

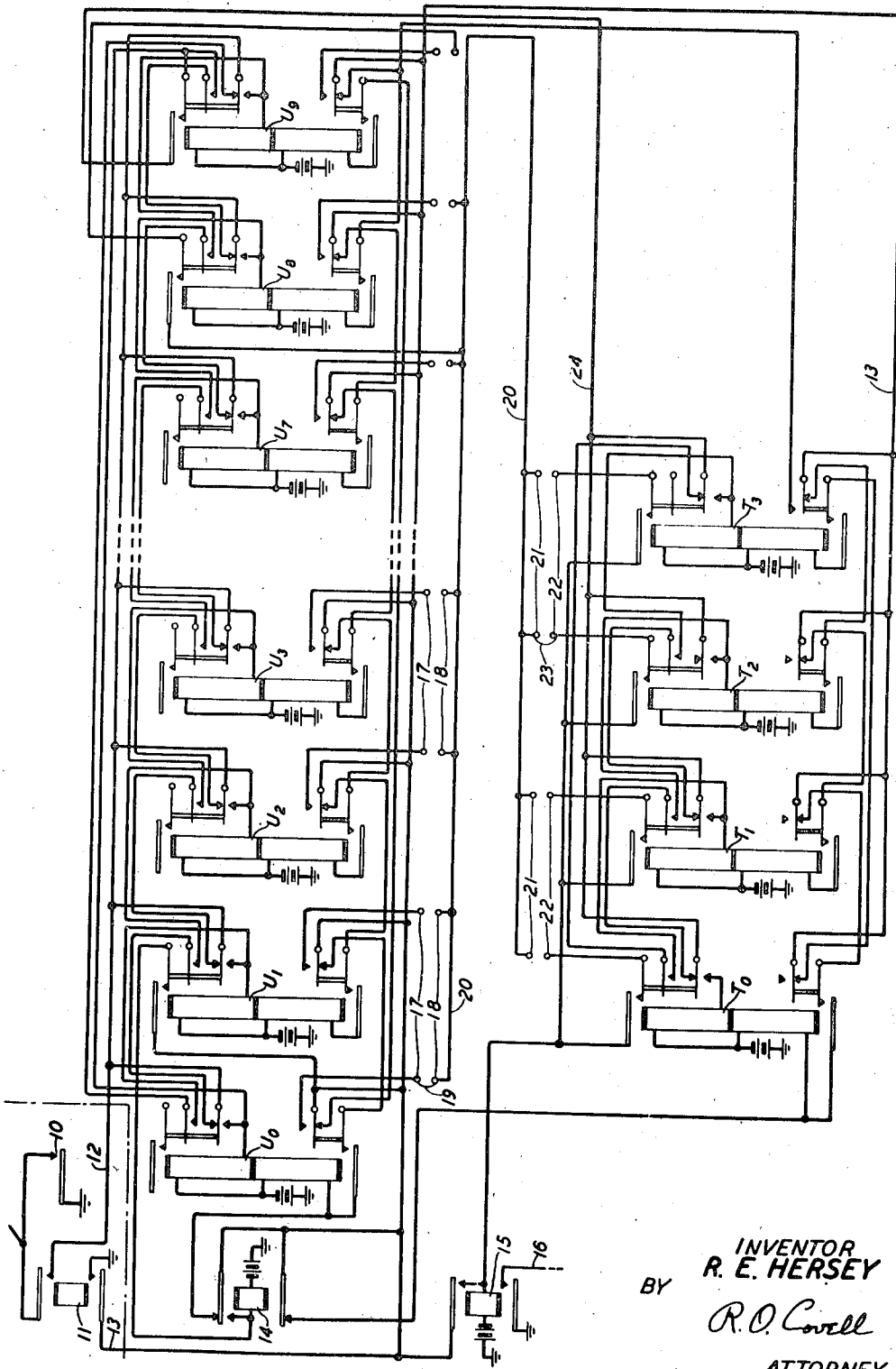
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RELAY SYSTEM

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RELAY SYSTEM

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This invention relates to relay systems and particularly to systems comprising a chain of relays arranged for successive operation as counting or selective switching means.

Objects of the invention are to minimize the number of relays required to effect desired counting and switching operations responsive to a varying number of control operations and to otherwise simplify and improve counting relay operations.

