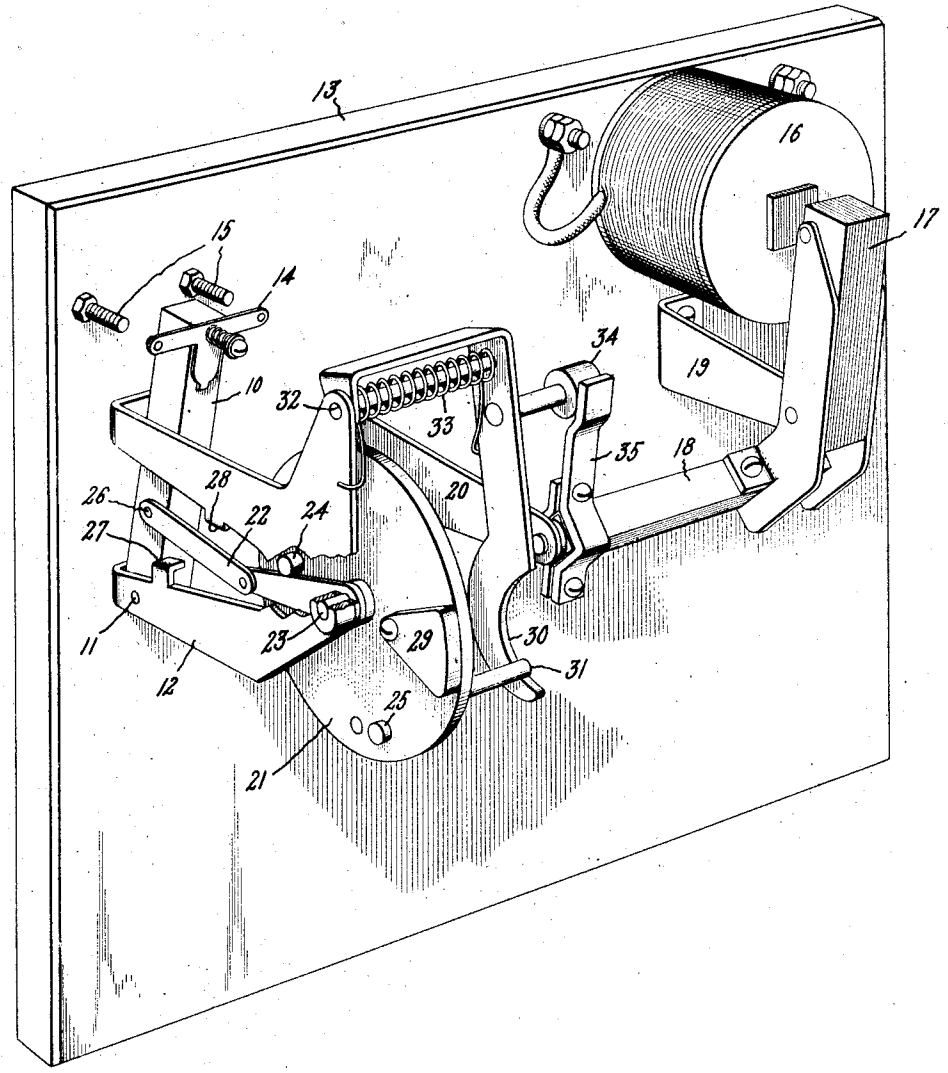
Sept. 2, 1930. J. EATON 1,774,966

TIME ELEMENT DEVICE

Filed May 15, 1926



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UNITED STATES PATENT OFFICE

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TIME-ELEMENT DEVICE

Application filed May 15, 1926. Serial No. 109,391.

The present invention relates to time element devices for use in connection with the control of electric circuits and has for its object the provision of an improved device of this character that is capable of introducing a definite and predetermined time delay in the operation of an electric switch between a plurality of positions.

