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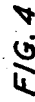
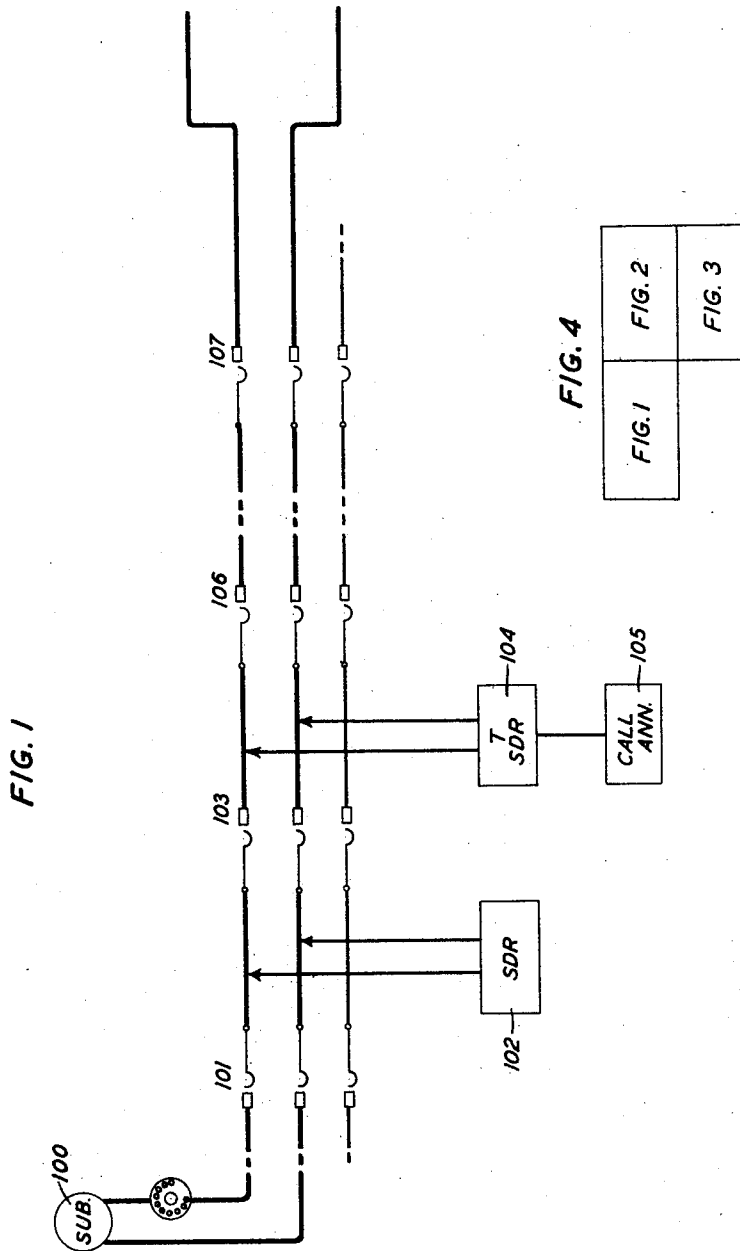
H. W. ULRICH

