

March 22, 1932.

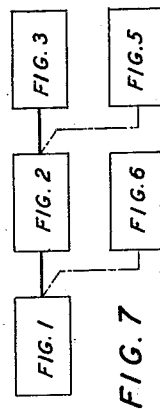
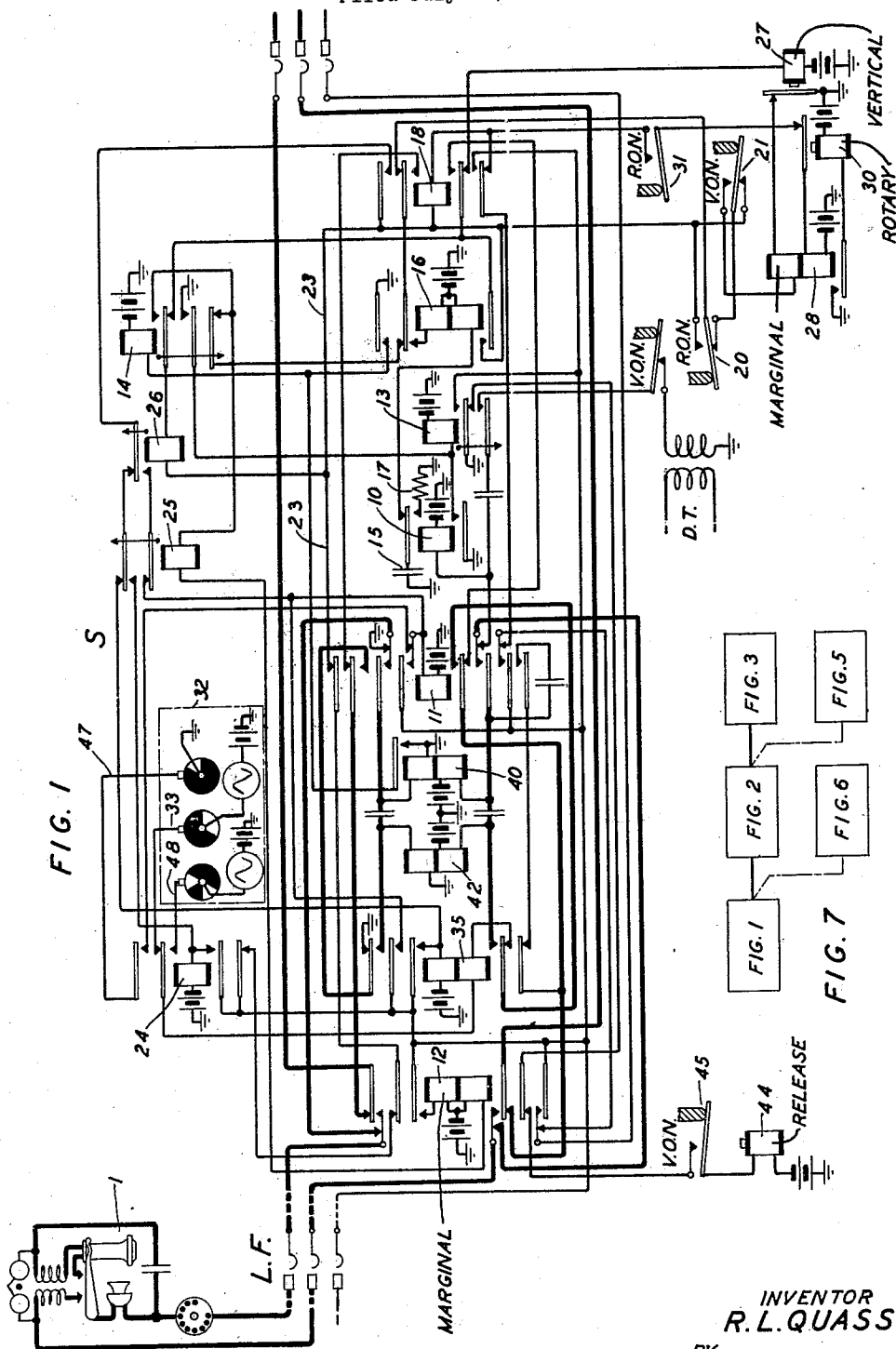
R. L. QUASS

1,850,603

TELEPHONE SYSTEM

Filed July 31, 1930

5 Sheets-Sheet 1



INVENTOR
R. L. QUASS

BY

M. P. McFarmer
ATTORNEY

March 22, 1932.

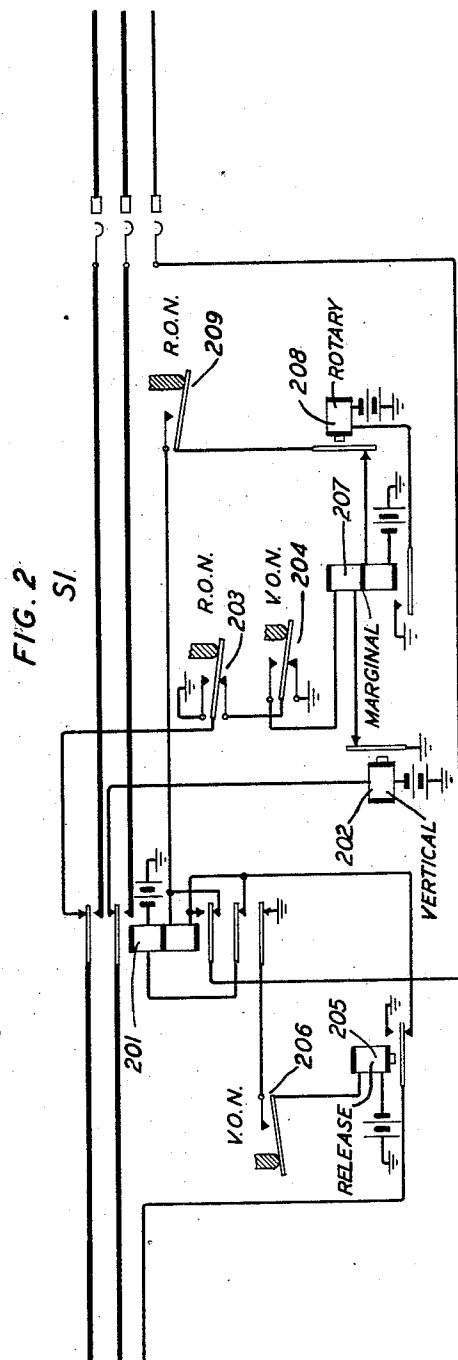
R. L. QUASS

1,850,603

TELEPHONE SYSTEM

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5 Sheets-Sheet 2



INVENTOR
R. L. QUASS
BY
M. B. McJannet
ATTORNEY

March 22, 1932.

R. L. QUASS

1,850,603

TELEPHONE SYSTEM

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5 Sheets-Sheet 3

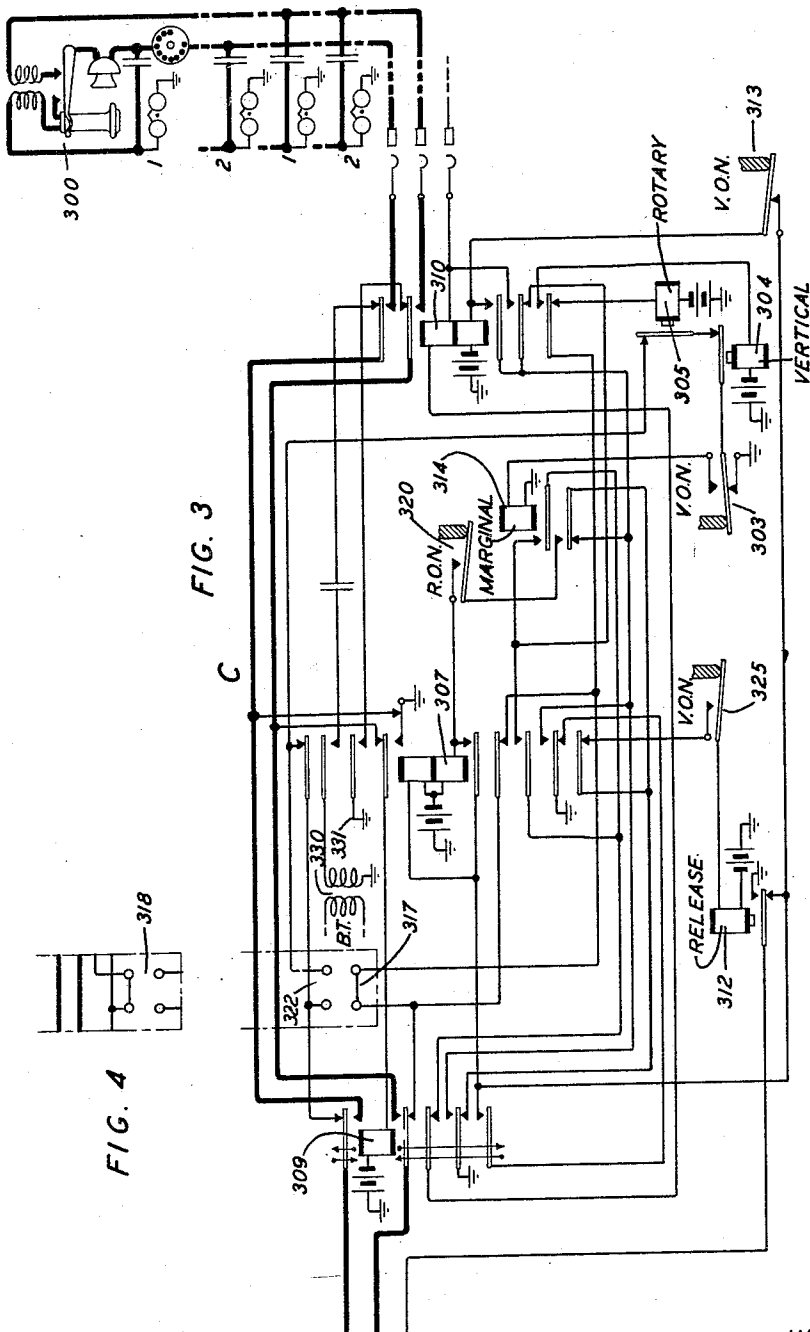


FIG. 4

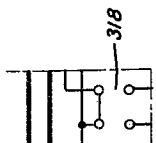


FIG. 3

INVENTOR
R. L. QUASS
BY *James W. McInerney*
ATTORNEY

March 22, 1932.

