Dec. 12, 1950 J. A. FAVRE 2,534,115

TRANSITORY ELECTRORESPONSIVE SWITCHING CONTROL

Filed Dec. 30, 1948 2 Sheets-Sheet 1

Fig. 1.

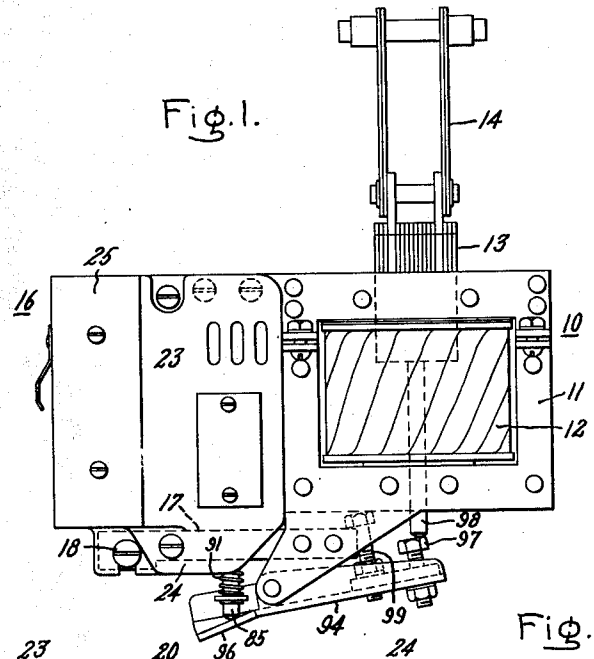


Fig. 3.

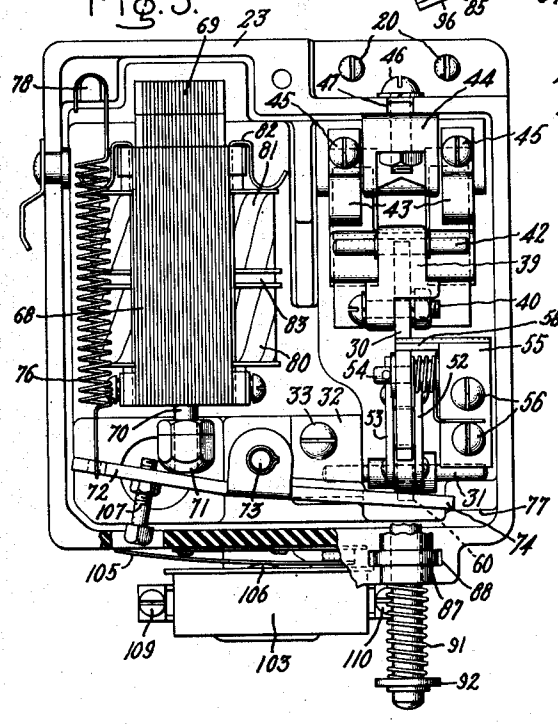
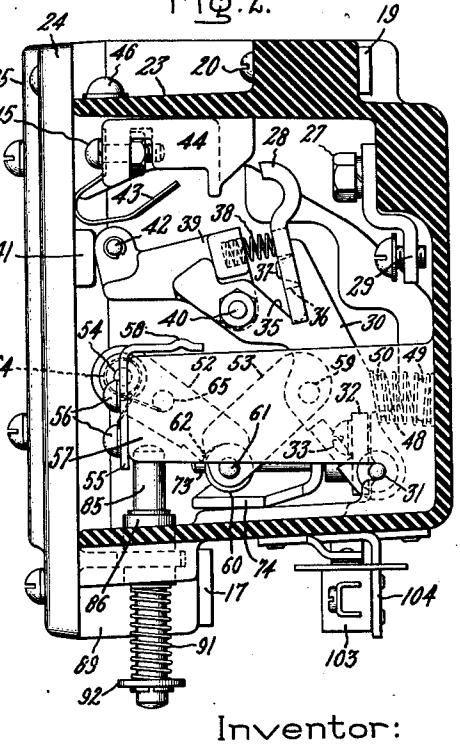


Fig. 2.



