Dec. 29, 1925. 1,567,257

C. B. FOWLER

TELEPHONE SYSTEM

Filed Dec. 20, 1923 3 Sheets-Sheet 1

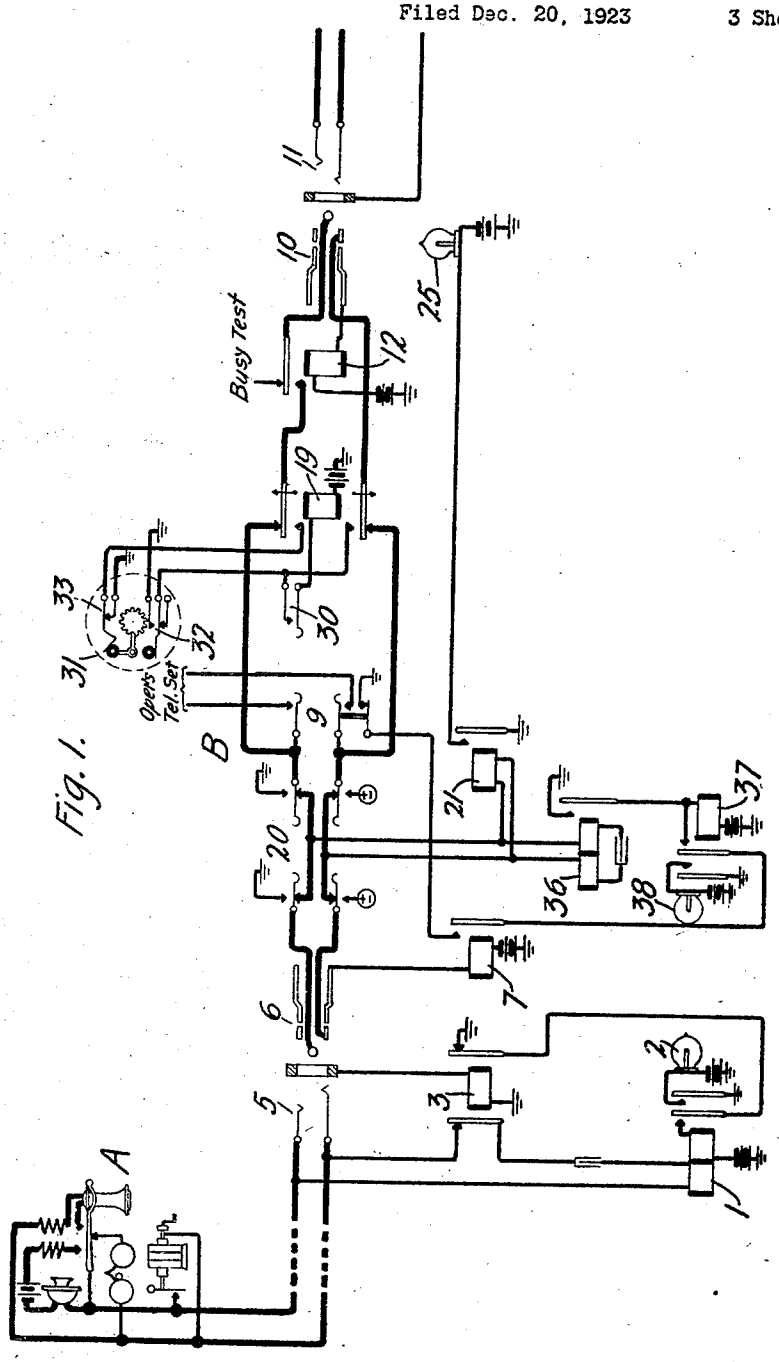

Fig. 1.

Inventor:
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Att'y.

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Filed Dec. 20, 1923 3 Sheets-Sheet 2

