Dec. 28, 1926. 1,612,014

E. E. HINRICHSEN

RECORDING MECHANISM

Filed July 9, 1923 2 Sheets-Sheet 1

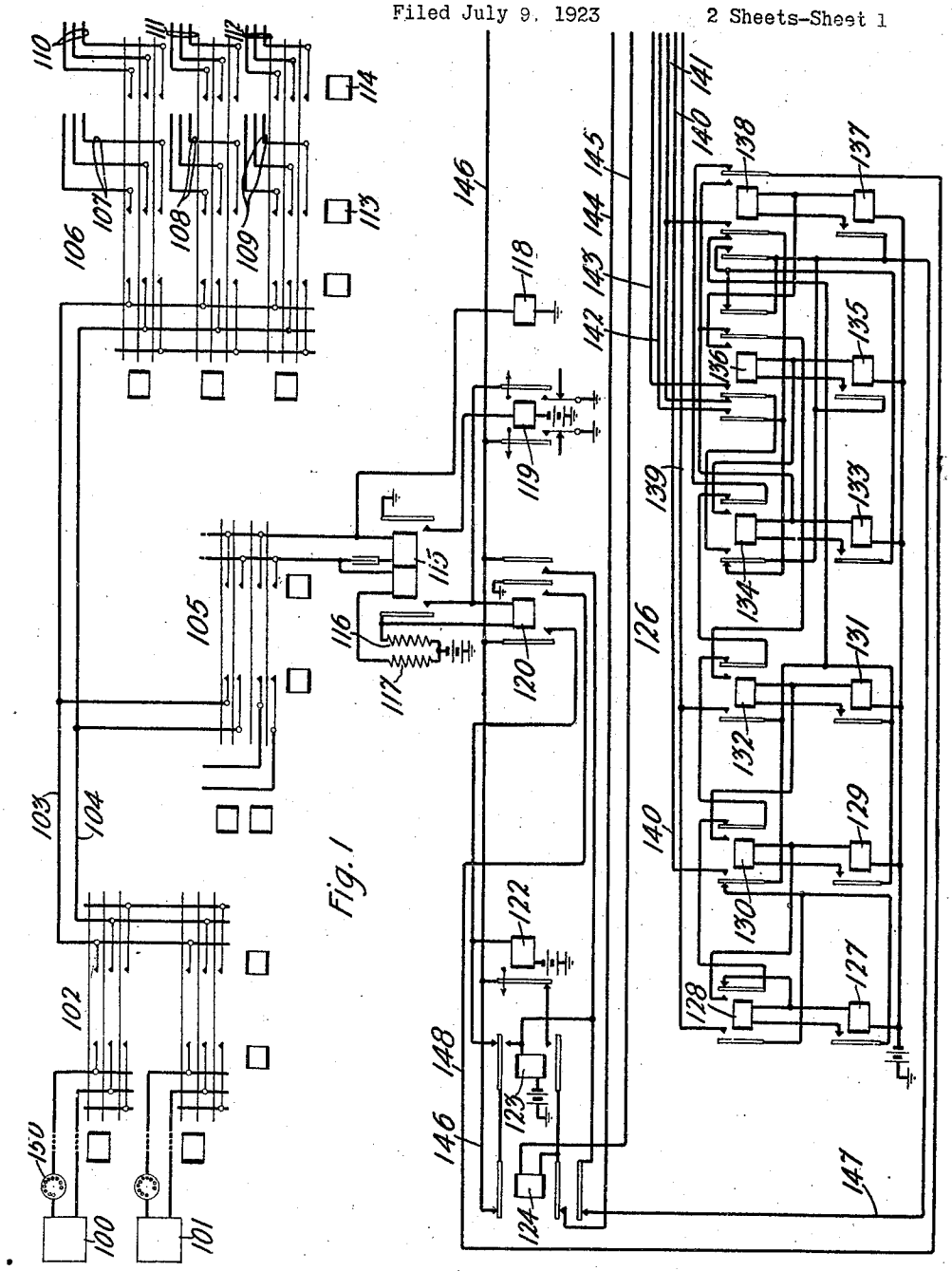


Fig. 1

Inventor:
Edward E. Hinrichsen.
by E. W. Adams
Att'y.

