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W. P. SILVIUS

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ELECTRICAL CONTROL SWITCH

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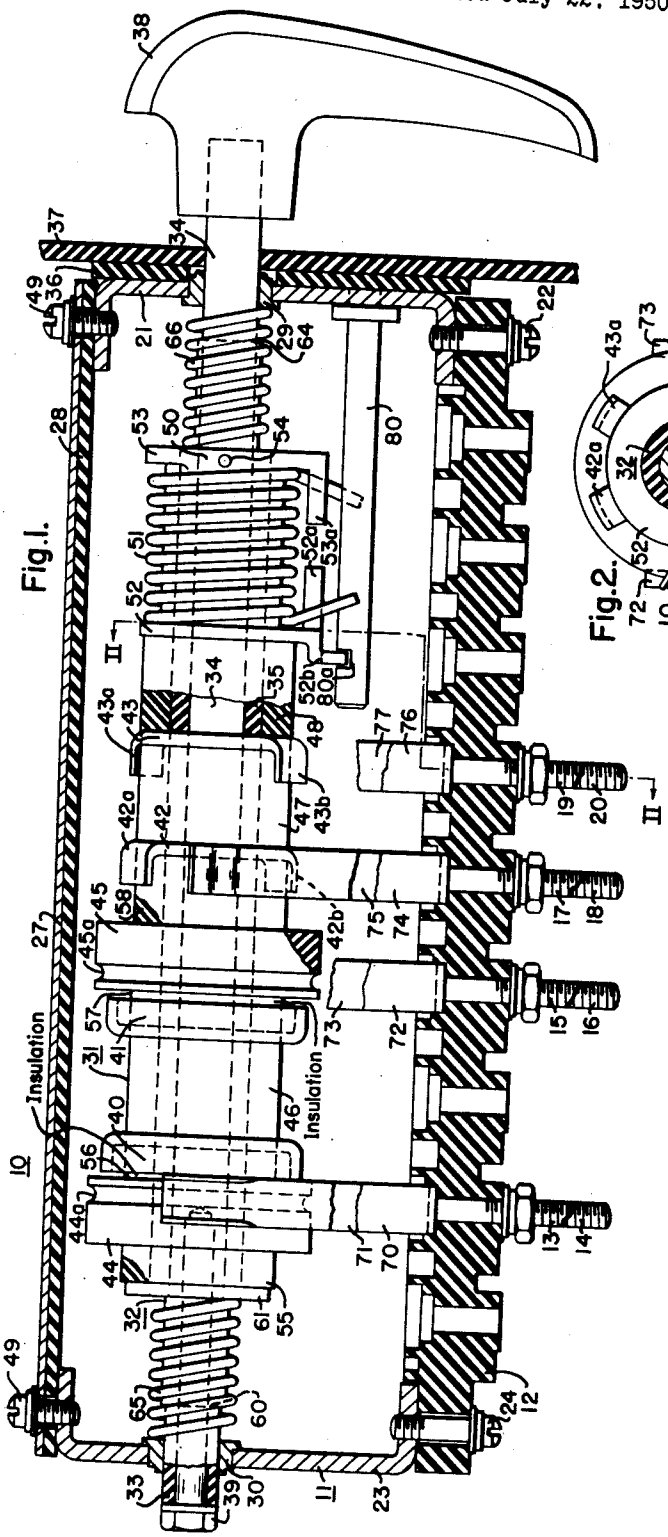


Fig. 1.

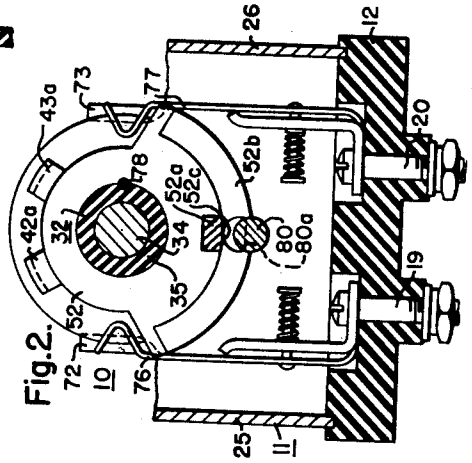


Fig. 2.

