Oct. 4, 1955 J. M. BRADY 2,719,893

SNAP ACTION DEVICE

Filed May 13, 1953 2 Sheets-Sheet 1

Fig. 1.

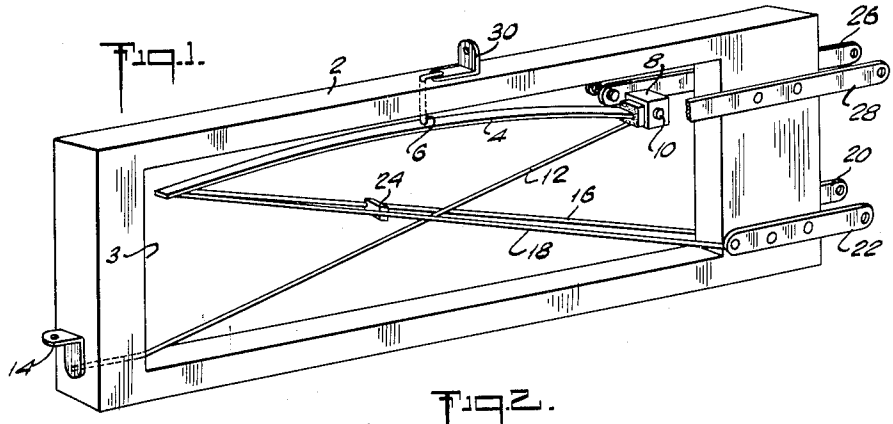



Fig. 2.

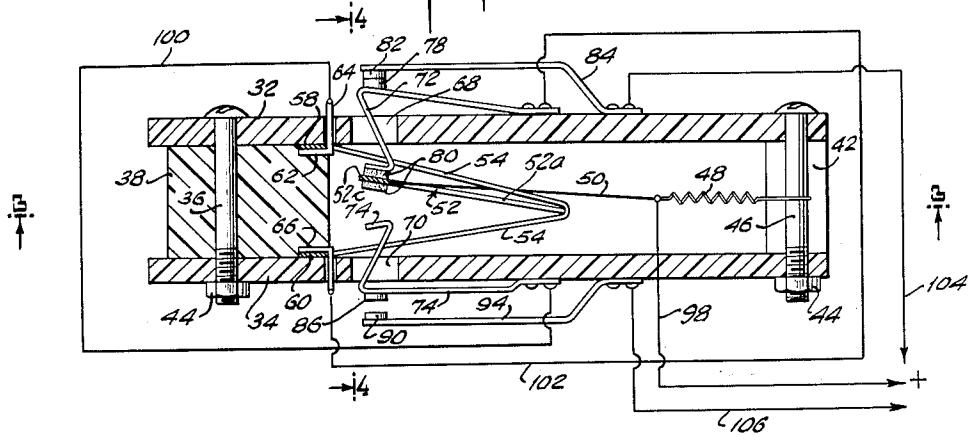



Fig. 3.

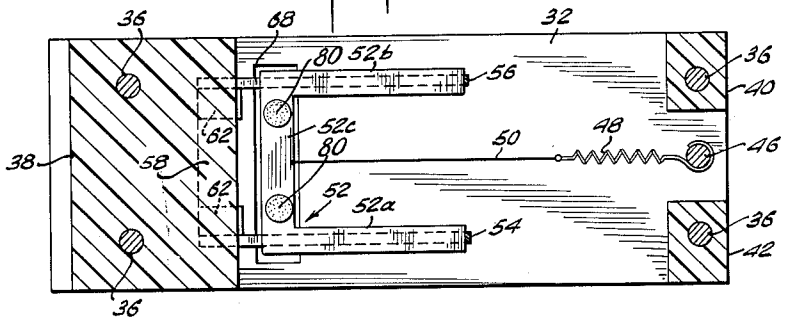
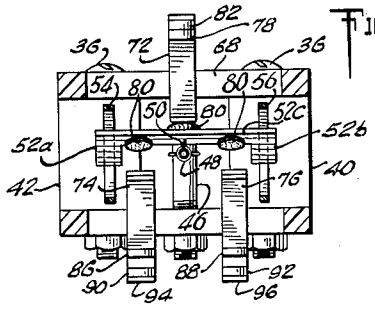



Fig. 4.




INVENTOR
JAMES M. BRADY
BY
Eyre, Mann & Burrows
ATTORNEYS

Oct. 4, 1955 J. M. BRADY 2,719,893

SNAP ACTION DEVICE

Filed May 13, 1953 2 Sheets-Sheet 2

Fig. 5.

