Feb. 24, 1959 D. C. VAN SICKLE 2,875,287

SEQUENTIAL SWITCH

Filed June 4, 1957 4 Sheets-Sheet 1

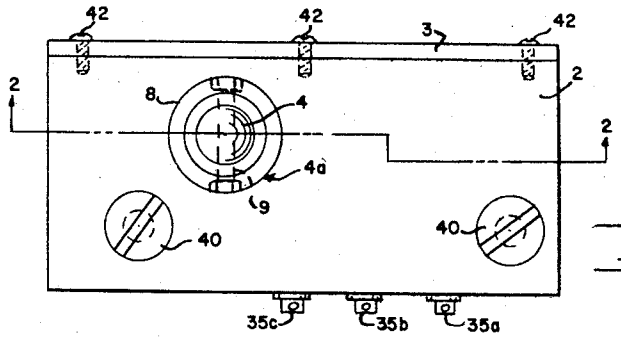


Fig-1

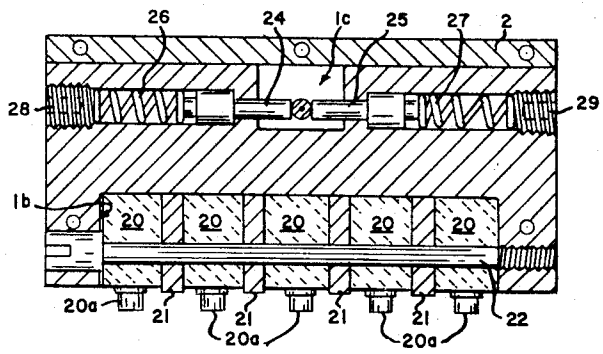


Fig-4

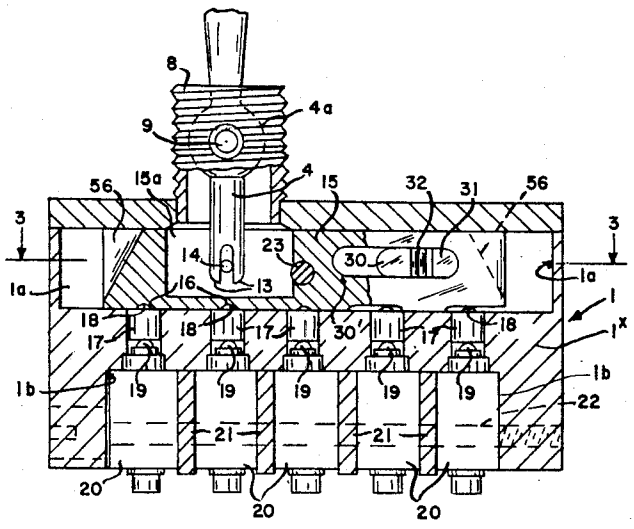


Fig-2

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SEQUENTIAL SWITCH

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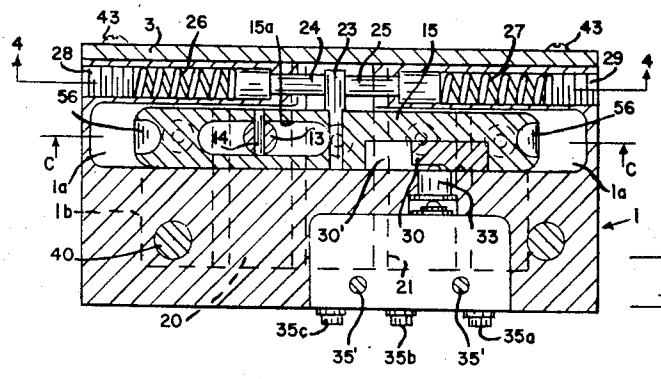


