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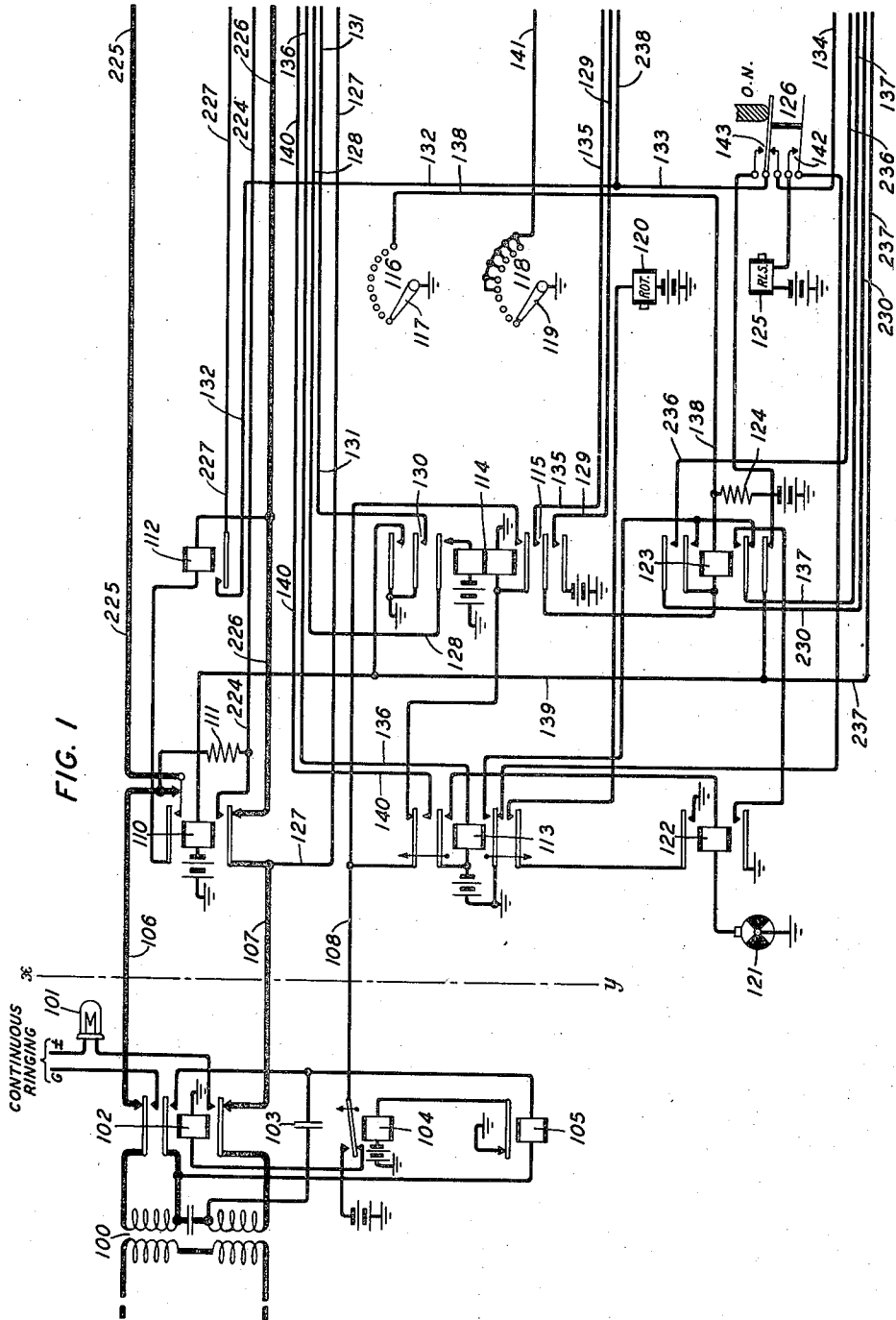
E. VON DER LINDEN

