

April 30, 1940.

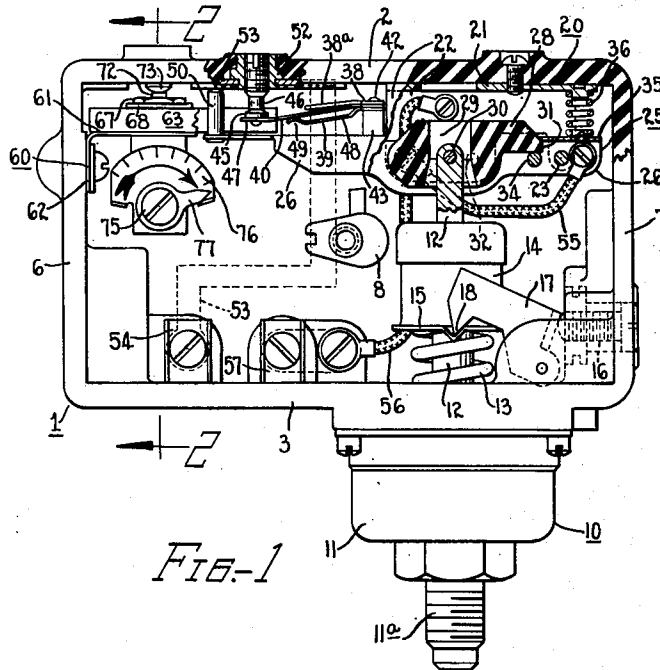
E. J. DILLMAN ET AL

2,199,357

SWITCH

Filed Dec. 19, 1936

2 Sheets-Sheet 1



April 30, 1940.

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SWITCH

Filed Dec. 19, 1936

2 Sheets-Sheet 2

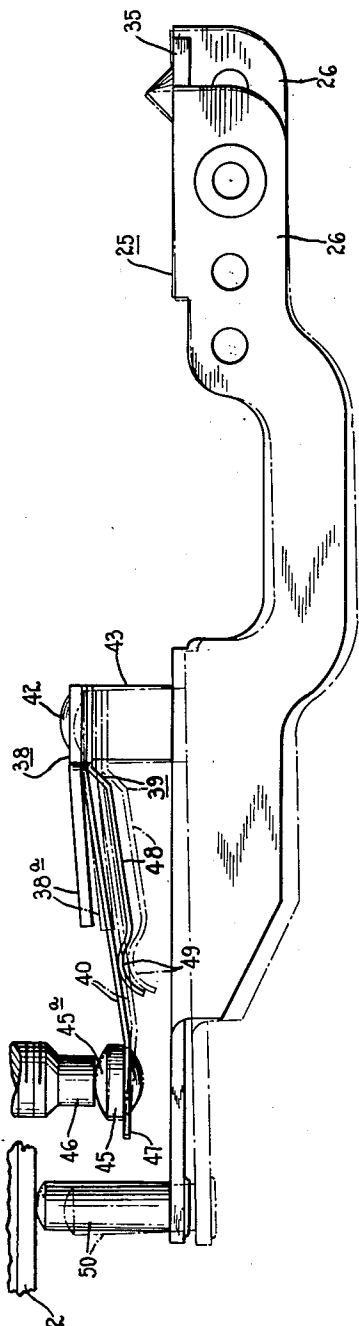


Fig. 4

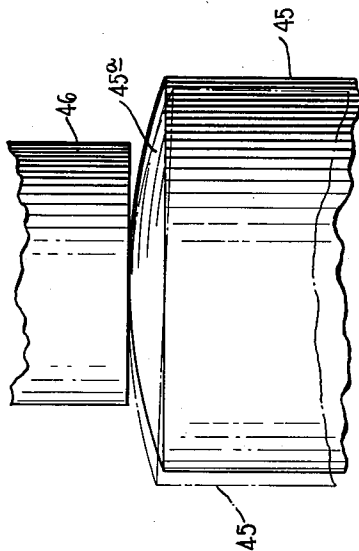


Fig. 5

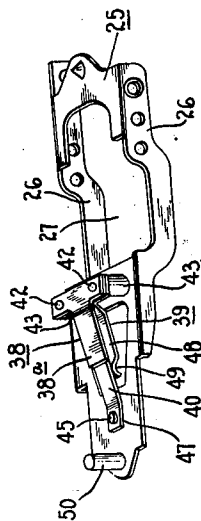


Fig. 3

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2,199,357

SWITCH

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Application December 19, 1936, Serial No. 116,750

