

Dec. 29, 1936.

T. H. NEELY

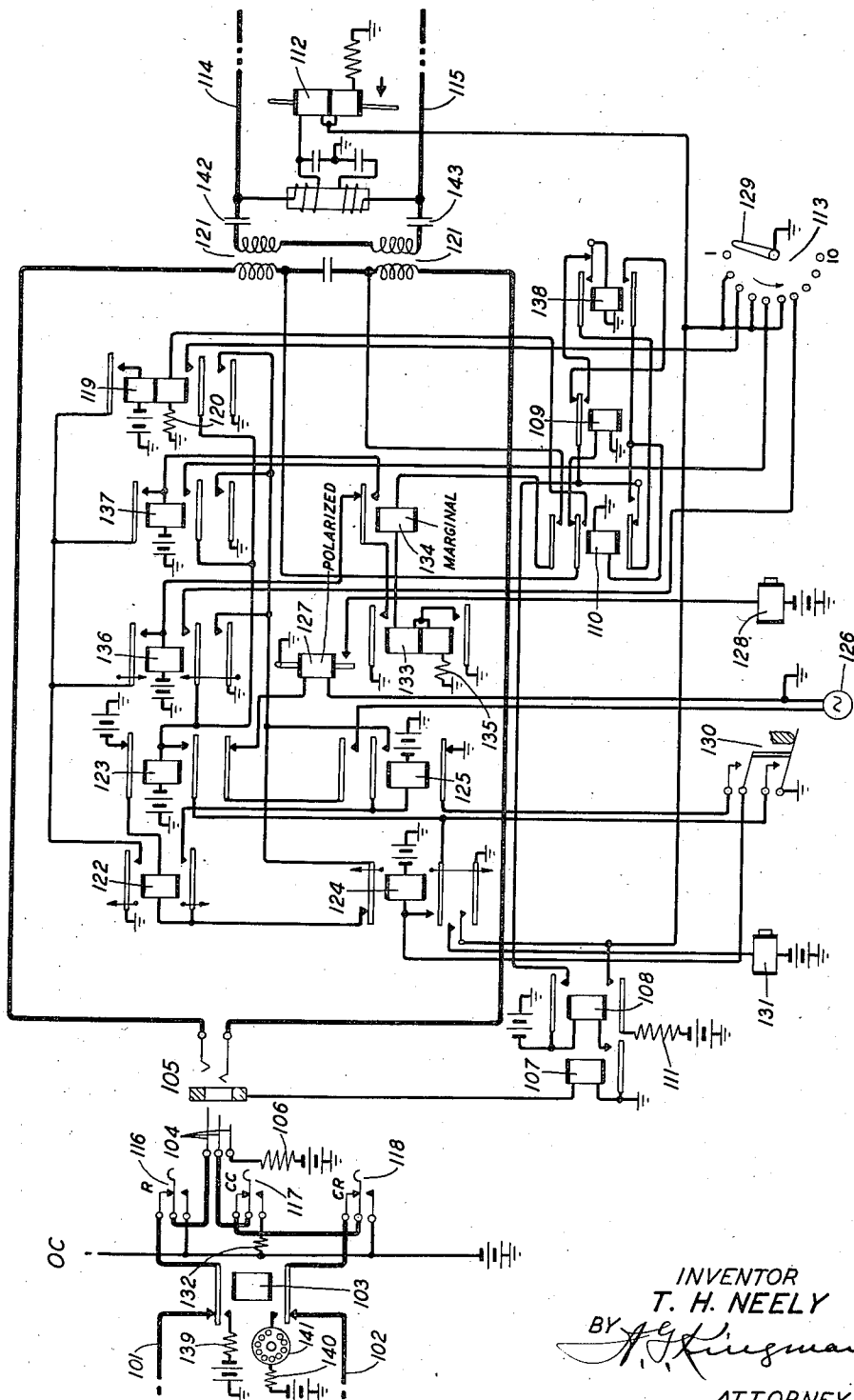
2,065,905

SIGNALING SYSTEM

Filed Sept. 18, 1935

3 Sheets-Sheet 1

FIG. 1



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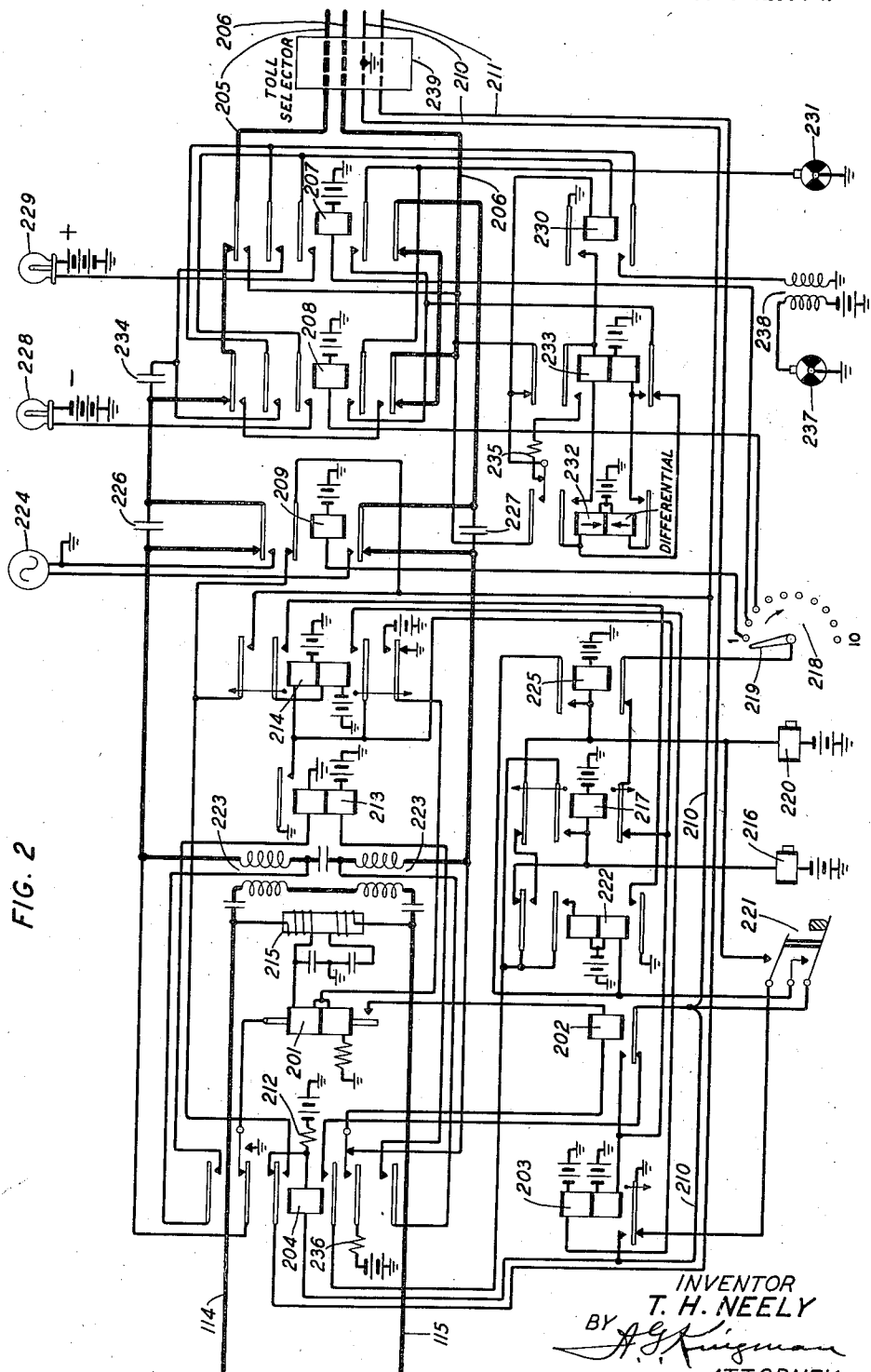
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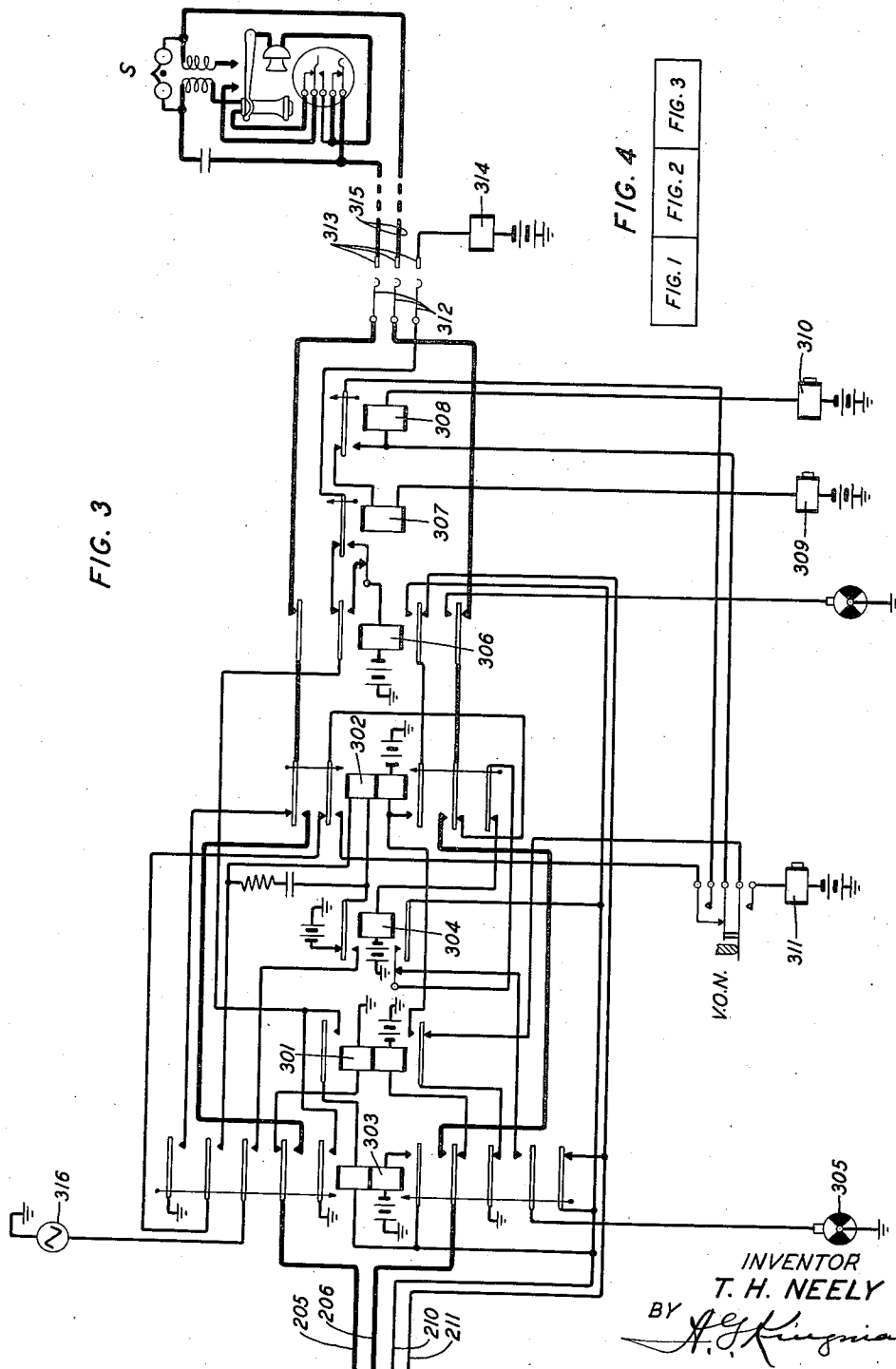


FIG. 3

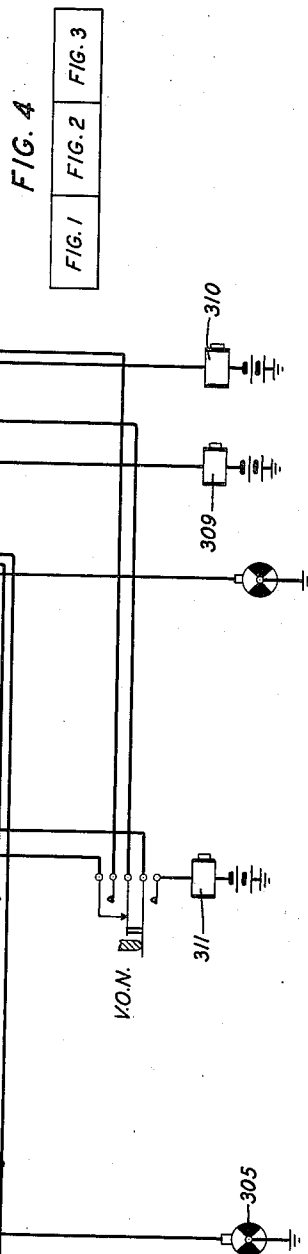


FIG. 4

FIG. 1	FIG. 2	FIG. 3
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SIGNALING SYSTEM

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5 Claims. (Cl. 179—27)

This invention relates to remote control, i. e., operation or release of electric devices, over a telephone line or other circuit, by means at the receiving end of the line controlled by momentary line impulses, either open or closed circuit, initiated at the control end of the line by the respective operation and release of functional switching devices, as, for example, simple circuit closing keys.