INVENTOR
Walter P. Silvius.
BY Ruthven T. Stratton
ATTORNEY

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ELECTRICAL CONTROL SWITCH

Walter P. Silvius, Murrysville, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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5 Claims. (Cl. 200—4)

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This invention relates to electric switches and more particularly to switches which are operable for controlling a plurality of circuits.

An object of this invention is the provision of a rotary switch construction which effectively and reliably combines rotary and push-pull movements and is thoroughly satisfactory for controlling various electrical circuits.

Another object of the present invention is that of providing a unitary switch construction capable of push-pull operation from an intermediate neutral position and capable of rotary movement in opposite directions from the neutral position, for achieving switching functions.

A further object is to provide a switch construction of the character indicated above, having a highly useful biasing arrangement for resiliently biasing the switch to intermediate neutral position both with respect to rotation and push-pull operation.

Another object of this invention is the provision of a switch construction of the character indicated above which includes a novel arrangement of contact members to secure selective control of a pair of electrical circuits depending upon the direction of rotation from neutral position and selective control of another pair of circuits depending upon push-pull operation from neutral position.

A still further object is to provide a switch of the above character in which change from any one of the switching functions to another of the switching functions introduces operation through neutral position.

The above and other objects and novel features of the invention will appear more fully hereinafter from the following detailed description where taken in connection with the accompanying drawing. It is to be expressly understood, however, that the drawing is utilized for purposes of illustration only and is not to be taken as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawing, wherein similar reference characters denote similar parts throughout the several views:

Figure 1 is a longitudinal sectional view of a rotary push-pull switch embodying the principles of the present invention; and

Fig. 2 is a transverse sectional view taken substantially along the line II—II in Fig. 1.

In the embodiment of this invention represented in the accompanying drawing, it will be seen that a multi-way electrical switch 10 is provided having a support as in the form of a casing generally indicated at the reference numeral 11. The casing 11 comprises a base 12 made of an insulating material such as phenolic resin, fiber or fiber filled with resin such as of the phenolic type. Affixed to the base 12 are a plurality of terminals in pairs, including the terminals 13, 14, 15, 16, 17, 18, 19 and 20 for connection into electrical circuits which are to be controlled by the multi-way switch 10. These terminals conveniently are bolts made of electrically conductive material, such as copper or an electrically conductive alloy, and extend through openings in separate rows along the length of the base 12 and are held to this base by suitable nuts on their outside ends. Terminals 19 and 20 (see Fig. 2) are in different ones of these rows and are laterally opposite each other on the base 12 to constitute a pair, as are terminals 13 and 14, terminals 15 and 16, and terminals 17 and 18. The switch casing 11 further includes a front wall 21 having an inturned flange fastened to the base 12 as by machine screws 22, and a back wall 23 which also has an inturned flange fixed to the base, also for example by means of machine screws 24. Side walls 25 and 26 of the casing 11 conveniently seat in grooves in the base 12 and are closed off at the top by suitable flanges of a cover 27, the latter forming a closure of the casing and conveniently being held in place by machine screws 49 engaging inturned flanges at the upper ends of the front and back walls 21 and 23. Cover 27 preferably has a lining 28 of insulating material, as for example of the same composition as the base 12.

Front wall 21 and back wall 23, respectively, include substantially centrally disposed bushings 29 and 30 which, for example, are received in openings in these walls, and may be firmly secured to the same, as by press fit or the like. If desired, the bushings and main body portions may be made integral as by punching and stamping the walls 21 and 23 from sheet metal. The bushings 29 and 30 support a switching member or rotor 31 so that this member may not only be rotated but longitudinally moved as by sliding relative thereto. The switching member 31 preferably comprises a shaft 32 which includes a metallic core 34 (see Fig. 2) and a tube 35 of insulating material such as phenolic resin or the like covering and secured to the part of the core which carries the contacts. One end of shaft core 34 extends through bushing 29 and, for example, through a spacer plate 36 and panel

37 preferably provided for covering the front face of casing wall 21 and for mounting the switch in any suitable manner. On the outside, shaft core 34 supports an operating handle 38 for the switching member 31 as by press fit, or as by set screw attachment. Plate 36 and panel 37 preferably are made of insulating material such as phenolic resin or the like, the panel 37 having indicia or instructions on the outside face thereof for facilitating operation of the switch handle 38 and proper positioning of the switching member 31. The opposite end of shaft 32 has a demountable extension including a machine screw 39 threadedly engaging the core portion 34 of the main body portion of the shaft, and a sleeve 33 received on the screw and passing through bushing 30 for supporting this end of the shaft. Sleeve 33 is interposed between the head of screw 39 and the adjacent end of shaft core 34.

