Feb. 6, 1951 F. J. BROCH 2,540,421

ELECTRICAL SNAP SWITCH

Filed Nov. 7, 1947 2 Sheets-Sheet 1

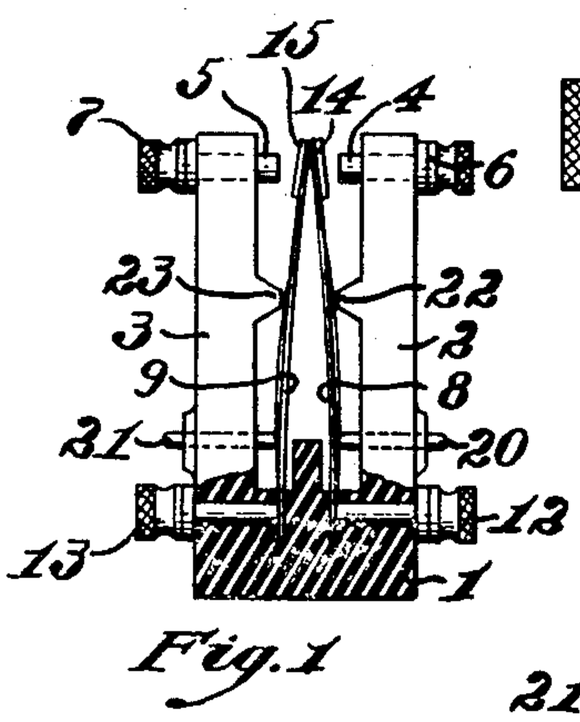


Fig. 1

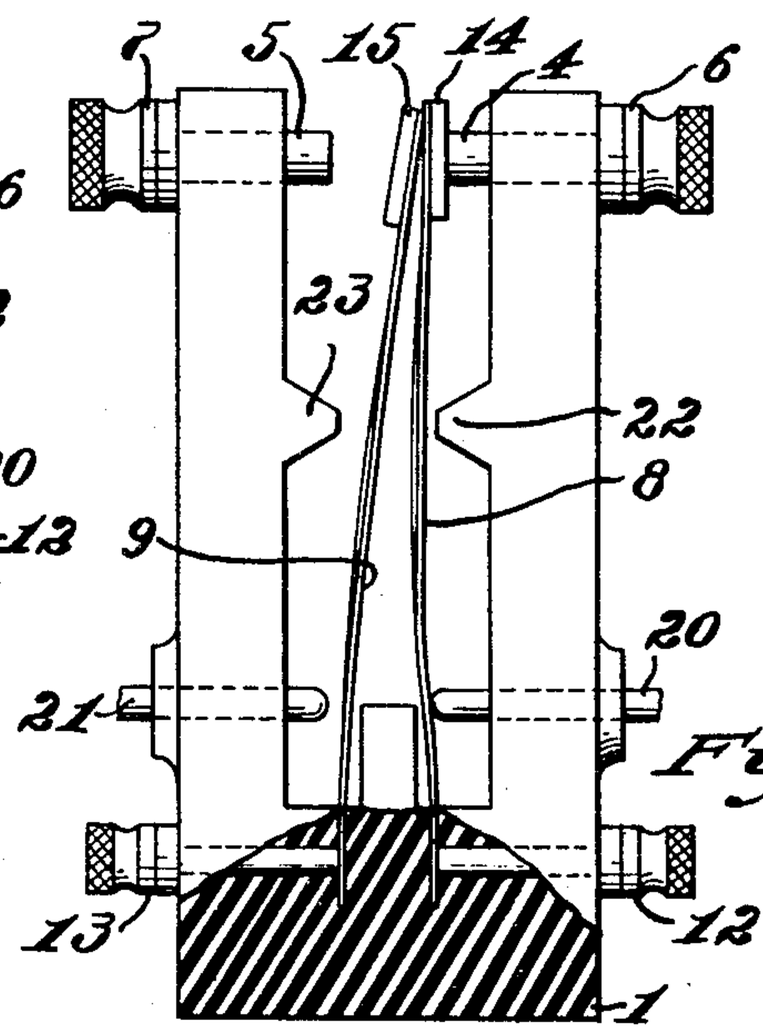


Fig. 2

