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1,644,060

H. HOVLAND
TELEPHONE SYSTEM

Filed April 30, 1926

3 Sheets-Sheet 1

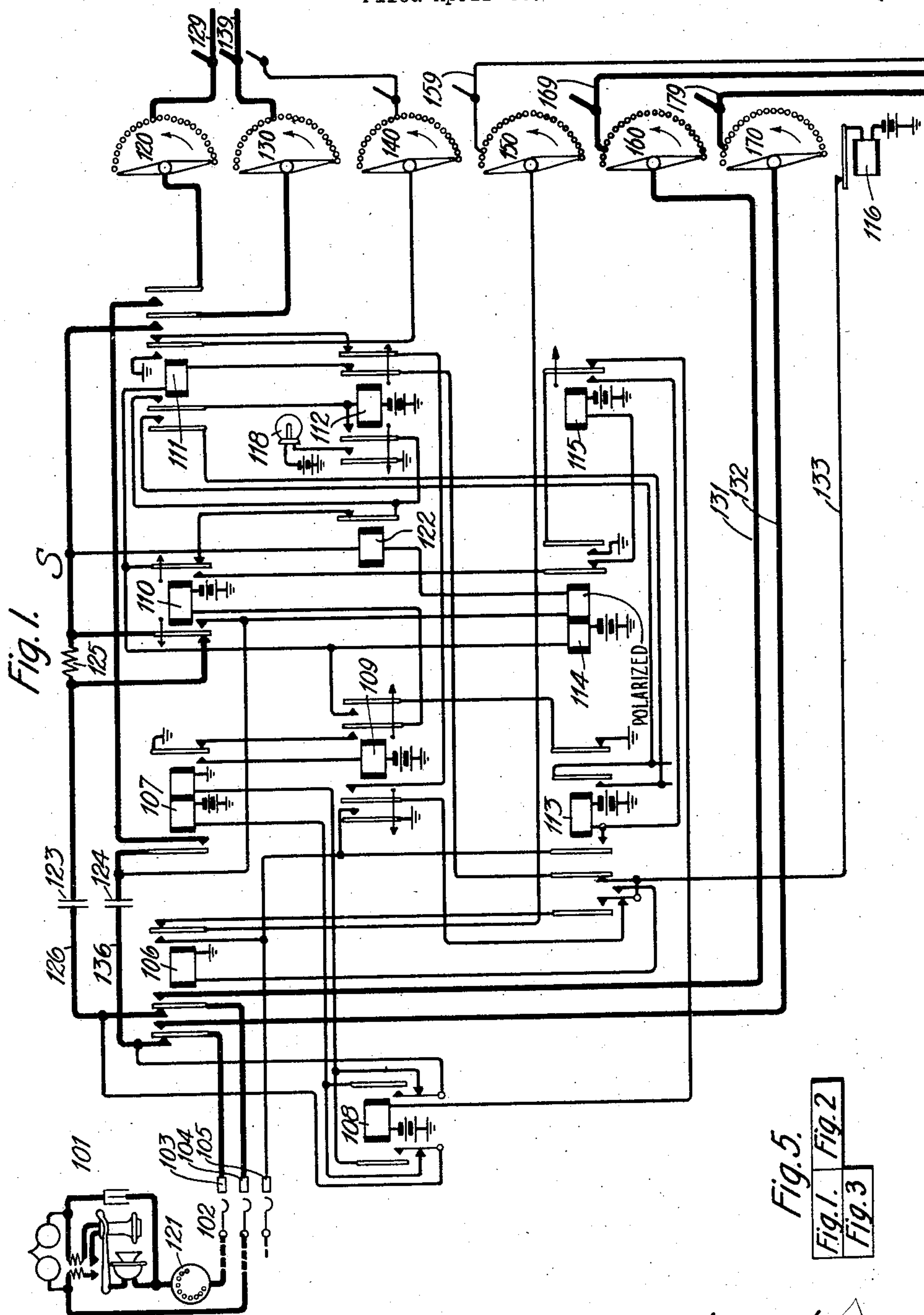


