

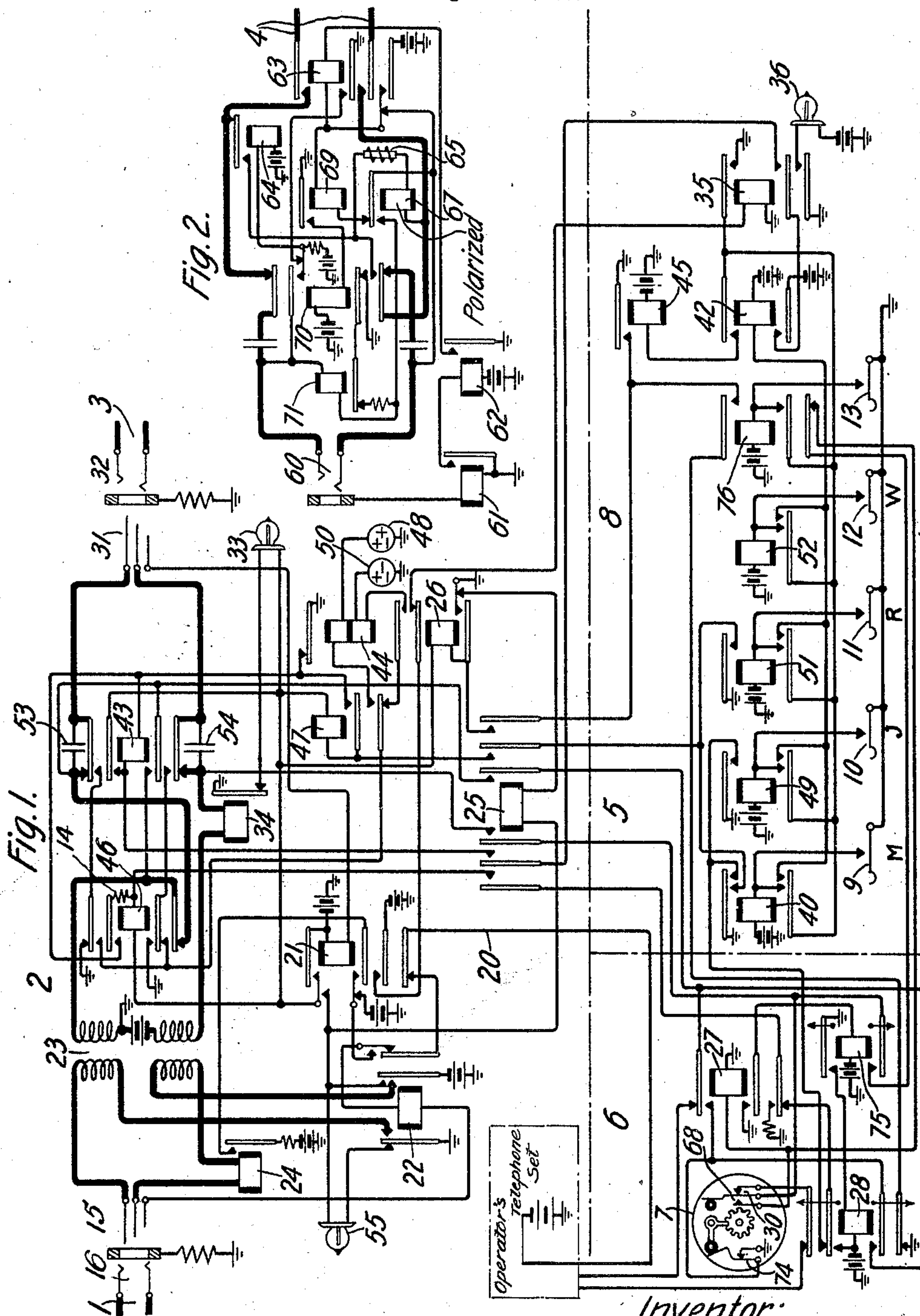
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM.

