Nov. 23, 1943. C. W. DANN 2,335,110

ELECTRICAL SWITCH

Filed June 11, 1941 2 Sheets-Sheet 1

Fig. 1

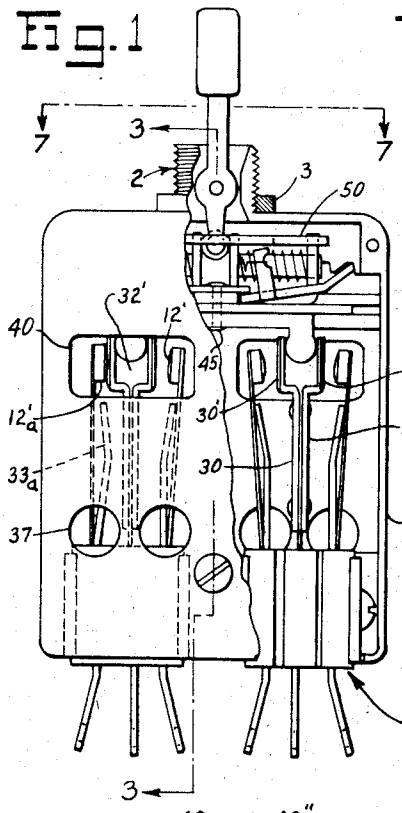


Fig. 2

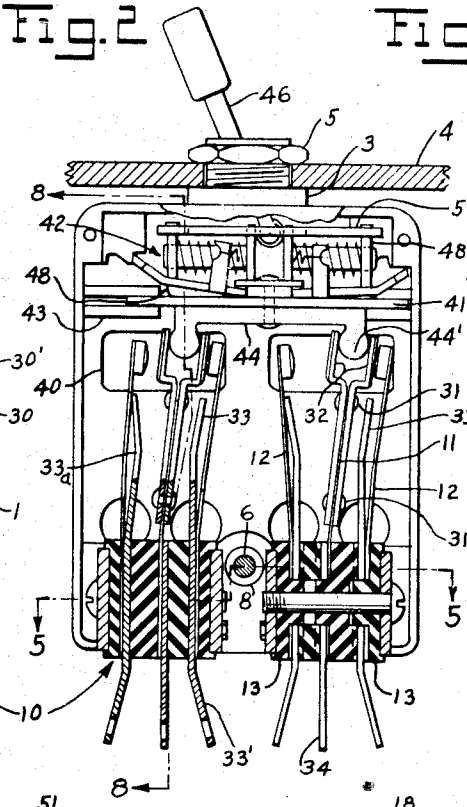
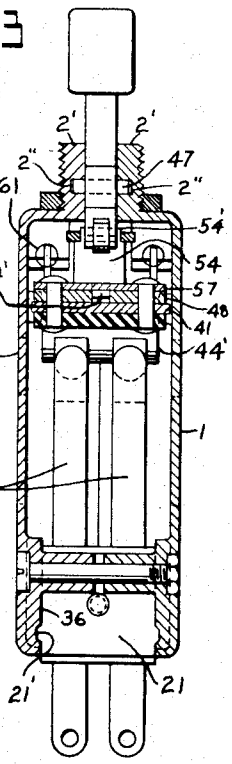


Fig. 3



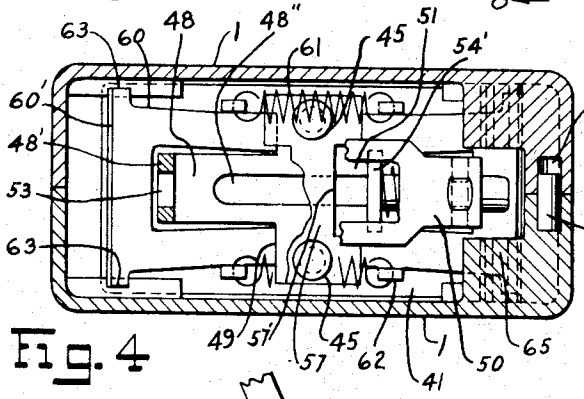


Fig. 4

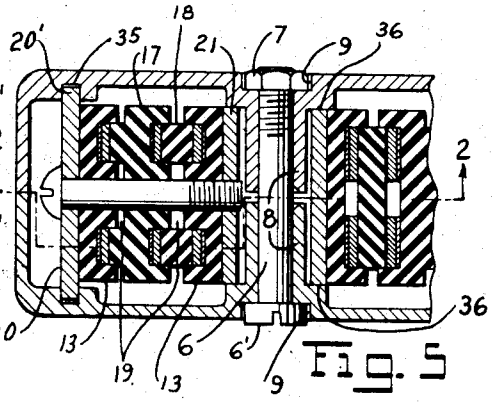


Fig. 5

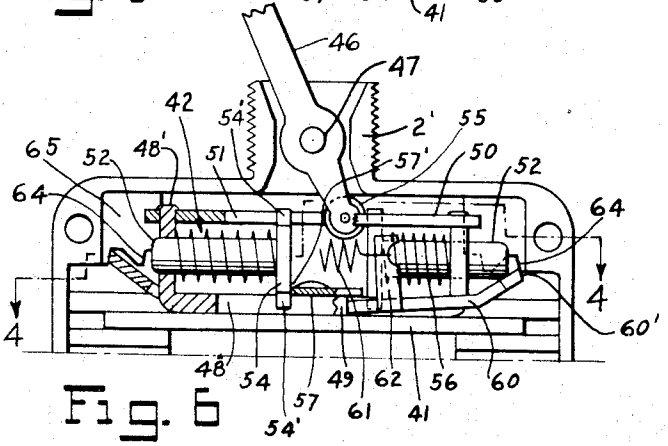


Fig. 6

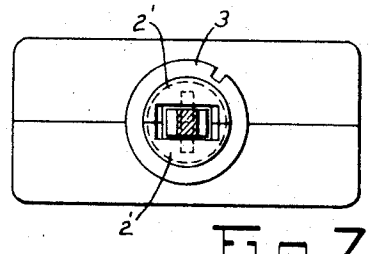


Fig. 7

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Nov. 23, 1943. C. W. DANN 2,335,110

