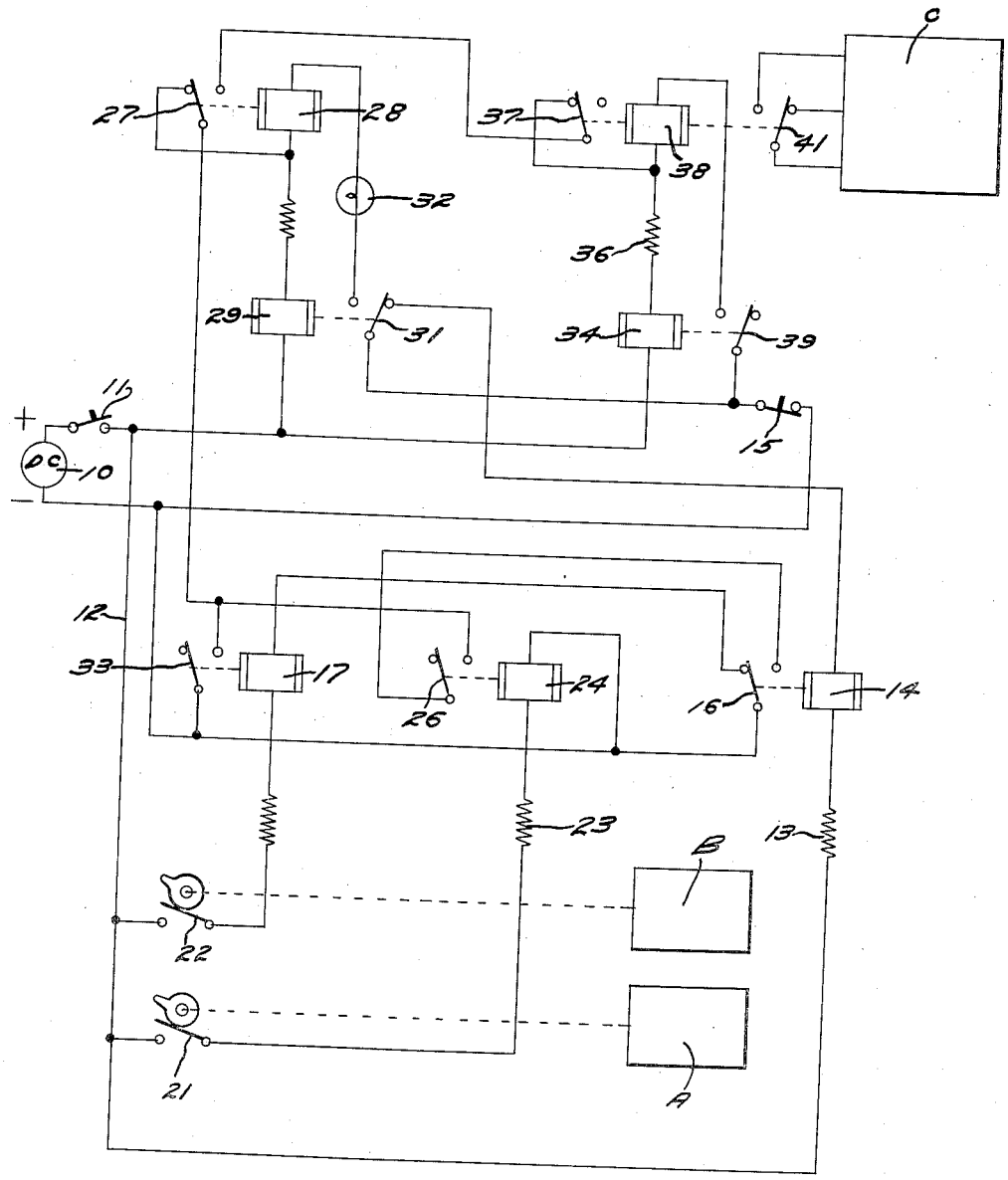
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SEQUENCE COUNTING AND LOCKING CIRCUIT

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SEQUENCE COUNTING AND LOCKING CIRCUIT

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This invention relates to a sequence counting and locking circuit and more particularly to a locking circuit which upon ascertainment of successive switch closures in a predetermined sequence functions to control external circuitry.

The subjection of articles to successive testing or manufacturing operations at numerous diverse locations has in the past required an extensive amount of costly handling and scrutinization of articles undergoing the various operations. To eliminate these problems, it is highly desirable to provide a circuit which will be rendered effective by successive satisfactorily completed operations at several utilization stations and which will give notification of any unsatisfactory conditions disclosing, at the same time, whereat the malfunction occurs. It is also desirable that a circuit of this type, upon completion of a satisfactory cycle of operation, be adapted to render external circuitry effective.

