Dec. 29, 1936. H. HOVLAND 2,065,894

TELEPHONE SYSTEM

Filed March 26, 1935 2 Sheets-Sheet 1

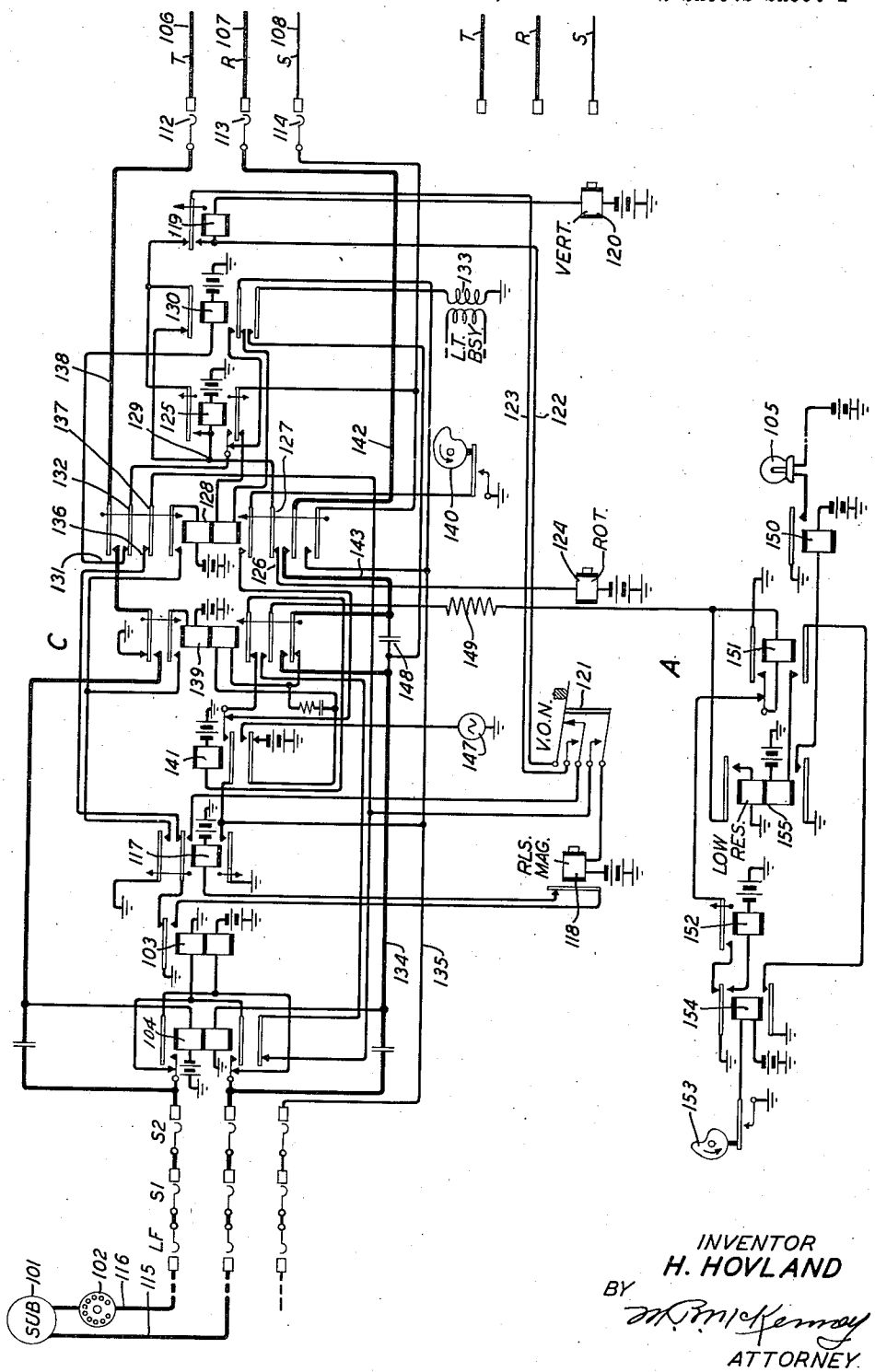

FIG. 1

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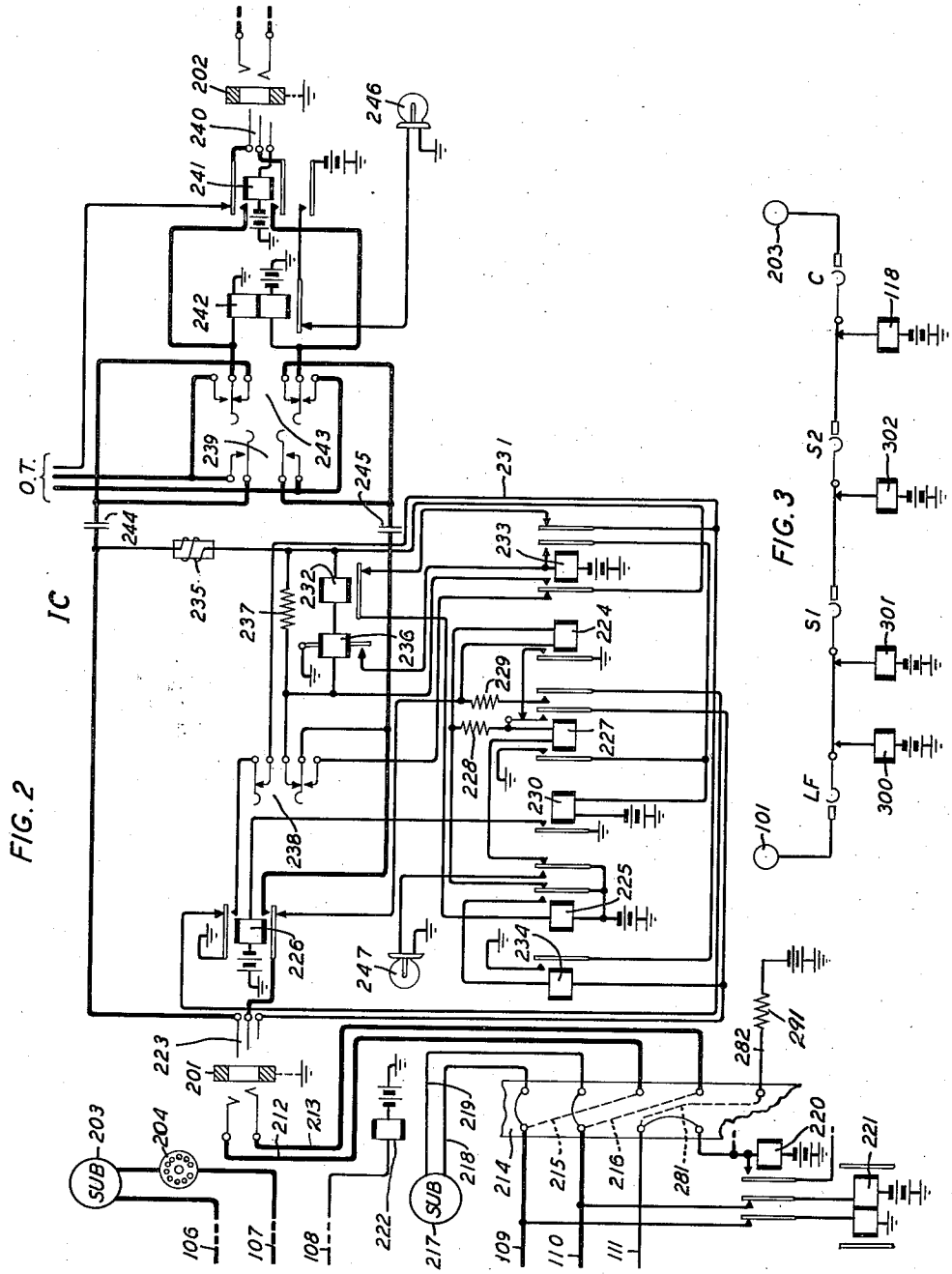

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TELEPHONE SYSTEM

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5 Claims. (Cl. 179—27)

This invention relates to telephone systems and particularly to those in which conversational connections are established wholly or in part by automatic switches.

The objects are to simplify and improve the releasing operations of established connections; to enable a distinction to be made between different classes of calls for certain purposes while preserving the same release conditions; and to otherwise improve such systems.

Systems have been devised heretofore in which the immediate release of all switches of the connection takes place when the calling subscriber replaces his receiver, and in which release of the final or connector switch is effected at the end of a measured interval following the replacement of the called subscriber's receiver, provided the calling party is slow in hanging up his receiver. Moreover, it is common practice to employ the relay of the connector that responds to the called subscriber's switchhook not only for the purpose of controlling the release circuits but also to effect a reversal in the direction of current flow in the established connection for supervision or for message register operation.

