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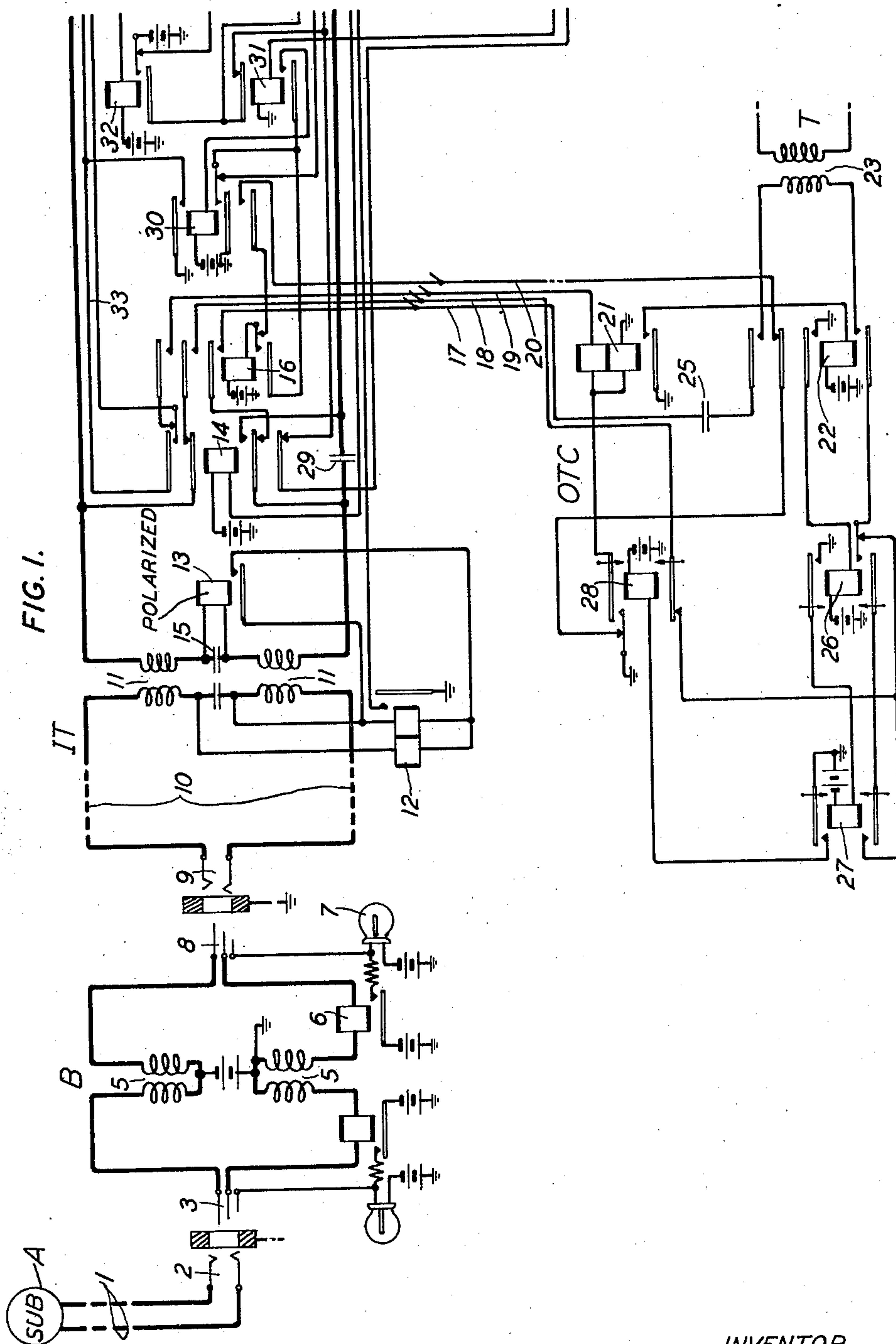
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1,859,404

