

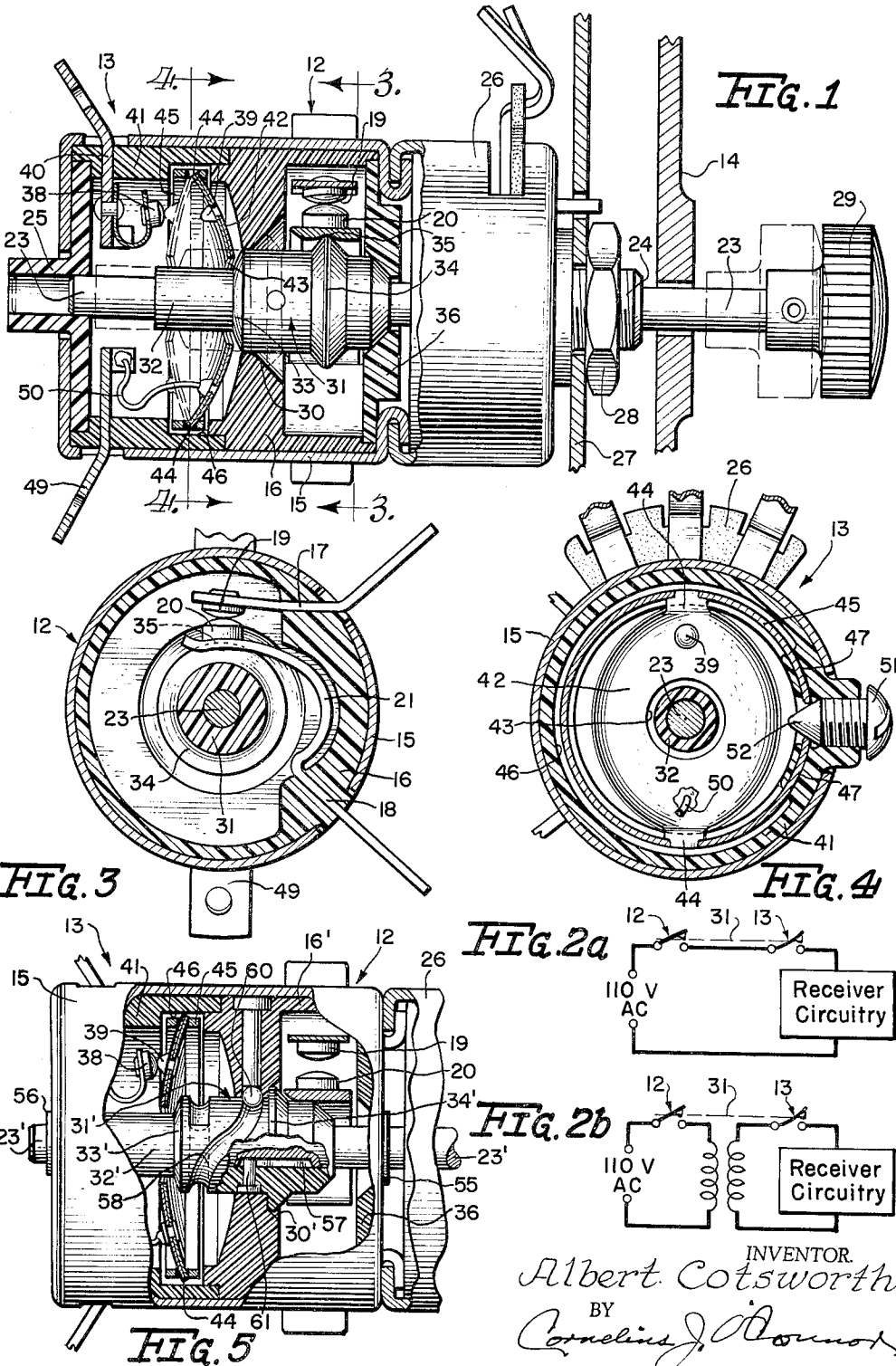
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COMBINATION ON-OFF SWITCH AND CIRCUIT BREAKER

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1

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## COMBINATION ON-OFF SWITCH AND CIRCUIT-BREAKER

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This invention relates in general to television receiver power supplies and in particular to an improved protection system for use therewith.

