June 13, 1950 O. H. KAMINKY ET AL 2,511,271

ELECTRIC SWITCH ACTUATOR

Filed March 15, 1946 3 Sheets-Sheet 1

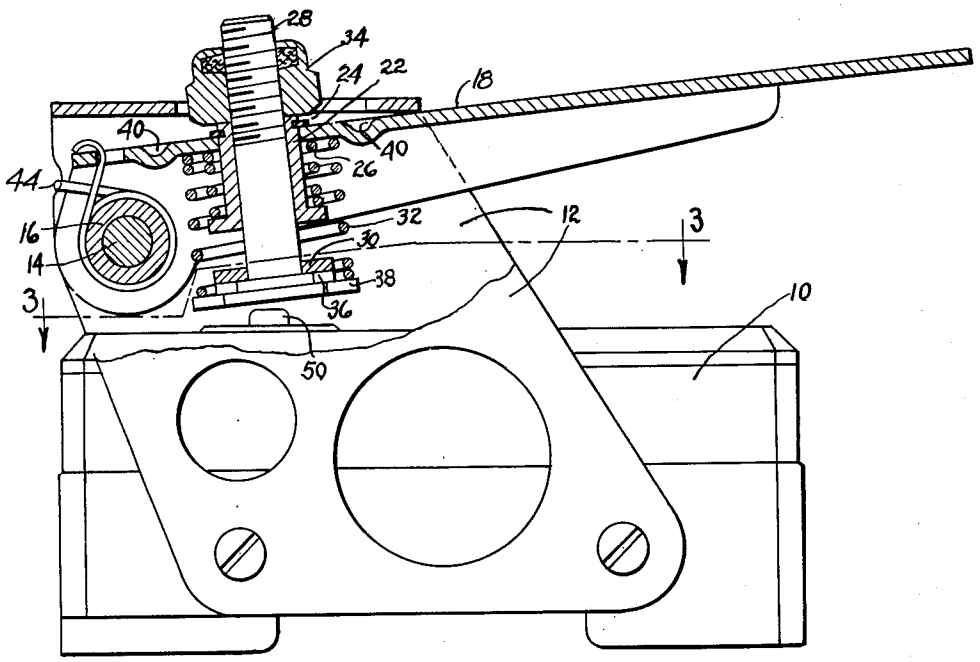

Fig. 1

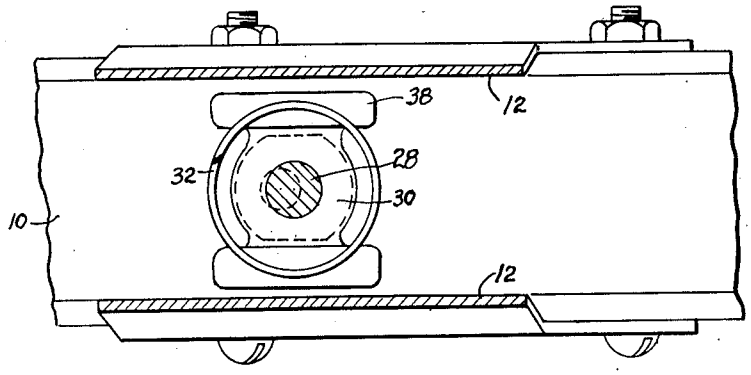

Fig. 3

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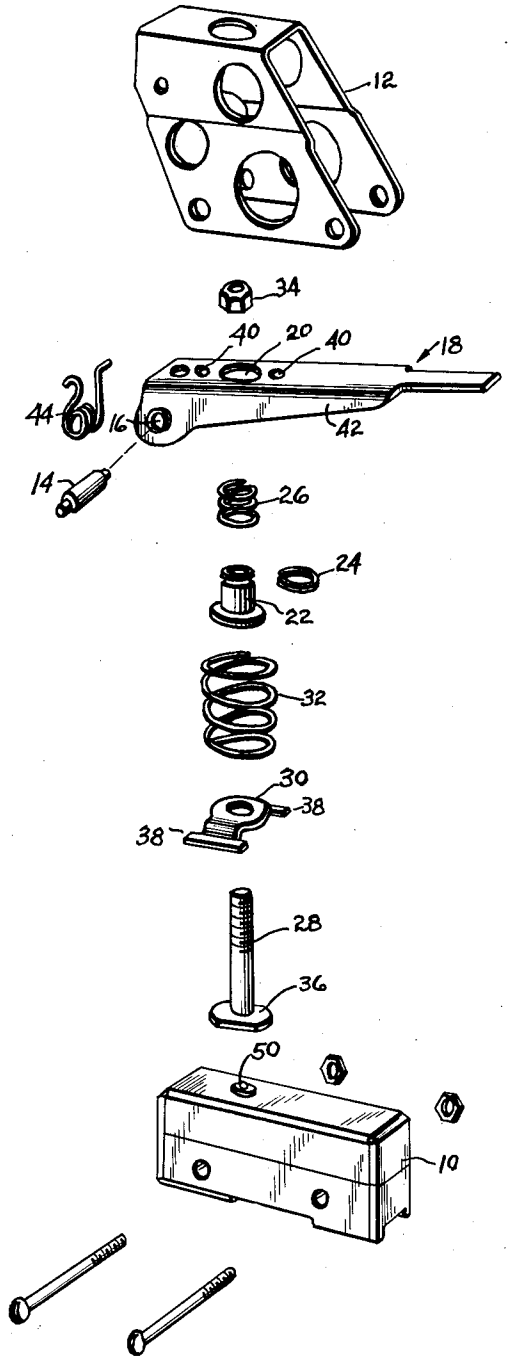

Fig. 2

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Fig. 4

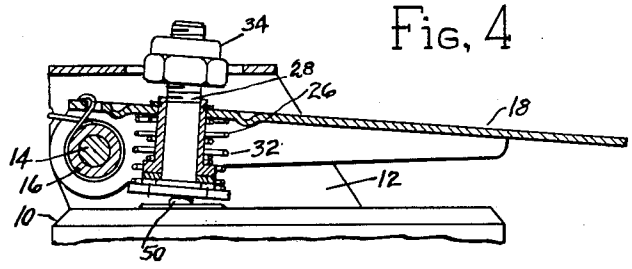


Fig. 5

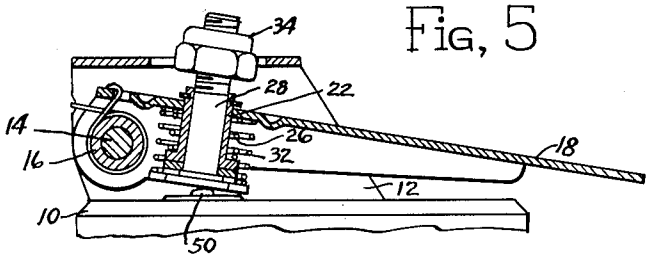
