

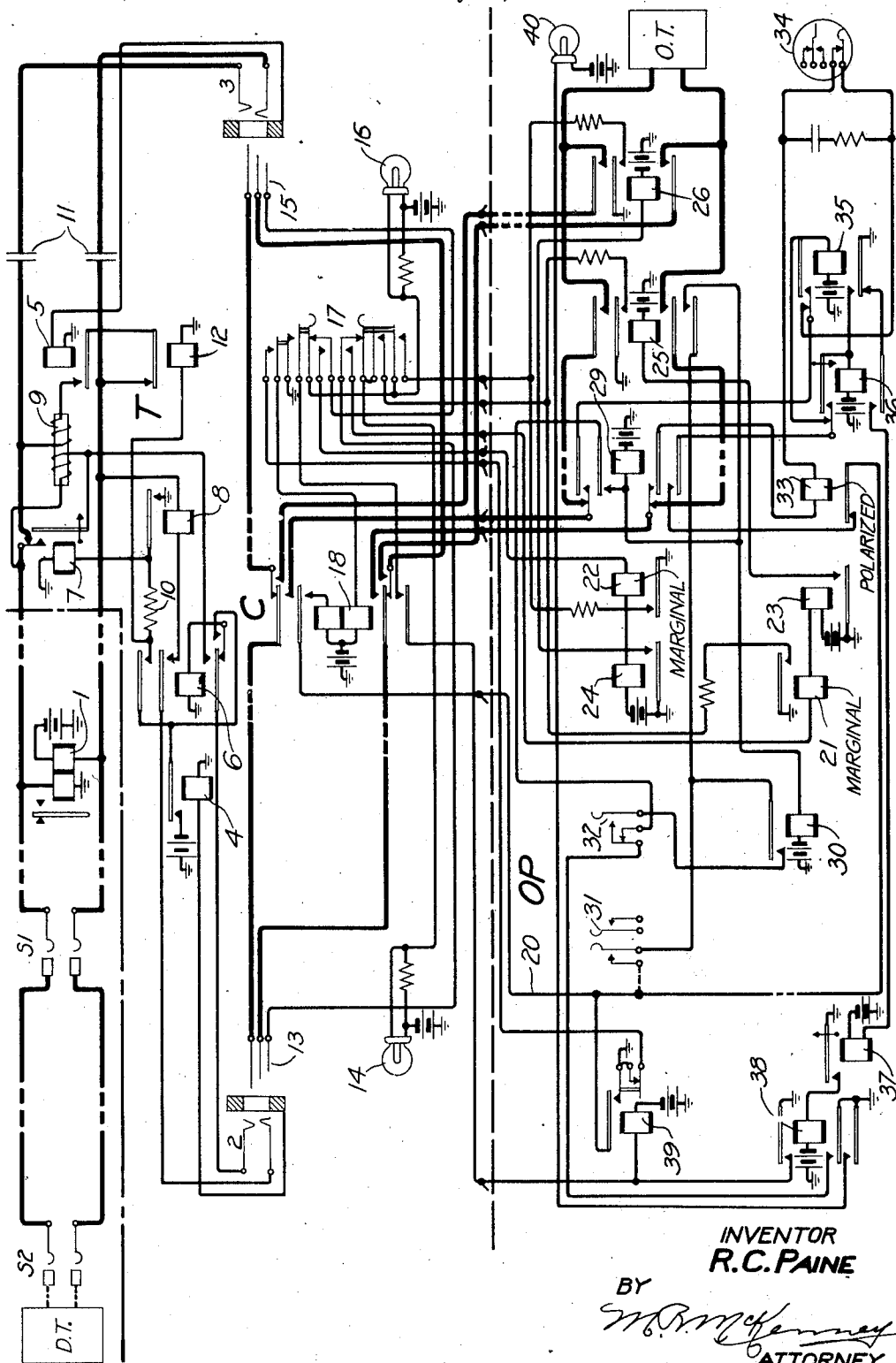
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TELEPHONE EXCHANGE SYSTEM

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TELEPHONE EXCHANGE SYSTEM

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This invention relates to telephone systems and more particularly to automatic and semi-automatic telephone systems.

The object of this invention is to provide more reliable controlling circuits whereby switching mechanism becomes effective during the transmission of a train of impulses such as are employed in establishing connections in automatic telephone systems.