1,883,158

TRUNK CIRCUIT

Filed Jan. 23, 1932

3 Sheets-Sheet 1



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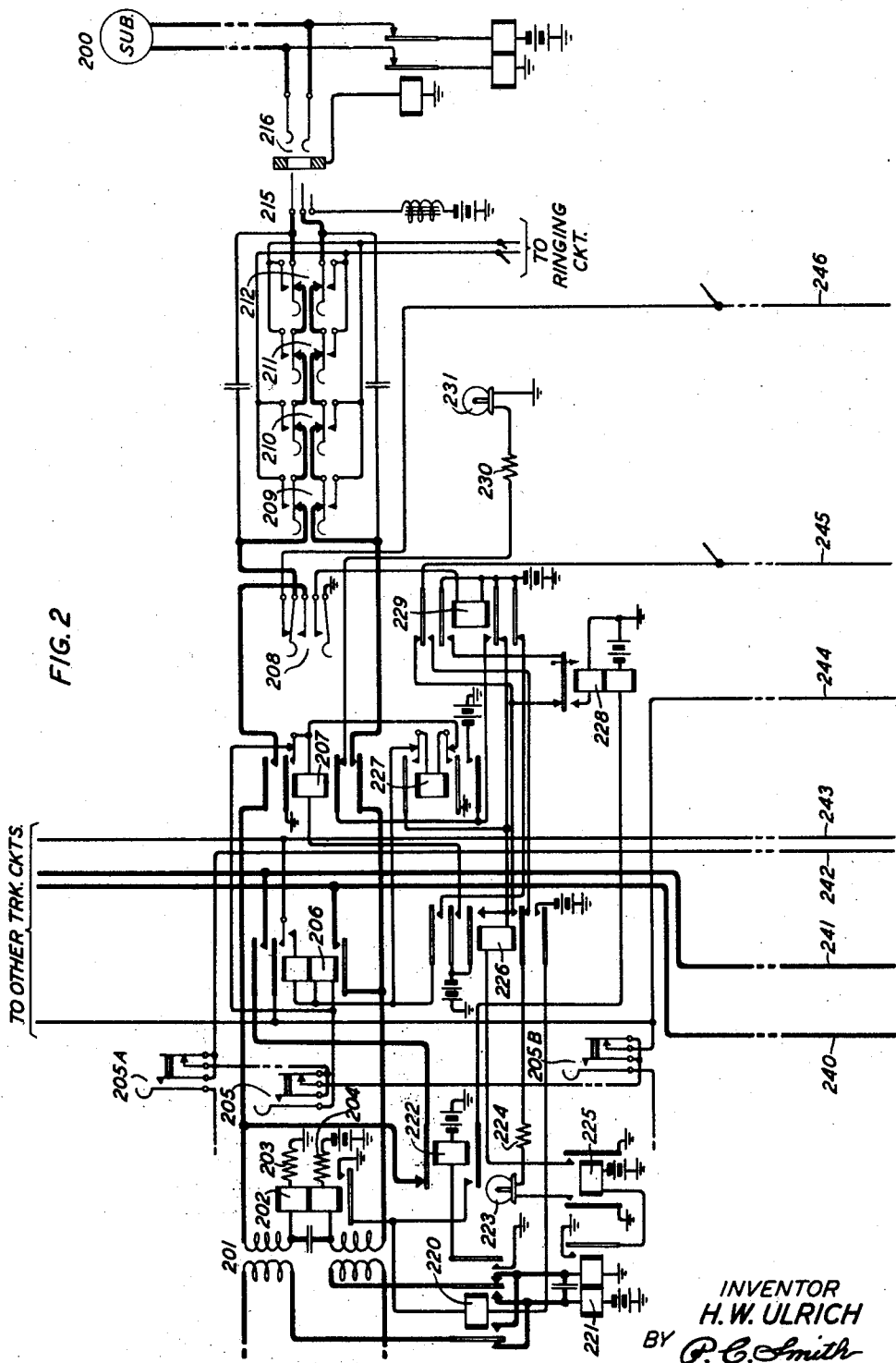
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TRUNK CIRCUIT