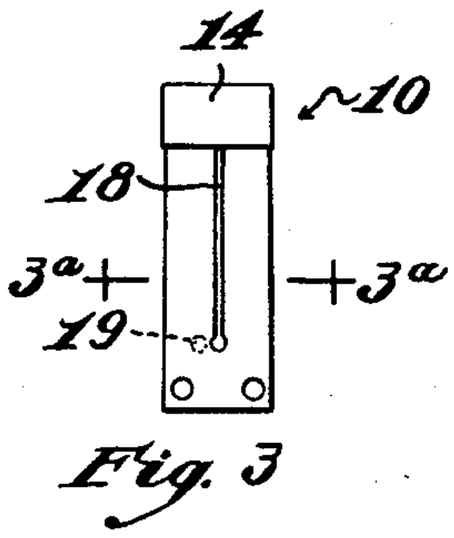


Fig. 3

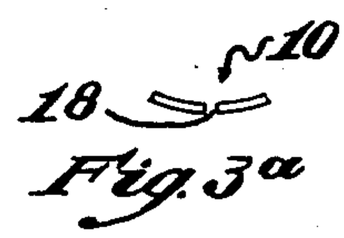


Fig. 3a

Fig. 4

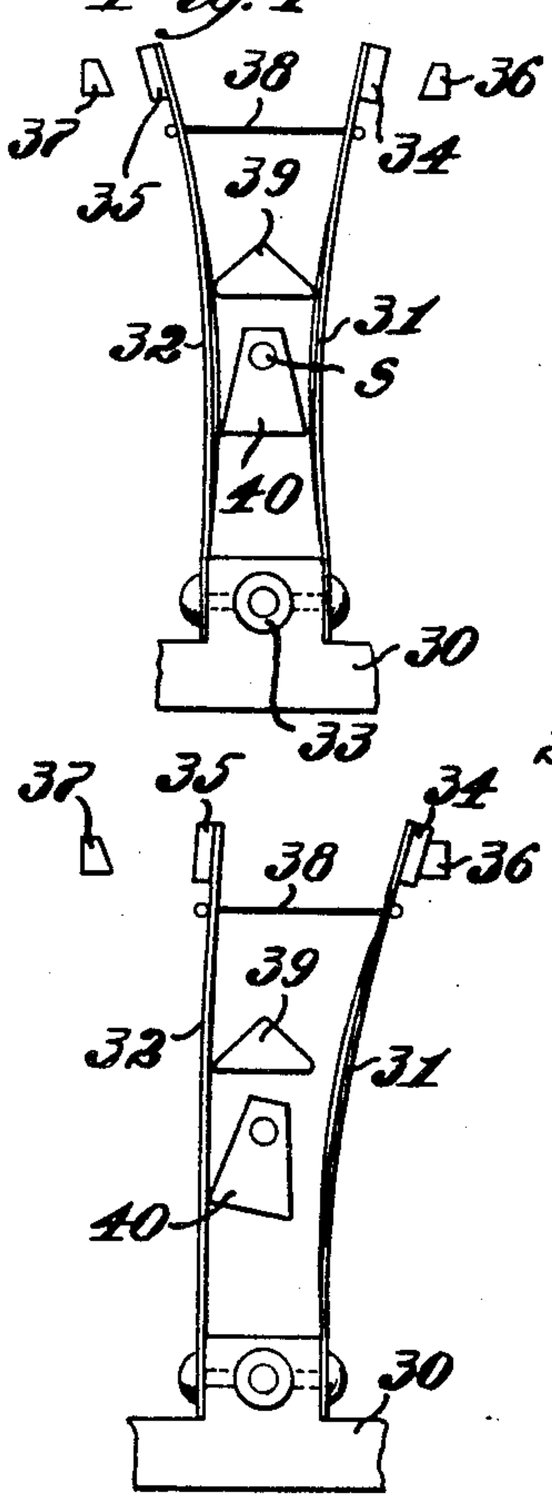
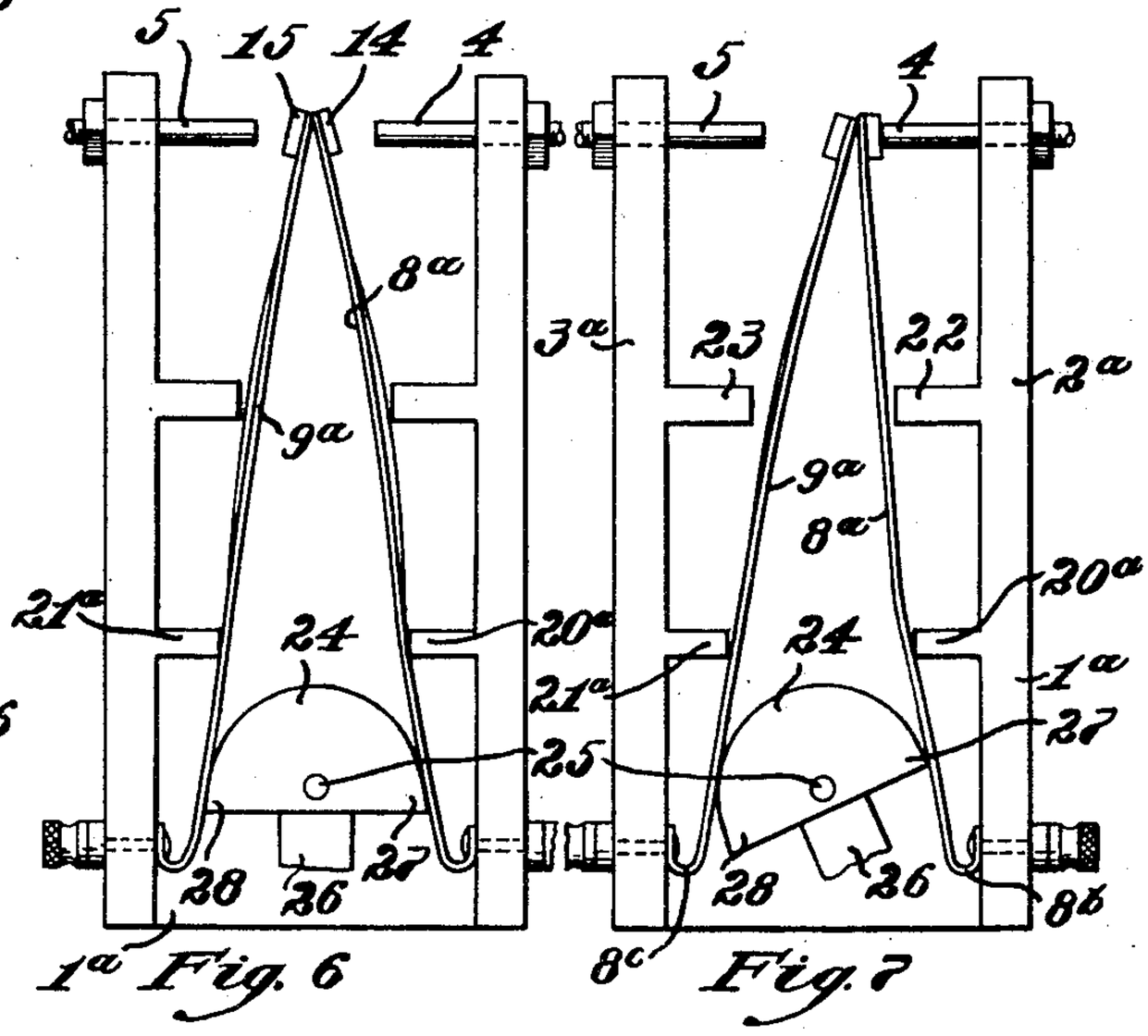