According to this invention the winding of a control relay is connected in series with means for creating and means for receiving and responding to impulses of current, the uninterrupted energization of the control relay being effective to prevent the operation of a switching relay. Upon operation of the impulse sender the first release of the control relay permits the operation of the switching relay, and the switching relay holds until all of the impulses have been transmitted. As thus controlled the switching relay may perform a desired switching operation.

One application of this invention is disclosed in the drawing which represents schematically a portion of a telephone system. A toll operator's position equipment is represented at OP, with one of the cord circuits of this position designated C. Only those parts of the position and cord circuits are shown which are necessary to fully explain their operation as far as it relates to this invention; the operator's telephone circuit is therefore represented by the enclosure OT. The toll cord C is employed in establishing connections to and from toll lines terminating in jacks (not shown) at this position with local subscribers' lines in an automatic office (not shown).

The operator's position equipment includes a dial for directly controlling the operation of the automatic switches employed in establishing connections between any toll cord at the position and local subscriber's lines. It is, of course, important that this dial create impulses of such a character and at such a frequency that accurate operation of the automatic switches results. Dial testing equipment is, therefore, made available for testing the operation of the dial at a toll operator's position by providing a special

dial testing trunk such as is shown at T for use in extending a connection from any of the cords at a toll position to an automatic dial tester, which in this drawing is represented by the enclosure designated DT. One or more automatic switches, may be employed in extending the connection from trunk T to the dial tester under control of the dial which is to be tested; and in the drawing the trunk T is extended by the selector S1 to a selector S2 having direct access to the dial tester DT. But in some cases the trunk T, or the line selected by the automatic switches, may terminate at a test desk and the connection is then completed to the dial tester by the use of a cord or the operation of a key. The automatic dial tester DT is arranged to receive a series of impulses and thereafter to transmit a signal back to the toll operator, the character of the signal indicating whether the dial is too fast, too slow, or within the proper speed limits. For a detailed description of such a dial testing device reference may be had to the United States Patent 1,690,269 issued to W. T. Booth and A. C. McGrath November 6, 1928 and 1,653,782 issued to G. Riggs December 27, 1927. It is, therefore, necessary that the trunk circuit T should provide both a talking and a dialing connection with automatic transfer from one to the other. To secure this end two jacks are provided. The front plug 13 of a cord such as C is inserted in the jack 2 for the dialing connection and the rear plug 15 is inserted in the jack 3 for the talking connection. As shown in the drawing the circuits are arranged so that the dial may only be associated with the front plug 13; but they could, of course, be arranged so that the dial might be associated with either the front or rear plugs. Assume the plugs 13 and 15 to have been inserted in the jacks 2 and 3 respectively, thereby operating sleeve relays 4 and 5. The supervisory lamps 14 and 16 do not light in series with the high resistance windings of the relays 4 and 5. The operation of relay 5 closes a bridge across the outgoing line conductors of trunk T so as to operate the line relay 1 of the selector S, this being the first switch employed in extending the connec-

tion to the dial tester. This circuit is traced from ground through the left-hand winding of relay 1, over the tip conductor of trunk T through the back contact of relay 7, right-hand winding of retard coil 9, front contact of relay 5, back contact of relay 12, over the ring conductor of trunk T, and through the right-hand winding of relay 1, to battery. No further operation takes place until the talking key 17 is operated. The operation of key 17 closes a circuit for operating relay 18, in the cord circuit C; this circuit may be traced from battery through the lower winding of relay 18, front contact of key 17, to ground at the back contact of relay 39 in the position circuit. The operation of relay 18 closes a circuit for operating relay 39; this circuit may be traced from battery through the winding of relay 39, outer lower front contact of relay 18, to ground at the next-to-the-outer upper front contact of key 17. In operating, relay 39 closes a circuit from battery through the upper winding and locking contact of relay 18 over conductor 20, to ground at the front contact of relay 39; the front contact of relay 39 is closed before the operating circuit for relay 18 is opened at the back contact of relay 39. The operation of relay 18 is also effective to disconnect the tip and ring conductors of plug 13 from the corresponding conductors of plug 15 and to extend these four conductors to the position circuit OP.

