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R. W. PASHBY

2,490,320

METHOD FOR ADJUSTING SPRING MECHANISMS

Filed Sept. 25, 1946

3 Sheets-Sheet 1

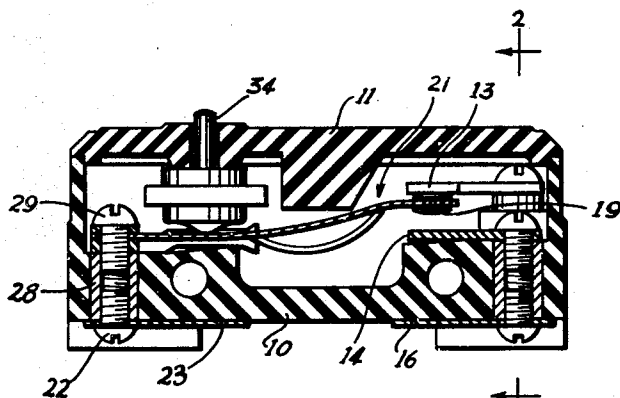


Fig. 1

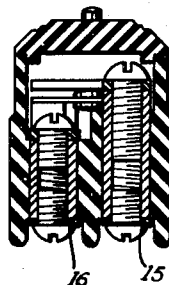


Fig. 2

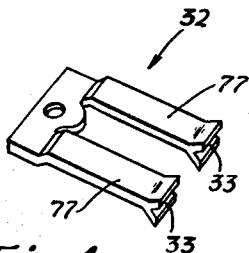


Fig. 4

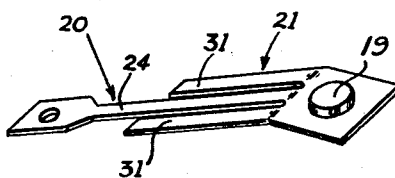


Fig. 3

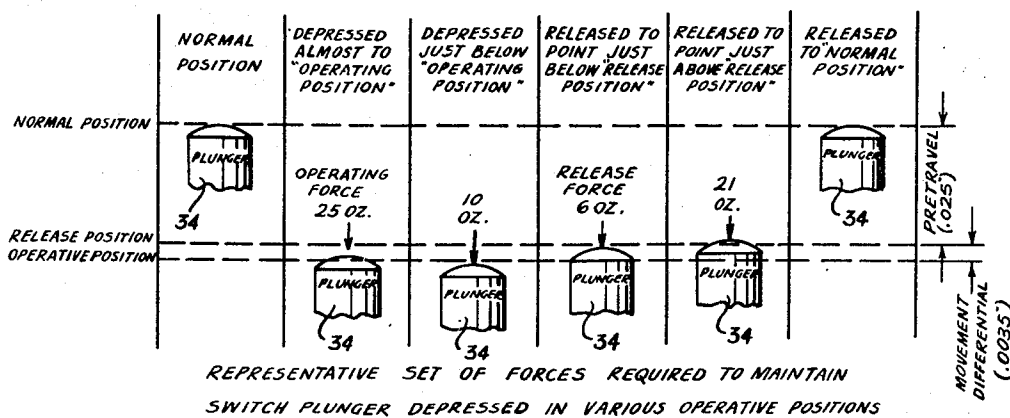


Fig. 5

Inventor
Robert W. Pashby
By
McCanna and Morsbach
Attys.

