July 23, 1946. G. M. HAUSLER 2,404,633

SWITCH OPERATING MECHANISM

Filed June 22, 1944

Fig. 1.

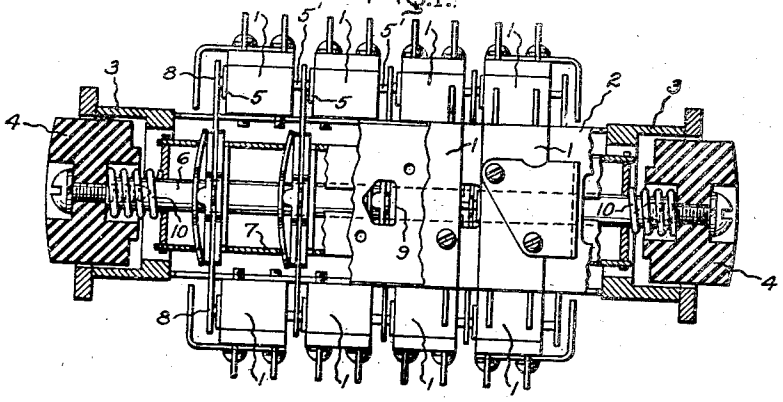


Fig. 2.

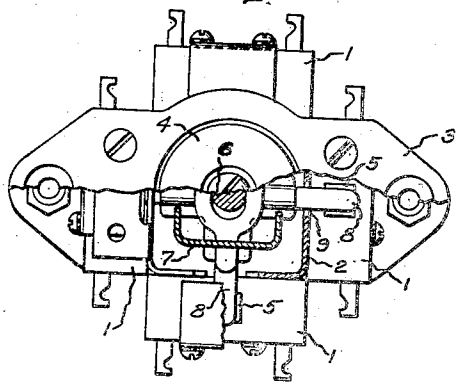


Fig. 3.

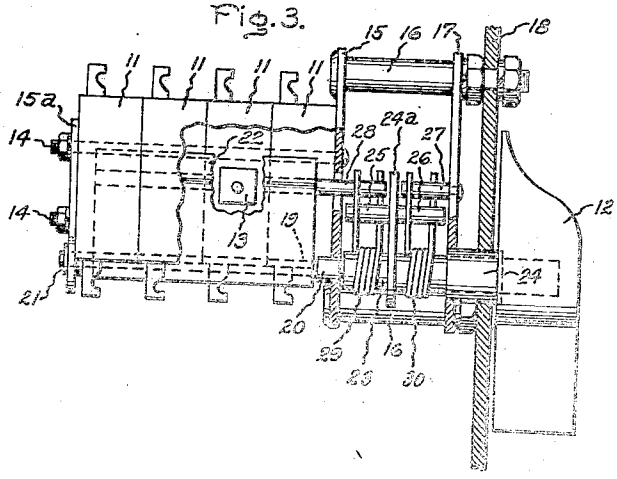
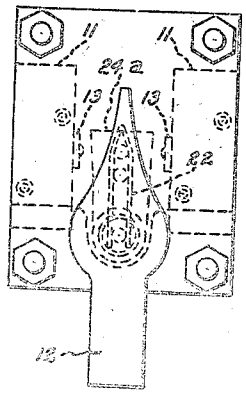


Fig. 4.



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SWITCH OPERATING MECHANISM

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3 Claims. (Cl. 200—17)

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My invention relates to switch operating mechanisms, and more particularly to operating means for a plurality of switches of the snap-acting type.

It is a general object of the invention to provide a new and improved common switch operating member for a plurality of snap-acting switches.

It is a more specific object of my invention to provide a common operating mechanism for actuating substantially simultaneously a plurality of separate switches of the snap action type, and particularly of the type described and claimed in my Patent 2,332,911, issued October 26, 1943. Switches of the type shown in the aforesaid patent are commonly mounted in gangs for multicircuit control. Where sequential actuation of such gang-mounted switches is desired, a plurality of operating cams mounted upon a single operating shaft provide a convenient actuating means.

