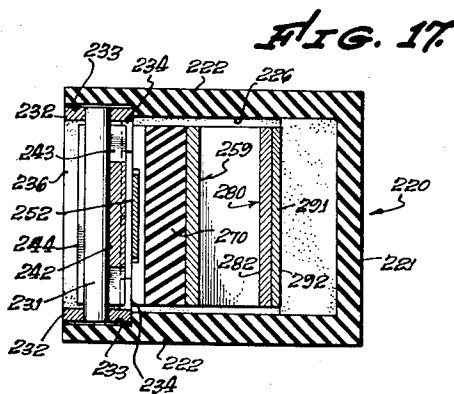
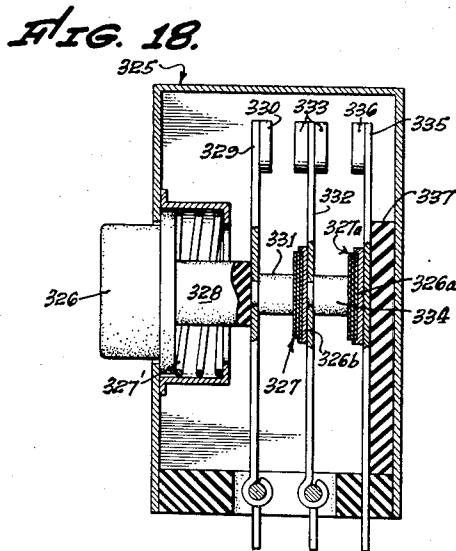
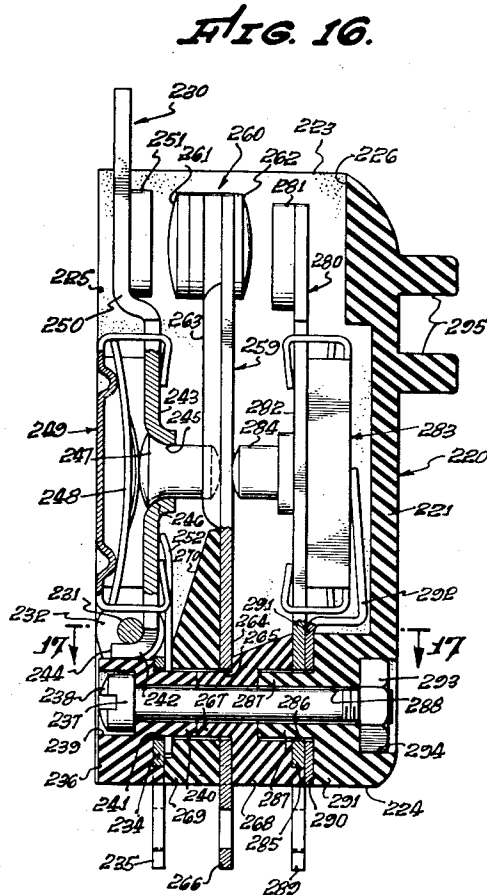
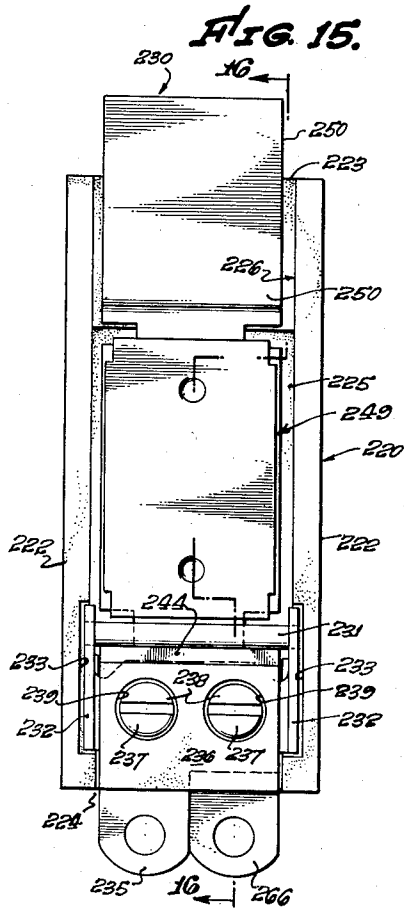
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H. F. MASON
SNAP SWITCH

2,826,657

Filed April 12, 1954

4 Sheets-Sheet 4



INVENTOR.

HOWARD F. MASON,

By His ATTORNEYS.

HARRIS, KIECH, FOSTER & HARRIS.

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2,826,657

SNAP SWITCH

Howard F. Mason, Los Angeles, Calif., assignor to Mason Electric Corporation, Los Angeles, Calif., a corporation of California

Application April 12, 1954, Serial No. 422,645

18 Claims. (Cl. 200—67)

The present invention relates to a new and improved snap switch construction. More specifically, the present invention relates to improvements over the switch constructions shown in my co-pending applications Serial No. 162,256, filed May 16, 1950, and Serial No. 163,409, filed May 22, 1950, now Patent No. 2,678,974.