3 Claims. (Cl. 200-164)

Our invention relates generally to the method and means for controlling an electric circuit and more particularly to the method of and switch for controlling an electric circuit.

One of the objects of our invention is to provide a new and improved method of closing a switch in a manner such that the time period of usefulness of the switch contacts is materially prolonged.

Another object of our invention is to provide a new and improved switch of a character such that fusing of the contacts is very unlikely to occur.

Another object of our invention is to provide a switch having a new and improved closing action to provide good contact between the contact members.

Another object of our invention is to provide a new and improved switch in which the bouncing or relative vibratory action between the contacts following initial closing of the switch is minimized to aid in avoiding fusing of the contacts.

Another object of our invention is to provide a switch in which, during the bouncing or relative vibratory action of the contacts following initial closing of the switch, the contact engaging surfaces engage at successive areas on each of the contact surfaces to still further aid in avoiding fusing of the contacts.

Another object of our invention is to provide a switch mechanism employing an armature and magnet for determining the differential of operation of the switch and to provide new and improved adjustment means for adjusting the differential of operation of the switch.

Another object of our invention is to provide a switch having adjusting means for changing the differential of operation of the switch and for indicating the differential setting of the switch.

The invention consists in the improved construction and combination of parts, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings, to be taken as a part of this specification, we have fully and clearly illustrated our invention, in which drawings—

Figure 1 is a side view of a control device embodying our invention, the cover of the device being removed to show the arrangement of the parts, certain of which are shown in elevation and other of which are broken away and shown partly in section;

Fig. 2 is a view shown in vertical cross section taken along the line 2—2 of Fig. 1;

Fig. 3 is a view shown in perspective of parts of our device including parts of our improved switch;

Fig. 4 is an enlarged view shown in side elevation of parts of our device including our new and improved switch and illustrating the closing action of our switch, and

Fig. 5 is an enlarged view shown in side elevation of a pair of cooperative contacts of our switch and illustrating the engaging action of the contacts.

Referring first to Figs. 1 and 2 of the drawings, the control device shown for the purpose of illustrating our invention includes a supporting member, preferably a casing 1 that is rectangular in shape having a top wall 2, bottom wall 3, side walls 4, 5 and end walls 6, 7. The casing 1 is preferably constructed of a good electric insulating material and the side wall 4 thereof is preferably removable as a cover. The cover 4 may be secured in place by a screw that may screw thread into a boss 8 formed integral of side wall 5.

Carried by the casing 1 and secured to the bottom wall 3 thereof there is an actuator which, among other types of actuators, may be employed to actuate our hereinafter described switch, the actuator shown being a pressure responsive power element designated in general by the numeral 10. The power element 10 is not shown nor described in detail since such devices are well known in the art to which this invention appertains but, in general, such devices comprise an expansible chamber which may include a bellows (not shown) that is usually enclosed in a cap-like casing, as at 11, the expansible chamber being communicable with a source of pressure through a fitting 11^a. Carried by and movable with the bellows there is a thrust rod 12 that projects upward into the casing 1 through an aperture in the casing bottom wall 3. The power element 10 is operable to move the thrust rod 12 upward and surrounding the rod, within casing 1, there is a helical coil spring 13 which, in the present instance, is under compression acting to move the thrust rod 12 downward. The power element 10 and spring 13 thus oppose each other and when one overcomes the force exerted by the other, the thrust rod 12 is moved in a corresponding direction. The upper end of the coil spring 13 may abut a movably adjustable abutment member 14 which, in the present instance, is in the form of a cap that fits over an upper end portion of the