Dec. 6, 1949

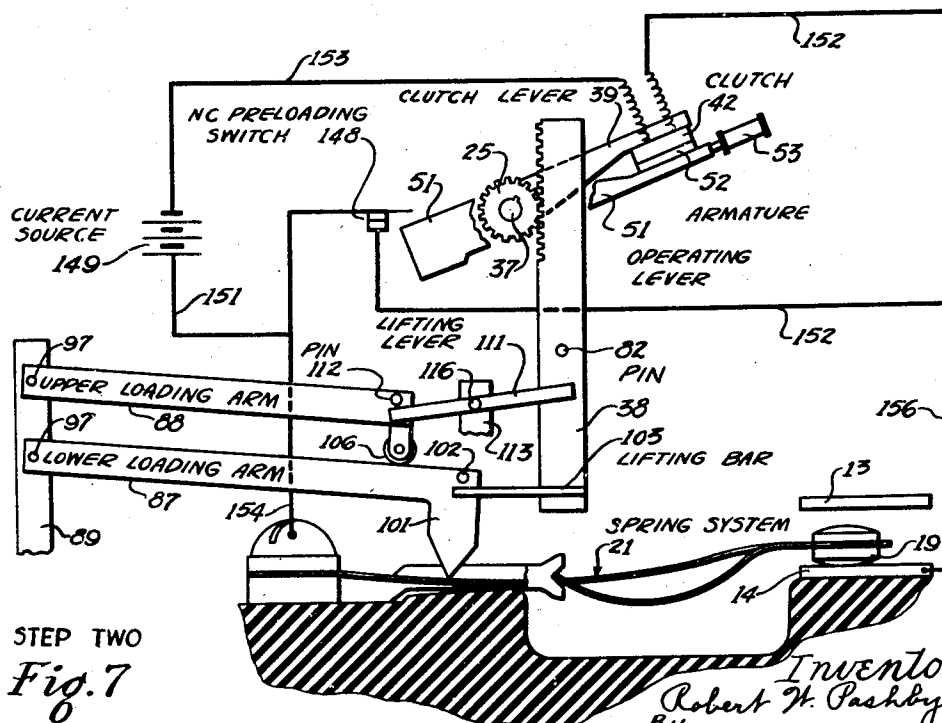
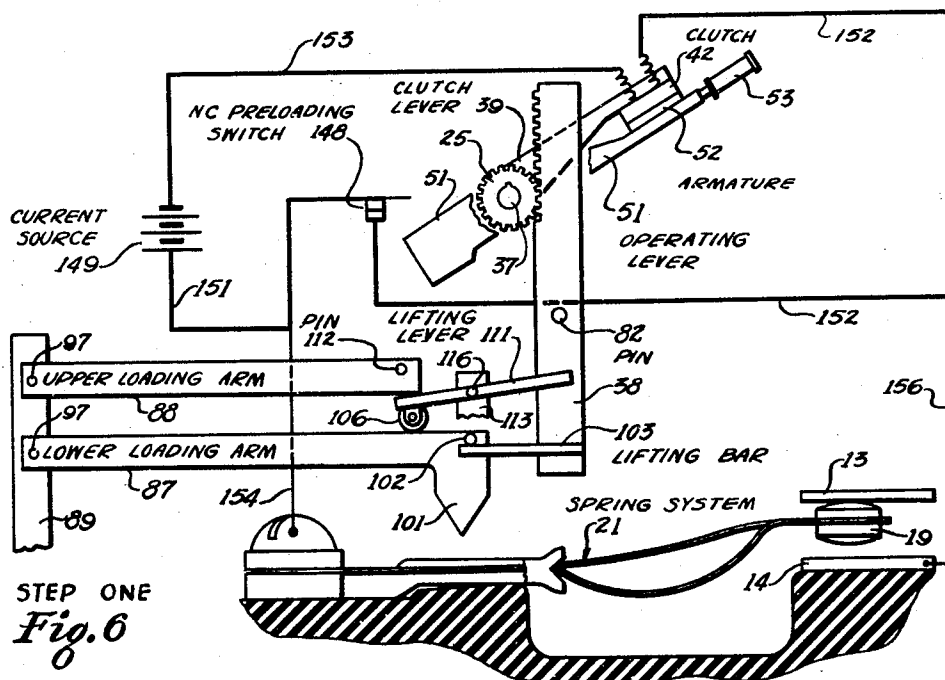
R. W. PASHBY

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3 Sheets-Sheet 2



Inventor
Robert H. Pashby
By
McCanna and Morsbach
Atty's.