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This invention relates to telephone systems, and more particularly to improvements in operators' connecting circuits equipped for establishing connections to subscribers' lines that may be reached by manually extended connections or by automatically operated means under control of the connecting circuit employed.

In systems of this type it is common practice to employ in the case of a manually extended connection to the subscriber's line a common master ringing key circuit that is automatically associated with the connecting or cord circuit taken for use. This common key circuit may be manipulated to transmit different types of ringing current in different manners over the connected subscriber's line to call corresponding parties thereon. It is also common practice to employ cord circuits of this type whereby if the desired subscriber's line can only be reached through automatically operated switching devices, a dialing equipment common to a plurality of cord circuits is automatically connected to the cord circuit employed and whereby the manipulation of this dialing equipment controls the selection through said switching devices of the desired subscriber. The arrangement is usually such that after the dialing and common master ringing key equipments are automatically associated with a cord circuit the release therein will take place upon the actuation of a manually operated key when the dialing equipment alone has been employed in automatic connections and that the release of said equipment will take place automatically after the master ringing equipment has been employed in a manually extended connection.

It is an object of this invention to improve cord circuits of this general character to perform the functions for which they are designed in a more expedient and efficient manner than heretofore.

To attain this and other objects of the invention, as will hereinafter appear, there is provided means whereby the usual impulse sender, in the common dialing equipment when associated with a cord circuit taken for use, is automatically connected to this cord circuit only on the operation of the sender from its normal position.

Another feature of the invention resides

in means whereby after the sender has once been connected to a cord circuit, it cannot be released therefrom until a manually operated key is depressed and the sender itself has returned to normal position.

The invention has been illustrated in the accompanying drawings, in which Fig. 1 shows a system whereby a connection may be extended from an ordinary subscriber's line 1, over a cord circuit 2, arranged in accordance with this invention, and from this cord circuit to an ordinary subscriber's line 3, while Fig. 2 shows the outgoing end of a trunk line 4 whereby a connection may be extended from cord circuit 2 to a distant automatic exchange where a desired subscriber's line may be reached through the operation of automatically actuated switches.

Referring now to the drawings, the cord circuit 2 represents one of a plurality of similar cord circuits at an operator's position, with which the common equipment 5 shown below the dash-dotted line may be associated in succession, as required for the successful manipulation of connections established by said cord circuits. This common equipment comprises a dialing circuit 6, including an impulse sender 7, and a master ringing key circuit 8, including party line ringing keys 9, 10, 11 and 12, whereby any one of four parties on a connected subscriber's line, such as 3, may be rung, and a so-called trunking key 13, whereby the dialing equipment 6 and master key ringing equipment 8 may be disconnected from a cord circuit when it is of no further use in the establishing of a connection.

To more clearly bring out the various features of the invention, a description will first be made of the functions of the system illustrated in the establishing of a connection between line 1 and line 3, through cord circuit 2, followed by a description of a connection between line 1 and a trunk 4, through the cord circuit 2, and parts played by the common dialing and ringing equipments in connections of these types.

Assuming then that the operator at the switchboard where cord circuit 2 is located observes in the usual manner that a connection is desired by the subscriber connected to line 1, she will insert plug 15 of the cord circuit 2 in the multiple jack 16 of line 1.

