Feb. 11, 1947. P. E. WILLMAN 2,415,546

THERMAL SNAP-ACTING SWITCH

Filed Dec. 22, 1944 3 Sheets-Sheet 1

Fig.-1

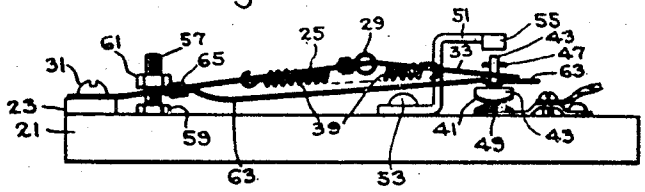


Fig.-2

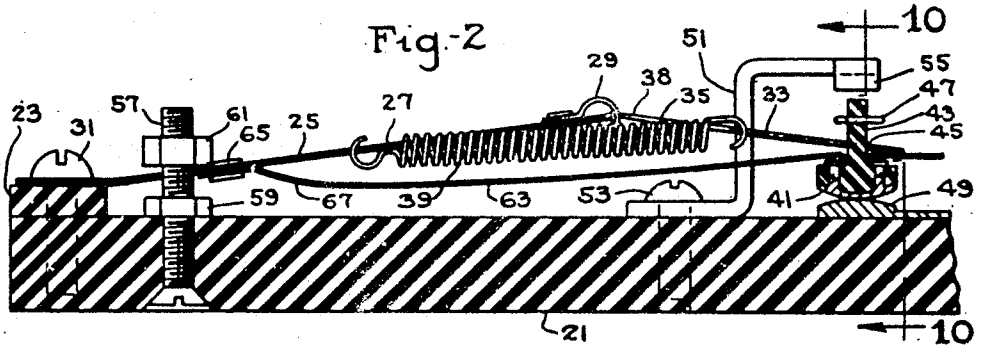
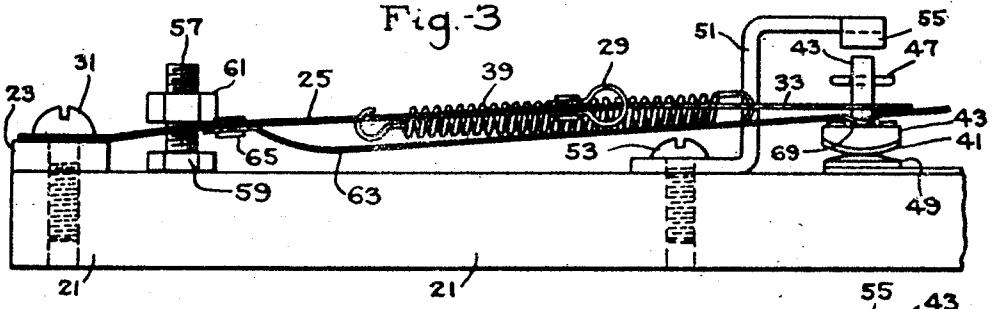


Fig.-3



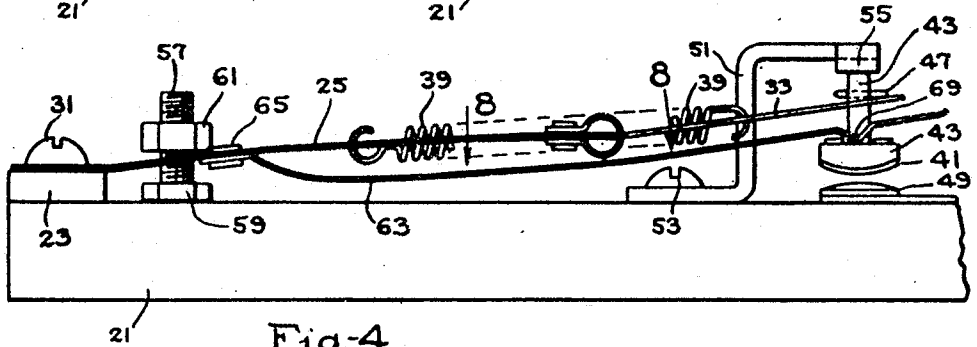


Fig.-4

INVENTOR.
P. E. WILLMAN
BY
N. M. Bielul
ATTORNEY.