It is a prime object of this invention to provide an improved sequence counting and locking circuit which may be utilized to control external circuitry.

A further object of this invention is to provide a sequence counting and locking circuit which may be adapted to function in cooperation with numerous external utilization stations.

Still another object of this invention is to provide a sequence counting and locking circuit with indicating devices that function to give notification of an unsatisfactory condition at an utilization station.

A more finite object of this invention is to provide a locking circuit which is rendered effective to operate other instrumentalities subsequent to a series of switch closures resulting from the satisfactory operation of a plurality of external utilization stations in a predetermined sequence.

With these and other objects in view, the present invention contemplates a locking circuit comprising two or more series of three relays each. The first or control relay of each series is momentarily energized by a switch closure resulting from the actuation of a cam which, in turn, is controlled by the satisfactory completion of an operation at a utilization station. The momentary energization of this first relay in turn results in the energization of the remaining two relays which are locked in an energized state. Upon application of power to the circuit, a starting relay is energized which precludes the functioning of one of the series of relays until the locking relays of the other series have been energized. The operation of the second or subsequent series of relays completes the locking circuit and results in a switch closure which may be utilized to render other instrumentalities effective.

Other objects and advantages of the present invention will be apparent from the following detailed description when considered in conjunction with the accompanying drawing wherein the single figure is a diagrammatic view of a sequence counting and locking circuit forming one embodiment of the invention.

Referring to the drawing, there is disclosed a D.C. source 10 which supplies power to the circuit upon closure of a starting switch 11. Closure of switch 11 provides a path for energizing current through a conductor 12, a resistor 13, a starting relay 14 and back to the source 10 through a reset switch 15. The energization of relay 14 draws up contacts 16 and results in the opening of a circuit to the windings of a relay 17.

A pair of utilization stations A and B are provided and control cam-operated switches 21 and 22. The utilization station A, which may be either a testing or manufacturing device, momentarily closes the cam-operated switch 21 after satisfactorily completing a cycle of operation. The closure of the switch 21 completes a path for current from the conductor 12 through the switch 21, a resistor 23 and a relay 24 to the source 10. The energized relay 24 momentarily draws up contacts 26 thereby completing a circuit from the source through the contacts 16 and 26 and a contact 27 of a relay 28 to a relay 29. Energizing current to the relay 29 results in the drawing up of contacts 31 thereby opening the locking circuit to the relay 14 and at the same time completing a locking circuit to relays 28 and 29 for retaining the relays in an energized state after the cam-operated switch 21 reopens. A path of energizing current for the relay 28 may be traced from the source through the relay 29, the relay 28, a low-resistance indicating lamp 32, contacts 31 and the reset switch 15.

Upon satisfactorily completing a cycle of operation of the utilization station B and with the contacts 16 returned to a former position as a result of the deenergization of relay 14, the utilization station B renders the cam-operated switch 22 effective resulting in the energization of the relay 17 and the drawing up of contacts 33. Energizing current to the relay 17 passes from the conductor 12 through the switch 22, the relay 17 and the contacts 16 to the source 10. Closure of contacts 33 provides a path for current from the source 10 through a relay 34, a resistor 36, contact 37 of a relay or electromagnet 38, and the contacts 27 and 33.

The energization of relay 34 draws up contacts 39 and provides a direct path for current from the source through the reset switch 15 and the contact 39 to the relay 38. Energization of relay 38 results in the drawing up of contacts 37 and locks up the entire relay network excluding relays 14, 17 and 24. In addition, the energization of relay 38 results in the closure of a switch 41 which may be utilized to control the operation of any external device C.

Mode of operation

The sequence counting and locking circuit is conditioned to function in a predetermined sequence subsequent to the closure of the starting switch 11. The momentary energization of a relay 17 and the energization and locking up of relays 34 and 38 controlled by the operation of the cam-operated switch 22 after that of relay 24 and relays 28 and 29 under the control of the switch 21 is guaranteed by the opening of the coil circuit of the relay 17 as a result of the energization of the relay 14 and the drawing up of contacts 16. Irrespective of when the starting switch 11 is closed, the locking circuit will not function until the utilization station A has completed a satisfactory cycle of operation prior to that of the utilization station B.

