March 20, 1956 H. F. MASON 2,739,193

SNAP SWITCH

Filed May 16, 1950 2 Sheets-Sheet 1

Fig. 1

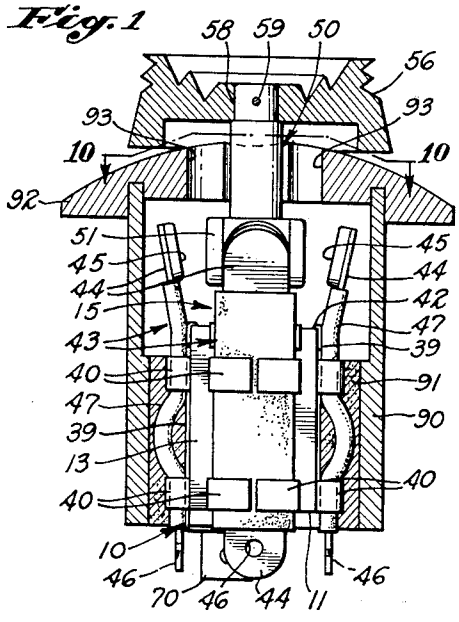


Fig. 3

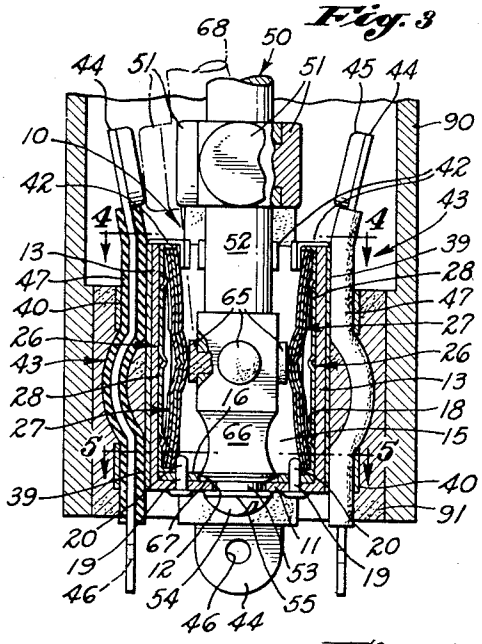


Fig. 2

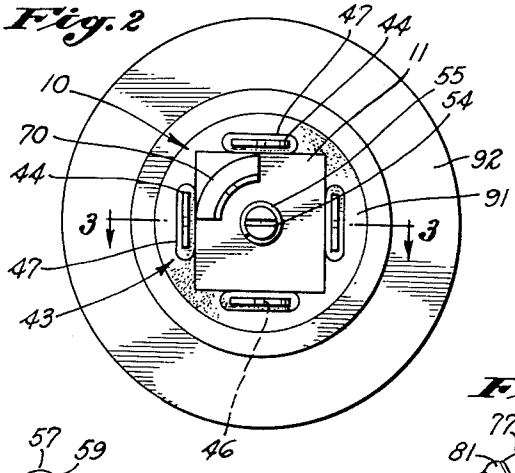


Fig. 4

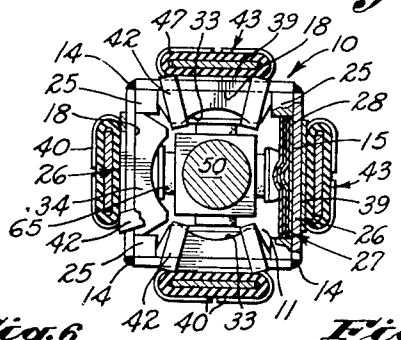


Fig. 6

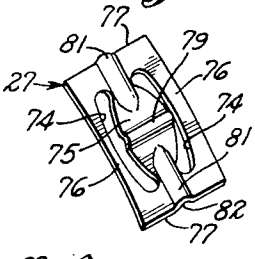


Fig. 5

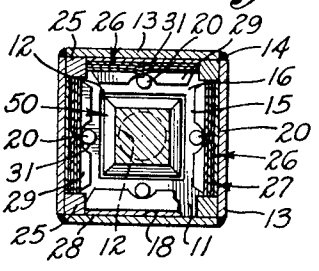
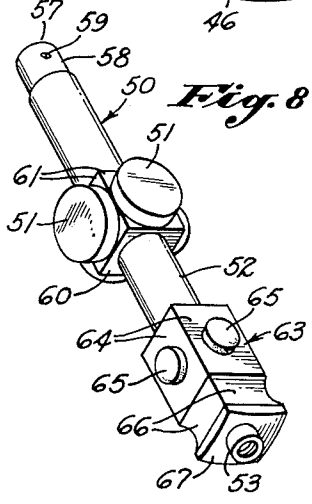


