

May 5, 1942.

W. B. STRICKLER

2,281,636

TANDEM TELEPHONE SYSTEM

Filed Dec. 31, 1940

17 Sheets-Sheet 1

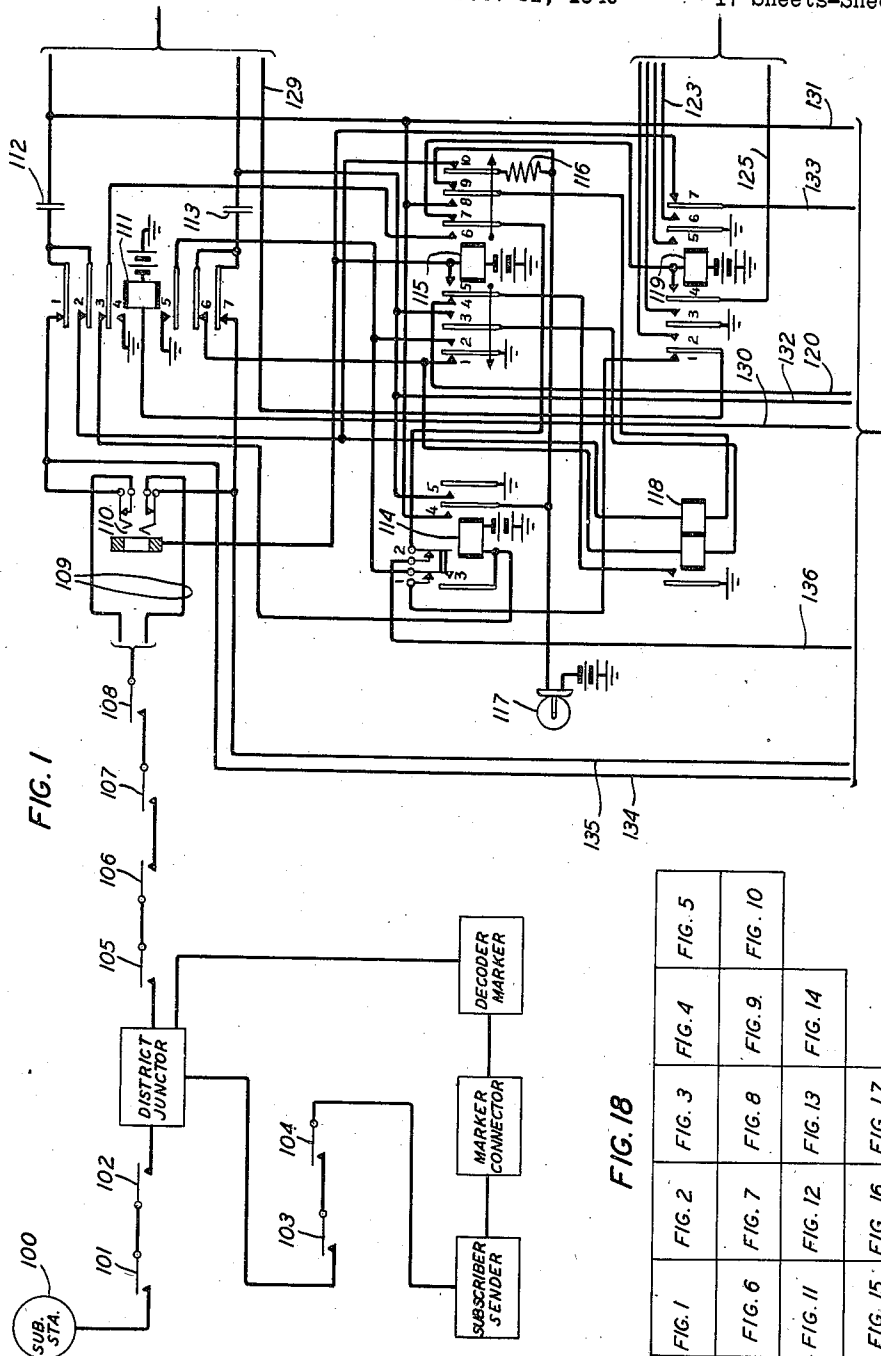


FIG. 18

FIG. 1	FIG. 2	FIG. 3	FIG. 4	FIG. 5
FIG. 6	FIG. 7	FIG. 8	FIG. 9	FIG. 10
FIG. 11	FIG. 12	FIG. 13	FIG. 14	
FIG. 15	FIG. 16	FIG. 17		

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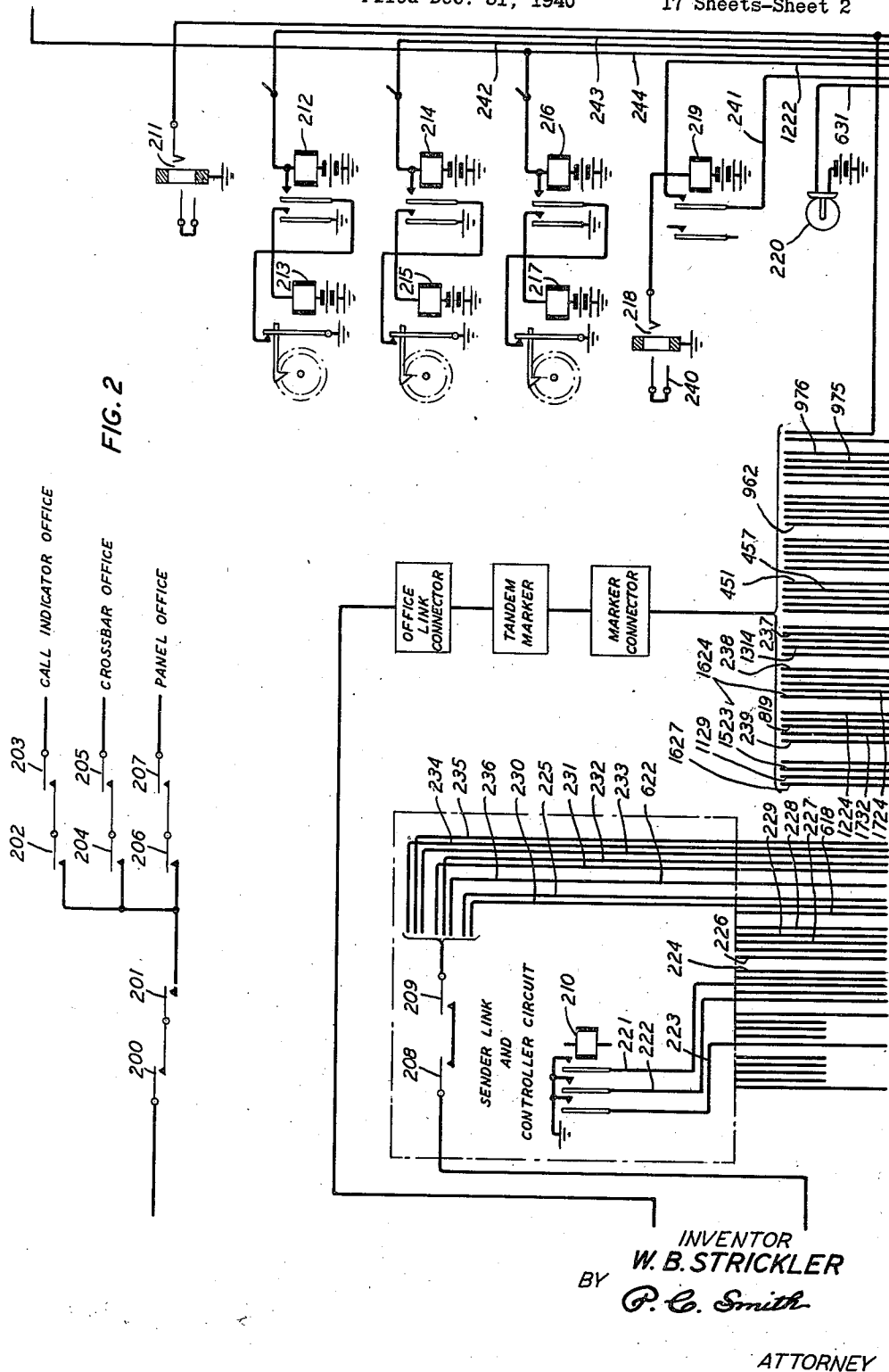
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TANDEM TELEPHONE SYSTEM

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17 Sheets-Sheet 2



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17 Sheets-Sheet 3

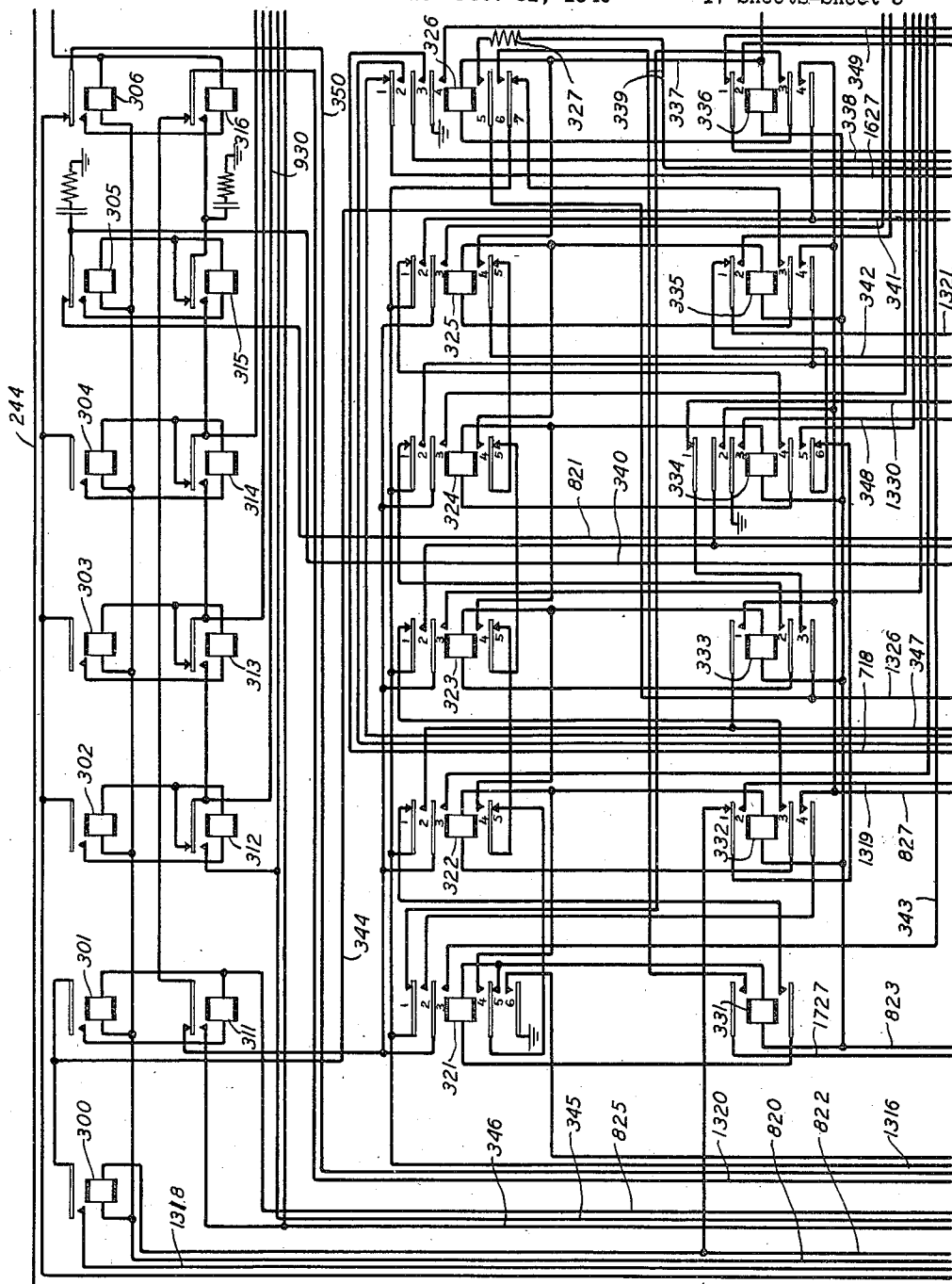


FIG. 3

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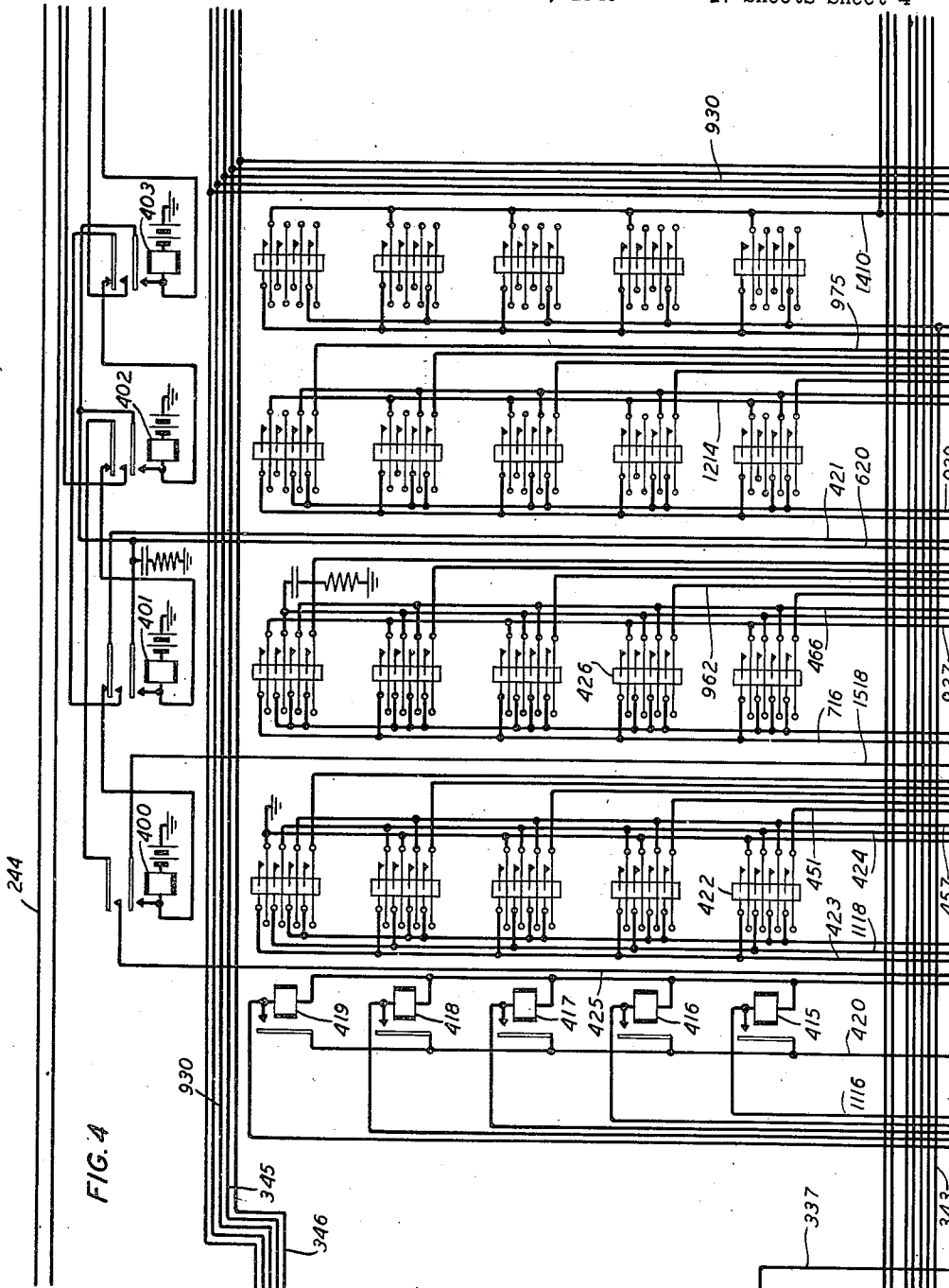
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17 Sheets-Sheet 4



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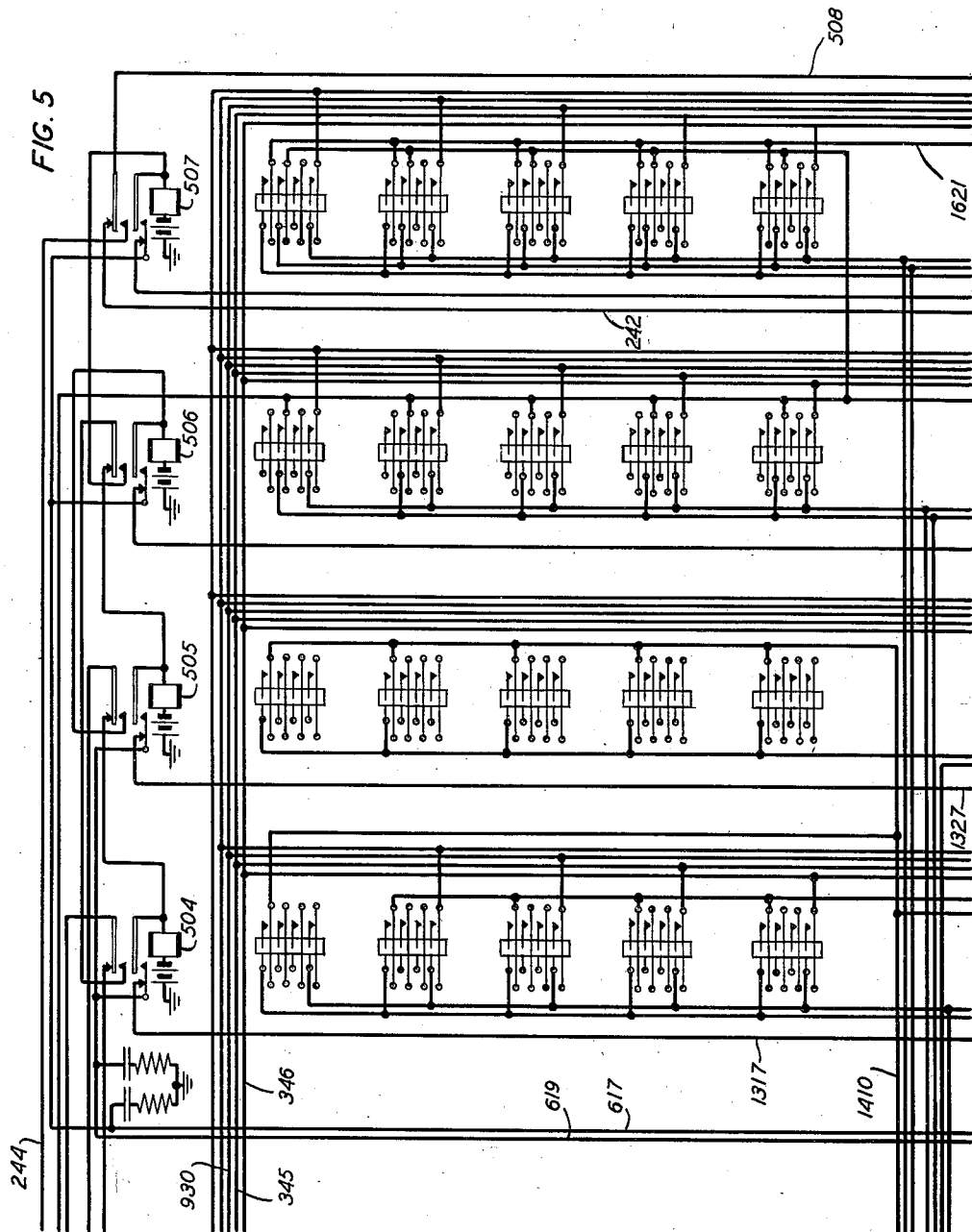
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17 Sheets-Sheet 5