As shown, the switching member 31 further includes switch contact members 40, 41, 42 and 43 spaced along the shaft. The switch contact members 40 and 41 preferably are annular cup-shaped elements having centrally perforated bottoms for receiving the shaft 32, and, for example, open away from each other toward cam discs 44 and 45, respectively, adjacent thereto, both of the discs having substantially central openings receiving the shaft 32. A plurality of spacer sleeves are also on the shaft 32, among these being insulating sleeves 46 and 47, respectively, between contact members 40 and 41 and the contact members 42 and 43, for maintaining these members electrically separate. Immediately forward of the contact member 43 and on the shaft is an insulating spacer sleeve 48 which abuts this contact member and a forward support 50 for a double-acting helical spring 51, the support, for example, being substantially in the shape of a spool, having a central bore admitting the shaft 32 and having opposite end flanges 52 and 53. Flange 53 of the spring support, illustratively has a radial bore into shaft 32 so as to receive a pin 54 giving interconnection of the support 50 and insulating tube 35 with the core 34. Also on the shaft 32 in the present instance are spacer sleeves 55, 56, 57 and 58, these and the spacer sleeves 46, 47 and 48 all, for example, being made of phenolic resin, fiber, or the like. Sleeves 57 and 58 abut opposite faces of cam disc 45 and, respectively, extend to abutment against contact members 41 and 42. Spacer sleeve 56 is disposed between cam disc 44 and contact 40. The sleeve 55 is between cam disc 44 and sleeve 33. Sleeve 33 illustratively has a central longitudinal bore receiving the shank of machine screw 39 and includes a flange 61 at the forward end thereof abutting the spacer sleeve 55. The outer end of sleeve 33 is reduced in section where it passes through bushing 30 to form a stop shoulder 60. Tightening of the machine screw 39 into the core 34 of the main body portion of the shaft 32 forces the shaft sleeve 33 longitudinally and forces flange 61 thereof against the spacer sleeve 55. Likewise, tightening of the machine screw 39 forces spacer element 48 against the spring support 50, and the inbetween elements including contact members 40, 41, 42 and 43, cam discs 44 and 45 and spacer elements 46, 47, 56, 57 and 58 accordingly are urged and held together in assembled relation.

Longitudinal movement of the switching member 31 by inward push on the operating handle 38 is limited by the shoulder 60 of the sleeve 33 cooperating with the adjacent inner face of bushing 30 to afford a stop. Likewise, longitudinal movement of the switching member 31 by outward pull on the operating handle is effectively limited by means of a shoulder 64 disposed on shaft 32 in advance of the spring support 50. The outer end of this shoulder 64 cooperates with the adjacent inner face of bushing 29 to afford a stop against the outward pull.

The switching member 31 is held to a neutral longitudinal position by helical biasing springs 65 and 66, and may be pushed or pulled from this position to achieve certain switching operations as will be more fully described hereinafter. Spring 66 is disposed on shaft 32 and is compressed between the forward end of spring support 50 and the inner face of the front wall 21 of the switch casing. The helical spring 65 is also on the shaft 32, but extends between the rearmost face of the flange 61 on sleeve 35 to the forward or inner face of the rear wall 23 of the switch casing. The springs 65 and 66 act against each other across the switching member 31 to bias the same to the neutral longitudinal position represented in Fig. 1. In the latter position of the switching member 31 it will be observed that shoulders 60 and 64 on the outer ends of shaft 32 are some distance away from the corresponding rear wall 23 and the corresponding front wall 21 of the switch casing, so as to allow push or pull of the switching member prior to effecting a stopping action against the respective walls.