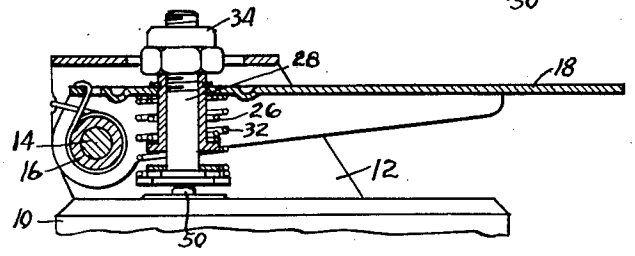
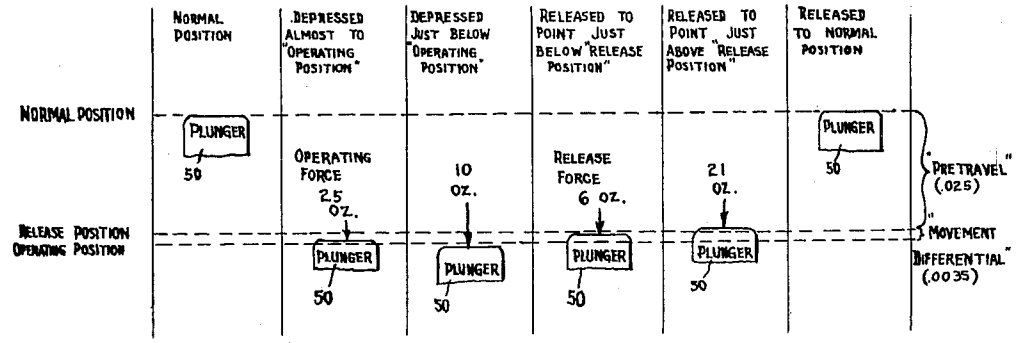


Fig. 6





FORCES REQUIRED TO MAINTAIN PLUNGER DEPRESSED IN VARIOUS OPERATIVE POSITIONS

Fig. 7

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2,511,271

ELECTRIC SWITCH ACTUATOR

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15 Claims. (Cl. 200—153)

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The present invention relates to actuators for electric switches.