In the interest of safety, home entertainment devices such as television receivers incorporate a fuse element for disconnecting the receiver from the line voltage in the event an abnormally high current is drawn by the receiver. Often as not fuse destruction is attributable to a temporary line surge which does not inflict permanent damage to the receiver circuits. While replacing a fuse in the receiver does not constitute a major repair, the viewer, unaware of the nature of the failure, generally calls a serviceman.

In order to eliminate the inconvenience, as well as the expense involved in calling a serviceman, many manufacturers have substituted resettable circuit breakers for such fuses. Moreover, and as a further convenience, the reset control for the breaker has been made available for actuation by the viewer. Experience has shown, however, that many viewers either neglect to read the instructions for resetting the breaker in the operating manual, or else forget the procedure since the breaker opens but infrequently. Thus resort to resettable circuit breakers has not, in most instances, been the boon to the viewer that was intended.

It is therefore a principal object of the invention to provide a novel protection system for the power supply of a television receiver.

It is a specific object of the invention to provide a novel on-off switch and circuit breaker arrangement for protecting a television receiver power supply.

It is a more specific object of the invention to provide a circuit breaker arrangement which is automatically reset by actuation of the on-off switch.

In accordance with the invention, a combination switch and circuit-breaker arrangement for the power supply system of a television receiver comprises an on-off switch having a fixed contact and a movable contact shiftable along a predetermined path between an open position and a closed position in which it engages the fixed contact to establish an electrical connection through the switch. The circuit-breaker is effectively connected in series relation with the switch contacts and comprises a first terminal and a bi-stable second terminal which is shiftable along a predetermined different path between an open position in which it is out of engagement with the first terminal and a reset position in which it engages the first terminal. If subjected to an electrical current exceeding a predetermined value when so engaged, the bi-stable terminal shifts from the reset to the open position. The arrangement further includes a bi-stable actuator which is displaceable between first and second stable positions and comprises an operator which is engageable with the movable switch contact for shifting that contact along its path between its open and closed positions to establish an electrical connection in the first stable position and to open this connection in the second stable position. The actuator further comprises a driver which is engageable with the bi-stable terminal for shifting that terminal along its path to its reset position in response to displacement of the actuator to its second stable position after the movable switch con-

2

tact shifts to its position if, at that instant, the bistable terminal is in its open position.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood, however, by reference to the following description taken in conjunction with the accompanying drawings, in the several figures of which like numerals identify like elements, and in which:

FIGURE 1 is a side view, partly in section, of a combination on-off switch and circuit breaker constructed in accordance with the invention;

FIGURE 2a is a schematic representation of the switch and circuit breaker arrangement of FIGURE 1 in a television power supply;

FIGURE 2b is a schematic representation of the switch and circuit breaker arrangement of FIGURE 1 in a different type television power supply;

FIGURE 3 is a sectional view of the on-off switch taken along lines 3-3 of FIGURE 1;

FIGURE 4 is a sectional view of the circuit breaker taken along lines 4-4 of FIGURE 1; and

FIGURE 5 is a side view, partly in section, of an alternate embodiment of the invention.

FIGURE 1 shows a protected power supply system 10 for a television receiver comprising an on-off switch 12 and a circuit breaker 13. As best illustrated in FIGURE 2a, switch 12 and circuit breaker 13 are electrically connected in a series relation with a source of electric potential. If the receiver is transformer operated, the circuit breaker can be inserted in the primary or, as shown in FIGURE 2b, in the secondary. In any event, on-off switch 12 and circuit breaker 13 are effectively in series with the potential source.

