Dec. 15, 1936.

R. W. GOFF

2,064,657

CONTROL DEVICE

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Fig. 1.

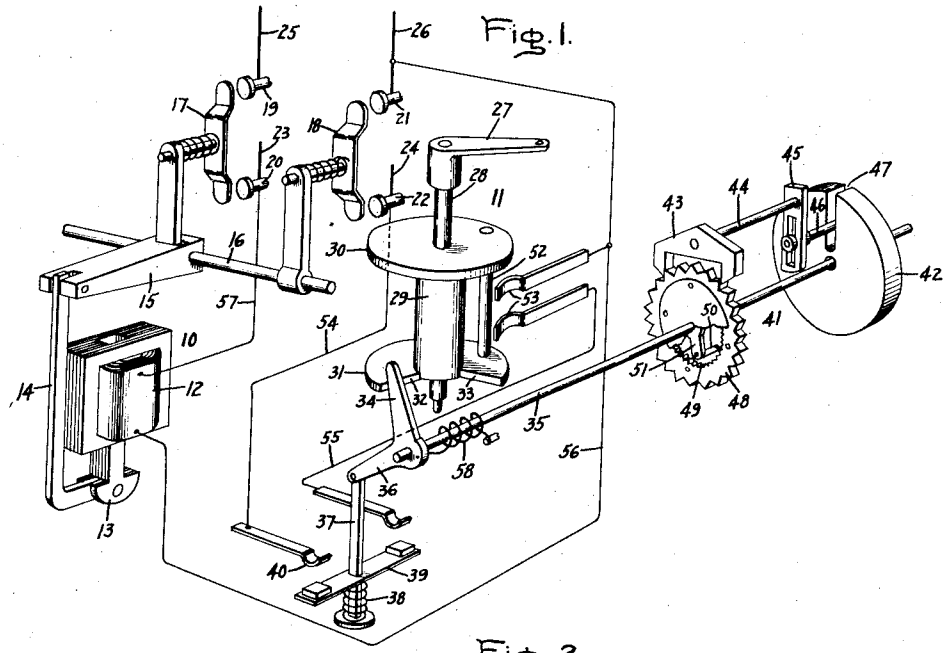
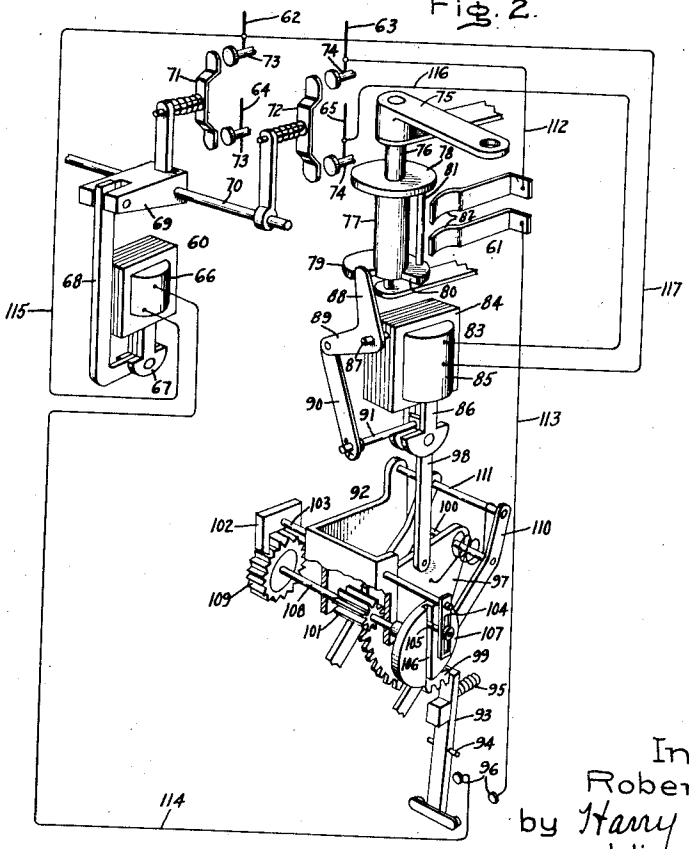


Fig. 2.



