

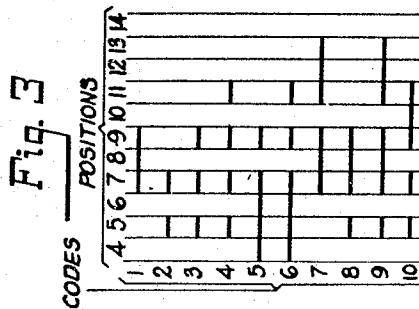
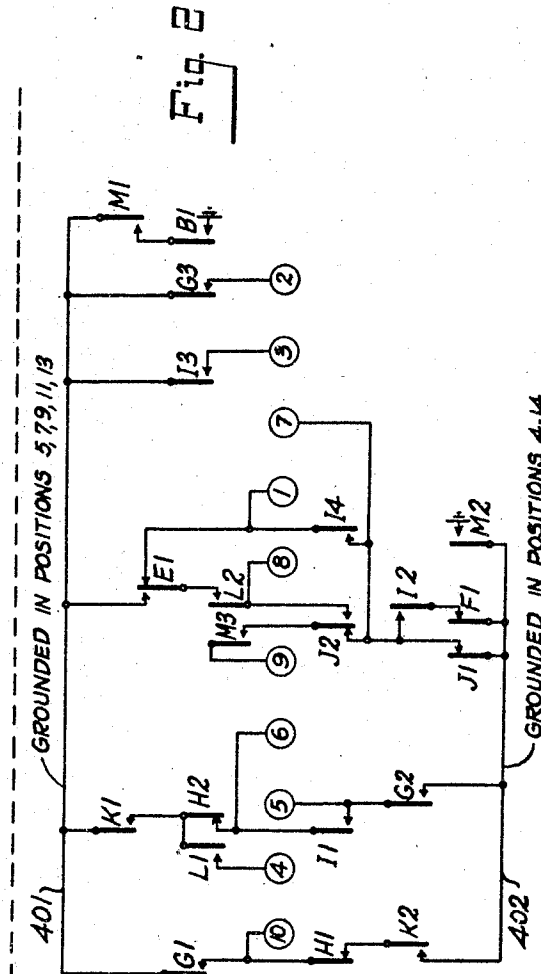
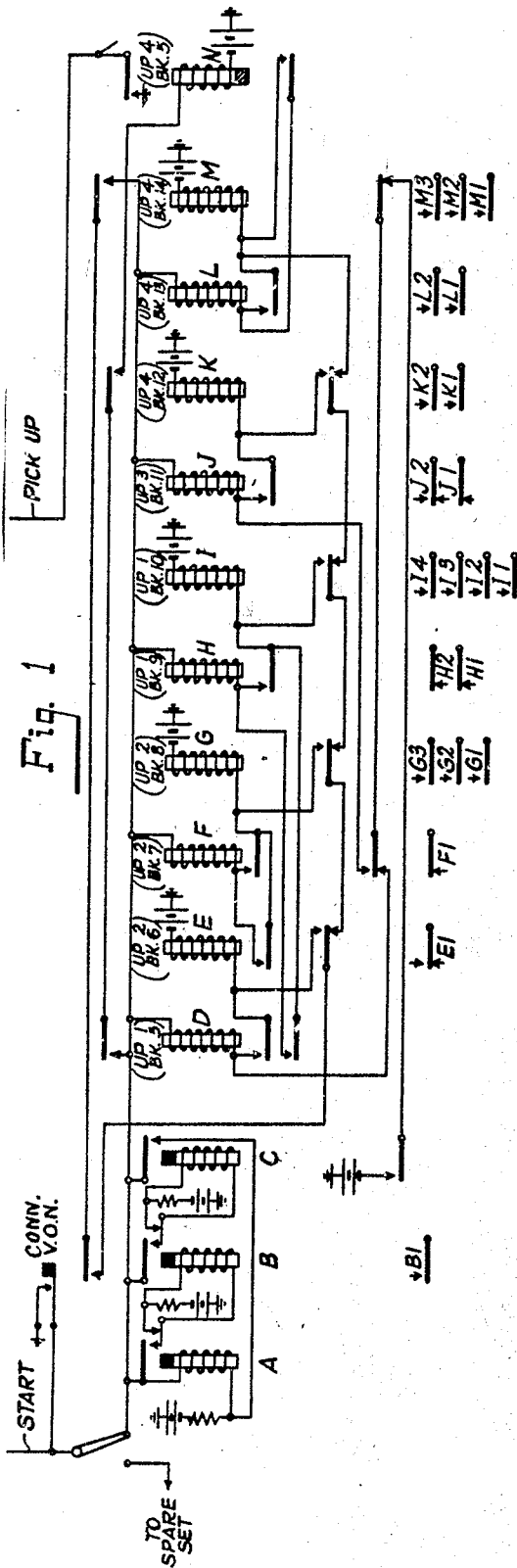
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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Original application March 30, 1927, Serial No.
179,443, now Patent No. 1,686,879, dated October
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The present invention relates to automatic telephone systems, being concerned more particularly with relay-type code generators used therein to generate the codes used in party-line
5 signalling.