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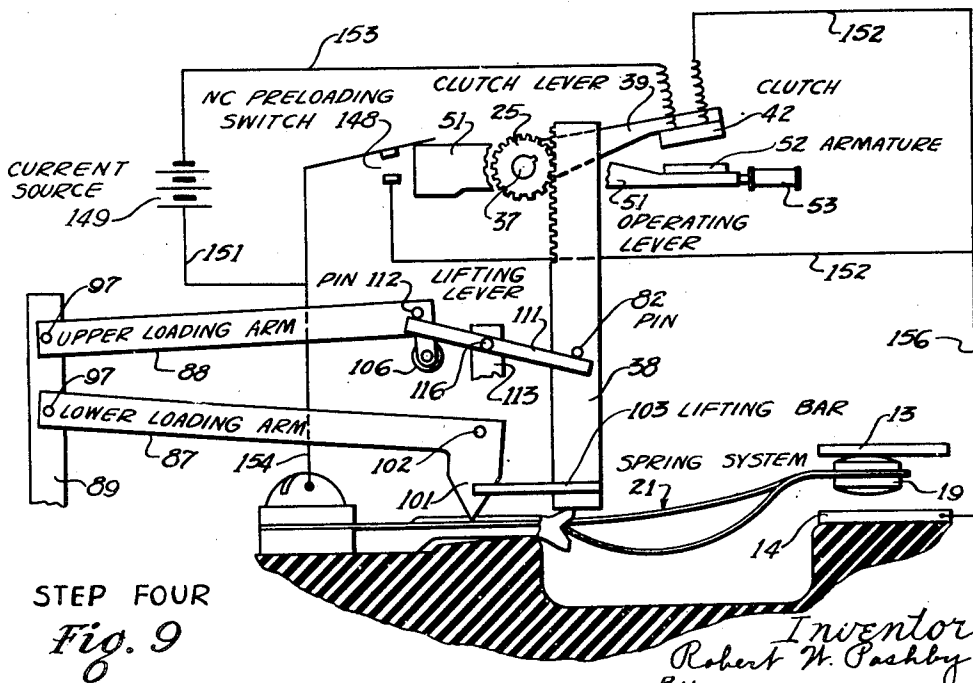
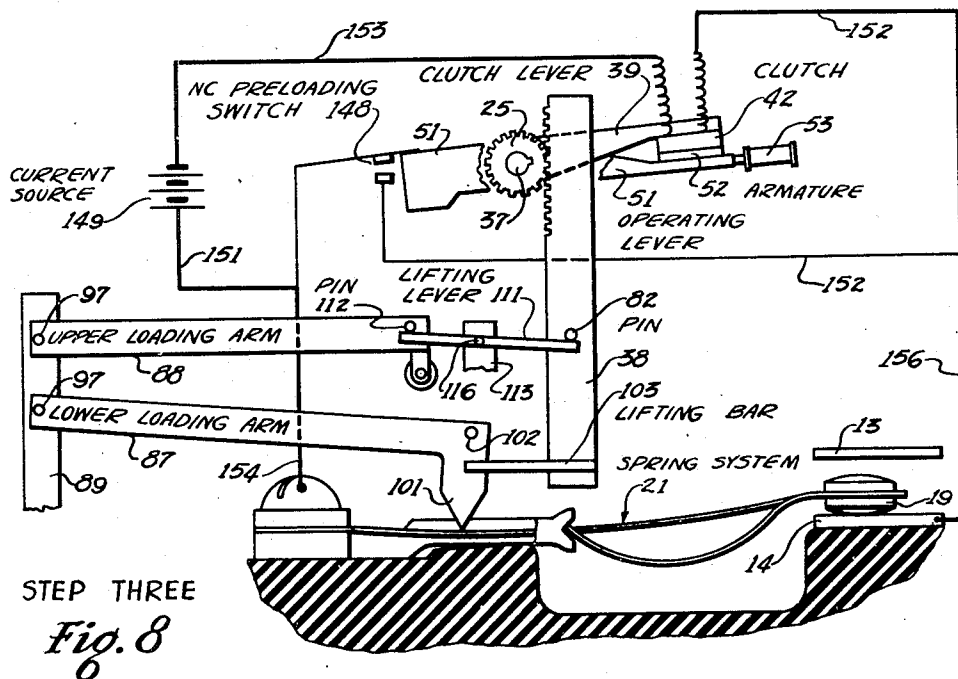
R. W. PASHBY

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METHOD FOR ADJUSTING SPRING MECHANISMS

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3 Sheets-Sheet 3



Inventor
Robert W. Pashby
By
McLanna and Morsbach
Atty.

UNITED STATES PATENT OFFICE

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METHOD FOR ADJUSTING SPRING MECHANISMS

Robert W. Pashby, Park Ridge, Ill., assignor to
First Industrial Corporation, Wilmington, Del.,
a corporation of Delaware

Application September 25, 1946, Serial No. 699,315

10 Claims. (Cl. 153-10)

1

The present invention relates to a method for the adjustment of spring mechanisms, particularly to those types of snap acting spring mechanisms employed in certain electric switches. It is especially adapted to the adjustment of overcenter snap acting spring mechanism such as employed in compact precision type electric switches illustrated by the McGall Patent 1,960,020. Apparatus for effecting adjustment in accordance with this method is disclosed and claimed in copending application, Serial No. 699,314, filed September 25, 1946.