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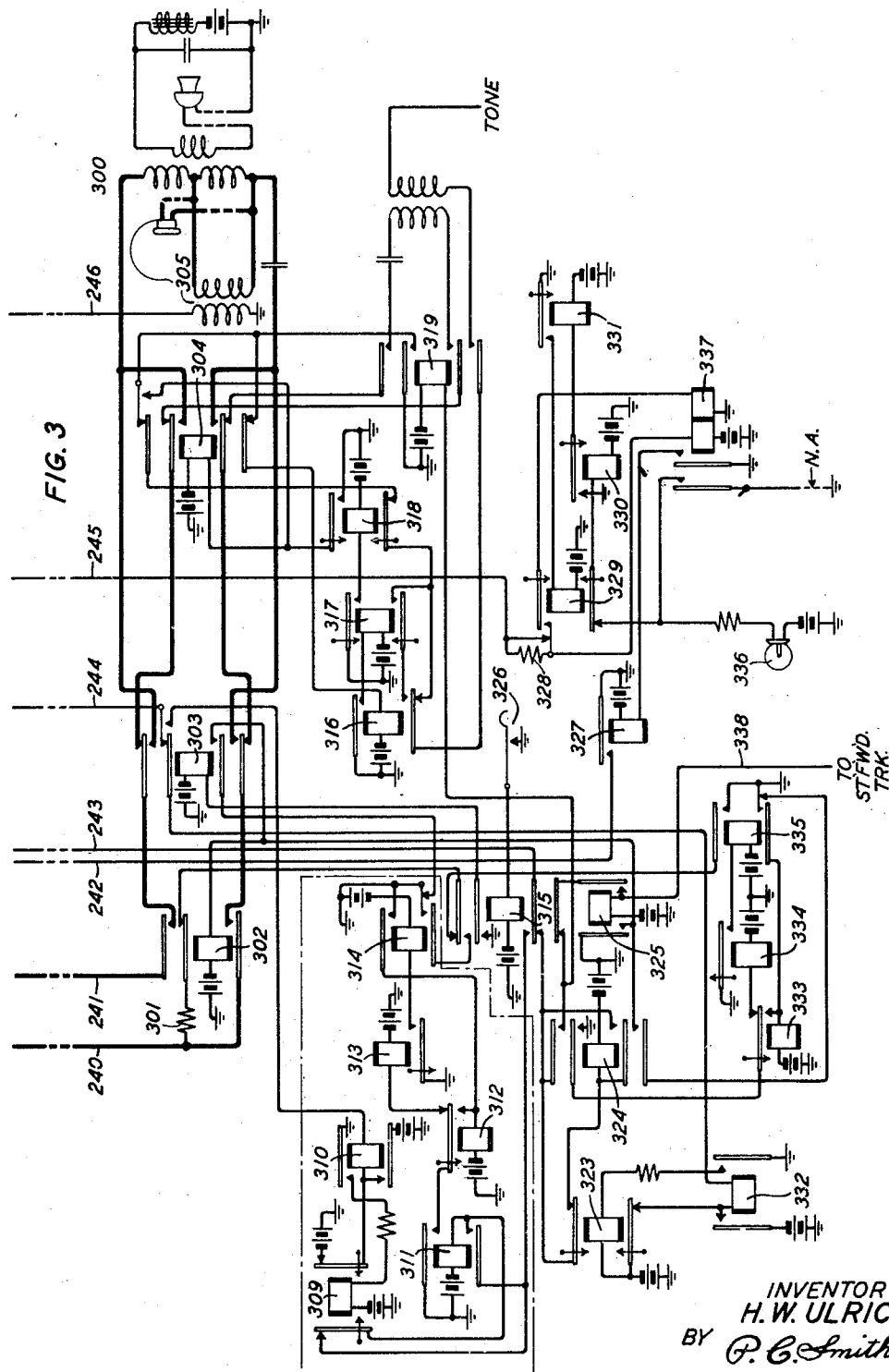
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TRUNK CIRCUIT

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3 Sheets-Sheet 3



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TRUNK CIRCUIT

Application filed January 23, 1932. Serial No. 538,233.

This invention relates to telephone systems employing both manual and automatic equipment and has for its object to increase the efficiency with which connections are established between such offices.

More particularly the invention concerns the establishment of connections which originate in dial offices and are completed by means of manual operators, the number being transmitted by means of automatic call announcement. The operator at the manual office is provided with trunks terminating in plugs for connection by means of jacks with called subscribers' lines. The extension of a connection to one of these trunks is indicated to the operator by a lamp signal to which she responds by operating a key individual to the trunk. This key causes connection of the trunk to her control equipment which in turn transmits a signal to the dial office to start the call announcement. To prevent the premature transmission of this signal the signal transmitting mechanism of the control equipment is disabled in response to the seizure of the trunk until after the operator has operated and released the trunk key. Disconnect lamps are associated with the trunk circuits of the present invention and a plurality of circuits provided for displaying the lamp depending upon whether or not the connection has been extended to a called line.

The invention will be more clearly understood from a consideration of the following description in connection with the accompanying drawings in which:

Fig. 1 shows in diagrammatic form equipment at an originating office and at a tandem office;

Fig. 2 shows a trunk circuit at a manual office;

Fig. 3 shows the operator's equipment at the manual office; and

Fig. 4 is a diagram showing how Figs. 1 to 3, inclusive should be arranged.

