Dec. 4, 1951 C. H. REX 2,577,155

ELECTRIC SWITCHING SYSTEM

Filed Feb. 23, 1946

Fig. 1.

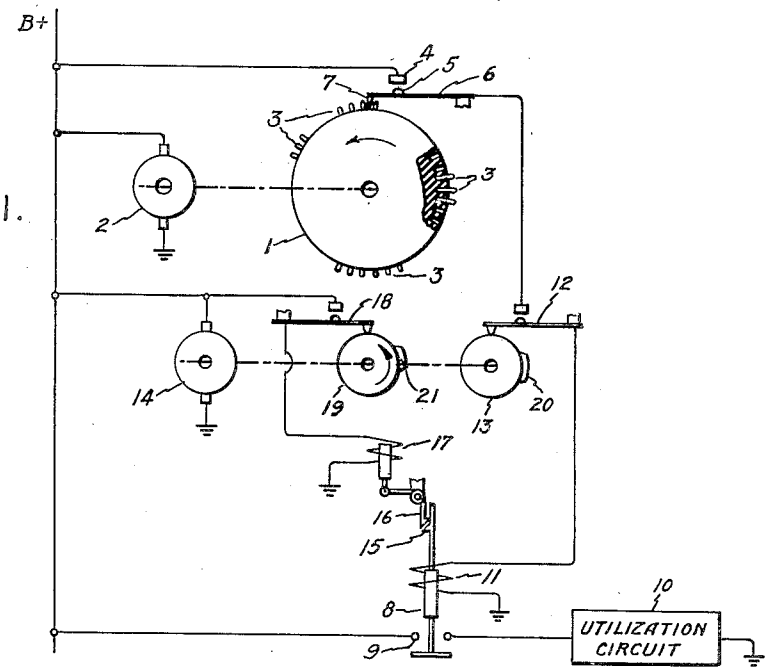
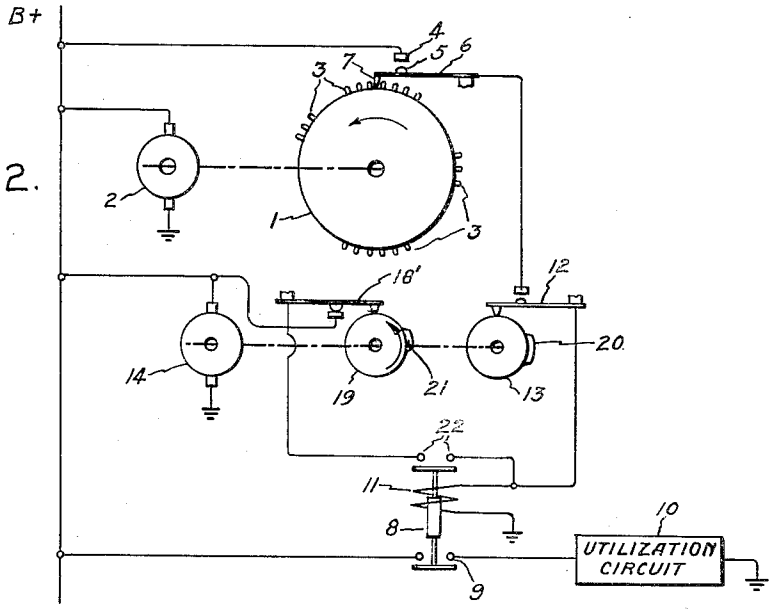


Fig. 2.



Inventor
Charles H. Rex.
by Claude N. Mott
His Attorney

Patented Dec. 4, 1951

2,577,155

UNITED STATES PATENT OFFICE

2,577,155

ELECTRIC SWITCHING SYSTEM

Charles H. Rex, Marblehead, Mass., assignor to General Electric Company, a corporation of New York

Application February 23, 1946, Serial No. 649,593

8 Claims. (Cl. 175—373)

1

My invention relates to electric switching systems, and more particularly to holding circuits for electromagnetic switching means arranged for energization through a program switch which is recurrently opened and closed during a desired holding interval. The invention is especially applicable to program selector drums of the type wherein adjustable camming pins are so arranged that the cooperating program cam switch will not be held actuated as it passes between pins in adjacent positions.

It is a general object of my invention to provide new and improved program means for controlling an electromagnetic switching system.

It is a further object of my invention to provide new and improved circuit holding means operable in conjunction with a program switch of the type which is recurrently opened and closed during a desired holding interval.

