June 2, 1936. R. B. BUCHANAN ET AL 2,042,828

TELEPHONE SYSTEM

Filed March 7, 1935 3 Sheets-Sheet 1

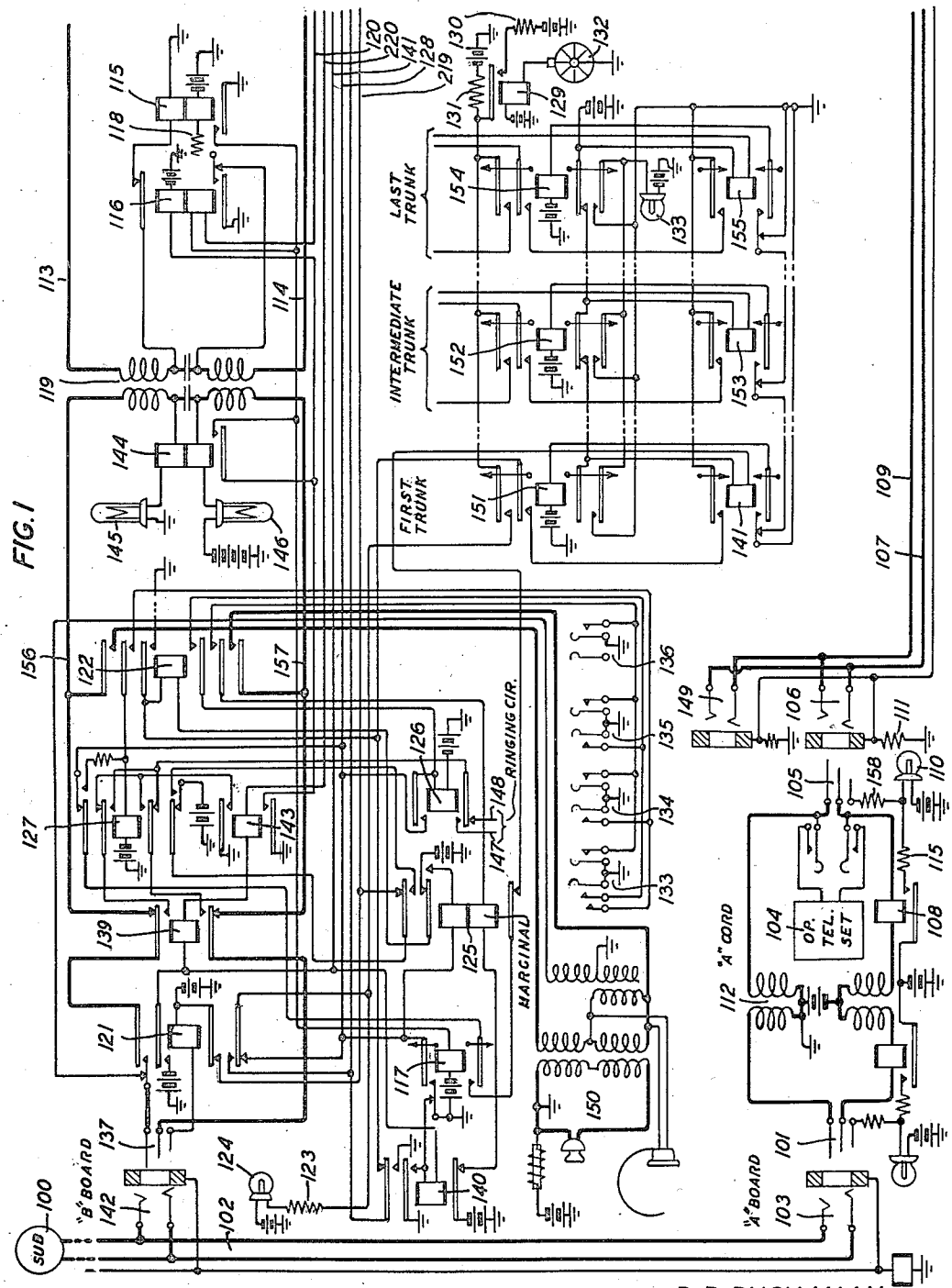


FIG. 1

INVENTORS R. B. BUCHANAN
L. A. KILLE

BY P. C. Smith

ATTORNEY

June 2, 1936. R. B. BUCHANAN ET AL 2,042,828

TELEPHONE SYSTEM

Filed March 7, 1935 3 Sheets-Sheet 2

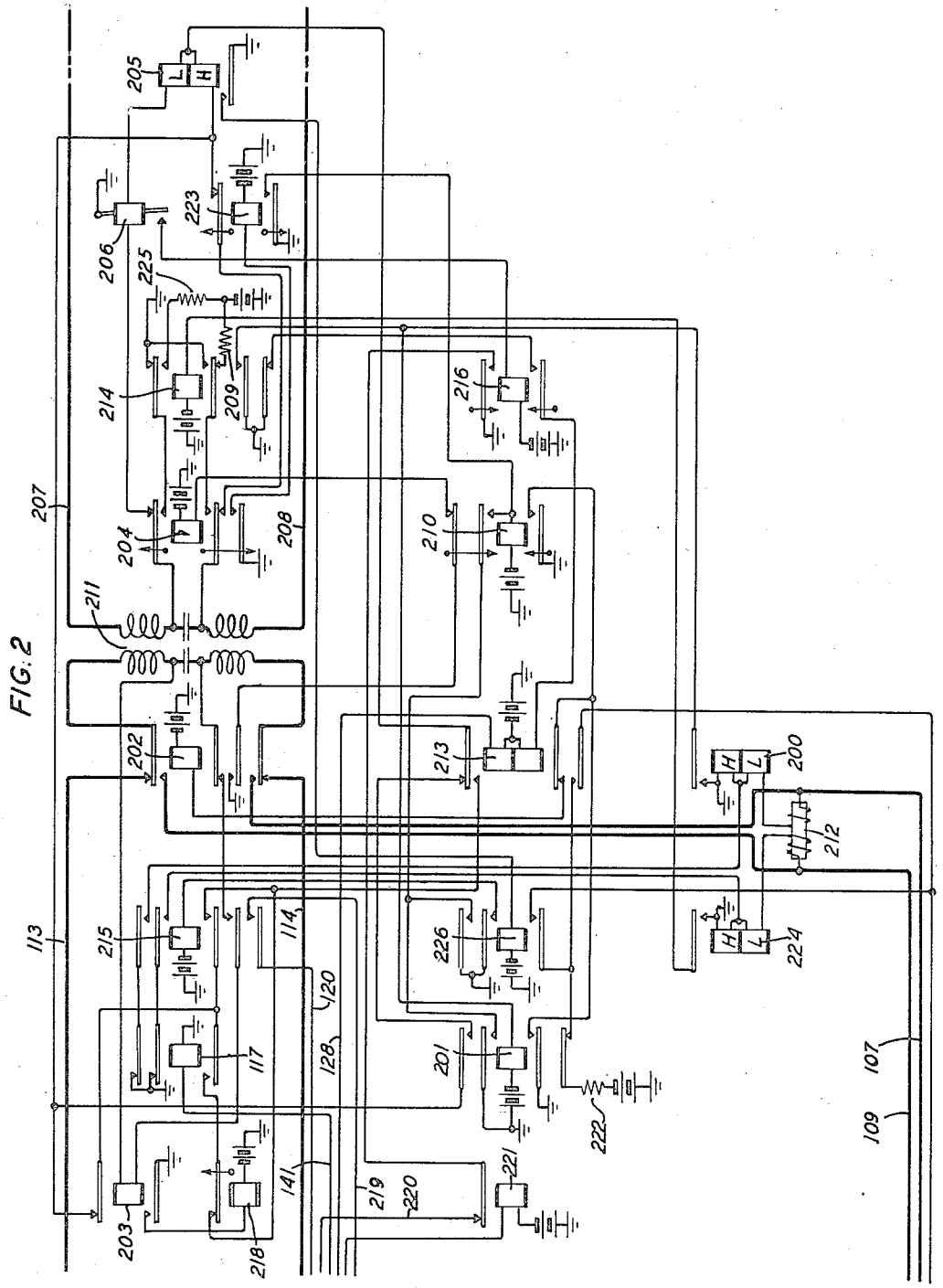


FIG. 2

INVENTORS R.B.BUCHANAN
L.A.KILLE

BY P. C. Smith

ATTORNEY

June 2, 1936. R. B. BUCHANAN ET AL 2,042,828

TELEPHONE SYSTEM

Filed March 7, 1935 3 Sheets-Sheet 3

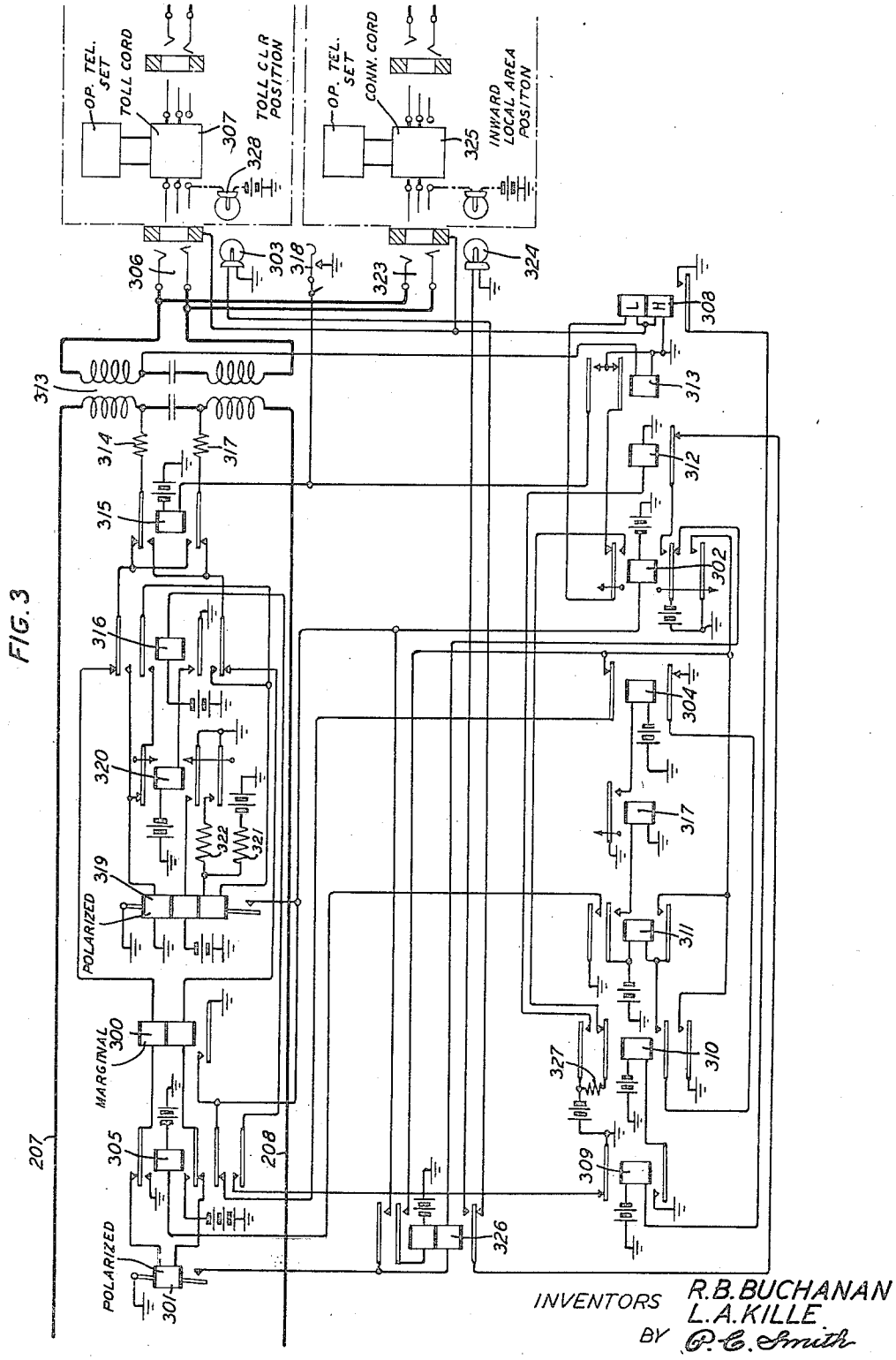


FIG. 3

INVENTORS R.B.BUCHANAN
L.A.KILLE
BY P.C.Smith
ATTORNEY

Patented June 2, 1936 2,042,828

# UNITED STATES PATENT OFFICE

2,042,828

## TELEPHONE SYSTEM

Russell B. Buchanan, Lynbrook, N. Y., and Lindley A. Kille, Morristown, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application March 7, 1935, Serial No. 9,728

17 Claims. (Cl. 179—43)

This invention relates to telephone systems and particularly to improvements in the means for completing toll connections. It is in the nature of an improvement over known trunking arrangements and contemplates the use of means whereby a single trunk between the originating office and the toll office is employed for recording as well as for completing the toll connection.

An object of the invention is an arrangement whereby a trunk used for recording and completing in one direction may be used as an ordinary toll switching trunk for calls in the opposite direction, said trunk terminating at one end in a trunking operator's board and an A operator's board while at the other end it terminates in a trunking operator's board. A considerable saving in cost in handling toll traffic is therefore effected.

Another object of the invention is an arrangement whereby a trunk used for recording and completing a call in one direction may also be used as an ordinary B trunk in completing a local interoffice call in the same direction as, for instance, in those cases where lines terminate in a local board located in the toll office; said trunk for this purpose, further appearing in a special jack at the originating A board and terminating in a special jack at the local B board of the toll office. By means of this arrangement the use of local interoffice trunks to complete ordinary interoffice connections is avoided.

One feature of the invention is the use of a novel signaling circuit comprising a high-low relay in combination with a marginal relay and a source of high voltage current at one time and the use of another relay and a source of low voltage in combination with said high-low relay at another time whereby a plurality of signals are transmitted in either direction over the trunk to operate signals and control circuit operations at the three terminal outlets of the trunk in the most economical and efficient manner.

The method and means of handling toll connections in accordance with this invention may, in general, be outlined as follows: When an A operator receives a request for a long distance toll connection, she plugs the calling plug of an "A" cord into a jack of a combined recording and completing trunk designed in accordance with this invention. This connects the A operator with a toll operator at the recording-completing board, and the latter is advised of the call completing information, after which she momentarily depresses a key associated with this trunk to cause a lamp associated with the trunk at the toll switching position to light as an indication