R. L. QUASS

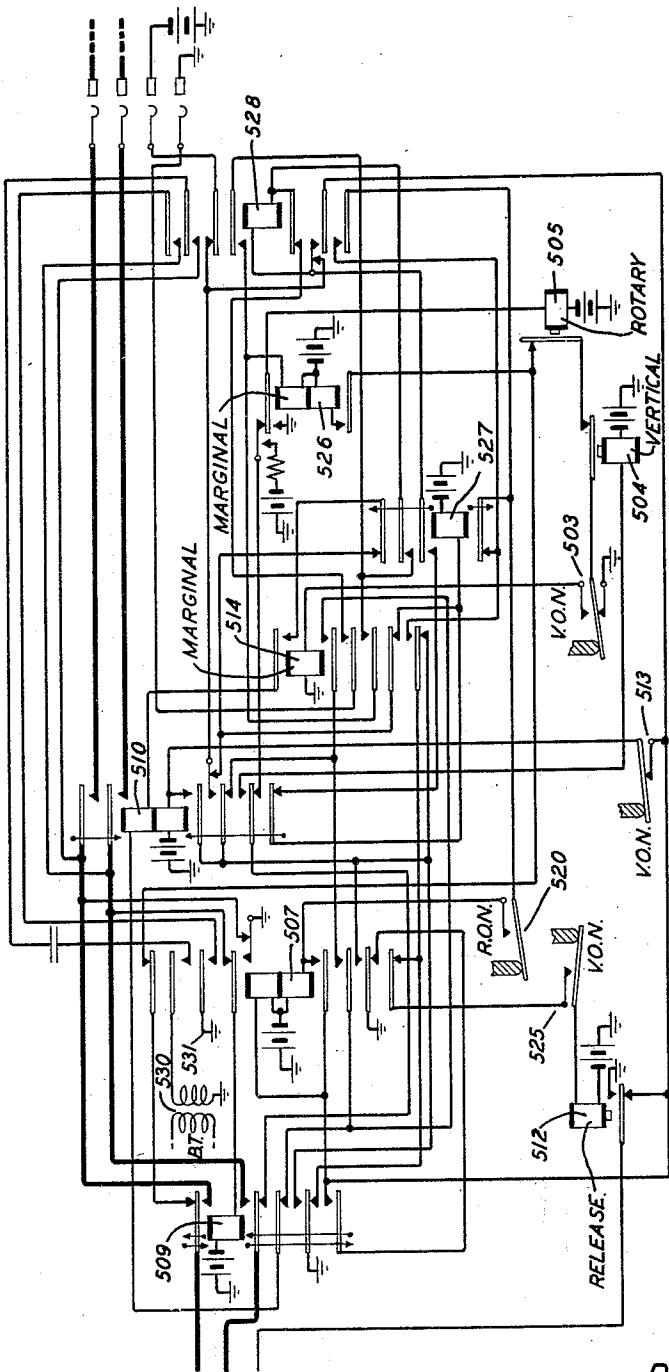
1,850,603

TELEPHONE SYSTEM

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FIG. 5
C1



INVENTOR
R. L. QUASS
BY
M. J. Kennedy
ATTORNEY

March 22, 1932.

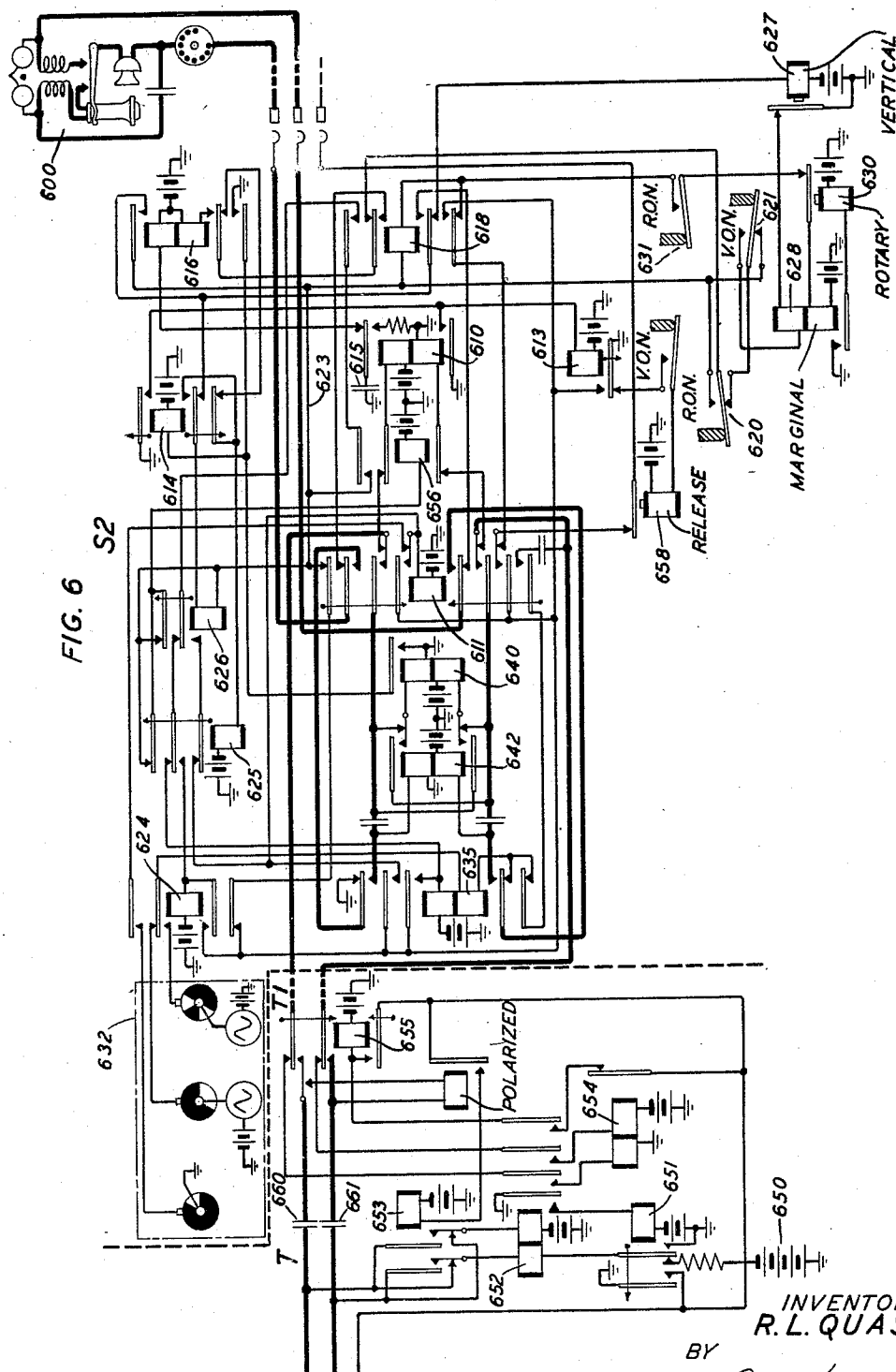
R. L. QUASS

1,850,603

TELEPHONE SYSTEM

Filed July 31, 1930

5 Sheets-Sheet 5



INVENTOR
R. L. QUASS

R. L. QUASS

BY

W. B. McFadden
ATTORNEY

ATTORNEY

UNITED STATES PATENT OFFICE

RALPH L. QUASS, OF HAWTHORNE, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TELEPHONE SYSTEM

Application filed July 31, 1930. Serial No. 471,966.

This invention relates to telephone systems and particularly to machine switching systems.

5 The object of this invention is to simplify the equipments and circuits for the automatic switches employed in establishing telephone connections.

Heretofore systems have been used whereby, in the control or pulsing relay equipment 10 for switches, the holding relay is maintained operated during pulsing either due to its own slow-to-release characteristics or to a locking winding thereon under control of the operating magnets of said switches. This control 15 equipment for a train of switches has also in the prior art been centralized in one switch. For example, the pulsing relay equipment for controlling the operating magnets in the first and succeeding selector switches and the con- 20 nector may be located in the first selector switch. In the prior systems where the holding relay is maintained operated by a locking winding; this winding may be placed under control of the operating magnets of the suc- 25 ceeding switches as they are included in the train of switches employed in establishing a connection. The equipment for ringing on party lines may also be located in a preceding switch in systems of these types.

30 Certain features of the present invention reside in the pulsing relay arrangement in a preceding switch or the first selector. One of these features is the means whereby a help relay employed to complete the circuits for the 35 operating magnets in the switches is energized momentarily by the release of the pulsing relay and thereafter controlled independently by the operating magnets in the first and succeeding switches. Another feature is 40 the means whereby the change-over relay in the first switch is actuated directly by the help relay. A third feature is the means whereby the holding relay is held operated by this change-over relay. By these means the help 45 relay is not released until the magnets controlled thereby are operated and the holding relay is held energized during the entire period of sending the series of impulses so that its slow-to-release characteristics need not be 50 exceptionally closely adjusted.