Dec. 28, 1926. 1,612,014

E. E. HINRICHSEN

RECORDING MECHANISM

Filed July 9, 1923 2 Sheets-Sheet 2

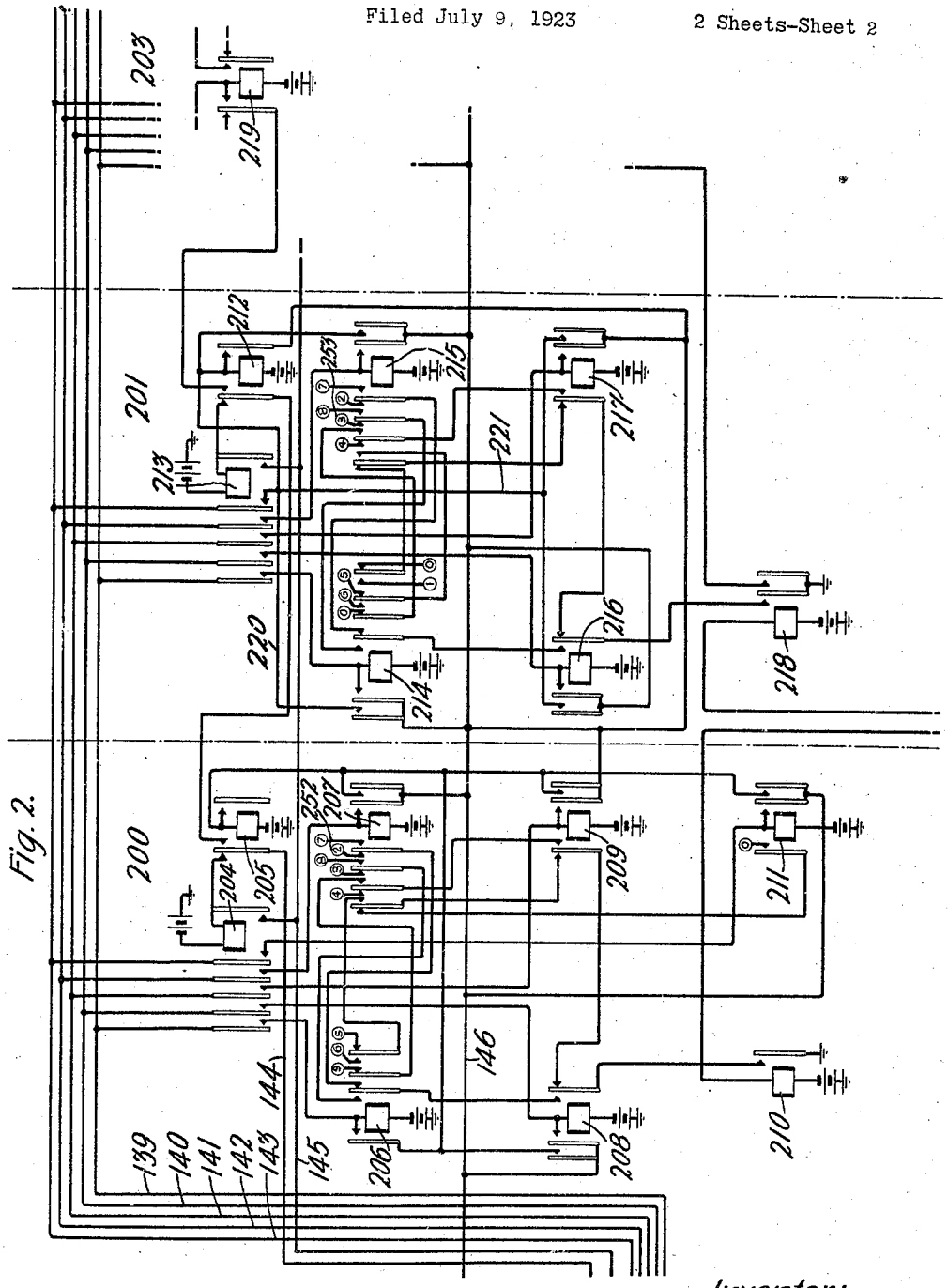


Fig. 2.

Inventor:
Edward E. Hinrichsen.
by E. W. Adams
Att'y.

Patented Dec. 28, 1926. 1,612,014

UNITED STATES PATENT OFFICE.

EDWARD E. HINRICHSEN, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

RECORDING MECHANISM.

Application filed July 9, 1923. Serial No. 650,290.

This invention relates to recording and selecting mechanisms, and more particularly to such devices when adapted to telephone exchange systems.

The object of the invention is an improved recording and selecting equipment comprising a plurality of counting devices, such as relays, operated in response to impulse series representing designations.