that a call is awaiting thereon. The toll switching operator at the originating office, and before whom one of the three branches of the trunk terminates in the form of a cord plug, then connects her telephone head-set to the trunk and receives the number of the subscriber from the recording-completing operator, after which the plug of the switching trunk is inserted into a multiple jack of the calling line and the calling supervisory signal of the "A" cord is caused to light to apprise the A operator that the "A" cord may now be removed from the connection since the calling line is now extended to the toll completing position via the toll switching branch of the trunk. After the toll switching operator has connected the trunk to the calling subscriber's line and the A operator's position cord is removed from the connection, the recording-completing operator at the toll office has complete supervision of the call. Should the calling subscriber have restored his receiver in the meanwhile, the fact is made known to the toll operator by the lighting of a "ring and guard" lamp in the toll cord then connected to the trunk. The operator may then rering the subscriber by operating the ringing key associated with the cord. When the calling subscriber restores his receiver and the recording-completing operator receives the disconnect signal to this effect, the connection is taken down by removing the toll cord from the trunk whereupon the toll switching operator receives a disconnect signal and removes the plug of the trunk from the calling subscriber's jack.

As outlined above, therefore, means are provided for recording and completing toll calls over a single trunk and the A operator's work, relating to the extension of such a toll call, remains the same as in present practice; that is, her functions in this respect are practically the same as when she extends a connection between two local lines.

A clearer conception of the scope and purpose of the invention may be obtained from a consideration of the following description and appended claims taken in connection with the attached three drawings placed in their consecutive numerical order. These drawings, taken together, show a toll trunk which extends between a local office, where it has outgoing outlets such as jacks 106 and 149 at the A board and one incoming completing trunk plug 137 at the B board, as disclosed in Fig. 1, and a toll office where it terminates, as disclosed in Fig. 3, in jacks such as 306 for the extension of toll or long distance connections and in jacks such as 323 for the com-

pletion of calls within an area which is local to the toll center.

Referring now to the illustration of the invention as applied to the establishment of a call from an originating A board to the toll office for completion therefrom to a toll subscriber beyond, the extension of a connection over the trunk for this purpose may be described as follows: A subscriber at substation 100 calls an A operator in the usual manner. The operator, in answering the call, inserts plug 101 of the cord "A" into jack 103 of line 102 and connects her telephone head-set 104 to the cord by the usual means. The subscriber 100 asks for a toll connection by saying "long distance". The A operator will then insert plug 105 of the "A" cord into jack 106 of the combined recording and completing trunk. It should be understood, of course, that a plurality of such trunks are available to the A operator and that she first tests for and locates an idle trunk.