TELEPHONE EXCHANGE SYSTEM

Filed Dec. 19, 1930

2 Sheets-Sheet 1



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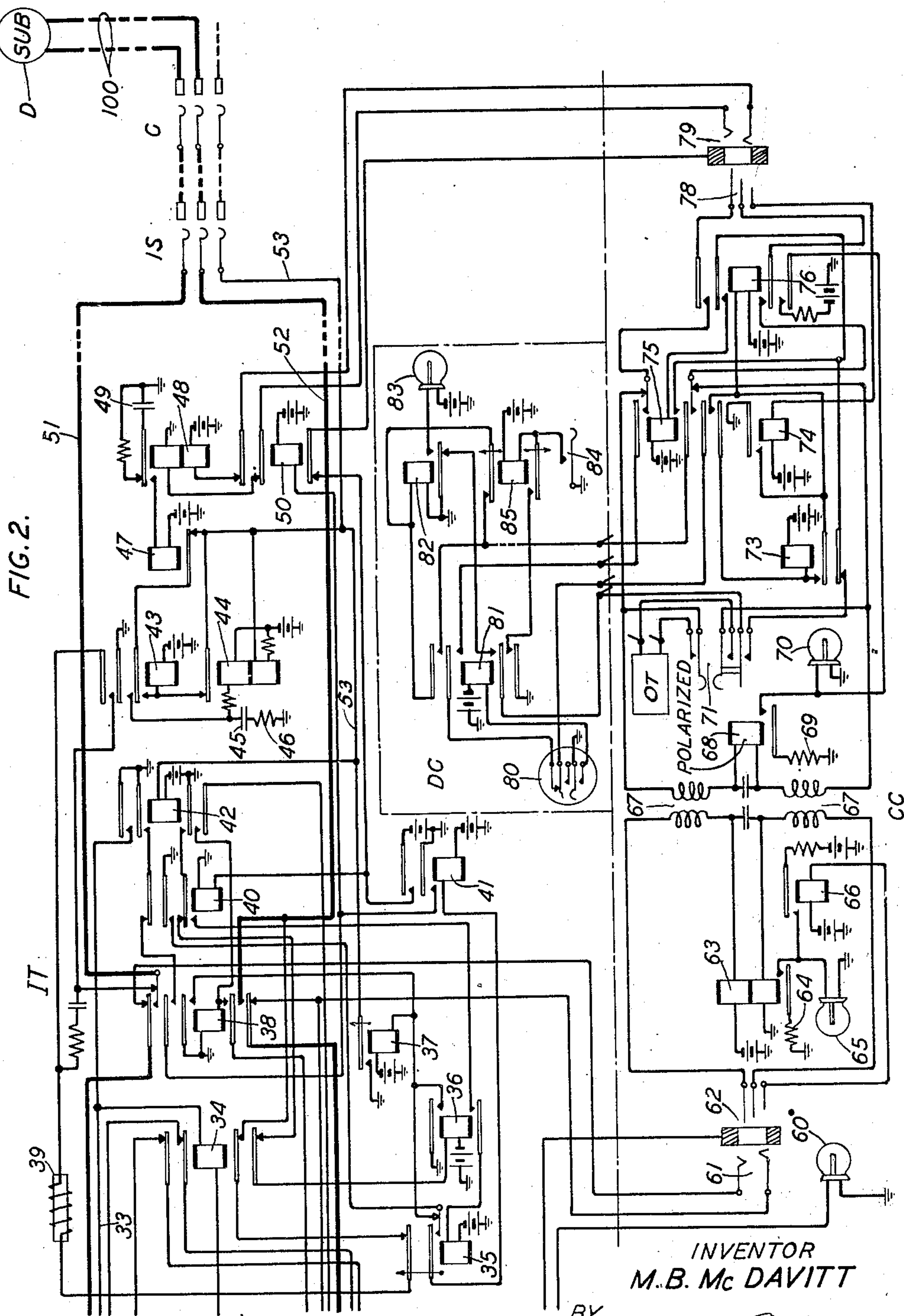
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TELEPHONE EXCHANGE SYSTEM

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2 Sheets-Sheet 2



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TELEPHONE EXCHANGE SYSTEM

Application filed December 19, 1930. Serial No. 503,601.

This invention relates to telephone systems and more particularly to automatic and semi-automatic telephone systems in which switching mechanisms are directly responsive to incoming impulses.

The object of this invention is to eliminate the possibility of prematurely releasing a step-by-step switch upon the permanent opening of the impulse circuit at the point where the impulses are originated.

A feature of this invention is an impulse repeater so arranged that the incoming impulse circuit may be permanently opened without causing the opening of the outgoing impulse circuit.

Another feature of this invention is an intermediate-dialing trunk circuit in a step-by-step office arranged so that the answering and dialing cords, associated therewith on any particular call, may be disconnected in either sequence without causing the release of the automatic switches through which connection with the called line is established.

The drawings which consist of Figures 1 and 2, represent schematically a portion of a telephone system in which this invention is embodied.