In certain instances, however, it is desired that a plurality of gang-mounted switches of this type be substantially simultaneously actuated. The use of a common manually actuated cam or depressing bar for this purpose is not entirely satisfactory by reason of the fact that necessary manufacturing tolerances in the switches themselves result in unequal distances of travel between the normal and over-center positions of the switch actuating buttons of the various switches. Further inequalities are introduced in the mounting of the switches adjacent a cam or bar. Thus, if a plurality of switch actuating buttons are simultaneously moved by a single rigid operating member, such as a common cam or bar, it will be found that ordinarily sequential, rather than simultaneous, actuation of the individual switches is effected.

In accordance with my invention, I provide a spring actuated operating member for simultaneously actuating a plurality of snap action overcenter switches, together with manual means for loading the common spring actuated operating member. The spring load of the common operating member is opposed by the sum of the forces of the overcenter springs of the individual switches, and, also, by the automatic return springs of the individual switches, if the switches are provided with such springs. In operation, the main loading spring stores sufficient energy so that, as soon as any one of the snap-acting switches operates, the increment of spring force suddenly applied to the remaining switches is great enough to immediately move all the remaining switches overcenter. Thus, since the operation of all remaining switches is automatically effected by the spring as soon as any one switch goes overcenter, it is impossible to select any position of the manually movable member in which some switches have operated and some have failed to operate. In this manner simultaneous operation of the switches at one definite position of the handle is ensured.

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My invention will be more fully understood and its objects and advantages further appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawing in which Fig. 1 is a side view, partly in section, of a plural switch actuating mechanism embodying my invention; Fig. 2 is a front view, partly in section, of the mechanism shown at Fig. 1; and Figs. 3 and 4 are side and front elevations, respectively, of another switch actuating mechanism embodying my invention in modified form, the side elevation of Fig. 3 being shown partly in section.

Referring now to the drawing, and particularly to Figs. 1 and 2, I have shown a gang switch comprising a plurality of snap action switches 1 mounted in four aligned groups externally of a hollow tubular casing 2 of rectangular cross section. The casing 2 is provided at each end with a recessed head portion 3 arranged slidably to receive a handle member or push button 4.

Each of the snap action switches 1 is preferably of the type described and claimed in my aforesaid Patent 2,332,911, and comprises an overcenter spring (not shown) and a rectilinearly movable actuating member 5. In the form of the present invention shown at Fig. 1, the switches 1 are not provided with automatic return springs, but instead each actuating member 5 is extended entirely through the switch casing and out the opposite side, as indicated at 5'. It will, of course, be appreciated that my present invention is not limited in its scope to use in connection with overcenter snap-acting switches of the type here referred to by way of illustration, but that the invention is applicable to other types of snap action switches.

The push buttons 4 are rigidly connected together by a bolt 6 which passes through the interior of the casing 2. Within the casing 2 and slidably mounted upon the bolt 6, I provide a common movable operating member 7 having rigidly attached thereto and extending outwardly therefrom at spaced intervals a plurality of switch actuating arms 8. In the form of the invention shown where four groups of switches are

mounted around the outside of the casing 2, each actuating arm assembly comprises four actuating arms extending outwardly in quadrature relation through suitable apertures 9 in the casing 2. The arm 8 of the intermediate groups of actuating arms extends between the actuating button 5 and the extension 5' of a pair of adjacent switches, and each arm 8 of each end group of actuating arms engages the actuating members 5, 5' of the end switches of each aligned group of switches. The actuating arms are in close proximity to the switch actuating members 5, 5', so that, in effect, all the switch actuating members 5, 5' are connected together and to the common operating member 7 without any lost motion.

The switch operating assembly of Figs. 1 and 2 is completed by a pair of helical compression loading springs 10 encircling opposite ends of the through bolt 6 and interposed between the rigidly connected push buttons 4 and the relatively movable common actuating member 7.

