Dec. 6, 1949 R. W. PASHBY 2,490,741

ADJUSTING APPARATUS FOR SPRING MECHANISM

Filed Sept. 25, 1946 10 Sheets-Sheet 1

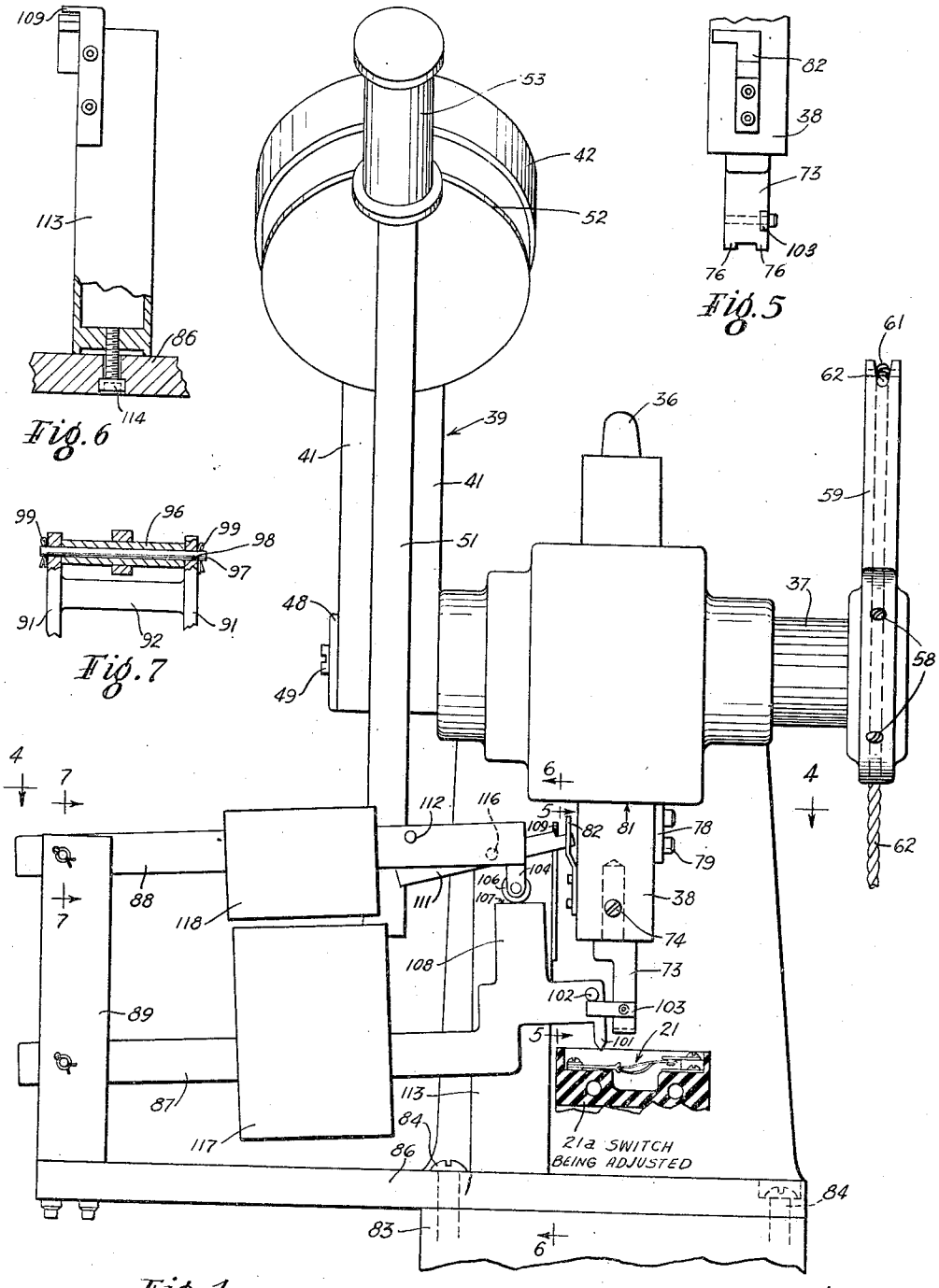


Fig. 1

Fig. 5

Fig. 6

Fig. 7

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10 Sheets-Sheet 2

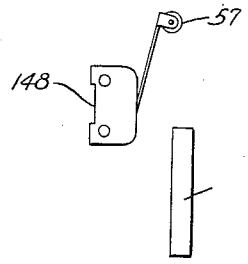


Fig. 8

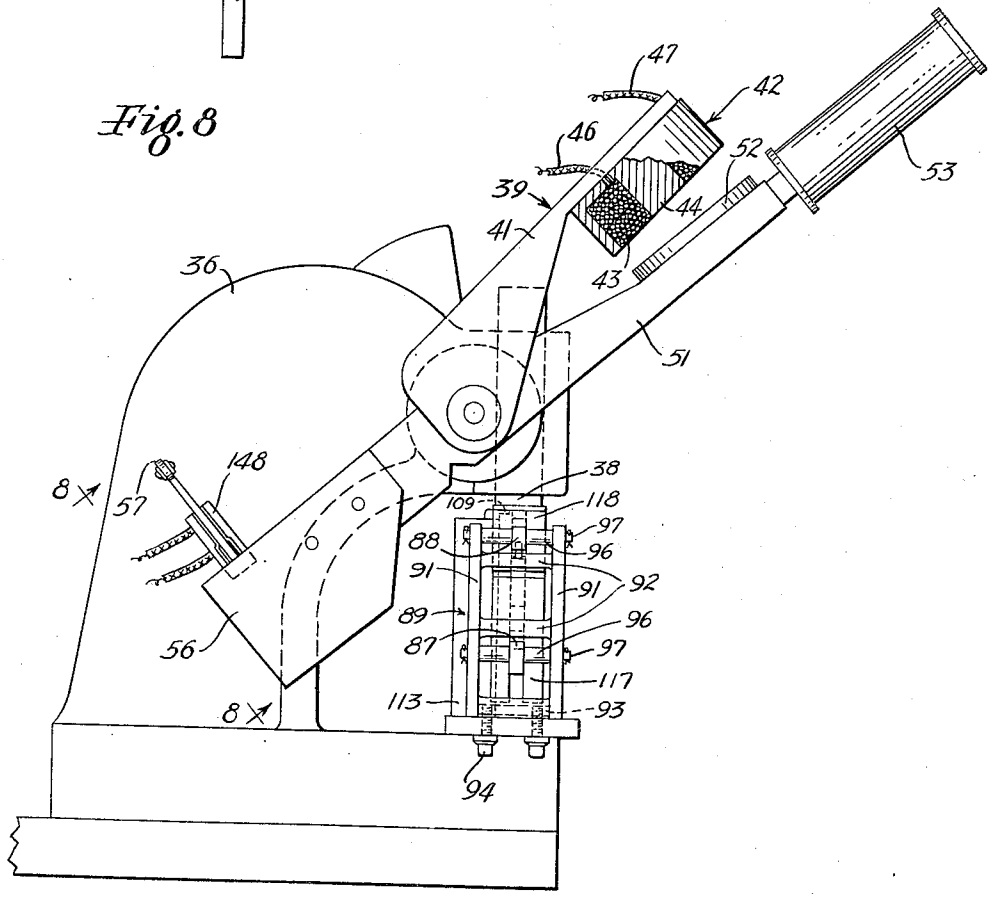


Fig. 2

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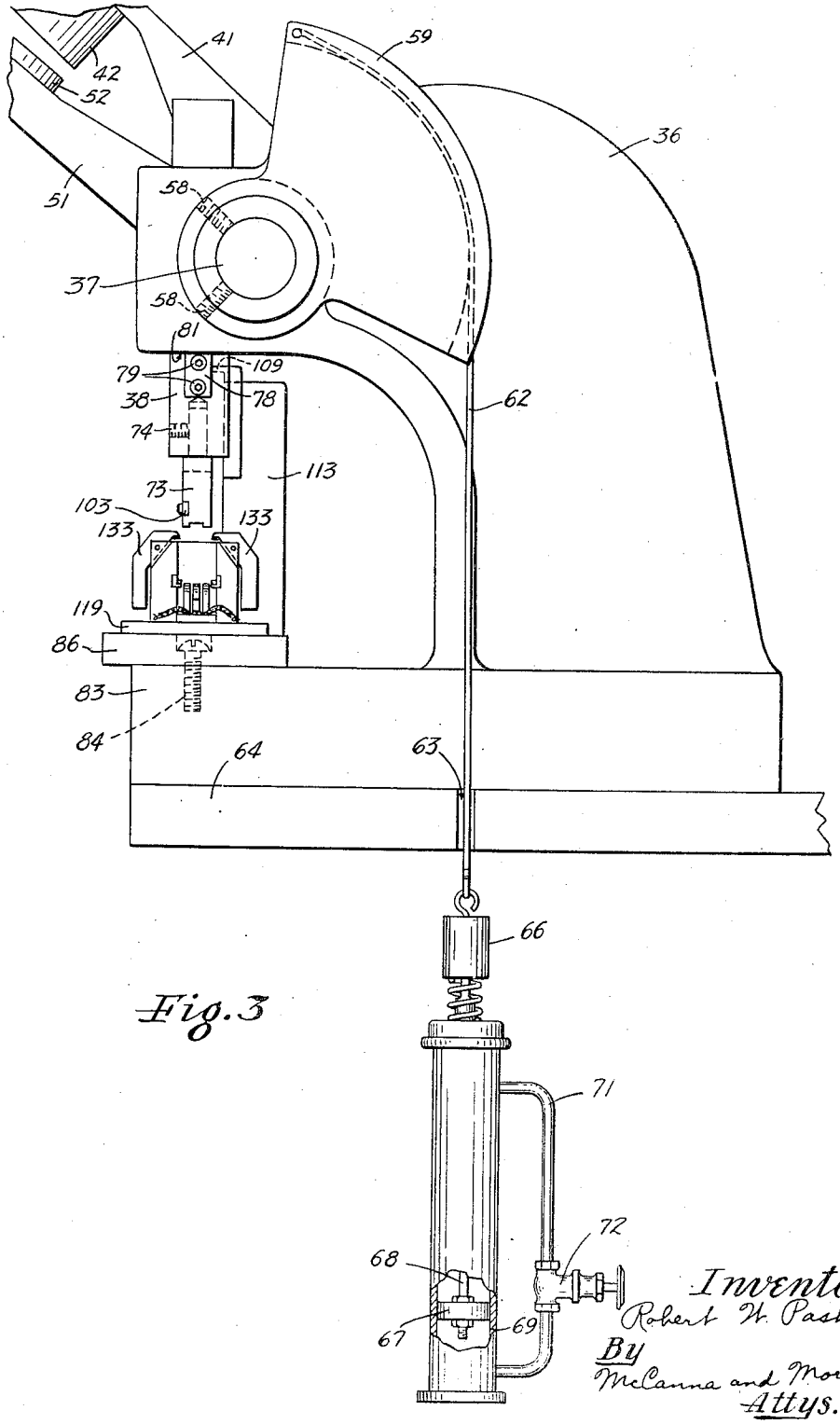