Fig. 5



1a Fig. 6 Fig. 7

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ELECTRICAL SNAP SWITCH

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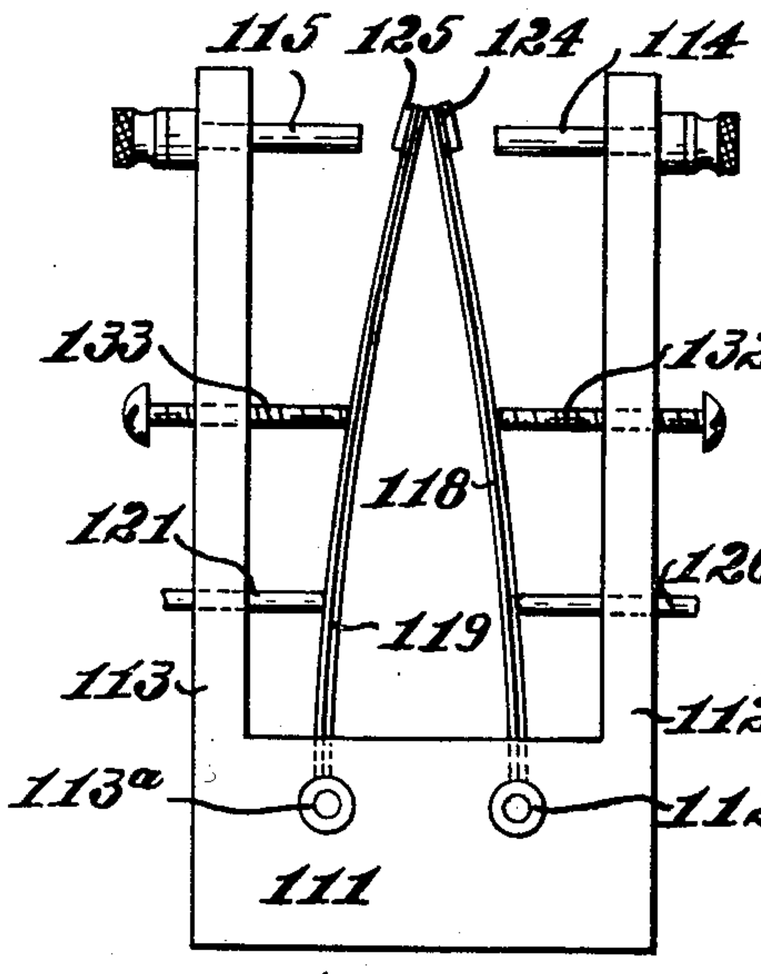

