

Jan. 23, 1934.

F. A. KORN

1,944,244

TELEPHONE SYSTEM

Filed Dec. 6, 1930

3 Sheets-Sheet 1

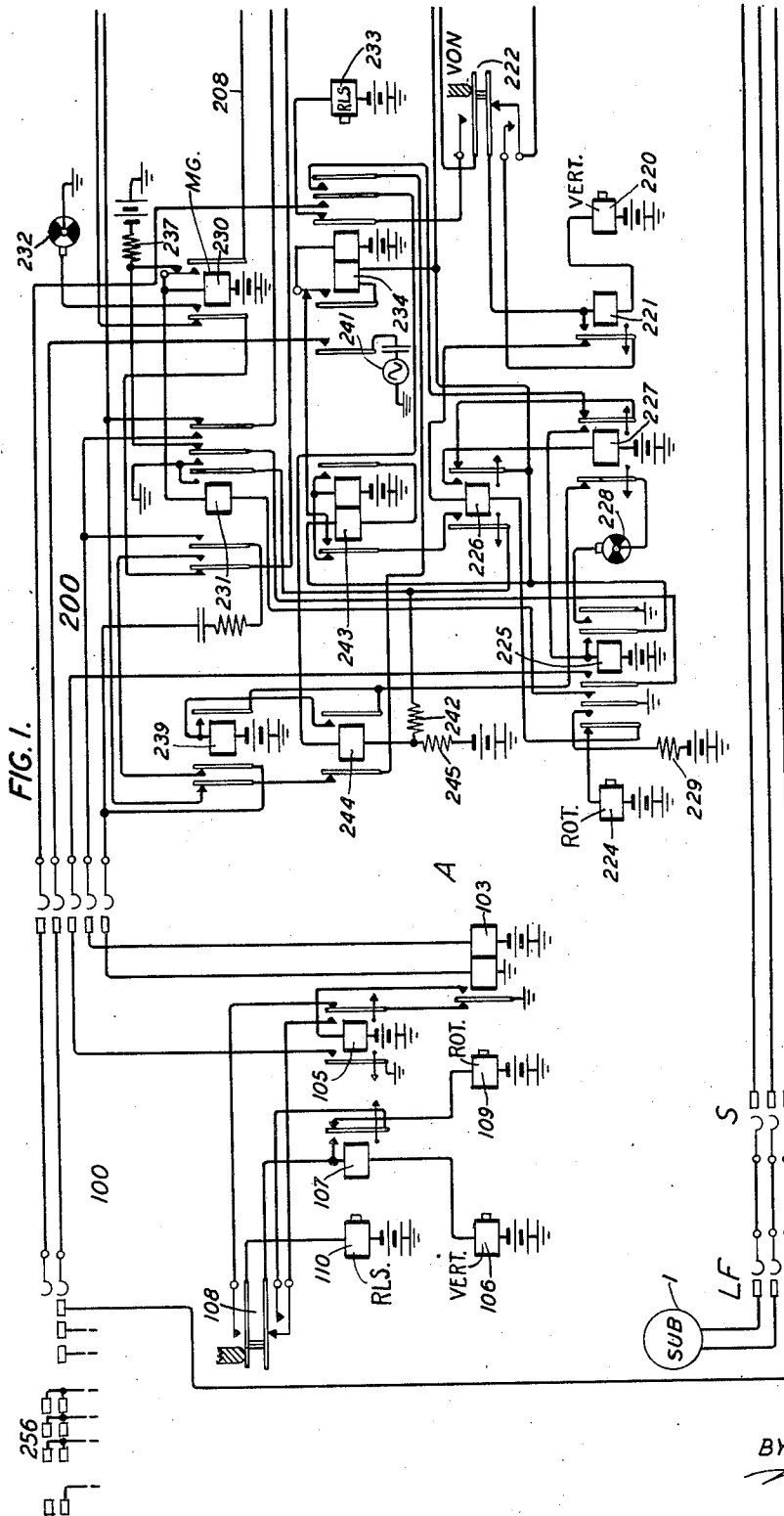


FIG. 4.

FIG. 1.	FIG. 2	FIG. 3
---------	--------	--------

INVENTOR
F. A. KORN

BY

ATTORNEY

Jan. 23, 1934.