Battery is connected to lead 20 through the action of any well-known sequence circuit so that the operator's telephone circuit will be connected in succession to engaged cord circuits. In this case therefore this battery will be supplied over lead 20 through the lower outer armature and back contact of relay 21, outer right-hand armature and back contact of relay 22, winding of relay 22, sleeve terminals of plug 15 and jack 16 through a resistance to ground. This circuit causes the operation of relay 22, which now closes a circuit from battery and ground at its left-hand armature and front contact and right-hand inner armature and a front contact through the left hand windings of coil 23 to the tip and ring conductors and corresponding terminals of plug 15 and jack 16 to the subscriber's line 1 and through the loop of the subscriber's telephone set, as is well known in the art. This circuit causes the operation of relay 24, which closes a circuit, the purpose of which will be hereinafter described. The operation of relay 22, in operating also closes a circuit through its make-before-break contacts to battery at the make-before-break contacts of relay 21 and opens its original energizing circuit to battery on lead 20. This relay will, therefore, be locked under control of relay 21. The operation of relay 22 also closes a circuit for the operation of relay 25, as follows: battery, inner right-hand armature and another front contact of relay 22, winding of relay 25, make-before-break contacts of relay 26 to ground. Relay 25 operates in this circuit and associates the common equipments 5 with cord circuit 2 by closing at its various armatures and front contacts a number of circuits the purpose of which will appear as the description proceeds. One of the circuits closed by the operation of relay 25 will be a circuit from the operator's telephone set connected at OT, to the tip and ring conductors of cord circuit 2. This circuit may be traced as follows: from the tip conductor of cord circuit 2, inner right-hand armature and front contact of relay 25, upper armature and back contact of relay 27, the tip conductor through the operator's telephone set, back through the ring conductor of the set, upper outer armature and back contact of relay 28, normally closed off-normal contacts 30 of dial 7, inner left-hand armature and front contact of relay 25 to the ring conductor of cord circuit 2. The operator is now, therefore, connected to the calling subscriber's line through the repeating coil 23 and may ascertain the number of the wanted subscriber's line. If, for example, a subscriber on line 3 is desired, this subscriber may be rung by the operation of a corresponding key in the common master ringing key equipment 8.

The first action on the part of the oper-

ator towards accomplishing this purpose will of course be to insert plug 31 in jack 32 of line 3. A circuit is thereby closed for the operation of relay 21, as follows: battery, winding of relay 21, sleeve terminals of plug 31 and jack 32, through a resistance to ground. The operation of relay 21 results in closing its inner lower armature to the corresponding front contact to extend the locking circuit for relay 22 to a battery connected at the armature and front contact of relay 24, so that relay 22 is now locked under control of this latter relay. Another circuit closed by the operation of relay 21 is a circuit for supervisory lamp 33. This circuit may be traced as follows: battery, upper armature and front contact of relay 21, lamp 33, armature and back contact of supervisory relay 34 to ground, so that lamp 33 now lights to indicate to the operator that cord 2 is engaged. The operation of relay 21 also closes an additional circuit for the operation of relay 35, as follows: battery, lower middle armature and front contact of relay 21, upper inner armature and back contact of relay 26, winding of relay 35 to ground. The operation of relay 35 closes an obvious circuit for the master ringing and dialing equipment lamp 36 to indicate to the operator that these equipments are engaged in a connection.

When the operator finds lamp 35 lighted she depresses the ringing key of the desired party on line 3. If the party desired is party M, she operates key 9. This closes an obvious energizing circuit for relay 40 and relay 40 in energizing closes a locking circuit for itself through its lower armature and front contact to ground at the upper armature and front contact of relay 35. The operation of relay 40 also closes an obvious circuit for the energization of relay 42. Relay 42 in operating closes a circuit for the operation of relay 43 as follows: battery, lower armature and front contact of relay 42, lower inner armature and front contact of relay 35, middle left-hand armature and front contact of relay 25, winding of relay 43, armature and back contact of ringing trip relay 44 to ground. The operation of this relay closes various circuits as will hereinafter appear. The operation of relay 42 closes an obvious circuit for relay 45 which in energizing closes a circuit for the operation of relay 26 as follows: battery, upper armature and front contact of relay 21, winding of relay 26, outer right-hand armature and front contact of relay 25, armature and front contact of relay 45 to ground. Relay 26, in operating, closes a locking circuit for itself independent of the ground at the armature and front contact of relay 45 through its own lower armature and front contact to ground. The operation of relay 26 in opening its own make-before-break contacts to