Fig. 12

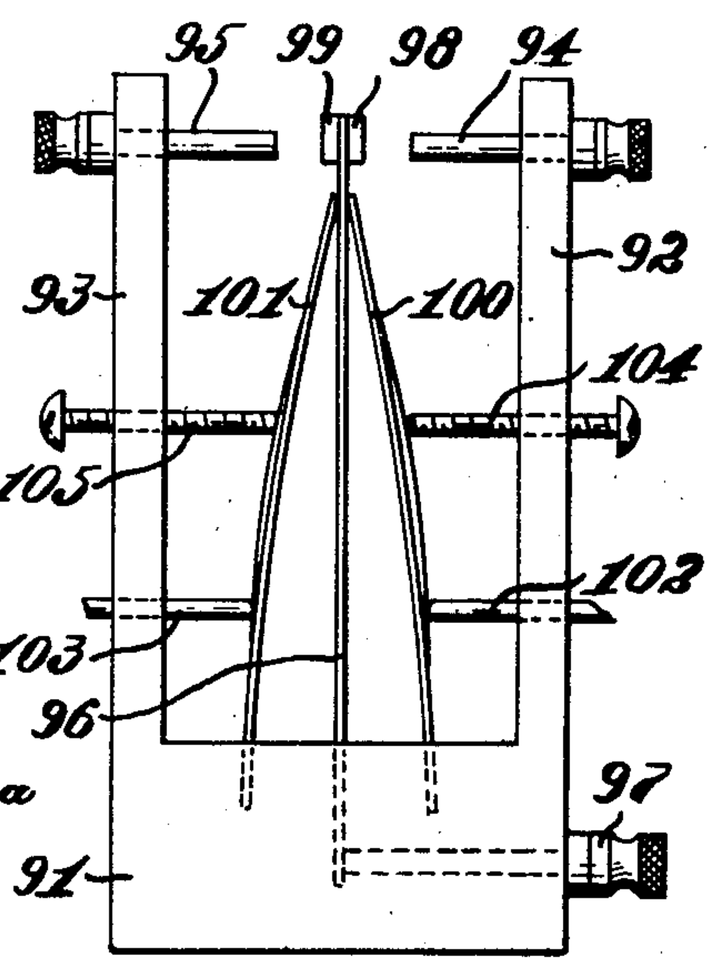

Fig. 11

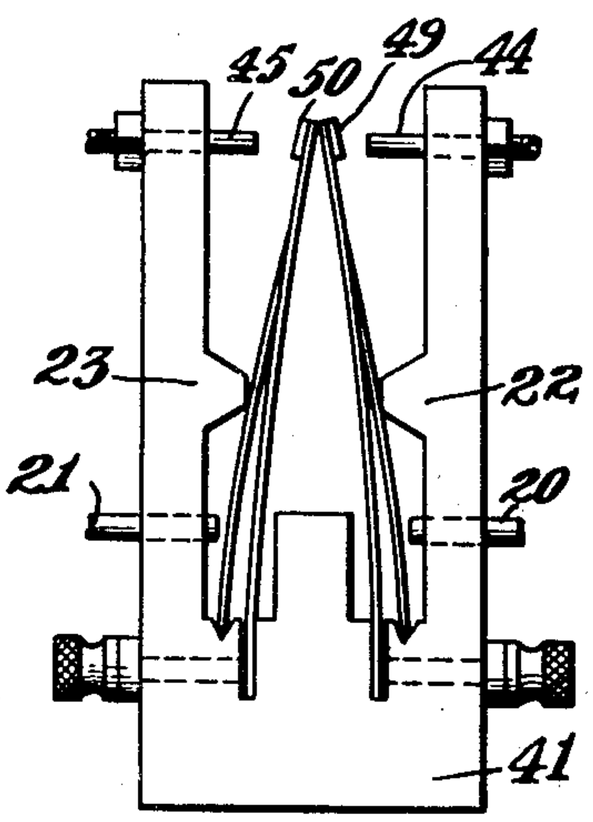

Fig. 8

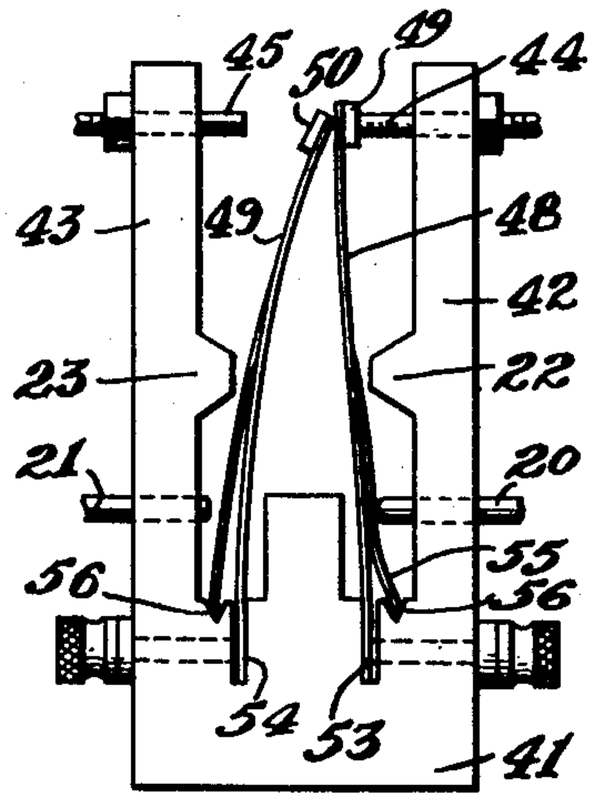

Fig. 9

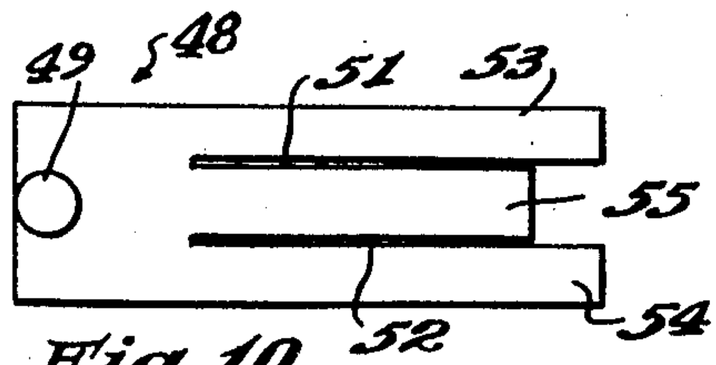

Fig. 10

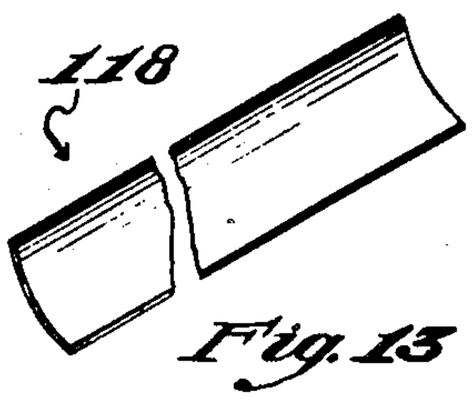

Fig. 13

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Patented Feb. 6, 1951 2,540,421

UNITED STATES PATENT OFFICE

2,540,421

ELECTRICAL SNAP SWITCH

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Application November 7, 1947, Serial No. 784,676

16 Claims. (Cl. 200—67)

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This invention pertains to electrical switches, particularly to snap switches and more especially to a snap switch operative alternatively to close either of two electrical circuits, the present application being a continuation-in-part of my copending application for Letters Patent Serial No. 630,760, filed November 26, 1945, now abandoned.

For many purposes snap acting switches are preferred to switches of other types, particularly because they open with a minimum of arcing so that relatively heavy currents may be controlled by switches of small dimensions. However, switches of this type do not always provide the proper degree of pressure between the contacts when the switch is closed and in many cases are complicated and expensive to make and assemble, or are lacking in mechanical strength and durability. So far as is known to me switches of this type have not heretofore been so designed as automatically to assume a neutral position with both circuits open when the actuating pressure is released.

