Dec. 11, 1928.

1,694,406

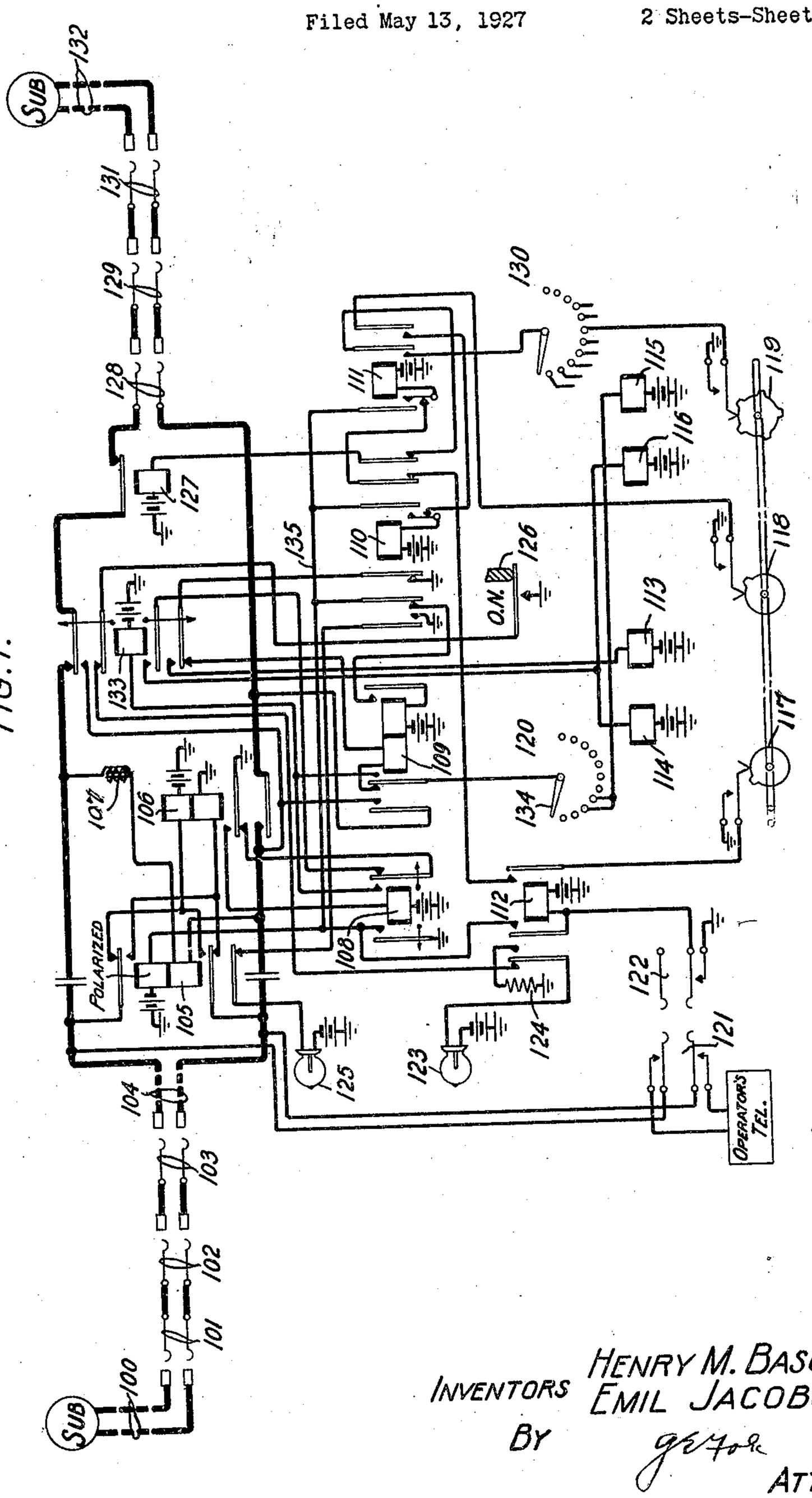
H. M. BASCOM ET AL

TELEPHONE EXCHANGE SYSTEM

Filed May 13, 1927

2 Sheets-Sheet 1

FIG. 1.



