Dec. 1, 1925. 1,563,738

O. C. FROM

REGISTERING DEVICE

Filed Aug. 6, 1923 2 Sheets-Sheet 1

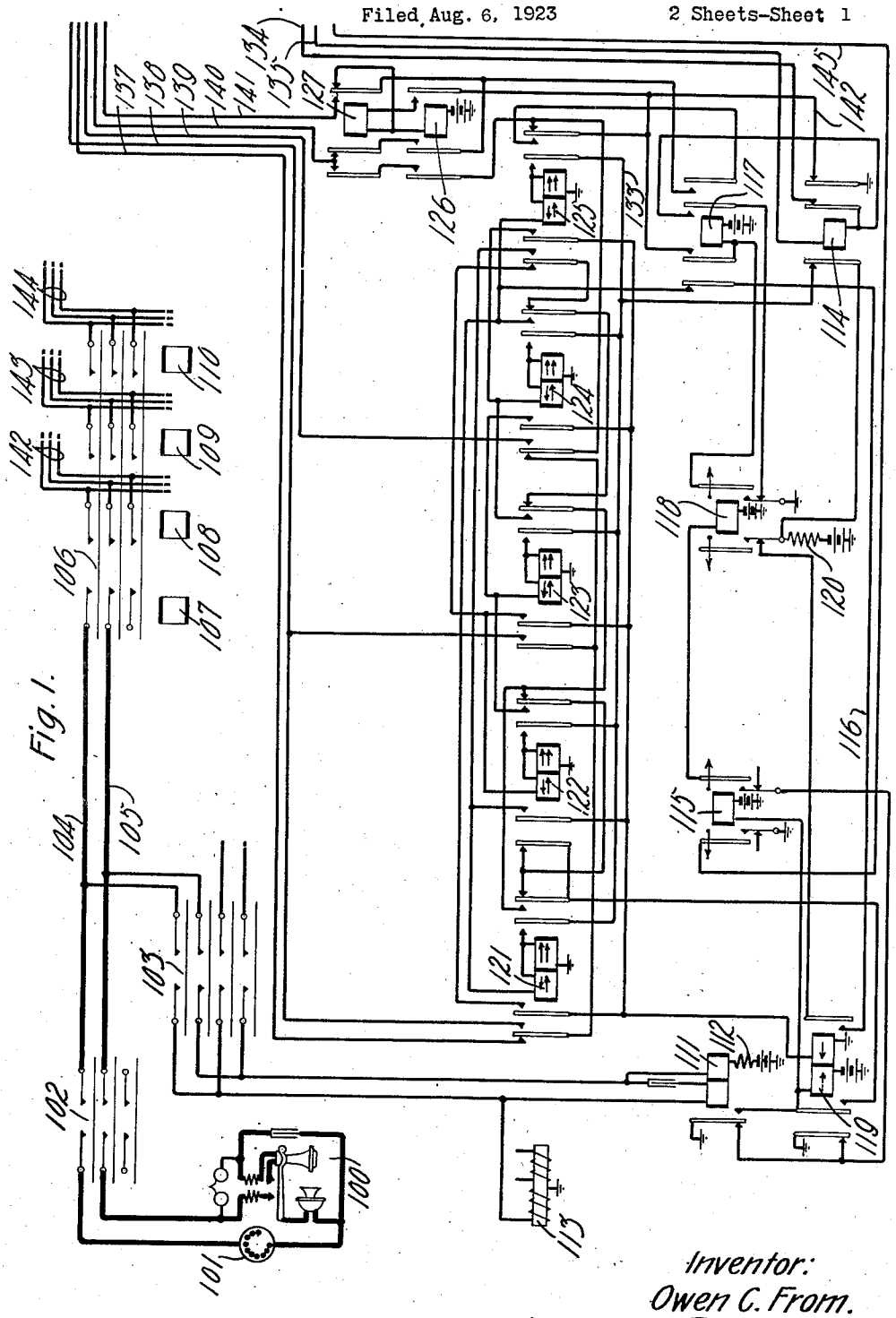


Fig. 1.