A principal object of the present invention is to provide a snap action switch designed to provide good pressure between the contacts and in particular one wherein the pressure is substantially at a maximum just prior to the opening of the switch. A further object is to provide a snap acting switch of improved design which normally assumes a neutral position in which both circuits are automatically opened as soon as the switch closing force ceases to act. A further object is to provide a snap switch which is devoid of high precision parts or delicate members requiring pivotal bearings. A further object is to provide a snap action switch which is simple, inexpensive to manufacture, compact in design and of durable construction. Other and further objects and advantages of the invention will be pointed out in the following more detailed description and by reference to the accompanying drawings wherein

Fig. 1 is a side elevation, partly broken away and in section, illustrating one embodiment of the invention and showing the parts in the neutral position in which both circuits are open;

Fig. 2 is a view similar to Fig. 1 but to larger scale, showing the switch parts positioned to close one of the circuits;

Fig. 3 is a side elevation, to smaller scale, illustrating one type of spring arm which may be used in the construction of a switch according to the present invention;

Fig. 3ª is a section on the line 3ª—3ª of Fig. 3;

Fig. 4 is a view generally similar to Fig. 1 but, diagrammatic in character, showing a modified

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construction in which the spring arms are reversed in arrangement as compared with that of Fig. 1, the switch being shown in the neutral position with both circuits open;

Fig. 5 is a view similar to Fig. 4 but showing the switch parts arranged so that one circuit is closed;

Fig. 6 is an elevation, with parts broken away, illustrating a modification of the arrangement of Fig. 1 wherein the actuating pressure is exerted by a cam so designed that the switch may be set to remain with either one or the other circuit closed;