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Fig. 4.

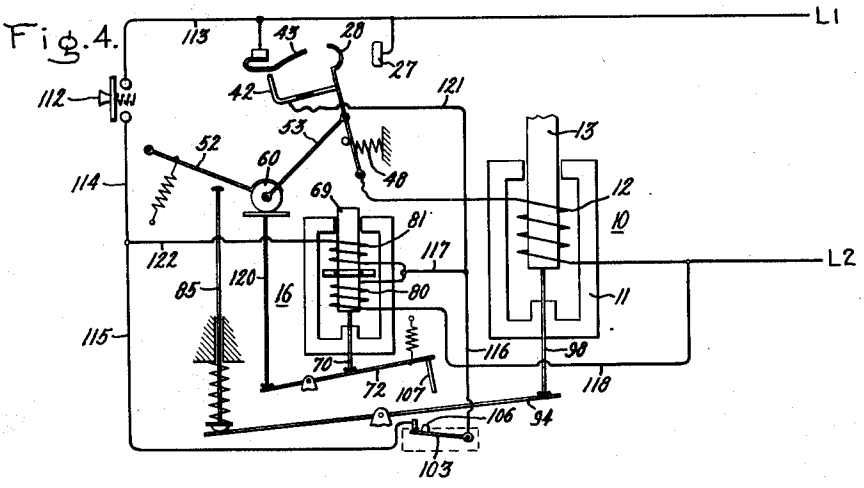


Fig. 5.

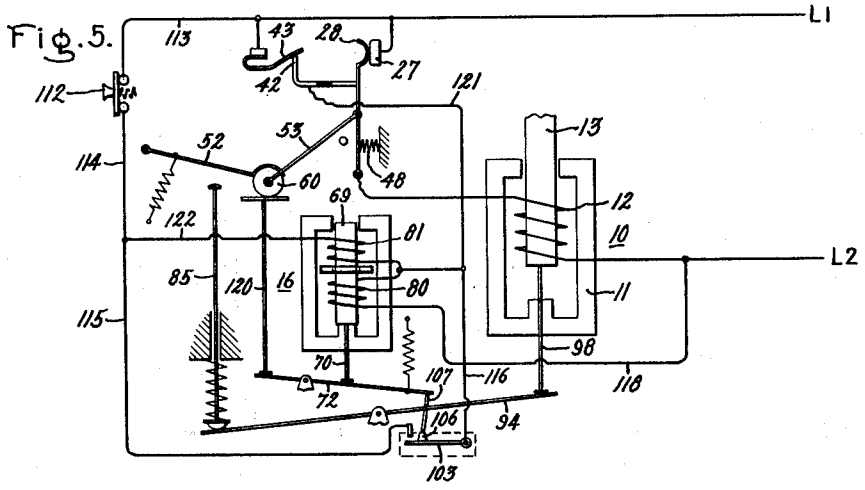
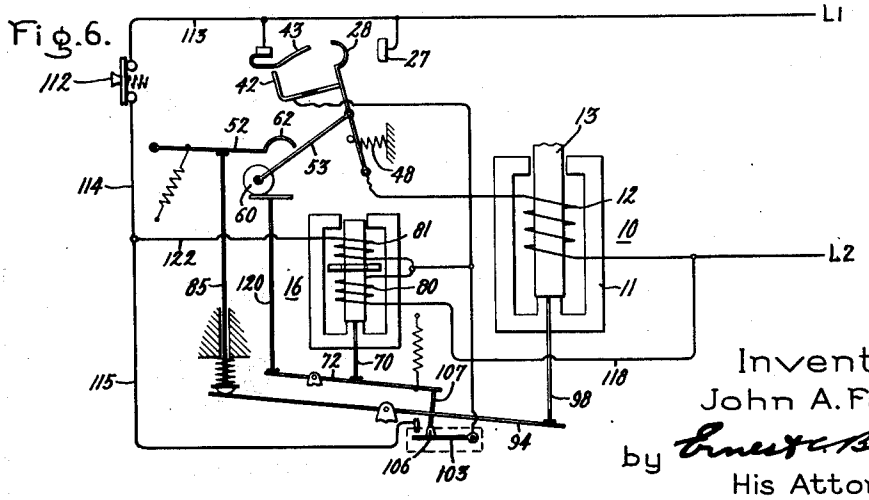