The above connection between the "A" cord and the trunk jack 106 causes the calling supervisory lamp 110 to light in a circuit which is completed from battery through lamp 110, resistance 158, sleeve of jack 106, resistance 111 to ground. A circuit is also completed for relay 200 extending from ground through its upper and lower windings in series, right winding of retard coil 212, ring conductor 107, ring of jack 106, ring of the "A" cord, winding of calling supervisory relay 108, right lower winding of repeating coil 112, battery to ground. Relay 200 operates and closes an obvious circuit for relay 201 which operates and then completes a circuit for relay 202 extending from ground through its lower inner contacts, bottom inner contacts of relay 213, winding of relay 202 to battery. Relay 202 operates, transfers the trunk conductors extending to the left windings of repeating coil 211 to the local trunk conductors 109 and 107 and therefrom to the tip and ring conductors of the "A" cord, opens its bottom inner contact in the circuit path of the winding of relay 203 in order to prevent the winding of this relay from shunting, and thereby interfering with, the proper operation of the calling supervisory relay 108 in the "A" cord, and closes a circuit for operating relay 204 which extends from ground through the bottom middle contacts of relay 202, top outer contacts of relay 210, winding of relay 204 to battery. Relay 204 operates and disconnects the outward supervisory bridge consisting of the winding of polarized relay 206 and both windings of relay 205 from the trunk conductors 207 and 208, connects ground to conductor 207 over the upper back contacts of relay 214, the top front contacts of relay 204 and right upper winding of repeating coil 211, and further connects battery through resistance 209, over the bottom inner back contacts of relay 214, bottom inner front contacts of relay 204, right lower winding of repeating coil 211 to trunk conductor 208. The connection of ground and battery to the trunk conductors serves to operate a signal at the toll end of the trunk to the effect that a call is waiting thereon, as more clearly explained hereinafter. Relay 204 further closes an obvious circuit for relay 223 which operates and opens another contact in the circuit path of the calling supervisory bridge while through its bottom contacts relay 223 closes an obvious circuit to operate relay 210 which, on operating, locks through its top inner contacts to ground on the upper inner contacts of relay 201. Relay 210 further connects supplementary ground to the circuit of relay 202 while over its top inner contacts it opens the circuit of relay 204 which, on releasing after an interval, opens the circuit of relay 223 which also releases after an interval and opens the circuit of relay 210. Relay 210, however, does not release since at this time it is held locked under the control of relay 201. With relay 204 released, battery and ground are removed from the tip and ring conductors 207 and 208, while on the release of relay 223 the supervisory bridge consisting of the windings of relays 206 and 205 is again connected across the trunk conductors.

In the meanwhile and at the time ground and battery were connected to conductors 207 and 208, a circuit was completed for relay 300 extending from ground on conductor 207 as previously traced, left upper winding of repeating coil 313, resistance 314, top back contacts of relay 315, top outer back contacts of relay 316, upper winding of relay 300, top back contacts of relay 305, winding of polarized relay 301, bottom inner back contacts of relay 305, lower winding of relay 300, bottom outer back contacts of relay 316, bottom back contacts of relay 315, resistance 317, left lower winding of repeating coil 313, conductor 208 to battery through resistance 209 as previously traced. Relay 300 operates in this circuit, but relay 301, being polarized, operates only when the current is in the reverse direction. Relay 300 now closes an obvious circuit for relay 302 which operates and then locks in a circuit which extends from ground on its bottom outer contacts, top contacts of relay 304, bottom middle back contacts of relay 305 to the winding of relay 302. Relay 302, on operating, connects battery through resistance 327, upper inner contacts of relay 316, top front contacts of relay 302 to one side of the L (low resistance) winding of relay 308 to establish a busy test condition at every position to which the trunk is multipled and particularly to guard the trunk against seizure at those positions where it is available for completing calls in the opposite direction only; closes a circuit for trunk lamp 303 at every toll or CLR answering position at which the trunk appears, said circuit extending from battery through the bottom inner front contacts of relay 302, contacts of relay 312, bottom back contacts of relay 326, lamp 303, to ground, lighting said lamp to indicate to the operator that a call is awaiting on the trunk.

It will be recalled that the circuit for relay 300 is maintained only during the period during which relay 204 is operated, a period measured from the time said relay is operated until it is released by the operation of relay 210. This period is measured by the time taken to operate relay 223, the time taken to operate relay 210 and the time taken to release relay 204 which, being slow-release, takes an interval long enough to insure the operation of relay 300, the operation of relay 302 and the consequent lighting of lamp 303 at the distant end. Hence when relay 204 releases and the supervisory loop consisting of relays 205 and 206 is reconnected to the trunk conductors 207 and 208 subsequent to the release of relay 223, sufficient time will have been allowed to operate relay 302 and light trunk lamp 303 so that, upon the release of relay 300 which follows the release of relay 204, relay 302 will have been locked in and lamp 303 will remain lighted.

The toll operator, upon seeing the lamp 303 lighted, plugs the answering end of a regular toll cord 307 into the trunk jack 306 and connects her telephone circuit across the cord in the well-

known manner. A circuit is now completed for relay 308 which extends from battery through cord lamp 328, the sleeve of the cord, sleeve of jack 306, lower winding of relay 308 to ground. Relay 308 operates and closes an obvious circuit for relay 309 which, on operating, closes an obvious circuit for relay 310. Relay 310 operates and closes a circuit for operating relay 311 which extends from ground on the bottom contacts of relay 304, bottom inner contacts of relay 310, winding of relay 311 to battery, and further closes an obvious circuit for relay 312. Relay 311, on operating, locks over its bottom contacts to ground on the lower outer front contacts of relay 302, closes an obvious circuit for operating relay 317, and further closes another obvious circuit for operating relay 305. Relay 317 causes the operation of relay 304. Relay 304 opens the locking circuit of relay 302 which releases, and further opens the operating circuit of relay 311; but the last-mentioned relay does not release since it is locked to ground on the bottom outer contacts of relay 310. Relay 312, on operating, opens the circuit of lamp 303 thereby extinguishing it while relay 302, in releasing, connects ground through the top inner contacts of relay 313 and its own top back contacts to the upper winding of relay 308 which, in combination with the battery supplied from the sleeve of the toll cord and the ground through the H (high resistance) winding of relay 308, supplies the same busy test potential to the sleeve of the trunk jacks that was previously maintained by battery through resistance 327, which latter was removed by the operation of relay 310 and further causes the cord lamp to light.

At the time relay 305 operated as already described, it disconnected relay 301 from the trunk conductors 207 and 208 and connected ground and high voltage battery to said conductors through its inner front contacts and thereby completed a circuit which extends from ground through the top front contacts of relay 305, upper winding of relay 300, top outer back contacts of relay 316, top back contacts of relay 315, resistance 314, upper left winding of repeating coil 313, conductor 207, right upper winding of repeating coil 211, top back contacts of relay 204, winding of relay 206, (L) winding of relay 205, top back contacts of relay 213, top outer contacts of relay 201, top contacts of relay 223, bottom inner back contacts of relay 204, right lower winding of repeating coil 211, conductor 208, left lower winding of repeating coil 313, resistance 317, bottom outer back contacts of relay 315, bottom outer back contacts of relay 316, lower winding of relay 300, bottom inner front contacts of relay 305 to high voltage battery. It will be observed that the (H) or high resistance winding of relay 205 is, at this time, short-circuited. The quantity of current flowing through the circuit, therefore, is such as to cause both relay 205 and relay 300 to operate. Relay 206 does not operate because it is polarized in the opposite direction. Relay 300, in operating, causes the operation of relay 302 which, in turn, removes ground from the (L) winding of relay 308 through the toll cord lamp. Said toll cord lamp is now in series with the high resistance (H) winding of this relay and is extinguished because the quantity of current is below its luminosity level. Relay 205, in operating, closes an obvious circuit for relay 226 which, on operating, provides an additional holding circuit for relay 219 over its top outer contact, and closes an obvious relay for relay 215. Relay 215, in operating, connects ground from the top outer back contacts of relay 217, top outer contacts of relay 215 to the mid-point of the two windings of relay 200 and thereby short-circuits the upper high resistance winding. As a result, the current flowing through the circuit extending from ground through the lower winding of relay 200, the right winding of retard coil 212, conductor 107, relay 108 in the "A" cord to battery is now sufficient to cause the operation of relay 108, whereupon battery through resistance 115 is connected in shunt of lamp 110 which is thereby extinguished to indicate to the A operator that the distant toll operator has connected her telephone set through a toll cord to the trunk and that a talking connection now exists between the operator's telephone circuit 104 over the tip and ring 109 and 107, respectively, of the trunk, the top front and bottom outer front contacts of relay 202 to the left windings of the repeating coil 211. The talking circuit to the toll operator is then completed from her telephone set connected to the toll cord 307 inductively through the windings of repeating coil 313, tip and ring conductors 207 and 208, respectively, and the right windings of repeating coil 211. Relay 215 further connects ground to the mid-point of the windings of relay 224 which is identical with relay 200 but, inasmuch as relay 224 is not used on this type of a call, it performs no function at this time.

