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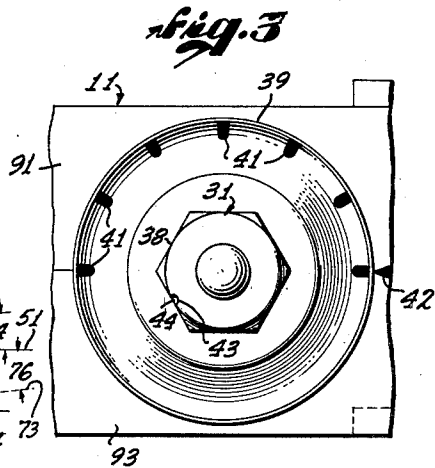
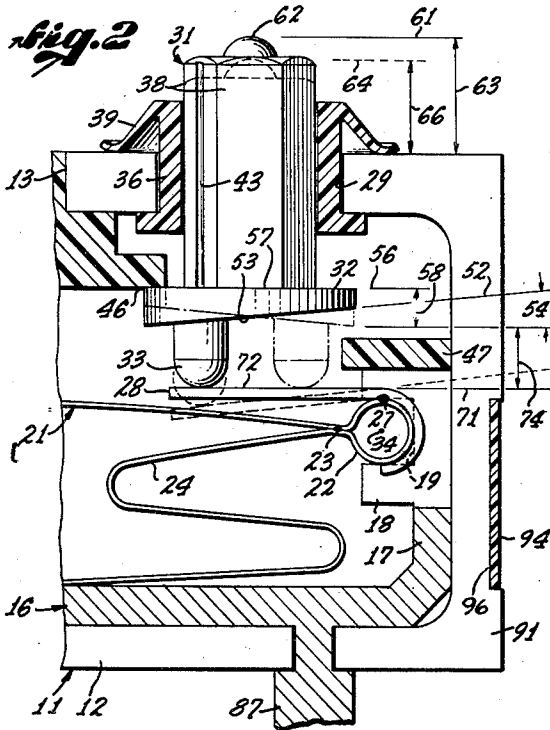
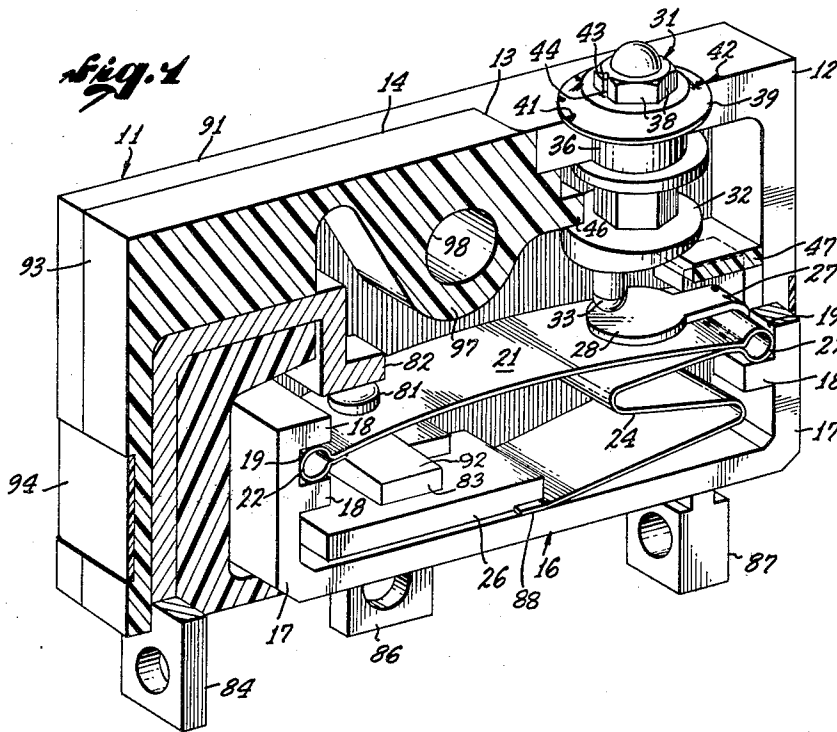
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SNAP-ACTING MECHANISM