Fig. 6.



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UNITED STATES PATENT OFFICE

2,534,115

TRANSITORY ELECTRORESPONSIVE SWITCHING CONTROL

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Application December 30, 1948, Serial No. 68,363

13 Claims. (Cl. 175—335)

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The invention relates to transitory electroresponsive switching control, and provides improvements whereby a powerful operating electromagnet or other electroresponsive device energized under control of an electroresponsive relay can respond immediately to deenergize itself. The improved transsitory switching control of the present invention is of particular advantage in providing a transitory energization of the powerful closing solenoid for an automatic circuit breaker or in other similar service where manual master switch (or automatic) relay control of the energization of an electroresponsive device is desired but the device inherently must be deenergized immediately upon response thereof to avoid the danger of overheating or for other reasons.

One of the objects is to provide an improved pumpfree form of transitory electroresponsive relay switching control for an electroresponsive device that will insure completion of but one transitory energization of the electroresponsive device for each time the relay master control switch is operated. This effectively prevents the "pumping" of the closing solenoid of an automatic circuit breaker usually encountered with the ordinary forms of control, i. e., the repeated reclosures of the breaker in case the circuit conditions are such as to automatically trip out the breaker immediately upon each reclosure thereof.

Another object is to provide an improved automatic transitory switching control that is pumpfree irrespective of whether the master control switch is only momentarily closed or is held in the closed position indefinitely.

Another object is to provide an improved form of transitory electroresponsive switching control relay having a disjointable toggle operated control switch and mechanism whereby the toggle links become disjoined to open the switch upon each energization of an electroresponsive device under the control of the relay and become rejoined for a succeeding control operation only when both the relay and the controlled electroresponsive device are concurrently deenergized.

Further objects and advantages of the invention will appear in the following description of the accompanying drawings in which Fig. 1 is a front view of a circuit breaker closing solenoid provided with a transitory relay switching control embodying the improvements of the present invention in the preferred form; Fig. 2 is an enlarged side view of the improved form of transitory electroresponsive switching control relay with one wall of the molded enclosing casing broken away to reveal the operating parts; Fig. 3 is a

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front view of the transitory switching control relay with the cover for the enclosing casing removed; Fig. 4 is a schematic diagram showing the circuit connections of both the closing solenoid and the transitory switching control relay together with a schematic showing of the disjointable operating connections for effecting transitory switching under transitional control of both the solenoid and the relay; Fig. 5 is a similar schematic diagram showing the relation of the circuit connections and the transitory switch operating parts during the transitory energization of the closing solenoid; and Fig. 6 shows the relative positions of the disjointable operating parts after the transitory energization of the solenoid and before the control relay is deenergized.

As shown in Fig. 1, the circuit breaker closing solenoid indicated generally by the reference character 10 is of the usual form having a magnetic frame 11, a magnetizing winding 12, and a movable magnetic member in the form of a plunger or core 13 provided with a suitable operating linkage 14 for connection with the circuit breaker reclosing mechanism. Due to the quick and powerful operating stroke of the plunger 13 and corresponding large energizing current requirements of the winding 12, such a solenoid is representative of an electroresponsive device that should be deenergized immediately upon response thereof to avoid overheating and for other reasons.