The electric snap action switch of the type shown in McGall Patent 1,960,020 has been widely adopted by manufacturers for use in products ranging from vending machines to machine tools and aircraft where it is valued for its small size and high load-handling capacity, for its extreme ruggedness and the small operating effort it requires, and for its dependable and precise performance. However, the operating characteristics of each switch, that is the force and motion required for actuating it, are adjusted or otherwise fixed when the switch is manufactured and generally cannot be changed without impairing the precision or life of the switch. And yet it is highly desirable for certain purposes that some adjustments of these characteristics be permitted after the switch is installed. For example, in certain controls, the distance between the turn-on and turn-off points (called movement differential) must be made just large enough to prevent hunting. In other uses, the turn-on and turn-off points must be separately chosen and even varied from time to time. It is not economically feasible to make either the switch or the equipment in which it is to be installed, to close enough tolerances to meet these performance requirements.

One object of the present invention is the provision of an improved switch actuating mechanism that is adjustable for varying the movement required of the actuator between the turn-on and turn-off actions of the switch.

Another object is the provision of such an actuator that attaches directly to a switch of the McGall type so as to facilitate its installation.

Another object is the provision of an actuator that is adjustable for enlarging the movement differential but which need not add to the required actuating force or otherwise diminish the inherent precision and high sensitivity of the switch itself.

Still another object is the provision of an improved switch actuator.

In the drawings:

Figure 1 is an elevation, partly in section, of a switch and an actuator embodying the invention;

Fig. 2 is an exploded view of the assembly of Figure 1;

Fig. 3 is a partial section taken along the line 3—3 in Figure 1;

Figs. 4, 5 and 6 are views similar to Figure 1 showing the mechanism in different stages of its operation, and

Fig. 7 is a diagram showing the forces required to maintain the plunger of the switch illustrated in various operative positions.

In Figure 1, a unitary, electric, snap switch 10 is straddled by a U-shaped bracket 12 having a

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pin 14 on which is fitted a bearing 16 carrying an actuating arm or lever 18. A hole 20 in this lever (see Fig. 2) guides a sleeve 22 which is retained by a stop-ring or C-washer 24 and held normally depressed by an overtravel spring 26. A bolt or plunger 28 slides within the sleeve 22, and carries a spring holder 30 which supports a spring 32 that bears directly against the arm 18 to urge the plunger 28 downward so that its adjusting nut 34 stops against the upper end of sleeve 22. As is shown in Figs. 2 and 3, the spring support 30 fits down over the sides of the bolt head 36 and has a pair of straight-sided ears 38 that lie against the sides of the bracket 12 to prevent spring support 30 and the bolt 28 from turning when the nut 34 is being adjusted. The upper end of spring 32 is prevented from slipping lengthwise of the arm 18 by a pair of dimples 40. A spring 44 holds the arm 18 raised so that it normally occupies the position shown in Fig. 1. The bolt head 36 lies just above the actuating pin 50 of the switch 10 for driving against it when arm 18 is depressed.

The switch 10 is of the type shown and described in the McGall Patent 1,960,020, already referred to. Its internal mechanism snaps a movable electric contact back and forth between two stationary contacts in response to very small down and up motions of its plunger 50.

To have a proper understanding of our invention it is necessary first to understand the operating characteristics of the plunger in the above-mentioned McGall type of switch, with which our invention is illustrated. That is, it is desirable to have an understanding of the forces required to maintain the switch plunger or operator 50 depressed in various operative positions. Fig. 7 indicates the depressive forces necessary to maintain the plunger just above and just below the "operating position" and just above and just below the "release position," these terms being defined in the next paragraph. These values, it will be understood, are subject to almost infinite variations in different switches of this type.

As shown in Fig. 7, the actuating pin or plunger 50 may be moved down from the "normal position" an initial distance of perhaps .025 inch (called "pretravel") before actuating the switch contact; and the force needed for depressing the plunger will increase to about 25 ounces. The position of the downwardly moving plunger 50, just when the switch 10 snaps, is the first actuating position or so-called "operating position" of plunger 50, and the force required to bring the plunger to this position (assumed above to be 25 ounces, for purposes of illustration) is called the "operating force." Accompanying this snap action is an abrupt reduction in the force required to maintain the plunger depressed, this required force dropping to perhaps 10 ounces. Then, if

plunger 50 is permitted to rise, the switch will snap again. This second snap occurs at a second actuating position, or so-called "release position" of plunger 50. This "release position" is slightly above the "operating position," perhaps .0035 inch; this distance is known as the "movement differential." The upward movement of the plunger as it approaches this "release position" is accompanied by a reduction of the force required to maintain the plunger depressed, this force decreasing to perhaps 6 ounces just before the second snap action and being called the "release force." The second snap action causes this force to increase abruptly to a value slightly less than the "operating force" which we have already assumed to be 25 ounces; for purposes of illustration this slightly reduced force is indicated in Fig. 7 as 21 ounces. Downward motion of the plunger repeats the action above described.