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Att'y

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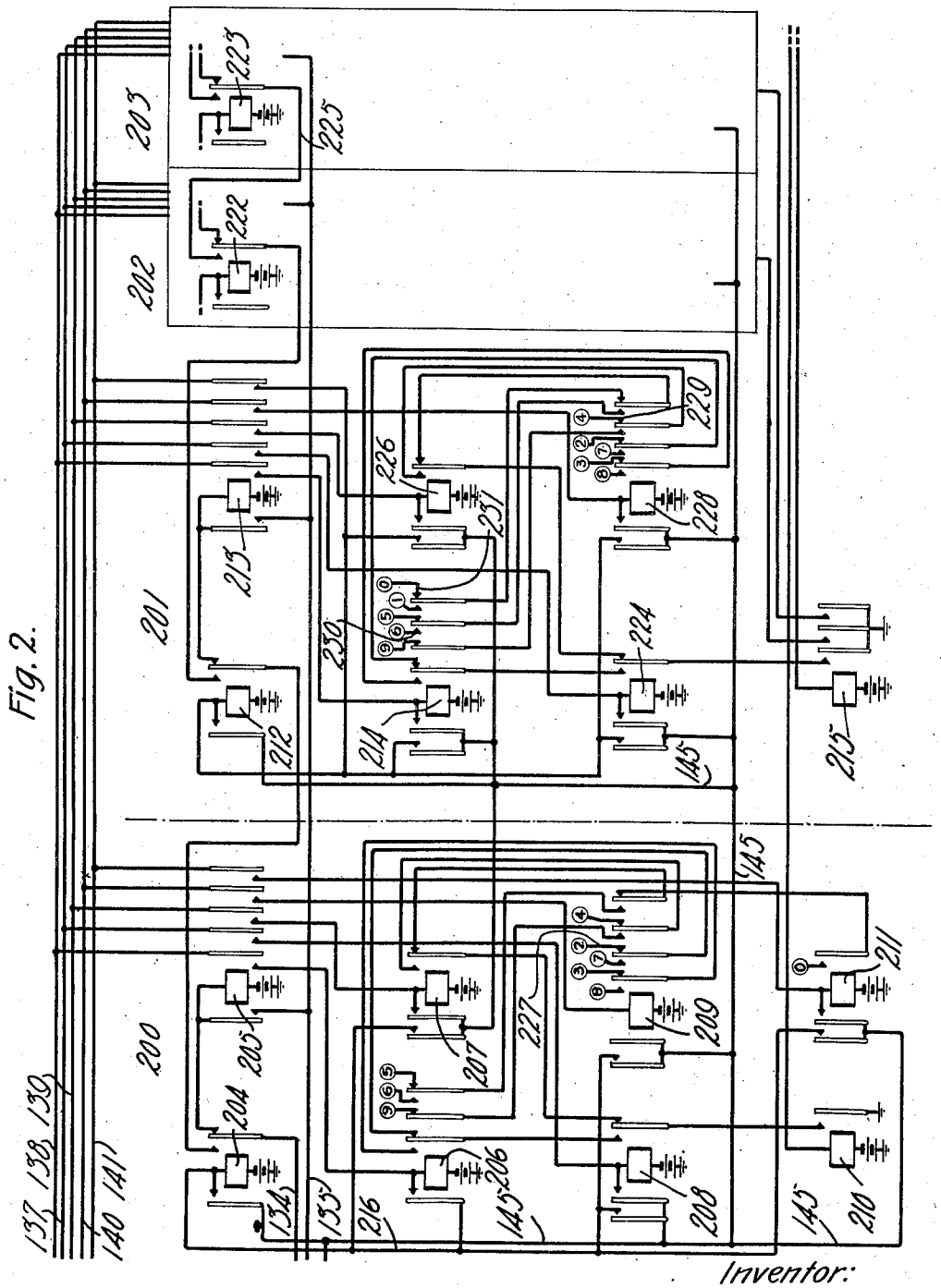


Fig. 2.