Fig-3

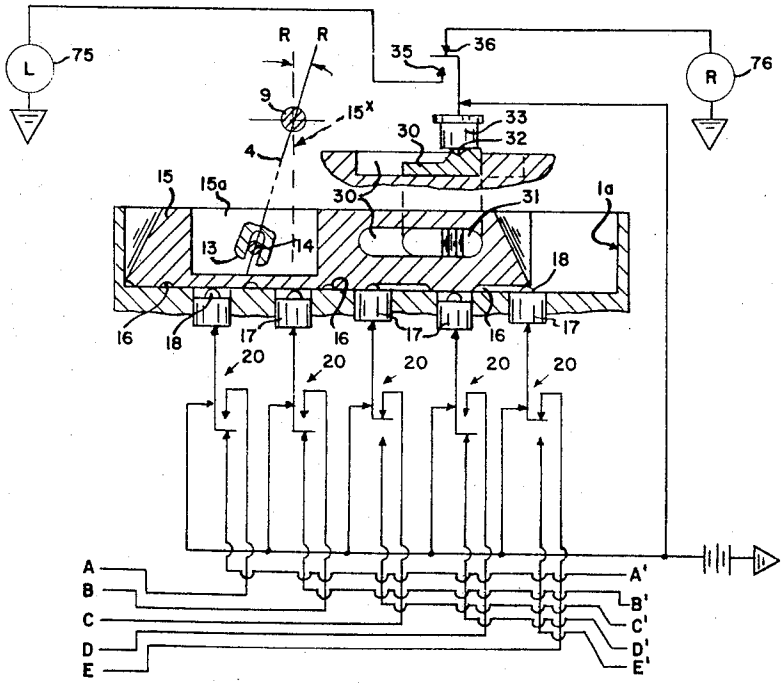


Fig-8

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SEQUENTIAL SWITCH

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4 Sheets-Sheet 3

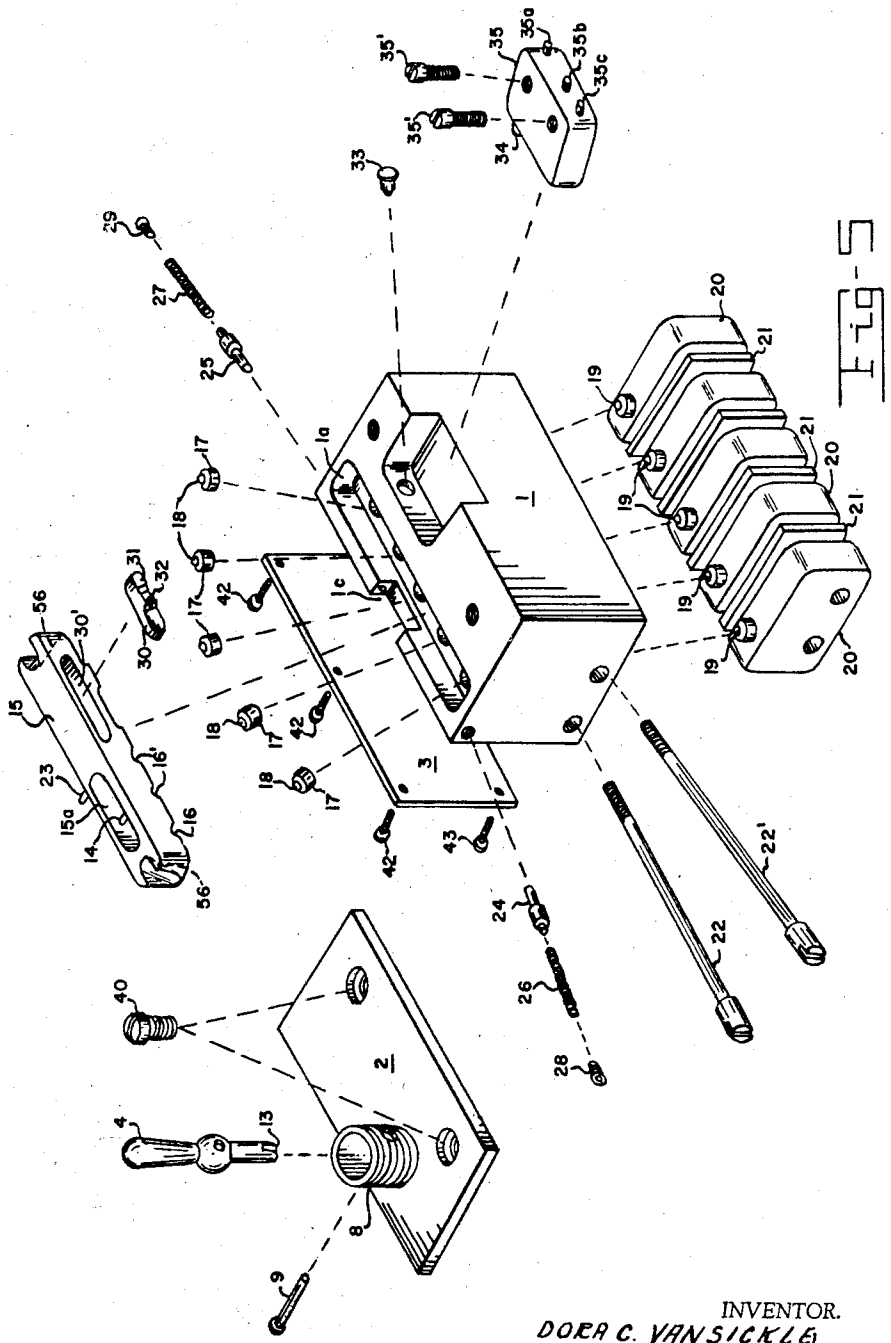


Fig. 5

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SEQUENTIAL SWITCH

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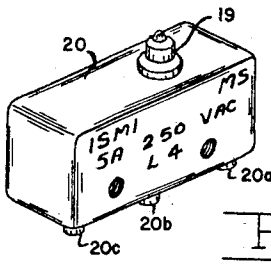


Fig-6

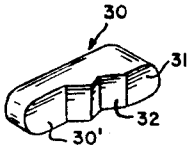


Fig-7

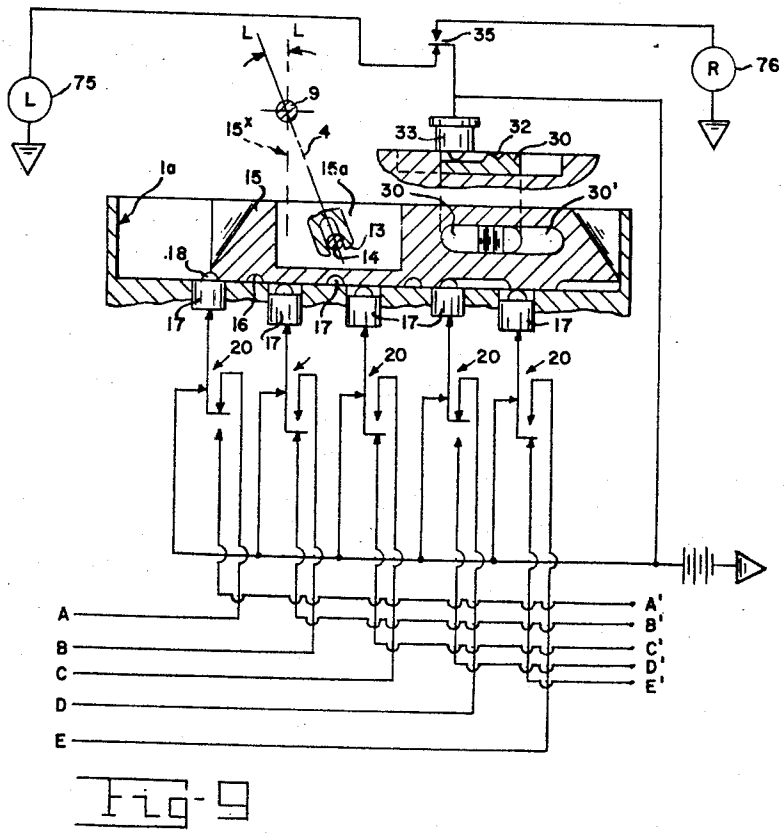


Fig-9

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United States Patent Office 2,875,287 Patented Feb. 24, 1959

2,875,287

SEQUENTIAL SWITCH

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Application June 4, 1957, Serial No. 663,562

4 Claims. (Cl. 200—5)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

This invention relates to electrical switch and signal devices, and more particularly to a sequential signal switch with the inclusion of a "memory" device therein. The problem with which this switch device is concerned is primarily in the field of guided missiles and drone aircraft wherein it is desirable to sequentially perform a plurality of illustratively three functions followed by a command function which is followed by a return of the equipment in its inactive original or initial position.

Each sequence switch device is a compact unit and is adapted to perform two separate or individual commands or functions such as up-down, left-right, rudder, flaps, wheels, brakes, arm, fire, etc.

The device is adapted to change in number and in sequence the functions it is capable of performing.

The memory device therein is capable of operating an additional function of remembering the last command given, executing that command and then initiating the return of the control device to its original position.

The switch is adapted to be actuated in four ways, namely by toggle actuation, push button, rotary actuator, slide motion, etc. However, only the toggle lever actuation is illustrated. It is also contemplated that the actuation of the switch device may be accomplished by electrical control, inclusive of remote control means.