Fig. 1 shows a subscriber's station A, a cord circuit B in a manual office, an incoming trunk circuit IT in an automatic office and an order tone circuit OTC.

Fig. 2 shows the remainder of the incoming trunk circuit IT, a cord circuit CC at a position of the "A" switchboard in the automatic office, an operator's telephone circuit OT, the associated dialing circuit DC, an incoming selector switch IS, a connector switch C, and a called subscriber's station D.

In the system shown in the drawings, calls from subscribers in the manual office to subscribers in the automatic office are completed over interoffice trunks which terminate at positions of the special A switchboard in the automatic office. These trunks are operated on a straight-forward basis, a call being answered at the automatic office by inserting the plug of an answering cord in the answering jack associated with the lighted lamp of an incoming trunk. Upon receipt of an order tone from the automatic office, the man-

ual office operator passes the number of the called station to the operator at the automatic office. The operator in the automatic office then inserts the plug of the calling cord in a dialing jack associated with the incoming trunk and dials the called number, thereby automatically extending the connection to the called line. The incoming trunk circuit in the automatic office is known as an intermediate dialing trunk circuit since the operator in the automatic office does not supervise the connection but disconnects both the answering and calling cords from the answering and dialing jacks as soon as the called number has been dialed, the connection being under the supervision of the operator in the manual office.

The subscriber's station A in the manual office is equipped with a common battery type subset and the cord circuit B is of the usual type provided in common battery manually-operated offices. As already indicated the outgoing interoffice trunks are of the straight-forward type. The incoming trunk circuit IT is shown and hereinafter described in its entirety; but the associated incoming selector IS and the connector C are represented by their multiple brushes and one set of terminals, the remainder of these circuits being omitted. It is of course understood that in larger systems one or more additional selectors may be required in extending a connection from the incoming selector IS to a connector switch. The selector and connector switches are of the well known Strowger type and reference may be had to pages 53 to 65 inclusive of the second edition of Automatic Telephony by Smith and Campbell for a complete description of the operation of these switches. The position equipment at the special A switchboard of the automatic office is not shown in its entirety, only so much of the cord circuit CC, dial circuit DC, and order tone circuit OTC being shown as is necessary for a clear and complete description of the features of the invention. The order tone circuit OTC differs somewhat from the usual arrangement since it is designed for use with intermediate dialing trunks.

The operation of the circuits shown in the

drawings, on a call from station A in the manual office to station D in the automatic office, will now be described in detail. Assume that the calling line 1 has been extended through the answering cord 3 and the calling cord 8 of the cord circuit B in the usual manner, over the interoffice trunk 10 to the incoming trunk circuit IT in the automatic office. Relay 12 in the trunk circuit IT is operated in a circuit which may be traced from battery through the upper right-hand winding of repeating coil 5 of cord circuit B, the tip conductor of the calling cord 8, the tip spring of jack 9, the tip conductor of trunk 10, the upper left-hand winding of the repeating coil 11 of trunk circuit IT, through both windings of relay 12, the lower left-hand winding of repeating coil 11, the ring conductor of trunk 10, the ring spring of jack 9, the ring conductor of the calling cord 8, the winding of supervisory relay 6, and through the lower right-hand winding of the repeating coil 5 to ground. The resistance of this circuit is so high that the supervisory relay 6 in the cord circuit B cannot operate; and the supervisory lamp 7 remains lighted until the called party answers. Relay 12 closes a circuit for operating the slow-to-release relay 32; this circuit is traced from ground through the front contact of relay 12, the outer upper back contact of relay 34, and through the winding of relay 32 to battery. Relay 32 closes a circuit for lighting an answering lamp 60 which is associated with an answering jack 61 located at a position of the A switchboard in the automatic office; this circuit is traced from battery, through the front contact of relay 32, the back contact of relay 31, the outer lower back contact of relay 14, and through lamp 60 to ground.