It is a particular object of my invention to provide a new and improved switching system for a program selector of the type including a program switch which is actuated for only a portion of any of a plurality of selectable unit time intervals, as by adjustable pins in a revolving drum.

In accordance with my invention, an electromagnetic switch or contactor provided with holding or locking means is energized through the recurrently actuated program switch. The energizing current, however, is not made or broken at the program switch, but at a timing switch which is closed for only a portion of each closing interval of the program switch. Further means are provided for disabling the holding or locking means during only an initial or included portion of each closing interval of the timing switch. Thus, in those positions of the program selector in which the program switch is actuated, the contactor energizing circuit is completed and the holding means simultaneously disabled; but the holding means is again rendered operable before the energizing circuit is broken. On the other hand, in those positions of the selector where the program switch is not actuated, the energizing circuit is never completed, but the holding means is disabled at least momentarily.

My invention will be more fully understood and its various objects and advantages further appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawing, in which Figs. 1 and 2 are schematic circuit diagrams of electromagnetic program switching systems illustrating various embodiments of my invention.

Referring first to Fig. 1, I have illustrated diagrammatically a rotatable program drum 1 driven by a motor 2 and provided with a plurality of adjustable switch actuating pins 3. The pins 3 may, for example, be selectably positioned in any of a plurality of holes around the entire periphery of the drum 1. The camming pins 3 cooperate with a program switch comprising a stationary contact 4 and a movable contact 5 mounted upon a resilient spring strip 6. The spring strip 6 is fixedly mounted at one end and is provided at its other end with a turned-down camming extension 7 arranged to engage the pins 3 in the drum 1.

2

The camming pins 3 are so formed that, even when positioned in adjacent holes in the drum 1, each pin causes a separate actuation of the program switch 6. Thus, where a plurality of pins 3 are arranged in adjacent holes of the drum to define a desired continuous holding interval, the program switch 6 is recurrently actuated to close its contacts a plurality of times during the holding interval.

In order to overcome the effect of recurrent actuation of the program switch 6 during a single holding interval, the switch 6 is arranged to energize an electromagnetic contactor 8 which is provided with holding means independent of the drum 1. The contactor 8 comprises a normally open switch contact 9 arranged to connect a desired utilization circuit 10 to a suitable source of electric current supply indicated by the symbol B+. An energizing winding 11 for the contactor 8 is arranged to be connected to the supply source B+ through the program switch contacts 4, 5 in series circuit relation with the contacts of a normally open timing switch 12. The contacts of the timing switch 12 are periodically closed by a cam 13 driven by a timing motor 14. The cam 13 is arranged to make one complete revolution in the unit time interval defined by the time required for the drum 1 to revolve through the angular distance between two adjacent holes or pins in its periphery.

The contactor 8 of Fig. 1 is of the self-latching type, and includes a latching detent 15 arranged for cooperation with a spring biased latch 16. Electromagnetic means including a coil 17 are provided for releasing the latch 16. The release coil 17 is arranged to be energized from the supply source B+ through a normally open timing switch 18. The contacts of the timing switch 18 are periodically closed at least momentarily at the same frequency as the switch 12 by a cam 19 driven by the timing motor 14.

In operation, the program drum 1 and the timing cams 13 and 19 are continuously rotated at different speeds. The drum 1 defines a continu-

ous series of unit time intervals equal in length to the time taken for the drum 1 to rotate the angular distance between adjacent pins or holes in its periphery. The cams 13 and 19 each make one complete revolution in each such unit time interval. By way of example, let it be assumed that the unit time intervals defined by the distance between adjacent holes in the drum 1 are of twelve minutes duration, so that the cams 13 and 19 make one complete revolution each twelve minutes.

The cam 13 is provided with a shoulder 20 arranged to close the contacts of the switch 12 for a predetermined period during each unit time interval. Similarly, the cam 19 is provided with a shoulder 21 arranged to close the contacts of the switch 18 at least momentarily during an initial portion of each closing period of the switch 12. By way of example, let it be assumed that the shoulder 20 closes the switch 12 for thirty seconds during each twelve minutes, and that the shoulder 21 closes the switch 18 for the first twenty seconds of each thirty-second closure period of the switch 12.

It is to be noted also that the closure periods of the switch 12 are arranged to fall in those portions of the twelve-minute intervals defined by the drum 1 during which the program switch 6 is directly over a hole in the drum or is closed by a pin if a pin is positioned in that hole.