Switch terminals 13 and 14 on the base 12 of the switch casing are individually connected with resilient contact fingers 70 and 71 forming a normally open set which, for example, extend upwardly respectively from affixation from between the heads of the terminal bolts and base 12 to positions on opposite sides of the contact member 40 on shaft 32. The upper ends of these resilient fingers preferably are substantially V-shaped in cross section so as to respond to camming action of the cam disc 44 when the latter is longitudinally moved. In the position of the switch 10 represented in Fig. 1, the V-shaped ends of the resilient fingers conveniently rest in an annular groove 44a in the surface of the camming disc 44, and this disc in being made of insulating material interposes a non-conductive space between the finger ends, thus maintaining open circuit across the terminals 13 and 14.

Switch terminals 15 and 16 also have a normally open set of resilient switch contact fingers extending upwardly therefrom, these being fingers 72 and 73 similar to fingers 70 and 71 and each preferably having a substantially V-shaped cross section at the upper ends for seating in an annular groove 45a in the cam disc 45 from opposite sides of the latter. The fingers 72 and 73 individually correspond to the terminals 15 and 16, and the cam disc 45 in being made of an insulating material is effective for separating the ends of the fingers thereon against conducting current across the related terminals when the switch 10 is in the intermediate neutral position represented in Fig. 1.

A push inwardly of the handle 38 from the position indicated in Fig. 1, however, displaces the cam disc 44 longitudinally from between the contact fingers 70 and 71 and brings the contact member 40 to the in-between position. The fingers 70 and 71 being resilient and sprung in favor of moving toward each other at their upper free ends, move into electrical connection with con-

tact member 40 interposed by the longitudinal movement, and thus complete connection across the terminals 13 and 14. The inward movement of the switching member 31 for achieving the latter connection fails to displace the cam disc 45 so far as to free the contact fingers 72 and 73 from the insulating effect at this point. Release of the operating handle 38 allows the biasing springs 65 to return the switching member to the neutral longitudinal position. A pull outwardly on the switch operating handle causes longitudinal movement of the cam disc 45 in a forward direction from between the resilient contact fingers 72 and 73, which are sprung in favor of advancing toward each other at their free upper ends until engaging contact member 41 which now occupies the in-between position. This engagement closes connection across the terminals 15 and 16. The forward movement of the switching member from neutral position is insufficient to displace the cam disc 44 from between resilient contact members 70 and 71 and thus open circuit conditions prevail at this point. Release of the operating handle 38 at the outer position allows biasing spring 66 to return the switching member 31 to the neutral longitudinal position represented in Fig. 1, the cam discs 44 and 45 then both being effective for separating the related pairs of switch fingers adjacent thereto and accordingly maintain open circuit conditions across the terminals 13 and 14 and terminals 15 and 16. The neutral position is defined by grooves 44*a* and 45*a* in the cam discs receiving their respective contacts, to thus act as indexing means for defining the longitudinal neutral position.

The spaced switch contact members 42 and 43 rotate bodily with the switching member 31 by means of rotation of the operating handle 38. These contact members, for example, each have diametrically opposite arms radiating from a central hub portion thereof which receives the shaft 32. On the contact member 42 these arms turn in at their outer ends to form diametrically opposed contacts 42*a* and 42*b* individually corresponding to a normally open set of resilient contact fingers 74 and 75 extending upwardly respectively from connection with terminals 17 and 18 at opposite sides of the switching member 31. Likewise, the contact arms of contact member 43 turn in to afford contacts 43*a* and 43*b* which are diametrically opposed to each other and individually correspond to a normally open set of resilient contact fingers 76 and 77 extending upwardly from connection with the respective terminals 19 and 20 at opposite sides of the switching member 31. As shown, contact members 42 and 43 from member to member have their arms and the contacts at the ends thereof about 60° removed from each other in terms of rotation on shaft 32. This angular relation is conveniently maintained by an insulating key 78 (see Fig. 2) between the sleeve 35 of the shaft 32 and the hubs of the contacts 42 and 43 on the shaft tube. This key also extends between the spring support 50, and other contacts 40, 45, and the tubular portion 35 of the shaft to prevent relative rotation of these elements.