Fig. 5.
Fig. 1. Fig. 2
Fig. 3

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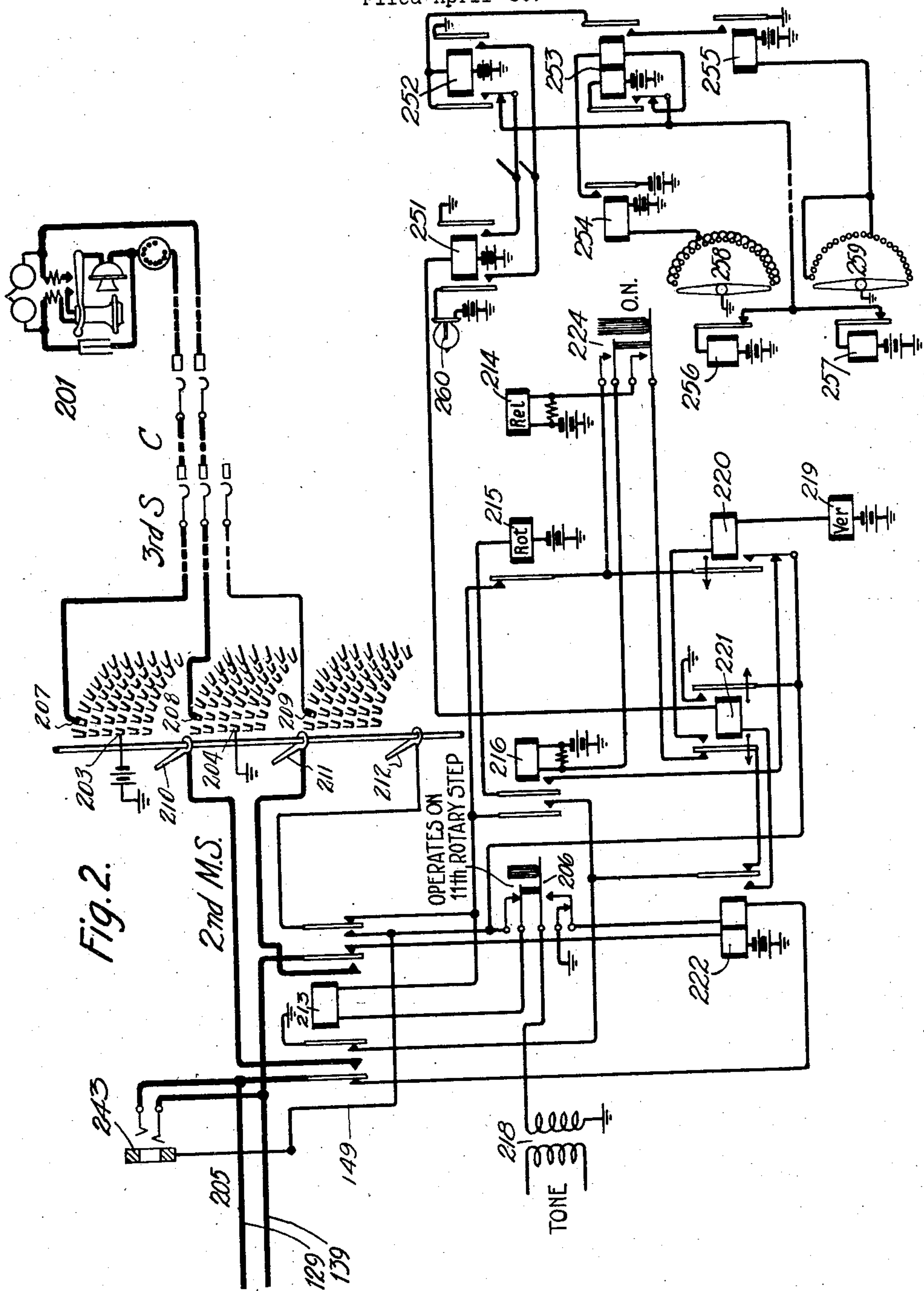