2,100,400

TELEPHONE SYSTEM

Filed June 30, 1936

2 Sheets-Sheet 1



INVENTOR
E. VON DER LINDEN
BY *H. H. Ferguson*
ATTORNEY

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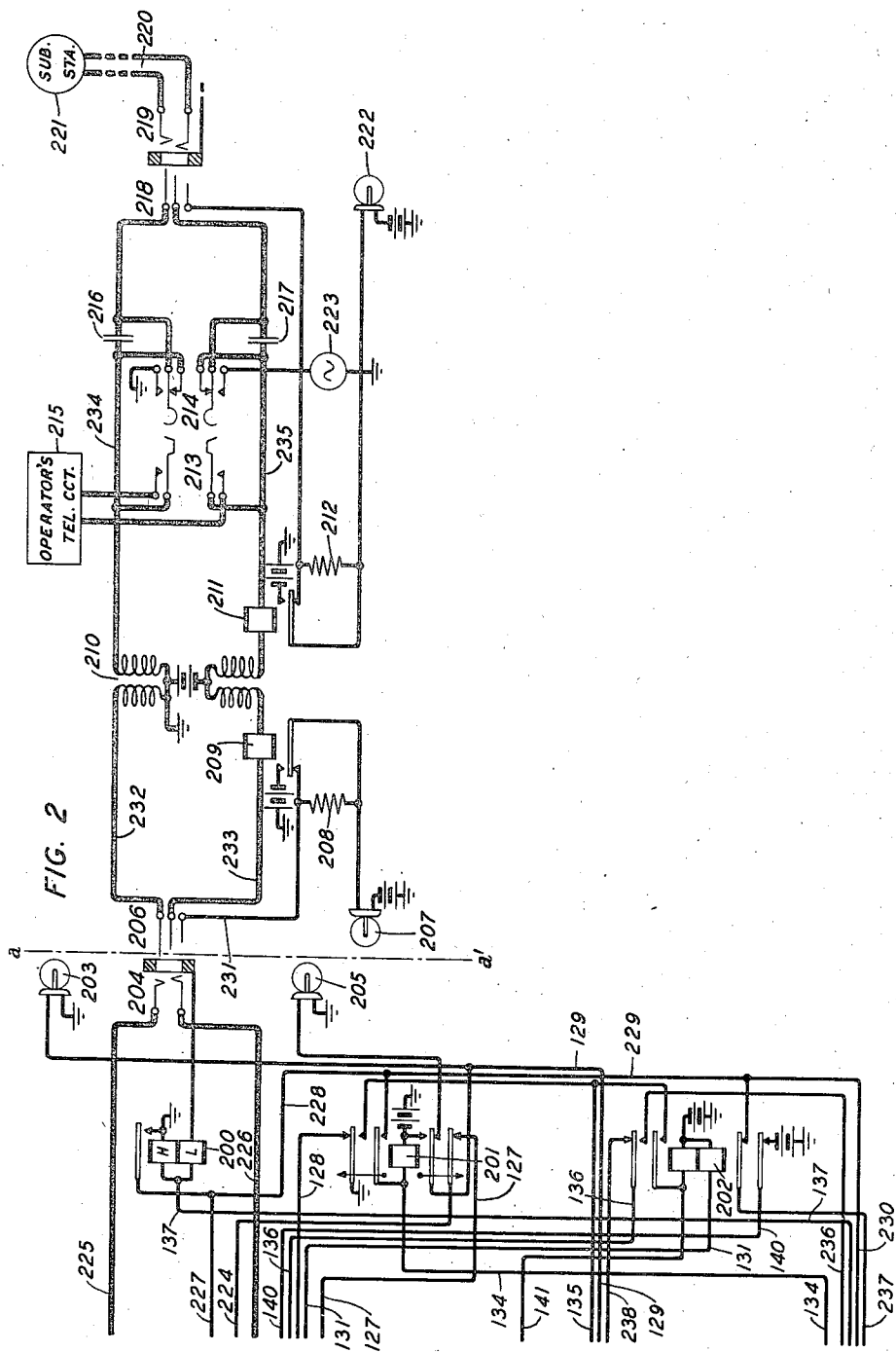
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INVENTOR
E. VON DER LINDEN
BY *A. J. Kugman*
ATTORNEY

UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Ernst von der Linden, Millburn, N. J., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

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5 Claims. (Cl. 179—41)

This invention relates to telephone systems and more particularly to ringdown toll lines arranged to terminate at a common battery subscriber's switchboard position and to function with standard local cord circuits thereat for either inward or outward calls.

An object of the invention is to provide such an arrangement as to permit the proper functioning of such lines under these conditions.

A feature of the invention resides in means whereby the connection of a common battery cord circuit to such a line causes ringing current to be transmitted out over the line for a single predetermined interval of time.

A related feature resides in means for lighting the connected cord supervisory lamp during the interval ringing current is connected to the line.