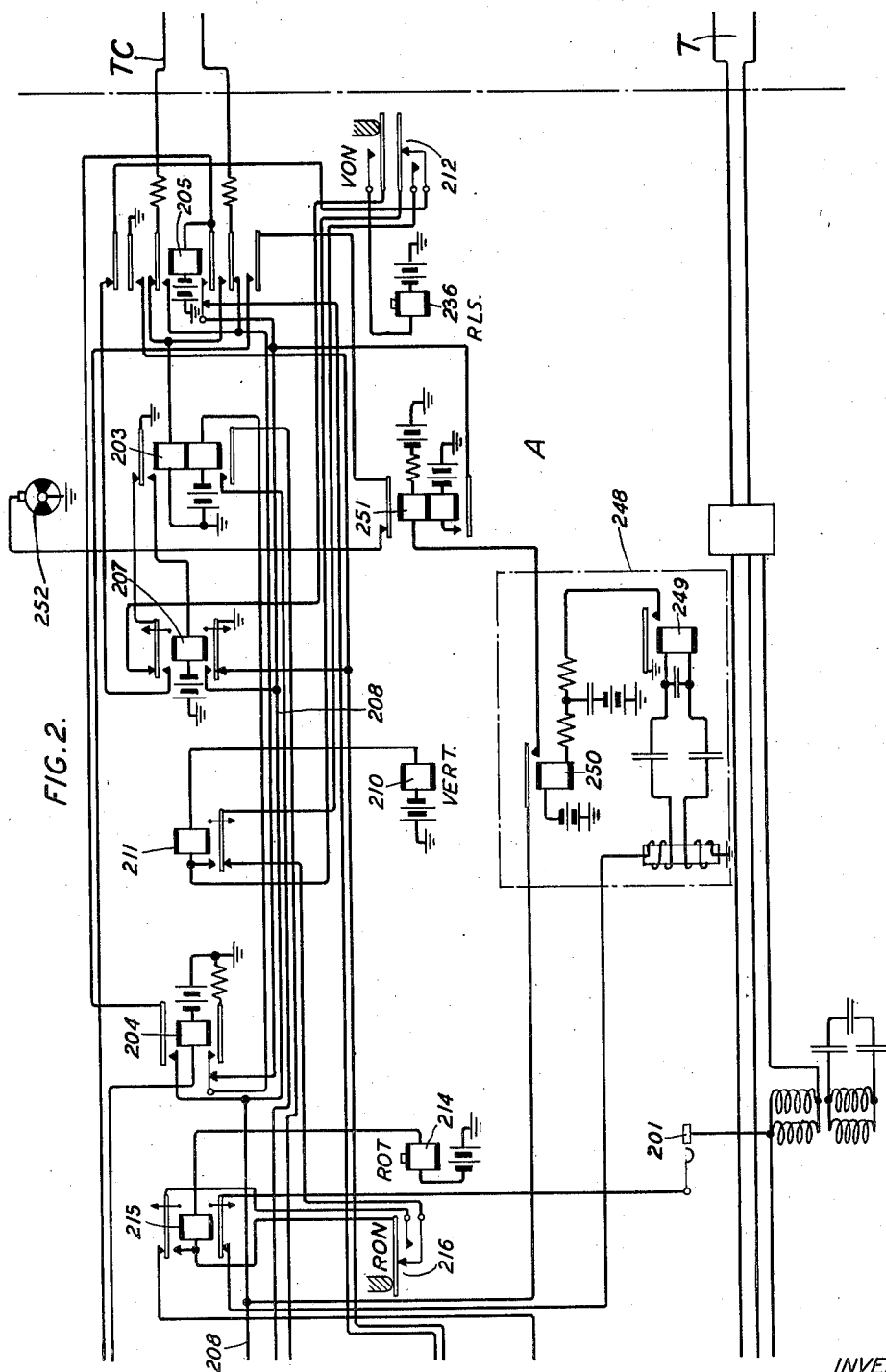
F. A. KORN

1,944,244

TELEPHONE SYSTEM

Filed Dec. 6, 1930

3 Sheets-Sheet 2



INVENTOR
F. A. KORN

BY
M. P. McFerry
ATTORNEY

Jan. 23, 1934.

