Sept. 7, 1937. H. HOVLAND 2,092,513

TELEPHONE SYSTEM

Filed March 26, 1935 2 Sheets-Sheet 1

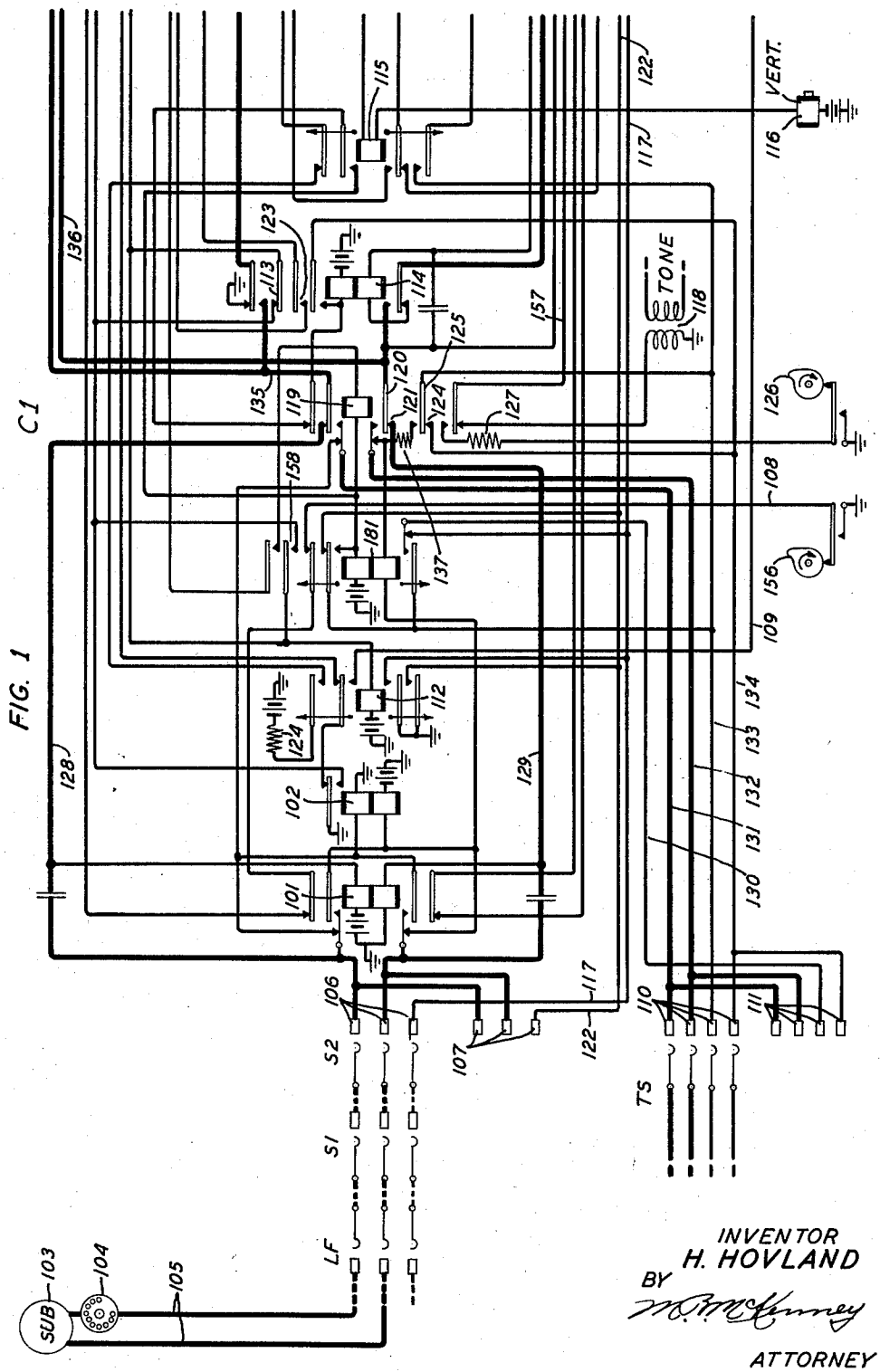

FIG. 1

INVENTOR
H. HOVLAND
BY
ATTORNEY

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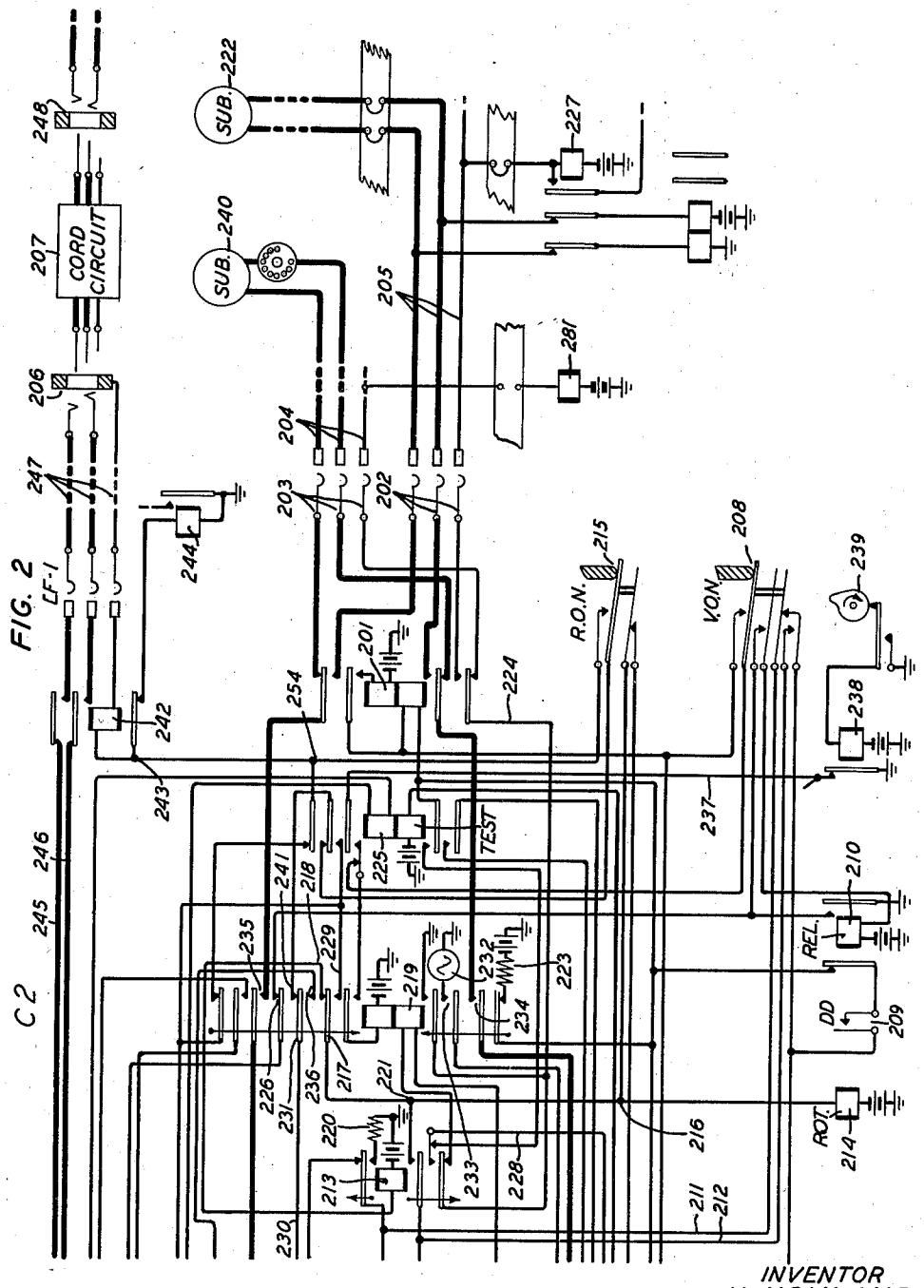

FIG. 2

INVENTOR
H. HOVLAND
BY
M. B. McKenney
ATTORNEY

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UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Henry Hovland, Williston Park, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application March 26, 1935, Serial No. 13,072

8 Claims. (Cl. 179—27)

This invention relates to telephone systems and particularly to those having automatic switches for establishing the connections.

The objects are to improve the release conditions in dial telephone systems; to distinguish between different classes of called lines, such as those to subscribers and those to operators' positions, and to prepare the release circuits accordingly; and to effect other improvements in systems of this kind.

It has been proposed heretofore to place the immediate release of the entire connection, including the connector switch, under control of the calling subscriber and at the same time to provide for the release of the connector switch at the end of a timed interval after the called party disconnects in case the calling party delays in replacing his receiver. Systems have also been devised such that, when a call is made to a line that is disconnected and out of service, the connector switch on reaching the line terminals detects this condition and omits to cut through the talking circuit in the regular way but starts a line finder instead to find the connector involved for the purpose of extending the call to an intercept operator's position.

According to the present invention certain advantages are attained in systems of this character by an arrangement in which the relay in the connector that cuts through the connection to a called subscriber's line also prepares a circuit for a time-measure device so that the called party may control the release of the connection independently of the calling party, and in which said relay by failing to operate when a call is made to a disconnected line enables the closure of a circuit to start a finder to search for the connector and to extend the call to an intercept position.

Another feature of the invention is a system of the foregoing character in which the timing mechanism is rendered ineffective on calls extended to the intercept operator, and the calling party is given sole control over the release of the entire connection.

These and other features of the invention will be more fully described in the following description taken in connection with the accompanying drawings and will also be more clearly understood from the appended claims.

In Fig. 1 of the drawings a calling line, a line finder, and two selectors are shown diagrammatically, and a part of a connector switch is shown in detail.

Fig. 2 shows the remainder of the details of the connector switch and two subscribers' lines appearing in said connector, one of which is wired for regular service and the other for intercept service. This figure also shows schematically an intercept operator's position together with a finder switch and other circuits for extending intercepted calls to said position.