spring and at its lower or open end preferably has an outturned annular flange 16. The position of the abutment member or cap 14 may be adjusted by means of an adjusting screw 16 acting through a lever 17. The lever 17 is pivotally supported within casing 1, and preferably one end thereof is bifurcated or forked for straddling the cap 14 and has downwardly directed, pointed, extended portions 18 for engaging in upwardly facing indentations or sockets in the cap flange 15. The adjustment screw 16 abuts the lever 17 adjacent the fulcrum thereof and may be screw threaded into the casing end wall in a manner such that the screw will be accessible from externally of the casing.

Disposed within the casing 1 there is a metallic, channel-shaped supporting member 20 that is secured to the casing top wall 2 and overlies the power element thrust rod 12. The supporting member 20 has a base 21 and spaced, depending, substantially parallel sides or flanges 22, the member 20 being arranged such that its flanges 22 extend longitudinally of the casing 1. A shaft 23 has its opposite ends secured in and to the flanges 22 and a movable supporting or carrier member 25 in the form of a lever is pivoted adjacent one of its ends on the shaft 23. The lever 25 is of plate-like form and preferably has downturned, substantially parallel side flanges 26 that position between the depending side flanges 22 of the supporting member 20 and are provided with aligned apertures to receive the shaft 23. The lever 25 extends longitudinally of the casing 1 and is provided with an opening 27 therethrough intermediate its ends, as is more clearly shown in Fig. 3, the opening 27 overlying and receiving the upper end of the power element thrust rod 12. Positioned in the opening 27 between the lever side flanges 26 there is a second lever 28, and this lever 28 is preferably constructed of electric insulating material. The lever 28 has a vertical aperture 29 therethrough in which an upper end portion of the power element thrust rod 12 projects, the rod being pivotally connected adjacent its upper end to the lever 28 by a pin 30. The lever 28 extends longitudinally of lever 25 and has one end, as at 31, that is disposed toward the shaft 23 of lever 25, and intermediate this end of the lever 28 and the pivot pin 30 the lever 28 is provided with an aperture to receive pins or trunnions 32 secured in and to the depending side flanges 22 of the channel-shaped support 20. An abutment member 34, which may be in the form of a pin, has its opposite ends secured in and to the side flanges 26 of lever 25, intermediate the fulcrums of the levers 25 and 28, and the lever 28, adjacent its free end 31, rests on the abutment pin 34. When the power element 10 moves the thrust rod 12 upwardly, the lever 28 will be pivoted in a clockwise direction, as seen in Fig. 1, and through the abutment or pin 34 will pivot lever 25 in a counterclockwise direction. The lever 25 has a relatively short lever arm 35 extending toward the casing end wall 7, and acting downwardly on the lever arm 35 there is preferably a helical coil spring 36 that acts to pivot lever 25 in a clockwise direction. In the present instance, the spring 36 is under compression, one end thereof abutting the underside of the base 21 and the other end abutting the upper surface of lever arm 35.

Carried by the lever 25 adjacent its free end there is a rigid metallic strip or backing member 38 having a downwardly extending portion 38^a, a flexible metallic strip or leaf spring 39 and