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Patented Dec. 1, 1925. 1,563,738

UNITED STATES PATENT OFFICE.

OWEN C. FROM, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

REGISTERING DEVICE.

Application filed August 6, 1923. Serial No. 655,804.

To all whom it may concern:

Be it known that I, OWEN C. FROM, a citizen of the United States of America, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Registering Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to registering mechanisms and more particularly to controlling means therefor.

The object of the invention is the provision of an improved method of receiving and registering impulses.

A feature of the invention relates to the provision of a series of successively operable relays responsive to a series of impulses, each relay being released differentially on the operation of the succeeding relay.

This and other features of the invention will be more clearly apparent from a consideration of the following description, in connection with the accompanying drawings and the appended claims.

Referring to the drawing, Figs. 1 and 2 taken in conjunction with each other illustrate so much of a telephone exchange system, incorporating a receiving and registering mechanism of a type embodying the present invention, as is necessary for a complete understanding thereof. Fig. 1 discloses a subscriber's line terminating in a switch at the central office, other switches for extending the line, together with the details of a receiving mechanism responsive to designation impulses for establishing the record of a call at the office. Fig. 2 shows in full two separate relay register devices, each for receiving and recording a different portion of a designation. At the right of this figure there are also illustrated in schematic form two additional registers for recording other parts of the designation.

In telephone systems of the automatic and semi-automatic types, it is found desirable to register on apparatus located at the central exchange the designation of the wanted line or circuit. This registration having been registered may later be used for governing the selective operations of switches to extend the required connection or for controlling well-known call indicating mechanism. It is in a system of this general character that the registering mechanism embodying the features of applicant's invention is particularly useful.

In the system disclosed, the subscriber's line 100 extends to the central office and there terminates in a line switch 102 diagrammatically shown. The line switch 102 is adapted to extend the subscriber's line 100 to any one of a number of trunks, one of which, trunk 104, 105, is illustrated leading to a first selective switch 106. Switch 106 may be of the same character as the line switch 102 and serves to extend the incoming trunk 104, 105 to other trunks 142, 143 and 144. Obviously, trunks 142, 143 and 144 may lead to succeeding selective switching devices where they are again selectively connected to other trunks and so on until the connection is completed.

Also located at the central office is a signal receiving and registering mechanism comprising an organization of relays and circuits, the function of which is to receive series of signals transmitted over the calling subscriber's line and to record the designations represented by such signals. There may be any desired number of these registering mechanisms arranged to serve a group of subscriber's lines, the particular one to be taken for use at any given time depending upon its busy or idle condition. A selecting switch 103 is provided for associating an idle one of the registering mechanisms, comprising the remainder of Figs. 1 and 2, with the particular trunk 104, 105 to which the calling subscriber's line has been extended by the switch 102.

The switches 102, 103 and 106 may be of the general type shown and described in detail in the patent to C. L. Goodrum et al., No. 1,515,735, granted November 18, 1924. On the other hand, these switches may be of any well-known type such as power driven selectors, or switches in which multicontact relays are employed for building up the connections with means for selecting and operating the necessary relays. While the registering mechanism embodying this invention is well adapted for use in systems employing switches of the character illustrated, it is to be understood that any other suitable form of switching device may be used.