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

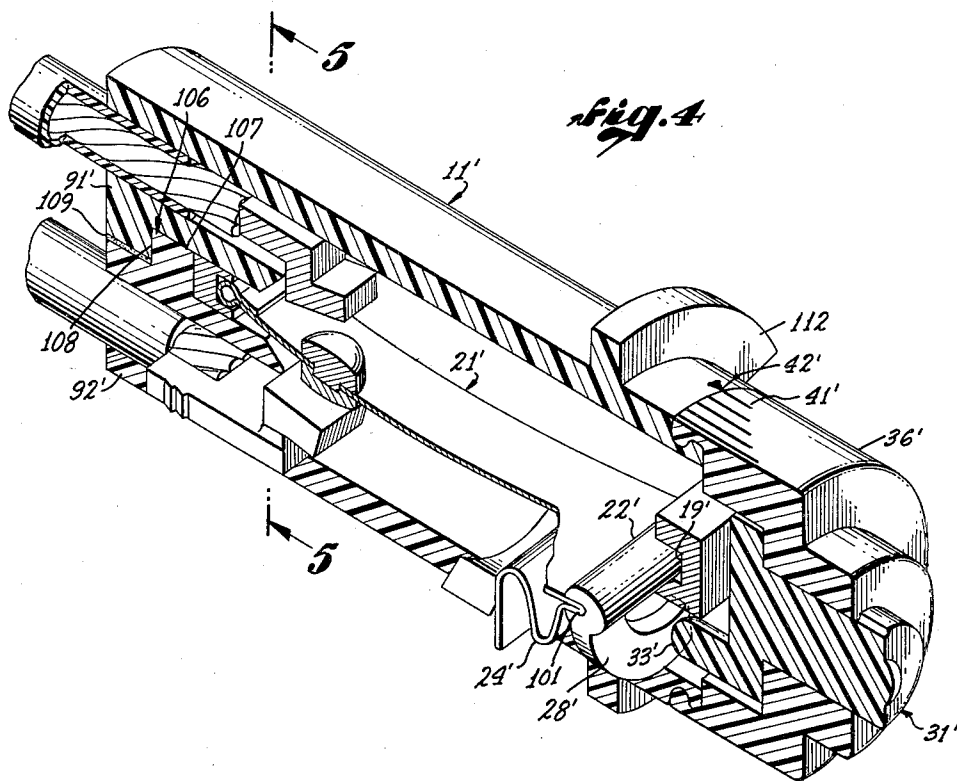
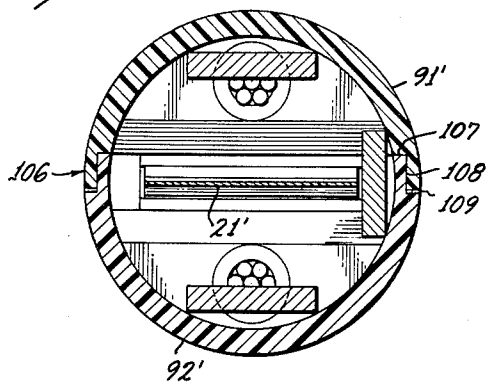


*fig. 5*



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## SNAP-ACTING MECHANISM

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This invention relates to snap-acting mechanisms, for example snap-acting electric switches.

It is an object of this invention to provide a snap-acting mechanism consisting of a bowed leafspring member which is unbroken throughout its length, being of uniform cross-section throughout its entire length.

It is another object of this invention to provide in a snap-acting leaf spring mechanism, a combined return spring and shunt, which is formed integral with the leaf spring, both of the integral parts, viz. leaf spring and return spring, being of uniform cross-section throughout the entire length of the integral members.

It is another object of this invention to provide improved means for actuating a bowed, snap-acting leaf spring from one stressed position to the other.

It is a further object of this invention to provide a snap-acting mechanism operated by a reciprocable push button, which may be adjusted in easy manner to provide an adjustable stroke of the push button, between operated positions of the snap-acting member or leaf spring.

It is a further object of this invention to provide an improved joint between two portions of the housing or case of an electrical equipment such as an electrical switch.

It is another object of this invention to provide an improved snap-acting leaf spring, wherein the pivot shafts at one or both ends of the spring are formed integral with the leaf spring itself.

It is a further object of this invention to provide simple and effective means to control and adjust the limit stops of a push button for operating a snap acting leaf spring.