ELECTRICAL SWITCH

Filed June 11, 1941 2 Sheets-Sheet 2

Fig. 12

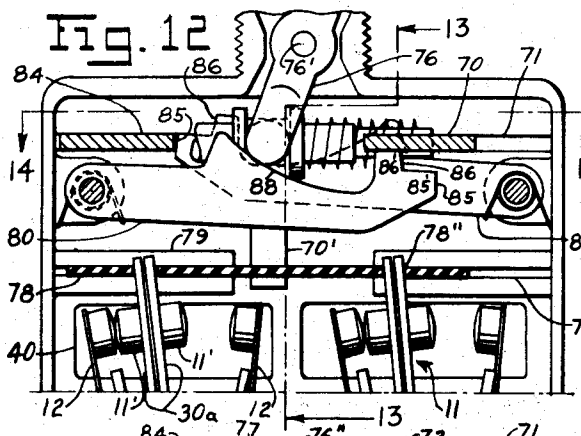
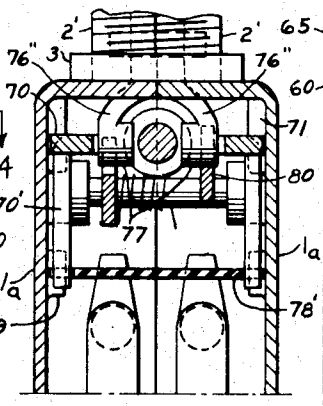


Fig. 13



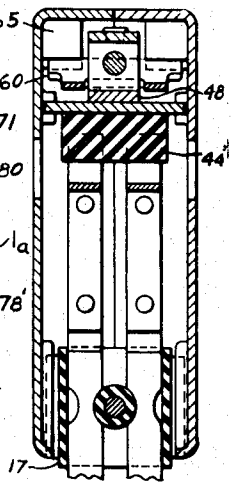


Fig. 8

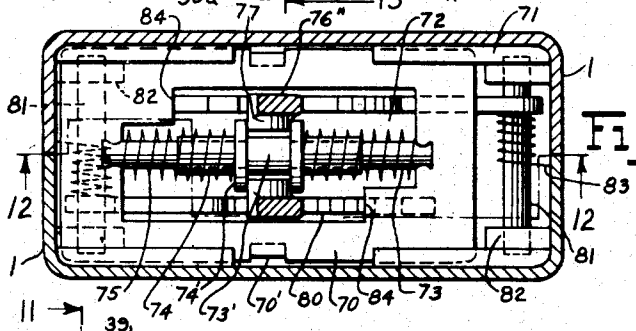


Fig. 14

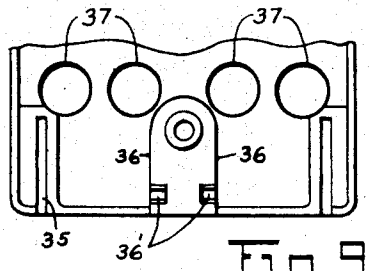


Fig. 9

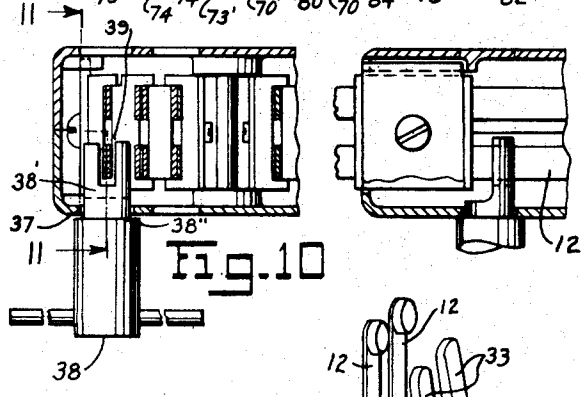


Fig. 10

Fig. 11

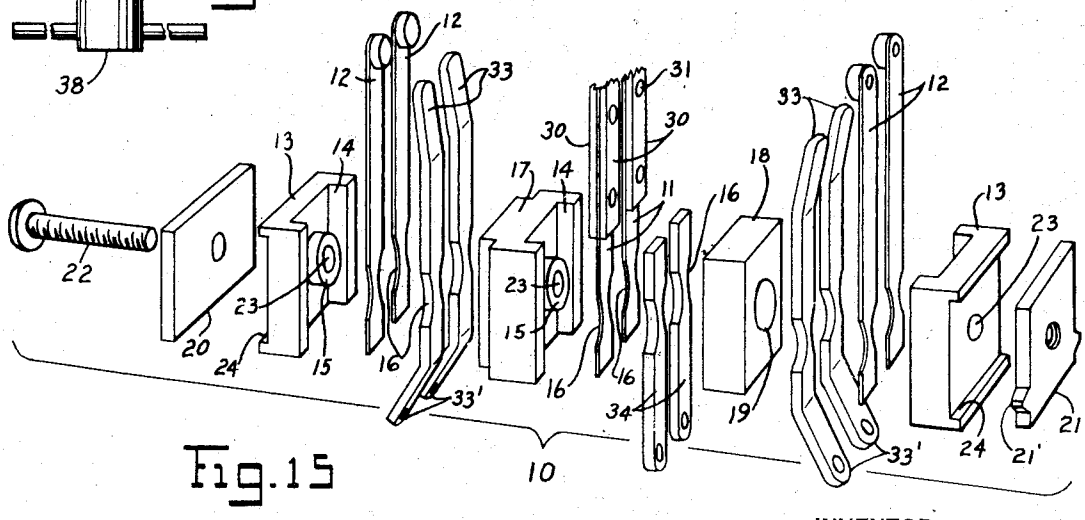


Fig. 15

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UNITED STATES PATENT OFFICE

2,335,110

ELECTRICAL SWITCH

Charles W. Dann, East Orange, N. J.