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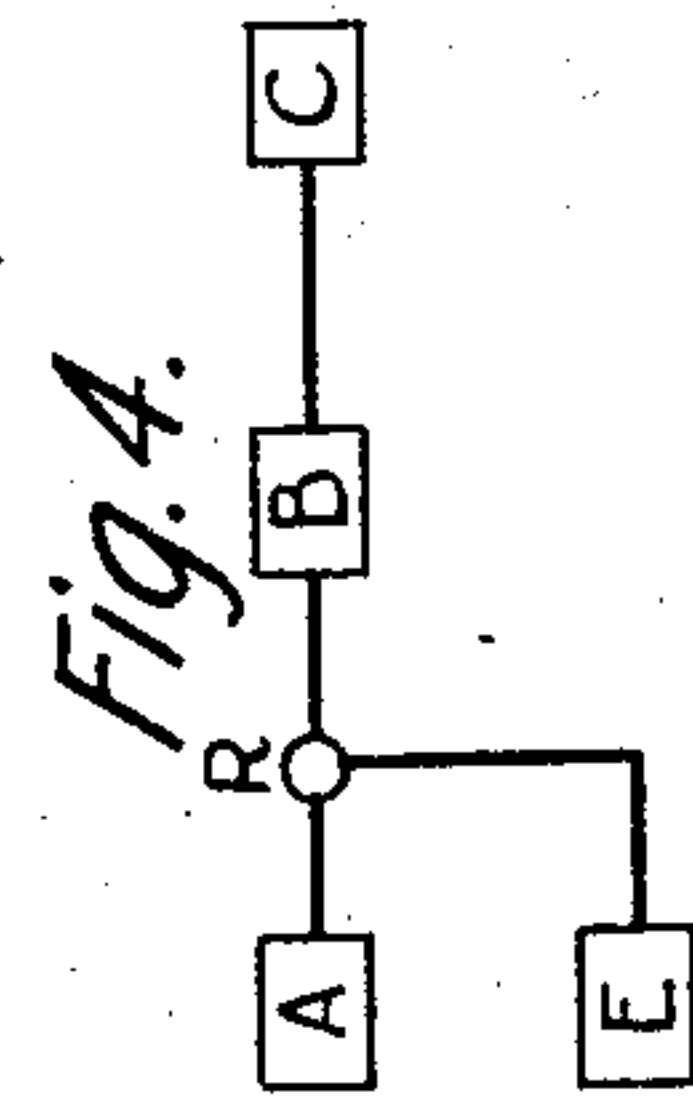
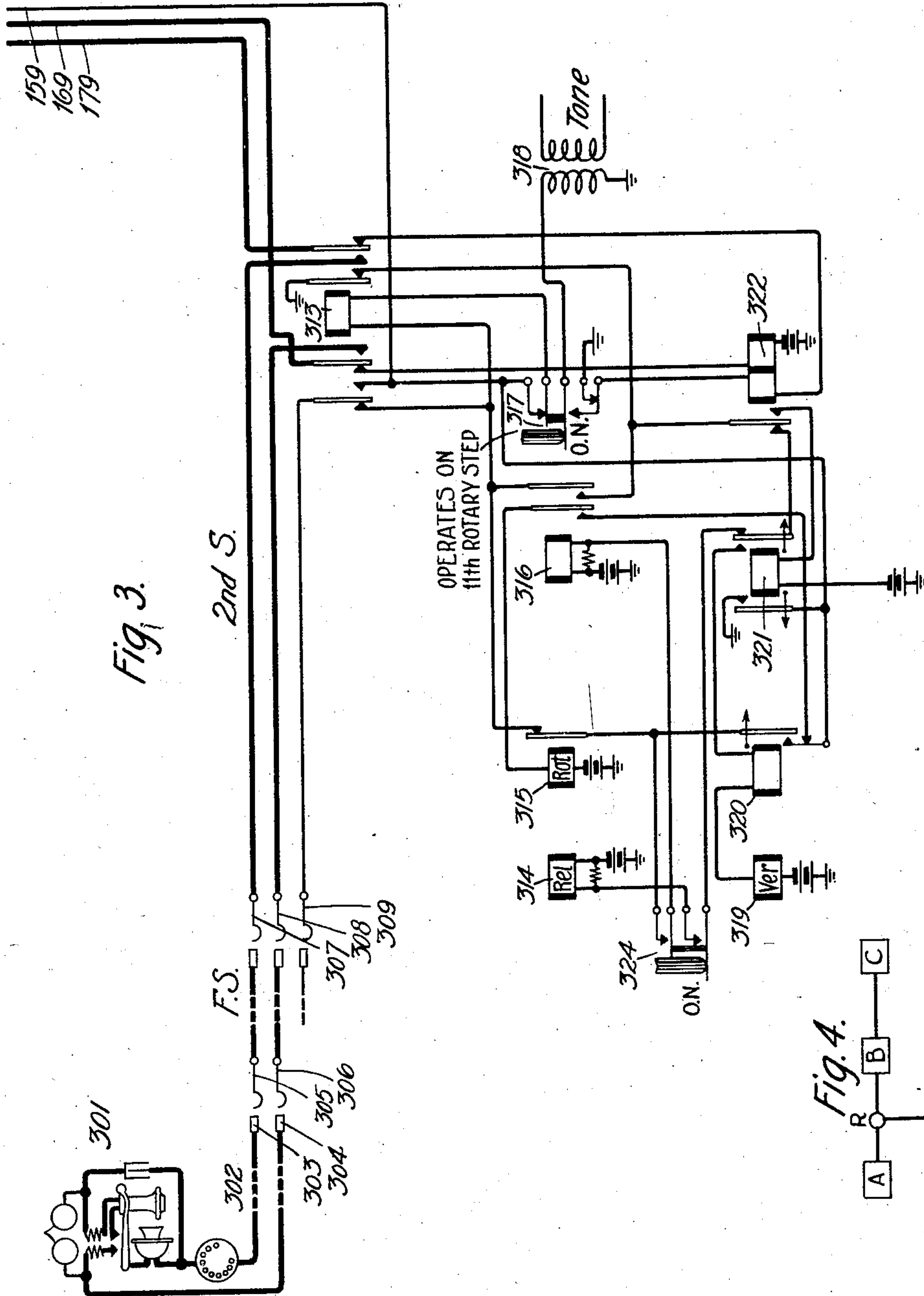
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