Another feature resides in means responsive to ringing current incoming over the line while a cord circuit is connected to the line at the switchboard position to cause the cord supervisory lamp to flash for a predetermined time interval and then to be retired independent of the duration of the incoming ring.

Other features and advantages will be clearly understood from the following detailed descriptions and by reference to the accompanying drawings, in which Fig. 1, and the portion of Fig. 2 at the left of the broken line $a-a'$ taken together represent one end of a two-way ringdown toll line circuit adapted to be connected to by the common battery cord circuit of a local manual switchboard, shown at the right of the line $a-a'$ in Fig. 2.

Considering the combined circuit arrangement shown in Figs. 1 and 2 let it be assumed that a toll operator in a distant "ringdown" office wishes to complete a toll call to a subscriber indicated at 221 in Fig. 2, over the two-way ringdown toll line, one end of which is shown in Figs. 1 and 2.

The toll operator in the distant office (not shown) rings on the toll line in the usual way. At the incoming end of the circuit (Fig. 1) this ringing current (20 cycles) is translated into direct current for controlling the associated toll line equipment and to light the line and busy lamps in front of the operator (Fig. 2). After the call has been established to the subscriber 221, the originating toll operator may transmit a ring-off or re-ring signal by again ringing on the toll line. In this case that portion of Fig. 1 to the left of the vertical broken line $x-y$ serves to translate the alternating current signal into one of direct current and cause the operator's cord supervisory lamp to flash for a definite interval of time de-

pending on the time it takes the rotary switch of Fig. 1 to step to the last terminal in the bank under the control of a timing interrupter 121. As the toll line is designed for two-way connections, a call will also be described as originating with the subscriber 221, answered by the operator's cord circuit of Fig. 2, and extended to a distant ringdown toll operation (not shown) over the toll line of Figs. 1 and 2. On a connection of this kind the circuit and apparatus, shown to the left of the vertical broken line $x-y$ in Fig. 1, serves to automatically send out 20 cycle ringing current over the toll line to the distant toll office for a definite interval of time. The time interval in this case being determined by the rotary switch shown in Fig. 1, as will presently be described.

Incoming toll call

When the distant operator rings on the line, 20 cycle ringing current will pass through the repeating coil 100 and operate relay 105 in a circuit traced from the bottom right terminal of repeating coil 100, bottom armature and contact of relay 102, conductors 107, and 127, outer bottom contact and armature of relay 201, conductor 224, resistance 111, conductor 106, outer top contact and armature of relay 102, upper winding of repeating coil 100, through winding of relay 105, condenser 103, and lower winding of repeating coil 100. Relay 105 operates and removes ground that normally holds slow release relay 104 operated. Relay 104 in releasing connects battery to lead 108 thereby operating relay 114 in an obvious circuit including the top armature and outer contact of relay 113. Relay 114 operates and at its inner top contacts closes a locking circuit for itself traced from battery through its upper winding and lead 128 to ground at outer top contact and armature of relay 201, thus setting up a calling condition in the toll line of Fig. 1 that is independent of the incoming ringing signal current that operated relay 105. Momentary operating of relay 105 due to line discharge and the like does not start a ringing signal because relay 104 is slow to release.

Relay 114 at its outer bottom contact connects battery to lead 129 to light line busy lamp 203 and to light line lamp 205 through the bottom inner armature and back contact of relay 201, thus informing the operator of an incoming call. Relay 114 at its top contact connects ground to winding of relay 110 which relay operates and prepares a circuit for the later operation of relay 112. Relay 110 at its inner bottom contact, maintains the termination resistance 111 across

the talking conductors 106 and 107, and disconnects these conductors from conductors 225 and 226 respectively. Relay 114 at contact 130 connects ground to lead 131 for operating relay 202 through its lower winding to battery. The latter relay opens, at its outer top contact, the operating circuit of relay 113 so that this relay will not operate and start an outgoing ringing signal when the call is answered by the operator.