Fig. 8



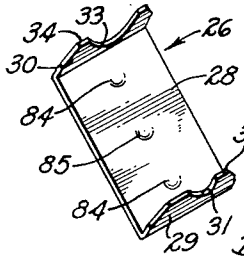


Fig. 7

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SNAP SWITCH

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Fig. 9a

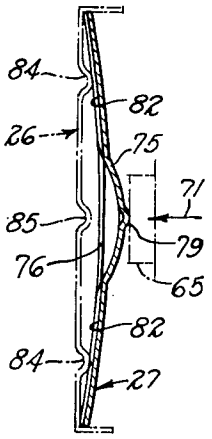


Fig. 9b

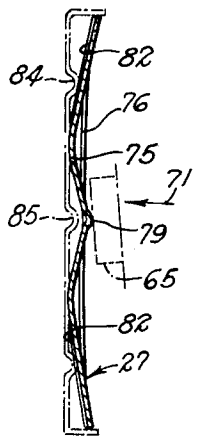


Fig. 11

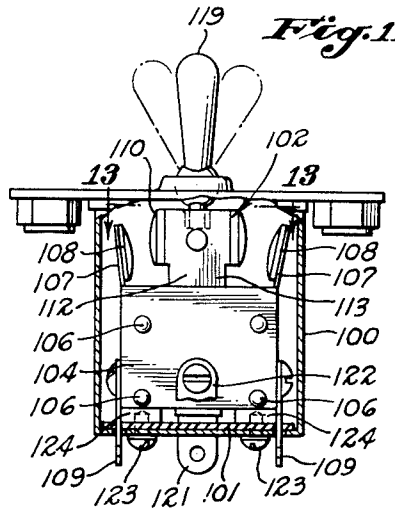


Fig. 10

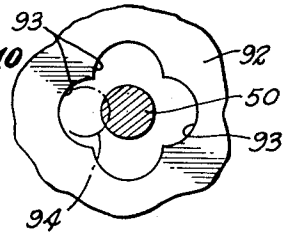


Fig. 12

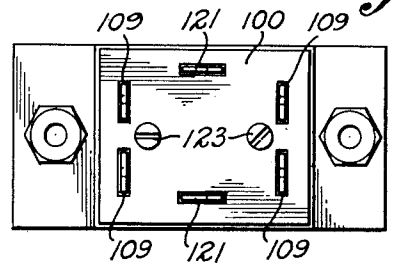


Fig. 14

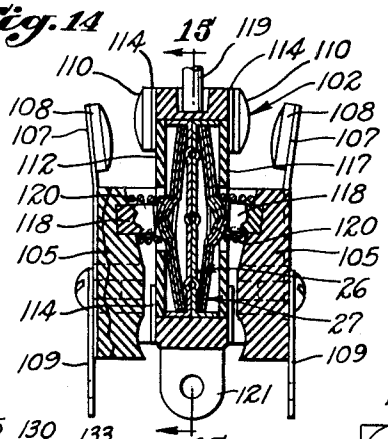
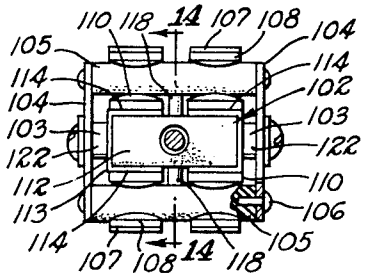


Fig. 13



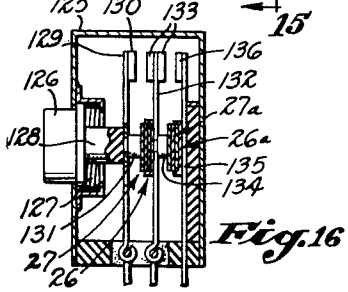


Fig. 16

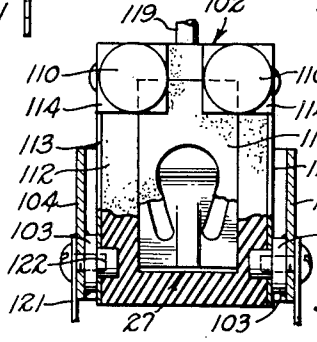


Fig. 15

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2,739,193

SNAP SWITCH

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Application May 16, 1950, Serial No. 162,256

24 Claims. (Cl. 200—6)

This invention relates to new and useful improvements in an electrical switch and deals more particularly with a momentary or self-centering manually operable switch.

Heretofore, momentary switch structure development has not sufficiently advanced to accommodate the mandatory prerequisites required for certain usage. For instance, in the aircraft industry, particular need is for a momentary switch with a positive feel or snap action to affirmatively apprise the operator thereof by sense of touch of the completing or interrupting of an electrical circuit for the predominant noise level in aircraft precludes use of the sense of hearing. Snap characteristics have been incorporated into switch design by means of current carrying leaf springs or revese bend stress buckling devices intermediate the control toggle or plunger and the contact of the circuit to be completed. Such design has proved unsatisfactory and potentially hazardous in aircraft for no provision is made for forceably separating the contacts in the event of their fusing together as may be caused by a remote short circuit in the electrical network.

Further, it is not infrequent that the buckling devices themselves form a part of the electrical circuit to be completed wherein their functional characteristics are subject to alteration due to current passing therethrough. Prior attempts to alleviate this danger resulted in addition of undesirable components supplementing the already excessive weight and size of aircraft control devices.

It is, therefore, an object of this invention to provide a momentary electrical switch that is positive in action, the closing and opening of which can be readily perceived by touch.

It is another object of this invention to provide a momentary electrical switch with perceptible snap action characteristics and yet provide means to forceably separate the contacts in event of failure of its self-contained returning means.

Another object is to provide a momentary switch wherein the actuating element is one of the conducting members whereby direct and positive engagement of the other contact or contacts may be made.

An incidental object herein is to flexibly mount the receiving contact so that engagement is substantially a progressive wiping action that both reassures a completed circuit as well as subordinate cleaning of the contact surfaces.

Another object is to provide a switch with such snap action, but relieve the restraining force approximately at the time of the contact engagement, whereby the energy available to overcome the restraining force is converted to an increase in contact pressure.

Another object is to provide a switch with a means to rapidly separate the contacts upon interruption of the circuit to minimize arcing at the contacts.

Another object is to provide a momentary switch of the above nature that serves a plurality of circuits, the actuating element being a conductor common to the said circuits. Further, it is an object to provide such plural service and yet maintain the unit comparably miniature in dimension and weight as compared to multi-pole switches in present use.

Another object is to provide such a switch with a high current rating that is relatively compact and light weight compared to the function to be performed with an incidental particular characteristic of the insulation occupying greater space than the operating elements.

The invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. However, the drawings merely show and the following description merely describes a few embodiments of the present invention, which are given by way of illustration or example only.

In the drawings, like reference characters designate similar parts in the several views.

Fig. 1 is a side elevational view of one embodiment of the present invention with the case partially removed showing the internal working parts thereof

Fig. 2 is a bottom view of the structure shown in Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view, partially cut away, taken along the line 3—3 of Fig. 2;

Fig. 4 is a sectional plan view taken along the line 4—4 of Fig. 3;

Fig. 5 is a sectional plan view taken along the line 5—5 of Fig. 3;

Fig. 6 is a perspective view of the spring element or detent embodied in the present invention;

Fig. 7 is a perspective view of a support plate that may be used in conjunction with the spring detent of Fig. 6;

Fig. 8 is a perspective view of the armature included in the present invention

Figs. 9*a* and 9*b* are enlarged elevational sections of the spring detent shown in the normal and in the stressed positions respectively

Fig. 10 is a fragmentary sectional plan view of the cap taken along the line 10—10 of Fig. 1;

Fig. 11 is a side elevational view of another form of a switch embodying the present invention

Fig. 12 is a bottom view of the switch shown in Fig. 11;

Fig. 13 is a sectional plan view of the switch taken along the line 13—13 of Fig. 11;

Fig. 14 is an enlarged sectional elevational view of the operable components of the switch taken along the line 14—14 of Fig. 13;

Fig. 15 is a side elevational sectional view taken along the line 15—15 of Fig. 14; and

Fig. 16 is a sectional side sectional view of another form of the switch embodying the present invention.

In the drawings, wherein for the purpose of illustration are shown the preferred embodiments of this invention, and first particularly referring to Figs. 1–5, inclusive, representing one embodiment illustrated as a four pole switch, the reference numeral 10 indicates the frame of the switch which is preferably fabricated of sheet metal and having a base 11 with a center hole 12 therein as seen in Fig. 5 and having upturned side portions 13, the side portions meeting at their edges as indicated by the numeral 14, thus forming a cavity 15 for the frame. The frame 10 is shown as substantially a parallelepiped, but it is within contemplation that other forms may be constructed, for example, cylindrical or octagonal.

A key plate 16 as best seen in Figs. 3 and 5 having an outside periphery corresponding to the inner wall surfaces 18 of the frame 10 is attached to the base 11 on the cavity side thereof by means of a plurality of studs 19, the

studs being secured to the base and extending through the key plate to provide a protruding stem 20 adjacent each side portion 13. The key plate 16 is provided with a central void extending therethrough and having an internal periphery substantially parallel to the side portions 13.

A guide bar 25 is provided at each juncture 14 of adjacent side portions, extending from the key plate 16 to the opening of the cavity 15, and is secured to each adjacent side portion by spot welding or any adequate attaching means. Such securing effects complete structure rigidity of the frame 10 and retains the key plate 16 in position.

Disposed between each adjacent pair of guide bars 25 is a support plate 26 (detailed in Fig. 7) and one or a plurality of spring detents 27 (detailed in Fig. 6) associated with each plate, which comprise the spring means for the switch. The spring detents 27 may be used individually or nested together as indicated in the drawings. For purposes of expediency, the function of the plate 26 and detents 27 will be described hereinafter.

Referring to Fig. 7, the support plate 26 has a base portion 28 and upturned opposite ends 29 and 30 substantially parallel to each other to provide retaining abutments for the detents 27. The end 29 is provided with a notch 31 on the outer edge 32 thereof, whereas the end 30 has a circumferential depression 33 on the outer edge 34 thereof.

One or more spring detents 27 may be nested or stacked on the base portion 28 and within the ends 29 and 30 of the support plate 26 and the combination slidably inserted between the guide bars 25 (see Fig. 5) to engagement with the key plate 16 whereby the protruding stem 20 of a stud 19 engages the notch 31 to retain the base portion of the plate in fixed abutment with the inner side wall 18 of the side portion 13. The stem 20 also serves to prevent the detent 27 from falling from position. Thus, it is readily seen that the support plate 26 and its associated detent 27 are retained in position on three sides.

To complete the securing of the plate 26 and the detent 27, a bracket 39, as best seen in Figs. 1 and 4, is attached, for example, by spot welding to the outer surface of each side portion 13, each bracket being provided with extending fingers 42 that bend over the side portions and into the cavity 15 and firmly engage the outer edge 34 of the support plate 26 and extend further to retain a detent or detents 27 in position.

The brackets 39 also serve by means of integral straps 40 to mount electrical contact assemblies 43 to the frame 10. Each assembly 43, as best seen in Fig. 3, comprises an arm or pole 44 made of a flat strip of electrical conductive material and sufficiently flexible and resilient to yield along the flat under cantilever stress as hereinafter will be described. At one end of the arm 44 is a contact button 45, the other end 46 being provided with a hole to receive a connecting wire. A band of electrical insulating material 47 is wrapped about the arm 44 intermediate the ends thereof so that when the assembly 43 is placed in position it will be electrically insulated from the frame 10. The straps 40 that laterally extend from the bracket 39 are bent over to secure the assembly 43 in such a position that the contact button 45 is disposed above and directly toward the cavity 15 of the frame 10. For purposes of illustration only, four contacts are utilized and are symmetrically disposed about the frame 10 and directed toward the cavity 15. It is contemplated, however, that the structure may be so arranged to accommodate any plurality of contact buttons symmetrically disposed about the said frame. The associated arm 44 of each contact 45 is connected at the hole 46 to the appropriate circuit to be connected or energized.