In accordance with these and other objects which will become apparent hereinafter, preferred forms of the present invention will now be described in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view, broken away and partially sectioned, illustrating one form of snap-acting mechanism constructed in accordance with the present invention.

FIG. 2 is a fragmentary sectional elevation illustrating the operating end of the snap-acting mechanism.

FIG. 3 is a fragmentary plan view of the push button actuating mechanism for the snap-acting mechanism.

FIG. 4 is a sectioned perspective view of another form of the present invention.

FIG. 5 is a cross-section taken on line 5-5 in FIG. 4.

Referring to FIG. 1, 11 designates a case or housing, preferably made of insulating material. The housing is made in two parts separated at a parting surface or plane 12 offset at 13 and continued at 14.

Held within the housing 11 is a conducting frame 16 having upstanding portions 17 at each end thereof, from which project pairs of shelves 18. The spaces 19 between the shelves 18 form bearings for pivot shaft means formed at each end of a bowed resilient leaf spring 21. At each end, the leaf spring 21 is bent back on itself in the shape of a loop 22 to form a shaft means journaled in the space 19.

The total length of the leaf spring 21, including the shaft loops 22, is slightly greater than the distance between the bearing portions 19, and as a consequence the resilient spring 21 is compressed and bowed between the two arms 17 of the frame 16.

In FIG. 1 the right hand end of the leaf spring 21 constitutes the operating end. The shaft loop 22, after being bent back upon the main portion of the leaf spring 21 and welded at 23, is returned underneath the leaf spring

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21 to form a serpentine return spring and shunt 24. The shunt 24 has two reverse bends as shown, the end being secured against the body of the frame 16 underneath an insulating ledge 26. The leaf spring 21 and shunt 24 are made of a single strip of resilient metal of uniform cross-section throughout its length, and is unbroken as shown. The portion 24 serves as a return spring which keeps the leaf spring portion 21 biased to its upwardly bowed position, from which it is snapped to its lower bowed position by a push button means or member now to be described.

Joined to the operating shaft loop, as by spotwelding 27, is a tab or plate 28 made of metal, which is thick enough to be substantially rigid compared to the flexibility of the leaf spring 21, which is relatively thin. The tab 28 constitutes an operating member for snapping the leaf spring 21 to its downward position. It extends away from the axis of the shaft loop 22 generally parallel to and overlying the surface of the leaf spring 21. Reciprocally mounted in a bore 29 in the upper portion of the case 11 is a push button 31. On the lower end of the push button 31 is a disk 32, from the lower portion of which extends a rounded protuberance or button 33, that engages the operating tab 28 to snap the leaf spring 21 to its downward position. The protuberance 33 is located appreciably from the axis 34 of the shaft loop 22, and therefore pressure upon the push button 31 causes a torque to be applied to the shaft loop 22, which serves to snap the leaf spring 21 to its downward bowed position. When pressure is released from the push button 31, the resilient bias of the serpentine leaf spring portion 24, also acting through the shaft loop 22, snaps the leaf spring 21 back to its upper position, shown in FIG. 1.

The distance which the push button 31 is required to travel in order to snap the leaf spring 21 to its downward bowed position is dependent upon the distance from the axis 34 to the point of engagement between the protuberance or button 33 and the operating tab 28. This latter distance may be adjusted by rotating the push button 31 about its axis. This is effected by reciprocally mounting the push button 31 in a grommet 36, which may be rotated within the bore 29 of the housing 11. To simplify rotation of the push button 31, it is made hexagonal, so that its outer faces 38 may be engaged by a wrench or other suitable tool and appropriately rotated.

To indicate externally the position of the operating button 33, the grommet 36 is provided with an apron 39 having indicia 41 located around its edge, which cooperate with an index mark 42 on the case 11. The push button 31 is keyed to the grommet 36 by a groove 43 cooperating with an engaging an inwardly extending spline 44 on the grommet 36.

One of the advantages of the present structure is that the length of the case 11 is held to a minimum by placing the two pivot shafts 22 at virtually the end extremities within the case 11. This is achieved by operating the leaf spring 21 from within the region bounded by the shaft loops 22, i.e., bounded by two parallel planes substantially normal to the leaf spring 21 and located at the respective ends of the leaf spring 21, i.e., at the shaft loops 22. This advantage is attained while still retaining the full functional operating length of the resilient leaf 21, by providing the relatively rigid operating tab 28 joined to the pivot shaft portion 22 and extending back over the leaf 21 itself.