A feature of the invention relates to a series of counting relays less in number than the number of impulses in a series in which the energized relays are released as a result of the operation of succeeding relays, and in which certain relays are released by the operation of a particular relay on the first operation of the series, and released upon the operation of another and different counting relay in a subsequent operation of the series.

Other and further features contemplated by the present invention will be more clearly understood from the following detailed description and from the appended claims.

Referring to the drawing, Figs. 1 and 2 taken together illustrate an embodiment of the recording and selecting mechanism employed in a telephone system. Fig. 1 discloses two subscribers' lines terminating in a line switch at the central office, other switches for extending the line, together with the details of an impulse receiving and selecting mechanism. 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 is also illustrated schematically an additional register for recording another part of the designation.

In telephone systems of the automatic and semi-automatic type it is sometimes desirable to register on apparatus at the central office the designation of the wanted line or circuit. This registration serves to control the selective operations of the switches to extend the required connection or for controlling the operation of indicating mechanism, which enables an operator to extend or complete the desired call. It is in a system of this general character that the recording mechanism embodying the features of applicant's invention is particularly useful. Obviously, however, the invention is applicable in its broadest aspects to any system wherein it is desired to establish a record by means of impulses.

In the system disclosed, the subscribers' lines, such as lines 100 and 101, extend to the central office and terminate in a line switch 102, diagrammatically shown. The line switch 102 is adapted to extend the calling line to any of a number of trunks, one of which, trunk 103, 104, is illustrated leading to a first selector switch 106. Switch 106 may be of the same character as the line switch 102, and has for its function to extend the incoming trunks to outgoing trunks. Several of the outgoing trunks 107 to 112, inclusive, are illustrated. Obviously, these outgoing trunks may lead to succeeding selective switching devices, where they are again selectively connected to other trunks, and so on until the connection is complete.

Also located at the central office is an impulse receiving and recording mechanism comprising an organization of relays and circuits the function of which is to receive the impulses transmitted from the calling line and record the designations represented by these impulses. There may be any desired number of recording mechanisms for serving a group of subscribers' lines, the particular one to be taken for use at any one time depending upon its busy or idle condition. The selector switch 105 is provided for associating an idle one of the recording mechanisms with a particular trunk 103, 104, to which the calling subscriber's line has been connected.

The switches 102, 106 and 105 may be of the coordinate type, such as generally shown and described in detail in the Patent 1,517,331, issued to S. B. Williams, December 2, 1924. Furthermore, these switches may be of any well known and approved type, such as power driven selectors or selectors in which multi-contact relays are employed for building up connections with means for selecting and operating the necessary relays.

A detailed description will now be given of the operation of the systems. Assume, for example, that the subscriber of line 100 wishes to make a call to a line, the first two digits in the designation of which are represented by series of two and three impulses respectively, transmitted over the line.

These impulse series are received by the counting relay set 126, shown in Fig. 1, and recorded successively on the respective register 200 and 201, shown in Fig. 2. When the calling subscriber initiates the call by removing his receiver from the switchhook, the line switch 102 operates to extend the line 100 to an idle trunk 103, 104. Moreover, the selecting switch 105 also operates and associates the idle recording register shown with the selected trunk 103, 104.

In response to these operations, a circuit is closed from battery, resistance 117, left hand winding of impulse relay 115, contacts of the selector switch 105, trunk conductor 104, through contacts of the line switch 102 over the subscriber's line 100 and returning through contacts of the line switch 102, trunk conductor 103, contacts of selector switch 105, through the balancing coil 118 to ground. Relay 115 operates and at its right contact closes a circuit of the slow release relay 119. Relay 119 at its left contact applies ground potential to the holding conductor 146 for maintaining the various relays operated. Relay 119 also closes a circuit from battery through the resistance 116, winding of relay 120 to ground at the right contact of relay 119. Relay 120, however, does not operate in this circuit so long as relay 115 remains energized to maintain the following shunt path around the winding of relay 120: battery, through the resistance 116, left contact of relay 115, right contact of relay 119 to ground.

When the subscriber operates his impulse transmitter 150 to send two impulses constituting the first series, the impulse relay 115, deenergizes twice in succession. On the first deenergization of relay 115 the shunt circuit around relay 120 is opened and this relay immediately operates. Relay 120 completes a circuit from ground over conductor 146, outer right contact of relay 120, winding of relay 123 to battery. Relay 123 energizes and locks in a circuit from battery, through its upper front contact, upper contact of relay 124 to grounded conductor 146.