The above-mentioned plurality of circuits are individually energized from a common source of potential and are initiated by a manually displaceable armature 50 as seen in Fig. 1 which is partially disposed in the confines of the cavity 15 and having contact buttons 51 appropriately located thereon and juxtaposed opposite to the corresponding contact buttons 45 of the assemblies 43.

The armature 50, as detailed in Fig. 8, is essentially a shaft 52 and has a stem 53 that extends through the center hole 12 of the base 11 as best seen in Fig. 3. The armature 50 is limited in vertical movement by means of a screw or stud 54 tapped or pressed into the stem 53 from the exterior of the frame 10. A lockwasher 55 may be used to prevent the screw 54 from loosening due to external vibration as well as to provide a greater contact area against the base 11. The stem 53 is of such diameter and sufficient length to extend substantially through the base 11 so as to permit the armature 50 to be angularly displaced within the cavity without stressing the base 11. The actuated end 57 of the armature 50 is provided with an undercut 58 and a dowel or pin hole 59 to accommodate attachment of a knob 56, as seen in Fig. 1. Intermediate the ends of the armature 50 is an enlarged portion 60 that may be of any suitable shape to provide an adequate mounting area for the contact buttons 51. The drawing shows this enlarged portion 60 to be substantially cuboid in shape providing mounting spaces or surfaces 61 to which the contacts 51 are rigidly fixed and electrically conductive thereto.

Adjacent the stem 53 is another enlarged portion 63 having faces 64 parallel to faces 61 of the enlarged portion 60. Each surface 64 has a salient stud 65 protruding therefrom to engage with its corresponding detent 27 when the armature 50 is angularly moved toward the said detent. The stud 65 is rigidly pressed into each surface 64 and is made of an insulating material and abradable as compared to the detent 27 so that any abrasion or wear will appear at the stud 65 so as to preserve the spring characteristics of the detent. The surfaces 64 are grooved transversely and tangential to the shaft 52 as indicated by the numeral 66 to preclude intereference with the studs 19 when the armature is displaced.

The bottom face 67 of portion 63 is substantially spheroid in form, being in abutment with the base 11 and accommodates the rocking motion of the armature 50 at the base 11 of the frame 10 so as to maintain continuous electrical contact therewith. Referring to Fig. 3, the contact of the armature 50 with the base 11 can be visualized. Effectively the armature may be displaced from the vertical in any direction, as by universal movement, and maintain itself in continuous contact with the base 11.

Since a plurality of the detents 27 adapted to the frame 10 are juxtaposed opposite the corresponding stud 65 of the armature 50, the detents themselves provide a means to maintain the freely displaceable armature 50 centermost of the cavity 15 and out of engagement with the contact buttons 45. In Figs. 1 and 2, the switch contacts are all normally open. However, it is contemplated that one or more may be normally closed. Manual armature actuation to the phantom position indicated by numeral 68 as seen in Fig. 3, will cause engagement of corresponding contacts 45 and 51 to energize the associated circuits. Release of the armature will result in the associated detent 27 forceably returning the armature 50 to its center normal position.

The electrical aspects of the switch are as follows: The armature 50 serves as a common terminus for all of the contacts 45. A source of electrical energy may be applied to the armature 50 through the medium of a common terminal 70 that may be attached to any portion of the frame 10, in the drawings being indicated as attached to the outer face of the base 11 as best seen in Fig. 2. Electrical energy is conducted from the base 11 (see Fig. 3) through the surface contact of spheroid face 67 of the armature 50 and thence through the armature to the contacts 51 thereon. Angular displacement of the armature 50 toward any of the contacts 45, being against restraint of the associated detent 27, communicates the appropriate contacts 45 and 51 thereby con-

ducting the potential through the associated arm **44** and to the circuit to be energized.

Particularly significant during engagement of contacts **45** and **51** is the progressive wiping action thereof as the armature **50** moves to its maximum displacement. As hereinabove indicated, the arm **44** is resilient and when contact is made, it will yieldingly move away from the upper portion of the frame **10** under influence of the armature. The pivotal motion of the armature, its radius arm, and the outward angle of the arm **44** all coactively interrelate so that from the instant of contact to the maximum displacement of the armature, the contacts **45** and **51** will slide or wipe with respect to each other, the said wipe being effective as to both of said contacts. Thus, if the engaging surface has oxidized, pitted or become contaminated by foreign elements, the slide action will substantially assure completion of the circuit to be energized. Further, the relative portion of the contacts will effectively wipe the surface and remove, by abrasion, the deposit of foreign substances that may have accumulated thereon.

The hazard of fused contacts is minimized by the structure disclosed in that the contacts may be forceably separated by manual pressure of the operator in the event that the detent force is insufficient to separate the contacts. Angular displacement of the knob **56** away from the fused contacts tends to draw the arm **44** along with the armature **50**. The internal shearing stress built up in the arm **44** coupled with longitudinal stress therein as the contacts tend to wipe is sufficient to separate the contacts **45** and **51** under usual fused conditions. In addition, when the arm **44** has returned to a position wherein it presses against the bracket **39** which is firmly mounted to the frame **10**, its motion is further restrained at the upper portion of the frame to practically assure interrupting the circuit.

Hence, there is provided a means to individually energize the four circuits that may be connected to the arms **44**. Although four paths for circuit energization are shown in the drawing, such is not to be deemed a limitation of the disclosure. It is contemplated that the frame structure and associated components may be designed in variation to accommodate a plurality of circuits, more or less than represented herein.