Certain other features reside in circuit arrangements for the control of succeeding switches from the preceding switch. One of these features is the means whereby the 55 change-over relay of a succeeding switch is operated after the magnet for operating this switch in its primary movement has completed its function in this respect. The change-over relay, which is marginal, depends on the release of the change-over relay 60 in the preceding switch and on the marginal characteristics of the locking winding of the help relay. This locking winding is of a high resistance so that the change-over relay in a succeeding switch, which is in circuit with 65 this winding during the control of the primary movement, does not operate during this period but operates when the change-over relay in the preceding switch releases to close a low resistance path for said change-over 70 relay in the succeeding switch.

Another feature relates to the selection and application of party line signaling codes and comprises means whereby a momentary ap- 75 plication of battery on the ring conductor and opening of the connection to the tip conductor, or a momentary application of ground on the tip conductor and opening of the ring conductor takes place as determined by the selection of the group in which an idle suc- 80 ceeding switch is found and over which a connection is to be established to the desired party line, and means whereby the operation of one test relay and release of another test relay, or vice versa, in the preceding switch in which 85 the code selecting equipment is located, is effective, due to this momentary application of battery or ground on one conductor or the other and opening of the connection of the complementary conductor, to cause the selec- 90 tion of the desired code for application to the connected line.

Another feature consists of means whereby when a trunk instead of a subscriber's 95 line is seized by the last switch, the battery and ground connections for the ring and tip conductors are removed to release both said test relays in the preceding switch and thereby cause the ringing trip relay to be actuated 100 to prevent transmission of a code signal and

whereby other circuit changes are effected by the operation of said trip relay to supply battery feed conditions in said preceding switch for the talking conductors.

Another feature consists of means whereby when the connection is extended to certain types of trunks or to operators' positions, booster battery is applied to the tip conductor and the battery connection is maintained on the ring conductor to cause both said test relays to remain operated and in addition to cause a third marginal test relay to be operated over the tip conductor circuit to prevent a signaling code to be transmitted and to complete the connection through the preceding switch without supplying transmission battery for the talking conductors.

This invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows a calling subscriber's lines, a line finder in diagrammatic form and a first selector switch embodying features of this invention;

Fig. 2 shows an intermediate selector;

Fig. 3 shows a connector embodying other features of this invention;

Fig. 3 also shows a called four-party line in diagrammatic form;

Fig. 4 shows a portion of the wiring arrangement of a condenser similar to the connector shown in Fig. 3, the purpose of which will be explained hereinafter;

Fig. 5 shows a connector switch having access to trunks leading to a distant office and may be used in place of Figs. 3 and 4 in connection with Figs. 1 and 2; and

Fig. 6 shows a trunk circuit outgoing from one office, a trunk terminating in a connector at a distant office which connector may be used for extending calls through standard automatic step-by-step switches to called subscribers' lines one of which has been shown in diagrammatic form.

Fig. 7 shows how the above figures may be arranged for reading of the circuits thereon.

Referring to the drawings, a description will first be made of a call from the calling subscriber's line at 1 through the line finder LF, the first selector S, the second selector S' and the connector C to a subscriber of the four-party line 300. A description will then be made of a connection extending through a connector similar to connector C but wired in accordance with Fig. 4 to another subscriber of the line 300. A description will then be made of a connection from the calling subscriber at 1 over line finder LF, selectors S and S' and the trunk hunting connection C1 of Fig. 5 to an idle trunk outgoing to a distant office and finally a description will be made of a connection from the subscriber 1 over line finder LF, selector S, the trunk circuit T and trunk T1 to a distant office to a selector S2 and then through suitable switches (not shown) to a called subscriber's

line at 600. The switches shown in diagrammatic form in these drawings may be of any well known step-by-step type.

When the subscriber at 1 has established in the usual manner a connection through line finder LF to the selector S a circuit is established for the operation of relay 10 as follows: Battery, winding of relay 10, inner lower make-before-break contacts of relay 11, inner lower make-before-break contacts of relay 12 to the ring conductor over the line finder LF and the subscriber's loop back through the line finder over the tip conductor, the upper make-before-break contacts of relay 12, the outer upper make-before-break contacts of relay 11 to ground. Relay 10 in operating closes an obvious circuit for the operation of relay 13 which is slow in releasing and remains operated during the operation and release of pulsing relay 10 in response to the digits. Relay 13 is held operated while relay 10 is released by a locking circuit closed through the second lower armature and front contacts of relay 14 which is operated during the sending of the impulses of each digit as will hereinafter be described. On the operation of relay 10 the condenser 15, which is normally charged from battery through the lower winding of relay 16, discharges through resistance 17 to ground. On the first release of relay 10 in response to the first impulse a circuit is completed from battery, winding of relay 16, upper armature and back contacts of relay 10, condenser 15 to ground. This circuit charges condenser 15 and the current produced thereby through the lower winding of relay 16 causes this relay to operate. Relay 16 in operating closes a locking circuit for itself from battery through its upper winding and upper inner armature and front contact, upper inner armature and back contacts of relay 18, rotary off-normal contacts 20, vertical off-normal contacts 21, conductor 23, upper outer and armature and back contacts of relay 11, second upper armature and back contacts of relay 12, second lower armature and back contacts of relay 24, lower inner armature and front contacts of relay 13 to ground. On the operation of relay 16 an obvious circuit is closed for the operation of relay 14 which is slow in releasing and remains operated during the sending of the impulses of each digit. Relay 14 in operating closes the above mentioned locking circuit for relay 13 and also a circuit as follows: Battery, lower winding of relay 12, winding of relay 25, lower inner armature and front contacts of relay 14, winding of relay 26 to ground over conductor 23 as hereinbefore described. This circuit causes relays 25 and 26 to operate in series while relay 12 remains deenergized as relay 12 is of a marginal character. The vertical magnet 27 is also operated on the operation of relay 16 from bat-

tery, winding of vertical magnet 27, lower
 inner armature and back contacts of relay
 18, lower armature and front contacts of
 relay 16 to ground on conductor 23. The
 operation of the vertical magnet 27 causes
 the brushes of the selector to advance one
 step. In this movement of the selector, the
 vertical off-normal contacts 21 are shifted to
 switch the locking circuit for relay 16 to ex-
 tend through the lower winding of relay 28
 to ground at the armature and back contact
 of magnet 27. However in shifting the ver-
 tical off-normal contacts 21 the holding cir-
 cuit for relay 16 is opened and relay 16 re-
 leases. This causes the release of magnet 27.
 On the next operation of relay 10, condenser
 15 is discharged and on the next release of
 relay 10, relay 16 is again operated causing
 the operation of the magnet 27. The lock-
 ing circuit for relay 16 is now extended as
 hereinbefore mentioned to the ground at the
 armature of magnet 27, and this locking cir-
 cuit is opened on the operation of magnet
 27, causing relay 16 to release. Relay 16 is
 therefore held operated each time under con-
 trol of magnet 27 after having been momen-
 tarily energized by the release of relay 10.
 These operations of relays 10 and 16 and of
 magnet 27 continue until all the impulses of
 the first digit have been sent to advance the
 brushes of switch S to the desired level.
 Relay 28 is marginal so that it will not op-
 erate in the locking circuit for relay 16
 due to the high resistance of the upper wind-
 ing of relay 16. At the end of this series
 of impulses, relay 14 releases and this causes
 a circuit to be completed for the operation
 of relay 28 as follows: Battery, lower wind-
 ing of relay 12, winding of relay 25, lower
 outer armature and back contacts of relay
 14, upper inner armature and back contacts
 of relay 16, upper inner armature and back con-
 tacts of relay 18, rotary off-normal contacts
 20, vertical off-normal contacts 21, upper
 winding of relay 28 to ground at the arma-
 ture and back contacts of magnet 27. Relay
 25 is maintained operated in this circuit while
 relay 12 remains released and relay 26 re-
 leases. The release of relay 26, however, has
 no effect on the circuits at this time.

The operation of relay 28 closes an ob-
 vious circuit for the rotary magnet 30. The
 energizing circuit for relay 28 is now opened
 due to the shifting of the rotary off-normal
 contacts 20, and relay 28 in releasing causes
 the release of magnet 30 the brushes of the
 selector now contact with the terminals of
 the first trunk leading to a second selector.
 If this selector is busy there will be a ground
 on the sleeve terminal and this ground cause
 a circuit to be closed for the reoperation of
 relay 28 from battery, lower winding of re-
 lay 28, armature and back contacts of mag-
 net 30, rotary off-normal contacts 31, lower
 outer armature and back contacts of relay

18, lower outer make-before-break contacts
 of relay 11, lower outer make-before-break
 contacts of relay 12 to ground on the sleeve
 terminal of the busy second selector. The
 operation of relay 28 again closes the circuit
 for the magnet 30 to advance the brushes to
 the terminals of the next second selector
 magnet 30 opens the circuit for relay 28 at
 its armature and back contact and relay 28
 releases. The alternate operation and re-
 lease of magnet 30 and relay 28 will now
 continue until an idle second selector has
 been found. When this takes place, the ab-
 sence of ground on the sleeve terminal will
 then cause the operation of relay 18 over a
 circuit from battery, lower winding of re-
 lay 28, armature and back contact of mag-
 net 30, winding of relay 18 to the ground on
 conductor 23. The lower winding of relay
 28 is also marginal in character so that this
 relay will not operate in the circuit for the
 operation of relay 18. Relay 18 opens the
 pulsing circuit for magnet 27 at its lower
 inner armature and back contact and extends
 the pulsing circuit over the ring conductor
 to the second selector S1 at this armature
 and its front contact, the lower inner arma-
 ture and back contact of relay 11, lower in-
 ner armature and back contact of relay 12,
 ring conductor of selector S1, upper inner
 armature and back contact of relay 201,
 winding of the vertical magnet 202 to bat-
 tery. Relay 18 also extends the locking cir-
 cuit for relay 16 through its inner upper
 and front contact, third upper armature and
 back contact of relay 11, third upper arma-
 ture and back contact of relay 12, tip con-
 ductor of selector S1, upper outer armature
 and back contact of relay 201, rotary off-
 normal contacts 203, vertical off-normal con-
 tacts 204 to ground. The second selector S1
 is now in condition for reception of the im-
 pulse of the second digit.

