

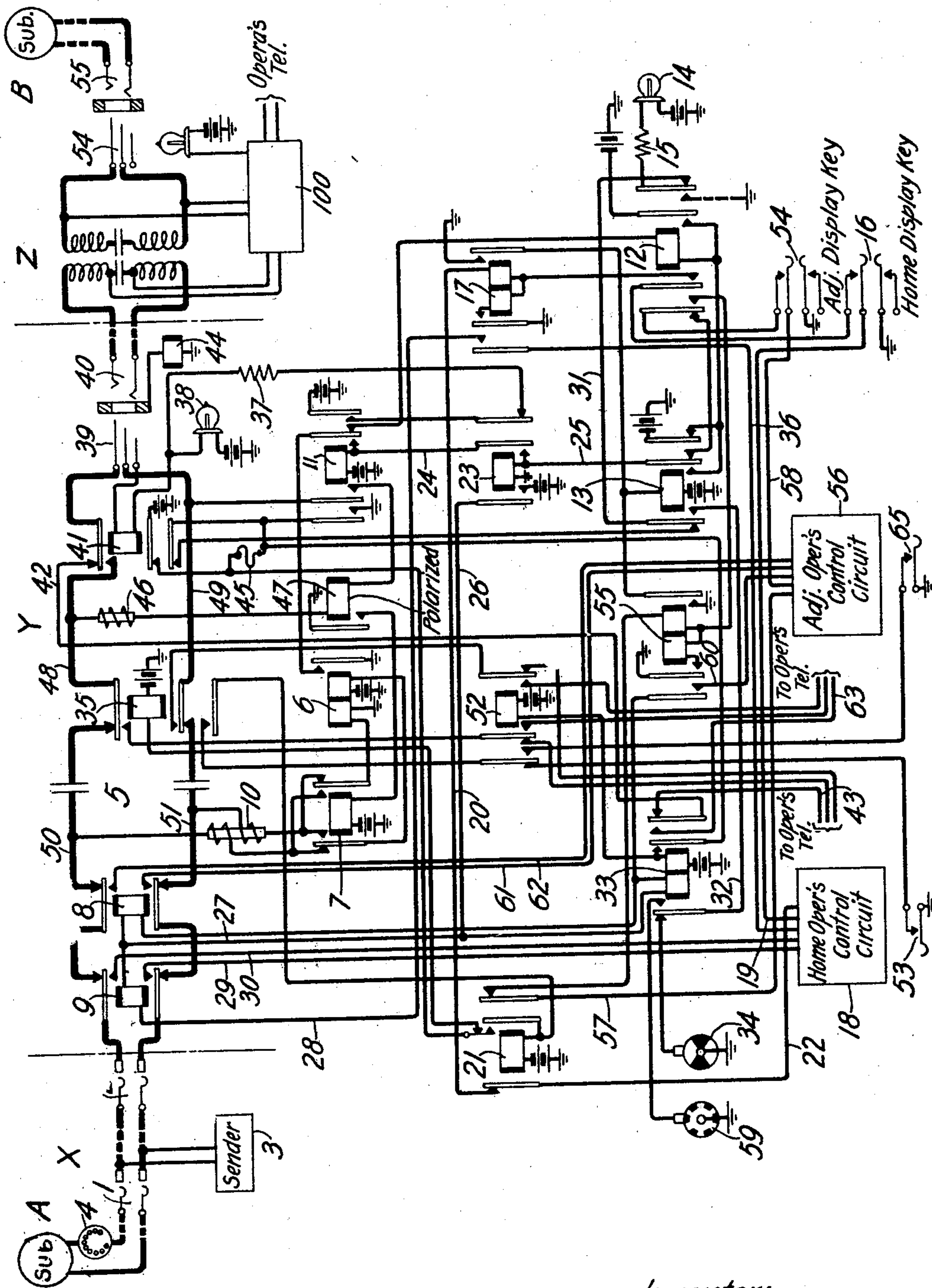
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G. H. PETERSON

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TRUNK CIRCUITS

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UNITED STATES PATENT OFFICE.

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TRUNK CIRCUITS.

Application filed February 25, 1926. Serial No. 90,644.

This invention relates to telephone exchange systems in which connecting operators are employed for extending connections, with indicating mechanisms at such operators' positions to identify the designations of desired lines.