Application June 11, 1941, Serial No. 397,514

15 Claims. (Cl. 200—5)

This invention relates to electrical switches and more particularly to improvements in the construction and operation of such switches.

My invention has especial relation to and is herein illustrated and described in connection with multiple-point multiple-throw snap switches, but it will be understood that no unnecessary limitation of my invention to this type of switch is intended as many of the features of my invention may be advantageously employed in other types of switches.

Multiple-throw snap switches have a wide field of application. They are, for instance, employed in high voltage power circuits as well as in low level audio circuits such as in oscillation amplifiers and other communication devices. In some instances of these applications, it is highly important that the switches be well insulated and well shielded against shock to the operator, and that they have a fast action to avoid undue arcing at their contact points; in other instances, it is of prime importance that the switches make a reliable positive contact at their points without bouncing, and that they have a low capacity between their circuit elements and still be small in overall size. It is an object of my invention to provide a switch which is particularly well suited to these widely different applications.

It is another object to provide a switch in a completely shielded form which is easy to adjust and wherein the parts are readily removable for replacement or repair.

Other objects are to provide a compact construction of a switch which is adapted for easy mounting and wherein the parts are cheap to manufacture and easy to assemble.

Multiple-point multiple-throw snap switches are of a kind wherein a progressive actuation of the switch mechanism will cause the movable contact member of the switch to be moved with a snap action through intervals into successive switch positions. In this kind of switch, the latch for catching the movable switch contact member in its respective positions must be carefully designed or else it may fail to operate and cause the movable switch contact member to overshoot the position at which it is to be stopped. In the present invention this possible misoperation of the switch is prevented by the provision of a latch of an improved construction for the switch.

It is accordingly an object of my invention to provide an improved latch for a multiple-throw snap switch which is positive and dependable in its action and well-nigh foolproof against misoperation.

Another object of my invention lies in the provision of an improved construction and arrangement of a snap mechanism for a multiple-throw switch wherein the latch members are moved into latching relationship during the travel of the movable switch contact member from one switch position to the next.

It is another object to provide a latch arrangement the release of which at one switch position automatically renders the same effective at the next succeeding switch position.

Another object is to provide a latch arrangement having cooperating latch members which, upon a progressive engagement thereof, are rendered effective at successive switch positions.

Other and allied objects and features of my invention lie in the combinations of elements and arrangements of parts herein disclosed and will be apparent from the following description and the appended claims.

In the description of my invention reference is had to the accompanying drawings, of which:

Figure 1 is a view in elevation of a three-position (i. e., double-throw) snap switch constructed in accordance with one embodiment of my invention, a portion of the front half of the housing being however broken away for the better illustration of the interior parts of the switch, and the switch parts being shown in the positions which they occupy when the switch is in its intermediate position;

Figure 2 is a view similar to Figure 1 but showing the switch parts in the relationship which they have to one another when the switch is in one of its terminal positions, the front half section of the housing however being largely removed and the switch stack assemblies appearing in section on the line 2—2 of Figure 5;

Figure 3 is a vertical section taken substantially on the line 3—3 of Figure 1;

Figure 4 is a horizontal section taken through the top portion of the switch substantially on the line 4—4 of Figure 6;

Figure 5 is another horizontal section taken however through the lower portion of the switch substantially on the line 5—5 of Figure 2;

Figure 6 is a fragmentary view similar to Figure 2, showing the switch mechanism in a partially actuated condition;

Figure 7 is a top horizontal sectional view taken on the line 7—7 of Figure 1;

Figure 8 is a vertical sectional view taken on the line 8—8 of Figure 2;

Figure 9 is an internal view of the lower portion of one of the sections of the housing;

Figure 10 is a fragmentary sectional view illustrating the mode of adjusting the contact springs of the switch;

Figure 11 is a sectional view taken substantially on the line 11—11 of Figure 10;

Figure 12 is a vertical view of a second embodiment of my invention, the front housing section of the embodiment being removed and parts thereof being in section substantially on the line 12—12 of Figure 14;

Figure 13 is a vertical sectional view taken substantially on the line 13—13 of Figure 12;

Figure 14 is a horizontal sectional view taken substantially on the line 14—14 of Figure 12; and

Figure 15 is an exploded view of a switch stack assembly as in accordance with the present invention.

Reference being had to Figures 1 through 11 there will be seen an embodiment of my invention having a frame or housing comprising two identical sections 1. These sections are substantially in the form of rectangular shells made for example of a suitable material such as zinc and formed as by die casting. The sections are aligned with one another by means of dowel pins 1' in one of the sections which engage holes 1'' in the other of the sections. When the sections are assembled they form a housing which is open at the bottom and provided with a threaded tubular neck 2 at the top. The neck 2 is employed as a means to hold the housing sections together at the top, it being made up of two semicircular portions 2' which are integrally formed on the respective housing sections and held together by a nut 3. The neck also serves as a means for mounting the switch on an apertured support or panel 4 shown in Figure 2, it being extended through the support and secured thereto by a nut 5 threaded on the outer portion of the neck. (As is hereinafter explained, this neck also provides the opening in the housing through which the switch-operating lever projects.) The housing sections are clamped together at the bottom by a bolt 6 and nut 7 as is shown in Figure 5. This bolt passes through interior apertured bosses 8 in the housing sections, which serve to guide the bolt through the housing sections in the assembling of the switch. The head 6' of the bolt, and the nut 7, are each received in recesses 9 so as not to project beyond the contour of the housing.