Answering incoming toll call

The operator, noting the lighting of lamp 205, answers the call by inserting plug 206 in jack 204 of the toll line, thereby closing a sleeve circuit through relay 200, traced from battery through lamp 207, armature and back contact of relay 209, plug sleeve 231, thence over the jack sleeve and through the lower and upper windings of relay 200 in series to ground. When the plug is seated all the way in the jack, battery and ground from the cord circuit repeating coil 210 is fed back over the tip and ring conductors of the cord and toll line, upper make contacts of relay 110 and through winding of relay 112. This circuit includes the cord supervisory relay 209 which however does not operate in the above circuit due to the high resistance of relay 112, but the latter relay does operate and closes a path for operating relay 201 from ground on lead 227 placed there by relay 200, and further traced over leads 132 and 133, top armature and break contact of off-normal springs 126 and lead 134 to battery through winding of relay 201. The latter relay operates and at its inner bottom break contact opens the circuit to line lamp 205 but at its inner bottom make contact continues to maintain battery on busy lamp 203. Relay 201 at its inner top contact closes a locking circuit for itself over lead 228 to ground at contact of relay 200, thus eliminating relay 112 from its holding path. Relay 201 at its outer top break contact removes ground from lead 123, thereby permitting relay 114 to release. Relay 201 at its outer top make contact supplies ground for holding relay 202 operated through its inner top contact and upper winding to battery, after relay 114 has released. The release of relay 114, removes ground from lead 131 that previously was used to operate relay 202, opens the ground circuit that has been holding relay 110 operated which thereupon releases, and at contact 115 opens the operating path of relay 123. Relay 110 released, removes the termination 111 from across the talking circuit, opens the circuit through relay 112, and connects conductors 106 and 107 through to conductors 225 and 226 respectively for talking. The operator, in the meantime having thrown key 213 to connect her telephone circuit 215, challenges the calling operator to learn the number of the wanted subscriber's station.

The cord supervisory lamp 207 under the above conditions remains dark due to the series resistance of the two windings of relay 200. Upon learning that subscriber 221 is wanted the operator inserts plug 218 in jack 219 and rings the subscriber by operating ringing key 214. Through the ringback condensers 216 and 217 the distant calling subscriber is informed that the called subscriber is being rung. When subscriber 221 answers, a circuit is closed through his transmitter across the line 220 which is now connected with the cord talking conductors 223 and 235 thence through supervisory relay 211 to battery at repeating coil 210. The cord supervisory lamp 222, controlled by relay 211, remains dark as long as

the called subscriber's receiver is off the hook in accordance with usual practice.

Recall

During the connection the distant toll operator may recall the operator in the manual office by ringing on the toll line in the usual manner. This ringing signal results in causing the operator's cord lamp 207 to flash for a definite period of time and then restores the circuits to their former condition. The manner in which this is accomplished will now be described.

The incoming ringing signal operates relay 105, causing slow relay 104 to release and connect battery to lead 108, thereby operating relay 114 as previously described for an incoming call. The latter relay 114 operates and at its outer top contact connects ground to relay 110 causing it to operate and open the talking circuit, with the termination 111 connected across the talking conductors towards the distant toll office, and relay 112 connected across the talking conductors towards the cord circuit (Fig. 2). Relay 114 at its inner bottom contact closes a locking circuit to lead 108 for holding itself operated when relay 113 operates. Relay 114 at contact 115 closes the circuit for operating relay 123, traced from battery through resistance 124, winding relay 123, contact 115 of relay 114 and lead 135 to ground at outer top contact of operated relay 201.

The operation of relay 123 starts the operator's cord lamp 207 flashing in the following manner. At its outer top contact relay 123 closes a circuit for operating relay 113 traced from battery through winding relay 113, lead 136, top armature and front contact of operated relay 202, lead 236, outer top contact of relay 123, leads 230, 229 and 228, to ground at contact of relay 200. The operation of relay 113, at its inner bottom contact provides a locking path to ground for relay 123. At its inner top contact, relay 113 closes a battery circuit through the winding of interrupter relay 122 to ground through interrupter 121, and at its outer bottom contact a circuit is closed to rotary magnet 120 of a rotary timing switch so that this switch will be made to take one step every time relay 122 operates and releases. Upon the first closure of ground at interrupter 121 relay 122 operates and at its bottom contact connects ground over lead 137 to the mid-point of the windings of relay 200. Cord lamp 207 now lights over the sleeve circuit previously traced, due to ground on lead 137 shunting out the high resistance upper winding of relay 200. Relay 122 at the same time connects ground at its upper contacts to rotary switch magnet 120 through the inner bottom contact of relay 113, thereby causing switch arms 117 and 119 to move to the first terminal in terminal banks 116 and 118 respectively. Interrupter 121 may provide for any desired time interval of operating and releasing relay 122 but usually it operates at 120 interruptions per minute. When, on the first opening of the interrupter, ground is removed from the winding of relay 122, this relay releases to extinguish cord lamp 207 and to release rotary switch magnet 120. On the next closure of ground to relay 122, this relay reoperates to again light the cord lamp and to cause the rotary switch to take another step. Thus the cord lamp 207 continues to flash until arm 117 of the switch reaches the last terminal of switch bank 116 and connects ground to lead 138.