A feature of the present invention is an improvement in these prior systems which consists in providing a timing mechanism which effects the release of the connector switch at the end of an interval following the replacement of the called subscriber's receiver and in providing an operating circuit for said mechanism which is controlled by the bridge relay, which energizes either fully or partially at the time the connection is completed and releases when the called party disconnects. This bridge relay operates fully when the call is for a subscriber's line and the called party answers, and by operating fully it reverses current in the usual way for message register or supervisory purposes. However, if the call is for a line that is connected to the intercept position, the operator in answering causes the partial operation of the bridge relay, thus avoiding a current reversal and the consequent operation of the calling subscriber's register. In this way the release mechanism is effective on either type of call, but such calls are distinguished from each other for the purpose of supervision or registration.

The foregoing and other features of the invention will be described more fully in the following detailed specification, which should be taken in conjunction with the accompanying drawings, and also in the appended claims.

Referring to the drawings, Fig. 1 shows abbreviated diagrammatic representations of a subscriber's telephone 101 and dial 102, a line finder LF, and first and second selectors, S1 and S2, all of the usual type found in step-by-step offices. There are also shown in detail a connector switch C and a timing and alarm circuit A common to a number of connectors, the function of said mechanism being to effect the release of connector C and the preceding switches of the established connection. At the right of Fig. 1 are shown connector terminals associated with conductors 106, 107, 108, 109, 110 and 111 leading to Fig. 2. To these terminals connector brushes 112, 113 and 114 have access.

In Fig. 2 there are shown two subscribers' lines 203 and 217, an intercepting operator's cord circuit IC, which is adapted to answer intercepted calls and to complete these calls when required, and also a part of a cross-connecting frame 214.

Fig. 3 is schematic of the switch train illustrating the release magnets of the respective switches.

Assume that it is desired to discontinue service on the line of station 217, and that it is necessary that incoming calls for this station be directed to an intercepting operator. For normal service the conductors 218 and 219 of line 217 are connected at frame 214 to conductors 109 and 110, which lead to the terminals of connector C. The line is changed to intercept service by cross-connecting conductors 109 and 110 to conductors 212 and 213 by means of jumpers 215 and 216, respectively, at the same time opening connection with conductors 218 and 219. At the left of Fig. 2 is shown another subscriber's station 203, with dial 204, which is associated with line conductors 106, 107 and 108 of Fig. 1. For descriptive purposes it is assumed that the subscriber's line 203 is connected for regular, non-intercepted service. Its frame connections and line circuit are of the usual type found in step-by-step dial offices and are omitted here, the omissions being indicated by the dotted lines.

The finder LF and selectors S1 and S2 may be of any suitable type, such as the Strowger switch, the operation and release of which are well known.

A detailed description of the operation of the system will now be given, first in connection with a call routed to station 203, for regular non-intercepted service, and secondly for a call to

the intercepting operator who answers with the intercepting cord IC.

Let it be assumed that the subscriber of line 101 desires to establish a connection with the station 203 and that the connection has been extended in the usual manner through line finder LF and selectors S1 and S2 to the tip, ring and sleeve terminals of connector C. When this circuit is seized by the selector S2 a circuit is closed through the windings of relay 103 which may be traced from battery through the lower winding of relay 103, lower inner normally closed contacts of relay 104, ring contacts of selectors S1, S2, and line finder LF, thence over line conductor 115 and through subscriber's telephone 101 and dial 102, over conductor 116 and through tip contacts of line finder LF, and selectors S1 and S2, upper normally closed contacts of relay 104 and upper winding of relay 103 to ground. Relay 103 operates and operates relay 117 through a circuit traceable from battery through the winding of relay 117, break contacts of release magnet 118 to ground on the operated contacts of relay 103. Relay 117 in operating connects ground on its lower contacts to the sleeve contacts of selectors S1, S2 and line finder LF, thereby holding in the operated position the selectors and line finder and guarding connector C from other hunting selector circuits. On the first break of the contacts of dial 102 for the purpose of dialing the tens digits of the called number, relay 103 releases and closes a circuit from battery through the windings of vertical magnet 120 and relay 119, upper normally closed contacts of the vertical-off-normal contact assembly 121, upper inner operated front contacts of relay 117 to ground on back contacts of relay 103. Relay 117 is slow to release and does not release during the momentary open periods of the front contacts of relay 103, while responding to the pulses of dial 102. Relay 119 and vertical magnet 120 are operated through the circuit hereinbefore traced. As soon as the shaft of the connector switch is moved from its normal position on the first vertical step, the vertical-off-normal springs 121 operate and transfer the operating circuit for relay 119 to vertical magnet 120 from conductors 122 and 123, thereby placing the windings of relay 119 and vertical magnet 120 in series with the operated make contacts of relay 119. This transfer from conductor 122 to 123 is made without interrupting the circuit, since the three upper springs of combination 121 are of the make-before-break type. After the contacts of dial 102 are closed again after the first break, relay 103 reoperates and again closes the circuit through the winding of relay 117, before this relay has had time to release, as hereinbefore explained. On the next open period of dial 102, relay 103 again releases and transmits a second ground pulse, through the circuit of relay 119 and vertical magnet 120. Relay 119 is slow to release and remains locked up over the open periods of the back contacts of relay 103. The second ground pulse aforesaid causes the shaft of the switch to take another step upward. This action continues until all required pulses for the tens digits are transmitted by dial 102 and connector brushes 112, 113 and 114 have reached the level containing the terminals of the line being called.