Fig. 3

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ADJUSTING APPARATUS FOR SPRING MECHANISM

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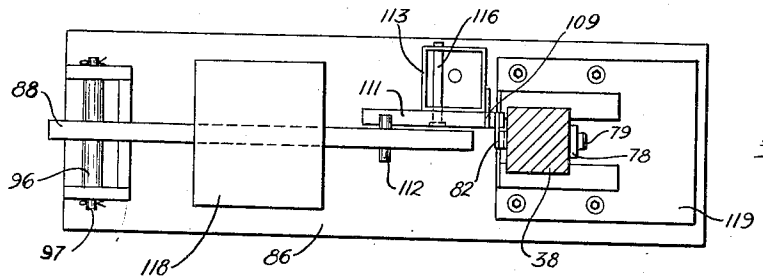


Fig. 4

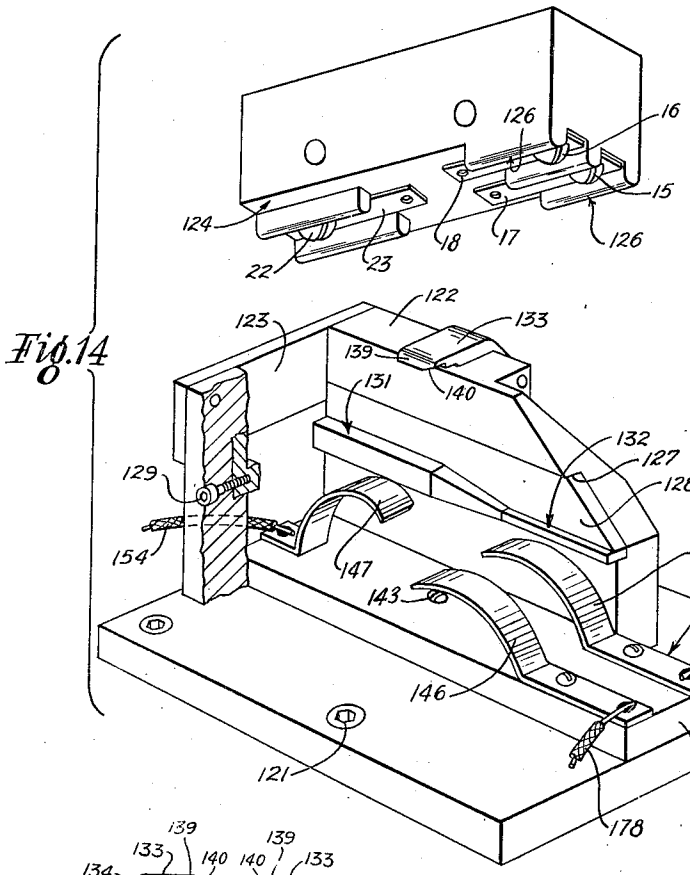


Fig. 14

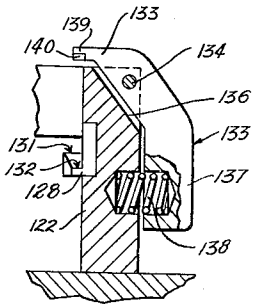


Fig. 15

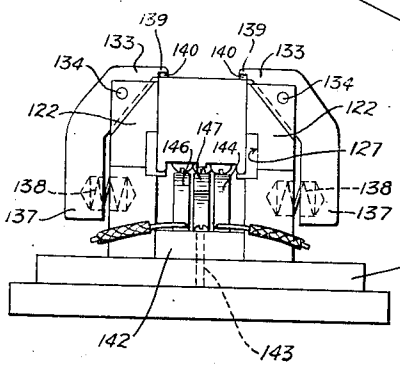


Fig. 16

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ADJUSTING APPARATUS FOR SPRING MECHANISM

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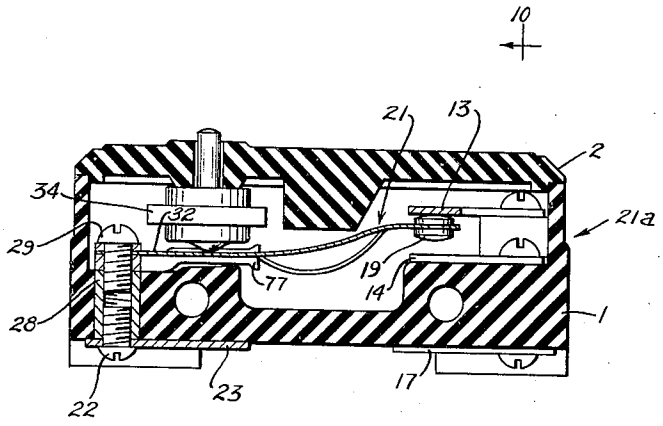


Fig. 9

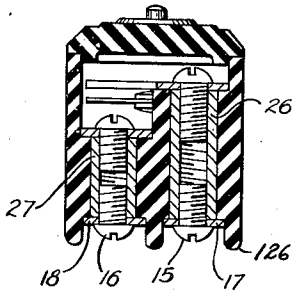


Fig. 10

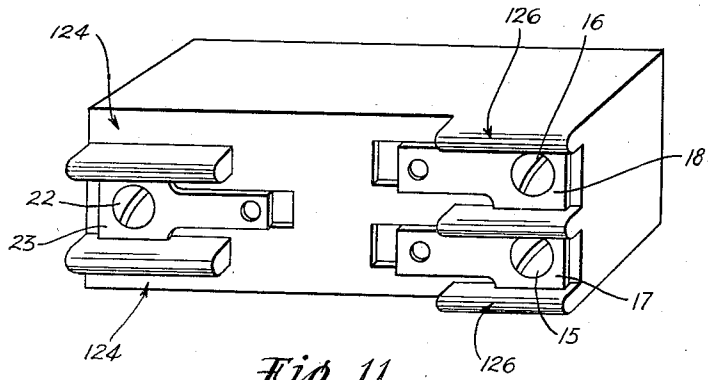


Fig. 11

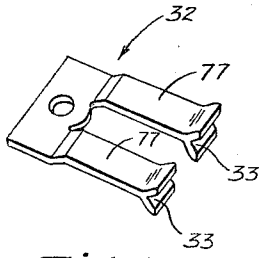


Fig. 12

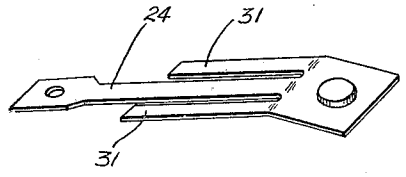


Fig. 13

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ADJUSTING APPARATUS FOR SPRING MECHANISM

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SIMPLIFIED ELECTRICAL CIRCUIT FOR ADJUSTING DOUBLE THROW AND NORMALLY OPEN SWITCHES