a resilient or flexible metallic strip or blade 40. The blade 40 is interposed between the rigid strip 38 and the leaf spring 39, the spring being beneath the blade and the strip 38 being above the blade. The rigid strip 38, leaf spring 39 and blade 40 are T-shaped, in the present instance, and the cross pieces thereof are provided with aligning apertures for receiving rivets 42 that secure the strip 38, spring 39 and blade 40 together and to the top of laterally spaced, upwardly extending posts 43 that are carried by and rigidly secured to the lever 25 intermediate the ends of the lever. The strip 38, spring 39 and blade 40 are spaced above the upper surface of lever 25 by the posts 43 and extend from the posts longitudinally of the lever toward the free end thereof, the blade 40 being longer than either the strip 38 or spring 39, and adjacent its free end carrying an upwardly facing contact member 45. The upper surface of the contact member 45 is preferably rounded or convex, as at 45^a, see Figs. 4 and 5, and the contact 45 cooperates with a depending contact member 46 for controlling an electric circuit, the contact member 46 preferably having a flat contact surface for engagement by the rounded contact surface 45^a. As seen in Figs. 1 and 4, the blade 40 is preferably formed such that it extends downward from, and at an angle to its fixed end portion or cross piece that seats on the posts 43. Adjacent its free end the blade 40 is bent in a manner such that the end portion thereof, as at 47, to which the contact member 45 is secured, extends upwardly from the bend at a slight angle, the purpose of which is hereinafter described. The leaf spring 39 preferably has a downwardly directed, offset portion 48 intermediate its ends and an end portion of the spring, at its free end, is preferably bent upwardly, as at 49, providing an upwardly facing, rounded or convex surface for engagement with the underside of blade 40. The rounded spring portion 49 provides for a definite point of force transmission between the blade 40 and spring 39, and for best vibration dampening results the spring should engage the blade as near the free end of the blade as is practical. The leaf spring 39 preferably is arranged such that it urges the blade 40 upwardly, holding the blade under a slight tension force when the blade is in open circuit position. The leaf spring 39 and blade 40 being of different lengths and shapes have different vibratory frequencies which, together with the friction between the blade and spring, serve to dampen vibrations of the blade and in so doing materially reduces the bouncing action of contact member 45 on contact member 46 on initial engagement of the contact members. The rigid strip 38 is preferably bent having a downwardly extending portion 38^a that follows in general the shape of the blade 40 but preferably extends at a slight angle to, or is spaced from the upper face of the blade, as shown.

Carried by the lever 25 and rigidly secured thereto adjacent its free end there is an upwardly extending post 50 that is adapted to engage the underside of the casing top wall 2 for limiting movement of the lever in a clockwise direction, as seen in Fig. 1. A metallic, open ended, tubular fitting or terminal post 52 is preferably secured in and to the top wall 2 in overlying relation to the contact member 45, and in the terminal post 52 the contact member 46, which is preferably in the form of a screw, may be adjustably screw threaded and be accessible from externally of the casing 1. The contact member 46 is adjusted to

a position such that on closing of the switch the contact member 45 will engage the contact member 46 prior to engagement of the stop member 50 with the casing top wall 2. Secured to the terminal post 52 is one end of a conductor member or jumper strip 53, which jumper strip, in the present instance, is embedded in the casing top wall 2, side wall 5 and bottom wall 3, the other end of the jumper strip 53 being connected to a terminal post 54 secured in and to the casing bottom wall 3 adjacent the cover 4. Preferably a jumper wire 55 connects the lever 25 and its metallic supporting member 20, and a jumper wire 56 connects the supporting member 20 and a terminal post 57 that may be disposed in the casing 1 adjacent the other terminal post 54. Lead wires from a device, the operation of which may be controlled, may be connected to the main terminals 54 and 57 and when the switch is closed the following circuit will be established: From the contact member 45 through blade 40, lever 25, jumper wire 55, supporting member 20, jumper wire 56, terminal post 57 through the device to be controlled, terminal post 54, jumper strip 53, post 52, contact member 46 and back to the contact member 45.

Disposed within the casing 1 and preferably secured to the casing end wall 6 there is a supporting member 60 that is preferably a resilient, or flexible, plate or hinge member preferably formed of spring metal having a horizontally disposed portion 61 that is under tension acting to spring upward. The horizontally disposed portion 61 preferably extends from the casing end wall 6 toward and terminates adjacent the free end of lever 25, the horizontal portion 61 and lever proper being preferably in substantially the same horizontal plane. The supporting member or spring plate 60 may have a downturned flange portion 62 that may be provided with apertures for receiving screws, or other suitable means, for securing the supporting member 60 to the casing end wall 6. Carried by and supported on the upper surface of the spring supporting member 60 there is a magnet 63, preferably of the so-called U-shaped, permanent type. The magnet 63 extends horizontally, or extends substantially parallel with and adjacent the underside of the casing top wall 2, and the magnet is arranged such that its opposite end portions or poles overlie an end portion of the free end of lever 25, which end portion serves as an armature for attraction by the magnet. The magnet 63 is also preferably arranged so that its poles straddle the stop member 50 and the cooperative contact members 45 and 46.