The operation of key 17 is also effective to transfer the sleeve conductors of the plugs 13 and 15 from battery through lamps 14 and 16, respectively, to battery through the windings of relays 21 and 23 in series, and the windings of relays 22 and 24 in series, respectively. Relays 23 and 24 operate but relays 21 and 22 are marginal and do not operate in series with the high resistance relays 4 and 5. The sleeve relays 4 and 5 do not release since the circuits through the windings of relays 21 and 23 and through the windings of relays 22 and 24 are closed before the circuits through lamps 14 and 16 are opened. The operation of relay 23 closes a circuit for operating relay 25 and the operation of relay 24 closes a circuit for operating relay 26. In operating, relay 25 extends the connection from the tip and ring conductors of plug 13 through the continuity back contacts of relay 29 and the front contacts of relay 25 to the operator's telephone circuit; and relay 26 extends the connection from the tip and ring conductors of plug 15 to the operator's telephone circuit.

If the trunk T terminated directly at a manual test desk the toll operator could now talk to the desk attendant and have the trunk extended to the dial tester. With the trunk T connected to the selector S1 as shown in the drawing, the further extension of the connection to the dial tester is secured by operating

the dial key 31 followed by the dialing of the number assigned to the line which terminates at the dial tester. With key 31 operated, a circuit is closed for operating relays 29 and 30; this circuit may be traced from battery through the windings of relays 29 and 30 in parallel, outer lower front contact of relay 25, contacts of key 31, to ground at the front contact of relay 39. Relay 29 disconnects the tip and ring conductors of the plug 13 from the operator's telephone circuit and connects these conductors, through the winding of relay 33 and through the back continuity contact of relay 35, to the interrupter contacts of the dial 34. Relay 29 also closes a circuit from battery through the winding of relay 35, back contact of relay 36, outer lower front contact of relay 29, back contact of relay 33, to ground over conductor 20 at the front contact of relay 39. In operating, relay 35 connects its own winding to the tip conductor of plug 13 and disconnects this conductor from the dial; relay 35 also closes a circuit for operating relay 36. Relay 36 opens the operating circuit for relay 35; but relay 35 holds temporarily in a circuit from battery through its winding and upper front contact, outer upper front contact of relay 29, middle upper front contact of relay 18, tip conductors of plug 13 and jack 2, and through the lower back contact and winding of relay 6 in the trunk circuit, to ground. Relay 6 operates in this circuit and locks under control of relay 4. In operating, relay 6 opens the holding circuit for relay 35. Relay 35 releases but relay 36 is held operated in a circuit from battery through its winding and upper front contact, outer lower front contact of relay 29, back contact of relay 33, over conductor 20 to ground at relay 39.

The release of relay 35 reconnects the tip conductor of plug 13 to the dial, and the operation of relay 6 is, therefore, effective to bridge the interrupter contacts of dial 34, in series with the windings of relays 33 and 8 and the left-hand winding of retard coil 9, across the tip and ring conductors of trunk T in parallel with the right-hand winding of retard coil 9. The current which flows over the trunk circuit, from battery and ground through the windings of line relay 1, is effective to operate relay 8 but is ineffective to operate the polarized relay 33. The resistance of the winding of relay 8 is small so that the current over trunk T is sufficient for satisfactory operation of the selectors S1 and S2 under the control of the dial. The operation of relay 6 is also effective to close a circuit from battery at the upper contact of relay 4, through the outer upper front contact of relay 6, and through the winding of relay 12, in parallel with resistance 10 and the winding of relay 7 in series, to ground. Relay 12 operates in this circuit; relay 7 may also operate, but relay 8 short-

circuits the winding of relay 7 so that this relay immediately releases. The operation of relay 12 opens the bridge through the right-hand winding of retard coil 9, leaving
 5 only the dial contacts and the left-hand winding of retard coil 9 bridged across the trunk.

The release of relay 35 also closes a circuit, through its lower back contact and the
 10 lower front contact of relay 36, to operate relay 37. Relay 37, in turn, closes a circuit for operating relay 38; and relay 38 closes a circuit from ground at its outer lower front contact, through the normal contacts
 15 of the dial-release key 32, to the inner upper front contact of relay 29 to hold relays 29 and 30 operated, independently of relay 25, and independently of the dial key 31 which may now be released without destroying the
 20 dialing connection. Relay 38 also closes a circuit for lighting the pilot lamp 40 to inform the operator that dialing may begin, and closes a circuit for holding relay 39 operated independently of relay 18 and key
 25 17.