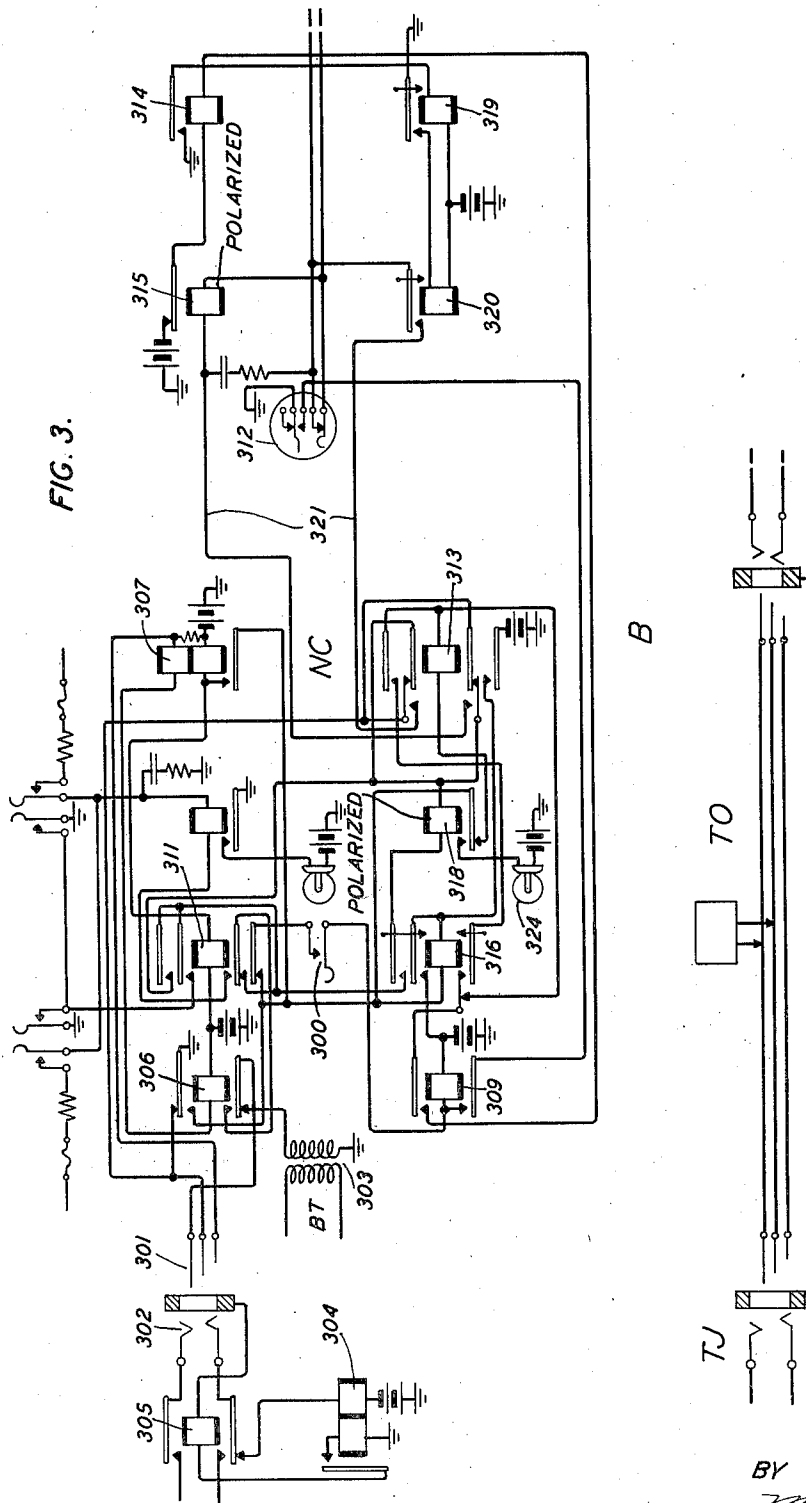
F. A. KORN

1,944,244

TELEPHONE SYSTEM

Filed Dec. 6, 1930

3 Sheets-Sheet 3



INVENTOR
F. A. KORN

BY
W. A. McFerry
ATTORNEY

UNITED STATES PATENT OFFICE

1,944,244

TELEPHONE SYSTEM

Franklin A. Korn, Elizabeth, N. J., assignor to
Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application December 6, 1930. Serial No. 500,466

18 Claims. (Cl. 179—27)

This invention relates to telephone systems and particularly to means for checking calling subscribers' numbers, and the object of the invention is to simplify and improve the checking of numbers when applied to automatic systems.

In a copending application by R. L. Quass filed Dec. 6, 1930, Serial No. 500,492, Patent No. 1,864,553, June 28, 1932, a system has been disclosed in which an operator at one office may check the number of a calling subscriber who has established automatically a connection from a distant office to said operator's position by establishing automatically over a trunk line between said offices a separate connection to the calling subscriber's line and applying an alternating current signal over the second connection and the original connection back to the trunk line. This signal when received at the trunk line, is then translated into a direct current signal which is transmitted over the trunk line to the operator's position where a visual signal is actuated thereby, to indicate to the operator that the correct number was given.

A feature of the present invention is an arrangement, in systems of this kind, in which the separate connection is established by series of circuit interruptions controlling automatic switches, whereby means actuated by the last two series of circuit interruptions controls the application of an alternating current signal to take place after the last series has controlled the last switch to complete the connection.

Another feature of this invention is means for applying number checking to groups of private branch exchange lines. The last switch will select a group in the same manner as a single subscriber's line is selected and hunt over the terminals of this group under control of a relay that will be actuated through circuit connections made by a brush through terminals of the succeeding lines in the group regardless of whether these terminals are connected to battery or ground.

This invention is illustrated in the accompanying drawings in which Figs. 1, 2 and 3 may be arranged as shown in Fig. 4 for the disclosure of a number checking system.

Referring to the drawings, a connection from a calling subscriber's station is shown extending from a call-originating office A through a line finder LF, and a selector S over a trunk T, to a distant office B where trunk T terminates in a jack TJ, at a number checking toll operator's position TO. A number checking connection embodying features of this invention is shown

terminating in office B in a jack 300 and extending over trunk TC to office A and the circuits as shown in Figs. 3, 2 and 1 may be used for number checking of individual lines as well as lines of private branch exchanges.

To establish a number checking connection the operator at B seizes, by means of the cord NC (shown in Fig. 3), the number checking trunk TC and first dials two numbers to connect the trunk selector 201 to the trunk T and then dials four additional numbers to establish a connection to the sleeve of the calling subscriber's line. This connection will extend over a first selector 200 and a connector 100. If the connection is for an individual line, the connector 100 will be directed to the sleeve terminal of the individual line while in the case of a private branch exchange the connector will be directed to the group of terminals representing this exchange and then actuated to hunt over the terminals of this exchange. An alternating current signal will be applied through the trunk selector 201 to the sleeve of the connection between the calling subscriber and the toll operator and be detected by the connector 100 and then translated into a direct current signal which is transmitted over the trunk TC to the toll operator's position where a visual signal is actuated thereby, to indicate to the operator that the correct number was given.

The connection from the calling subscriber at 1 to the toll operator TO has been shown in diagrammatic form as any well known system for establishing connections of this kind may be used. The switches employed in the number checking connection may be of any well known two-movement step-by-step type.

Assuming now that the operator TO at B has answered the call from the subscriber at 1, by inserting the answering plug of a regular toll cord shown diagrammatically at TO into trunk jack TJ and received his number, she may proceed to check this number while extending the connection in the desired direction. The number checking cord NC will be used for this purpose and the first action on the part of the operator will be to activate the key 300 and then test the number checking trunk TC by touching the tip of the plug 301 to the sleeve of the jack 302. If the trunk is busy a click will be heard through the busy test arrangement shown at 303 by the operator in the usual manner. If the trunk TC is idle the operator will insert plug 301 into jack 302 and thereby cause the operation of relay 304 in the number checking trunk over a circuit as