The A operator now passes the details of the call to the toll operator who will, from the information received, complete the connection to the distant subscriber through the calling portion of the toll cord 307 and then extend the connection back to the calling subscriber by way of the trunk extension to the B board.

When the toll operator has extended the connection to the called subscriber or even before she has done so, she operates key 318 of which there is one associated with the trunk at every position to which the trunk is multipled for completing toll connections. As a result of the operation of key 318, a circuit is completed for relay 315 which, on operating, reverses the direction of current flowing over the circuit that includes relays 300, 205 and 206 previously traced, the effect of which is to operate polarized relay 206 and hold relays 300 and 205 operated. Relay 206 closes a circuit to operate relay 216 which, on operating, completes a circuit for relay 213 which extends from ground on the bottom outer contacts of relay 214, lower contacts of relay 216, lower winding of relay 213 to battery. Relay 213, on operating, releases relay 202, and transfers the path for short-circuiting the lower (H) winding of relay 205 from the top outer contacts of relay 201 to the back contacts of relay 203 by way of the bottom inner contacts of relay 215. Relay 202, upon releasing, transfers the talking conductors of the trunk from conductors 109 and 107, which extend to the "A" cord, to conductors 113 and 114 which extend to the plug extension of the trunk at the B board, and further connects relay 203 across the trunk conductors 113 and 114 in a circuit which may be traced from battery through the lower winding of relay 115, resistance 118, lower normal contacts of relay 116, right lower winding of repeating coil 119, conductor 114, bottom outer back contacts of relay 202, left lower winding of repeating coil 211, bottom inner contacts of relay 202, bottom middle contacts of relay 215, winding of relay 203, upper left winding of repeating coil 211, top back contacts of relay 202, conductor 113, right

upper winding of repeating coil 119, top contacts of relay 116, upper winding of relay 115 to ground. Both relays 203 and 115 operate in this circuit. However, relay 203 is only operated momentarily since, with the operation of relay 115, a circuit is closed to operate relay 116 which extends from ground on the contacts of relay 115, lower winding of relay 116, conductor 120, bottom outer contacts of relay 215, conductor 219, bottom inner contacts of relay 121 to battery and in parallel therewith, winding of relay 117 to battery, both of which relays operate. With the operation of relay 116, battery and ground is removed from conductors 114 and 113, respectively, causing relay 203 to release if it has operated while relays 115, 116 and 117 are held locally, relay 115 in a circuit through its lower winding to ground on the bottom contacts of relay 116, and relays 116 and 117 in parallel circuits to ground on the contacts of relay 115.

Relay 117, on operating, closes a circuit to light guard and disconnect lamp 124 to signal the B operator that the trunk identified by said lamp has been taken up at the CLR toll position. The circuit for the lamp extends from battery through lamp 124, resistance 123, bottom outer back contacts of relay 121, to ground on the top front contacts of relay 117. Relay 117 further connects ground to conductor 128 to close another circuit for relay 213 over its upper winding to insure its operated condition when the original operating circuit of said relay is opened by the release of relay 206, which happens when the operator releases key 318 and thereby causes the release of relay 315 and the consequent reversal in the direction of current flowing through the circuit which includes relay 206. Relay 117 further provides a locking circuit for relays 125, 126 and 127 when these relays operate as described hereinafter.

All of the trunks appearing at the B position are arranged for operation on an automatic listening basis; that is, the operator's telephone circuit 150 is automatically attached to each of the trunks in succession in a defined order of preference regardless of the time and order in which the trunks are taken into use at the CLR board. This feature is, of course, old in the telephone art and the control circuit by which the order of preference is carried out is not disclosed except as to such parts of it as relate to the operation of the trunk herein being described. It is understood, however, that the features of the invention which are claimed hereunder are not limited to any particular kind of a trunk or in the manner in which the operator's telephone circuit is connected thereto, but is applicable to any organization of signal circuits wherein signals are transmitted in both directions over a marginal-polarized circuit consisting of relays 309, 319, 206 and 205 or their equivalent.

A pair of cut-in relays is provided for each trunk appearing at the B position and arranged to operate in the prescribed order for the connection of the operator's telephone circuit to the preferred trunk if two or more should happen to be taken into use at different CLR boards at the same time. Relays 141 and 151 are shown connected to the trunk of Fig. 1 which is further assumed to be the first trunk in the order of selection, relays 152 and 153 are associated with an intermediate trunk while relays 154 and 155 are associated with the last trunk in the order of selection. Consequently when relay 117 operates, a circuit is completed for relay 141, extending from ground on its top front contacts, top outer back contacts of relay 127, lower contacts of relay 117, bottom back contacts of relay 125, winding of relay 141, through the chain of contacts which extends through other relays similar to relay 151 associated with the other trunks appearing at the position, to battery. Relay 141 operates and closes a circuit for relay 151 extending from battery through the winding of said relay, lower front contacts of relay 141 to ground. Relay 151, when operated, completes a circuit for operating relay 122, which extends from ground through the top contacts of relay 141, top inner front contacts of relay 151, winding of relay 122, top inner back contacts of relay 125 to battery; closes a circuit for flashing lamp 124 by completing a low resistance battery path through resistance 130, contacts of relay 129, which is continuously flashing under the influence of interrupter 132, top outer contacts of relay 151, resistance 123, lamp 124 to battery and further causes a circuit to be closed for lighting lamp 133 which extends from battery through said lamp, bottom outer contacts of relay 141 to ground. Relay 122 operates, locks over its top inner contacts to a ground in the common control circuit (not shown), connects the talking conductors of the operator's telephone circuit to the trunk conductors 156 and 157, and further extends the party ringing keys common to the position to relays 125, 126 and 127. The flashing of lamp 124 indicates to the operator that her telephone set and the common ringing keys have been connected to the trunk, the connection of which to the calling subscriber's line must be disposed of before said control circuit can operate to cause the lighting of a similar lamp 124 on other trunks which may have been seized for completing purposes at the distant toll positions.

With relay 122 operated, the operator's telephone circuit 150 is connected directly across the trunk conductors 156 and 157 over which an inductive talking circuit is established back to the toll operator's cord 307 and the telephone circuit connected thereto by way of repeating coils 119, 211, and 313. It is not believed necessary to trace this circuit since, with relay 202 normal, said circuit is perfectly evident by following the talking conductors drawn in heavy line across Figs. 1, 2 and 3.

The toll operator now communicates the details of the call to the B operator by telling her the calling line number together with the particular party designation.

The next function of the B operator is to depress the particular ringing key for signaling the calling subscriber's station. In the disclosure of this application, it is assumed that the subscriber's substation 100 may be one of the usual four party line substations connected to the line 102 and that it becomes necessary, therefore, to depress the key which characterizes the kind of ringing current which has to be transmitted over the line to ring the correct subscriber. If, for instance, substation 100 is the so-called party M, then ringing key 133 is operated whereupon a circuit is completed for relay 125 extending from the right contacts of said key, bottom middle contacts of relay 122, lower winding of relay 125, bottom contacts of relay 140 to battery, while at the same time two other circuits are completed over the left contacts of said key: one through the bottom inner conacts of relay 122, winding of

relay 126 to battery, and the other over the top middle contacts of relay 122, winding of relay 127 to battery. All three relays operate, relay 125 locking over its top inner front contacts to ground on the contacts of relay 117, while relays 126 and 127 also lock to ground on the front contacts of relay 117 as previously traced. If, on the other hand, the party is the so-called party J, the operator will momentarily depress key 134 whereupon only relays 125 and 127 are operated. For party R, relays 125 and 126 are operated, whereas for party W, key 136 is operated in which case only relay 125 responds. Thus, as soon as the operator knows the calling station to which the call is to be completed, the particular ringing key is depressed and the ringing combination as determined by relays 125, 126 and 127 is set up in preparation for ringing the subscriber as described hereinafter.