The talking key 17 may also be restored to normal without destroying the dialing connection since relay 39 is held operated under the control of relay 38. The trunk T is
 30 thus disconnected from the operator's telephone circuit, so that the operator may turn her attention to some other connection, if required. Relays 23, 24, 25 and 26 are released, but relays 29 and 30 hold under control of the dial-release key 32 and relay 38; relay 36 remains operated, thereby holding
 35 relays 37 and 38 operated; and relays 4 and 5 are held operated in series with lamps 14 and 16.

When the pilot lamp 40 lights, the dial is operated in accordance with the first digit of the number of the test line which connects to the dial tester. At the first opening of the contacts of dial 34 relay 8 releases, thereby opening the short-circuit around the
 45 winding, and causing the operation of relay 7. Relay 8 releases and reoperates each time the dialing circuit is opened but relay 7 is slow in releasing and remains in its operated position until all of the impulses in train have been transmitted. The operation of relay 7 short-circuits the left-hand winding of retard coil 9 to decrease the impedance of the dialing circuit and thus insure
 50 proper operation of automatic switches in response to the impulses transmitted. Relay 7 also holds the talking circuit, from trunk T through condensers 11, open during the transmission of the train of impulses.

The remaining digits of the number are dialed to further extend the connection through selector S2 to the line leading to the dial tester. As each digit is dialed the trunk relays 8 and 7 function as described
 60 in the preceding paragraph. If an error is

made in dialing the operation of the dial-release key 32 and the restoration of the talking key 17 to normal position are effective to entirely release the position and dial circuit. Relays 23, 24, 25 and 26 release when
 70 key 17 is restored; and relays 29 and 30 release when key 32 is operated. The release of relay 29 causes the successive release of relays 36, 37, 38 and 39 and also causes the release of relay 8. The release of relay 39 causes the release of relay 18. Relays 4 and 5 hold in the circuits through lamps 14 and 16, and relays 6 and 12 hold under control of relay 4. When relay 8 releases, relay 7 operates thereby opening the bridge across
 80 trunk T so as to cause the release of the switches involved in the connection as far as it has been established. The release of key 32 and the reoperation of key 17 are now effective to connect trunk T for dialing, provided dial key 31 has not been restored to normal. If the dial-release key 32 is operated without also restoring the talking key 17, relays 29 and 30 are held operated in a circuit from battery through their windings, outer lower front contact of relay 25, front contact of relay 30, and through the continuity contact of release key 32 to ground at the inner lower front contact of relay 38. It is, therefore, also necessary either to restore the talking key 17 or to withdraw the plug 13 from jack 2.

Should any of the switches used in extending the connection to the dial tester find all trunks busy, or if the line leading to the dial tester is busy, the current over trunk T is reversed thereby causing the operation of the polarized relay 33 and the release of relay 36. Relay 33 opens the circuit through the winding of relay 37 but this relay is slow in releasing to prevent opening of the dialing circuit before the reversal of current has effected certain necessary operations in the connection beyond trunk T. The release of relay 37 and the consequent release of relay 38 extinguishes the lamp 40 and releases relays 29 and 30. The release of relay 29 re-connects the tip and ring conductors of plug 13 to the operator's telephone circuit.
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When connection with the dial-tester has been established an additional digit is dialed to operate the testing device. Upon transmission of the first impulse, relay 7 is operated to reduce the impedance of the dialing circuit and to open the talking circuit as hereinbefore described. When all of the impulses have been transmitted, relay 7 releases thereby closing the talking circuit and inserting the left-hand winding of retard coil 9 into the dialing circuit to improve transmission through the talking circuit. The supervisory signal is then received from the dial tester to indicate whether the dial is too fast, too slow, or within the proper speed
 120 125 130

limits. The test may be repeated by dialing another digit.

When the test is completed plugs 13 and 15 are removed from jacks 2 and 3 thereby causing the release of all of the relays in the trunk circuit and the release of the switches involved in the connection to the dial tester. Relays 23, 24, 25 and 26 release when the plugs are removed, and operation of the dial release key causes the release of relays 36, 37, 38, 39 and 18.

Although only one application of this invention is disclosed it is understood that the invention is applicable to other systems and circuit arrangements wherein it is necessary to provide switching means which is actuated upon receipt of the first impulse of a train of impulses and which is released when all of the impulses in the train have been received.

What is claimed is:

1. In combination interrupter contacts for creating current impulses, impulse receiving means, a control relay, the winding of said control relay being in series with said interrupter contacts and said impulse receiving means, a switching relay, and contacts of said control relay for short circuiting the winding of said switching relay.