The improved transitory switching control relay indicated generally by the reference character 16 is shown in Fig. 1 mounted directly on the frame of the closing solenoid 10 by means of the supporting member 17 having a holding screw 18 and a similar supporting member 19 having the holding screws 20. The relay 16 is provided with an enclosing casing 23 of molded insulating material within which the relay operating and electrical parts are mounted as shown in Figs. 2 and 3. The casing 23 is provided with a removable cover 24 which in turn is provided with a removable insulating panel 25 for ready access to the various circuit terminals of the relay that are mounted on the cover beneath the removable panel 25 and interconnected by flexible leads with the relay electrical parts inside the enclosing casing 23. The various terminals and leads have been omitted from Figs. 2 and 3 of the drawing for the sake of clarity since the electrical interconnection of the various parts is shown schematically in the circuit diagrams of Figs. 4, 5, and 6.

The transitory switching control relay 16 has mounted on the back wall of the enclosing casing 23 a pair of spaced-apart main switch stationary contacts 27 that are bridged by the movable contact 28 to close the energizing circuit of the operating winding 12 of the circuit breaker closing solenoid 10. Each stationary contact 27 is provided with a suitable terminal 29 for connection with a corresponding terminal on the cover 24 under the panel 25 in order to facilitate connection into the energizing circuit for the solenoid winding 12.

The main switch bridging contact 28 of the transitory switching relay 10 is carried by the movable switch element 30 having a pivotal mounting on the bearing pin 31 that is seated in suitable recesses formed in the mounted enclosing casing 23 and held in place by the locking plate 32 and the holding screw 33. The bridging contact 28 is notched at one end to rock in the V-shaped notch 35 formed in the switch member 30 and is provided with an opening 36 for receiving the hump 37 therein to maintain a substantial alignment. A pair of springs 38 are carried by a molded insulator 39 that is secured to the pivotally mounted switch member 30 by the bolt 40 so as to provide a yielding wiping bias for the bridging contact 28.

The molded insulator 39 on movable switch member 30 also carries an auxiliary switch bridging contact pin 42 into wiping engagement with a pair of spaced-apart resilient stationary auxiliary switch contacts 43 that are secured to a molded insulator 44 by the terminal screws 45 with the insulator 44 adjustably mounted inside the enclosing casing 23 by means of the holding screw 46 that slides in a suitable slot 47. The pivotally mounted switch member 30 that carries the main switch bridging contact 28 and the auxiliary switch bridging contact 42 is biased to the open position in which the insulator 39 engages a boss 41 on cover 24 as shown in Fig. 2 by means of the biasing spring 48 having one end seated upon a boss 49 formed on the inside of the enclosing casing 23 and the other on a boss 50 formed on the movable switch member 30.

In accordance with the present invention, the movable switch member 30 is operated to the closed position against its bias by means of a disjointable mechanism such as the toggle formed by a pair of interlocking links 52 and 53. The toggle link 52 is pivotally mounted upon a fixed pivot pin 54 extending from an angle element 55 that is secured by means of the holding screws 56 to a molded rib 57 extending along the side wall of the casing 23. The angle element 55 also has a stop 58 extending laterally therefrom into the path of the movable switch member 30 so as to limit the movement of this switch member by spring 48 when the cover 24 is removed.

The toggle link 53 is double with the two halves thereof spaced apart and pivotally connected at one end to the switching member 30 by means of the pivot pin 59. A roller 60 is mounted between the other ends of the two halves of the pivot link 53 on the pin 61. The fixedly pivoted toggle link 52 slides between the two spaced-apart halves of link 53 and is provided with a notch 62 of semi-cylindrical or quadrantal form for nesting interlocking engagement with the roller 60 so as to operatively interconnect the disjointable toggle links 52 and 53 to exert a force to move the pivotally mounted switch member 30 against the bias of spring 48 when the toggle is extended by moving the roller 60 upwardly from the position in which it is shown in Figs. 3 and 2. A biasing spring 64 has one end hooked into the opening 65 formed in the link 52 and the other end secured by one of the holding screws 56 so as to exert a biasing force tending to hold the semi-cylindrical or quadrantal notch 62 in interlocking operative engagement with the roller 60 while permitting disjoining of the toggle links in their extended position by an upward force applied to the separately pivoted link 52. In this way, the switch operating toggle formed by the links 52 and 53 is provided with a disjointable knee that is biased to rejoin the links into operative relation only when the links are in their relative biased positions in which they are shown in Figs. 2 and 3. Thus such a toggle provides disjointable operating connections for closing the switch contacts of the relay 16 and for permitting these contacts to open in accordance with their bias when the operating connections are disjoined.