The magnet 63 determines the differential of operation of the switch, and carried by the supporting member 60 there is a manual adjustment means for flexing the supporting member to move the magnet poles closer to or farther away from the lever 25. By changing the distance between the magnet poles and the lever 25 it will be understood that the effective holding force of the magnet 63 will be changed with accompanying change in the differential of operation of the switch. The supporting member 60 is provided with an aperture therethrough that is disposed between the parallel portions of the U-shaped magnet 63 and receives an upper end portion of a tubular, open ended fitting 65 that has an external, upwardly facing, annular shoulder that seats against or abuts the underside of the supporting member 60. The fitting 65 is preferably formed out of square stock and is internally

threaded longitudinally thereof to receive a tubular screw 66 that threads into the fitting from the top thereof, the screw 66 preferably having a head 67 beneath which there is preferably a washer 68 that rests on the upper surface of the parallel magnet portions. By screw threading the screw 66 tightly into the fitting 65 the fitting 65, magnet 63 and supporting member 60 may be rigidly secured together.

A lower end portion of the fitting 65 is preferably of enlarged diameter, as at 69, and extending through this portion of the fitting, transverse to the longitudinal axis thereof, there is a manually rotatable adjustment member 69 in the form of a pin or shaft. The shaft 69 extends through and is journaled in aligned apertures in opposite walls of the fitting 65 and extends substantially perpendicular to the casing cover 4. The end of shaft 69 that is disposed toward the casing side wall 5 has an annular slot or recess externally of the fitting 65, and in this recess there is preferably clamped and secured a friction washer 70 that engages the outer wall surface of the fitting to prevent the shaft 69 from being too easily rotated. Within the enlarged bore portion 69 of the fitting 65 the shaft 69 is formed having a cam or eccentric portion 71, and seating on the eccentric portion 71 is one end of a pin or thrust member 72 that is slidably received in the bore of tubular screw 66. The upper end of the thrust pin 72 projects above the screw head 67 and abuts end to end with a screw 73 that is adjustably screw threaded into a metallic, open ended, tubular insert member that is secured in and to the casing top wall 2. The screw 73 may be provided with a slot in its upper end for receiving a screw driver, or other tool for adjusting the position of the screw. By means of the screw 73 the resilient supporting member 60 and all the parts carried thereby may be moved upward or downward to the positions desired. The end of the shaft 69 that is disposed toward the casing cover 4 is provided with an enlarged portion or head 75 that provides an external, annular shoulder 75^a facing toward and spaced from the outer wall surface of the fitting 65. A dial plate 76 is provided and preferably has an aperture to receive the shaft 69 and positions between the outer wall surface of the fitting 65 and the head or enlarged portion 75 of shaft 69. A pointer member 77 is provided and preferably has an aperture to receive the shaft 69 and is disposed between the enlarged portion 75 of the shaft and the face of the dial plate 76, the pointer 77 being secured to the shaft for rotary movement therewith. On the face of the dial plate 76 there may be provided suitable indicia for cooperation with the pointer 77 to aid in determining the desired position of the magnet poles relative to the armature portion of lever 25. It will be seen that the dial 76 and pointer 77 cooperate to indicate the differential of operation of the switch and that the dial and pointer are readily observed upon removal of the cover 4.