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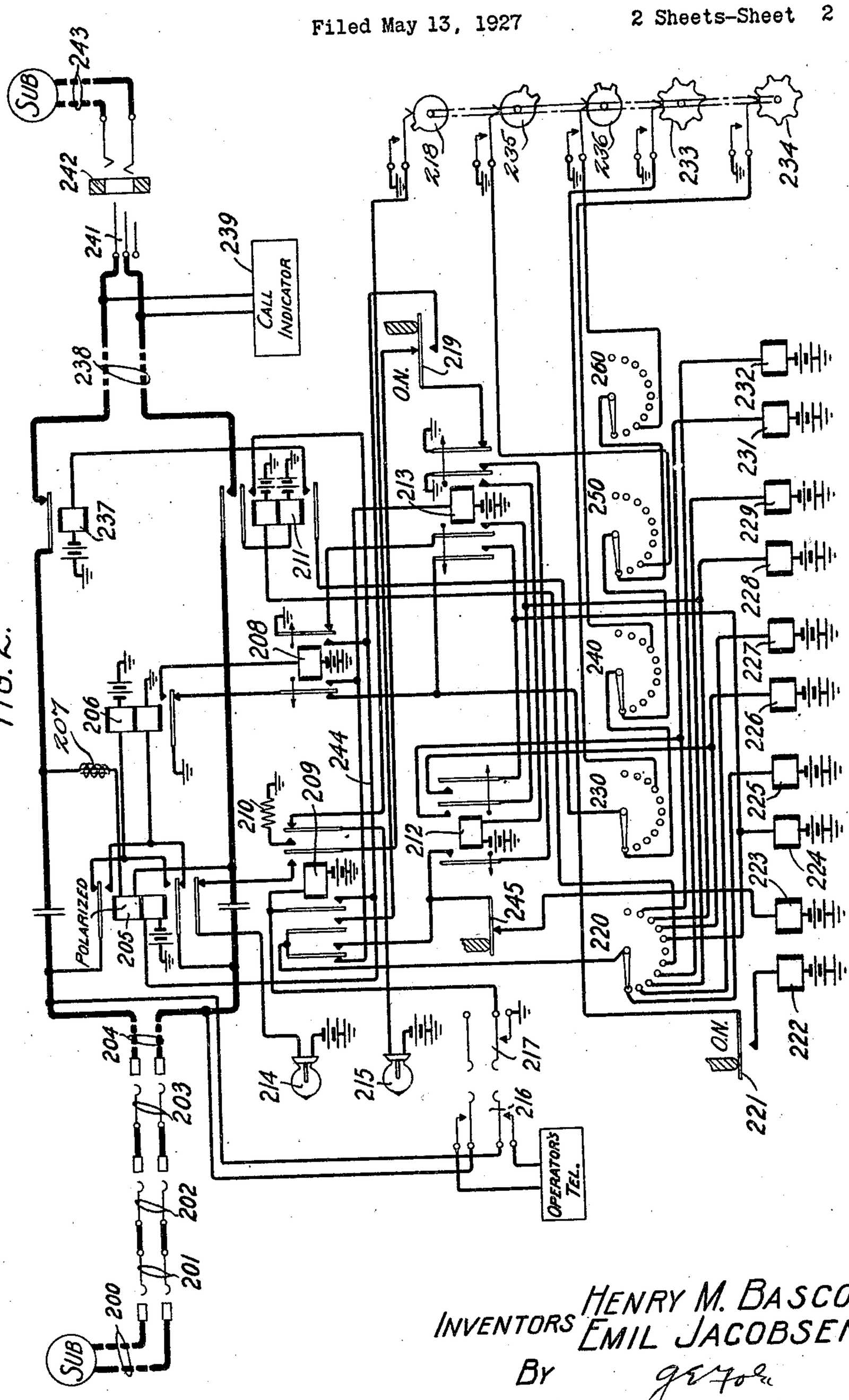

FIG. 2.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

Application filed May 13, 1927. Serial No. 191,165.