Let it now be assumed that the first of a group of adjacent pins comes under the program switch 6 and closes the switch. Then, during the closing interval of the contacts 4 and 5, the timing switch 12 will be closed for thirty seconds. Thus, an energizing circuit will be completed for the contactor coil 11 and the contactor 8 picked up. During the first twenty seconds of this energizing interval, the latch 16 is rendered ineffective by the closure of the timing switch 18. However, before the timing switch 12 is opened, the timing switch 18 is opened, so that when the switch 12 is finally opened at the end of the thirty seconds, the contactor 8 is retained in its energized position by the latch 16.

If now, during the next twelve-minute interval defined by the drum 1, the program switch 6 encounters another pin 3, the same simultaneous energization and sequential deenergization of the closing coil 11 and the release coil 17 will take place, with the closing coil taking precedence because it is the last to be deenergized. Thus, the contactor 8 will be held in its energized position for a total holding interval defined by the number of adjacent pins in the drum 1. When the last pin of a group passes the program switch 6 so that, upon the next closure of the timing switch 12, the program contacts 4 and 5 remain open, the contactor closing coil 11 will not be energized, but the release coil 17 will be energized through the timing switch 18. Thus, at the first opportunity after the passage of the last pin of a series, the contactor 8 will be dropped out and will remain out until the program switch 6 encounters another pin on the drum.

It will be evident that the arrangement of Fig. 1 may be modified for use with a contactor having a holding coil in place of the release coil 17. For such use, it is only necessary to arrange the timing switch 18 to be normally closed and periodically opened, rather than normally open and periodically closed as shown.

In Fig. 2, I have shown another embodiment of my invention generally similar to that shown in Fig. 1, but in which the contactor 8 is held

closed by a holding contact 22 thereon connected in circuit with the contactor energizing winding 11. In Fig. 2, the holding circuit for the coil 11 comprises the contact 22 connected in series circuit relation with a timing switch 18'. The contacts of the switch 18' are normally closed and arranged to be opened periodically by the timing cam 19. In all other respects, the embodiment of Fig. 2 is similar to that of Fig. 1 and like parts have been assigned the same reference numerals.

In operation of the arrangement shown in Fig. 2, the timing switch 12 is closed for a portion of each unit time interval defined by adjacent holes in the drum 1 and the timing switch 18' is opened for only an initial or included portion of the closure period of the timing switch 12. Thus, if in any given unit time interval the program switch 6 encounters a pin 3, an energizing circuit is completed for the winding 11 by the switch 12, and the holding circuit is simultaneously disabled by the switch 18' for a portion of the energizing interval. The switch 18', however, is closed before the switch 12 is opened, so that when the switch 12 is finally opened the holding circuit is effective. So long as the program switch 6 continues to encounter adjacent pins, this action is repeated during each closing interval of the switch 6, so that the contactor 8 is maintained in its energized position. If, however, the program switch 6 does not encounter a pin during any selected unit time interval, the timing switch 12 is ineffective to complete the contactor energizing circuit, while the holding circuit is disabled for an interval by the timing switch 18'. Thus, the contactor 8 is dropped out and remains out until the program switch 6 encounters the next pin on the drum.

It will now be evident from the foregoing description of the operation of my invention that the timing switch 18 or 18' may be actuated to disable the holding or locking circuit at any time during the closure period of the timing switch 12, other than the final portion of the period. Thus, where in the appended claims the term "initial portion" is used with respect to the closure period of the switch 12, it shall be taken to mean a portion which terminates prior to termination of the closure period, whether it begins at or after the beginning of the period.

While I have described only certain preferred embodiments of my invention by way of illustration, many modifications will occur to those skilled in the art and I therefore wish to have it understood that I intend in the appended claims to cover all 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, electromagnetic switching means, means for energizing said switching means comprising two pairs of normally open contacts in series circuit relation, first timing means for establishing a continuous series of unit time intervals, selectable program means arranged to close one of said pairs of contacts for a predetermined portion of any of said unit time intervals, second timing means for recurrently closing the other said pair of contacts for a predetermined period during each said unit interval, said periods being included in said predetermined portions of said unit intervals, holding means including a circuit independent of said energizing means for maintaining said switching means in its energized position, and switching means in said circuit actuated by said second tim-

ing means for recurrently disabling said holding means at least momentarily for an initial portion of each said predetermined period.