In order to operate the toggle formed by the disjointable links 52, 53, the relay 16 is provided with an operating electromagnet 68 having a plunger or core 69 operating the push rod 70 having an adjustable head 71 for engaging an operating lever 72 that is centrally pivoted on the pin 73 extending from the back of the enclosing casing 23 so as to raise the end 74 of the lever 72 into engagement with the roller 60 and thereby exert an upward force thereon to extend the toggle. A biasing spring 76 is connected with the operating lever 72 so as normally to bias the end 74 thereof into engagement with the step 77 and raise the relay plunger 69 to the unattracted position in which it is shown in Fig. 3. The spring 76 has one end hooked into a suitable opening formed in the opposite end of the lever 72 and the other end hooked over an anchor pin 78 formed in the molded enclosing casing 23.

The frame 68 of the relay operating electromagnet is mounted inside casing 23 by means of suitable holding screws extending through the back wall thereof and a pair of series-connected relay energizing windings 80 and 81 are mounted in the magnetic frame 68 by means of the holding springs 82 and a magnetic washer 83 is interposed between the main operating winding 80 and the current limiting winding 81 so as to provide a magnetic barrier therebetween. This enables the main winding 80 to be more effectively energized to attract the plunger 69 when the current limiting winding 81 is short-circuited as described hereinafter in connection with the schematic circuit diagrams of Figs. 4, 5, and 6 since the magnetic washer 83 serves to localize the flux generated by the main winding 80 to the lower part of the magnetic frame 68 and thereby minimize the currents induced in the short-circuited winding 81 while the main winding 80 is energized. Suitable terminals for each of the windings 80 and 81 are connected to corresponding terminal screws carried in the cover 24 under the removable panel 25 in the manner previously indicated so as to enable ready circuit connections to be made thereto in the manner indicated in the schematic circuit diagrams of Figs. 4, 5, and 6.

In order to disjoin the disjointable toggle link 52, the relay 16 is provided with a plunger 85 that slides in a bushing 86 provided with a projecting ridge 87 for mounting in a slot 88 formed in the molded enclosing casing 23 so as to be held in its operative position by a boss 89 extending inwardly from the cover 24 as shown in Fig. 2. In this way the plunger 85 is mounted in alignment with the disjointable link 52 so that when the toggle is in

its extended position and plunger 85 is moved upwardly into engagement with link 52, the quadrantal notch 62 will become disengaged from roller 60 thereby disjoining the knee of the toggle to permit the switch member 30 to open in accordance with its bias. The plunger 85 is normally biased to the position in which it is shown in Figs. 2 and 3 out of engagement with the link 52 by means of the biasing spring 91 that extends between the bushing 86 and a collar 92 suitably secured to the lower end of the plunger 85.

As shown in Fig. 1, the plunger 85 is operated upon response of the closing solenoid 10 by means of a centrally pivoted lever 94 having its pivotal mounting pin 95 supported in the arm 96 extending from the frame 11 of the reclosing solenoid 10. One end of the lever 94 is provided with an angularly extending portion 96 for engagement with the pin 85 and the other end of lever 94 is provided with an adjustable stop 97 for engagement by the push rod 98 that is operatively connected with the plunger 13 of the reclosing solenoid 10. The adjustable stop 99 serves to limit the movement of lever 94 by the biasing spring 91 of the plunger 85.