It is desirable to provide stops for limiting both the upward and downward excursions of the push button 31. To that end the case 11 is provided with an inwardly extending stop in the form of a shelf 46 located above the disk 32, and with a second inwardly extending stop in the form of another shelf 47 located below the disk 32, i.e., between the disk 32 and the operating tab 28.

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Shelf 46 forms an upper stop limiting the upward or unoperated travel of the push button 31, and shelf 47 forms a lower stop limiting the downward or operated travel of the push button 31. The lower shelf 47 is particularly important in that it prevents the push button 31 from being pushed downward an excessive amount after it has already effectuated downward snapping of the leaf spring 21. Such excessive downward travel on the part of the push button 31 might cause damage to the leaf spring 21 or might bend the tab 28, thereby disturbing the geometric relationship between the tab 28 and the leaf spring 21, which in many uses could be quite critical.

As noted, the push button 31 is rotatable to adjust the amount of travel required to cause the leaf spring 21 to snap to its downward position. When the push button 31 is rotated so as to bring the operating protuberance or button 33 to its farthest left position, the push button 31 must be depressed a maximum in order to snap the leaf spring 21. Conversely, when the rotational adjustment of the push button 31 is such as to bring the protuberance 33 to its farthest right position, then the travel required of the push button 31 is a minimum.

In accordance with the present invention the down stop position of the push button 31 is appropriately and automatically adjusted to compensate for the travel necessary to snap the leaf spring 21 over. This is effected by forming the annular undersurface of the disk 32 on an oblique angle with respect to a plane normal to the axis of the push button 31. Thus, as shown in FIG. 2, when the button 33 is farthest to the left, the thinnest portion of the disk 32 resides above the stop shelf 47, thus allowing maximum travel of the push button 31. Conversely, when the button 33 is farthest to the right the thickest portion of the disk 32 resides over the stop shelf 47 and allows minimum travel of the push button 31 before it engages its downward stop.

This design lends itself elegantly to adjustment and selection of parameters which provide a wide range of adjustability in the operating limits of the push button 31. Referring to FIG. 2, the reference line 51 is a horizontal reference line denoting simply zero angle of deviation from the horizontal. Reference line 52 is a reference line paralleling the undersurface 53 of the disk 32. Thus the angle 54 represents the obliquity of undersurface 53 from the horizontal. Similarly the reference line 56 is an angular line of reference paralleling the upper surface 57 of the disk 32. Thus, the angle 58 represents the obliquity of the surface 57 with respect to the horizontal. In the specific form shown in FIG. 2 angle 58 is zero, while angle 54 is about 5°.

Also in FIG. 2, the line 61 represents the height of the top surface 62 of the push button 31 when it is upward, in its unoperated position, with the stop disk 32 bearing against the stop shelf 46. The distance 63 represents the height of this surface 62 above an arbitrary horizontal reference surface, chosen in this case as the upper surface of the case 11. The line 64 represents the level of the surface 62 when the stop disk 32 bears against the lowermost stop shelf 47. The distance 66 represents the height of the surface 62 above the arbitrary reference surface, for this condition of operation. This distance 66 is only slightly less than the position of the reference line 64 at the moment when the leaf 21 snaps downward to its lower bowed position. That is to say, the parameters and dimensions are so adjusted that the stops 32 and 47 come into engagement very shortly after the leaf spring has snapped over. Similarly as pressure on the push button 31 is released, the stops 32 and 46 come into engagement very shortly after the leaf spring 21 has been returned to its upper bowed position by the bias of the serpentine return spring 24.

Reference line 71 is an angular reference line paralleling the upper surface 72 for the operating tab 28 in the unoperated position of the push button 31, i.e., when

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the leaf spring 21 is in its upper bowed position. Reference line 73 is an angular reference line paralleling the surface 72 when the push button 31 is in its lower position with the stops 32 and 47 in engagement. Thus angle 74 represents the obliquity between the surface 72 and a horizontal reference plane 51 in the unoperated position of the push button 31; and angle 76 represents the obliquity between the surface 72 and the arbitrary horizontal reference surface 51 when the push button 31 is in its lowermost position.