In systems where certain offices are equipped with mechanical switching apparatus, whereas other offices employ manual operators for establishing connections, it is found desirable that the manual operators be given the information required for them to extend or complete the connections incoming from the mechanical office without the necessity of communicating orally with the calling subscriber. To this end each operator's position, in the manual office, is provided with call indicator mechanism, including a set of number indicating devices, which is operated automatically under the control of registering mechanism in the mechanical office, to inform the manual operator of the number and character of the required connection. It is customary, in arrangements of this character, to provide each trunk circuit incoming to an operator's position from the distant mechanical office with a signal lamp, the illumination of which advises the operator that a call is awaiting her attention on the corresponding trunk. At her convenience she associates the calling trunk with the common indicating mechanism at her position, and thereupon the wanted designation is set up and displayed before the operator, who proceeds to complete the connection.

Where no attempt is made to secure a uniformity in the distribution of the calls to the several operators in an office of this character, it may frequently occur during busy hours of the day, that an excessive number of calls simultaneously appear on the trunks of any given operator's position, while at a position adjacent thereto only a comparatively few calls are awaiting attention. In order that the completion of calls shall not be unduly delayed on this account, provision is made whereby an operator adjacent to a home operator's position may assist the home operator by attending to some of the calls at her position.

In systems of this character it may further be undesirable because of cost to extend direct trunks from each office having me-

chanical switching apparatus to each manual terminating office. In such a case, tandem offices are provided which are directly accessible from originating mechanical offices, at which tandem offices are located operators' positions equipped with number indicating devices. These operators, in turn, trunk desired connections to terminating manual offices in which subscribers' lines, the numbers of which are indicated on the number indicating mechanism, terminate. It then becomes necessary for the tandem operator to converse with the terminating manual operator to inform her of the desired line number. It is desirable that this be done over the established connection between the operators' positions without the knowledge of the calling subscriber, and this is done by splitting the trunk at the tandem position and connecting the tandem operator's telephone circuit to the calling end of the trunk circuit at her position.

Where provision is made to enable an operator at a position, adjacent to the home position on which a call is incoming from a mechanical office, to attend to calls at the home position, it is necessary upon splitting the trunk circuit to connect the adjacent operator's telephone circuit to the trunk circuit rather than the home operator's telephone circuit.

It is therefore the object of this invention to provide means for automatically splitting the incoming trunk circuit when it is plugged up to a trunk circuit outgoing to a terminating office, and for connecting the telephone circuit of the home or adjacent operator to the calling end of the trunk circuit dependent upon which operator has responded to the call.

The invention is illustrated in the accompanying drawing, wherein a calling subscriber's line is shown at the left of the drawing, terminating in an office X equipped with mechanical switching apparatus, and at the right of the drawing a called subscriber's line terminating in the manual office Z, connection being extended between the offices X and Z through a manual tandem office Y.

To simplify the disclosure the line switch 1, district selector 2 and sender 3 of the mechanical office X have been only diagrammatically illustrated. For a full disclosure

of this apparatus, reference may be made to the patent to F. A. Stearn 1,505,171, issued Augusts 19, 1924. At the tandem office Y an interconnecting trunk circuit incoming from the office X has been disclosed with the complete equipment thereof. The control and indicator circuits at the home and adjacent operators' positions, which may be connected to all of the incoming trunk circuits of these positions, have been illustrated by small rectangles in the lower portion of the drawing. This indicator mechanism may be of the type disclosed in the patent to A. E. Lundell and E. H. Clark No. 1,464,084, issued August 7, 1923.

The "B" operator's equipment shown in outline at office Z is fully disclosed in a co-pending application Serial No. 738,488, filed September 18, 1924, in the name of R. S. Bailey and E. P. Broe and a complete disclosure thereof herein is deemed unnecessary. It is thought that the invention may be best understood from a description of the manner in which a call is extended from substation A in office X to the substation B in office Z. Upon the removal of the receiver at substation A, the line switch 1 functions in the usual manner to select an idle district selector 2, and thereupon an idle sender, such as 3, becomes associated with the calling line. The calling subscriber then manipulates his calling dial 4 in accordance with the office and numerical designation of the desired line, whereupon the registers of the sender function in the usual manner to register the full line designation. Following the registration of the office portion of the designation, the sender operates to set the district selector 2 upon a group of trunks extending to the tandem office Y, through which access to the desired terminating office Z may be obtained. The selector 2 then proceeds to hunt for and seize an idle trunk 5 extending to such tandem office Y.