The switch assembly, as above described, is disposed within the confines of a hollow case **90** as seen in Fig. 1, the case being preferably formed of an insulating material such as bakelite, and the assembly being retained in said case by a filler substance **91** such as polyethyl and properly heat treated to cause adherence of the switch assembly to the case. A cap **92** is rigidly affixed to the top of the case and is provided with a central opening therethrough defined by coalescent circumferential coves **93**, as best shown in Fig. 10, that are adapted to receive the armature **50** when displaced. The coves **93** are effective to direct as well as limit the motion of the displaced armature, as indicated in phantom by the numeral **94**.

The detent **27** provides a novel means of action of the switch armature and the resultant physically perceptible snap. Fig. 6 shows a perspective of the detent **27** in detail in normal position. Figs. 9*a* and 9*b* show an exaggerated cross section of the detent as normal and as flexed respectively, when operatively associated with the support plate **26**. As hereinbefore indicated, a stud **65** is the engaging member with the detent, the force being represented by the arrow **71** as seen in Figs. 9*a* and 9*b*.

The detent **27** is preferably made of a material such as strip beryllium copper which, after fabrication and heat treating, is highly resilient and fatigue resistant. It is substantially rectangular in plan view with a length approximately twice that of the width, but dimensional variations are expressly within the scope of the disclosure. In both side elevations ,the detent **27** is convexo-concave or

slightly arched. Two symmetrical longitudinal and curvilinear slots or voids **74** are die stamped or perforated through the detent to provide an intermediate or center band **75** and two side bands **76** which terminate at buttress ends **77**. The center band **75** is provided with a more pronounced arch than the side bands and protrudes above the side bands as shown in Fig. 9*a*. Also, the center band **75** is further deformed intermediate its ends by an upwardly coved transverse arch **79**. Two convexo-concave reinforcing ribs **81** provide further deformation of the center band **75** and buttress ends **77** being longitudinal of the center band **75** and extending from a point adjacent the transverse arch **79** to and through the buttress ends **77**, thereby forming channels **82** on the under side thereof.

The detent **27** is flexed by means of force applied to the transverse arch **79**. Let it be assumed that the detent is placed upon a flat supporting surface and force progressively applied. The said force tends to flatten the center band **75** causing the ends **77** to first depress into firm contact with the support surface. The force also tends to spread the buttress ends **77** away from each other thereby effectively causing the side bands **76** to come into flat engagement with the support surface. Further, the force tends to transversely flatten the buttress ends **77**. When this longitudinal and transverse flattening reaches an ultimate point, the center band **75** is under considerable stress, the forces being resolved against the sides of the transverse arch **79** and resulting in a flexing thereof to permit the center band to snap through in a direction normal to the surface, the reactive force component operating through the reinforcing ribs **81** to cause the buttress ends to rise from the surface. Simultaneously, the side bands **76** will rise from the surface. The detent is then flexed as seen in Fig. 9*b* but under internal stress that tends to cause a return to normal position as seen in Fig. 9*a*.

If the detent **27** is used in conjunction with the support plate **26**, which is the preferred application, a more positive snap action will occur. This is primarily due to two salient projections or dimples **84** which are provided in the base portion **28** of the support plate **26**. The projections **84** are substantially laterally central of the base portion **28** and adjacent the depending ends **29** and **30** and so positioned to engage the channels **82** of the detent **27**. The initial force on the center band **75** tends to flatten it, but instead of the ends **77** thereof being firmly pressed onto the support surface as hereinbefore indicated, the channels **82** are depressed into firm point contact with the dimples **84**. The side bands **75** and buttress ends **77** progressively flatten, but the opposing force is now primarily at projections **84**. Under these conditions, the snap through of the detent is more pronounced.

The support plate **26** may be provided with a third upwardly convex projection or dimple **85** located symmetrically centermost of the base portion **28**, to engage with the under side of the transverse arch **79**. In this manner, any excessive force that may be applied to the detent will not crush the transverse arch.

Peculiarly characteristic of the detent action is the restraining force opposing the force applied. For example, but not in limitation, the detent may be so designed that two and one-half pounds force is necessary to cause a snap through, however, only one-half pound is necessary to maintain the detent flexed. Effectively, therefore, the restraining force is relieved to such an extent to retain only sufficient force to assure a return of the armature to neutral. The internal stresses in the detent that tend to return it to normal provide only relatively small force against its engaging stud **65** which is physically perceptible at the armature as a flaccid or spongy condition. Little effort, therefore, is necessary to maintain the contacts closed. Upon relieving the holding force by the operator, the internal stresses in the detent are relieved and transmitted to the armature as a physically perceptible snap.

Accordingly, the operator has a definite touch indication when the circuit is closed or opened.

The force necessary to actuate the switch is capable of variation by using a plurality of detents nested or placed on top of each other. Fig. 3 is representative of such application wherein three detents are shown in cross section for each individual switch element.

The function of the detent in minimizing arcing at the contacts may now be readily understood in that the contacts make and/or break with a considerably greater velocity than they would otherwise in the absence of the detents. The increase in velocity is effected due to the relieving of the restraining force as the detent snaps through. Conversely, when permitting the circuit to open, the internal stresses in the detent that convert to an active force when snapping back increase the velocity of contact break. The interaction of the detent with the purely physical muscular reaction of the operator affords this velocity increase without the aid of mechanical acceleration devices.

Figs. 11 through 15 show a modified form of the present invention wherein the detent is carried within the confines of the armature itself. This embodiment as shown is representative of a double-pole, double-throw switch, but application is contemplated to encompass any combination of single or double-throw with any plurality of poles. Referring particularly to Fig. 11, a case **100** and a support plate **101** provide the housing for the switch assembly. Electrical connections are conveniently extended from the bottom of the case for attachment to the circuits to be completed.