The operation of the herein described device is as follows: When the spring 13 overcomes the power element 10 the spring will move the thrust rod 12 downwardly, pivoting lever 28 in a counterclockwise direction, as seen in Fig. 1. Counterclockwise movement of lever 28 will permit the spring 36 to pivot lever 25 in a clockwise direction about its fulcrum member 23 moving the lever 25 toward the poles of magnet 63 and the contact member 45 toward its cooperative contact member 46. After the lever 25 has been

moved a predetermined distance toward the poles
 of magnet 63, the attractive force of the magnet
 will become effective and pivot the lever with a
 quick action moving contact member 45 into en-
 5 gagement with its cooperative contact member
 46. Initial engagement of contact member 45
 with contact member 46 is made before the stop
 member 50, carried by lever 25, engages the cas-
 ing top wall 2, and the positions that the contact
 10 member 45, blade 40 and leaf spring 39 will be
 in upon initial engagement of the contacts are
 shown in dot-and-dash lines in the enlarged
 views, Figs. 4 and 5. As the lever 25 continues to
 pivot in a counterclockwise direction, after initial
 15 engagement of contact member 45 with contact
 member 46, a rolling motion is imparted to the
 contact member 45 due to the angle of the end
 portion 47 of blade 40 that carries the contact
 member 45. Simultaneous with the rolling ac-
 20 tion the contact member 45 is pulled and slid
 along the contact surface of contact member 46
 to its final position, which position is reached
 when the stop member 50 engages the casing top
 wall 2. The sliding action of the contact member
 25 45 also keeps the contact member engaging sur-
 faces clean. As the contact member 45 is moved
 from its initial point of engagement with con-
 tact member 46 to its final point of engagement
 therewith, the blade 40 and leaf spring 39 are
 30 further tensioned and the tension force urges
 contact member 45 against contact 46, which ten-
 sion force remains constant irrespective of the
 differential setting of the device. The leaf spring
 35 39 rubs against the flexible or spring blade 40 and
 this action, in addition to the difference in the
 natural vibratory frequencies of the blade and
 spring, tends to dampen vibratory motion of the
 blade and vibratory motion of the whole switch
 assembly. Thus the leaf spring 39 dampening
 40 vibration of the blade 40 minimizes the bouncing
 action of the contact member 45 on initial en-
 gagement of the contact members. The rolling
 action of contact member 45 following its initial
 engagement with contact member 46 provides
 45 for engagement of the contact members at suc-
 cessively new contact areas on each of the sur-
 faces during vibration of contact member 45
 to avoid fusing of the minute molten pools of
 contact metal which are present at each end of
 50 the electric arc, even though bouncing or vibra-
 tion of the contact member 45 is minimized by the
 leaf spring 39.

When the force exerted by the power element
 10 builds up and becomes equal to the force
 55 exerted by the spring 13 and the holding force
 of magnet 63, the power element will move the
 thrust rod 12 upwardly which will pivot lever 25
 in a clockwise direction, as seen in Fig. 1, and
 will pivot lever 25 in a counterclockwise direc-
 60 tion. Counterclockwise movement of lever 25
 will move the contact member 45 out of engage-
 ment with contact member 46 thus opening the
 circuit. Movement of the lever 25 by the power
 element 10 is quick or with a snap action, and
 65 therefore the contact members 45, 46 are quickly
 parted to reduce sparking of the contact mem-
 bers on parting of the same. It will be seen that
 parting of the contact members with a quick
 movement is aided by the tension forces of the
 70 blade 40 and spring 39 for these forces are act-
 ing to part the contact members when the switch
 is in closed circuit position. In the event that
 the contact members 45, 46 do stick, downward
 75 movement of lever 25 will cause a prying or bend-
 ing action between the contact members which

for slight sticking will disengage contact mem-
 ber 45 from contact member 46, and in the event
 of severe sticking the bending or prying action
 will be augmented by the rigid strip or backing
 member 38 as lever 25 continues in its downward
 5 movement.