More specifically, the present invention affords certain improvements upon the time element circuit-controlling device described in the McLain Patent No. 1,499,178, granted June 24, 1924. In the McLain time element circuit-controlling device, a rotatable inertia element in the form of a disk flywheel is biased to rotate from one position so as to operate the circuit-controlling contacts in another position and thereby introduce a time interval in the opening or closing of an electric circuit dependent upon the time taken by the disk in rotating from the first position to the second position. Due to the simplicity, reliability, ease of adjustment of the time interval, as well as the low cost of manufacture, the time element circuit-controlling device of the McLain type has a wide field of application, particularly in motor control systems. However, the McLain time element device introduces a time inerval only in either the opening or in the closing of an electric circuit. Under certain circumstances as, for example, in the motor control system described in my copending application, S. N. 109,392, filed May 15, 1926, it is desirable that both the opening and closing of a circuit be delayed for a desired time interval after the device is set into operation. My present invention provides a time element circuit-controlling device that is capable of introducing a time delay in both the opening and closing of an electric circuit and at the same time retains the advantageous features of the McLain type of inertia flywheel construction.

In carrying my present invention into effect in a preferred form, I employ a flywheel, preferably in the form of a disk, which is arranged to cooperate with a toggle mechanism so as to operate a circuit-controlling member from the circuit opening position to the circuit closing position a time interval after the flywheel is set into rotation in one direction and to return the circuit-controlling member to the first position a time interval after the flywheel is set into rotation in the reverse direction. The flywheel is set into rotation in each direction under the control of a member which is operated between two positions, preferably by an electromagnet. The whole arrangement is such that the flywheel is connected through lost motion connections with both the controlling member therefor and the circuit controlling member controlled by the flywheel so as to operate the circuit controlling member a time interval after operation of the controlling member. Thus the circuit-controlling member is operated in each direction between its positions a time interval after the operation of the controlling member between corresponding positions and in this way introduces a time delay in both the closing and opening of the circuit controlled by the circuit controlling device.

A better understanding of the invention may be had from the accompanying drawing in which the single figure is a perspective view of an electroresponsive time element circuit-controlling device embodying a preferred form of the invention.

As shown in the drawing, the movable circuit-controlling member 10 is pivotally mounted upon the shaft 11 carried by the bracket 12, which is secured on a suitable base or panel 13, preferably of insulating material. The movable circuit-controlling member 10 carries at its free end a bridging member 14 in operative relation with the two stationary contacts 15 which are mounted upon the panel 13 and connected in the circuit to be controlled by the electroresponsive time element device.

The member 10 is shown in its circuit-opening position and the operation of the switch member between the circuit-opening position and the circuit-closing position in which the bridging member 14 engages with the contacts 15, is controlled by the electromagnet 16 having the movable controlling member or armature 17 of magnetic material. The controlling member 17 is mounted

upon the shaft 18 which may carry movable switch members, not shown, and is pivotally supported in the brackets 19 and 20 secured to and extending from the base 13.

The time delay in the operation of the circuit controlling member 10 is obtained by means of the rotatable inertia disk 21 which is arranged to be controlled by the armature 17 and in turn controls the operation of the switch member 10 through the agency of the toggle mechanism 22. The inertia disk 21 is rotatably mounted upon the shaft 23 and is provided with the operating pins 24 and 25 which form a lost motion connection with the toggle mechanism 22 and serve respectively to collapse the toggle 22 when the disk 21 is in the position shown and to extend the toggle 22 when the disk 21 is rotated to bring the operating pin 25 into engagement therewith. The toggle 22 is pivotally connected at one end to the switch member 10 at 26 and is pivotally connected to the shaft 23 at the other end. The toggle mechanism operates between the stops 27 and 28 which are suitably formed on the bracket 12 and the arrangement is such that when the toggle is collapsed the switch member 10 is operated to the circuit-open opening position as shown and when the toggle is extended the switch member 10 is operated to carry the bridging member 14 into engagement with the stationary contacts 15.