2. In a telephone system, a trunk, an automatic switch to which said trunk is connected, a line relay for controlling the operation of said automatic switch, means for creating impulses, a control relay, a circuit including said impulse creating means, the winding of said control relay, the conductors of said trunk and the windings of said line relay, a switching relay, contacts of said control relay for short-circuiting the winding of said switching relay, and contacts of said switching relay actuated during the transmission of a series of impulses over said circuit.

3. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections, a dial common to said cords, a device for testing said dial, a trunk circuit having talking conductors terminating in one jack and dialing conductors terminating in another jack, means including one of said cords and said trunk circuit for extending a connection from said operator's position to said testing device, and switching means actuated upon transmission of the first impulse in a train created by the operation of said dial for opening the connection from said device to said talking conductors.

4. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections and with a telephone set and a dial common to said cords, a device for automatically testing said dial, means including a trunk for extending a connection from said position to said device,

a jack for establishing a talking connection between said trunk and said operator's telephone set, another jack for establishing a dialing connection between said trunk and said dial, and switching means actuated during the transmission of a train of impulses created by the operation of said dial for opening said talking connection.

5. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections and with a telephone set and a dial common to said cords, a talking key for each cord for connecting said cord and telephone set, a dialing key for connecting any one of said cords to said dial, a device for testing said dial, means including a trunk for extending a connection from said position to said device, a jack for establishing a talking connection over one of said cords from said trunk to said operator's telephone set, another jack for extending a dialing connection over said one of said cords from said trunk to said dial, and switching means actuated during the transmission of a train of impulses created by the operation of said dial for opening said talking connection.

6. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections and with a telephone set and a dial common to said cords, a talking key for each cord for connecting said cord and telephone set, a dialing key for connecting any one of said cords to said dial, a device for testing said dial, means including a trunk for extending a connection from said position to said device, a jack for establishing a talking connection between said trunk and said operator's telephone set, another jack for establishing a connection between said trunk and said dial, a control relay associated with said trunk in series with said dialing connection, a switching relay for controlling said talking and said dialing connections, contacts of said control relay for short circuiting the winding of said switching relay, and contacts of said switching relay actuated during the transmission of a series of impulses created by the operation of said dial.

7. In combination, an impulse sender, an outgoing trunk, a control relay, means for connecting said impulse sender in series with the winding of said relay across the conductors of said trunk, a switching relay and a circuit through its winding closed upon the connection of said sender across said conductors, contacts of said control relay for short-circuiting the winding of said switching relay, and a circuit controlled by contacts of said switching relay.

8. In combination, a relay for responding to current impulses through its winding, a switching relay, contacts of said impulse relay effective while said impulse re-

lay is operated to short-circuit the winding of said switching relay, a circuit closed through the winding of said switching relay and effective upon the release of said impulse relay to operate said switching relay, said switching relay being slow in releasing so as to remain operated during the response of said impulse relay to a series of impulses, and a circuit controlled by said switching relay.

9. In combination, an impulse sender, a circuit for transmitting impulses created by the operation of said sender, a switching relay, means controlled by said circuit for preventing the operation of said relay prior to the operation of said sender, and a circuit closed by said switching relay in response to the first impulse of a series, said last mentioned circuit being maintained until all of the impulses in said series have been transmitted.

10. In combination, an impulse sender, a circuit for transmitting impulses created by the operation of said sender, a switching relay, means controlled by said circuit for preventing the operation of said relay prior to the operation of said sender, and a circuit opened by said switching relay in response to the first impulse of a series, said last mentioned circuit being held open until all of the impulses in said series have been transmitted.

11. In combination, an impulse sender, a circuit for transmitting impulses created by the operation of said sender, a control relay in said circuit, said control relay being alternately released and reoperated in response to a series of said impulses, a switching relay, a short-circuit across the winding of said switching relay while said control relay is operated, a circuit for operating said switching relay upon the release of said control relay in response to the first of a series of said impulses, said short-circuit being ineffective to cause the release of said switching relay until all of the impulses of said series have been transmitted, and a circuit controlled by said switching relay.

12. In combination, a trunk, a bridge including the winding of a control relay across the conductors of said trunk, means for alternately opening and closing said bridge to cause the alternate release and reoperation of said control relay, a second relay, contacts of said control relay for short-circuiting the winding of said second relay, a circuit rendered effective in consequence of the release of said control relay to operate said second relay, said second relay remaining operated between successive openings of said bridge, and a circuit controlled by said second relay.