When the switch is designed so that angle 74 is zero, dimension 63 will be constant for all rotative positions of the push button 31, i.e., all positions of the operating button 33 with respect to the axis 34. Any changes in stroke length brought about by angular adjustment of the push button 31 are reflected in corresponding changes in dimension 66, i.e., the operated position of the push button 31. When angle 74 is zero, angle 58 is made zero, since the uppermost position of the surface 62 is constant for all rotative positions of the push button 31. Under this condition angle 54 is a maximum to compensate appropriately for all rotative positions of the push button 31.

At the other extreme, let it be assumed that the tab 28 is bent upward far enough, for example, to bring the angle 76 to zero. That is to say, the tab 28 is bent up a sufficient extent so that when the push button 31 is depressed, the leaf spring 21 snaps to its downward position just as the surface 72 comes horizontal. For this adjustment of the tab 28, the angle 54 on the disk 32 would be made zero, and the angle 58 of the upper surface 57 would be made a maximum. The net result of these changes in parameters would be that the dimension 66 would remain constant for all angular adjustments of the push button 31, and such angular adjustments would cause a progressive change in the dimension 63. From the above it will be clear that any desired adjustment of the initial setting of the tab 28 may be made, with a corresponding and correlated change in the surfaces 57 and 53, and a consequent control over the dimensions 66 and 63, as desired.

The snap acting mechanism has been illustrated in FIG. 1 as a double throw single pole electric switch, wherein the leaf spring 21 carries a pair of contacts 81 on opposite sides of the leaf. These contacts come into engagement respectively with stationary contacts 82 and 83 which are connected with respective external terminals 84 and 86.

The serpentine resilient member 24, in addition to serving as a return spring for the leaf member 21, also serves as a shunt carrying current directly and without sliding contact from the leaf 21 to the frame 16 and then to the terminal 87. To this end the lower end of the return spring 24 is bonded to the frame 16 at 88 and lies under the aforementioned insulating ledge 26 which projects from the far wall 91 of the case 11.

For ease of construction, stationary contact 83 extends the full width of, and is formed integral with, the terminal 86. It is overlaid with a precious metal covering 92 at the particular region where it is engaged by the movable contact 81.

The two halves 91 and 93 of the case 11 are held together by a tough plastic band 94 seated in a groove 96 formed around the case 11.

For external mounting of the switch mechanism, a solid portion 97 is formed within the interior of the housing 11 and through it passes a bore 98, by means of which the mechanism may be suitably mounted or anchored, without endangering the sealed nature of the interior of the casing 11.

Another configuration of the switch means is shown in FIGS. 4 and 5. In this embodiment the housing 11' is made cylindrical instead of rectangular, and the push button 31' operates on an axis substantially parallel to the length of the leaf spring 21'. To link push button

31' to the leaf spring 21', the shaft 22', instead of being formed by the shaping of the leaf spring itself, is made of a solid member (journaled in the recess 19') to which is integrally formed a semicircular yoke 28', which extends substantially at right angles to the surface of the leaf spring member 21'. Engaging the yoke 28' is a protuberance or button 33' formed on the end of the reciprocable push button 31'. As in FIG. 1, the push button 31' is rotatable about its axis to cause the button 33' to bear at adjustable points on the yoke 28', which are at varying radii from the axis of the shaft 22'. In this way the stroke of the push button 31' may be adjusted in a manner generally similar to that of the push button 31 of FIGS. 1 and 2.

In the embodiment shown in FIG. 4, the shaft 22' is provided with a slot 101, within which the leaf spring 21' is folded directly back on itself, emerging from the slot 101 to form the serpentine return spring 24'. It will be noted that the convolutions of the spring 24' extend generally parallel to the leaf spring 21', whereas in FIG. 1 the convolutions extended generally downward at right angles away from the surface of the leaf spring 21. However, the function of the serpentine leaf springs 24 and 24' is substantially similar, namely to apply a constant return bias torque to the shaft 22', to snap the leaf 21' to its downward position, whenever pressure is released from the push button 31'.