In both of these co-pending applications, switches are shown in which yieldable snap means capable of being deformed from an original configuration to a second configuration under pressure, and capable of returning to the original configuration by the release of such pressure, are positioned between a fixed contact member and an actuating contact member or armature. Constructions such as are shown in these prior applications are extremely advantageous inasmuch as the yieldable snap means allows the operation of the switches in such a manner that the contacts are whipped towards or away from one another with a comparatively large amount of force as the pressure within the snap means is either built up and then suddenly released, or, once the snap means has been deformed, is suddenly released and the snap means returns to its original configuration. Experience has proven that such rapid making or breaking of electrical contacts is extremely valuable, cutting down unnecessary arcing as the contacts are moved towards or away from one another. Constructions shown in the aforesaid applications are extremely valuable inasmuch as with them a positive feel is obtained which enables the operator of the switch to determine positively whether contact has been made or broken. This is extremely advantageous for many uses, such as, for example, in aircraft when the operator of the switch must know without any question whether or not a circuit has been closed.

It has been discovered that it is possible to create new and improved switch constructions in which the contacts are moved towards or away from one another even more rapidly than in the constructions shown in the aforesaid applications, and which retain all of the advantageous features noted in these applications. Briefly, it may be stated that one object of the instant invention is to produce new and improved switches in which the mating contacts are whipped together or apart much more rapidly than in any known prior constructions of a similar commercial category.

A more detailed object of the instant disclosure is to produce new and improved electrical switches in which a "stationary" mating contact is resiliently mounted as with a spring or pad of resilient material such as a rubber pad adjacent to a snap means, which, in turn, is mounted adjacent to a movable armature containing a movable contact in such a manner that motion of the armature causes both the snap means and the stationary mating contact to be moved with a build-up of pressure as the armature is moved towards this mating contact until the point is reached at which the pressure is suddenly released by deformation of the snap means, whipping the contacts against one another.

As the armature in a construction indicated in the pre-

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ceding paragraph is moved away from the resiliently mounted "stationary" mating contact, the reverse of the process described is repeated, and the contact points on both the "stationary" mating contact and the armature are whipped away from one another. It may be considered a further object to create a switch construction having this breaking action.

The yieldable snap means employed with this invention is specifically as described in my pending application Serial No. 243,722, filed August 25, 1951, now Patent No. 2,684,843, and is of such a construction that it is capable of being deformed from an original configuration to a second configuration under pressure and is capable of returning to said original configuration by the release of such pressure. Such yieldable snap means may be termed a "detent," if desired. The use of a detent plus a resilient flexible mounting of the "stationary" contact employed with switches of this invention allows, as briefly indicated in the preceding discussion, an increased amount of pressure to be built up as an armature is moved towards the resiliently mounted "stationary" member, this pressure being capable of being released suddenly when the detent of the invention is deformed, releasing built-up pressure. This increased amount of pressure allows a much more rapid mating of the contact than has heretofore been possible or practical with prior related constructions. In addition, this construction is advantageous from a commercial point of view inasmuch as it is relatively easy to manufacture and is virtually foolproof.

A still further object of the invention is to produce a snap action switch of the class described in which a plurality of "stationary" mating contacts are resiliently mounted with a detent or snap means, as described above, positioned between or adjacent to such contacts and a movable armature containing contacts so as to obtain the advantages indicated. If desired, these "stationary" mating contacts may be positioned around the sides of a polygonal armature so that this armature may be moved against any one of the "stationary" mating contacts as desired.

A further object of the invention is to produce a rotary switch in which, as the shaft is turned, a detent positioned between a movable armature and a resiliently mounted "stationary" contact is subjected to pressure until it is suddenly deformed, allowing the armature and the contact to come rapidly against one another.

A further object of the invention is to create sequentially-operated switches, employing the advantageous features herein described. More specifically, it is an object to create sequentially-operated switches in which resiliently mounted contact-containing members are placed so that, as one of these members is moved from the original position by the application of force, pressure is built up to a given point by snap means positioned either between or adjacent to these members, at which point the pressure built up within the snap means is released, allowing the contacts mounted on such members to come rapidly against one another. A related object is to produce constructions of this type in which such contacts may be rapidly whipped away from one another by the release of the initial actuating pressure.

Still further objects of the present invention, as well as many advantages of it, will be apparent from the balance of this specification, the appended claims and the accompanying drawings, in which:

Fig. 1 is a cross-sectional view of a four-way switch construction of the invention in an open position;

Fig. 2 is a partial sectional view of the switch shown in Fig. 1 in a closed position;

Fig. 3 is a sectional view taken at line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken at line 4—4 of Fig. 1;

Fig. 5 is a sectional view taken at line 5—5 of Fig. 1;
Fig. 6 is a cross-sectional view of a modified four-way switch construction of the invention which is similar to the sectional view shown in Fig. 1 of the drawings;

Fig. 7 is a cross-sectional view taken at line 7—7 of Fig. 6;

Figs. 8, 9, 10 and 11 of the drawings are partial cross-sectional views of the switch construction shown in Fig. 6 illustrating part of this switch construction in operation;

Fig. 12 is a side view of a rotary switch construction of the invention;

Fig. 13 is a sectional view taken at line 13—13 of Fig. 12 of the drawings;

Fig. 14 is a sectional view taken at line 14—14 of Fig. 13 of the drawings;

Fig. 15 is a side view of a sequentially operating switch of the invention;

Fig. 16 is a sectional view taken at line 16—16 of Fig. 15;

Fig. 17 is a sectional view taken at line 17—17 of Fig. 16 of the drawings; and

Fig. 18 is a cross-sectional view of a modified sequentially operating switch construction of the invention.