Referring particularly to the drawings, the connector switch C1—C2 is arranged according to this invention to provide the features hereinbefore stated. At the left of Fig. 1 is indicated the telephone 103 of a calling subscriber, with associated dial 104, and line conductors 105. The line 105 may be extended to connector C1—C2 by way of line finder LF and local selectors S1 and S2. The selector S2 is in a group of selectors having access to connector C1—C2 by way of multiple terminals 106. Terminals 107 are not accessible to selectors in the group in which selector S2 is located, but are accessible to local selectors of another group which are not shown. Similarly toll selector TS is in a group having access to terminals 110. Terminals 111 are not accessible to selectors in the group in which TS is located, but are accessible to toll selectors of another group which are not shown. The connector circuit C1—C2 is arranged so that one group of selectors may connect through to upper connector bank terminals and the other group through to lower bank terminals as will be hereinafter explained. The tip, ring and sleeve conductors of C1—C2, shown in Fig. 2, have access through contacts of brush selecting relay 201 to upper brushes 203 or lower brushes 202, according to whether the connector was seized by way of terminals 107 or 110 on the one hand or by way of terminals 106 or 111 on the other hand. Said lower brushes have access to terminals connecting with line conductors 205 and said upper brushes have access to terminals connecting with line conductors 204. Line 205 is that of a subscriber receiving regular service, while line 204 is that of a subscriber whose service has been discontinued, the discontinuance of service being effected by disconnecting the sleeve terminal from the winding of the associated cut-off relay 281. The finder LF—1 routes calls from the connector to the intercept position when the connector brushes connect to the terminals of lines, such as line 204, which are removed from service by the aforesaid disconnection of the associated cut-off relays. Line finder LF—1 extends the call to jack 206, to which an intercepting operator has access with the cord circuit 207.

Referring to the timed release feature aforementioned, when relay 101 releases due to the disconnection of the called subscriber, while relay 102 is still operated because the calling subscriber has failed to disconnect, a connection is made to interrupter lead 108. As will be hereinafter described, the arrangement shown functions so that, after a predetermined interval following the grounding of lead 108 by interrupter 156, the connector circuit and all other preceding circuits of the established connection are caused to release.

Let it be assumed that subscriber 103 desires to call subscriber 222 and has extended the connection in the usual manner through line finder LF and selectors S1 and S2 to selector terminals 106 to which are connected the conductors of connector C1—C2. Relay 102 now operates through a circuit traceable from battery through the lower winding of relay 102, lower inner break contacts of relay 101, thence over the loop established through the telephone 103, through the upper inner break contacts of relay 101 and upper winding of relay 102 to ground. Relay 102 in operating operates relay 112 through a circuit from battery through the winding of relay 112, contact springs 113 of relay 114, to ground on the front contacts of relay 102. Relay 112 in operating connects a guarding ground to sleeve terminals 106 and 107 through its inner and outer lower make contacts respectively. The ground on sleeve terminal 106 is extended to sleeve terminal 111 through lower back contacts of relay 101, and the ground on sleeve terminal 107 is extended to sleeve terminal 110 through upper inner back contacts of relay 101. The calling subscriber now actuates the dial 104 to dial the tens digits of the called number. On the first break of the dial contacts, relay 102 releases, but relay 112, which is slow releasing, remains operated, connecting a ground pulse from the back contacts of relay 102, through upper inner operated make contacts of relay 112 to conductor 109, thence through normally closed contacts of vertical-off-normal springs 206, over conductor 211 and through windings of relay 115 and vertical magnet 116 to battery. Relay 115 operates and vertical magnet 116 causes the shaft of the connector switch to step upward one step. In order to assist the pulse furnished over relay 115 from the back contacts of relay 102, a supplementary ground pulse is connected to conductor 109 through double dog springs 209. Upon a slight upward movement of the switch shaft, springs 209 are closed, and remain closed until the shaft has taken a complete step, when the double dog drops into the ratchet of the shaft and opens springs 209. The aforesaid supplementary ground pulse is connected from ground on the lower outer springs of relay 112, through left-hand break contacts of release magnet 210, double dog springs 209 to conductor 109. This pulse help arrangement is not a part of this invention but is covered in my copending application filed June 20, 1934, Serial No. 731,432, granted as Patent 2,006,354, July 2, 1935. As the shaft takes its first vertical step the VON springs 208 are operated transferring conductor 109 from connection with conductor 211 to conductor 212. The pulsing circuit through the vertical magnet may then be traced over conductor 212, through lower inner front contacts of relay 115, upper back contacts of relay 213, and windings of relay 115 and vertical magnet 116 to battery. On the next break of the dial, another pulse is transmitted to vertical magnet 116 which causes the vertical shaft to take another step upward, sustained as before by the supplementary pulse through the double dog springs 209. Slow release relay 115 remains operated during the open period between successive pulses. This action continues until the required number of pulses for the tens digits has been sent, when the connector brushes will have reached the level in which is located the called line.