The trunk circuit of Fig. 2 is arranged for completing calls extended to the manual office from a tandem office equipped with a call announcer mechanism, while the operator's circuit of Fig. 3 is arranged to serve

both trunks of the above type and those incoming from manual offices operating on a straightforward basis. The connection of the operator's equipment with a particular trunk is under the control of a listening key such as key 205 individual to that trunk and the equipment is released from the trunk either by the manipulation of a ringing key or by the operation of a listening key of another trunk. The trunk is equipped with a combined guard and ringing lamp 223 and a disconnect lamp 231 and with semi-selective manual ringing keys 209 to 212, inclusive. These ringing keys are mechanically interconnected with a key 208 so that the operation of any of the ringing keys releases key 208, but key 208 must be reoperated separately in order to complete the release of the trunk.

Assuming that the subscriber at substation 100 in a dial office wishes to converse with a subscriber at substation 200 in a manual office to which access is obtained through a dial tandem office, he will remove his receiver from the switchhook, whereupon his line will be connected by means of line finder 101 with the district selector 103 and by means of a link circuit (not shown) with a sender 102. When the sender is ready, a dial tone is transmitted to the subscriber and he operates his dial in accordance with the wanted number which is recorded in the sender. The sender controls the district selector 103 to select an outgoing trunk leading to the tandem office, where the tandem sender 104 is associated with the district selector 106 in which the trunk terminates. The complete designation is then transferred to the tandem sender and the local sender 102 is released. The tandem sender 104 next controls the operation of the district selector 106 and the office selector 107 in selecting a trunk outgoing to the manual office at which the wanted line terminates. Since this manual office is assumed to be equipped to receive line designations by means of automatic call announcement, the tandem sender 104 also associates with itself the call announcer mechanism 105.

When the trunk has been selected, a relay

in the sender 104 is connected across the tip and ring conductors of the trunk, completing a circuit from battery through the left winding of relay 221, left back contact of relay 220, upper left winding of repeating coil 201, over the tip conductor, through office selector 107 and district selector 106, through the relay in the sender 104 and back over the ring conductor to the lower left winding of repeating coil 201, right back contact of relay 220, right winding of relay 221 to ground. Relay 221 operates in this circuit closing an obvious circuit for relay 225. Relay 225 prepares a circuit for guard lamp 223 and operates relay 226 in a circuit from ground at the right contact of relay 225, winding of relay 226, inner lower contact of relay 229 to battery. Relay 226 locks to battery at its inner upper front contact. It also extends the circuit of lamp 223 from ground at the left contact of relay 225, through resistance 224, over the inner lower front contact of relay 226, upper back contact of relay 229, to conductor 245, and thence over the upper normal contact of relay 329, left winding of relay 337 to battery, lighting lamp 223. Relay 337 also operates in this circuit, connecting ground from the night alarm circuit to the position pilot lamp 336 and over the lower contact of relay 329 to the winding of relay 330. Relay 330 in turn operates relay 331 and relay 331 operates relay 329. Relay 329 opens the shunt closed over its upper normal contact around resistance 328, thus reducing the current flow through lamp 223 to substantially extinguish it. At the same time relay 329 connects the grounded right winding of relay 337 to the left winding of that relay, holding relay 337 operated. The operation of relay 329 disconnects ground from relay 330 causing relays 330, 331 and 329 to release in turn restoring the shunt around resistance 328 and the operating circuit for relay 330. Relays 329, 330 and 331 are slow to operate, so that lamp 223 is flashed at regular intervals, measured by the operating time of the group of relays, relay 337 remaining operated steadily.

Relay 337 also operates relay 327 which connects ground to conductor 242. This conductor extends to the contact of the listening key 205a which is individual to the last trunk of the group served by the control circuit of Fig. 3. When none of the keys is operated, as is normally the case, a circuit is completed from grounded conductor 242 over the normal contacts of the listening keys of all trunks served by this operator, such as key 205a, 205, 205b etc., conductor 244, inner upper normal contact of relay 303, winding of relay 332 to battery at the lower back contact of relay 323. Relay 332 locks to battery at its left contact and closes an obvious circuit for relay 323 which is slow to operate and after an interval opens the operating circuit of relay 332 as

well as the circuit of relay 324 preventing the premature operation of relay 324.