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17 Sheets-Sheet 6

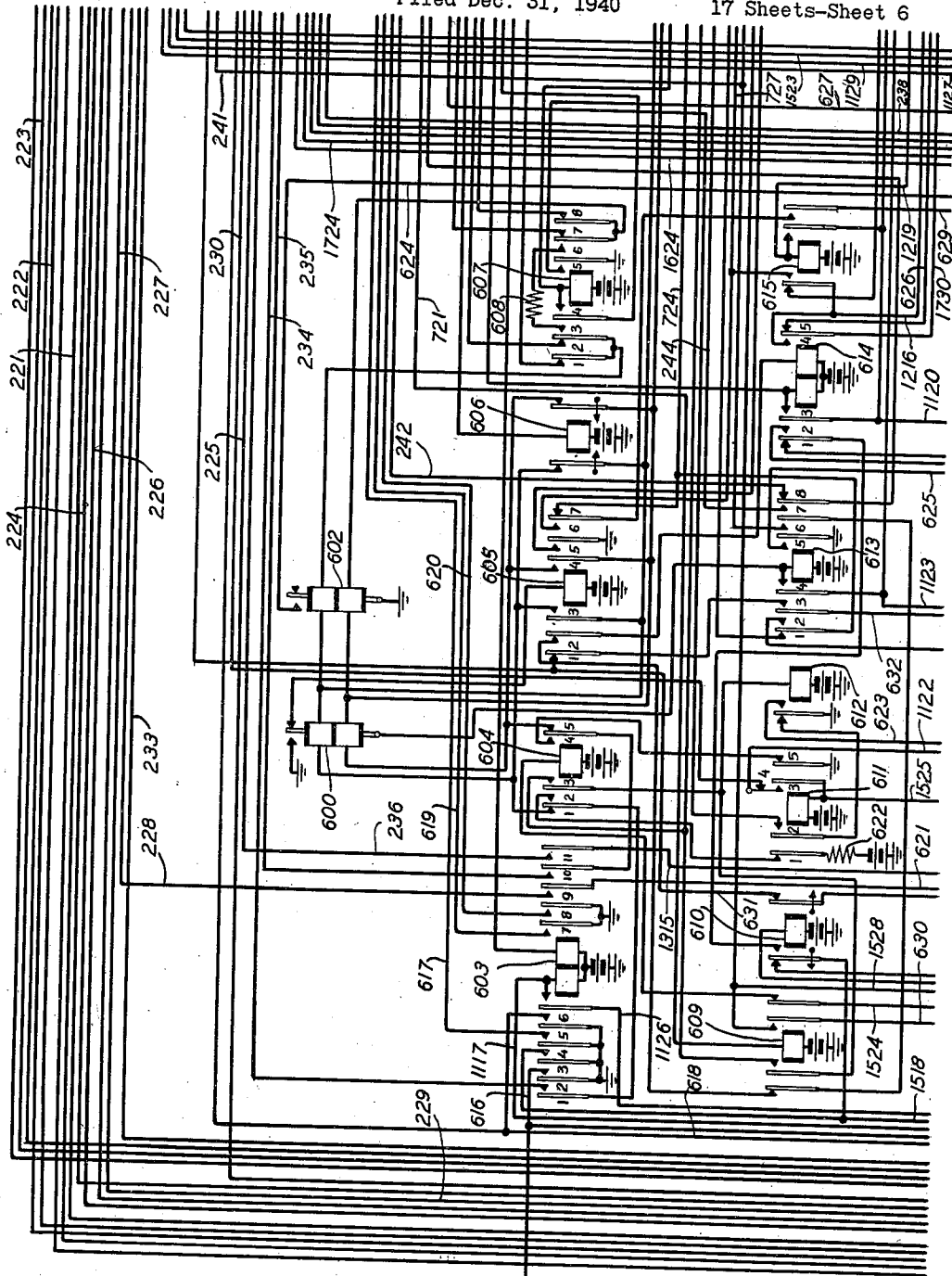


FIG. 6

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17 Sheets-Sheet 7

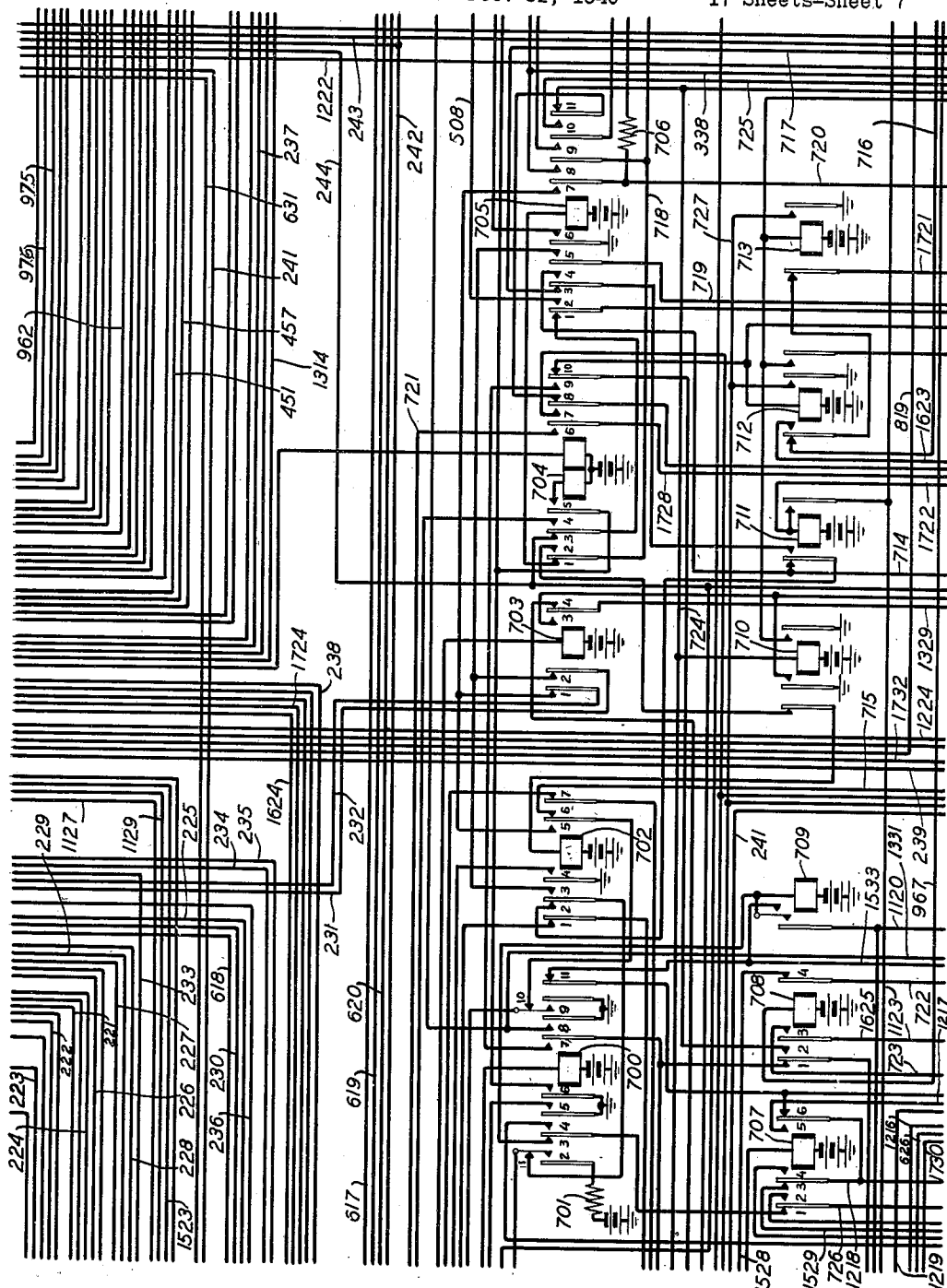


FIG. 7

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17 Sheets-Sheet 8

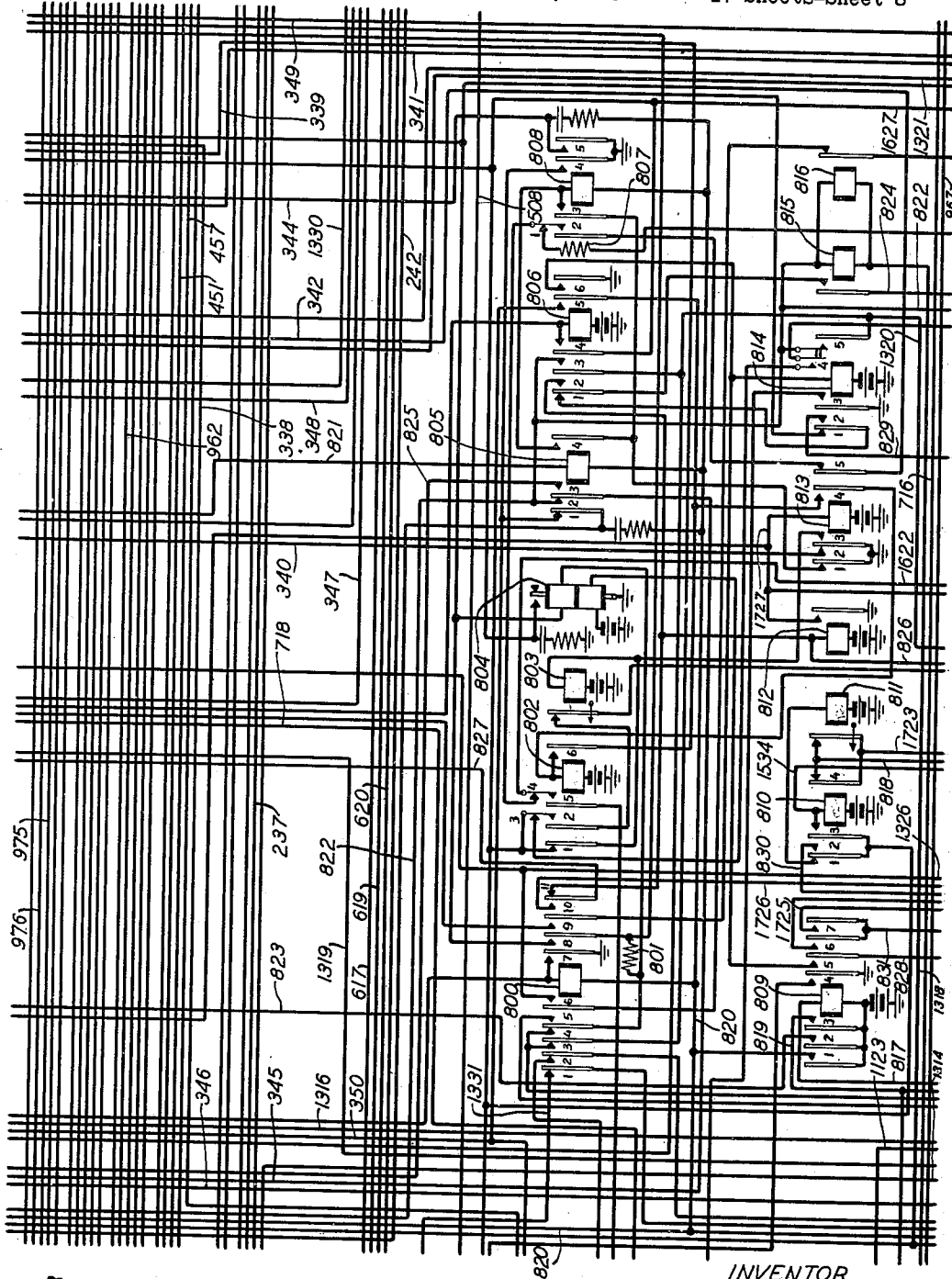


FIG. 8

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17 Sheets-Sheet 9

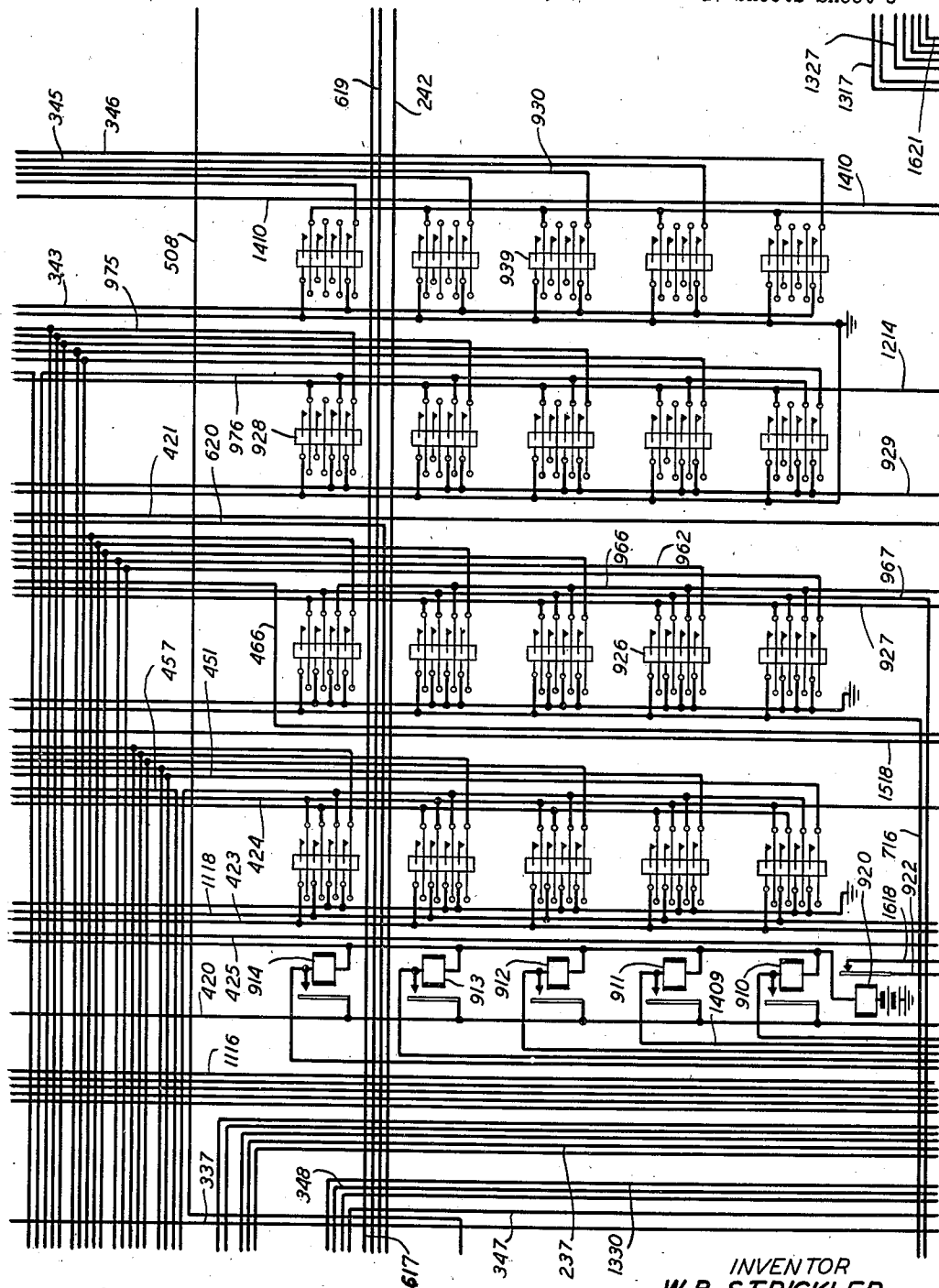


FIG. 9

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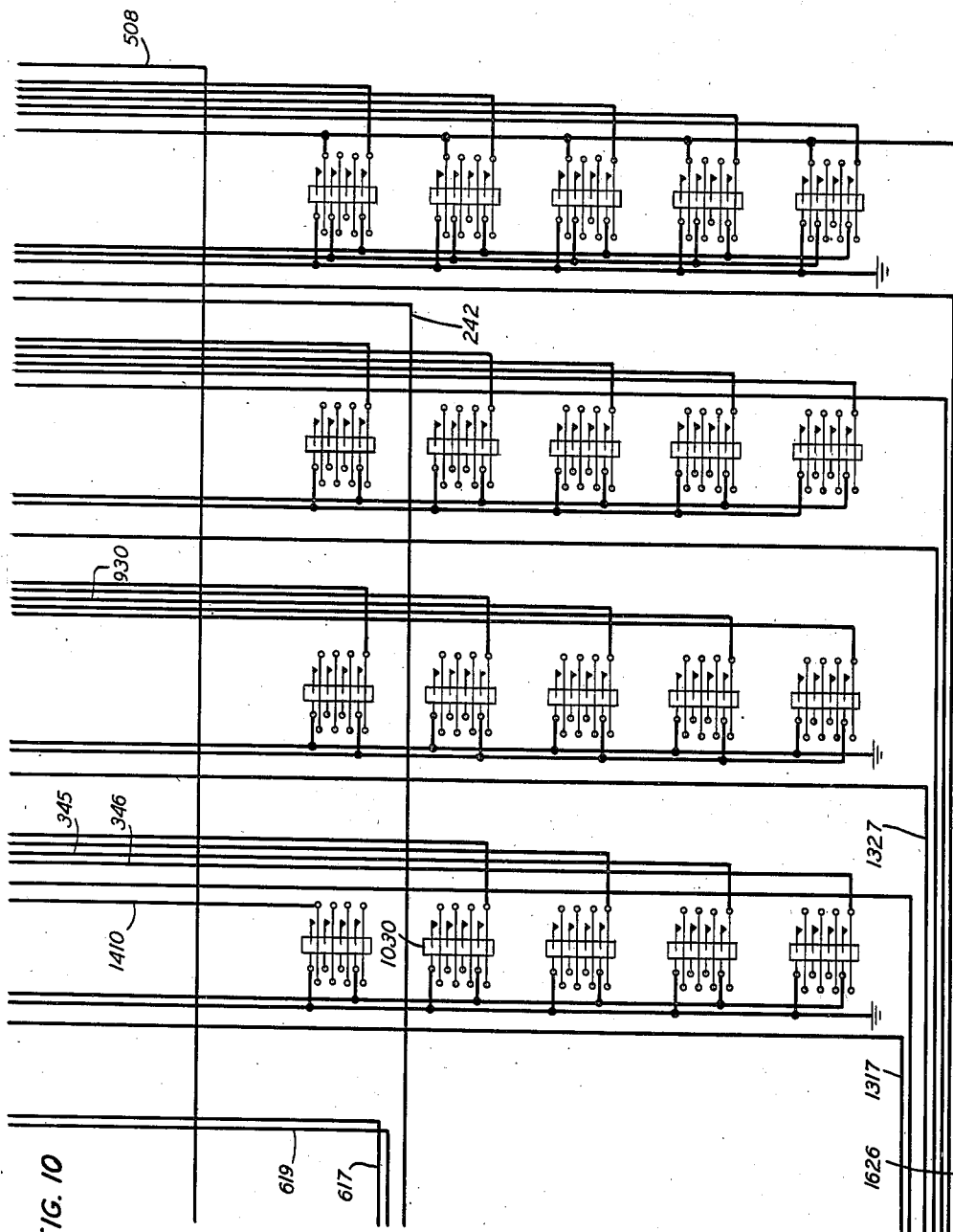
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TANDEM TELEPHONE SYSTEM