After the dialing for vertical stepping has been completed, relay 115 releases, and the pulsing circuit is transferred from the vertical magnet 116 to rotary magnet 214. This circuit is traceable from pulse conductor 109 through lower operated front contacts of VON springs 208, over conductor 212, through lower inner back contacts of relay 115, lower break springs of rotary-off-normal combination 215 through winding of rotary magnet 214 to battery. The pulsing ground that energizes rotary magnet 214 is also effective from junction point 216 to operate relay 213. This operating circuit is traced from junction 216 through springs 217 and 218 of relay 219 and winding of relay 213 to battery. Relay 213 is slow to release and remains operated during the open periods between pulses. In operating relay 213 closes a circuit for operating relay 115, which extends from battery through the winding of vertical magnet 116, winding of relay 115, upper operated front contacts of relay 213 and resistance 220 to ground. Vertical magnet 116, however, does not operate in this circuit. When relay 213 operates, the pulsing circuit is completed through another circuit which may be traced from conductor 212, lower inner make contacts of relay 213 through winding of rotary magnet 214 to battery. Relay 213 is held operated during pulsing from junction point 221 over the circuit hereinbefore traced, from junction point 216. The pulsing circuit through the contacts of relay 213, replaces the circuit through the lower RON springs 215, when these operate after the first rotary movement of the switch. The ground pulses transmitted over conductor 212 cause the switch to rotate in the horizontal direction in the usual manner until the line of the called subscriber 222 is reached.

The reason for extending the pulse circuit of the magnet 214 through the springs 215 for the first pulse and through front contacts of relay 213 for all succeeding pulses of the series is to make it impossible to give the connector brushes an additional step by sending an additional impulse following the units series and the release of relay 213 and before relay 219 has had time to operate and fully open the rotary magnet circuit. As soon as the rotary pulses cease, relay 213 measures an interval of time for testing the line. If the line is idle, relay 219 operates, when relay 213 releases, and prepares for ringing. Should an extra impulse be received after the test is completed and the line found idle and relay 115 has released, the connector would step to the next line, except for the fact that the circuit for magnet 214 is now open at springs 215.

Let it be assumed now that the brushes 202 are resting on terminals connected with the associated line 205. At the time the selector S2 seized the terminals 106 it applied ground to conductor 117 causing the operation of brush selecting relay 201 through a circuit traceable from battery through resistance 223, lower break contacts of relay 219, lower winding of relay 201, to ground on conductor 117. This ground is applied to

conductor 117 to operate relay 201 before relay 112 operates and grounds conductor 122, the effect of ground on this latter conductor being to shunt the relay 201 as will appear later. When relay 112 does operate as already described it grounds conductor 117 to supply the holding condition after the preliminary ground is removed at the selector S2. Relay 201 now locks over its upper winding to the conductor 117. Relay 201 in operating transfers the tip and ring conductors and sleeve conductor 224 from their normal connection with upper brushes 203 to lower brushes 202. Assume now that the called line 205 is busy. Under this condition ground is found on the associated sleeve terminal and causes the operation of relay 225 through a circuit traced from battery through the lower winding of relay 225, lower break contacts of relay 101, lower outer operated make contacts of slow release relay 213, before this relay can release after completion of rotary pulsing, lower outer operated front contacts of relay 201 to ground on sleeve terminal of line 205. When relay 213 finally releases a circuit is closed for holding relay 225 operated, which is traced from conductor 228, through lower inner break contacts of relay 213, and lower inner operated make contacts of relay 225 to ground on conductor 122. Relay 225 in operating connects the usual busy tone to the line of the calling subscriber from ground on the secondary winding of transformer 118 through lower outer back contacts of relay 119, lower outer make contacts of relay 225, contacts 120 and 121 of relay 119 to the ring conductor 129 and thence over the line through station 103 to ground through the upper winding of relay 102. Calling subscriber 103 hearing the busy signal hangs up his receiver releasing relay 102, which releases relay 112. The release of relay 112 removes ground from conductors 117 and 122 which opens the holding circuit through the upper winding of relay 201, which releases, and also opens the holding circuit hereinbefore traced for relay 225, removes ground from the sleeve of selector S2, thereby causing its release and that of the preceding switches and also removes the guarding ground from the sleeve terminals 107, 110, and 111 of the other selectors. When relay 112 is released it closes a circuit for energizing release magnet 210 which is traced from battery through winding of magnet 210, middle make contacts of VON combination 208, springs 226 of relay 219, and back contacts of relay 112 and 102. The energizing of magnet 210 causes the release of the connector switch, including the restoration to normal of VON springs 208 and RON springs 215. When magnet 210 is energized it closes a circuit through its right-hand contacts to ground thereby assuring that the magnet will be energized until the switch is completely restored, that is, until VON springs 208 restore to normal and open the circuit of the winding of magnet 210.