The operator observing the flashing of lamp 223 operates the non-locking listening key 205 individual to this trunk circuit. A circuit is thereby closed from grounded conductor 242 over the normal contacts of key 205a and the listening keys of other trunks above the selected trunk in the sequential arrangement, operated contact of key 205, lower winding of relay 206, outer upper contact of relay 226, outer lower contact of relay 229 to battery. The key 205 is then released and the relation of the contacts is such that relay 206 locks in a circuit from battery through its upper winding and inner upper front contacts over the normal contacts of all of the listening keys of the position to grounded conductor 242. Relay 206 when operated connects the tip and ring conductors of the trunk to the conductors 241 and 240 and thence to the control circuit of Fig. 3 and also extends ground from its locking circuit to conductor 243.

The operation of key 205 also closed a circuit from battery at the middle upper contact of relay 226, winding and normal contacts of relay 207 to ground over the operated contact of key 205. Relay 207 operates in this circuit and locks to ground at its inner upper contact closing the tip and ring conductors through to key 208 and the ringing keys. At the same time a circuit is closed from ground over the operated contact of key 205, upper normal contact of relay 207, lower and upper normal contacts and winding of relay 227, outer upper contact of relay 226 to battery at the outer lower contact of relay 229. Relay 227 locks in a circuit from ground at its lower alternate contact, through its winding and upper alternate contact to battery at the inner lower contact of relay 229 and also at the inner upper contact of relay 226.

The operation of key 205 opens the circuit of relay 332 and that relay releases, in turn releasing relay 323. With relay 323 released and relay 206 operated and locked, a circuit is closed from battery through the winding of relay 324, upper back contact of relay 323, inner lower back contact of relay 315, conductor 243, to ground over the locking circuit of relay 206. If relays 332 and 323 were not used, it might be possible by operating key 205 slowly for relay 206 to operate over the alternate contact of the key and complete the circuit of relay 324 before the normal contact of the key was opened. This might result in the transmission of a double signal to the tandem sender causing a mutilated announcement. However, with relays 323 and 332 operating as described, relay 323 holds the circuit of relay 324 open until after the normal contact of key 205 has been opened, and premature operation of relay 324 is prevented.

The function of relay 324 is to transmit a signal to the tandem sender to initiate the transmission of the call announcement and also to bring about the connection of the operator's telephone with the trunk at the proper time. For the first purpose, relay 324 closes a circuit from ground at the lower normal contact of relay 335, outer lower contact of relay 324, winding of relay 302 to battery to prevent the premature transmission of the signal. It also closes a circuit from ground at its inner upper contact, upper back contact of relay 333, winding of relay 334 to battery. Relay 334 operates, in turn closing an obvious circuit for relay 335. Relay 335 connects ground over its upper contact and the upper back contact of relay 315 to the back contact of relay 302, and in addition it opens the operating circuit of relay 302 which now releases, extending the ground connected to its contact through resistance 301, conductor 240, lower contact of relay 206, lower right winding of repeating coil 201, lower winding of relay 202, resistance 204 to battery. Relay 202 closes a circuit from ground at its contact through the winding of relay 220 to battery at the outer lower contact of relay 226. Relay 220 reverses the connection of battery and ground through the windings of relay 221 to the sender relay. This prepares the sender for the transmission of the call announcement as described in Patent 1,840,132 to T. H. Roberts, granted January 5, 1932. Relay 220 also closes an obvious circuit for relay 222. Relay 222 in turn closes a circuit for relay 228, but this relay has no function at this time. Relay 222 also holds open the connection of the tip conductor to conductor 241 until the signal is transmitted to prevent the tone signals from interfering with the operation of the sender.

The operation of relay 335 also closes a circuit for relay 333 which is slow to operate and after an interval locks to ground at the inner upper contact of relay 324 and opens the circuit of relay 334. Relay 334 is slow to release and after an added interval opens the circuit of relay 335, which disconnects ground from resistance 301 and the ring conductor. Relays 202, 220, 222 and 228 release restoring the direction of the current flow to the sender and starting the transmission of the call announcement. Relay 335 also restores the operating circuit of relay 302 which extends conductors 240 and 241 toward the operator's telephone.