The operation of relay 18 also places a
 busy ground on the sleeve of selector S1
 from ground at the inner low armature and
 front contact of relay 13, second lower arma-
 ture and front contact of relay 18, lower
 inner armature and front contact of relay 18,
 lower outer make-before-break contacts
 of relay 12 to the sleeve for the purpose of
 making the selector S1 busy.

This ground on the sleeve is now connected
 through the armature and back contacts of
 release magnet 205, second lower armature
 and back contact of relay 201, upper wind-
 ing of relay 201 to battery. This circuit
 causes the partial operation of relay 201 to
 open the connection to ground through its
 lower outer armature and front contact to
 prevent the operation of the release magnet
 205 at the time the vertical magnet 202 op-
 erates to shift the vertical off-normal con-
 tacts 206 on the subsequent operation of the ver-
 tical magnet 202 in response to the second

series of impulses. When relay 16 responds to the first impulse of the second digit, vertical magnet 202 operates over the circuit through the ring conductor as hereinbefore described and the locking circuit for relay 16 as hereinbefore described is opened by the first operation of the vertical magnet 202 due to the shifting of the vertical off-normal contacts 204. On the second impulse, the locking circuit for relay 16 will extend through the vertical off-normal contacts 204 through the upper winding of relay 207 to ground at the armature and back contacts of the vertical magnet 202. From this time on this locking circuit is controlled by magnet 202. Relay 207 is marginal in character and will not be operated by this circuit through its upper winding.

When the second series of impulses ceases relay 14 releases as hereinbefore described and a circuit will then be completed for the operation of relay 207 over the circuit hereinbefore described extending from battery, windings of relays 12 and 25 and contacts of relays 14, 16, 18, 11 and 12 over the tip conductor. The relay 26 is in this case maintained operated due to the operation of relay 18 over the circuit from battery through the winding of magnet 202 and contacts of relays 201, 12, 11, 18 and the inner lower armature and back contact of relay 14 winding of relay 26 to ground on conductor 23. The rotary magnet 208 is now operated over an obvious circuit due to the operation of relay 207 to advance the brushes of the selector S1 to the terminals of the first connector. If this connector is busy a ground will be present on the sleeve to close a circuit for the reoperation of relay 207 which is released on the first step of rotary magnet due to the shifting of the rotary off-normal contacts 203. The ground for the tip conductor is now supplied through the shifting of the rotary off-normal contacts 203 to maintain relay 25 operated. The circuit for relay 207 may be traced from battery through the lower winding of relay 207, rotary off-normal contacts 209, lower inner armature and back contact of relay 201, sleeve conductor to the ground on the sleeve of the connector C. Relay 207 in operating closes the circuit for the magnet 208 and this magnet in turn opens the circuit for relay 207. These alternate operations of relay 207 and magnet 208 are continued until an idle connector is found, when relay 207 will be permanently released and a circuit completed for the full operation of relay 201 as follows: Battery, lower winding of relay 207, rotary off-normal contact 209, lower winding of relay 201, lower armature and back contacts of release magnet 205 to ground on the sleeve at selector S. Relay 201 in operating extends the ground connection on the sleeve, from the first selector S through its lower inner armature and front contact to the

sleeve of the connector C to make it busy. Relay 201 also extends the tip and ring conductors from selector S, through selector S1 to the connector C and the circuits are now in condition for the reception of the last two series of impulses to control the connector C.

To select the desired subscriber's line the connector C may be operated to select either one of two sets of terminals leading to the desired line. In one case the tip and ring conductors are connected as shown in Fig. 3 and in the other case the tip and ring conductors are reversed. The ringing will take place on the ring conductor and the bells of the subscribers on this line are connected as shown at 300, that is, the bells of two subscribers connected to one conductor and the bells of the other two subscribers connected to the other conductors. To distinguish between the two bells on one conductor the ringing will be applied in codes of one or two impulses and it will be explained hereinafter how the code signals are selected.

Returning now to the transmission of the last two digits to select a desired subscriber's line, the ground connection for the tip conductor to maintain relay 25 operated and to lock relay 16 as hereinbefore described will now be supplied on the operation of relay 201 from the ground at the vertical off-normal contacts 303 through armature and back contact of the vertical magnet 304, armature and back contact of the rotary magnet 305, upper outer armature and back contact of relay 307, upper outer armature and back contact of relay 309 to the tip conductor to the second selector S1 through the upper outer armature and front contact of relay 201 to the tip conductor to selector S, while the pulsing circuit will be extended to the vertical magnet 304 through the inner upper armature and front contacts of relay 201 over the ring conductor to the connector and the lower inner armature and back contact of relay 309, second lower armature and back contact of relay 307, third lower armature and front contact of relay 310, winding of the vertical magnet 304 to battery. It should be obvious that the connection from ground at the selector S through the sleeve conductor of selector S1 and connector C is extended through the armature and back contact of the release magnet 312, the vertical off-normal contacts 313, lower winding of relay 310 to battery. This circuit causes the partial operation of relay 310 to open the connection through its outer lower armature and back contact for the rotary magnet 305 and extend it through this armature and the associated front contact to the winding of the vertical magnet 304, so that the above mentioned circuit for the vertical magnet 304 will be completed as described. This ground connection from the sleeve will also be extended through the armature and back contact of release mag-

net 312 through the upper winding of relay 307 to battery to partially operate relay 307 to open the connector through its lower outer armature and back contact to prevent the operation of the release magnet when the off-normal contacts 325 are closed. A locking circuit for maintaining relay 310 in partial operation will also be closed from battery through the lower winding of this relay, the lower outer armature and back contacts of relay 314 to ground on the third lower armature and back contact of relay 309. On the first pulse of the next digit the vertical magnet 304 will operate over the above mentioned pulsing circuit and the locking circuit for relay 16 will be opened not only at the armature and back contact of the vertical magnet 304 but also at the vertical off-normal contacts 303, which contacts shift the ground connection for this locking circuit to ground through the winding of relay 314. This locking circuit is necessary as the vertical off-normal contacts 313 open on the first step of the vertical magnet the original energizing circuit for relay 310. At the next impulse of this digit, the locking circuit for relay 16 will be opened at the armature and back contacts of the vertical magnet 304. Relay 314 which is marginal in character will not operate through this locking circuit during the sending of the impulses. When these impulses cease, however, and relay 16 releases relay 14 releases as hereinbefore described and a circuit will be extended from battery through the winding of relay 12 and winding of relay 25, lower armature and back contacts of relay 14 and the tip conductor as hereinbefore described, to ground through the winding of relay 314 causing this relay to operate. This relay in operating opens the locking circuit for relay 310 which now releases and transfers the pulsing circuit through its lower outer armature and back contact to battery through the winding of rotary magnet 305. The rotary magnet 305 does not operate through this circuit, hereinbefore traced to ground over conductor 23 through the winding of relay 26 and contacts of relays 14 and 18 over the ring conductor, but maintains relay 26 operated until the next series of impulses are transmitted.

The next series of impulses of the last digit will now operate magnet 304 to advance the brushes of connector C until they are associated with the terminals of the desired subscriber's line 300. The locking circuit for relay 16 as hereinbefore described, is extending through the winding of the marginal relay 314 during the sending of the impulse of this digit and relay 314 will therefore again release during the sending of this series of impulses. Relays 25 and 26 will be maintained operated during the sending of these impulses in the series connection established by the operation of relay 14. When this se-

ries of impulses are completed and on the release of relay 14, the above mentioned circuit for relay 314 will extend only through the windings of relays 25 and 12 to maintain relay 25 operated. Relay 314 will therefore now be operated a second time, while relay 25 will be maintained operated in the circuit through the ring conductor and the winding of the rotary magnet 305. In case the desired subscriber's line is busy relays 314 and 307 operate as usual but relay 310 does not operate as a ground is present on the sleeve of the busy line. Hence when relay 309 operates a busy signal from the source 330 and ground 331 are applied over the second and third upper armatures and front contacts of relay 307, upper armatures and back contacts of relay 310 and upper and inner lower armatures and front contacts of relay 309 to the calling subscriber's line.

The circuits are now prepared for the sending of the proper ringing code to signal the desired subscriber. The selection by the selector S1 will determine the code to be transmitted by selecting an idle connector from either one of two groups of connectors. This selection will bring about circuit operations in the selector S to apply the one ring code or the two ring code. If the one ring code is desired the selector S1 will select an idle connector wired as connector C and particularly as shown at the terminals 317 while if a two ring code is desired the selector S1 will select a connector wired the same as connector C except as shown at 318 of Fig. 4.

