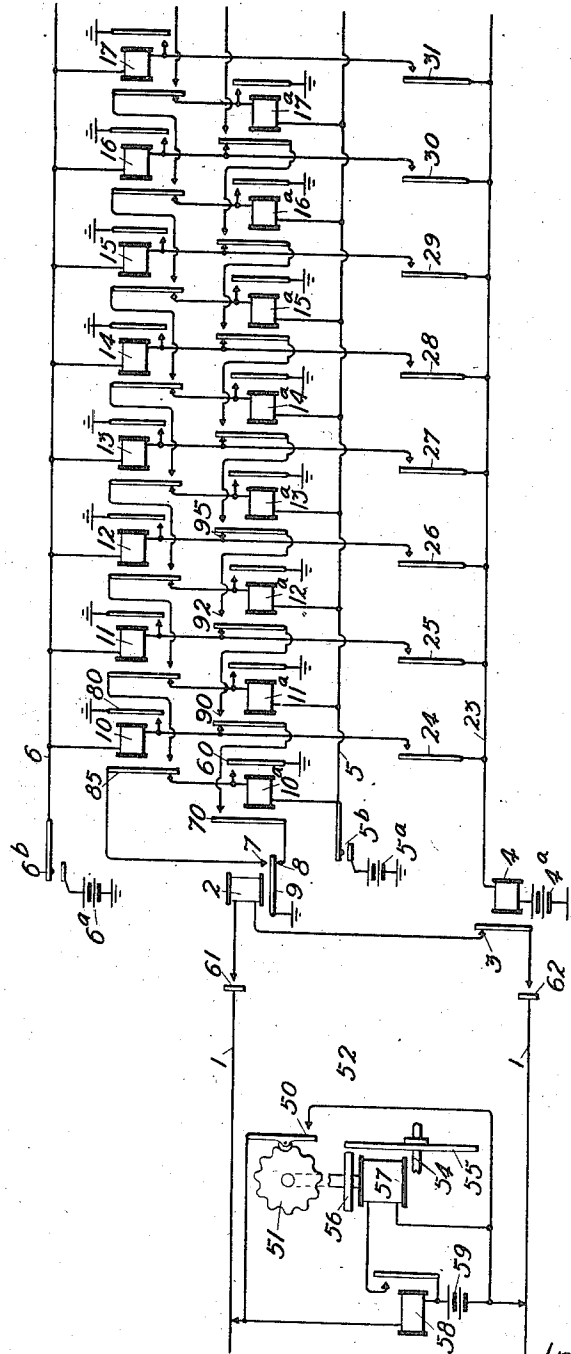


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ELECTRICAL CONTROLLING MECHANISM.
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UNITED STATES PATENT OFFICE.

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ELECTRICAL CONTROLLING MECHANISM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRANK N. REEVES, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Electrical Controlling Mechanism, of which the following is a full, clear, and exact description.

This invention relates to controlling mechanism for electrical switching apparatus; its objects are to increase the effective operation of a series of electrical devices, referred to herein as counting relays, in their control of a responsive device associated with the switching apparatus and simplify the mechanism.

Heretofore controlling mechanism of the type known as counting relays has been used for governing the operation of selectors in telephone exchange systems. Such counting relays may comprise a series of successively operable relays and a series of keys or switches for selecting for effective operation a variable group of the relays. Associated with these relays there has been employed a responsive device which was not actuated until after the last relay of the variable group of relays had been energized.

According to the present invention a series of electrical devices is so arranged in relation to a series of independently operable switches and a responsive device that a circuit for the latter is prepared simultaneously with that of the last one of a predetermined group of electrical devices selected by one of the series of switches.

In the embodiment of my invention shown herein, the responsive device is in the form of a relay and operates simultaneously with the last one of any selected group of electrical devices or so-called counting relays.

The invention is useful more particularly in the control of high speed selective switching apparatus for telephone exchange systems wherein the selector is continuously driven by the application of power and a controlling device intermittently operated by impulses transmitted to the controlling device in the movement of the selector, the controlling device in turn operating the responsive device to stop the movement of the selector and to interrupt the sending of impulses.