For the purpose of explaining the effect of my new and improved switch operating mechanism upon the actuation of the snap action switches 1, let it be assumed that the switch actuating members 5, 5' move unequal distances between their normal positions of stable equilibrium on either side of their overcenter positions of unstable equilibrium. Ordinarily, this will be found to be the case, since practical manufacturing tolerances result in differences in operating travel sufficient that if the common operating member 7 is slowly moved, as by hand, it will be found that it has a plurality of definite spaced positions in which the switches 1 operate sequentially, singly, or in groups. In accordance with my invention, however, it is impossible to effect such sequential actuation of the switches 1.

In operation, when one or the other of the push buttons 4 is pressed inwardly toward the casing 2, the associated spring 10 is compressed and applies a spring loading to the common operating member 7. The force of the spring 10 is applied through the member 7 and the switch actuating arms 8 to the actuating buttons 5, 5' and is balanced by the sum of the forces of the overcenter springs in the switches 1. As the operating member 7 is moved under the influence of the spring 10, all the switch actuating members 5, 5' move in unison toward their overcenter positions of unstable equilibrium. As this movement progresses, the overcenter spring forces opposing the force of the spring 10 gradually diminish. At some predetermined point in the movement of the handle member or button 4, the force of the spring 10 is sufficiently great to move the common operating member 7 to such a position that at least one of the individual switch actuating members 5, 5' reaches its overcenter position. At this position, the longitudinal component of overcenter spring force of that switch or group of switches falls rapidly to zero, so that an increment of force from spring 10 is suddenly applied to the remaining switches of the gang. Since all these switches are themselves relatively near to their overcenter positions, the increment of spring force thus applied is sufficient to produce substantially instantaneous actuation of the remaining switches substantially simultaneously with the operation of the first switch to reach the overcenter position. It will now be understood that the loading springs 10 must be sufficiently strong so they will not collapse completely when compressed by the sum of the forces of the overcenter springs of $n-1$ snap action switches, where

n is the total number of switches engaged by the common spring pressed operating member. The springs must also be sufficiently resilient so that the expansion of the loading spring upon removal of the force of the overcenter spring of one snap action switch is great enough to move the common spring pressed actuating member from the position at which the first switch operates to that at which the last switch operates.

It is important to observe from the foregoing explanation that, when the common operating handle or button reaches that position at which the first of the gang of switches reaches its overcenter position, the operation of the remainder of the switches is effected automatically by the spring 10 and without any further movement whatever of the manual push button 4. It is thus evident that it is impossible to select any position of the push button 4 in which some of the switches 1 will have operated and other of the switches will have failed to operate.

At Figs. 3 and 4, I have shown another embodiment of my invention in which two oppositely disposed gangs of snap action switches 11 are alternatively actuated by a rotatable operating handle 12. Each of the switches 11 of Figs. 3 and 4 is provided with an individual automatic return spring, and the switches are mounted in two oppositely disposed aligned groups arranged so that the actuating buttons 13 of each group of switches face each other. The groups of snap action switches 11 are clamped between a base plate 15 and an end plate 15a by bolts 14. The base plate 15 is connected by studs 16 to a spaced parallel base plate 17 and the studs 16 extend beyond the plate 17 to connect the entire switch assembly to a suitable panel 18.