Assuming that the connector C has been selected with the connections as shown at 317 the following operations will not take place to extend the connection to the line 300 and apply the one ring code at the completion of the series of impulses of the last digit. As shown relay 307 will be operated over a circuit from battery through the lower winding of this relay, the rotary off-normal contacts 320, lower inner armature and front contact of relay 314 to ground at the third lower armature and back contacts of relay 309. This circuit will cause relay 307 to fully operate to close a number of circuits for the purpose as will hereinafter be described. Due to the opening of the connection to ground through the winding of relay 314 for the tip conductor at the upper outer armature and back contact of relay 307 ground will release relay 25 in the circuit hereinbefore described for this relay. Relay 314 will also release but relay 307 will remain operated through its locking circuit completed through the lower winding and lower inner armature and front contact to ground on the sleeve. On the other hand even though ring conductor connection is opened at the second lower armature and back contact of relay 307 relay 26 will remain operated due to the connections at 317. The circuit for relay 26 may be traced from bat-

tery through the winding of the rotary magnet 305, lower outer armature and back contact of relay 310 through the connection 317, lower inner armature and back contacts of relay 309 over the ring conductor through the selector S1 and inner upper armature and front contact of relay 201, lower inner armature and back contact of relay 12, lower inner armature and back contact of relay 11, lower inner armature and front contact of relay 18, lower inner armature and back contact of relay 14, winding of relay 26 to ground on lead 23. The maintaining of relay 26 operated and the release of relay 25 now closes a circuit for the operation of relay 11 from battery, winding of this relay, upper inner armature and back contact of relay 25, upper armature and front contact of relay 26, upper outer armature and front contact of relay 18 to the ground on lead 23. Relay 11 locks to ground at relay 13, opens the circuit for relay 10 and extends the connection from the calling subscriber's line to battery and ground through windings of relay 40. Relay 40 operates to close an obvious circuit for relay 14 which closes a holding circuit for relay 13 to maintain the selector in operated condition even though relay 10 releases. Relays 25 and 26 will now be maintained operated in series in the circuit hereinbefore described through the lower inner armature and front contact of relay 14. While these operations take place the signaling path has been prepared at the connector C. On the operation of relay 307 and release of relay 314 a circuit was completed from battery through the usual cut-off relay (not shown) of line 300 through the sleeve conductor, upper winding of relay 310, second lower armature and back contact of relay 309, third lower armature and front contact of relay 307, second lower armature and back contact of relay 310, lower outer armature and back contact of relay 314, third lower armature and back contact of relay 309 to ground. Relay 310 operates in this circuit and locks itself from battery through its lower winding and lower inner armature and front contact, fourth lower armature and front contacts of relay 307 to ground independent of the energizing circuit as established through contacts of relay 304. Relay 307 when operated also closed an obvious circuit for the operation of relay 309. Relay 309 was however slow in operating to permit the momentary conditions to be established in regard to relay 310 and relays 25 and 26, namely the operation of relay 310 and the momentary release of relay 25 to select the code signal. When relay 309 operated it opened the tip and ring connections to the relay 314 and rotary magnet 305 and when relay 310 operated these conductors were extended to the called subscriber's line 300. As the circuits are now prepared to send the selected code signal to the called subscriber's

line it will be transmitted as follows. Relay 11 in operating closes a connection for the ring conductor from the one ring source connected at the box 32 over lead 33, upper inner armature and back contact of relay 24, lower winding of ringing trip relay 35 and its lower inner armature and front contact, lower inner armature and front contact of relay 11, lower inner armature and back contact of relay 12 to the tip conductor through selector S1, lower inner armature and front contact of relay 309, upper inner armature and front contact of relay 310, ring conductor of relay 301 due to bells of the subscriber's station connected as shown at 300. These bells being responsive to the one code signal, it being understood that the subscriber having assigned to him the one code signal will only answer this call.

When the called subscriber answers this call by removing the receiver from the switchhook a circuit is completed for the operation of the ringing trip relay 35. The return ground connection is completed through the subscriber's loop back over the tip conductor as hereinbefore described to the third upper armature and front contact of relay 11 to ground at the upper outer armature and back contact of relay 35. Relay 35 in operating provides a locking circuit for itself from battery through its upper winding and upper inner armature and front contact to ground at the inner lower armature and front contacts of relay 13. Relay 35 in operating opens the ringing circuit at its lower inner armature and back contact and connects the tip and ring conductors through to the called subscriber's line. The connection now extends for the tip conductor from the called subscriber's line through the third upper armature and front contact of relay 35 upper winding of relay 42 to ground and for the ring conductor from the called subscriber's line through the lower inner armature and front contact of relay 35 lower winding of relay 42 to battery. This provides talking current for the called subscriber's line while talking current for the calling subscriber is supplied from battery and ground through the windings of relay 40. The connection is now ready for conversation.

When the conversation is ended and the calling subscriber replaces his receiver on the hook relay 40 releases, causing the release of relay 14 which in turn releases relay 13. Relay 13 causes the release of relays 35 and 11. The release of relay 13 closes a circuit for the operation of release magnet 44 from battery winding of this magnet, vertical off-normal contacts 45, second lower armature and back contacts of relay 12, inner lower armature and back contacts of relay 13. This returns the selector S to normal, and the release circuit is opened when the vertical off-normal contacts 45 are opened. The release

of selector S removes ground from the sleeve of the selector S1 which causes the release of relay 201. This relay closes an obvious circuit for the release magnet 205 which returns selector S1 to normal, and the circuit for the release magnet is then opened at the vertical off-normal contact 206. The removal of the ground from the sleeve of connector C, when selector S1 returns to normal, opens the locking circuit for relay 307 which in turn releases relays 309 and 310 and closes the circuit for the release magnet 312 through vertical off-normal contacts 325, outer lower armature and back contacts of relay 307, third lower armature and back contacts of relay 309 to ground. When the connector C has returned to normal, the circuit for release magnet 312 is opened at the vertical off-normal conductor 325.

If a connector in a group wired in accordance with Fig. 4 as shown at 318 had been selected, the two ring code would have been transmitted to the called subscriber's line 300. In this case when the rotary magnet has finished its function of placing the brushes of the connector on the desired line and relay 314 had operated to cause relay 307 to operate, the circuit for relay 26 would have opened while the circuit for relay 25 would have been maintained due to the connection as shown at 318. The release of relay 26 and the maintaining of relay 25 operated closes a circuit for relay 24 from battery, winding of this relay, upper outer armature and front contact of relay 25, upper outer armature and back contact of relay 26, upper outer armature and front contact of relay 18 to ground on lead 23. Relay 24 in operating closes a circuit for the operation of relay 11 from battery, winding of relay 11, and its upper inner make-before-break contacts, upper outer armature and front contact of relay 24 to ground through the pick-up lead 47 to ground at box 32. The arrangement of the circuits for producing the one ring code signal on lead 33, the ground on the pick-up lead 47 and the two ring code signal on lead 48 may be of any type suitable for this purpose. For example, the leads 33 and 48 may be connected to ringing battery through interrupters for producing the desired codes of one and two impulses per a certain unit of time. The pick-up lead 47 may also be connected to an interrupter to ground to prevent mutilated codes from being connected to the line. In case of the one ring code this pick-up lead is not necessary, as relay 11 is operated as soon as relay 25 releases. When relay 24 operates to cause the operation of relay 11 it also connects lead 48 which supplies the two ring code through the upper inner armature and front contact to the lower winding of relay 35 over the ring conductor circuit to the called subscriber's line as hereinbefore described. When the called sub-

scriber answers this code relay 35 operates and the talking connection is completed from the called subscriber's line as hereinbefore described.

If a connection is desired to a trunk leading to a distant office, the connection is made through line finder LF, selector S, selector S1 and the connector C1 in Fig. 5. The operation of the connector shown in Fig. 5 is similar to the connector shown in Fig. 3 except that it is arranged to hunt over a group of trunks for an idle outgoing trunk. This connector will be directly actuated to select a certain group of trunks, the brushes thereof will be associated with the terminals of the first brush in this group. When the connector is seized by the second selector S1 ground on the sleeve causes the partial operation of relay 507 to open the circuit for the release magnet 312. Ground on the sleeve also causes relay 510 to be partially operated over contacts 513 and close a connection for the vertical magnet 504, through its third lower armature and back contact to the ring conductor. The connection to ground for the tip conductor extends from the tip to the upper armature and back contact of relay 509, upper outer armature and back contact of relay 507, armature and back contact of rotary magnet 505, armature and back contact of vertical magnet 504, vertical off-normal contacts 503 to ground. The first impulse for actuating the connector in a vertical direction operates magnet 504, opens the locking circuit for the relay 16 in the selector S at the armature and back contact of magnet 504 and transfers the ground connection by the operation of vertical off-normal contacts 503 to ground through the winding of relay 514 which is marginal and does not operate in series with the upper winding of relay 16, so that the succeeding impulses operating the vertical magnet 504 will merely open the locking circuit for relay 16. At the end of the series of impulses relay 514 operates over the circuit completed due to the release of relay 14 as hereinbefore described. Relay 514 in operating opens the locking circuit for relay 510, at its lower outer armature and back contact which thereby releases and prepares the connector for the reception of impulses to advance it in the rotary direction. The circuit for the rotary magnet 505 may now be traced from battery, winding of this magnet, upper armature and back contact of relay 526, third lower armature and back contact of relay 510, lower inner armature and back contact of relay 509 to the ring conductor. On the first operation of the rotary magnet 505 in response to the last digit the locking circuit for relay 16 is opened at the armature and back contact of this magnet and relay 514 is released. At the end of this series of impulses, relay 514 is again operated to close a circuit for the full operation

of relay 507 from battery, lower winding of this relay, rotary off-normal contacts 520, lower armature and back contact of relay 527, lower outer armature and front contact of relay 514 to ground at the third lower armature and back contact of relay 509. Relay 507 in operating closes a locking circuit for itself to ground on the sleeve lead through its lower winding and lower inner armature and front contact.