This invention relates to machine switching telephone exchange systems and its object is to effect improvements in recording and completing toll connections.

In a system embodying this invention a number of the switch setting impulses are effective to partially establish the desired connection, the remainder of the impulses being stored until an operator, on being signaled, listens in on the connection and obtains the necessary data to make out a ticket charging the call and wherein the operator then releases the stored impulses which become effective to cause the completion of the connection.

The invention is applicable to automatic toll switching systems and is illustrated in a step-by-step interoffice system arranged for the calling subscriber to dial the complete designation, which may consist of two code digits and four numerical digits. The code digits cause the setting of switches in the calling office to select a trunk leading to the called office. In case the called office is equipped with automatic switches the numerical impulses are transmitted over the trunk and cause the setting of these switches to partially complete the connection to the called line. The last digit, however, is temporarily stored in the trunk and a signal given an operator. The operator, after listening in on the connection and securing the necessary data from the calling party to make a record of the call, releases the stored digit, which is delivered to the switches and the connection is completed.

If the called office is a manual office equipped with call indicators all of the numerical digits are stored and subsequently released by the operator to set the call indicator.

Referring to the drawing, Figure 1 shows a telephone system embodying one modification of the invention in which one digit of a called number is temporarily stored in the trunk.

Fig. 2 shows another modification in which four digits are temporarily stored.

A detailed description will first be given of the system shown in Fig. 1. Assume the subscriber of line 100 wishes to converse with the subscriber of line 132 and that the connection is one for which a toll charge is made. On initiating the call, the line 100 is extended to a first selector switch 102 by means of a line finder 101. The subscriber dials the first two digits which may constitute the office code and which cause the setting of switches 102 and 103 to seize a trunk 104 leading to the called office. When the trunk 104 is seized relay 106 operates in a circuit from battery, through its upper winding, upper back contact of relay 105, over the tip side of the connection and returning over the ring side through the inner lower back contact of relay 105, lower winding of relay 106, to ground. Relay 106 closes an obvious circuit for slow release relay 108. Relay 108 closes an obvious circuit through the upper winding of relay 105. The relay 105 is a polarized relay and the upper winding is insufficient to cause the attraction of its armatures. Relay 106 also closes a bridge across the tip and ring conductors leading to the succeeding selector switch 128. This bridge may be traced from the tip side of the trunk, through the coil 107, lower winding of relay 105, thence through the lower front contact of relay 106, to the ring side of the trunk. At the selector switch 128, battery and ground are connected to the sides of the trunk, but the flow of current through the bridge including the lower winding of relay 105 is in such a direction that relay 105 does not operate.

The subscriber after dialing the first two code digits proceeds immediately to transmit four series of impulses representing the numerical designation of the called line 132. On the first impulse of the first numerical series, relay 106 releases and closes a circuit from ground, through its lower back contact, right front contact of relay 108, winding of slow release relay 133 to battery. Relay 106 in releasing also opens the bridge across the tip and ring conductors to deliver the first impulse to the switch 128. Relay 133 operates and the bridge across the tip and ring conductors now leads from the tip conductor, through the upper front contact of relay 133, and thence through the lower contact of relay 106 to the ring conductor. The lower winding of relay 105 is thus excluded from the bridge circuit. Relay 133 in operating closes a circuit from ground, through the inner left contact of relay 110, lower front contact of relay 133, winding of the stepping magnet 113 of the switch 120 to battery. Magnet 113 energizes and drives the brush arm 134 forward one position. The control

switch 120 is arranged to advance its brush on energization of the magnet. For each succeeding impulse in the first series, relay 106 releases and delivers an impulse to the switch 128. The switch 128 is therefore operated in its primary movement to select the desired group of trunks. At the end of the first series, relay 106 remains energized for an interval causing the release of relay 133. Relay 133 recloses the bridge circuit as traced through the lower winding of relay 105.