The inertia disk 21 is normally biased by the unbalancing weight 29 to rotate in a clockwise direction to carry the operating pin 25 into engagement with the toggle 22 and thereby extend the latter. The disk 21 is rotated to and maintained in the position in which it is shown by means of the curved operating arm 30 which engages with the pin 31 secured to and extending from the disk 21. The operating arm 30 is pivotally mounted upon the shaft 32 which is secured to the bracket 12 and the arm is biased to operate the disk 21 to the position in which it is shown by the spring 33. However, the operating arm 30 is rendered ineffective when the electromagnet 16 is energized to attract the armature 17 by means of the pin 34 carried by the operating arm 30 and the lever 35 which is secured to the shaft 18. The operating arm 30, pin 34 and lever 35 cooperate to form a lost motion connection between the electromagnet operating shaft 18 and the flywheel 21. Thus it will be seen that when the controlling armature 17 is in the position shown the predominating bias of the spring 33 serves to bring the inertia disk 21 into the position in which it is shown, while the bias of the weight 29 serves to rotate the disk when the spring 33 is rendered ineffective by the attraction of armature 17.

The operation of my improved electro-responsive time element circuit-controlling device is as follows: With the various operating parts of the device in the position in which they are shown, the switch member 10 is in the circuit-opening position and the armature 17 is in the unattracted position. Upon energization of the electro-magnet 16 from a suitable source of current supply the armature 17 is attracted and immediately moves the operating arm 30 out of engagement with the pin 31 due to the engagement of the lever 35 with the pin 34. This releases the inertia disk 21 and the disk immediately starts to rotate in a clockwise direction due to the bias of the weight 29. When the time interval required for the disk 21 to rotate sufficiently to bring the operating pin 25 into engagement with the toggle 22 has elapsed, the toggle 22 is extended to move the switch member 10 to the circuit-closing position, the momentum acquired by disk 21 serving to insure operation of the toggle slightly over center into engagement with the stop 28 and thereby providing positive engagement between the bridging member 14 and the stationary contacts 15. In this way the operation of the switch member 10 to the circuit-closing position is delayed for a definite and predetermined time interval after the controlling armature 17 is operated into the attracted position. Due to the fact that the toggle 22 is set slightly over center against the stop 28, the possibility of accidental movement of the switch member 10 from the circuit-closing position by jars or vibration is effectively eliminated even though the inertia disk 21 is jarred out of engagement with the toggle. The switch member 10 remains in the circuit-closing position as long as the electromagnet 16 is maintained energized.

When the electromagnet 16 is deenergized the armature 17 immediately returns to the position in which it is shown, thus permitting the operating arm 30 to engage with the pin 31 to start rotation of the inertia disk 21 in a counter-clockwise direction under the biasing force of the spring 33. By reason of the inertia of the disk 21, the return thereof into the position in which it is shown is delayed for a definite and predetermined time interval. When the disk 21 finally approaches the position in which it is shown the operating pin 24 is carried into engagement with the toggle 22 so as to trip or collapse the latter, and thereby operate the switch member 10 to the circuit-opening position. Again it will be seen that the inertia disk 21 serves to introduce a time delay in the operation of the switch member 10 after the controlling armature 17 is returned to the unattracted position.

From the foregoing it will be seen that the improved circuit-controlling device embodying my present invention introduces the time delay in both the opening and the closing of the movable circuit switch member and that

the time delay is obtained for a fixed and predetermined time interval in either case. Adjustment of the time interval may be readily obtained by varying the position of the operating pins 24 and 25, as well as by varying the mass of the biasing weight 29 or the strength of the biasing spring 33.

While I have illustrated and described a preferred embodiment of my invention it should be understood that the apparatus shown may be modified considerably without departing from the spirit and scope of the invention.

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

1. A time element device for controlling electric circuits comprising a controlling member movable between two positions, a movable circuit controlling element operable between corresponding positions under the control of said controlling member, and time delay means operatively connecting the controlling member and the circuit controlling element and having lost motion connections therewith to delay the operation of said circuit controlling element between the corresponding positions for a time interval after the operation of said controlling member between each of its positions and the other.