CIRCUIT A

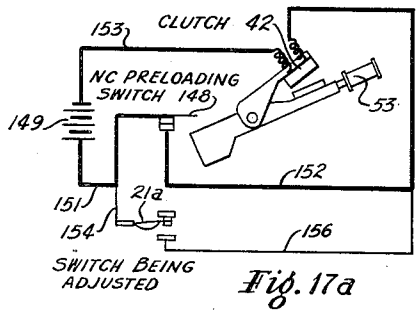


Fig. 17a

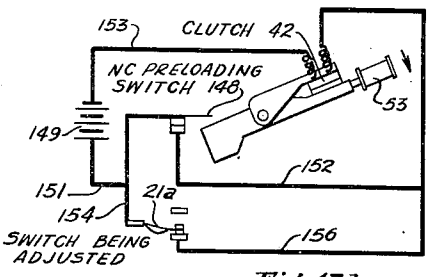


Fig. 17b

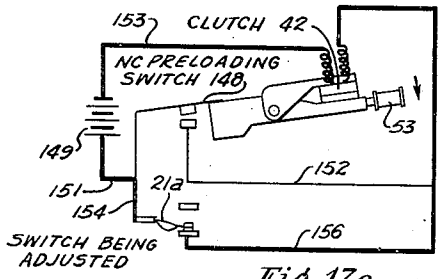


Fig. 17c

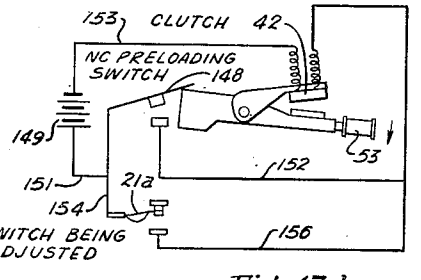


Fig. 17d

SIMPLIFIED ELECTRICAL CIRCUIT FOR ADJUSTING NORMALLY CLOSED SWITCHES

CIRCUIT B

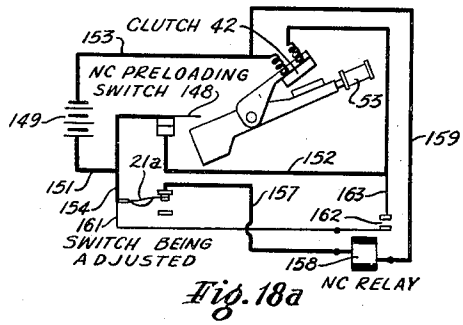


Fig. 18a

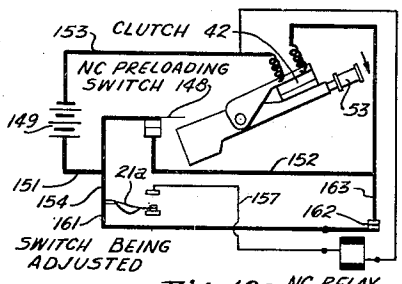


Fig. 18b

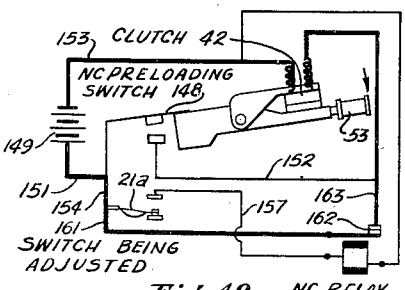


Fig. 18c

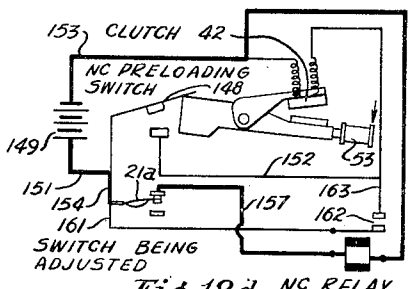


Fig. 18d

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CIRCUIT AB

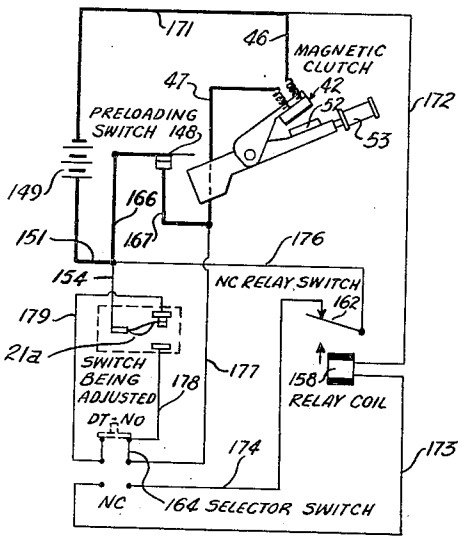


Fig. 19a

CIRCUIT AB

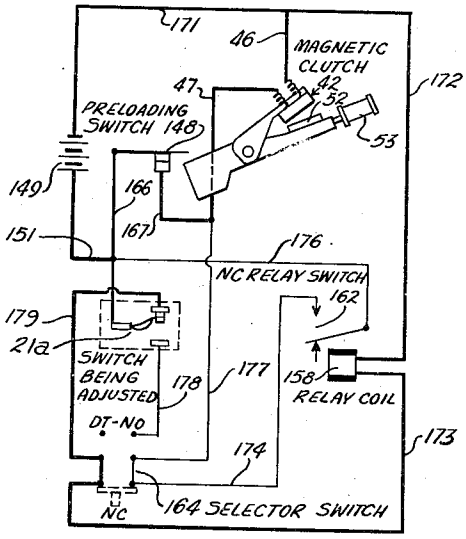


Fig. 19e

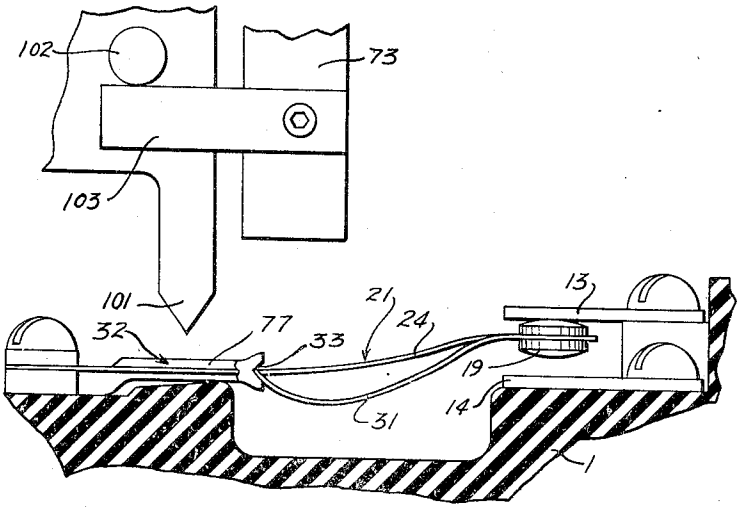


Fig. 20

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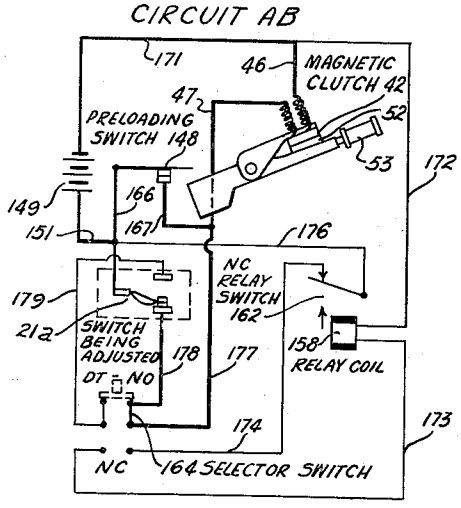


Fig. 19b

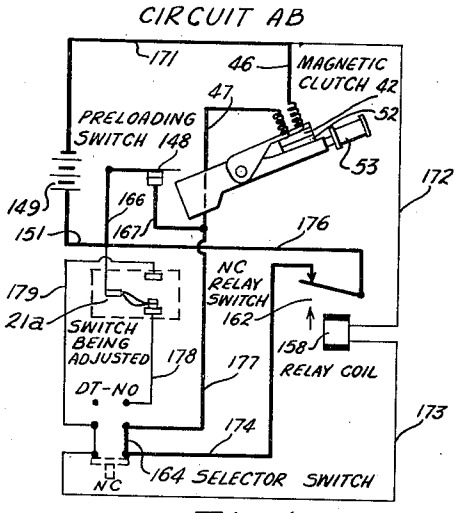


Fig. 19f

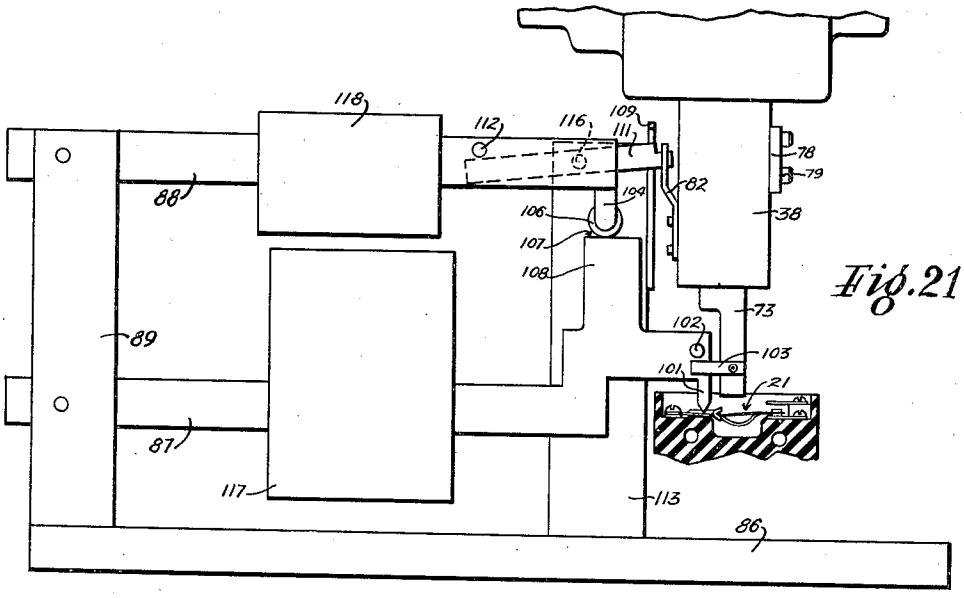


Fig. 21

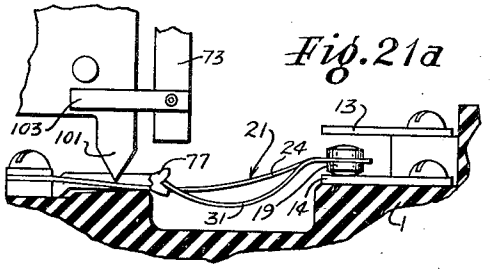


Fig. 21a

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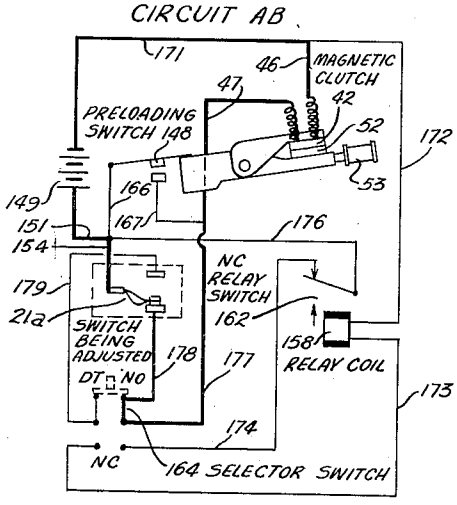


Fig. 19c

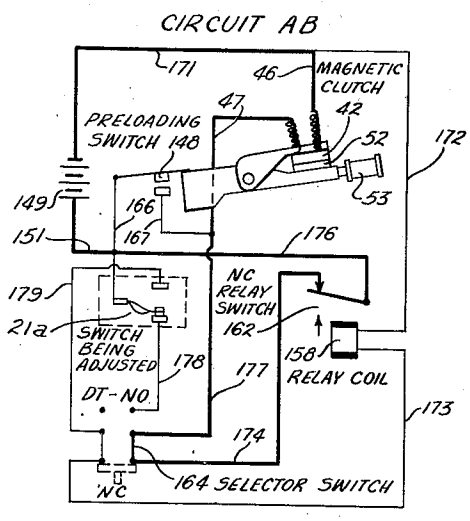


Fig. 19g

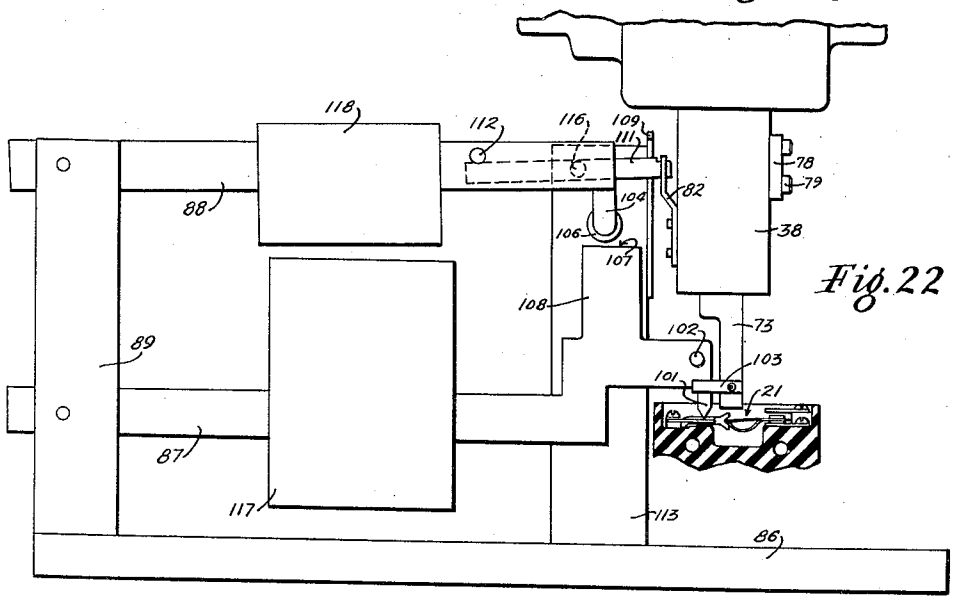


Fig. 22

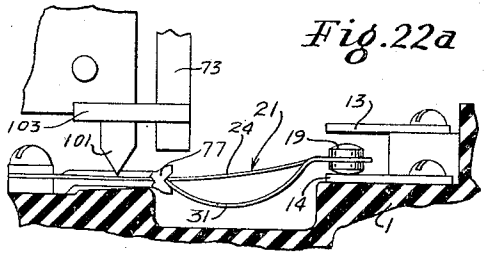


Fig. 22a

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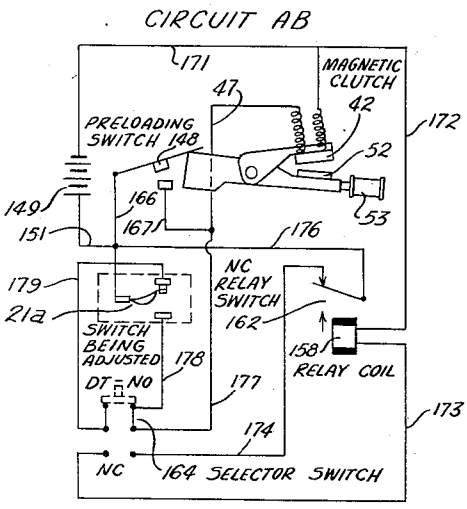