The selector switch 128 trunk hunts in the usual manner to seize an idle trunk leading to the next selector 129. The next series of impulses are repeated in the same manner to operate the selector 129. The first impulse causes the operation of relay 133 which again energizes the magnet 113 of the switch 120 to advance the switch another step. At the end of the second series relay 133 releases. The switch 129 trunk hunts and chooses an idle trunk leading to the connector switch 131.

The third series of impulses operate the relay 106 and are repeated to the connector switch 131 in the same manner. Relay 133 reoperates and closes the circuit for magnet 113 to drive the switch 120 another step forward. At the end of this series the connector 131 has been positioned in its primary movement. When the relay 133 releases a circuit is closed from ground, through the inner left contact of relay 110, lowermost back contact of relay 133, left winding and contact of relay 109, brush 134, through the winding of stepping magnet 115 of the register switch 130, to battery. Relay 109 operates and locks in a circuit from battery, through its right winding and contact, left back contact of relay 110, conductor 135, to ground through the contact of relay 108. Relay 109 is so adjusted that it closes its locking circuit before its energizing circuit is opened. The apparatus is now in condition to receive and temporarily store the next and last series of impulses instead of delivering them directly to the connector switch 131.

Upon the first impulse of the last series, relay 106 releases but does not open the circuit leading to the connector 131 since the lowermost contact of relay 106 is now shunted by a circuit leading through the outer left contact of relay 109. Relay 106 in releasing completes a circuit from ground, through its inner lower back contact, right front contact of relay 108, inner left front contact of relay 109, brush 134, through the winding of the stepping magnet 115 to battery. The magnet 115 operates to advance the register 130 forward one position. Relay 133 also operates in parallel with the stepping circuit. Relay 133 recloses the circuit of the stepping magnet 113 advancing switch 120 another position, but this does not open the stepping circuit for the switch 130. Likewise, the remaining impulses of the last series are effective to advance the register 130 to a position corresponding to this digit. At the end of the series relay 133 releases and a circuit is now completed from ground, through the off-normal contact 126 of the register 130, inner upper contact of relay 133, outer left back contact of relay 112, line lamp 123, to battery. The lamp 123 notifies the operator that a call is waiting on the trunk 104.

The operator thereupon depresses her key 121 and listens in on the connection. She obtains the necessary information from the calling subscriber to make out a ticket charging the call to his account, or in the case of a coin box line, requesting the deposit of the necessary coin. The operator next manipulates her start key 122 which serves to free the stored digit in order that it may be transmitted over the partially established connection to operate the connector switch 131 in its final movement to seize the called line 132. Key 122 closes an obvious circuit for relay 112, which operates and locks through the contact of relay 108. Relay 112 closes the circuit of lamp 123 through the resistance 124, causing the lamp to burn dimly. As soon, after the relay 112 operates, as the start cam 117 closes its contact, a circuit is completed for the relay 111.

It should be noted at this point the cam 117 is driven in any suitable manner by a constantly operating device which also drives the stop cam 118 and a plurality of impulse cams 119.

The circuit for relay 111 may be traced from ground, through the contacts of the cam 117, right contact of relay 112, middle right back contact of relay 110, normal contact of relay 111, winding of the latter relay to battery. Relay 111 locks to the grounded conductor 135.

It will be assumed that the register switch 130 has its brush standing on the contact to which the cam 119 is connected. It will be clear that other cams having different contours for the different digits will be connected to other terminals of the register 130. With relay 111 operated, a circuit is closed for relay 127 traceable from battery, through the winding of this relay, outer right back contact of relay 110, inner right front contact of relay 111, register 130, through the contacts of the cam 119 to ground. As the cam 119 rotates, it opens and closes the circuit of relay 127 to send a number of impulses equal to the number of impulses stored by the register 130. The connector switch 131 is positioned in response to these impulses on the terminals of the called line 132. When the cam 119 has made a complete rotation the stop cam 118 closes a circuit from ground, through its contacts, outer right contact of relay 111, normal contact and winding of relay 110 to battery. Relay 110 operates and locks to the grounded conductor 135. Relay 110 closes

a circuit from ground, through its outer left contact, lower contact of relay 105, through the supervisory lamp 125. This lamp notifies the operator that the called line has been seized. Relay 110 also opens the circuit of relay 109.