A detailed description will now be given of the operation of the system. It will be assumed that the designation which the sub-

scriber wishes to record comprises four digits representing the number 2460. Each of these digits is represented by a separate series of impulses transmitted over the line which are received by the counting relay series shown in Fig. 1 and recorded successively on the four registers 200, 201, 202 and 203. When the calling subscriber initiates the call by removing his receiver from the switchhook, the line switch 102 operates to extend the calling line to an idle trunk 104, 105. Moreover the selecting switch 103 operates to associate the idle recording mechanism shown in detail with the selected trunk 104, 105. In response to these operations a circuit is closed from battery through resistance 112, right winding of the relay 111, through the switch 103, conductor 105, through the switch 102, over the loop of the calling line 100 and returning to the switch 102, conductor 104, through the switch 103, left winding of balancing coil 113 to ground. Relay 111 operates and closes a circuit from ground through its left front contact, winding of relay 115 to battery, in which circuit relay 115 operates.

Relay 111 in operating also closes a circuit from ground, front contact of relay 111, left winding of relay 119 to grounded battery. Relay 119 operates and closes a circuit from battery, resistance 120, left normal contact of relay 118, right contact of relay 119, conductor 116, outer left contact of relay 117, both windings of relay 125 to ground. Current flow at this time causes the windings of relay 125 to magnetically aid one another and relay 125 operates and closes a locking circuit for itself through its right winding and inner right contact, conductor 133, left contact of relay 114, resistance 120 to grounded battery. As soon as relay 125 attracts its armatures, a circuit is closed from grounded battery, left winding of relay 119, inner left contact of relay 119, outer right back contact of relay 121 and outer left contact of relay 122 in parallel, outer right back contact of relay 122, outer right back contact of relay 123, outer right back contact of relay 124, outer left front contact of relay 125, the windings of relay 121 in series to ground. This circuit has no effect on relay 121 at this time due to the direct connection to ground from the winding of relay 119 to the front contact of relay 111. Nothing further happens until the calling subscriber manipulates his dial.

When he operates his dial 101 to send the impulses corresponding to the first digit 2 of the number of the called subscriber, the circuit of relay 111 is opened twice causing relay 111 to deenergize and energize twice in succession. When relay 111 deenergizes it opens the circuits of relays 119 and 115. Relay 115 being slow to release maintains its armatures attracted during such brief interruptions of its circuit. Therefore when relay 111 closes its back contact a circuit is closed from ground, back contact of relay 111, right contact of relay 115, winding of relay 118 to grounded battery. Relay 118 operates and at its left armature opens the energizing circuit above traced for relay 125. At its right armature relay 118 closes an obvious circuit for relay 117. Relay 117 operates and closes a locking circuit for itself by way of its inner left contact, outer right contact of relay 114 to ground. Relay 117 at its outer left armature also opens the energizing circuit for relay 125 at another point, and at its right armatures closes various circuits which will be traced later when they are used.

Meanwhile relay 119 whose original energizing circuit was opened when relay 111 retracted its armature, is maintained energized over the circuit previously traced to relay 121. The shunt around this relay having been removed, relay 121 attracts its armatures. At its inner right front contact relay 121 closes a locking circuit through its right winding to conductor 133 and thence through the left contact of relay 114 to resistance 120 and battery. The resistance of this locking circuit being much less than that of the original energizing circuit through relay 119, the current in relay 119 is reduced to such a point that it will no longer retain its armatures attracted. At its outer left contact relay 119 closes ground to the circuit of relay 118, supplementing the ground from the back contact of relay 111 and thus shortening the open circuit period over which relay 118 must hold its armatures attracted.

Relay 121 also closes a circuit from ground, right winding of relay 119, inner left contact of relay 121, left winding of relay 125, inner right front contact of relay 125, conductor 133, left back contact of relay 114, resistance 120 to grounded battery. The current in this circuit flows in the opposite direction to the original energizing current of the left winding of relay 125. The windings of relay 125, as well as those of the other counting relays, are so adjusted that these opposing currents neutralize one another and relay 125 retracts its armatures. The other counting relays operate in a similar manner, that is, they operate through the two windings in series, lock through one winding and release due to differential circuits though the two windings. The current in the above traced releasing circuit has a differential effect on the right winding of relay 119 and causes that relay to release more quickly than it otherwise would. The magnetic effect of the right winding is not sufficient to reenergize the relay, nor to materially hinder its reenergization when the left winding becomes again effective. When relay 111 attracts its armature at the