follows: Battery, right hand winding of relay 304, lower armature and back contact of relay 305, ring terminals of jack 302, and plug 301 to ground at the upper armature and back contact of relay 306. Relay 304 in operating closes a circuit for relay 305 over the sleeve connection, as follows: Battery, winding of relay 306, upper winding of relay 307, the sleeve terminals of plug 301 and jack 302, winding of relay 305, armature and front contact of relay 304, left hand winding of this relay to ground. This circuit holds relay 304 operated and causes the operation of relay 305, which completes the tip and ring connections from the jack 302 over the trunk TC. Relay 307 does not operate in this circuit as this relay is part of a coin control circuit arrangement shown in this cord but which does not form part of this invention and will therefore not be described. Relay 306, however, operates to open the original circuit for relay 304 at the upper armature and back contact. As key 300 is operated a circuit will now be completed for the operation of relay 309 from battery, winding of this relay key 300, lower outer armature and back contact of relay 311, upper armature and front contact of relay 306, to ground. Relay 309 in operating provides at its lower armature and front contact a locking circuit for itself to the off-normal contact of the dial 312, to hold this relay operated while dialing as will hereinafter be described. Relay 309 in operating also closes a circuit for the operation of relay 313 and 314 as follows: Battery, armature and back contact of relay 315, winding of relay 314, upper armature and front contact of relay 309, lower make-before-break contact of relay 316, winding of relay 313, armature and back contact of relay 318, to ground at the upper armature and front contact of relay 306. Relay 314 in operating closes an obvious circuit for the operation of relay 319 and this relay closes an obvious circuit for the operation of relay 320. Relay 320 in operating closes a connection from the dial 312 to conductors 321 connected to the cord. These are the pulsing conductors. Relay 313 in operating closes a circuit for the operation of relay 316 from battery, lower outer armature and front contact of relay 313, winding of relay 316, to the ground at relay 306. Relay 316 in operating opens the original energizing circuits for relay 313 and completes another circuit for this relay through the lower armature and front contact of relay 316 and upper outer armature and front contact of relay 313. Relay 316 also provides a locking circuit for itself from battery through its upper inner armature and front contact to ground at relay 306, independent of the battery supplied at the lower outer armature and front contact of relay 313. The operation of relays 313 and 316 extends the conductors 321 to the tip and ring conductors of the cord so that the operator may now begin to dial the calling subscriber's number for the purpose of checking it.

The dialing circuits completed by relays 316 and 313 now cause the operation of relay 203 over a circuit as follows: Battery, lower winding of relay 203, make-before-break contact of relay 204, middle lower armature and back contact of relay 205, the ring conductor of trunk TC, lower armature and front contact of relay 305, ring terminals of jack 302 and plug 301, upper make-before-break contacts of relay 313, armature and front contact of relay 320, pulsing contacts of dial 212, winding of relay 315, lower make-before-break contacts of relay 313, wind-

ing of relay 318, upper outer armature and front contact of relay 316, lower inner armature and back contact of relay 311, lower armature and front contact of relay 306, the tip terminals of plug 301 and jack 302, upper armature and front contact of relay 305, tip conductor of trunk TC, upper inner armature and back contact of relay 205, upper winding of relay 203 to ground. Relay 203 closes an obvious circuit for the operation of relay 207 and this relay in operating provides at its lower armature and front contact a connection to ground for conductor 208. The operator may now dial the first digit for the control of the trunk connector 201 to select the sleeve of trunk T over which the connection from the calling subscriber to the toll operator has been established. Relay 203 follows the pulses of this digit while relay 207 which is slow-in-releasing remains operated during the pulsing.

The first series of impulses causes the operation of the vertical magnet 210, over a circuit from battery through the winding of this magnet, winding of relay 211, vertical off-normal contacts 212, upper outer armature and back contact of relay 205, upper armature and front contact of relay 207, to ground at the upper armature and back contact of relay 203. Relay 211 also operates in this circuit and as it is slow-to-release it will remain operated during the pulsing. This relay closing a substitute circuit through its armature and front contact and vertical off-normal contact 212 for the vertical magnet 210. At the end of the first series of impulses relay 211 releases to shift the pulsing circuit to the rotary magnet 214. The second series of impulses will now operate the rotary magnet 214 over a circuit from battery, winding of this magnet, winding of relay 215, rotary off-normal contact 216, armature and back contact of relay 211, vertical off-normal contact 212, upper outer armature and back contact of relay 205, upper armature and front contact of relay 207, to ground at the upper armature and back contact of relay 203. The second series of impulses will now advance the brush of the trunk selector 201 to connect with the sleeve conductor of the trunk T. Relay 215 operates in the pulsing circuit for the rotary magnet and as it is slow-to-release it will remain operated during the pulsing. At the end of this series of impulses, relay 215 releases to prepare circuit connections for the control of the selector 200 and this selector will now be actuated by the next two series of impulses to select the connector

A pulsing circuit from relay 203 will now be extended for the control of the vertical magnet 220 of selector 200 as follows: Battery, winding of magnet 220, winding of relay 221, vertical off-normal contacts 222, upper armature and back contact of relay 215, rotary off-normal contacts 216, lower armature and back contact of relay 211, vertical off-normal contacts 212, upper outer armature and back contact of relay 205, upper armature and front contact of relay 207 to ground at the upper armature and back contact of relay 203. The vertical magnet 220 responds to the next series of impulses to advance the brushes of the selector 200 to the desired level. Relay 221 also operates in this circuit for the vertical magnet 220 and as it is slow-to-release it will remain operated during this series of impulses. It should be noted that relay 221 in operating shifts the pulsing circuit through its

armature and front contact and contacts of the vertical off-normal contacts 222, so that when relay 221 releases at the end of this series of impulses, the pulsing circuit will be extended to the rotary magnet 224 as follows: Battery, winding of the rotary magnet 224, outer left hand armature and back contact of relay 225, winding of relay 226, armature and back contact of relay 221, vertical off-normal contacts 222, over the circuit hereinbefore traced to ground at relay 203. The operator may now dial the fourth series of impulses of the fourth digit, to connect the brushes of selector 200 with connector 100. The relay 226 operates in the pulsing circuit for the rotary magnet and as it is slow-to-release it will remain operated during the pulsing. At the end of this series of impulses relay 226 releases to prepare the pulsing circuit for the control of the connector 100.