This invention is a counting relay arrangement comprising two chains of counting relays for counting a varying number of control operations, the relays of the first chain being operated in succession, one by each control operation and the relays of the second chain being operated in succession, one by each control operation which effects the operation of the last relay in said first chain, the first relay of the first chain being reoperated responsive to the next control operation following operation of the last relay of the first chain and the release of each relay being effected following operation of the next succeeding relay whereby the particular relays operated in said first and second chains indicate the number of control operations which have been counted.

According to one feature of the invention the operating circuit for each of a closed chain of counting relays includes control contacts common to the counting relays, a front contact of the first preceding counting relay and a back contact of the second preceding counting relay of the closed chain, and each of the counting relays is locked operated after the succeeding relay is operated by the closure of the control contacts until the operating circuit of the next succeeding relay is opened by the control contacts.

According to another feature the counting relays are arranged in two decimal chains, the first of said chains being arranged to operate as a closed chain wherein each relay is again connected for reoperation after all of the other relays in said chain have been operated and one of the relays of the second chain is operated each time the last relay of said first chain is operated.

According to a further feature the counting relays are arranged in a plurality of chains, the first chain being arranged to operate as a closed

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chain beginning with a first one of the relays and a second chain being arranged to count the number of cycles of operation of the first chain.

The invention and these and other features of the invention will be further explained and described by considering the counting relay arrangement shown schematically in the drawing of this specification.

The drawing which consists of a single figure 10 discloses units and tens chains of counting relays arranged for operation in an automatic telephone system. The telephone system may be similar to that disclosed in the patent to Carpenter 2,235,803, March 18, 1941, in which it may be found desirable to count the number of times a call is routed to an operator due to a permanent signal condition. The contact 10 represents a contact of a permanent signal route relay in a decoder-marker of an office of such a system; and, when it is desired that the permanent signal calls in such an office be counted, a switching relay 11 or other switching device is operated to connect ground to start conductor 13 of the counting relay arrangement and to connect the control conductor 12 of the counting relay arrangement to a contact 10 of each of the permanent signal route relays in the office.

The counting relay arrangement comprises ten units counting relays designated U0 to U9, inclusive, four tens counting relays designated T0 to T3 and a start relay 14. Another relay designated 15 is provided for closing a signaling or switching circuit when a desired number of counting operations have been made. When the switching device 11 is operated, ground is connected to conductor 13 to effect the operation of relays U0 and T0 thereby to prepare relays U1 and T1 for operation. The circuit for operating relay U0 includes the lower winding of relay U0, upper back contact of relay 14, conductor 13 and the lower front contact of relay 11. The circuit for operating relay T0 includes the lower winding of relay T0, the lower back contact of relay 14, conductor 13, and the lower front contact of relay 11. Relay U0 locks through its lower winding and outer lower front contact and the lower back contact of relay U1 to grounded conductor 13. Relay T0 locks through its lower winding and outer lower front contact and the lower back contact of relay T1 to grounded conductor 13.

After the counting relays have been prepared for counting by the operation of relays U1, U0 and T0, the operation of any permanent signal route relay in the office connects ground to control conductor 12; and as soon as the route relay releases, ground is again disconnected from conductor 12. The first connection of ground to conductor 12 effects the operation of relay U1 and holds relay U0 operated independent of relay U1. The circuit for operating relay U1 includes the upper winding of relay U1, the middle upper front contact of relay U0, the upper back contact of relay U9, and conductor 12. The circuit for holding relay U0 includes the upper winding and inner upper front contact of relay U0 and conductor 12. The operation of relay U1 opens the locking circuit through the lower winding of relay U0 and closes a circuit for operating relay U2. Relay U2 locks directly to conductor 13 and opens the circuits closed by the operation of relay U1 for energizing the lower windings of relays U0 and T0 whereby relays U0 and T0 were operated as above described to prepare the units and tens chains for counting. When ground is disconnected from conductor 12 after operation of relay U1, relay U0 releases but relay U1 is held operated by a locking circuit through its lower winding and outer lower front contact, the lower back contact of relay U2 and conductor 13.

The next connection of ground to conductor 12 operatively energizes the upper winding of relay U2 and energizes the upper winding of relay U1 to hold relay U1 operated after relay U2 operates until ground is again disconnected from conductor 12. The operation of relay U2 opens the locking circuit through the lower winding of relay U1 and closes a locking circuit through its own lower winding and front contact and a back contact of relay U3. When ground is disconnected from conductor 12 after the operation of relay U2, relay U1 releases. Thus each time ground is connected to conductor 12, one of the units counting relays is operated, and, when ground is again disconnected, the preceding units counting relay is released to prepare a circuit for operating the next relay in the units chain.