If the first trunk on which the brushes of connector C1 have been placed are busy, ground will be connected to the sleeve terminal of this trunk to cause the operation of relay 527 before relay 514 is operated as follows: Battery, winding of relay 527, fourth lower armature and back contact of relay 514, lower make-before-break contact of relay 510, second upper armature and back contact of relay 528 to ground on the sleeve terminal of this busy trunk. Relay 527 closes a locking circuit for itself through the lower outer armature and back contact of relay 510, upper inner armature and part contact of relay 527, lower make-before-break contacts of relay 528 to ground on the sleeve. Relay 514 will now operate as hereinbefore described and cause the operation of relay 526 over a circuit from battery through the upper winding of this relay third lower armature and front contact of relay 514, second upper armature and front contact of relay 527, inner lower armature and back contact of relay 528, second lower armature and front contact of relay 514 to ground on the fourth or hunting terminal of the busy trunk. The hunting terminals of all the trunks in the group except the last are connected to ground. The operation of relay 526 closes an obvious circuit for the operation of rotary magnet 505 which opens the locking circuit for relay 526 extending from battery through the lower winding of this relay, lower armature and front contact of magnet 505, armature and back contact of magnet 504, vertical off-normal contacts 503, winding of relay 514 to ground and also the circuit for relay 514. The release of relay 514 causes the release of relay 526 and relay 527 will release as the locking circuit therefore is opened at the sleeve brush. If the next trunk is busy, the operations hereinbefore described will be repeated until an idle trunk is found. When the idle trunk has been found relay 514 operates. Relay 507 will now be fully operated over a circuit from battery, lower winding of this relay, rotary off-normal contacts 520, lower armature and back contact of relay 527, lower armature and front contact of relay 514, to ground, at the third lower armature and back contact of relay 509. Relay 507 locks through its lower inner armature and front contact to ground on the sleeve. The operation of relays 514 and 507 now causes the operation of relay 510 over a circuit as follows: Battery on the sleeve

conductor, second upper armature and back contact of relay 528, make-before-break contacts of relay 510, upper outer armature and back contact of relay 527, upper armature and front contact of relay 514, upper winding of relay 510, second lower armature and back contact of relay 509, inner lower armature and front contact of relay 514, second lower armature and back contact of relay 510, third lower armature and front contact of relay 507 to ground. Relay 510 locks through its lower winding to ground at the third lower armature and front contact of relay 507. The operation of relay 507 will close an obvious circuit for the operation of relay 509 which is slow in operating to permit the above mentioned operation of relay 510 to take place. Relays 510 and 509 now cut through the tip and ring conductors to the engaged trunk.

If the connector C1 finds all of the trunks busy, it will as its brushes come in contact with the terminals of the last trunk find that there is no ground connection on the hunting terminal of this trunk and relay 526 will therefore not be operated after the operation of relay 527 over the circuit hereinbefore traced, but relay 528 will instead be operated over a circuit from battery, upper winding of relay 526, third lower armature and front contact of relay 514, second upper armature and front contact of relay 527, winding of relay 528, make-before-break contacts of relay 528 and the second upper armature and back contact of relay 528 to ground on the sleeve of the last trunk. Relay 526 does not operate in this circuit due to its marginal characteristics. Relay 507 now operates on the operation of relay 528 over a circuit from battery, lower winding of relay 507, rotary off-normal contacts 520, lower outer armature and front contact of relay 528, lower outer armature and front contact of relay 514, to ground at the third lower armature and back contact of relay 509. Relay 509 now operates but relay 510 does not operate due to the operation of relay 527. A busy tone will now be supplied from the source 530 and ground at 531 through the second and third upper armatures and front contacts of relay 507, the two upper outer armatures and front contacts of relay 528, upper and inner lower armatures and front contacts of relay 509 to the tip and ring conductors, back to the subscriber's line. The connector will be released on the release of the connection by the calling subscriber. This release will be accomplished by removing ground from the sleeve conductor to release relays 528, 527 and 507, relay 507 releasing relay 509. Relay 514 was released on the operation of relay 507. The circuit for the release magnet 512 will be closed on the release of relay 507 through vertical off-normal contacts 525, outer lower armature and back contact of relay 507, to

ground at the third lower armature and back contact of relay 509.

It should be obvious that on the operation of relay 509 under the above circumstances the connection to ground and battery, for the tip and ring conductors will open at the upper and lower inner armatures and back contacts and ringing will therefore not be transmitted over the trunk from the selector S as both relays 25 and 26 will be released causing the operation of relay 35 over a circuit from battery, upper winding of relay 35, upper outer armature and back contact of relay 25, upper armature and back contact of relay 26, upper outer armature and front contact of relay 18 to ground on conductor 23. Relay 35 in operating causes the operation of relay 11 as hereinbefore described to close the connection through for the operation of relay 40, which causes the operation of relay 14 to maintain relay 13 operated while relay 10 releases. Relay 13 holds the selector S in operated condition. Talking current for both the calling subscriber and the connection extending over the trunk is supplied due to the operation of relays 35 and 11 as hereinbefore described in connection with the description of a call between a subscriber at station 1 and a subscriber at station 300.

A description will now be made of a connection over a long trunk such as is shown in Fig. 6. In this case the selector S may be actuated to select an idle trunk circuit T associated with a long trunk T' terminated at a distant office in selector S2. This selector which is similar to the selector S and may be employed to extend connections to a desired subscriber's line in the same manner as selector S. In such connections the selector S will not transmit ringing current nor will it supply talking battery for the calling subscriber and the called subscriber but extend the connection directly to the trunk circuit T without any encumbrances. Talking battery will in this case be supplied for the calling subscriber from the trunk circuit T1 while talking battery for the trunk T' will be supplied at the distant office from the selector S2 from which talking battery for the called subscriber will also be supplied. While the connection may extend from a calling subscriber through the line finder LS, selector S, trunk circuit T, trunk T1 and selector S2, as will be described, it should be understood that the connection made includes intermediate selectors such as selector S1 if the arrangement at the call originating office is such as to require more than one digit for the selection of the long trunk to an outgoing office. When the connection has been extended in the usual manner to the selector S and this selector has found an idle trunk circuit such as T there will be battery on the tip conductor from the booster battery 650, inner left-hand armature

and back contact of relay 651, right-hand winding of relay 652, outer left-hand make-before-break contacts of relay 653 to the tip conductor, whereas for the ring conductor there will be supplied battery, right-hand winding of relay 652, inner left-hand make-before-break contacts of relay 653 to the ring conductor. The booster battery 650 will be sufficient to overcome battery through the lower winding of relay 12 over the circuit hereinbefore described existing at this time for this relay and relay 25. Relay 12 will therefore in this case be operated in series with relay 25 while relay 26 will be maintained operated as usual. The operation of relays 25 and 26 will now prevent ringing current from being supplied, while relay 12 in operating provides a locking circuit for itself to the ground on the sleeve conductor from trunk circuit T over the upper winding and upper inner armature and front contact and the lower outer armature and front contact. It will presently be described how this ground is applied. Relay 12 cuts through the tip conductor at its upper outer armature and front contact and the ring conductor at its lower inner armature and front contact to the trunk circuit T. The subscriber's loop is now extended through the windings of relay 652 which operates from the circuit from booster battery 650 through the subscriber's loop to the battery at the right-hand winding of relay 652. As soon as this relay operates it closes an obvious circuit for relay 651 which in operating connects ground at its inner left-hand armature and front contact and thereby eliminates the subscriber's loop from battery at the right-hand winding of relay 652 to this ground. Relay 651 in operating supplies the above mentioned ground on the sleeve conductor at its outer left-hand armature and front contact. The operation of relay 12 however, opens the circuits for relays 25 and 26 at the same armatures and these relays in releasing close the circuit for the ringing trip relay 35, which in turn causes the operation of relay 11, relay 35 locking to the ground on the sleeve from trunk circuit T. Relays 35 and 11 in operating can at this time not cause the operation of relays 42 and 40 due to the operation of relay 12 and consequently relay 44 will not be operated so relays 10 and 13 may release. Relay 18 will also release due to the opening of the ground connection for lead 23.

A complete pulsing loop is now therefore established from the subscriber's dial at 1 through the windings of relay 652. The subscriber may then by operating her dial cause relay 652 to respond to impulses of succeeding digits. These impulses will be repeated through the trunk circuit T to selector S2 for the operation of this selector and succeeding selectors and a connector to select a desired

subscriber's line at the distant exchange in the same manner as selections are made over selector S1 and connector C. On the first operation of relay 652, relay 654 operates over a circuit from battery, right-hand winding of relay 654, third order right-hand, armature and front contact of relay 652, upper inner armature and back contact of relay 655, ring conductor of trunk T1, inner lower make-before-break contacts of relay 611, lower armature and back contact of relay 656, lower winding of relay 610 to ground and another circuit from battery, upper winding of relay 610, upper inner armature and back contact of relay 656, upper outer make-before-break contacts of relay 611, tip conductor of trunk T1, upper armature and back contact of relay 655, second outer right-hand armature and front contact of relay 652 to ground through the left-hand winding of relay 654. Relays 654 and 610 operate in these circuits. The operation of relay 652 opens the circuit for relay 655 which was closed to ground at the outer left-hand armature and front contact of relay 650 to prevent relay 655 from operating at this time. On the release of relay 652, relays 654 and 610 release but due to the slow to operate characteristic of relay 655 and release of relay 652, relay 655 is prevented from operating during the pulsing of relay 652.