After the tens digit has been dialed and dial 102 is restored to normal relay 103 remains operated, relay 119 releases, and the winding of vertical magnet 120 is deenergized. When relay 119 releases a circuit is closed through rotary magnet 124 for rotary stepping. This circuit may be traced from battery through the winding of rotary magnet 124, normally closed springs 126 and 127 of relay 128 to junction point 129, from battery through the winding of relay 125 to said junction point 129, thence through the upper normally closed contacts of relay 130, back contacts of relay 119, over conductor 123, through upper operated contacts of combination 121 to the upper inner front contacts of relay 117. On the first break of dial 102 for dialing the units digits of the called number, i. e., for rotary stepping, relay 103 releases and transmits a ground impulse through the upper, inner, operated front contacts of relay 117 and the rotary stepping circuit just traced. Relay 117 remains operated during dial pulses, as in the case of vertical stepping. In response to said first ground impulse rotary magnet 124 will operate and cause the switch to rotate one step in the horizontal direction and relay 125 will operate and short circuit the upper contacts of relay 130, which were included in the original operating circuit. Subsequent dial pulses cause rotary magnet 124 to step the switch around until the line 203 of the called subscriber is reached.

Before connecting ringing current to this line a test is made to determine whether the line is busy or idle. If busy, ground will be found on the sleeve terminal connected to conductor 108, and will cause the operation of test relay 130 from battery through its winding, normally closed contacts 131 and 132 of relay 128, lower operated make contacts of slow release relay 125, conductor 144, to ground on sleeve conductor 108 through brush 114. Relay 130 in operating opens through its upper break contacts the original circuit for rotary magnet 124 and when slow-release relay 125 finally releases after rotary pulsing is completed further rotary stepping is stopped. Relay 130 in operating connects to ring conductor 134 from the secondary winding of transformer 133, through its lower outer make contacts, a potential of audible frequency, interrupted by the usual busy-back interrupter (not shown) and which indicates to the calling subscriber 101 that the called line is busy. Relay 130 is locked up through a circuit traced from battery through the winding of relay 130, contacts 131 and 132 of relay 128, lower inner back contacts of relay 125, lower inner operated make contacts of relay 130 to ground on sleeve conductor 135. Under this condition the calling subscriber will disconnect, causing the release of relays 103 and 117, thereby closing a circuit from battery through the winding of release magnet 118 lower operated contacts of VON combination 121, normally closed contacts 136 and 137 of relay 128, through back contacts of relays 117 and 103 to ground. Release magnet 118 is energized and causes the restoration of the connector switch, including VON springs 121 to normal. Relay 130, which was locked to ground on sleeve conductor 135, releases since ground was removed by the opening of the lower make contacts of relay 117 when this relay released. The removal of ground from conductor 135 causes in the well-known manner the energization of release magnets 300, 301, 302 of the preceding switches and the consequent release of these switches.