Hand adjustment of small compact snap acting switches has long been a bottleneck in their manufacture. The production of individual parts of the switches as well as their assembly has long been completely mechanized so that one worker could produce thousands of individual parts or assemble thousands of switches per day; but adjustment for the desired operating and release forces have been carried out only by painstakingly slow hand methods requiring a high degree of skill and entailing much trial and error.

The object of the present invention lies in the provision of a method which eliminates this long existing production bottleneck by enabling the switch adjusting operation to be made completely automatic so that all the operator has to do is feed in the switches to be adjusted. For example, in the case of one specific type of switch that the present method has been applied to, one workman can adjust approximately 3200 switches in a day as contrasted with approximately 400 by the old hand method. Furthermore, the adjustment made by the present method is far more competent and accurate than present with the hand method.

A primary object of the present invention is to provide a method of adjusting a self-returning spring mechanism by initially positioning the spring support to one side of a preferred position and deforming or moving the spring support toward its preferred position while at the same time applying a predetermined release load to the spring system and terminating the deformation or movement of the support when the spring system snaps to released position.

Another object of the present invention lies in the provision of a method of adjusting a compact precision type switch having a casing with an overcenter snap spring system mounted on a support and carrying a movable contact between normal and abnormal positions, one modification of the method comprising the steps as follows: initially assembling the spring system and sup-

2

port within the casing in such a manner that the support is positioned to one side of the position it must assume for proper operation of the switch, and with the spring system in normal position; moving the spring system to abnormal position by a load exceeding a predetermined maximum operating force for the switch, this load being applied to the spring system at the point normally engaged by the operating plunger in the assembled switch; changing the loading on the spring system operating point to a value determined by the desired release force for the switch and applying a force to the support to deform or move it toward a position to cause the spring system to snap from abnormal to normal position; and terminating the movement or deformation of the support at the time the spring system moves to normal position.

Other objects and advantages will become apparent from the following description in connection with the drawings in which—

Figure 1 is a longitudinal sectional view of one form of compact precision type snap acting switch which is presented to illustrate how the method of the present invention may be applied to the adjustment of an overcenter spring system;

Fig. 2 is a sectional view of Figure 1 on the line 2-2;

Fig. 3 is a perspective view of the spring system shown in Figure 1;

Fig. 4 is a perspective view of the spring supporting member shown in Figure 1;

Fig. 5 is a diagram showing a representative set of forces required to maintain the plunger of the Figure 1 switch in various operative positions;

Fig. 6 is a diagrammatic view of one form of apparatus illustrating the first step in adjusting an electric switch by the method of the present invention;

Figs. 7, 8 and 9 are diagrammatic views similar to Fig. 6 illustrating second, third and fourth steps involved in the method of the present invention.

As will be seen, the method of the present invention is applicable to the adjustment particularly during manufacture of self-returning snap acting mechanisms generally, as well as specifically to the adjustment of electric switches employing snap acting mechanisms.

Referring first to Figures 1-5, inclusive, for a preliminary description of the construction and operation of the switch shown, it includes an insulating case having a base 10 and a cover 11; upper and lower stationary contacts 13 and 14,

3

respectively, having terminal tabs 15 and 16; and a movable double faced contact 19 carried by an overcenter snap spring member 21 which is connected at the opposite end to the terminal tab 23.

The snap spring system 21 comprises a thin leaf tension element 24 which is connected in cantilever fashion to terminal tab 23 by means of screws 22 and 29, and bushing 28. A pair of thin leaf compression elements 31 are joined to the tension element 24 at the movable contact 19 and pivotally supported intermediate the ends of the tension element 24 where they bear against an anchor or support member 32 (see Fig. 4). This support member 32 is cut out in the center so as to clear the tension member 24 and has a pair of notches 33 for receiving and pivotally supporting the compression elements 31. The spring is such that when the plunger 34 is depressed with a force slightly in excess of 25 ounces, in the case of the particular switch illustrated, as shown in Fig. 5, it will move the tension element 24 downward through a position of maximum stress in line with the pivot grooves 33. This will cause the spring system 21 to move downwardly to its abnormal position where the movable contact 19 is maintained in engagement with the lower stationary contact 14 as long as the operating plunger is maintained depressed. As shown in Fig. 5, as soon as the operating position is passed, the force required to maintain the operating plunger depressed will be much diminished and a force of ten ounces will be sufficient to maintain it beneath the operating position. To release the switch, the force on the operating plunger will be released and it will move upward to the release position which in the case of the switch illustrated is approximately .0035 inch above the operating position. At the release point, the force of the plunger will have dropped to six ounces and at this time the tension element 24 will have been allowed to move upwardly to a position once more in line with the anchor pivots 33. Thus, in the present instance, the release force will be six ounces and when the downward force on the operating plunger is diminished below that the spring system 21 will snap upwardly beyond the position of maximum stress to its normal position where the movable contact 19 will once more engage the upper stationary contact 13.