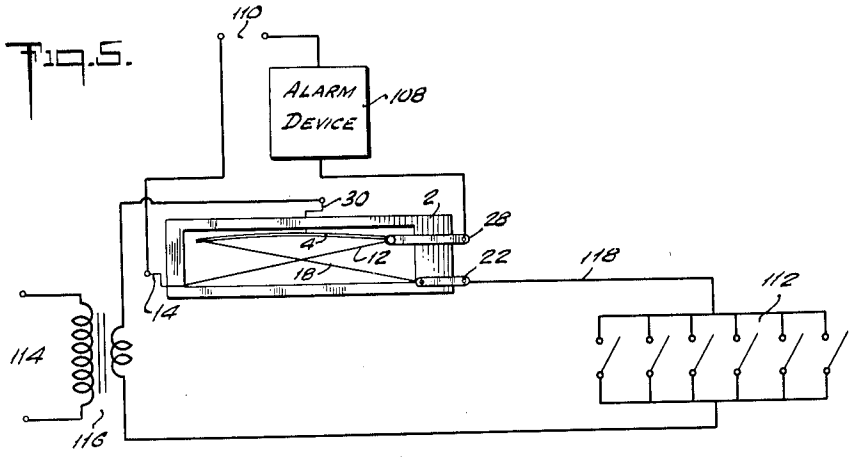



Fig. 6.

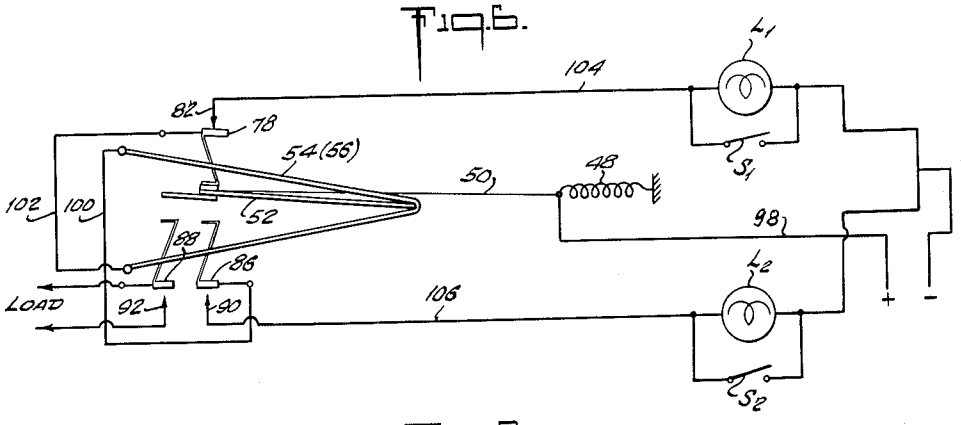
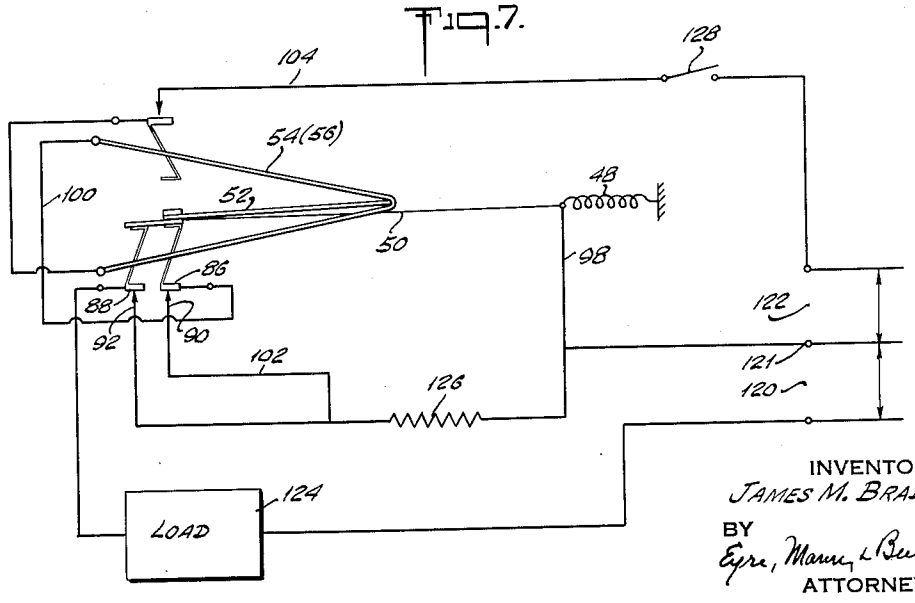



Fig. 7.