More specifically, the invention relates to means at the control end of the line, responsive to closure of a key or other circuit closing device for initiating transmission over the line of a predetermined number of short impulses, either open or closed circuit, and means at the distant end of the line for receiving and translating these impulses to operate a desired device, as for example, a relay, corresponding to the key operated at the control point, said means at each end of the line also being adapted to similarly initiate and receive a predetermined number of similar impulses (usually one) when the control key is restored to release the relay.

One embodiment of the invention wherein a feature of the present invention resides consists of a toll dialing system comprising a trunk line extending between a toll dialing operator's position at one end and an automatic or machine switching office at the other, said trunk line being arranged for so-called composite dialing, i. e., arranged for transmitting dial impulses and other signals and for holding an established connection over a single conductor. In such a system it may be required to perform auxiliary functions at the automatic office under control of the toll operator after the desired connection has been established by dialing and is being held such, for example, as starting ringing on the selected line, reringing, or connecting coin potential of either one polarity or the other to the selected line for the purpose of collecting or refunding a coin at the automatic subscriber's station.

Under such conditions, in accordance with the present invention, the toll operator's cord circuit is provided with the usual ringing key, coin collect key and coin return key and all so arranged as to operate respective relays in the outgoing end of the toll line to which the operator's cord circuit is connected.

In the outward end of the toll line circuit means, initiated by operation of any one of these relays, is also provided for momentarily interrupting the closed composite circuit a predetermined number of times depending on the

relay operated thereby momentarily releasing and reoperating the usual polarized relay at the automatic office end of the line a corresponding number of times. At the automatic office end of the line this release and reoperation of the polarized relay causes translating means thereat to select and operate a particular one of several relays depending upon the number of times the composite circuit is opened and closed, which particular relay is adapted when operated to perform the desired function, as for example, starting ringing on the line selected by a previous dialing operation.

After the relay at the automatic office is operated it is held operated under control of the impulse translating means at that end of the line.

When the toll operator releases the operated key the interrupting means at the outgoing end of the line again functions to momentarily interrupt the composite circuit once only thereby causing a corresponding release and reoperation of the polarized relay at the distant end of the line which monetary release causes the translating means thereat to respond and release the operated relay.

In general, regardless of the path over which the impulses are transmitted, the invention may be broadly stated as an arrangement whereby the operation of a functional circuit closer initiates the transmission of a predetermined number of momentary line impulses of any predetermined character to cause the selection and operation of a corresponding electromagnetic device at the distant end of the line and whereby the release of the circuit closer initiates the transmission of a single or predetermined number of impulses over the line which will cause release of the device.

The invention will be understood from the following description when read in connection with the accompanying drawings.

Referring to the drawings, Figs. 1, 2 and 3, when taken in the order illustrated in Fig. 4, disclose a portion of a telephone system employing a toll dialing trunk circuit which embodies the remote control signaling features of this invention for controlling the ringing and coin disposal at the subscriber's station.

Fig. 1 shows such portions of the toll switchboard end of a toll switching trunk circuit arranged for composite signaling, and also such portions of a toll operator's cord circuit, as are required to illustrate the features of this invention;

Fig. 2 shows the essential portions of the step-by-step office end of the toll switching trunk the other end of which trunk is shown in Fig. 1; and

Fig. 3 shows a step-by-step toll connector circuit the function of which is to establish connections to subscribers' stations one of which, station S, is also shown in Fig. 3.

Since this invention relates to the control of ringing and coin disposal at a subscriber's station, all of which takes place after connections between the toll switchboard operator and the called subscriber have been established, it will be assumed that the toll operator by means of dial 141 of the cord circuit OC has dialed the number of the called station S and thereby caused the toll connector circuit shown in Fig. 3 to function, in a manner well known to the art, and connect its brushes 312 to connector bank terminals 313 thereby establishing connections over line 315 to the subscriber's station S.

With connections established to station S as set forth above the following conditions obtain in the trunk circuit shown in Figs. 1 and 2 and in the connector circuit shown in Fig. 3. Dialing having been completed, relay 103 of the operator's cord circuit OC is in its unoperated position. Plug 104 of cord OC has been previously inserted into jack 105, thereby operating relay 107 to battery through resistance 106. Relay 107, operated, operates relay 108 locally. Relay 108, operated, connects battery through resistance 111 and over its lower front contact to the junction of the two windings of the composite signaling relay 112 thereby causing the operation of composite signaling relay 201 at the step-by-step end of the trunk. Relays 109, 110 and 138 of Fig. 1 provide for transferring the control conductors to the ringing, coin collect and coin return control relays at the conclusion of dialing and function as set forth in the subsequent paragraphs.

When the toll operator initiates a call by inserting plug 104 into jack 105 the connection to station S is established by the toll connector shown in Fig. 3 which functions under control of dial pulses from dial 141. The manner in which these pulses are transmitted over the composite signaling trunk and also the manner in which the toll connector circuit functions are well known to the art and since this is not a feature of the invention no detailed description thereof will be given. However, since the dial impulses are transmitted to the trunk over the ring conductor of the operator's cord OC and since the coin collect and coin return impulses are also transmitted over the same conductor, means is provided in the toll switchboard end of the trunk for transferring from the dialing portion of the circuit to the ringing and coin disposal portion at the conclusion of dialing. This is accomplished by relays 109, 110 and 138 in the following manner: With plug 104 in jack 105 the operation of the toll operator's dialing key (not shown) operates the cord circuit relay 103. A circuit is thereupon completed from battery through resistance 139, upper front contact of relay 103, back contact of ringing key 116, tip conductor of cord OC, tip of plug 104 and jack 105, left upper winding of repeating coil 121, upper back contact of relay 110, to ground through the winding of relay 109. Relay 109 operates and completes the circuit for relay 138 which operates in a circuit from ground through its winding and over its normally closed contact, front contact of relay 109, to battery over the

upper front contact of relay 108. Relay 138 locks over the lower back contact of relay 110, to the same battery over the upper front contact of relay 108 and prepares an operating circuit for relay 110. The portions of the trunk circuit involved in the transmission of the dial pulses have not been shown since this function is not a feature of the invention.