HENRY HOVLAND, OF FLUSHING, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed April 30, 1926. Serial No. 105,690.

This invention relates to improvements in telephone systems and particularly to selective switching arrangements for use in automatic telephone systems.

5 The principal object of this invention is to enable the transfer of a permanent signal from a main office selector to a local selector and the release of the main office selector.

10 Another object is to remove, under control of the local trunk, the dialing bridge and condensers from the connection while dialing over said local trunk.

15 It has been the practice heretofore when a line in a satellite office became grounded to light a signal in the main office selector which remained lighted until the trouble was cleared and the connection released thereby holding a trunk and selector in the 20 main office busy. It is also old in the art to remove a dialing bridge from a repeater.

By this invention the signal is transferred from the main office selector to a by-pass repeater in the local office. The by-pass repeater then causes a lamp associated with 25 itself to light and releases the main office trunk and selector. The signal then remains lighted in the by-pass repeater until the trouble is cleared but does not hold the main 30 office trunk and selector busy. The dialing bridge is removed under control of the local selector when the call is transferred from the main office to the local office thereby economizing in the use of apparatus.

35 The system disclosing the invention in one of its limited embodiments consists of a calling subscriber's line in a satellite or local office, a by-pass selector and repeater circuit, a trunk to a main office, a main office 40 selector and a trunk from the by-pass selector to a local selector in a local or satellite office. The by-pass selector is used for by-passing a call from one local subscriber to another local subscriber without involving 45 the main office. This feature is claimed in a copending application by E. Jacobsen, Serial No. 107,755, filed May 8, 1926. When a call is initiated whether for a local or main office subscriber, it is routed to a 50 main office selector. Certain levels of this selector have battery and ground connected thereto and these levels are reached by the dialing of certain numbers which are assigned to local office subscribers. The bat- 55 tery and ground connected to these levels

operate a polarized relay in the by-pass selector which causes the release of the main office selector switch and initiates the selection of a trunk to a selector in a tributary office. This leaves the main office selector free for 60 use by other by-pass repeaters.