Assuming that an operator answers the call by inserting the plug of the answering cord CC into the answering jack 61, a circuit is closed from battery through the winding of relay 66, the sleeve conductors of the answering cord 62 and jack 61, and through the winding of relay 31 to ground; relays 66 and 31 both operate in this circuit. Relay 31 extinguishes the answering lamp 60 and closes a circuit from battery through the winding of relay 30, the front contact of relay 31, the back contact of the continuity springs of relay 30, the ring spring of jack 61, the ring conductor of the answering cord 62, the lower left-hand winding of repeating coil 67, and through the lower winding of relay 63 to ground. Relay 30 operates in this circuit, but relay 63 does not operate until a circuit is closed through both of its windings as hereinafter described. Relay 30 opens its own operating circuit but it locks under the control of relay 31 to the ground at the front contact of its continuity spring. Relay 30 connects the winding of relay 16 to the pick-up conductor 20 of the order tone circuit

OTC. If the tone circuit is idle, relay 16 operates in a circuit which is traced from battery through its winding and the normally closed contact of its continuity springs, the outer lower front contact of relay 30, pick-up conductor 20, the back contact of relay 22, to ground at the normally closed contact of the continuity springs of relay 28. Relay 16 locks through the front contact of its continuity spring to ground at the inner lower front contact of relay 30. Relay 16 closes a circuit from battery through the winding of relay 14, the inner upper back contact of relay 34, the normally closed contact of the continuity springs of relay 14, the outer upper front contact of relay 16, over the start conductor 19 to the order tone circuit OTC, and through the windings of start relay 21 to ground. Relay 21 operates but relay 14 is marginal and it does not operate in series with both windings of relay 21. Relay 21 closes an obvious circuit for operating relay 22. Relay 22 connects the secondary winding of the tone transformer 23 to the incoming trunk circuit IT so that the order tone is transmitted through repeating coil 11 to the operator in the manual office; this connection is traced from the upper end of the secondary winding of transformer 23, through the outer upper front contact of relay 22, through condenser 25, over conductor 17 to the trunk circuit IT, through the inner upper front contact of relay 16, the inner lower back contact of relay 14, the lower right-hand winding of repeating coil 11, winding of supervisory relay 13 in parallel with condenser 15, the upper right-hand winding of repeating coil 11, the inner upper back contact of relay 14, the middle upper front contact of relay 16, over conductor 18, through the lower back contact of relay 28, the back contact of relay 26, and through the lower front contact of relay 22 to the other end of the secondary winding of tone transformer 23. Relay 22 also closes an obvious circuit for operating relay 26, and the operation of relay 26 opens the aforementioned circuit through the secondary winding of tone transformer 23. The operation of relay 26 also closes a circuit for operating relay 27; and relay 27 again closes the circuit through the secondary winding of tone transformer 23, this circuit now being traced through the lower front contacts of both relays 26 and 27 instead of through the back contact of relay 26. Relay 27 also closes a circuit for operating relay 28, and relay 28 again opens the circuit for transmitting the order tone to the conductors of trunk circuit IT. With relay 28 operated, the ground at the back contact of its continuity springs cannot be reconnected to the pick-up conductor 20 until all of the relays in the order tone circuit have released. Each of relays 26, 27 and 28 is slow in operating so that two closures of the

tone circuit result; the first begins when relay 22 operates and ends when relay 26 operates, and the second begins when relay 27 operates and ends when relay 28 operates. With relay 28 operated, the lower winding of start relay 21 is short-circuited so that the marginal relay 14 in the trunk circuit IT now operates. Relay 14 locks through the front contact of its continuity spring to the ground at the upper front contact of relay 30. Relay 14 short-circuits condenser 29 so that the connections from the right-hand windings of repeating coil 11 are now extended through the outer back contacts of relay 38 and the tip and ring springs of the answering jacks 61 to the windings of relay 63 in the cord circuit CC. The operation of relay 63 connects resistance 64 in parallel with the answering cord supervisory lamp 65 to extinguish this lamp.

In response to the double order tone which was transmitted through the windings of repeating coil 11 over the conductors of trunk 10, the operator in the manual office passes the number of the called station D to the operator at the A switchboard in the automatic office, it being assumed that the talking key 71 was operated at the time that the plug of the answering cord 62 was inserted in the answering jack 61. The operator in the automatic office then inserts the plug of the calling cord 78 into the dialing jack 79 associated with the trunk circuit IT, thereby closing a circuit for operating relay 74 in the cord circuit and relay 40 in the trunk circuit. Relay 40 closes a circuit for operating relay 37; and relay 37 connects ground to the sleeve conductor 53 leading to the associated incoming selector IS. With ground connected to conductor 53, relays 42 and 43 are operated and the lower winding of relay 44 is energized, but relay 44 is not operated by the energization of the lower winding alone. Relay 42 connects ground to conductor 33 so as to hold relay 14 operated, after the operator in the automatic office has disconnected, until the connection is released by the operator in the manual office. Relay 43 closes a bridge across the conductors 51 and 52 leading to the incoming selector switch IS; this bridge may be traced from conductor 51 through the continuity spring and back contact of relay 38, the outer upper front contact of relay 43, retard coil 39, the outer back contact of relay 35, and through the inner lower back contact of relay 34 to conductor 52. Relay 43 also closes a circuit through the upper winding of relay 44 and this relay now operates thereby opening the operating circuit for relay 43; but relay 43 does not release since a locking circuit was closed through its inner upper front contacts and the back contact of relay 47 to the ground on conductor 53.