ground opens the circuit for relay 25 which now deenergizes and disconnects the master ringing key and dialing circuits from the cord circuit 2. Relays 35, 40, 42 and 45 are thereby released and the master ringing and dialing lamp 36 is extinguished. It should be noted, however, that before relay 25 is deenergized, a circuit is closed through the operation of relay 40 for the operation of relays 46 and 47. The circuit for the operation of relay 46 is as follows: battery, upper armature and front contact of relay 21, winding of relay 46, outer left-hand armature and front contact of relay 25, lower outer armature and back contact of relay 27, upper armature and back contact of relay 28, upper armature and front contact of relay 40 to ground. The circuit for relay 47 may be traced as follows: battery, armature and front contact of relay 21, winding of relay 47, middle right-hand armature and front contact of relay 25, upper armature and another front contact of relay 40 to ground. The operation of relay 46 connects ground at its lower inner armature and front contacts through the lower outer armature and front contact of relay 43 to the ring terminal of plug 31 and the operations of relays 46 and 47 connect positive potential ringing current from the ringing generator 48 through the upper winding of tripping relay 44, lower outer armature and front contact of relay 47, upper outer armature and front contact of relay 46, upper outer armature and front contact of relay 43 to the tip terminal of plug 31. It should be noted that relays 43, 46 and 47 when operating provide locking circuits for themselves to the ground at the armature and back contact of tripping relay 44. The locking circuit for relay 43 being closed through its upper inner armature and front contact, the locking circuits for relay 46 being closed through its upper inner armature and front contact, the locking circuits for relay 46 being closed through its upper inner armature and front contact, while the locking circuit for relay 47 is closed through its lower inner armature and front contacts. These relays are therefore independent of their original energizing circuits previously traced through the contacts of relay 25 so that when relay 25 deenergizes, these relays are not affected. The ringing current from source 48 and back to ground is applied through the tip and ring terminals of plug 31 and transmitted in the usual manner to ring the wanted subscriber's bell, that is, with the ground on the ring conductor and with the positive ringing current on the tip conductor the bell of party M on line 3 is rung.

If the party J had been the party wanted, key 10 would have been operated and relay 49 would have become energized. The functions of the master ringing key equipment

and the cord circuit would in this case have been identical with the functions previously described when party M was called, except that relay 47 is not energized. It should be noted that no energizing circuit will be closed for this relay at the armatures and front contacts of relay 49. Therefore, instead of current from the positive ringing source 48 being transmitted over the tip conductor of the cord circuit 2 to line 3, negative ringing current is transmitted over this conductor from source 50 as follows: source 50, lower winding of the ringing trip relay 44, upper outer armature and front contact of relay 26, lower outer armature and back contact of relay 47, upper outer armature and front contact of relay 46, upper outer armature and front contact of relay 43 to the tip terminal of plug 31 and jack 32 over the tip conductor of line 3, and in this instance the bell of party J will be operated.

If the party desired had been party R, key 11 would have been operated to close an obvious energizing circuit for relay 51. In this instance the operations will be the same except that relay 46 will not operate. In this instance then the positive ringing current from source 48 and ground will be connected in reverse manner to the tip and ring terminals of plug 31 and if party W had been the party desired, relay 52 would have been operated and in this instance, the current from the negative ringing current source 50 and ground would have been connected to the tip and ring conductors in reverse manner, as in this instance neither relay 47 nor relay 46 would have been operated.

It should be noted that during the ringing of a wanted subscriber current is induced from the tip and ring leads of the cord circuit 2, through the repeating coil 23 by the presence of the condensers 53 and 54 in the tip and ring conductors of cord circuit 2. The calling subscriber will, therefore, hear the ringing of the wanted subscriber as is well known in the art.