In order to insure full initial energization of the main operating winding 80 of the relay, a second auxiliary switch 103 of the enclosed type having normally closed contacts is connected to normally short circuit the winding 81. Switch 103 is mounted on a bracket 104 suitably secured to the bottom of the enclosing casing 23 and is arranged to be operated so as to open its normally closed contacts while the relay armature 69 is being attracted. This is accomplished by means of a resilient operating arm 105 engaging with the switch operating button 106 when flexed downwardly by the adjustable finger-107 carried by the relay switch operating lever 72. When the button 106 is thus depressed, the normally closed contacts of the second auxiliary switch 103 are opened. The terminals 109 and 110 of the second normally closed auxiliary switch 103 are connected by suitable flexible leads so as to normally short-circuit the relay winding 81 as indicated in the schematic circuit diagrams of Figs. 4, 5, and 6. Thus when the operating button 106 is depressed during the attractive movement of armature 69, the short circuit is removed from the current limiting winding 81 so that this winding becomes connected in series with main winding 80 to reduce the relay energizing current when the plunger 69 is in its attracted position.

Operation

As shown in the schematic circuit diagram of Fig. 4, the circuit breaker reclosing solenoid 10 and the transitory switching control relay 16 are connected to be separately energized from the supply lines L1, L2. Thus the relay movable switch contact 28 is operable into engagement with the stationary contact 27 to close the energizing circuit for the solenoid energizing winding 12 and the manually operable normally open master control switch 112 is operable to close the energizing circuit for the relay 16. Upon closure of the master switch 112, only the relay main operating winding 80 is initially energized with the energizing circuit therefor extending from supply line L1 through conductor 113, master switch 112 in its closed position, conductor 114 and thence through the short circuit around the current limiting winding 81 provided by conductor 115, the normally closed second auxiliary switch 103, conductors 116 and 117, and thence

through only the main relay operating winding 80 and conductor 118 to supply line L2. With the current limiting winding 81 thus short-circuited, the relay main operating winding 80 is initially energized with full current to attract the relay plunger 69 so as to press the operating rod 70 against the switch operating lever 72 and thereby exert an upward force on the roller 60 (through the extra push rod 120 as schematically shown in Fig. 4) to extend the toggle formed by the links 52 and 53 against the bias of spring 48 and move the bridging contact 28 into engagement with the stationary relay contact 27, thereby closing the energizing circuit for the operating winding 12 of the reclosing solenoid 10. During the extension of the toggle the bridging pin 42 of the first auxiliary switch engages with the stationary spring contact 43 to close a seal-in circuit in shunt with both the relay current limiting winding 81 and the master control switch 112. This seal-in circuit extends from the conductor 113 through the auxiliary switch contacts 42, 43 to conductor 121. The closure of this seal-in circuit provides continued energization of the relay operating winding 80 even though the master switch 112 is released and returns to its normally open position in which it is shown, thereby insuring full completion of the relay transitory energization cycle when once started by closure of the master switch 112.

After the engagement of the seal-in contacts 42, 43 of the first auxiliary switch during the attraction of plunger 69, operating lever 72 becomes tilted sufficiently to engage the finger 107 with the operating button 106 of the second normally closed auxiliary switch 103 so as to operate the contacts thereof to the open position as shown in Fig. 5. This opens the initial short-circuit for the current limiting winding 81 through the conductors 115, the second auxiliary switch 103, the conductor 116 but leaves the seal-in circuit around the current limiting relay winding 81 and the master switch 112 through conductor 121 and the contacts 42, 43 of the first auxiliary switch to insure completion of the closure of the main switch contacts 27 and 28 as shown in Fig. 5. Thereupon the energizing circuit of the reclosing solenoid operating winding 12 is closed and the plunger 13 is attracted to exert its powerful stroke for operating the circuit breaker reclosing mechanism. At the same time push rod 98 operates the centrally pivoted lever 94 to raise the plunger 85 into engagement with the disjointable toggle link 52 and thereby disjoin the knee of the toggle as shown in Fig. 6. Immediately biasing spring 48 becomes effective to disengage the bridging contact 28 from the stationary contact 27 and thereby open the energizing circuit of the solenoid operating winding 12 immediately upon response of the solenoid as indicated in Fig. 6. As soon as winding 12 is thus deenergized, spring 91 will become effective to return plunger 13 to its unattracted position in which it is shown in Fig. 4. However, the disjointable toggle link 52 will remain disjointed until relay 16 is concurrently deenergized.