This application is a division of my application Serial No. 179,443, filed March 30, 1927, Patent No. 1,686,879, issued October 9, 1928. The object of the invention claimed herein is the production of a new and improved relay arrangement for generating the necessary codes for use in signalling the party line substations.

One feature of the new relay arrangement is that, in a progressive counting relay arrangement
15 two impulse circuits are provided, one for operating the relays, and the other for subsequently restoring the relays one at a time.

Another feature of the arrangement is concerned with the provision of contacts controlled
20 by the counting relays for holding various code circuits closed over a relatively long interval of time in connection with an impulse circuit for grounding the code wires at intervals to produce the necessary combinations of rings.

There are other objects and features more or less incidental to the foregoing. Such objects and features may be understood best after the specification has been considered in connection with the accompanying drawing forming a part
30 thereof.

Referring now to the drawing comprising Figs. 1-3, they show by means of the usual circuit diagrams a sufficient amount of apparatus in a telephone system embodying the features of the
35 invention to enable the invention to be understood.

Fig. 1 shows the relays of the relay-type code generator. These relays operate to supply grounded impulses to the ten code conductors
40 connected to the banks of code selectors. It will be noted that certain contacts of the relays B and E—M of Fig. 1 are not connected together. These contacts connect together and to the code conductor terminals 1—10 in the manner indicated in Fig. 2. The contacts in Fig. 1 have been
45 given the same reference characters as in Fig. 2 and are placed so that the conductors joining them do not cross over one another. This arrangement has been adopted in order to enable
50 the connections to be easily seen, as they are somewhat complicated when the contacts are placed in their natural relay order.

Fig. 3 indicates the respective codes placed on the code terminals.

The invention having been described generally,

a detailed description of the operation of the apparatus shown will now be given.

When ground is placed on the start conductor shown in Fig. 1, due to a connector moving from its normal position and closing its off-normal
50 contacts, such as V. O. N., relay A operates through the associated resistance and closes a circuit for relay B, at the same time removing the short circuit from around the winding of relay B. Relay B operates and closes a circuit
65 for relay C, at the same time removing the short circuit from around the winding of C. Relay C operates and places a short circuit around the winding of relay A. Relay A falls back when it is short circuited by relay C. Upon falling
70 back relay A replaces the short circuit around the winding of relay B and opens the circuit to B. Similarly relay B replaces the short circuit around the winding of relay C and opens the circuit to relay C. Relay C thereupon falls back
75 and removes the short circuit from around the winding of relay A. As will be apparent, relays A, B and C now reoperate, the reoperation being followed by the falling back of the relays one after the other in the above manner. This op-
80 eration continues as long as the start conductor remains grounded.