13. In combination, an impulse sender, impulse actuated mechanism, means for interconnecting said sender and mechanism, a control relay in series with said sender, a switching relay, a circuit through the winding of

said switching relay closed in consequence of the interconnection of said sender and said mechanism, contacts of said control relay for short-circuiting said switching relay to prevent its operation, the release of said control relay in response to the first of a series of impulses created by the operation of said sender being effective to operate said switching relay, and a circuit closed by the operation of said switching relay, said switching relay being slow in releasing to maintain said last mentioned circuit during the response of said control relay to the succeeding impulses of said series.

14. In combination, an impulse sender, impulse actuated mechanism, means for interconnecting said sender and mechanism, a control relay in series with said sender, a switching relay, a circuit through the winding of said switching relay closed in consequence of the interconnection of said sender and said mechanism, contacts of said control relay for short-circuiting said switching relay to prevent its operation, the release of said control relay in response to the first of a series of impulses created by the operation of said sender being effective to operate said switching relay, and a circuit opened by the operation of said switching relay, said switching relay being slow in releasing to hold said last mentioned circuit open during the response of said control relay to the succeeding impulses of said series.

15. In a telephone system, a trunk terminating at its distant end in an automatic switch, a telephone station, an impulse sender at said station, conductors for establishing a talking connection between said station and said trunk, conductors for establishing a connection between said sender and said trunk, a control relay in series with said sender for responding to impulses, a second relay, contacts of said control relay for short-circuiting the winding of said second relay, a circuit effective upon the release of said control relay in response to the first of a series of impulses to operate said second relay, and contacts of said second relay for opening said talking connection, said second relay remaining operated until said control relay has responded to all of the impulses in said series.

16. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections, a dial common to said cords, an impulse controlled switch, a trunk circuit having talking conductors terminating in one jack and dialing conductors terminating in another jack, means including one of said cords and said trunk circuit for extending a connection from said operator's position to said switch, and switching means actuated upon transmission of the first impulse in a train created by the operation of said dial for opening the connection from said device to said talking conductors.

17. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections and with a telephone set and a dial common to said cords, an automatic switch, means including a trunk for extending a connection from said position to said switch, a jack for establishing a talking connection between said trunk and said operator's telephone set, another jack for establishing a dialing connection between said trunk and said dial, and switching means actuated during the transmission of a train of impulses created by the operation of said dial for opening said talking connection.
18. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections and with a telephone set and a dial common to said cords, a talking key for each cord for connecting said cord and telephone set, a dialing key for connecting any one of said cords to said dial, impulse controlled mechanism, means including a trunk for extending a connection from said position to said mechanism, a jack for establishing a talking connection over one of said cords from said trunk to said operator's telephone set, another jack for extending a dialing connection over said one of said cords from said trunk to said dial, and switching means actuated during the transmission of a train of impulses created by the operation of said dial for opening said talking connection.
19. In a telephone system, an operator's position equipped with a plurality of cords for establishing connections and with a telephone set and a dial common to said cords, a talking key for each cord for connecting said cord and telephone set, a dialing key for connecting any one of said cords to said dial, an impulse actuated mechanism, means including a trunk for extending a connection from said position to said mechanism, a jack for establishing a talking connection between said trunk and said operator's telephone set, another jack for establishing a connection between said trunk and said dial, a control relay associated with said trunk in series with said dialing connection, a switching relay for controlling said talking and said dialing connections, contacts of said control relay for short-circuiting the winding of said switching relay, and contacts of said switching relay actuated during the transmission of a series of impulses created by the operation of said dial.
20. In a telephone system, a trunk terminating at its distant end in an automatic switch, a telephone station, a dialing device at said station, conductors for establishing a talking connection between said station and said trunk, conductors for establishing a connection between said sender and said trunk, a control relay in series with said sender for responding to impulses, a second relay, contacts of said control relay for short-circuiting the winding of said second relay, a circuit effective upon the release of said control relay in response to the first of a series of impulses to operate said second relay, and contacts of said second relay for controlling said talking and dialing connections, said second relay remaining operated until said control relay has responded to all of the impulses in said series.
- In witness whereof, I hereunto subscribe my name this 9th day of May, 1930.
- ROBERT C. PAINE.