A similar action with proportionally smaller values for the forces and proportionally greater values for the distances can be observed at the end of the arm 18. However, the "release position" of the arm 18 may be varied by adjusting the nut 34 so as to vary the movement differential, as will be explained presently.

Spring 32 has a free length sufficiently great that it is preloaded to perhaps 15 ounces in the assembly, a value that lies between the two actuating forces (25 ounce operate, 6 ounce release) of the switch 10. Spring 26 is also preloaded and its force is sufficient that when spring 32 is compressed enough to make the lower end of sleeve 22 butt against the top of the spring holder 30 as seen in Fig. 4, the combined force exerted by the two springs 26 and 32 exceeds the "operating force" (in this case 25 ounces) of the switch 10.

Accordingly, as lever 18 is moved down for actuating the switch, no operation of the contacts of switch 10 occurs until the lever 18 reaches the position of Fig. 4 because only then does spring 26 come into action to exert a sufficient force to produce the first or operating actuation of switch 10. Further downward motion of arm 18 simply compresses the two springs 26 and 32, allowing the sleeve 22 to slide in its mounting hole 20 in lever 18 as shown in Fig. 5. This excess motion is called "overtravel," and this overtravel action is provided especially to prevent the application of excessive forces to the plunger 50. Then when the lever 18 is permitted to rise sufficiently to lift sleeve 22 off the top of the spring holder 30, the force of 15 ounces exerted on pin 50 by spring 32 still exceeds the "release force" (in this case 6 ounces) of switch 10 to prevent it from snapping. Only when the arm 18 rises enough to bring the top of sleeve 22 up against the nut 34 as shown in Fig. 6 for lifting the bolt 28, is the force on plunger 50 reduced to a value below the 6 ounce "release force" for making switch 10 snap. Obviously the position to which arm 18 must rise to effect this operation is determined by the position of nut 34 on the bolt 28.

It is thus seen that spring 32 exerts a force of such value that, acting alone, it can never actuate snap switch 10; that additional upward and downward forces are applied to bolt 28 by sleeve 22 which butts alternately against the spring holder 30 and nut 34; and that the nut 34, by adjusting the amount of lost motion through which sleeve 22 travels between these two abutments, regulates the movement differential observed at the arm 18.

Although here illustrated by a specific embodiment, the invention should be limited only as required by the claims.

We claim:

1. The combination, with an electric switch having an operator adapted to be moved in one direction by the application of a preselected operating force and in the opposite direction by a reduction of said force to a predetermined release force of an actuating member, a yielding abutment member movable by said actuating member for applying force to said switch operator, said yielding abutment member being so constructed that the value of the force it applies is between the operating and release forces at which said switch is actuated, and another yielding abutment member movable by said actuating member for applying an additional force to said switch operator supplementing the force applied by said first yielding abutment member for actuating said switch.

2. In combination in an actuator for an electric snap switch having a plunger or the like, an actuating member movable between preselected positions, an abutment member shaped to engage said plunger on the switch when the actuating member moves between its preselected positions, a yieldable connector coupling said actuating member to said abutment member for applying a driving force thereto greater than the release force and less than the operating force of the switch, and a yieldable lost motion connector also coupling said actuating member to said abutment member for applying additional driving force thereto, said additional driving force together with the driving force of the first connector being at least equal to the operating force of the switch.

3. The combination of the preceding claim wherein there is included means for adjusting the amount of lost motion in said lost motion connection.

4. In combination in an actuator of the class described, a member movable between preselected positions, an abutment member movable between opposed positions, an over-travel actuator moved by said movable member for applying a preselected driving force to said abutment member at one preselected position of said movable member to effect initial movement of the abutment member from one of said opposed positions to a position intermediate said opposed positions, a second over-travel actuator mounted on and moved by said movable member and arranged to apply a supplementary driving force to said abutment member at another predetermined position of the movable member, said force together with the first driving force moving said abutment member from said intermediate position to said other opposed position, and means providing an adjustable lost motion, driving connection between said second over-travel actuator and said abutment member.