Relay 610 now follows the impulses controlled by relay 652 to advance the selector S2 in the vertical direction. The operation of relay 610 closes an obvious circuit for relay 613 which relay remains operated during the pulsing. Relay 610 also in operating discharges the condenser 615 and on the first release of relay 610, relay 616 is operated over an obvious circuit through its upper winding due to the charging of condenser 615. Relay 616 in operating closes a circuit for vertical magnet 637 from battery, winding of this magnet, lower inner armature and back contact of relay 618, upper armature and front contact of relay 616, conductor 623, fourth upper armature and back contact of relay 611, lower outer armature and back contact of relay 624 to ground at the armature and front contact of relay 613. Relay 616 provides a locking circuit for itself from battery through its lower winding, and lower inner armature and front contact, upper outer armature and back contact of relay 618, rotary off-normal contacts 620, vertical off-normal contacts 621 to ground on conductor 623. On the first operation of the vertical magnet 627, the vertical off-normal contacts 631 shift the ground connection for the locking circuit for relay 616 at these contacts to the upper winding of relay 628 and ground at the armature and back contact of vertical magnet 627 so that on the succeeding impulses the release of relay 616 is under control of the vertical magnet. The operation of relay 116

also closes an obvious circuit for the operation of relay 614 which remains operated during the pulsing due to its slow release characteristics. On the operation of relay 614 a circuit is completed for the operation of relays 625 and 626 as follows: Battery, winding of relay 625, inner lower armature and front contact of relay 614, winding of relay 625 to ground on lead 623.

At the end of the pulsing for this digit on the release of relay 616, relay 614 releases and closes a circuit for the operation of relay 628 in series with relay 625 from battery, winding of relay 625, outer lower armature and back contact of relay 614, lower inner armature and back contact of relay 616, upper inner armature and back contact of relay 618, rotary off-normal contacts 620, vertical off-normal contacts 621, upper winding of relay 628 to ground at the armature and back contact of magnet 627. Relay 626 is also maintained operated while relay 614 is released over a circuit from battery, winding of magnet 627, lower inner armature and back contact of relay 618, lower inner armature and back contact of relay 614, winding of relay 626 to ground on lead 623.

The operation of relay 628 closes an obvious circuit for the operation of rotary magnet 630 for the purpose of advancing the brushes of selector S2 in a rotary direction. The operation of the rotary magnet shifts the rotary off-normal contact 620 to open the circuit for relay 628 so that this relay will now release and cause the release of rotary magnet 630. If the first trunk and the associated second selector to which the brushes of selector S2 have established a connection is busy there will be a ground on the sleeve conductor of this trunk which causes the reoperation of relay 628 over a circuit from battery, lower winding of relay 628, the armature and back contact of rotary magnet 630, rotary off-normal contacts 631, lower outer armature and back contact of relay 618, lower outer make-before-break contacts of relay 611, armature and back contact of relay 658 to the ground on the sleeve. Relay 628 in operating closes the circuit for magnet 630 which opens the locking circuit for relay 628. This alternate operation of relay 628 and magnet 630 will continue until an idle trunk is found when relay 618 will operate, over a circuit from battery, lower winding of relay 628, armature and back contact of magnet 630, rotary off-normal contacts 631, winding of relay 618 to ground on lead 623. Relay 628 is marginal in character and will not operate in series with relay 618. Relay 618 in operating shifts the pulsing circuit to the ring conductor of the selected trunk from ground on lead 623 and the upper armature and front contact of relay 616, to lower inner armature and front contact of relay 618, lower inner armature

and back contact of relay 611 and the ring conductor. The holding circuit for relay 616 will be shifted to the tip conductor from battery and lower winding of relay 616; lower armature and front contact of this relay, upper inner armature and front contact of relay 618 third upper armature and back contact of relay 611 to the tip conductor. The selector S2 is now ready for the reception and transmission of the next series of impulses for the operation of the succeeding selectors and a connector to cause them to select the proper subscriber's line at 600. The intermediate switches have been omitted as they are identical with selector S1 and connector C. When the called subscriber's line has been reached, relay 25 will be released before relay 26 as in connector C when a single party line is connected to which is the same as when a one ring code is to be transmitted to a party line. A circuit will thereby be completed for the operation of relay 656 from battery, winding of this relay, upper outer armature and back contact of relay 625, to ground on lead 623. Relay 656 in operating closes a circuit for the operation of relay 611 from battery, winding of this relay, upper inner armature and back contact of relay 625, upper inner armature and front contact of relay 626, upper outer armature and front contact of relay 618, upper outer armature and front contact of relay 656 to ground on lead 623. Relay 611 in operating provides a locking circuit for itself from battery through its winding, upper inner armature and front contact to ground on lead 623. Relay 611 in operating applies the one ring code signal from the supply at 632 the same as in selector S and when the called subscriber answers relay 635 operates. This relay and relay 611 cut through the connection for relay 640 to provide talking battery for the called subscriber's line and for relay 642 to provide talking battery for the calling subscriber's line over the trunk T1. The operation of relay 640 closes an obvious circuit for relay 614 which now provides a holding circuit for relay 613 to maintain this circuit in operated condition while relay 610 releases. The connections from battery and ground through the windings of relay 640 will now extend, due to the operation of relay 642 over the tip and ring conductors respectively, so that relay 654 will now release. When this relay releases, the connection for the operating of relay 655 is complete at the armature and back contact of relay 654. Relay 655 extends the connection from the trunk condensers 660 and 661 to complete the talking circuit to the calling subscriber, battery and ground for the trunk T1 being supplied from this battery and ground through windings of relay 640. Selector S2 is otherwise identical to selector S in Fig. 1 in regard to application of ring-

ing current to the called party line subscriber's lines.

It should be understood that although the various features of the invention have been illustrated in but a few applications to automatic telephone systems, the invention could readily be applied to a number of other systems without departing from the spirit thereof.

What is claimed is:

1. In a telephone system, switching device, an operating magnet therefor, a relay, a pulsing relay, a condenser, means for charging said condenser responsive to the actuation of said pulsing relay, means for operating said first relay in response to the discharge of said condenser when said pulsing relay releases, and means for locking said first relay in operated condition under control of the operating magnet.
2. In a telephone system, a switching device, an operating magnet therefor, a relay, a pulsing relay, means for momentarily operating said first relay responsive to the operation and release of said pulsing relay, means for operating said operating magnet in response to the joint operation of said pulsing relay and said first relay, means for locking said first relay responsive to the operation of said pulsing relay, and means for holding said first relay locked until said operating magnet operates.
3. In a telephone system, a switching device, an operating magnet therefor, a help relay, a pulsing relay, means responsive to the operation and release of said pulsing relay for operating said help relay, a holding relay, means for operating said holding relay responsive to the operation of said pulsing relay, a changeover relay, means for operating said changeover relay responsive to the operation of said help relay, means for locking said holding relay in operated condition under control of said changeover relay, means for locking said help relay under control of said holding relay, and means for transferring said locking of the help relay from the holding relay to the operating magnet.
4. In a telephone system, a train of switches, operating magnets for said switches for actuating said switches to establish connections between them, a pulsing relay in the first switch, a help relay in said first switch, means for momentarily energizing said help relay each time the pulsing relay is released, and means for locking said help relay in operated condition under control of the operating magnets in the first and succeeding switches as they are connected in the train.
5. In a telephone system, a train of switches, operating magnets for actuating said switches to establish a connection between them, a pulsing relay in the first switch in the train for controlling the operation of said magnets, a help relay in the first switch,

means responsive to the operation and release of said pulsing relay for actuating said help relay, a holding relay in the first switch, means for operating said holding relay in response to the operation of said pulsing relay, a changeover relay in said first switch, means for operating said changeover relay in response to the operation of the help relay, means for locking said holding relay in operated condition under control of said changeover relay, means for locking said help relay under control of said holding relay, and means for transferring said locking of the help relay from the holding relay to the operating magnet of the first switch and to the operating magnets of the succeeding switch as they are added in the train.

6. In a telephone system, two switches, a pulsing relay in the first switch, operating magnets for said switches for actuating them to establish a connection between them, a help relay in the first switch, means for actuating said help relay in response to the actuation and release of the pulsing relay, a changeover relay, means for actuating said changeover in response to the actuation of the help relay, a locking circuit for said help relay controlled by the operating magnet of the first switch, a locking switch for said help relay controlled by the operating magnet of the second switch, means for transferring the help relay from control by the first locking circuit to control by a second locking circuit in response to the establishing of a connection between the first and the second switch, a changeover relay in the second switch included in the second locking circuit but unresponsive in said locking circuit, means for establishing a no resistance path for said second circuit in response to the release of the changeover relay in the first switch for the operation of said changeover relay in the second switch.

7. In a telephone system, two switches, a pulsing relay in the first switch, means including a help relay and a changeover relay in the first switch for establishing a connection between said switches in response to the actuation of said pulsing relay, a changeover relay in the second switch, and means responsive to the establishing of a connection between said switches and the release of said help and changeover relays in the first switch for actuating the changeover relay in the second switch.