Let it be assumed now that the line 203 of the called subscriber is found idle. Under this condition battery will be found by sleeve brush

114 on the terminal connected to sleeve conductor 108. This conductor is connected through the winding of cut-off relay 222. Under this condition relay 130 will not operate as hereinbefore described when the line 203 was found busy, since now a battery potential is connected to both winding terminals of relay 130. After relay 125 has released upon the completion of rotary stepping, a circuit is closed for the operation of relay 128, which may be traced from aforesaid battery connection on brush 114, through lower outer normally-closed contacts of relay 125, lower winding of relay 128, lower normally-closed contacts of relay 130, to ground on sleeve conductor 135. Relay 128 in operating locks through its upper winding and upper inner make contacts to ground on the upper outer operated make contacts of relay 117. In operating relay 128 also connects tip conductor 138, through its upper, outer contacts to ground on the upper back contacts of relay 139; opens the circuit of the winding of relay 130, by opening its contacts 131 and 132; connects ground from pick-up interrupter 140, through its lower inner make contacts, inner normally closed contacts of relay 141, lower inner normally closed contacts of relay 139 to battery through the winding of relay 141. Relay 141 operates and locks through its inner make contacts to ground on the lower operated contacts of relay 117. Relay 128 in operating also disconnects the winding of rotary magnet 124 by opening its contacts 126 and 127; connects ring conductor 142 to conductor 143 through the contacts of springs connected thereto and joins sleeve conductor 135 to sleeve conductor 144, thereby grounding said conductor 144, operating cut-off relay 222, and guarding the terminals of the line of subscriber 203 from seizure by another connector.

When relay 141 operates it closes a circuit for ringing the station 203. This circuit is traced from source of ringing current 147, which may comprise an alternating-current generator connected in series with battery, through lower operated make contacts of relay 141, lower winding of relay 139, lower outer normally closed contacts of relay 139, over conductor 143, associated operated contacts of relay 128, over conductor 142, through connector brush 113 and associated contacts, over line of subscriber 203, connector brush 112 and associated contacts, conductor 138, upper outer operated contacts of relay 128, to ground on the upper outer back contacts of relay 139. The ringer (not shown) of station 203 is now actuated, but relay 139 does not operate on the ringing current through its lower winding until subscriber 203 answers by removing his receiver from the switchhook, thereby connecting a low impedance bridge across the line. Ringing tone is sent back to the calling subscriber through condenser 148. Relay 139 is adjusted so that in operating a locking circuit is closed from battery through its upper winding and upper inner make contacts to ground on the upper outer contacts of relay 117 before the circuit through its lower winding is broken at either its upper or lower outer break contacts. If the called subscriber should remove his receiver from the switchhook before relay 141 operates in response to pick-up interrupter 140, then relay 139 operates from the battery on the lower back contacts of relay 141. The operation of relay 139 accordingly, either disconnects ringing current or the aforesaid battery on the lower contacts of relay 141. Relay 139 also completes the conversational circuit between the calling and called subscribers, by closing through the tip conductors on its upper outer make contacts, and the ring conductors on its lower outer make contacts, and opens the locking circuit for relay 141 which releases. Relay 139 in operating also completes the operating circuit for relay 104, which may be traced from battery through the upper winding of relay 104, over the tip conductors of connector C and the line of station 203, through station 203 including dial 204, ring conductors of the line and of connector C to ground through the lower winding of relay 104. Relay 104 in operating reverses the direction of current over the line of calling station 101, thereby causing the operation of an associated line message register (not shown) in the well-known manner. After aforesaid reversal, battery through the lower winding of relay 103 is connected by the upper operated make contacts of relay 104 to the tip conductor, and ground through the upper winding of relay 104 by the lower make contacts of relay 104 to the ring conductor.

At the end of the conversation, when the calling subscriber disconnects, relays 103 and 117 release, removing ground from the upper locking windings of relays 139 and 128, which release. The release of relay 128 closes a circuit for operating release magnet 118, which may be traced from battery through the winding of magnet 118, lower make contacts of VON combination 121, contacts 136 and 137 of relay 128, to ground through upper back contacts of relays 117 and 103. The operation of release magnet 118 restores the connector switch to normal in the well-known manner. Also the removal of ground from conductor 135 causes the operation of release magnets 300, 301, and 302 and the immediate release of the preceding switches LF, S1, and S2.