When the connection is extended to the trunk 5, a circuit is established for the relay 6 of the trunk 5, which may be traced in part from battery through the right winding of relay 6, the left back contact of relay 7, the upper winding of impedance coil 10, conductor 50, the upper back contacts of relays 8 and 9, thence through the selector 2 and the sender 3, returning through the lower back contacts of relays 8 and 9, conductor 51, the lower winding of coil 10, the right back contact of relay 7 to ground through the left winding of relay 6. Relay 6 energizes in this circuit and establishes a circuit for relay 12, which may be traced from battery, through the outer right back contact of relay 13, winding of relay 12, inner right back contact of relay 11 to ground at the contact of relay 6. Relay 12, upon energizing, closes a locking circuit for itself independent of the contact of relay 13, which

extends from battery through the inner right contact of relay 12, and thence to ground as traced at the contact of relay 6. At its outer right contact relay 12 establishes a circuit for lamp 14, from ground through auxiliary signaling apparatus (not shown), through the resistance 15, whereby the lamp 14 becomes lighted as a signal to the operator that a call is incoming on the trunk 5 at her position.

The home operator noting the illumination of lamp 14, depresses the display key 16 at her position, whereupon a circuit is established for relay 17 which may be traced from battery at control circuit 18, over conductor 22, the left contact of relay 21, conductor 20, the right winding of relay 17, the inner left contact of relay 12, upper contact of key 16, conductor 19, to ground at the control circuit 18. Relay 17 operating in this circuit locks directly to ground through both of its windings and its inner left contact, independently of key 16, and at its right contact closes an obvious circuit for relay 13. At its outer left contact, it prepares a circuit for relay 9. Relay 13, upon energizing, opens at its outer right contact the initial energizing circuit of relay 12, and closes at its inner right front contact a circuit for relay 23, which may be traced from battery, through the inner right contact of relay 12, the inner right front contact of relay 13, conductor 25, to ground through the winding of relay 23. Relay 23, upon energizing, extends conductor 25 through its inner right contact over conductor 24 through the winding of relay 11 to battery, thus placing the windings of relays 23 and 11 in series, but relay 11 cannot operate so long as battery is connected to conductor 25 at the inner right contact of relay 12.

With relays 17 and 23 both energized, a circuit is now effective for energizing relay 9 which may be traced from battery at the left contact of relay 23, over conductors 26 and 27, winding of relay 9, conductor 28, outer left contact of relay 17, conductor 36 to ground at the control circuit 18. The operation of relay 9 severs the incoming trunk conductors from the windings of relay 6, and connects these conductors over the front contacts of relay 9 and conductors 29 and 30 to the control circuit 18, thereby causing such an operation of the sender as to initiate the transmission of impulses to the control circuit 18 in accordance with the registrations recorded in the sender, to record the line designation in the control circuit 18 in the well-known manner.

The opening of the circuit of relay 6 by the operation of relay 9 causes the release of relay 6, and in turn, the release of relay 12. Relay 12, upon releasing, removes battery at its inner right contact from the conductor 25, thereby permitting relay 11 to become

energized in series with relay 23. With relay 12 released, the circuit of lamp 15 is transferred from steady ground at the outer right front contact of relay 12 to interrupted ground at interrupter 34, over a circuit which may be traced from battery, through lamp 14, resistance 15, outer right back contact of relay 12, conductor 31, left front contact of relay 13, conductor 32, left back contact of relay 33, interrupter 34 to ground. Lamp 14 then flashes as an indication to the operator that the call incoming on trunk 5 has received her attention and that the desired line designation is being recorded on her control circuit 18. Relay 11, upon energizing, prepares a circuit for the splitting relay 35, and also prepares a circuit for establishing a bridge across the calling end of the trunk circuit as will hereinafter be described.

After the complete number has become recorded in the control circuit 18, ground is removed at the control circuit from conductor 36 and relay 9 thereupon releases, disconnecting conductors 29 and 30 extending to the control circuit, from the incoming end of trunk 5 and again connecting the incoming end of the trunk to the windings of relay 6. Since the sender has now completed its functions, it now becomes disconnected from the district selector 2 and the calling line, and the calling line becomes connected with the incoming end of the trunk circuit 5. When relay 6 is again connected to the incoming end of the trunk circuit 5, it reenergizes and at its front contact, and the right inner front contact of relay 11, establishes a holding circuit for relay 11 and shunts the winding of relay 23, whereupon relay 23 deenergizes removing at its left contact the battery connection to the winding of relay 9 and also opening the initial energizing circuit of relay 11. At the outer right back contact of relay 23, a circuit is now closed in shunt of the disconnect lamp 38 extending through resistance 37, the outer right back contact of relay 23 and the outer right front contact of relay 11 so that the lamp 38 will not light when the operator inserts the plug 39 into jack 40.