When ground is again connected to conductor 12 after operation of relay U9 and release of relay U8, relay U0 is operated by the energization of its upper winding and at the same time relay T1 is operated by the energization of its upper winding. The circuit for operating relay U0 includes the middle upper front contact of relay U9, the upper back contact of relay U8 and conductor 12; and the circuit for operating relay T1 includes the middle upper front contact of relay T0, the upper back contact of relay T3, conductor 24, outer and middle upper front contacts of relay U9, upper back contact of relay U8 and conductor 12. Relays U9 and T0 are held operated after relays U0 and T1 operate until ground is again disconnected from conductor 12; and relays U0 and T1 are then held operated by the energization of their lower windings in circuits including their locking contacts and back contacts of relays U1 and T2, respectively. The counting operation of the units relays continues and when ground is connected to conductor 12 to effect the second counting operation of relay U0 it also effects the operation of relay T2. Thus the tens relays are successively operated to count the number of cycles of operations of the units relays whereby the particular units and tens relays which are operated at any time indicate the number of times ground has been connected to

and disconnected from conductor 12. For instance, if units relay 8 is operated and tens relay T0 is operated, the number of operations registered by the counting relays is 8; or if units relay U0 is operated and tens relay T2 is operated, the number of operations registered by the counting relays is 20.

When a desired number of operations have been registered, relay 15 is operated to effect a desired switching or signaling operation. In the system of the drawing this operation may be the transmission of a permanent signal alarm when a certain number of permanent signal calls have occurred. To this end, the winding of relay 15 is connected to the upper armature spring of each of the tens relays; the upper outer front contact of each of these relays is connected to a terminal 22 arranged for strapping to a terminal 21; the inner lower front contact of each of the units relays is connected to a terminal 17 arranged for strapping to a terminal 18; and terminals 18 and 21 are all interconnected by conductor 20. As shown in the drawing, relay 15 is operated when 20 permanent signal calls have been registered as indicated by the operation of relays U0 and T2, terminal 22 associated with relay T2 being connected by conductor 23 to the associated terminal 21 and terminal 17 associated with relay U0 being connected by conductor 19 to the associated terminal 18. When operated, relay 15 locks to conductor 13.

Since the tens chain comprises only four relays the counting arrangement shown in the drawing can register a total of 39 operations. It is of course apparent that the tens chain may also include ten relays; or, if the decimal system is not necessary, that each of the two chains may consist of any desired number of relays. Furthermore, additional chains may be added, for instance hundreds and thousands chains. Although each of the tens and units relays is shown as having contacts actuated in a predetermined sequence, this is not necessary and the contact springs may be arranged for simultaneous or any order of actuation.

It is further to be noted that the operation of the counting relays may be responsive to a train of selective impulses, in which case each of the relays may be provided with additional contacts for effecting desired selective operations.

What is claimed is:

1. In combination, a chain of counting relays, control contacts common to said relays, operating circuits, one for each of said relays, each of said operating circuits being closed in succession by successive closures of said control contacts, each of said operating circuits comprising said control contacts, a front contact of the next preceding one of said relays and a back contact of the second preceding one of said relays, each operating circuit being initially opened by the next opening of said control contacts following closure of the operating circuit means independent of said control contacts for holding each of said relays operated after the opening of its operating circuit by said control contacts until the next succeeding relay is operated, and means including said control contacts for holding each of said relays operated after the operation of the next succeeding relay until the operating circuit of the next succeeding relay is opened.

2. In combination, a chain of counting relays, control contacts common to said relays, operating circuits, one for each of said relays, each of said

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operating circuits being closed in succession by successive closures of said control contacts, means independent of said control contacts for operating one of said relays thereby to prepare the succeeding one of said relays for operation responsive to the next succeeding closure of said control contacts, each of said operating circuits comprising said control contacts, a front contact of the next preceding one of said relays and a back contact of the second preceding one of said relays, each operating circuit being initially opened by the next opening of said control contacts following closure of the operating circuit means independent of said control contacts for holding each of said relays operated after the opening of its operating circuit by said control contacts until the next succeeding relay is operated, and means including said control contacts for holding each of said relays operated after the operation of the next succeeding relay until the operating circuit of the next succeeding relay is opened.