When relay 226 operated it closed a circuit for relay 227 from battery, winding of this relay, right hand armature and front contact of relay 226, lower make-before-break contact of relay 205, to the ground on conductor 208. The relay 227 is slow in releasing so that when relay 226 releases after the four series of impulses have been sent a circuit will be momentarily closed for the operation of relay 225 from battery, winding of this relay, right hand armature and front contact of relay 227, right hand armature and back contact of relay 226 to the ground on conductor 208 as described above. Relay 225 in operating provides itself with a locking circuit through its right hand armature and front contact to the ground on conductor 208 independent of relays 227 and 226. Relay 227 then releases. Relay 225 in operating closes at its outer right hand armature and front contact, a connection to ground for the interrupter 228, the purpose of which will be hereinafter described. Relay 225 also establishes a connection from battery through a resistance 229, outer left hand armature and front contact of relay 225 to one side of the winding of relay 226. Relay 225 also closes an obvious circuit for relays 230 and 231. These two relays are provided for the purpose of testing connector 100 in regard to its busy or idle condition. The arrangement may be such that the connector 100 may be seized by a number of selectors such as 200. Connector 100 may also be employed as a test connector and may therefore also become busy in this connection. For these purposes the connector 100 may be wired to the terminals of other number checking selectors and similar test selectors. If connector 100 in any of these types of connections is busy, a ground connection will be found on the third terminal of the connector to short-circuit relay 231, before it has time to operate, on the closure of the connection therefor to ground by relay 225. Relay 230 however will operate over the connection to ground on the test terminal over a circuit as follows: Battery, winding and make-before-break contacts of relay 230, middle right hand armature and back contact of relay 231, inner left hand armature and front contact of relay 225, test brush of selector 200 and test terminal of connector 100 to ground at left hand armature and front contact of relay 105 which will be operated in this case. Relay 230 provides a locking circuit for itself through its right hand armature and front contact, to ground on conductor 208. Relay 230 in operating closes a connection at its left hand armature and front contact to ground through an interrupter 232. A circuit from this

interrupter may be traced for relay 204 as follows: Battery, winding of relay 204, outer right hand armature and back contact of relay 231, lower armature and front contact of relay 203, outer left hand armature and back contact of relay 231, left hand armature and front contact of relay 230, through interrupter 232 to ground. This connection causes the operation of relay 204 at intervals under control of the interrupter. Relay 204 when first operated closes an obvious circuit for the operation of relay 205 at its upper armature and front contact. Relay 205 in operating provides a locking circuit for itself through its lower inner armature and front contact to the ground on conductor 208. Relay 204 in operating opens at its make-before-break contacts the connection over the trunk TC from battery and ground through the windings of relay 203, but it also closes at its lower armature and front contact an obvious circuit for holding relay 203 operated. Each time relay 204 is released, it permits, due to the operation of relay 205, a reversed impulse from the battery and ground connection through the windings of relay 203 to be transmitted over trunk TC. Relay 203 is held operated while relay 204 is released and the reversals cause the alternate operation and release of a polarizing relay 318 in the cord NC. Relay 318 in operating closes an obvious circuit for the lighting of lamp 324. Lamp 324 is therefore alternately lighted and extinguished to signal the operator that the connector 100 is busy. Relay 205 in operating also closes a circuit for the operation of the release magnet 233 over a circuit from battery, right hand make-before-break contacts of relay 234, vertical off-normal contacts 222, middle upper armature and front contact of relay 205 to ground. Relay 205 also opens at its lower make-before-break contacts the holding circuit for relay 225 which now releases. The operation of the release magnet 233, causes the release of selector 200, and when the operator removes the plug 301 from jack 302, the connection through the tip and ring conductors of trunk TC will be opened to cause the release of relay 203, which in turn causes the release of relay 207. The release of relay 203 opens the circuit for the intermittent operation of relay 204 and relay 207 in releasing closes the circuit for the release magnet 236, from battery, winding of this magnet, vertical off-normal contacts 212, upper armatures and back contacts of relays 207 and 203, thus causing the release of the trunk selector 201. Relay 207 opens the ground connection for conductor 208 and thus causes the release of relay 230. The circuits of the number checking trunk TC are now in normal condition.

On the other hand if connector 100 is idle there will be no ground connection on the sleeve terminal of this connector. Relay 231 will therefore be operated while relay 230 remains released due to its marginal characteristics and the shunt connection to battery through resistance 237. The operation of relay 229 extends the pulsing circuit from relay 203 to connector 100 as follows: Battery, right hand winding of the pulsing relay 103, ring terminal of connector 100 and the corresponding brush of selector 200, outer right hand armature and front contact of relay 231, lower armature and front contact of relay 203, outer left hand armature and front contact of relay 231, inner left hand armature and back contact of relay 239, tip brush and corresponding terminal of connector 100 through the left hand winding of pulsing relay 103 to ground. A ground

connection is also made at the middle right hand armature and front contact for the sleeve connection of connector 100 to make this connector busy. While a ground is also connected at the inner right hand armature and front contact through a resistance 242 for the operation of a counting relay arrangement that will be described hereinafter. The circuits are now arranged for controlling the connector 100 to select the sleeve terminal of the calling subscriber's line. The toll operator will now send the fifth series of impulses to control relay 103 over the circuit therefor through the lower armature and front contact of relay 203. The operation of relay 103 closes an obvious circuit for the operation of relay 105 which, due to its slow-to-release characteristics, remains operated during the pulsing. On each release of relay 103 a circuit is completed for the operation of the vertical magnet 106. The circuit for the vertical magnet may be traced from battery, through the winding of this magnet, winding of relay 107, vertical off-normal contacts 108, right hand armature and front contact of relay 105, armature and back contact of relay 103 to ground. Relay 107 included in this circuit operates and remains operated due to its slow-to-release characteristics during the pulsing and prepares a path for the pulsing circuit through its armature and front contact and the closed contacts of the vertical off-normal contacts 108, so that when this relay releases at the end of this series of impulses a circuit will be closed for the control of the rotary magnet 109. The operator will now send the sixth and last series of impulses. The circuit for the rotary magnet may be traced from battery, through the winding of this magnet, armature and back contact of relay 107, vertical off-normal contacts 108, right hand armature and front contact of relay 105, armature and back contact of relay 103 to ground. When this series of impulses ceases, the brushes of the connector 100 have been replaced on the sleeve terminal of the calling subscriber's line if the number given by this subscriber was correct.