If a line in the tributary office should become grounded, or the conductors be crossed the system will operate in the same manner 65 as when a call is being initiated with the exception that no number is dialed and a permanent signal will be given after a predetermined lapse of time in the first selector at the main office. This signal is received by an attendant in the main office who short- 70 circuits the trunk conductors thereby causing the by-pass selector to release the trunk and light a similar signal connected with the by-pass repeater in the local office. A more clear conception may be obtained of 75 the objects and operation of this invention from the following description in which:

Fig. 1 shows the by-pass selector S with two sets of brushes, the upper set of which 80 are connected to a selector in the main office and the lower connected to a selector in a local or satellite office.

Fig. 2 shows a second selector in a main office, the banks of which are shown connect- 85 ed to a subscriber's station in the main office and other banks to which battery and ground are connected for controlling the selector S. An alarm circuit and timing device is shown in the lower right hand corner.

Fig. 3 shows a selector in a local office. 90

Fig. 4 is a diagrammatic representation of the system. A is a calling line, R the by-pass selector, B the main office selector and C the 95 main office line. E is the selector in the local office and the line from R to E designates the trunk from the by-pass selector to the local office selector E.

Fig. 5 illustrates the manner in which the 100 different sheets of the drawing should be arranged.

When subscriber 101 removes the receiver from the switch hook, line switch 102 selects the by pass selector S in a manner well 105 known in the art. A circuit is closed for relay 107 from ground through its right winding, right back contact of relay 108, outer left back contact of relay 106, brush and terminal 103 of line switch 102, through the subscriber's loop 101, line switch 102, brush and terminal 104, inner left back con- 110

tact of relay 106, left back contact of relay 108 to battery through the left winding of relay 107. The operation of relay 107 prepares the bridge formed by the right winding of relay 114 and the winding of relay 122 across the conductors to the arcs 120 and 130. The operation of relay 107 also operates relay 109 over an obvious circuit. The operation of relay 109 connects ground from its outer left front contact to terminal 105 holding line switch 102 operated and also prepares in part a circuit for stepping magnet 116 and test relay 111. If the brushes 120, 130 and 140 are in contact with a busy trunk such as trunk 205 to the main office, ground will be connected to brush 140 thereby closing a circuit for magnet 116 from said ground, inner right back contact of relay 111, outer right back contact of relay 112, inner left front contact of relay 109, outer left back contact of relay 113 to battery through the interrupter contact and winding of magnet 116. A parallel circuit is also closed from ground on the outer right back contact of relay 113, outer right front contact of relay 109, winding of relay 111, inner right back contact of relay 112, middle left back contact of relay 113 to battery through the magnet 116. The ground on arc 140 acts as a shunt to the winding of relay 111, which does not operate, but magnet 116 operates and steps brushes 120, 130 and 140 until an idle trunk is found at which time relay 111 operates in a series circuit through the winding of magnet 116. Magnet 116, however, does not operate as the resistance of relay 111 is too high. The operation of relay 111 closes the talking conductors through to arcs 120 and 130 and connects ground to the brush of arc 140 thereby making the trunk test busy to all other selectors. The operation of relay 109 also closes an obvious circuit from ground on the outer right back contact of relay 113 through the left winding of relay 114 thereby preparing it as a polarized relay. This relay, however, does not operate at this time over its left winding.