Fig. 7 is a view similar to Fig. 6 but showing the parts arranged to close one of the circuits;

Fig. 8 is a view generally similar to Fig. 1 but showing the use of spring arms of a different type, the parts being in the neutral position;

Fig. 9 is a view similar to Fig. 8 but showing one of the circuits closed;

Fig. 10 is a plan view of one of the spring arms used in the switch of Figs. 8 and 9;

Fig. 11 is a view generally similar to Fig. 1 but showing a modification in which the movable contacts are mounted upon a part which is supported independently of the spring arms;

Fig. 12 is a view generally similar to Fig. 1 but showing a switch in which the spring arms are of another type; and

Fig. 13 is a perspective view showing one of the spring arms of Fig. 12.

Briefly, the invention contemplates the provision of two normally equal opposed forces, provided, for example, by two normally stressed resilient arms, acting against each other, and with provision for causing one or the other suddenly to exert a predominating effective force thereby to close one or the other of two circuits.

For convenience in description, one of the spring arms may be termed the "loaded arm" and the other the "loading arm," although the spring arms are preferably identical in construction. These arms may be of various types customarily used in snap switches. For instance they may be of the kind illustrated in Fig. 2 of the patent to Leupold 1,780,758, November 4, 1930. Considering such an arm as the loading arm, it is fixed at one end and is normally bowed longitudinally, having its concave side toward the loaded arm, its free end bearing with substantial resilient pressure against the free end of the loaded arm. The loading arm is also normally slightly curved transversely, at least near its fixed end, having a "sensitive spot" at its convex side. Pressure exerted at the sensitive

applies pressure to the arm 8, its first effect is to decrease the section modulus of the arm 8 at the region of the sensitive spot 19, at the same time exerting a bending stress on the arm 8, tending to swing its free end toward the left. This motion of the arm is opposed by the other arm 9 which during this action is first moved slightly to the left until it engages the stop 23. Except for the stop 23, this motion of the arm 9 would continue until the contact 15 engaged the fixed contact 5 which would thus close the wrong circuit for an instant. Assuming that the arm 9 has been brought into engagement with the stop 23, the continued pressure of the inner end of member 20 against the sensitive spot 19 of the arm 8 causes the latter arm suddenly to try to reverse its longitudinal curvature. However, the fixed contact 4 is so positioned that the spring arm cannot reverse its curvature to a degree beyond which it loses its tendency to return to its initial curvature when the pressure is retarded, although its free end snaps suddenly to the right, bringing movable contact 14 into engagement with fixed contact 4. At this point it may be noted that, as described, the spring arm has two different degrees of stiffness, the first when the arm is of normal shape, before the actuating force has been applied, and the second, after reversal of curvature has been initiated, the latter stiffness being much less than the first but still sufficient to restore the arm to its original shape when the actuating force ceases. This movement of the arm 8 permits the arm 9 to move further to the right (as it normally tries to do) so that its free end follows the free end of the arm 8 and when the movable contact 14 engages the fixed contact 4, the pressure between these contacts is accentuated by the force exerted by the free end of the arm 9 against the free end of the arm 8. The arms remain in this position with the circuit closed through the fixed contact 4 so long as the pressure is exerted on the actuating pin 20. As soon as the pressure exerted by the inner end of the pin 20 is released, the arm 8 automatically reassumes it original position, as shown in Fig. 1, forcing the arm 9 back until the arms again reach the neutral position. Obviously by actuating the pin 21, the reverse action of the switch takes place, thereby closing the circuit through the fixed contact 5.

In Figs. 4 and 5 a slight modification is illustrated wherein the base 30 supports the two like longitudinally bowed spring arms 31 and 32 (like the arms 8 and 9) which are secured at their lower ends to the base in any appropriate way, the lower ends of these arms being electrically connected to a binding post 33. In this instance the longitudinal curvature of the arms is such that their free ends are widely separated, the convex faces of the arms being opposed to each other. The free ends of the arms carry the movable contacts 34 and 35 which are designed to engage the fixed contacts 36 and 37 respectively, to close electrical circuits. The free ends of the arms are connected by a link 38 so that when one arm moves the other must likewise move. Interposed between the arms is a motion-limiting element 39, here shown of triangular shape, having opposite corners designed to limit movement of the respective arms 31 and 32. Between the arms there is arranged a single actuator 40 mounted on a rotary shaft S. By swinging this actuator, whose lower corners, constituting the pressure-applying elements, are arranged to engage the sensitive spots of the arms 31 and 32 respectively, one or the

other of the arms may be caused to initiate a change in its longitudinal curvature. The results of this action is shown in Fig. 5 where the movable contact 34 has been brought into engagement with the fixed contact 36. As illustrated in Fig. 5 the actuator 40 has engaged the sensitive spot of the arm 32, thus causing the latter to straighten. In so doing it forces the arm 31 (by means of the link 38) into contact with the fixed contact 36, the normal tendency of the arm 31 to bend to the right being accentuated by the force exerted by the arm 32 in attempting to move further to the right than is shown in Fig. 5.