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UNITED STATES PATENT OFFICE

2,064,657

CONTROL DEVICE

Robert W. Goff, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application February 28, 1935, Serial No. 8,653

10 Claims. (Cl. 175—294)

My invention relates to control devices, more particularly to control devices of the type which are operable to close an electric circuit and which are incapable of maintaining the circuit closed beyond a predetermined period of time, and has for an object the provision of a simple and reliable device of this type.

In various electrical circuits, it is desirable to close an initial energizing circuit to an electroresponsive device for a predetermined time only. For example, where an electroresponsive device is employed to protect a circuit against voltage failure, the device is usually provided with means for establishing an initial energizing circuit and with means for establishing a holding circuit to maintain the device energized in accordance with the voltage of the circuit to be protected. In order that the initial energizing circuit may not be manually held closed upon a failure or a dip in the voltage, it is desirable that the control device for establishing the initial energizing circuit shall be incapable of maintaining this energizing circuit closed regardless of the position in which the control device is held. Much is yet to be desired in a "foolproof" device of this type which is simple and reliable and which cannot be held in a circuit-closing position. Accordingly, it is a further object of my invention to provide a "foolproof" control device sequentially operable to a plurality of positions to establish an energizing circuit, which device includes time delay means for maintaining the circuit closed for a predetermined time, the device being incapable of maintaining a closed circuit after the time delay means has operated.

In carrying out my invention in one form, I provide a control switch comprising a member sequentially movable to a plurality of positions to close a plurality of pairs of contacts which are connected in series circuit relation in an electrical circuit. One pair of contacts is normally biased to open circuit position and is released for movement to that position under the influence of suitable time delay means when the movable member is moved to close another pair of contacts whereby the movable member is incapable of being so operated as positively to retain all of the contacts in closed circuit position.

For a more complete understanding of my invention, reference may now be had to the drawing, in which Fig. 1 illustrates diagrammatically an undervoltage protective system provided with a control switch embodying my invention, and Fig. 2 illustrates diagrammatically the application of a control switch embodying my invention to a different type of undervoltage protective system.

Referring now to the drawing, I have shown in Fig. 1 an undervoltage protective system comprising an electroresponsive device 10 arranged to be initially energized through a control switch 11 embodying my invention, to establish a holding circuit for the electroresponsive device 10 whereby after my improved control switch has completed its cycle of operation, the electroresponsive device 10 remains energized in accordance with the voltage of the circuit to be protected. As shown, the electroresponsive device 10 comprises an energizing winding 12 and a movable core 13 which is connected by means of a link 14 and an arm 15 to a rotatable shaft 16 on which are resiliently mounted a pair of bridging members 17 and 18 for respectively completing a circuit through a plurality of pairs of stationary contacts 19, 20, and 21, 22 from a pair of supply lines 23 and 24 to a load circuit such, for example, as an electric motor which may be connected to the conductors 25 and 26.

The control switch 11 for initially energizing the winding 12 of the electroresponsive device 10 comprises an operating arm 27 secured to a rotatable shaft 28 on which is mounted an insulated control member 29 provided with a pair of laterally extending flanges 30 and 31. It will be apparent that the operating arm 27 may be moved by any suitable means. In certain applications of my invention, for example, in the control of manufacturing machinery, it is desirable to operate the control switch 11 from a distance and in such a case the arm 27 may be operated by means of a suitable operating lever or shipper rod.

As shown, a portion of the flange 31 is cut away to provide a notch therein which is bounded by the portions 32 and 33 of the flange. Extending into the notch in the flange 31 is an arm 34 of a bifurcated operating member which is secured to a rotatable shaft 35, the other arm 36 of the bifurcated member being connected to a link 37 upon which is mounted a wiping spring 38 for resiliently supporting a bridging member 39 in co-operating relation with a pair of stationary contacts 40.