INVENTOR
JAMES M. BRADY
BY
Eyre, Mann & Burrows
ATTORNEYS

United States Patent Office

2,719,893

Patented Oct. 4, 1955



2,719,893

# SNAP ACTION DEVICE

James M. Brady, Wantagh, N. Y., assignor to Servomechanisms, Inc., a corporation of New York

Application May 13, 1953, Serial No. 354,778

11 Claims. (Cl. 200—113)

The present invention relates to electrical switching devices and more particularly to automatic switching devices of the type actuated in response to expansion or contraction of one or more wires or ribbons and comprises a novel snap action device of this character that is of simple construction, light in weight, and of precise and controllable operation. The new device, depending upon circuit connections thereto, upon the thermal characteristics of certain of its parts and upon adjustment thereof may operate as a single pole single or double throw relay, as a self-opening relay, as a latching relay, as a flasher, as an overload protector, as a temperature indicator, as a remote controlled thermostat or as a power integrating switch. The new device requires but small current and low voltage for operation.

Briefly, the new switching device comprises a movable arm carrying or controlling electrical contacts and adapted to snap to different contact operating positions under control of angularly disposed expansible pull means, such as wires or ribbons, which are connected under tension to the arm, the position of the arm depending in general upon the difference in tension in the pull means. The difference in tension in the pull means may be caused by passage of current through one wire or ribbon, causing expansion thereof, or by change in ambient temperature when the wires or ribbons have different thermal coefficients of expansion or by both current flow and ambient temperature change. The initial tension in the pull means may be equal or different, depending on the particular field of use for which the device is designed.

For a better understanding of the invention and of automatically controlled snap switch devices embodying the same, reference may be had to the accompanying drawings, of which:

Fig. 1 is an isometric view of a simple form of relay or flasher embodying the invention;

Fig. 2 is a vertical longitudinal section through a self-opening device representing another embodiment of the invention;

Fig. 3 is horizontal sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view taken on the line 4—4 of Fig. 2;

Fig. 5 is a circuit diagram illustrating use of the device of Fig. 1 as a low voltage light weight relay for remote control of the circuit of a high voltage device from a plurality of locations;

Fig. 6 is a circuit diagram illustrating use of the device of Fig. 2 as a latching relay; and

Fig. 7 is a circuit diagram illustrating the use of the device of Fig. 2 as an overload protector.

The invention will first be described with reference to the simple switch of Fig. 1 to which reference may now be had. A relatively thick rectangular block 2 of insulating material has a large rectangular opening 3 formed therein and in this opening is disposed a bowed spring member 4 which is mounted for pivotal motion about a pin 6 extending through the part of the block 2 extending over the rectangular opening. One end of the member 4 adjacent one corner of the opening 3 has insulatedly mounted thereon a cap 8 carrying contacts 10 on opposite sides thereof, only one of the contacts 10 being visible in the view shown in Fig. 1. Cap 8 has welded, or otherwise firmly secured thereto, one end of a wire 12 the other end of which is anchored in the wall of block 2 adjacent the diagonally opposite corner of the opening 3. The wire 12, which is under sufficient tension to maintain the bow shape of the member 4 is connected to a terminal 14 on the block 2. Secured to the other end of the member 4 are a pair of wires 16 and 18 which extend diagonally of the opening toward the corner opposite terminal 14. Wire 16 is connected at its other end to a terminal connector 20 disposed on one surface of the block 2 and wire 18 at its other end is connected to a terminal connector 22 disposed on the other surface of the block 2. Wires 16 and 18 at the center of the opening span the wire 12 and preferably a spacer 24 of insulating material is provided at the crossover point of the wires 16 and 18 with wire 12 to prevent contact between any of the wires at this point. Secured to opposite surfaces of the block 2 adjacent the cap 8 are two fixed terminal members 26 and 28 which on their inner ends carry adjustably mounted electrical contacts for engagement with contacts 10 carried by the housing 8. The wire 12 is preferably of nonexpansible material, as for example, silver-plated phosphor bronze, whereas the wires 16 and 18 are of materials having relatively high thermal coefficients of expansion. Wires 16 and 18 may be of the same material or of material having different thermal coefficients of expansion depending upon the particular application for which the switch is designed.