In Fig. 1 of the drawings, there is shown a switch 20 which consists of a cylindrical side casing 21 to the top of which there is attached a cap 22 by means of an edge flange 23 secured to the casing 21 by conventional means, such as, for example, an adhesive. The bottom of the casing 21 is closed by a positioning member 24 consisting of a flat bottom wall 25 and side walls 26 placed within the casing 21.

Periodically around the outside of the walls 26 of this positioning member 24, substantially flat rectangular recesses 27 are located so as to accommodate and tightly hold portions 32 of stationary contact members 30 between the positioning member 24 and the casing 21. As is quite apparent from Fig. 1 of the drawings, the bottoms of these contact members 30 are formed as connecting terminals 31 which may be easily and conveniently connected to electrical leads by conventional procedures. The portions 32 of the contact members 30 which are positioned in contact with both the casing 21 and the positioning member 24 and are within the recesses 27, are further held in position within these recesses by pins 33 projecting through apertures 34 within the positioning member 24 and apertures 35 within the contact members 30. If desired, these pins 33 may be formed integrally with the contact members 30, or they may consist of separate elements merely located as shown during the assembly of the construction.

The central portions 36 of the contact members 30 are preferably formed with slight offsets 37 and are located within larger, flat, elongated, rectangular depressions 40 formed within the walls 26 of the positioning member 24. The upper portions 41 of these contact members 30 are preferably provided with contacts 42 which are offset from the central portions 36 of the contact members 30 by means of slight offsets 43. As shown, these contacts 42 are located within the casing 21 beyond the end 44 of the positioning member 24.

Within the bottom wall 25 of the positioning member 24 there is formed a conductive armature ring 45 which is connected to a conductive connecting tab 46 of similar construction to the terminals 31 projecting from the bottom wall 25 externally of the switch 20. Also connected to the armature ring 45 is a conductive armature cup 47 which is positioned within an aperture 50 centrally located within the bottom wall 25, and which projects internally of the casing 21 as shown in Fig. 1 of the drawings. The bottom 51 of this armature cup 47 is located medially within the wall 25 and is thus spaced from the exterior of this wall 25 within the aperture 50. This bottom 51 is provided with a centrally located opening 52 which is adapted to hold a small cylin-

drical projection 54 upon an armature 55, as shown in the drawings.

This projection 54 is provided with a small flanged element 56 adjacent to the outside of the switch 20 which serves to prevent the armature 55 from slipping away from the wall 25 during the assembly of the various components comprising the switch 20. Immediately within the armature cup 47 there is formed upon the armature 55 connected to the projection 54 a sloping shoulder 57 fitting tightly within the cup 47 so that, as the armature 55 is moved with pressure holding it against the cup 47, this sloping shoulder 57 will always be in electrical contact with the cup 47. Immediately above the sloping shoulder 57, there is located a central body portion 60 of the armature 55, around which there is located an actuating band 61 within the positioning member 24. This band 61 is adapted to bear against yieldable snap means or detents 62 held within the positioning member 24 with their bottom edges 63 being positioned at the juncture of the bottom wall 25 and the slide walls 26 of this positioning member, and with their upper portions 64 bearing against buttons 65 projecting through apertures 66 within the walls 26, as shown, and projecting against the central portions 40 of the contact members 30. It is seen from a close examination of Fig. 1 of the drawings that when the switch is in the position indicated in this figure the contact members 30 hold the outer ends 67 of these buttons 65 flush against the walls 26 with the inner ends 68 of the buttons 65 projecting from these walls against the upper portions 64 of the detents 62. The permissible motion of the detents 62 caused by these buttons 65 is limited by projections 69' on a retaining ring 69 held adjacent to the positioning member 24.

Positioned on the portion of the body 60 of the armature 55 removed from the wall 25, there are a series of contact members 70 positioned approximately opposite the contacts 42 as indicated in the drawings. These contacts 42 and 70 are provided with flat surfaces which are adapted to mate with one another, as will be more fully explained later. Immediately above the contacts 70 on the armature 55 there is provided a flat upper surface 71 surrounding an upstanding threaded projection 72 which is adapted to retain an actuator 73 having a curved bottom 74 fitting over a curved top 75 of the cap 22 within a cruciform-shaped opening 76, as shown in the drawings. This actuator 73 is attached to the threaded projection 72 by an internally threaded projection 77, as shown.

Positioned around the projection 72 against the flat surface 71 of the contact members 70 is a disc-shaped spring means 80 which is held in place against this surface 71 by means of a washer 81 bearing against the internally threaded projection 77. The edge of the spring means 80 is provided with a flange 82 which fits within a corresponding groove 83 formed within the top of the casing 21, as shown, and is held in position within this groove by action of the cap 22 bearing against the surface 84 of the spring means 80. Midway between the inner and outer edges of the spring 80, there is provided an upwardly curved groove 85 which serves to provide increased spring action of the spring member. A recess 86 is provided within the cap 22 for the purpose of accommodating the groove 85.