Feb. 11, 1947. P. E. WILLMAN 2,415,546

THERMAL SNAP-ACTING SWITCH

Filed Dec. 22, 1944 3 Sheets-Sheet 2

Fig.-5

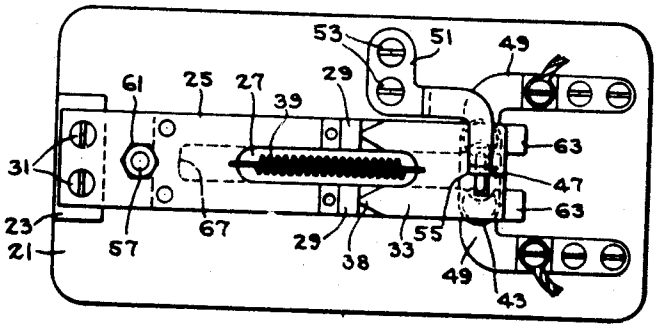
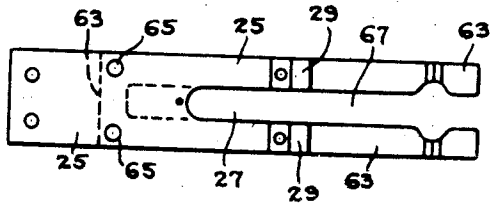


Fig.-6



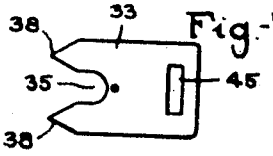


Fig.-7

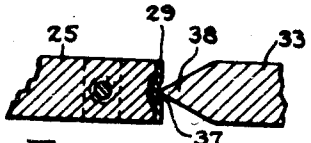


Fig.-8

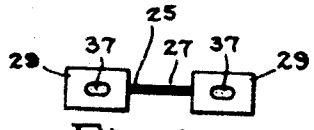


Fig.-9

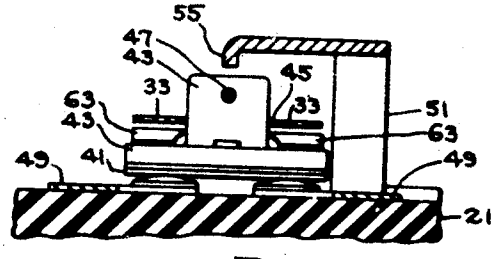


Fig.-10

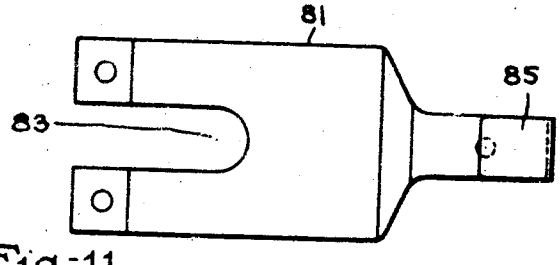


Fig.-11

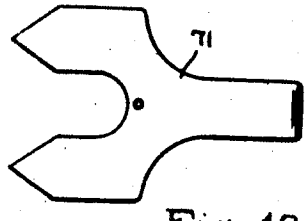


Fig.-12

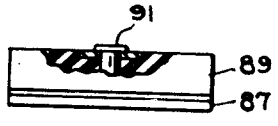


Fig.-13

INVENTOR.
P.E. WILLMAN.
BY
N M Bielel
ATTORNEY.