When the called subscriber answers by removing his receiver from the hook, the ringing trip relay 44 will operate as is well known in the art and release the relays 46, 47 and 43 and disconnect the ringing source from the conductors of the cord circuit. The release of relay 43 short circuits the condensers 53 and 54 so that the circuit will now be completed through the subscribers' loops from the battery and ground at the right-hand windings of repeating coil 23 and supervisory relay 34 is now operated in this circuit. The operation of this relay extinguishes the lamp 33 to indicate to the operator that the wanted subscriber has answered.

Conversation between the subscribers may now take place and when the calling sub-

scriber hangs up his receiver on the hook, supervisory relay 24 is released, causing the release of relay 22. The release of relay 22 closes a circuit for the lighting of lamp 55. This circuit may be traced as follows: battery, upper armature and front contacts of relay 21, lamp 55, left-hand armature and back contact of relay 22 to ground. The lighting of this lamp indicates to the operator that the calling subscriber has released and she may now remove plug 15 from jack 16 and plug 31 from jack 32. On the removal of plug 31, relay 21 is released and lamp 55 extinguished.

A connection extended through the trunk 4 to a subscriber that may be reached by the operation of automatic switches will now be described. The function of cord circuit 2 in connecting the common master ringing key and dialing equipments 5 to the cord circuit is the same as previously described up to the preparation of the cord circuit for the insertion of plug 31 in the jack of the line to which the connection is to be extended.

If now the operator inserts plug 31 in jack 60 of trunk 4 the following circuit is completed: battery, winding of relay 21, sleeve terminals of plug 31 and jack 60, winding of relay 61 to ground. This circuit causes the operation of relays 21 and 61. The operation of relay 61 causes an obvious energizing circuit to be closed for relay 62, and relay 62 when energizing closes a circuit for relay 63 as follows: battery, lower right-hand winding of repeating coil 23, winding of supervisory relay 34, lower outer armature and back contact of relay 43, ring terminals of plug 31 and jack 60, make-before-break contacts of relay 63, winding of relay 63, armature and front contact of relay 62 to ground. This causes the operation of relay 63 which now provides a locking circuit for itself independent of the battery at the repeating coil 23. This locking circuit is completed through the lower outer armature and front contact of relay 63 to battery. The operation of relay 63 also closes the tip and ring conductors of trunk 4 through from the line side to the outward end of the trunk. The operation of relay 63 also closes an obvious circuit for relay 64 and the operation of relay 64 closes a circuit across the tip and ring conductors of the trunk through the retardation coil 65 and relay 67. Relay 67, however, does not operate at this time as this relay is polarized and does not respond to the current incoming over the trunk 4 as it is of a direction opposite to that to which relay 67 would respond. The lighting of lamp 36 as previously described indicates to the operator that the ringing key and dialing equipments are connected to the cord 2 and that the dial 7 may be manipulated to select the wanted subscriber's number.

If now the operator manipulates dial 7 in accordance with the wanted subscriber's number the contacts 30 are opened as the dial moves off-normal and contacts 68 are closed. At the closing of these contacts a circuit is closed for the operation of relay 27, in the dialing circuit, and relay 69, in the outward end of the trunk circuit 4, as follows: battery, lower outer armature and front contact of relay 63, winding of relay 69, armature and back contact of relay 67, ring terminals of jack 60 and plug 31, lower outer armature and back contact of relay 43, inner left-hand armature and front contact of relay 25, off-normal contacts 68 of dial 7, winding of relay 27 to ground. The operation of relay 69 closes an obvious energizing circuit for relay 70. The operation of this relay closes at its upper inner armature and front contact the tip side of the cord 2 from the ground at the upper right-hand winding of repeating coil 23 through to the winding of relay 64 so as to maintain relay 64 operated until the circuit from the pulsing contacts 74 of dial 7 is completed as will hereinafter be described. This relay 70 also opens at its inner lower armature and back contact a connection to ground through a resistance and one side of the winding of relay 71. Relay 70 also closes at its outer lower armature and front contact a shunt circuit across the line side of the trunk 4. This shunt circuit is now under control of the armature and front contact of relay 64 so that at each operation and release of relay 64, as will be hereinafter described, the line side of the trunk will be alternately opened and closed. It should be noted that the operation of relay 70 also disconnects the line side of trunk 4 from the outgoing end at its outer upper and lower armatures and back contacts. On the operation of relay 27 the tip conductor from the cord 2 to the operator's telephone at OT is disconnected at the upper armature and back contact of this relay. Relay 27 also closes a circuit for relay 46 as follows: battery, upper armature and front contact of relay 21, winding of relay 46, outer left-hand armature and front contact of relay 25, lower outer armature and front contact of relay 27 to ground. Relay 46 in operating disconnects the ground connection from the upper right-hand winding of repeating coil 23 to the tip conductor of the cord, but as this conductor is now connected through the inner right-hand armature and front contact of relay 25 and the upper armature and front contact of relay 27 to ground at the pulsing contacts 74 of dial 7, relay 64 will be maintained operated. Relay 27 also closes an obvious energizing circuit for relay 75. Relay 75, in operating, closes a circuit for maintaining relay 27 operated independent of the subsequent opening or