In the embodiment shown in FIG. 4, the cylindrical case 11' is formed of two substantially semi-cylindrical portions 91' and 92', which are joined together by a stepjoint shown at 106. In this joint the surfaces 107 and 108 are made substantially flush with each other, whereas a gap between adjacent surfaces is deliberately left at 109. In the assembly of the housing or case 11', cement is cotated the lower of the surfaces which are to form the gap 109, and then the two halves are brought together, with the surfaces 108 sliding tightly against each other, until the surfaces 107 bottom. This leaves the gap 109 filled with compressed cement to bond the two halves together. By virtue of this construction the casing halves are precisely positioned relative to each other, the thickness of cement in the joint is exactly as desired, and entrance of cement into the casing is prevented.

All terminals exit through the end wall, as shown in FIG. 5.

An annular mounting flange 112 encircling the housing 11' is provided for mounting the switch mechanism to any suitable chassis or base.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention which is therefore not to be limited to the details disclosed herein but it to be afforded the full scope of the claims.

What is claimed is:

1. Snap-acting mechanism comprising frame means having pivot bearing means at each end, resilient leaf spring means compressed and bowed between said pivot bearing means, and being of uniform, unbroken cross-section between said bearing means, one end of said leaf spring means being an operating end, shaft means at said operating end journaled in the adjacent corresponding pivot bearing means, said operating end of said leaf spring means being joined to said shaft means, a relatively rigid operating member joined to said shaft means and extending generally away from the axis of said shaft means, and push button means mounted for reciprocation substantially transverse of said operating member and engaging said operating member in a region substantially spaced from said axis of said shaft means, said push button means including a laterally projecting stop and said frame means including a stop projecting into the path of reciprocation of said push button means stop, one of said stops being annular in form and having at

least one face inclined with respect to a plane normal to the line of reciprocation of said push button means, whereby upon rotation of said push button means about its line of reciprocation, the relative stopping position of said push button means with respect to said frame may be adjusted.

2. Mechanism in accordance with claim 1 including another stop on said frame means, one of said frame means stops being positioned between said operating member and said push button means stop, and the other of said frame means stops being positioned on the opposite side of said push button means stop, whereby to provide limits for both the operated and unoperated positions of said push button means.

3. Snap-acting mechanism comprising frame means defining a pair of spaced pivot bearing means, resilient leaf spring means compressed and bowed between said pivot bearing means, shaft means formed at at least one end of said leaf spring means and journaled in the adjacent corresponding pivot bearing means, said shaft means being formed integral with said leaf spring means and having a looped bent-over configuration of the end of said leaf spring means, said bent-over end of said leaf spring means further having a serpentine configuration to form a return spring for said leaf spring means to return said leaf spring means from an astable bowed position in said frame to a stable bowed position therein, means for affixing the extremity of said bent-over end of said leaf spring means to said frame means, and reciprocally movable actuating means mounted in said frame means for actuating said leaf spring means from the stable bowed position in said frame to the astable bowed position therein.

4. Snap-acting mechanism comprising frame means defining a pair of spaced pivot bearing means, resilient leaf spring means compressed and bowed between said pivot bearing means, shaft means formed at at least one end of said leaf spring means and journaled in the adjacent corresponding pivot bearing means, said shaft means being formed integral with said leaf spring means and having a looped bent-over configuration of the end of said leaf spring means, said bent-over end of said leaf spring means further having a serpentine configuration to form a return spring for said leaf spring means to return said leaf spring means from an astable bowed position in said frame means to a stable bowed position in said frame means, means for affixing the extremity of said bent-over end of said leaf spring means to said frame means, a relatively rigid operating member mounted on said shaft means and extending away from the axis of said shaft means, and reciprocally movable push button actuating means mounted in said frame means for engaging said operating member so as to actuate said leaf spring means from said stable bowed position to said astable bowed position.

5. The mechanism defined in claim 4 in which said reciprocally movable push button actuating means is rotatable in said frame means and includes a longitudinal protuberance at the end thereof adjacent said operating member, said protuberance being eccentric with respect to the axis of rotation of said actuating means, so that rotation of said actuating means in said frame means variably adjusts the distance from the axis of said shaft means of the engagement of said protuberance with said operating member.

6. The mechanism defined in claim 4, wherein said push button actuating means includes a radially projecting annular stop member, and said frame means includes a pair of space stop members for selective engagement with said annular stop member respectively to limit the reciprocal movement of said actuating means.

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