Ringing current is applied to the called line in the usual manner and when the called subscriber answers, current is reversed through the lower winding of relay 105 which operates to in turn reverse the direction of current flowing through the windings of relay 106, back in the direction of the calling line. The relay 105 in operating extinguishes the lamp 125 notifying the operator that the subscriber has answered.

When the calling subscriber hangs up his receiver relay 106 releases and closes a circuit for slow release relay 133. After an interval relay 108 releases. With relay 108 released and while relay 133 is still holding its armatures, a circuit is closed for the release magnets 114 and 116. This circuit leads through the magnets in parallel, inner lower contact of relay 133, right back contact of relay 108, to ground at the contact of relay 106. Magnets 114 and 116 cause the release respectively of the switches 120 and 130. The release of relay 108 releases relays 110, 111 and 112. Relay 112 extinguishes the lamp 123.

A description will now be given of the modification shown in Fig. 2. In this system the trunk circuit 204 instead of leading to selector switches terminates in an operator's cord circuit 238 at a call indicator position. The operator's position is equipped with a call indicator 239 which in the well known manner receives impulses corresponding to the subscriber's line designation and causes the illumination of lamps to apprise the operator of the wanted number. In this system all four digits are temporarily stored on the switches 230, 240, 250 and 260 and are released by the operator after she has made out a toll record.

The subscriber of line 200, on initiating a call, causes the operation of the line finder 201 and by dialing the first two digits sets the switches 202 and 203 to extend his line to the trunk 204. Thereupon the impulse relay 206 operates in a circuit from battery, through its upper winding, upper back contact of relay 205 over the tip side of the connection and returning over the ring side through the back contact of relay 205 and the lower winding of relay 206, to ground. Relay 206 operates the first slow relay 208. On the first impulse of the first digit, relay 206 releases and closes a circuit over its back contact, left front contact of relay 208, outer left back contact of relay 209, through the first position of the control switch 220, stepping magnet 225 of the first register switch 230, to battery. This circuit also extends in parallel through the winding of the second slow relay 213. Relay 213 closes an obvious circuit for slow relay 212. When the relay 206 again attracts its armature, the circuit of magnet 225 is opened and the switch 230 advances one position. In like manner the remaining impulses of the first digit cause the switch 230 to step to a position corresponding thereto. At the end of the series relay 213 releases and with relay 212 maintaining its armatures a circuit is closed from battery, through the winding of stepping magnet 223, contact 245, left contact of relay 212, inner right back contact of relay 213 to ground. Magnet 223 energizes and on energization advances its brush forward one step. When relay 212 later releases, magnet 223 deenergizes.

The next series of impulses is received in the same manner causing the repeated opening and closing of the stepping circuit. The stepping circuit this time, however, leads through the control switch 220 in its second position to the winding of the second magnet 227. Thus, the register 240 is driven to a position corresponding to the second digit. At the end of this digit, relay 213 releases and the control switch 220 advances to its third position.

In like manner the third and fourth series of impulses are received and recorded on the registers 250 and 260, respectively. At the end of the last series the control switch 220 advances to its fifth position. When relay 213 releases, following the last digit, the line lamp 215 is lighted in a circuit through the outer right back contact of relay 209, off-normal contact 219 of the register 260, back contact of relay 213 to ground. Lamp 215 advises the operator that a call is awaiting her attention. The operator thereupon listens in with the key 216, obtains the necessary information for the ticket and then operates start key 217. This key closes an obvious circuit through relay 209, which locks to the grounded conductor 244. Relay 209 opens the original circuit for lamp 215 and closes a substitute circuit through the resistance 210. The resistance 210 causes the lamp to burn dimly.