Referring now to FIGURES 1 and 3, switch 12 comprises a housing 15 having an insert 16 of insulating material for receiving and confining the shank portions 17, 18 of a pair of engageable contacts 19, 20, respectively. To the end that contact 20 is movable relative to contact 19, shank 18 is formed of a resilient material and provided with a bight portion 21 which tends to bias contact 20 out of engagement with contact 19.

Switch 12 further includes a switch actuator for selectively closing contacts 19, 20 to establish an electrical connection therebetween. This actuator comprises a shaft 23 which is supported for axial displacement by a threaded collar 24 and a bushing 25. Collar 24, which is affixed to the housing of an adjustable control, such as a potentiometer 26, protrudes through an aperture in a chassis wall 27 of the receiver and is secured thereto by a conventional nut fastener 28. Shaft 23 is mechanically coupled in a driving relation to the adjustable element of potentiometer 26 in a conventional fashion, as by a key arrangement, not shown. Bushing 25 is mounted at one end of switch housing 15 which, in turn, is supported by control 26. A control knob 29 is fitted to one end of shaft 23. An escutcheon 14, or other decorative element, is usually interposed between chassis wall 27 and knob 29.

Affixed to shaft 23, intermediate bushing 25 and potentiometer 26, for axial translation therewith is a switch actuating member 31 formed, preferably, of insulating material. Actuator 31 comprises a reduced section 32, a shoulder portion 33 and an annular collar 34. As shown in FIGURES 1 and 3, collar 34 is engageable with a detent 35 formed on the underside of movable contact 20. Collar 34 is also engageable with a chamfered inner wall 30 of insert 16 for limiting inward displacement of actuator 31. Outward travel of actuator 31 is arrested by switch cover 36.

Circuit breaker 13 is disposed within housing 15 adjacent switch 12 and comprises a first terminal 38 and a second terminal 39 which, as will be shown, is a bi-stable element. Terminal 38 includes a shank portion 40 which is captivated by an insulator insert 41. Terminal 39, on the other hand, is affixed to, or can form an integral portion of, a support member 42. Member 42 includes a central aperture 43 of sufficient diameter to admit actuator section 32. Preferably, member 42 comprises a layered disc formed from two metallic elements having different coefficients of expansion. For example, Invar, which has a low coefficient of expansion, and bronze, having a relatively high coefficient, are two metals suitable for a bi-stable disc of the type herein considered. Additionally, and as best seen in FIGURE 1, the lower portion of bi-metal disc 42 is electrically connected to a terminal 49 via a conductor 50.

Terminal 39, together with disc 42, has a reset position, shown by broken line construction in FIGURE 1, in which the disc, while urging terminal 39 into engagement with terminal 38, assumes a relatively shallow curvature. Also as shown in FIGURE 1, terminal 39 has an open position in which it is out of engagement with terminal 38 and disc 42 is adjacent shoulder 33 of actuating member 31. For reasons soon to be apparent, the spacings between terminal 38 and disc 42 and between disc 42 and shoulder 33 are such as to insure that disc 42 is permitted a significantly greater deformation or curvature when it is in the open position.

To permit displacement between these positions, disc 42 has a pivotal mount comprising a pair of oppositely disposed tabs 44, preferably integrally formed from disc 42, which are seated within cooperating apertures in an open-ended mounting ring 45, see FIGURE 4. Ring 45 is fashioned from a resilient or spring material and is seated within a recessed portion 46 of insert 41. In order to maintain disc-supported terminal 39 in alignment with terminal 38, the free ends of ring 45 are fitted into the slots 47 in the inner wall of insert 41. Since the distance across the surface of disc 42 between the points where tabs 44 seat in ring 45 is slightly greater than the inside diameter of the ring, disc 42 has an over-center snap action at a point along a line extending between tabs 44. As a result, disc 42 is constituted a bi-stable device in that it will remain in either the rest or open position until displaced by an actuating force.