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17 Sheets-Sheet 11

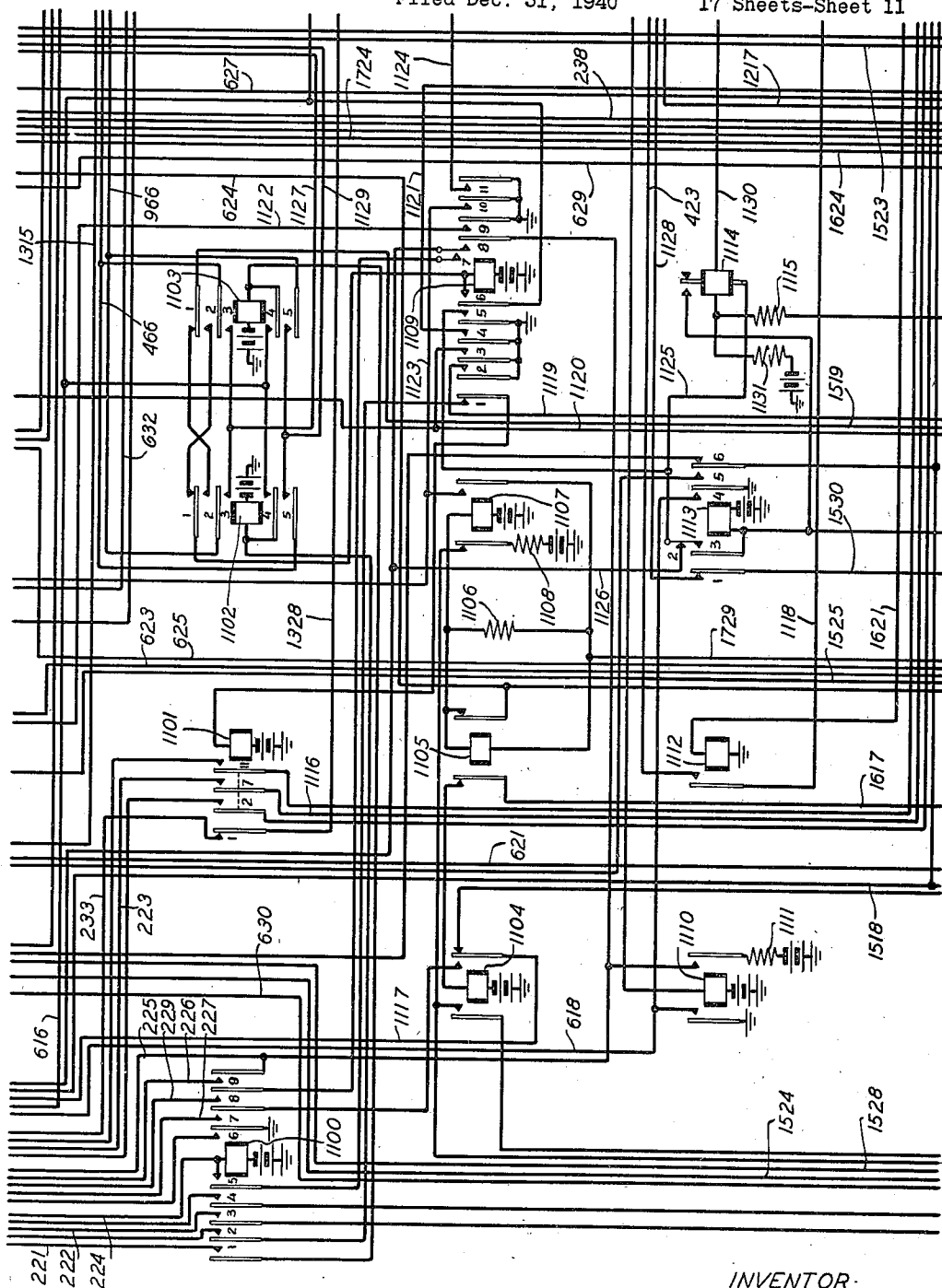


FIG. 11

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TANDEM TELEPHONE SYSTEM

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17 Sheets-Sheet 12

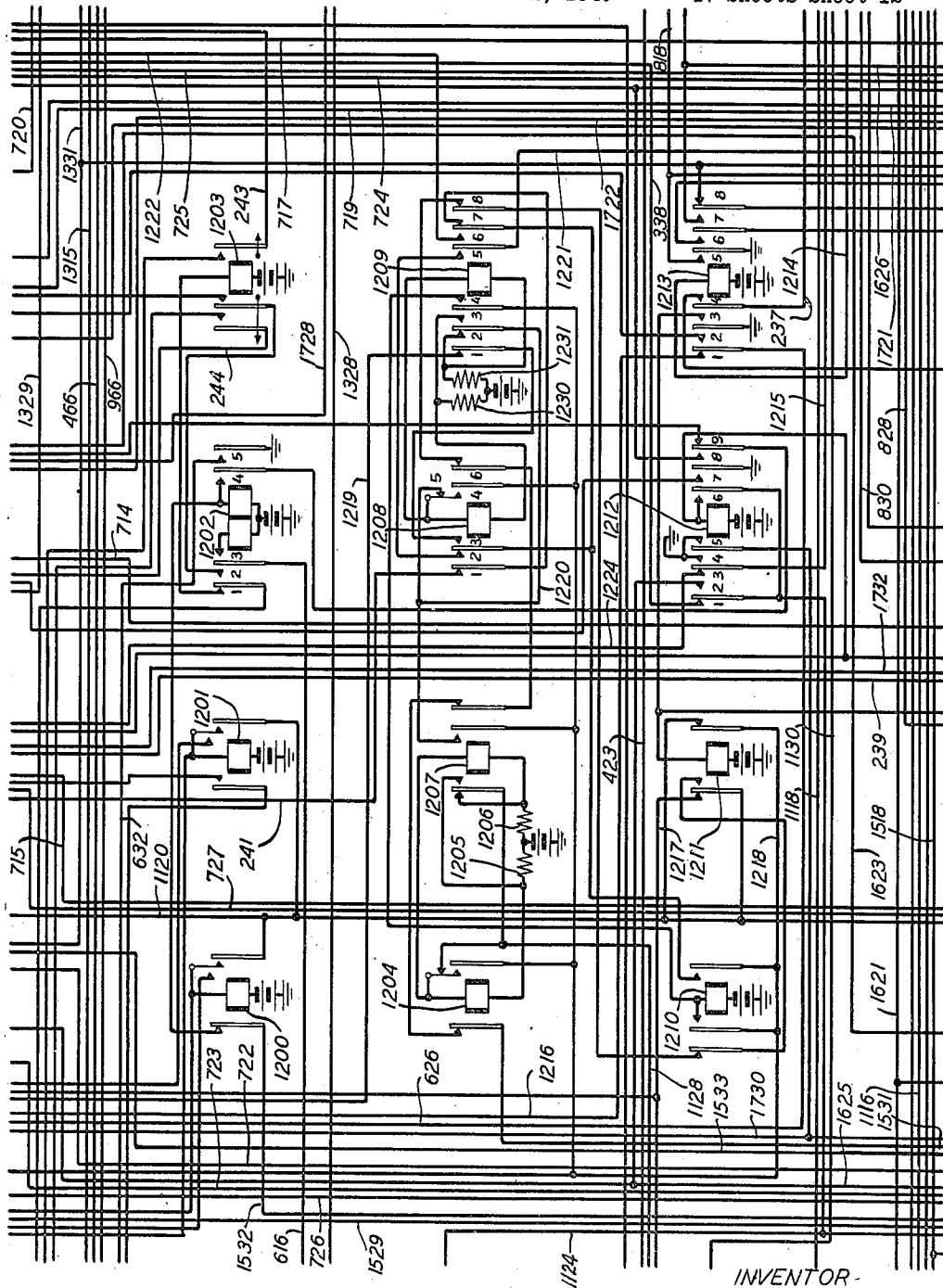


FIG. 12

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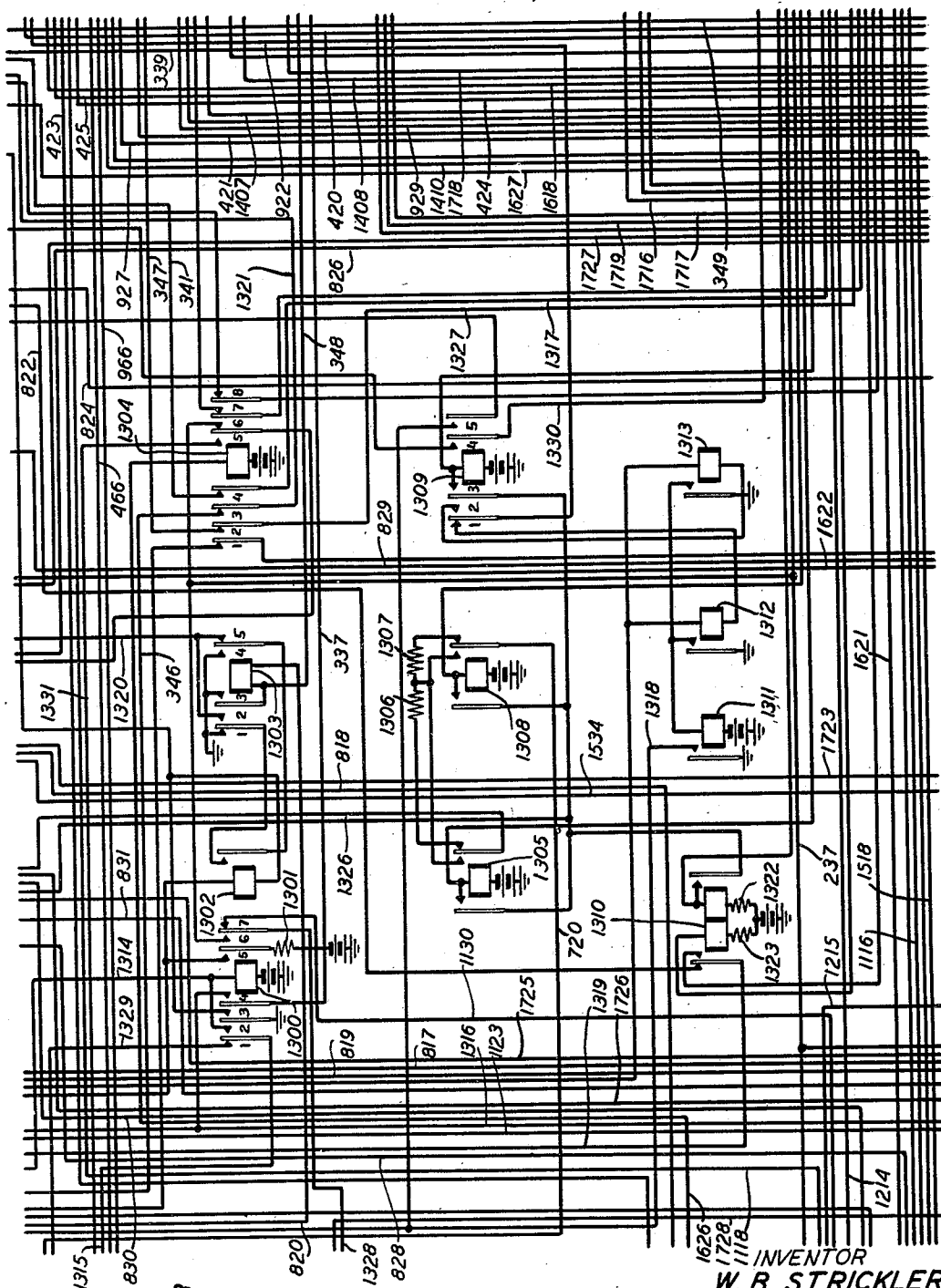
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17 Sheets-Sheet 13



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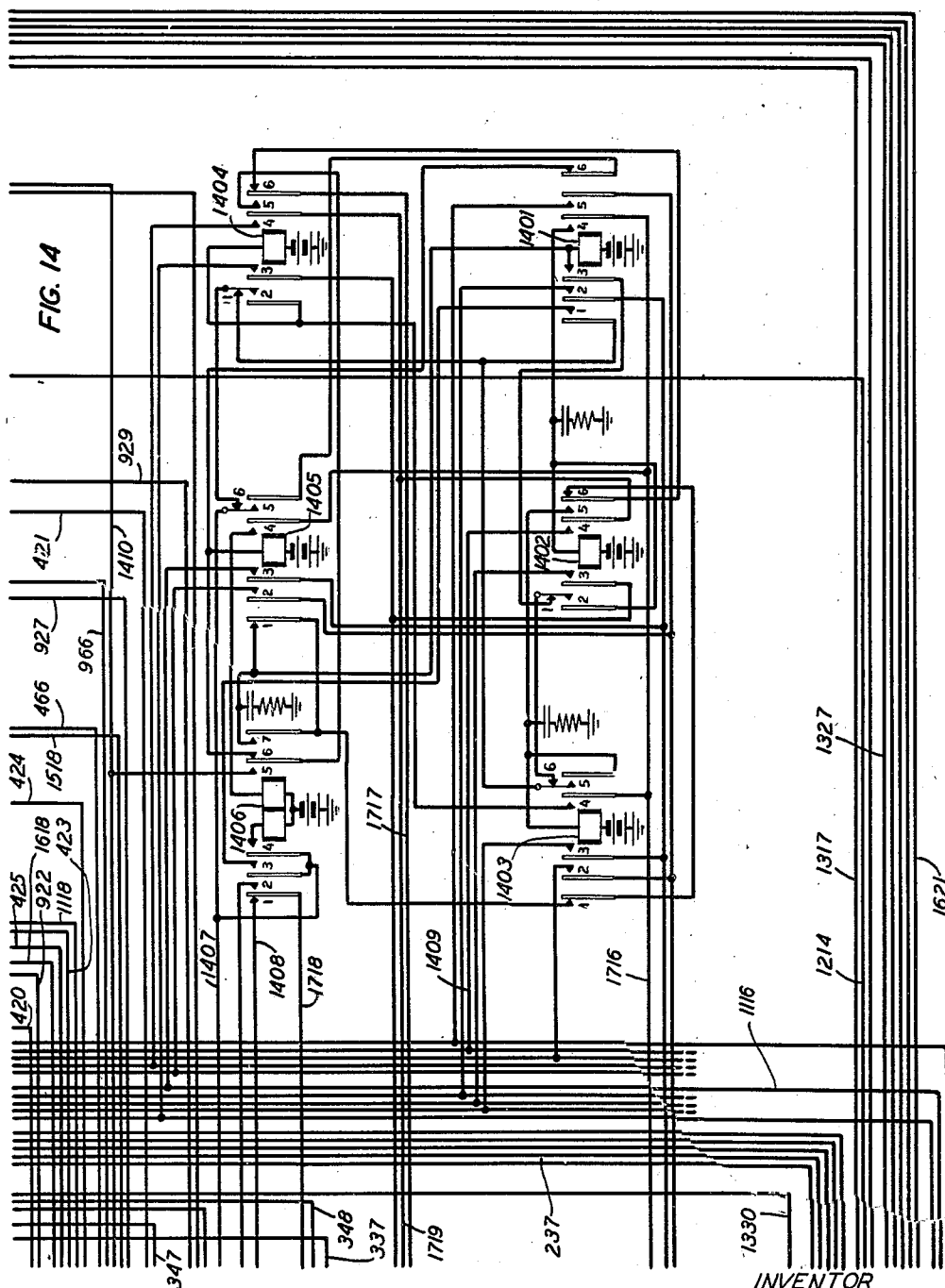
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TANDEM TELEPHONE SYSTEM

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17 Sheets-Sheet 14



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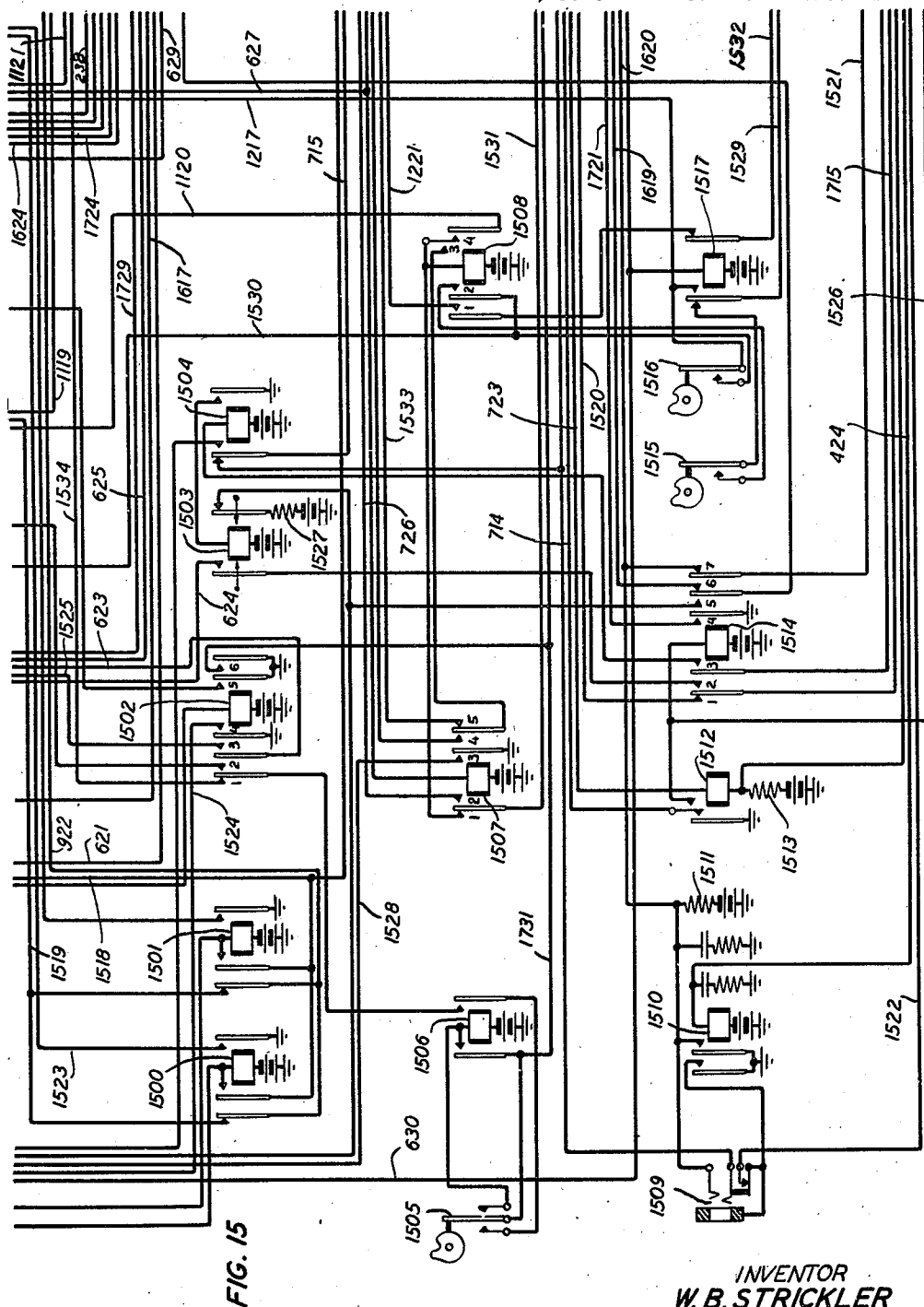
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17 Sheets-Sheet 15