The operation of relay 125 opens the locking circuit of relay 122 which, in releasing, disconnects the ringing keys and the operator's telephone circuit 150 from the trunk in preparation for connection with any other trunk which may have been waiting, or which may have been subsequently seized, and further opens the circuit of relay 141, followed by the subsequent release of relay 151. The release of relay 141 restores the path for operating any other relay, such as relay 153 or 155, of the pairs of relays associated with other waiting trunks, opens the original operating circuit of relay 122, and further disconnects the grounds originally connected to lamp 124. The release of relay 151 disconnects the flashing circuit for lamp 124 and reestablishes the series battery connection for operating any of the relays 141 . . . 153 . . . 155 of a waiting trunk in the chain of preference.

The B operator now inserts the plug of the trunk into the jack of the calling line 102. As a result, a circuit is completed for relay 121 extending from battery through the winding of said relay, sleeve of plug 137, sleeve of jack 142 to ground, through the winding of the line cut-off relay. The operation of relay 121 opens another pair of contacts in the circuit of trunk lamp 124, removes battery from conductor 219 which, through the bottom outer contacts of relay 215 and conductor 120 removes it from relay 116 and causes said relay to release if the subscriber has disconnected in the meanwhile as described hereinafter, connects battery to relays 139 and 140, while it further connects battery to conductor 141 which completes the circuit for relay 217, causing said relay to operate.

If the calling subscriber has restored his receiver in the meanwhile, the holding circuit for relay 116 is released as already described, whereupon battery and ground through relay 115 is again connected to the trunk conductors 113 and 114 as a result of which a circuit is completed for relay 203 extending from battery on conductor 114, bottom inner back contacts of relay 202, left lower winding of repeating coil 211, bottom inner contacts of relay 202, bottom middle contacts of relay 215, winding of relay 203, left upper winding of repeating coil 211, top back contacts of relay 202, conductor 113 through the upper winding of relay 115 to ground. Relay 203 operates and removes the short circuit from around the high resistance (H) winding of relay 205 which in turn causes the release of relay 300, the release of relay 302, the connection of ground to the low resistance (L) winding of relay 308 and the consequent lighting of the toll cord lamp 328 due to the increase in current now flowing therethrough. The lighting of the lamp indicates to the toll operator that the calling subscriber has restored his receiver and must be rerung. The application of battery to conductor 141 causes the operation of relay 217. As said before, it removes the short circuit from around the high resistance winding of relay 200 whereupon the current for relay 108 in the "A" cord is increased, said relay operating and lighting lamp 110 as a signal to the A operator that the connection has been taken up at the B board and that she may now take down the "A" cord which connects the calling line with the A branch of the trunk. In removing plug 105 from the trunk jack 106, the operator disrupts the circuit of relay 200 whereupon said relay releases followed by the release of relay 201.

When the toll operator depresses the ringing key (not shown) of the toll cord 307, battery is connected to the tip side of the trunk whereupon a circuit is completed from battery (not shown) on the tip of the cord and tip of the trunk, right upper winding of repeating coil 313, winding of relay 313 to ground. Relay 313 operates, opens the ground to the (L) winding of relay 308 and thereby causes the toll cord lamp to be extinguished, closes an obvious circuit for relay 315 which, on operating, reverses the current direction of the supervisory circuit which includes relays 300 and 206 and 205 and thereby causes the operation of polarized relay 206 as on a previous trunk reversal. Relay 206, on operating, causes the operation of relay 216 which, on operating, connects ground through its upper contacts, the contacts of relay 221 to conductor 220 and completes thereby a circuit through the winding of relay 143 and the winding of relay 139 to battery on the top inner contacts of relay 121. Relay 139 operates and connects the tip and ring conductors of the trunk which extend to the calling line to the contacts of the ringing relay combination as determined by the operation of relays 127, 125, and 126 as called for by the ringing key which was depressed at the time the B operator was notified of the calling station to which the call had to be completed. The operation of relay 143 closes the circuit from ground on its lower contacts to the upper winding of relay 116 to battery, causing said relay to operate which, in turn, closes the holding circuit for relay 115 and removes battery and ground through said relay 115 from the trunk. As a result, relays 203 and 218 release, reestablishing the short circuit around the (H) winding of relay 205, causing the reoperation of relay 300, the consequent operation of relay 302 and the removal of ground from the upper winding of relay 308, which then causes the cord lamp to remain extinguished as evidence that ringing current is being applied to the line during the time that the toll operator keeps the ringing key depressed. Relay 143 further connects ground from the ringing circuit, through its upper contacts and then through the lower inner front contacts of relay 127 if operated, bottom front contacts of relay 139 to the ring of the trunk plug 137, or through the top inner back contacts of said relay if not operated, and thence through the top front contacts of relay 139 to the tip of the trunk plug 137. In either case, the ground is carried through the subscriber's substation loop and completed either to the ringing source on conductor 147 or another ringing source on conductor 148 depending upon whether relay 126 has or has not been operated as called for by the ringing key that was depressed. In this manner

the particular station 100 is rung. When the toll operator restores the ringing key relay 206 releases in consequence of which both relays 139 and 143 release. With the release of relay 143, relay 116 is released and battery and ground are again connected to the trunk, reoperating relays 203 and 218, removing the short circuit from around the high resistance winding of relay 205, in consequence of which relay 300 releases followed by the release of relay 302, the connection of ground to the high resistance winding of relay 308, and the lighting of the toll cord lamp as already described.

It has been shown that if, at the time the B operator inserts the trunk plug into the subscriber's jack, the subscriber has restored the receiver, the toll operator receives a ringing signal by the lighting of the toll cord lamp, and that this signal was the result of the release of relay 116, the reconnection of battery and ground to the trunk conductors 114 and 113, respectively, and the consequent release of relay 302 following the release of relay 300 in virtue of the removal of the short circuit around the high resistance (H) winding of relay 205. However, if the subscriber should happen to have the receiver off the hook, a circuit is completed for relay 144 over a path which extends from ground through ballast lamp 145, upper winding of relay 144, left upper winding of repeating coil 119, conductor 156, top back contacts of relay 139, top outer front contacts of relay 121, tip of plug 137, tip of jack 142, subscriber's loop, ring of jack 142, ring of plug 137, bottom back contacts of relay 139, left lower winding of repeating coil 119, lower winding of relay 144, ballast lamp 146, to battery. Relay 144 operates and completes a holding circuit for relay 116 which extends from ground on the contacts of relay 115, contacts of relay 144, upper winding of relay 116 to battery. Relay 116 thus remains operated, prevents battery and ground from being connected to the trunk conductors 114 and 113, respectively, and thereby prevents the operation of previously described circuits which result in the lighting of the toll cord lamp. The failure to light the lamp indicates to the operator that the subscriber is already on the line and may be communicated with without ringing.

When the subscriber answers, relay 144 operates over the circuit above described and further closes the above described circuit for relay 116. Relay 116 operates, holds relay 115, removes battery and ground from trunk conductors 114 and 113, respectively, causes the release of relays 203 and 218 as previously described and initiates the operation of the circuits which result in extinguishing the toll cord to indicate that the subscriber has answered.

In case the toll operator finds it necessary to rering while the subscriber's receiver is off the switch-hook, relays 139 and 143 are reoperated as already described. The operation of relay 139 releases relay 144 and applies to the called line the same ringing current as that previously set up by the operation of relays 125, 126 and 127 as called for by the operation of the proper ringing key. The operation of relay 143 holds relay 116 operated after relay 144 releases and connects ringing ground to the contacts of relay 127. When the toll operator finds it necessary to rering after the receiver has been placed on the switch-hook at the calling station, relays 139, 143 and 116 reoperate and ringing current is applied to the line as on an original call. When the toll operator restores the ringing key, relays 139 and 143 release. Relay 139 removes the ringing current from the line and closes the tip and ring of the trunk cord through the repeating coil 119. Relay 143, on releasing, opens the holding circuit for relay 116 and opens the ringing current circuit. Relay 144 now reoperates if the receiver is off the switch-hook and holds relay 116 operated, thus keeping the toll operator's cord lamp unlighted.