Fig. 19d

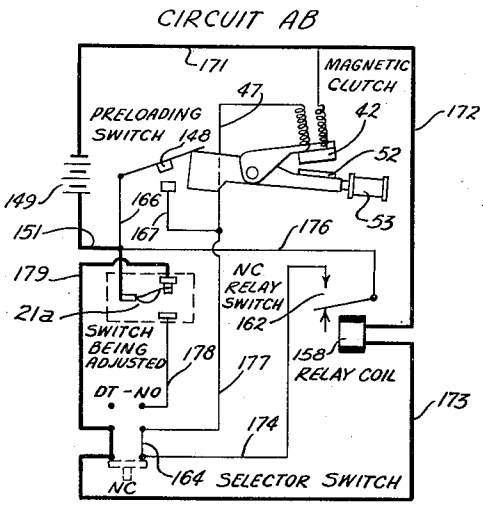


Fig. 19h

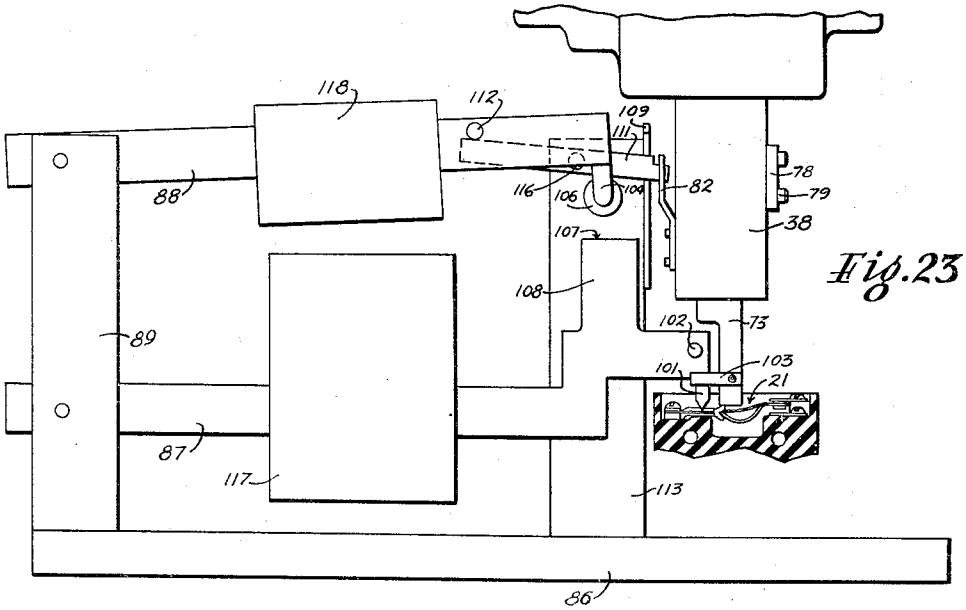


Fig. 23

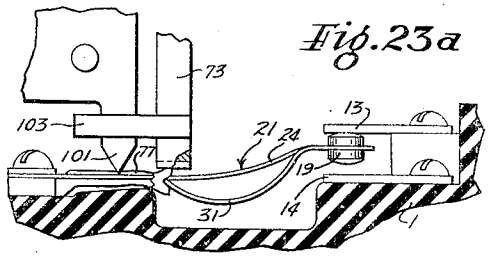


Fig. 23a

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Patented Dec. 6, 1949

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UNITED STATES PATENT OFFICE

2,490,741

ADJUSTING APPARATUS FOR SPRING MECHANISM

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

Application September 25, 1946, Serial No. 699,314

23 Claims. (Cl. 153—48)

1

The present invention relates to apparatus for the adjustment of snap acting mechanisms, particularly to the adjustment of snap acting switches, in accordance with the method disclosed and claimed in copending application, Serial No. 699,315, filed September 25, 1946.

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

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

An object of the present invention when appiled to a self-returning type of snap acting mechanism having an overcenter snap spring with a support therefor lies in the provision of apparatus which first loads the spring sufficiently to operate it, that is, to move it from normal to abnormal position, then changes the loading to a value dependent upon a desired release force, followed by moving or deforming the support through an axis of maximum stress until the spring snaps back to its normal position.

Another object is the provision of an adjusting apparatus for a self-returning type of snap spring mechanism an example of which is the general kind employed in double throw, normally open, and normally closed switches, the adjusting apparatus including means for initially moving the spring to abnormal position and including an electromagnetic clutch for transmitting a force from an operating member to the spring support while the spring is in abnormal position to permanently move the support through an axis of maximum stress to initiate movement of the spring from abnormal to normal position, the clutch being deenergized in response to movement of the spring to normal position to prevent further transmission of force from the operating member to the support.

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Another object is the provision of an adjusting apparatus for a snap spring mechanism having an overcenter snap spring system mounted on a support, the mechanism being initially assembled with the support spaced to one side of a certain position preferred for proper operation, the apparatus including means for moving the spring system to abnormal position and then applying a preselected release load to the spring system and means for moving the support in the direction of its preferred position until the spring snaps to normal position to signify the end of the adjusting operation.

A specific object is the provision of a switch adjusting apparatus in which the switch being adjusted is incorporated into the control circuit to automatically terminate the adjusting operation when it has progressed to the point that the switch spring snaps back to its normal position.

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

Figure 1 is a front view of one form of switch adjusting mechanism embodying the principles of the present invention;

Fig. 2 is a left side view of Figure 1 drawn to a different scale than Figure 1;

Fig. 3 is a right side view of Figure 1 drawn to a different scale than Figure 1;

Fig. 4 is a plan view of the mechanism, taken on the line 4—4 of Figure 1;

Fig. 5 is a sectional view of Figure 1, taken on the line 5—5;

Fig. 6 is a sectional view of Figure 1 taken on the line 6—6;

Fig. 7 is a sectional view of Figure 1 taken on the line 7—7;

Fig. 8 is a view of Fig. 2, taken on the line 8—8;

Fig. 9 is a longitudinal, vertical sectional view of one form of electric switch which may be adjusted by the present mechanism;

Fig. 10 is a transverse sectional view of Fig. 9, taken on the line 10—10;

Fig. 11 is a perspective bottom view of the switch of Fig. 9, showing the terminal connections;

Fig. 12 is a perspective view of the anchor employed in the Fig. 9 switch;

Fig. 13 is a perspective view of the snap spring system employed in the Fig. 9 switch;

Fig. 14 is a fragmentary, perspective view of the switch holding mechanism and of a switch with cover plate removed as will be the case during adjustment;

Fig. 15 is a partial sectional view of Fig. 14, showing the shoulders and fingers employed to support the switch undergoing adjustment;

Fig. 16 is an end view of Fig. 14 showing the switch housing in place and showing the leaf springs which engage the terminal screws to make the switch part of the adjusting circuit;

Figs. 17*a*, 17*b*, 17*c* and 17*d* are views in the various operative positions of a simplified circuit which may be employed with the present invention for adjusting double throw and normally open switches. This circuit is designated "A" in the following description.

Figs. 18*a*, 18*b*, 18*c* and 18*d* are views similar to Figs. 17–20, respectively, and show another simplified circuit which may be employed with the present invention for adjusting normally closed switches. This circuit is designated "B" in the following description.

Fig. 19*a* is a view of a circuit, designated "AB" in the following description, which combines both the "A" and "B" circuits so the mechanism may be employed to adjust double throw, normally open, or normally closed switches. Figs. 19*a*, 19*b*, 19*c* and 19*d* show the "AB" circuit in the various operative positions for adjusting double throw or normally open switches. Similarly, Figs. 19*e*, 19*f*, 19*g*, and 19*h* show the "AB" circuit in the various operative positions for adjusting a normally closed switch.

Fig. 20 is an enlarged view of a portion of Figure 1 showing the parts in their normal position at the start of the adjusting operation. This corresponds with the normal position of the parts shown in Figs. 19*a* and 19*e*.

Fig. 21 is a partial front view similar to Figure 1, showing a succeeding operative position, corresponding to Figs. 19*b* and 19*f*, in which the spring system of the switch being tested is loaded by the weight of both loading arms;

Fig. 21*a* is an enlarged view of Fig. 21, similar to Fig. 20;

Fig. 22 is a view similar to Fig. 21 showing a succeeding operative position, corresponding to Figs. 19*c* and 19*g*, in which the spring system of the switch being tested is loaded by the weight of only the lower loading arm;

Fig. 22*a* is an enlarged view of Fig. 22, similar to Fig. 21*a*;

Fig. 23 is a view similar to Fig. 22 showing a succeeding operative position, corresponding to Figs. 19*d* and 19*h*, in which the support for the spring system is deformed sufficiently to cause the spring to snap to its normal position, and

Fig. 23*a* is an enlarged view of Fig. 23, similar to Fig. 22*a*.