2. A time element device for controlling electric circuits comprising a controlling member movable between two positions, a movable circuit controlling element operable between corresponding positions under the control of said controlling member, and lost motion connections between the controlling member and the controlled element including an independently movable member arranged to be set into operation upon movement of the controlling member from each of its positions to the other for operating the circuit controlling element between its corresponding positions a time interval thereafter.

3. A time element device for controlling electric circuits comprising a switch member operable between two positions, an operating member therefor having a plurality of definite positions and arranged to move quickly therebetween, and lost motion connections between the operating member and the switch member including a reversible time element power transmitting device set into operation upon movement of said operating member each way between its positions for effecting operation of said switch member between corresponding positions an interval of time after movement of said operating member.

4. A time element device for controlling electric circuits comprising a switch member movable between two positions, an operating means therefor, and lost motion connections between the operating means and said switch member including an independently movable inertia element which operates to delay for an interval the response of said switch member to move from each of its positions to the other after operation of said operating member.

5. A time element device for controlling electric circuits comprising a controlling member movable between two positions, a movable circuit controlling element operable between corresponding positions under the control of said controlling member, and means including a rotatable inertia element for delaying the operation of said circuit controlling element between the corresponding positions for a time interval after operation of said controlling member between each of its positions and the other.

6. A time element device for controlling electric circuits comprising a movable circuit controlling element operable between two positions, a controlling member therefor movable between two positions, and means including a rotatable inertia element for delaying the operation of said circuit controlling element each way between its positions for a time interval after movement of said controlling member between the corresponding positions.

7. A time element electroresponsive device for controlling electric circuits comprising a movable circuit controlling element operable between two positions, a controlling member therefor movable between two positions, and a rotatable inertia element under the control of said controlling member and arranged to be set into rotation in one direction to operate said circuit controlling element to one position a definite time interval after movement of said controlling member to a corresponding one of its positions and arranged to be set into rotation in the reverse direction to operate said circuit controlling element to its other position a definite time interval after the movement of said controlling member to its other position.

8. A time element device for controlling electric circuits comprising a movable circuit controlling element having two positions, a rotatable inertia element operable between two positions and arranged to operate the circuit controlling element to each of its positions a definite time interval after the rotatable element is set into operation to a corresponding one of its positions, and means including a controlling member having two positions for setting the rotatable element into operation to one of its positions upon operation of the member to the first of its positions and for setting the rotatable element into operation to the other of its positions upon operation of the member to the second of its positions.

9. A time element device for controlling electric circuits comprising a controlling member movable between two positions, a movable circuit controlling element operable between corresponding positions under the

control of said controlling member, lost motion connections between the controlling member and the controlled element including an independently movable member biased to move to one position upon operation of the controlling member to one of its positions to operate the controlled element to a corresponding position a time interval thereafter, and biasing means for returning the independently movable member to its initial position a time interval after the return of the controlling member to its first position to thereby effect the operation of the controlled element to its initial position.

10. A time element device for controlling electric circuits comprising a movable circuit controlling element having two positions, an independently operable controlling member therefor having two corresponding positions, a toggle mechanism for operating the circuit controlling element to one position when the toggle is extended and to the other position when the toggle is collapsed, and a rotatable inertia element cooperating with said controlling member to extend the toggle a time interval after movement of said controlling member from one of its positions to the other and for collapsing the toggle a time interval after the return of said controlling member to said one position.

11. A time element device for controlling electric circuits comprising a movable circuit controlling element having two positions, a toggle mechanism for operating the circuit controlling element to one position when the toggle is extended and to the other position when the toggle is collapsed, a rotatable inertia element provided with means for extending the toggle when the element is rotated to one position and for releasing the toggle when the element is rotated to a second position, and means including a controlling member operable between two positions for setting the inertia element into operation from its second position to its first position to set the toggle a time interval after operation of said controlling member to one of its positions and for setting the inertia element into operation from its first position to its second position to collapse the toggle a time interval after operation of the controlling member to its other position.