end of the first interruption of its circuit, the energizing circuit for relay 119 is again closed and this relay operates. A circuit is closed from grounded battery, left winding of relay 119, inner left front contact of relay 119, outer right front contact of relay 121 and in parallel therewith through the outer left and right back contacts of relay 122, and thence through the outer right back contact of relay 123, outer right back contact of relay 124, outer left back contact of relay 125 through the two windings of relay 122 to ground. Relay 122 is shunted by direct ground at the armature and front contact of relay 111 at this time and does not attract its armatures.

When relay 111 retracts its armature in response to the second and last interruption of its circuit at the dial 101, the shunt around relay 122 is removed and that relay attracts its armatures. At its inner right front contact relay 122 establishes a locking circuit from ground through its right winding to battery over conductor 133. This circuit shunts relay 119 and that relay retracts its armatures.

Relay 122 also closes a circuit through the right winding of relay 119, inner left front contact of relay 122, left winding of relay 121, inner right armature of relay 121 to battery over conductor 133. This circuit, being opposed to the locking circuit previously traced, causes relay 121 to release.

At the end of the second opening of the circuit of relay 111 that relay again operates, causing in turn the operation of relay 119 and the closure of a circuit for relay 123, which circuit is ineffective as in the cases of relays 121 and 122, due to the shunt closed at the front contact of relay 111.

The circuit of relay 111 is closed for a comparatively long time between the sending of the digits and ground is removed from the circuit of relay 118 long enough for that relay to retract its armatures. Relay 118 on deenergizing closes a circuit from ground, right normal contact of relay 118, inner right front contact of relay 117, inner right back contact of relay 114, conductor 134, right armature and back contact of relay 204, winding of relay 205 to battery. Relay 205 operates and completes a circuit from battery through its winding, left front contact, conductor 135, winding of relay 114 inner right front contact of relay 117, normal contact of relay 118 to ground. Relay 114, however, does not operate in this circuit since it is shunted by the circuit first traced through the winding of relay 205. Relay 205 at its right contacts extends the control conductors 137, 138, 139, 140 and 141 through to the relays of the first register 200.

Since the counting relay 122 is operated, relay 121 is deenergized and a circuit may be traced from ground at the outer right back contact of relay 114, conductor 142, outer right back contact of relay 125, left back contact of relay 124, left back contact of relay 121, conductor 137, next to the inner right contact of relay 205, winding of relay 208 to battery. Inasmuch as none of the remaining counting relays are operated, no ground is placed on any of the other control conductors and hence relay 208 is the only one to be energized in the register set 200. Relay 208 attracts its armatures and closes a circuit from battery through its winding and inner left contact, conductor 145 to ground at the left contact of relay 115. Relay 208 also closes a circuit from battery through the winding of relay 204, conductor 216, outer left contact of relay 208 to ground over conductor 145. Relay 204 attracts its armatures and opens the shunt around the winding of relay 114. Relay 114 immediately operates in series with the winding of relay 205 by means of the circuit previously described. Relay 114 at its left contact opens the holding circuit of counting relay 122 and this relay deenergizes. Relay 114 at its outer right contact also opens the holding circuit for relay 117 and this latter relay becomes deenergized. Relay 117, in turn, opens the energizing circuit of relays 205 and 114 and they also release their armatures. Thus, the counting relays and the receiving circuit of Fig. 1 are completely restored to normal condition at the end of the series of impulses in readiness to receive the series representing the next digit. Relay 205, on deenergizing, disconnects control leads 137, 138, 139, 140 and 141 from the first register 200 to prevent interference when the next digit is recorded.