Consideration will be given first to a representative switch of the compact precision type to which the present invention is applicable. Figs. 9–13, inclusive, show a compact precision type switch of the kind disclosed in McGall Patent 1,960,020 to which reference may be had for details concerning this type of switch. Briefly, it includes an insulating case having a base 1 and a cover 2; upper and lower stationary contacts 13 and 14, respectively, having terminal screws 15 and 16 and tabs 17 and 18; and a movable contact 19 carried by the over-center snap spring system generally designated 21 which is connected at the opposite end to the common terminal screw 22 and tab 23. Terminal bushings 26 and 27 which are preferably molded integral with the base portion 1 provide support for the stationary contacts as well as providing electrical connection between the stationary contacts and the terminal tabs 17 and 18.

The spring member 21 comprises a thin leaf tension element or reed 24 which is connected in cantilever fashion to the terminal bushing 28 by means of a screw 29. 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 the anchor or supporting member 32. This support member 32 is cut out in the center so as to be left U-shaped to clear the tension member 24 and has a pair of notches 33 for receiving and pivotally supporting the compression elements 31. The operation is such that when the plunger 34 is depressed it will move the tension element 24 downward to a position in line with the pivots 33. This position is a position or axis of maximum stress for the spring system 21 and further depression of the plunger 34 moving the tension element through this axis will cause the spring to move downwardly of its own accord with a snap action, disengaging the contacts 13 and 19 and engaging contacts 14 and 19; conversely, when the depressive force on the plunger 34 is released, since in this instance the switch illustrated is of the self-returning type, the tension element 24 will move upwardly through an axis of maximum stress and the spring system will be caused to return by snap action to the normal position shown in Fig. 9.

The switch adjusting mechanism here shown to illustrate the present invention comprises a frame 36 (Fig. 2) of the general type employed in arbor presses and the like having a rotatable shaft 37 engaged within the housing with the vertically reciprocable rack 38, as by means of a conventional rack and pinion (not shown), so that rotation of the shaft 37 causes reciprocation of the rack 38. A clutch lever 39 comprising a pair of spaced parallel arms 41 is keyed to one end of the shaft 37 and carries an electromagnetic clutch member 42 having a coil 43, a core 44 and lead wires 46 and 47. The clutch lever 39 is maintained on the shaft 37 by means of a retaining disk 48 and screw 49. Between the clutch lever arms 41 an operating lever 51 is freely rotatable about the shaft 37, independently thereof, and carries a disk-shaped armature 52 adapted to be attracted by the clutch member 42 when the coil 43 is energized. In this case, means for manual operation is provided in the form of the handle 53 but it will be obvious that suitable motor means may be employed. Opposite the handle 53 the end of the lever 51 is elongated to serve the dual purpose of counterweighting it to seek a position approximately that shown in Fig. 2 and to operate the normally closed switch 148, hereinafter referred to as the pre-loading switch. The end portion 56 of the operating lever 51 is of sufficient width that it will maintain the pre-loading switch 148 opened when the handle 53 is pulled downward through its various operating positions to be described. The manner in which the portion 56 of the operating lever is adapted to overrun the pre-loading switch actuating lever 57 to hold it open is best shown in Fig. 8. At the opposite end of the rotatable shaft 37 and held in place by set screws 58 (Fig. 3) is a pulley sector 59 having a peripheral groove 61 with a wire or cable 62 fastened in its upper

end. The wire 62 extends through the aperture 63 in the bench or support 64 and is connected to a weight 66 large enough to move the sector 59 and clutch lever 39 to their normal positions shown in Figs. 3 and 2, respectively, when no torque is applied to the clutch lever through the operating lever 51. Beneath the weight 66 and connected to it is a double-acting dashpot means for regulating the speed of movement of the weight and hence for regulating the rate of rotation of the shaft 37 in both directions. This dashpot means comprises a piston 67 connected to the weight by rod 68, a cylinder 69 preferably filled with a liquid, and a by-pass line 71 connecting the ends of the cylinder. The rotational speed of the shaft 37 is controlled by the position of the by-pass valve 72.

The vertically reciprocable rack 38 has an axially extending ram 73 mounted therein by means of a set screw 74. The end of the ram 73 is formed with a pair of projections 76 (Fig. 5) adapted to contact the anchor legs (designated 77 in Fig. 12) of the switch being adjusted and to bend the anchor downwardly. A stop plate 78 (Fig. 3) fastened to the rack 38 by bolts 79 limits its upward movement by engagement with the under surface 81 of the housing. Fig. 5 also shows the forwardly extending hook member 82 which is mounted on the side of the rack 38, the function of which will be brought out as the description proceeds. Mounted on the housing platform 83 by screws 84 is a plate 86 (Fig. 2) which carries the loading arms 87 and 88 (Fig. 1) for applying pre-selected loads to the switch spring in sequence controlled by the downward movement of the ram 73. At the end of the plate 86 remote from the platform 83 is an upstanding fulcrum member 89 having a pair of spaced vertical columns 91 (Fig. 2) connected by tie bars 92 and 93, the latter being drilled and tapped for mounting on the plate 86 by bolts 94. Each of the loading arms 87 and 88 is fulcrumed between the columns 91 by means of a spacer bushing 96 (see Fig. 7) on which the arm is centered by a press fit, the bushings 96 being trunnioned on small diameter rods 97 which are held positioned within apertures 98 in the columns 91 by cotter pins 99.

The movable end of the lower arm 87 is formed with a transverse, pointed, downward extension 101 which during the adjusting operation is engageable with that portion of the switch spring system that is normally engaged by the plunger 34. In this case the portion of the spring which is engaged by the plunger is near the mounted end of the tension element 24, between the anchor legs 77, as shown in Fig. 9. A transverse pin 102 extending from the arm 87 is engageable with the lifting bar 103 carried by the ram 73 so that upward movement of the ram will lift the lower arm. The upper arm 88 is provided with a downward extension 104 carrying a roller 106 at its free end which bears on the flat upper surface 107 of the transverse extension 108 formed on the lower arm. This provides for the upper arm to add its weight to that exerted by the lower arm on the spring system 21 and minimizes frictional drag between the two arms.

In operation, as the ram 73 is lowered the weight of both arms will first be applied to the spring system 21 and then at a lower ram position the weight of the upper arm 88 will be removed. This is accomplished by the coaction of the hooks 82 and 109, lever 111 and pin 112. The hook 109 and lever 111 are mounted and fulcrumed, respectively, on the upright member 113 which is fastened to the plate 86 by a bolt 114, as shown in Fig. 6. The end of the lever 111 which engages the pin 112 is somewhat longer and, therefore, heavier than the opposite end so that the lever is urged in a counterclockwise direction about the pivot pin 116 by gravity to normally clear the pin 112, thereby preventing the lever from disturbing the load applied by the upper arm. The stationary hook 109 functions as a stop to limit counterclockwise movement of the lever 111 so it cannot be rotated beyond the position where it can be engaged by the movable hook 82 on the rack. As the ram moves downwardly there will at first be a period during which both arms load the spring. As the ram continues to move downwardly the movable hook 82 will engage the lever 111 and rotate it around the pin 116 until the opposite end of the lever 111 engages the pin 112 mounted on the back side of the upper arm 88. Further downward movement of the ram will then cause the lever 111 to lift the upper arm from the lower. Weights 117 and 118 are provided for the loading arms 87 and 88, respectively, and may be adjusted suitably along the length of the arms to apply a desired loading force to the spring system 21.

Combined holding and contacting mechanism is provided for the switch being adjusted. This mechanism is best shown in Figs. 14, 15, and 16, and comprises a plate 119 mounted on the plate 86 by means of bolts 121 (see also Fig. 3). A pair of similarly formed but oppositely facing side members 122 are mounted on the plate 119 and a strut 123 serves to tie them together at one end, the side members 122 and strut 123 being fastened together and onto the plate 119 in any suitable manner, as for example, by silver soldering. It will be noted by reference to Fig. 11 and Fig. 14 that the lower side edges 124 and 126 at opposite ends of the particular switch casing shown are at different levels so that they must be supported at different heights to maintain the switch normal to the ram 73 during adjustment. To this end grooves 127 are cut interiorly of the side members 122 and longitudinal inserts 128 are mounted therein by screws 129. The cross-section of the inserts 128, generally L-shaped, have an inwardly extending shoulder 131 at one end engageable with the switch casing edge 124 and having a similar shoulder 132 at a lower level (best shown in Fig. 15) which is engageable with the lower switch casing edges 126. The inserts 128 may be readily replaced by others to accommodate switch housings of different dimensions, thereby making the adjusting mechanism applicable to a wide variety of switch sizes and shapes. To hold the switch in place during adjustment a holding lever 133 is pivoted on a pin 134 fitted in a cut-away upper corner 136 of each of the side members 122. Each lever 133 is formed with a lower vertical portion 137 urged outwardly by a coil spring 138 which is fitted within shallow aligned bores in the lever vertical portion and the corresponding side member. At the upper end each holding lever 133 is formed with a horizontal lip 139 extending inwardly beyond the side member 122 and engageable with the upper edge of the switch housing (see Fig. 16) to hold the latter in place. A chamfer 140 is provided at the leading edge of each lip 139 to facilitate ready insertion of the switch.

Means for incorporating the switch undergoing adjustment into the electric control circuit (which will be described subsequently) is provided by the

contact carrying member 141 which comprises a base 142 of electrical insulating material of suitable strength, mounted on the plate 119 between the side members 122 as by a screw 143. Riveted onto the top side of the insulator 142 are three inwardly extending arcuate leaf spring contacts 144, 146 and 147, so positioned that when the switch is mounted as shown in Fig. 16 they engage respectively the terminal screws 15, 16, and 22 or the terminal tabs 17, 18, and 23.

Switches of this type fall into three general classes: double throw, such as shown in Fig. 9, in which the common terminal 23 is normally connected to terminal 17 but which may be connected to terminal 18 by holding the plunger 34 depressed; normally open, in which stationary contact 13 is replaced by a non-conducting stop and terminal 17 is omitted, or the terminal 17 is simply not used; and normally closed, in which the stationary contact 14 is replaced by a non-conducting stop and terminal 18 is omitted, or the terminal 18 is not used. In practice, it will be preferable to provide an electrical circuit for the adjusting mechanism which will permit any of these three types of switches to be adjusted. To provide a clearer understanding of the operation of the adjusting mechanism two simplified circuits, Figs. 17*a–d* and 18*a–d*, will first be described showing how in one case the invention may be applied to adjusting double throw or normally open switches and in the other case to normally closed switches. After these simplified circuits are described attention will then be directed to a more complicated circuit which combines both the simplified circuits in such a way that the invention may be applied to adjust either double throw, normally open, or normally closed switches as desired.