At the time relay 119 is operated it closes a circuit from battery, through the winding of slow release relay 122, upper back contact of relay 123, upper contact of relay 124, conductor 146, to ground at the left contact of relay 119. Relay 122 operates in this circuit and is held in the following circuit after relay 123 becomes energized: battery, through the winding of relay 122, left front contact of relay 120 to the grounded conductor 146.

When relay 120 operates at the first opening of the line circuit, it closes a circuit from ground, through its inner right contact, conductor 148, right back contacts of counting relays 138, 134, 132, 130, and 128, winding of counting relay 127 to battery. Relay 127 operates and closes a circuit from battery through its winding and the winding of relay 128, contact of relay 127, left back contact of relay 130, inner left back contact of relay 138, left back contact of relay 134, conductor 147, lower contact of relay 124, upper front contact of relay 123, upper contact of relay 124 to the grounded conductor 146. Relay 128, however, does not operate in this circuit since its winding is shunted by the above traced operating circuit for relay 127. When the relay 115 operates upon the next closure of the line, relay 120 is shunted and deenergizes. Relay 120 in deenergizing opens the shunt around the relay 128 and this relay operates in series with relay 127 in the circuit above traced. Thus, at the end of the first opening of the subscriber's line counting relays 127 and 128 are energized and locked through contacts of relay 123.

The circuit of relay 119 is opened at each deenergization of the line relay 115 and the circuit of relay 122 is opened at each deenergization of the relay 120. Relays 119 and 122, however, being slow to release, maintain their armatures attracted during these momentary interruptions of their circuits.

When the line circuit opens the second time, relay 115 releases, and removing the shunt, allows relay 120 to operate. A circuit is now closed from ground, through the inner right contact of relay 120, thence over conductor 148, as above traced, through the right front contact of relay 128, winding of relay 129 to battery. Relay 129 operates and closes a circuit from battery through its winding and the winding of relay 130, contact of relay 129, inner left back contact of relay 138, left contact of relay 134, conductor 147 to ground. Relay 130, however, being shunted, does not operate at this time. At the end of the opening period of the line, relay 120 is released, and removing the shunt, permits relay 130 to operate in series with relay 129. Relay 130 operating, opens at its left back contact the holding circuit of relays 127 and 128, and these relays become deenergized.

After the usual interval has expired following the first series of interruptions, relay 120 will remain deenergized for a sufficient period to permit slow relay 122 to release. Relay 122 completes a circuit from ground over conductor 146, through its contact, lower contact of relay 123, inner lower contact of relay 124, conductor 144, left back contact of relay 205, winding of relay 204 to battery. Relay 204 operates and prepares a circuit from battery through its winding and right contact, conductor 145, winding of relay 124, lower contact of relay 123, contact of relay 122 to the grounded conductor

146. Relay 124, however, being shunted by the above traced circuit does not operate. Relay 204 at its left contacts extends the conductors from the counting relays through to the register relays 206, 207, 208, 209 and 211.

Since the second set of counting relays 129 and 130 are operated, representing the first digit of the designation, a circuit is completed from ground over conductor 147, left back contact of relay 134, inner left back contact of relay 138, left front contact of relay 130, conductor 140, next to the outermost contact of relay 204, winding of register relay 208 to battery. Relay 208 operates and locks in a circuit from battery, through its winding and inner left contact to ground over conductor 146. Relay 208 completes a circuit from ground over conductor 146 to its outer left contact, winding of relay 205 to battery. Relay 205 operates, and removing the shunt, permits relay 124 to energize in series with relay 204. Relay 124 at its upper contact opens the holding circuit of relay 123. Relay 123 releases and in so doing opens the circuit of relays 124 and 204. Relay 124 releases, restoring the impulse receiving mechanism, and relay 204 deenergizes to disconnect the counting relay set 126 from the register 200. At the time relay 124 operates, it removes ground from conductor 147, whereby relays 130 and 129 become deenergized.

The subscriber now manipulates his dial 150 to transmit a series of three impulses, representing the second digit of the designation. As already explained, the transmission of two impulses causes the operation of relays 127, 128, 129 and 130 and the release of relays 127 and 128. Upon the third and last opening of the subscriber's line, relay 120 operates and ground is extended over conductor 148 to contacts of relays 138, 134 and 132, right front contact of relay 130, winding of relay 131, to battery. Relay 131 operates and prepares a circuit from battery through its winding and the winding of relay 132, contact of relay 131, thence to ground over conductor 147. The relay 132 being shunted at this time, it is not operated. At the end of the opening of the line, relay 120 again releases, and removing the shunt, permits relay 132 to operate in series with relay 131. It will be noted that relays 129 and 130 remain energized instead of becoming deenergized upon the operation of the third set of counting relays.