A description will now be given of that feature of the system whereby the called subscriber by hanging up his receiver is enabled to effect a timed release of the connector C and all the other switches of the connection, assuming that the calling subscriber fails to disconnect promptly. When called subscriber at station 203 disconnects, relay 104 releases, restoring the original direction of current flow, but relay 103 and relay 117 remain operated and also relays 128 and 139. A circuit is now closed from battery through the winding of release magnet 118, lower operated contacts of VON combination 121, lower outer break contacts of relay 104, lower middle operated contacts of relay 139, resistance 149, winding and normally closed contacts of relay 151 to the armature of relay 152. The interrupter 153 is arranged to connect ground to the winding of relay 154 for two minutes and then to disconnect said ground for two minutes. When relay 154 operates through an obvious circuit in response to the closure of said interrupter contacts, relay 152 also operates through an obvious circuit. On the next opening of the interrupter contacts, relay 154 releases immediately, but relay 152 being slow to release holds up momentarily, and a circuit is closed for operating relay 151, which is traced from ground on the back contacts of relay 154, through operated contacts of relay 152 and thence through the hereinbefore traced circuit to battery on the winding of release magnet 118. Relay 151 locks to ground on its upper make contacts, but release magnet 118 does not receive sufficient cur-

rent in this circuit to open its contacts. On the next closure of interrupter 153 relay 154 reoperates and closes a circuit for operating relay 155, which circuit may be traced from ground on the lower contacts of relay 154, through lower operated contacts of relay 151 and through lower winding of relay 155 to battery. Relay 155 now operates and locks through its low-resistance upper winding to the release magnet circuit, hereinbefore traced. This causes a shunting down and release of relay 151. The low resistance ground applied through the upper winding of relay 155 now permits sufficient current to flow through release magnet 118 to open the contacts of said magnet, thereby releasing relay 117. However, magnet 118 does not energize sufficiently to release connector C. The release of relay 117 removes ground on its lower contacts from sleeve conductor 135, which causes the release of the preceding switches and relay 103. Relay 117 in releasing also causes the release of relays 139 and 128 by removing the holding ground from the upper windings of these relays. When relay 128 releases a circuit is closed, for fully operating release magnet 118 which may be traced from battery through the winding of release magnet 118, lower operated contacts of VON combination 121, contacts 136 and 137 of relay 128, upper back contacts of relays 117 and 103 to ground. The connector switch, including the VON springs 121 and all associated apparatus is now restored to normal. When the circuit through release magnet 118 is opened relay 155 is unlocked and releases. If, however, due to some trouble condition the connector fails to release, as hereinbefore described, provision is made for indicating the presence of this trouble condition. When relay 155 operated it also operated relay 150 through an obvious circuit. Relay 150 in operating closes a circuit to battery through lamp 195 and a pick-up circuit (not shown), which is arranged so that, if relay 150 remains operated for a certain predetermined interval, lamp 195 is lighted and remains lighted until the trouble condition is manually removed and relay 155 and 150 release.