Let it be assumed now that line 205 is idle. Under this condition battery will be connected to the sleeve terminal of line 205 through the winding of cut-off relay 227. When relay 213 releases after the completion of dialing, a circuit is closed for operating relay 219 which is traced from battery on sleeve terminal of line 205, through sleeve brush 202, lower outer operated make contacts of relay 201, lower outer break contacts of relay 213, lower winding of relay 219, lower outer operated make contacts of slow releasing relay 115 before this relay releases, upper inner break contacts of relay 181 to ground on conductor 122. Relay 219 in operating locks from battery through its upper winding and upper inner contacts, upper inner normally closed contacts of relay 225, upper closed contacts of VON springs 208 to ground on conductor 117. Relay 219 in operating also closes the tip and ring conductors through to the contacts of relay 114, connects ground through its lower inner make contact to conductor 224, thereby making line 205 test busy and holding operated cut-off relay 227, disconnects resistance 223 from the lower winding of relay 201, disconnects contact spring 217 from spring 218 and connects it to spring 229, disconnects conductor 230 from the contacts of relay 225 and connects it to contacts 123 of relay 114 and short circuits contacts 113 of relay 114, thereby maintaining relay 112 operated after its original operating path through contacts 113 is broken by the subsequent operation of relay 114. Relay 219 also connects a source of interrupted ringing current 232 by its contacts 233 to the lower winding of relay 114. The ringing source 232 may comprise an alternating-current generator connected in series with battery. Ringing current now passes through said lower winding and lower back contacts of relay 114 to the ring conductor passing through operated contacts 234 of relay 219 thence through lower inner operated front contacts of relay 201, ring contacts 202, ring conductor of line 205, through substation 222, tip conductor of line 205, tip contacts 202, upper outer operated make contacts of relay 201, contacts 235 of relay 219, to ground on the upper outer back contacts of relay 114. When subscriber 222 removes his receiver from the switchhook in response to the actuation of the ringer at his station relay 114 operates through its lower winding. Relay 114 is adjusted so that its lower back contacts and its upper outer back contacts do not break until its upper inner make contacts are closed. Relay 114 accordingly locks up from battery through its upper winding and upper inner make contacts, contacts 124 and 125 of relay 119, upper inner break contacts of relay 181 to ground on conductor 122. Relay 114 in operating opens the ringing circuit hereinbefore traced and completes the conversational circuit between the calling and called subscribers, the tip conductor being closed through its upper outer front contacts and the ring conductor through its lower front contacts. Relay 101 now operates over a circuit traced from battery through the upper winding of relay 101, upper middle break contacts of relay 119, upper outer operated make contacts of relay 114, operated make contacts 235 of relay 219, upper outer operated front contacts of relay 201, tip conductor brush 202 and associated terminal, over line 205, ring conductor brush 202 and associated terminal, lower outer operated front contacts of relay 201, operated contacts 234 of relay 219, lower operated front contacts of relay 114, springs 120 and 121 of relay 119, and lower winding of relay 101 to ground. Relay 101 in operating reverses, with its make before break springs, in the usual manner, the direction of current flow toward the line of the calling subscriber 103, thereby causing the operation of the associated line message register (not shown).

The hereinbefore mentioned feature of the system whereby, if the calling subscriber 103 delays in hanging up his receiver after called subscriber 222 has hung up, the entire connection is released, will now be described. When the called

subscriber hangs up his receiver, the circuit traced hereinbefore through the windings of relay 101 is opened, and relay 101 releases. The release of relay 101 closes a circuit for operating relay 225 through its upper winding. This circuit may be traced from battery through resistance 124, upper outer operated make contacts of relay 112, upper outer break contacts of relay 115, operated springs 231 and 236 of relay 219, operated springs 123 of relay 114, upper winding of relay 225, upper outer break contacts of relays 101 and 181 to interrupter lead 108. When interrupter 156 momentarily grounds lead 108, relay 225 operates and locks up under control of relay 101 through a circuit traced from battery through the lower winding of relay 225, lower outer break contacts of relay 101, lower inner normally closed contacts of relay 213, lower inner make contacts of relay 225 to ground on lead 122. Relay 225 in operating transfers the upper holding winding of relay 219 from sleeve ground on lead 117 to lead 237, which is connected to ground on the back contacts of relay 238, which is common to a number of connectors. This transfer is effected by means of the upper inner make-before-break spring combination of relay 225. Relay 238 operates when interrupter 239 grounds its contacts, which occurs at a predetermined interval after interrupter 156 grounds lead 108. When relay 238 in operating removes ground from lead 237, relay 219 releases. The release of relay 219 opens through its upper outer make contacts the operating circuit for relay 112, which releases. The release of relay 112 opens the holding circuit for relay 225, hereinbefore traced, which releases and also removes ground from sleeve terminal 106 thereby causing the immediate release of all switches preceding the connector and consequently the release of relay 102. The release of relay 112 also releases relay 114 by opening its locking circuit, which extends from battery through the upper winding and inner make contacts of relay 114, through contact springs 124 and 125 of relay 119, upper inner break contacts of relay 181 to ground on the lower inner make contacts of relay 112. The release of relays 102, 112 and 219 closes a circuit through release magnet 210, thereby effecting the release of the connector switch in the manner hereinbefore described.