In the lower part of the housing there are provided two switch stack assemblies 10 which are respectively mounted on opposite sides of the clamping bolt 6. These stack assemblies each comprise two sets of switch contact members arranged to effect a double-pole double-throw switch action, there being two centrally located switch pole members 11—the movable switch contact members hereinbefore referred to—and two pairs of outer semi-stationary switch contact members 12 which are held in line with the central pole members 11 respectively. These switch members 11 and 12 are held in cantilever fashion between insulating blocks as in the manner illustrated in Figure 15. The outer ones of these insulating blocks are identical in shape and are each referred to as 13; these blocks have recesses 14 in their inner faces which extend through the blocks from top to bottom. At the center of the recesses, however, there are provided bosses 15. The semi-stationary contact members 12 fit these recesses at opposite sides of the bosses 15 and are provided with arcuate notches 16 which are engaged by the sides of the bosses; this engagement serves to hold the switch members from longitudinal displacement in relation to the stacks. For purposes of standardization of parts, to permit the contact members 12 to be used interchangeably at the sides of the switch stack assembly, the contact members may be provided with a notch 16 in each edge thereof, as is shown in Figures 8 and 15. Between the central and outer switch contact members 11 and 12 there are provided two insulating blocks 17 and 18. The faces of these intermediate blocks which are adjacent to the outer blocks 13 are identical in shape and formed to fit the recesses 14, the faces each having central holes 19 to receive the bosses 15 when the blocks are clamped together (see Figures 5 and 15). The two intermediate blocks 17 and 18 fit one another at their adjacent faces in the same way as that in which they fit the outer blocks 13. For instance, the intermediate block 17 is provided with a recess 14 and central boss 15 and the other block 18 is centrally apertured to receive the boss and shaped to fit the recess, the block 18 thus having its aforementioned central hole 19 extending therethrough and having its opposite faces similar in shape. Between the intermediate blocks are clamped the pair of switch pole members 11, they being disposed in the recess 14 of the block 17 at opposite sides of the boss 15 of this block and also provided with notches 16 to engage this boss as for the reason above explained. These blocks may be conveniently formed by molding and may be made of any suitably moldable insulating material.

The switch stack assembly above described is clamped together by means of two end plates 20 and 21 and a bolt 22 which passes centrally through one of the plates and threads into the other. The bolt 22 passes centrally through the insulating blocks by way of apertures 23 in the bosses 15, and the end plates are received in depressions 24 provided in the outer faces of the insulating blocks 13 to locate the plates accurately in the switch stacks.

In the switch stack assembly here described, each switch contact member is embraced by the cooperating insulating blocks and is firmly held in place against both lateral and longitudinal displacements. Moreover, each is fully insulated from the clamping bolt 22 through the medium of the bosses 15 of the insulating blocks. Since these insulating bosses are integrally provided on the insulating blocks, the number of parts of the stack assembly is reduced; further, the provision of a clamping means wherein the clamping bolt is not passed through the switch members, permits the switch members to be made quite narrow. This reduction in parts and avoidance of the necessity for threading the switch contact members on the clamping bolt greatly simplifies the assembling of the stack.

The switch contact members 11 and 12 are in the form of flat springs which are made of any suitably conductive and resilient material. In the case of the switch pole members 11, these springs serve merely as hinges since the members are each held rigid along their free lengths by a pair of bars 30 which are secured to the springs through rivets 31. The upper end portions 32 of these bars are offset from each other so as to form sockets 32' for effecting a coupling of the pole members with the switch-operating means, as is hereinafter described; furthermore, these offset upper-end portions 32 are adapted to form the contact points for the pole members and are

for this purpose faced with layers 30' of a suitable contact material such as silver. The outer contact members 12 are each provided with contact points 12' mounted in position for contact with the respective switch pole members. The positioning of the outer contact members 12 and thus the spacing between the pairs of cooperating contact points, is controlled by respective stop members 33 for the outer switch contact members. These stop members are clamped in the stack assembly against the inner sides of the outer switch contact members, and like the switch contact members 11 and 12, are provided with notches 16 which engage the bosses 15 of the insulating blocks to hold the stop members from longitudinal displacement. The semi-stationary contact members are biased inwardly against the respective stop members and the latter are made of a dead-soft (i. e., ductile) material so as to be capable of being readily bent into desired positions. For instance, in Figures 1 and 2 the stop member 33a on the left has been bent inwardly sufficiently to allow the contact point 12a' to make contact with the opposing member 11 not only in the left but also in the central switch position.

In the sides of the housing sections, at the place where the outer or semi-stationary contact members 12 and respective stop members 33 emerge from the switch stacks, there are provided circular openings 37. These openings are adapted to receive a tool for adjusting the contact members 12 and to guide this tool into engagement with these members. A suitable adjusting tool for this purpose, which is shown in Figure 10 as 38, has an end portion 38' provided with an open slot 39 so that it may engage the respective pairs of contact members 12 and stop members 33 of the stack; also, the tool has a shoulder 38'' near the end thereof which is adapted to abut against the switch housing as the tool is inserted in the openings 37, to limit the distance of insertion of the tool. Thus, to adjust the spacing between any particular set of contact points, or to set a stop member 33 so that its contact member 12 will make contact also in the central switch position, the tool is inserted into the desired one of the openings 37, is turned until the slot 39 is aligned with the pair of contact and stop members adjacent to that one opening and is then further inserted into the opening until the shoulder 38'' abuts against the switch housing, after which the tool is suitably turned to effect the desired adjustment. To permit observation of the contact points during such adjustment, there are provided windows 40 in the housing sections at the points as shown in Figures 1 and 2. As the stop member 33 and contact member 12 are bent in this way, the contact member 12 will be placed into a new position determined by the amount of permanent set given to the stop member. Since the stop members are made of a ductile material, and the contact members are made of a spring material whose elastic limit is not exceeded by the bending operation, the new position of the contact member may be very accurately determined. Also, the contact pressure, which is determined by the degree of loading or biasing of the switch member 12 against its stop, will remain substantially unchanged.

In order that soldering will not have to be done to the springs of the contact members 11 and 12, to make the lead connections to the switch, the stop members 33 are provided with lugs 33', and the switch pole members 11 are provided with separate lugs 34 which are clamped in the stacks against these members, all of these lugs projecting below the stacks as shown. The lugs 34 are also held against longitudinal displacement by notches 16 provided therein which engage the sides of the bosses 15 of the insulating blocks.