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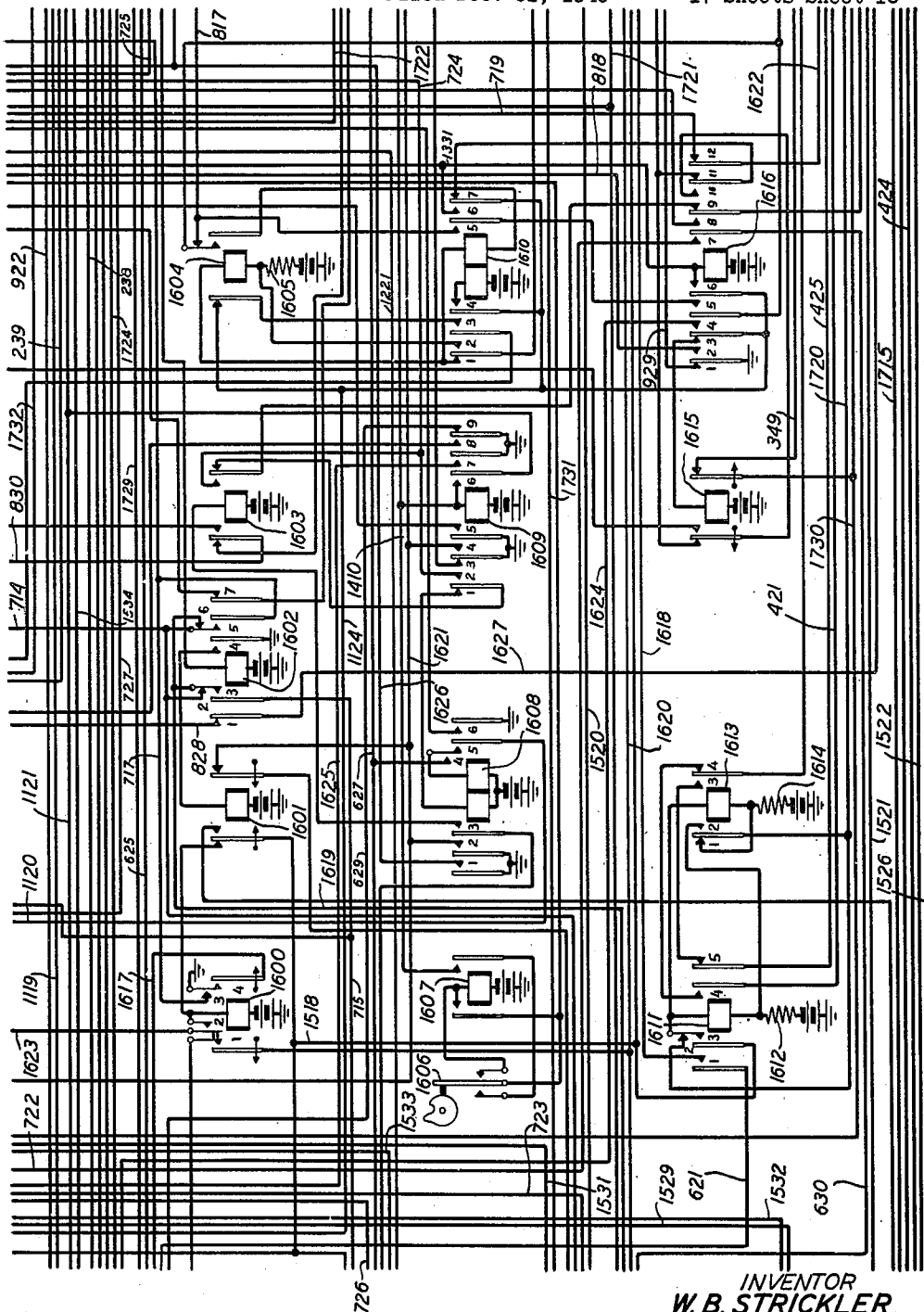


FIG. 16

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17 Sheets-Sheet 17

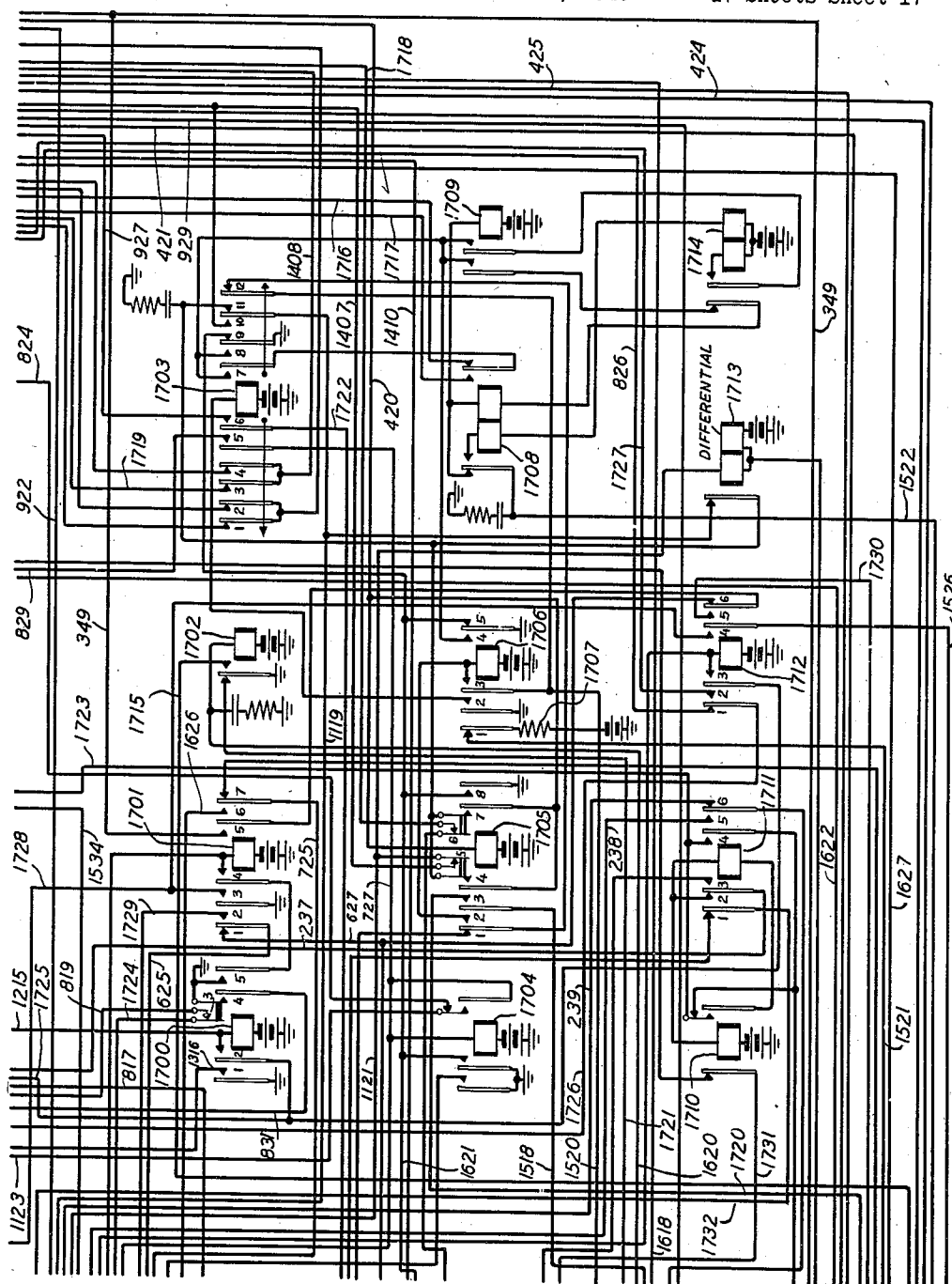


FIG. 17

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UNITED STATES PATENT OFFICE

2,281,636

TANDEM TELEPHONE SYSTEM

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Application December 31, 1940, Serial No. 372,580

13 Claims. (Cl. 179-27)

This invention relates to telephone systems and has for its object to facilitate the establishment of connections between subscribers in offices within exchange areas.

Offices within an exchange area may be connected either by direct trunks or by trunks extending through a tandem office. Whether direct trunks or tandem trunks are provided for use in a particular connection is primarily a question of traffic density, although tandem trunking may also serve to supplement direct trunking.

When two offices are connected through a tandem office, the resulting connection may or may not exceed the length over which the terminating equipment may be controlled, and that length also depends on the nature of the terminating equipment.

In accordance with the present invention, means is provided, controlled by the nature of the terminating office, to determine whether the line designation shall be recorded in the tandem sender or passed through the tandem sender to the terminating office.

In case of trouble, the tandem sender first tries to route the call to a special trunk in order to cause the originating sender or operator to take over the signaling of the calling subscriber. If this fails the tandem sender itself transmits the signals to the originating office.

Means is also provided whereby, when the terminating office fails to exert the necessary control of the connection, that control is supplied at the tandem sender.

In particular, if no assignment is received from a terminating call indicator office the tandem office supplies an artificial assignment and if the originating sender fails to provide the necessary reverse battery pulse, the tandem sender is equipped to provide such a pulse.

These and other features of the invention will be more clearly understood from a consideration of the following description in connection with the accompanying drawings in which:

Fig. 1 shows in diagrammatic form, equipment at an originating office as well as an incoming trunk at a tandem office;

Fig. 2 shows switches connecting with trunks to a plurality of terminating offices, and, schematically, a sender connector, an office link connector, a marker and a marker connector;

Figs. 3 to 17 show the tandem sender of which:

Fig. 3 shows the counting relays and the steering relays;

Figs. 4, 5, 9 and 10 show the cross-bar register;

Figs. 6 and 7 show the relays for supervising a call indicator call;

Figs. 8 and 13 show the circuits for controlling a full selector call;

Fig. 11 shows the sender release relays;

Figs. 12, 15 and 16 show the trouble timing circuits;

Figs. 14 and 17 show the circuits for receiving designations; and

Fig. 18 shows the manner of arranging Figs. 1 to 17, inclusive.

No details of the originating and terminating offices have been shown. Reference is here made to U. S. Patent No. 2,235,803, granted March 18, 1941, to W. W. Carpenter, for a complete showing of the originating circuits at a cross-bar office, to Patent No. 2,089,921, granted August 10, 1937, to W. W. Carpenter for Terminating cross-bar circuits, to Patent No. 1,658,829, granted February 14, 1928, to C. H. Berry for Panel automatic equipment having access to called lines, and to Patent No. 1,968,420, granted July 31, 1934, to A. C. Powell for Call indicator equipment at a manual office.

In the establishment of a telephone connection through a tandem office the connection is extended from the calling subscriber to the tandem office under the control of an originating sender and marker.

An office brush and an office group registration is then transmitted by means of reverive pulses to the tandem sender, which calls in a tandem marker and transfers these registrations to the marker. The marker selects a trunk outgoing to the wanted office and transmits an indication to the sender of the nature of the terminating office. For a full selector office the tandem sender receives the numerical designation and retransmits it to control the terminating equipment to select the wanted line. For a call indicator office, the incoming and outgoing trunk conductors are connected together in the sender and the designation is transmitted directly from the originating to the terminating office, the tandem sender receiving an indication when the transfer is completed. When the designation has been received at the terminating office the sender causes the incoming and outgoing trunk conductors to be connected together by the trunk equipment and the sender releases.

Considering the invention in more detail, when the subscriber at substation 100 originates a call for a subscriber at an office which is reached by way of the tandem office, substation 100 is connected by line switches 101 and 102 to a district junctor which is in turn connected over sender link switches 103 and 104 with a subscriber or originating sender. The subscriber then dials the designation of the wanted line, whereupon the sender connects with a decoder marker through the marker connector and the marker connects with the district junctor. The sender transmits the office designation to the marker, which translates the designation into

the necessary information for selecting an outgoing trunk to the wanted office, in this case a tandem office, and transmits to the sender instructions as to the manner in which the line designation is to be transmitted to the terminating office. After an idle trunk has been seized, switches 105 to 108 are operated to connect the district junctor with the trunk, and the marker and marker connector are released. The subscriber sender closes a bridge across the tip and ring conductors of the trunk to inform the distant office that it is ready to proceed.

At the incoming trunk in the tandem office the tip of the trunk 109 extends over the tip contact of jack 110, contacts 1 and 2 of relay 111, right winding of relay 118 in parallel with contact 10 of relay 115 and resistance 116 to battery through resistance lamp 117. The ring conductor of trunk 109 extends over the ring contact of jack 110, contacts 7 and 6 of relay 111 to ground at contact 1 of relay 115. A branch of this circuit extends to the left winding of relay 118 but is incomplete with relay 115 normal. The originating sender completes its trunk test operation and then closes a lower resistance bridge ready for office brush selection.

Relay 118 operates over the circuit above traced and this selection loop at the originating office, and connects ground over contact 4 of relay 115 to conductor 120 thereby causing the sender link control circuit to select an idle tandem sender and operate sender link switches 208 and 209 to connect the trunk with the sender.

During the operation of the link circuit, trunk group relay 210 is operated, grounding conductors 221, 222 and 223. At the same time, conductor 224 is grounded, operating relay 1100 which extends its operating ground over contact 1 of relay 1109 to the winding of relay 1101 and battery.

The grounding of conductors 222 and 223 identifies the frame on which the incoming junctor is located. Ground on conductor 222 is connected, over contact 3 of relay 1100 to the winding of relay 1500 which in turn connects its operating ground to conductor 1518 to serve as a locking ground until relay 603 operates. Ground on conductor 1518 extends over the left back contact of relay 1601 to the winding of relay 1600 and battery. Relay 1600 closes a circuit from ground at its outer right contact over conductor 1617, left contact of relay 1105, to the winding of relay 1104 and battery. Ground on conductor 223 extends over contact 7 of relay 1101, conductor 1116 through the windings of select magnet 415 and marginal relay 920 to battery. In the absence of trouble, relay 920 does not operate but magnet 415 operates, preparing the cross-points in the corresponding level, and extending its operating ground over conductor 420 to the winding of relay 1705 and battery.

Relay 1705 closes a circuit from ground on conductor 1518, over contact 3 of relay 1705, conductor 1720, contact 2 and winding of relay 1611 to battery through resistance 1612. Relay 1611 operates, locking over its contact 3 to ground on conductor 1518. At the same contact relay 1611 prepares a circuit for relay 1613 from battery through resistance 1614, but relay 1613 is shunted over its own contact 1 by the operating circuit of relay 1611. Relay 1611 closes a circuit from battery through the winding of hold magnet 400, back contact of magnet 401, conductor 421, contact 4 of relay 1611, contact 4 of relay 1613 to the windings of relay 1713. The right winding of

relay 1713 extends to battery while the circuit through the left winding remains open until relay 1109 is operated.

The grounding of conductor 221 completes a circuit over contact 1 of relay 1100, winding of relay 1103 to battery to identify the office unit in which the wanted line is located.

With relay 1100 operated conductors 225 and 226 are connected together. The link controller circuit responds to this signal and certain other tests by grounding conductor 227, thereby completing a circuit over contact 7 of relay 1100, right front contact of relay 1104, conductor 1117 to the left winding of relay 603 and battery. Relay 603 connects ground to conductors 616 to 620 as well as to conductor 1518. Relay 1103 now locks to conductor 616 and relay 1500 locks to conductor 1518. Ground on conductor 618 operates a relay in the controller circuit which marks the sender busy and which returns ground over conductor 228 completing a circuit over contact 9 of relay 603, conductor 621, contact 1 of relay 1611, conductor 1618, back contact of relay 920, conductor 922, back contact of relay 1501, conductor 1519, contact 2 of relay 1103, contact 1 of relay 1102 to the winding of relay 1109 and battery.

It may be observed that the circuit for operating relay 1109 makes a number of tests since it can only be completed if one and only one of the office unit relays 1102 and 1103 is operated. Likewise it cannot be closed if more than one frame units relay is operated as would be indicated by the operation of relay 920. Nor can it be operated if two frame tens relays are operated. The fact that one frame units and one frame tens relay have been operated is shown by the operation of relay 1611.

Relay 1109, when operated, locks to conductor 616 and grounds conductors 1119 to 1125. Ground on conductor 1119 completes a locking circuit for relay 1705 over contact 11 of relay 1703 and the back contact of relay 1713 in parallel, contacts 4 and 7 of relay 1705 to battery through the winding of relay 1705. Ground on conductor 1125 extends over contact 2 of relay 1113 to conductor 1126, contact 6 and left winding of relay 603 to hold relay 603 operated. Ground also extends from conductor 1126 over contacts 7 and 8 of relay 1109 to conductor 225 to hold the link switches 208 and 209. A further branch of this circuit extends over contact 8 of relay 1100 to conductor 229 as an indication that the connection between the incoming junctor and the sender is complete and controller may release.

Relays 603 and 1109 also operate several relays which have no function in the normal operation of the senders. For example, ground on conductor 1518 completes a circuit over contact 6 of relay 1113 to battery through the winding of relay 610. Relay 610 in turn closes a circuit from grounded conductor 1518, front contact of relay 610, contact 1 of relay 614, contact 1 of relay 1202 to battery through the winding of relay 1203. Ground on conductor 1124 operates relay 1615 over contact 3 of relay 1616. The function of relays 610, 1203 and 1615 will be discussed in connection with calls which encounter trouble or delay.

When relay 1109 operates, it opens the circuit of relay 1101 and, when the controller circuit releases, the circuit of relay 1100 is opened and that relay releases. The circuits connecting the controller with the sender which extend over contacts of relays 1100 and 1101 are common to a

group of senders, were individualized to this sender by the operation of relays 1100 and 1101, and on the release of these relays revert to the use of the remaining senders of the group. The sender is connected with the incoming trunk of Fig. 1 over the incoming tip and ring conductors 234 and 235, the outgoing tip and ring conductors 231 and 232 and control conductors 230, 233 and 236, by means of link switches 208 and 209, while conductor 225 extends to the hold magnets of the link switches as above described.

When relay 1109 grounds conductor 1121 the circuit previously traced for hold magnet 400 of the register switch is extended, in parallel with battery through the right winding of relay 1713, through the left winding of relay 1713 to ground on conductor 1121. Relay 1713 being differential does not operate at this time, but magnet 400 does operate, locking over its inner contact to grounded conductor 1518. With select magnet 415 operated, the operation of hold magnet 400 closes cross-point 422. The locking ground for magnet 400 extends back over the operating circuit of magnet 400 to the right winding of relay 1713, permitting that relay to operate. Relay 1713 opens one branch of the locking circuit of relay 1705.

When the switches 208 and 209 have operated, the trunk tip and ring conductors 134 and 135 are connected through the link to conductors 234 and 235 respectively. The operation of relay 603 extends tip conductor 234 over contact 1 of relay 603, contact 1 of relay 604, left contact of relay 606, contact 1 of relay 702, contacts 2 and 1 of relay 607, contact 1 of relay 700, contact 2 of relay 702, back contact of relay 711, conductor 714, contacts 2 and 6 of relay 1692, conductor 1619, contact 6 of relay 1514, contact 1 of relay 1600, conductor 1620 to the winding of relay 1702 and battery. In parallel with relay 1702, conductor 1620 extends to battery through resistance 1511 and over contact 7 of relay 1514, conductor 1521, contact 1 of relay 1706 to battery through resistance 1707.

Ring conductor 235 is also extended over contact 10 of relay 603, contact 5 of relay 604, right contact of relay 606, contact 7 of relay 702, contacts 7 and 8 of relay 607, contact 10 of relay 700, contact 6 of relay 702, conductor 715, left contact of relay 1504, right contact of relay 1601, conductor 1621 to ground through the winding of stepping relay 1112. Relay 1112 is shunted by ground over contact 8 of relay 1705, contact 5 of relay 1706 and contact 9 of relay 1703.

When relay 1109 grounds conductor 1122 it completes a circuit over contact 4 of relay 611, conductor 230, through the link switches 209 and 208 to conductor 130, operating relay 111. Relay 111 disconnects battery and ground through the windings of relay 118 from conductors 134 and 135 to improve the pulsing condition between the subscriber sender and the tandem sender.

Relay 1702 operates in the circuit above traced and closes a circuit from ground at its front contact, conductor 1715, contact 1 of relay 1514, conductor 1520, contact 12 of relay 1703, contact 2 of relay 1705, winding of relay 1706 and battery. Relay 1706 locks to conductor 1520, disconnects battery through resistance 1707 from in shunt of relay 1702 and closes a circuit for relay 1703. Relay 1703 at its contact 12 opens the locking circuit for relay 1705 and magnet 415 permitting them to release. With relays 1703 and 1706 operated and relay 1705 released, the shunts around

the winding of relay 1112 are opened and that relay operates.

Relay 1112, in operating, closes a circuit from ground over the top contact of cross-point 422, conductor 423, contact of relay 1112, conductor 1118, inner upper contact of cross-point 422, conductor 424 to the winding of relay 1510 and battery.

It may be noted that to extend the life of the contact of the stepping relay the current flow over that contact is reversed under the control of the frame register cross-points for approximately half of the calls, since, for odd-numbered frames, conductor 423 is grounded and conductors 1118 and 424 connected over the cross-point, while for even-numbered frames, conductor 1118 is grounded and conductors 423 and 424 connected together.

When relay 1510 operates in response to the operation of relay 1112, it connects ground to conductor 1620, holding relay 1702 operated and shunting both relay 1112 and the stepping relay of the subscriber sender. Relay 1112 releases, opening the circuit of relay 1510 which removes the shunt from relay 1112. Relay 1112 reoperates and reoperates relay 1510. This cycle continues until the subscriber sender, having counted a number of releases of its stepping relay determined by the setting of the register thereat, opens the pulsing circuit to release both relay 1112 and relay 1702 to terminate the transmission of the registration.