The aforementioned operation of relay 74, when the plug of the calling cord 78 was in-

serted in jack 79, closes a circuit for operating relay 76. Relay 76 closes a circuit for lighting the calling cord supervisory lamp 70. Relay 76 also closes a circuit for operating the impulse receiving relay 48 of the trunk circuit IT; this circuit is traced from battery through the lower winding of relay 48, the upper outer back contact of relay 50, the ring conductors of jack 79 and cord 78, through the inner lower front contact of relay 76, the normally closed contact of the lower continuity springs of relay 75, the lower right-hand winding of repeating coil 67, the winding of supervisory relay 68, the upper right-hand winding of repeating coil 67, the normally closed contact of the upper continuity springs of relay 75, the upper outer front contact of relay 76, the tip conductors of cord 78 and jack 79, the inner upper back contact of relay 50, and through the upper winding of relay 48 to ground. Relay 68 is a polarized relay and does not operate since the current through its winding is not in the operating direction. When relay 48 operates it connects the winding of relay 47 to the condenser 49; and relay 47 is, therefore, temporarily operated during the flow of current to charge the condenser 49.

When the operator at the automatic office moves the dial 80 off-normal, relay 81 in the dial circuit DC operates. Relay 81 closes a circuit for operating relay 75 in the cord circuit CC; this circuit is traced from battery through the winding of relay 75, the inner upper front contact of relay 76, the back contact of relay 73, the lower contacts of key 71, and through the lower front contact of relay 81 to ground at the back contact of relay 82. Relay 75 closes a locking circuit for itself which is traced through its inner lower front contact, the back contact of relay 85 and through the winding of relay 82 to ground. Relay 82 is operated in this circuit thereby lighting the pilot lamp 83. Relay 75 transfers the tip and ring conductors of the answering cord from the windings of repeating coil 67 to the dial circuit DC, so that relay 48 is now held operated by a bridge which is traced from the front contact of the upper continuity springs of relay 75, the inner upper front contact of relay 81, and through the interrupter contacts of the dial 80 to the front contact of the lower continuity springs of relay 75. Relay 75 also closes a circuit for operating relay 73. Relay 73 locks under control of relay 74 and opens the operating circuit for relay 75 so as to prevent the reoperation of relay 75 after it has once released.

As the dial returns to normal it interrupts the circuit of relay 48 so that relay 48 is alternately released and reoperated in response to the impulses created by the dialing of each digit of the number of the called station D. The release of relay 48 upon receipt of an

impulse from the dial 80 does not cause the opening of the bridge across conductors 51 and 52, but a circuit is closed through the back contact of relay 48 for discharging condenser 49. When relay 48 reoperates, relay 47 is temporarily reoperated by the current which flows to charge condenser 49; and the operation of relay 47 causes the release of relay 43, thereby opening the bridge across conductors 51 and 52. Relay 43 also opens the circuit through the upper winding of relay 44 so that relay 44 is also released. The release of relay 44 again closes the operating circuit for relay 43 and the reoperation of relay 43 again closes the bridge across conductors 51 and 52. Relay 43 also causes the reoperation of relay 44; and with relay 44 operated, relay 43 is held operated by its locking contact under control of relay 47. Each release and reoperation of relay 48 causes relays 43, 44 and 47 to repeat their cycle of operations and thereby transmit impulses over conductors 51 and 52 to the succeeding switches. The condenser 45 and resistance 46 control the releasing time of relay 44, being designed to prevent the reoperation of relay 43 until the bridge across the conductors 51 and 52 has been held open for an interval sufficient to insure proper operation of the switch to which impulses are being transmitted.