During this time interval, it is assumed the

incoming ringing signal has ceased, thereby resulting in the release of relay 114 and in turn the release of relay 110. The latter relay 110 as previously described removes the termination 5 111 from the toll line and reconnects the talking circuit through to the operator. The operator's cord lamp 207 continues to flash, however, because relay 123 is held operated by relay 113. When the rotary switch arm 117 reaches the last terminal, ground placed on lead 138 shunts 10 relay 123, through the common resistance 124 to battery causing its release. The release of relay 123 at its outer top contact opens the operating path for relay 113 causing it to release 15 and open the circuit of interrupter relay 122. Relay 123 at its inner bottom contact also opens the ground path to the winding of relay 200 thereby stopping the flashing of cord lamp 207. In this manner the operator is advised of a recall by the distant toll operator. If she fails to observe the flashing signal the calling toll operator will repeat the signal and cause lamp 207 to flash for a second period.

Disconnect

The operator receives a lighted lamp 222 as a disconnect signal when the called subscriber 221 restores his receiver to the switchhook but under normal operating conditions the operator waits 30 until lamp 207 flashes before taking down the connection. Lamp 207 flashes as a disconnect signal when the subscriber connection in the distant toll office is taken down and the toll operator sends a "ring-off" signal to the manual operator. This "ring-off" signal is received in 35 the same manner as a recall signal and, assuming both lamps are lighted, whereupon the operator removes plugs 206 and 218, thus opening the sleeve circuit that has been holding relay 40 200 operated. Relay 200 releasing removes ground from the holding lead 228 to relay 201 which thereupon releases. Relay 201 releasing removes the holding ground for relay 202 which also releases, thus restoring the circuit to normal. 45

Outgoing call

The operation of the toll line circuit will now be described under the assumption that the operator in the manual office receives a call from 50 subscriber 221 for a connection to a distant toll point. In this case after inserting plug 218 in jack 219 and receiving the wanted subscriber's number from subscriber 221, the operator inserts plug 205 in toll line jack 204 in order to reach the distant toll office. The toll line circuit is so arranged that when plug 206 is inserted in jack 204, a ringing signal is automatically caused to be sent out over the line to the 60 distant toll office. This is accomplished as the result of operating relay 200 on the plug-in which connects ground to lead 228. This ground path is traced over lead 229, inner bottom normal contact of relay 202, leads 237 and 139 to battery through winding of relay 110. The latter 65 relay operates to split the talking circuit as previously described and to connect relay 112 across the talking conductors 225 and 226. Relay 112 then operates on battery received from the cord circuit and closes a contact for operating relay 70 201, over a path traced from battery through winding of relay 201, lead 134, contact and armature on off-normal springs 126, leads 133 and 132, contact of relay 112 to ground placed on 75 lead 227 by relay 200. The operation of relay

201 at its inner bottom contact connects battery to busy lamp 203 and otherwise performs the same functions as described for an incoming call. Relay 113 also operates on the same ground 5 path, i. e., traced from battery through winding relay 113, lead 136, outer top armature and contact relay 202, lead 238, thence over lead 132 and contact relay 112 to ground on lead 227. Relay 113 operating closes a circuit for 10 relay 102, traced from ground through winding relay 102, front contact and armature of relay 104, lead 108, outer top armature and contact of operated relay 113, lead 140 to battery at outer bottom contacts of relay 202. Relay 102 15 thereupon operates to connect 20 cycle continuous ringing current through ballast lamp 101 to the windings of repeating coil 100 and thence over the line to the distant toll office. Relay 102 at its inner top contact also closes a shunt around relay 105 to prevent its operation on 20 the ringing current. The ringing signal continues until stopped by the action of the rotary switch shown in Fig. 1 which will now be described.