As will be seen from the following part of the description, the entire device passes through a definite cycle of operations, there being fourteen
85 distinct positions in each cycle. The device as a whole is in position 1 with relays A—C operated and it is in position 2 when relays A—C have all fallen back. When the relays have all operated the second time, the device is in position 3, and
90 when they have all fallen back the second time the device is said to be in position 4. In all odd numbered positions of the device, relays A—C are operated, and in all even numbered positions of the device relays A—C are restored. It will be
95 understood of course that there is no clean cut division between the different positions of the device as regards the operation of relays A—C, as they operate and reoperate continuously without hesitation. It will be noted that each of the
100 relays A, B, and C is provided with a copper collar on its armature end. This is for the purpose of making the relay slightly slow in pulling up so as to steady the operation and render it less rapid. It will be noted further that when one of the
105 relays falls back it does so because its winding is short circuited. Therefore the relays fall back rather slowly due to their self-induced circulating currents. It has been found that the device works best when the relays A—C are adjusted to
110

go through a complete cycle of operations in about one second. Consequently, each relay pulls up and falls back once per second.

The relays D—N operate as follows: Upon the operation of relay C when the device is in position 1, a circuit is closed through contacts of relays F and M for relay D, the circuit being from battery on the contacts of C to ground on the start conductor. Relay D operates and closes a locking circuit for itself in series with relay E, but relay E does not operate immediately due to the fact that it is short circuited as long as C is operated. All battery symbols shown on the drawing represent the same battery. Relay D also closes a circuit for relays H and I in series, whereupon both of these relays operate. It will be noted that the operating position and the falling-back position of each of the relays D—N is given in parenthesis above each relay so as to enable the operation to be followed more readily.

In position 2, the initial circuit of relay D is opened, whereupon relay E operates in series with relay D, relay D remaining operated. Relay E closes a circuit for relays F and G in series, whereupon relays F and G operate. Relay F disconnects the relay-C impulse conductor from relay D and connects it instead to relay J. The result is that relay J operates when relay C is re-operated in position 3 of the device. Relay J closes a locking circuit for itself in series with relay K, but relay K does not operate until the device passes into position 4 and the initial circuit of relay J is opened. Relay J remains operated in series with relay K, and relay K operates.

Upon operating, relay K closes a circuit for relay N through contacts of relay D. Relay N operates and places ground on the pick-up conductor so as to enable the waiting connectors to start to ring at the beginning of a code cycle. Relay N also closes a circuit for relays L and M in series, whereupon these relays both operate. Relay M opens the relay-C impulse circuit, and prepares an impulse circuit through the upper contacts of relay B. Relay M also closes circuits shown in Fig. 2 so as to start the delivery of the ringing codes. The generation of the codes will be discussed after the description of the operation of the relays has been completed.

When the device arrives in position 5, a short circuiting impulse is delivered by relay B to the junction of relays D and E. This impulse is a ground impulse from the grounded start conductor and its path includes the upper armatures of relays M and B. When the ground potential is delivered to the junctions of the winding of relays D and E, through an operated armature of relay E, relay D is short circuited and falls back, opening the initial circuit of relays H and I. Relays H and I however remain operated in series with each other owing to the fact that their circuit is closed through contacts of relay H. Relay D also opens the circuit of relay N, whereupon relay N falls back and terminates the pick-up impulse, at the same time opening the initial circuit of the now-locked relays L and M.

With the device in position 6, the impulse delivered through the contacts of B is terminated, whereupon relay E falls back, having been maintained operated after the falling back of relay D solely through the upper contacts of relay B. Upon falling back, relay E transfers the relay-B impulse conductor through an operated armature of G to the junction of relays F and G. Relay

E also opens the initial circuit of the now-locked relays F and G.

From a consideration of the foregoing description and from an inspection of the drawing it will be apparent that relay G falls back in position 8; that relay H falls back in position 9; that relay I falls back in position 10; that relay J falls back in position 11; that relay K falls back in position 12; that relay L falls back in position 13; and that relay M falls back in position 14. It will be apparent also that relay M falls back responsive to the deenergization of relay B, and that relay C is still operated when relay B falls back. That being the case, position 1 of the device follows immediately after position 14, as relay M opens the B-relay impulse circuit and recloses the C-relay impulse circuit. While relay C is falling back, after its circuit is opened and its short circuit is replaced by relay B, relays D, H and I operate again in position 1 of the device, following which the above described operations of the relays take place in the next cycle.

