May 28, 1940. R. H. BEACH 2,202,440

ELECTRICAL SWITCHING MEANS

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FIG.1.

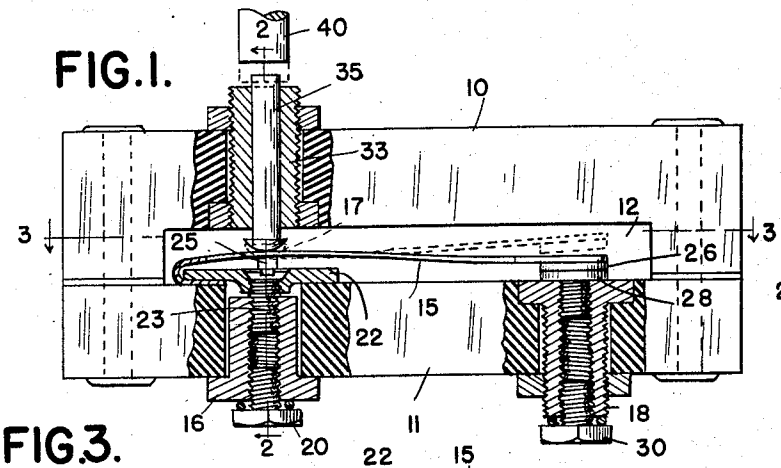


FIG.2.

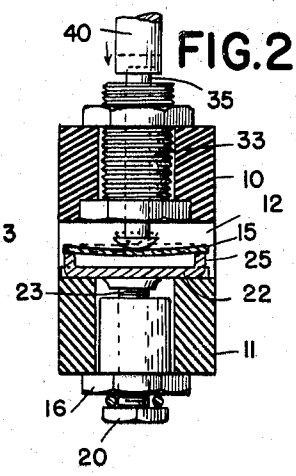


FIG.3.

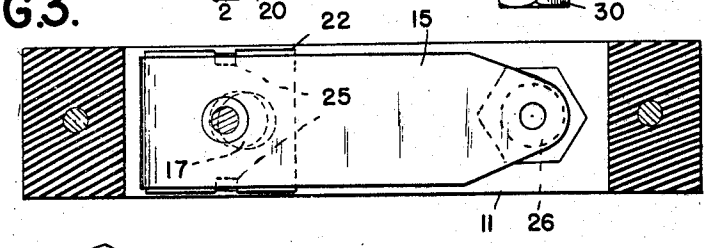


FIG.4.

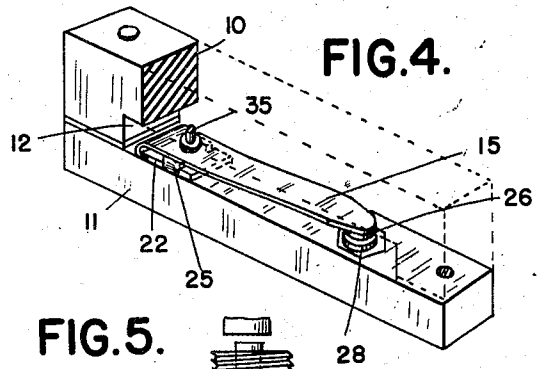


FIG.6.

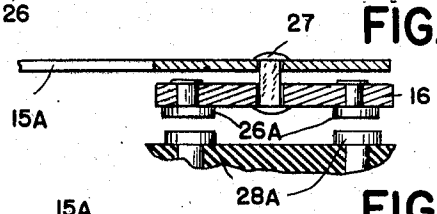


FIG.7.

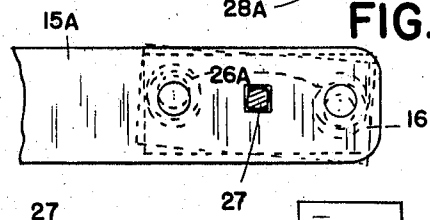
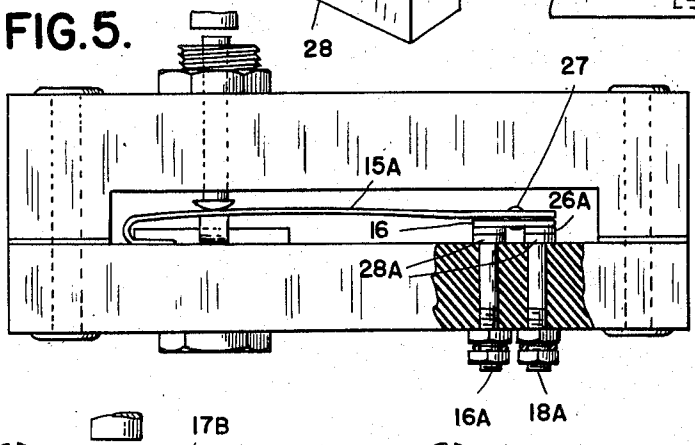