An object of the invention is therefore the provision of a sequence switch device, preferably a microswitch device having a movable actuator with a predetermined initial intermediate position and shiftable in one direction from said intermedial position to actuate certain circuit controlling switch devices, and shiftable from the intermediate position in another direction for controlling certain other switch devices and a movable sequence determining switch means which is controlled by the actuator when it is moved from the intermediate position in either of the different directions and then returned to the intermediate position to determine the preceding direction of movement of the actuator from the intermediate or initial position.

A further object is the provision of an actuator movable longitudinally in opposite directions from an intermediate initial position having camming means thereon for actuating predetermined microswitches when the actuator is moved in one direction from the initial position and actuating predetermined different microswitches when it is moved from the initial position in the opposite direction, and additional sequence determining switch means which is operated by the actuator when it is shifted from the intermediate position to its extreme position in either direction but is not actuated by the actuaor during return movement of the actuator from its immediately preceding extreme position to its initial intermediate position and signal means controlled thereby for indicating the preceding direction of movement of

the actuator after it has returned to the initial position.

A further object is the provision of means for automatically returning the actuator to its initial position upon release after it has been shifted in either direction from its initial predetermined position.

Other objects and advantages of the invention will become apparent from the following description and accompanying drawings in which like reference characters refer to like parts in the several figures.

Drawings

Figure 1 is a top plan view of the improved sequence switch device.

Figure 2 is a longitudinal vertical sectional view taken about on the plane indicated by line 2—2 in Figure 1, certain of the parts therein being shown in elevation.

Figure 3 is a horizontal longitudinal sectional view taken about on the plane indicated by line 3—3 in Figure 2.

Figure 4 is a vertical longitudinal sectional view taken about on the plane indicated by line 4—4 in Figure 3.

Figure 5 is an exploded view of the improved switch device in perspective.

Figure 6 is a detail perspective view of one of the microswitches.

Figure 7 is a detail perspective view of the sequence switch actuator cam.

Figure 8 is a fragmentary, diagrammatic vertical sectional view illustrating the main microswitch actuator bar 15 shifted from its intermediate position to its extreme position to the left to actuate predetermined microswitches and the actuation of the sequence switch actuator to the left for closing another microswitch for closing a first actuating sequence signal circuit.

Figure 9 is a view similar to Figure 8, but showing the main microswitch actuator bar 15 shifted from its former extreme position as shown in Figure 8 through its intermediate position to its extreme position to the right to actuate the sequence signal microswitch device and the actuation thereof by the bar 15 during its movement from the intermediate position to the right. It being noted that the return of the toggle switch and main actuator 15 to its central position as indicated by the dotted central line 15X of the toggle switch does not return the sequence microswitch actuator 30 and the sequence signal microswitch 35 remains in its former position until the main actuator 15 is returned past the intermediate position.

Referring to the drawings the improved switch device comprises a supporting housing or casing 1 having a top or cover plate 2 and a side closure plate 3. The cover plate 2 carries some form of switch actuating means such as a toggle lever 4 for manual actuation of the switch device. The toggle lever or other operating means is carried by an externally threaded sleeve 8 for mounting on an instrument panel and the sleeve 8 is counter-bored on its opposite sides for flush mounting of the toggle pivot.

The togle lever 4 is pivoted on a pivot pin 9 which extends transversely through the sleeve 8 and is secured therein so that its opposite ends are flush below the bottom of the external threads.

The toggle lever 4 terminates in a downwardly forked extremity or a pair of tines 13 which are disposed at opposite sides of an actuating pin 14 fixed in a main microswitch actuator or sequential actuator bar 15 and extends across a recess 15a on the bar 15.

The lower or camming surface of the actuator bar 15 has a plurality of transverse grooves or slots 16 formed therein for selectively actuating a plurality of microswitch operating push rods 17 which are slidably disposed in cylindrical bores and extend downwardly from the elongated guide recess 1a for the actuator bar 15 into a

recess 1b in which a plurality of microswitches 20 are fixed. The push rods 17 have semispherical tips 18 which seat in the bar slots 16 between operations when the actuator bar 15 is in its mid position as shown in Figure 2. When the bar 15 is shifted longitudinally from its intermediate position in either direction to its extreme position in that direction certain of the push rods are pressed downwardly as the tips 18 of the push rods 17 ride up on camming sides of the grooves or lands 16 onto the lower flat side of the bar 15. As before mentioned the push rods 17 seat in cylindrical holes or bores extending through the partition 1X in the casing into the microswitch compartment 1b of the casing. When depressed by the camming bar 15 the push rods 17 depress spring biased triggers or plungers 19 in the tops of the microswitch devices 20. The microswitch devices 20 are separated from each other by spacers 21. The microswitches 20 are preferably of the double throw single pole type and have terminals 20a, 20b and 20c, the contact terminal 20a being the ground or common return while the contact 20b and 20c are the other double throw switch contact terminals normally established upon depression or non-depression of the push rods 17 in the usual manner.