Each time that relay 1510 operates, it also closes a circuit from ground at its outer contact, contact of jack 1509 to conductor 1522. The first connection of ground to conductor 1522 completes a circuit over the left back contact of relay 1708 through the winding of relay 1709 to battery. Relay 1709 locks through the right winding of relay 1708, back contact of relay 1714, outer contact of relay 1709 to ground at contact 4 of relay 1706 and contact 8 of relay 1703. Relay 1708 does not operate in this locking circuit, being shunted by the operating circuit of relay 1709. When relay 1510 releases, relay 1708 operates. The next grounding of conductor 1522 completes a circuit over the left front contact and left winding of relay 1708, right winding of relay 1714 and battery. Relay 1714 opens the locking circuit of relays 1709 and 1708. Relay 1709 releases, but relay 1708 remains operated in series with relay 1714 until relay 1510 removes ground from conductor 1522, at which time relays 1708 and 1714 release, leaving the three relays 1708, 1709 and 1714 normal, as at the beginning of the first pulse. This cycle is repeated as long as relay 1510 continues to operate and release. The right contact of relay 1708 is grounded over contacts 8 and 7 of relay 1703. Therefore, with relay 1708 operated at the end of odd pulses, conductor 1717 is grounded and with relay 1708 released at the end of even pulses conductor 1716 is grounded.

The first connection of ground to conductor 1717 completes a circuit over contact 6 of relay 1404, contact 6 of relay 1402, contact 1 of relay 1403, contact 1 of relay 1405 to the winding of relay 1401 and battery. Relay 1401 locks over normal contacts of relays 1402, 1403, 1404 and 1405, conductor 1407 over contact 10 of relay 1703 to grounded conductor 1119 and over contact 5 of relay 1705 to grounded conductor 1121.

On the second pulse, ground on conductor 1716 extends over contact 4 of relay 1401 to the winding of relay 1402 and battery. Relay 1402 locks

over its alternate contact and over the normal contact of relay 1403, and thence as above traced to grounded conductors 1119 and 1121. Relay 1402 opens the locking circuit of relay 1401 which releases.

The third, fourth, fifth and sixth operations of relay 1510 cause relays 1403, 1404, 1405 and 1406 to operate in turn. Relay 1405 locks over contact 6 of relay 1401 and, therefore, remains operated during the sixth pulse. Relay 1406 locks through its left winding and contact 4 to conductor 1407 and thence to ground and remains operated through any additional pulses. With relays 1406 and 1405 operated the previously traced circuit from conductor 1717 to the winding of relay 1401 extends over contact 7 of relay 1406 instead of over contact 1 of relay 1405. Therefore, the seventh pulse operates relay 1401, releasing relay 1405, and the eighth, ninth and tenth pulses operate relays 1402, 1403 and 1404, respectively.

The originating sender causes the registration of office brush selection and office group selection irrespective of the nature of the terminating office.

When the originating sender circuit breaks the pulsing circuit at the end of office brush selection, releasing relays 1702 and 1112 to stop the generation of the revertive pulses, the release of relay 1702 in turn releases relay 1706 and relay 1703. Relay 1703 is made slow to release to allow sufficient time for the operation and locking of the last pulse counting relay.

Assuming that relay 1402 is operated at the end of the selection, a circuit is closed as soon as relay 1703 releases from ground at contact 3 of relay 1609, contact 6 of relay 1705, conductor 1718, contact 1 of relay 1405, conductor 1408, contact 3 of relay 1703, conductor 1719, contact 4 of relay 1402, conductor 1409, winding of select magnet 911 to battery through the winding of relay 920. Magnet 911 extends its operating ground to conductor 420, operating relay 1705 which locks over back contacts of relays 1703 and 1713 to grounded conductor 1119.

When relay 1705 releases, following the frame registration, relay 1613 operated in the locking circuit of relay 1611. Therefore, the present operation of relay 1705 closes a circuit from grounded conductor 1518, over contact 3 of relay 1705, conductor 1720, contact 2 of relay 1613 to battery through resistance 1612 in shunt to the winding of relay 1611, causing relay 1611 to release. Relay 1613 is held operated over the normal contact of relay 1611 and conductor 1720. With relay 1611 released, relay 1613 and hold magnet 400 operated, a circuit is closed from battery through the winding of the office brush hold magnet 401, back contact of hold magnet 402, upper front contact of magnet 400, conductor 425, contact 5 of relay 1611, contact 3 of relay 1613 to the windings of relay 1713. Since the left winding is now connected to ground over conductor 1121, magnet 401 operates immediately, closing cross-point 926 and locking to ground over conductor 620, thereby causing relay 1713 to operate to open one branch of the locking circuit of relay 1705.

With cross-point 926 closed a circuit is completed from ground over the inner upper contact of cross-point 926, conductor 967, winding of relay 708 to battery as an indication that office brush selection has been completed.

When the originating sender is ready for the next selection, that is, office group selection, relay

1702 reoperates, in turn operating relays 1705 and 1703 and releasing relays 1705 and 1613. The stepping relay may now operate to cause the generation of the next set of revertive pulses.

The control of the registration is primarily in the originating sender, which holds the pulsing circuit closed until it has counted the correct number of pulses. Then it holds the circuit open while it performs several internal operations to get ready for the next selection, after which it recloses it. However, in order to prevent selections from succeeding one another too rapidly to be registered properly in the tandem sender, the latter is arranged to prevent a succeeding selection from starting until the preceding selection has been registered.

The originating sender counts one set of pulses, breaks the pulsing circuit, then closes it again for the next set of pulses. The pulses are also counted on relays 1401 to 1406 as above described, and when the pulsing circuit is broken, relays 1702, 1706 and 1703 release and a select magnet is operated in turn operating relay 1705. Relay 1705 either operates or releases relay 1611 to close the circuit for one of the hold magnets and relay 1713 operates.

The originating sender may complete its function and reclose the pulsing circuit, reoperating relay 1702, before the tandem sender can complete the above operations. The next set of pulses must not start before the operated one of the pulse counting relays 1401 to 1406 has released and that relay must not release before the select magnet and relay 1705 have operated. Therefore, the pulse counting relays are made to lock over a back contact of relay 1705 and relay 1706 is made to operate over a front contact of relay 1705.

When relay 1705 operates for a first selection the pulse counting relays are released and relay 1706 can operate, in turn operating relay 1703 but the pulses for the second selection cannot start until relay 1705 releases, and relay 1705 is held operated until relay 1713 operates to indicate that the cross-point has been closed. Relay 1705 is also held operated until relay 1702 operates so that, if the tandem sender completes the registration faster than the originating sender completes its operation, the pulsing cannot start prematurely.

The office group selection takes place in a manner similar to the office brush selection above described, resulting in the operation of hold magnet 402 and a cross-point in the corresponding vertical, for example, cross-point 928. When relay 1702 releases, and before slow relay 1703 releases, a circuit is closed from ground at the back contact of relay 1702, conductor 1721, back contacts of relays 713 and 712, conductor 716, uppermost contact of cross-point 926, conductor 927, contact 6 of relay 1703, conductor 1722, winding of relay 711 and battery. Relay 711 locks to grounded conductor 1123.

Relay 711 disconnects relay 1702 from the interoffice tip conductor and extends that conductor over the left front contact of relay 711, contact 3 of relay 705, conductor 717 to ground at contact 3 of relay 1600. This operation prevents trunk test from taking place at the originating sender until the tandem sender knows the nature of the terminating office, and also discharges the cable conductors.

With cross-point 928 closed, a circuit may be traced from battery through the winding of relay 1213, conductor 1214, uppermost contact of

cross-point 928 to ground. Relay 1213 operates in this circuit and closes a circuit from ground over its contact 5, conductor 818, back contacts of relays 810 and 811 in parallel, conductor 1723, normal contacts of relay 1710 and 1604, conductor 817 to the winding of relay 809 and battery.

With relay 809 operated, battery is connected over conductor 819 directly to the marker connector as a battery supply to certain relays and over conductor 819, contact 3 of relay 1700 and conductor 1724 to the marker connector to cause the connector to seize an idle marker and connect it with the sender.

When the marker and sender have been connected together, ground from conductor 1124 is extended over contact 7 of relay 1610, contact 11 of relay 1616, contact 6 of relay 1711 to conductor 239 to notify the marker that a first trial is being made.

With cross-points 422, 926 and 928 operated, the frame, office brush and office group registrations are transmitted to the marker through the marker connector by grounding two of seven conductors at each cross-point. One conductor identifies the position of the cross-point as in the first or second half of the vertical while the second conductor identifies the position of the cross-point in the half vertical. Cross-points 422 and 926 ground conductors 451, 457, 962 and 966 employing ground connected directly to the cross-point. Cross-point 928 grounds conductors 975 and 976 by means of ground supplied over conductor 929 and contact 1 of relay 1616. Conductors 451, 457, 962, 975 and 976 extend directly to the marker connector. Conductor 966 extends over contact 5 of relay 1103 and conductor 1129 to the marker connector. Relay 1500 also grounds conductor 1523 to complete the frame identification.

The marker records these registrations and employs the frame registration as a means for obtaining access to the tandem trunk and the office link switches of Fig. 2 through the office link connector. The office brush and office group designations are translated by the marker into the operation of a route relay which identifies the terminating office, controls the selection of a trunk outgoing to that office and the connection of the tandem trunk with the outgoing trunk. In these operations the marker functions in essentially the same manner as the originating marker shown in the above-mentioned Carpenter Patent 2,235,803.

Since, in normal operation, the originating sender is equipped to select one of five brushes and one of ten groups, the maximum number of codes transmitted to the tandem sender and marker in that case is fifty. However, certain senders are equipped to receive more than five reverte pulses during office brush selection on tandem calls, permitting the use of as many as one hundred codes. Other offices obtain access to a possible one hundred codes by using different groups of trunks for two offices identified by the same code. In the latter case the tandem sender receives a discriminating signal from the trunk group relay in the sender link, operating either relay 1102 or 1103 according to the incoming trunk group. When both arrangements appear in the same exchange area, the tandem sender is equipped to receive either signal.

In the operations above traced it has been assumed that the connection originated in an office of the latter type. Cross-point 926 was closed in response to the office brush registration and con-

ductors 962 and 966 were grounded as previously described. From an inspection of the drawing it will be apparent that conductor 962 is grounded when cross-point 926 is closed in response to two reverte pulses or when cross-point 426 is closed in response to seven reverte pulses and, therefore, indicates the position of the cross-point in either group of five. Conductor 966 is closed by any cross-point in the lower group of five and is extended to either conductor 1129 or conductor 1127 according as relay 1103 or 1102 is operated. Conductor 466 which is grounded by any cross-point in the upper group of five is extended to conductor 1129 if relay 1102 is operated and to conductor 1127 if relay 1103 is operated. It is, therefore, apparent that discrimination between two sets of fifty codes may be made either by the addition of five pulses to the office brush selection or by a signal from the trunk group through the sender link.

When the marker has determined what office is wanted it transmits a signal to the sender indicative of the type of office and the manner in which the sender must function in the extension of the connection. The class of call is indicated by relays 1712, 704 and 1701 which are operated as follows:

Full selector call to panel office.....	None
Full selector call to cross-bar office.....	Relay 1712
To call indicator office, tandem or direct.....	Relay 704
To an operator.....	Relays 1701 and 704
To a vacant code.....	Relays 1701 and 1712

The marker also indicates the resistance to be included in the out-pulsing circuit by operating relays 1305 and 1308 as follows:

900 ohms.....	None
600 ohms.....	Relay 1308
300 ohms.....	Relay 1305
0 ohms.....	Relays 1305 and 1308

For calls to certain panel type offices, relay 1309 is operated.

If multioffice terminating units are reached over common trunk groups, the marker will operate relay 1310 for one of the offices and this relay will be normal for the other.

Call to panel office

Assuming first that the wanted office is a panel office, none of the relays 1712, 704 or 1701 will be operated and assuming that a high resistance is required, neither relay 1305 nor 1308 will be operated but relay 1309 will be. For a full selector call, whether to a panel or cross-bar office, the remaining selections are recorded in the tandem sender and are retransmitted to the terminating office.

After the marker has decoded the registration, has transmitted the selection control information to the sender and has seized the office link connector, it grounds conductor 1314, operating relay 1300. Relay 1300 operates and extends ground from conductor 1314 over contact 2 of relay 1300, conductor 1315, contact 11 of relay 603, conductor 236, through the sender link switches 209 and 208 to conductor 136, contact 2 of relay 114, contact 7 of relay 115, winding of relay 119 and battery. Relay 119 locks over its contact 4 and conductor 125 through the office link connector to ground in the marker. This ground also serves as a locking ground for relay 1300 after the direct connection between the marker and sender has been opened.

With relay 1300 operated, a local circuit is closed from battery through resistance 1301, contact 5 of relay 1300, winding of out-stepping relay 1302, contact 3 of relay 1300 to ground, soaking the winding of relay 1302 in preparation for connection to the outgoing trunk.

The marker now grounds conductor 1224 completing a circuit over contact 3 of relay 1212, conductor 1215, winding of relay 1700 and battery. Relay 1700 closes a locking circuit over contact 2, conductor 1725, contact 7 of relay 809, conductor 831 to ground at contact 4 of relay 1700.

With relay 1700 operated the start circuit for the marker connector is opened, the marker connector is released and the marker disconnected from the sender. The marker continues to function and may send a trouble release signal to the sender by way of the office link connector, the trunk and the sender link if it cannot complete its function.

When relay 1700 operates it closes a circuit from battery over contact 2 of relay 809, conductor 823, winding of relay 336, conductor 337, contact 4 of relay 1301, conductor 1316 to ground at contact 1 of relay 1700. Relay 336 operates in this circuit and closes a locking circuit for itself through the winding of relay 326, contact 3 of relay 336, contact 1 of relay 321, conductor 1316 to ground at the contact 1 of relay 1700. Relay 326 cannot operate at this time, being shunted by the operating circuit of relay 336.

When the marker has completed the connection between the trunk of Fig. 1 and the wanted office, it disconnects ground from conductor 125, releasing relays 119 and 1300. The release of relay 1300 opens the operating circuit for relay 336 and permits relay 326 to operate.

When relay 326 operates it closes a circuit from battery through the winding of relay 705, contact 1 of relay 704, conductor 718, contact 3 of relay 326, conductor 338, contact 1 of relay 1212 to ground on conductor 1124. Relay 705 locks, independent of relay 326 over contact 1 of relay 704, contact 8 of relay 705 to ground over conductor 338 as above traced.

When relay 705 operates, a circuit is closed from ground at its contact 6, contact 1 of relay 810 to the winding of relay 811 and battery. Relay 811 opens one of the parallel connections between conductors 818 and 1723 for a purpose which will appear hereinafter. A branch of the circuit for relay 811 extends over contact 1 of relay 802 to the winding of relay 803 and battery. Relay 803 holds open a circuit, the purpose of which will be discussed later.

With relay 705 operated, the impulsing circuit is reclosed, relay 705 at its contact 3 disconnecting the incoming tip conductor from ground and at contact 4 connecting it to conductor 714 and thence to the winding of relay 1702. Five registrations, namely, incoming brush, incoming group, final brush, final tens and final units are received in the same manner as the office selections and are set up on the five remaining verticals of the cross-bar register.

When relay 336 operated it closed a circuit from battery through the winding of relay 812, contact 11 of relay 800, conductor 827, contact 4 of relay 336, conductor 341, contact 4 of relay 1304, conductor 1317, normal contact of hold magnet 504, which controls the incoming group vertical, to grounded conductor 619. Relay 812 closes an obvious circuit for relay 813.

When the incoming brush selection has been received one of the cross-points in that verti-

cal, for example, cross-point 939 is closed and hold magnet 403 operated. Magnet 403 locks over conductor 620. Similarly, in response to the registration of the incoming group selection, one of the cross-points controlled by magnet 504 is operated, for example cross-point 1030, and magnet 504 is operated, locking to conductor 619.

When magnet 504 operates, the circuit of relay 812 is opened and that relay releases, in turn releasing relay 813. The release of relay 813 completes a circuit from battery, contact 1 of relay 809, conductor 820, winding of relay 805, conductor 821, back contact of relay 305, conductor 340 to ground at contact 2 of relay 813. With relay 805 operated, relay 808 operates in a circuit from battery on conductor 820, winding of relay 808, contact 4 of relay 805 to ground at contact 1 of relay 813. Relay 808 locks over its contact 3 to contact 1 of relay 813 independent of relay 805, supplies ground to the counting relays of Fig. 3 and prepares a test circuit for the trunk outgoing to the terminating office.

This trunk test circuit is completed when relay 326 operates and extends to battery and ground at the incoming selector of the terminating office. The circuit may be traced in part from battery on the outgoing tip conductor through the switches 207, 206, 201 and 200, conductor 131, through sender link switches 208 and 209, conductor 231, contact 2 of relay 703, contact 5 of relay 705, conductor 719, contact 12 of relay 1616, conductor 1622, contact 4 of relay 802, contact 2 of relay 808, contact 5 of relay 813, contact 2 of relay 336, contact 3 of relay 800, winding of relay 1313, contact 2 of relay 1309, conductor 339, resistance 327, contact 5 of relay 326, conductor 1326, back contact of relay 1305, resistances 1306 and 1307, back contact of relay 1308, conductor 720, contact 7 of relay 705, contact 1 of relay 703, conductor 232, through the sender link switches 209 and 208, conductor 132 and through the switches 200, 201, 206 and 207 to ground at the panel office.

If the trunk circuit is ready for use, relay 1313 operates, closing an obvious circuit for relay 1311. Relay 1311 closes a circuit from ground at its contact, conductor 1318, windings of relays 815 and 816 in parallel, conductor 822, winding of relay 300, conductor 820 to battery at contact 1 of relay 809.

Relay 815 closes a circuit from battery over conductor 823, winding of relay 331, contacts 5 of relays 321, 322, 323, 324 and 325, conductor 342, contacts 1 of relays 814 and 806, front contact of relay 815, conductor 824, normal contact of relay 1704 to grounded conductor 1123. Relay 331 operates and locks through the winding of relay 321, lower contact of relay 331, contact 1 of relay 322, to ground over conductor 1316. At its upper contact, relay 331 closes a circuit from battery through the winding of relay 813, conductor 1727, upper contact of relay 331, contact 6 of relay 326, to ground over conductor 1316.

Relay 813 opens the circuits of relays 805 and 808 causing them to release. Relay 808 opens the trunk test circuit, releasing relay 1313 which in turn releases relay 1311 and permits relay 321 to operate in the locking circuit of relay 331, above traced. The operation of relay 321 opens the locking circuit of relays 326 and 336 permitting these relays to release. The release of relay 336 releases relay 813 and thereby causes relays 805 and 808 to reoperate. Relay 321 closes a circuit from ground at its contact 6, winding

of relay 800 to battery on conductor 820. Relay 800 locks to ground over its contact 7.

The sender is now ready to control the incoming brush selection at the terminating office, and the out-pulsing circuit for this purpose extends as traced for the test circuit to the contact 5 of relay 813, whence it extends over contact 1 of relay 336, or contact 8 of relay 800 and through resistance 801, in parallel with the upper winding of relay 804, contact 5 of relay 890, winding of out-stepping relay 1302, contact of relay 816, contact 6 of relay 800, to conductor 1326 and thence as traced for the test circuit.

Relay 804 does not operate in this circuit, being polarized, but relay 1302 operates closing the counting relay circuit from ground at contact 1 of relay 1303, contact of relay 1302, contact 5 of relay 1303, conductor 1320, back contact of relay 316, back contact of relay 311, contact 3 of relay 321, conductor 343, bottom contact of cross-point 939, conductor 930, back contact of relay 312, winding of relay 302 to battery over conductor 820. Relay 302 operates and prepares a locking circuit for itself through the winding of relay 312, contact of relay 302, back contact of relay 306, conductor 350, to ground at contact 4 of relay 898. Relay 312 cannot operate being shunted by the operating circuit of relay 302.