If the switch is to be employed as a simple single pole single throw relay, the wires 16 and 18 would be of like material, for example, of a nickel alloy having a high coefficient of expansion. One terminal 26 or 28 would be connected to the circuit to be controlled as would also terminal 14. The control circuit would be connected to one or the other of terminals 20 or 22 and to a terminal 30 mounted on the frame 2 and connected to the pin 6. If the circuit to be controlled is connected to terminal 26 and the relay is to be normally open, then the initial tension in wire 16 is adjusted to be higher than that in wire 18 and terminal 20 is connected to the control circuit. The difference in the initial tensions in wires 16 and 18 holds arm 4 in a position where contact 10 engages the contact carried by connector 28, thereby holding open the circuit between terminals 14 and 26. When the control circuit connected to terminals 20 and 30 is closed, current will flow through the wire 16 and arm 4 to terminal 30 heating the wire and causing expansion thereof and reduction of tension therein. The reduction in tension in the wire 16 permits wire 18 to swing arm 4 into the position where contact 10 engages the contact on connector 26, thereby closing the circuit between terminals 14 and 26. Movement of the arm 4 from one contact closing position to another is effected by a snap action when the arm passes through the equilibrium position at which the moment arms determined by the spacing of the wires 16 and 18 from the wire 12 at the crossover point are equal.

If the above described switch is to be employed as a normally closed rather than as a normally open relay, the external circuit to be controlled would be connected to terminal 28, rather than to terminal 26, assuming that the control circuit is connected to terminal 20. If the relay is to operate as a single pole double throw switch, external circuits would be connected to both terminals 26 and 28. For flasher operation, terminal 30 would be externally connected to terminal 14 and the tension in wire 16 when cold would be such as to keep

arm 4 in a position for engagement of contact 10 with the contact carried by connector 28. When a voltage is applied across connector 28 and connector 20, current flows through the tensioned wire 16 and terminal 30 to terminal 14, wire 12, contact 10 and connector 28. This current heats the wire 16 causing it to expand and the switch to snap to open circuit position with consequent cooling of wire 16 and repetition of the cycle. The time of dwell of a contact 10 with the contact carried by connector 28 when the device is operated as a flasher is dependent on the current through the tensioned wire 16 and upon the spacing of the contacts relative to the neutral position of the arm 4 whereas the time of dwell of the other contact 10 with the contact or stop carried by connector 26 (open circuit) remains substantially the same irrespective of the current through the wire 16 during the heating periods. Thus, by providing a second set of contacts to be operated by arm 4, the integrated power to a load circuit including such contacts and a source of energy could be controlled by control of the current in the circuit connected to terminal connectors 20 and 28. On the other hand, if a sufficiently high heating current is employed, the time of dwell in the heating position will depend practically entirely upon contact spacing. Hence by initial adjustment of the contacts carried by connectors 26 and 28, any desired time delay between closure of the heating circuit and operation of the switch can be obtained.

The device of Fig. 1 when wire 16 has a lower coefficient of expansion than wire 18 can be employed as a temperature indicator. With the circuit as described for a single pole single throw switch, the current through wire 16 sufficient to make the switch operate is measured and this current is a measure of the ambient temperature. If it is desired to utilize the switch of Fig. 1 as a remote control thermostat, the wires 16 and 18 are of materials having different coefficients of expansion and their lengths are so selected as to be different when the device is cold but the same at some predetermined high temperature, for example, 500° F. By delivering current to the shorter of the wires, that having the higher coefficient of expansion, the wires are brought to the same length at any desired temperature lower than that specified. Thus the ambient temperature at which the switch operates can be controlled by control of the current to the wire having the higher coefficient of expansion. Various other applications of the device of Fig. 1 will be apparent to those skilled in the art. It is of particular value as a light weight low voltage relay for control of a high voltage circuit and one example of such use is shown in the diagram of Fig. 5 to which reference will be made hereinafter.