In using the construction shown in Fig. 1 of the drawings, the terminals 46 and 31 are connected into an electrical circuit in the expected manner, and the armature 55 is forced towards one side of the casing 21 so as to establish contact between the adjacent contact members 70 and 42. The net result of this motion is shown perhaps most clearly in Fig. 2 of the drawings. As the armature 55 rotates about the armature cup 47 in a pivotal manner, the band 61 bears against the central portion of a detent 62, which, in turn, transmits pressure exerted against it by means of the buttons 65 to the

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central portion 36 of a contact member 30, causing this contact member to move in the same general direction in which the armature 55 is forced. As a sufficient amount of pressure is built up by virtue of the motion of the armature 55 and the motion against the inherent resiliency of the contact member 30, the detent 62 will suddenly assume the position shown in Fig. 2 of the drawings with its central portion 86 collapsing and with its end portion 87 moving towards the armature 55. This motion will cause a rapid release of the pent-up pressure within the contact member 30, causing this member to whip towards the armature 55 as the force exerted by the detent 62 holding the armature away from the contact member 30 is also suddenly released, allowing the armature 55 to whip in the direction of the contact member 30. The net result of these motions is to produce extremely rapid mating of the contacts 42 and 70. This rapid mating action reduces the possibility of undesired scintillation, and, further, the sudden release of pressure which accompanies the action provides a signal that contact has been achieved which may be readily detected by one holding the armature 55.

When the armature 55 is pulled back to its original position, as shown in Fig. 1 of the drawings, the pressure within the detent 62 will suddenly, with an exertion of pressure, snap back to its original configuration and in so doing will force the button 65 against the central portion 36 of the contact member 30, tending to shove or whip this contact member away from the armature 55 with an extremely rapid motion, matching the motion described above in connection with placing the contacts 42 and 70 against one another. Normally, the detent 62 is manufactured in such a manner as is described in the co-pending applications referred to above so that it will resume its initial configuration by the mere release of pressure on the armature 55, tending to close contacts 42 and 70.

It will be understood that either the actuating band 61, or the pins 33 and the buttons 65, must be of insulating material to prevent shorting of the contacts 42 and 70 through the detents 62.

In Figs. 6 through 11 of the drawings, constructions are illustrated which are extremely closely related to those constructions described in conjunction with the initial configuration of the drawings, but which differ from such constructions in that the detents or snap means employed are mounted within a casing upon the resiliently mounted "stationary" contact members.

By a detailed examination of Fig. 6 of the drawings, it is seen that the switch 100 shown in this figure consists of a substantially cylindrical casing 101 having a domed top end 102 provided with a cruciform-shaped center opening 103. The bottom 104 of the cylindrical casing 101 is normally open when the switch 100 is in an unassembled condition, and when it is assembled, the bottom 104 is occupied by a bottom plate 105 having a center armature holding construction 106 which consists of a metal contact plate 107 held between a flanged side plate 108 and a flange 109 on a bottom terminal sleeve 110 having an aperture 111 so located that this sleeve may be readily connected by conventional means to an electrical conduit. The contact plate 107 is centrally provided with an opening 112 of smaller dimension than the inside diameter of the bottom terminal sleeve 110 and of smaller diameter than the flanged plate 108 as shown. All three of these members 110, 107 and 108 are normally held within a resinous body 113 as shown, and may be formed in this configuration by any conventional operation, such as, for example, injection molding.

Around the outside of the bottom plate 105 there are provided a series of recesses 114, between this plate 105 and the casing 101, which are adapted to hold "stationary" contact members 115. Each of these contact mem-

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bers preferably is composed of a resilient metal strip, one end of which is formed into a terminal 116 of a conventional nature leading to a U-shaped spring clip member 117 which is adapted to fit in and within the recess 114 around the bottom plate 105 between this bottom plate and the casing 101 in a fixed position with the top 118 of the U-shaped member 117 bearing against the cylindrical casing 101. Each of the stationary contact members 115 is preferably further formed with a central section 120 which is aligned with the terminal 116, as shown, and which carries within the cylindrical casing 101 a detent retaining housing 121 consisting of a back wall 122 running parallel to the section 120 of the contact member 115 between this section and the casing 101 and end walls 123 secured to this central section 120 by means of bent-over tabs 124 as shown and side walls 124' similarly secured to the center section 120.

Within each of the housings 121, there is positioned a yieldable snap means or detent 125 having ends 126 bearing against raised projections 127 positioned on the back 122 of the housing 121 and having a center section 128 positioned adjacent to the center section 120 of the contact member 115 so as to be engaged by an insulating button 130 placed within an opening 131 within the center sections 120. These buttons 130 are held in place within such openings by means of flange shoulders 132 thereon engaging curved sides 133 of the openings 131. It is seen from a detailed examination of this construction that the detents 125 normally force the buttons 130 against the center section 120 so as to project as fast into the center of the casing 101 as conveniently possible. The top portions 134 of the contact members 115 are preferably provided with flat contacts 135 of a conventional nature placed as shown adjacent to the top 102 of the casing 101 in such a position that they may mate readily with contacts 136 mounted adjacent to them upon an armature 137.

This armature preferably consists of a top handle 138 attached to a shaft 140 projecting through the opening 103 on the top 102 of the casing 101, and leading to a contact support portion 141 which carries within a groove 142 an edge 143 of a resilient membrane 144 secured at its edge 145 to the junction of the casing 101 and the top 102. Immediately below the contact support portion 141, the armature 137 contains a second shaft member 146 leading to a button contact section 147 having flat surfaces 148 which are adapted to bear against the buttons 130 as the armature 137 is moved. Immediately below this button contact section 147, the armature 137 contains a third shaft section 150 leading within a top opening 151 within the bottom plate 105 to the opening in the contact plate 107, the flanged plate 108, and the bottom terminal sleeve 110. This shaft section 150 is provided with a sloping shoulder 152 which is adapted to rest against the contact plate 107 within the flanged plate 108, as shown, and which is held generally within this locus by means of a screw 153 projecting through the aperture 112 from within the sleeve 110 so as to fasten the shaft 150 of the armature 137.