Feb. 11, 1947. P. E. WILLMAN 2,415,546

THERMAL SNAP-ACTING SWITCH

Filed Dec. 22, 1944 3 Sheets-Sheet 3

Fig.-14

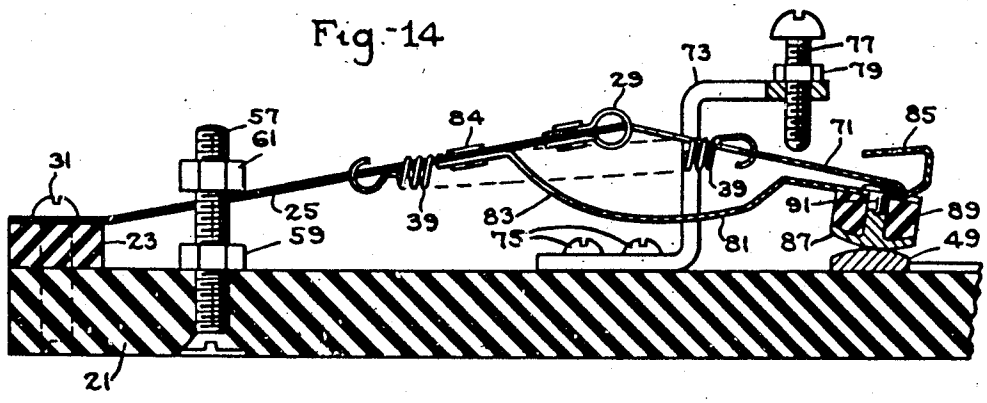
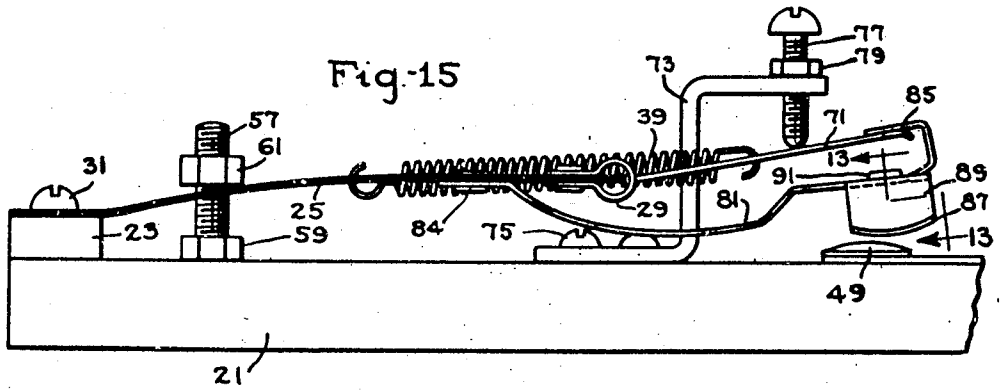


Fig.-15



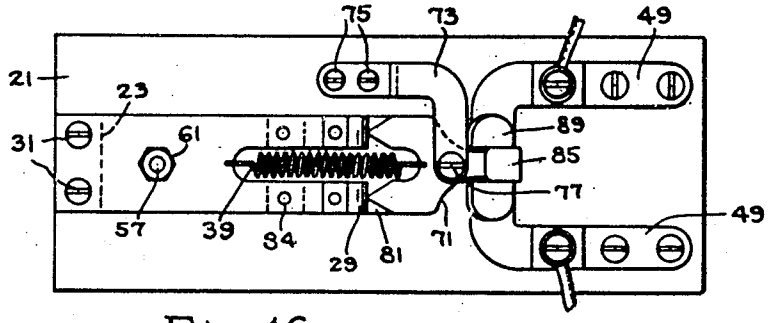


Fig.-16

INVENTOR.
P. E. WILLMAN
BY
H. M. Bielel
ATTORNEY.

Patented Feb. 11, 1947

2,415,546

UNITED STATES PATENT OFFICE

2,415,546

THERMAL SNAP-ACTING SWITCH

Philip E. Willman, Chicago, Ill., assignor to McGraw Electric Company, Elgin, Ill., a corporation of Delaware

Application December 22, 1944, Serial No. 569,307

6 Claims. (Cl. 200—138)

1

My invention relates to thermally-actuable switches and particularly to thermal snap-acting switches.

An object of my invention is to provide means that shall cause an increased pressure to be maintained between cooperating contacts of a toggle arm, snap-acting type switch, until the moment of disengagement between the said contacts.

Other objects of my invention will either be apparent from a description of several modifications embodying my invention or will be set out in the course of such description and particularly in the appended claims.

In the drawings,

Figure 1 is a full size, side elevational view of one form of device embodying my invention, the parts being shown in their cold positions,

Fig. 2 is a central, longitudinal, vertical sectional view of Fig. 1, with the parts shown in their cold positions and in double size,

Fig. 3 is a side elevational view shown in double size, with the parts in their heated positions just prior to disengagement of the contacts,

Fig. 4 is a view similar to Fig. 3, showing the parts when heated and the contacts disengaged from each other,

Fig. 5 is a full size, top plan view of Fig. 1,

Figs. 6 and 7 are detailed views of the bimetallic bar spring and for plates which make the toggle connections,

Fig. 8 is a double size view on the line 8—8 of Fig. 4, showing the construction of the pivotal toggle connection,

Fig. 9 is a front end view showing the bimetal bar and its clips, which constitute the sockets for the toggle joint connection,

Fig. 10 is a lateral, sectional view taken on the line 10—10 of Fig. 2,

Fig. 11 is an enlarged plan view of the spring used in Figs. 14, 15, and 16,

Fig. 12 is an enlarged plan view of one part of the toggle connections operating in combination with the spring shown in Fig. 11,

Fig. 13 is a detailed, sectional view of the contactor plate used in Figs. 14, 15, and 16, taken on the line 13—13 of Fig. 15,

Fig. 14 is a central, vertical, longitudinal, sectional view of another form of snap toggle switch, using the spring shown in Fig. 11, the parts being shown in their cold positions and on a double size scale.