A latching relay operating on the principle of that of Fig. 1 is illustrated in Figs. 2, 3 and 4 to which reference may now be had. The movable parts of the switch of this embodiment of the invention are mounted within a framework comprising rectangular plates 32 and 34 of insulating material held together at their corners by four bolts 36 which extend through alined holes in the plates and in suitable insulating spacer blocks 38, 40 and 42 and have nuts 44 threaded thereon, block 38 being rectangular in section and extending the full width of the plates 32 and 34 and blocks 40 and 42 being generally square in section and located at the corners of the plates. A bolt or post 46 interconnecting the plates 32 and 34 and centrally disposed between the blocks 40 and 42 has anchored thereto one end of a strong tension spring 48, the other end of which is secured to one end of a nonexpansible relatively heavy wire 50. Wire 50 serves, like wire 12 of the switch of Fig. 1, to maintain the movable member of the switch under tension and to insure firm contact pressure. The movable member comprises a stiff flat U-shaped element 52 of metal having legs 52*a* and 52*b* and base 52*c*. It is to the base portion 52*c* of the movable member that the other end of wire 50 is attached. The expansible pull means, corresponding to the wires 16 and 18 of Fig. 1, comprise flat flexible metal strips 54 and 56 which are interconnected at their ends by wider strips 58 and 60. Strip 58 is clamped flush against the undersurface of frame plate 32 by a pair of angle members 62 each of which has one leg extending upwardly through a slot 64 in the plate and the other leg underlying the strip 58 and firmly held thereagainst by the spacer block 38. Strip 60 is similarly clamped against the upper surface of the lower plate member 34 by angle members 66 of which only one is visible in the sectional view of Fig. 2. The strips 54 and 56 are bent around the ends of the legs 52*a* and 52*b*, respectively, of the movable member, and are thereby maintained under tension due to the pull of the spring 48 acting through wire 50 on the base portion 52*c* of member 52. Plates 32 and 34 are provided with alined rectangular openings 68 and 70 above and below, respectively, the base 52*c* of member 52. Through opening 68 extends a spring contact operating arm 72 and through opening 70, in the particular embodiment illustrated in the drawings, extend two spring contact operating arms 74 and 76. Arms 72, 74 and 76 beyond the openings 68 and 70 extend longitudinally of the frame plates 32 and 34 and are secured at their ends to the respective plates. Arm 72 at the bend thereof above the opening 68 carries a contact 78 which, when the arm is raised by engagement of the lower end thereof with an insulating pad 80 carried on the member 52, engages a contact 82 carried on the underside of the end of an arm 84, the other end of which is secured to the upper surface of the frame plate 32 and serves as one terminal of the switch. Similarly, arms 74 and 76 at the bends thereof underlying the opening 70 carry contacts 86 and 88, respectively, which are adapted to engage, when insulating pads on the lower surface of the part 52*c* of member 52 engage the spring arms, with contacts 90 and 92, respectively, carried on the upper side of the ends of arms 94 and 96 respectively, which latter arms are secured at their other ends to the under surface of frame plate 34 and serve as additional terminals of the device. In Fig. 2 only arm 94 contacts 86 and 90 are visible. The juncture of wire 50 and spring 48 also serves as a terminal for the switch and therefore a lead 98 is shown in Fig. 2 as connected therewith. In order to provide the self-opening feature of the device, one anchor member 62, which is in electrical communication with the strip 58 and therefore with the ribbons 54 and 56 at the upper ends thereof, is connected through a lead 100 with contact arm 74 and one or both of the anchor members 66 which are in electrical connection with strip 60 and therefore with the other ends of the ribbons 52 and 54 is connected by a lead 102 to spring arm 72.

The operation of the above described switch, omitting for the time being any circuit controlled by contacts 88 and 92 is as follows. Assuming the parts in the position illustrated in the drawing, namely, with member 52 positioned for closure of contacts 78 and 82, and with contacts 86 and 90 open, if a source of energy is connected across lead 98 and a lead 104 connected to terminal 84, current will flow through wire 50 and the movable member to the midpoint of the ribbons 54 and 56, from this midpoint through the lower halves of the ribbons to anchor members 66 and from there through lead 102 to spring arm 72, through closed contacts 78 and 82, and arm and lead 104 back to the source of energy. No current will flow through the upper halves of the ribbons 54 and 56 because the circuit thereof is open at the contacts 86 and 90. The current through the lower halves of the ribbons will cause expansion thereof and reduction in tension with the result that the uneven pull upon the legs of the member 52 will tend to rotate the member in a counter-clockwise direction as viewed in Fig. 2, moving upward the points of contact of the ribbons with the legs of member 52. When the expansion of the lower halves of these ribbons is such as to cause the ends of the legs of member 52 to reach or pass the level of the wire 50, the member 52 will snap rapidly into position to close contacts 86 and

90 and open contacts 82 and 78 thereby opening the heating circuit for the lower parts of the ribbons. If conductor 106 connected to contact arm 94 is not connected to any external circuit, the switch will remain open. However, when the lead 106 is connected to the negative terminal of the source connected to lead 98, current will flow through lead 98, wire 50, the upper halves of ribbons 54 and 56, anchor member 62, lead 100, closed contacts 86 and 90 to lead 106 heating the upper halves of the ribbons and causing eventual reversal of the switch to the position shown in Fig. 2. Thus, by manipulation of suitable switches in the leads 104 and 106, remote control of the switch and of any external circuit connected to contact arms 76 and 96 may be effected, contacts 88 and 92 being closed whenever contacts 86 and 90 are closed.