The subscriber at substation 101 now operates dial 121 which opens the circuit through relay 107. The release of relay 107 does not release relay 109 as it is a slow-to-release type relay which holds up, thereby closing a circuit from ground on the right back contact of relay 107, inner right front contact of relay 109 to battery through the winding of relay 110. Relay 110 is also slow-to-release and does not release at any time during dialing. The operation of relay 110 closes a circuit from ground on the outer right back contact of relay 113, outer right front contact of relay 109, right front contact of relay 110, inner back contact of relay 114 to battery through the winding of relay 115. As the dial 121 returns to nor-

mal, relay 107 follows the dial impulses and opens and closes the circuit from battery through the left winding of relay 222, inner right back contact of relay 213, conductor 139 of trunk 205, brush and arc 130, middle right front contact of relay 111, left front contact of relay 110, left front contact of relay 107, outer right front contact of relay 111, brush and arc 120, conductor 129 of trunk 205, outer left back contact of relay 213 to ground on the lower normal contact of the eleventh rotary position off normal springs 206, through the right winding of relay 222. The opening and closing of the left contact of relay 107 causes relay 222 to operate and release. On the first operation of relay 222, relays 221 and 251 are operated over a circuit from ground on the inner left back contact of relay 213, front contact of relay 222 to battery through the windings of relays 221 and 251. The operation of relay 221 connects ground to trunk 205 over conductor 149. The release of relay 222 now closes a circuit from ground on the inner left back contact of relay 213, back contact of relay 222, left front contact of relay 221, winding of relay 220 to battery through the vertical magnet 219. During the following impulses relays 220 and 221 remain operated as they are of a slow-to-release type. The operation of vertical magnet 219 causes brushes 210, 211 and 212 to be moved upward to the desired level which contains terminals 207, 208 and 209. When these brushes leave their normal position the off normal springs 224 are closed to enable the closing in part of a circuit for relay 216 from ground on the right front contact of relay 221, front contact of relay 220, upper contact of off normal contact springs 224, to battery through the winding of relay 216. Relay 216 locks over a circuit from ground on the inner left back contact of relay 213, outer front contact of relay 216, back contact of magnet 215, upper contact of off normal contact springs 224 to battery through the winding of relay 213.

When the dial has returned to normal after sending the first digit, relay 220 releases and a circuit is closed for the rotary stepping magnet 215, traceable from battery through the winding of said magnet, inner contact of relay 216, normal contact of relay 220 to ground at the right contact of relay 221. The magnet 215 advances the brushes 210, 211, 212 to the first set of terminals. Magnet 215 releases the relay 216 and the relay in turn opens the operating circuit of the magnet, permitting it to release. If the terminals of the first set engaged by the brushes are busy, the relay 216 reoperates in a circuit from battery through its winding, contacts 224, contact of magnet 215, right hand contact of relay 213, brush 212 to the grounded busy terminal. Relay 216 operates

and closes the circuit for magnet 215, which advances the brushes to the next set of terminals. This operation will continue until an idle trunk is found. A circuit is also
 5 closed during the operation of magnet 215 from ground on the right front contact of relay 221, upper normal contact of the eleventh rotary position off normal contact spring 206, winding of relay 213, back con-
 10 tact of magnet 215, upper alternate contact of off normal contact spring 224 to battery through the winding of relay 216 in parallel with one from busy ground on brush 212 through the outer right back contact of relay
 15 213 and thence over the same circuit through the winding of relay 213. While the brush 212 is resting on a busy terminal relay 213 is shunted but, as soon as an idle terminal is found, this shunt is removed and relay
 20 213 operates and connects conductors 129, 139 and 149 through to brushes 210, 211 and 212. When the call is for a subscriber such as 301 in a local office, certain levels such as those containing terminals 203 and 204
 25 corresponding to the first digit of the subscriber's number have battery and ground connected thereto for giving a battery reversal to the by-pass selector.