The apparatus shown diagrammatically in Figures 6-9, inclusive, to illustrate the progressive operative steps in the method of the present invention is the same as disclosed in the aforesaid copending application.

The switch already described in connection with Figs. 1-5 inclusive, is fragmentarily shown much enlarged with respect to the scale of the rest of the apparatus in these diagrammatic views. Upper and lower loading arms 88 and 87 are pivotally mounted on pins 97 attached to the stationary fulcrum member 89. The pointed extension 101 of the lower arm 87 is engageable with the spring tension element 24 at 20 (see Fig. 3) where the switch plunger 34 normally engages the spring system when the switch is assembled. Upper arm 88 is adapted to apply its weight to the lower arm through roller 106. A vertically movable rack 38 is engaged with a pinion 25, the latter being mounted on a rotatable shaft 37. An electromagnetic clutch coil 42 is mounted on a clutch lever arm 39 which in turn is keyed to the shaft 37. An operating lever 51 shown only partially in the diagrammatic views of Figs. 6-9, is rotatably journaled about the shaft 37 inde-

4

pendently thereof, and can be swung independently of the clutch lever when the coil 42 is deenergized. An armature 52 is mounted on the operating lever 51 and is adapted to be attracted to the clutch coil 42 when the latter is energized. An operating handle 53 is mounted on one end of the lever 51 and the opposite end of the lever is elongated and adapted to open a normally closed switch 148 which is referred to herein as the "preloading switch." Movement of the loading arms 87 and 88 through a series of positions to apply preselected loads to the spring system 21 in predetermined sequence as the rack 38 is lowered is controlled by the lifting bar 103 and lower arm pin 102 which coact to lift the weight of both arms from the spring system when the rack is raised and also by the lifting lever 111 which is mounted on the stationary post 113, the lifting lever 111 being engageable by pins 82 and 112 on the rack and upper arm, respectively, to lift the upper arm from the lower arm when the rack is moved downwardly. The preloading switch 148 and clutch coil 42 are connected in series with the current source 149 by means of conductors 151, 152 and 153; and in this instance the spring system 21 of the switch being adjusted and the clutch coil 42 are connected in series with the current source 149 through conductors 151, 154, 155, 152 and 153. 149 may be either an alternating current or direct current source but direct current is preferable since in many instances a cheaper clutch can be used.

Operation

Considering now the application of the present invention employing the apparatus shown diagrammatically in Fig. 6 to adjust a self-returning switch such as shown in Figure 1, the adjustment will be carried out with the cover plate 11 and operating plunger 34 removed so that the lower loading arm extension 101 and rack 38 may extend through the open top of the casing 10. Step 1 in the adjustment consists, therefore, of mounting the casing portion of the switch within a suitable mounting means beneath the loading arms and rack.

The clutch lever 39 will have a suitable counterweight (not shown) attached to it so as to urge the clutch lever counterclockwise to the position shown in Figure 6 where it will be at the beginning of the adjusting operation. The lifting bar 103 on the rack 38 will normally maintain both loading arms 87 and 88 in raised position as also shown in Fig. 6. The end of the operating lever 51 opposite the handle 53 will be heavy enough to act as a counterweight and maintain the handle 53 in a raised position substantially as shown in Fig. 6 with the armature 52 proximate to the clutch coil 42. In the Fig. 6 position the clutch coil 42 will be energized through the preloading switch 148 by current source 149 so that the clutch coil and armature will be magnetically connected and downward movement of the handle 53 will cause the clutch lever 39 to follow it as long as the coil is energized.