The operation of this modified construction of the invention, as shown in Fig. 6, is perhaps most clearly shown in Figs. 8, 9, 10 and 11 of the drawings. For convenience of illustration, part of the casing construction illustrated in Fig. 6 has been omitted from these figures. In the use of this switch construction, the armature 137 may be moved in any direction in such a manner that it pivots about the contact plate 107 with the shoulder 152 always in contact with this plate 107. During such motion, a surface 148 of this armature will bear against a button 130 which will, in turn, tend to force the contact member 115 to rotate slightly in a clockwise direction as viewed in Fig. 8 of the drawings. Throughout such motion, the contacts 135 and 136 remain apart as shown. After the contact member 115 has been moved from its original

location a given amount, sufficient pressure will be built up between the armature 137 and this contact member 115 so that suddenly the detent 125 will be deformed to the configuration shown in Fig. 9 of the drawings, with the center portion 122 of this detent moved towards the casing 101 by virtue of motion of the button 130 towards this casing. This motion is accompanied by the movement of the contact member 115 back to its original configuration. Thus, from a detailed analysis of the drawings, it is seen that the mating action of contacts 135 and 136 is essentially a whip action of the contact member 115 and the detent 125, and is a result of a build-up of force caused by movement of the armature 137 transmitted through the button 130 to both this detent 125 and to the contact member 115, and which is suddenly released by a snap action of the detent 125. In Figs. 10 and 11 of the drawings, it is seen that the breaking of the contact of the invention commences by a simple movement of the armature 137 back to its original central position with a subsequent rapid return of the button 130 to its original configuration removed a maximum possible distance from the casing 101 with essentially the reverse of the action previously described.

In Figs. 12, 13 and 14 of the drawings, a rotary switch 160 is shown which is constructed following the broad teachings of this invention. This switch consists of a cylindrical casing 161, one end 162 of which is covered by a washer 163 which, in turn, is capped by an annular ring 164 which is closed by means of a top cap 165, as shown in Fig. 14. The other end 166 of the casing 161 is closed by means of a plate 167. The plate 167, casing 161, washer 163, annular ring 164 and the top cap 165 are secured in relationship to one another by means of bolts 168, as shown, these bolts projecting through aperture 170 formed within these members 161, 162, 163, 164, 165 and 167. The top cap 165 is provided with a centrally protruding boss bearing 171 provided on its external surface with threads 172 for attachment to an appropriate mounting device. Within this bearing 171 a shaft 173 projects into the space between the washer 163, the ring 164 and the top cap 165, where it is attached to a disc-like rotor 174 having a dependent center boss 175 which projects through the center of the washer 163 into the end 162 of the cylindrical casing 161. Mounted upon this rotor 174 so as to project from it through the boss 175 into the casing 161, is a small pin 176 which is adapted to be turned as the shaft 173 is rotated. In order to prevent this shaft 173 from slipping towards the exterior of the device, it is provided with a shoulder 177 which bears against an appropriate shoulder 178 within the boss 171.

Disposed within the inner surface 180 of the casing 161, there are provided a series of regularly shaped notches 181 which are adapted to hold the ends of various fastening elements 182.

As shown in Figs. 13 and 14, these fastening elements 182 consist of rounded heads 183 provided with centrally located slots 184 secured within the casing 161 over boss-like washers 185 secured within notches 181, as shown, so as to hold ends 186 and 186' against these washers 185. To accomplish this purpose, each head 183 is attached by means of screw threads (not shown) to a central shaft 187 projecting through an aperture 190 within the casing 161, being held in position with respect to this casing by a flange 191 bearing against the external surface of the casing 161, as shown. In order to attach appropriate electrical leads to the fastening elements 182, exterior slotted heads 192 are attached to the shaft 187 by means of internal screw threads (not shown). It will be understood, from a brief inspection of the drawings, that the fastening elements 182 are held in place by virtue of the slotted heads 183 being drawn up so as to pull the various elements held by these heads

towards the casing 161 while the flanges 191 grasp the outside of this casing 161.

The end 186, shown most clearly in Fig. 13 of the drawings, forms part of a resiliently mounted, stationary contact member 194, having an upstanding portion 195 leading from the end 186 to a flat body portion 196 containing, on its extremity removed from the end 186, a contact 197, adjacent to which there is positioned a flange 193 which is adapted to bear against the casing 161 as the contact member 194 is moved from the position shown to any considerable extent, preventing too great a motion of this contact member.

The other end 186' is attached to a detent-holding contact member or armature 200 having a central section 201 curved around the interior of the casing 161, as shown, leading to a detent-holding housing 202 positioned within the casing 161 so as to be substantially parallel to the body portion 196 of the stationary contact member 194. This housing 202 is essentially of the same category illustrated in the modification of the invention shown in Figs. 6 through 11 of the drawings, and consists of a rear wall 203, side walls 204, end walls 205 and a front wall 206, upon which there is mounted a contact 207 and through which there projects an insulating button 210 having internal shoulders 211 adapted to bear against a curved flange 212. This button 210 is normally held in the position indicated by means of a detent or snap means 213 positioned within the housing 202, as shown, with its opposed extremities bearing against projections 214. In order to provide structural stability to support the housing 202, a triangularly-shaped flange web 215 is provided between the back wall 203 of this housing and part of the central section 201 of the contact member 200.