When relay 113 first operated, it connected 25 battery at its inner top contact to the winding of relay 122 thereby causing this relay to operate and release under control of interrupter 121. Relay 113 at its outer bottom contact also closed a circuit to rotary switch magnet 120 30 which includes a contact of relay 122 thereby causing the rotary switch to step under control of interrupter 121. At this point it should be observed that the operator's cord supervisory lamp 207 remains lighted during the period that 35 the ringing signal is being sent out, due to ground, at the inner bottom contact of relay 113, being connected to the middle of the windings of relay 200 over a path traced through inner bottom normal contact of relay 123 and 40 lead 137. When the switch arm 119 reaches the fourth terminal in the bank 118 it connects ground to lead 141 which operates relay 202 through its upper winding to battery. Relay 202, at its inner top contact locks to the 45 outer top contact on operated relay 201, stops the ringing signal from going out, restores the rotary switch to normal, and reconnects the toll line conductors to the manual operator's cord circuit.

The ringing signal is removed from the toll 50 line due to the release of relay 102 which relay releases due to removal of battery at the outer bottom contact of relay 202 that has been holding relay 102 operated. Further stepping of the rotary switch is prevented by the release 55 of relay 113 due to opening its operating circuit at the outer top contact of relay 202. The release of relay 113 connects ground, at its inner bottom contact, through contact 142 of off-normal springs 126 to operate the release magnet 125, thereby restoring the rotary switch to normal. The toll line conductors 106 and 107 are 60 reconnected to conductors 225 and 226 for talking due to the release of relay 110 which is caused by the opening of contact 143 of the off-normal springs 126 when the switch restores to normal. The holding path for relay 110 is traced over 65 lead 139, outer bottom contact of relay 123, contact 143 of off-normal springs 126, leads 133 and 132, contact of relay 112 and thence over lead 227 to ground at contact of relay 200. All relays of the toll line circuit are thus restored to normal except relays 200, 201 and 202 which are 70 the same relays that remain operated on an in- 75

coming call previously described. The cord lamp 207 is extinguished due to release of relay 113 thus leaving the circuits in a condition to receive a recall signal in the manner previously described.

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Disconnect

Assuming conversation has terminated on the above described connection, the manual operator will proceed to disconnect as soon as she receives
 10 a disconnect lamp signal 222 indicating that the calling subscriber 221 has restored his receiver to the switchhook and without waiting to receive a flashing ring-off signal on lamp 207 because she is the originating operator holding a ticket
 15 on the connection. Said operator therefore may or may not have received a flashing disconnect lamp 207. If, however, the plug 206 is removed from jack 204 before lamp 207 flashes the operator must send a ring-off signal to the distant
 20 toll office. This is accomplished by reinserting plug 206 in the toll line jack long enough to cause a ringing signal to be sent to the distant toll office, in the same manner as previously described in originating the call.

25 What is claimed is:

1. In a telephone system, an operator's position, a line terminating thereat, a common battery cord circuit at said position including a supervisory signal device adapted to be connected to
 30 said line, a source of ringing current, and means in said line responsive to the connection of said cord with the line for connecting said source to the line and displaying said supervisory signal for a predetermined time interval.

35 2. In a telephone system, an operator's position, a line terminating thereat, a common battery cord circuit at said position including a supervisory signal device adapted to be connected to said line, a source of ringing current, and

means including a selector switch in said line responsive to connection of said cord with the line for connecting said source to the line and displaying said supervisory signal for a predetermined time interval.

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3. In a telephone system, an operator's position, a line terminating thereat, a common battery cord circuit at said position including a supervisory signal device connected to said line, and means including a selector switch associated with
 10 said line and responsive to ringing current incoming over said line for intermittently displaying said supervisory signal for a predetermined interval of time irrespective of the length of the incoming ring.

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4. In a telephone system, an operator's position, a line terminating thereat, a common battery cord circuit at said position including a supervisory signal device connected to said line, and means associated with said line and responsive
 20 to ringing current incoming over said line for intermittently displaying said supervisory signal for a predetermined interval of time irrespective of the length of the incoming ring.

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5. In a telephone system, a telephone line extending between a first and second exchange, a cord circuit at said second exchange including a supervisory signal device, a source of ringing current, means including a selector switch in said
 25 line responsive to the connection of said cord with said line for connecting said source to said line for a predetermined interval of time, said selector switch also being responsive to the transmission of signaling current over said line from the first exchange for displaying said cord circuit
 30 supervisory signal for a predetermined interval of time irrespective of the length of the incoming ring.

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ERNST VON DER LINDEN.