Referring now to Fig. 3 it will be noted that the codes, placed on the ringing code conductors 1—10, consists of various numbers of long and short rings. The long rings are produced from the steadily grounded conductor 402, Fig. 2, through armature M2 of relay M, while the short rings are delivered from conductor 401 through armature B1 of relay B and armature M1 of relay M. The code conductors will now be considered in order and the way in which the codes are placed on these conductors in accordance with the table shown in Fig. 3 will now be explained.

Considering the code conductor 1, the code placed on this conductor consists of one long impulse. This impulse is started when relay F falls back in position 7, while relay I is still operated. The path of the impulse from the grounded conductor 402 includes armature F1, armature I2, and armature I4. This impulse circuit is opened at armatures I2 and I4 when relay I falls back in position 10, and it is not again closed until position 7 is reached in the next cycle of operations.

Considering now the two short impulses placed on code conductor 2, these impulses are delivered from the impulse conductor 401 under the control of armature B1. Conductor 2 is connected to conductor 401 through armature G3 when armature M1 is operated in position 4 and it remains so connected until relay G falls back in position 8. The first short impulse is delivered to conductor 2 when relay B operates in position 5, and the second short impulse is delivered when relay B operates in position 7. Relay G falls back and disconnects conductor 2 at the beginning of position 8.

Regarding conductor 3, the three short impulses are delivered to this conductor in a manner similar to that described in connection with conductor 2, the difference being that the connection between conductors 401 and the impulse conductor 3 includes armature I3, which remains operated until the device goes into position 10. As a result, code conductor 3 receives an impulse in position 5, another in position 7, and another in position 9.

Considering now impulse conductor 4, the code placed on this conductor is four short impulses. It will be noted that code conductor 4 is connected to the impulse conductor 401 through contacts L1 and K1 until relay K falls back in position 12. Accordingly, code conductor 4 re-

ceives an impulse in each of the positions 5, 7, 9 and 11.

Considering code conductor 5, the code placed on this conductor is one long pulse and one short pulse. The long pulse is delivered from conductor 402, starting in position 4 when contacts M2 are closed, and continuing until position 8 is reached when the pulse circuit is opened at armature G2, terminating the long pulse. When relay H falls back in position 9, a connection is closed from the impulse conductor 401 through armatures K1, H2, and I1 for placing the short pulse on code conductor 5. This short pulse is terminated at the end of position 9 upon the falling back of relay B, and the path between conductor 401 and code conductor 5 is opened at armature I1 when relay I falls back in position 10.

Considering code conductor 6, the code placed on this conductor is one long impulse and two short impulses. The long and short impulse placed on code conductor 5 while the device is passing through positions 4—9 is also placed on conductor 6, as the two conductors are connected together at armature I1 during such positions. After conductor 5 is disconnected from conductor 6 at armature I1 at the beginning of position 10, the connection between conductor 6 and conductor 401, including armatures K1 and H2 remains until it is broken at armature K1 when relay K falls back at the beginning of position 12. The second short impulse is placed on conductor 6 when conductor 401 is grounded at armature B1 in position 11.

Considering now the code placed on code conductor 7, this code is two long pulses, the pulses being placed on the conductor in positions 7—9 and in positions 11—13. The first pulse is placed on code conductor 7 from conductor 402 through armatures F1 and I2 when relay F falls back at the beginning of position 7 while relay I is still operated. Relay I falls back at the beginning of position 10 and terminates this impulse. At the beginning of position 11, relay J falls back and starts the second long impulse at armature J1. This second impulse is terminated when conductor 402 is ungrounded at the beginning of position 14 by the falling back of relay M.