When such a call is made the operation
 30 of the main office selector switch will be as follows. After the first digit is dialed and the rotary magnet 215 is operated brushes 210, 211 and 212 are caused to hunt. No ground will be found for brush 212 in this
 35 level, therefore relay 213 will operate as described above and close the conductors 129, 139 and 149 through to brushes 210, 211 and 212 which are assumed to be resting on terminals 203 and 204. Battery and ground
 40 will be connected to these terminals, and will close a circuit from battery on terminal 203, brush 210, outer left front contact of relay 213, conductor 129, arc and brush 120, outer right front contact of relay 111, left front
 45 contact of relay 107 through the polarized winding of relay 114, winding of relay 122, middle right front contact of relay 111, arc and brush 130, conductor 139, inner right front contact of relay 213 to ground on terminal 204 through brush 211. Relays 114
 50 and 122 operate. Relay 114 opens the circuit through relay 115 which is slow-to-release and so holds up until a circuit has been closed for operating relay 113 from ground on the outer front contact of relay 114, front
 55 contact of relay 115 to battery through the winding of relay 113. The operation of relay 122 performs no function at this time but the windings of these relays form a repeater bridge to the main office. Relay 113
 60 operates and locks over an obvious circuit to ground on the outer left front contact of relay 109. The operation of relay 113 closes a circuit from battery through the winding of magnet 116, outer left front contact of re-

lay 113 to ground through the winding of relay 106. The operation of relay 113 opens the circuits for relays 111, 122, and 114 and allows them to release. The release of relay
 70 213 closes a circuit from ground on its inner left back contact; back contact of relay 222, left back contact of relay 221, lower alternate contact of off normal contact spring 224 to battery through the winding of relay magnet 214. The operation of release mag-
 75 net 214 causes brushes 210, 211 and 212 to restore to normal thereby restoring the entire switch to normal.

If the brushes of arcs 150, 160 and 170 are resting on a busy trunk, ground will be
 80 connected to brush 150 thereby closing a shunt around relay 106 through its right back contact to the outer left front contact of relay 113. If relay 106 is shunted, magnet 116 will be operated thereby stepping
 85 brushes 150, 160 and 170 until an idle trunk is reached when the shunt around relay 106 is removed allowing it to operate. Magnet 116 does not operate at this time as the resistance of relay 106 is too high. The op-
 90 eration of relay 106 disconnects conductors 126 and 136 from terminals 103 and 104 and connects conductors 131, 132 and 133 to terminals 103, 104 and 105 through the contacts of relay 106. When conductors 126 and 136
 95 are disconnected from the terminals, the circuit for relay 107 also opens allowing it to release, in turn releasing relays 109 and 110. The release of relay 110 removes the repeater bridge from across the main office
 100 trunk and the circuit is ready for direct dialing.

Selector S is now in condition for the next digit to be dialed to the selector in the local office over leads 169 and 179. A circuit is
 105 closed from ground through the left winding of relay 322, outer right back contact of relay 313, conductor 179, brush and arc 170, conductor 132, outer left front contact of relay 106, terminal and brush 103 of line switch 102, through the subscriber's loop, brush and terminal 104, inner left front con-
 110 tact of relay 106, conductor 131, brush and arc 160, conductor 169, inner left back contact of relay 313 to battery through the right winding of relay 322. Relay 322 follows the dial impulses in the same manner as relay 222 and the operation of the circuit is the same as that described for the selector in
 115 Fig. 2. It will be noted that the numbering of the apparatus of Fig. 3 is the same as that of Fig. 2 with the exception of the hundred digit.
 120

After the brushes 307, 308 and 309 of the second selector have been positioned on the
 125 terminals of an idle trunk, the final selector switch FS is operated by subsequent impulses to position its brushes 305 and 306 on the terminals 303 and 304, which are connected by connectors 302 to the called line.
 130

When subscriber 301 replaces the receiver on the switchhook, the release of the switches in Fig. 3 is the same as that described for the switches in Fig. 2 when released by the by-pass selector.

When a line in a satellite or local office is grounded or the leads are crossed selector S will operate as described above and select an idle main office trunk and first selector which will operate in the usual manner with the exception that relay 222 will not be operated and released by the operation of the dial. Therefore the circuit through relays 221 and 251 will be closed for an abnormal length of time. This period of time is determined by a timing mechanism consisting of magnets 256 and 257 with their respective switches 258 and 259. Magnet 256 is so adjusted that switch 258 will step one step every five seconds while magnet 257 is so adjusted that switch 259 makes one step every thirty seconds. It is desirable when giving a signal concerning these two types of trouble to wait about five minutes, therefore the switch 259 is wired to give an impulse every five minutes.