The operation of the system will now be described in reference to the feature whereby, if the called line is disconnected from service, the calling subscriber's line is connected through a line finder to an intercepting operator's position. Let it be assumed now that station 240, which has been disconnected from service, is called. To effect said disconnection the cut-off relay 281 has been disconnected from the associated sleeve terminal of the line 204, which, it will be observed, is connected to the top set of terminals to which brushes 203 have access. To complete a connection to a top set of terminals, brush selecting relay 201 must remain deenergized which is the condition which obtains when a selector seizes terminals 107 and grounds sleeve lead 122 which is connected to battery through the lower outer break contacts of relay 219 and resistance 223. Therefore relay 201 now fails to operate. When relay 112 operates and applies ground to conductor 117 because said relay 201 is shunted by the ground that has already been applied to conductor 122 by the selector at terminals 107. Assume now that the number of station 240 has been dialed, that brushes 203 have seized the terminals of line 204 and that the connection is ready to be cut through in the manner hereinbefore described in establishing connection to line 205. Under this condition relay 219 will not operate because there is no battery on the sleeve terminal of line 204. When relay 115 releases due to the release of relay 213, a circuit is closed from battery through resistance 124, upper outer make contacts of relay 112, upper outer break contacts of relay 115, springs 231 and 241 of relay 219, upper outer break contacts of relay 225, upper operated RON contacts 215, through winding of relay 242 to the sleeve terminal of line finder LF—1. From junction point 243 the circuit branches through the lower break contacts of relay 242 and the winding of relay 244 to ground. Relay 244, which is a part of line finder LF—1, operates and causes line finder LF—1 to hunt for the connector C1—C2. When the connector is found, ground is connected to the sleeve terminal which operates relay 242, connecting tip and ring conductors 245 and 246 to intercepting trunk circuit 247, which is represented only in abbreviated form. The operation of relay 242 opens the circuit of relay 244 which releases.

The aforesaid intercepting trunk circuit 247 when connected to conductors 245 and 246 causes the functioning of a signal associated with jack 206. The operator in responding to this signal inserts the answering plug of cord circuit 207 into jack 206 and if required can complete a connection to another line by inserting the calling plug of cord circuit 207 into jack 248 of the called line. If required to give supervision or to operate the usual message register associated with the line of the calling subscriber the operator will connect a bridge across the line to operate reversing relay 181. When the intercepting operator removes the plug of cord circuit 207 from jack 206, after the conversation is completed the connection is held by the calling subscriber, and the timed release feature hereinbefore described is not now effective since relay 219 is not operated and the circuit for operating relay 225 is open at contacts 231 and 236 of relay 219. When the calling subscriber disconnects relays 102, 112 and 242 release, all relays now being restored to normal. The release of relays 102 and 112 causes the energizing of release magnet 210, which releases the connector switch as hereinbefore described.

The operation of the system will now be described when the connecter C1—C2 is seized by a toll selector.

Assume now that a toll selector not indicated has seized terminals 111. The upper two terminals are connected to tip and ring conductors 131 and 132, respectively and the lower two terminals to the sleeve and control conductors, 130 and 134, respectively. The seizure of the tip and ring terminals causes the operation of relays 102 and 181 through a circuit traced from battery through the lower windings of relays 102 and 181, lower inner break contacts of relay 119 over the ring conductor 132 and through the loop of the toll selector back over the tip conductor 131, through the upper inner break contacts of relay 119 and the upper winding of relay 102 to ground. Relay 181 in operating locks to ground on sleeve conductor 130 through its upper and lower front contacts and connects ground on sleeve conductor 133 through its lower operated make contacts and contacts 124 and 125 of relay 119 to the control lead 134. Ground is also connected

through the lower operated contacts of relay 181 to sleeve lead 133 thereby guarding terminals 110 against seizure by another selector. Relay 102 in operating operates relay 112 from ground on its front contacts through operated contacts 158 of relay 181 in multiple with break contacts 113 of relay 114. Relay 112 connects ground through its lower contacts to sleeve leads 117 and 122, thereby guarding the associated terminals against seizure.