The operation of the system has been described for a regular, non-intercepted call between subscribers. The system will now be described in its operation for an intercepted call. Assume for this purpose that the calling subscriber at station 101 wishes to be connected to subscriber's line 217, whose telephone, as hereinbefore stated, has been removed from service by disconnecting conductors 109 and 110 on frame 214 from line conductors 218, and 219, and by cross-connecting said conductors 109 and 110 by jumpers 215 and 216 to conductors 212 and 213 leading to jack 201 at an intercepting operator's position. Also the line relay 221 is disconnected, and the sleeve conductor 111 is disconnected from relay 220 and connected by jumper 281 to sleeve conductor 282 of trunk 212—213. Let it be further assumed that a connection has been made in the usual manner by connector brushes 112, 113, 114, with terminals connected to conductors 109, 110 and 111 of line 217. The description of the operation for establishing the connection with conductors 106, 107, and 108 is sufficient to explain the connection with conductors 109, 110 and 111. When the connector switch engages the terminals of line 109, 110, 111, relay 128 operates in the manner already described, the current for operating the relay being furnished in this instance from battery through the resistance 291 and thence over conductors 282, 281 and 111 through the winding of relay 128 as previously traced. Ringing current transmitted over conductors 212 and 213 causes the operation of a line signal (not shown) associated with jack 201. The intercepting operator in response inserts plug 223 into jack 201, thereby closing a circuit for operating relay 224, over a circuit that may be traced from battery on the inner back contacts of relay 225, through the winding of relay 224, lower back contacts of relay 226, ring conductors of plug 223, and jack 201, to a ground (not shown) on the ring conductor of trunk 212—213. Relay 224 in operating, operates relay 227 through a circuit from ground on the contacts of relay 224 through the right-hand inner back contacts of relay 227, resistance 228 and battery on the right-hand outer back contacts of relay 225. Relay 227 in operating connects a ground to the ring conductor through resistance 229, thereby operating relay 139 of the connector circuit through its lower winding in the manner described hereinbefore in connection with the call to station 203. The operation of relay 139 trips the ringing. The circuit for operating relay 139 may be traced from ground on the upper back contacts of relay 226, right-hand outer make contacts of relay 227, resistance 229, lower back contacts of relay 226, ring conductors of plug 223 and jack 201, conductor 213, jumper 216, conductors 210 and 110, brush 113, conductors 142 and 143 and associated operated contacts of relay 128, lower outside back contacts and winding of relay 139, outer operated front contacts of relay 141, and source of ringing current 147 to ground. Relay 227 in operating locks to ground on the sleeve of jack 201, through its right-hand inner make contacts and operates relay 230 through an obvious circuit. Relay 230 in operating operates through an obvious circuit relay 226, which disconnects ground from its upper back contacts and the winding of relay 224 from its lower back contacts. Relay 224 releases. Relay 226 in operating, connects through, with its lower front contacts the ring conductors of cord circuit IC and with its upper front contacts connects ground to conductor 231 through the upper contacts of key 238. Key 238 is a flashing key for use with calls from an operator. When relay 226 operated, it connected through the lower back contacts of key 238 a bridge across the tip and ring conductors of cord circuit IC, said bridge including retardation coil 235 and relays 232 and 236 all in series. Polarized relay 236 is used for toll calls. In multiple with the series connection of the windings of relays 232 and 236 is a resistance 237. Relay 232 operates in series with the windings of relay 104 over the tip and ring conductors of cord circuit IC, through the operated contacts of relay 226, thence over tip and ring conductors of the connector C, which are closed through by operated contacts on relays 128 and 139. Relay 232 in operating disconnects the windings of relay 225 from the right-hand outer contacts of relay 233. Consequently relay 225 does not operate when ground is connected to conductor 231 by the aforesaid operation of relay 226. Relay 236 does not operate in series with relay 232 as the current flow through its winding is in the direction opposing operation. Because of the resistance in the circuit traced, relay 104 operates only partially in accordance with a feature of this invention, sufficiently to open its lower outer break contacts,

but not enough to operate its other contacts. Accordingly there is no reversal of current over the tip and ring conductors extending towards the station of calling subscriber 101, thereby avoiding the operation of the line register, which, of course, should not operate on this call to an intercepting operator. The operation of aforesaid lower break contacts of relay 104 opens the hereinbefore described timed release circuit that was momentarily closed through the lower middle make contacts of relay 139.

The intercepting operator now operates the listening key 239 and thereby connects the operator's telephone (not shown) to the tip and ring conductors of the cord circuit IC. The operator converses with the calling subscriber 101 and if desired the connection may be extended over another line (not shown) which terminates on jack 202. If there is a multiple of jack 202 the usual busy test is made through the tip conductor of plug 240 and the upper back contacts of relay 241. If the line is found idle plug 240 is inserted into jack 202 and relay 241 operates through an obvious circuit over the sleeve conductors of plug 240 and jack 202. Relay 241 in operating connects the windings of a supervisory relay 242 to the tip and ring conductors of plug 240 and connects through normally closed contacts of key 243 said tip and ring conductors to the corresponding conductors of the answering end of cord circuit IC. The conversational connection with the called line is now completed through condensers 244 and 245. By operating key 243, the intercepting operator can split the connection and talk only on the line of jack 202. Relay 241 in operating closes a circuit from battery on its outer lower contacts through the contacts of relay 242 to ground through supervisory lamp 246, which lights. When the call is answered relay 242 operates, extinguishing lamp 246.