The helical spring 51 on support 50 is effective for biasing the switching member 31 to a neutral intermediate position of rotation. In this, for example, flanges 52 and 53 of the spring support 50 have lateral extensions 52*a* and 53*a* disposed adjacent to a pin 80 fast at one end to the casing front wall 21. Respective ends of the

helical spring 66 extend across outside surfaces of the lateral extensions 52*a* and 53*a* and straddle the pin 80, thus to render this spring double-acting for returning the switching member 31 to an intermediate position of rotation regardless of the direction of rotation of the handle 38. With this arrangement for example, it is possible to rotate the switch handle 38 and accordingly the switching member 31, from an intermediate neutral position of rotation wherein contacts 42*a* and 42*b* of the contact member 42 remain disengaged from fingers 74 and 75 and wherein the contacts 43*a* and 43*b* of contact member 43 remain disengaged from fingers 76 and 77, to a position angularly removed in one direction of rotation for connecting the circuit across the terminals 17 and 18, or in the opposite direction to a position angularly removed from neutral to close the circuit across switch terminals 19 and 20.

The rotation of contacts 42 and 43 preferably is achieved only when neutral longitudinal position of the switching member 31 prevails. For preventing rotation of the switching member at other than neutral longitudinal position, flange 52 of the spring support 50 conveniently includes an arcuate lip 52*b* in which a notch or groove 52*c* is sufficiently large to receive and somewhat clear the pin 80, thus giving guided longitudinal movement of the switching member 31 along the pin when the notch or groove and pin are in alignment but stopping rotation of the switching member. The biasing springs 65 and 66, however, in being effective for urging the switching member 31 to intermediate neutral longitudinal position also conveniently serve to bring flange 52*b* to alignment with a groove or notch 80*a* in the pin 80 in the latter position, so that the switching member may be rotated in the appropriate one of opposite directions for selectively closing circuit across terminals 17 and 18 or across terminals 19 and 20. In this, clockwise rotation of the switching member 31 as viewed in Fig. 2, serves to bring contacts 43*a* and 43*b*, respectively, into engagement with the resilient fingers 77 and 76 and thus the contact member 43 occupies closed circuit position relative to terminals 19 and 20. Contact member 42 remains clear of fingers 74 and 75 in this position and accordingly occupies open circuit position relative to terminals 17 and 18. At neutral position of rotation, the contact members 42 and 43 both are clear of the corresponding resilient contact fingers 72, 73, 74 and 75, and terminals 17 and 18 and terminals 19 and 20 thus are disconnected. A counterclockwise rotation of the switching member 31 as viewed in Fig. 2, brings contacts 42*a* and 42*b*, respectively, into engagement with the contact fingers 74 and 75 and in this manner the contact member 42 occupies closed circuit position relative to terminals 15 and 16. Contact member 43 remains clear of fingers 76 and 77 in this position, thus leaving the terminals 19 and 20 disconnected.

It will also be seen that the switching member 31 is effectively stopped against longitudinal movement from the intermediate longitudinal position thereof, by pin 80 and flange 52*b*, when the switching member is rotated from the intermediate neutral position of rotation and the notch or groove 52*c* is out of alignment with the pin. The double-acting helical spring 51, however, is conveniently effective not only for urging neutral intermediate position of rotation of the switching member 31, but for aligning notch or groove 52*c* with pin 80 so that longitudinal move-

ment may be had from the intermediate neutral position of rotation. A pull exerted on the operating handle 38 under the latter conditions displaces the switching member to position where insulating cam disc 45 moves clear of the resilient fingers 72 and 73 and contact 41 advances to between these fingers thus completing connection across terminals 15 and 16. At this point insulating cam disc 44 still separates fingers 70 and 71, and rotary contacts 42 and 43 remain clear of engaging the respective fingers 74 and 75 and fingers 76 and 77. Release of the operating handle allows return of switching member 31 to neutral longitudinal position, this under the bias of spring 66. At neutral longitudinal position, insulating cam discs 44 and 45 maintain open circuit conditions respectively between fingers 70 and 71 and fingers 72 and 73, and rotary contact members 42 and 43 are in open circuit positions, respectively, relative to fingers 17 and 18 and fingers 19 and 20. A push executed on the operating handle 38 moves the switching member longitudinally from intermediate longitudinal and rotary position, which moves insulating cam disc 44 from between resilient fingers 70 and 71, and moves contact 40 to between the latter for connecting terminals 13 and 14. Insulating cam disc 45 meanwhile separates fingers 72 and 75, and rotary contacts 42 and 43, respectively remain clear of fingers 74 and 75 and fingers 76 and 77 for open circuit conditions at these points.