After a sufficient interval has elapsed following the third series of impulses, the slow relay 122 releases and a circuit is closed as above traced over conductor 114, through the left front contact of relay 205, left back contact of relay 212, winding of relay 213 to battery. Relay 213 operates and prepares a circuit for itself over conductor 145 through the winding of relay 124 to ground, as above traced, relay 124 remaining deenergized, having a shunt around its winding. Relay 213 at its left contacts associates the counting relay set with the second register 201.

Since the second and third sets of counting relays are operated for the digit 3, a circuit is closed from grounded conductor 147, left back contact of relay 134, inner left back contact of relay 138, left front contact of relay 130, conductor 140, next to the outer contact of relay 213, winding of register relay 216 to battery. Another circuit is traceable through the left contact of relay 132, conductor 139, outermost contact of relay 213, winding of relay 214 to battery. Relays 214 and 216 lock through their inner left contacts to the grounded conductor 146. With these register relays operated, a circuit is completed from battery, through the winding of relay 212, thence over conductors 220 and 221, through the outer left contacts of relays 214 and 216 in parallel to the grounded conductor 146. Relay 212 operates and locks to grounded conductor 146. Relay 212 at its left contact opens the shunt and permits relay 124 to operate in series with relay 213. Relay 124 opens the circuit of relay 123, which becomes released and opens the circuit of relays 124 and 213. Relay 124 restores the impulse mechanism and relay 213 disassociates the counting relays from the second register 201. It will be noted that when relay 124 operates, as above described, it opens the holding circuits of all energized counting relays.

In a manner similar to that described, other series of impulses may be transmitted over the calling line representing other digits of the designation, which are received and recorded upon receiving registers similar to those shown in Fig. 2. The variable settings of these registers represent the different digits of the wanted designation, and circuits controlled by said registers may be closed in a well known manner for determining the selective operations of the switches. When the last digit has been recorded on the register, a circuit may be closed for relays 210 and 218 in any desired manner, as for example, to contacts of the relay on the last register corresponding to relays 205, 212 and 219. Relays 210 and 218 merely serve to apply ground potential to the different contacts of the register relays to determine the selection of the circuit represented by the setting of the registers. In connection with the register 200, a selecting circuit leads from ground, through the contact of relay 210, right front contact of relay 208, inner right back contact of relay 206, innermost left back contact of relay 207 to the selecting conductor 252. For the register 201 a selecting circuit may be traced from ground,

through the inner contact of relay 218, right front contact of relay 216, innermost right front contact of relay 214, next to the inner left back contact of relay 215, to the selecting conductor 253. In a similar manner the selecting circuits for the remaining registers are also completed.

Inasmuch as the present invention relates more particularly to the arrangement and functions of the counting relay set shown in Fig. 1, it has not been considered necessary to illustrate in detail the method of control which the several registers may exercise over the switches.

Thus far only the first three counting relay sets have been operated, accounting for series up to three impulses in number. In order to illustrate the further operations of the counting relays, a description will now be given of the apparatus in response to series of impulses representing the remaining seven digits.

Assume that a series of four impulses is received. The operation is the same as already described for the first three impulses. Upon the opening of the subscriber's line for the fourth time, relating to the last impulse in a series of four, relay 120 operates and the grounded conductor 148 is extended over the back contacts of relay 138, 134, right front contact of relay 132, inner right back contact of relay 136, winding of relay 133 to battery. Relay 133 operates and closes a circuit from battery, through its winding and the winding of relay 134, contact of relay 133, outer right contact of relay 136 to ground over conductor 147. Relay 134, however, does not operate at this time since its winding is shunted. A moment later, when the line circuit closes and relay 120 releases, the shunt is removed and relay 134 operates in series with relay 133. Relay 134 at its left back contact opens the holding circuits of relays 129, 130, 131 and 132 and these relays become deenergized.