An armature **102** is pivotally mounted by studs **103** between two pivot plates **104** made of electrically conductive material, the plates in turn being attached at their sides to two oppositely disposed contact plates **105** made of insulating material as seen in Fig. 13. The assembly is completed by means of pins **106** that are rigidly affixed to the sides of the pivot plate **104** and extend therethrough and into dowel engagement with the contact plate **105**. Each contact plate cantilever mounts a pair of arms **107** as seen in Fig. 14. A contact **108** is adapted to the free end of each arm, the opposite end **109** being provided with a hole for wire attachment to the circuit to be completed.

The armature **102** comprises a rectangular frame **112** made of insulating material and is provided with a rectangular opening therethrough to accommodate the support plates **26** and associated detents **27**. A pair of conductor straps **113** as seen in Fig. 15 mounted by means of studs **111** to the sides of the frame **112**, each strap having two oppositely extending portions **114** at each end thereof, the said portions of which form about and are in flat abutment with the faces of the armature **102**. The lower extremity of each conductor strap is provided with a hole to receive the pivot studs **103**. The portions **114** of the other extremities of the straps **113** serve to mount the contacts **110** in engagement juxtaposition to the contacts **108**.

To accommodate a double-throw type switch, two support plates **26** as seen in Fig. 14 are disposed back to back within the frame **112** and one or a plurality of the detents **27** are stacked on each as desired. These components are retained by means of retainer plates **117** of insulating material each having an opening substantially central thereof, the plates being conveniently maintained in position by the overlapping of the portions **114** of the straps **113**. Each opening provides access to the detents **27** for engagement with a stud **118**, the stud being firmly mounted to and extending from the plate **105**.

As the armature is displaced by a control toggle **119**, the stud **118** urges the transverse arch **79** of the detent as hereinabove described with the resulting snap action. Engagement of the contacts **108** and **110** is thereby effected in a similar manner as hereinbefore described.

It may be desirable to decrease the number of detents in each stack or to increase the normally open span between the contacts to provide additional lost motion prior to contact. To accommodate such variations and prevent the armature from moving freely between the studs **118**, a pair of springs **120** may be utilized, as seen in Fig. 14, each being intermediate the armature **102** and the plates **105**. The springs as shown are of the coil type but it is contemplated that any appropriate yieldable spring element may be used.

The working elements are mounted in position within the confines of the case **100** as seen in Fig. 11, the electrical connections extending down and through the case for convenient attachment to the associated circuits.

The electrical circuit is completed as follows: Through one of a pair of terminals **121** which is attached to one of the pivot plates **104**, from an annular portion **122** of the pivot **103** through its face abutment to the strap **113**, through the strap **113** to and through the contacts **110** and **108**, and thence through the arm **107** to the arm extremity **109**.

It is to be noted that the circuit is completed through the annular portion **122** and the strap **113** which are movable with respect to each other. This engagement, however, is rendered firm and electrically continuous by the expedient of stressing the strap **113** so that the normal tendency of the unsecured lower extreme thereof is to extend away from the side of the armature. When the switch is assembled within the case **100**, the plates **104** are located so as to cause the annular portion **122** to normally press against the extended strap **113**, thus rendering an effective spring loaded pivotal contact. In maintaining this firm abutment a means is provided to preclude the passage of foreign material therebetween that otherwise may adversely affect the action of the pivot joinder.

Figs. 11 and 12 show the terminals **121** and the arm extremities **109** extending through the bottom of the case **100**, the case being provided with slots to receive the said terminals and arms and thereby retain the component pairs attached thereto in fixed relationship with one another. A pair of screws **123** hold the assembly in position by means of a pair of bosses **124** and in such a manner the dowel type assembly as described is adequately secured. If necessary, the case **100** may tightly accommodate the switch element to prevent separation of the plates **104** and **105**.

The action of the switch components in this embodiment is the same as hereinbefore described including the snap characteristics, the wiping of the contacts, and the means to forceably separate the contacts in event of fusing.

Fig. 16 shows a plunger actuated switch utilizing two detents or sets of nested detents **27** and **27***a*. A case **125** houses the switch components and also slidably mounts a plunger **126** and a compression spring **127**. A stem **128** of the plunger is the actuating extremity and engages a contact leaf or arm **129** which is supported at one end by the case **125**, the other end thereof having a contact button **130**. Affixed to the arm **129** is a stud **131** which is in alignment with the axis of the plunger, the stud extending into engagement with one of the sets of nested detents **27**. The detents are supported by a retainer plate **26** in the hereinbefore described manner, except that the plate is provided with overlapping extensions to retain the detents within the confines of the plate. The plate **26** is rigidly attached to a second contact leaf or arm **132**, one extremity of the arm being attached to the case **125** and the other extremity thereof having a pair of contacts **133**. Similarly affixed to the arm **132** is a stud **134** which engages the next adjacent set of nested detents **27***a*. This set of detents is retained in a similar manner by a retainer plate **26***a*, the plate being rigidly attached to a conductor arm **135** which is in firm engagement with the case **125**. The conductor **135** extends similar to other contact arms and has a

contact button 136 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 132 may be constructed as a double leaf with insulation therebetween and with a contact 133 on the end of each leaf. In such a structure the center conductor 132 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 set of nested detents may contain a determined number of leaf detents whereas the other set may contain a more or less number. In such a manner, when the plunger 126 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 detents affixed to the conductor 135 are fewer in number than the detents affixed to the contact leaf 132. When the plunger is depressed, the contacts 133 and 136 will first close and as force is progressively applied to the plunger, then the contacts 133 and 130 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 an equal number of detents for each conductor by the expedient of varying the location of the detents and engaging stud with respect to the conductor. For example, in Fig. 16, if the detents 27*a* and the associated stud 134 are moved toward the contact extremity of the conductors 132 and 135, the moment arm is increased. Thus, with equal characteristics of both sets of detents 27 and 27*a*, actuation of the plunger 126 will first cause engagement of the contacts 130 and 133, and progressive actuation through the increased moment arm will cause subsequent engagement of the contacts 133 and 136.