In response to the impulses thus transmitted over conductors 51 and 52, the selector switch IS and the connector switch C operate to extend the connection over the line 100 to the called station D in the usual manner. As soon as all of the digits of the called number have been dialed, the operator disconnects the cord CC from jacks 61 and 79, the release of the connection being under the control of the operator at the manual office. If the plug of the calling cord is withdrawn before the plug of the answering cord is withdrawn, relays 74 and 40 release. The release of relay 40 closes a circuit for operating relay 36 from battery through the winding of relay 36, outer lower back contact of relay 34, inner upper back contact of relay 40, and through the inner lower front contact of relay 42 to ground. Relay 36 holds relay 37 operated to prevent the release of relay 42. Relay 48 releases when the calling cord is withdrawn from jack 79, but the bridge across conductors 51 and 52 is not opened since relay 47 is not operated and consequently relay 43 does not release. When the answering cord is also disconnected, relays 66 and 31 release thereby causing the operation of relay 38 in a circuit from ground through the winding of relay 38, the lower front contact of relay 42, the back contact of relay 31, and through the front contact of relay 32 to battery. Relay 38 closes a holding circuit for relay 37 and extends the talking conductors of trunk IT to conductors 51 and 52,

so that the call is now entirely under the control of the operator in the manual office. The aforementioned operation of relay 38 also closes the circuit for operating relay 50; this circuit may be traced from battery through the winding of relay 50, the middle upper front contact of relay 38, the outer upper back contact of relay 40, and through the inner upper front contact of relay 42, to ground. Relay 50 disconnects the tip, ring and sleeve conductors of jack 79 from relays 48 and 40. The marginal relay 14 is now held operated by the ground connected to conductor 33 at the outer upper front contact of relay 42. All of the relays in the cord circuit CC and dial circuit DC are released when the cord is disconnected from the jacks 61 and 79, and these circuits may now be used for completing other connections.

If the plug of the answering cord is withdrawn from jack 61, before the plug of the calling cord is withdrawn from the jack 79, the release of relay 31 closes the circuit for operating relay 38 as above described and relay 38 locks under control of relay 32. Relay 38 disconnects the talking conductors of the trunk IT from the answering cord and extends these conductors to the selector switch IS. Relay 38 also closes a holding circuit for relay 37. When the calling cord is disconnected relay 40 releases, thereby operating relays 36 and 50. Relay 50 disconnects the windings of relays 48 and 40 from the dialing jack 79; and relay 36 closes another holding circuit for relay 37.

It is apparent, therefore, that relay 43 holds coil 39 bridged across conductors 51 and 52 until the right-hand windings of repeating coil 11 in series with the winding of supervisory relay 13 are connected across these conductors; so that the selector switch IS and connector switch C are not released until the operator in the manual office disconnects the calling cord 8 from jack 9, as hereinafter described.

In case the operator at the A switchboard in the automatic office wishes to correct a dialing error, the plug of the dialing cord is removed from jack 79 and then reinserted without disconnecting the answering cord. When the dialing cord is disconnected, relays 48, 74 and 40 release. The release of relay 48 is ineffective to open the bridge across conductors 51 and 52 but the release of relay 40 causes the operation of relay 36. The release of relay 74 causes the release of relays 73 and 76; and the release of relay 76 causes the release of relays 75 and 82. Relay 82 extinguishes the dial lamp. The aforementioned operation of relay 36 closes a holding circuit for relay 37, so that relays 42, 43 and 44 are held operated by the ground on conductor 53. Upon reinsertion of the plug of the calling cord in jack 79, relay 40 reoperates. The reoperation of relay 40 causes the

release of relay 36; but relay 36 is slow in releasing so that a circuit is temporarily closed for operating relay 35; this circuit may be traced from battery through the winding of relay 35, the lower front contact of relay 36, the inner upper front contact of relay 40, and through the inner lower front contact of relay 42 to ground. Relay 35 opens the bridge across conductors 51 and 52, and closes a circuit for operating relay 41; this circuit may be traced from battery through the winding of relay 41, the front contact of the continuity springs of relay 35, to ground at the middle upper front contact of relay 40. Relay 41 closes a circuit for operating relay 50 and also closes a circuit for holding relay 40 operated after relay 50 has disconnected the winding of relay 40 from the sleeve conductor of jack 79. When relay 36 releases, relays 37 and 35 are released; relay 35 also being slow in releasing. Relay 37 disconnects ground from sleeve conductor 53 thereby causing the release of relays 42, 43 and 44. When relay 35 releases, relay 37 is again operated to the ground at the outer upper front contact of relay 40; and the reoperation of relay 37 again connects ground to conductor 53 thereby causing the reoperation of relays 42, 43 and 44, as hereinbefore described. With relay 35 released and relay 43 reoperated, the retard coil 39 is again connected across conductors 51 and 52 but the bridge was held open a sufficient length of time to cause the release of all of the switches which had been operated in response to impulses transmitted over these conductors. The aforementioned release of relay 35 also causes the release of relay 41 and the release of relay 41 causes the release of relay 50. With relay 50 released, the winding of relay 40 is again connected to the sleeve conductor of jack 79 so that relay 40 is now held operated in series with relay 74 of the cord circuit CC. The relays in the cord circuit CC and dial circuit DC are now operated in the manner hereinbefore described to close the dialing circuit from the dial 80 to the windings of relay 48 in the trunk circuit IT and the operator proceeds to dial the correct number.