In operation of the device shown in Figs. 12 through 14 of the drawings, this device is mounted by means of the threads 172 and appropriate leads are attached to the fastening elements 182 in a conventional manner. The device is then ready for use, and, by rotating the shaft 173, the pin 176 can be brought to bear against the flange web 215, causing the contact member of the detent-holding housing 202 to move against the stationary resilient contact member 194. As this occurs, the button 210 presses against the section 196 of the contact member 194, forcing this latter contact member from its normal position and building up pressure within it by virtue of its inherent resiliency. Simultaneously, pressure is built up by virtue of the button 210 pressing against the snap action means or detent 213. When a certain amount of pressure has been reached, depending upon the precise characteristics of this detent 213, it will deform rapidly from its original configuration to a second configuration, allowing the button 210 to be forced within the housing 202 by the action of the stationary contact member 194 whipping towards this housing. As this occurs, the two contacts 197 and 207 will be whipped towards one another with very rapid mating action. As the shaft 173 is turned from the web flange 215, the detent or snap action means 213 will suddenly revert to its original configuration, causing the contacts 197 and 207 to whip rapidly apart.

In Figs. 15, 16, and 17 of the drawings there is shown a sequentially operated switch construction in accordance with the broad teachings of the invention which comprises a housing 220 having a bottom wall 221, parallel side walls 222, an open end 223, a closed end 224, and an open top 225, so as to define an internal cavity 226. Within the cavity 226 adjacent to the top 225 is an electrical conductor or contact 230 which is pivotally mounted about a rod 231 carried by side bars 232 within cavities 233 in the side walls 222, these side bars 232 forming ends of a flat terminal section 234 having a terminal tab 235 for connection to an appropriate electrical lead (not shown). This terminal section 235 is held in po-

sition within the closed end 224 by contact with a cap 236 and by the action of bolts 237 having heads 238 fitting within top recesses 239 in the cap 236, these bolts 237 and dependent flanges 240 on the cap 236 projecting through openings 241 in the terminal section 234.

A curved end section 242 of a body section 243 of the contact 230 engages the rod 231 with a flat end 244 of this curved section 242 engaging the cap 236, preventing undesired retention of the contact 230 out of the cavity 226. The body section 243 is provided with an aperture 245 defined by a flange 246 facing the bottom wall 221 and having curved shoulders 247' carrying an insulating button 247 which is adapted to bear against a detent 248 as previously described. This detent 248 is held within a housing 249 of essentially the category indicated in the modification of the invention shown in Figs. 6 through 11 of the drawings and in the modification of the invention shown in Figs. 12 through 14 of the drawings. Because the construction of this housing has been described in conjunction with the description of these figures, it will not be described here.

The body section 243 of the contact 230 removed from the curved end section 242 carries an offset handle 250 projecting beyond the open end 223. This handle 250 is equipped on its side adjacent to the bottom wall 221 within the cavity 226 with a contact button 251. The contact 230 is manually held in the position shown in Fig. 16 by a spring 252 engaging the body section 243, the terminal tab 235, and the dependent flanges 240 over the cap 236.

Placed within the cavity 226 so as to manually be held against the button 247 is a body section 259 of a second electrical conductor or contact 260 having contact buttons 261 and 262 positioned on opposite sides of this body section adjacent to the contact button 251, and adapted to mate with this latter contact button. The body section 259 is provided with upstanding flanges 263 along its sides to provide structural rigidity, and is connected to a terminal section 264 having an aperture 265 and carrying a terminal tab 266 for the obvious purpose. This aperture is designed to be placed around flanges 267 of a spacing member 268, the flanges 267 bearing against the flanges 240, and being traversed by the bolts 237. The terminal sections 264 and 235 are held apart by a spacing member 269 placed in the end 224 around the flanges 240 and 267, this opening member being equipped with an internal supporting projection 270 bearing against the body section 259 within the cavity 226.

A third electrical conductor or contact 280 is positioned within the cavity 226 between the contact 260 and the bottom wall 221 so that a contact button 281 positioned on a body section 282 of this contact 280 is positioned adjacent to the contact 262 or the contact 269 so as to be adapted to mate therewith. This body section 282 carries a housing 283 which is similar in construction to the housing 249 and a projecting insulating button 284 held in the same manner as the button 247 is held. As is most clearly seen in Fig. 16, both the buttons 284 and 247 bear against the body section 259 of the second contact 260.

Attached to the body section 282 of the contact 280 is a terminal section 285 having an aperture 286 surrounding an upstanding flange 287 on the bottom wall 221 and held in this position by the bolts 237 projecting through an aperture 288 in this flange and by contact with the spacing member 268 with the flange 287 fitting within an internal boss 288 within this latter member. The terminal section 285 carries a terminal tab 289 for the obvious purpose of attachment to an electrical lead.

Positioned between this terminal section 285 and a shoulder 290 on the bottom wall 221 and the flange 287 is a spring 291 having a lower section 292 projecting into the cavity 226 and contacting the housing 283 so as to

provide spring support to this housing. A nut 293 in each bolt 237 is held in a cavity 294 in the bottom wall 221. Positioned on this wall 221 there are also projections 295 for use in positioning the construction shown.

