

April 1, 1952

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2,590,926

MULTIRELAY ELECTRIC TIMER

Filed Feb. 7, 1950

FIG. 1

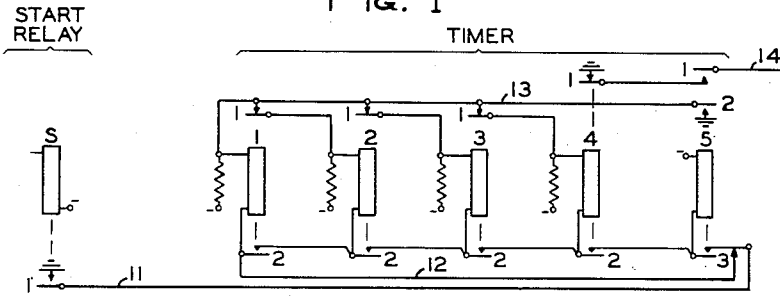


FIG. 2

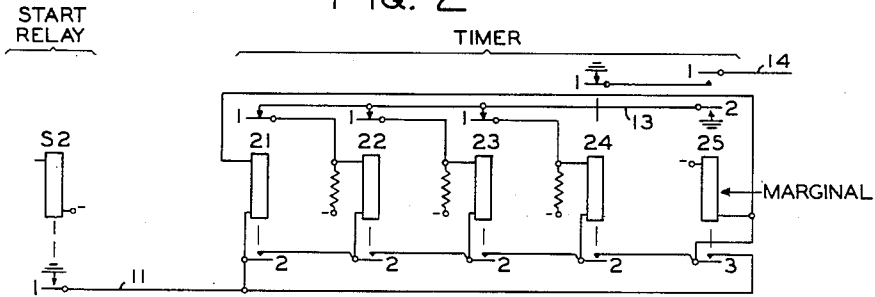
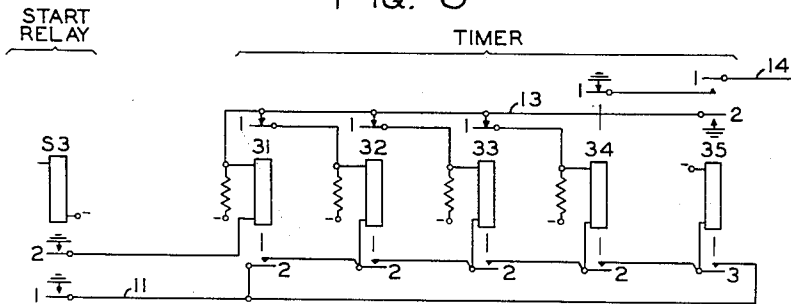


FIG. 3



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MULTIRELAY ELECTRIC TIMER

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Application February 7, 1950, Serial No. 142,924

7 Claims. (Cl. 175—320)

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This invention relates to multi-relay electric timers.

Its principal object is to provide a new and improved timer of this character, and particularly one which provides reliable and accurate timing when used as a limit timer for each of a succession of events likely to succeed each other in great rapidity, the events varying more or less randomly in duration, with many of them enduring for substantially less than the limit for which the timer is constructed or adjusted.

It has been chosen to illustrate the invention as applied to a so-called cycle timer such as is employed in a common controller used on an automatic telephone switchboard, such as the line controller disclosed in Fig. 5 of the drawings in the Bellamy Patent 2,485,351, issued October 18, 1949. Such a controller is common to a large number of circuit paths and is called into use each time a connection is to be extended over one of them. Normally the controller disposes of the connection (or call) within a few seconds and thereupon clears out and returns to normal condition in readiness to accept a further call. The function of the cycle timer in such a controller is to effect the clearing out of the controller at the end of a predetermined interval (slightly longer than the longest time normally required for a cycle of controller operations) in the event that some malfunctioning has prevented the controller from clearing out within such interval. The previously noted succession of events in this example, comprises the successive calls which cause the line controller to be taken for use.

In the cycle timer shown in the above patent, the principal timing relays are all operated at the same time, but are restored in succession only.

A feature of the invention resides in the arrangement whereby the timing relays are first operated in succession and are thereafter restored in succession to provide the desired timing. A special advantage of the noted operational arrangement is that no special timing provision (such as the normally short-circuited winding on relay 509 of the noted patent) is required to insure saturation of the winding of the first relay before it is short-circuited to induce its slow release.