Mounted on the rotatable shaft 35 is a timing device indicated generally by the reference numeral 41. This timing device 41, which I have illustrated somewhat diagrammatically, is preferably of the type described and claimed in Patent No. 1,967,880, issued July 24, 1934, to William J. Fleming and me, and comprises an oscillating

weight 42 arranged to be driven by an escapement gear 43 connected to a shaft 44 which operates a driving member 45 adjustably secured to a pin 46, one end of which nests within a slot 47 in the oscillating weight 42. The rotatable shaft 35 supports a second escapment gear 48 and in order that the shaft 35 may be rotated in one direction without interference from the timing device 41, the escapement gear 48 is provided with a one-way clutch which is effective to connect the escapement gear 48 to the shaft 35 only when the shaft 35 rotates in a counterclockwise direction, as viewed in the drawing, relative to the gear 48. As shown, the escapement gear 48 is cylindrical and the inner surface thereof is provided with a plurality of serrations or very fine gear teeth 49 arranged to be engaged by a plurality of pivoted fingers, one of which is indicated by the reference numeral 50, supported on a spider 51 secured to the shaft 35. It will be apparent that when the shaft 35 is rotated in a clockwise direction, the fingers 50 will move over the teeth 49 without establishing a driving connection between the shaft 35 and the escapement gear 48, and that when the shaft 35 is rotated in a counterclockwise direction, the pivoted fingers 50 will engage the teeth 49 to drive the escapement gear 48 with the shaft 35.

Supported between the flanges 30 and 31 of the rotatable insulating member 29 is a bridging member 52 of conducting material arranged to co-operate with a pair of stationary contacts 53 which are connected in series circuit relation with the stationary contacts 40.

Having in mind the construction and arrangement of the principal elements thereof, it is believed that a complete understanding of my invention may now be had from a description of the operation. In the drawing the control switch 11 is shown in a neutral position with the contacts 40 and 53 in open circuit relation, and the electroresponsive device 10 is in its deenergized position with the load circuit represented by the conductors 25 and 26, disconnected from the supply lines 23 and 24. In order initially to energize the electroresponsive device 10, the arm 27 is rotated in a counterclockwise direction as viewed in the drawing to its first position and it will be apparent that the portion 32 of the flange 31 engages the arm 34 to rotate the shaft 35 in a clockwise direction and to operate the bridging member 39 into engagement with the contacts 40. Closing the contacts 40, however, has no immediate effect since the circuit therethrough is open at the contacts 53. The arm 27 may now be operated in a clockwise direction to its second position in which the bridging member 52 engages the contacts 53 to complete an initial energizing circuit for the energizing winding 12 of the electroresponsive device 10. This circuit may be traced from the supply line 24 through the conductor 54, by way of the contacts 40 and the bridging member 39 to the conductor 55, by way of the contacts 53 and the bridging member 52 to the conductor 56, through the energizing winding 12 and the conductor 57 to the supply line 23.

The operating mechanism for the bridging member 39 which comprises the arms 34 and 36 and the shaft 35 is normally biased to the position shown in the drawing either by gravity or by a spring 58, and as soon as the operating arm 27 is moved in a clockwise direction to operate the insulating member 29 from its first position to its second position, the portion 32 of the flange 31 moves away from the arm 34, and the operating mechanism for the bridging member 39 will be released for movement in accordance with its bias within the notch in the flange 31. Movement of the arms 34 and 36 in this direction, however, is retarded by the time delay mechanism 41, and the spring 38 provides sufficient lost motion between the link 37 and the bridging member 39 to prevent opening of the circuit through the contacts 40 until after the circuit has been completed through the contacts 53.

Upon initial energization of the device 10, the bridging members 17 and 18 are operated to connect the load circuit represented by the conductors 25 and 26 to the supply lines 23 and 24 through the contacts 19 to 24 inclusive, and a holding circuit for the device 10 is thereby established which may be traced from the supply line 24 through the contact 22, the bridging member 18, the contact 21, the conductors 26 and 56, the energizing winding 12, and by way of the conductor 57 to the supply line 23. Subsequent operation of the bridging member 39 to open the initial energizing circuit through the contacts 40 is therefore ineffective to deenergize the device 10, which remains energized in accordance with the voltage applied to the load circuit represented by the conductors 25 and 26.

It will be apparent now that the control device 11 cannot be held in a position to maintain closed the initial energizing circuit through the contacts 40 and 52 after the time delay mechanism 41 has operated and that the load circuit is protected against undervoltage conditions by the device 10 which operates to interrupt the circuit through the bridging members 17 and 18 upon a dip in voltage, thereby interrupting the holding circuit for the winding 12.