While the invention that has been illustrated and described is now regarded as the preferred embodiments, the constructions are, of course, subject to modifications without departing from the spirit and scope of the invention. It is, therefore, not desired to restrict the invention to the particular forms of construction illustrated and described, but to cover all modifications that may fall within the scope of the appended claims.

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 conductively mounted to said armature; stationary means providing a plurality of second contacts in paired juxtaposition with said first contacts; a corresponding plurality of yieldable snap means intermediate the wall of said cavity and said armature but insulated therefrom to position said armature centermost of said cavity, each said 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.

2. In a multiple-pole electric switch, the combination of: a frame having a base and providing a cavity; an armature partially disposed within said cavity and universally mounted to said base and in continuous conductive relation thereto; a plurality of first contacts mounted on the outer end of said armature; yieldable snap means disposed within said cavity intermediate the wall thereof and said armature to position said latter means substantially centermost of said cavity; a plurality of resilient conductors mounted to said frame but insulated therefrom; a plurality of second contacts each conductively mounted on said conductors and in paired operative juxtaposition with said first contacts; and unitary means connected to said armature operative to selectively register any pair of juxtaposed contacts in conductive relation against restraint of said yieldable snap means, said unitary means also being operative to cause displacement of the associated conductor to effect a wiping action between said contacts while in conductive relation.

3. In a multiple-pole electric switch, the combination of: a frame having a base and providing a cavity; a movable armature partially disposed within said cavity and universally mounted in continuous conductive relation to said base; a plurality of first contacts in secured conductive relation to said armature and disposed about the extended end thereof; a corresponding plurality of studs mounted on the armature portion within said cavity and in substantial planar alignment with said first contacts; a plurality of resilient conductors mounted to said frame but insulated therefrom each having a second contact in paired operative juxtaposition to each of said first contacts; a plurality of yieldable means intermediate the wall of said cavity and the said armature for operative engagement with said studs; and unitary means connected to said armature operative to selectively register any pair of juxtaposed contacts in conductive relation against restraint of the corresponding yieldable means, said unitary means also being operative to cause displacement of the associated conductor to produce a wiping action between said contacts while in conductive relation.

4. An electric switch according to claim 3 wherein each of said yieldable means provides a predetermined reactive force and includes a snap element to substantially relieve said force prior to engagement of said contacts to cause said contacts to engage with rapid motion.

5. An electric switch according to claim 3 wherein said studs comprise an insulating material comparably abradable relative to said yieldable means.

6. In an electric switch, the combination of: a frame having a base; a movable armature disposed within said frame and universally mounted in continuous conductive relation to said base; a plurality of first contacts mounted on and in conductive relation to said armature and disposed thereabout; a plurality of resilient conductors mounted in normal abutment to said frame but insulated therefrom each having a second contact in paired juxtaposition to one of said first contacts; a corresponding plurality of yieldable elements intermediate said armature and said frame; and unitary means connected to said armature operative to initially displace said armature against restraint of any of said yieldable elements to selectively register the corresponding pair of juxtaposed contacts in operative engagement, said means also being operative in event of inadvertent adherence of said contacts to forceably displace said armature and separate said contacts due to internal stress and by restraint of the associated conductor in abutment with said frame.

7. In a snap switch, the combination of: a support; movable, first contact-carrying means mounted on said support and providing a first contact; second contact-carrying means mounted on said support and providing a second contact engageable by said first contact upon movement of said first contact-carrying means toward said second contact-carrying means; yieldable, snap-acting, spring means engaging and positioned between and mounted on one of said first and second contact-carrying means for resisting movement of said first contact-carrying means toward said second contact-carrying means with a predetermined reactive force; and control means connected to said first contact-carrying means for moving same toward said second contact-carrying means so as to overcome the resistance offered by said reactive force provided by said spring means, whereby said spring means yields with a snap action to provide for movement of

said first contact into engagement with said second contact with a snap action.

8. A snap switch as defined in claim 7 wherein said spring means is mounted on said second contact-carrying means.

9. A snap switch as defined in claim 7 including another first contact on said first contact-carrying means, another second contact-carrying means mounted on said support and providing another second contact engageable by said other first contact upon movement of said first contact-carrying means toward said other second contact-carrying means, and another spring means corresponding to the one defined in claim 7 and engaging and positioned between and mounted on one of said first contact-carrying means and said other second contact-carrying means.

10. A snap switch as defined in claim 9 in which said spring means are mounted on said second contact-carrying means, respectively.

11. A snap switch according to claim 9 wherein said spring means are mounted on said first contact-carrying means.

12. A snap switch according to claim 7 wherein said spring means is mounted on said first contact-carrying means.

13. A snap switch as defined in claim 12 wherein said spring means comprises leaf-spring detent means.

14. A snap switch as defined in claim 12 wherein said spring means is located in a cavity in said first contact-carrying means.

15. A snap switch as defined in claim 7 including additional spring means for biasing said first and second contact-carrying means apart to separate said first and second contacts in the event of adherence thereof.