Considering code conductor 8, the code on this conductor is one short impulse and one long impulse. The short impulse is placed on conductor 8 through armatures E1 and L2 while the device is in position 5. The connection between impulse conductor 401 and code conductor 8 is closed at armature L2 when relay L operates in position 4. When relay E falls back in position 6, code conductor 8 is disconnected from impulse conductor 401 and is connected to code conductor 1, with the result that it receives a long impulse in positions 7—9 at the same time that code conductor 1 is receiving its single long impulse.

Regarding code conductor 9, it will be noted that conductor 9 is connected to conductor 8 through armatures M3 and J2 until relay J falls back at the beginning of position 11, at which time the short pulse and long pulse have been placed on conductors 8 and 9. The complete code for conductor 9 is one short pulse and two long pulses. Accordingly, conductor 9 must receive a second long pulse through armatures J1 and J2. This second long pulse is received in positions 11—13, at which time it will be noted that conductor 9 is receiving its second long pulse at the same time that conductor 7 is receiving its second long pulse, the pulse on both conductors being

terminated when conductor 402 is ungrounded at M2 at the beginning of position 14.

The code on code conductor 10 is two short pulses and one long pulse. Conductor 10 is connected to impulse conductor 401 through armature G1 in position 2 of the device, and it remains so connected until the device reaches position 8, receiving a short pulse in position 5 and another in position 7. When relay H falls back at the beginning of position 9, a connection is closed at armature H1 through armature K2 between conductors 10 and 402. This connection remains closed until relay K falls back at the beginning of position 12, causing a long pulse to be placed on conductor 10 in positions 9, 10, and 11.

What is claimed is:

1. In a relay-type code-generating device, a plurality of counting relays, two impulse circuits, circuit arrangements such that all of said relays are operated in response to the transmission of impulses over the first impulse circuit, contacts on one of said relays for opening the first impulse circuit and closing the second, and circuit arrangements such that said relays are restored one at a time responsive to the transmission of impulses over the second impulse circuit.

2. In combination, a plurality of pairs of counting relays, means for operating said relays and for locking them operated in pairs by locking contacts on one relay of each pair, means for transmitting a plurality of impulses to said counting-relay pairs, the impulses being of such a polarity as to shunt the relay of any pair which carries the locking contacts, whereby the relay carrying the locking contact falls back when the impulse is delivered while the other relay of the pair remains operated as long as the impulse endures, and contacts on each of the relays last to fall back with the exception of the last relay of the last pair for transferring the impulse circuit to the next pair of relays upon falling back.

3. In combination, a pair of relays, a source of potential, one terminal of one relay being connected to one pole of the source of potential, one terminal of the other relay being connected to the other pole of the source of potential, a pair of locking contacts on the first relay for joining the free terminals of the two relays together in a locking circuit when the first relay is operated, means for momentarily connecting the second current-source pole to the free terminal of the first relay whereby the first relay operates and closes a locking circuit through the second relay so that the second relay is maintained non-operated until the momentary connection to the first relay is opened, whereupon the second relay operates also, and means for momentarily connecting the first current source pole to the free terminal of the second relay, whereupon the first relay falls back and opens the locking circuit and the second relay remains operated until the momentary connection is opened, whereupon the second relay falls back also.

4. In a code-generating device for generating a plurality of codes comprising combinations of short pulses and long pulses, a plurality of code conductors over which said codes are to be transmitted, respectively, an impulse conductor, means for grounding said conductor periodically, a second conductor, means for grounding said second conductor continuously, and circuit arrangements for generating desired codes by connecting the code conductors to said first or said second conductor at the correct time.