FIG.5.



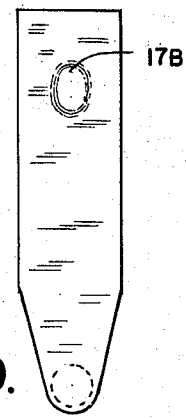


FIG.9.

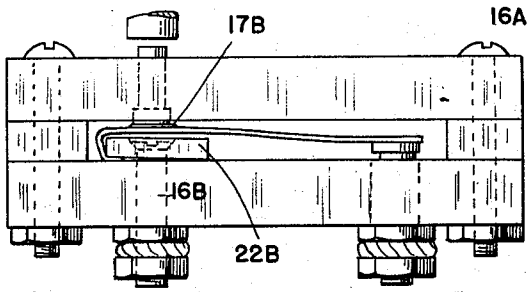


FIG.8.

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FIG.10.

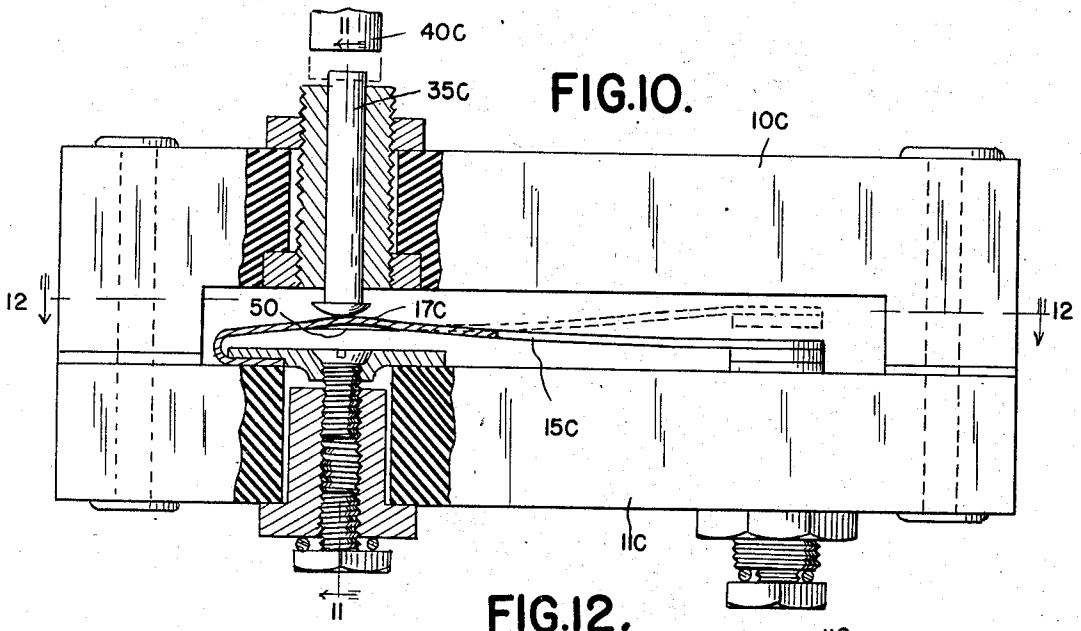


FIG.12.