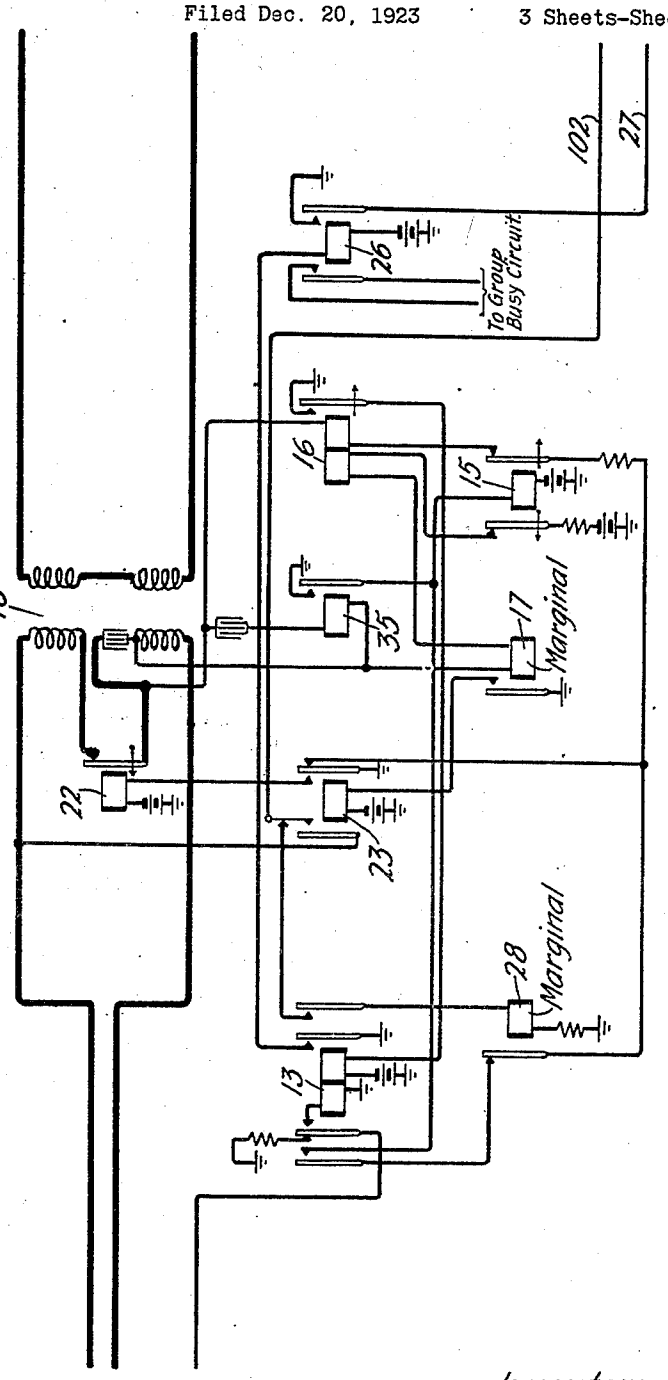

Fig. 2.

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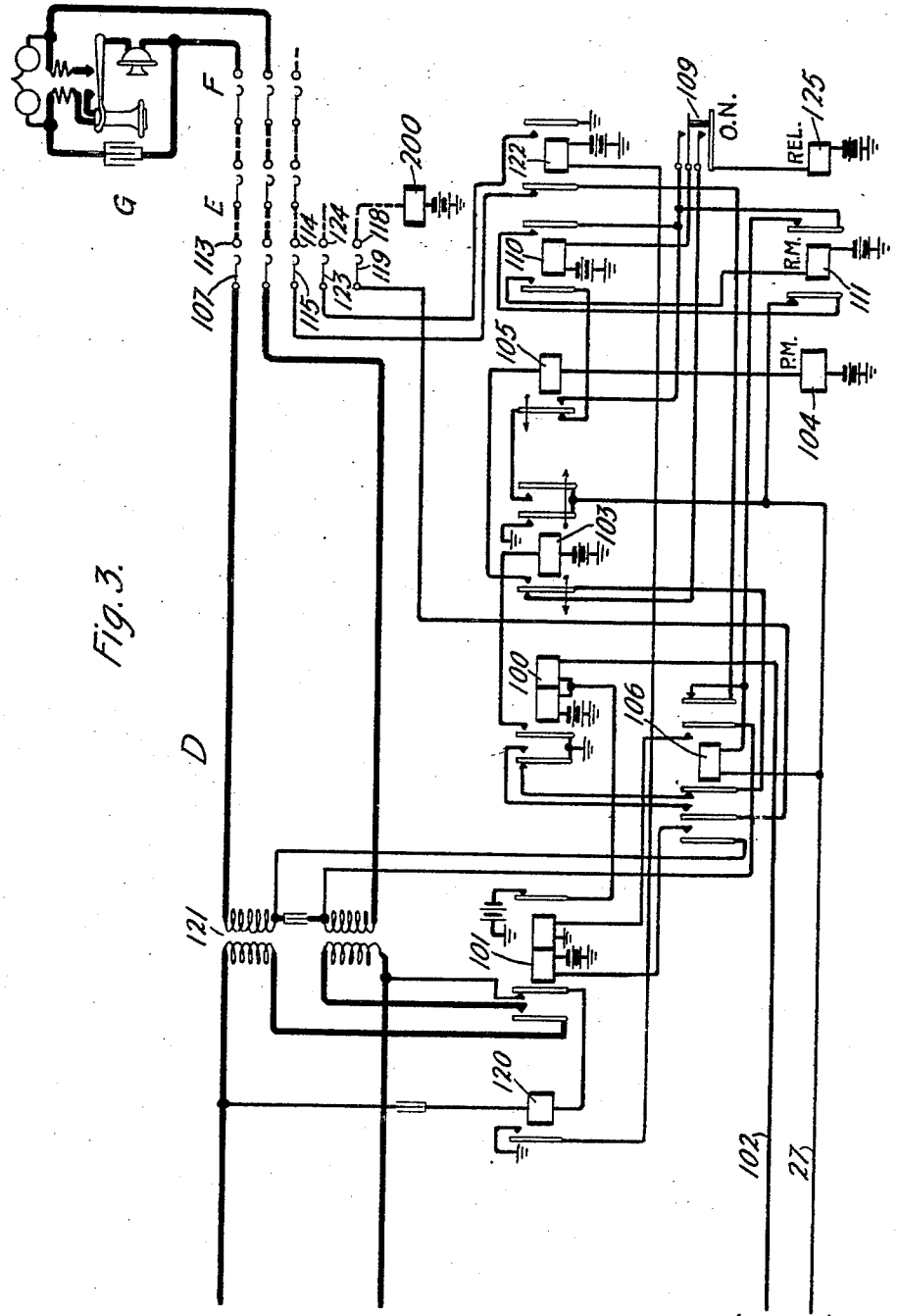