The operation of the switch shown in Figs. 15, 16, and 17 is comparatively simple in spite of the apparent complexity of the construction. After appropriate leads are connected to the terminal tabs 235, 266, and 289, the contact 230 is formed on the bottom wall 221 causing pressure to be built up within the detent 248 because of the button 247 being forced against the body section 259 of the second contact 260. Simultaneously, pressure is built up within the detent (not shown) in the housing 283 because of the body section 259 being forced toward the contact 280 against the button 284 contacting this detent. The spring 291 absorbs some of this pressure and the contacts 260 and 280 tend to act as springs, also absorbing some of this pressure. When the pressure has been built up to a sufficient predetermined level, the detents suddenly deform to a second position, releasing pressure, allowing the contact buttons on the contacts 230, 260, and 280 to whip together rapidly. This motion is aided by a release of tension in the spring 291 and in the contacts 260 and 280. When the pressure on the contact 280 is released, the various elements indicated return rapidly to their original positions.

Fig. 18 shows a plunger-actuated switch utilizing two detents or sets of nested detents 327 and 327a. A case 325 houses the switch components and also slidably mounts a plunger 326 and a compression spring 327'. A stem 328 of the plunger is the actuating extremity and engages a contact leaf or arm 329 which is pivotally supported at one end by the case 325, the other thereof having a contact button 330. Affixed to the arm 329 is an insulating stud 331 which is in alignment with the axis of the plunger, the stud extending into engagement with a detent 327. This detent is supported by a retainer plate 326b and is held in position with overlapping extensions (not shown) retaining the detent within the confines of the plate. The plate 326b is rigidly attached to a second contact leaf or arm 332, one extremity of the arm being pivotally attached to the case 325 and the other extremity thereof having a pair of contacts 333. Similarly affixed to the arm 332 is an insulating stud 334 which engages the adjacent detent 327a. This detent is retained in a similar manner by a retainer plate 326a, the plate being rigidly attached to a conductor arm 335 which is in firm engagement with a resilient pad 337 of rubber or the like serving as a spring, this pad being mounted on the case 325. The conductor arm 335 extends similarly to other contact arms and has a contact button 336 at the end thereof. Only two sets of contacts and associated detents have been shown as representative of a sequential structure.

It is contemplated that conductor arm 332 may be constructed as a double leaf with insulation therebetween and with a contact 333 on the end of each leaf. In such a structure the center conductor 332 would not be electrically common to both adjacent arms and thus it will provide for individual circuit connections. It is also contemplated that any plurality of contact leads may be placed in sequence and operate substantially as will hereinafter be described.

Of particular novelty herein is the sequential operation of the contacts. One detent may require a different force to cause deflection through the other detent. In such a construction, when the plunger 326 is depressed, the associated contacts will engage in accordance with the restraining force of the detents whereby one set of contacts will close before the other set will close. For example, assume that the detent affixed to the conductor arm 335 requires less force to cause deflection than the detent affixed to the contact leaf 332. When the plunger is depressed, the contacts 333 and 336 will first close and, as force is progressively applied to the plunger, then the

contacts 333 and 330 will close. The appropriate circuits to be energized are selectively attached to the contact arms and conductor arm. The perceptible snap action and the wiping of the contacts are equally attained in this embodiment.

The same sequential action may be provided with detents of equal strength on each conductor by the expedient of varying the location of the detents and engaging stud with respect to the conductor. For example, in Fig. 18, if the detent 327a and the associated stud 334 are moved toward the contact extremity of the conductors 332 and 335, the moment arm is increased. Thus, with equal characteristics of both detents 327 and 327a, actuation of the plunger 326 will first cause engagement of the contacts 330 and 333, and progressive actuation through the increased moment arm will cause subsequent engagement of the contacts 333 and 336.

Similar modifications may be made of the construction shown in Figs. 15 through 17 by varying the strength of the detents employed with this construction, or by varying the location of these detents and the contact buttons on the contacts 230 and 230. Such modifications obtain substantially the same results indicated in the discussion of Fig. 13 with respect to a sequentially operating structure. In the specific construction shown in the drawings described previously, the device shown in Fig. 16 operates with all the contacts whipping together simultaneously, whereas in an altered device as described herein these contacts would come together and go apart in a predetermined manner with a rapid mating and breaking action.

Those skilled in the art will realize that a number of other modifications may be made within the broad scope of the instant disclosure. As an example of such modification, two or more detents may be employed for any application, instead of a single detent as herein described, and such detents may be either stacked one upon another or may be positioned side by side. Similarly, pads of resilient material or separate springs of either a leaf or coil category or a flexible spring strip forming part of an electrical contact can be substituted for one another or can be used in conjunction with one another.

I claim as my invention:

1. In a multiple-pole electric switch, the combination of: a frame having a base and providing a cavity; an armature disposed within said cavity and universally mounted to and in continuous conductive relation with said base; a plurality of first contacts mounted upon said armature; resilient means attached to said frame providing a plurality of second contacts in paired juxtaposition with said first contacts; a plurality of yieldable snap means connecting said armature and said resilient means, each of said snap means having reactive characteristics; and unitary means connected to said armature operative to selectively register any pair of said first and second contacts in conductive relation against restraint of said associated snap means.