Fig. 15 is a view similar to Fig. 14, showing a side elevational view of the same, with the parts in heated positions, and,

Fig. 16 is a top plan view of the parts shown in Fig. 14 and reduced to full or normal size.

2

Referring first of all to Figs. 1 to 10 inclusive, I have there shown a snap-acting toggle type switch embodying a base 21, which is preferably made of electric-insulating material and which may be of substantially rectangular shape. On this member 21 is mounted adjacent to one end thereof, a block 23, which is also made of electric-insulating material and which has secured thereagainst, adjacent the outer surface thereof, an arm 25, which is made of bimetal. This arm has a slot or recess 27 therein extending from the free end thereof to a point at about one-half of its length. I provide further a pair of pivot plates 29, substantially of U-shape, the central portion of which is of arcuate shape, while the end portions thereof are of straight or flat shape secured to the free end portions of the sides of the bimetal bar 25 at its movable, outer end. Bimetal bar 25 is held by bolts or screws 31 extending through member 23 and into operative engagement with member 21.

I provide a second toggle arm 33, which may be made of bimetal, but not necessarily so, said bar being also provided with a slot or recess 35 and having its sides pointed as will be noted particularly by reference to Figs. 5, 7 and 8. Each of the pivot plates 29 is provided with an indentation 37 (see Fig. 8) to receive the sharpened ends 38 of the sides of the second toggle arm 33, so as to provide a pivotal engagement therebetween.

An over-center spring 39 is positioned in the slots 27 and 35 and has its respective ends in pivotal engagement with members 25 and 33 through small openings immediately adjacent to the ends of the respective slots 27 and 35. This will provide a structure which, when subjected to changes of temperature acting upon the bimetal bar 25, will cause snap-acting movement of the outer end portion of the second arm 33.

I provide a contact bridging member 41, which is insulatedly mounted on a support 43 of substantially T-shape, the stem of which extends through an opening 45 in arm 33, the stem of member 43 being relatively long, so as to provide a lost motion connection between the contact bridging member 41 and arm 33. A cotter pin 47 extends through the upper end of the stem of member 43, so as to provide a lost motion connection, as noted above.

I provide a pair of fixed contacts 49, which are secured against the upper face of member 21 in laterally, spaced relation, so that they may be operatively engaged by contact bridging member 41.

I provide also a stop member 51, which may be made of substantially L-shape, having one end

portion thereof secured against the upper surface of base 21 as by a pair of machine screws or bolts 53, with the other raised end portion 55 thereof adapted to be engaged by the end of the stem of member 43 when the contact bridging member 41 is out of engagement with fixed contacts 49.

I provide further, means for varying the operating temperature of the assembly hereinbefore described, comprising a machine screw or bolt 57 extending through member 21 adjacent to the supporting block 23 thereon, a lock nut 59 being provided thereon, as well as an adjusting nut 61, this latter nut being positioned against the outside surface of bimetal bar 25, so that the initial position of bimetal bar 25, and of the second arm 33, may be varied. As is well known in the art, the temperature at which disengagement of the movable and of the fixed contacts will take place, is decreased with a position of the adjusting nut 61 on screw 57 which is closer to the upper surface of base 21, than would be the case with such position of nut 61 further away from the upper surface of base 21.