Referring now to the above-mentioned counting relay arrangement, it will be noted that the release of relay 203 during the sending of the last two series of impulses, causes the operation of relay 226, over a circuit from battery through resistance 229, outer left hand armature and front contact of relay 225, winding of relay 226, armature and back contact of relay 221, vertical off-normal contacts 222, upper armature and back contact of relay 215, rotary off-normal contacts 216, armature and back contact of relay 211, vertical off-normal contacts 212, upper armature and back contact of relay 205, upper armature and back contact of relay 207, to ground at the upper armature and back contact of relay 203. Relay 226 remains operated during the sending of this series of impulses, closes a circuit for relay 243 from battery, right hand winding of this relay, left hand armature and back contact thereof, left hand armature and front contact of relay 226, to ground at the middle right hand armature and front contact of relay 231. Relay 243 is a so-called two-step relay so that the energization of the right hand winding merely closes a connection through the right hand armature and front contact of this relay, while the left hand armature remains unoperated. Relay 226 in operating also closes a circuit for the operation of relay 227, but this relay performs no useful function at this time. At the end of the fifth series of impulses, relay 226 releases and thereby opens the circuit through the right hand winding of relay 243 to ground. This relay will now therefore be fully operated through the circuit closed by the right hand armature and front contact from battery, right hand winding and this armature and front contact through the left hand winding to ground on conductor 208. As the next and last series of impulses are sent relay 226 again operates. The operation of this relay will now, due to the operation of relay 243 cause a circuit to be closed from battery through the right hand winding of relay 234, left hand make-before-break contacts of this relay, left hand armature and front contact of relay 243, left hand armature and front contact of relay 226 to ground at the middle right hand armature and front contact of relay 231. This circuit causes the partial operation of relay 234 as this relay is also a two-step relay. The partial operation of relay 234 only closes the connection through the inner left hand armature and front contact. On the second operation of relay 226, relay 227 will also be operated and open at its left hand make-before-break contacts a circuit for relay 239, that will be completed later through the right hand armature and front contact of relay 244, and it also opens at its right hand armature and back contact a circuit that will be closed later for the relay 204. When relay 226 releases at the end of the last series of impulses, relay 234 is fully operated over a circuit from battery through its right hand winding, left hand inner armature and front contact and left hand winding to ground on conductor 208. Relay 234 in operating closes a circuit for applying the signal from the alternating current source at 241 to the sleeve conductor as follows: From source 241, outer left hand armature and front contact of relay 234, sleeve brush of selector 200, sleeve terminal of connector 100, the sleeve brush of this connector and the sleeve terminal of the calling subscriber's line. Relay 234 also opens the circuit at the right hand make-before-break contact of the release magnet 233 and closes a circuit for relay 244 from battery, resistance 245, winding of relay 244, middle right hand armature and front contact of relay 234, upper brush of selector 200, and the upper brush of connector 100. In this case the calling subscriber's line is an individual line so relay 244 does not operate. The alternating current signal applied to the sleeve connection to the calling subscriber's line will be transmitted over the trunk connection sleeve to the trunk selector 201 where it is received through the lower armature and back contact of relay 215 and the alternating current responsive device 248 to cause the operation of relay 249. This relay in operating closes an obvious circuit for the operation of relay 250 and relay 250 closes a circuit for the operation of relay 251 from battery, upper winding of this relay, armature and front contact of relay 250 to ground on conductor 208. It should be observed that on the release of relay 226, relay 227 will release, so that a circuit is closed for the operation of relay 204 from battery, winding of this relay, outer left hand armature and back contact of relay 239, left hand armature and back contact of relay 244, outer right hand armature and front contact of relay 234, right hand armature and back contact of relay 227, right hand armature and back contact of relay 226 to ground on conductor 208. Relays 226 and 227 are slow in releasing so that the alternating current signals will be transmitted over the trunk connection to cause the above men-

tioned operation of relay 251 to take place before relay 204 is operated. Relay 204 in operating causes the operations hereinbefore described resulting in the lighting of lamp 324 in the toll operator's cord circuit. In this case this lamp will be lighted steadily as the relay 204 will not be alternately operated and released. In this case where the checking of the calling subscriber's number was successful, relay 251 in operating opens the circuit to an interrupter 252 to prevent the pulsing of relay 204 as will hereinafter be described in connection with an unsuccessful check. The steady signal will be taken by the operator as an indication that the check was successful. The operation of relay 205 will release relay 225 which releases relay 234 and causes the release of the selector 200 as hereinbefore described and selector 200 causes the release of connector 100 by the release of relays 103 and 105 which closes the circuit for release magnet 110. Relay 231 will also be released and thereby cause the release of relay 204, to extinguish the signal 324 and when the operator removes plug 301 from jack 302, relays 203 and 207, 205 and 251 will be released to restore the circuits to normal. It should be observed that the counting relay arrangement described above causes the signal over the trunk to be applied through the selector 200 and connector 100 after the last series of impulses has been sent and that the application is controlled by the two last series of impulses. In case the calling subscriber had given the wrong number the connector 100 would have connected with a wrong sleeve terminal and the operation of relay 251 would not have taken place as the alternating current signal would not have been transmitted over the trunk connection from the calling subscriber's line. In this case on the operation of relay 204 at the release of relay 227, relay 205 would have operated in the same manner to cause the release of the selector 200 and the connector 100 and thereby cause the release of relay 204, and the extinguishing of lamp 324 after its first operation. After the release of relays 234 and 231 a circuit will be closed for again operating relay 204 as follows, from battery, the winding of relay 204, outer right hand armature and back contact of relay 231, lower armature and front contact of relay 203, outer left hand armature and back contact of relay 230, lower outer armature and front contact of relay 205, upper armature and back contact of relay 251, interrupter 252 to ground. Relay 204 will thereby be alternately operated and released to cause the alternate operation of relay 318 and alternate lighting and extinguishing of the lamp 324 to indicate to the toll operator that the checking was not successful. The interrupter 252 may have a different frequency of interruption from that of interrupter 232 so as to distinguish this signaling from a busy signal.