In Figs. 6 and 7 a further modification is illustrated wherein the switch is designed to maintain one or the other of the circuits closed until the circuit is properly opened. In this arrangement the base 1a has the parallel arms 2a and 3a, these arms carrying the spaced fixed contacts 4 and 5 respectively. The two like spring arms 8a and 9a may be of the same general kind as previously described, but their lower ends are bent to U-shape and are fixed at 8b and 8c respectively, to the switch base, these lower ends being connected to binding posts or other devices whereby they are connected into the respective electrical circuits. In this instance, instead of the movable pins 20 and 21 of Fig. 1 there are provided two fixed pressure-applying members 20a and 21a respectively carried by the arms 2a and 3a of the switch block and arranged with their inner ends opposed to the sensitive spots of the spring arms 8a and 9a. Motion-limiting elements 22 and 23, like those shown in Fig. 1, are carried by the arms 2a and 3a. Interposed between the lower portions of the spring arms there is arranged a cam 24 mounted on a rock shaft 25. The cam 24 is of symmetrical shape, shown as segmental in contour, having the lower corners 27 and 28 which are normally disposed in a plane below the horizontal plane of the axis of the shaft 25. A handle 26 is provided for swinging the actuating cam. Normally the parts are as shown in Fig. 6 with the spring arms 8a and 9a longitudinally bowed and with their free ends forcibly pressing against each other with substantially equal pressure so that the movable contacts 14 and 15 are spaced from the fixed contacts 4 and 5. When, for example, the cam 24 is rocked in a counterclockwise direction, as shown in Fig. 7, the corner 27 of the cam engages the lower part of the spring 8a and forces the latter outwardly against the fixed pressure applier 20a. Pressure exerted by the spring against the fixed pressure applier causes the spring suddenly to initiate reversal of its longitudinal curvature so that the movable contact 14 is forcibly engaged with the fixed contact 4, the spring arm 9a following up the arm 8a so as to increase the contact pressure. If the cam 24 be turned far enough, so that its corner 27 rises above the horizontal plane of the shaft 25, the parts will remain indefinitely in this position with the circuit closed until the cam is swung back to normal position. Obviously, the actuator cam need not be symmetrical, for example the corner 28 may be so extended laterally that it could never be raised to the horizontal plane of the cam axis, and thus would have no locking action.

In Figs. 8, 9 and 10 a further modification is illustrated wherein the switch is in general like that of Fig. 1, but in which a different type of spring arm is employed. Thus the switch comprises the base 41 with the parallel arms 42 and 43 carrying the fixed contacts 44 and 45, the arms 42 and 43 being spaced apart to receive between

able and available source. Merely by way of example it may come from the action of a bi-metallic thermally responsive element. Such an element, for example a snap disk may take place of any of the above described actuating pins or parts, such as parts 20, or 120, or the part 40 of Fig. 4, so as to respond to ambient temperature changes, or it may be included in the circuit so as to respond to overload. Alternatively, the disk or other bi-metallic element may be incorporated in or form the switch arm itself, and in responding to temperature change will incline the arm in one or the other direction.

Furthermore, the opposed arms may be of different types, for example one may be like that of Fig. 3 and the other like that of Fig. 13. Again, for added contact pressure, each arm may consist of a plurality of individual members all of the snap acting type, and arranged so that all operate at the same time.

In order to provide for a wide gap between the terminals it may be desirable to hinge the spring arms at their lower ends so as to provide for a greater movement of the upper end of the arm.

While simple one-piece spring arms have here been illustrated as desirable, by reason of their simplicity and cheapness of construction, it is to be understood that spring arms of other types, for example arms comprising several parts and, in fact, arms in which the resilient element is a coil spring rather than than a leaf-spring, may be employed, providing the spring arms or elements be arranged so as to exert equal and opposite forces when in the mid-position. All such variations and modifications as fall within the terms of the appended claims are thereby regarded as within the scope of the invention.

I claim:

1. A snap action switch comprising a pair of spaced fixed contacts, a pair of elongate arms each fixed at one end, the fixed ends being spaced apart, an electric contact at the free end of each arm, said contacts being interposed between the fixed contacts and each being engageable at times with one of the respective fixed contacts, each arm comprising a thin longitudinally bowed spring, the material of each spring being internally strained and having a sensitive area at which a slight pressure will tend to cause a sudden reversal of the longitudinal curvature of the spring, the normal longitudinal curvatures of the arms being opposed to each other and the free ends of the arms normally pressing forcibly against each other, and actuators engageable with the sensitive areas of the respective arms, and stop elements engageable by each arm respectively, at a point intermediate the free end of the arm and its sensitive area so as, when force is applied to one arm, motion of the other arm in response to the said force is limited.