When the connector C1—C2 is seized by a toll selector, a ground is connected by the toll transmission selector to the sleeve conductor 130. This ground is maintained by the toll transmission selector until the toll operator disconnects. The ground on conductor 130 results in a circuit for operating brush selecting relay 201 which is traced from ground on sleeve terminal 111, over conductor 130, lower back contacts of relay 181, and thence over conductor 117 and the circuit hereinbefore traced in connection with a call from selector S2. Relay 201 operates and locks as before, connecting the tip, ring and sleeve conductors to lower brushes 202. The pulsing now proceeds as in the case of a local call, except that now on the first vertical pulse relay 114 is also operated through a circuit from battery through the upper winding of relay 114, upper outer break contacts of relay 119, upper inner operated make contacts of relay 115 to sleeve ground on the upper front contacts of relay 181. Let it be assumed now that station 222 is being called and that the associated line 205 is busy, which is indicated by the presence of ground on its sleeve conductor. Relay 225 now operates and locks in the manner hereinbefore described for a local call and now causes the operation of relay 119 through a circuit traceable from battery through resistance 124, upper outer operated make contacts of relay 112, upper outer contacts of relay 115 which released on completion of dialing, contacts 231 and 241 of relay 219, upper outer operated front contacts of relay 225, upper outer operated contacts of relay 181 and winding of relay 119 to ground on the right-hand terminal of the upper winding of relay 181. Relay 119 in operating removes with its contacts 124 and 125 sleeve ground from control lead 134 causing a connection to be made to the toll operators cord circuit (not shown) but relay 114 is still held operated by ground from the toll selector over control lead 134. Relay 119 also removes the winding of busy tone transformer 118 from its connection with conductor 157 and connects said conductor 157 through resistance 127 to busy flash interrupter 126. Relay 119 also transfers tip and ring conductors 135 and 136 from connection with local tip and ring conductors 128 and 129 to connection with toll tip and ring conductors 131 and 132. Relay 119 also disconnects from the windings of relays 102 and 131 the operating circuit for these relays hereinbefore traced over the tip and ring conductors of the toll selector. The disconnection is made at the upper and lower inner back contacts of relay 119. Another operating circuit is established by relay 119 for relays 102 and 181 which may be traced from battery through the lower windings of relays 102 and 181, resistance 137, lower operated middle make contacts of relay 119, and lower make contacts of relay 181 to ground on sleeve conductor 130.

The operation of relay 119 as hereinbefore described causes a flashing of the toll operator's supervisory lamp (not shown) over a circuit from ground on interrupter 126, lower outer operated front contacts of relay 119, over conductor 157, lower outer operated contacts of relay 225, and lower inner operated make contacts of relay 119 to ring conductor 132. The toll operator, on observing the flashing lamp releases the connection at the toll switchboard thereby causing ground to be removed from sleeve conductor 130. This causes the release of relays 102, 112, 181, 119, 201, and 225. Ground is also removed from control lead 134, releasing relay 114. Release magnet 210 is now energized over the circuit hereinbefore traced in describing the system for a local call, thereby restoring all apparatus to normal.

The system will now be described for the condition existing when called station 222 is idle. Let it be assumed that the terminals of line 205 have been seized by the brushes 202 as hereinbefore described. Battery through the winding of cut-off relay 227 is now found on the sleeve terminal of line 205 and it causes the operation of relay 219 as hereinbefore traced in connection with a local selector, except that now the operating ground is obtained from sleeve conductor 130 through the lower operated make contacts of relay 181. Relay 219 in operating locks through its upper winding and performs the various functions described before and now also operates relay 119 through a circuit from battery through the winding of rotary magnet 214, contacts 217 and 229 of relay 219, upper outer make contacts of relay 181 and winding of relay 119 to ground on the upper inner operated make contacts of relay 181. Relay 119 functions as before described excepting now the busy flash interrupter 126 is ineffective due to the non-operation of relay 225, which operated when line 205 was assumed to be busy. Accordingly, the removal from the control lead 134 of sleeve conductor ground by contacts 124 and 125 of relay 119 causes the aforesaid toll operator's lamp to light steadily as an indication that the terminals of the called line have been seized and that the called subscriber's station may now be rung. When the toll operator rings, the holding ground for relay 114 over control lead 134 is removed and relay 114 releases, thereby establishing the ringing circuit for ringing the station of subscriber 222 as hereinbefore described in connection with the call from a local selector. When the called subscriber in answering removes his receiver from the switchhook relay 114 operates as before and completes the conversational connection. It will be noted that the timed release feature, described in connection with a local call is not now effective, as interrupter lead 198 is now disconnected at the upper break contacts of relay 181. Accordingly, the holding of the connection is under the exclusive control of the calling toll operator. When the toll operator releases the toll selector, ground is removed from sleeve conductor 130 which deenergizes the upper winding of relay 181 and the circuit through the lower windings of relays 102 and 181 is also opened. Relays 102 and 181 release. The release of relay 102 releases relay 112 and the release of relay 181 releases relay 119. Relay 114 releases when ground is removed from control lead 134 and relays 219 and 201 release when relay 181 releases. The release magnet is energized over the circuit hereinbefore described restoring the connector switch to normal.

The system has been described for a call by a toll selector in a group having access to the

connector leads of terminals 111. It will now be described for a call by a selector in a group having terminals 110. In this case brush selecting relay 201 does not operate, as ground on sleeve conductor 133, which is connected through the upper inner break contacts of relay 181 to conductor 122, grounds the battery side of the lower winding of relay 201. Connection is now established through the back contacts of relay 201 and brushes 203 with the terminals of line 204 in the same manner as described hereinbefore in the establishment of the connection with the terminals of line 205. After connection to said line 204 is made, relay 219, however, does not operate, as there is now no battery connected to the sleeve terminal of line 204. Accordingly, as hereinbefore described there is a circuit closed from battery through resistance 124 and the contacts of relays 112, 115, 219, 225, RON contacts 215, lower contacts of relay 242 and winding of relay 244 to ground. A branch circuit from junction point 254 is also closed, for operating relay 119 which may be traced through upper outer break contacts of relays 225 and 219, upper outer make contacts of relay 181, through the winding of relay 119 to ground on the right-hand upper winding terminal of relay 191. Relay 244 operates to start line finder LF—1 and connection to the intercepting operator is now established in the manner described for a local call, except that in this case the tip and ring conductors 245 and 246 are transferred by relay 119 from their normal connection with conductors 128 and 129 to toll conductors 131 and 132.