A related operational feature resides in a circuit arrangement whereby the timing relays maintain a slow-release characteristic on their timed release, but promptly revert to a fast-release characteristic incidental to clearing out or resetting, the timer before it has reached its tim-

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ing limit. Moreover, the unrestored timing relays are permitted to restore all together.

Other objects and features will appear as the description progresses.

The drawings

Referring to the accompanying drawings, Figs. 1, 2, and 3 are schematic circuit diagrams of a preferred embodiment and two desirable modifications, respectively.

It is assumed that each of start relays S, S2 and S3 (Figs. 1, 2, and 3 respectively) perform the same functions as start relay 508 of the line controller disclosed in Fig. 5 of the drawings of the noted Bellamy patent.

In the first embodiment (Fig. 1) the timing relays are prevented from reoperating during any one timing period, and prompt release of all operated relays of the timer is insured by an arrangement for locking all timer relays, and opening the operating circuit of the first timer relay on operation of the release relay.

In the second embodiment (Fig. 2) the release relay (relay 25) is located in the battery-supply circuit of the first timing relay, the relay simplifying the contact requirements and eliminating one battery-supply resistor, but introducing the requirement that relay 25 be marginal.

In the third embodiment (Fig. 3), the operating circuit of the first timing relay is isolated from the holding circuit of the release relay (relay 35), to render the make-before-break contacts of relay 5 (Fig. 1) unnecessary, but requiring the additional contacts 2 on relay S3.

Detailed description

The invention having been described generally, a detailed description will now be given.

First embodiment (Fig. 1)

When start relay S operates to initiate a timing period, its contacts 1 apply ground over wire 11, through closed contacts 3 of release relay 5, and over wire 12 to operate timer relays 1 to 5 in succession. Relay 1 is operated directly from the ground on wire 12 while each of the succeeding relays is operated from the ground on wire 12 through contacts 2 of the preceding relays. Release relay 5, at its make-before-break contacts 3, locks itself and the preceding timing relays to the ground on wire 11 (in preparation for the restoration of timing relays 1 to 4 in succession) at the same time, opening the initial operating path (ground on wire 12) of relays 1 to 5 to prevent interference with their intended prompt restoration if start relay S restores (line

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controller clears out) before the timer has reached its limit (relay 5 operated alone).

The operation of relays 1 to 5 in succession insures that the current through the winding of relay 1 has substantially reached its full value by the time release relay 5 operates.

With timer relays 1 to 5 in an operated condition, release relay 5, at its contacts 2, grounds wire 13, thereby directly short-circuiting timing relay 1 (ground from wire 11 on one side of the winding and ground from wire 13 on the other side) causing it to restore as a slow-releasing relay. The noted time required for relays 2 to 5 to operate after relay 1 has operated provides full saturation of the winding of relays 1 and insures constant release characteristics on successive operations thereof.

When relay 1 releases after the time delay caused by the short-circuited winding, its contacts 1 extend the ground on wire 13 to the winding of relay 2 and at the same time, its contacts 2 open its locking circuit. Relay 1 remains restored as the operating circuit is open at contacts 3 of release relay 5. Relay 2 releases due to the short-circuited winding and at its contacts 1 places ground from wire 13 on the next succeeding relay. The remainder of the timing relays restore in succession, each when restoring, extending ground to the winding of the next succeeding relay.

If the line controller disposes of the current call before all timing relays have restored in slow succession, start relay S restores and removes the holding ground from the winding of release relay 5 and from the windings of all operated preceding timing relays. All currently operated timing relays and release relay 5 quickly restore and the timer is prepared for another timing period. If, for example, timing relays 1, 2, and 3 have restored in slow-succession and timing relay 4 and release relay 5 are still operated when start relay S releases, a self-locking series circuit still exists for relays 4 and 5. This circuit is from ground on wire 13 from contacts 2 of relay 5, back contact 1 of timing relay 3, the winding of relay 4 and its contacts 2, and through the winding of relay 5 to battery. The current flow through this circuit causes the current flow to be reversed through the winding of relay 4, causing a reversal of magnetic flux through its magnetic structure (not shown). This reversal of flux causes relay 4 to release, opening the noted locking circuit at its contacts 2. Relay 5 restores responsive to the release of timing relay 4 and start relay S. This action is similar when any timing relay preceding relay 5 is still operated when start relay S restores.