The assembly of the microswitch 20 and spacers 21 within the recess 1b of the casing 1 is accomplished by the screws 22, the shouldered heads of the screws 22 being positioned within reamed out apertures in the left hand end of the casing 1 to engage the nearer microswitch 20 in stacking the microswitches 20 and spacers 21 snugly together. The threaded right hand ends of the screws 22 are tightened into threaded openings of the right hand end of the casing.

The top of the casing 1 is apertured to provide an elongated longitudinal guide recess 1a with sufficient clearance at the ends for predetermined longitudinal movement of the main sequence actuator bar 15 in either direction from an intermediate position, as shown in Figures 2 and 3.

The casing 1 is also apertured at 1c (Figure 4) to provide for movement of a return or centering pin 23 which projects from the side of the actuating bar 15 between a pair of spring loaded shouldered plungers 24 and 25 stressed toward each other against the pin 21 by coil springs 26 and 27 held in place in the opposing guide bores by mounting screws 28 and 29, as shown in Figures 3 and 4.

The actuating bar 15 is also apertured longitudinally on one side at 30' and a memory actuator camming bar or sequence actuator bar 30 having a low end 30', a high end 31 projecting from its side with a retainer notch or detent 32 adjacent the riser is slidably disposed in the aperture or elongated guide recess 30'. The elongated guide way or recess 30' for the sequence bar 30 is longer than the actuator bar 15 to provide a desired linear movement therefor in the bar 15, substantially equal to the distance of movement of the actuator bar from its intermediate position to its extreme limit of movement in either direction, in other words, substantially half the total distance that the actuator bar 15 is shiftable.

The head of push rod 33, as seen in Figure 3, engages for depression thereof a trigger or actuating plunger 34 of a sequence determining, preferably single pole double throw, microswitch 35 which is secured in the casing by screws 35' threaded into the casing 1. The microswitch 35 is a duplicate of the microswitches 20 and is positioned to expose its three circuit control contacts 35a, 35b, 35c similar to contacts 20a, 20b and 20c of microswitches 20, which latter contacts are exposed from the bottom of the casing.

The casing 1 and its contents or operating parts is preferably sealed to remain dust proof by suitable means (not shown) such as wax impregnated gaskets between the top of the casing 1 and its cover 2, and between the side of the casing and the closure plate 3. The cover plate 2 is secured to the casing 1 by the screws 40 while the side plate or closure 3 is secured to the casing 1 along its edges by screws 42 and 43. It should be noted that the cover 2 shown carries the toggle lever 4, however, a cover having push-in plungers may be substituted for the cover 2 with the lower ends of the plungers disposed to engage the inclined ends 56 of the main actuator bar 15 so that depression of one or the other of the plungers of this arrangement shifts the actuator bar to its limit of movement in either direction from its initial predetermined intermediate position, as shown in Figures 2 and 3, this specific form of actuating means forming no part of the invention is not shown. A rotary actuator may also be used by substituting a cover plate with a vertical actuator shaft journalled therein and extending downwardly toward the actuator bar 15 with a laterally extending forked end, this requiring a slightly modified actuator bar (not shown) with an elongated notch cut in its top surface to receive the forked extremity of the rotary actuator and an upstanding actuating pin seated in the forked extremity of the rotary actuator.

Referring to Figures 2, 3, 6 and 7 it will be observed that when the actuator bar 15 is in its intermediate position as shown in Figure 2 the sequence actuator bar or detent 30 will be either in the position shown in Figure 8 or in the position shown in Figure 9 depending upon the previous direction of actuation of the toggle lever 4 and direction of movement of the actuator bar 15. In other words it remembers the pervious microswitch sequence actuation of the actuator bar 15 after the actuator bar 15 has automatically returned to its intermediate position to provide an indication of the previous sequence actuation of the microswitch devices 20. A pair of suitable signals such as the electric lamps 75 and 76 are connected to the two terminals 35b and 35c of the sequence or memory microswitch 35 as shown in the drawings (Figures 8 and 9).