It is often desirable to control a high voltage device from a number of locations and to effect such control without utilizing high voltage connections between the points of control and the device to be controlled. For example, in a factory, or the like, an alarm device operated at 220 volts should be controllable from many different locations in the building and yet it may not be desirable to submit the circuit connections between the control points and the alarm device to such high voltage. By the use of the relay of Fig. 1, a low voltage circuit, for example, 6 volts, may be employed for control of the circuit of the alarm device. In Fig. 5 such an alarm device is indicated diagrammatically at 108 and high voltage terminals for supply of energy thereto are indicated at 110. At 112 six switches are indicated as connected in parallel. The switches may be located in different rooms or parts of the building to be protected. Aa a suitable outlet indicated by terminals 114 across which 110 volts or more is impressed, is connected the primary of a stepdown transformer 116, the secondar yof which provides the low voltage, say 6 volts, for the relay control circuit. One end of the secondary winding is connected to the terminal 30 of the relay of Fig. 1 and the other end of the secondary is connected to the movable arms of the switches 112. The fixed contacts of the switches are connected through a lead 118 to terminal 22 of the relay and the alarm device 108 is connected between one terminal 110 and terminal connector 28 of the switch, the other terminal 110 being connected to terminal 14 of the switch. Assuming the initial tension in the pull wires of the switch to be such that the circuit is normally open through wire 12, that is, that the initial tension in wire 18 connected to terminal 22 is greater than that in the other pull wire so that the contact on terminal connector 28 is disengaged by the contact on arm 4 then, upon closure of any one of the switchse 112, wire 18 will be heated to expand and permit closure of the circuit of the alarm device through wire 12 and terminal 28 and the alarm device will continue to operate until all switches 112 are open. The relay and alarm device may be located near the high voltage terminal 110 and the switches 112 at widely separated points. As only low voltage is applied to the control circuit including the switches 112, bell cord or the like can be employed for the wiring.

Fig. 6 illustrates the circuit of the switch of Figs. 2 to 4 when arranged for operation as a latching relay. Lead 98 is connected to one terminal, indicated by the + sign, of a source of energy, and leads 104 and 106 are connected through lamps $L_1$ and $L_2$, respectively, bridged by switches $S_1$ and $S_2$, to the other terminal of the source, indicated by the — sign: A circuit including a load to be controlled is connected across contacts 88 and 92. With the movable member 52 in the position indicated in the drawing and both switches $S_1$ and $S_2$ open the circuit of lamp $L_1$ will be closed through contacts 78 and 82 and the lower parts of the ribbons 54 and 56 whereas the circuit of lamp $L_2$ will be open at contacts 86 and 90 and the load circuit will be open at contacts 88 and 92. The current through lamp $L_1$ and the lower parts of the ribbons will be insufficient to cause reversal of the switch and lighting of the lamp will be an indication that the load circuit is open. If now switch $S_1$ is momentarily closed, the increased current through the above described circuit will cause expansion of the lower parts of the ribbons and opening of the circuit at contacts 78 and 82 and closure of the circuits of lamp $L_2$ and the load. Closure of the circuit through lamp $L_2$ gives an indication that the load circuit is energized. To open the load circuit switch $S_2$ is momentarily closed to cause reversal of the switch upon expansion of the upper part of the ribbons. Thus the device acts as a self-opening remote control relay, momentary closure of switch $S_1$ causing reversal of the switch and closure of the load circuit which remains closed until switch $S_2$ is momentarily closed to reverse the switch and open the load circuit.

By providing at different locations a plurality of switches in parallel with the switch $S_1$ the load circuit could be closed from each switch location and if each such switch were connected across a lamp, closure of the load circuit by operation of any one of the switches would be indicated at all locations by extinguishment of the associated lamps and by lighting of lamp $L_2$. This is a convenient arrangement in the case, for example, of an alarm system, as opening of the load or alarm circuit could be controlled from a single location, that of switch $S_2$ which in such case would be that of the guard or other authorized person. The closure of switch $S_2$ at such station would be indicated at the other stations by lighting of the lamps at those stations. When a plurality of indicating lamps are employed the parallel resistance thereof should of course be high enough to keep the current to the relay below the operating value.

The circuit of Fig. 6, when both switches $S_1$ and $S_2$ are maintained closed operates to alternately open and close the load circuit and hence, if the load is a lamp load, to flash the lamps thereof.