If start relay S is still operated after relays 1 to 4 have released in slow succession, ground from contact 1 of start relay S maintains release relay 5 operated. Contacts 1 of relay 4 extend ground through contacts 1 of relay 5 to wire 14 to signal the completion of the timing limit.

Second embodiment (Fig. 2)

When start relay S2 operates, its contacts 1 applies ground on wire 11 to operate relays 21 to 25 in succession. The operating circuit of relay 21 includes the winding of release relay 25 but relay 25 being marginal does not operate in series with relay 21. Relay 21 operates directly from the ground on wire 11 while each of the succeeding relays operates from ground on

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wire 11 through contacts 2 of the preceding relay. Wire 11, through contacts 2 of the preceding relays is placed to the winding of release relay 25. It is also placed on the battery-supply side of relay 21. Relay 21 is short-circuited and restores as a slow-release relay.

Release relay 25 operates before relay 1 releases and at its contacts 3, locks itself and the preceding relays to ground on wire 11. When relay 21 restores, its contacts 1 extend ground from contact 2 of relay 25 to the winding of relay 22 and at the same time its contacts 2 open the operating path of the succeeding relays. Relay 21 remains restored as its winding remains short-circuited. Relay 22 releases and extends a short-circuiting ground to the next succeeding relay. The remainder of the timing relays restore in slow succession. Relay 25 remains locked to ground on wire 11 and relay 21 remains unoperated as it is short-circuited. Ground is placed on wire 14 from contacts 1 of relay 24 and contacts 1 of relay 25.

If start relay S2 restores before the timing relays 21 to 24 have released, the clearing out of the timer in preparation for another timing period is as described for Fig. 1.

Third embodiment (Fig. 3)

When start relay S3 operates to initiate a timing period, its contacts 2 apply ground to the winding of relay 31, operating it. Contacts 2 of relay 31 extend ground from contact 1 of relay S3 over wire 11 to the winding of relay 32. Relays 32 to 35 operate in succession from the ground on wire 11 through contacts 2 of the preceding relays. Release relay 35 at its contacts 3, locks itself and all preceding relays, excepting the first, to ground on wire 11 and at the same time, its contacts 2 ground wire 13, thereby directly short-circuiting relay 31 (ground from wire 13 on one side of the winding and ground from contact 2 of start relay S3 on the other side) causing it to restore as a slow-releasing relay.

When relay 31 releases after the delay caused by the short-circuited winding, its contacts 1 extend the ground on wire 13 to the winding of relay 32 and at the same time opens the operating circuit of the succeeding relays. Relay 32 releases due to the short-circuited winding and at its contacts 1 places ground from wire 13 to the next succeeding relay. The remainder of the timing relays restore in succession as hereinbefore described in connection with Fig. 1.

When all timing relays, relays 31 to 34 have restored in slow succession, ground from contacts 1 of relay 34 is extended through contacts 1 of release relay 35 (relay 35 is locked operated to the ground on wire 11) to wire 14 to signal the completion of the timing limit. Relay 31 does not reoperate as it is short-circuited as previously noted.

If start relay S3 releases before the timer has reached its limit (relay 35 operated alone) all operated relays are released as hereinbefore described in connection with Fig. 1.

We claim:

1. An electric timer comprising a series of electromagnetic relays, means for operating the first relay, contact means included in and operable with each relay preceding the last for closing an operating circuit for the next succeeding relay, contact means responsive to the operation of the last relay for closing a self-locking circuit for each relay, means responsive to the operation of the last relay for short-circuiting the first relay,

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any relay restoring responsive to being short-circuited, and control means included in and operable with the restoration of each said relay preceding the last for short-circuiting the next succeeding one of said relays.

2. An electric timer employing electromagnetic relays comprising a series of timer relays followed by a release relay, with the relays operable in succession and with the timer relays thereafter restorable in the same succession, means for closing an operating circuit for the first timer relay, each timer relay including contacts operable therewith for closing an operating circuit for the next succeeding one of said relays, the release relay having contacts operable therewith for closing a self-locking circuit and for opening the initial operating circuit of the first relay, branches of said self-locking circuit passing through the said contacts of the timer relays to lock each of them operated, and other contacts operable with said release relay for short-circuiting the first timer relay, any such relay restoring responsive to being short-circuited, and contacts operable with the restoration of each timer relay preceding the last for short-circuiting the next succeeding relay.