Relay 324 in operating also closes a circuit from battery through the winding of relay 319, outer upper contact of relay 324 to ground over conductor 243 as previously traced. Relay 319 closes a circuit from ground over its inner upper contact, lower contact of relay 304 to the winding of relay 316 and battery. Relay 316 causes the successive operation of relays 317, 318 and 304,

relays 317 and 318 being slow to operate so that a measured interval elapses before the operation of relay 304. Relay 304 locks over its outer upper front contact to ground at the inner upper contact of relay 319. It also opens the circuit of relay 316 which in turn releases relays 317 and 318. Relay 304 completes the connection of the operator's telephone set 300 over the outer back contacts of relay 303 to the front contacts of relay 302. Therefore, when relay 302 reoperates following the transmission of the signal to the tandem sender, the operator is ready to receive the transmitted designation.

Having received the wanted line number the operator touches the tip of plug 215 to the sleeve of jack 216 leading to the wanted line 200. If the line is busy, battery from the associated circuit will be connected to the sleeve of the jack and a circuit will be completed from that battery, tip of plug 215, over the normal contacts of the ringing keys, upper normally operated contact of key 208, conductor 246, through the left winding of coil 305 to ground causing a click in the operator's receiver. If the line is idle no such battery is present and no click is heard. Assuming that the line is idle, the operator will insert plug 215 in jack 216 and operate the proper one of the ringing keys 209 to 212. The ringing keys and key 208 are mechanically interconnected so that the operation of a ringing key in addition to connecting ringing current to the subscriber's line, releases key 208, completing the tip conductor and operating relay 229. Relay 229, in operating, opens the circuit of relay 206 and that relay releases disconnecting the operator's telephone circuit from the trunk and in turn releases relay 324. Relay 229 also disconnects lamp 223 from the flashing circuit and connects it over the back contact of relay 228 to battery so that the lamp now lights steadily as a ringing lamp. Relay 229 opens one locking circuit of relay 227, but that relay is held under the control of relay 226.

When the subscriber at substation 200 answers, with the ringing key normal, relay 202 operates over the substation loop operating relays 220, 222 and 228 as previously described. Relay 228 extinguishes the ringing lamp 223 as a signal to the operator that she can discontinue ringing. Since relay 229 is now operated, relay 228 locks in a circuit from ground through its upper winding and over its upper front contact to battery over the inner upper contact of relay 229.

In the control circuit of Fig. 3 the operation of relay 229 opens the circuit of relay 337 so that when relays 329, 330 and 331 have released at the end of a cycle, they remain unoperated. Relay 327 is also released, in turn releasing relays 332 and 333. Relay 324 in releasing opens the circuit of relay 319 which in turn releases relay 304. Relay 324

also permits the release of relays 333 and 302 so that the control circuit is now completely restored to normal.

When the called subscriber restores his receiver to the switchhook, relay 202 releases, in turn releasing relays 220 and 222, but relay 228 remains locked. The restoration of the current flow over the incoming trunk gives a release signal to the dial equipment at the tandem office which in turn transmits a release signal to the originating office. When the district selector 106 and office selector 107 release, the circuit of relay 221 is opened and that relay releases, releasing relay 225. Relay 225 in turn releases relays 226, 227 and 207, opening the tip and ring conductors. A circuit is now closed from ground through disconnect lamp 231, resistance 230, lower back contact of relay 207, over the lower front contact of relay 229 to battery. The operator observing the disconnect signal removes plug 215 from jack 216 and operates key 208 thereby releasing relays 229 and 228 and extinguishing lamp 231. Key 208 remains in its operated position until released by the subsequent operation of a ringing key.

If the call is abandoned at the originating office before ringing is started, the release of the dial equipment releases relay 221 in turn releasing relays 225, 226, and 207, but relay 227 is locked to the inner lower back contact of relay 229. With these relays released the circuit of lamp 223 is opened and that lamp is extinguished. However, a circuit is closed from ground through lamp 231, resistance 230, over the back contact of relay 207 to battery at the outer lower front contact of relay 227 to light the disconnect lamp 231. To extinguish the lamp, key 208 must be momentarily released and reoperated.