From the foregoing description it will be seen
 that we have provided a new and improved
 switch and one in which bouncing of one of the
 contact members on its cooperative contact is
 10 minimized. It will also be appreciated that in
 our switch, danger of fusing of the contact mem-
 bers is minimized by providing for the contact
 members to engage at different points on each
 of their contact surfaces as the movable contact
 15 member bounces or vibrates following initial en-
 gagement of the contact members. Furthermore
 we have provided a switch in which fusing and
 accompanying sticking of the contact members
 is very unlikely to occur, but one having pro-
 20 visions to part the contacts in the event that
 sticking does take place. Also, we have provided
 a control device having a new and improved ad-
 justment means for adjusting the position of a
 magnet relative to its armature. In addition, we
 25 have provided a switch of a character such as to
 prolong the time period of usefulness of the con-
 tact members and one which is efficient and reli-
 able in operation.

What we claim and desire to secure by Letters
 Patent of the United States is:

1. In an apparatus of the character described,
 a fixed contact member having a flat contact
 surface, a second contact member having a con-
 35 vex contact surface engageable with said flat
 surface, a spring blade carrying at one end said
 second contact member, a lever movable rela-
 tive to said first contact member and having an
 offset portion, means securing the other end of
 said spring to said offset portion, said offset por-
 40 tion being so positioned relative to said first con-
 tact member that as said lever is moved in one
 direction to engage said second contact member
 with said first contact member the offset portion
 will move away from said first contact member
 45 so that upon engagement of said contact mem-
 bers said convex surface will be drawn slidably
 over said flat surface, said blade flexing upon en-
 gagement of said surfaces so that said convex
 surface is rolled on said flat surface simultane-
 50 ously with the sliding engagement of said sur-
 faces, and a spring blade secured to said offset
 portion and having a free end portion engaging
 said first-named blade intermediate said offset
 portion and said second contact member and
 55 tending to urge said contact surfaces into engage-
 ment, said blades having different periods of vi-
 bration so that upon engagement of said contact
 surfaces said second blade will frictionally and
 resiliently dampen vibration of said first blade
 60 and said second contact member.

2. In an apparatus of the character described,
 a fixed contact member having a flat contact
 surface, a second contact member having a con-
 65 vex contact surface engageable with said flat
 surface, a spring blade carrying at one end said
 second contact member, a lever movable rela-
 tive to said first contact member and having an
 offset portion, means securing the other end of
 said spring to said offset portion, said offset por-
 70 tion being so positioned relative to said first con-
 tact member that as said lever is moved in one
 direction to engage said second contact member
 with said first contact member the offset portion
 will move away from said first contact member
 75

so that upon engagement of said contact members said convex surface will be drawn slidably over said flat surface, said blade flexing upon engagement of said surfaces so that said convex surface is rolled on said flat surface simultaneously with the sliding engagement of said surfaces, a spring blade secured to said offset portion and having a free end portion engaging said first-named blade intermediate said offset portion and said second contact member and tending to urge said contact surfaces into engagement, said blades having different periods of vibration so that upon engagement of said contact surfaces said second blade will frictionally and resiliently dampen vibration of said first blade and said second contact member, and means to limit movement of said second contact member on said fixed contact member.

3. In an apparatus of the character described, a fixed contact member having a flat contact surface, a second contact member having a convex contact surface engageable with said flat surface, a spring blade carrying at one end said second contact member, a lever movable relative to said first contact member and having an offset portion, means securing the other end of said spring to said offset portion, said offset portion being so

positioned relative to said first contact member that as said lever is moved in one direction to engage said second contact member with said first contact member the offset portion will move away from said first contact member so that upon engagement of said contact members said convex surface will be drawn slidably over said flat surface, said blade flexing upon engagement of said surfaces so that said convex surface is rolled on said flat surface simultaneously with the sliding engagement of said surfaces, a spring blade secured to said offset portion and having a free end portion engaging said first-named blade intermediate said offset portion and said second contact surfaces into engagement, said blades having different periods of vibration so that upon engagement of said contact surfaces said second blade will frictionally and resiliently dampen vibration of said first blade and said second contact member, and means to positively disengage said contact members upon movement of said lever member in a direction opposite to said one direction.

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