8. In a telephone system, a train of switches, a pulsing relay in the first switch, operating magnets in all of said switches for actuating said switches in succession to complete a connection through said train of switches, a help relay in the first switch, a changeover relay in each of said switches, means for operating the help relay in response to the operation and release of the pulsing relay, means for holding said help

relay operated under control of the operating magnets in the succeeding switches as they are added to the train, means for actuating the changeover relay in response to the actuation of the help relay while a series of impulses are transmitted by the pulsing relay, and means responsive to the release of the help relay and the changeover relay in the first switch for actuating the changeover relays in the succeeding switches when the switches are added to the connection.

9. In a telephone system, a first relay, a second relay, means for actuating the first relay, means for actuating the second relay in response to the actuation of the first relay, a third relay having marginal characteristics, a circuit for said third relay including a high resistance winding of the first relay when said first relay is energized to maintain said third relay in a non-operated condition and a circuit completed through a low resistance path and responsive to the release of the first relay for actuating said third relay.

10. In a telephone system, calling lines, party lines, groups of final switches having access to said party lines, preceding switches for connecting calling lines with party lines through final switches, code signaling means associated with preceding switches for signaling party lines, two relays in a preceding switch for controlling the connection of the code signal to be transmitted, means responsive to the establishing of a connection through final switches of one group for controlling said relays to select one code and through the final switches of another group for controlling said relay to select another code, and means responsive to the establishing of connection to a party line for transmitting the selected code.

11. In a telephone system, calling lines, party lines, groups of final switches having access to said party lines, preceding switches for connecting calling lines with party lines through final switches, code signaling means associated with preceding switches for signaling party lines, two relays in a preceding switch for controlling the connection of the code signal to be transmitted, means responsive to the establishing of a connection through final switches of one group for releasing one relay and maintaining the other operated to select one code and through the final switches of another group for releasing one relay and maintaining the other relay in the reverse order to select another code and means responsive to the establishing of connection to a party line for transmitting the selected code.

12. In a telephone system, calling lines, party lines, groups of final switches having access to said party lines, preceding switches for connecting calling lines with party lines through final switches, code signaling means associated with preceding switches for sig-

nalizing party lines, two relays in a preceding switch for controlling the connection of the code signal to be transmitted, means for applying battery on the tip conductor and opening the ring conductor responsive to the establishing of connections through final switches of one group and for applying battery on the ring conductor and opening the tip conductor responsive to the establishing of the connections through final switches of another group, means for actuating one of said relays on the release of the other relay if battery is applied to the tip conductor and the ring conductor is opened for selecting one code and for actuating one relay and releasing the other in the reverse order if battery is applied to the ring conductor and the tip conductor is opened for selecting another code, and means specific to the establishing of a connection to a party line for transmitting the selected code.

13. In a telephone system, calling lines, party lines, groups of final switches having access to said party lines, preceding switches for connecting calling lines with party lines through final switches, code signaling means associated with preceding switches for signaling party lines, two relays in a preceding switch for controlling the connection of the code signal to be transmitted, means for momentarily applying battery on the tip conductor and momentarily opening the ring conductor responsive to the establishing of connections through final switches of one group and for applying battery on the ring conductor and opening the tip conductor responsive to the establishing of the connections through final switches of another group, means for actuating one of said relays on the release of the other relay if battery is applied to the tip conductor and the ring conductor is opened for selecting one code and for actuating one relay and releasing the other in the reverse order if battery is applied to the ring conductor and the tip conductor is opened for selecting another code, and means specific to the establishing of a connection to a party line for transmitting the selected code.

14. In a telephone system, calling lines, trunks, trains of switches for connecting a calling line with a trunk, signaling means in a preceding switch, means in said preceding switch responsive to the establishing of a connection to a desired trunk for disabling said signaling means.

15. In a telephone system, calling lines, trunks, trains of switches for connecting a calling line with the trunk, signaling means in a preceding switch, a battery feed supply in a preceding switch for the calling line and for said trunk, and means in said preceding switch responsive to the establishing of a connection to a desired trunk for disabling said

signaling means and for including said battery feed supply in the connection.

16. In a telephone system, calling lines, trunks, trains of switches for connecting a calling line with a trunk, two relays in a preceding switch, means for maintaining said relays operated during the establishing of connections until the last switch is connected in the train, means for releasing said relays in response to the connection of the desired trunk to the last switch in the train, signaling means in said preceding switch and means responsive to the release of said relays for disabling said signaling means.

17. In a telephone system, calling lines, trunks, trains of switches for connecting a calling line with a trunk, two relays in a preceding switch, means for maintaining said relays operated during the establishing of connections until the last switch is connected in the train, means for releasing said relays in response to the connection of the desired trunk to the last switch in the train, signaling means in said preceding switch, means in a preceding switch for establishing a battery feed for the calling line and for the trunk, and means in said preceding switch responsive to the release of said relays for disabling said signaling means and for establishing said battery feed connection.

18. In a telephone system, calling lines, trunks, trains of switches for connecting a calling line with a trunk, two relays in a preceding switch, means including battery and ground connections for the tip and ring conductors for maintaining said relays operated during the establishing of a connection through the last switch in the train, and means for removing said battery and ground connections from the tip and ring conductors in response to the establishing of the connection by said last switch to the desired trunk to release the said relays, signaling means in said preceding switch, and means responsive to the release of said relays for disabling said signaling means.

19. In a telephone system, calling lines, trunks, trains of switches for connecting a calling line with a trunk, two relays in a preceding switch, means including battery and ground connections for the tip and ring conductors for maintaining said relays operated during the establishing of a connection through the last switch in the train, and means for removing said battery and ground connections from the tip and ring conductors in response to the establishing of the connection by said last switch to the desired trunk to release the said relays, signaling means in said preceding switch, a battery feed supply in said preceding switch for the calling line and for the trunk, and means responsive to the release of said relays for disabling the signaling means and for completing the connection between the calling

line and the trunk with the battery feed supply included.

20. In a telephone system, calling lines, called lines, trains of switches for connecting a calling line with a called line, two relays in a preceding switch, means for maintaining said relays operated during the establishing of a connection, a third relay in said preceding switch, means for actuating said third relay in response to the establishing of a connection to a called line, a signaling means in said preceding switch, and means responsive to the actuation of all three relays for disabling the signaling means.

21. In a telephone system, calling lines, called lines, trains of switches for connecting a calling line with a called line, two relays in a preceding switch, means for maintaining said relays operated during the establishing of a connection, a third relay in said preceding switch, means for actuating said third relay in response to the establishing of a connection to a called line, a signaling means in said preceding switch, a battery feed supply in said preceding switch for the calling line and the called line, and means responsive to the actuation of all three relays for disabling the signaling means and for preventing said battery feed supply from being included in the connection.

22. In a telephone system, calling lines, called lines, trains of switches for connecting a calling line with a called line, signaling means in a preceding switch, a battery feed supply in said preceding switch for the calling line and the called line, and means in said preceding switch responsive to the establishing of a connection to the called line for disabling said signaling means and for preventing battery feed from being included in the connection.

23. In a telephone system, calling lines, called lines, trains of switches for connecting a calling line with a called line, two relays in a preceding switch, means including battery and ground connections for the tip and ring conductors for maintaining said relays operated during the establishing of the connection, a third relay in said preceding switch, means for adding a booster battery to the tip conductor of said connection in response to the establishing thereof to a called line for actuating said called relay a signaling means in said preceding switch, and means responsive to the actuation of all three relays for disabling said signaling means.

24. In a telephone system, calling lines, called lines, trains of switches for connecting a calling line with a called line, two relays in a preceding switch, means including battery and ground connections for the tip and ring conductors for maintaining said relays operated during the establishing of the connection, a third relay in said preceding switch, means for adding a booster battery to the

tip conductor of said connection in response to the establishing thereof to a called line for actuating said called relay a signaling means in said preceding switch, a battery feed supply in said preceding switch for the calling line and for the called line, and means responsive to the actuation of all three relays for disabling the signaling means and for preventing said battery feed supply from being included in said connection.

25. In a telephone system, calling lines, called lines, a train of switches for connecting a calling line with the called line, two relays in the preceding switch, a third relay in said preceding switch, a circuit including one of said first mentioned two relays and a third relay in series in the tip conductor, a circuit including the other of said first mentioned two relays in the ring conductor, means including a battery connected in the circuit for the tip conductor to maintain operated the relay in said circuit of the first mentioned two relays and for maintaining a third relay in said circuit released and a ground connection in the circuit for the ring conductor for maintaining the relay included therein operated, means for adding booster battery to the circuit for the tip conductor in response to the establishing of a connection to the called line for actuating the third relay in this circuit, a signaling means in the preceding switch, and means responsive to the actuation of all three relays for disabling said signaling means.

26. In a telephone system, calling lines, called lines, a train of switches for connecting a calling line with the called line, two relays in a preceding switch, a third relay in said preceding switch, a circuit including one of said first mentioned two relays and a third relay in series in the tip conductor, a circuit including the other of said first mentioned two relays in the ring conductor, means including a battery connected in the circuit for the tip conductor to maintain operated the relay in said circuit of the first mentioned two relays and for maintaining a third relay in said circuit released and a ground connection in the circuit for the ring conductor for maintaining the relay included therein operated, means for adding booster battery to the circuit for the tip conductor in response to the establishing of a connection to the called line for actuating the third relay in this circuit, a signaling means in the preceding switch, a battery feed supply in said preceding switch for the calling line and for the called line, and means responsive to the actuation of all three relays for disabling the signaling means and for preventing said battery feed supply from being included in said connection.

In witness whereof, I hereunto subscribe my name this 25th day of July, 1930.

RALPH L. QUASS.