At the conclusion of dialing the toll operator releases her dialing key (not shown) thereby releasing relay 103 of cord circuit OC. Relay 109 thereupon releases and operates relay 110 in a circuit from ground through the winding of relay 110, over the lower front contact of relay 138, back contact of relay 109, to battery over the upper front contact of relay 108. Relay 110, in operating, locks over its lower front contact to the battery over the upper front contact of relay 108, opens the locking circuit for relay 138 which releases; transfers the tip conductor of the trunk, through the left upper winding of repeating coil 121, from the winding of relay 109 to the lower or operating winding of the ringing control relay 119; and closes the ring conductor of the trunk, through the left lower winding of repeating coil 121, to the windings of the coin disposal control relays 134 and 133 in series, thereby transferring the control connections of the toll switchboard end of the trunk from the dialing phase to the ringing and coin control phase.

Referring now to Figs. 2 and 3, the initial application of battery to the windings of the composite signaling relay 112 of Fig. 1 prior to dialing caused the operation of composite signaling relay 201 of Fig. 2 in a manner well known to the art. The operation of relay 201 causes a toll selector circuit (represented by block 239) to be seized. Subsequent dialing by the toll operator causes the toll selector circuit and the toll connector circuit shown in Fig. 3 to function, the toll connector circuit establishing connections to the called station S in a manner well known to the art. Dialing having been completed, the following conditions obtain in the step-by-step office end of the toll trunk: Relay 201 is operated as set forth above. Relay 204 is operated in a circuit from battery through resistance 212, winding of relay 204, to a ground on conductor 210, this ground being returned from toll selector circuit upon its seizure. Relay 202 is operated in a circuit from ground over the upper middle front contact of relay 204, armature and contact of relay 201, winding of relay 202, lower middle front contact of relay 204, to battery through resistance 236. Relay 203 is operated in a circuit from battery through its lower winding, over the front contact of relay 202, to the ground over conductor 210.

In the toll connector circuit shown in Fig. 3 the following conditions obtain following the establishment of connections to station S. Assuming that the called station S was idle, upon the connection of brushes 312 to terminals 313, under control of vertical stepping magnet 309 and rotary magnet 310, in a manner well known to the art, a circuit was completed from battery through the winding of the cut-off relay 314, sleeve terminal and brush, back contact of relay 307, upper inner back contact of relay 306, upper front contact of relay 301, through the upper winding of relay 303, to ground over conductor 210 supplied by the toll selector circuit. Relay 303 operated and locked through its lower winding and over its lower inner front contact

to ground on conductor 210. The operation of relay 303 opened the circuit through the windings of relay 301 which released. Relay 303 also connected ringing current from the source 316 to the upper front contact of relay 304 and, in addition, opened a locking circuit for relay 302, this circuit being traceable from battery through the lower winding of relay 302, lower inner front contact of relay 302, lower inner back contact of relay 306 and over the lower outer back contact of relay 303, to ground over conductor 210 from the toll selector circuit. Relay 302 remains operated, however, under control of the toll switching trunk circuit in a circuit traceable from battery through its lower winding and over its lower inner front contact, lower inner back contact of relay 306, conductor 211, upper inner front contact of relay 204 of Fig. 2, upper inner back contact of relay 209, to ground on conductor 210 from the toll selector circuit. Ringing of the called station S by the toll operator under control of the remote control selective signaling system which comprises this invention now takes place in the manner described in subsequent paragraphs.

The operation of the cord circuit ringing key 116 operates relay 119 in a circuit from ground through resistance 120 and the lower winding of relay 119, over the upper inner front contact of relay 110, left upper winding of repeating coil 121, tip conductor of the trunk, tip spring of jack 105 and tip element of plug 104, front contact of ringing key 116, to battery. Relay 119, operated, operates relay 122 in a circuit from battery over the upper back contact of relay 123, winding of relay 122, back contact of relay 124, to ground over the lower outer front contact of relay 119. Battery, through the winding of relay 123, is connected over the lower inner front contact of relay 119, to the third bank terminal of the selective control switch 113 the function of which will later be described. Relay 122, in operating, locks relay 119 through the upper winding of that relay, and operates relay 125 from battery through the winding of relay 125, lower front contact of relay 122, back contact of relay 124, to ground over the lower outer front contact of relay 119. Relay 125, in operating, locks directly under control of relay 119, and connects a low frequency alternating current from the source 126, over its upper outer front contact, to the winding of relay 127. Relay 127, which is a polarized relay, follows the alternating current pulses, its armature intermittently closing ground through the winding of rotary magnet 128 which is associated with switch 113. Brush 129 of switch 113 advances one step for each closure of the circuit through rotary magnet 128. As brush 127 contacts the second terminal of switch 113 the ground on the brush short-circuits the battery through resistance 111 which has been connected to the junction of the two windings of the composite signaling relay 112 thereby causing the composite signaling relay 201 at the step-by-step end of the trunk to release and function as will later be set forth. When brush 129 leaves the second bank terminal of switch 113 to advance to the third bank terminal it removes the short circuit from resistance 111 reconnecting battery to the windings of relay 112 and thereby reoperating relay 201 at the step-by-step end of the trunk. When brush 129 contacts the third bank terminal of switch 113 relay 123 operates over the lower inner front contact of relay 119 and locks over its front contact to ground over the lower front

contact of the off-normal springs 130 these latter springs having operated as soon as switch 113 took its first step. Relay 123, in operating, opens the circuit through the winding of relay 127 to prevent any further stepping of switch 113, and also opens the circuit through the winding of relay 122. Relay 122, in releasing, opens the locking circuit through the upper winding of relay 119, this latter relay remaining operated over its original operating circuit through its lower winding should the ringing key of the chord circuit still be operated.