When the conversation is over and subscriber 100 restores his receiver, relay 144 releases, in turn causing the release of relay 116 and the reapplication of battery and ground to the trunk which, as in previous operations, results in the operation of relays 203 and 218, whereupon the high resistance winding of relay 205 is again short-circuited and relay 300 is operated in consequence thereof. The operation of relay 300 is followed by the operation of relay 302 which in turn connects ground to the upper winding of sleeve relay 308 as before described and causes the lighting of the toll cord supervisory lamp 328 as a disconnect signal to the operator.

Upon the toll operator removing the plug of toll cord 307 from the trunk jack 306, relay 308 releases followed by the release of relay 309, in turn by the release of relay 310. Relay 310 causes the release of relay 312, connects battery through resistance 327 to the (L) winding of relay 308 by way of the top front contacts of relay 302 to establish the busy potential on all CLR jacks which has been removed by the disconnection of cord sleeve battery from the sleeve of the trunk jack, and further causes the release of relay 311. The release of relay 312 reestablishes the circuit for trunk lamp 303. This, however, is only momentary because the release of relay 311 causes the release of relay 305 which, in turn, disconnects battery and ground from the signal loop that includes relay 300 and causes this relay to release. The release of relay 311 is further followed by the release of relay 317 and that of relay 304. However, relay 317 is slow release, so that while relay 305 releases before relay 300 and thereby establishes a locking circuit for relay 302, this locking circuit is ineffective at this time since it depends upon the normal condition of relay 304 which, depending upon slow-release relay 317, is operated at the time relay 305 releases and thereby will not be successful in causing relay 302 to remain locked which, upon releasing, causes trunk lamp 303 to be extinguished.

The removal of battery and ground from the trunk loop by the release of relay 305 further causes the release of relay 205 which, in turn, causes the release of relay 226. Relay 226 upon releasing, unlocks relay 210 and releases relay 215. With the release of relay 215, the previously described circuit which includes relays 203 and 115 is now opened, whereupon relay 115 releases and causes the release of relay 117 which, upon releasing, unlocks relay 125 as well as relays 126 and 127 if operated. It further causes a circuit to be established for relay 140 extending from ground on the top normal contacts of relay 117, winding of relay 140, top inner contacts of relay 121 to battery. Relay 140 operates, locks to ground on its own top inner contacts, but under the control of relay 121, and establishes a steady lighting circuit for lamp 124 extending from ground on the top inner contacts of relay 140, bottom outer front contacts of relay 121, resistance 123, lamp 124 to battery. The lighting of the lamp is a signal to the B operator to take down

the connection. The disconnection of trunk plug 137 from line jack 142 causes the release of relay 121, which in turn causes lamp 124 to be extinguished and unlocks relay 140 which, upon releasing, restores the trunk to normal.

In case the plug of the toll cord 307 is withdrawn from the trunk jack 306 before the calling subscriber has disconnected, relay 308 releases, in turn, releasing relay 309. Relay 309 causes the release of relay 310. Relay 311, however, which would normally release after the release of relay 310, does not release at this time since it is held locked to ground on the lower outer contacts of relay 302 which, in turn, is held operated to the contacts of relay 300, the latter being held operated over the trunk loop in series with relays 205 and 206 from battery and ground supplied through the contacts of relay 305. Relay 205, it will be remembered, has its high resistance winding short-circuited by virtue of the fact that relays 203 and 218 are released because of the absence of battery and ground through relay 115, since relay 116 is locally held by relay 144 which, in turn, is held over calling line loop. Relay 309, on releasing, completes a circuit for relay 316 which extends from ground on its top contacts, bottom outer contacts of relay 305, winding of relay 316 to battery. Relay 316 operates, disconnects the loop circuit which includes relay 300 and battery and ground thereto, closes an obvious circuit for relay 320 which operates, connects ground through the upper winding of polarized relay 319 to the tip conductor 207 by way of the top outer front contacts of relay 316, top back contacts of relay 315, resistance 314, left upper winding of repeating coil 313 to conductor 207, connects a definite potential determined by battery through resistance 321 and ground through resistance 322 through the lower winding of polarized relay 319, bottom outer contacts of relay 319, bottom back contacts of relay 315, resistance 317, left lower winding of repeating coil 313 to conductor 208. The battery and ground thus supplied to the trunk replaces the high voltage and ground supplied through relay 305 and is, therefore, in series with relays 205 and 206. Inasmuch as the polarity of the current is the same in both cases, relay 206 remains unaffected by the substitution of relay 319 in the circuit for relay 300. Relay 319, however, operates and maintains ground to hold relay 302 operated to replace the ground which was disconnected from the circuit of the relay by the release of relay 300. By maintaining relay 302 operated, the circuit for lamp 303 is closed, the lighting of which apprises the operator that the calling subscriber has not yet restored while the connection of resistance 327 to the (L) winding of relay 308 causes busy test potential to be connected to each of the sleeves of the trunk at the various positions at which it appears to prevent its seizure. The effect of reducing the voltage on conductor 208 causes the release of relay 205 which, in turn, releases relay 226. The release of relay 226, in turn, releases relay 210, if operated, and further releases relay 215. Beyond this, the release of relay 205 serves no useful function at this time.

However if, at the time the connection has been extended to the CLR position from the originating A board, and the operator at said CLR position has taken up the connection by inserting the plug of cord 307 into the trunk and thereafter failed to extend the connection back to the B position of the calling office by depressing key 318, but wished to flash the A operator before doing so, or otherwise wished to abandon the connection, the withdrawal of the plug of cord 307 would cause the circuit operations above described to take place. In this case, however, the release of relay 205, and the consequent release of relay 215 would remove the short circuit around the high resistance winding of relay 200, cause thereby the release of relay 108 in the "A" cord as a result of which lamp 110 will light. If the CLR operator fails to reinsert the plug of cord 307 into the trunk jack, the steady lighting of lamp 110 serves as a disconnect signal to the A operator. On the other hand if the CLR operator repeatedly withdraws and reinserts the cord plug, lamp 110 is flashed to call the A operator's attention to the fact that the CLR operator wants to communicate with her.

No further operations occur until the subscriber disconnects since relays 203 and 218 are already released at this time due to the fact that relay 116 is held from the contacts of relay 144 and battery and ground thereby disconnected from the trunk. These relays, when normal, maintain a short circuit around the high resistance winding of relay 205 which thus holds the connection at the toll end of the switchboard by causing relay 319 to remain operated. The subscriber, therefore, is enabled to hold the connection and make the fact known to the toll operator.

When the subscriber restores his receiver, relay 144 releases which further releases relay 116. Ground and battery are again connected to conductors 113 and 114, respectively, through relay 115 as a result of which the short circuit around the (H) winding of relay 205 is removed. Due to the increase of the resistance in the circuit including relays 205 and 319, relay 319 is released, in turn, followed by the release of relay 302, in turn, releasing all the operated relays, restoring the trunk to normal, and extinguishing lamp 303.

If the subscriber does not disconnect, and the plug of the toll cord is reinserted in the trunk jack, relays 308, 309, 310 and 312 reoperate, removing the busy test potential from the winding of relay 308 which is now replaced by battery from the toll cord sleeve, extinguishing lamp 303 and disconnecting ground from the circuit of relay 316, causing it thereby to release, remove relay 319 from the trunk and reconnect the high voltage through relay 300, allowing the trunk signaling apparatus to function as previously described.

In case the toll operator disconnects after the operation of the transfer key 318 but before the toll switching trunk plug 137 is plugged into the calling line jack 142, relays 308, 309, 310 and 312 will release and function as before to protect the trunk against selection at other toll positions. The disconnect condition passed back over the trunk by the operation of relays 316 and 320 causes the release of relays 205, 226 and 215 as before described. The release of relay 215 opens the circuit of relay 116 the effect of which is the opening of the steady lighting circuit of lamp 124 and the release of relay 213. The release of relay 213 disconnects the short circuit around the high resistance (H) winding of relay 205, thus permitting the apparatus at the toll switchboard end of the trunk to restore to normal.