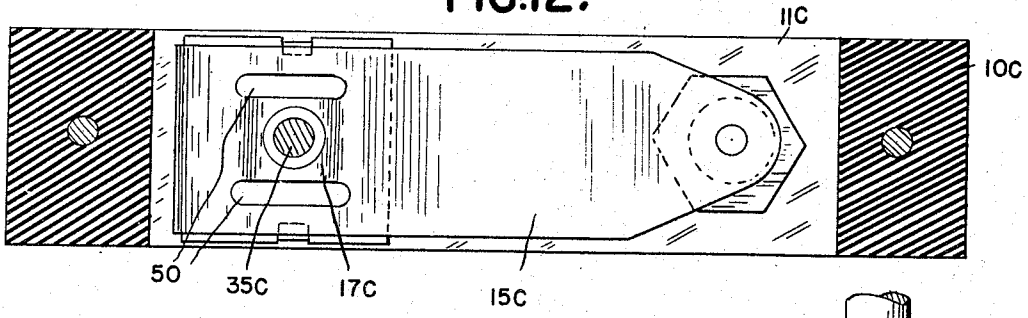


FIG.13.

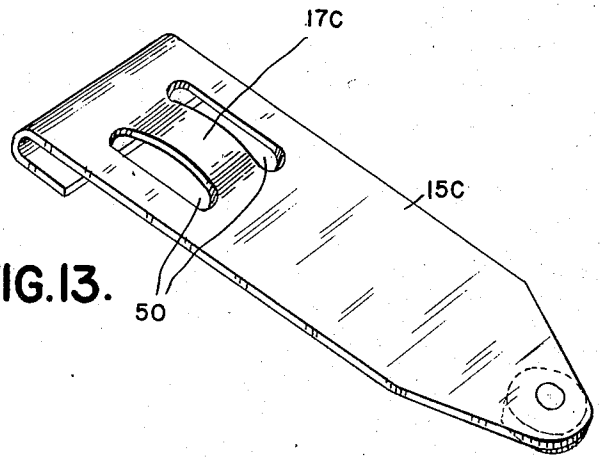
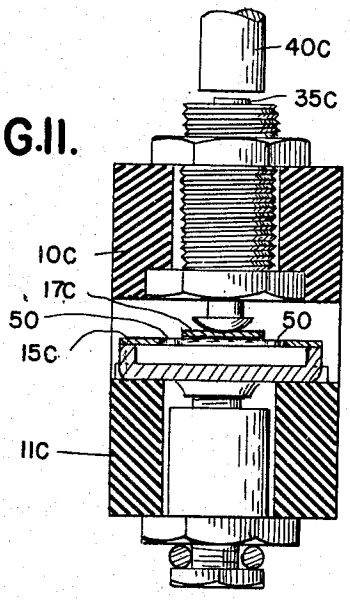


FIG.11.



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FIG.16.

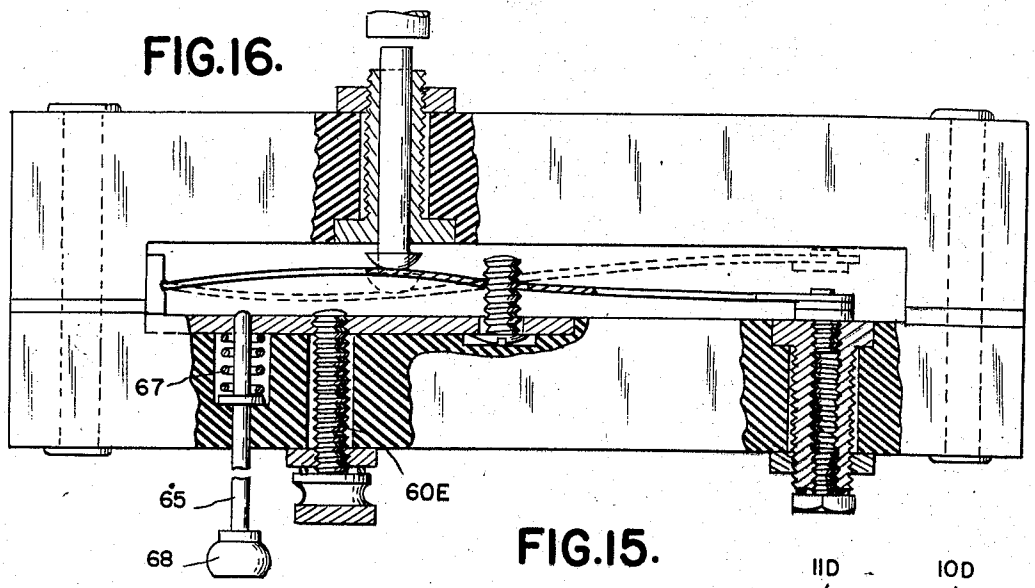
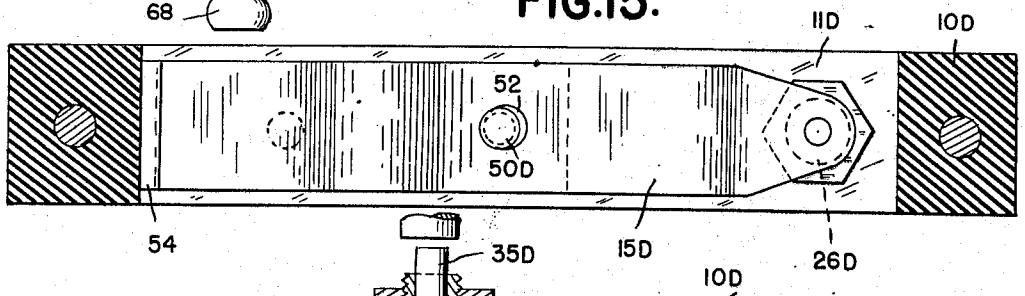