In the embodiment of my invention shown in Fig. 2, I have illustrated an undervoltage protective system comprising an electroresponsive device 60 and a control device 61 embodying my invention for controlling the supply of energy from a source of supply represented by the supply lines 62 and 63 to a load circuit represented by the conductors 64 and 65. As shown, the electroresponsive device 60 comprises an energizing winding 66 and a movable magnetic member 67 which is connected by means of a link 68 and an arm 69 to a rotatable shaft 70 on which are resiliently mounted a pair of bridging members 71 and 72 in co-operating relation with a plurality of pairs of stationary contacts 73 and 74.

In this embodiment of my invention, the control device 61 comprises an operating arm 75 secured to a rotatable shaft 76 on which is mounted an insulated control member 77 provided with a pair of laterally extending flanges 78 and 79. The control member 77 is similar to the control member 29 shown in Fig. 1 and accordingly, the flange 79 is provided with a notch 80 and a conducting bridging member 81 is supported between the flanges 78 and 79 for co-operation with a pair of stationary contacts 82.

Arranged adjacent the control member 77, I provide an electromagnet 83 comprising a magnetic frame 84, an energizing winding 85 and the movable magnetic element 86 normally biased by gravity to its unattracted position. Extending from the magnetic frame 84 is a pin 87 on which is pivotally mounted a bifurcated member having an arm 88 extending into the notch 80, the other arm 89 of the bifurcated member being

connected by means of a link 90 and a pin 91 to the movable magnetic element 86. As shown, the movable magnetic element 86 is connected to suitable time delay mechanism indicated generally at 92 in order to control a movable switch member 93 pivoted at 94 and biased by spring 95 in a direction to close the circuit to a pair of contacts 96 connected in series circuit relation with the contacts 82, the time delay mechanism being arranged normally to hold the switch member 93 in its open circuit position when the magnetic element 86 is in its normal unattracted position.

Although any suitable time delay mechanism may be provided which is operable in one direction with a time delay and operable substantially instantaneously in another direction, I have shown for purposes of illustration a time delay mechanism of the type described and claimed in my copending application Serial No. 8,652, filed February 28, 1935, which application is assigned to the same assignee as the present invention. As shown, the time delay mechanism 92 comprises a segmental gear 97 connected to the magnetic element 86 by a link 98 and provided with an end portion 99 for operating the switch member 93. The segmental gear 97 is pivoted on a pin 100 and is operable upon movement of the magnetic element 86 to drive a toothed element or pinion 101 which in turn, drives a timing device similar to the device 41 shown in Fig. 1. In this embodiment of my invention, the timing device comprises an escapement gear 102 connected to a shaft 103 which operates a driving member 104 adjustably secured to a pin 105, one end of which nests within the slot 106 in an oscillating weight 107. The oscillating weight 107 is rotatably supported on a shaft 108 to which the pinion 101 is secured for driving a second escapement gear 109 through a one-way clutch (not shown).

For purposes fully described in my copending application, the pivot pin 100 for the segmental gear 97 is mounted on a pair of movable arms 110 pivoted on a fixed pin 111. However, for the purposes of the present invention, the pin 100 may be considered as a fixed pivot and accordingly, further details of the arrangement of the movable arms 110 will not be described.

Having in mind the construction and arrangement of the principal elements of this embodiment of my invention, it is believed that a complete understanding may now be had from a description of the operation. When it is desired to energize the load circuit represented by the conductors 64 and 65 from the supply lines 62 and 63, the operating handle 75 is first moved by any suitable means to rotate the control member 77 in a counterclockwise direction as viewed in the drawing, and the flange 79 will thereupon operate the arm 88 to raise the magnetic element 86 to its attracted position. As the magnetic element 86 is raised, the segmental gear 97 is rotated to release the switch member 93 for movement to bridge the contacts 96 in accordance with the bias exerted by the spring 95, the segmental gear 97 rotating the pinion 101 independently of the timing mechanism due to the one-way clutch within the escapement gear 109.