In Figs. 17*a–d* a simplified circuit for the above described mechanism is shown in the successive operative positions for adjusting a double throw or normally open type of switch. This circuit is designated hereinafter as the "A" circuit. The normally closed preloading switch 148 which remains closed when the operating handle 53 is in its raised position is connected in series with the magnetic clutch 42 and a source of electric current 149 through the conductors 151, 152, and 153. The source of current 149 may comprise a battery or a rectifier connected to an A. C. line in the event that it is desired to test the switch 21*a* with direct current or if it is to be tested with alternating current the source 149 may be an alternating current generator. The switch being adjusted, designated here as 21*a*, is connected through conductors 154 and 156 in shunt with the preloading switch 148. In the present instance, the switches 21*a* and 148 are shown as both being connected in series with the same source of electric current 149 but in practice where it is preferred separate sources of current may be employed provided that the clutch 42 is in series with each switch. Thus, in the particular circuit shown in Fig. 17*a* both switches 21*a* and 148 are in parallel with one another but each is in series with the clutch 42 so that the latter may be separately energized through either. Switch 148 is referred to as the "preloading switch" because in operation it serves to energize the coil of clutch 42 until the loading arms 87 and 88 (Fig. 1) are effective to snap the spring system 21 to its abnormal position when the clutch is energized through the switch 21*a*.

Considering now the operation of the mechanism employing the simplified circuit A, assume that a double throw switch such as shown in Fig. 9 is to be adjusted. The upper stationary contact 13 will serve only as a stop since the terminal 17 will not be connected. Thus, the switch will behave exactly as a normally open switch and for this reason adjustment procedures for double throw and normally open switches are identical. Initially the clutch arm 39 and operating lever 51 will be in positions shown in Fig. 17*a* and the clutch coil 43 will be energized through the preloading switch 148. Movement of the operating handle 53 upward will cause the armature 52 to be attracted by the clutch member 42. Movement of the handle 53 and clutch lever 39 downward to the position shown in Fig. 17*b* will then lower the arms 87 and 88 so they are both effective to load the spring system; the combined weights 117 and 118 will apply a predetermined load to the spring system to snap the switch to its abnormal or closed position (see Figs. 21 and 21*a*) so the clutch coil will now be energized through both switches 21*a* and 148. Further downward movement of the handle to the Fig. 17*c* position causes the end of the operating lever to engage the preloading switch and open it so that the clutch coil is energized only through the switch being tested. Further movement of the handle will cause the upper arm to be lifted by lever 111 so that only the lower arm 87 is effective to load the spring system (see Figs. 22 and 22*a*), the weight 117 being such that the load applied by the lower arm alone is substantially equivalent to the desired release force to be applied by the plunger 34 (Fig. 9) after the switch is assembled. The "release force" for the switch is the downward force on the plunger 34 which will just allow the spring system to snap from its abnormal to its normal position. Still further, final downward movement of the handle to the position shown in Fig. 17*d* forces the ram 73 down upon the ends of the anchor 32 (see Figs. 23 and 23*a*) and bends the legs 77 so that the pivot grooves 33 cross the tension element 24 whereupon the spring system 21 snaps upwardly to its normal or open position. This deenergizes the clutch coil nullifying its attraction for the armature 52 and, therefore, further movement of the operating lever is ineffective to deform the switch anchor.

In Figs. 18*a–d* another simplified circuit, hereinafter designated "B," for the adjustment of normally closed switches, is shown. This is basically the same circuit as that just described for double throw normally open switches except that a normally closed relay is employed to deenergize the clutch coil when the switch 21*a* is in its normal or closed position. As in the previous case, the normally closed preloading switch 148 is connected in series with the clutch 42 and the source of current 149 through conductors 151, 152 and 153; a sub-circuit in parallel with the sub-circuit containing the preloading switch and clutch includes the conductor 154, switch 21*a* to be adjusted, conductor 157, relay coil 158 and conductor 159; and a third sub-circuit in parallel with switch 148 includes the conductor 161, the normally closed relay switch 162 and the conductor 163.

Considering now the operation of the mechanism of the present invention employing the simplified "B" circuit shown in Figs. 18*a–d*, assume that the switch to be adjusted designated 21*a* is a normally closed switch. This again may be a switch similar to that shown in Fig. 9 with

the lower stationary contact 14 either unused or replaced by a non-conducting stop. Initially the clutch arm 39 and the operating lever 51 will be in the position shown in Fig. 18*a* and the clutch 42 will be energized through the sub-circuit including the preloading switch 148; the relay switch 162 will be held open by the energized coil 158. Movement of the operating handle 53 upward will cause the armature 52 to be attracted by the clutch member 42. Movement of the handle and clutch lever downward to the position shown in Fig. 18*b* will then lower both arms 87 and 88 to place their combined weight on the spring system (see Figs. 21 and 21*a*); this will snap the switch to its abnormal or open position so the clutch coil will be energized through both the preloading switch 148 and the relay switch 162 which will now be closed due to the deenergization of the relay coil 158 by opening switch 21*a*. Further downward movement of the handle to the 18*c* position causes the end of the operating lever to engage the preloading switch and open it so that the clutch 42 is energized only through the relay switch 162. Further movement of the handle will cause the upper arm to be lifted by lever 111 so that only the lower arm 87 is effective to load the spring system, this load being substantially equivalent to the desired release load as above mentioned. Still further, final downward movement of the handle to the position shown in Fig. 18*d* forces the ram 73 down upon the ends of the anchor (see Figs. 23 and 23*a*), and bends that part so that the pivot grooves 33 cross the tension element 24, whereupon the spring system snaps upwardly to its normal or closed position; this closes the subcircuit 154—21*a*—157—158—159 to energize the relay coil which in turn opens the relay switch 162, thereby deenergizing the coil of clutch 42 and releasing the clutch lever 39 from the operating lever 51.

In actual shop use, it is preferable to combine both the A and B simplified circuits so that the mechanism may be readily applied to the adjustment of either double throw, normally open, or normally closed switches. They may be so combined as shown in the wiring diagram illustrated in Figs. 19*a–h*, this wiring diagram being designated for convenience herein as the "AB" circuit. Figs. 19*a–d* show the AB circuit as it is applied to the adjusting of a double throw or normally open switch; and Fig. 19*e–h* show the AB circuit as it is applied to adjusting the normally closed switch. In each of the circuits illustrated herein heavy lines are employed to designate that part of the circuit that is energized.

It will be noted that when the selector switch is moved to the DT—NO position, as shown in Fig. 19*a*, the effective part of the AB circuit is the same as that shown in Fig. 17*a*, namely, with the preloading switch 148, the clutch 42 and the source of electricity 149 connected in series. Likewise, Figs. 19*b*, 19*c*, and 19*d* show how the effective parts of the AB circuit are identical with the A circuit in the various operative positions shown in Figs. 17*b*, 17*c*, and 17*d*, respectively.

It will be further noted that when the selector switch 154 is moved to the NC position to convert the mechanism to adjustment of normally closed switches the effective parts of the AB circuit as shown in Figs. 19*e*, 19*f*, 19*g* and 19*h* are identical with the B circuit in the various operative positions shown in Figs. 18*a*, 18*b*, 18*c* and 18*d*, respectively.

Operation

The operation of the switch adjusting mechanism employing the preferred combined AB circuit will now be described, first through the sequence of operations for adjusting a double throw or normally open switch, and then through a similar sequence of operations for adjusting a normally closed switch.

A double throw switch, such for example as shown in Fig. 9 but with the cover 2 and plunger 34 removed, will be inserted between the side members 122 of the holding mechanism shown in Fig. 4. The end of the switch being adjusted will abut the tie bar 123. Its top edge will be engaged by the spring pressed fingers 139 of the holding levers 133. Bottom edges 124 and 126 of the switch will rest respectively on the shoulders 131 and 132 of the inserts 128. And the switch terminal screws 15, 16 and 22 will be engaged respectively with spring fingers 144, 146 and 147 which in turn are connected to conductors 179, 178 and 154. Initially, the clutch 42 will be moved to its uppermost limit (Fig. 2) by the weight 66 acting on the pulley sector 59 (Fig. 3). The counterbalancing end portion 56 of the operating lever 51 will urge the latter to a normal position approximately as shown in Fig. 2. As shown in Figure 1 and Fig. 20 both the ram 73 and the weighted arms 87 and 88, which are supported on the ram by means of pin 102 and bar 103, are retracted upward from the switch being adjusted which is designated 21*a* and (see Fig. 20) the spring system 21 in the switch 21*a* is in its normal position with its movable contact 19 pressed against the upper stationary contact 13. The anchor 32 will have been formed, preferably prior to assembly in the switch, with its pivot grooves 33 above their correct position so that downward movement of the ram 73 in carrying out the adjusting operation will bend the legs 77 downward until the grooves are correctly positioned.

To condition the mechanism for adjusting a double throw switch the selector switch 164 will be closed on the DT—NO side. Adjustment of the switch 21*a* will then be carried out entirely automatically by first moving the operating lever upwardly sufficiently to engage the armature 52 by the clutch 42 and then pulling the handle downward in one steady sweep until the clutch 42 is automatically deenergized, as will be described, by release movement of the spring system 21 in snapping from the abnormal to normal positions to signify that the adjusting operation has been completed. The speed of downward movement of the handle 53 during adjustment is regulated by the dashpot mechanism shown in Fig. 3 as is also the speed of upward movement of the clutch lever 39 responsive to the pull of weight 66 when the armature is released at the end of the adjusting operation.

At the start, the coil of clutch 42 will be energized through the preloading switch 148, as shown in Fig. 19*a*. That part of the circuit which places the preloading switch and the clutch in series with the current source may be traced as follows: 149–151–166–148–167–47–42–46–171.

As the operator pulls down the handle 53 the rack 38 on which the ram 73 is mounted is moved downwardly. At the position shown in Fig. 19*b* and Fig. 21 the lifting bar 103 will have moved downward away from the pin 102 on the lower arm and, since the upper arm 88 likewise bears on the lower arm through the roller 106, the weight of both arms 87 and 88 will be effective

on the tension element 24 to operate the spring to its lower or abnormal position as shown in Fig. 21a where the carried contact 19 is engaged by the lower stationary contact 14. The coil of the clutch 42 will now be energized through both the preloading switch 148 and switch 21a (Fig. 19b). That portion of the circuit which places the preloading switch and the clutch in series with the current source may be traced exactly as outlined in the above paragraph. That portion of the circuit which places the switch being adjusted in series with the clutch may be traced as follows: 149–151–154–21a–178–164–177–47–42–46–171. If preferred, these two parts of the circuit may be energized by separate current sources. Furthermore, if necessary the clutch means represented by the clutch 42 may take the form of separate clutch coils energized by the separate current sources.