In case the toll switching operator at the B board completes the call to the wrong subscriber's line, the toll operator will instruct the subscriber to disregard the call and disconnect. When the subscriber disconnects, the circuit operations initiated by the release of relay 144 results in the

consequent release of relay 302 by those circuit operations which have already been described and by which the toll cord lamp is lighted as an indication that the subscriber has restored. The toll operator may then reconnect the trunk to the distant A operator's cord circuit, providing that said operator has not yet disconnected, by withdrawing the plug of the toll cord and reinserting it into the trunk jack. The withdrawal of the toll cord plug causes the release of relays 309, 310, 311, 317, 312 and 304 as previously described, giving a disconnect signal to the B operator. However, due to the fact that the distant A operator has not yet disconnected, the connection will automatically be transferred back to the A operator's cord circuit by virtue of the fact that the release of relay 205 as previously described results in the subsequent release of relay 215, the removal of short circuiting ground from the high resistance winding of relay 200, the release of relay 108 in the "A" cord and the consequent lighting of cord lamp 110. When the plug of the toll cord is reinserted in the jack, relay 308 operates, operating relay 309. The operation of relay 309 causes the operation of relay 310 which, in turn, causes the operation of relay 311. The operation of relay 311 now causes supervision to be passed back over the trunk as previously described, that is, by causing the operation of relay 205 and the extinguishing of the A operator's calling cord lamp 110 as a signal that the toll operator's cord is reconnected to the trunk. The toll operator will ask the A operator for the calling subscriber's number and may then transfer the connection back to the toll switching trunk by the operation of transfer key 318 as already described. In case the plug of the toll switch trunk has not yet been disconnected from the incorrect line, relay 302 will be released, which will cause the lighting of the toll supervisory lamp as previously described. When the plug of the toll switching trunk is withdrawn from the jack of the wrong line, relay 302 will reoperate and extinguish the toll cord supervisory lamp. The call may then be completed to the correct line, as already described.

Having described the use of the trunk in extending a connection from a local office to the toll switching point, its use in a connection which extends in the opposite direction will now be described, that is, on a toll inward call which is to be completed by way of the trunk to a called line in some distant local office, such as, for instance, subscriber 100 located on line 102.

When the plug of a toll cord is inserted in the multiple jack of this circuit, such as, for instance jack 306, relay 308 operates. Relay 308, on operating, operates relay 309, which causes, in turn, the operation of relay 310. The operation of relay 310 in turn causes the operation of relays 311 and 312, as already described.

The operation of relay 311 causes the operation of relay 305 which, in turn, connects high voltage battery and ground to the signaling loop including relays 300, 205 and polarized relay 206. As a result, relay 205 operates, in turn causing the operation of relays 226 and 215, whereupon the signaling loop including relays 203 and 115 is closed and results in the operation of relays 115 and 203, the former of which operates, as already described, to light trunk lamp 124 as an indication that a call is waiting upon the line, while the relay 203 causes the operation of relay 218. The operation of relay 115 further causes the operation of relay 116 which locks relay 115 and releases relay 203, and connects ground to conductor 128 causing the operation of relay 213. Relay 213 opens the operating circuit of relay 202 and short-circuits the high resistance (H) winding of relay 205 through the contacts of relay 203 which is now deenergized. The effect of this is to cause the operation of relays 300 and 302 and the extinguishment of the toll cord lamp if it lighted the momentary interval during which relay 300 was operated prior to the short circuiting of the (H) winding of relay 205. Relay 311 further causes the operation of relays 317 and 304 as already described and the latter, on operating, opens the operating circuit of relay 311. Relay 311, however, remains locked through its own contacts and the contacts of relay 310 to ground. The operation of relay 204 also opens the locking circuit of relay 302 so that this relay remains under the direct control of relay 300.

When the B operator's telephone set 150 is connected to the trunk at the distant end, order tone is passed over the trunk conductors to the toll operator as in the previous type of call. When the details of the call are passed to the B operator and the plug of the toll switching trunk 137 is inserted in the idle line jack of line 102, relay 300 releases, followed by the release of relay 302 as previously described, and the connection of ground to the toll cord sleeve through the low resistance winding of relay 308. This ground lights the toll cord supervisory lamp as a ringing signal, whereupon the toll operator will then ring out over the trunk to call the subscriber in the manner previously described. It is obvious, however, from the circuit operations already described, that if the toll operator should disconnect the toll plug from the trunk before the toll switching operator connects plug 137 to the called subscriber's jack, the release of relay 205 will extinguish lamp 124 at the toll switching position as an indication that the call has been abandoned. In all other respects, disconnection is identical to that described for the previous type of call.

This trunk may also be used in completing calls between two offices within the local area immediately contiguous to the toll point. For this purpose an extra pair of jacks is provided at the A terminus of the trunk such as, for instance, jack 149. This jack differs from the jack 106 only in the fact that the talking conductors 107 and 109 are reversed. When a call is initiated by a line, such as subscriber 100 on line 102, for some called subscriber whose line terminates in an office within the toll office area, the operator inserts plug 105 of a regular "A" cord into jack 149. Since the trunk conductors are reversed, "A" cord battery is connected to conductor 109 whereupon a circuit is completed through the left winding of retard coil 212 and both windings of relay 224 in series to ground. Relay 224 closes an obvious circuit for relay 214 which, on operating, completes an obvious circuit for relay 201, and reverses the battery and ground connection to conductors 207 and 208, causing battery through resistance 225 to be connected to conductor 207 and ground to be connected to conductor 208. At the same time, relay 204 operates as a result of the operation of relay 202, which follows in consequence of the operation of relay 201, as in the previous use of the trunk in establishing a toll connection from line 102 to the CLR position. This battery and ground connection is in the circuit of relays 300 and 301, but inasmuch as the direction of current flow has been reversed by

the operation of relay 214, and inasmuch as the value of resistance 225 is such as to limit the quantity of current to a value below that which will operate relay 300, only relay 301 will operate. Relay 301, on operating, closes a circuit for relay 326 which extends from ground on the contacts of relay 301, lower winding of relay 326, bottom inner back contacts of relay 302 to battery. Relay 326 operates, and through its top outer contacts closes a circuit for operating relay 302, and then locks over its top winding and top inner contacts to ground on the bottom outer contacts of relay 302 when operated. A circuit is thereafter completed for lamp 324 at the inward local position, extending from ground through said lamp, bottom front contacts of relay 326, contacts of relay 312, bottom inner contacts of relay 302 to battery, lighting said lamp as a signal to the operator at the inward position that a call is waiting thereon, while the operation of relay 302 further establishes busy test potential to the sleeve of the trunk jacks at other positions in the manner already described. The operator then plugs the calling cord 325 into the jack 323, after which operations proceed as before described except that, since there is no transfer key 318 to be operated in this instance, relay 202 at the originating end will remain operated under the control of relay 201. The trunk connection therefore will extend from the inward position to the calling subscriber over the front contacts of relay 202 and through the "A" cord to the subscriber's line. All other operations are then the same as previously described for a toll connection.

What is claimed is:

1. In a toll switching system, a trunk comprising one outgoing end and two incoming ends, means responsive to a connection to said outgoing end for establishing a talking and signaling connection between said outgoing end and one of said incoming ends, and means controllable after the establishment of said connection for establishing a talking and signaling connection between said incoming end and said other incoming end.

2. In a telephone system including subscribers' telephone lines, a trunk for use in connecting said lines terminating at its one end in an A operator's board and in a first B operator's board and at its opposite end in a second B operator's board, a signal at said A board associable with said trunk, a signal for said trunk at said first B board, a signal at said second B operator's board associated with said trunk, and a circuit to control said signals including a first relay, a second relay and a third relay, means responsive to a first operation at said second B board for operating said first and third relays to affect the signals at said A board and at said second B board respectively and means responsive to a second operation at said second B board for operating said second relay to affect said signal at said first B board.

3. In a telephone system including subscribers' telephone lines, a trunk for use in connecting said lines terminating at its one end in an A operator's board and in a first B operator's board and at its opposite end in a second B operator's board, a key for said trunk at said second B operator's board, a signal at said A board associable with said trunk, a signal for said trunk at said first B board, a signal at said second B operator's board associated with said trunk, a circuit to control said signals including a first relay, a second polarized relay and a third relay, means responsive to an operation at said second B board for operating said first and third relays to affect the signals at said A board and at said second B board and means responsive to the operation of said key for operating said second polarized relay to affect said signal at said first B board.

4. In a telephone system including a calling telephone line, a trunk terminating at one end in an A operator's board and in a first B operator's board and at its opposite end in a second B operator's board, means at said A board for extending said calling line over said trunk to said second B board, means for extending said trunk to said calling line at said first B board, a signal for said trunk at each of said boards, and a circuit to control said signals including a first relay having a high resistance winding and a low resistance winding and a second relay, means responsive to the extension of said connection at said second B board for operating both of said relays to light said signal at said first B board and to extinguish the signal at said second B board, and means responsive to the restoration of said calling line for short-circuiting the high resistance winding of said first relay for releasing said second relay to light said signal at said second B board in the event that said connection at said second B board has been disrupted.