A satisfactory cycle of operation having been completed at utilization station A, the switch 21 is closed and the energization of relay 24 occurs momentarily. The interval of time during which the relay 24 is energized is sufficient for the energization and locking up of relays 28 and 29 to take place. This phase of the cycle having been completed and the relay 14 having been deenergized, the circuit is prepared for the operation of the switch 22

under the control of station B. Should there have been some malfunction in the operation performed at station A, the indicating lamp 32 will not be lit and therefore, an operator will be apprised of this unsatisfactory condition. When the lamp 32 is lit, however, the operator is notified that the second half of the cycle under the control of station B is in progress.

Closure of switch 22 results in the momentary energization of the relay 17. Again, a sufficient length of time is provided so that the energization and locking up of the relays 34 and 38 might be accomplished. The last relay in the locking circuit to be energized is relay 38 and the energization of this relay operates the switch 41. The closure of switch 41 may be utilized in any number of ways to control external circuitry. The locking circuit having completed a cycle of operation and being locked in the above-described manner will require an operator to depress the reset button 15 in order to deenergize the locked-up relays and condition the circuit for a subsequent cycle of operation.

It is to be understood that the above-described arrangements are simply illustrative of the application of this invention. Numerous other arrangements, such as increasing the number of series of relays operated by a greater number of utilization stations, may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A circuit for controlling external instrumentalities in accordance with the sequential operation of utilization devices, which circuit comprises electromagnetic means having a normally open contact, said normally open contact being connected to said external instrumentalities to control the operation thereof, a power supply, a first normally open relay circuit shunting said power supply, switch means controlled by one of said utilization devices for closing said first normally open relay circuit to accomplish the energization thereof, a locking circuit shunting said power supply and having a normally open contact of said first normally open relay circuit connected in series therewith, said locking circuit being energized upon actuation of said switch means and the energization of said first normally open relay circuit, a circuit connected to said electromagnetic means and conditioned for operation by the energization of said locking circuit, a second normally open relay circuit shunting said power supply, and switch means controlled by another of said utilization devices to concomitantly energize said conditioned circuit and said electromagnetic means to close said normally open contact and render said external instrumentalities effective.

2. A sequence counting and locking circuit, which comprises a power supply, a starting switch connected to said power supply, a starting relay shunting said power supply and energized upon closure of said starting switch, a first series of relays, a first switch means connected in series with said first series of relays for selectively shunting said first series of relays across said power supply, one relay of said first series having a contact drawn up upon the energization thereof for locking said first series of relays in an energized state and for deenergizing said starting relay, a second series of relays, another relay of said first series of relays having a contact drawn up by the

energization thereof for conditioning said second series of relays for operation, a second switch means connected in series with said second series of relays for selectively shunting said second series of relays across said power supply subsequent to the energization of said first series of relays, one relay of said second series having a contact drawn up upon the energization thereof for maintaining said second series of relays in an energized state, and reset means connected to said power supply means for deenergizing said first and second series of relays to condition the circuit for a subsequent cycle of operation.

3. A sequence counting and locking circuit for controlling external instrumentalities comprising a starting relay, first and second control relays, a source of potential, means for selectively shunting said source of potential with said starting relay, sequentially operated switch means for selectively shunting said source of potential with said first and second control relays, a first locking circuit, means rendered effective upon energization of said starting relay for conditioning said first locking circuit for operation, means for rendering said first locking circuit operable upon energization of said first control relay subsequent to the actuation of said switch means associated therewith, said second control relay being precluded from energization concomitantly with the conditioning of said first locking circuit upon energization of said starting relay, means for interrupting the energizing circuit for said starting relay upon energization and locking up of said first locking circuit, a second locking circuit, means rendered effective by the energization of said second locking circuit for rendering external instrumentalities effective, and means for rendering said second locking circuit effective upon actuation of said second control relay subsequent to the energization and locking up of said first locking circuit.

4. A relay circuit for controlling external instrumentalities in accordance with the sequential operation of utilization devices, which relay circuit comprises a source of potential, a starting relay shunting said source of potential, a starting switch interconnecting said starting relay and said source of potential for selectively applying energizing potential to said starting relay, first and second control relays, means rendered effective by the sequential operation of said utilization devices for selectively shunting said source of potential with said first and second control relays, a first locking circuit conditioned for operation upon energization of said starting relay, means rendered effective by the energization of said first control relay for rendering said first locking circuit effective, a second locking circuit, means controlled by said starting relay for conditioning said second locking circuit for operation, means rendered operable upon actuation of said first locking circuit for deenergizing said starting relay thereby actuating said controlled conditioning means for said second locking circuit, and means actuated upon the energization and locking up of said second locking circuit for rendering said external instrumentalities effective.

References Cited in the file of this patent

UNITED STATES PATENTS

2,436,809	Joel	Mar. 2, 1948
2,844,317	Shillington	July 22, 1958