Further downward movement of the rack 38 and the hook 82 attached thereto will cause the lever 111 to lift the upper arm 88 from the lower arm surface 107 (Fig. 22), the load applied by the lower arm being preselected to be equivalent to a desired release load for the switch; this further movement will also cause the widened end 56 of the operating lever 51 to overrun the actuating arm 57 of the preloading switch (see Fig. 8 for the relative dimensions of the actuating arm and the end of the operating lever), and will hold the preloading switch open for the remainder of the downward movement of the operating handle 51. That portion of the circuit which places the switch being adjusted and the clutch in series with the current source is the same as that traced in the preceding paragraph. As shown in Fig. 22a the spring system 21 will remain in its lower or abnormal position after the lifting of the upper arm 88.

Still further downward movement of the ram 73, with the desired release load being applied to the spring system 21 by the lower arm 87 at the plunger loading point, will bring the ram into contact with the ends of the anchor legs 77 (Fig. 23) and the latter will be deformed downwardly until the pivot grooves 33 are moved beyond the plane of the tension element 24 whence the spring system will release, that is, will snap upwardly to its normal position as shown in Fig. 23a. At this time, as shown in Fig. 19d, the coil of clutch 42 is deenergized, thereby breaking the electromagnetic connection between the operating and clutch levers 51 and 39. The clutch lever 39 is then moved upward by the weight 66 and when the operator releases the handle 53 it also moves upwardly and the parts resume their original positions shown in Fig. 2 and are ready for another adjusting cycle.

To adjust a normally closed switch with this mechanism the procedure on the part of the operator is exactly the same except that he first closes the NC side of the selector switch 164. Fig. 19e is the circuit at the beginning of the adjustment operation for the normally closed switch, the coil of clutch 42 being energized through the preloading switch 148 and the relay coil 158 being energized through the switch 21a being adjusted. That portion of the circuit which places the preloading switch and the clutch in series with the source of electric current may be traced as follows: 149–151–166–148–167–47–42–46–171. That portion of the circuit which places the switch being adjusted and the relay coil in series with the source of electric current may be traced as follows: 149–151–154–21a–179–164–173–158–172–171. As has been explained previously, separate sources of electricity may be employed for these two parts of the circuit if desired. Fig. 19f shows the circuit after the parts have been moved down to the Fig. 21 and 21a positions where both arms 87 and 88 are effective to load the spring system 21 sufficiently to snap it down to its abnormal position, the clutch coil now being energized through both the preloading switch 148 and the relay switch 162. That part of the circuit which places the preloading switch and the clutch in series with the source of current is traced exactly as outlined in the preceding paragraph. That portion of the circuit which places the relay switch in series with the clutch and the current source may be traced as follows:

149–151–176–162–174–164–177–47–42–46–171

Fig. 19g shows the circuit after the operating lever 51 has moved to open the preloading switch 148 so that at this time the clutch coil is energized only through the relay switch, as traced above. Also, at about this time, as shown in Figs. 22 and 22a, the upper loading arm 88 will be lifted leaving only arm 87 applying a desired release load to the spring system.

Fig. 19h shows the circuit after the ram has moved down to engage the anchor (Figs. 23 and 23a) and has deformed the latter sufficiently to cause the spring system to snap upward to its normal position and engage the stationary contact 13, thereby energizing the relay coil 158 which in turn opens the relay switch 162 and deenergizes the coil of clutch 42. That part of the circuit which now places the switch being adjusted and the relay coil in series with the current source may be traced as follows:

149–151–154–21a–179–164–173–158–172–171

After the clutch 42 has been deenergized in this manner the ram 73, arms 87 and 88, clutch and operating levers 39 and 51 will be retracted to their original positions shown in Figs. 1 and 2.

Now, for the sake of simplifying the description, it has been stated that the load applied to the spring by the lower arm 87 will be adjusted to a value substantially equivalent to the desired release load which will subsequently be applied by the plunger 34 when the switch is assembled. Actually, the load applied by the arm 87 must be in excess of the desired release load, to an extent determined by experiment for each design of anchor, so as to compensate for the resilience or spring-back of the anchor when the deforming load is released. Furthermore, while I have described the present invention in connection with means for actually permanently deforming the anchor legs 77, it will be obvious that in some types of spring mechanisms it may be preferable to move or tip the entire anchor or spring support in the desired direction rather than locally deforming it; the basic principle of the present invention resides in permanently moving a supported portion of the spring system to effect automatic, closely controllable adjustment of the switch mechanism. Furthermore, while the invention has been illustrated as applied to the adjusting of a specific type of spring system in a specified type of electric switch, it will be obvious that it may be applied to the adjustment of many other specific types of spring systems whether in electric switches or not.

Thus, while a particular arrangement of parts has been shown to illustrate the present invention, it will be apparent that changes therein will readily suggest themselves to others skilled in the

art without departing from the spirit and scope of the invention. Having thus described the invention, what is claimed as new is:

I claim:

1. Apparatus for adjusting an assembled spring mechanism having a snap acting spring system movable between two positions and a separate fixed support member for a portion of said spring system comprising means for applying a preselected load to the spring system, means for permanently moving the support in a direction to initiate movement of said spring system from one to the other of said two positions while said preselected load is applied thereto, and means responsive to said initiated movement of said spring system for terminating the operation of the last mentioned means and the permanent movement of said support.

2. Apparatus for adjusting a spring mechanism of the self-returning type having an overcenter snap spring system movable between normal and abnormal positions and a support for said spring system, comprising means for moving said spring system to abnormal position, means for applying to said spring system while in abnormal position a load determined in accordance with a predetermined release load, means for permanently changing the position of said support concurrent with the application of said load to the spring system while in the abnormal position to initiate movement of said spring system from abnormal to normal position, and means responsive to the movement of said spring system from abnormal to normal position to limit the permanent change in position of said support.

3. Apparatus for adjusting a self-returning spring mechanism having an overcenter spring system movable between normal and abnormal positions, said spring system having a support therefor initially spaced from a preferred position, said spring system adapted to move from normal to abnormal position responsive to application of a certain operating force thereto and adapted to move from abnormal to normal position when the force on said spring system is diminished to a certain release force, said apparatus comprising means for applying to said spring system a load in excess of its operating force to cause it to move to abnormal position, means for diminishing the load on said spring system to a value determined by its release force, means for permanently moving said support toward its said preferred position concurrently with the application of said diminished load on said spring system to initiate the movement of said spring system from abnormal to normal position, and means responsive to the movement of said spring system to normal position to terminate the movement of said support at said preferred position.

4. Apparatus for adjusting an assembled snap acting mechanism having a support and an overcenter snap spring system with a portion thereof pivotally mounted on said support, comprising means for applying a preselected load to said spring system and means for concurrently applying a force to permanently move the portion of said support pivotally engaged with said spring system.

5. Apparatus for adjusting an assembled self-returning type of snap acting mechanism having an overcenter snap spring system with a portion thereof pivoted on the free end of a support, comprising means for applying a preselected release load to said spring system and means for concurrently applying a force to the free end of said support to move the pivoted portion thereof to a preselected permanent position.

6. Apparatus for adjusting an assembled snap spring mechanism having a support and an overcenter snap spring system supported thereon and movable with respect thereto, comprising means for applying a preselected load to a portion of said spring system and means for concurrently applying a bending force to said support to bend it permanently to an extent determined by snap motion of said system under said preselected load.

7. Apparatus for adjusting the spring mechanism of an electric switch having a contact movable by a spring system between two positions with respect to another contact and having supporting means for said spring system, comprising loading means for applying a preselected load to said spring system while it is in one of said two positions, means for moving the supporting means while said loading means is effective on said spring system to initiate the movement of said spring system to the other of said two positions, and means responsive to the movement of said spring system to said other position for limiting movement of said supporting means.

8. Apparatus for adjusting an electric switch having a contact carried by an over-center snap spring system between two positions with respect to another contact, operating means engageable with said spring system, and means for supporting said spring system for snap movement with respect thereto, comprising means for preselectively loading said spring system at the position where said operating means would normally be engaged, means for permanently moving the supporting means while the preselected loading is effective on the spring system to initiate snap movement of said spring system from one to the other of its said two positions, and means dependent on the movement of said spring system between said two positions for terminating permanent movement of said supporting means.

9. Apparatus for adjusting a switch having a contact movable by a spring system through an unstable position of maximum stress between preselected switching positions, and deformable supporting means for a portion of said spring system, comprising means for applying a preselected force to that portion of said spring system where the operating force would normally be applied, means effective concurrently with the application of said preselected force for permanently deforming said supporting means to cause said spring system to move between said switching positions, and electromagnetic means controlled by the switch being adjusted for limiting the deformation of said supporting means in response to said movement of said spring system between switching positions.

10. Apparatus for adjusting a switch having a contact movable by an overcenter snap spring system in a snap action manner between normal and abnormal positions with respect to another contact, and a deformable support for a portion of said spring system, comprising a movable actuating member, means responsive to movement of said actuating member for applying a preselected load to said spring system to move it from normal to abnormal positions, means responsive to movement of the actuating member for applying a second preselected load to said spring system, means operably associated with said actuating member and effective concurrently with the application of said second load for deforming said support to cause said spring system to

snap to said normal position, and means for terminating the deformation of said support when said spring system is snapped to said normal position.

11. Apparatus for adjusting a switch having a contact movable by an overcenter snap spring system between normal and abnormal positions with respect to another contact and a support for a portion of said spring system comprising means for applying a load to a movable portion of said spring system sufficient to move it from normal to abnormal positions, means for subsequently applying a preselected load to said spring system above a specified release force for the particular system, means effective concurrently with the application of said preselected load for permanently bending said support to cause said spring system to return by snap action to said normal position, and electromagnet means controlled by said switch for stopping the deformation of said support when said spring system is returned to said normal position in response to the bending of said support.

12. Apparatus for adjusting a self-returning type of switch having a contact movable by an overcenter snap spring system between a normal and an abnormal position, a second contact engageable by said movable contact in one of said positions, and a support for a portion of said spring system, comprising: means for moving the spring system from normal to abnormal position; means for loading said spring system with a load dependent on a predetermined release force for the assembled switch; a ram element engageable with said support; means for moving said ram element to deform said support to snap said spring system from abnormal to normal position; and means for terminating the operation of the last mentioned means in response to movement of the spring system from abnormal to normal position.

13. Apparatus for adjusting a self-returning type of switch having a contact movable by an overcenter snap spring system between a normal and an abnormal position, a second contact engageable by said movable contact in one of said positions, and a support for a portion of said spring system, comprising: means for moving the spring system to abnormal position; means for loading said spring system with a load dependent on a predetermined release force; deforming means dependent on the electrical energization of electromagnet means for deforming said support; means for moving said deforming means to deform said support to snap said spring system from abnormal to normal position; and means for deenergizing the electromagnet means in response to movement of the spring system from abnormal to normal position, to prevent further deformation of said support.