3. In combination, a chain of counting relays, control contacts common to said relays, operating circuits, one for each of said relays, each of said operating circuits being closed in succession by successive closures of said control contacts, each operating circuit being initially opened by the next opening of said control contacts following closure of the operating circuit means independent of said control contacts for holding each of said relays operated after the opening of its operating circuit by said control contacts until the next succeeding relay is operated, and means including said control contacts for holding each of said relays operated after the operation of the next succeeding relay until the operating circuit of the next succeeding relay is opened.

4. In combination, a chain of counting relays, control contacts common to said relays, operating circuits, one for each of said relays, each of said operating circuits being closed in succession by successive closures of said control contacts, each of said operating circuits comprising said control contacts, a front contact of the next preceding one of said relays and a back contact of the second preceding one of said relays, each operating circuit being initially opened by the next opening of said control contacts following closure of the operating circuit means for holding each of said relays operated after the opening of its operating circuit by said control contacts until the next succeeding relay is operated, and means including said control contacts for holding each of said relays operated after the operation of the next succeeding relay until the operating circuit of the next succeeding relay is opened.

5. In combination, first and second chains of counting relays, a single set of control contacts for controlling the relays in both chains, operating circuits, one for each of said relays, each of said operating circuits for relays in the first chain being closed in succession by successive closures of said control contacts, each of said operating circuits for relays in both chains comprising said control contacts, a front contact of the next preceding one of said relays, and a back contact of the second preceding one of said relays, each of the operating circuits of said second chain further comprising a front contact of a particular one of the relays of the first chain and a back contact of the next preceding one of the relays of the first chain, means independent of said control contacts for holding each of said

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relays operated after the opening of its operating circuit by said control contacts until the next succeeding relay is operated, and means including said control contacts for holding each of said relays operated after the operation of the next succeeding relay until the operating circuit of the next succeeding relay is opened.

6. In combination, first and second chains of counting relays, a single set of control contacts for controlling the relay in both chains, operating circuits, one for each of said relays, each of said operating circuits for relays in the first chain being closed in succession by successive closures of said control contacts, means independent of said control contacts for operating one of said relays in each chain thereby to prepare the succeeding one of the relays in the first chain for operation by the next succeeding closure of said control contacts and to prepare the succeeding one of the relays in the second chain for operation by a succeeding closure of said control contacts, each of said operating circuits for relays in both chains comprising said control contacts, a front contact of the next preceding one of said relays and a back contact of the second preceding one of said relays, each of the operating circuits of said second chain further comprising a front contact of a particular one of the relays of the first chain and a back contact of the next preceding one of the relays of the first chain, means independent of said control contacts for holding each of said relays operated after the opening of its operating circuit by said control contacts until the next succeeding relay is operated, and means including said control contacts for holding each of said relays operated after the operation of the next succeeding relay until the operating circuit of the next succeeding relay is opened.

7. In combination, first and second chains of counting relays, a single set of control contacts for controlling the relays in both chains, operating circuits, one for each of said relays, each of said operating circuits for relays in the first chain being closed in succession by successive closures of said control contacts, each of said operating circuits for relays in both chains comprising said control contacts, a front contact of the next preceding one of said relays and a back contact of the second preceding one of said relays, each of the operating circuits of said second chain further comprising a front contact of a particular one of the relays of the first chain and a back contact of the next preceding one of the relays of the first chain, means for holding each of said relays operated after the opening of its operating circuit by said control contacts until the next succeeding relay is operated, and means including said control contacts for holding each of said relays operated after the operation of the next succeeding relay until the operating circuit of the next succeeding relay is opened.

8. In combination, a chain of counting relays, each relay having two windings, intermittently closed control contacts common to said relays, operating circuits, one for each of said relays, said operating circuits being closed one at a time by successive closures of said control contacts, each of said operating circuits including in series said control contacts, a back contact of the second preceding one of the relays in said chain, a front contact of the next preceding one of the relays in said chain and one winding of the relay which is being operated, each of said operating

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circuits remaining closed until opened by said control contacts, an individual holding circuit for each of said counting relays which includes the other winding of the relay for holding the relay operated after its operating circuit is opened by said control contacts until the next succeeding relay in the chain is operated, and another individual holding circuit for each of said counting relays which includes said control contacts and a front contact and said one winding of the relay for holding the relay operated after the operation of the next succeeding relay in the chain until the operating circuit of the next succeeding relay in the chain is opened by said control contacts.