In order to provide for a greater and appreciable contact pressure between contact bridging member 41 and the two contacts 49, I provide a leaf spring 63 having one of its ends secured as by rivets 65 to arm 25 intermediate the ends thereof. Leaf spring 63 is provided also with a slot 67 extending centrally and longitudinally thereof from a point near its left hand end, as seen in Figs. 5 and 6. The right hand end of spring 63 extends to beyond the end of the second arm 33 and is provided with an indentation 69 therein, which is adapted to engage the upper surface of the enlarged part of the support 43 of the contact bridging member 41. Leaf spring 63 is so shaped initially as to press against the upper surface of member 43 when assembled as shown in Figs. 1 to 4. The positions of the two arms 25 and 33 relatively to the spring 63 when the temperature is low, that is to say at ordinary room temperature, is shown in Fig. 2 of the drawings, while the relative positions of these various parts just before disengagement of the contact bridging member 41 from the two fixed contacts 49 are shown in Fig. 3 of the drawings. It is evident that the spring 63 will press the contact bridging member 41 into close operative engagement with the pair of contacts 49 and that the pressure thus provided results in an appreciable contact pressure therebetween, when the bimetal bar 25 flexes downwardly, because of the turning movement of arm 25 in a clockwise direction.

Fig. 4 of the drawings shows the relative positions of arms 25 and 33 and of the spring 63 during the time when the contact bridging member 41 has been moved upwardly with a snap action out of engagement with the fixed contacts 49, from which it will be noted that the outer end of the second arm 33 has been moved upwardly into engagement with the cotter pin 47, effected by snap-acting impact of bar 33 against cotter pin 47 causing snap-acting movement of the contact bridging member 41 out of engagement with fixed contacts 49 against the pressure of spring 63. It is also to be noted that the presence of the bent leaf spring 63, as has hereinbefore been described, results in an increased and appreciable contact pressure between the contact bridging member 41 and the fixed contacts 49 up to the movement of disengagement therebetween.

Referring now to Figs. 11 to 16 inclusive, I have there shown a modification of device embodying my invention. This modification em-

bodies a base 21 of rectangular shape and of electric-insulating material, having a block 23 secured thereto at one end thereof and having a bimetal bar 25 secured against the outside surface of block 23, as by a pair of rivets 31. I provide further a second toggle arm 71, and it may be noted that the shape of these arms is substantially the same as has been hereinbefore set forth in combination with members 25 and 33 in Figs. 1 to 5 inclusive. I provide further an over-center spring 39, having its ends in pivotal engagement with the two arms 25 and 33, all as hereinbefore noted. I provide a pair of pivot plates 29 on the outer ends of the sides of arm 25, so that the sharpened end portions of bar 33 can engage the indentations in pivot plates 29.

I provide an adjusting means comprising a machine screw or bolt 57, all as has been hereinbefore described in connection with the device shown in Figs. 1 to 10 inclusive. I provide further a stop member 73, of substantially L-shape, having one end portion secured against the upper surface of base plate 21 as by a plurality of short machine screws 75. I provide an adjustable stop 77, constituted by a short machine screw and a lock nut 79 thereon, so as to adjust the temperature differential of the device.

I provide a leaf spring 81, which has a slot 83 therein extending from its left hand end portion, which end portion is secured as by rivets 84 against arm 25, of bimetal, adjacent its right hand end portion. The right hand end portion of bent and shaped spring 81 is provided with a return bent portion 85, which is spaced from the adjacent main portion of spring 81 a measured distance to receive therebetween the end portion of the second toggle arm 71 with a relatively large amount of clearance therebetween.

I provide a contact bringing member 87, which is adapted to be engaged with and disengaged from a pair of fixed contacts 49 secured in laterally-spaced relation against the upper surface of the right hand end portion of base plate 21. Contact bridging member 87 is secured to a support 89, of electric-insulating material, by a rivet 91 in an electrically-insulated manner relatively to spring 81.

Referring now to Fig. 14 of the drawings, I have there shown the toggle arms 25 and 71, as well as the spring 81, when the temperature of the parts is say that of an ordinary room and when the contacts are in engagement with each other. In Fig. 15, I have shown the positions of these various parts upon a change of temperature sufficient to cause snap-acting disengagement of the contact bridging member 87 from the fixed contacts 49. It is evident from an inspection of Fig. 15, that the downward movement, or to put it in other words, the flexure of toggle arm 25 in a clockwise direction, has caused an increased pressure to be provided between the contact bridging member 87 and the first contacts 49, which pressure increases until just before the snap-acting disengaging movement of toggle arm 71. It will be noted, by reference to Fig. 14 that toggle arm 71 is held in engagement with the main portion of spring 81 and that the quick upward movement of toggle arm 71 effects disengagement of contact bridging member 87 from contacts 49 by impact against the return bent portion 85. The same comment applies also to that modification shown in Figs. 1 to 10 inclusive, as will be evident from an inspection of Figs. 2 to 4 inclusive, from which it will be noted that the second toggle arm 33 initially

presses against the outer end of spring 63 and that upon sudden snap-acting, upward, disengaging movement of toggle arm 33, the toggle arm will move the contact bridging member 41 by impact against the cotter pin 47.