In Fig. 7, suitable connections for use of the switch of Figs. 2 through 4 as an overload circuit breaker are shown. High voltage terminals for the load are indicated at 120 and 121 and low voltage terminals for the circuit breaker are indicated at 121 and 122, terminal 121 being common to both the high and the low voltage systems. The load 124, the current through which is to be protected, is connected between terminal 120 and auxiliary contact 88 of the switch. Contact 92, adapted to cooperate with contact 88, is connected through a potential dropping resistor 126 to the common terminal 121. Wire 50, through lead 98 is connected to terminal 121 and contact 90 through lead 102 and resistor 126 is connected to terminal 121. Lead 104 of the switch is connected through a manually operated switch 128 to the low voltage terminal 122.

With the above described connections, and with switch 128 open, there will be a potential difference across resistor 126 which is dependent upon the load current. Current will flow, therefore, through the wire 50, member 52, the upper halves of the wires 54 and 56, lead 100, contacts 86 and 90 and lead 102. If this current is small, the expansion of the upper part of the ribbons 54 and 56 will not be sufficient to reverse the position of the member 52 and consequently the load circuit will be maintained closed at contacts 88 and 92. Upon excessive current through the load, however, the potential drop across the resistor 126 will increase to a point where the current through the upper halves of ribbons 54 and 56 will be sufficient to cause reversal of the switch and opening of the load circuit at contacts 88 and 92. The circuit will remain open until manual closure of switch 128 to cause heating of the lower halves of the ribbons 54 and 56 and consequent reclosure of the load circuit.

The invention has now been described with reference to two specific embodiments thereof. It will be noted that in each of the illustrated embodiments of the in-

vention the stops or contacts and the points of attachment of the pull strands and of the tensioning strand (wire **12** of Fig. 1 or wire **50** of Fig. 2) are so located that the angle between the pull strands at either contact controlling position of the member is greater than the angle which the tensioning strand makes with the longitudinal plane through the movable member containing the pivotal axis thereof. In other words, in each embodiment of the invention the locations at which the ends of the pull strands are secured are on opposite sides of the longitudinal plane through the movable member containing the pivotal axis, whether the member is in one or the other of the contact controlling positions and the point to which the tensioning strand is secured is located in a plane which at some moment in the travel of the member between contact controlling positions coincides with the longitudinal plane of the member containing the pivotal axis. When the stops or contacts and the points of attachment of the pull and tensioning strands are so located, snap action of the device under the influence of the tensioning strand with differential expansion of the pull means is insured. In each embodiment the pull strands and tensioning strand are so coupled to the movable member that components of the forces exerted thereby on the member tend to compress the member longitudinally. This arrangement tends to counterbalance all forces except those tending to rotate the member from one circuit controlling position to the other. In each case the movable member pivots about an axis intermediate its ends. In the embodiment of Fig. 1 a fixed pivotal axis is provided and therefore but two pull strands are required as the fixed axis prevents rotation about any other axis. In Fig. 2 the member pivots about a floating axis determined by the forces applied by the pull strands and tensioning strand to the ends of the member in conjunction with the reaction forces acting through the stop members. Two pairs of pull strands are provided, to give, with the tensioning strand a three point suspension insuring against rotation about a longitudinal axis. When the stop members are resilient, and the pivotal axis of the member not fixed, as is the case in the construction of Fig. 2, contact closure may be maintained up to the instant when the member snaps to the other contact controlling position, thus minimizing sparking and improving the operation of the device.

It will be apparent from the foregoing description that the invention provides a new snap acting device that can be made quick or slow acting as desired, that insures good contact pressure in circuit controlling position, that can be efficiently employed in numerous applications and that can be remotely controlled.

As the new device can be made extremely light in weight as compared to conventional relays employing coils, cores and armatures, it is of particular value for use in airplanes where weight is a factor that must be considered. For airplane circuits, latching relays are preferred because momentary failure or drop in voltage which occurs at times during take-off, does not effect such relays. The excessive weight of such relays, as heretofore constructed, has prevented the industry from taking full advantage of this type of relay. The light weight latching relay of the present invention thus satisfies a decided need in the airplane industry. Obviously, various changes in the specific constructions illustrated could be made without departing from the spirit of the invention or the scope of the accompanying claims.

The following is claimed:

1. A snap action device comprising a metallic member pivotally movable about an axis intermediate its ends to two different circuit controlling positions, at least one pair of flexible metallic pull means connected at one end to an end of said member, said pull means tending to move said member to different circuit controlling positions and tensioning means secured to the other end of said member and tending to hold said member in either circuit controlling position whereby, when an energizing circuit is connected to said member and to one or the other of said pull means, differential expansion of the pull means causes snap action movement of said member from one circuit controlling position to the other.