When the toll operator releases ringing key 116 relay 119 releases in turn releasing relay 125. Relay 124 thereupon operates in a circuit from battery through its winding, over the upper contacts of the operated off-normal springs 130, to ground over the back contact of relay 125. Relay 124 locks over its inner front contact to ground over the lower contacts of springs 130, energizes release magnet 131, and also short-circuits the battery through resistance 111 thereby causing a second release of the composite signaling relay 201 at the step-by-step end of the trunk. The function of this second release of relay 201 will be set forth later. Release magnet 131 energized causes the switch 113 to restore to normal at which time the off-normal springs 130 also restore. The opening of the contacts of spring 130 release relay 124 which in turn opens the circuit through the winding of release magnet 131. Two single impulses have been transmitted over the composite signaling circuit from the toll switchboard end of the trunk to the step-by-step office end of the trunk. The first single impulse controls the ringing current at the step-by-step office while the second single impulse serves to restore the remote control signaling circuit at that office to normal so that this said signaling circuit may be receptive to subsequent coin disposal signals, these operations taking place in the manner hereinafter described.

Referring now to the step-by-step office end of the trunk shown in Fig. 2, the first release of the composite signaling relay 201, in response to the short-circuiting of the battery at the windings of relay 112 as previously described, opens the circuit through the winding of relay 202. Relay 202 releases and operates relay 217 and energizes rotary magnet 216 of switch 218 in a circuit traceable from battery through the windings of this said relay and magnet in parallel, over the back contact of relay 222, lower inner front contact of relay 204, back contact of relay 202, and over conductor 210 to ground supplied from the toll selector circuit. Relay 217, in operating, locks over its front contact to the ground over conductor 210 under control of the lower inner front contact of relay 204 and the back contact of relay 202, and opens the circuits to the brush 219 of switch 218 and to the winding of release magnet 220. Rotary magnet 216, energized, causes brush 219 to advance and contact the first terminal of switch 218. As brush 219 moves out of its normal position the off-normal springs 221 close their contacts and complete a circuit from ground on conductor 210, lower contacts of springs 221, to battery through the lower winding of relay 222. Relay 222 operates and closes, in part, the circuit to release magnet 220, relay 222 remaining operated through its lower winding as long as switch 218 is in any position other than normal.

When relay 201 reoperates following the first

signaling pulse relay 202 reoperates and opens the locking circuit for relay 217. Relay 217 releases and operates relay 209 in a circuit traceable from battery through the winding of relay 209, first terminal of the bank of terminals of switch 218, brush 219, back contact of relay 225, lower back contact of relay 217, front contact of relay 202, to ground supplied from the toll selector circuit (not shown) over conductor 210. Relay 209, operated, opens the circuit between conductors 210 and 211 thereby removing ground from conductor 211 and also connects ringing current from the source 224 to the tip and ring conductors 205 and 206 toward the toll connector circuit over back contacts of relays 208 and 207.

Referring now to the toll connector circuit shown in Fig. 3, as previously set forth relays 302 and 303 are operated up to this time, relay 302 being locked operated through its lower winding to the ground supplied over conductor 211 under control of the back contact of relay 209, while relay 303 is locked operated over its lower winding to ground supplied over conductor 210 from the toll selector circuit. The removal of ground from conductor 211 by the operation of relay 209 as set forth above causes relay 302 of the connector circuit to release. Upon the release of relay 302 a circuit is completed from ground through the pick-up interrupter 305, over the lower outer front contact of relay 303, lower normally closed contacts of relay 304, lower outer back contact of relay 302, to battery through the winding of relay 304. When the brush of pick-up interrupter 305 contacts a conducting commutator segment relay 304 operates and locks over the lower outer back contact of relay 302 and over its own lower front contact to ground over conductor 210. Ringing current is thereupon connected to the called station S in a circuit traceable from the ringing current source 316, over the upper middle front contact of relay 303, upper front contact of relay 304, upper winding of relay 302, next-to-outer upper front contact of relay 303, upper and lower inner back contacts of relay 302, lower outer back contact of relay 306, ring conductor, ring brush of brushes 312, ring terminal of connector bank terminals 313, ring conductor of line 315, through station S, tip conductor of line 315, tip terminal and brush of terminals 313 and brushes 312, tip conductor of the connector, upper outer back contacts of relays 305 and 302, to ground over the upper outer front contact of relay 303.

When the subscriber at station S answers and removes the receiver from the switchhook relay 302 operates on the ringing current through its upper winding sufficiently to close its lower inner front contact and thereupon completely operates and locks through its lower winding in a previously traced circuit to ground over conductor 211, ground having been replaced on conductor 211 by the trunk circuit in the manner which will be set forth in the succeeding paragraphs. Relay 302, in operating, removes the ringing current from line 315 and opens the locking circuit for relay 304 which latter relay thereupon releases.

The operation of relay 209 at the step-by-step end of the toll trunk, in addition to opening the ground from conductor 211 to cause the connector circuit to function and ring the called station as set forth above, also connects ringing current from the source 224 to one side of con-

densers 226 and 227, the other side of which condensers connect to the right windings of repeating coil 223. A portion of the ringing current is induced in the left windings of coil 223 and extends over conductors 114 and 115, through condensers 142 and 143, to the right windings of repeating coil 121. This ringing current is further induced through the left windings of coil 121 to the toll operator over the cord OC as a signal that the called station is being rung.

When the toll operator releases ringing key 116 and relay 125 releases, battery through resistance 111 to the windings of relay 112 is short-circuited as previously set forth, resulting in the transmission of a single restoring pulse to the step-by-step end of the trunk and causing the release of relay 201 at that end of the trunk. Relay 201, releasing, releases relay 202 which completes a circuit from ground over conductor 210, back contact of relay 202, lower inner front contact of relay 204, upper outer front contact of relay 222, and over the upper back contact of relay 217, through the windings of release magnet 220 and relay 225 in parallel, to battery. Relay 225 operates, locks over its front contact and the lower contacts of springs 221 to ground over conductor 210, maintains the circuit through the winding of magnet 220, and opens the operating circuit for relay 209. Relay 209 releases, removing ringing current from condensers 226 and 227 and again closing the circuit between conductors 210 and 211 thereby permitting relay 302 of the connector circuit to lock after operating at the time the called subscriber answers as has hereinbefore been set forth. Release magnet 220, energized, causes the brush 219 of switch 218 to restore to its normal position at which time the off-normal springs 221 also restore and thereby open the locking circuits for relays 222 and 225 and magnet 220. Relays 222 and 225 release and thereby restore the signaling circuit to normal.