The operating handle 75 may now be rotated from its first position in a clockwise direction to its second position, in which position the bridging member 81 engages the fixed contacts 82 and the magnetic element 86 will begin to move to its normal position, the arm 88 being released for movement within the notch 80. However, the time delay mechanism is now effective to retard movement of the magnetic element 86 and the segmental gear 97 and accordingly, these members will not move sufficiently to actuate the switch member 93 until after the bridging member 81 has completed an energizing circuit for the electroresponsive device 60. This circuit may be traced from the supply lead 63 through the conductor 112, the contacts 82 and the bridging member 81, the conductor 113, the contacts 96 and the bridging member carried by the switch member 93, the conductor 114, the energizing winding 66 and the conductor 115 to the supply lead 62. Upon energization of the winding 66, the movable member 67 of the electroresponsive device 60 will be operated and the bridging members 71 and 72 will respectively engage the contacts 73 and 74, thereby connecting the load circuit to the supply lines and establishing an energizing circuit for the winding 85 of the electromagnet 83, which energizing circuit may be traced from the supply line 63 through the contacts 74 and the bridging member 72, the conductors 65 and 116, the energizing winding 85 and the conductor 117 to the supply line 62. The movable magnetic element 86 will now be magnetically operated to its attracted position and accordingly, the switch member 93 is permitted to maintain a closed circuit through the contacts 96.

It will be apparent now that the electroresponsive device 60 and the electromagnet 83 will remain energized so long as the voltage across the supply lines 62 and 63 is maintained at a normal value. Upon the occurrence of a dip in voltage of sufficient magnitude to release the movable member 67 of the device 60, the bridging members 71 and 72 will be operated to disconnect the load circuit from the supply lines and to deenergize the winding 85 of the electromagnet 83, the movable element 86 of which will then begin to move towards its unattracted position under the influence of the timing mechanism. In the event that normal voltage is restored to the supply lines 62 and 63 before the segmental gear 97 has moved sufficiently to operate the switch member 93, the winding 66 will be energized through the previously traced circuit to reclose the bridging members 71 and 72 and reenergize the winding 85. However, if the dip in voltage continues for an interval of time greater than that for which the timing device is set, the segmental gear 97 will operate the switch member 93 to open the circuit through the contacts 96. The load circuit may then be reconnected to the supply lines only by operating the control device 61 in the manner described above.

It will be apparent that when the device 61 has been so operated as to establish energizing circuits for the electroresponsive device 60 and the electromagnet 83, the control member 77 of the control device 61 cannot be held in such a position as to maintain a closed circuit during the occurrence of undervoltage conditions.

The load circuit may be disconnected from the supply lines at any time by moving the operating handle 75 of the control device 61 in a counterclockwise direction from its second position to open the energizing circuit for the winding 66 through the contacts 82.

While I have shown a particular embodiment of my invention, it will be understood, of course,

that I do not wish to be limited thereto since many modifications may be made and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

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

1. In combination, a control member movable between a plurality of positions, means responsive to movement of said control member to one position for partially completing an electric circuit, means responsive to movement of said control member to a second position for completing said partially complete circuit, said first-mentioned means being normally biased to open circuit position and being released for movement in accordance with its bias when said control member is moved from said one position to said second position, and time delay means for preventing said first-mentioned means from moving to said open circuit position for a predetermined time after said control member is moved from said one position.

2. In combination, a control member movable between a plurality of positions, a first pair of contacts, means responsive to movement of said control member to one position for controlling said first pair of contacts, a second pair of contacts, means responsive to movement of said control member to a second position for controlling said second pair of contacts, said first pair of contacts being immediately released for movement to normal position upon movement of said control member from said one position, and time delay means for preventing said first pair of contacts from returning to normal position for a predetermined time after said control member is moved from said one position.

3. In combination, a control member movable between a plurality of positions, a first pair of contacts normally biased to open circuit position, means responsive to movement of said control member to one position for operating said contacts to closed circuit position, a second pair of contacts, means responsive to movement of said control member to a second position for closing said second pair of contacts, said first pair of contacts being immediately released for movement to said biased position upon movement of said control member from said one position, and time delay means for preventing said first pair of contacts from moving to said biased position for a predetermined time after said control member is moved from said one position.

4. In combination, a control member rotatable between a plurality of positions, said member including a flange provided with a notch, means including an arm extending into said notch for partially completing a circuit upon movement of said control member to one position, means including a bridging member carried by said flange for completing said partially complete circuit upon movement of said control member to a second position, said notch and said arm having sufficient lost motion to permit said arm to remain in its circuit completing position when said control member is moved from said one position, said arm being biased to open circuit position, and time delay means for preventing said arm from moving to open circuit position for a predetermined time after said control member is moved from said one position.