FIG.15.



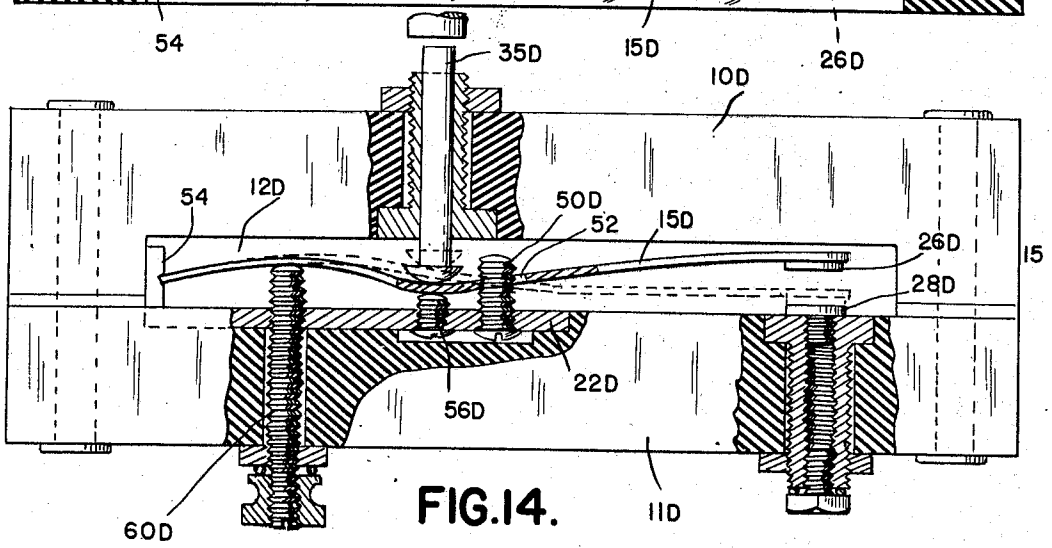


FIG.14.

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UNITED STATES PATENT OFFICE

2,202,440

ELECTRICAL SWITCHING MEANS

Ralph H. Beach, Ann Arbor, Mich.

Application August 7, 1937, Serial No. 157,973

11 Claims. (Cl. 200—67)

This invention relates to electrical switching devices, and particularly aims to provide an improved switch having a quick make and break action, and which is extremely sensitive in its response to slight pressure and travel of its actuating means.

A further object is a switch incorporating a switch blade arranged to maintain itself positively in one position when relaxed, but which when subjected to stress imposed by the actuating member is moved in a manner which provides for distortion of a part of the blade through and beyond a central position, the movement of such distorted portion being translated and multiplied to impart wide and quick movement to the contacts to sharply open or close them at a predetermined critical point in the travel of the actuating member.

Additional objects comprise the provision of such a switch which is of very simple, inexpensive and compact construction and reliable in operation, which incorporates few moving parts, requires no adjustment in service, is usable in any position, and is unaffected in its operation by vibration or bodily movement.

In the drawings:

Figure 1 is a side elevational view, partly broken away, of a preferred switch construction embodying the principles of this invention.