5. In a code generating device, a plurality of relays, an impulse conductor, means for grounding said conductor periodically, a second conductor, means for grounding said second conductor continuously, means for energizing and deenergizing said relays in predetermined sequence, and a plurality of code conductors connected to said first two conductors through contacts of said relays in various combinations so that a desired code of short and long impulses is transmitted to each of said code conductors.
6. In combination, a plurality of counting relays, two impulsing circuits, means responsive to impulses of a given polarity transmitted over the first of said circuits for operating said relays, contacts on one of said relays for opening said first circuit and for closing a point in the second of said circuit, and means responsive to impulses of a different polarity transmitted over said second circuit for deenergizing said relays one after the other.
7. In combination, a plurality of pairs of counting relays, means for energizing said relays and for locking the relays of each pair in series, a circuit over which impulses are transmitted, means for causing successive impulses to shunt the first relays of successive pairs, and means controlled by each of said first relays for opening the locking circuit of the pair.
8. In combination, a plurality of pairs of counting relays, means for energizing said relays, an impulsing circuit, means responsive to the transmission of impulses over said circuit for shunting the first relays in successive pairs, and means controlled by the shunted relay of each pair for causing the deenergization of its mate.
9. In combination, a train of counting relays, two impulsing circuits, means responsive to the transmission of an impulse series of predetermined length over the first of said circuits for operating all of said relays, contacts on one of said relays for opening said first circuit and closing a point in the second of said circuits, and means responsive to the transmission of an impulse series of greater length over said second circuit for restoring said relays to normal one after the other.
10. In combination, a circuit, means for closing and opening said circuit, a chain of counting relays deenergized successively responsive to successive closures of said circuit, and a chain of transfer relays deenergized successively responsive to successive openings of said circuit.
11. In combination, a chain of relays comprising counting relays and transfer relays arranged alternately in the chain, means including a conductor for momentarily shunting a counting relay and for holding energized the adjacent transfer relay, and contacts on each transfer relay for transferring said conductor to the next counting relay.
12. In combination, a chain of counting relays, means for energizing said relays, a pair of contacts, a conductor adapted to shunt and deenergize the first of said counting relays upon the closure of said contacts, and a transfer relay controlled by each counting relay for associating said conductor with the next counting relay, whereby successive additional closures of said contacts will shunt and deenergize the succeeding counting relays.
13. In combination, two pairs of counting relays, means for energizing said relays and for locking the relays of each pair in series, a shunting circuit for the first relay of the first pair, means for momentarily closing said circuit to short-circuit said first relay, contacts on said first relay for opening the locking circuit of the first pair to bring about the deenergization of the second relay of the first pair, and contacts on said second relay for extending said shunting circuit to the first relay of the second pair.
14. In combination, two pairs of counting relays, means for energizing said relays and for locking the relays of each pair in series with a battery, a conductor connected to the junction between the relays of the first pair, means for momentarily connecting one pole of said battery to said conductor whereby the first of said relays is short-circuited and the second is held energized, contacts on the first relay for opening the locking circuit of the first pair whereby the second relay is deenergized at the end of said momentary connection, and contacts on said second relay for transferring said conductor to the junction between the two relays of the second pair.
15. In combination, a plurality of relays, means for energizing said relays, a locking circuit for the second relay controlled by the first relay and a locking circuit for the fourth relay controlled by the third relay, a conductor associated with the first and second relays, means for momentarily applying a potential to said conductor whereby said first relay is shunted and deenergized to open the locking circuit of the second relay, said potential being also effective to maintain said second relay energized, and means responsive to the deenergization of said second relay when said potential is disconnected from said conductor for associating said conductor with the third and fourth relays.
16. In combination, a plurality of counting relays, means for operating all of said relays responsive to impulses and for maintaining them all in energized position at the same time, an impulse conductor extending to said relays, means for transmitting impulses over said conductor, and means for causing said impulses to release said relays successively, said means including circuit arrangements such that each impulse releases one relay at the beginning of the impulse, maintains the succeeding relay energized for the duration of the impulse, and allows said succeeding relay to release at the termination of the impulse to extend said conductor to the next succeeding relay.
17. In combination, a plurality of counting relays, means for causing all of said relays to be in operated position at the same time, an impulsing circuit extending to said relays, means for transmitting impulses over said circuit to successively deenergize said relays, one for each impulse, and means for preventing an impulse from releasing more than one counting relay, said means comprising a transfer relay which is held energized by the impulse and releases at the cessation thereof to transfer the impulsing circuit to the succeeding counting relay.

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