closing of contacts 68 of dial 7 between digits. This circuit may be traced as follows: from the battery, at the lower armature and front contact of relay 63, through the ring conductors of trunk 4 and cord 2 as hereinbefore described to the inner left-hand armature and front contact of relay 25 and from there through the lower armature and front contact of relay 75, lower outer armature and back contact of relay 76, winding of relay 27 to ground. Relay 75 also closes an obvious energizing circuit for relay 28 which at its upper armature and back contact opens a circuit controlled by relays 40 and 49 to prevent the inadvertent operation of the keys 9 and 10 from effecting the setting of the relays in cord circuit 2 at this time. Relay 28 also opens at its upper outer armature and back contact the ring conductor to the operator's telephone set at OT.

When now the impulse sender or dial 7 is released to send the first series of impulses, contacts 74 are alternately opened and closed a number of times in accordance with the number of the first digit. Relay 64 is thereby alternately operated and released to alternately close and open the line side of the trunk 4. As is well-known in the art, this opening and closing of the tip and ring conductors of trunk 4 will cause switching operations to take place at the distant end in the automatic office for the selection of the wanted subscriber's line. The subsequent operations of dial 7 in accordance with the remaining digits will have similar switching effects at the automatic office, so that when the last digit is dialed the subscriber's line will be connected to trunk 4.

The operator will now in order to connect the calling and called subscriber together through the cord 2 and disconnect the common equipments 5 operate key 13. The operation of this key closes an obvious energizing circuit for relay 76 which in energizing locks to ground at the armature and front contact of relay 35. The operation of relay 76 opens the holding circuit for relay 27, which in releasing opens the circuit for relay 75. Relay 75 in releasing opens the energizing circuit for relay 28, but as both these relays 75 and 28 are slow to release, a circuit is temporarily closed on the release of relay 27 from battery, through the upper inner armature and front contact of relay 28, lower outer armature and back contact of relay 27, outermost lefthand armature and contact of relay 25, winding of relay 46 to cause the release of relay 46 which it should be noted is locked to the ground at the upper armature and back contact of ringing trip relay 44 through resistance 14. The release of relay 46 closes the connection from ground at the upper right-hand wind-

ing of repeating coil 23, through to the tip terminal of plug 31, so as to maintain relay 64 operated after relay 27 is released. It should be noted that between the release of relay 27 and before the release of relays 28 and 46 a ground connection for the maintenance of relay 64 operated over the following circuit: ground at the closing contacts 74 of dial 7, through the lower inner armature and front contact of relay 28 to the tip conductor of cord 2. When relay 28 finally releases, this ground is removed, but as the ground connection has been established from repeating coil 23 for relay 64 by this time the release of relay 28 will have no further control over relay 64. At the same time upon the release of relay 67, relay 69 is released. The release of relay 69, in turn, releases relay 70. The release of relay 70 connects relay 64 to ground at the lower contact of relay 63, thus holding it operated, opens the short circuit about relay 67 and closes the tip and ring conductors of the trunk. A circuit is now established by the release of relay 28 for the operation of relay 26 as follows: battery, upper armature and a front contact of relay 21, winding of relay 26, outer right-hand armature and front contact of relay 25, upper armature and front contact of relay 76, lower outer armature and back contact of relay 28 to ground. The operation of relay 26 now causes the disconnection of the common equipments 5 in the same manner as hereinbefore described. Relay 76 in the ringing key equipment 8 is released on the release of relay 35 in this circuit.