2. A snap switch designed alternatively to close either of two independent electric circuits, said switch comprising an insulating base which supports a pair of spaced, fixed contacts pertaining respectively to the two circuits, a pair of elongate arms having their lower ends rigidly fixed in spaced parallel relation in the base, means for electrically connecting the lower end of each arm to one of the respective circuits, each arm being of thin, resilient metal so designed that the metal is under a normal internal stress tending to bow it longitudinally, but having a sensitive spot intermediate its ends at which pressure, applied perpendicular to the convex surface of the arm, causes a sudden reversal of curvature of the arm, the two arms being normally concave toward each other and pressing against each other at their free ends with substantially equal pressure, the free ends of the arms being interposed between and normally spaced from the fixed contacts, motion-limiting stops designed to engage the outer surfaces of the respective arms at points intermediate the free ends of the latter and their sensitive spots, and movable actuators independently operative to apply force to the sensitive spots of the respective arms with resultant sudden reversal of curvature of the arm to which such force is applied, whereby the free end of said arm is moved by the pressure of the other arm in a direction opposite to that of the applied force.

3. A snap switch comprising an insulating support, a pair of elongate, resilient current-conducting arms each fixed at one end to the support, the fixed end of each arm being electrically connected to a circuit terminal, each arm having an electrical contact element near its free end, a pair of fixed, spaced, electrical contacts engageable at times by the aforesaid contacts respectively, thereby alternatively to close electrical circuits, the parts being so constructed and arranged that the free end of each arm always exerts stress tending to bow the other arm longitudinally, the normal stiffness of the two arms and the normal bending stress exerted by each arm on the other being substantially equal whereby the free ends of the arms normally occupy a neutral position wherein each of the arm-supported contacts is spaced from the corresponding fixed contact, means selectively operative suddenly to reduce the effective stiffness of one or the other of said arms whereby the other of said arms becomes effective to swing the free ends of both arms from the normal position and thereby close one of the circuits, and normally fixed, motion-limiting means engaging each arm at a point intermediate the free end of the arm and the support.

4. An actuating device for use in electrical snap switches or the like, said actuating device comprising a support, a pair of elongate, resilient, current-carrying arms each fixed at one end to the support, the fixed end of each arm being electrically connected to a circuit terminal, the arms being so constructed and arranged that each arm normally exerts stress tending to bow the other arm longitudinally, a pair of fixed, spaced stops arranged to be engaged at times by the free ends of the respective arms, said arms normally exerting substantially equal and opposite bending stress upon each other whereby their free ends are normally positioned substantially midway between the stops, a motion-limiting element operative by engagement with the convex side of each bowed arm, respectively, to prevent movement of the free end of said arm toward its proximate fixed contact, so long as said arm retains its normal direction of curvature, and independent means selectively operative suddenly to decrease the bending stress which either arm exerts upon the other whereby the free ends of both arms selectively move toward one of the stops.

5. A snap switch comprising a support, a pair of like elongate, resilient current-conducting arms each fixed at one end to the support, the fixed end of each arm being electrically con-

arms consists of a length of thin, resilient sheet metal having one of the movable contacts secured to one of its ends, the other end portion of said length of material being longitudinally slitted to define three parallel legs, the middle leg being shorter than the other two, a support to which the ends of the longer legs are fixed, the free end of the shorter leg being seated in a notch in the support, the position of the notch being such, relatively to the location of the ends of the longer legs that the length of resilient material is normally bowed longitudinally, the pressure applier contacting the longitudinally convex face of the shorter leg.

13. A snap switch as set forth in claim 8, further characterized in that the convex faces of the bowed arms are opposed to each other with the free, contact-carrying ends of the arms normally spaced apart, and a link connecting the arms near their free ends so that when one arm moves the other must move likewise.

14. A snap switch as set forth in claim 8, further characterized in that the arms normally diverge toward their free ends and are united near their free ends by motion-transmitting means, the motion-limiting means being interposed between the arms, and the means for selectively reducing the effective stiffness of one or the other of the arms comprising a pivotally supported member which is interposed between the arms and which comprises parts engageable alternatively with the respective arms.

15. A snap action switch as set forth in claim 8, further characterized in that each pressure applier is a normally fixed part and that the means for causing relative movement of the pressure applier and the respective arm is a pivotally supported rocker interposed between the arms, and having parts which are alternatively engageable with the respective arms.

16. A snap action switch as set forth in claim 8, further characterized in that each pressure applier is a normally fixed part and that the means for causing relative movement of the pressure applier and the respective arm is a cam supported to rock about an axis midway between said arms, the cam having corners disposed in a plane below the pivotal axis of the cam and which are engageable alternatively with the respective arms at points between the fixed ends of the arms and the respective pressure appliers, and means for rocking the cam.

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