2. In combination, electromagnetic switching means, means for energizing said switching means comprising two pairs of normally open contacts in series circuit relation, first timing means for establishing a continuous series of unit time intervals, selectable program means arranged to close one of said pairs of contacts for a predetermined portion of any of said unit time intervals, second timing means for recurrently closing the other said pair of contacts for a predetermined period during each said unit interval, said periods being included in said predetermined portions of said unit intervals, latch means for maintaining said switching means in its energized position, and switching means including a circuit independent of said energizing circuit controlled by said second timing means for recurrently rendering said latch means ineffective at least momentarily for an initial portion of each said predetermined period.

3. In combination, electromagnetic switching means, means for energizing said switching means comprising two pairs of normally open contacts in series circuit relation, first timing means for establishing a continuous series of unit time intervals, selectable program means arranged to close one of said pairs of contacts for a predetermined portion of any of said unit time intervals, second timing means for recurrently closing the other said pair of contacts for a predetermined period during each said unit interval, said periods being included in said predetermined portions of said unit intervals, latch means for maintaining said switching means in its energized position, electromagnetic means including a coil for releasing said latch means, and means including a circuit independent of said first energizing circuit and a switch controlled by said second timing means for recurrently energizing said coil at least momentarily for an initial portion of each said predetermined period.

4. In combination, electromagnetic switching means, means for energizing said switching means comprising two pairs of normally open contacts in series circuit relation, first timing means for establishing a continuous series of unit time intervals, selectable program means arranged to close one of said pairs of contacts for a predetermined portion of any of said unit time intervals, second timing means for recurrently closing the other said pair of contacts for a predetermined period during each said unit interval, said periods being included in said predetermined portions of said unit intervals, electromagnetic means including a holding circuit independent of said normally open contacts for maintaining said switching means in its energized position, and means including a cam switch periodically actuated by said second timing means for disabling said holding circuit at least momentarily for an initial portion of each said predetermined period.

5. In combination, a program control switch arranged to be recurrently opened and closed during a desired holding interval, switching means having an energizing circuit including said program switch, a normally open timing switch in series with said program switch, timing means for closing said timing switch for a predetermined portion of each closing interval of said program switch, holding means including a circuit independent of said energizing circuit for maintaining said switching means in its energized position,

and switching means in said last named circuit controlled by said timing means for periodically disabling said holding means at least momentarily at recurrent instants falling within an initial portion of said predetermined portion of each said switch closing interval.

6. In combination, a program control switch arranged to be periodically opened and closed during a desired holding interval, switching means having an energizing circuit including said program switch, a normally open timing switch in series circuit relation in said energizing circuit, timing means for periodically closing said timing switch for a predetermined portion of each closing interval of said program switch, holding means including a circuit independent of said energizing circuit for maintaining said switching means in its energized position, and means including a second timing switch in said last named circuit controlled by said timing means for periodically disabling said holding means at least momentarily at recurrent instants falling within initial portion of said predetermined portion of each said switch closing interval.

7. In combination, a program timing device arranged to define a continuous series of unit time intervals, a normally open program switch controlled by said device and arranged to be recurrently closed and opened within each said unit interval included in a desired holding period extending over consecutive unit intervals, electromagnetic switching means having an energizing circuit including said program switch, holding means including a circuit independent of said energizing circuit for maintaining said switching means in its energized position, and timing means including a switch in said last named circuit for periodically disabling said holding means at least once during each said unit interval and at an instant during closure but prior to opening of said program switch.

8. In a program control system, a continuously operable program timer defining a continuous series of unit time intervals, means for selecting a series of consecutive unit intervals constituting an uninterrupted holding period, a normally open program switch arranged to be closed by said timer and then reopened during each unit interval in a selected holding period, electromagnetic switching means having an energizing circuit controlled by said program switch, holding means including a circuit independent of said energizing circuit for retaining said switching means in a picked up position independently of said energizing circuit, and timing means including a switch in said last named circuit for periodically disabling said holding means at least momentarily during each said unit interval and at an instant during but prior to termination of closure of said program switch in each unit interval in which said program switch is closed.

CHARLES H. REX.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,157,858	Miller	May 9, 1939
2,201,162	Elliott	May 21, 1940
2,209,108	Briggs	July 23, 1940
2,262,061	Somers	Nov. 11, 1941
2,447,752	Hathaway	Aug. 24, 1948