The switch stacks (the stack assemblies 10 hereinbefore described) are removably mounted in the lower portion of the switch housing in positions at the sides of the interior bosses 8. The end plate 20 has extensions 20' beyond the sides of the stacks, but the other end plate 21 is substantially flush with these sides, as is shown in Figure 5. In the interior walls of the housing sections are grooves 35 into which the plate extensions 20' fit and at the sides of the bosses 8 are shoulders 36 against which the ends of the plates 21 abut. These grooves 35 and shoulders 36 run down through the bottom of the switch housing to permit the stacks to be slid into and out of the housing. To retain the stacks in the housing, the plates 21 are provided with projections 21' and the shoulders 36 with notches 36' to fit these projections (see Figures 3 and 9). The width of the plates 21 is such that when the housing sections are clamped together the shoulders 36 will bear against the ends of these plates and firmly hold the stacks in place. The engagement of the extensions 20' of the plates 20 with the grooves 35 serves to effect a straight alignment of the switch stacks within the housing. As so arranged, the stacks are held firmly in place but are readily rendered removable merely by loosening the clamping bolt 6 and spreading the housing sections slightly apart.

The operating means for the switch comprises an operating or control lever 46 and a snap mechanism 42. The lever 46 extends through the neck 2 of the housing and has a pin 47 secured thereto which is pivoted at its ends in recesses 2'' provided in the neck portions 2' (see Figure 3). The snap mechanism 42 is of a unitary construction and is movably mounted in the top portion of the housing, the mechanism having a bottom plate 41 of rectangular shape which slides at its sides in grooved members 43 integrally formed on the housing sections. Secured to the bottom of the plate 41 by rivets 45 is a bracket-shaped member 44 having two downwardly extending lugs 44', this member being formed as by molding, from a suitable insulating material. The lugs 44' of this member pivotally engage the sockets 32' of the switch pole members 11 to couple the snap mechanism thereto. In the actuation of the snap mechanism, the plate 41 is moved along the grooved members 43 transversely of the housing and this movement is transmitted to the switch pole members 11 to operate the switch into its respective positions.

The snap mechanism 42 comprises a bracket 48 which is secured to the top of the plate 41 by the aforementioned rivets 45, the bracket being considerably narrower than the plate and having laterally extending lugs 49 at its central portion through which the rivets 45 pass (see Figures 4 and 6). The legs 48' of the bracket extend up from the plate 41 and are bridged at the top by a yoke 50 which has a slot 51 lengthwise thereof. Between the yoke and the bracket there are two pins 52 the outer portions of which extend slidably through apertures 53 in the legs 48' of the bracket 48. On the inner end of these pins are heads 54 which slide between the yoke and

bracket. The top and bottom portions 54' of these heads are reduced in width to fit the slot 51 in the yoke at the top and to fit a slot 48'' in the bracket 48 at the bottom, the engagement of the heads with these slots serving to hold the heads against lateral displacement. The lower end portion of the lever 46 extends down through the slot 51 in the yoke and carries a roller 55 at its end which is held between the heads 54. Coiled about the pins between the heads thereof and the legs 48' of the bracket 48 are compression springs 56 which press the heads of the pins against the opposite edges of a stop member in the form of an I-shaped plate 57 which is clamped against the central portion of the bracket 48 by the rivets 45 aforementioned. The width of this plate 57, at the place where the heads abut thereagainst, is made substantially equal to the diameter of the roller 55 in order that the roller may be normally held between the heads without play. By this construction the spring pressed pins 52 serve to yieldably couple the control lever 46 to the snap mechanism 42 and to normally confine the lever to a neutral (i. e., central) position in relation to the snap mechanism. While the lever and snap mechanism may be displaced in either direction out of this neutral position, it will be seen that this can occur only through a compression of one or the other of the springs 56.

The snap mechanism is normally held latched to the switch housing but is released by a predetermined displacement of the lever 46 out of its neutral position just mentioned, the particular one of the springs 56 which is compressed by such displacement of the lever serving as the motive means to propel the snap mechanism with an impulse when the mechanism is released. The propelling of this mechanism with a snap movement renders it particularly difficult to provide the mechanism with a positively acting latch. In the present instance, however, this difficulty has been effectively overcome by means of a latch arrangement which comprises a pair of unidirectionally or one-way acting latches, one for each direction of movement of the switch pole members, which latches are then respectively directed in the several directions of movement of these pole members. In such a latch arrangement, it will be seen that the cooperating latch members are permitted to move into engagement with one another during the travel of the movable switch members from one switch position to the next and that, as a result, a positive and dependable latch action is obtained.

The latches of the snap mechanism in the present embodiment comprise two similar U-shaped pawls 60 which overlie the plate 41 and straddle the opposite end portions of the bracket 48. These pawls pivot at their inner ends on the side edges of the lugs 49 of the bracket 48, the pawls being retained in such pivotal contact with the lugs by the cross extensions of the I-shaped plate 57 which overhang the sides of these lugs. The pawls are torsionally biased upwardly by means of tension springs 61 which are connected between upstanding lugs 62 provided at the sides of the pawls near their inner ends. The outer ends of the pawls have abutment faces 60', which in order to reduce wear, are made as wide as possible by lateral extensions 63. These faces engage the teeth 64 of catch members 65 provided in the top four corners of the housing and formed integrally with the housing sections (Figures 2, 4, 6 and 8). These teeth are ratchet-shaped and the pawls are inclined thereto to form a pair of one-way acting latches; however, the two pairs of catch members at the opposite ends of the housing have their teeth oppositely directed, as shown in Figures 2 and 6, in order that the latches will, in their joint action, be effective in both directions of travel of the snap mechanism.