When the toggle lever 4 is shifted from the position shown in Figure 2 to the position shown in Figure 8 the sequence microswitch actuator bar or detent 30 is shifted along with it causing the detent 30 to actuate the plunger 33 and actuate the microswitch 35 closing the energizing circuit to the signal means 76 indicating that the toggle switch is moved from its intermediate position to the "right."

Upon release of the toggle lever 4 the toggle lever and the main microswitch actuator bar 15 are centralized. The sequence actuator or indicator bar or detent 30 remains in its former position and is not returned and the signal light 76 remains lighted, indicating the immediately prior direction of movement or actuation of the toggle lever 4 and the prior sequence actuation of the microswitches 20. For instance, in a guided missile in which movement of the toggle lever to the right called for, or controlled, a right rudder actuation the signal light 76 would indicate this previous actuating control or command until some other different command signal was given such as a left hand or opposite control signal.

When the toggle lever 4 is moved to the left from its central position the main sequence actuator bar 15 would be shifted to the position shown in Figure 9 carrying the sequence or memory microswitch actuator 30 along with it, extinguishing the signal 76 and illuminating the signal 75. After completion of the command circuit as controlled by the selectively actuated microswitches 20, and return of the toggle 4 lever to its mid position again the signal 75 remains energized, indicating that the last actuation of the toggle lever was to the left to close the predetermined microswitches 20 as seen, for instance, in Figure 9.

The engagement of the detent of the micro or memory switch push rod 33 with the notch 32 or the inclined abutment between the low portion 30 the high portion 31 tends to resist free movement of the sequence actua-

tor bar 30 as the main actuator bar 15 is returned until the end of the guide way 30' engages the end of the sequence bar or detent 30. Of course, when the main actuator bar 15 is shifted from its mid or initial position in the opposite direction from its former shifted position the sequence actuator bar is then shifted with it to its other position so that the desired signal lamp will be lighted to indicate the previous actuation sequence of the microswitches 20 when the toggle 4 is centralized again.

Having described my invention it is obvious that minor changes may be made therein without departing from the spirit and scope of the invention as defined by the accompanying claims.

I claim:

1. A sequence determining switch device comprising a casing, a plurality of double throw microswitch devices fixed therein, a microswitch actuator slide reciprocatably mounted in said casing, said microswitch actuator slide having an intermediate position, said microswitch slide actuator having means thereon for actuating certain of said microswitch devices upon sliding movement thereof from said intermediate position in one direction to its limit of movement position in said one direction and movable from said intermediate position in the opposite direction to its limit of movement position in said opposite direction for actuating certain other of said microswitch devices, resilient means for returning said microswitch slide actuator from either of its limits of movement positions to said intermediate position, a sequence determining double-throw microswitch fixed in said casing, a sequence determining slide actuator reciprocatably mounted on said microswitch actuator slide having means thereon for actuating said sequence determining microswitch when said microswitch actuator slide is moved to its limit of movement position in one direction and disengaging said sequency determining microswitch when moved to its limit of movement position in the opposite direction, means for restraining subsequent movement of said sequence determining slide actuator from its limit of movement position 50, said sequence slide actuator remains in its former position during return movement of said microswitch actuator slide until the latter is moved in said return movement direction past said intermediate position.

2. In a sequence switch device a casing, a plurality of microswitches fixed in said casing in side by side relation having depressible actuating plungers disposed in transverse alignment, a switch actuating camming bar slidable in said casing having a predetermined intermediate position and shiftable across said microswitches in opposite direction from said intermediate position for selecting actuating predetermined ones of said actuating plungers to selectively actuate said microswitches, resilient means between said casing and said bar for returning said bar to said intermediate position upon release after said bar has been shifted in either of said opposite directions, said bar having an elongated guide passage formed longitudinally therein, an elongated sequence actuator cam slidably disposed in said guide passage having a length equal to substantially the length of the guide passage less the distance of movement of the camming bar from its intermediate position to either of its extreme movement positions in said opposite directions, said sequence actuator bar having a microswitch actuator cam thereon movable with the sequence actuator bar, and detent means for yieldably holding the sequence actuator bar against movement with said camming bar until the end of the elongated recess impinges the adjacent end of the sequence actuator bar, and a sequence determining microswitch fixed in said casing having an actuating plunger disposed in the path of said sequence actuator cam to be actuated thereby when the sequence actuator bar is shifted by said camming bar past its

intermediate position in one of said opposite directions to its extreme position in the latter direction.