Bi-metal disc 42 is responsive to electric currents to the end that, a current exceeding a predetermined value heats the disc causing one of the two constituent metals to expand to a greater extent than the other thereby straightening the disc and spreading ring 45. When the disc elongates to the point where it is coincident with the over-center line, a snap action, in part attributable to the biasing force of ring 45, shifts disc 42 and, of course, terminal 39, about its pivotal tabs 44 to the open position. The energy required to overcome the biasing force of ring 45 and so elongate disc 42 determines the operating threshold of the circuit breaker. After disc 42 cools, it remains in the open position since any potential energy in the disc tending to return it to its normal or reset position is insufficient to overcome the biasing force to mounting ring 45. As will be explained more fully below, shoulder 33 of actuator 31 constitutes a means for displacing terminal 39 from the open position to its reset position in response to displacement of actuator 31.

While bi-metal discs having relatively constant operating characteristics can be designed, from a practical standpoint production problems would be materially alleviated by the provision of an adjustable biasing arrangement for setting the operating threshold of the bi-metal disc. For example, this threshold can be controlled by adjusting the bias or tension applied by mounting ring 45 to disc 42. More particularly, and as best seen in FIGURE 4, an adjustment screw 51, threadably retained by insert 41, is provided with a conical cam termination 52 which abuts the free ends of mounting ring 45. Adjustment of screw

51 varies the spacing between the ends of ring 45 thereby changing the tension applied to disc 42 by the ring.

Prior to discussing an operating cycle of the disclosed protective system, attention is directed to the inoperative state of the switch and circuit breaker assembly. In the inoperative or "off" position, control knob 29, shaft 23 and switch actuator 31 assume the positions shown by dotted-line construction in FIGURE 1. In assuming this position, shoulder 33 of actuator 31 has necessarily driven disc 42 beyond the over-center point so that the disc shifts to its reset position to complete an electrical connection between terminals 38, 39. Under these conditions switch contacts 19, 20 are open since axial displacement of actuator 31 to the "off" position removes collar 34 from beneath detent 35 of contact 20 and permits the spring or bight 21 of contact 20 to bias it away from contact 19.

In operation the television receiver circuitry is energized by pulling knob 29 outward to the "on" position, to the right as viewed in FIGURE 1. As shaft 23 and switch actuator 31 are axially displaced, collar 34 urges contact 20 outwardly for engagement with contact 19. When such engagement is effected collar 34 seats in detent 35. At this point switch cover 36 limits outward displacement of actuator 31. Assuming, of course, that breaker terminals 38, 39 are closed, because actuation of knob 29 to the ON position does not cause contact 38 to shift from engagement with contact 39, closure of contacts 19, 20 serves to energize the television receiver. Moreover, since collar 34 is of annular construction, contacts 19, 20 remain closed as knob 29 is rotated to establish a desired operating condition for potentiometer 26.

Subsequently, should a fault occur in the receiver circuitry such as to produce an electric current flow through bi-metal disc 42 in excess of a predetermined or threshold value, the dissimilar metals of disc 42 will, upon heating, cause disc 42 to flex from its reset position to the open position shown by the solid line construction of FIGURE 1. This shifting of disc 42 is attributable, of course, to the different coefficients of expansion of the two metals forming disc 42. The deformation of disc 42 after it has shifted to the open position is such that, even after cooling, it cannot, without application of an external force, return to its reset position. Upon opening of breaker terminals 38, 39, the television receiver is immediately de-energized since the breaker terminals are electrically connected in series with switch contacts 19, 20 and the source of electric potential.