The subscriber now manipulates his dial 101 to cause four interruptions of the line circuit. With relays 118, 117 and 114 deenergized and relays 111 and 119 energized, the above traced circuit for operating relay 125 is completed and the circuit for energizing relay 121 prepared. In response to the first interruption caused by the dial 101, relay 111 releases its armature and relay 121 operates and locks and closes the differential circuit for deenergizing relay 125. In response to the second interruption relay 122 operates and releases relay 121 as before. In response to the third interruption relay 123 is operated and locked and relay 122 released. In response to the fourth interruption relay 124 is operated and locked and relay 123 is released.

At the end of the series of interruptions, slow to release relay 118 becomes deenergized as before and a circuit is closed from ground at the right normal contact of relay 118, inner right contact of relay 117, inner right contact of relay 114, conductor 134, right front contact of relay 204, right back

contact of relay 212, winding of relay 213 to grounded battery. Relay 213 operates and closes a circuit from battery through its winding and left contact, conductor 135, winding of relay 114 to ground as previously explained. Relay 114 does not operate since it is shunted by the energizing circuit of relay 213. Relay 213 at its right contacts extends the control conductors through to the relay registers of the second set 201.

Since the fourth counting relay 124 alone is operated, a circuit is traceable from ground at the outer right contact, of relay 114, conductor 142, outer right back contact of relay 125, outer left front contact of relay 124, conductor 139, middle right contact of relay 213, winding of relay 226 to battery. Relay 226 operates and locks through its inner left contact to grounded conductor 145. At its outer left contact this relay also closes a circuit from battery through the winding of relay 212 to ground on conductor 145. Relay 212 operates and locks through its winding and left contact to ground over conductor 145. Relay 212 opens the shunt around the winding of relay 114 and this relay operates in series with relay 213. Relay 114 opens the circuit of relay 117, as explained, which in turn opens the circuits of relays 114 and 213 and these relays become deenergized. Also the counting relay 124 and the other relays of the impulse receiving circuit are restored to normal ready for the next series of impulses.

The subscriber next operates his dial 101 to interrupt the circuit of relay 111 six times. At the end of the fourth impulse relay 124 is operated and locked as above explained and the energizing circuit for relay 125 is prepared. The fifth interruption causes relay 125 to operate and lock, and 40 to release relay 124. The operation of relay 125 prepares the energizing circuit for relay 121 as before. At this time, however, the operation of relay 125 also closes a circuit for relay 126 from ground at the outer contact of relay 114, conductor 142, outer right front contact of relay 125, outer right contact of relay 117, right back contact of relay 127, winding of relay 126 to battery. Relay 126 operates and closes a locking circuit for itself through the winding of relay 127, right contact of relay 126 to ground over conductor 142.

It is to be noted that in the case of the first energization of relay 125, relay 121 is operated as soon as the armature of relay 111 breaks contact, thus releasing relay 125, while relay 117 is operated only after relay 118 has operated which does not take place until relay 111 makes its back contact. It is therefore clear that at the time of the preliminary energization of relay 125 the circuit which has just been traced for relay 126 is opened at the outer right armature of relay 125 before it can be closed at the outer right contact of relay 117.

In response to the sixth interruption of the circuit of relay 111, relay 121 is operated and locked and relay 125 released. As soon as relay 125 releases, the energizing circuit for relay 126 which is in shunt of relay 127 is opened and relay 127 operates in the locking circuit of relay 126.

At the close of the sixth and last signal relay 118 releases and a circuit is completed from ground at the right normal contact of relay 118, inner right contact of relay 117, inner right contact of relay 114, conductor 134 through the right front contacts of relays 204 and 212, right back contact of relay 222, thence through the winding of a relay at the third register 202 corresponding to relays 205 and 213. In the manner already explained the control conductors 137, 138, 139, etc., are extended through to the register relays of the third set 202. Inasmuch as the third and fourth registers 202 and 203 correspond identically to the register 201, these registers have not been shown in detail. Since the counting relay 121 is operated a circuit may be traced from ground on conductor 142, outer right back contact of relay 125, outer left back contact of relay 124, outer left front contact of relay 121 to conductor 138. Moreover, a second circuit is closed from ground on conductor 142, outer right back contact of relay 125, outer left contact of relay 126, outer left contact of relay 127, to conductor 140.