3. A sequence determining microswitch device comprising a casing having an elongated microswitch receiving recess in one side thereof, a plurality of double throat microswitches fixed in said recess in side by side relation, said microswitches having actuating plungers disposed in alignment longitudinally of said recess and depressible to change the throw of the microswitches, said casing having a longitudinally disposed elongated microswitch actuator bar receiving recess formed in the side thereof opposite from said microswitch receiving recess in a plane through all of said plungers, cylindrical guide passages concentric to the axes of said plunger extending between said actuator bar receiving recess and said microswitch receiving recess, cylindrical plungers slidably positioned in said cylindrical guide passages engaging said microswitch actuating plungers at one end, each of said plungers having a reduced other end portion extending into said actuator bar recess, a microswitch actuator bar slidably fitting said actuator bar recess, resilient centering means between said casing and said actuator bar for centering said actuator bar in said actuator bar recess in a predetermined intermediate position, camming means projecting from the surface of said actuator bar adjacent the bottom of the actuator bar recess for depressison of predetermined cylindrical plungers when said actuator bar is shifted in one direction in said actuator bar recess from said intermediate position, and depressing predetermined different cylindrical plungers when said actuator bar is shifted in the opposite direction from said intermediate position, whereby different microswitch plungers are depressed and different circuits may be closed by said microswitches, when said actuator bar is shifted from said intermediate position in either direction to its extreme position in the latter direction, said actuator bar having an elongated sequence camming bar receiving recess formed in one side thereof extending longitudinally of the actuator bar in a plane perpendicular to said cylindrical guide passages, an elongated sequence actuator bar reciprocatably mounted in said sequence camming bar receiving recess having longitudinal movement in its recess equal substantially to the distance of movement of said actuator bar from said intermediate position to its limit of movement position in either direction aforesaid, said sequence cam having a low surface at one end and a higher surface at its other end with an inclined cam surface therebetween and detent means between said higher and lower surfaces, said casing having a sequence determining microswitch receiving recess formed in one side thereof in a plane extending longitudinally through said sequence camming bar receiving recess perpendicular to said plane through said cylindrical guide passages, said casing having a cylindrical guide passage formed therein between the sequence microswitch receiving recess and said actuator bar recess in the last mentioned plane with its axis, when extended, passing through the longitudinal and transverse centers of said sequence camming bar receiving recess when said actuator bar is in its intermediate position aforesaid, a cylindrical sequence actuating plunger slidably positioned in the sequence microswitch plunger receiving recess and having a reduced end engaging said sequence camming bar, a double throw sequence determining microswitch fixed in said sequence microswitch receiving recess and having an actuating plunger facing said cylindrical sequence plunger in contact therewith for actuating said sequence microswitch to change the throw thereof when said sequence camming bar is shifted relative to said cylindrical sequence plunger, and means for shifting said microswitch actuating bar from said intermediate position to its extreme position in either direction.

4. In a sequence determining switch device, a first circuit closing switch device, a second circuit closing

switch device, an actuator for actuating said circuit closing switch devices having an intermediate position and shiftable from said intermediate position in a first direction to actuate said first circuit closing switch device and shiftable from said intermediate position in a second direction to actuate said second circuit closing switch device, a sequence determining switch device movable in a first direction to close a first signal circuit and movable in a second direction to close a second signal circuit, actuating means between said actuator and said sequence determining switch device for shifting the latter in said first direction to close said first signal circuit when said actuator is moved from said intermediate position in said first direction toward its extreme limit position in said first direction said actuator being returnable from its extreme limit position in said first direction to said intermediate position independent of movement of said sequence determining switch device to thereby indicate the previous direction of movement of said actuator after said actuator has been returned to its intermediate position,

said sequence determining switch device being movable in said second direction to close said second signal circuit by movement of said actuator from said intermediate position toward its extreme position in said second direction, said actuator being returnable from its last mentioned extreme position in said second direction to its intermediate position independently of movement of said sequence switch device to thereby maintain said second signal circuit energized to indicate the previous direction of movement of said actuator after said actuator has been returned to its intermediate position.

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