What is claimed is:

1. In a telephone system, subscribers' lines, an automatic switch for extending calls to said lines, a timing mechanism separate from said switch for controlling the release thereof, a second automatic switch for extending calls incoming to said first switch, and means in said first switch effective when a call is extended to one of said subscribers' lines to render said timing mechanism operative and effective when a call is extended to another of said lines to start said second switch in operation.

2. In a telephone system, an automatic switch, selective switching means for extending connections to said switch, two subscribers' lines appearing in terminal sets in said automatic switch, means for operating said automatic switch to seize the terminals of either of said lines, a timing mechanism for controlling the release of said switch, a second automatic switch for further extending connections incoming to said first switch, and relay means associated with said first switch which operates to render effective said timing mechanism when the switch seizes one of said sets of terminals and which remains inert to cause the starting of said second automatic switch in operation when the first-mentioned switch seizes the other set of terminals.

3. In a telephone system, an automatic switch, means for extending connections to said switch, two subscribers' lines appearing in terminals of said switch, one of said lines being connected for service and the other being disconnected from service, means for operating said switch to seize the terminals of either of said lines, a timing mechanism for controlling the release of said switch, an operator's position, a second automatic switch for extending to said position connections incoming to said first automatic switch, and relay means which energizes to render effective said timing mechanism when the first-mentioned switch seizes one of said lines and which remains deenergized to cause the starting of said second automatic switch in operation when the first-mentioned switch seizes the other of said lines.

4. In a telephone system, a connector switch, means for extending calls to said switch, two subscribers' lines appearing in said switch, one of said lines being connected for service and the other line being disconnected from service, means for operating the switch to seize either of said lines, mechanism for controlling the release of said switch, an operator's position, a finder switch for extending to said position calls incoming to said connector switch, and means associated with said connector switch, the operation of which varies according to whether the switch seizes one or the other of said lines, and means controlled by said last mentioned means either for rendering effective said release controlling mechanism or for starting in operation said finder switch.

5. In a telephone system, a connector switch, means for extending calls to said switch, two lines, one of which is and the other of which is not in a condition for receiving calls, means for operating said connector switch to seize either of said lines, release mechanism for controlling the release of said switch, an operator's position, a finder switch for extending to said position calls incoming to said connector, a relay in said connector switch which operates or remains inoperative according to whether the connector seizes one or the other of said lines, a circuit closed by said relay when operated for rendering effective said release mechanism, and a circuit closed by said relay when deenergized for starting said finder switch in operation.

6. In a telephone system, a connector switch, a subscriber's line connected to a set of terminals of said switch for service, a second line appearing in a set of terminals in said connector but disconnected from service, means for extending a connection to said connector from a calling party, release means for said connector, a relay in said connector operable when the connector seizes the terminals of the line in service, a circuit closed through front contacts of said relay for placing the release means of said switch under control of the called line, said relay remaining deenergized when the connector seizes the terminals of the disconnected line, an operator's position, a finder switch for seizing the connection extended to said connector and extending it to said position, a circuit closed through back contacts of said relay for starting said finder in operation, and means for placing the operation of said release means under the sole control of the calling party when said relay is deenergized.

7. In a telephone system, an automatic switch, means for extending connections to said switch, two subscribers' lines appearing in terminal sets in said switch, means for operating said automatic switch to seize the terminals of either of said lines, a timing mechanism, a second automatic switch for further extending connections incoming to said first switch, a relay in said first switch which operates or remains inoperative according to whether said first switch seizes one or the other of said lines, a circuit closed by said relay when operated for rendering effective said timing mechanism, a circuit closed by said relay when deenergized for starting said second automatic switch in operation, means for placing the

release of said relay under control of said timing mechanism, and circuit means controlled by the release of said relay for effecting the release of said first automatic switch.

8. In a telephone system, a connector switch, means for extending calls to said switch, two subscribers' lines appearing in said switch, test circuits for said lines, the test circuit of one of said lines being closed to enable the line to receive service and the test circuit of the other line being opened to deny service to said line, means for operating the switch to seize either one of said lines, timing mechanism, an automatic switch for further extending calls incoming to said connector switch, a relay for the connector switch which operates or remains inoperative according to whether the test circuit of the subscriber's line seized is closed or open, a circuit closed by said relay when operated for rendering effective said timing mechanism, means controlled by said timing mechanism for causing the release of said connector switch, and a circuit closed by said relay when deenergized for starting said automatic switch in operation.

HENRY HOVLAND.