Figures 2 and 3 are cross sectional views taken respectively on the lines 2—2 and 3—3 of Figure 1, and looking in the direction of the arrows.

Figure 4 is a perspective view of the switch, also partly broken away.

Figure 5 is a view similar to Figure 1 of a modified construction.

Figures 6 and 7 are detailed sectional views upon a larger scale of the contact portions of the modified switch.

Figure 8 is a side view of a switch of another somewhat modified construction, and

Figure 9 is a plan view of the switch blade of such modified construction.

Figure 10 is a view similar to Figure 1 of another somewhat modified embodiment.

Figure 11 is a cross sectional view thereof similar to Figure 2, taken substantially on the line 11—11 of Figure 10 and looking in the direction of the arrows.

Figure 12 is a view thereof similar to Figure 3, taken substantially on the line 12—12 of Figure 3 and looking in the direction of the arrows.

Figure 13 is a perspective view of the modified spring switch blade.

Figure 14 is a view similar to Figure 1 of still another modified construction.

Figure 15 is a horizontal section thereof similar to Figure 3, taken substantially on the line 15—15 of Figure 14 and looking in the direction of the arrows.

Figure 16 is a view similar to Figure 1 of a still further somewhat modified construction, constituting a circuit breaker of the type requiring manual re-setting.

Referring now to the drawings, reference characters 10 and 11 designate the two halves of a rigid, hollow, elongated casing, box-like, but shown as open top and bottom, although this is optional. The casing may be formed of any suitable insulating material, but preferably of a substance, such as porcelain, which is virtually proof against warping and deflection, and which is not deleteriously affected by temperature or humidity conditions. The switch blade 15 is housed and extends longitudinally in the central open space 12, being connected at one end to a contact post 16 by means of a blade supporting plate 22, over and beneath the farther end of which it is folded, the part extending therebeneath being clamped in place by the the plate, which is tightened down by the screw 23. At its other end the blade is adapted to make and break connection with a contact 28 carried by a second contact post 18.

As best shown in Figure 1, contact post 16 comprises an internally threaded bushing extending through the casing and into the outer end of which is threaded the terminal screw 20, while the supporting plate 22 for the switch blade is secured to the post within the casing, as by means of screw 23. The switch blade is preferably formed of spring material, such as phosphor bronze, and is looped under the blade 22 at its secured end, extending over spaced lugs 25 carried by, and one of which projects upwardly from each side of, the plate 22, such lugs supporting the blade in spaced position above the plate. The other end of the blade carries a contact point 26, and the blade is so stressed that when relaxed it bears downwardly against the cooperating contact 28 carried by contact post 18, to which connection is adapted to be made as by terminal screw 30. It will be seen that the bowing of the blade which results in forcing contact 26 against contact 28 in the manner described is a curvature about a transverse axis, and that such bowing precludes curvature of the blade about a longitudinal axis. It will also be seen that the portion of the blade extending from

the lugs 25 to the back of plate 22 is so inclined that straightening of the aforementioned bow would result in the blade being inclined upwardly toward the right, as viewed in Figure 1, and contact 26 accordingly being carried away from contact 28. Such removal of the bowed contour which maintains the contacts closed, is effected by providing means for inducing curvature of the blade about a longitudinal axis, and comprises an actuating plunger 35 slidable in a bushing 33 carried by the casing section 10, in such position that its head may engage the opposite side of the blade to that engaged by the lugs 25, and at a point approximately midway between such lugs. It will readily be perceived that when such plunger is pushed downwardly, as viewed in Figure 1, a channeled configuration is imparted to the blade which overcomes the bowing about the transverse axis, straightening the blade as viewed from the side, so that it then extends upwardly at an angle determined by the height of lugs 25. Since the blade is formed of spring material, and the stresses of the two bowings exert their effort in directions perpendicular to each other, its deformation in the manner described results in one stress overcoming the other at a very sharply defined instant in time, as the pressure upon plunger 35 increases, as well as at a very definite position with respect to the travel of the plunger.

These factors impart to the contact-carrying end of the blade a snap action, and the bowing of the blade is such, and the stresses so balanced, that contact 26 remains in engagement with contact 28 until the instanct at which the effort to channel the blade longitudinally overcomes the transverse bowing, as a result of which instantaneous separation is secured. The longitudinal channeling effect induced by the plunger is clearly shown in Figure 2.