In order to restore the receiver to operation, the viewer merely depresses control knob 29 to the "off" position. Simultaneously actuating member 31 is driven inwardly until arrested by wall 30 of insert 16. This operation on the part of the viewer accomplishes two results; first, collar 34 of actuator 31 is removed from beneath contact 20 thereby opening on-off switch 12; secondly, and preferably after switch 12 has been opened, shoulder 33 of actuator 31 encounters disc 42 and drives it beyond the over-center point at which juncture it snaps to the reset position and re-establishes an electrical connection between breaker terminals 38, 39. Although the circuit breaker has been reset the television receiver is not energized since the on-off switch contacts have been opened. To restore the receiver to operation, the viewer then pulls control knob 29 out to the "on" position thereby re-establishing the electrical connection between switch contacts 19, 20.

Not infrequently the fault which caused the breaker to open is attributable to a momentary surge of line voltage or, possibly, to an unexplainable current surge in the receiver circuitry itself. The described protective circuit permits the viewer to safely restore his receiver to normal operation. On the other hand, if a permanent circuit failure has occurred, the breaker will automatically open when the viewer pulls knob 29 to close switch contacts 19, 20 thus safeguarding the receiver.

FIGURE 5 shows an alternate embodiment of the invention which, except for the switch actuator and the control shaft, is substantially similar to the principal embodiment. The actuator 31' differs from its counterpart in FIGURE 1 in that it is designed to respond to a rotary actuated switch control rather than an axially displaceable control. To this end, shaft 23' is supported for rotational displacement in the same fashion as shaft 23 of the principal embodiment but is axially restrained by a pair of C-washers 55, 56 which abut the end walls of housing 15. Additionally, and for purposes subsequently to be explained, shaft 23' is slotted at 57.

Actuator 31' comprises, in addition to a reduced section 32', a shoulder 33' and a collar 34', a serpentine annular groove 58. This groove traces an incomplete circle about the periphery of actuator 31' adjacent shoulder 33' and then progresses in spiral fashion toward collar 34'. The insert 16' is relieved to accommodate a drive ball 60 which is captivated between insert 16' and groove 58. Additionally, actuator 31' is fitted with a pin 61 which protrudes into slot 57 of shaft 23'. Pin 61 serves as a coupling element which permits shaft 23' to rotatably drive actuator 31' while the ball 60, in cooperation with groove 58, serves to effect axial displacement of actuator 31' along shaft 23' when the shaft is rotated.

Insofar as operation of the alternate embodiment is concerned, it will initially be assumed that control shaft 23' has been rotated fully counterclockwise to the off position, as is conventional in rotary switch arrangements to de-energize a receiver. Under this condition, and as shown in FIGURE 5, shoulder portion 33' of actuator 31' extends slightly beyond the over-center point of bi-metal disc 42 so that breaker contacts 38, 39 are closed and switch contacts 19, 20 are opened. To energize the receiver shaft 23' is rotated in a clockwise direction. When shaft 23' rotates, slot 57 drives pin 61 to rotate actuator 31'. As actuator 31' rotates the cooperation between drive ball 60 and groove 58 displaces actuator 31' to the right, as viewed in FIGURE 5. After approximately one-quarter turn of shaft 23', the circular portion of groove 58 has been transported to a point beneath ball 60 and collar 34' has been driven beneath switch contact 20 to establish an electrical connection between that contact and contact 19. A desired operating condition for potentiometer 26 may then be selected by further rotation of shaft 23. Such rotation will not effect additional displacement of actuator 31 since ball 60 then merely rides within the circular portion of groove 58. This ball and groove construction, of course, eliminates any necessity for an arresting provision for actuator 31' when it is displaced to the right, as viewed in FIGURE 5. Such construction also renders unnecessary a detent provision between collar 34' and switch contact 20.