As soon, following the depression of the start key, as the start cam 218 closes its contacts, relay 211 is operated in a circuit through its upper winding, brush of the control switch 220, middle left contact of relay 209, to ground at the cam 218. The magnet 223 of the control switch is also energized at this time in a circuit from battery, through its winding, contact 245, outer left front contact of relay 209, middle left contact of relay 209, to ground at the cam 218. The switch 220 advances to its sixth position which is seen to be open. Relay 211 in operating locks through its lower winding and contact to the grounded conductor 244. Relay 211 closes a bridge across the tip and ring conductors

leading to the cord circuit 238 to cause the association of the call indicator 239 with the cord circuit ready for the receiving of the stored impulses. The bridge circuit may be traced from the tip conductor of the cord circuit 238 to the contact of relay 237, coil 207, upper winding of relay 205, through the upper contact of relay 211 and thence returning over the ring side of the connection. Relay 205 does not operate at this time for the same reasons explained in connection with relay 105.

Shortly after relay 211 operates, the impulse cam 233 becomes effective to close and open the circuit of relay 237 a number of times corresponding to the first digit. The circuit for relay 237 may be traced through its winding, lower contact of relay 211, register 230, to the grounded contacts of cam 233. Relay 237 opens and closes the circuit leading to the call indicator 239 causing the record of the first digit to be stored therein. When the first digit has been transmitted, the stop cam 218 again closes and drives the control switch 220 to its seventh position. In this position and while the stop cam 218 is still closed, a circuit is extended from said cam over the middle left contact of relay 209, switch 220, winding of release magnet 224, to battery. Magnet 224 releases the register switch 230 to its normal position.

The next impulse cam 234 now becomes effective to operate the relay 237 a corresponding number of times to send the second digit. The circuit may be traced from battery, through the winding of the relay, lower contact of relay 211, normal position of register 230, register 240, in its operated position, to ground at the contacts of cam 234. Following the transmission of this series, cam 218 closes advancing the control switch to its next position where the magnet 226 is operated to release the switch 240.

Next, the impulse cam 235 becomes effective to operate the relay 237 in a circuit through the relay, contact of relay 211, normal contacts of switches 230 and 240, register 250 in its set position, to ground at the contacts of cam 235. At the end of this digit cam 218 drives the control switch 220 into its next position and energizes relay 228 to release the register 250.

Finally the relay 237 is operated in a circuit leading through the normal contacts of registers 230, 240 and 250, register 260 in its set position, to ground at the contacts of cam 236. At the end of this digit cam 218 closes driving the control switch 220 into its next position and operating release magnet 231 to release the register 260.

With register 260 released, the off-normal contact 219 is shifted and the supervisory lamp 214 is now lighted in a circuit through the lamp, lower contact of relay 205, inner right contact of relay 209, contact 219, to ground at the contact of relay 213. The lamp 214 notifies the operator that the complete record has been transmitted to the call indicator. The operator at the call indicator position completes the connection by inserting the plug 241 into jack 242 of the called line 243. When this is done, current through the winding of relay 205 is reversed in the well known manner and this relay operates to in turn reverse the connections of relay 206 to the tip and ring conductors of the trunk 204. Relay 205 also opens the circuit of the lamp 214 as a signal to the operator that the called subscriber has answered.

On the next closure of the interrupter 218, the control switch 220 advances to its last position. In this position, the normally closed contacts 245 are opened to prevent further stepping of the switch. When the conversation is completed and the connection is released, the relay 206 deenergizes to cause the release of relay 208. Relay 208 releases the relays 209 and 211. Relay 209 extinguishes the lamp 215. The release magnet 222 is operated in a circuit from battery, through its winding, off-normal contact 221 of switch 220, to ground through the back contacts of relays 208 and 206. Switch 220 thereupon restores to its normal position.

In case the connection is abandoned while the registers 230, 240, 250 and 260 are positioned, these switches are released by means of special release circuits. The circuit for release magnet 224 leads through the outer left contact of relay 213 and the normal contacts of relays 208 and 206, to ground. It will be noted that relay 213 energizes upon the release of relay 206 and retains its armatures for an interval following the release of relay 208. The circuits for magnet 226 leads through the outer right front contact of relay 212, and thence as previously traced to ground at the contact of relay 206. Relay 212 is operated during the operation of relay 213. The circuit for magnet 228 leads through the inner back contact of relay 213 to ground at the right back contact of relay 208. The circuit for magnet 231 may be traced through the inner right contact of relay 212, inner left contact of relay 213, to ground at the right back contact of relay 208.