Fig. 7 illustrates step 2 where the handle 53 has been moved downward to lower the rack bar 103 sufficiently to permit the weight of both loading arms 87 and 88 to be applied to the tension element 24 of the spring system 21. The combined weight of arms 87 and 88 will be sufficient to apply a load to the spring system in excess of the operating force for the switch being adjusted, in this case 25 ounces (see Fig. 5). This will "operate" the spring system 21, that

is, move the carried contact 19 from its upper or normal position to its lower or abnormal position in engagement with the stationary contact 14. Clutch coil 42 is now energized by the current source 149 through both the preloading switch 148 and the spring system 21 which is being adjusted. Fig. 8 illustrates step 3 where the handle 53 has been moved to lower the rack 38 further an amount sufficient to move the pin 82 down upon lever 111 which in turn is effective to lift the upper arm from the lower arm by engagement with the pin 112. The weight applied by the lower arm 87 upon the tension element 24 is now approximately the desired "release force" for the spring system, in this case (see Fig. 5) being approximately six ounces. Theoretically, if the anchor 32 were made of completely non-resilient material which would not spring back after deformation, the loading applied by the lower arm 87 would be exactly the release load desired, in this case, exactly six ounces. Actually, to compensate for this spring-back, the load applied by the lower arm 87 will be somewhat in excess of the theoretical six ounces, the exact load being best determined by experiment for a particular size and shape of support 32.

Between the second step (Fig. 7) already described and the fourth step (Fig. 9) to be described, the operating lever 51 will be moved to the position shown in Fig. 8 where it will open the preloading switch 148, thereby causing the clutch coil 42 to be energized by current source 149 only through the spring system 21 which is being adjusted.

Fig. 9 illustrates the fourth and last step, when the handle 53 moves the rack 38 down upon the ends of the anchor legs 77, while the release load is applied to the spring tension element 24, and by a load transmitted through the magnetic clutch, deforms the anchor leg 77 downward until the pivot grooves 33 are moved past the plane of the tension element 24 at which time the spring system snaps to its upper or normal position, deenergizes the clutch coil 42 and releases the operating lever 51 from the clutch so as to prevent further deformation of the support 32.

Thus, a basic feature of the method of adjusting spring systems by the present invention comprises applying a preselected release load to the spring system, moving or deforming the spring support until the spring system moves from one position to another, and terminating the movement or deformation of the support at the time the spring system moves.

While the method of the present invention has been described in connection with a self-returning snap acting switch it will obviously be applicable to self-returning snap acting systems generally. Furthermore, while the invention has been described as applied to the adjustment of a double throw switch it is likewise applicable to normally open or normally closed types.

The difference between the operating and release forces, which is known as the force differential and in the present instance indicated as 19 ounces in Fig. 5, is substantially consistent for a given distance between the stationary contacts when substantially identical parts are used. For this reason, adjustment of either the operating or the release force to a particular value will automatically adjust the other to a particular value determined by the stationary contact spacing. To adjust the switch in this

manner, it is, of course, necessary to control the gap between stationary contacts closely to closely choose the value of the force being adjusted so that the other force is maintained within tolerance limits for it. In the case of the particular switch illustrated in the drawings, the present method has been directed to adjusting the release force, thereby automatically determining the operating force. It will be obvious from the above that the converse would be true, that is, the operating force may be adjusted, thereby automatically determining the release force. This alternate method of adjustment would be preferable, for example, in a switch of the type in which the plunger extends through the base instead of through the cover and the anchor or spring support is so positioned that the movable contact would normally engage the lower stationary contact instead of the upper stationary contact. Thus, the method of the present invention also contemplates broadly applying a preselected load, not necessarily a release load, to the spring system and concurrently applying a force to permanently move a support for the spring system to effect the movement of the latter from one position to another.

It will be obvious that the present invention may be applied by a number of minor changes that will readily suggest themselves to others skilled in the art without departing from the spirit and scope of the present invention.

Having thus described the invention, what is claimed as new is:

1. The method of adjusting an assembled spring mechanism having a spring system movable between two positions and a separate support member for said spring comprising the steps of applying a preselected load to the spring system and permanently moving the support in one direction sufficient to cause movement of the spring from one to the other of said two positions.

2. The method of adjusting an assembled mechanism having an overcenter snap spring system movable between two positions and a separate support member for a portion of said spring system comprising the steps of applying a preselected load to the spring system, permanently moving the support member through an axis of maximum stress to cause said spring system to move from one to the other of said two positions, and terminating the permanent movement of said support member at that time.