More in detail a type of mechanism in which my invention may be employed com-

prises a series of electromagnets, which are preferably relays and which are caused to operate successively in response to current impulses from an impulse transmitter or interrupter, and a series of keys or other suitable form of contact switches, one key or switch being associated and arranged with each relay in such a manner that upon the operation of any key a responsive device is actuated simultaneously with the corresponding relay. The impulse transmitter or interrupter is preferably in the form of a "stepping" relay, the switch contacts of which alternately make and break a contact in the circuit of the relays. The responsive device is employed as the means of stopping the operation of the impulse transmitter and the selector. It may be in the form of an ordinary cut-off relay and its winding may be included in a local circuit having a plurality of normally open branch circuits, each of which is adapted to be closed by a corresponding switch or key. A second series of relays is preferably employed in conjunction with the series first mentioned and the two series of relays are associated with two local circuits respectively. These local circuits are arranged to be closed alternately by the stepping relay, the winding of which is included in a main controlling circuit which circuit is provided with some suitable form of contact making device or interrupter, operating in unison with or in the movement of the selector. The relays in the two series which are operated in alternate succession are self-locking. The cut-off relay stops the operation of the interrupter and the movement of the selector preferably by opening the main controlling circuit.

Referring now to the drawing, 1 is a main controlling circuit including the winding of a "stepping" relay or interrupter 2 and a contact 3 normally closed but adapted to be opened by a cut-off relay 4. Relay 2 is adapted to alternately close and interrupt two local circuits 5, 6 through its front and back contacts 7, 8, respectively.

Current is supplied to the local circuits 5 and 6 from batteries 5^a and 6^a through switches 5^b and 6^b, which are closed during the operation of the counting relays. There are two series of these counting relays, the first 10 to 17 inclusive being those fed by the local circuit 6 and the second 10^a to 17^a inclusive by the local circuit 5. The winding

of the cut-off relay 4 is included in a circuit 23 having a series of switches or keys 24 to 31 inclusive each adapted to close a branch of the circuit 23 and thus energize the cut-off relay 4 simultaneously with a counting relay of the second series corresponding to the key depressed. In the drawing there is shown a contact device 50 cooperating with a starwheel 51 which is rotated in the advance movement of a controlled automatic selector 52. This selector may be employed to perform any desired function in the telephone exchange system, such as the selection of a connection between telephone lines. The advance movement may be secured by an electromagnetic clutch comprising a constantly rotating power shaft 54, cooperating disks 55 and 56 and an electromagnet 57. The circuit of the electromagnet may be controlled in a local circuit by a relay 58 whose winding is in the main controlling circuit. A battery 59 may supply current to both circuits. Upon the closing of the circuit of the clutch magnet 57 the rotating disk 55 engages the normally stationary disk 56 which drives the starwheel 51. Contact 50 is thus caused periodically to close and open a shunt path about the stepping relay 2 in the main controlling circuit. This circuit is adapted to be closed initially by contacts 61, 62 when it is desired to start the selecting operation.

The operation of the controlling apparatus is as follows: Consider, for example, that it is desired to send three impulses in order to permit the selector to advance three steps. Switch 26 is closed and contacts 61 and 62 are also closed to complete the controlling or fundamental circuit. Relays 58 and 2 are energized and the selector 52 begins its advance movement. The rotation of the starwheel 51 causes the current to be shunted from relay 2, once for each step. Relay 58, however, is not affected but remains energized. Upon the first closing of controlling circuit 1 relay 2 operates to close local circuit 5 at contact 7, which circuit normally includes only the winding of relay 10^a. This relay is energized and becomes locked in a circuit supplied with current from the same battery but grounded through its own switch spring or armature 60 instead of switch spring 9 of relay 2. Relay 10^a also prepares a circuit from local circuit 6 through switch spring 70 for relay 10 and the latter becomes energized over this circuit upon the closing of contact 8 when relay 2 is deenergized by the closure of the shunt circuit at contact 50. Relay 10 in turn is locked up through a circuit supplied with current from the same battery 6^a but grounded through its own switch spring 80 instead of switch spring 9 of relay 2. Relay 10 in turn likewise prepares a circuit from local circuit 5 through switch