The over-center action may be intensified by slightly embossing the area engaged by the plunger, as at 17. Such embossed section is preferably raised out of the plane of the blade only .001 or .002 inch. When passing through the plane of the blade under the influence of the plunger, it imparts a more positive snap action to the free arm of the blade, while when relaxed it tends to reassume its raised position, helping also in inducing a rapid closing. Preferably I similarly emboss two over-lapping circular areas, as indicated in dotted lines in Figure 3. The centers of the embossed circles, lying approximately upon the longitudinal center-line of the blade, are spaced a distance approximating one-sixth their diameter. A single embossed area will function satisfactorily, but the double embossing in the manner described is definitely superior, although I have not been able to determine the reason, or the precise action which takes place. Whether single or double embossing is used, it will be seen that the effort and travel of the actuating plunger 35 which is necessary to throw the embossed section over-center (simultaneously channeling the adjacent portions of the blade to operate the switch), depends upon how near the center of the embossed section the head of the plunger strikes. With the plunger arranged to engage nearer the center of the embossed section, greater travel and less effort is required than when the head strikes nearer the periphery of the (or one of the) embossed circles. As indicated in Figure 3, in order to shorten the stroke, I preferably locate the center of the plunger about mid-way between the center and periphery of the circular embossed section which is farther from the free end of the blade, although if less driving power is available from the thermostat or other actuating agency, it may be preferable to locate the plunger upon a centerline which strikes nearer the center of the embossed section, this being a matter of design in each case.

Preferably, since it is important that the elastic properties of the blade be retained, plunger 35 extends but very slightly farther from bushing 33, when the switch is closed, than the plunger must be moved to actuate the switch, while the push rod or ram 40, or other operating element, overhangs the bushing, and so is capable of depressing the plunger only until the ram strikes the end of bushing 33, such travel of the plunger being insufficient to harm the blade or permanently deform the embossed section. When the pressure upon the plunger is relieved, the bowing about the transverse axis reasserts itself, and the emmossed section returns to its normal, raised position driving contact 26 back into engagement with contact 28. It will readily be perceived, however, that the switch could also be made to stand in open position, and to be closed when distorted by the plunger 35.

In the construction just described, the current passes through the blade 15. I have found that no harmful effects result, however, provided only that good contact points or pads, of silver or the like, be provided, and that the blade be heavy enough to carry the current without heating. In Figures 5, 6 and 7 is shown a modified construction in which the blade 15A, although similarly mounted and actuable, is not utilized to carry current, but carries upon its end, in place of a single contact point, a bridging contact bar 16 having contacts as 26A at its opposite ends, engageable and disengageable, upon movement of the blade, with respect to a pair of fixed contacts 28A, one carried by each of the two contact posts 16A—18A. The contact bar is rockable with respect to the contact blade, but not rotatable about a perpendicular axis, being carried by a loose rivet 27, the shank of which, as well as the aperture in the contact bar through which it extends, is squared to prevent turning of the contact bar.

In the embodiments of Figures 8 and 9 the embossed section 17B, which passes over-center when the switch is actuated, is of proportionately larger size than in the embodiments previously described, and of oval shape rather than formed of a pair of overlapping circles, this also being definitely better than a circular embossed area. In this case the embossing may act as the principal actuating means for the blade, which, at its secured end, is looped under and held beneath a holding plate 22B secured in place by a terminal screw 16B, to the outer end of which one of the switch connections is made. The plate 22B is countersunk to accommodate the screw 16B, and also to provide clearance for the embossed section when pushed downwardly through the plane of the blade to the "switch open" position in which it projects from the under side, the embossed section then simply projecting into the countersunk top of the screw hole.

Another somewhat modified construction, shown in Figures 10 to 13 inclusive, incorporates a spring type switch blade 15C similarly supported in a casing formed of a pair of porcelain sections 10C—11C. This is also shown as biased to close, although movable to open position when the operating plunger 35C is depressed, as by a

ram 40C, to deform an actuating section 17C. With the exception of the blade itself, the several elements of this switch may be similar to the equivalent parts of the embodiments first described, and it is believed that no detailed redescription of such analogous parts will be required. They have been designated by like reference characters distinguished by the addition of the letter "C" to each.