The pawls are selectively disengaged from the catch members by the lever 46 through the medium of the pins 52. This disengagement occurs through a displacement of the lever out of its neutral position abovementioned, the particular pawl which is disengaged depending upon the direction of this displacement. For instance, when the lever 46 is swung to the left, as is illustrated in Figure 6, the rightward one of the pins 52 is moved to the right and in relation to the plate 41. When this pin has been so displaced a predetermined distance, the outer end thereof impinges against the top central portion of the rightward one of the pawls 60 and cams this pawl downwardly out of engagement with its respective catch members, whereupon the plate 41 is propelled to the right. As the plate or snap mechanism is so propelled the pin 52 is retracted from the pawl just released to permit the latter to return, under the influence of the springs 61, back into engagement with its associated catch members. In the movement of the snap mechanism from central to terminal switch positions, this reengagement with the catch members of the pawl last released is, in the present structure, of no importance as the snap mechanism is stopped at its terminal positions by the abutment of the pawls or plate 41 against the ends of the housing (and since the snap mechanism is stopped in its terminal positions in this manner the catch members need each have only one complete tooth or two abutments as shown); however, in the movement of the snap mechanism from terminal to central positions, the reengagement with the catch members of the pawl last released is relied upon to stop the mechanism. This reengagement is, however, insured in the present structure as the ratchet shape of the teeth of the catch members permit the released pawl to move back into engagement with the respective catch members while the snap mechanism is moving to central position. As the mechanism completes an interval of travel the trailing pawl engages one or the other of the two abutments abovementioned to latch the mechanism against return movement.

Since the snap mechanism 42 and the stack assemblies 10 are provided as self-contained units, the assembly of the switch is very simply carried out. For instance, to assemble the switch, the lever 46 and the mechanism 42 are laid in place in one of the housing sections—the pivot 47 of the lever being inserted in the recess 2'' of the housing neck portion 2' and the mechanism 42 being laid with its plate 41 in engagement with the grooved member 43—and the other housing section is put in place and secured to the first section by the collar 3 and the clamping bolt 6, the latter being however not tightened; the switch stack assemblies are now inserted into the bottom of the housing with the projecting edges of the plates 20 being brought into engagement with the grooves 35, and then the stack assemblies are pushed inwardly until the sockets 32' come into engagement with the legs of the bracket 44 and the projections 21' with the notches 36'. The tightening of the clamping bolt 6 completes the assembly operation.

In Figures 12, 13 and 14 there is shown a sec-

ond embodiment of my invention which differs from the embodiment above described, principally in the arrangement of its switch-operating mechanism. (In the showing of this second embodiment, those parts which are identical with the corresponding parts of my first embodiment are given the same reference characters and several parts which are slightly modified are given like reference characters with the addition of the letter *a*, while other new parts are given new reference characters.) This second embodiment comprises two identical housing sections *1a*, differing from the sections 1 only in the shape of their interior walls. The housing sections are clamped together at the bottom in the same way as before, and have the neck portions 2' embraced by the collar 3 to hold the sections together at the top. In the lower part of the housing there are provided the switch stack assemblies 10, the same being removably mounted in the manner hereinbefore described. An adjustment of the spacing between adjacent contact points is made by the tool 38 in the manner hereinbefore described, and inspection of the contact points is again had through windows 40 provided in the housing sections.

The snap mechanism of this embodiment includes a plate 70 of rectangular shape which is slidably mounted at its sides in grooved wall portions 71 integrally formed with the housing sections. This plate is insulatedly coupled with the switch pole members 11 through the medium of a plate 78 of insulating material, which is slidably mounted below the plate 70, in grooved wall portions 79 also integrally formed with the housing sections. These two plates are intercoupled by means of lugs 70' turned down from the sides of the plate 70 into engagement with notches 78' provided in the plate 78, and the plate 78 is coupled to the switch pole members 11 by means of straight bars 30*a*. These bars are secured to the pole members by the rivets 31 (not shown) and engage apertures 78'' provided in the insulating plate. On these bar members 30*a* there are provided contact points 11' for the switch pole members. Thus, the plate 70 is mounted to slide back and forth transversely of the housing and, as the plate is so moved, the switch pole members 11 are swung back and forth into and out of contact with the semi-stationary contact members 12 of the switch stack assemblies 10.

The plate 70 of the snap mechanism has a central opening 72 which is bridged centrally thereof, in the direction lengthwise of the plate, by a rod 73 which is staked at its ends to the plate, as is shown in Figure 14. Slidably mounted on the rod are sleeves 74 which are respectively confined to the end portions of the rod by a central enlarged-diameter portion 73' of the rod. The sleeves 74 have flanges 74' at their inner ends, and are pressed inwardly against the shouldered ends of the central portion 73' of the rod by means of compression springs 75 which are coiled about the rod and sleeves between the flanges and the portions of the plate at the ends of the rod. A manual control lever 76 for the switch is pivoted as at 76' to the neck 2 of the housing. This lever has two diverging arms 76'' at its inner end which straddle the rod 73 and clear the flanges 74'. On these arms are inwardly extending cylindrical projections 77 which terminate between the flanges 74'. Thus through the spring-pressed sleeves 74 the lever 76 is yieldably coupled to the plate 70 and is normally held in a neutral or central position in relation thereto.

The plate 70 is adapted to be latched in central and terminal positions by means of two identical pawls 80 which underlie the plate. These pawls are pivoted to opposite end portions of the switch housing through rods 81 secured to the pawls and fitted at their ends in bearings 82 integrally formed with the housing sections. The pawls are disposed along the side walls of the housing sections and are biased upwardly by means of torsional springs 83 which are coiled about the rods 81, hooked at one of their ends on the pawls and restrained at their other ends by the housing. The pawls are arranged to pass up through the opening 72 of the plate 70 and to abut at their end portions, against inward extensions 84 of the plate at the diagonally opposite corners of the opening 72, the pawls and the plate extensions 84 in this way forming a pair of oppositely directed latches each of the one-way acting type. As before, an abutment of the plate 70 against the housing ends is utilized to define the terminal positions of the plate; accordingly, each of the latches need have only two latching positions. To render the pawls effective at such two positions, each is provided with two abutting faces at its inner end portion, a face 85 constituting the vertical edge of a step 85' provided on the pawl and a shoulder 86 positioned above and in from the face 85 and constituting the vertical edge of a step 86'.