If the call is abandoned during the ringing period, relays 221, 225, 226, 227 and 207 release. Relay 229 has been operated by the release of key 208 and lamp 231 is lighted over the lower back contact of relay 207, and the inner lower front contact of relay 229.

If the trunk should be reselected before the operator has reoperated key 208 and removed the plug from the jack, relays 221 and 225 will be operated as previously described. Relay 226 can not operate since its operating circuit is opened at the contact of relay 229 but lamp 223 will flash in a circuit from ground at the left contact of relay 225, lamp 223, resistance 224, lower back contact of relay 226, outer upper front contact of relay 229, conductor 245 to the flashing relays of Fig. 3, and lamp 231 remains lighted over the back contact of relay 207 and the front contact of relay 229. With both lamps lighted, the operator will withdraw plug 215 from the jack and operate key 208. The operation of key 208 releases relay 229 extinguishing lamp 231 and permitting relay 226 to operate. The release of relay 229 also releases relay

228. With relays 228 and 229 released the circuit of lamp 223 is again extended to the flashing relays of Fig. 3. From that point the call is completed as previously described.

If the subscriber's line is busy, the plug 215 is inserted in the busy-back jack (not shown) and a ringing key operated in order to release key 208. The release of key 208 completes the tip conductor and operates relay 229 as above described. Relay 229 in operating releases relay 206, and transfers the circuit of lamp 223 to steady battery. The busy-back circuit connects intermittent tone and ground to the ring of plug 215, intermittently operating and releasing relay 202. Relay 202 is effective as previously described to operate relays 220, 222 and 228 thereby intermittently reversing battery and ground over the trunk. The tone informs the calling subscriber that the line is busy and the battery reversals are provided in case the originating office is manual to also give a busy signal to the operator at the originating office. When relay 228 operates, it locks under the control of relay 229 and extinguishes lamp 223. When the calling subscriber releases, relays 221, 225, 226 and 207 release disconnecting relay 202 from the busy-back equipment. If the trunk is now reselected, relays 221 and 225 reoperate but relay 226 can not. Therefore, if the operator should inadvertently operate key 205 without removing the plug from the busy-back jack, it will be impossible for relay 207 to operate. Therefore, relay 202 can not be operated to transmit a false signal to the tandem sender. In a similar manner relay 202 can not operate if the trunk is reselected while plug 215 is in the jack of a line on which the receiver is off the switchhook or of a line which is short-circuited by a trouble condition.

The position control circuit of Fig. 3 is equipped to serve trunks incoming from manual offices as well as trunks incoming from dial tandem offices. Such trunks connect ground by the operation of a relay such as relay 206 to conductor 338 operating relay 325 instead of relay 324. Relay 325 connects ground to the winding of relay 302 holding that relay operated to prevent the operation of relay 202 in connection with a manual call and to connect conductors 240 and 241 through the back contacts of relay 303 to the armatures of relay 304. It also operates relay 319 over a back contact of relay 315. Relay 319 causes the successive operation of relays 316, 317, 318 and 304 to connect the operator's telephone with the incoming trunk as above described and also initiates the transmission of the well known order tone to the manual operator. Since relay 302 is held operated, thereby preventing the operation of relay 222, the circuit for transmitting the tone to the originating office is completed in this case.

In case the tone apparatus becomes inoperative key 326 can be operated in turn operating relays 315 and 303. The operation of relay 315 disconnects conductor 243 from the contacts of relays 323 and 324, and extends it to the emergency circuit included in the dotted rectangle. Relay 303 extends the tip and ring conductors from the front contacts of relay 301 directly to the operator's headset independent of the contacts of relay 304. In addition conductor 244 is transferred from the winding of relay 332 to the winding of relay 310. Relays 310 and 309 thereafter function in the same manner as relays 332 and 323 to prevent the premature transmission of a signal to the tandem sender. Relays 313, 314 and 312 function under the control of relay 311 to transmit the signal to the call announcer mechanism in the same manner as relays 334, 335 and 333 operate under the control of relay 324. Relay 302 operates under the control of relay 314 in the manner described in connection with relay 335. However, in this case the connection of the operator's telephone to the trunk is not delayed but is effective as soon as relay 302 is operated and relay 222 released. In the case of calls from a manual office the operator must challenge over the trunk to inform the originating operator that she is ready to receive the wanted number.