3. An electric timer employing electromagnetic relays comprising a series of timer relays followed by a release relay, with the relays operable in succession and with the timer relays thereafter restorable in the same succession, a control conductor having a normally connected branch conductor extending to the first timer relay, means for energizing said control conductor to close an operating circuit for the first timer relay over said branch conductor, the timer relays including serially-related contacts operable therewith for extending said branch conductor successively to the relays succeeding the first timer relay, to thereby operate such relays in succession, the release relay having contacts operable therewith for extending the said extended branch conductor back to said control conductor and for opening the normal connection between such conductors, the release relay having other contacts operable therewith for short-circuiting the first timer relay, any relay restoring responsive to being short-circuited, and contacts operable with the restoration of each timer relay preceding the last for short-circuiting the next succeeding timer relay.

4. An electric timer employing electromagnetic relays comprising a series of timer relays followed by a release relay, with the relays operable in succession and with the timer relays thereafter restorable in the same succession, a control wire extending to the first timer relay, a further wire extending between the first timer relay and the release relay to join them in series, means for energizing said control wire to close an operating circuit for the first timer relay thereover in series with the release relay, the release relay being non-operable in series with the first timer relay, the timer relays including serially-related contacts operable therewith for extending said control wire successively to the relays succeeding the first timer relay, to thereby operate such relays in succession, the release relay having contacts operable therewith for extending the said extended control wire back to the original control wire, the said closure of an operate circuit for the release relay short-circuiting the first timer relay, any timer relay restoring responsive to being short-circuited, and contacts operable with the restoration of each timer relay preceding the

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last for short-circuiting the next succeeding timer relay.

5. An electric timer employing electromagnetic relays comprising a series of timer relays followed by a release relay, with the relays operable in succession and with the timer relays thereafter restorable in the same succession, a control wire and means for energizing it, other means effective therewith for closing an operating circuit for the first timer relay, the timer relays including serially-related contacts operable therewith for extending said control wire successively to the relays succeeding the first timer relay, to thereby operate such relays in succession, the release relay having contacts operable therewith for extending the said extended control wire back to the original control wire, the release relay having other contacts operable therewith for short-circuiting the first timer relay, any relay restoring responsive to being short-circuited, and contacts operable with the restoration of each timer relay preceding the last for short-circuiting the next succeeding timer relay.

6. An electric timer comprising a series of electromagnetic timer relays operable in succession and thereafter restorable in the same succession to measure an interval of time beginning with the closure of an operating circuit for the first timer relay and ending with the restoration of the last timer relay, start means operable to start the timer, contact means included in the start means and including a contact pair closed by an operation thereof, circuit elements connected in circuit with said contact pair and constituting therewith a closed operating circuit for the first timer relay upon any operation of the start means with the timer in normal condition, each timer relay preceding the last including contact means closed with an operation thereof, circuit elements included in circuit with any of the last said contact means and constituting therewith a closed operating circuit for the next succeeding timer relay whenever the concerned contact means become closed with the start means operated, means including contact means operable with the last timer relay for effecting restoration of all the timer relays in the same succession in which they became operated, and a time-controlled circuit and means for controlling it dependent upon the last timer relay being in restored condition after having been operated and further dependent upon said start means having remained continuously in operated condition, and means included at least partially in the foregoing structure and dependent upon the last timer relay having operated for preventing reoperation of said timer relays, following their said restoration, so long as said start means remains in operated condition.

7. An electric timer comprising a series of electromagnetic relays, means for operating the first relay, contact means included in and operable with each relay preceding the last for closing an operating circuit for the next succeeding relay, means responsive to the operation of the last relay for closing a self-locking circuit for each relay, means responsive to the operation of the last relay for short-circuiting the first relay, any relay restoring responsive to being short-circuited, and control means included in and operable with the restoration of each said relay preceding the one immediately before the last for short-circuiting the next succeeding one of the said relays, the self-locking circuit of the last relay being effective to maintain the relay

operated indefinitely notwithstanding the restoration of the preceding relays, a normally open signal circuit path, and means dependent jointly upon the relay immediately preceding the last being restored, and the last relay being operated, 5
for closing said signal circuit path.

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