When relay 251 is operated a circuit is closed from ground on its right front contact, left back contact of relay 252 to battery through the back contact and winding of magnet 256 thereby causing switch 258 to step in a well known manner. The operation of switch 258 operates relay 254 over an obvious circuit at five second intervals. Relay 254 operated closes a circuit from battery on its front contact through the right winding and left back contact of relay 253, left back contact of relay 252 to ground on the right front contact of relay 251. Relay 253 operates and locks to the same ground through its left winding and left front contact. Magnet 257 has in the meantime been stepping switch 259 at the rate of one step each thirty seconds. After the elapse of five minutes the brush of switch 259 should be resting on terminal 10 and an obvious circuit is then closed for relay 255 which operates and closes a circuit from ground on its front contact, right front contact of relay 253 to battery through the winding of relay 252. Relay 252 operates and locks to ground on the right front contact of relay 251 and closes an obvious circuit for lighting lamp 260. This lamp is a signal to the attendant at the main office that a line in a satellite office is in trouble. The attendant then inserts a plug in test jack 243 which short-circuits conductors 129 and 139 thereby releasing relays 114 and 122. The release of relay 122 closes a circuit from battery through the winding of relay 112, inner left front contact of relay 111, back contact of relay 122, right back contact of relay 110, outer right front contact of relay 109 to ground on the outer right back con-

tact of relay 113. Relay 112 operates and locks to the same ground through its inner left front contact. An obvious circuit is also closed for lamp 118 through its outer right front contact as an indication that the line connected to selector S, such as line 101, is in trouble. The operation of relay 112 also opens a circuit for relay 111 releasing it and thereby opening the conductors to arcs 120, 130 and 140 thus disconnecting the trunk to the main office. Lamp 118 will remain lighted until the trouble is cleared and relay 107 is released in turn releasing relay 109 which opens the locking circuit for relay 112. The by-pass selector S is then in condition for further use.

What is claimed is:

1. In combination, a local office, a subscriber's line, and an automatic switch in said local office, a main office trunk, a main office, a selector therein, a permanent signal in said selector to indicate an unstandard condition on said line, causing said line to be extended over said trunk to said selector, and means in said automatic switch for transferring said signal from the main office selector to said automatic switch.
2. In a telephone system, a local office, a subscriber's line, and a repeater in said local office, a main office trunk, a main office, a selector therein, a permanent signal in said selector to indicate an unstandard condition on said line, causing said line, repeater, trunk and selector to be interconnected, and means in said repeater for releasing said main office trunk and selector and transferring said signal to said repeater.
3. In a telephone system, a local office, a subscriber's line, and a by-pass repeater in said local office, a main office trunk, a main office, a selector therein, a permanent signal in said selector to indicate an unstandard condition on said line, causing said line, repeater, trunk and selector to be interconnected, and a relay in said repeater for causing the release of said main office trunk and selector.
4. In a telephone system, a local office, a subscriber's line, and a repeater in said local office, a main office trunk, a main office, a selector therein, a permanent signal in said selector to indicate an unstandard condition on said line causing said line, repeater, trunk and selector to be interconnected, and a relay in said repeater for transferring said signal from the main office selector to the repeater and causing the release of said main office trunk and repeater.
5. In a telephone system, a main office, a local office, a repeater having trunks to said main and local offices connected thereto, contact wipers for connecting to said trunks, a single operating mechanism for driving all of said wipers, a dialing bridge in said repeater, and automatically selective means in

said repeater for removing said bridge when dialing over said local trunk.

6. In a telephone system, a main office, local offices, a repeater in one of said local
5 offices having trunks to both main and local offices connected thereto, contact wipers for connecting to said trunks, a single operating

mechanism for driving all of said wipers, a dialing bridge in said repeater, and a relay in said repeater for removing said bridge 10 when dialing over said local trunk.

In witness whereof, I hereunto subscribe my name this 29th day of April, A. D. 1926.

HENRY HOVLAND.