12. A time element device for controlling electric circuits comprising a movable circuit controlling element having two positions, a rotatable inertia element operable between two positions for controlling the operation of said circuit controlling element between said positions, means normally biasing said rotatable element to one position, independently operable means for biasing the rotatable element to a second position, and means including a member operable to one position for disabling said independently operable biasing means to permit the rotatable element to move from its second position to its first position and thereby operate the circuit controlling element to one position after a time interval, said member being operable to restore the effectiveness of said independently operable biasing means to return the rotatable element to the second position and thereby operate the circuit controlling element to its other position after a time interval.

13. An electroresponsive time element device for controlling electric circuits comprising a movable switch member having two positions, a controlling electromagnet therefor having a magnetic member operable between two positions in accordance with the energization of said electromagnet, and means including a rotatable inertia element for operating said circuit controlling element to a corresponding one of its positions a definite time interval after operation of said magnetic member to each of its positions.

14. An electroresponsive time element device for controlling electric circuits comprising a rotatable inertia element normally biased to move from one position to a second position, a movable circuit controlling element under the control of said rotatable element and arranged to be operated to a corresponding position when the rotatable element is in each of its positions, and electroresponsive means for releasing the rotatable element to operate with a time delay in accordance with its normal bias from said one position to said other position and for biasing the rotatable element to return with a time delay action to said one position.

15. An electroresponsive time element device for controlling electric circuits comprising a movable switch member having two positions, an electromagnet for controlling the movement of the switch member to each position, and means including a rotatable inertia element under the control of said electromagnet for effecting operation of the switch member from one position to the other position a time interval after the electromagnet is energized and for effecting the return of the switch member to said one position a time interval after the electromagnet is deenergized.

16. An electroresponsive time element device for controlling electric circuits comprising a movable switch member having two positions, an electromagnet having a magnetic member operable between two positions for controlling the operation of said switch element, a toggle mechanism for operating the switch member to one of its positions when the toggle is extended and to the other of its positions when the toggle is collapsed, a cooperating rotatable inertia element provided with means for extending the toggle when the rotatable element is in one position and collapsing the toggle when the rotatable element

is in a second position, and connections between said rotatable inertia element and the magnetic member of said electromagnet whereby the rotatable element is operated to said one position a time interval after the electromagnet is energized and is operated to said second position a time interval after the electromagnet is deenergized.

17. A time element circuit controlling device comprising a controlling member movable between two positions, a movable circuit controlling element operable between corresponding positions under the control of said controlling member, and a movable element having lost motion connections with both the said controlling member and the said circuit controlling member, one of said lost motion connections operating to set said movable element into motion upon movement of the controlling member each way between said two positions and another of said lost motion connections operating to effect operation of the circuit controlling member between corresponding positions a time interval after the completion of the movement of the controlling member.

18. A time element circuit controlling device comprising a switch member movable between two positions, operating means therefor including a controlling member movable between two positions, an inertia element mounted for relative movement with respect to both the said switch member and the said movable controlling element, and lost motion connections between said inertia element and both said switch member and said controlling member through which the inertia element is set into operation upon movement of the controlling member each way between said two positions and continues movement to effect operation of the controlling member between corresponding positions a time interval after the completion of the movement of the controlling member.

19. A time element circuit controlling device comprising a movable switch member operable between two positions, a controlling member therefor operable between two corresponding positions, a rotatable inertia element for delaying the operation of said circuit controlling element each way between its positions for a time interval after movement of said controlling member between corresponding positions, and mechanism establishing lost motion connections between the controlling member and the inertia element, and the inertia element and the switch member, to permit separate movement of the inertia element during said time interval.

20. A time element circuit controlling device comprising an electromagnet having a movable magnetic member operable between two positions, a movable switch member having two corresponding positions, and means operatively connecting the magnetic member of the electromagnet with the switch member including a rotatable inertia element having a lost motion connection with both said magnetic member and said switch member to permit the inertia element to be set into operation upon movement of the magnetic member each way between said two positions and continue in movement to effect operation of the switch member between the corresponding positions a time interval thereafter.

In witness whereof, I have hereunto set my hand this 14th day of May, 1926.

JOHN EATON.