Thus it will be seen that in accordance with the present invention, the switch 10 has a switching member 31 which not only is operable in opposite longitudinal directions from a neutral longitudinal position for selectively achieving switching functions, but is operable by rotation from a neutral position of rotation for selecting other switching functions. It will also be seen that the switching member 31 of the switch is effectively biased for regaining a neutral position which is intermediate the ranges of longitudinal and rotary movements and from which neutral position any of the switching functions mentioned may readily be initiated. Of still further importance, it will be noted that the switch 10 introduces movement through the neutral position in being operated to achieve the different switching functions, thus affording protection to the working parts of the switch and to the related circuits and apparatus in the circuits which the switch may be used to control.

While one embodiment of the invention has been shown and described herein with considerable particularity, it will readily be understood by those skilled in the art that various modifications may be resorted to without departing from the spirit of the invention. Reference will, therefore, be had to the appended claims for a definition of the limits of the invention.

I claim as my invention:

1. A switch comprising, a support, contacts mounted on said support, contact actuating means mounted for rotatable and longitudinal movement on said support and biased to normally occupy a neutral position intermediate the extremes of its longitudinal and rotative positions on the support, said contact actuating means having means for closing different circuits through said contacts in accordance with movement in opposite directions of rotation from said neutral position and opposite directions longitudinally from said neutral position, respectively, notched pin means secured to the support, and notched flange means secured to the contact actuating means, said notched pin means and said notched flange means cooperating to so control the movement of the contact actuating means that the contact actuating means must pass through said neutral position when changing between rotational and longitudinal movement.

2. A switch comprising, a support, contacts mounted on said support, contact actuating means mounted for rotatable and longitudinal movement on said support and biased to normally occupy a neutral position at intermediate longitudinal and rotative positions, said contact actuating means having means for closing circuits selectively through said contacts in accordance with movement selected from opposite directions of rotation from said neutral position and opposite directions longitudinally from said neutral position, notched pin means secured to said support and notched flange means secured to said contact actuating means, said notched pin means and said notched flange means cooperating to require the contact actuating means to pass through said neutral position when changing between rotational and longitudinal movement.

3. A unitary switch construction comprising, a support having four separate contact means thereon, a switching member mounted on said support for longitudinal adjustment in opposite directions from an intermediate neutral longitudinal position and for rotation in opposite directions from said intermediate neutral longitudinal position, means carried by said switching member for selectively closing the circuit to said contact means, respectively, upon longitudinal movement of said switching member in said opposite directions from the intermediate neutral longitudinal position and upon rotation of said switching member in said opposite directions, respectively, notched pin means secured to the support, and notched flange means secured to the switching member, said notched pin means and said notched flange means cooperating to so control the movement of the switching member that the switching member must pass through said neutral position when changing between rotational and longitudinal movement.

4. A unitary switch construction comprising, a support, contact elements mounted in normally open pairs along said support, a switching member mounted on said support and extending between the elements of each pair of said contacts for longitudinal adjustment in opposite directions from an intermediate neutral longitudinal position and for rotation in opposite directions from said intermediate neutral longitudinal position, a plurality of contacts carried by said switching member for selectively bridging the elements in a different one of said pairs of elements upon longitudinal movement of said switching member in said opposite directions from the intermediate neutral longitudinal position and upon rotation of said switching member in the opposite directions from said neutral position, respectively, notched pin and notched flange means for stopping said switching member against rotation other than in substantially said intermediate neutral longitudinal position thereof and for stopping said switching member against longitudinal movement other than in said neutral position, and resilient means cooperating with said stop means to yieldingly oppose rotational movement of the switching member.

5. A unitary switch construction comprising, a support, contact means mounted on said support, a switching member mounted on said support for longitudinal adjustment in opposite directions from an intermediate neutral longitudinal position and for rotation from said intermediate neutral longitudinal position, resilient means for normally maintaining the switching member in said neutral longitudinal position, means carried by said switching member for selectively actuating said contacts upon longitudinal movement of said switching member in either of said opposite directions from the intermediate neutral longitudinal position and upon rotation of said switching member from said intermediate neutral position thereof, notched pin and notched flange means for stopping said switching member against rotation other than substantially in said intermediate neutral position thereof, and

resilient means cooperating with said stop means to yieldingly oppose rotational movement of the switching member.

WALTER P. SILVIUS.

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