What is claimed is:

1. In a telephone system, a dial office, a manual office, an operator's position at said manual office, trunks interconnecting said dial office and said manual office, an operator's control circuit common to said trunks, a key individual to each trunk for connecting said control circuit to said trunk, a call announcer mechanism at said dial office, means in said control circuit to initiate the operation of said call announcer mechanism, and means responsive to the seizure of one of said trunks to disable said initiating means until after the key of said trunk has been operated and released.

2. In a telephone system, a dial office, a manual office, an operator's position at said manual office, trunks interconnecting said dial office and said manual office, an operator's control circuit common to said trunks, a key individual to each trunk for connecting said control circuit to said trunk, a call announcer mechanism at said dial office, a supervisory relay in each trunk, means in said control circuit for momentarily operating said supervisory relay to transmit a signal to said dial office to initiate the operation of said call announcer mechanism, and means responsive to the seizure of one of said trunks to prevent the operation of said supervisory relay until after the key of said trunk has been operated and released.

3. In a telephone system, a dial office, a manual office, an operator's position at said

manual office, trunks interconnecting said dial office and said manual office, an operator's control equipment common to said trunks, a relay in each of said trunks for connecting said operator's control equipment with said trunk, a key individual to each of said trunks for operating said relay, a relay in said control equipment for transmitting a signal to said dial office to initiate the operation of said call announcer mechanism, a circuit controlled by said trunk relay and a normal contact of said key for operating said control equipment relay, and means responsive to the seizure of said trunk for preventing the completion of said circuit until said key has been operated and released.

4. In a telephone system, a dial office, a manual office, an operator's position at said manual office, a plurality of trunks interconnecting said dial office and said operator's position, an operator's control equipment common to said trunks, a relay in each of said trunks for connecting said operator's control equipment with said trunk, a key individual to each trunk for operating said trunk relay, a relay in said control equipment for transmitting a signal to said dial office to initiate the operation of said call announcer mechanism, a circuit controlled by said trunk relay and the normal contacts of all of said trunk keys in series for operating said control equipment relay and means responsive to the seizure of said trunk for preventing the completion of said circuit until the key of said trunk has been operated and released.

5. In a telephone system, an operator's position, a trunk appearing at said position, means for extending connections to said trunk, a called line, a disconnect signal for said trunk, and separate means for operating said disconnect signal depending on whether disconnection takes place before or after the connection has been extended to said called line.

6. In a telephone system, an operator's position, a trunk appearing at said position, means for extending connections to said trunk, a called line, a disconnect signal for said trunk, means responsive to the release of said trunk to display said disconnect signal, and means for maintaining the display of said disconnect signal independent of subsequent connections made to either end of said trunk.

7. In a telephone system, an operator's position, a trunk appearing at said position, means for extending connections to said trunk, a called line, a relay operated when said called line is signalled, a disconnect signal for said trunk, means responsive to the release of said trunk to display said disconnect signal, and means under the control of said relay for maintaining the display of said disconnect signal independent of subsequent

connections made to either end of said trunk.

8. In a telephone system, an operator's position, a trunk appearing at said position, means for extending connections to said trunk, a called line, a disconnect signal for
5 said trunk, a relay operated when said called line is signalled, and separate means under the control of said relay for operating said disconnect signal depending on whether dis-
10 connection takes place before or after the called line has been signalled.

9. In a telephone system, an operator's position, a trunk appearing at said position, means for extending connections to said
15 trunk, a called line, a disconnect signal for said trunk, separate means for operating said disconnect signal depending on whether disconnection takes place before or after said called line has been signalled, and means for
20 maintaining the display of said disconnect signal independent of subsequent connections made to either end of said trunk.

10. In a telephone system, an operator's position, a trunk appearing at said position,
25 means for extending connections to said trunk, a called line, a disconnect signal for said trunk, a relay operated when said called line is signalled, separate means under the control of said relay for operating said dis-
30 connect signal depending on whether disconnection takes place before or after said called line has been signalled, and means for maintaining the display of said disconnect signal independent of subsequent connections made
35 to either end of said trunk circuit.

In witness whereof, I hereunto subscribe my name, this 21st day of January, 1932.

HORACE W. ULRICH.

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