Revertive pulses from the incoming selector intermittently release relay 1302. The first release permits relay 312 to operate and extend the counting circuit over its front contact, conductor 345, contact 3 of relay 805, conductor 825 to the winding of relay 301 and battery over conductor 820. When relay 1302 reoperates at the end of this pulse, relay 301 operates and locks through the winding of relay 311 and conductor 344 to ground at contact 5 of relay 808. At the next pulse relay 311 operates and extends the counting circuit from the back contact of relay 316, over the front contact of relay 311, conductor 346, contact 3 of relay 1304, conductor 1321, contact 1 of relay 335, contact 6 of relay 334, contact 1 of relay 332, conductor 822 to the winding of relay 300 and battery on conductor 820. When relay 1302 reoperates, relay 300 operates and locks in a circuit from battery on conductor 820, winding of relay 300, conductor 822, windings of relays 815 and 816 in parallel, conductor 1318, front contact of relay 300, conductor 344 to ground.

At the third pulse relays 815 and 816 operate, relay 816 opening the out-pulsing circuit to permit the incoming selector to advance for group selection. Relay 815 closes a circuit which extends from ground to its front contact as previously traced, contact 1 of relay 806, contact 1 of relay 814, conductor 342, contacts 5 of relays 325, 324, 323 and 322, contact 4 of relay 321, winding of relay 332 to battery over conductor 823. Relay 332 locks through the winding of relay 322, contact 3 of relay 332, contact 1 of relay 323 to ground over conductor 1316. Relay 322 does not operate at this time.

Relay 332, in operating, closes a circuit from battery through the winding of relay 812, conductor 826, contact 1 of relay 1712, conductor 1726, contact 10 of relay 809, conductor 827, contact 4 of relay 332, contact 2 of relay 321 to ground over conductor 1316. Relay 812 operates, in turn operating relay 813, which releases relays 805 and 808. Relays 808 and 813 further open the out-pulsing circuit and release the counting relays. Relays 815 and 816 are, therefore, released and relay 322 operates in the locking cir-

cuit of relay 332, opening the locking circuit for relays 321 and 331 which release. With relay 331 released, relays 812 and 813 release, after which relays 805 and 808 reoperate.

In general, incoming group selection takes place under the control of relays 332 and 322 and cross-point 1030 in substantially the same manner as did incoming brush selection.

When relay 808 releases following incoming group selection, at which time relay 333 will be operated under the control of relay 815, the out-pulsing circuit is closed as above traced from the outgoing tip conductor to contact 4 of relay 892, and thence over contact 1 of relay 808, high resistance 807, contact 4 of relay 1309, conductor 1330, contact 1 of relay 334, contact 3 of relay 333 to conductor 1326 and back to the outgoing ring conductor. When relay 815 releases, relay 323 operates in the locking circuit of relay 333 to release relays 332 and 322 and prepare for final brush selection.

In order to prevent the start of this selection before the corresponding registration incoming from the originating sender has been completed, at the same time that relay 333 operates, grounding conductor 827 to operate relay 812, it closes a branch of that circuit from conductor 827 over contact 1 of relay 333, conductor 347, contact 2 of relay 1304, conductor 1327, normal contact of final brush hold magnet 595 to ground over conductor 619. When the final brush registration has been completed magnet 595 operates, opening the holding circuit for relay 812 and permitting that selection to be sent out to the terminating office.

Final tens selection takes place with relays 334 and 324 operated and final units selection with relays 335 and 325 operated. In each case relay 812 is held operated over the normal contact of the corresponding hold magnet until the incoming registration has been completed. When relay 334 operates, it closes a circuit from ground over its contact 3, conductor 348, winding of relay 1303 to battery on conductor 820. Relay 1303 locks to ground over its contact 3 and reverses the direction of current flow over the contacts of stepping relay 1302 to minimize wear on them.

Either final tens or final units selection may require more than five pulses, in which case, when relay 311 operates, the counting circuit is extended by relay 334 or 335 and the cross-point to the winding of relay 306. Relay 306 locks in series with relay 316 under the control of relay 808 and subsequent pulses operate relays 305, 364, 303 and 302. When relay 305 operates the circuit of relay 805 is opened and the pulsing circuit extends from the contact of relay 312 over conductor 345, over contact 2 of relay 805 to conductor 822 and the winding of relay 300, to terminate the pulsing.

When relay 815 is operated at the end of the final units selection, it operates relay 336 which, as before, locks through the winding of relay 326. The counting relays are released, permitting relay 326 to operate and the out-pulsing circuit is re-established. At the incoming selector a single long pulse of reversed battery is transmitted as the selector advances to position to ring the called subscriber. Relay 1302 operates as before, in response to this pulse. Since the current is now reversed, relay 804 also operates, closing a locking circuit for itself from battery through its lower winding, contact 5 of relay 309, conductor 823, contact 1 of relay 1602, conductor 1627 to

ground over the contact of relay 804. Ground on conductor 1627 also extends over contact 2 of relay 326, contact 9 of relay 800, winding of relay 814 and battery. With relay 814 operated, ground connected to conductor 1320 by relay 1302 extends over contact 5 of relay 814 to conductor 822 and the winding of relay 300. Relay 300 locks through the windings of relays 815 and 816 as before, relays 815 and 816 operating when relay 1302 releases at the end of the reverse battery pulse.

To guard against failure of these relays to operate due to an exceptionally short operation of relay 1302, which might occur with certain trunks, relay 1309 is operated as above described whenever such a trunk is to be used. A supplementary circuit is therefore closed from battery on conductor 820, winding of relay 300, conductor 822, windings of relays 815 and 816 in parallel, conductor 1318, contact 5 of relay 1309, contact 4 of relay 814, contact 3 of relay 802 to ground at contact 6 of relay 705. Relay 816 opens the out-pulsing circuit as before.

When the final units selection has been received from the originating sender, the in-pulsing circuit is reclosed by the originating sender to await a reverse battery pulse. Relay 1702 operates as before, in turn operating relays 1706 and 1703, but the in-stepping relay is prevented from operating by a shunting ground connected to conductor 1621 over the upper contact of the final units cross-point. When relay 815 operates following the operation of relay 814, in response to the reverse battery pulse from the terminating office, a circuit is closed from grounded conductor 1123, normal contact of relay 1704, conductor 824, front contact of relay 815, contact 1 of relay 806, contact 2 of relay 814, conductor 829, contact 5 of relay 1703, to the winding of relay 1704 and battery. Relay 1704 operates and locks over its alternate contact to conductor 1123. Relay 1704 at its inner left contact also grounds conductor 1621 to prevent the in-stepping relay 1112 from operating and at its outer left contact closes a circuit for relay 1602.

Relay 1602, in operating, extends the incoming tip conductor 234, which may be traced to conductor 714 as before, over contact 5 of relay 1602 to ground on conductor 717 and extends the incoming ring conductor 235, which may be traced to conductor 715 as before, over contact 3 of relay 1602 to conductor 1619 and thence to the winding of relay 1702 and battery. Contacts 3 and 5 of relay 1602 close before contacts 2 and 6 open and during the short space of time when both sets of contacts are closed, the inter-office cable is discharged and relay 1702 is heavily energized. The reverse battery is not immediately transmitted to the originating sender, since a branch of conductor 715 extends over the back contact of relay 1504 and the right back contact of relay 1601 to ground over conductor 1621 in shunt of the battery through relay 1702. When relay 1602 operates it connects ground over its contact 4 to the winding of relay 1601 and battery. Relay 1601 operates slowly to disconnect ground from conductor 715 and start the reversed battery pulse. At its left contact relay 1601 opens the circuit of relay 1600 which releases slowly to terminate the pulse by opening both tip and ring conductors. This reverse battery pulse permits the originating sender to release.

When relay 1600 releases it opens the circuit of relay 1104 and that relay also releases. When relay 1104 closes its back contact it completes a

circuit from grounded conductor 1125, contact 2 of relay 1113, conductor 1126, contact 6 of relay 603, conductor 1117, back contact of relay 1104, winding of relay 1502 and battery. Relay 1502 operates and closes a circuit from ground over its contact 4, conductor 1524, right back contact of relay 609, winding of relay 604, and battery. Relay 604 operates and connects the incoming tip and ring conductors over contacts 1 and 10 of relay 603, contacts 2 and 4 of relay 604 to battery and ground, respectively, at contacts 1 and 5 of relay 611. This discharges the cable from the preceding reverse battery pulse.

Relay 1502 connects ground over its contact 5 and low resistance 1115 to the winding of relay 1114 which is also connected to battery through resistance 1131. The other side of the winding of relay 1114 is connected over conductor 1130, contact 7 of relay 1300, conductor 1328, contact 1 of relay 1101, conductor 233, through sender link switches 209 and 208, conductor 133, contact 7 of relay 119, winding of relay 115 and battery. Relay 115 operates in this circuit, but polarized relay 1114 is not energized in the proper direction to operate. Relay 115 in operating closes a circuit from ground over contact 4 of relay 111, contact 6 of relay 115, contact 2 of relay 114, conductor 124, through switches 208 and 209 to conductor 236, contact 11 of relay 603, conductor 1315, contact 1 of relay 1300, conductor 1329, contact 4 of relay 703, contact 3 of relay 604 to the winding of relay 612 and battery. Relay 612 operates in this circuit closing a circuit from ground at its front contact, conductor 623, contact 3 of relay 1502, conductor 1525, winding of relay 611 and battery. Relay 611 locks over its contact 3 to grounded conductor 1122.

Relay 611 operated, disconnects battery and ground from the incoming tip and ring conductors and also opens the circuit of relay 111. With relay 111 released and relay 115 operated the windings of relay 118 are connected between the tip and ring conductors leading to the originating and terminating offices. Relay 111 also opens the circuit of relay 612 which releases, closing a circuit from ground, back contact of relay 612, contact 2 of relay 611, winding of relay 703 and battery. Relay 703 disconnects the outgoing tip and ring conductors from relay 1302.

When the incoming selector has ended the reversed battery pulse, it connects direct battery to the out-pulsing circuit and awaits a closure before starting to ring the called subscriber. Therefore, when the trunk is closed at the originating office, relay 118 operates connecting ground to contact 5 of relay 115 to lock the latter relay. This locking ground extends back over the operating circuit for relay 115 to the winding of relay 1114 which is now able to operate.

Relay 1114 closes a circuit from battery through the winding of release relay 1113, contact of relay 1114, to ground on conductor 1125. Relay 1113 locks over its contact 3 to conductor 1125 and grounds conductor 618 to hold the sender busy until released. At its contact 2, relay 1113 also disconnects ground from conductor 1126, releasing relay 603 and disconnecting ground from conductor 225 to release the link switches 208 and 209. The release of the link switches frees the sender from its external connections. The release of relay 603 releases relay 1109 and all locked relays. When relay 1113 releases it removes ground from conductor 618 and the sender is ready for the next call.

In the junctor of Fig. 1, relays 118 and 115

remain operated under the control of the originating office and the connection through switches 200, 201, 206 and 207 is held by ground over contact 2 of relay 115, contact 1 of relay 114, contact 1 of relay 119, to conductor 129 and the hold magnets of the switches.

Call to cross-bar office

The operation for a call to a cross-bar office differs only slightly from that to a panel office. As indicated above, relay 1712 is operated by the marker to indicate that the call is directed to a cross-bar office. With relay 1712 operated the time between selections is decreased by operating relay 813 directly from the steering relay instead of from relay 812. For example, when relay 332 operates, it closes a circuit from ground at contact 1 of relay 1700, conductor 1316, contact 2 of relay 321, contact 4 of relay 332, conductor 827, contact 10 of relay 800, conductor 1726, to the outer left armature of relay 1712. With relay 1712 normal, as for a call to a panel office, this circuit extends over conductor 826 to the winding of relay 812 which operates, in turn operating relay 813. With relay 1712 operated for a call to a cross-bar office the circuit extends over conductor 1727 to the winding of relay 813. In addition, relay 1309 is not operated during calls to a cross-bar office, therefore omitting the cable discharge closure between incoming group and final brush selections. A cross-bar office may be one of a pair of units served by common senders. In that case, relay 1310 may be operated to distinguish between the office units. It may be operated from the marker or from the incoming group vertical of the register. When operated, it serves to transfer the counting relay circuit from relay 300 to relay 306 to cause an additional five pulses to be sent out.

Call to call indicator office

For a call directed to an office equipped with a call indicator, the marker will operate relay 704. Relay 704 locks in a circuit from battery through its left winding and contact 5 to ground, at contact 4 of relay 809. Relays 336 and 326 operate for trunk test under the control of relay 1300 and the marker as in the previous calls. With relays 326 and 704 operated, a circuit is closed from battery through the winding of relay 702, back contact of relay 710, contact 2 of relay 704, conductor 718, contact 3 of relay 326, conductor 338, contact 1 of relay 1212, to grounded conductor 1124. Relay 702 at its contact 4 closes a circuit for relay 606 which operates slowly to remove a short circuit around the windings of relay 600, which served to prevent the latter relay from operating falsely on cable discharge.

With relay 702 operated, the incoming tip conductor 234 is connected over contact 1 of relay 603, contact 1 of relay 604, upper windings of polarized relays 600 and 602, contact 1 of relay 607, contact 1 of relay 700, contact 3 of relay 702, contact 2 of relay 703 to the outgoing tip conductor 231. Similarly, the incoming ring conductor 235 is connected over contact 10 of relay 603, contact 5 of relay 604, lower windings of relays 600 and 602, contact 8 of relay 607, contact 10 of relay 700, contact 5 of relay 702, contact 1 of relay 703 to the outgoing ring conductor 232.

When the connection of the originating sender and the terminating trunk circuit is completed for trunk test, relay 600 operates, completing a circuit from ground over the left contact of re-

lay 600, winding of relay 613 and battery. Relay 613 locks over its contact 4 to grounded conductor 1123. When assignment takes place at the terminating office, the removal of battery and ground at that office permits relay 600 to release and extend the locking ground of relay 613 over the right contact of relay 600 to the winding of relay 605 and battery. Relay 605, in operating, closes at its contacts 3 and 4, shunts around the windings of relay 600 so that relay 600 remains deenergized throughout the transmission of the call indicator code pulses.

When the designation has been transmitted, a heavy positive pulse is sent out, which is effective to operate relay 602. Relay 602 closes a circuit from ground over its contact, conductor 624, right contact of relay 1105, winding of relay 1107 and battery. Relay 1107 operates and locks through the winding of relay 1105 and resistance 1106 in parallel, front contact of relay 1107 to grounded conductor 1123. When the pulse ends and relay 602 opens the operating circuit of relay 1107, relay 1105 operates and opens the circuit of relay 1104. Relay 1104 brings about the release of the sender in the manner described for the previous calls.

Call to operator's position

For a call directed to an operator's position, the marker operates relay 1701 as well as relay 704. Relay 704 locks and operates relays 702 and 606 when ready for trunk test, as before. Relay 1701 locks over its contact 4 and contact 5 of relay 1700. Relay 1701 closes a circuit from ground over its contact 3, conductor 1728, contact 6 of relay 704, conductor 721 to the winding of relay 609 and battery.

With relay 702 operated, the incoming and outgoing trunk conductors are connected together through the windings of relays 600 and 602 as for the call indicator class of call. Relay 600 operates in response to trunk test and in turn operates relay 613. With relay 1701 operated, the operation of relay 613 closes a circuit from ground over its contact 5, conductor 625, contact 2 of relay 1701, conductor 1729, windings of relays 1105 and 1107 in series to battery.

Relay 1105 in operating releases relay 1104 which in turn operates relay 1502 as previously described. With relay 609 operated, the circuit of relay 604 is opened and that relay does not operate as described in the call to panel office. Therefore the connection between the incoming and outgoing trunks through the sender is maintained until a substitute circuit is closed in the trunk of Fig. 1. Relay 1502 causes the operation of relay 115 as previously described. The operation of relay 115 causes the operation of relays 612, 611 and 703, the circuit of relay 612 extending over the left front contact of relay 609 in place of contact 2 of relay 604.

With relay 115 operated, relay 118 is connected between the incoming and outgoing trunks. Relay 118 is shunted by relays 600 and 602 and may or may not operate following the operation of relay 115. However, when relay 703 operates, the shunt is opened and relay 118 operates, locking relay 115. This locking ground operates relay 1114 as before and the release of the sender is completed in the usual manner.

Vacant code registered

If the office brush and office group registration does not correspond to an actual office, the marker in translating the registration will oper-

ate a vacant code route relay and set the switches on a reorder or overflow trunk. The reorder or overflow trunk provides battery reversals and tone to signal either the originating operator or the calling subscriber. The marker will also cause the operation of class relays 1701 and 1712. A circuit is thereupon closed from battery through the winding of relay 1514, conductor 1526, contact 4 of relay 1712, to ground at contact 3 of relay 1701.

With relay 1514 operated, battery through relay 1702 and resistances 1707 and 1511 is disconnected from the in-pulsing tip conductor. When the marker releases, permitting relay 326 to operate in preparation for trunk test, a circuit is closed from ground at contact 4 of relay 326, conductor 349, contact 5 of relay 1701, and contact 5 of relay 1712 in parallel with the right contact of relay 1615, conductor 1730, contact 5 of relay 614, conductor 626, contact 2 of relay 1213, winding of relay 712 and battery. Relay 712 at its inner right contact connects ground to conductor 727 and through the winding of relay 1704 to battery. Relay 1704 locks over its alternate contact to grounded conductor 1123, grounds conductor 1621 and operates relay 1602.

Relay 1602 starts the application of reversed battery to the originating sender, operating relay 1601 as before. However, with relay 712 operated, relay 1600 is not released by the operation of relay 1601 but remains operated in a circuit from battery through its winding and contact 2, conductor 1623, left front contact of relay 712, left contact of relay 713, conductor 1721 to ground at contact 4 of relay 1514. With relay 1514 operated, the operation of relay 1601 closes a circuit from ground on conductor 1518, front contact of relay 1601, contact 3 of relay 1514, to the winding of relay 1504 and battery. Relay 1504 closes an obvious circuit for relay 1503.

When relay 1504 operates, the incoming ring conductor which extends to conductor 715 as previously traced, is connected over the left front contacts of relays 1504 and 1104, contact 5 of relay 1514 and contact 1 of relay 1600 to the winding of relay 1702 over conductor 1620. Relay 1702 is shunted by battery through resistance 1108 over the back contact of relay 1107 and by battery through resistance 1527 over the back contact of relay 1503. Relay 1503, which operates after a short interval following the operation of relay 1504, removes the shunt through resistance 1527. The object of these shunts is to prevent the false operation of relay 1702 in response to cable charge or the trunk test closure at the originating sender. The shunt through resistance 1527 absorbs the cable charge while the shunt through resistance 1108 prevents relay 1702 from operating in the high resistance trunk test circuit.

When the originating sender closes a low resistance circuit for the next selection or for a call indicator trunk test, relay 1702 operates, closing a circuit from ground at the front contact of relay 1702, conductor 1715, contact 2 of relay 1514, left contact of relay 1503, conductor 624, right contact of relay 1105 to the winding of relay 1107 and battery.

When the originating sender opens the in-pulsing circuit in response to the reverse battery closure, relay 1702 releases and relay 1105 operates in the locking circuit of relay 1107. Relay 1105 releases relay 1104, permitting the tandem sender to release as for a full selector call.

Second and third trials

If the marker encounters trouble, the sender may reject the information received from it and seize another marker for a second or third trial. This is also possible if the sender itself meets trouble in completing selections.

If the first marker encounters trouble in receiving the information from the sender, in decoding the information or in transmitting information to the sender, it grounds conductor 237, completing a circuit over contact 2 of relay 1711 to battery through the winding of relay 1710. Relay 1710 closes a locking circuit for itself through the winding of relay 1711, alternate contact of relay 1710, conductor 1723, back contacts of relays 810 and 811, conductor 818 to ground at contact 5 of relay 1213. Relay 1711 cannot operate, being shunted by the operating circuit of relay 1710. Relay 1710 opens the operating circuit for relay 809 which releases, in turn releasing the marker connector and disconnecting the first marker from the sender. The operating circuit for relay 1710 is opened, permitting relay 1711 to operate. Since relays 1712, 1701 and 704 as well as the compensating resistance control relays lock under the control of relay 809, the dismissal of the first marker wipes out the information set up by that marker.