As is also well-known in the art when the subscriber's line is reached, it is automatically rung from the automatic office and when the called subscriber answers, the battery connected to the trunk 4 at the automatic office will be reversed, causing the operation of relay 67. The operation of relay 67 disconnects relay 69 from the ring conductor. Relay 67 in operating, closes a circuit from battery through the right-hand lower winding of repeating coil 23, winding of relay 34, lower outer armature and back contact of relay 43, ring terminals of plug 31 and jack 60; armature and front contact of relay 67, winding of relay 71 through the tip conductors of the trunk and cord circuit to ground at the repeating coil 2. This circuit causes the operation of relay 34 which now opens the circuit for lamp 33 so that this lamp is extinguished and thereby notifies the operator that the wanted subscriber's line has been found and connected to trunk 4.

The connection is now complete between the calling and called subscriber with relays 22, 21, 24 and 34 in the cord 2 held operated and with relays 71, 61, 62, 63, 64 and 67 in the trunk circuit held operated.

If the key 13 is operated before the sending of the last digit is completed, relay 27 will not release. As the off-normal contacts 68 of dial 7 are still closed and thus maintain the circuit for this relay closed until the dial has returned to normal, at which time, the release of the circuits take place as hereinbefore described.

In accordance with this invention, therefore, the dial 7 is not connected to the cord circuit 2 until it has been moved off-normal and its off-normal contacts 68 have been closed and neither can the dialing circuit equipment 6 be removed from cord 2 until the dial has returned to normal and key 13 has been operated.

What is claimed is:

1. In a telephone system, lines, cord circuits, a ringing key and dialing equipment common to said cord circuits, means for associating said equipment with a cord circuit responsive to the connection of said cord circuit to a line, means for disassociating said equipment from said cord circuit jointly responsive to the extension of said cord circuit to another line and to the operation of the ringing key in said equipment.

2. In a telephone system, lines, cord circuits, a ringing key equipment and a dialing equipment both common to said cord circuits, means for associating said equipments with a cord circuit responsive to the connection of said cord circuit to a line, means for disassociating said equipments from said cord circuit jointly responsive to the extension of said cord circuit to another line, to the actuation and release of the dial-

ing equipment and to the actuation of a key in said ringing key equipment.

3. In a telephone system, lines, cord circuits, a dialing circuit including a sender common to said cord circuits, means for associating the dialing circuit with a cord circuit responsive to the connection of said cord circuit to a line, means for connecting the sender to said cord circuit jointly responsive to the extension of said cord circuit to another line and to the actuation of the sender, and means comprising a manually operated key and a circuit arrangement for disconnecting the sender and disassociating the dialing circuit from said cord responsive to the joint control over said circuit arrangement by the actuation of the key and the return of the sender to normal position.

4. In a telephone system, a line, a cord circuit, an impulse sender, means for connecting the impulse contacts of said sender to one conductor of the cord circuit responsive to the connection of the cord circuit to said line and the operation of the sender, said connection being controlled over a circuit including another conductor of said cord circuit and the off-normal contacts of said sender, and means for disconnecting said sender from the cord circuit responsive only on the opening of the control circuit by the off-normal contacts of the sender on the return of said sender to normal position.

In witness whereof, I hereunto subscribe my name this 17th day of August A. D., 1925.

WILLIAM M. BEAUMONT.