5. The combination with an electric switch of the class described, of an actuating member movable between preselected positions, an abutment member mounted on said actuating member for relative movement and adapted to be moved against the switch for operating it, a first preloaded spring acting between said abutment member and the actuating member for providing a yielding, driving connection between said actuating member and said abutment member, and a second preloaded spring and lost motion means mounted on said actuating member between said actuating member and said abutment member to apply a driving force thereto upon a preselected yielding of the first spring, said first spring ex-

erting a force intermediate the values of force required to operate the switch and to effect release of it, and said first and second springs exerting a force at least as great as that required to operate the switch.

6. The combination of claim 5 with retracting means acting between said switch and said actuating member exerting a force in a direction opposed to that required for urging said abutment member against the switch.

7. In combination in a device of the class described, an actuating arm, a sleeve reciprocable in said arm, a plunger having limited reciprocation in said sleeve, a spring urging said sleeve to one extreme of its travel in said arm, and another spring urging said plunger in the same direction, said springs arranged to supplement each other in resisting movement of the plunger beyond its limit of travel in one direction.

8. The combination of the preceding claim wherein there is included, means for adjusting the distance that said plunger is free to reciprocate in said sleeve.

9. As an article of manufacture, a frame adapted to be attached to an electric switch, an actuating arm hinged to said frame to swing toward and away from the switch, a sleeve reciprocable in said arm in approximately the direction of motion of said arm, a plunger reciprocable in said sleeve, a nut, said plunger having a head at the end toward the switch and being threaded to receive said nut at the other end for limiting the reciprocable movement of said plunger in said sleeve, a spring exerting a light force for urging said plunger toward the switch, and a second spring exerting a force for urging said sleeve toward said switch.

10. In combination in a device of the class described, a driving member arranged for bodily movement between preselected positions, yieldable means for applying a driving force thereto at one of said preselected positions to effect initial movement of the driving member, the value of said force lying within a predetermined range for moving said driving member from one of said preselected positions to a position intermediate said preselected positions, and yieldable separate means for applying an additional supplemental force to said driving member only when said member is in said intermediate position, said force being of such value that the resultant of said two forces lies outside said range and moves said driving member from said intermediate position to the other preselected position.

11. In a mechanism for actuating a switch operated by a movable element, the combination of an actuator movable between opposed positions, a first yieldable abutment means mounted on said actuator to be engageable with said movable element, a first force applying means acting between the actuator and the first abutment for applying a force to said movable element insufficient to operate the switch but sufficient to hold the switch in an operated position, and second overtravel means mounted on said actuator for engaging the first abutment means at the operating position of the switch to supplement the force of the first force applying means to thereby apply a force for operating said switch.

12. In a detachable mechanism for actuating a switch operated by a movable element, the combination of a pivotally mounted lever movable between preselected positions, a first yieldable abutment mounted on said lever to be engageable with said movable element, a first force applying means acting between the actuator and the first abutment for applying a force to said movable element insufficient to operate the switch but sufficient to hold the switch in an operated position and second overtravel means mounted on said lever and positioned to engage the first abutment means at an intermediate position of the lever to supplement the force of the first force applying means to thereby apply a force sufficient to actuate said switch.

13. The combination recited in claim 12 wherein means is provided whereby the forces of the respective force applying means may be adjusted.

14. The combination with an electric switch and a movable element for the switch of, an actuator adjacent said movable element and movable in one direction from a normal to an operating position of the switch and in the opposite direction movable from the operating position through a release position to the normal position, a first yieldable abutment means mounted on said actuator to engage said movable element, a first means acting between the actuator and the first abutment means for applying a force to said movable element having a value less than the operating force of the switch upon movement of the actuator toward the operating position and to apply a force to said movable element having a value greater than the release force of the switch when the actuator moves away from the operating position to the release position, a second yieldable abutment means mounted on said actuator to engage the first abutment means at the operating position of the actuator when the actuator moves to the operating position and to move out of engagement with said first abutment means when the actuator moves away from the operating position toward the release position, and a second means acting between the actuator and the second abutment means operable to supplement the force of the first force applying means when the actuator is at the operating position to thereby apply a force to the movable element sufficient to operate the switch.

15. The combination recited in claim 14 with means for adjusting the operating position and release position of the actuator independently of the switch.

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