The tandem home operator perceiving the complete number on her indicator, and noting that the office designation is for a line terminating in manual office Z, tests the jack 40 of a trunk extending to such office by touching the tip of plug 39 to the sleeve of the jack.

If the outgoing trunk is busy, she will receive a busy click in her telephone circuit over a circuit which may be traced from the tip of plug 39, through the upper back contact of relay 41, conductor 42, outer right back contact of relay 33, conductor 43, through the tone coil of her telephone circuit (not shown) in the usual manner. If the trunk is idle, as will be assumed, she in-

serts the plug 39 into the jack 40, thereby closing a circuit from ground, through coil 44, sleeve of jack 40, sleeve of plug 39, winding of relay 41, thence in parallel to battery through the lamp 38 and the resistance 37. Relay 41 operates in this circuit, but lamp 38 being shunted as above described does not light. Relay 41 upon energizing, disconnects the test conductor 42 from the tip of plug 39, and connects the tip of plug 39 to the tip conductor 48 of the trunk 5. Before the operation of relay 41, a shunt existed around the winding of relay 35 from battery, through the intermediate back contact of relay 41, intermediate normal contacts of relay 21 to battery through the winding of relay 35. Upon the energization of relay 41, this shunt is removed and relay 35 operates in a circuit from battery through its winding, intermediate contacts of relay 21, resistance 45 to ground at the outer left contact of relay 11.

Upon the operation of relay 41, a bridge is also established across the tip and ring conductors 48 and 49 of the trunk circuit extending from the tip of plug 39, upper front contact of relay 41, impedance coil 46, winding of polarized relay 47, inner left contact of relay 11 to the ring contact of plug 39, thus establishing a circuit extending to the office Z for supervisory purposes.

The operation of relay 35 severs the tip and ring conductors 48 and 49 of the calling end of the trunk circuit 5, from the incoming conductors 50 and 51 and connects conductors 48 and 49 through the upper and intermediate front contacts of relay 35, inner left and right back contacts of relay 52 to the talking conductors extending to the home operator's telephone circuit. The home operator may now converse with the "B" operator at the office Z, but the calling subscriber cannot hear the conversation. The home operator now gives the "B" operator the number of the desired called line as indicated on the indicator and control circuit 18.

After the tandem home operator has given the number, she depresses the wipe-out key 53, thereby establishing a circuit for relay 21 extending from battery, winding of relay 21, lower contact of relay 35, outer left back contact of relay 52 to ground at key 53. Relay 21 thereupon operates locking over its inner left front contact through resistance 45 to ground at the outer left contact of relay 11 and opening at its inner right contacts the energizing circuit of relay 35. Relay 35 thereupon deenergizes disconnecting the operator's telephone circuit from conductors 48 and 49 and establishing the continuity of the trunk circuit between the originating office X and the terminating office Z. At its left contact relay 21 opens the holding circuit of relay 17 which now releases, in turn,

opening the circuit of relay 13. Relay 13 upon releasing opens the previously traced flashing circuit for lamp 14 and the lamp becomes dark.

5 In response to the instructions given to the "B" operator at office Z, the "B" operator in the well-known manner extends the connection over plug 54 and jack 55 to the line of the desired subscriber. Upon the re-
10 sponse of the called subscriber at station B, apparatus at 100 functions in the manner set forth in the above mentioned application, Serial No. 738,488, to reverse the direction of current flowing through the polarized
15 relay 47, whereupon relay 47 energizes closing an obvious circuit for reversing relay 7. Relay 7 now reverses the direction of current flowing in the trunk extending to the originating office X for supervisory or
20 call charging purposes.

When the calling subscriber replaces his receiver on its switchhook, relay 6 releases in turn releasing relay 11. Relay 11 upon releasing releases relay 21 and opens the
25 circuit of relay 47. With relay 11 deenergized the shunt around lamp 38 is removed and the lamp lights as a disconnect signal. Upon observing the lighting of lamp 38 the tandem operator removes the plug 39 from
30 the jack 40 thereby releasing relay 41.