When the called subscriber answers, relay 13 is operated by the usual reversal of current supplied from the connector switch C. With relay 13 operated, the high resistance winding of relay 12 is short-circuited so as to increase the current flowing over trunk 10 and thereby cause the operation of the supervisory relay 6 in the cord circuit B in the manual office. The operation of the relay 6 extinguishes the lamp 7 in the usual manner to indicate that the called subscriber has answered.

When the connection is released, the operator in the manual office disconnects the cords 3 and 8 from the jacks 2 and 9 thereby causing the release of relay 12. Relay 12 causes

the release of relay 32; and when relay 32 releases, it causes the release of relay 38 and the operation of relay 34. The release of relay 38 opens the circuit through the winding of relay 50 and disconnects conductors 51 and 52 from the winding of the repeating coil 11. With relay 34 operated, the release of relay 38 is ineffective to connect the retard coil 39 across conductors 51 and 52 so that the selector switch IS and connector which C are released and restored to normal in the usual manner. The operation of relay 34 causes the release of relays 14 and 36. The release of relay 36 is effective to cause the release of relay 37; and the release of relay 37 causes the release of relays 42, 43 and 44. All of the circuits have now been restored to normal and are ready for use on another connection.

What is claimed is:

1. In combination, a relay for receiving impulses, a circuit, means for causing the operation of said impulse receiving relay and the closing of said circuit, and means for opening and closing said circuit in response to each impulse received by said relay and for holding said circuit closed when said relay releases.

2. In combination, a first circuit, a second circuit, an impulse receiving relay included in said first circuit, means for causing the operation of said relay and the closing of said second circuit, means effective in response to each impulse received by said relay for repeating said impulse to said second circuit and for holding said second circuit closed when said first circuit is opened.

3. In combination, a first circuit, a second circuit, an impulse receiving relay included in said first circuit, means for causing the initial operation of said relay and the closing of said second circuit, and means for opening and closing said second circuit in response to each impulse received by said relay, said last mentioned means being ineffective to open said circuit when said relay releases and does not reoperate.

4. In a telephone system, a circuit including an impulse sender and an impulse receiving relay, a trunk, an inductance, means effective to cause the operation of said relay and the bridging of said inductance across the conductors of said trunk, means for successively opening and closing said bridge in response to impulses received by said relay and for holding said bridge closed when said circuit is permanently opened.

5. In a telephone system, an operator's position, an impulse sender at said position, a trunk, means for operatively associating said sender with said trunk, an impulse receiving relay individual to said trunk for receiving impulses created by the operation of said sender, an automatic switch to which the outgoing conductors of said trunk are

permanently connected, means for closing a pulsing circuit over said conductors, means for causing the operation of said impulse receiving relay, means for repeating the im-
 5 pulses received by said impulse receiving relay to said pulsing circuit and for holding said pulsing circuit closed after said sender has been disconnected.

6. In a telephone system, an operator's
 10 position and telephone circuit, a cord circuit at said position, a line terminating at an answering jack, an impulse sender, an auto-
 15 matic switch, conductors extending from said line to said switch, a second jack individual to said conductors, means responsive to the
 20 insertion of the plug of the answering cord into said answering jack for extending said line to said telephone circuit, an impulse re-
 25 ceiving relay, means responsive to the insertion of the plug of the calling cord into said second jack for associating said impulse
 30 sender with said impulse receiving relay, a bridge connected across said conductors in consequence of said insertion of the plug of
 35 the calling cord, means for successively opening and closing said bridge in response to im-
 40 pulses received by said relay and for holding said bridge closed when said relay releases.