If the calling subscriber had been located in a private branch exchange the connector 100 would have selected the group of terminals 256 which represents terminals of subscribers' lines in this exchange and the brushes of the connector would have stopped on the first set of terminals representing the first subscriber's line in this exchange. It will be noted that the brushes of connector 100 in this case encounter two terminals. These terminals as well as those representing the succeeding subscriber lines are connected together except the terminals of the last in the group. Therefore when the brushes of connector 100 connect with a first set of terminals a circuit will be completed for the operation of relay 244 over the circuit hereinbefore traced through the upper brushes and terminals of connector 200 and connector 100 to the sleeve terminal of this private branch exchange subscriber's line where battery or ground will be encountered. Relay 244 in operating opens at its left hand armature and back contact at the circuit for relay 204 which would ordinarily be completed, on the release of relays 227 and 226. Relay 244 in operating closes a circuit at its right hand armature and front contact for the operation of relay 239 as follows: From battery, winding of relay 239, right hand armature and front contact of relay 244, left hand armature and back contact of relay 227, interrupter 228 to ground at the outer right hand armature and front contact of relay 225, when the interrupter establishes a connection through its contacts. Relay 239 in operating closes at its right hand armature and front contact a circuit directly to the interrupter 226 to ground at relay 225, independent of relay 244. This relay 239 opens at another point the circuit for relays 204 and also at its inner right hand armature and back contact the circuit for relay 103. This causes relay 103 to release and a circuit for the operation of the rotary magnet 102 is closed to advance the connector 100 to the next set of terminals of this private branch exchange group of lines. As the brushes of connector 100 pass from the first set of terminals to the second, relay 244 may momentarily release but this is of no consequence as relay 239 holds open the circuit for relay 204 under control of interrupter 228. As the next set of terminals is reached relay 244 will be operated and relay 239 will be released by the interrupter 228, and again operated by the closing of the connection through the interrupter 226 to cause the relay 103 to again step the brushes of connector 100 to the next set of terminals. These operations will continue until the last set of terminals has been reached. In the meantime relay 234 has been operated as heretofore described to apply an alternating current signal from the source 241 to the sleeve terminals of the succeeding private branch subscribers' lines, so that this signal will be transmitted over the sleeve of the calling subscriber's line in this group no matter which one of the subscribers has established the connection to cause the operation of relay 251 as hereinbefore described. When the terminals of the last private branch exchange subscriber's line are reached relay 244 will release as the upper terminal is not connected to the sleeve terminal. Relay 244 in releasing will open the circuit for relay 239 so that when it releases, it can not again be operated by interrupter 228. The above mentioned circuit for relay 204 will thereby be completed to cause the signal 324 to be operated and the number checking connection released as hereinbefore described.

If the calling subscriber had given the wrong number it is evident that relay 251 would not have operated and the signal 324 would have indicated this unsuccessful check. It is of course only necessary for the calling subscriber to give the private branch exchange number rather than his individual number as the alternating current signal from the source 241 is transmitted over each succeeding sleeve of all the lines in the private branch exchange and the line connected over the trunk will have its sleeve connection to cause the operation of relay 251 for the signaling of the toll operator.

While this invention has been illustrated in

connection with but a single system it should be understood that it could be readily applied to a number of other system without departing from the spirit thereof, and that the present disclosure of the invention is merely illustrative thereof.

What is claimed is:

1. In a telephone system, a series of automatic switches, means responsive to circuit interruptions for establishing a connection through said series of switches, and means in a preceding switch responsive solely to the circuit interruptions for establishing the connection through a succeeding switch for applying a signal over the established connection when completed.

2. In a telephone system, a series of switches, means responsive to series of circuit interruptions for establishing a connection through said series of switches, and means controlled solely by the last two series of circuit interruptions for applying a signal over the connection when completed.

3. In a telephone system, a series of switches, means responsive to series of circuit interruptions for establishing a connection through said series of switches, and means in a preceding switch solely under control of the last two series of circuit interruptions for applying a signal over the established connection when the last series of circuit interruptions ceases.

4. In a telephone system, a series of automatic switches, means in a preceding switch for controlling through circuit interruptions the directive operations of a succeeding switch to establish a connection through said switches, and means in said preceding switch responsive solely to said circuit interruptions for applying a signal over the established connection when completed.

5. In a telephone system, an operator's position, a series of automatic switches, a called line, means responsive to circuit interruptions for establishing a connection between said operator's position and the called line through said automatic switches, and means in a preceding switch responsive solely to the circuit interruptions for establishing the connection through a succeeding switch for applying a signal from said preceding switch over the circuit connection to the called line when said connection is completed.

6. In a telephone system, a series of automatic switches, means responsive to series of current interruptions for establishing a connection through said series of switches, a relay in a preceding switch, means for maintaining said relay operative during the last two series of interruptions and for releasing it after the completion of each of said series, and means responsive on the second release of said relay for transmitting a signal from said preceding switch over the established connection.

7. In a telephone system, a series of automatic switches, means responsive to series of current interruptions for establishing a connection through said series of switches, a relay in a preceding switch, means for maintaining said relay operative during the last two series of interruptions and for releasing it after the completion of each of said series, an alternating current source and means including two relays operative in response to said operations and release of the first mentioned relay for applying current from said source to the established connection.