Relay 41, upon releasing, replaces the shunt around relay 35 and extinguishes the lamp 38. When the relay 11 deenergized, the bridge through relay 47 and coil 46 is
35 opened and the "B" operator at the terminating office is given a disconnect signal in the usual manner and proceeds to take down the connection at her position. At the originating office the apparatus is restored in the
40 manner fully set forth in the patent to Stearn 1,505,171 hereinbefore referred to.

If at the time the call came in from the mechanical switching office X, the home operator had been too busy with other calls
45 to attend to such incoming call, the adjacent operator, if free, would have attended to it by depressing her display key 54. At this time relays 6 and 12 are operated as previously described and therefore upon the oper-
50 ation of key 54 a circuit is established for relay 55 extending from battery at the adjacent operator's control circuit 56, over conductor 57, the outer right contact of relay 21, right winding of relay 55, outer left
55 front contact of relay 12, contact of key 54, conductor 58 to ground at the adjacent operator's control circuit 56.

Relay 55, upon energizing, closes a locking circuit for itself through both of its
60 windings and its inner left contact independent of the contacts of key 54, and closes an obvious circuit for relay 13. Relay 13, upon energizing, causes the operation of relay 23 and performs the other functions as
65 previously described. With relays 23 and

55 operated, a circuit is now closed extending in parallel through the winding of relay 8 and the left winding of relay 33 which may be traced from ground at the adjacent operator's control circuit 56, conductor 60, 70
outer left contact of relay 55, thence in parallel through the left winding of relay 33 and the winding of relay 8, conductor 26 to battery at the left contact of relay 23. Relay 8 upon energizing in this circuit, con- 75
nects the incoming conductors of the trunk circuit 5 over conductors 61 and 62, to the adjacent operator's control circuit 56, and opens the connection of the trunk circuit to the windings of relay 6. As before relay 6 80
deenergizes releasing relay 12 whereupon relay 11 energizes.

With relays 11 and 33 energized a circuit is now closed to lock relay 33 and to ener- 85
gize relay 52, this circuit extending from battery through the winding of relay 52 and the right winding of relay 33 in parallel through the inner right contact of relay 33, to ground at the outer left contact of relay 11. The circuit of lamp 14 is now trans- 90
ferred from steady ground at the right contact of relay 12 to interrupted ground at the fast interrupter 59, over a circuit extending from battery through the lamp 14, resistance 15, the outer right back contact of relay 12, 95
conductor 31, left front contact of relay 13, conductor 32, left front contact of relay 33 to ground through the interrupter 59. The lamp 14 now flashes rapidly as an indication to the operators at both the home and adja- 100
cent positions, that the adjacent operator is attending to the incoming call on trunk 5.

When the pulses have all been received and the indicator lamps associated with control circuit 56 display the complete line 105
designation, the adjacent operator tests the trunk extending to the desired terminating office Z, establishing a test circuit which may be traced from tip of plug 39, upper back contact of relay 41, conductor 42, outer right 110
front contact of relay 33, conductor 63 to the tone coil of the adjacent operator's telephone circuit (not shown). If the trunk tested is idle and the operator receives no click in her telephone circuit, she inserts 115
plug 39 into jack 40. In response thereto, relays 41 and 35 operate as before. Since, however, relay 52 is now operated, relay 35 connects conductors 48 and 49 of the trunk circuit, through the inner left and right 120
front contacts of relay 52 to the talking conductors of the adjacent operator's telephone circuit, to enable the operator at the adjacent position to converse with the "B" operator at office Z. 125

To wipe out the display on the indicator and control circuit 56, the adjacent operator depresses her wipe-out key 65 which closes a circuit for relay 21 extending from bat- 130
tery through the winding of relay 21, the

lower front contact of relay 35, the outer left front contact of relay 52, to ground through the contact of key 65. From this point, the circuits function in the manner previously described.

What is claimed is:

1. In a telephone system, a plurality of operators' positions, a trunk circuit incoming to one of said positions and terminating in a plug, a trunk signal, means at each operator's position operable by the operator thereat in response to said signal, a telephone set at each operator's position, and means automatically responsive to the insertion of said plug into an outgoing line jack for disconnecting the talking conductors of said trunk circuit and for connecting said plug to the telephone set of that operator's position which has responded to said signal.