The selector switches illustrated diagrammatically in Figs. 1 and 2 may be of any suitable type such as those known as two-movement step-by-step switches.

The relay call indicator illustrated in Fig. 2 may be of the general type shown and described in the application of Jacobsen, Serial No. 540,888, filed March 3, 1922, Patent No. 1,623,118, granted April 5, 1927.

What is claimed is:

1. In a telephone system, subscribers' lines, automatic switches, means for transmitting

a number of impulses, means responsive to a part of said impulses to partially operate said switches to extend a connection in the direction of a subscriber's line, an operator's position, means for storing the remainder of said impulses, and means controlled by the operator for releasing the stored impulses to further operate said switches to complete the connection.

2. In a telephone system, telephone lines, automatic switches, means for transmitting designation impulses, means responsive to a part of said impulses to partially operate said switches to extend a connection in the direction of a telephone line, an operator's position, means individual to the extended connection for storing the remainder of said designation impulses, and means controlled by the operator for releasing the stored impulses to further operate said switches to complete a connection.

3. In a telephone system, telephone lines, automatic switches, senders for transmitting impulses representing the designation of a desired line, means responsive to a part of said impulses to partially operate said switches to extend a connection toward the desired line, an operator's position, a signal thereat, means for storing other of said designation impulses, means effective due to the storing of impulses to operate said signal, and means controlled by the operator for causing the transmission of impulses corresponding to the stored impulses to further operate said switches to complete the connection.

4. In combination, subscribers' lines, automatic switches, means for transmitting a number of impulses, means responsive to a part of said impulses to partially operate said switches to extend a connection in the direction of a subscriber's line, an operator's position, a key thereat, means for storing other of the impulses, and means responsive to the actuation of said key to release the stored impulses to further operate said switches to complete the connection.

5. In combination, a number of telephone lines, selective switches, means for transmitting impulses representing the designation of a called line, means responsive to a portion of said impulses for operating the selective switches to partially extend a connection to the called line, a register individual to the connection for storing other of said designation impulses, and means controlled by said register to send impulses in accordance with the stored impulses to further operate said selective switches to complete the connection to the called line.

6. In combination, a number of telephone lines, selective switches, means for transmitting impulses representing the designation of a called line, means responsive to a portion of said impulses for operating the selective switches to partially extend a connection to the called line, an operator's position, a register individual to the connection for storing the remainder of said impulses, and means controlled by the operator for releasing impulses corresponding to those stored by the register for operating said switches to complete the extension of the connection.

7. In a telephone system, subscribers' lines, a series of switches, means for sending a number of impulses, means responsive to a part of said impulses to set all switches except the last and to partially set said last switch to extend a connection to a desired line, means for storing other of said impulses temporarily, and means for releasing the stored impulses to complete the setting of said last switch to complete the connection.

8. In a telephone system, subscribers' lines, impulse responsive mechanism, means for transmitting a number of impulses, means responsive to a part of said impulses for operating said mechanism to extend the connection in the direction of a subscriber's line, an operator's position, means for storing the remainder of said impulses temporarily, and means controlled by the operator for releasing the stored impulses to further operate the impulse responsive mechanism for the purpose of completing the partially extended connection.

9. In a telephone system, a first office having selective switches therein, a second office having impulse responsive mechanism therein, lines appearing in said second office, means for transmitting designation impulses, means responsive to a part of said impulses for operating the switches in the first office to extend a connection to said second office, means in the second office individual to the extended connection for temporarily storing the remainder of said designation impulses, and means for releasing the stored impulses to operate said impulse responsive mechanism for the purpose of completing the connection to a called line.

In testimony whereof, we have signed our names to this specification this 12th day of May, 1927.

HENRY M. BASCOM.
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