It is obvious that the bending or flexure of the bimetal toggle arm 25 in a clockwise direction, attendant upon change of temperature thereof, causes a contact pressure between the contact bridging members and the fixed contacts, which increases as the two toggle arms become coplanar or approach a straight line relation relatively to each other, until the sudden disengagement of the contact bridging member from the fixed contacts by impact of the outer end of the second toggle arm upon the cotter pin 47 or by impact against the return bent portion 85 of the spring 81 carrying the contact bridging member.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof, and all such modifications coming clearly within the scope of the appended claims shall be considered a part of my invention.

I claim as my invention:

1. A snap-acting thermal switch structure comprising a first toggle arm of bimetal, having one end fixed, a second toggle arm pivotally abutting the other end of the first arm, an over-center spring connecting the two arms and bridging the pivotal connection therebetween, a contact member adjacent the outer end of the second arm and adapted to be moved thereby, a fixed contact, and a leaf spring having one end thereof secured to the first toggle arm and extending along the under surface thereof and of the second toggle arm to cause increasing pressure of the contact member on the fixed contact as the two toggle arms approach a straight line relation relatively to each other.

2. A snap-acting thermal switch structure comprising a first toggle arm of bimetal, having one end fixed, a second toggle arm pivotally abutting the other end of the first arm, an over-center spring connecting the two arms and bridging the pivotal connection therebetween, a contact member adjacent the outer end of the second arm and adapted to be moved thereby, a fixed contact, and a leaf spring having one end thereof secured to the first toggle arm and extending along the under surface thereof and of the second toggle arm to cause increasing pressure of the contact member on the fixed contact just prior to snap-acting disengagement therebetween.

3. A snap-acting thermal switch structure comprising a pair of toggle arms having a pivotally abutting end-to-end connection, at least one of said arms being of bimetal and having its other end fixedly supported, each of said arms having a slot in its abutting end portion, an over-center spring in said slots bridging the pivotal connection and having its ends connected to the respective arms, a fixed contact, a movable contact having lost motion connection with the free end of the second arm, a leaf spring having one end

secured to said bimetal arm intermediate its ends and extending adjacent the lower surfaces of both said arms and shaped to cause the pressure of said movable contact against said fixed contact to increase as the two arms become coplanar upon change of temperature.

4. A snap-acting thermal switch structure comprising a pair of toggle arms having forked ends in pivotal abutment with each other, at least one of said arms being bimetal and having its other end fixedly supported, an over-center spring in said forked ends having its ends connected to said arms, a fixed contact, a movable contact having a lost motion connection with the outer end of the second arm and a leaf spring having one end secured against the under surface of said one arm and extending to the outer end of the second arm and causing increasing pressure of the movable contact on the fixed contact until the instant of separation of the two contacts by operative impact of the outer end portion of the second arm therewith.

5. A snap-acting thermal switch structure comprising a pair of toggle arms having forked ends in pivotal abutment with each other, at least one of said arms being bimetal and having its other end fixedly supported, an over-center spring in said forked ends having its ends connected to said arms, a leaf spring having one end thereof secured against the under surface of said one arm and extending to the outer end of the second arm and loosely bent thereover, a fixed contact, a movable contact mounted on the outer end of said leaf spring and adapted to have its pressure on said fixed contact caused by said spring increased until the instant of snap-acting separation therebetween.

6. A snap-acting thermal switch structure comprising a pair of toggle arms having forked ends in pivotal abutment with each other, at least one of said arms being bimetal and having its other end fixedly supported, an over-center spring in said forked ends having its ends connected to said arms, a leaf spring having one end thereof secured against the under surface of said one arm and extending to the outer end of the second arm and loosely bent thereover, a fixed contact, a movable contact mounted on the outer end of said leaf spring and adapted to have its pressure on said fixed contact caused by said spring increased until the instant of snap-acting separation therebetween by impact of the outer end of the second arm against the bent-over portion of the leaf spring.

PHILIP E. WILLMAN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,390,987	Denison	Sept. 20, 1921
1,855,959	Guinot	Apr. 26, 1932
1,977,393	McCormick	Oct. 16, 1934
2,144,120	Parks	Jan. 17, 1939