2. In a telephone system, a plurality of operators' positions, a trunk circuit incoming to one of said positions and terminating in a plug, an indicating device at each position, means at each position for associating the indicating device of that position with said trunk circuit, a telephone set at each operator's position, and means automatically responsive to the insertion of said plug into an outgoing line jack for disconnecting the talking conductors from said trunk circuit and for connecting said plug to the telephone set of that operator's position whose indicating device is associated with said trunk circuit.

3. In a telephone system, an operator's position, a trunk circuit incoming to said position and terminating in a plug, a trunk signal, means controlled by the operator at said position in response to said signal, a telephone set at said position, a second operator's position, means controlled by the operator at said second position in response to said signal, a telephone set at said second position, and means automatically responsive to the insertion of said plug into an outgoing line jack for disconnecting the talking conductors of said trunk circuit and for connecting said plug to the telephone set of that operator's position which has responded to said signal.

4. In a telephone system, an operator's position, a trunk circuit incoming to said position and terminating in a plug, an indicating device at said position, means at said position for associating said indicating device with said trunk circuit, a telephone set at said position, a second operator's position, an indicating device at said second position, means at said second position for associating said second indicating device with said trunk, a telephone set at said second position, and means automatically responsive to the insertion of said plug into an outgoing line jack for disconnecting

the talking conductors of said trunk circuit and for connecting said plug to the telephone set of that operator's position whose indicating device is associated with said trunk.

5. In a telephone system, a plurality of operators' positions, a trunk circuit incoming to one of said positions and terminating in a plug, a jack, a trunk signal, means at each operator's position operable by the operator thereat in response to said signal, a telephone set at each operator's position, a relay, means controlled by said relay when said plug is placed in said jack for disconnecting the talking conductors of said trunk circuit and for connecting said plug to the telephone set of that operator's position which has responded to said signal, a key at each position, and means responsive to the key of the connected position to disconnect the connected operator's set and to reestablish the continuity of said trunk circuit.

6. In a telephone system, a plurality of operators' positions, a trunk circuit incoming to one of said positions and terminating in a plug, an indicating device at each position, means at each position for associating the indicating device of that position with said trunk circuit, a telephone set at each operator's position, a jack, a relay, means controlled by said relay when said plug is placed in said jack for disconnecting the talking conductors of said trunk circuit and for connecting said plug to the telephone set of that operator's position whose indicating device is associated with said trunk circuit, a key at each position, and means responsive to the key of the connected position to disconnect the connected operator's set and to reestablish the continuity of said trunk circuit.

7. In a telephone system, a plurality of operators' positions, a trunk circuit incoming to one of said positions and terminating in a plug, an indicating device at each position, means at each position for associating the indicating device of that position with said trunk circuit, discriminating means responsive to said last named means, a telephone set at each operator's position, and means automatically responsive to the insertion of said plug into an outgoing line jack and to the operation of said discriminating means for disconnecting the talking conductors of said trunk circuit and for connecting said plug to the telephone set of that operator's position whose indicating device is associated with said trunk circuit.

8. In a telephone system, an operator's position, a trunk circuit incoming to said position and terminating in a plug, a trunk signal, means controlled by the operator at said position in response to said signal, a telephone set at said position, a second position, means controlled by the operator at

said second position in response to said signal, a telephone set at said second position, a listening in circuit, a transfer relay under control of one of said means for transferring
5 said circuit from one telephone set to the other, and means automatically responsive to the insertion of said plug into an outgoing line jack for disconnecting the talking conductors of said trunk circuit and for connecting
10 said plug to the listening in circuit.

9. In a telephone system, a plurality of operators' positions, a trunk circuit incoming to one of said positions and terminating in a plug, an indicating device at each position,
15 means at each position for associating the indicating device of that position with said trunk circuit, a telephone set at each operator's position, a discriminating relay responsive to said last named means, a second

relay, means controlled by said second relay responsive to the insertion of said plug
20 into an outgoing trunk jack for disconnecting the talking conductors of said trunk circuit and for connecting said plug through contacts of said discriminating relay to the
25 telephone set of that operator's position whose indicating device is associated with said trunk circuit, a key at each position, and means operable through contacts of said discriminating relay under control of the key
30 of the connected position to disconnect the connected operator's set and to reestablish the continuity of said trunk circuit.

In testimony whereof, I have signed my name to this specification this 23rd day of
35 February, 1926.

GEORGE H. PETERSON.