5. In a telephone system including a calling telephone line, a trunk terminating at one end in an A operator's board and in a first B operator's board, and at the other end in a second B operator's board, a source of ringing current in said trunk, means at said A board for extending said calling line over said trunk to said second B board, means for extending said trunk to said telephone line at said first B board, a signal for said trunk at each of said boards and a circuit to control said signals including a first relay having a high resistance winding and a low resistance winding, said high resistance winding being normally short-circuited, a second polarized relay and a third relay, means responsive to a first operation at said second B board for operating said first relay and said third relay for operating said signal at said first B board and keeping non-operated said signal at said second B board, means responsive to the extension of said trunk to said telephone line at said first B board for removing said short circuit around the high resistance winding of said first relay to release said third relay to operate said signal at said second B board, means responsive to a second operation at said second B board for operating said second polarized relay to connect said ringing source to said line over said trunk at said first B board, and other means responsive to the operation of said second polarized relay for short-circuiting said high resistance winding of said first relay for operating said third relay to render said signal at said second board non-operative.

6. In a telephone system including a calling telephone line, a trunk terminating at one end in an A operator's board and in a first B operator's board and at the other end in a second B operator's board, signals associated with said trunk at said A board and at said first B board and a first and second signal associated with said trunk at said second B board, means for controlling the operation of each of said signals comprising a first relay having a high resistance winding and a low resistance winding, said high resistance winding being normally short-circuited, a second polarized relay and a third relay, means responsive to the extension of said telephone line to said second B board over said A board for operating

said third relay to operate said first signal at said second B board, means effective after the operation of said signal for connecting said three relays in a series current path for placing said second signal under the control of said third relay for operating said first relay to affect the signal at said A board and to operate said third relay to extinguish said first signal at said second B board, means responsive to a second operation at said B board for operating said second relay to affect the signal at said first B board, means responsive to the extension of said trunk to said telephone line over said first B board for removing the short circuit around the winding of said first relay to effect the release of said third relay, and means responsive to the restoration of said calling line to short-circuit said high resistance winding for reoperating said third relay and effect the operation of said second signal at said second B board.

7. In a telephone system, a toll trunk for extending a calling line from an A board to a toll board, a signal for said trunk at said A board, a first and second signal for said trunk at said toll board, and a circuit for controlling the operation of each of said signals comprising a relay having a high resistance winding and a low resistance winding, said high resistance winding being normally short-circuited, a second relay, a third relay, means responsive to the extension of said calling line to said toll board for connecting said first and said third relay in series and for operating them to render said signal at said A board and said first signal at said toll board non-operative, means responsive to an operation at said toll board prior to the disconnection of said calling line for disconnecting said third relay from said first relay and connecting said second relay with said first relay and operating said second relay to affect said second signal at said toll board, and means responsive to the restoration of said calling line for removing said short circuit around the winding of said first relay to release said second relay and restore said second signal.

8. In a signaling system, a trunk having three terminal ends, a signal for each of said terminal ends, and a signaling circuit for controlling the operation of all of said signals comprising a relay with a high and low resistance winding, a polarized relay, a marginal relay, sources of potential, means for reversing the current direction in said circuit, and means for short-circuiting the high resistance winding of said high-low relay whereby upon the application of one of said sources of potential said high-low relay operates to control one of said signals and said marginal relay operates or non-operates to control another of said signals depending upon whether said short-circuiting means are operated or non-operated respectively, and whereby when said current reversal means are operated said polarized relay is operated to control the last of said signals.

9. In a telephone system, a trunk terminating at one end upon a trunking operator's board and having its opposite end divided into parallel branch circuits terminating upon different operators' boards, a calling signal for said trunk located upon one of said last boards, a supervisory signal for said trunk located upon another of said last boards, means for operating said calling signal to denote a call and other means for operating said supervisory signal to show that the call has been completed at the board where said calling signal is operated.

10. A telephone system comprising subscribers' telephone lines, a trunk for interconnecting said lines, one end of said trunk appearing upon a trunking operator's board and the opposite end of said trunk having parallel branches appearing upon different operators' boards, a signal for each parallel branch of said trunk circuit and means controllable by the trunking operator for operating said signals in a definite order or sequence.

11. A telephone system comprising subscribers' lines, a trunk for interconnecting said lines, one end of said trunk circuit terminating upon a trunking operator's board and the opposite end of said trunk circuit being divided into two parallel branches which appear upon a trunking operator's board and a local operator's board, a signal for each parallel branch of said circuit, and means controlled by said first trunking operator for operating one of said signals on one type of connection and both of said signals on another type of connection.

12. In a telephone system, a trunk terminating at one end in an originating operator's board and in a terminating operator's board and at the other end in another terminating operator's board, means for establishing a talking connection over said trunk between said originating operator's board and said last-mentioned terminating operator's board, and manually controlled means at said last-mentioned terminating operator's board for disrupting said talking connection and establishing another talking connection between said first terminating operator's board and said last-mentioned terminating operator's board.

13. In a telephone system, a trunk terminating at one end in an originating operator's board, and at the other end in a trunking operator's board, a link for connection at either end of said truck, a signal in each of said links, and means in said trunk for operating said signals comprising a first relay having a high resistance winding and a low resistance winding, a second marginal relay in series with said first relay and a source of potential, means responsive to the connection of one of said links to the originating end of said trunk for short-circuiting said high resistance winding of said first relay, means responsive to the connection of said other link to the terminating end of said trunk for applying said source of potential to both of said relays, means responsive to the operation of said first relay to operate the link signal at said originating board, means responsive to the operation of said second relay to cause the link signal at said terminating board to remain non-operative, and means responsive to the disconnection of said first link from said trunk for removing the short circuit around the high resistance winding of said first relay to cause the release of said marginal relay to operate said link signal at said terminating board.

14. In a signaling system having three separate signals, means for controlling each of said signals comprising a first marginal relay, a second polarized relay, and a third relay having a high resistance winding and a low resistance winding, a current path extending through all of said relays in series, means for short-circuiting said high resistance winding, means for reversing said current path, and a source of potential connectible to said current path.

15. In a telephone system, a trunk having three outlets, a signal at each outlet, and means in said trunk for controlling each of said signals comprising a first relay having a high resistance winding and a low resistance winding for con-

trolling a signal at the first outlet, a second polarized relay for controlling a signal at the second outlet and a marginal relay for controlling the signal at the third outlet, a serial circuit path for all of said relays, a source of potential connectible to said path for operating said first and third relays, means for reversing said circuit path for operating said second relay and means for short-circuiting the high resistance of said first relay to effect the release of said third relay.

16. In a telephone system including subscribers' telephone lines, a trunk for use in connecting said lines terminating at its one end in an A operator's board and at its other ends in two different B operators' boards, a signal for each branch of said trunk, and means to control each of said signals comprising a first relay having a high resistance winding and a low resistance winding normally short-circuited, a second relay connected to a source of potential, a third relay connected to a different source of potential, means for connecting said second relay to said first relay for operating said first relay to selectively operate said signal at said A board and said signal at one of said B boards and for operating said second relay to hold said signal at the other of said B boards non-operated, means for removing said short circuit to release said second relay for operating said signal at the other of said B boards and means for disconnecting said second relay and connecting said third relay to said first relay to release said first relay and operate said third relay for extinguishing said signals at said A board and one of said B boards and maintaining operated said signal at other of said B boards.

17. In a signaling system having five signals, a circuit for controlling the operation of each of said signals comprising a first relay having a high resistance winding and a low resistance winding, said high resistance winding being normally short-circuited, a second polarized relay, a third marginal relay, a fourth relay and a fifth relay, means for effecting a series connection between said first, second and third relay for operating said first and said third relays to control a first and second signal, means for reversing said connection to operate said second relay to control a third signal, means for removing said short circuit around the high resistance winding of said first relay to release said third relay to control a fourth signal, means for disconnecting said third relay from said connection and for connecting said fourth relay thereto for releasing said first relay with its high resistance winding short-circuited and for operating said fourth relay to operate said second signal, means for releasing said fourth relay when said short circuit is removed to control said second signal, and means for disconnecting said fourth relay from said connection and for connecting said fifth relay thereto for operating said fifth relay to control a fifth signal.

RUSSELL B. BUCHANAN.
LINDLEY A. KILLE.