These pawls are operated through three positions, the intermediate and uppermost positions constituting the two effective or latching positions of the pawls. For instance, the latching of the plate 70 in the rightward one of its terminal positions is effected, when the left one of the pawls is in uppermost position, by the abutment of the end face 85 of this pawl against the end of the respectively associated plate extension 84, and the latching of the plate in the leftward one of its terminal positions is effected when the rightward one of the pawls is in uppermost position by the abutment of its end face 85 against the respective one of the plate extensions 84. Whichever one of the two pawls is not in use in the latching of the plate in a terminal position, is held in its lowermost position by the abutment of the step 86' of the pawl against the bottom of the respective extension 84 of the plate. The latching of the plate 70 in central position requires the use of both pawls at the same time, and is effected when both pawls are in their intermediate positions by the abutments of their shoulders 86 against the ends of the respective extensions 84 of the plate.

The pawls 80 are appropriately controlled by the manual lever 76 through a camming of the two arms 76'' of the lever with respective cam faces 88 provided on the pawls. These faces extend along the central portions of the pawls and are so curved that when the upper end of lever 76 is to the left, the left pawl is in its uppermost position and the right pawl in its lowermost position; that when the lever is in central position, both pawls are held in their intermediate positions; and that when the lever is to the right, the left pawl is in its lowermost position and the right pawl in its uppermost position (see Figure 12).

The operation of the switch mechanism of this second embodiment is as follows: When the lever 76 is moved to the left from its right terminal position the plate 70 is placed under a right-

ward bias by the displacement of the right one of the spring-pressed sleeves 74, and the right pawl, which now latches the plate in its left terminal position, is cammed downwardly to disengage the end face 85 thereof from the plate, the left pawl being freed from the lever for upward movement but restrained momentarily by the plate. When this disengagement of the right pawl occurs, the plate is propelled to the right, to break the circuit between the left set of semi-stationary contact members 12 and the switch pole members 11. The plate is however, stopped positively at its central position by its abutment against the shoulder 86 of the right pawl, and is automatically latched against return movement when it reaches this position by the left pawl which is snapped upwardly into intermediate position as the plate slides off the step 86' of this pawl. Upon a further leftward movement of the lever 76, this action repeats itself; the plate being again placed under a rightward bias, the right pawl being cammed down into its lowermost position to unlatch the plate, the plate being then propelled into its right terminal position, and the left pawl then snapping upwardly into its uppermost position (as the plate slides off the step 85') to latch the plate against return movement. Upon moving the lever 76 to the right, the sequence of operations here related will, of course, be reversed.

The mode of operation of the latches of this second embodiment is one causing the switch to be latched in its several positions in succession as the pawls are moved progressively through their successive latching positions (i. e., as the pawls and respective plate extensions 84 are progressively engaged), and the release of each pawl from one latching position automatically renders the same effective as to its next latching position. In other words, the switch is unlatched by one pawl for movement in only one direction at a time and then only for a distance from one position to the next; and when the switch has reached this next position, the other pawl snaps into place to latch the switch against return movement. This mode of action of the latches will be seen to be wholly positive and dependable.

As a summary of certain salient features of my invention, it will be noted that the switch embodiments herein disclosed are of a durable construction and dependable operation; that the switches are completely housed to protect the parts thereof from dirt, to guard against shock and to electrostatically shield the switch circuits; that while the switch is completely housed, yet it may be readily adjusted and serviced or repaired; that while the construction thereof is compact, yet the switch circuits are relatively widely spaced to reduce the electrostatic capacity therebetween; that the locating of the semi-stationary spring contact members by biasing the same against adjustable stops serves to provide definite yieldable contact pressure between the contact points, which is effective in producing a clean making and breaking of the points without bouncing; and that, by making up the switch from separate unitary assemblies, the overall assembling of the switch is very much simplified.

While I have illustrated my invention in terms of a three-position switch, no unnecessary limitation of my invention to a switch having this number of positions is intended as the principles herein disclosed are applicable also to switches having higher numbers of positions. Also the embodiments herein disclosed are subject to many other changes and modifications without departure from the scope of my invention, which I undertake to express according to the following claims.

I claim:

1. A mechanism for latching a switching member of a multiple-throw switch in its several positions respectively, comprising a frame, a pair of one-way acting latches operatively interposed between said switching member and frame and respectively effective on said switching member in the opposite directions of movement thereof, each of said latches including two cooperating and relatively movable members and one of the members of each of said latches having a portion provided with a plurality of successive steps adapted for selective engagement with the other of said members, the release of one of said latches at one step thereof operating to unlatch said switching member for movement in one direction from one position thereof, and concurrently to place the next adjacent step in line for engagement with the other member to latch the switching member in its next succeeding position.

2. An electrical switch comprising separable housing portions, an operator movably connected to said housing between the portions thereof, an operating mechanism installed as a unit between said housing portions in coupled relationship with said operator to be actuated thereby, and a unitary contact-spring assembly removably mounted between said housing portion and brought automatically into and out of coupled relationship with said operating mechanism in the mounting and removal of the assembly into and out of the housing.

3. A switch construction including a switch unit comprising contact-carrying springs and intermediate insulating plates clamped together in stacked relation; and a housing for said switch unit having openings therein at places where said springs emerge from the stack assembly, said openings being circular and adapted to receive a spring-adjusting tool having a cylindrical shank, and the edges of said openings forming journal bearings for said shank whereby to guide the tool into engagement with the respective springs of the stack assembly and hold the tool for rotational adjusting movement.

4. An operating mechanism for a multi-position snap switch comprising a frame; a reciprocative switch member latchable into successive switch positions to said frame; a pair of slides on said member spring pressed towards one another; abutment means on said member defining a minimum spacing between said slides; an actuating member movably connected to said frame and held yieldably between said slides in a neutral position in relation to said switch member; and means controlled by said actuating member for unlatching said switch member.