Relay 1711 at its contact 4 recloses the circuit of relay 809 and a marker is summoned for a second trial. With relay 1711 operated, ground on conductor 1124 is extended over contact 7 of relay 1610, contact 11 of relay 1616, contact 5 of relay 1711 to conductor 238 to inform the marker that a second trial is being made.

The second marker will try to establish the connection in all other respects the same as the first did, functioning as previously described.

If the first marker encounters either trouble or an all-paths-busy condition when trying to establish connection to a chosen idle trunk or overflow trunk after its direct connection has been broken down, it sends a trouble release signal by grounding conductor 123 momentarily through the office link connector, completing a circuit over contact 6 of relay 119, conductor 133, through the sender link switches 208 and 209 to conductor 233, contact 1 of relay 1101, conductor 1328, contact 6 of relay 1309, conductor 237, contact 2 of relay 1711 to the winding of relay 1710 and battery. Relay 1710 functions as above described to operate relay 1711, release relay 809 and prepare for a second trial.

The sender may also summon a marker for a second trial if it receives an overflow signal from a distant panel or cross-bar office. The operation under this condition will be described hereinafter.

If, during second trial, the marker or sender encounters any of the above-described troubles, connection of ground to conductor 237 now completes a circuit over contact 3 of relay 1711, contact 1 of relay 1610 to the winding of relay 1604, resistance 1605 and battery. Relay 1604 closes a locking circuit through its winding and the right winding of relay 1610, alternate contact of relay 1604, contact 4 of relay 1711, conductor 1723, back contacts of relays 810 and 811, conductor 818 to ground at contact 5 of relay 1213. Relay 1610 cannot operate in this circuit, being shunted by the operating circuit of relay 1604. Relay 1604 opens the circuit of relay 809 which functions to dismiss the marker as for a first trial. The release of the marker permits relay

1610 to operate and lock through its left winding and contact 4 to grounded conductor 1124. Relay 1610 at its contact 6 connects the winding of relay 1616 to conductor 1124, operating relay 1616. Relay 1616 locks over its contact 6 directly to conductor 1124 and recloses the operating circuit for relay 809 to initiate the third trial. Relay 1616 at contact 1 removes ground from conductor 829 and the office group register to prevent the marker from receiving a complete code. At contact 4, relay 1616 connects grounded conductor 1124 to conductor 1624 to notify the marker to establish connection with an overflow trunk.

If trouble is experienced in connecting with an overflow trunk, conductor 237 is again grounded. Since relay 1610 is now operated the ground is extended over contact 2 of relay 1610 to resistance 1605 in shunt of the winding of relay 1604. Relay 1604 releases, closing a circuit from grounded conductor 1124, left back contact of relay 1604, contact 3 of relay 1610, winding of relay 1212 and battery. Relay 1212 locks over its contact 6 to grounded conductor 1124. Relay 1212 at its contact 4 connects ground to conductor 1215, operating relay 1700 to open the start circuit of the marker connector and release the marker.

At contact 2 relay 1212 connects ground on conductor 1124 to conductor 1525, closing a circuit over contact 3 of relay 702 and conductor 723 to the winding of relay 1512, resistance 1513 and battery. Relay 1512 closes an obvious circuit for relay 1514 and grounds conductor 714. At contact 5 relay 1212 grounds conductor 1730, operating relay 712. Relays 1514 and 712 function as for a call to a vacant code.

In the trunk circuit relay 115 is operated and relay 111 released as before, relay 115 operating relay 612 which in turn operates relay 611. When relay 111 releases relay 612 releases and relay 703 operates. Relay 111 in releasing connects battery through the winding of relay 114, over contact 3 of relay 111, contact 6 of relay 115 and contact 2 of relay 114 to conductor 136. With relay 1212 operated, conductor 136 is connected through the sender link to conductor 235, contact 11 of relay 603, conductor 1315, contact 1 of relay 1300, conductor 1329, contact 3 of relay 703 to ground at contact 7 of relay 1212. Relay 114 operates in this circuit and locks over its contact 3 to ground at contact 2 of relay 115. With relay 114 operated the right winding of relay 118 is connected over contact 8 of relay 115 and contact 4 of relay 114 to battery through resistance lamp 117, while the left winding of relay 118 is connected over contact 3 of relay 115 and contact 5 of relay 114 to ground, thereby providing an operating circuit for relay 118 to hold relay 115 operated and to permit the originating sender to advance to release.

This arrangement is necessary since the marker was unable to connect the tandem trunk with either a service trunk or a reorder trunk.

Overflow and telltale from terminating equipment

A panel selector or a cross-bar terminating sender when advanced to telltale or overflow, connects reversed battery to the trunk conductors, recognizes a closure at the tandem sender; then connects direct battery to the trunk, awaits a second closure and finally returns to normal.

At the time that a panel selector or cross-bar sender goes to telltale or overflow, the tandem sender will be in some selective position with relays 804 and 1302 included in

the out-pulsing circuit. The reverse battery supplied at the distant office will operate both relays 1302 and 804. Relay 804 locks in the circuit traced for the normal completion of a call. Since, at this time relay 326 is not operated, relay 804 also closes a circuit from its contact over conductor 1627, contact 1 of relay 326, winding of relay 806 and battery. Relay 806 locks under the control of relay 804. Relay 806 at its contact 6 closes an obvious circuit for relay 814. In addition, relay 806 closes a circuit from battery on conductor 820, winding of relay 300, conductor 322, contact 3 of relay 806, conductor 1320, contact 5 of relay 1303, contact of relay 1302, contact 1 of relay 1303 to ground. Relay 300 locks through the windings of relays 815 and 816 in the usual manner, the latter relays operating when the reverse battery is removed at the distant office.

Relay 815 closes a circuit from battery through the winding of relay 812, contact 2 of relay 806, front contact of relay 815 to ground over conductor 824 as previously traced. Relay 812 operates relay 813, which opens the out-pulsing circuit as did relay 816. Relay 813 closes an obvious circuit for relay 803 and also closes a circuit from battery through the winding of relay 802, contact 4 of relay 813, contact 5 of relay 806, to ground at contact 6 of relay 705.

With relay 802 operated, the out-pulsing tip conductor 231 is connected over contact 2 of relay 703, contact 5 of relay 705, conductor 719, contact 12 of relay 1616, conductor 1622, contact 5 of relay 802, through resistance 706, contact 7 of relay 705, contact 1 of relay 703 to the out-pulsing ring conductor 232 to supply a closure for the distant selector or sender. At contact 4, relay 802 disconnects that part of the out-pulsing circuit which extends through relay 1302 or 1312 so that these relays cannot operate in this simulated trunk closure.

Relay 813, in operating, opened the locking circuit for relay 808 and that relay releases. With relay 808 released and relay 802 operated, all circuits for relays 300, 815 and 816 are opened and these relays release. The release of relay 815 opens the circuit for relay 812 which releases, in turn releasing relay 813. With relay 802 operated and relay 813 released the circuit of relay 803 is opened and that relay releases slowly.

When relay 803 recloses its contact, the trouble release conductor 237 is grounded over contact 6 of relay 1304, back contact of relay 803, contact 2 of relay 802 and contact 6 of relay 705. This causes the release of relays 809 and 1700 and any relays which may be locked under the control of relay 809 or receive battery over its contacts. Relay 804 is also released, in turn releasing relays 806, 814 and 802. With relay 802 released ground is disconnected from conductor 237 and a marker is summoned for a second or third trial.

Telltale from originating office

If in receiving a registration from the originating sender more than ten pulses are sent out, the eleventh pulse, being an odd pulse, grounds conductor 1717 as previously described. Relay 1406 is locked and relay 1404 operated, from the tenth pulse. Ground on conductor 1717 therefore extends over contact 5 of relay 1404, contact 5 of relay 1406, conductor 1410 to the winding of relay 1609 and battery. Relay 1609 locks over its contact 5 to grounded conductor 1121.

If relay 1609 is operated during office brush selection it may be the result of a previous call

indicator call which was not completed because of slow dialing, or it may be caused by trouble on a new call indicator or full selector call. Since the resulting action would differ in the two cases, the tandem sender makes a test to determine which of the two conditions exists.

To do this, relay 1609 closes a circuit from ground at its contact 5, contact 8 of relay 1213 which has not yet operated, winding of relay 1616 and battery. Relay 1616 locks to grounded conductor 1124. With relay 1616 operated, the circuit of relay 1615 is opened and that relay releases slowly. At contact 2, relay 1616 grounds conductor 813 to operate relay 809 and summon a marker. With relay 1616 operated, ground on conductor 1124 is extended to conductor 1624 to cause the marker to select an overflow trunk.

When the marker transmits its release signal, permitting relay 326 to operate, a circuit is closed from ground, contact 4 of relay 326, conductor 349, right back contact of relay 1615, conductor 1730, contact 5 of relay 614, conductor 626, contact 1 of relay 1213, conductor 1216, back contact of relay 615, contact 1 of relay 708 to the winding of relay 607 and battery. Relay 607 disconnects relays 1702 and 1112 from the incoming tip and ring conductors 234 and 235 and connects conductor 234 over contact 1 of relay 603, contact 1 of relay 604, left contact of relay 606, upper winding of relay 602, contact 3 of relay 607, resistance 608, contact 6 of relay 608, lower winding of relay 602, right contact of relay 606, contact 5 of relay 604, contact 10 of relay 603 to conductor 235.

If the operation of relay 1609 was due to a prior call indicator call which reselected a tandem sender when all digits were dialed, the originating sender will be in a position to send out code pulses. Relay 607 by disconnecting the tip and ring conductors from battery and ground through relays 1702 and 1112 and connecting them together through resistance 608, has the effect of an artificial assignment, causing the originating sender to send out the code pulses followed by the heavy positive pulse. Relay 602 operates in response to this positive pulse.

Relay 607 in operating also grounds conductor 627, operating relay 1507 which starts a new timing cycle as will be described hereinafter. Relay 1507 also closes a circuit from ground over contact 3, conductor 1528, contact 4 of relay 708, conductor 722, contact 7 of relay 1616, conductor 630, winding of relay 1517 and battery. At the end of four to five seconds relay 615 operates.

If relay 602 operates and releases before the end of the time interval, the tandem sender will release in the usual manner. If relay 602 does not operate, it indicates that the originating sender is in position to make either office brush or office group selection but, since because of trouble it cannot be satisfied by reverte pulses, must receive a reverse battery pulse to release.

When relay 615 operates at the end of the above period, it locks to grounded conductor 1120 and closes a circuit from battery through the winding of relay 1704, conductor 727, left front contact of relay 615, conductor 1216, and thence to ground at contact 4 of relay 326 as above traced. Relay 1704 operates relay 1602 which transmits a pulse of reverse battery to the originating sender in the usual manner. This should cause the originating sender to advance to bring about its release. The tandem sender proceeds to cause the trunk to connect through

to the overflow trunk, accept trunk closure and release.

If this reverse battery pulse does not advance the originating sender, the timing circuit will release the tandem sender.

If relay 1609 is operated during office group selection, it is probably the result of trouble in the originating sender. Relay 1609 will operate relay 1616 and release relay 1615 as above, summoning a marker and grounding conductor 1624 to cause the marker to select an overflow trunk. When the office brush cross-point was closed, it completed a circuit for relay 708 as before. With relay 708 operated, relay 1609 closes a circuit from ground over contact 7 of relay 1609, conductor 1625, contact 3 of relay 708, conductor 723, winding of relay 1512 and battery. Relay 1512 closes an obvious circuit for relay 1514.

As before, the release of the marker permits relay 326 to operate, grounding conductor 349 and completing a circuit as traced above to the left back contact of relay 615, which extends, with relay 708 operated, over contact 2 of relay 708, contact 10 of relay 704 to the winding of relay 712 and battery. Relay 712 grounds conductor 727 to operate relay 1704. Relay 1704 operates relay 1602 and the reversed battery cycle and tandem sender release take place as previously described. Relay 1512 connects ground to conductor 714 to discharge the incoming cable before relay 1514, in operating, disconnects relay 1702 from the trunk. This operation prevents a false reverse battery pulse at the originating sender due to cable capacity.

Abandoned call

If a call is abandoned during office selections, the originating sender opens the counting relay circuit so that the tandem sender is allowed to continue to send pulses until relay 1609 operates, after which the tandem sender functions as just described.

If a call is abandoned after the connection has been established with the tandem sender and the office registration made, the action differs according as the terminating office is a full selector or a call indicator office.

In the case of a call indicator call, the tandem sender will function as for a completed call since the originating sender sends out a complete set of pulses.

For a full selector call, the originating sender will not open the in-pulsing circuit and pulsing will continue until relay 1609 is operated. Relay 1609, operating after office group selection, short-circuits relay 1112 to stop the pulsing and closes a circuit from ground over its contact 5, contact 7 of relay 1213, winding of relay 1304 and battery.

Relay 1304 at contact 3 opens the circuit of relay 300 so that the selector or sender at the terminating office cannot cause the tandem sender to open the out-pulsing circuit and is therefore driven to telltale. The pulse of reversed battery sent out by the distant office operates relay 804, and the tandem sender functions as described for telltale due to trouble at the distant office.

In the previous case the marker was called in and given a second trial indication. In this case, a marker is called in to connect the trunk to the battery and ground required to make the trunk closure, furnished by the originating sender, effective in the tandem trunk.

When relay 803 releases as previously described, a circuit is closed from ground at con-

tact 6 of relay 705, contact 2 of relay 302, contact of relay 803, contact 5 of relay 1304, conductor 1331, to the winding of relay 1616 and battery.

Relay 1616 locks to conductor 1124 at contact 6 and at contact 4 connects conductor 1124 to conductor 1624 to give an overflow signal to the marker. During the releasing time of relay 1615 ground from conductor 1124 is connected over contact 7 of relay 1610, contact 10 of relay 1616, front contact of relay 1615, contact 4 of relay 1213 to trouble release conductor 237, operating relay 1710, followed by relay 1711 when relay 1615 opens its contact. Relay 1710 releases relays 809, 1700 and the relays held thereby, while relay 1711 reoperates relay 809 to summon another marker.

After the marker has seized a reorder trunk in response to the grounding of conductor 1624, relays 1700, 336 and 326 operate as described. Relay 326 at contact 4 grounds conductor 349, completing a circuit over the right contact of relay 1615, conductor 1730, contact 5 of relay 614, conductor 626, contact 2 of relay 1213, winding of relay 712 and battery. Relay 712 operates relay 1704, which operates relays 1602 and 1601.

With relay 712 operated, relay 1609 is locked over its contact 2, conductor 1623, left front contact of relay 712, back contact of relay 713, conductor 1721 to ground at the back contact of relay 1702. Therefore the reverse pulse is not terminated until the in-pulsing circuit is closed long enough for relay 1702 to operate and release relay 1609.

Trouble timing

In general, trouble conditions are disposed of by causing the originating sender to give the subscriber an overflow signal or the operator a reorder signal by transmitting a premature reverse battery signal thereto, or by extending the connection to a reorder trunk in the tandem office.

For the purpose of timing for trouble, four interrupters are employed, namely interrupters 1516, 1515, 1606 and 1505. Interrupter 1516, when used with relays 1204, 1207, 1208, 1209 and 1210, provides a four to five-second interval. Interrupter 1515 with these same relays provides intervals of from twenty to forty seconds, forty to sixty seconds or sixty to eighty seconds. Interrupter 1606 with relay 1607 provides an interval of one to two seconds, while interrupter 1505 with relays 1506 and 1502 provides an interval of from three to six seconds.

When relay 1109 operates at the beginning of a call, grounding conductor 1120, ground is connected to interrupter 1516, over the left back contact of relay 1211, and conductor 1217. When interrupter 1516 closes its contact, it extends ground to conductor 1530 over contact 1 of relay 1113, conductor 1128, normal contact and winding of relay 1204 to battery through resistance 1205. Relay 1204 locks over its alternate contact, conductor 1218 and the right back contact of relay 1211 to grounded conductor 1120, and closes a circuit from battery through resistance 1206, winding of relay 1207, alternate contact of relay 1204 to ground on conductor 1218. Relay 1207 is shunted by ground on conductor 1128 over its left back contact. When the interrupter opens, relay 1207 operates.

The next closure of ground to conductor 1128 closes a shunt around the winding of relay 1204 over the left front contact of relay 1207 to resistance 1205. Relay 1204 releases but relay 1207 is held over the normal contact of relay 1204. When the interrupter opens for the second time,

relay 1207 also releases. This cycle continues as long as the interrupter is grounded.

Each time that relay 1207 operates, ground from conductor 1218 is connected to conductor 1220. The first grounding of conductor 1220 operates relay 1208 which locks and prepares the circuit of relay 1209. When relay 1207 releases, relay 1209 operates, closing a circuit from ground on conductor 1218, contact 4 of relay 1209, winding of relay 1210 and battery. Relay 1210 locks to conductor 1218. At the second operation of relay 1207, relay 1208 releases and when relay 1207 releases, relay 1209 also releases. With interrupter 1516 in use relay 1208 operates within one second after the interrupter is grounded, and four seconds elapse between the first and second operations of relay 1208.

If office brush and group selections are received within this time, the operation of relay 1213 over the office group cross-point closes a circuit for relay 1214, which disconnects ground from interrupter 1516. Relay 1214 also disconnects conductor 1120 from conductor 1218 to release the locked timing relays.

When the timing relays have released, a circuit is closed from battery through the winding of relay 1508, contact 1 of relay 1507, conductor 1531, back contacts of relays 1204, 1207, 1208, 1209 and 1210, front contact of relay 1211 to grounded conductor 1120. Relay 1508 locks over contact 4 to conductor 1120 and extends ground from that conductor over contact 3 of relay 1508, contact 5 of relay 1507, conductor 1533, contact 11 of relay 700, contact 6 of relay 707 to conductor 1218 to again provide locking ground for the timing relays. From conductor 1218 a branch extends over contact 3 of relay 707, conductor 1529, left back contact of relay 1517 to interrupter 1515. With relay 1508 operated, the contact of interrupter 1515 is connected over contact 2 of relay 1508 to conductor 1530 to prepare the timing relays to measure a forty-second or longer cycle.

If, during the timing interval measured by interrupter 1516, relays 1213 and 1211 have not operated, when relay 1208 operates for the second time a circuit is closed from grounded conductor 1120, right contact of relay 1211, right contact of relay 1210, contact 3 of relay 1208, contact 1 of relay 1209, conductor 1219, winding of relay 615 and battery. Relay 615 locks to conductor 1120 and closes a circuit from battery through the winding of relay 710, conductor 724, contact 7 of relay 605, outer right contact of relay 615, conductor 629 to ground at contact 9 of relay 1609. Relay 710 closes an obvious circuit for relay 713 which connects ground to conductor 727, operating relay 1704. Relay 1704 brings about the release of the tandem sender as previously described. Relay 710 also connects ground to contact 3 of relay 703 to bring about the operation of relay 114 as did relay 1212.

Since interrupter 1515 has a twenty-second period, relay 1204 operates from zero to twenty seconds after the interrupter is grounded. Twenty seconds later relay 1210 operates. At the end of forty seconds relay 1208 releases and ground is extended from conductor 1218 over the right contact of relay 1210, contact 2 of relay 1208 and contact 5 of relay 1209 to conductor 1221. At the end of sixty seconds relay 1209 also releases and ground is extended over contact 7 of relay 1209 and contact 1 of relay 1208 to conductor 241. When eighty seconds have elapsed relay 1208 reoperates and ground

extends from the front contact of relay 1210, over contact 3 of relay 1208 and contact 1 of relay 1209 to conductor 1219.

If the call being handled by the tandem sender is a full sector call, the sender should release within a forty to sixty-second interval following the operation of relay 1508. If the sender releases, all of the time relays release.