Supervision

After the connector relay 302 operates following the answer by the called subscriber supervisory relay 213 at the step-by-step end of the trunk circuit operates in a circuit from ground through its upper winding, over the upper outer front contact of relay 204, right upper winding of repeating coil 223, upper outer back contacts of relays 209, 208 and 207, tip conductor 205, upper next-to-inner front contact of relay 303, upper outer front contact of relay 302, upper outer back contact of relay 306, tip conductor of line 315, through the subscriber's station S, ring conductor of line 315, lower outer back contact of relay 306, lower outer front contact of relay 302, lower middle front contact of relay 303, ring conductor 206, lower back contacts of relays 208, 207 and 209, right lower winding of coil 223, lower outer front contact of relay 204, to battery through the lower winding of relay 213. Relay 213, in operating, operates relay 214 through the upper winding of that relay. The operation of relay 214 removes ground from the junction of the windings of the composite signaling relay 201 and connects battery to this point instead thereby causing the composite signaling relay 112 at the toll switchboard end of the trunk to operate for supervisory purposes. This supervisory circuit has not been shown since it is not a feature of this invention and functions in a manner well-known to the art.

Reringing by toll operator

Should the operator at the toll switchboard desire to rering the called station after the connection has been set up as hereinbefore set forth the manner in which the ringing control relay 209 at the step-by-step end of the toll trunk is operated by the remote control signaling circuit of the trunk under control of the operation of ringing key 116 of the cord circuit OC is identical with that previously described. From the point of the operation of relay 209 however the manner in which station S is rung differs since both relays 213 and 214 are operated, the subscriber at station S having answered in response to the initial ringing by the toll operator. The upper outer front contact of relay 214 parallels the upper inner back contact of relay 209 and, upon the operation of relay 214 when the subscriber answers, conductor 211 is therefore grounded from conductor 210 independently of the back contact of relay 209. The operation of relay 209 during reringing therefore does not release the toll connector relay 302, the release of which latter relay originally connected ringing current to line 315 as has previously been set forth. Since relay 302 remains operated ringing current is applied to line 315 in this instance from source 224, over front contacts of relay 209, back contacts of relays 208 and 207, conductors 205 and 206, front contacts of relays 303 and 302, and over the back contacts of relay 306.

Coin collection

When the toll operator is ready to collect coins at station S she depresses the coin collect key 117 of her cord circuit OC which causes the remote control selective signaling circuit of the toll trunk to function and apply coin collect potential over line 315 in the manner set forth in the subsequent paragraphs.

The operation of coin collect key 117 completes a circuit from battery, through resistance 132, front contact of key 117, ring of the plug 104 and jack 105, left lower winding of repeating coil 121, upper outer front contact of the previously operated relay 110, through the winding of relay 134, through the two windings of relay 133 in series, to ground through resistance 135. The coin collect control relay 133 operates over this circuit but the marginal coin return control relay 134 does not operate due to the limited current flow caused by the inclusion of resistance 132 in the circuit. Relay 133, operated, locks through its upper winding to its previously traced operating battery, and operates relay 136 in a circuit extending over the back contact of relay 134. Relay 136, operated, operates relay 122 in a circuit traceable from battery over the upper back contact of relay 123, winding of relay 122, back contact of relay 124, to ground over the lower outer front contact of relay 136; locks over its upper front contact to ground over the upper front contact of relay 122 as soon as relay 122 has operated; and connects the winding of relay 123 to the seventh terminal of the terminal bank of switch 113. Relay 122, in operating, operates relay 125 over a previously traced circuit. Relay 125 locks over its upper inner front contact to ground over the lower outer front contact of relay 136 and connects low frequency alternating current from the source 126, over its upper outer front contact and the lower back contact of relay 123 to the winding of polarized relay 127. Relay 127 follows the alternating cur-

rent pulses, its armature intermittently connecting ground to the winding of rotary magnet 128 associated with switch 113. Each time that magnet 128 is energized it causes the brush 129 to advance one step, progressively contacting the bank terminals of switch 113. At the completion of the seventh step of brush 129 a circuit is completed from ground on brush 129, over the seventh bank terminal of the switch, lower inner front contact of relay 136, to battery through the winding of cut-off relay 123. Relay 123 operates and locks over its front contact to ground over the lower contacts of the off-normal springs 130 which operated upon the first step of the brush of switch 113. The operation of relay 123 also opens the circuits through the windings of relays 122 and 127, both of which release. The release of relay 127 prevents any further stepping of switch 113, while the release of relay 122 opens the locking circuit for relay 136. If the toll operator has restored the coin collect key 117 of the cord circuit relay 133 therefore released and opened the operating circuit for relay 136, this latter relay thereupon releasing when its locking circuit is opened by the release of relay 122. Relay 136, in releasing, releases relay 125. Relay 124 thereupon operates in a circuit from ground over the back contact of relay 125, upper contacts of the operated off-normal springs 130, to battery through the winding of relay 124. Relay 124 operated, locks over its lower inner front contact to ground over the lower contact of springs 130, and energizes release magnet 131 which in turn causes the brush 129 of switch 113 to restore to normal. With switch 113 normal springs 130 restore and release relay 124. The release of relay 124 opens the circuit through the winding of release magnet 131 thereby restoring the selective signaling circuit to normal.

As brush 129 advances over the terminals of switch 113 during its seven steps as detailed in the preceding paragraph, the ground over the brush short-circuits the battery supplied through resistance 111 to the windings of relay 112 as the brush contacts the second, fourth and sixth bank terminals. This results in the transmission of three signal pulses to the step-by-step end of the trunk which functions as will subsequently be set forth and applies coin collect potential to the called station line. During the release of the signaling circuit at the toll switchboard end of the trunk, the operation of relay 124 also connects direct ground to the junction of the windings of relay 112 thereby short-circuiting the battery through resistance 111 and causing a single restoring pulse to be transmitted to the step-by-step end of the trunk which thereupon functions as will be described hereinafter.

Referring now to Fig. 2, the three signal pulses transmitted from the toll switchboard end of the trunk for controlling the application of coin collect potential to the called line cause the composite signaling relay 201 to release and reoperate three times. Relay 202 releases and reoperates in unison with relay 201 and causes rotary magnet 216 to be energized three times, over a previously traced circuit, thereby causing brush 219 of switch 218 to be advanced to contact the third terminal of the switch bank. Relay 217 operates in parallel with rotary magnet 216 and functions as previously set forth. Off-normal springs 221 operate as soon as brush 219 leaves its normal position and operate relay 222 over a previously traced circuit.