5. In a multi-position snap switch: the combination of a housing split into two sections; a snap mechanism in said housing including a frame slidably connected to said housing between said sections and adapted for connection to switch contact elements; actuating means for said switch movably connected to said housing between said sections; and a yieldable coupling between said actuating means and said frame comprising a pair of movable members on said frame yieldably pressed towards one another into inner spaced-apart positions, said actuating means having a portion interposed between said members.

6. In a multi-position snap switch: the combination of a housing having a mounting collar thereon, said housing being split substantially along a center plane through said collar into two substantially identical half sections; an actuating lever for the switch pivoted to said collar between said sections; a switching member movably connected to said sections and adapted for connection to switch contact elements; a yieldable coupling between said lever and said member normally confining the lever to a neutral position in relation to said member, said coupling comprising two parts movably mounted on said member and spring pressed towards one another, said parts being limited in their inward movements to define a gap of minimum width therebetween into which an inner end portion of said lever projects; and a pair of latch pawls controlled by said lever and operatively interposed between said switching member and said housing.

7. In a switch: the combination of a housing provided with a mounting collar and with an opening, said housing being split through said collar and opening into two sections; a switch operating mechanism within said housing including a switching member movably connected to said sections; an actuating lever pivoted to said collar between said sections and coupled to said switching member; and a contact spring assembly detachably coupled to said switching member and movably mounted in said housing for removal through said opening, said switching member and spring assembly being adapted to be coupled and detached automatically from one another upon inserting and removing said assembly into and out of said housing through said opening.

8. In an electrical switch: the combination of a split housing provided with interior abutments; a unitary snap mechanism movably connected to said housing between the sections thereof and including latch pawls engaging said abutments; and an actuating member for said switch also movably connected to said housing between said sections, said actuating member being detachably coupled to said unitary snap mechanism.

9. In a multi-position snap switch: the combination of a housing having inwardly projecting parallel teeth on an interior wall thereof; a switching member in said housing mounted for movement transverse to said teeth; and latch pawls for said switching member having faces adapted for engaging said teeth respectively, said faces extending parallel to said teeth along the length thereof whereby to provide a large surface contact between said pawls and said teeth.

10. An operating mechanism for a multi-position snap switch comprising a switch frame; a reciprocative switch member carried by said frame; means for latching said switch member selectively into a plurality of switch positions including oppositely directed latch pawls pivoted to said switch member and stationary catch means on said frame and engaged by said pawls; a pair of slides on said member spring pressed in opposite directions; abutment means defining limiting positions for said slides; means actuatable to move said slides selectively in opposite direction into constrained positions in relation to said switch member; and means to disengage said latch pawls from said catch means by said slides respectively.

11. In a multi-position snap switch: the combination of a housing having a collar adapted to be inserted through an aperture in a panel to mount the housing to the panel, said housing being split through said collar into two separate sections; an actuating lever pivoted to said collar between said sections and having an outwardly extending arm adapted for manipulation and an inner arm extending into the housing; a unitary snap mechanism in said housing comprising a base structure slidably connected to said sections, two members movably mounted on said base structure at opposite sides of the inner arm of said lever, said members being biased towards one another and restricted in their inward travel whereby to confine said lever yieldingly to a neutral position in relation to said base structure; spaced abutments within said housing; oppositely directed latch pawls pivoted to said base structure and biased into engagement with said abutments, said pawls being released by said members respectively in response to movements of said lever in opposite directions out of said neutral positions; and switch contact springs mounted in said housing and coupled to said base structure to be actuated thereby.

12. In a multi-position snap switch: the combination of a housing; a snap mechanism including a switching member movably connected to said housing and adapted for connection to switch contact elements; a rod mounted on said switching member and having a central enlarged-diameter portion providing spaced-apart shoulders; two members slidably mounted on the outer end portions of said rod and spring pressed towards one another against said shoulders; and an actuator for said switch having a part interposed between said two members to couple the actuator to said snap mechanism.

13. In a multiple-throw snap switch including a frame member, a reciprocable switch contact member mounted on said frame member and having at least three switch positions in succession, and a manually reciprocable mechanism on said frame member and yieldably coupled to said switch contact member for moving the latter back and forth into its respective switch positions: the combination of a pair of oppositely directed one-way latches, comprising oppositely directed ratchet-toothed means on one of said members and respectively cooperating pawls on the other of said members, for securing said switch contact member against movement in opposite directions relative to said frame member at said several switch positions respectively; and means coupling said mechanism to said latches for disengaging said latches selectively according to the direction of actuation of said mechanism.

14. In a multiple-throw snap switch including a frame member, a reciprocable switch contact member mounted on said frame member and having at least three switch positions in succession, and a manually reciprocable mechanism on said frame member and yieldably coupled to said switch contact member for moving the latter back and forth into its respective switch positions: the combination of a pair of oppositely directed one-way latches between said frame and switch members for latching said switch member against movement in either direction at said several switch positions respectively, said latches comprising two sets of abutments on one of said members and oppositely directed pawls on the other of said members, said pawls engaging said two sets of abutments respectively; and means coupling said mechanism with said pawls for dis-

engaging said pawls selectively according to the direction of actuation of said mechanism.

15. In a multiple-throw snap switch including a frame, a switch contact element movably mounted on said frame and having at least three switch positions in succession, and a manually reciprocable mechanism on said frame and yieldably coupled to said switch contact element for moving the latter back and forth into its several switch positions respectively: the combination of catch means connected to said switch contact element for movement therewith; relatively movable latch means on said frame comprising two sets of abutments spaced along the path of movement of said catch means, said latch means being controllable to place the respective abutments of each set into and out of the path of said catch means, the different abutments of one set being adapted to be placed selectively into said path to latch said switch contact element at different switch positions against movement in one direction and the different abutments of the other set being adapted to be placed selectively into said path to latch said switch contact element at different switch positions against movement in the other direction; and means controlling said latch means by said mechanism to cause the abutments of one of said sets to be placed successively into said path as said mechanism is actuated to successive positions in one direction and to cause the abutments of the other of said sets to be placed successively into said path as said mechanism is actuated to successive positions in the other direction.

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