2. The device according to claim 1 including a contact carried by said member and a fixed contact adapted to be engaged by said first mentioned contact in one circuit controlling position, whereby when said contacts are included in an energizing circuit including said member and that one of said pull means which tends to move the member into contact closing position, closure of said circuit heats said one of said pull means and permits the other of said pull means to move the member to the other position and to hold the member at such other position until said first one of said pull means has cooled and contracted sufficiently to move said member to contact closing position, whereby said device operates to alternately close and open said circuit.

3. The device according to claim 2 including a second energizing circuit including the other of said pull means and contacts closed by said member in the other position thereof whereby said device operates to close and open said circuits alternately.

4. The device according to claim 1 wherein said movable member is an arcuate member mounted for pivotal motion about an axis intermediate its ends and wherein said pull means comprises tensioned wires connected to one end of the member and extending therefrom to points positioned on opposite sides of the plane containing the longitudinal axis of the member and the pivotal axis thereof.

5. The device according to claim 1 wherein said movable member is of rigid material and of U-shaped with a pair of legs and a base part interconnecting the legs, and said pull means comprise a pair of conductive ribbons each fixed at both ends and engaging intermediate its ends an end of a leg of said member, said tensioning means being coupled to the base part of said member, the difference in tension between the parts of the ribbons extending from the legs of the member to the fixed ends determining the circuit controlling position of said member.

6. A snap action device comprising a conductive movable member of rigid material and of U-shape with a pair of legs and a base part interconnecting the legs, upper and lower frame members between which said movable member is disposed, a pair of flexible conducting strips secured at their ends to said frame members and folded over the ends of the legs of said movable member, contact controlling means carried by said frame members and engageable by the base part of said movable member in different angular positions thereof, tensioning means coupled to the base part of said movable member and acting in a direction to tension said strips and to hold said movable member with its base part in engagement with one or another of said contact controlling means, the circuit controlling means on one of said frame members operating when engaged by said movable member to close a circuit through said movable member and the parts of said strips extending from their points of engagement with the legs of said movable member to the ends carried by the other of said frame members whereby when said circuit is energized the tension in said parts of said strips is reduced and the base part of said movable member eventually moves with a snap action into engagement with the circuit controlling means carried by said other frame member, opening said circuit.

7. The snap action device according to claim 6 wherein the contact controlling means on said other frame member operate when engaged by said movable member to close a circuit through said member and the other parts of said strips whereby when energy is applied to both of said circuits, said device functions to close and open said circuits alternately.

8. The snap action device according to claim 6 wherein

the contact controlling means on said other frame member operate when engaged by said movable member to close a circuit through said member and the other parts of said strips and wherein said last mentioned frame member carries additional contact controlling means adapted to be engaged by said movable member and when so engaged to close a load circuit, whereby said device operates as a latching relay to close and open said load circuit in response to energization of one or the other of said first mentioned circuits.

9. A snap action device comprising a member pivotally movable about an axis intermediate its ends to assume two different circuit controlling positions, two flexible expansible pull strands each coupled at one end to an end of said member, the other ends of said pull strands being fixedly secured at locations on opposite sides of the longitudinal plane of the movable member containing the pivotal axis irrespective of the position of the member, a tensioning strand coupled at one end to the other end of said member and fixed at its other end at a location in a plane which at some moment in the travel between circuit controlling positions coincides with the longitudinal plane of the member containing the pivotal axis, the fixed ends of said pull strands and said tensioning strand being so located that components of the forces exerted on said member by said pull strands and tensioning strand tend to compresses said member longitudinally, means engaged by said member at the circuit controlling positions for limiting pivotal motion of the member, and means for causing differential expansion of said pull strands for moving said member from one circuit controlling position to the other.

10. The device according to claim 9 wherein said movable member is of the shape of a flat U with the ends of the legs of the U comprising one end of the member and the base of the U the other end of the member, said pull strands being coupled to the end of one leg of the U and wherein a second pair of pull strands are similarly coupled to the end of the other leg of the U, said tensioning strand being coupled to the base of the U, said two pair of pull strands and said tensioning strand entirely supporting said member and preventing rotation thereof about a longitudinal axis.

11. The device according to claim 9 wherein said motion limiting means are resilient contact controlling members.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,329,756 | Ewen | Feb. 3, 1920 |
| 1,773,708 | Whittingham | Aug. 19, 1930 |
| 1,783,450 | Klahn | Dec. 9, 1930 |
| 1,979,349 | Schmidinger | Nov. 6, 1934 |
| 2,141,775 | Varley | Dec. 27, 1938 |
| 2,508,637 | Bolesky | May 23, 1950 |