spring 85 for relay 11^a. In a similar manner the relay 11^a is operated upon the second closure of local circuit 5 at contact 7 of relay 2 and relay 11 upon the second closure of local circuit 6 at contact 8. Relays 12^a and 12 are in the same way operated in succession upon the third closing of local circuits 5 and 6, respectively. Finally simultaneously with the energization of relay 12, switch 26 being closed, relay 4 is energized since its local circuit 23 leads to ground through the same contact 95 as the circuit of relay 12. The circuit of relay 4 being battery 4^a, 4, 23, 26, 95, 92, 90, 70, 8, 9, ground and that of relay 12 being battery 6^a, 6^b, 6, 12, 95, 92, 90, 70, 8, 9, ground. No delay is occasioned by waiting for relay 12 to close, since not it, but the next to the last counting relay completes the circuit for the responsive device at the same instant that it completes a circuit for the last counting relay. Consequently the opening of the fundamental or main circuit at contact 3 of relay 4 is accomplished the moment the last counting relay is reached. Current is cut off immediately from stepping relay 2 and the sending of impulses ceases at once. The clutch magnet 57 also is deenergized more rapidly than it is when relay 4 is not energized until after the last counting relay has been energized. Not only is the sending of false impulses prevented but the stopping of the selector is accomplished with greater accuracy and speed than heretofore. It comes to rest after having taken three full steps. Relays 10^a, 10, 11^a, 11, 12^a, and 12 remain locked up until they are disconnected from batteries 5^a and 6^a by the opening of switches 5^b and 6^b respectively. The whole operation may be repeated with any one of the keys depressed.

The series of relays and keys may be extended to any desired extent by continuing the circuit arrangement as shown to other relays and keys.

What I claim is:

1. The combination with a series of successively operable electrical devices, of means for selecting a variable group of said devices, a responsive device, and means for preparing a circuit for said responsive device simultaneously with the preparation of a circuit for the last one of said electrical devices in any predetermined group.

2. The combination with a series of electrical devices, and means for causing the successive operation of a variable group of said devices, of controlling means for said last named means responsive over a circuit prepared simultaneously with the circuit for the last one of said electrical devices in any predetermined group.

3. The combination with a series of electrical devices and means for causing their successive operation, of means for selecting

- a predetermined group of said devices and means operating simultaneously with the last device of any selected group adapted to change the condition of said means for causing their operation.
4. The combination with a series of electrical devices and means for operating them in succession, of a series of selective switches arranged to select for effective operation a variable group of said electrical devices, a responsive device, and circuits connecting said device to cause its operation simultaneously with the last operated electrical device in any selected group.
5. The combination with an interrupter of a series of electromagnetic devices, a series of independently operated switches, a responsive device, and a circuit adapted to cause the simultaneous operation of the responsive device and a selected one of the electromagnetic devices.
6. The combination with an interrupter, and a responsive device for controlling said interrupter, of a series of counting relays operated in succession by said interrupter, a series of independently operated switches for selecting varying groups of said counting relays, and a circuit including a selected switch and said responsive device adapted to be closed simultaneously with the circuit of the last counting relay of a selected group.
7. The combination with an interrupter, of two series of electromagnets, each independently supplied with current, means under the control of the interrupter for successively causing current to flow through said electromagnets, a switch for each one of the electromagnets of one of the series adapted to be independently closed, and a responsive device adapted to effect a change in the interrupter simultaneously with the energization of an electromagnet whose corresponding switch has been closed.
8. The combination with a selector, its controlling circuit and an interrupter operating periodically in unison with the selector, of a series of counting relays, means under the control of the interrupter for successively operating said relays, a series of switches one for each relay, a responsive device adapted to act upon the controlling circuit of the selector to determine the operation of said selector, and circuits selected by said switches for connecting said responsive device to operate simultaneously with a predetermined one of said relays.
9. The combination with an interrupter, of a series of electromagnetic devices, means for selecting a variable group of said devices, a responsive device, and means for energizing said device under the control of the next to the last electromagnetic device in any selected group.
10. The combination with a series of successively operable electrical devices, of means for selecting a variable group of said devices, a responsive device, and means for preparing a circuit whereby said responsive device may be operated independently of the last electrical device of a group.
11. The combination with a plurality of relays arranged in pairs, of means for causing the successive operation of said pairs of relays, means for selecting a variable group of said pairs of relays, a responsive device, and a circuit therefor controlled by the first relay of the last pair of a preselected group.
- In witness whereof, I hereunto subscribe my name this 19th day of August, A. D. 1912.
- FRANK N. REEVES.
- Witnesses:
WALTER FREDERICK HOFFMAN,
ELLA EDLER.