3. The method of adjusting a self-returning type of snap acting spring mechanism having an overcenter snap spring system movable between normal and abnormal positions and a support for said spring system comprising the steps of moving said spring system to abnormal position, applying to said spring system while in abnormal position a load determined in accordance with a preselected release load, permanently deforming said support to initiate movement of said spring system from abnormal to normal position, and terminating the permanent deformation of said support at the time of said movement of said spring system to normal position.

4. The method of adjusting an assembled spring mechanism having a spring movable between two positions and a separate support for said spring, comprising the steps of forming the spring support so that when assembled with the spring a portion of the support supporting the spring is out of a preferred configuration in a preselected manner, loading the spring in one of said positions to an extent determined by a

7

preselected release force for the assembled mechanism, and permanently moving the support in the direction of said preferred configuration until the spring moves to its other position.

5. The method of adjusting an assembled snap acting spring mechanism having an overcenter snap spring movable between normal and abnormal positions and a deformable support for said spring, comprising the steps of initially forming the spring support so that when assembled a portion of the support supporting the spring will be spaced from a preferred position, loading the spring to move it from normal to abnormal position, thereafter loading the spring to an extent determined by a preselected release force for the assembled mechanism, and deforming the support in the direction of the preferred configuration until the spring moves from abnormal to normal position.

6. The method of adjusting an assembled mechanism having an overcenter snap spring system movable between two positions, a support for a portion of said spring system, and mounting means for said spring system and support, comprising the steps of: forming the support initially so that when assembled upon the mounting means a portion thereof supporting the spring will be spaced from a preferred location; applying to the spring system in one of said positions, a predetermined force corresponding to a preselected release force; applying a force to the support to permanently bend the support toward its preferred position while said predetermined force is effective on the spring system; and terminating the bending of said support when the movement thereof is sufficient to cause said spring system to snap from said one position to the other position.

7. The method of adjusting an assembled snap acting mechanism having an overcenter snap spring system movable between two stable positions, an operating plunger engageable with a portion of said spring system, and a support for a portion of said spring system, comprising: a step of loading the spring system at said position while the spring system is in one of said positions by a force dependent on a predetermined release force for the mechanism; and a succeeding step of moving a portion of the support carrying the spring system toward its said preferred position while said spring system is subject to said force in said one position until said spring system is caused to snap to the other of said positions.

8. The method of adjusting an assembled snap acting mechanism having an overcenter snap spring system therewithin movable between normal and abnormal positions, an operating plunger engageable with a portion of said spring system and a support for a portion of said spring system, comprising: a step of loading the spring system at the portion normally engaged by the plunger when the mechanism is fully assembled with a force exceeding a predetermined maximum operating force for the mechanism to cause the spring system to move to abnormal position; a succeeding step of loading the spring system, at said portion normally engaged by the plunger, while the spring system is in the abnormal position, with a force determined by a release force for

8

the mechanism; and a succeeding step of moving a portion of the support carrying the spring system towards its said preferred position while said spring system is subject to the last mentioned force until said spring system is caused to move to normal position, and terminating the movement of said support at that time.

9. The method of adjusting an assembled electric switch having mounting means, an overcenter snap spring system carrying a contact movable between two contact positions and a support for a portion of said spring system comprising the steps of: forming the support initially so that when assembled upon said mounting means a portion thereof supporting the spring will be spaced from an axis of maximum stress; applying to the spring system a predetermined force tending to hold it in one of said two positions; passing an electric current through said contact at said one contact position; applying an adjusting force to the support to move the support toward said axis of maximum stress while said predetermined force is effective on said spring system in said one position; and terminating the application of adjusting force in response to the interruption of the current upon movement of the spring system to the other of said positions.

10. The method of adjusting a switch having when assembled a casing with an overcenter snap spring system therewithin movable between normal and abnormal positions, an operating plunger engageable with a portion of said spring system and a bendable support for a portion of said spring system, comprising: a step of initially assembling the support and spring system within the casing so that said support is located to one side of a preferred position and said spring system is in its normal position; a succeeding step of loading the spring system at the position normally engaged by the plunger when the switch is fully assembled by a force exceeding a predetermined maximum operating force for the switch to cause the spring system to move to abnormal position; a succeeding step of loading the spring system, at said position normally engaged by the plunger, while the spring system is in the abnormal position, by a force exceeding a predetermined minimum release force for the switch; and a succeeding step of bending the support toward said preferred position, while said spring system is in abnormal position, until said spring system is caused to move to normal position, and terminating the bending of said support at that time.

ROBERT W. PASHBY.

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