2. In a multiple-pole electric switch, the combination of: a frame having a base and providing an internal cavity; an armature disposed within said cavity and universally mounted to and in continuous conductive relation with said base; a plurality of first contact means conductively mounted on said armature; resilient spring means providing a plurality of second contact means in paired juxtaposition with said first contact means; a plurality of yieldable snap means connecting said resilient means and said armature and attached to said resilient means, each of said snap means having predetermined reactive characteristics; and unitary means attached to said armature operative to register any pair of said first and second contact means in conductive relation against restraint of its associated snap means.

3. In a multiple-pole electric switch, a combination of: a frame having a base and providing a cavity; an armature disposed within said cavity and universally mounted to and in continuous conductive relation with said base;

a plurality of first contacts conductively mounted to said armature; resilient spring strip means providing a plurality of second contacts in paired juxtaposition with said first contacts; a corresponding plurality of yieldable snap means connecting said armature and said spring means mounted within said cavity, each of said snap means having predetermined reactive characteristics; and unitary means connected to said armature operative to selectively register any pair of said first and second contacts in conductive relation against restraint of its associated snap means.

4. In an electric switch, the combination of: a frame; two contact members carried by said frame and respectively carrying electrically interengageable contacts, one of said contact members being movable in a direction toward the other contact member upon application of an actuating force thereto to tend to produce electrical interengagement of said contacts, and one of said contact members being resiliently yieldable to tend to prevent electrical interengagement of said contacts when said movable contact member is moved in a direction toward the other contact member; actuating means for applying an actuating force to said movable contact member in a direction to tend to move said movable contact member toward the other contact member; means including a snap-acting spring operatively interconnecting said contact members and resisting movement of said movable contact member toward the other contact member so as to tend to prevent electrical interengagement of said contacts, said snap-acting spring having a normal configuration which spaces said contact members apart a distance sufficient to prevent electrical inter-engagement of said contacts, said snap-acting spring being capable of snapping over center from said normal configuration into a second configuration upon application of an actuating force of predetermined magnitude to said movable contact member, said second configuration of said snap-acting spring spacing said contact members apart a distance insufficient to prevent electrical interengagement of said contacts, whereby movement of said movable contact member in a direction toward the other contact member by the actuating force causes said yieldable contact member to yield to prevent electrical interengagement of said contacts until said snap-acting spring snaps over center from said normal configuration to said second configuration, whereupon relative movement of said contact members toward each other occurs suddenly to produce sudden electrical interengagement of said contacts; and means electrically insulating said snap-acting spring from at least one of said contacts.

5. An electric switch as defined in claim 4 wherein one of said contact members is said movable contact member and the other is said yieldable contact member.

6. An electric switch as defined in claim 5 wherein said yieldable contact member is a conductor strip carrying one of said contacts at one end thereof and secured to said frame at the other end thereof.

7. An electric switch as defined in claim 4 wherein one of said contact members is said movable contact member and the other is said yieldable contact member, said electric switch including resilient means interconnecting said yieldable contact member and said frame and biasing said yieldable contact member toward said movable contact member.

8. An electric switch as defined in claim 4 wherein said contact members are electrical conductors.

9. An electric switch as defined in claim 4 wherein one of said contact members is said movable contact member and the other is said yieldable contact member, said yieldable contact member being a spring.

10. An electric switch as defined in claim 4 wherein one of said contact members is said movable contact member and the other is said yieldable contact member, said yieldable contact member being a spring and both of said contact members being electrical conductors.

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11. An electric switch as defined in claim 4 wherein said snap-acting spring is positioned between said contact members.

12. An electric switch as defined in claim 4 wherein one of said contact members is said movable contact member and the other is said yieldable contact member, said movable contact member having a plurality of circumferentially spaced contacts thereon and said electric switch including a plurality of said yieldable contact members carried by said frame in circumferentially spaced relation and respectively having thereon contacts respectively engageable by said contacts on said movable contact member, there being a plurality of said snap-acting springs in circumferentially spaced relation and respectively related to said movable contact member and said yieldable contact members in the same manner as the snap-acting spring set forth in claim 4.

13. An electric switch as defined in claim 4 wherein said movable contact member is pivotally mounted on said frame.

14. An electric switch as defined in claim 4 wherein said actuating means is pivotally mounted on said frame.

15. An electric switch as defined in claim 4 wherein said actuating means is rotatably mounted on said frame.

16. An electric switch as defined in claim 4 wherein said actuating means is reciprocally mounted on said frame.

17. An electric switch as defined in claim 4 including

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a third, movable contact member carried by said frame and having a contact thereon which is engageable by a second contact on one of the contact members set forth in claim 4, said electric switch including a second snap-acting spring related to said third contact member and to one of the contact members set forth in claim 4 in the same manner as the snap-acting spring set forth in claim 4 is related to the two contact members set forth therein.

18. An electric switch as defined in claim 17 wherein the snap-acting spring set forth in claim 4 and said second snap-acting spring snap over center in response to different actuating forces.

References Cited in the file of this patent

UNITED STATES PATENTS

1,287,491	Spaulding	Dec. 10, 1918
1,818,801	Herden	Aug. 11, 1931
2,085,557	Uhl	June 29, 1937
2,418,965	Blair	Apr. 15, 1947
2,496,135	Sedwitz	Jan. 31, 1950
2,520,874	Bean	Aug. 29, 1950
2,616,996	Beeman	Nov. 4, 1952

FOREIGN PATENTS

116,820	Sweden	July 16, 1946
377,832	Germany	June 30, 1923
569,965	Great Britain	June 15, 1945