8. In a telephone system, a series of automatic switches, means responsive to a series of current interruptions for establishing a connection

through said series of switches, a relay in a preceding switch, means for maintaining said relay operative during the last two series of interruptions and for releasing it after the completion of each of said series, two two-step relays, means for partially operating one two-step relay on the first operation of said first mentioned relay and for fully operating said two-step on the release of said first mentioned relay, means for thereafter partially operating the other two-step relay on the second operation of the first mentioned relay and for fully operating said two-step relay on the second release of said first mentioned relay, a source of alternating current, and means responsive to the full operation of said second two-step relay for applying current from said source to the established connection.

9. In a telephone system, a switch, a group of lines, terminals in said switch representing the individual lines in said group, battery or ground connections on said terminals except the terminal of the last line, a pulsing relay in said switch, means for actuating said pulsing relay to control said switch to advance its brushes to the terminal of the first line, a relay, circuit means for actuating said relay when a brush of said switch comes in contact with said terminals regardless of whether they are connected to battery or ground, and means responsive to the actuations of said relay for controlling the pulsing relay to advance the brushes of said switch to contact with said terminals in succession until the last terminal is reached.

10. In a telephone system, a switch, a group of lines, terminals in said switch representing the individual lines in said group, battery or ground connections on said terminals except the terminal of the last line, a pulsing relay in said switch, means for actuating said pulsing relay to control said switch to advance its brushes to the terminal of the first line, a relay, a circuit for said relay comprising a connection from one side of its winding through two resistances in parallel to battery and ground respectively and from the other side of its winding to a brush of the switch so that when said brush comes in contact with the terminals of said lines said relay will be actuated regardless of whether said terminals are connected to battery or to ground, and means responsive to the actuations of said relay for controlling the pulsing relay to advance the brushes of said switch to contact with said terminals in succession until the last terminal is reached.

11. In a telephone system, a switch, a group of lines, terminals in said switch representing the individual lines in said group, battery or ground connections on said terminals except the terminal of the last line, a pulsing relay in said switch, means for actuating said pulsing relay to control said switch to advance its brushes to the terminal of the first line, a relay, circuit means for actuating said relay when a brush of said switch comes in contact with said terminals regardless of whether they are connected to battery or ground, means responsive to the actuations of said relay for controlling the pulsing relay to advance the brushes of said switch to contact with said terminals in succession until the last terminal is reached, and means for releasing said switch responsive on the release of said relay when a brush of the switch comes in contact with the terminal of the last line.

12. In a telephone system, a switch, a group of lines, terminal in said switch representing the

- individual lines in said group, battery or ground connections on said terminals except the terminal of the last line, a pulsing relay in said switch, means for actuating said pulsing relay to control said switch to advance its brushes to the terminal of the first line, a relay, circuit means for actuating said relay when a brush of said switch comes in contact with said terminals regardless of whether they are connected to battery or ground, a second relay, an interrupter, a circuit controlled by said interrupter to alternately actuate and release the second relay, means for closing said interrupter circuit on the operation of said first relay, and means controlled by said second relay for alternately actuating and releasing said pulsing relay to advance the brushes of said switch to contact with said terminals in succession until the terminal of the last line is reached.
13. In a telephone system, a switch, a group of lines, terminals in said switch representing the individual lines in said group, battery or ground connections on said terminals except the terminal of the last line, a pulsing relay in said switch, means for actuating said pulsing relay to control said switch to advance its brushes to the terminal of the first line, a relay, circuit means for actuating said relay when a brush of said switch comes in contact with said terminals regardless of whether they are connected to battery or ground, a second relay, an interrupter, a circuit controlled by said interrupter to alternately actuate and release the second relay, means for closing said interrupter circuit on the operation of said first relay, means controlled by said second relay for alternately actuating and releasing said pulsing relay to advance the brushes of said switch to contact, and means responsive to the release of said two relays when the last terminal is reached for releasing said switch.
14. In a telephone system, a series of switches, means for establishing a connection through said switches, a group of lines, a pulsing relay in the last switch, terminals in said last switch representing the lines in said group, means responsive to the actuation of said pulsing relay for controlling the last switch to connect its brushes with the terminals of the first line in said group, a relay in a preceding switch, means for applying battery or ground to the terminals of said lines except the last, circuit means for actuating said relay in response to said battery or ground connection on the terminals of said lines, a release means for said switches controlled by said relay when operated to prevent the release of the switches, means controlled by the operation of said relay for actuating the pulsing relay to advance said last switch over the terminals of said lines until the terminals of the last line have been reached, to cause the release of the relay at this time and in response thereto to cause the release of the switches under control of the release means.
15. In a telephone system, a series of automatic switches, means responsive to circuit interruptions for establishing a connection through said series of switches and means in a preceding switch responsive solely to the circuit interruptions for establishing the connection through a succeeding switch for applying an alternating current signal over the established connection when completed.
16. In a telephone system, a series of switches, means responsive to series of circuit interruptions for establishing a connection through said series of switches, the last switch in said series being controlled by the last two series of circuit interruptions, and means in a preceding switch controlled solely by said last two series of circuit interruptions for applying an alternating current signal over the connection when completed.
17. In a telephone system, a series of automatic switches, means responsive to series of current interruptions for establishing a connection through said series of switches, a relay in a preceding switch, means for maintaining said relay operated during the last two series of interruptions and for releasing it after the completion of each of said series, and means responsive to said operations and release of said relay for transmitting a signal from said preceding switch over the established connection.
18. In a telephone system, a series of automatic switches, means responsive to series of circuit interruptions for establishing a connection through said series of switches and means responsive to certain of said series of circuit interruptions only for applying a signal over the established connection when completed.
- FRANKLIN A. KORN.

55 130

60 135

65 140

70 145

75 150