With brush 219 in contact with the third terminal of the switch bank, the operation of relay 202 upon the reoperation of 201 following the third signal pulse operates relay 208 in a circuit traceable from battery through the winding of that relay, third terminal of switch 218, brush 219, back contacts of relays 225 and 217, front contact of relay 202, to ground over conductor 210. Relay 208, in operating, applies negative coin collect potential to the line 315 of station S in a circuit traceable from negative potential, through alarm lamp 223, over the upper inner front contact of relay 208, winding of relay 230, upper back contact of relay 233, to the ring conductor 205 which extends over front contacts of connector relays 303 and 302 and over a lower back contact of relay 306 to the ring conductor of the line. This coin collect potential, traced to the upper back contact of relay 233 also extends from that point, over the lower outer and upper outer front contacts of relay 208 and over the upper back contact of relay 207 to the tip trunk conductor 205 and from there extends to the tip of the called line over a previously traced circuit through the connector circuit. A circuit is also completed from ground through interrupter 231, over the lower inner front contact of relay 208, lower back contact of relay 233, to battery through the upper winding of relay 232. Relay 232 operates and extends its operating ground to the upper winding of relay 233. Relay 230 operates in series with the coin magnet (not shown) at the subscriber's station S and connects ground to the other end of the upper winding of relay 233 which remains unoperated being short-circuited by the ground over the upper inner front contact of relay 232. The operation of relay 230 also completes a circuit from ground through the right winding of repeating coil 238, over the lower front contact of relay 230, and over the upper middle front contact of relay 208 to one side of condenser 234 the other side of which connects to the tip conductor of the trunk extending towards the toll operator. The left winding of coil 238 is connected to battery and also to ground through the brushes of interrupter 237. A tone is thereby induced through coil 238 and condenser 234 to the toll switchboard operator as an indication that coin potential is being applied to the called station line.

Upon the first open period of interrupter 231 relay 223 operates through its upper winding, in series with the upper winding of relay 232, to ground over the upper front contact of relay 230. Relay 232 holds in this circuit through its upper winding and over its upper inner front contact. Upon the next closure of interrupter 231 relay 233 holds through its lower winding and over its lower front contact. This holding ground for the lower winding of relay 233 also extends over the lower front contact of that relay and over the lower front contact of relay 232 to battery through the lower winding of relay 232. The two windings of relay 232 are wound differentially, that is, they exert opposing forces, and, since they are both now energized, relay 232 releases and opens the circuit through the upper winding of relay 233, this latter relay holding through its lower winding as just set forth. The release of relay 232 also removes the negative coin collect potential from conductors 205 and 206 and therefore from the line 315 which extends to station S. Relay 230 remains operated upon the release of relay 232

in a circuit traceable from ground over its upper front contact, upper front contact of relay 233, through resistance 235, closed contacts of the make-before-break contacts of relay 232, winding of relay 230, upper inner front contact of relay 208, to the negative coin collect potential through lamp 228. The next open period of interrupter 231 opens the holding circuit through the lower winding of relay 233 which thereupon releases. Both relays 232 and 233 are now unoperated after having caused the application of one pulse of coin collect potential to the called station line. When the next conducting segment of the commutator of interrupter 231 contacts the brush of that interrupter relay 232 again operates over the previously traced circuit and again connects the negative coin collect potential to the called line. Upon the next open period of interrupter 231 relay 233 operates through its upper winding in series with the upper winding of relay 232 as previously set forth. Relay 232 releases when its lower winding is energized upon the next closure of interrupter 231 and again removes the coin collect potential from the line. This cycle of operation and release of relays 232 and 233 with its resultant intermittent application of coin collect potential to the line continues in the manner described as long as the operator at the toll switchboard continues to hold the coin collect key 117 of cord circuit OC operated.

After the elapse of an interval deemed sufficient for the collection of the coin or coins at the subscriber's station the toll operator releases key 117 thereby opening the circuit through the upper winding of relay 133. Relay 133 thereupon releases, in turn releasing relay 136. The release of relay 136 releases relay 125. Relay 124 thereupon operates in a circuit from battery through its winding, over the upper contacts of off-normal springs 130 associated with the operated switch 113, to ground over the back contact of relay 125. Relay 124, in operating, locks over its inner front contact and over the lower contacts of springs 130, energizes release magnet 131 and, in addition, short-circuits the battery supplied through resistance 111 to the windings of the composite signaling relay 112 thereby causing a release signal to be transmitted to the step-by-step office end of the trunk which thereupon functions as will be set forth later. Release magnet 131, being energized, causes the armature 129 of switch 113 to restore to its normal position at which time the off-normal springs 130 also restore to their unoperated position. The restoring of springs 130 opens the operating and locking circuits for relay 124 which thereupon releases and restores the toll switchboard end of the trunk to the condition in which it was prior to the operation of coin collect key 117 of cord circuit OC.

Referring again to the step-by-step office end of the trunk shown in Fig. 2, the short-circuiting of the battery at the windings of relay 112 at the toll office end of the trunk as a coin current application release signal, as outlined in the preceding paragraph, causes the release of composite signaling relay 201 at this end of the trunk. The release of relay 201 releases relay 202. Release magnet 220 and relay 225 thereupon energize in a circuit from battery through their respective windings in parallel, over the upper back contact of relay 217, upper outer contact of relay 222, lower inner front contact of relay 204, back contact of relay 202, 75

to ground over conductor 210, previously traced. The release of relay 252 also opens the circuit through the winding of relay 208 which releases and removes the coin collect potential from conductors 205 and 206 should relay 232 be in its operated position at this time. Relay 225 operates, locking over its front contact and over the lower contacts of the operated off-normal springs 221 to ground over conductor 210, and maintaining the energizing circuit for release magnet 220. The energizing of release magnet 220 causes brush 219 of switch 218 to restore to its normal position at which time the off-normal springs 221 also restore to normal and thereby release relay 225 and open the circuit through the winding of magnet 220. The aforementioned release of relay 208 opened the circuit from the brush of interrupter 231 to relays 232 and 233 which, if operated, release. Relay 230 also releases upon the release of relay 208. The coin disposal portion of the trunk circuit is now normal and the trunk circuit is in the condition where conversation between subscribers or between operator and subscriber may ensue.