5. In combination, a control member rotatable between a plurality of positions, said control member including a flange provided with a notch, a first pair of contacts normally biased to open circuit position, means including an arm extending within said notch for operating said contacts to closed circuit position upon movement of said control member to one position, a second pair of contacts, means including a bridging member carried by said flange for closing a circuit through said second pair of contacts upon movement of said control member to a second position, said notch and said arm having sufficient lost motion to permit said arm to remain in circuit closing position when said control member is moved to said second position, and time delay means for preventing said first pair of contacts from returning to open circuit position in accordance with the bias thereon for a predetermined time after said control member is moved to said second position.

6. In combination, a control member movable between a plurality of positions, an electromagnet having a movable magnetic element normally biased to unattracted position, means responsive to movement of said control member to one position for operating said magnetic element to attracted position, means responsive to operation of said magnetic element to said attracted position for partially completing a circuit, means responsive to movement of said control member to a second position for completing said partially complete circuit, said magnetic element being releasable for movement to said unattracted position when said control member is moved from said one position to said second position, time delay means for preventing said magnetic element from returning to said unattracted position to open said circuit for a predetermined time, and means responsive to completion of said circuit for energizing said electromagnet to maintain said magnetic element in its attracted position.

7. In combination, a control member movable between a plurality of positions, a first pair of contacts, an electromagnet having a movable magnetic element normally biased to unattracted position, means responsive to movement of said control member to one position for operating said magnetic element to attracted position, means responsive to operation of said magnetic element to said attracted position for closing said first contacts, a second pair of contacts, means responsive to movement of said control member to a second position for closing said second contacts, said magnetic element being releasable for movement to its biased position to open said first contacts when said control member is moved from said one position to said second position, time delay means for preventing said magnetic element from returning to said unattracted position for a predetermined time, and means responsive to closure of a circuit through both of said pairs of contacts for energizing said electromagnet to maintain said magnetic element in said attracted position.

8. In combination, an electroresponsive device including means for establishing a holding circuit therefor when said device is energized, control means for sequentially establishing and interrupting an initial energizing circuit for said electroresponsive device, whereby said device is maintained in its energized condition solely by said holding circuit, said sequential means comprising a control member movable between a plurality of positions to close a plurality of pairs of contacts, lost motion means for preventing one pair of contacts from being held in closed

circuit position by said control member when said control member is in position to close a second pair of said contacts, and time delay means for preventing said one pair of contacts from opening before said second pair of contacts is closed by said control member.

9. In combination, an electroresponsive device having means for establishing a holding circuit therefor when said device is energized, control means for sequentially establishing and interrupting an initial energizing circuit for said electroresponsive device, whereby said device is maintained in its energized condition solely by said holding circuit, said sequential means comprising a control member movable between a plurality of positions, means responsive to movement of said control member to one position for partially completing said energizing circuit, said circuit completing means being normally biased to open circuit position and being immediately released for movement in accordance with its bias when said control member is moved from said one position, means responsive to movement of said control member to a second position for completing said energizing circuit, and time delay means for preventing said first circuit completing means for moving to open circuit position for a predetermined time after said control member is moved from said one to said second position.

10. In combination, an electroresponsive device including means for establishing a holding circuit therefor when said device is energized, means for sequentially establishing and interrupting an initial energizing circuit for said device, whereby said device is maintained in its energized condition solely by said holding circuit, said sequential means comprising a control member movable between a plurality of positions, a first pair of contacts connected in circuit with said electroresponsive device and normally biased to open circuit position, means responsive to movement of said control member to one position for operating said contacts to closed circuit position, a second pair of contacts connected in series circuit relation with said first pair of contacts, means responsive to movement of said control member to a second position for closing said second pair of contacts, a lost motion connection between said control member and said operating means for said first contacts whereby said control member is incapable of holding said first pair of contacts in closed circuit position when said second contacts are closed, and time delay means for preventing said first pair of contacts from moving to open circuit position prior to the closure of said second pair of contacts.

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