7. In a telephone system, an operator's
 30 position and telephone circuit, a cord circuit at said position, a line terminating at an answering jack, an impulse sender, an auto-
 35 matic switch, conductors extending from said line to said switch, a second jack individual to said conductors, means responsive to the
 40 insertion of the plug of the answering cord into said answering jack for extending said line to said telephone circuit, an impulse re-
 45 ceiving relay, means responsive to the insertion of the plug of the calling cord into said second jack for associating said impulse
 50 sender with said impulse receiving relay, a bridge connected across said conductors in consequence of the insertion of the plug of
 55 the calling cord into said second jack, means for successively opening and closing said bridge in response to impulses received
 60 by said relay and for holding said bridge closed when said relay releases irrespective
 65 of which of said plugs is first removed from the associated jack.

8. In a telephone system, an operator's
 position and telephone circuit, a cord circuit at said position, a line terminating at an
 55 answering jack, an impulse sender, an auto-
 matic switch, conductors extending from said line to said switch, a second jack individual
 to said conductors, means responsive to the
 insertion of the plug of the answering cord
 60 into said answering jack for extending said
 line to said telephone circuit, an impulse re-
 ceiving relay, means responsive to the in-
 sertion of the plug of the calling cord into
 said second jack for associating said impulse
 65 sender with said impulse receiving relay, a

bridge connected across said conductors in
 consequence of the insertion of the plug of
 the calling cord into said second jack, means
 for successively opening and closing said
 70 bridge in response to impulses received by
 said relay and for holding said bridge closed
 when said relay releases irrespective of which
 of said plugs is first removed from the asso-
 ciated jack, and means for opening said
 75 bridge to release said switch in consequence
 of the removal and reinsertion of the plug
 of the calling cord.

9. In a telephone system, an impulse send-
 er, an impulse receiving relay, a circuit for
 80 operating said impulse receiving relay, a
 trunk, a coil, means for closing said circuit
 and for causing said coil to be bridged across
 the conductors of said trunk, an impulse
 circuit including the interrupter contacts of
 85 said sender and the windings of said im-
 pulse receiving relay, means responsive to
 the alternate release and reoperation of said
 impulse receiving relay for opening and
 closing said bridge and for holding said
 90 bridge closed when said impulse receiving
 relay releases and does not reoperate.

10. In a telephone system, an impulse
 sender, an impulse receiving relay, a first
 circuit for energizing said impulse relay, a
 95 second circuit including the interrupter con-
 tacts of said sender for energizing said im-
 pulse relay, a trunk, a bridge for connection
 across the conductors of said trunk, means
 for closing said first circuit and for causing
 the closure of said bridge, means for open-
 100 ing and closing said bridge in response to
 impulses received by said impulse relay from
 said sender and for holding said bridge
 closed when said impulse relay releases and
 does not reoperate, and means for tempora-
 105 rily opening said bridge when said first relay
 reoperates.

11. In a telephone system, a line having in-
 coming conductors and outgoing conductors,
 an impulse sender, means for associating said
 110 sender with said line, means for operatively
 associating said sender with said outgoing
 conductors, a bridge for connection across
 said outgoing conductors, means for closing
 said bridge prior to the operative association
 115 of said sender and outgoing line, means re-
 sponsive to impulses created by the operation
 of said sender for opening and closing said
 bridge and for holding said bridge closed
 after said sender is disconnected from said
 120 line, and means for connecting said incoming
 and outgoing conductors.

12. In a telephone system, a line having
 incoming conductors and outgoing conduc-
 125 tors, an impulse sender, means for associat-
 ing said sender with said line, means for op-
 eratively associating said sender with said
 outgoing conductors, a bridge for connection
 across said outgoing conductors, means for
 closing said bridge prior to the operative as-
 130

sociation of said sender and outgoing line, means responsive to impulses created by the operation of said sender for opening and closing said bridge and for holding said bridge closed after said sender is disconnected from said line, means for connecting said incoming and outgoing conductors, and means effective prior to the interconnection of said incoming and outgoing conductors for temporarily opening said bridge.

13. In a telephone system, a line having incoming conductors terminating in an answering jack and outgoing conductors terminating in a dialing jack, an operator's position and telephone circuit, said position circuit including a dial, a cord circuit having an answering cord and plug for connecting said position and telephone circuit with said incoming conductors and having a calling cord and plug for connecting said position circuit with said outgoing conductors, a bridge for connection across said outgoing conductors, means responsive to the insertion of said calling plug into said dialing jack for closing said bridge, means responsive to impulses created by the operation of said dial for opening and closing said bridge and for holding said bridge closed when said calling plug is removed from said dialing jack, and means for transferring said outgoing conductors from said bridge to said incoming conductors.

In testimony whereof, I have signed my name to this specification this 18th day of December, 1930.

MARCELLUS B. McDAVITT.