Coin return

If, instead of collecting coins at station S as set forth above, it is desired to return the coins deposited at that station the toll operator depresses the coin return key 118 of her cord circuit OC thereby connecting direct battery over the contacts of that key and over a previously traced circuit through the windings of relays 134 and 133 in series, through resistance 135 to ground. Relay 133 operates and marginal relay 134, which did not operate when the coin collect key 117 of the operator's cord circuit was depressed due to the inclusion of resistance 131 in the circuit at that time, now also operates. Relays 133 and 134, operated, lock in series through the upper winding and over the lower front contact of relay 133 to ground. Relay 137 operates from battery through its winding and over the upper front contacts of relays 134 and 133 to ground. Relay 122 thereupon operates in a circuit traceable from battery over the back contact of relay 123, winding of relay 122, back contact of relay 124, to ground over the lower outer front contact of relay 137. Relay 122, in operating, supplies a holding ground for relay 137 over its upper front contact and also completes a circuit from battery through the winding of relay 125, lower front contact of relay 122, back contact of relay 124, to ground over the lower outer front contact of relay 137. Relay 125 operates, locks over its upper inner front contact to ground over the lower outer front contact of relay 137, removes the ground from the upper contact of the off-normal springs 130 and, in addition, completes a previously traced circuit from the low frequency alternating current source 126 through the winding of polarized relay 127 thereby causing relay 127 to operate and release in unison with the alternating current and intermittently complete the circuit through the winding of rotary magnet 128 of switch 113.

Under control of relay 127 rotary magnet 128 causes brush 129 of switch 113 to advance, one step at a time, over the associated bank terminals. When brush 129 contacts terminal No. 5 a circuit is completed from ground over the brush and the bank terminal and over the lower inner front contact of relay 137 to battery through the winding of relay 123. Relay 123

operates and locks over its front contact to ground over the lower contacts of springs 130, these springs having operated as soon as brush 129 advanced out of its normal position. The operation of relay 123 opens the circuit through the winding of relay 127 thereby preventing any further advance of brush 129 of switch 113. As brush 129 contacted the second and fourth terminals in its advance to the fifth terminal the ground on the brush short-circuited the battery supplied through resistance 111 to the windings of the composite signaling relay 112 thereby transmitting two signal pulses to the step-by-step end of the toll trunk circuit.

In response to the two signal pulses just referred to, the step-by-step end of the trunk shown in Fig. 2 functions in a manner identical with that previously set forth in connection with the transmission of the coin collect signal except that in this instance the two pulses received from the toll switchboard end of the trunk cause brush 219 of switch 218 to advance to the second terminal of the associated bank instead of to the third terminal as was the case where three signal pulses were received in connection with coin collection.

Upon the subsequent reoperation of relays 201 and 202 following the transmission of the coin return signal from the toll end of the trunk relay 207 operates in a circuit traceable from battery through its winding, second terminal and brush 219 of switch 218, back contact of relay 225, lower back contact of relay 217, and over the front contact of relay 202 to ground over conductor 210 from the toll selector circuit. Relay 207 performs the same functions in connection with coin return as hereinbefore set forth for relay 200 in connection with coin collection except that positive coin return potential, through lamp 229 and over the upper inner front contact of relay 207, is connected to the winding of relay 230 and thence to the subscriber's line instead of the negative coin collect potential which was connected to the line when relay 208 operated. Relays 230, 232 and 233 and interrupters 231 and 238 perform functions identical with those set forth under the description of coin collection except that pulses of negative potential are connected to the line, under control of interrupter 231 and relays 232 and 233, to effect the return of the coin or coins deposited at station S.

The release of the coin return key 118 by the toll operator opens the circuit through the windings of relays 133 and 134 both of which release and in turn release relay 137. Relay 125 thereupon releases and operates relay 124 over its back contact and over the upper front contact of off-normal springs 130. From this point on the signaling portion of the circuit at both ends of the toll trunk restore to their normal condition in the manner previously described in connection with the restoring of these circuits at the conclusion of coin collection.

What is claimed is:

1. In a selective signaling system, a transmitting station, a receiving station, a line therebetween, a local circuit closer at the transmitting station, means responsive to operation of said circuit closer for transmitting a predetermined number of electrical impulses to said line and responsive to release of said closer for transmitting another predetermined number of impulses, means at the receiving station responsive to said first predetermined number of impulses

for operating said responsive device and responsive to said second predetermined number of impulses for releasing the device.

2. In a remote control signaling system, a line,
5 a circuit closer and an impulse transmitting means at one end of the line, said impulse means being arranged to respond to operation of said closer to transmit a predetermined number of electrical impulses to said line and to also transmit
10 a predetermined number of impulses when said closer is restored, impulse receiving and translating means and an electroresponsive device at the other end of said line, said receiving and translating means being responsive to said
15 first predetermined number of impulses to operate and hold operated said device and also responsive to said second predetermined number of impulses to release said device.

3. In a remote control signaling system, a line,
20 a key at one end of the line and a relay at the other end of the line, impulse transmitting means at the first end of the line and impulse receiving means at the second end of the line, said impulse transmitting means being so arranged
25 that operation of said key will cause said means to transmit a predetermined number of electrical impulses over said line, and release of said key will cause the same means to transmit another predetermined number of impulses, and said receiving means being arranged to respond to said
30 impulses transmitted when the key is operated to operate said relay and to respond to the impulses transmitted when the key is released to restore said relay.

4. In a remote control selective signaling system, a line, a plurality of keys at one end of the line and a plurality of corresponding relays at the other end of the line, impulse transmitting means at the first end of the line, and impulse
35 receiving means at the other end of the line, said impulse transmitting means being so arranged that operation of any key will cause said means to transmit a predetermined characteristic number of electrical impulses over said line

depending on the key operated and release of said key will cause the same means to transmit another predetermined number of impulses, and said receiving means being arranged to respond to said impulses transmitted when the key is
5 operated to operate the relay corresponding to the operated key and to respond to the impulses transmitted when the key is restored to release the relay.

5. In a remote control selective signaling telephone system, an operator's position, an automatic exchange, a trunk line extending therebetween, a line relay in said trunk line at the automatic end of the line and adapted to control selective switch mechanism at said automatic
10 exchange to selectively extend the trunk line to a desired called line, a cord circuit including a dial at said operator's position for controlling said line relay, a plurality of functional relays at the automatic end of said line, each relay
15 being adapted to perform a different specific function, a key associated with the cord individual to each of said functional relays, means associated with the operator's end of said trunk line and responsive to the operation of any one
20 of said keys, when said cord circuit is connected to said trunk line, to momentarily release and operate said line relay a predetermined characteristic number of times depending on the key operated and to momentarily release said line
25 relay once when any operated one of said keys is released, and means at the automatic end of said trunk line responsive to said predetermined number of release and closure operations of said line relay occasioned by the operation of a distinctive one of said keys to operate the corresponding functional relay, said means at the automatic end of the trunk line being also responsive to said single momentary release of the line relay when a key is released at the operator's position to release the operated functional.
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