The blade, in this embodiment, is not embossed to provide, as in the previous embodiments, an actuating portion approximating a partly spheroidal or oblate spheroid form. Instead, a similarly positioned section thereof, designated 17G, is partly separated from the remainder of the blade by a pair of parallel longitudinal slots 50, the portion 17C between them being slightly elongated or stretched, so that it assumes a partly cylindrical contour and tends to project upon one side or the other of the plane of the blade. The blade and such portion are so biased that portion 17C tends to reassume its upwardly projecting position, if the switch is intended to be self-closing.

When plunger 35C is depressed, the actuating portion 17C is forced downwardly and passes quickly through the plane of the blade with a snap action to a similar position in which it projects from the other side, forcing the free end of the blade to move sharply upwardly to the position indicated in dotted lines in Fig. 10 separating the contacts.

A further somewhat modified construction, shown in Figs. 14 and 15, incorporates an actuating section which also tends to move only in one direction and in a wavular manner. In this embodiment the blade, 15D, is also of the spring type, and may be somewhat longer proportionately, as also is the support and casing assembly 10D—11D. The actuating portion of the blade, which snaps over-center to move the free end, carrying the contact 26D, toward and from the fixed contact 28D, is stressed by and lies to the left (as viewed in the drawings) of a post formed by a screw 50D, the screw extending through an aperture 52 in the blade, which aperture is larger than the screw, and preventing the blade from flattening to the substantially plane form which it would assume relaxed. The other end of the blade is held in a suitably positioned transverse slot in an upturned end portion 54 of the plate 22D, which also supports the screw 50D.

The actuating plunger 35D engages the actuating section of the blade near one end, and preferably quite close to the screw 50D, as clearly shown in Figure 14, and a stop screw 56D carried by the plate 22D preferably backs the actuated section of the blade upon the side opposite to that engaged by the plunger 35D to limit downward bowing of such portion of the blade. If it is desired that the switch be self-closing when the pressure upon plunger 35D is relieved, the entire actuating section of the blade is not allowed to bow downwardly under the drive of the plunger, a stop screw 60D, which also constitutes one of the contact portions, being so located, at a point approximately half way between the point of engagement of plunger 35D and the end portion 54, as to prevent the entire section of the blade from being moved downwardly through the central plane. When the pressure upon plunger 35D is relieved, the entire actuating section normally lies in a (substantially) partly cylindrical upwardly bowed state, as indicated in dotted lines, while when the plunger is depressed, the deformation of the actuating section imparts an S-shaped or full wave curve thereto, only the portion to the right of stop screw 60D being moved downwardly through the plane of the blade. Such section may be somewhat shorter than the left half of the wave, which remains in the upwardly bowed condition, and/or the biasing of the blade in its entirety may be sufficient to return the depressed portion to the upwardly bowed condition when the pressure upon the plunger is relieved. A snap action is similarly imparted as the part moved by the plunger passes through the center, driving the movable contact sharply to and from the fixed contact.

If it is desired to give the switch the action of the circuit breaker, which remains open until manually reset, it is only necessary to allow unrestrained down-bending of the entire actuating section, as shown in Figure 16. The screw 60E in this embodiment will be seen not to interfere with the downward curvature of this portion, and screw 56D may also be eliminated if desired. Manual means may be provided for returning the spring to the upwardly closed position, such as the plunger 65, normally held away from the under side of the actuating section of the blade by a spring 67, but movable to press the same upwardly and return the movable contact to closed position.

What I claim is:

1. Switching means comprising in combination with a support and a resilient elongated switch blade secured at its one end thereto and free at its other end to move to make and break an electrical connection, said blade having a deformed area near its secured end offset out of plane, spaced means supporting one face of said blade on either side of said deformed area, said supporting means being substantially aligned transversely of the blade with the deformed area, means including a presser member bearing against the other face of the blade within said deformed area and movable to throw the free end of the blade in a desired direction, and means blocking movement of said presser member beyond a predetermined position, to protect the deformed area of the blade against undesired further distortion.