16. A snap switch as defined in claim 7 wherein said second contact-carrying means is movably mounted on said support and provides another second contact, said snap switch further including: a third contact-carrying means mounted on said support and providing a third contact engageable by said other second contact upon movement of said second contact-carrying means toward said third contact-carrying means; and another yieldable, snap-acting, spring means engaging and positioned between and mounted on one of said second and third contact-carrying means for resisting movement of said second contact-carrying means toward said third contact-carrying means with a predetermined reactive force, whereby said control means connected to said first contact-carrying means acts on said second contact-carrying means through said spring means between said first and second contact-carrying means, each of said spring means yielding with a snap action upon application to said control means of an operating force sufficient to overcome said reactive force provided by such spring means.

17. A snap switch according to claim 16 wherein said control means includes a plunger movably mounted on said support and engaging said first contact-carrying means.

18. A snap switch as defined in claim 16 wherein said reactive forces provided by said spring means differ to provide sequential engagement between said first contact and the first-mentioned second contact and between said other second contact and said third contact.

19. In a multiple-pole electric switch, the combination of: a frame providing a cavity; movable means disposed within said cavity and providing a plurality of first contacts; stationary means providing a plurality of second contacts in paired juxtaposition with said first contacts; a corresponding plurality of yieldable snap means for co-operation with said movable means to position said latter means centermost of said cavity, each of said snap means including at least one leaf spring shaped in convexo-concave form in one dimension having stresses therein tending to maintain said spring extending in a normally stable longitudinal direction and including perforations therethrough to provide longitudinally thereof two side portions and an intermediate portion; and control means connected to said movable means operative to displace said movable means against the intermediate portion of a said spring to selectively register any pair of juxtaposed first and second contacts in conductive relation with a snap action.

20. In a multiple-pole electric switch, the combination of: a frame having a base and providing a cavity; a movable armature partially disposed within said cavity and universally mounted in continuous conductive relation to said base; a plurality of first contacts in secured conductive relation to said armature and disposed about the extended end thereof; a corresponding plurality of studs mounted on the armature portion within said cavity and in substantial planar alignment with said first contacts; a plurality of second contacts mounted on said frame and in paired juxtaposition with said first contacts; a plurality of yieldable snap means intermediate the wall of said cavity and the said armature for operative engagement with said studs, each of said snap means having predetermined reactive characteristics and including at least one leaf spring shaped in convexo-concave form in one direction having stresses therein tending to maintain said spring extending in a normally stable longitudinal direction and including perforations therethrough to provide longitudinally thereof two side portions and an intermediate portion; and means engaging said armature to displace said armature to cause one of its studs to press against the intermediate portion of one of said springs whereby the corresponding yieldable means will flex with a snap action to selectively register the corresponding pair of first and second contacts in conductive relation.

21. In an electric switch, the combination of: a frame having a base and providing a cavity; a movable armature made of relatively rigid and conductive material partially disposed within said cavity and universally mounted in continuous conductive relation to said base; a plurality of first contacts mounted on said armature and disposed about a portion thereof spaced from said base; a plurality of resilient conductors mounted exteriorly of said frame but insulated therefrom each having a second contact in paired juxtaposition to one of said first contacts, each said insulated conductor having a portion thereof normally abutting and restrainable by said frame and relatively flexible for movement away from said frame; a corresponding plurality of yieldable elements intermediate said armature and said frame for maintaining said armature normally centermost of said cavity, each of said elements being characterized by a length of leaf material shaped in convexo-concave form in one dimension adapted to flex with a snap action; and unitary means connected to said armature operative to initially displace said armature against restraint of any of said yieldable elements for flexure thereof to selectively register the corresponding pair of juxtaposed contacts in operative engagement with rapid motion, said means being operative to cause displacement of said portion of the associated conductor to produce a wiping action between said last-mentioned contacts.

22. In an electric switch, the combination of: a frame having a base and providing a cavity; a movable armature made of relatively rigid and conductive material partially disposed within said cavity and universally mounted in continuous conductive relation to said base; a plurality of first contacts mounted on said armature and disposed about a portion thereof spaced from said base; a plurality of resilient conductors mounted on and exteriorly of said frame but insulated therefrom each having a second contact in paired juxtaposition to one of said first contacts, each of said insulated conductors having its lower portion rigidly secured to said frame, the upper portion mounting its said second contact normally extending in abutment with said frame and upwardly there-

of; a corresponding plurality of yieldable elements disposed intermediate said armature and said frame for normally urging said armature centermost of said cavity, each of said elements comprising a length of leaf material shaped in convexo-concave form adapted to yield with a snap action; and means engaging said armature for initially displacing the same against restraint of any of said yieldable elements to selectively register the corresponding pair of juxtaposed contacts in operative engagement with a wiping action, said means also being operative in event of inadvertent adherence of said contacts to forceably displace said armature and separate said contacts due to restraint of said upper portion of the associated insulated conductor in abutment with said frame.

23. In an electric switch, the combination of: a frame having a base and providing a cavity; an armature disposed at least partially in said cavity and universally mounted in continuous conductive relation to said base; a plurality of first contacts mounted on said armature; a plurality of resilient conductors mounted to said frame each having a second contact in paired juxtaposition to one of said first contacts, each said conductor having a portion thereof normally abutting and restrainable by said frame and relatively flexible for movement away from said frame; a corresponding plurality of yieldable elements intermediate the wall of said cavity and said armature to position said armature substantially centermost of said cavity, each of said elements having predetermined spring characteristics; and unitary means connected to said armature operative to initially displace said armature against restraint of any of said yieldable elements for flexure thereof to selectively register the corresponding pair of juxtaposed contacts in operative engagement with rapid motion, said means being operative to cause displacement of one of said resiliently mounted second contacts to produce a wiping action between the registering first and second contacts.

24. An electric switch according to claim 23 in which said unitary means is operative in event of inadvertent adherence of said registering contacts to forceably displace said armature and separate said contacts due to restraint by said frame of said portion of said conductor in abutment with said frame.

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