A shaft 19 is rotatably mounted in bearings 20 and 21 carried by the base plate 15 and the end plate 15a, respectively. The rod 19 is positioned centrally between the aligned groups of switches 11 and in parallel spaced relation to the bolts 14. One end of the shaft 19 extends through the base plate 15 into the space between the plates 15 and 17. Fixedly attached to the rod 19, I provide a common switch operating arm or member in the form of a flat vane 22 arranged to engage one or the other of the oppositely disposed groups of switch actuating buttons 13. A rotatable operating shaft 23 is fixedly connected at one end to the operating handle 12 and rotatably mounted within a journal 24 in the end plate 17. The other end of the operating shaft 23 is hollow and is journaled upon the extending end of the shaft 19. The operating shaft 23 carries a radial arm 24a having a pair of pins 25 and 26 extending axially in opposite directions therefrom. A pin 27 is mounted in the end plate 17 for cooperation with the movable pin 26, and a pin 28 carried by the common switch operating arm 22 extends into operative relation with the movable pin 25. At opposite sides of the radial arm 24a, the operating shaft 23 is provided with a pair of helical torsion springs 29 and 30 having upwardly extending ends. The spring 30 is positioned so that its ends lie upon opposite sides of the pins 26 and 27. The spring 29 is positioned so that its ends lie upon opposite sides of the pins 25 and 28.

It will now be observed that the torsion spring 30 normally maintains the pins 26 and 27 in alignment thereby to center the operating shaft 23 and the handle 12. In this normal centered position, the spring 29 also maintains the pins 25 and 28 in alignment and, since the pin 25 is in a central position, the pin 28 and the operating

arm 22 are normally maintained in a central position. In operation, if the handle 12 is turned to either one side or the other against the force of the spring 30, the pin 25 on the operating arm 24a carries with it the pin 28 and the operating arm 22 until the operating arm 22 engages one of the aligned groups of switch actuating buttons 13. The operating arm 22 is temporarily stopped by the opposing spring forces exerted upon the actuating buttons 13 by the individual over-center springs of the switches. Continued movement of the switch handle 12, however, stresses the spring 29 thereby to apply a spring load to the common operating arm 22 until sufficient pressure is built up to overcome the sum of the forces of the overcenter springs and return springs in the switches 11. It will be observed that, in this operation, as in the operation of the device of Figs. 1 and 2, the operating handle 12 must be moved sufficiently to build up enough force in the spring 29 so that the common operating member 22 is moved to the point where at least one of the group of overcenter switches reaches its position of unstable equilibrium. At this point a portion of the load of the spring 29 is suddenly transferred to the remaining snap action switches thereby substantially instantaneously to actuate the entire group of switches without any further movement of the operating handle 12.

While I have shown and described only certain preferred embodiments of my invention by way of illustration, many modifications will occur to those skilled in the art, and I therefore wish to have it understood that I intend in the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a plurality of snap-acting switches each including a movable actuating member and a snap action spring, means securing said switches to a common support, a common operating member movable in one direction to engage all said actuating members and move said actuating members in unison, said switches being so mounted upon said common support that said actuating members effect actuation of said switches at irregularly spaced positions along the path of travel of said common operating member, and spring means for moving said operating member in said one direction against the sum of the forces of said snap-acting springs thereby substantially simultaneously to actuate all said switches.

2. In combination, a plurality of snap action switches each including an overcenter spring and a movable actuating member, means mounting said switches on a common support, a common operating member arranged to move said actuating members in unison in said one direction thereby simultaneously to stress said overcenter springs, said switches being so mounted on said common support that said actuating members effect operation of said switches at irregularly spaced positions along the path of travel of said common operating member, and means including a resilient member for moving said common operating member whereby operation of any one of said switches so reapportions the load upon said resilient member that said operating member is moved substantially instantaneously to actuate all said switches without further stressing said resilient member.

3. In combination, a plurality of snap action switches each including an overcenter spring and a movable actuating member, means mounting said switches upon a common support, a common operating member arranged to move said actuating members in unison in said one direction against the sum of the forces of said overcenter springs, said switches being so mounted upon said common support that said actuating members effect operation of said switches at irregularly spaced positions along the path of travel of said common operating member, a movable operating handle, and an operating spring connected between said handle and said common operating member, said handle applying a spring loading to said operating member so that upon overcenter operation of any one of said switches said operating spring automatically effects substantially simultaneous and instantaneous operation of the remainder of said switches without further movement of said handle.

GEORGE M. HAUSLER.