2. Electrical switching means comprising in combination with a support, a resilient switch blade secured at its one end thereto and free at its other end to move to make and break an electrical connection, said blade having an embossed section comprising a pair of overlapping substantially circular areas embossed to project from the same face of the blade, and means for deforming the embossed section to throw the free end of the blade in a desired direction.

3. Electrical switching means as set forth in claim 2 in which the centers of said overlapping circular embossed areas lie substantially on the longitudinal centerline of the blade.

4. Electrical switching means as set forth in claim 2 in which the centers of said overlapping circular embossed areas lie substantially on the longitudinal centerline of the blade and near the secured end thereof, the blade being biased to maintain its free end in a position opposite to that in which it is thrown by deformation of said embossed area.

5. Electrical switching means as set forth in claim 2 in which the centers of said overlapping circular embossed areas lie substantially on the longitudinal centerline of the blade and near the secured end thereof, and said means for deforming the embossed area comprises a presser mem-

ber engageable therewith eccentrically of one of said circular areas.

6. Electrical switching means as set forth in claim 2 in which the centers of said overlapping circular embossed areas lie substantially on the longitudinal centerline of the blade and near the secured end thereof, and said means for deforming the embossed section comprising a presser member also disposed substantially on the longitudinal centerline of the blade and between the center and the periphery of the circular embossed area nearer the secured end of the blade.

7. Switching means comprising in combination with a support and a resilient switch blade secured at its one end thereto and free at its other end to move to make and break an electrical connection, said blade having a deformed portion near its secured end offset out of plane on one side of the blade, means for moving said deformed portion of the blade to throw the free end thereof in a desired direction, said means comprising a presser member engageable with said deformed portion, means blocking movement of said presser member beyond a predetermined position, to protect the deformed portion of the blade against undesired further distortion, supplemental supporting means backing the blade, near its secured end, upon either side of said deformed portion and from the opposite face of the blade to that engaged by the presser member whereby the presser member may also tend to channel the blade longitudinally, a medial portion of the blade being biased to urge its free end in one direction.

8. Electrical switching means comprising in combination with a support, a resilient switch blade secured at its one end thereto and free at its other end to move to make and break an electrical connection, said blade having a non-circular embossed section projecting from one face thereof and elongated longitudinally of the blade, operating means for the blade comprising a presser member engageable with the embossed section for moving the same through the plane of the blade to throw said free end thereof in a desired direction, and spaced supporting means for the blade engaging the under side thereof opposite to the face engaged by the presser member and upon either side of the point of engagement of such member and of the embossed section, whereby the presser member may also tend to channel the blade longitudinally.

9. Electrical switching means as set forth in claim 2 in which the centers of said overlapping circular embossed areas lie substantially on the longitudinally centerline of the blade, the blade being medially stressed to maintain its free end in one position, and spaced supporting means for the blade engaging the opposite face thereof to that engaged by the presser member and upon either side of the point of engagement of said member and of the embossed section, whereby the presser member also tends to channel the blade to straighten said medial stressing.

10. Switching means comprising in combination with a support and a resilient switch blade secured at its one end thereto and free at its other end to move to make and break an electrical connection, said blade having a deformed portion near its secured end offset out of plane on one side of the blade, means for moving said deformed portion of the blade to throw the free end thereof in a desired direction, said means comprising a presser member engageable with said deformed portion, means blocking movement of said presser member beyond a predetermined position, to protect the deformed portion of the blade against undesired further distortion, said deformed portion being located substantially equidistant from the sides of the blade, and separated therefrom by slots extending through the blade and longitudinally thereof.

11. Switching means comprising in combination with a support and a resilient switch blade secured at its one end thereto and free at its other end to move to make and break an electrical connection, said blade having a deformed portion near its secured end offset out of plane on one side of the blade, means for moving said deformed portion of the blade to throw the free end thereof in a desired direction, said means comprising a presser member engageable with said deformed portion, means blocking movement of said presser member beyond a predetermined position, to protect the deformed portion of the blade against undesired further distortion, said deformed portion being located substantially equidistant from the sides of the blade, and separated therefrom by slots extending through the blade and longitudinally thereof, said deformed portion being formed by elongating the section of the blade between such slots, whereby said portion tends to project from one side of the blade, and is curved about an axis substantially parallel to the axis of bending of the blade.

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