From a consideration of register 201, it will be clear that the ground thus placed on conductors 138 and 140 will cause the energization of relays corresponding to relays 214 and 228, which relays lock to conductor 145 and cause the energization of relay 222. Relay 222 opens the shunt around relay 114, which relay operates, to cause the restoration of the counting relays to normal and the disconnection of the conductors 137, 138, 139, 140, and 141 from register 202.

Lastly, the calling subscriber transmits a series of ten signals, corresponding to the digit 0, to establish a record on the last register 203, which, as observed, is identical with the register 201 shown in detail. At the end of the sixth interruption of the circuit of relay 111 relays 126 and 127 are locked in series to conductor 142, relay 121 is operated and locked and the circuit of relay 122 prepared. At the seventh interruption relay 122 is operated and relay 121 released; at the eighth, relay 123 is operated and relay 122 released; at the ninth, relay 124 is operated and relay 123 released and at the tenth, relay 125 is operated and relay 124 released.

After an interval following the end of the

series, the slow to release relay 118 deenergizes and the circuit previously traced from ground over conductor 134 now leads through the right front contacts of relays 204, 212 and 222 in series, conductor 225, right back contact of relay 223 to the winding of a relay corresponding to relay 213. This relay operates and extends the control conductors through to the register relays of the set 203. Since counting relay 125 is operated, as well as relays 126 and 127, ground from the back contact of relay 114 over conductor 142 is extended through the outer right front contact of relay 125, outer right contact of relay 117, right front contact of relay 127 to conductor 141 and thence through the outermost right contact of the relay of register 203 corresponding to relay 213 and thence direct to the winding of relay 223 and grounded battery. Since relay 125 is operated, the ground on conductor 142 is removed from the armatures of the other counting relays and hence none of the relays associated with the conductors 137, 138, 139 and 140 can be operated. As in the case of relay 212, relay 223 causes the operation of relay 114, which in turn brings about the restoration of the relays energized. Thus, at the end of the fourth series of signals, the relay 208 of the first register 200 is energized, relay 228 of the second register 201 is energized, the relays corresponding to relays 214 and 228 of the third register 202 are energized and none of the relays of the fourth register 203 is energized.

In the above described setting of the registers, four of the ten digits have been used. The operation of the relays 121 to 125 in response to the dialing of these digits has served to apply ground to various one of the conductors 137 to 141. Following is a table setting forth the relation between the digits dialed, the counting relay remaining operated when each digit is dialed, the conductors to which ground is connected due to the operation of the relays and the register relays of register 200 operated in each case:

Digits.	Counting relays.	Conductors.	Register relays.
0	125	141	211
1	121	138	206
2	122	137	208
3	123	138	206
		137	208
4	124	139	207
5	125	140	209
6	121	140	209
		138	206
7	122	137	208
		140	209
8	123	140	209
		138	206
		137	208
9	124	139	207
		140	209

It will be noted that, with the exception of register 200, when the digit 0, corresponding to 10 impulses is dialed, none of the register relays are operated. In the case of the first digit of a wanted number, it is customary to reserve the digit 0 for calls to operator's positions and not to use the digit 1 since it is possible that accidental operation of the switchhook may simulate a single impulse. Therefore, no provision is made for the digit 1 in connection with register 200 and a special routing is provided for the digit 0. It will also be remembered that in the case of digits 6 to 0 inclusive, relays 126 and 127 are also operated.