The operation of the system will now be described for the various conditions of release after the call to the intercepting operator has been established as hereinbefore described. When the party of the line connected to jack 202 disconnects, relay 242 releases and closes again the circuit of lamp 246 which lights as a disconnect signal. Plug 240 is now withdrawn from jack 202. If the calling subscriber 101, disconnects, the connector circuit C is restored to normal as hereinbefore described in connection with the call between subscribers 101 and 203. The cuit through relay 232 is accordingly opened, and this relay releases closing a circuit for operating relay 225. This circuit may be traced from battery through the winding of relay 225, contacts of relay 232, outer break contacts of relay 233 to ground on conductor 231. Relay 225 in operating closes an obvious circuit through supervisory lamp 247 which lights. The operation of relay 225, disconnects battery on its outer break contacts from the winding of relay 227, which releases thereby causing the release of relays 230 and 226. Relay 225 in operating operates relay 234 through a circuit from battery on its inner make contacts through the winding of relay 234 to ground on the sleeve conductor. In operating relay 234 connects ground to conductor 231, to replace the ground removed by the release of relay 226. In response to the lighting of the lamp 247 the intercepting operator now removes plug 223 from jack 201, thereby removing ground from the sleeve conductor of plug 223, releasing relays 234 and 225. All apparatus of Fig. 1 and Fig. 2 is now restored to normal.

The operation for the release of the connection has been described in the preceding paragraph for the condition existing when the calling subscriber 101 disconnects promptly at the end of the conversational period. Assume now, however, that said calling subscriber 101 delays in hanging up his receiver. Accordingly, the intercepting operator by removing plug 223 from jack 201 may effect the release of the connector circuit C in the manner hereinbefore explained in connection with the call between stations 101 and 203. When plug 223 is removed from jack 201 the circuit through the partially operated relay 104 is opened. Relay 104 releases and closes its lower outer break contacts thereby connecting the winding of release magnet 118 to alarm circuit A which now functions in the manner hereinbefore described to cause the timed release of the connector circuit C.

It will be noted that the circuit from the connector C to the timing device A by way of resistance 149 is closed by the operation of ringing-trip relay 139 as soon as a called subscriber or the intercept operator answers. However, this circuit is immediately opened at the lower contact of relay 104, which also operates either when the subscriber or the operator answers. But when the called subscriber or the intercept operator disconnects, after having answered and operated relay 139, relay 104 releases its lower contact, and the timing circuit becomes effective. As has been explained, the resistance of this circuit is reduced after a measured interval to cause release of all selectors, following which the connector C is released.

What is claimed is:

1. In a telephone system, an automatic switch, circuits of different classes accessible to said switch, means including said switch for establishing a connection to a circuit of any one of said classes, a timing mechanism for controlling the release of said switch, a relay for said switch operable over a circuit of one of said classes for sending a signal over the established connection and operable over a circuit of another of said classes without sending said signal over the established connection, and a circuit for said timing mechanism controlled on each operation of said relay.

2. In a telephone system, a called line of one class, a called line of a second class, means including an automatic switch for extending a connection to either of said lines, release means for said switch, a relay for said switch operable when connection is extended to one of said called lines for reversing the direction of current in the established connection, said relay being operable when connection is extended to the other of said called lines without reversing the direction of current, and a circuit for said release means controlled by said relay when connection is extended to either of said lines.

3. In a telephone system, a called subscriber's line, an operator's position, means including an automatic switch for extending a connection to said line or to said position, a release magnet for said switch, timing mechanism, a source of current for the extended connection, a relay operable when the subscriber of said line answers for reversing the direction of current from said source, said relay being partially operable without reversing the current direction when the operator at said position responds to an

extended connection, and a circuit for said release magnet controlled by said timing mechanism, said circuit being opened by said relay on connections extended either to said subscriber's line or to said operator's position.

4. In a telephone system an automatic switch, circuits of two different classes accessible to said switch, means including said switch for extending a connection to a circuit of either of said classes, a timing mechanism for controlling the release of said switch, a relay for said switch having contacts for supplying current to the extended connection, said relay being energized over a circuit of one of said classes for operating said contacts to send a signal over the extended connection and energized over a circuit of the other class without operating said contacts, other contacts for said relay operated on each energization thereof, and a circuit for said timing mechanism controlled by said other contacts.

5. In a telephone system, a called subscriber's line, an operator's position, means including an automatic switch for extending a connection to said line or to said position, a cord circuit at said position for answering calls extended thereto, a release magnet for said switch, timing mechanism, a source of current for the extended connection, a relay associated with said switch, an operating circuit including the subscriber's line for operating said relay when the subscriber answers, said relay in operating serving to reverse the direction of the current from said source, an operating circuit including the operator's cord for energizing said relay when the operator responds to a call extended thereto, resistance means in said last mentioned circuit for preventing said relay from operating fully, and a circuit for said release magnet controlled by said timing mechanism, said circuit being opened by said relay on connections extended either to said subscriber's line or to said operator's position.

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