If a series of five impulses are transmitted, the last opening of the subscriber's line causes the operation of relay 120, as explained, and the grounded conductor 148 is extended over the right back contact of relay 138, right front contact of relay 134, winding of relay 135 to battery. Relay 135 operates and prepares a circuit from battery through its winding, the winding of relay 136 to ground at conductor 147. Relay 136, being shunted, is not operated. When the line circuit is again closed and relay 120 releases, the shunt is removed and relay 136 operates in series with relay 135. Relay 136 in operating opens at its outer right contact the holding circuit of relay 133 and 134.

If a series of six impulses are transmitted, relay 120 is energized on the last opening of the subscriber's line and the circuit is again extended from ground, over conductor 148, right back contact of relay 138, right back contacts of relays 134, 132, 130 and 128, winding of relay 127 to battery. Relay 127 operates and in the manner above explained prepares a circuit for relay 128, relay 128, however, remaining deenergized. When the line is closed and relay 120 releases, the shunt is removed and relay 128 operates in series with relay 127. It will be noted that for a series of six impulses relays 127, 128, 135 and 136 are operated.

For a series of seven impulses, the relay 120 in operating on the last opening of the line extends a circuit over conductor 148, right back contacts of relays 138, 134, 132 and 130, right front contact of relay 128, winding of relay 129 to battery. Relay 129 operates and in the manner above described prepares a circuit for relay 130. When the line circuit closes again, relay 130 operates and relays 127 and 128 release.

For a series of eight impulses, relay 120 in operating on the last opening of the line circuit extends the grounded conductor 148 over the right back contacts of relays 138, 134 and 132, right front contact of relay 130, winding of relay 131 to battery. Relay 131 operates and prepares a circuit for relay 132. As the line circuit again closes the shunt is removed and relay 132 operates in series with relay 131. It will be noted that for a series of eight impulses counting relays 129, 130, 131, 132, 135 and 136 are operated and the remaining relays are deenergized.

Should the subscriber send nine impulses, the relay 120 in operating on the last opening of the line extends the grounded conductor 148 over the right back contact of relay 138, right back contact of relay 134, right front contact of relay 132, inner right front contact of relay 136, winding of relay 137 to battery. Relay 137 operates and prepares a circuit for itself in series with the winding of relay 138. When the line circuit closes, relay 138 operates in series with relay 137. Relay 138 in operating opens the holding circuit of relays 129, 130, 131 and 132. These relays become deenergized.

If a series of ten impulses are transmitted, the relay 120 in responding to the last opening of the line circuit completes a circuit over the grounded conductor 148, to the right front contact of relay 138, winding of relay 133 to battery. Relay 133 operates, and when the line circuit subsequently closes, relay 134 operates in a circuit as follows: battery, through the winding of relay 133, winding of relay 134, contact of relay 133, outer left contact of relay 138 to the grounded conductor 147.

From an inspection of the circuits it will be found that with the counting relays 126 operated in the various combinations above described for the different digits, the several relays of the registers 200, 201, 203, etc., are

correspondingly operated in different combinations.

The following chart shows the manner in which the counting relays are operated either singly or in combination to record the impulses transmitted in accordance with the ten numerical digits and the combinations of control conductors which are grounded by the relays.

When the recording mechanism is no longer required, the circuit of relay 115 is opened by the restoration of switch 105 as disclosed in the patent to S. B. Williams hereinbefore referred to. Relay 115 then opens the circuit of relay 119, which becomes deenergized and removes ground from conductor 146. The removal of ground from this conductor permits all energized relays in the control and register circuits to be released.

What is claimed is:

1. In combination, a series of relays including means whereby the relays of said series may operate successively and repeatedly, and means for releasing certain of said relays upon the operation of succeeding relays, including means whereby a given one of said relays is released in response to the operation of a particular succeeding relay upon the first operation of the series and is released in response to the operation of a different succeeding relay upon a subsequent operation of the series.

2. In combination, a series of pairs of relays including means whereby the pairs of relays of said series operate successively and repeatedly in response to series of impulses, and means for releasing a number of pairs of said relays while impulses are being received, including means whereby a given pair of said relays is released in response to the operation of a particular succeeding relay and on another operation of the series is released in response to the operation of a different succeeding relay.

3. In combination, a series of pairs of counting relays including means whereby the pairs of relays of said series may operate and reoperate one after another in response to series of impulses, there being less pairs of relays than the maximum number of impulses in a series, and means for releasing said relays in response to the operation of succeeding relays, including means whereby a plurality of said relays is released in response to the operation of a particular succeeding relay and on the next operation of the series is released in response to the operation of a different succeeding relay.

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

EDWARD E. HINRICHSEN.