It is to be noted that with relays 122 and 123 operated, ground is extended from conductor 142 over the outer right back contact of relay 125, outer left back contact to relay 124, left back contact of relay 121 to conductor 137. With relay 121 operated, ground is extended over the front contact of relay 121 to conductor 138. With relay 123 operated, ground is also extended to conductor 138 over the front contact of relay 123. When relays 124 or 125 are operated the circuit to the outer left armature of relay 121 is opened and ground is not extended to conductor 137 when either of these relays is operated. The relays 126 and 127 aid relay 125 in the connection of ground to conductor 140 or 141. When relay 125 operates in response to the fifth impulse, relay 126 is operated, but relay 127 is not and the path from grounded conductor 142 extends over a front contact of relays 125 and 126 and a back contact of relay 127 to conductor 140. When digits higher than 5 are dialed, relay 125 is operated and released, permitting the operation of relay 127 as previously described. For these digits a path extends to ground over a back contact of relay 125 and a front contact of relays 126 and 127 to conductor 140 for all digits from 6 to 9 inclusive. In response to the digit zero, relay 125 is again operated and the path from ground is extended over a front contact of relays 125 and 127 to conductor 141.

The variable settings of these registers represent the different digits of the wanted designation and circuits controlled by said registers may be closed in an obvious manner for determining the selective operation of the switches such as switch 106. For example, the trunks 142, 143, 144, etc., which may represent different numerical groups may be controlled by magnets or relays 108, 109, 110, etc. These magnets are selectable in any suitable manner by circuits controlled by the relays of the registers 200, 201, 202 and 203.

When the last digit has been recorded on the register 203 some element individual to said register such as the relay 223 may operate to close a circuit for relay 210. Relay 210 completes a circuit from ground through its contact, right front contact of relay 208,

innermost right back contact of relay 206, next to the innermost right back contact of register relay 209 to conductor 227. The conductor 227 may extend directly or through intermediate controlling devices to select a magnet 108, 109 and 110 representing an outgoing trunk identified by the registration on the register 200.

Similarly, at the proper time, relay 215 completes a circuit from ground through its innermost contact, right back contact of relay 224, right front contact of relay 226 next to the outer right back contact of relay 228 to conductor 229. The conductor 229 may correspondingly extend to cause the selection of a trunk for further extending the desired call. Similarly circuits are completed in register 202 and in register 203 to determine the selections at succeeding switching stages.

Inasmuch as this principle of governing the selective operation of switches in accordance with the designations registered on registers is well known and since it plays no important part with the subject matter of the present invention it is not believed necessary to disclose and describe the same in further detail.

When the recording mechanism is no longer required the circuit of relay 111 is opened in the manner disclosed in the patent to S. B. Williams, 1,517,331, granted December 2, 1924, causing in turn the release of slow relay 115 and the removal of ground from conductor 145. All relays of the recording mechanism are thereupon released.

Although the present embodiment of the invention is in connection with a system operated on a decimal basis, attention is called to the fact that there is no limitation on the number of times that the chain of relays may be operated and that by any suitable means, such as the substitution of a chain of counting relays for the pair 126 and 127, this arrangement could be used to receive large groups of signals.

What is claimed is:

1. In combination, a plurality of relays, means for successively operating said relays in response to a series of impulses, and means to release each relay on the operation of the next succeeding relay, comprising a differential circuit on the earlier operated relay.

2. A series of double wound relays, means responsive to a series of impulses to operate each of said relays including both windings of the relay in series, means for locking each relay through one of its windings, and means for releasing each relay upon the operation of the next succeeding relay of the series, including both windings in differential parallel circuits.

3. A series of double wound relays, means for energizing each relay comprising a circuit through both windings in series, a locking circuit for each relay including one winding, and means for extending said locking circuit differentially through the second winding of each relay when the next succeeding relay operates to release said relays.

4. In a registering system, a series of relays, an energizing circuit for said relays, means for completing said energizing circuit to operate one of said relays, and means under the control of said relay for preparing the energizing circuit of the succeeding relay and for differentially releasing the preceding relay of the series.

In witness whereof, I hereunto subscribe my name this 2 day of August, A. D. 1923.

OWEN C. FROM.