In the event of electrical failure in the receiver circuitry, breaker contacts 38, 39 open by virtue of the snap action of bi-metal disc 42 in the manner previously described. The viewer then rotates on-off control shaft 23' in a counterclockwise direction, as he would in normally turning off the receiver. After ball 60 has traversed the circular portion of groove 58 and enters the spiral portion, actuator 31' is displaced rearwardly to withdraw collar 34' from beneath contact 20 and opens the switch contacts. Shortly thereafter, and in the same fashion as described for the principal embodiment, shoulder 33' engages the center portion of bi-metal disc 42 and drives it rearwardly beyond the over-center point until disc 42 snaps to its reset position and re-establishes electrical connection between terminals 38, 39. At this juncture, the receiver is de-energized by virtue of the fact that switch contacts 19, 20 are opened; however, since breaker contacts 38, 39 have been re-engaged, merely rotating the on-off switch in a clockwise direction will re-energize the receiver.

Each of the embodiments above described illustrates a protective power supply system for a television receiver

which, not only protects the receiver, but also permits the viewer to readily restore the receiver to operation when it has been interrupted by a momentary voltage or current surge. Moreover, the described systems require no educating of the viewer and no special operating procedures since he resets the breaker contacts, if they have been opened, each time he turns off the television receiver. Such resetting is automatic upon the occurrence of a circuit fault since it is quite natural for the viewer to manipulate the on-off switch if he loses the picture and sound. It is recognized, of course, that while reference has been made to a television receiver the invention finds equally useful application in other home entertainment apparatus such as radios and high fidelity systems.

While particular embodiments of the present invention have been shown and described, it is apparent that changes and modifications may be made therein without departing from the invention in its broader aspects. The aim of the appended claims, therefore, is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A combination switch and circuit-breaker arrangement for the power supply system of a television receiver, or the like, comprising:

an on-off switch having a fixed contact and a movable contact shiftable along a predetermined path between an open position and a closed position in which it engages said fixed contact to establish an electrical connection through said switch;

a circuit-breaker effectively connected in series relation with said switch contacts, said circuit-breaker comprising a first terminal

and a bi-stable second terminal shiftable along a predetermined different path between an open position in which it is out of engagement with said first terminal and a reset position in which it engages said first terminal and responsive, when so engaged, to an electrical current exceeding a predetermined value to shift from said reset to said open position;

and a bi-stable actuator displaceable between first and second stable positions comprising an operator engageable with said movable switch contact for shifting said movable contact along its said predetermined path between its said open position and its said closed position to establish said electrical connection in said first stable position and to open said electrical connection in said second stable position of said actuator,

said actuator further comprising a driver engageable with said bi-stable terminal for shifting said bi-stable terminal along its said predetermined different path to its said reset position, in response to displacement of said actuator to said second stable position, after said movable switch contact shifts to its said open position if, at that instant, said bi-stable terminal is in its said open position.

2. A combination switch and circuit-breaker arrangement for the power supply system of a television receiver, or the like, comprising:

an on-off switch having a fixed contact and a movable contact shiftable along a predetermined path between an open position and a closed position in which it engages said fixed contact to establish an electrical connection through said switch;

a circuit-breaker effectively connected in series relation with said switch contacts, said circuit-breaker comprising a first terminal

and a bi-stable second terminal shiftable along a predetermined different path between an open position in which it is out of engagement with said first terminal and a reset position in which it engages said first terminal and responsive, when so engaged, to an electrical current exceeding a predetermined value to shift from said reset to said open position;

and a bi-stable actuator displaceable along its principal axis between first and second stable positions comprising an operator engageable with said movable switch contact for shifting said movable contact along its said predetermined path between its said open position and its said closed position to establish said electrical connection in response to axial displacement of said actuator to its said first stable position and to open said electrical connection in response to axial displacement of said actuator to its said second stable position,

said actuator further comprising a driver engageable with said bi-stable terminal for shifting said bi-stable terminal along its said predetermined different path to its said reset position, in response to axial displacement of said actuator to said second stable position, after said movable switch contact shifts to its said open position if, at that instant, said bi-stable terminal is in its said open position.