As shown in Fig. 6, the master control switch 112 may unnecessarily be maintained in its closed position after the solenoid operating winding 12 is deenergized. Such continued closure of master switch 112 will maintain an energizing circuit closed for both the current limiting winding 81 and the series connected operating winding 80 through conductors 114, 122, the series connected winding 81 and 80 and conductor 118. However,

the first auxiliary switch contacts 42 and 43 are open and also contacts of the second auxiliary switch 103 are open thereby insuring that the current limiting winding 81 is effective to limit the relay energizing current as long as the master switch 112 is thus unnecessarily maintained closed.

As long as the relay 16 is maintained energized after the deenergization of the reclosing solenoid 18, as indicated in Fig. 6, it is impossible for the disjointable toggle link 52 to rejoin the disjointable knee of the toggle since the roller 60 is maintained out of its normally biased position in which it is shown in Figs. 2, 3 and 4. Consequently, the disjointable link 52 simply rides on the roller 60 between the two halves of the double link 53 until the relay 16 is deenergized. Thereupon the roller 60 is permitted to return to its initial biased position in which it is shown in Figs. 2, 3 and 4 so that the quadrant notch 62 of the disjointable link 52 can return into nesting operative engagement with the roller 60 and thereby rejoin the disjointable knee of the toggle.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A transitory electroresponsive switching control having in combination, a pair of electroresponsive devices, a two-position switch controlling the response of one device, means biasing the switch to one position and operating mechanism for said switch provided with disjointable mechanical operating connections under transitional control of both devices for moving the switch to the other position to effect response of the one device upon response of the other device and to release the switch for movement to the biased position upon response of the one device.

2. A transitory electroresponsive switching control having in combination, a pair of separately energizable electroresponsive devices, a switch biased open and connected for closing the energization circuit of one device, and disjointable mechanism for operating the switch under transitional control of both devices having a movable operating element mechanically connected with the other device for closing the switch to energize the one device upon energization of the other device and a separately movable operating element mechanically connected with the one device for releasing the switch to deenergize the one device upon response thereof during continued energization of the other device.

3. A transitory electroresponsive switching control having in combination a pair of separately energizable electroresponsive devices, a switch biased open and connected for closing the energizing circuit of one device, a disjointable toggle for closing the switch, mechanism operated by the other device for extending the toggle to close the switch upon the response of the other device, and mechanism operated upon response of the one device for disjointing the toggle to open the switch.

4. A transitory electroresponsive switching control having in combination, a pair of separately energizable electroresponsive devices, a normally open switch for closing the energization circuit of one device, means including disjointable operating members operable jointly for closing the switch upon response of the other device, means for seperately operating one of the disjointable members to open the switch upon response of the one device, and means biasing said members to rejoin upon deenergization of both devices.

5. A transitory electroresponsive switching control having in combination, a pair of separately energizable electroresponsive devices, a normally open switch for closing the energization circuit of one device, means including a pair of disjointable links forming a toggle for closing the switch upon response of the other device, means for disjoining the toggle links to open the switch upon response of the one device, and means for biasing the toggle links into operative engagement to reform the toggle when both devices are deenergized.

6. A transitory electromagnetic operator control having in combination, an electromagnetic operator, an electroresponsive relay having a normally open switch controlling the energizing circuit of the electromagnetic operator and disjointable operating connections for closing the switch upon response of the relay and mechanism for disjointing said connections to open the switch to deenergize the electromagnetic operator upon operation thereof.