14. Apparatus for adjusting the assembled spring mechanism of a switch having normal and abnormal positions and having a contact carried by an overcenter snap spring system, a second contact engaged by said carried contact in one of said positions, and a support for a portion of said spring system, comprising: means imparting permanent movement to said support, loading means movable upon movement of said support moving means to apply preselected loads in predetermined sequence to said spring system, movable operating means, an electromagnetic clutch for retaining the support moving means and the operating means in engagement, preloading switch means for initially connecting said clutch means to a source of electric current to energize the clutch and render said loading means and said support moving means operable in response to movement of said operating means, means responsive to movement of said operating means in a direction to move said support for first causing said loading means to move said spring system to its abnormal position and then loading the spring system a predetermined amount depending on a desired release force, and means responsive to movement of said spring system from abnormal to normal positions upon movement of said support by said support moving means for deenergizing said electromagnetic clutch means and thereby limiting further permanent movement of said support by force exerted upon said operating means.

15. Apparatus for adjusting double throw and normally open switches having normal and abnormal positions and having a contact movable by an overcenter snap spring system, a second contact engageable by said movable contact in said abnormal position, and a deformable support for a portion of said spring system, comprising means for applying a deforming load to said support, loading means operable concurrently with movement of said deforming means for applying preselected loads in predetermined sequence to said spring system, movable operating means connected to said deforming means through an electromagnetic clutch, a normally closed preloading switch positioned to be opened by said operating means when the latter is moved in a direction to move said deforming means to deform said support, said preloading switch and the switch to be adjusted being connected in parallel with one another and in series with said clutch, whereby movement of said operating means is effective through said clutch to move said deforming means to cause said loading means to move said spring system to its abnormal position, and whereby upon further movement of said operating means the load on said spring system is reduced and said deforming means is effective to deform said spring support sufficiently to move said spring system to its normal position to deenergize the clutch and thereby limit deformation of said support.

16. Apparatus for adjusting double throw and normally open switches having normal and abnormal positions and having a contact movable by an overcenter snap spring system, a second contact engageable by said movable contact in said abnormal position, and a deformable support for a portion of said spring system comprising means for applying a deforming load to said support, loading means operable concurrently with movement of said deforming means for applying preselected loads in predetermined sequence to said spring system, movable operating means connected to said deforming means through an electromagnetic clutch, a normally closed preloading switch positioned to be opened by said operating means when the latter is moved in a direction to move said deforming means to deform said support, said preloading switch being connected in series with the electromagnetic clutch and the switch being adjusted being connected in shunt with said preloading switch, whereby said clutch is normally energized through said preloading switch but upon progressive movement of said operating means in a direction to cause said deforming means to deform said support, said loading means is caused to apply a load to said spring system to move

the latter from its normal to its abnormal position thereby energizing said clutch through the switch being tested whereby upon further movement of said operating means said preloading switch is opened, thereby energizing said clutch solely through said switch being tested, and whereby upon still further movement of said operating means said deforming means is caused to deform said support sufficiently to snap said spring system to its normal position, thereby deenergizing the clutch and preventing further deformation of said support.

17. Apparatus for adjusting double throw and normally open switches having normal and abnormal positions and having a contact movable by an overcenter snap spring system, a second contact engageable by said movable contact in said abnormal position, and a deformable support for a portion of said spring system comprising means for applying a deforming load to said support, loading means operable concurrently with movement of said deforming means for applying preselected loads in predetermined sequence to said spring system, movable operating means connected to said deforming means through an electromagnetic clutch, a normally closed preloading switch positioned to be opened by said operating means when the latter is moved in a direction to move said deforming means to deform said support, said switch being adjusted and the coil of said electromagnetic clutch and a source of electric current being connected in series, the preloading switch and said clutch coil and a source of electric current being connected in series, said operating means being movable through the following operative positions in a direction to cause deformation of said support; a position where said clutch coil is energized through said preloading switch; a position where said loading means is responsive to movement of said operating means to load said spring system to move the latter to its abnormal position, thereby energizing the clutch coil through the switch being adjusted; a position where said preloading switch is opened whereby said clutch coil is energized solely through said switch being adjusted; a position where said loading means is effective in response to movement of said operating means to reduce the load on said spring system to a predetermined release force; and a position where said deforming means is effective in response to movement of said operating means to deform said support sufficiently to move said spring system from its abnormal to its normal position, thereby deenergizing the clutch coil and causing the clutch to release the operating means.

18. Apparatus for adjusting normally closed switches having normal and abnormal positions and having a contact movable by an overcenter snap spring system, a second contact engageable by said movable contact in said normal position, and a deformable support for a portion of said spring system, comprising means for applying a deforming load to said support, loading means operable concurrently with movement of said deforming means for applying preselected loads in predetermined sequence to said spring system, movable operating means connected to said deforming means through an electromagnetic clutch, a normally closed preloading switch positioned to be opened by said operating means when the latter is moved in a direction to move said deforming means to deform said support, and a relay having a coil and a normally closed switch operable in response to energization of said coil; said relay, said electromagnetic clutch, said preloading switch and the switch being adjusted being connected by an electric circuit having first, second and third sub-circuits, the first sub-circuit having the preloading switch and the electromagnetic clutch in series, the second sub-circuit being in parallel with the first sub-circuit and having the switch being adjusted and the relay coil in series, and the third sub-circuit having the relay switch in parallel with the preloading switch; whereby movement of said operating means is effective through said clutch to move said deforming means to cause said loading means to move said spring system to its abnormal position, and whereby upon further movement of said operating means the load on said spring system is reduced and said deforming means is effective to deform said spring support sufficiently to move said spring system to its normal position to deenergize the clutch and thereby limit deformation of said support.

19. Apparatus for adjusting normally closed switches having normal and abnormal positions and having a contact movable by an overcenter snap spring system, a second contact engageable by said movable contact in said normal position, and a deformable support for a portion of said spring system comprising means for applying a deforming load to said support, loading means operable concurrently with movement of said deforming means for applying preselected loads in predetermined sequence to said spring system, movable operating means connected to said deforming means through electromagnetic clutch means, a normally closed preloading switch positioned to be opened by said operating means when the latter is moved in a direction to move said deforming means to deform said support, and a relay having a coil with a normally closed switch operable in response to energization of said coil; said preloading switch being connected in series with the electromagnetic clutch, the switch being adjusted and the relay coil being connected in series with one another and in parallel with that part of the circuit containing the preloading switch and the electromagnetic clutch, the relay switch being connected in parallel with the preloading switch, whereby said clutch is normally energized through said preloading switch but upon progressive movement of said operating means in a direction to cause said deforming means to deform said support said loading means is caused to apply a load to said spring system to move the latter from its normal to its abnormal position thereby energizing said clutch through the relay switch whereby upon further movement of said operating means said preloading switch is opened, thereby energizing said clutch solely through said relay switch, and whereby upon still further movement of said operating means said deforming means is caused to deform said support sufficiently to snap said spring system to its normal position to energize said relay coil to deenergize the clutch and prevent further deformation of said support.

20. Apparatus for adjusting a normally closed switch having normal and abnormal positions and having a movable contact carried by an overcenter snap spring system, a second contact engageable by said carried contact in said normal position, and a deformable support for a portion of said spring system, comprising means for applying a deforming load to said support, load-

ing means operable concurrently with movement of said deforming means for applying preselected loads in predetermined sequence to said spring system, movable operating means connected to said deforming means through an electromagnetic clutch, a normally closed preloading switch positioned to be opened by said operating means when the latter is moved in a direction to move said deforming means to deform said support, and a relay having a coil with a normally closed switch operable in response to electrical energization of said relay coil, said preloading switch being connected in series with said clutch coil and a source of electric current, said relay switch being connected in shunt with said preloading switch, said switch being adjusted being connected in series with said relay coil and a source of electric current, said operating means being movable through the following operative positions in a direction to cause deformation of said support; a position where said clutch coil is energized through said preloading switch; a position where said loading means is responsive to movement of said operating means to load said spring system to move the latter to its abnormal position, thereby energizing the clutch coil both through the preloading switch and the relay switch; a position where said preloading switch is opened whereby said clutch coil is energized solely through said relay switch; a position where said loading means is effective in response to movement of said operating means to reduce the load on said spring system to a predetermined release force; and a position where said deforming means is effective in response to movement of said operating means to deform said support sufficiently to cause said spring system to be moved from its abnormal to its normal position, thereby energizing the relay coil to open the relay switch and deenergizing the clutch coil to cause the clutch to release the operating means.

21. Apparatus for adjusting the assembled spring mechanism of a switch having an overcenter snap spring system movable between two positions and a support for said spring system comprising support moving means movable between a retracted position and a position operative on said support for moving the same to an adjusted position to snap the spring system from said one position to the other position, movable operating means, a clutch releasably connected between said support moving means and said operating means, said support moving means being releasable from said operating means in response to movement of said spring system from said one position to the other position, loading means for said spring system movable concurrently with movement of said support moving means for applying to said spring in the operative position of the support moving means, a load dependent upon a predetermined release force for the assembled spring mechanism, and means for releasing said clutch in response to the aforesaid snap movement of the spring system to terminate movement of said support.

22. Apparatus for adjusting the assembled spring mechanism of a switch having a contact

movable by an overcenter snap spring system between two positions, a second contact engageable by said movable contact in one of said positions, and a support for said spring system, comprising means movable between a retracted position and a position operative on said support for permanently moving said support, a clutch, movable operating means effective to move the support moving means through said clutch, and an electric circuit including said switch contacts operative to release said clutch upon opening of the circuit by movement of the movable contact away from the second contact whereby when said support is permanently moved to an extent sufficient to cause said spring system to snap from said one position to the other position said clutch is disengaged to prevent further permanent movement of said support.

23. Apparatus for adjusting an assembled mechanism having an overcenter snap spring system with a portion free to move between preselected positions and a support for mounting said spring system including a bendable member comprising means movable bodily between preselected positions for deforming the bendable member, means controlled by said latter means and engageable with said spring system before the deforming means engages the bendable member for applying a load to said spring system to move said free portion of the spring system to a preselected one of its positions, means operable upon predetermined movement of said deforming means for releasing a portion of said load applied to the spring system, manual means for effecting movement of said deforming means in a direction to deform said bendable member to move said spring system overcenter to move said free end portion to its other position, means for disengaging said manual means from the deforming means when said first portion moves from said one to its other position, means for moving the deforming means in a direction away from the bendable member upon disengagement of the manual means and the deforming means, and means for controlling the speed of movement of the deforming means in both directions of movement.

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