Fig. 3.

Inventor:
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Patented Dec. 29, 1925. 1,567,257

UNITED STATES PATENT OFFICE.

CLARENCE B. FOWLER, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Application filed December 20, 1923. Serial No. 681,693.

To all whom it may concern:

Be it known that I, CLARENCE B. FOWLER, a citizen of the United States of America, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems and more particularly to improvements in trunk circuits used for establishing connections between manual and automatic exchanges.

It is adapted for use in systems in which calls are received in the manual switchboard and from there extended by an operator's cord circuit through a trunk circuit and automatic switches to a called line in an automatic exchange. In such systems the operator is provided with an impulse sender that may be associated with the cord circuit and operated to transmit impulses through the cord and trunk circuits to control the automatic switches to select the desired line. The trunk circuits employed in systems of this character are usually arranged to transmit impulses by the aid of repeating relays over a third or sleeve conductor to the impulse responsive relays in the automatic switches.

An object of the invention is to provide an improved trunk circuit arrangement whereby the impulses may be transmitted to the impulse responsive relays over a simplex circuit comprising a portion of one of the talking conductors and a separate conductor directly to the impulse responsive relay of an automatic switch.

Another object is the provision of means in a trunk circuit of this type for the transmission of various supervisory signals incidental to the control of connections between the exchanges.

To attain these objects, in accordance with one feature of the invention a relay arrangement including a marginal relay is provided in the trunk circuit operative the moment the impulse sender is actuated, for connecting one talking conductor of the trunk circuit with a conductor leading directly to the impulse responsive relay of a selector switch.

A further feature is the provision whereby owing to a decrease in the current for the circuit of the impulse responsive relay, due to the disconnection of the called subscriber, a relay arrangement is operated to extinguish a supervisory signal at the operator's position.

Other features relating to the supervision of the connection will appear during the description of the invention.

One embodiment of the invention is illustrated in the accompanying drawings, in which Fig. 1 shows an operator's cord circuit at a manual exchange and a manual subscriber's line terminating thereat; Fig. 2 shows a trunk circuit embodyng the features of this invention and Fig. 3 shows a series of selector switches at an automatic exchange and a called subscriber's line terminating thereat.

Referring now to the drawings, a calling subscriber's line A terminates in jack 5 in a manual switchboard and a cord circuit B is employed to connect line A with trunk circuit C terminating in a plug 6 at the manual switchboard and extending from there to an automatic exchange where it is connected to a first selector D of the well known step-by-step type, which selector in turn is shown connected by means of a second selector switch E and a connector switch F to a called subscriber's line at G. As none of the step-by-step switches and their associated circuit arrangement form any part of this invention, only the circuits for the first selector switch D have been shown in detail to illustrate the application of the invention to a system of this type.