9. In combination, a chain of counting relays, each relay having two windings, intermittently closed control contacts common to said relays, operating circuits, one for each of said relays, said operating circuits being closed one at a time by successive closures of said control contacts, each of said operating circuits including in series said control contacts, a back contact of the second preceding one of the relays in said chain, a front contact of the next preceding one of the relays in said chain and one winding of the relay which is being operated, each of said operating circuits remaining closed until opened by said control contacts, an individual holding circuit for each of said counting relays which includes the other winding of the relay for holding the relay operated after its operating circuit is opened by said control contacts until the next succeeding relay in the chain is operated, another individual holding circuit for each of said counting relays which includes said control contacts and a front contact and said one winding of the relay for holding the relay operated after the operation of the next succeeding relay in the chain until the operating circuit of the next succeeding relay in the chain is opened by said control contacts, and other means common to said chain of relays operative to close an initial operating circuit through said other winding of a particular one of said relays and to connect said control contacts in operative association with said one winding of the next succeeding relay in the chain.

10. In combination, a chain of counting relays, each relay having two windings, intermittently closed control contacts common to said relays, operating circuits, one for each of said relays, said operating circuits being closed one at a time by successive closures of said control contacts, each of said operating circuits including in series said control contacts, a back contact of the second preceding one of the relays in said chain, a front contact of the next preceding one of the relays in said chain and one winding of the relay which is being operated, each of said operating circuits remaining closed until opened by said control contacts, an individual holding circuit for each of said counting relays which includes the other winding of the relay for holding the relay operated after its operating circuit is opened by said control contacts until the next succeeding relay in the chain is operated, another individual holding circuit for each of said counting relays which includes said control contacts and a front contact and said one winding of the relay for holding the relay operated after the operation of the next succeeding relay in the chain until the operating circuit of the next succeeding relay in the chain is opened by said control contacts, other means

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common to said chain of relays operative to close an initial operating circuit through said other winding of a particular one of said relays and to connect said control contacts in operative association with said one winding of the next succeeding relay in the chain, and means rendered effective by operation of the relay next succeeding said one relay for opening said initial operating circuit for said one relay.

11. In combination, first and second chains of counting relays, each relay having two windings, a single set of intermittently closed control contacts for controlling the relays in both chains, operating circuits, one for each of said counting relays, the operating circuits for relays in the first chain being closed one at a time by successive closures of said control contacts, the operating circuit for each of the counting relays in both chains including in series said control contacts, a back contact of the second preceding one of the relays in the same chain, a front contact of the next preceding relay in the same chain and one winding of the relay which is being operated, each of the operating circuits for relays of the second chain further comprising a front contact of a particular one of the relays of the first chain and a back contact of the next preceding one of the relays of the first chain, each of the operating circuits for relays in both chains remaining closed until opened by said control contacts, an individual holding circuit for each of the counting relays in both chains which includes the other winding of the relay for holding the relay operated after its operating circuit is opened by said control contacts until the next succeeding relay in the same chain is operated, and another individual holding circuit for each of the relays in both of said chains which includes a front contact and said one winding of each of said relays for holding the relay operated after the operation of the next succeeding relay in the same chain until the operating circuit of the next succeeding relay in the same chain is opened by said control contacts.

12. In combination, first and second chains of counting relays, each relay having two windings, a single set of intermittently closed control contacts for controlling the relays in both chains, operating circuits, one for each of said counting relays, the operating circuits for relays in the first chain being closed one at a time by successive closures of said control contacts, the operating circuit for each of the counting relays in both chains including in series said control contacts, a back contact of the second preceding one of the relays in the same chain, a front contact of the next preceding relay in the same chain and one winding of the relay which is being operated, each of the operating circuits for relays of the second chain further comprising a front contact of a particular one of the relays of the first chain and a back contact of the next preceding one of the relays of the first chain, each of the operating circuits for relays in both chains remaining closed until opened by said control contacts, an individual holding circuit for each of the counting relays in both chains which includes the other winding of the relay for holding the relay operated after its operating circuit is opened by said control contacts until the next succeeding relay in the same chain is operated, another individual holding circuit for each of the relays in both of said chains which includes a front contact and said one winding of each of said relays for holding the relay operated after the operation

of the next succeeding relay in the same chain until the operating circuit of the next succeeding relay in the same chain is opened by said control contacts, and other means common to said chains of relays operative to close an initial operating circuit for one particular counting relay in each of said chains, the initial operating circuit for each said one relay including said other winding of the relay, the operation of said one relay of each chain being effective to condition the next succeeding relay in the same chain for operation.

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