7. In a transitory switching control for an electroresponsive device, an electroresponsive control relay having a normally open switch for closing an energizing circuit for the device and an operating toggle for closing the switch upon response of the relay, said toggle having a disjointable knee, and mechanism connected for operation by the device to disjoint the toggle knee to open the switch.

8. A transitory switching control having in combination, a pivotally mounted two-position switch member, means for biasing the switch member to one position, an operating toggle for moving the switch member to the other position upon extension of the toggle, said toggle having a disjointable link for releasing the switch member for movement by the biasing means, an electroresponsive device effective upon energization thereof for moving the outer toggle link to extend the toggle, an electroresponsive operator energized upon movement of the switch member to the other position and provided with means for disjointing the disjointable toggle link upon operation thereof, and biasing means for rejoining the toggle links upon deenergization of the electroresponsive device.

9. A transitory electroresponsive switching control having in combination a first electroresponsive device, a switch for closing the energizing circuit of the first device, means biasing the switch open, a second electroresponsive device having disjointable operating connections and means for biasing said connections to rejoin when the second electroresponsive device is deenergized for closing the switch upon energization of the second device, and mechanism for disjointing said connections to permit the switch to open in accordance with its bias upon response of the first electroresponsive device.

10. In combination, an electromagnet having a movable magnetic member attracted thereby, a switch for closing the energizing circuit of the electromagnet, means biasing the switch open, a pair of interlocking links forming a toggle having a disjointable knee, one link having a fixed pivot and the other having a pivotal connection with the switch for closing the switch upon extension of the toggle, an electroresponsive device having a movable element engaging the knee of the toggle for extending the toggle to close the switch upon response of the electroresponsive

device, and mechanism operated upon attraction of the magnetic member for disjoining the toggle knee to permit the switch to open in accordance with its bias.

11. In combination, an electromagnet having a movable magnetic member attracted thereby, a switch for closing the energizing circuit of the electromagnet, means biasing the switch to a predetermined open position, a pair of interlocking links forming a toggle having a disjointable knee, one link having a fixed pivot and the other link having a pivotal connection with the switch for closing the switch upon extension of the toggle, an electroresponsive device having a movable element biased to a predetermined position and operable into engagement with the knee of the toggle for extending the toggle to close the switch upon response of the electroresponsive device, mechanism operated upon attraction of the magnetic member for disjoining the toggle knee to permit the switch to move to the predetermined open position in accordance with its bias, and means biasing the toggle links to rejoin only upon both movement of the switch to its predetermined open position and movement of the movable element to its predetermined biased position.

12. A transitory electroresponsive switching control having in combination a first electroresponsive device, a first switch for closing the energizing circuit of the first device, means biasing the first switch open, a second electroresponsive device having disjointable operating connections for closing the first switch upon energization of the second device, mechanism for disjointing the operating connections to permit the first switch to open in accordance with its

bias upon energization of the first device, a second switch for closing the energizing circuit of the second device, means biasing the second switch open, and means biasing the operating connections to rejoin only upon opening of both the first and second switches.

13. In combination, an operating electromagnet, a main control switch for closing the energizing circuit of the electromagnet, a relay having disjointable operating connections for closing the main control switch and provided with a pair of juxtaposed series connected operating windings having a magnetic isolating member therebetween, a master control switch for energizing said windings, a normally closed auxiliary switch shunting one of the windings and having mechanism operated upon response of the relay for opening the auxiliary switch, a second auxiliary switch closed upon the closure of the main control switch for shunting both said one winding and said master switch, and mechanism operable upon energization of the electromagnet for disjoining said operating connections to open the main control switch and the second auxiliary switch.

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Certificate of Correction

Patent No. 2,534,115 December 12, 1950

JOHN A. FAVRE

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 8, line 43, for the word "outer" read *other*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of May, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.