3. A combination switch and circuit-breaker arrangement for the power supply system of a television receiver, or the like, comprising:

- an on-off switch having a fixed contact and a movable contact shiftable along a predetermined path between an open position and a closed position in which it engages said fixed contact to establish an electrical connection through said switch;
- a circuit-breaker effectively connected in series relation with said switch contacts, said circuit-breaker comprising a first terminal
- and a bi-stable second terminal shiftable along a predetermined different path between an open position in which it is out of engagement with said first terminal and a reset position in which it engages said first terminal and responsive, when so engaged, to an electrical current exceeding a predetermined value to shift from said reset to said open position;
- and a bi-stable rotatable actuator displaceable between first and second stable positions comprising an operator engageable with said movable switch contact for shifting said movable contact along its said predetermined path between its said open position and its said closed position to establish said electrical connection in response to rotation of said actuator to its said first stable position and to open said electrical connection in response to rotation of said actuator to its said second stable position,
- said actuator further comprising a driver engageable with said bi-stable terminal for shifting said bi-stable terminal along its said predetermined different path to its said reset position, in response to rotation of said actuator to said second stable position, after said movable switch contact shifts to its said open position if, at that instant, said bi-stable terminal is in its said open position.

4. A combination switch and circuit-breaker arrangement for the power supply system of a television receiver, or the like, comprising:

- an on-off switch having a fixed contact and a movable contact shiftable along a predetermined path between an open position and a closed position in which it engages said fixed contact to establish an electrical connection through said switch;
- a circuit-breaker effectively connected in series relation with said switch contacts, said circuit-breaker comprising a first terminal
- and a bi-stable second terminal shiftable along a predetermined different path between an open position in which it is out of engagement with said first terminal and a reset position in which it engages said first terminal responsive, when so engaged, to an electrical current exceeding a predetermined value to shift from said reset to said open position;

and a bi-stable rotatable actuator displaceable between first and second stable positions comprising an operator supported for axial displacement along the principal axis of said actuator and engageable with said movable switch contact for shifting said movable contact along its said predetermined path between its said open position and its said closed position to establish said electrical connection in response to rotation of said actuator to its said first stable position and to open said electrical connection in response to rotation of said actuator to its said second stable position,

said actuator further comprising a driver likewise supported for axial displacement along the principal axis of said actuator and engageable with said bi-stable terminal for shifting said bi-stable terminal along its said predetermined different path to its said reset position, in response to rotation of said actuator to said second stable position, after said movable switch contact shifts to its said open position if, at that instant, said bi-stable terminal is in its said open position.

5. A combination switch and circuit-breaker arrangement for the power supply system of a television receiver, or the like, comprising:

- an on-off switch having a fixed contact and a movable contact shiftable along a path normal to a reference axis between an open position and a closed position in which it engages said fixed contact to establish an electrical connection through said switch;
- a circuit-breaker effectively connected in series relation with said switch contacts, said circuit-breaker comprising a first terminal
- and a bi-stable second terminal shiftable along a path parallel to said reference axis between an open position in which it is out of engagement with said first terminal and a reset position in which it engages said first terminal and responsive, when so engaged, to an electrical current exceeding a predetermined value to shift from said reset to said open position;
- and a manually operable bi-stable actuator displaceable along said reference axis between first and second stable positions comprising an operator engageable with said movable switch contact for shifting said movable contact along its said normal path between its said open position and its said closed position to establish said electrical connection in said first stable position and to open said electrical connection in said second stable position of said actuator,
- said actuator further comprising a driver engageable with said bi-stable terminal for shifting said bi-stable terminal along its said parallel path to its said reset position, in response to displacement of said actuator to said second stable position, after said movable switch contact shifts to its said open position if, at that instant, said bi-stable terminal is in its said open position.

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**Notice of Adverse Decision in Interference**

In Interference No. 96,070 involving Patent No. 3,236,971, A. Cotsworth, COMBINATION ON-OFF SWITCH AND CIRCUIT-BREAKER, final judgment adverse to the patentee was rendered Sept. 25, 1969, as to claims 1, 2 and 5.

*[Official Gazette March 17, 1970.]*