If the sender does not release promptly, the grounding of conductor 1221, as above traced, completes a circuit over contact 1 of relay 1508, back contact of relay 1517, conductor 1532, back contact of relay 1200, right winding of relay 1202 to battery. Relay 1202 locks through its left winding and contact 3 to grounded conductor 616 and extends its operating ground over its contact 4, contact 9 of relay 1212, contact 8 of relay 704, contact 10 of relay 705, conductor 725, contact 7 of relay 1701, contact 9 of relay 1616, right back contact of relay 1603, contact 1 of relay 1609, left winding of relay 1608 to battery. Relay 1608 locks over contact 5 to conductor 1120 and at contact 1 grounds conductor 1626, operating relay 1304 which disposes of the call as described for an abandoned call.

Relay 1608 also connects grounded conductor 1120 to conductor 627 and the winding of relay 1507. Relay 1507 operates, and at contact 5 disconnects ground from conductor 1533, thereby removing ground from interrupter 1515 and the locking circuit of the timing relays. When the timing relays release, a circuit is closed from battery through the winding of relay 709, contact 3 of relay 708, contact 1 of relay 707, conductor 726, contact 2 of relay 1507, conductor 1531 and thence over back contacts of the timing relays and the front contact of relay 1211 to grounded conductor 1120 as previously traced. Relay 709 locks to conductor 1120 and connects its locking ground over contact 11 of relay 700 and contacts 6 and 3 of relay 707 to conductors 1218 and 1529 to start a new timing cycle.

Relay 1507 also closes a circuit from grounded conductor 1120, contact 3 of relay 1508, contact 4 of relay 1507, contact 3 of relay 1618 to the winding of relay 1603 and battery.

If the sender releases, the timing relays release too. If the release does not take place promptly, when relay 1208 releases grounding conductor 1221 as before, this conductor extends as previously traced over contact 4 of relay 1202, to contact 9 of relay 1616, and thence over the right front contact of relay 1603, conductor 724 to the winding of relay 710 and battery. Relay 710 functions as above described to bring about the release of the tandem sender.

In the case of a call indicator call, the forty to sixty-second interval is measured to permit the originating sender to complete dialing and set up the circuit for trunk test, in which circuit relay 600 normally operates. If relay 600 operates properly it in turn operates relay 613 as previously described. Relay 613 at its contact 5 grounds conductor 625, operating relay 1507 over contact 1 of relay 1701 and conductor 627. Relay 1507 releases the timing relays and disconnects ground from interrupter 1515. When the timing relays have released, relay 709 is operated as described, grounding interrupter 1515 to start another timing interval during which assignment should take place. If assignment is made within the allowable time, the sender will restore in the usual manner.

If relay 600 does not operate within the first measured interval, the grounding of conductor

1221 operates relay 1202 as previously traced. Relay 1202 extends its operating ground over its contact 4, contact 9 of relay 1212, contact 7 of relay 704, (relay 704 being operated in connection with a call indicator call), contact 1 of relay 613, conductor 724 to the winding of relay 710 and battery. Relay 710 closes an obvious circuit for relay 713, in turn operating relay 1704 to bring about the release of both senders.

The interval allowed after the operation of relays 600 and 613 for assignment to take place is sixty to eighty seconds. The timing relays function to operate relay 1202, but relay 1202 is ineffective due to the operation of relay 613. When, twenty seconds later, conductor 241 is grounded, if assignment has not taken place, a circuit is closed from battery through the right winding of relay 614, contact 2 of relay 605, left back contact of relay 618, contact 6 of relay 613 to conductor 241. Relay 614 locks over its contact 3 to conductor 1120 and extends its locking ground to the winding of relay 700.

Relay 700 at contact 1 connects battery through resistance 701 to the upper windings of relays 602 and 600 and thence to the incoming tip conductor 234, while at contact 9 it connects ground to the lower windings of relays 602 and 600 and the incoming ring conductor 235. This prevents assignment at the distant office from becoming effective if it should take place at this time.

At contact 11 relay 700 opens the locking circuit for the timing relays and these relays release. When release is complete, a circuit is closed from grounded conductor 1120 over the timing relays to conductor 1531 as before, over contact 2 of relay 1507, conductor 726, contact 1 of relay 707, contact 4 of relay 700, winding of relay 1201 and battery. Relay 1201 locks to conductor 1120 and extends ground from that conductor, over contact 6 of relay 707 to conductor 1218 and over contacts 6 and 3 of relay 707 to conductor 1529 to start another timing cycle. At contact 8, relay 700 grounds conductor 1331 to operate relay 1616 to call in a marker and cause the call to be directed to a reorder trunk.

When the marker has functioned and released, relay 326 is permitted to operate. With relay 326 operated, ground is connected over its contact 4 to conductor 349, back contact of relay 1615, conductor 1730, contact 4 of relay 614, back contact of relay 615, contact 2 of relay 708, contact 9 of relay 704, contact 7 of relay 700 to the winding of relay 607 and battery.

Relay 607 locks over its contact 4 to ground over contact 5 of relay 700. At its contacts 3 and 6 it connects resistance 608 between the upper and lower windings of relays 600 and 602 and at contacts 1 and 7 disconnects battery and ground therefrom, thereby simulating assignment.

In response to this artificial assignment the originating sender should send out the call indicator pulses followed by the heavy positive pulse, operating relay 602 which will cause the sender to be restored in the usual manner.

In the tandem sender, artificial assignment causes relay 600 to release, in turn operating relay 605 as previously described. Relay 605, operated, at contact 5 closes a circuit for relay 707 which opens the operating and locking circuits for the timing relays. When these relays have released, they connect ground to conductor 726 as before, completing a circuit over contact 2 of relay 707 to the winding of relay 1200 and battery. Relay 1200 locks to conductor 1120 and

extends ground from that conductor over its inner front contact and contact 4 of relay 707 to conductor 1218 and also over contacts 4 and 5 of relay 707 to conductor 1217 and interrupter 1516.

The timing relays under the control of interrupter 1516 measure a four to five-second interval within which relay 602 should operate. If relay 602 fails to operate, the timing relays ground conductor 1219, operating relay 615. Relay 615 operates relay 1704 which causes the release of both senders.

If, when relay 700 operated, in turn operating relay 1616 to call in a marker to route the call to a reorder trunk, the timing relays continue to function until conductor 1221 is grounded, the previously traced circuit will be closed to battery through the right winding of relay 1202. Relay 1202 locks to conductor 616 and extends its operating ground as before to the winding of relay 710 and battery. Relay 710 causes the sender to release and causes relay 114 in the trunk to operate as previously described.

In the case of a call to an operator's position, relays 1701 and 609 are operated, and after the marker releases relay 1507 is operated in a circuit over conductor 627, contact 6 of relay 1712, contact 5 of relay 1701, conductor 349 to ground at contact 4 of relay 326 when that relay operates for trunk test. Relay 1507 releases the timing relays and operates relay 709 when the release is complete. In addition, relay 1507 grounds conductor 1523, completing a circuit over the right front contact of relay 609, conductor 630, to the winding of relay 1517 and battery. With relay 1517 operated, interrupter 1516 is substituted for interrupter 1515 so that a four to five-second interval is measured for the completion of trunk test and the release of relay 1507 instead of the longer periods used for other types of call. If the timing cycle is completed, relay 615 is operated, in turn operating relays 710, 713 and 1704 to bring about the release of the sender.

In the case of a full selector call, the trunk test is timed by means of interrupter 1505. In such calls, relay 705 is operated as soon as relay 326 is operated to control trunk test, and relay 808 is operated as soon as the incoming group has been recorded. With relays 705 and 808 operated, ground is connected over contact 4 of relay 808, contact 9 of relay 705, contact 2 of relay 800, contact 1 of relay 1304, left contact of relay 1710, conductor 1731 to interrupter 1505, to start the measurement of a three to six-second interval. When interrupter 1505 closes its right contact it operates relay 1506 which locks directly to conductor 1731. When the interrupter closes its left contact it extends ground from conductor 1731 over the right contact of relay 1506, contact 1 of relay 1502, conductor 1534 to the winding of relay 810 and battery. Relay 810, if operated, locks over its contact 3 to ground at contact 6 of relay 705. The operation of relay 810 causes relay 811 to start to release. Relay 810 at contact 4 opens the circuit of relay 809 which is also open at the contact of relay 811 until the latter relay completes its slow release. Relay 809 releases relay 1700. When relay 811 closes its back contact, relay 809 reoperates to call in a marker. With relay 810 operated, ground is connected over contact 6 of relay 705, contact 2 of relay 810, conductor 830, left back contact of relay 1603, contact 1 of relay 1711, to conductor 1732 leading to the marker connector to inform the marker that a trouble indicator

record is to be made. After this record has been made, the marker grounds the trouble release conductor 237, permitting the sender to make a second trial. On a second trial, the operated condition of relay 1710 disconnects ground from interrupter 1505 and a failure at this time would await the end of the longer time interval measured by relays 1204, etc., as above described.

Interrupter 1505 also serves to measure a time interval for the check of trunk closure and the release of the sender. When relay 1502 operates to operate relay 115 in the trunk, it also grounds interrupter 1505. Interrupter 1505 operates relay 1506 as before. After three seconds, with relays 1506 and 1502 operated, a circuit is closed for relay 1113 which brings about the release of the sender.

If a call has been abandoned, during incoming and final selections, after the in-pulsing circuit has been closed long enough to operate relays 1702, 1706 and 1703 and release relay 1705, but before any pulses have been sent for the ensuing selection, the opening of the in-pulsing circuit at the originating end will release relays 1702, 1706 and 1703 but since no pulses were recorded, relay 1705 does not operate. Therefore, when this circuit is reclosed for the purpose of recording a telltale condition preparatory to releasing, relay 1702 can operate but relay 1706 can not. With relay 1702 operated, a circuit is closed from ground, front contact of relay 1702, conductor 1715, contact 1 of relay 1514, conductor 1520, contact 12 of relay 1703, contact 1 of relay 1705, contact 7 of relay 1602, contact 6 of relay 1213, to interrupter 1606. When interrupter 1606 closes its right contact it operates relay 1507 which locks under the control of relay 1702 and when the interrupter closes its left contact it closes a circuit over the right contact of relay 1607 to the winding of relay 1609 and battery. Relay 1609 closes a circuit from ground over its contact 5, contact 7 of relay 1213, conductor 1626 to the winding of relay 1304 and battery. Relay 1304 functions as previously described to restore the terminating and tandem equipment.

Stuck sender lamp 220 is lighted under two conditions. When conductor 1518 was grounded it completed a circuit over contact 6 of relay 1113 to the winding of relay 610 and battery. When relay 1113 operates to release the sender, relay 610 releases slowly and if the sender does not release promptly, closes a circuit from grounded conductor 1518 over contact 5 of relay 1113, right contact of relay 610, conductor 631 to lamp 220 and battery. Another circuit for lamp 220 extends from conductor 631 over contact 1 of relay 605, contact 3 of relay 613, conductor 632 to ground over contact 5 of relay 1202. This circuit is closed while waiting for assignment and after the timing has gone on for forty to sixty seconds, at which time relay 1202 is operated.

Ordinarily the sender times sixty to eighty seconds before making an artificial assignment, but if a sender overload condition exists and the lighting of the sender busy lamps indicates a large number of slow assignments, plug 240 may be inserted in jack 218, operating relay 219 which closes a circuit from ground on conductor 1218, right front contact of relay 1210, contact 6 of relay 1209, conductor 1222, contact of relay 219, to conductor 241, and thence as previously traced to the winding of relay 614, operating relay 614 at the end of the twenty to forty-second period, when relay 1209 operates instead of waiting for

its release at the end of sixty to eighty seconds.

Registers 213, 215 and 217 are common to a group of ten senders and are operated by relays 212, 214 and 216, respectively. Relay 214 and register 215 operate if there is a delay in completing a call, due to failure of the originating sender. When conductor 1518 was grounded and relay 610 operated as above described, a circuit was also closed from battery through the winding of relay 1203, contact 1 of relay 1202, contact 1 of relay 614, front contact of relay 610 to grounded conductor 1518. As set forth above, after the marker has operated to determine the type of call, the timing circuit is operated under the control of interrupter 1515 to measure time intervals from twenty to forty, sixty or eighty seconds. At the end of the forty to sixty-second interval relay 1202 is operated, permitting relay 1203 to release slowly. With relay 1202 operated and before relay 1203 releases, a circuit is closed for relay 214, the circuit depending on the type of call. For a full selector call, if the incoming registration has not been completed, so that the final units hold magnet 507 has not operated, the circuit of relay 214 extends over conductor 242, back contact of magnet 507, conductor 503, contact 2 of relay 705, inner left contact of relay 1203, contact 2 of relay 1202, contact 1 of relay 614, front contact of relay 610 to grounded conductor 1518. When relay 1203 releases, this circuit is opened so that only one registration is made on meter 215.

In the case of a call indicator call, with relay 705 normal and relay 704 operated, if relay 600 fails to operate, and operate relay 613 within the forty to sixty-second time interval, the circuit of relay 214 extends over conductor 242, contact 8 of relay 613, contact 4 of relay 704, contact 1 of relay 705 to the inner left contact of relay 1203 and ground as above traced.

It will be remembered that, during a call indicator call, if relay 600 operates but does not release due to failure of assignment, the timing relays normally measure a sixty to eighty-second interval, which may be shortened to twenty to forty seconds by the insertion of plug 240 in jack 218. At the end of the interval relay 614 is operated. This relay in operating also opens the circuit of relay 1203, but before relay 1203 releases closes a circuit from grounded conductor 1518, front contact of relay 610, contact 2 of relay 614, right contact of relay 1203, conductor 243 to the winding of relay 212 and battery. Relay 212 operates during the releasing time of relay 212 to operate meter 213.

Relay 216 and meter 217 operate to indicate a stuck sender condition. The operating circuit extends over conductor 244, contact 3 of relay 704, contact 1 of relay 705 to the inner left contact of relay 1203 and over contact 2 of relay 1202 to ground as above traced if relay 1202 operates before a marker is seized and sets the class relays. It extends over the outer left contact of relay 1203 and the left back contact of relay 610 to grounded conductor 1518 if the sender fails to release after the operation of relay 1113. It extends over contact 7 of relay 613, contact 4 of relay 704, contact 1 of relay 705 to ground over the inner left contact of relay 1203 as above if relay 1202 operates because artificial assignment fails to release the sender. In addition, it extends over the front contact of final units hold magnet 507 to conductor 503 and thence to ground if the sender fails to release.

If, for incoming brush, incoming group or final

brush registration an unused cross-point is closed, ground will be connected to conductor 1410, operating relay 1609 which functions as described for other troubles due to the originating sender.

What is claimed is:

1. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, and means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted by said originating office registering device to said tandem office or to said terminating office.

2. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted to said tandem office or to said terminating office, means at said terminating office for signaling said originating office registering device to transmit said numerical designation and to then release, and means in said tandem office registering device for signaling said originating office if said terminating office fails to function promptly.

3. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted to said tandem office or to said terminating office, means in said tandem office registering device for establishing a pulsing circuit between said originating office and said terminating office, polarized relays in said pulsing circuit, means responsive to the establishment of said pulsing circuit for operating one of said relays, and means responsive to the complete transmission of said

numerical designation to operate another of said relays.

4. In a telephone system an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted to said tandem office or to said terminating office, means in said tandem office registering device for establishing a pulsing circuit between said originating office and said terminating office, a pair of polarized relays in said pulsing circuit, means responsive to the establishment of said pulsing circuit for operating one of said relays, means responsive to the complete transmission of said numerical designation to operate the other of said relays, and means in said tandem office registering device for establishing local circuits for said relays.

5. In a telephone system an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted to said tandem office or to said terminating office, means in said tandem office registering device for establishing a pulsing circuit between said originating office registering device and said terminating office, a pair of polarized relays in said pulsing circuit, means responsive to the establishment of said pulsing circuit for operating one of said relays, means responsive to the complete transmission of said numerical designation to operate the other of said relays, timing means in said tandem office registering device and means under the control of said timing means for establishing local circuits for said relays.

6. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted to

said tandem office or to said terminating office, means in said tandem office registering device for establishing a pulsing circuit between said originating office and said terminating office, polarized relays in said pulsing circuit, means responsive to the establishment of said pulsing circuit for operating one of said relays, means at said terminating office for releasing said one relay to start the pulsing, and means in said tandem office registering device for preventing the reoperation of said one relay in response to said pulsing.

7. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted to said tandem office or to said terminating office, means in said tandem office registering device for establishing a pulsing circuit between said originating office and said terminating office, a pair of polarized relays in said pulsing circuit, means responsive to the establishment of said pulsing circuit for operating one of said relays, means at said terminating office for releasing said one relay to start the pulsing, means in said tandem office registering device for preventing the reoperation of said one relay in response to said pulsing, timing means in said tandem office registering device, means under the control of said timing means to render said relays independent of said terminating office and to establish local circuits for operating said one relay, for releasing said one relay and for operating said second relay.

8. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means in said tandem office registering device under the control of said identifying means for transmitting said numerical designation to said terminating office, means at said terminating office responsive to the complete transmission of said designation to transmit a reverse battery pulse to said tandem office, and means in said tandem office registering device responsive to said reverse battery pulse from said terminating office to transmit a reverse battery pulse to said originating office registering device.

9. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an

office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means in said tandem office registering device under the control of said identifying means for transmitting said numerical designation to said terminating office, means at said terminating office responsive to the complete transmission of said designation to transmit a reverse battery pulse to said tandem office, means in said tandem office registering device responsive to said reverse battery pulse from said terminating office to transmit a reverse battery pulse to said originating office, timing means in said tandem office registering device and means under the control of said timing means for transmitting said reverse battery pulse to said originating office registering device if no reverse battery pulse is received from said terminating office.

10. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means in said tandem office registering device under the control of said identifying means for transmitting said numerical designation to said terminating office, means at said terminating office responsive to the complete transmission of said designation to transmit a reverse battery pulse to said tandem office, means in said tandem office registering device for transmitting reverse battery to said originating office to cause the registering device thereof to release, means normally under the control of the reverse battery pulse from said terminating office for operating said reverse battery transmitting means, and timing means in said tandem office registering device for operating said reverse battery transmitting means independent of said terminating office.

11. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means in said tandem office registering device under the control of said identifying means for transmitting said numerical designation to said terminating office, means at said terminating office responsive to the complete transmission of said designation to transmit a reverse battery pulse to said tandem office, means in said tandem office registering device for transmitting a reverse

battery pulse to said originating office to cause the registering device thereof to release, means normally under the control of the reverse battery pulse from said terminating office for operating said reverse battery transmitting means, timing means in said tandem office registering device for operating said reverse battery pulse transmitting means independent of said terminating office, and means in said tandem office registering device for terminating said reverse battery pulse if said timing means operates due to failure of said originating office registering device.

12. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means in said tandem office registering device under the control of said identifying means for transmitting said numerical designation to said terminating office, means at said terminating office responsive to the complete transmission of said designation to transmit a reverse battery pulse to said tandem office, means in said tandem office registering device for transmitting reverse battery to said originating office to cause the registering device thereof to release, means normally under the control of the reverse battery pulse from said terminating office for operating said reverse battery transmitting means, timing means in said tandem office registering device for operating said reverse battery transmitting means independent of said terminating office, and means to prevent the termination of said reverse battery if the connection with the terminating office was not established.

13. In a telephone system, an originating office, a tandem office, a terminating office, switching equipment at each of said offices, registering devices at each of said offices, means in the registering device at said originating office for recording a telephone designation comprising an office designation and a numerical designation, means for transmitting a registration based on said office designation to said tandem office registering device, means at said tandem office registering device for receiving said registration and for identifying the nature of the terminating office, means under the control of said identifying means for determining whether the numerical designation registered on the registering device of said originating office shall be transmitted to said tandem office or to said terminating office, a normally operated relay for initiating the release of said tandem office registering device, means for releasing said relay under the control of the terminating office if said tandem office registering device transmits the numerical designation to the terminating office, and means for releasing said relay under the control of said originating office if said originating office transmits the numerical designation to the terminating office.

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