The setting up of a connection between the calling subscriber A and the called subscriber G will now be described. Assuming that the subscriber A, who is equipped with a well known magneto type local battery telephone set, has initiated a call in the usual manner by causing the operation of relay 1, this relay locks up over its right-hand winding and thereby lights the lamp 2 to indicate to the operator at B that a connection is wanted.

The operator upon observing the lamp lighted inserts plug 6 in jack 5 thereby closing a circuit from battery, winding of relay 7, sleeve contacts of plug 6 and jack 5, winding of relay 3 to ground. This circuit causes the operation of relays 3 and 7. The operation of relay 3 extinguishes the lamp 2 and releases relay 1, while the operation of relay 7 performs no useful function at this time.

The operator now actuates the listening key 9 connecting her telephone set (not shown) to the calling line over an obvious circuit and inquires for the number wanted by the calling subscriber. Upon receiving the number, the operator releases the listening key and tests, in the usual manner, for an idle trunk line leading to the automatic exchange in which the wanted line terminates. Assuming that trunk line C is idle, the operator now inserts plug 10 into jack 11 and thereby completes the following circuit from battery, winding of relay 12, sleeve contacts of plug 10 and jack 11, inner left-hand armature and back contact of relay 13 to ground. This circuit operates relay 12 which thereby completes the following circuit: battery, left armature and back contact of relay 15, left winding of relay 16, winding of marginal relay 17, lower left-hand winding of repeating coil 18, ring contacts of jack 11 and plug 10, lower armature and back contact of relay 19, lower normal contact of ringing key 20, winding of relay 21, upper normal contact of ringing key 20, upper armature and back contact of relay 19, front contact and armature of relay 12, tip contacts of plug 10 and jack 11, upper left-hand winding of repeating coil 18, armature and back contact of relay 22, right winding of relay 16, right armature and back contact of relay 15, right-hand armature and back contact of relay 23 to ground. This circuit operates relays 21 and 16 but the current is insufficient to operate marginal relay 17 at this time. Relay 21 at its armature and front contact closes an obvious circuit for supervisory lamp 25, and relay 16 at its armature and front contact closes an obvious circuit for the right-hand winding of relay 13. Lamp 25 is now lighted to indicate that a connection has been made and relay 13 locks at its inner left-hand armature and front contact and left-hand winding to ground over the circuit previously traced for relay 12. Relay 13 also, in operating, causes the energization of relay 26 over a circuit from battery, winding of relay 26, inner right-hand armature and front contact of relay 13 to ground. Relay 26, in operating, closes a circuit at its right-hand armature and front contact to ground for lead 27 to prepare a busy test circuit for the first selector D as will hereinafter appear and, at its left-hand armature and front contact, this relay closes a series contact for a group busy signal (not shown) such as is usually employed to indicate to the operator that all trunks leading to a certain exchange are busy. Relay 13 also closes through its outer right-hand armature and front contact an energizing circuit for marginal relay 28 and the impulse responsive relay 100 of the first selector D as follows: battery, right armature and back contact of relay 101, right winding of impulse responsive relay 100, conductor 102, make-before-break contacts of relay 23, outer right-hand armature and front contact of relay 13, winding of marginal relay 28 to ground. The operation of relay 13, during the time between the operation of relay 13 and relay 28, closes a circuit momentarily for relay 15 as follows: battery, winding of relay 15, outer left-hand armature and front contact of relay 13, armature and back contact of relay 28, right-hand armature and back contact of relay 23 to ground, but, as relay 15 is slow to operate it will not attract its armatures at this time and therefore does not affect the circuits for relays 16 and 13.

Dialing.

The circuits are now prepared for the operation of the first selector switch D. The operator therefore depresses her dialing key 30 preparatory to dialing the number of the wanted subscriber's line and operates the impulse sender 31 to dial the first digit. The impulse sender 31 may be of any well known type in which an off-normal contact 32 is closed during the operation of the impulse contacts 33. The operation of the dial of the impulse sender from normal closes the off-normal contact 32 to ground and an energizing circuit is thereby completed for relay 19 as follows: battery, winding of relay 19, the closed contacts of dialing key 30, contacts 32 to ground. Relay 19, in operating, opens at its upper and lower back contacts the circuit previously traced for relay 21 which, therefore, is deenergized releasing its armature and causes the lamp 25 to be extinguished to indicate that the sender 31 is functioning. Relay 19, in operating also closes at its lower armature and front contact a circuit for the operation of marginal relay 17 as follows: battery, left armature and back contact of relay 15, left winding of relay 16, winding of marginal relay 17, lower left-hand winding of repeating coil 18, ring contacts of jack 11 and plug 10, lower armature and front contact of relay 19, off-normal contact 32 to ground. Marginal relay 17 operates at this time over this circuit due to the increased current from battery at relay 15, as it will be noted that the former circuit from battery at the left armature and back contact of relay 15 by way of both windings of relay 16 and winding of relay 21 in series prevented sufficient current from passing through the winding of marginal relay 17 to cause it to operate. The operation of marginal relay 17 closes a circuit for relay 23 as follows: battery, winding of relay 23, armature and front contact of relay 17 to ground. This circuit energizes relay 23 which, in operating, closes an energizing circuit for relay 22 as follows:

battery, winding of relay 22, right-hand armature and front contact of relay 23 to ground. The operation of relay 22 opens at its armature and back contact the connection for the tip conductor to the right winding of relay 16 to ground, and the operation of relay 23 at its left-hand armature and make-before-break contact opens the circuit previously traced for relay 28 and impulse responsive relay 100. Relay 28 is thereby released and closes a circuit for relay 15 at its armature and back contact but as relay 23 also at its right-hand armature and back contact opens the circuit to ground for relay 15, this relay does not operate. While relay 28 is deenergized as stated by the operation of relay 23, the impulse responsive relay 100 does not deenergize as the make-before-break contacts of relay 23 closes a circuit for this relay from battery, right armature and back contact of relay 101, right winding of relay 100, conductor 102, make-before-break contacts and right-hand armature of relay 23, tip contacts of jack 11 and plug 10, armature and front contact of relay 12, upper armature and contact of relay 19, pulsing contacts 33 of the sender 31 to ground. The circuit for relay 100 is, therefore, now extended and under control of the pulsing contacts 33 ready for the reception of the first digit impulses.

At the original energization of relay 100, a circuit was closed for the slow acting relay 103 from battery, winding of relay 103, inner armature and front contact of relay 100 to ground and when, therefore, the circuit for relay 100 is interrupted a number of times equal to the number of the first digit, on the return of the impulse sender 31 to normal and consequent interruption of contacts 33, the step-by-step selector D is advanced to the proper bank of trunks leading to the second selector E as follows: It should be understood that relay 103 does not deenergize during these interruptions of the pulsing circuit.

At the first interruption of the pulsing contacts 33, relay 100 is deenergized and closes a circuit from battery, winding of vertical magnet 104, winding of slow-to-release relay 105, left armature and front contact of relay 103, left armature and back contact of relay 106, lower armature and back contact of relay 100 to ground. This circuit energizes relay 105 and the vertical magnet 104. Relay 105 is held operated during the succeeding interruptions of the circuit for relay 100, whereas the vertical magnet 104 operates and deenergizes in response thereto to advance the brushes 107 of the selector D to the level of trunks assigned to the group of second selector switches E having access to connectors F by means of which a connection may be extended to a called subscriber G. It will be noted that on the energization of relay 105 and the first step of the vertical magnet 104, the off-normal contacts at 109 are operated to close a circuit for relay 110 as follows: battery, winding of relay 110, upper closed contacts at 109, armature and front contact of relay 105, outer right armature and front contact of relay 103 to ground. This circuit operates relay 110 preparatory to the operation of rotary magnet 111 when the sender 31 is returned to normal, and the trunk hunting movement of the selector D as controlled by the rotary magnet 111 will now be described.

When the sender 31 returns to normal, it is indicated to the operator by the lighting of supervisory lamp 25. The off-normal contacts of the sender are then opened, releasing relay 19 and marginal relay 17. The release of marginal relay 17 causes the release of relay 23 and as these two relays release slightly before relay 19, a holding circuit for impulse responsive relay 100 is closed by the release of relay 23 and extended through the winding of relay 28 which is thereby again energized and the circuit for impulse responsive relay 100 maintained. The operation of relay 28 prevents the ground on the left-hand armature and back contact of relay 23 from operating the relay 15 and this ground as well as the closing of the contacts of relay 22 prepares a circuit for relay 21 as soon as relay 19 is released. This circuit which has been previously traced now operates relay 21 and causes lamp 25 to light to indicate to the operator that trunk hunting is taking place. The trunk hunting is accomplished as stated by means of the rotary magnet 111 and over a circuit that is now closed directly to the ground at the inner right armature and front contact of relay 103 due to the continued holding of relay 100 and the consequent release of relay 105. A holding circuit is established for relay 110 as follows: battery, winding of relay 110, upper closed contact at 109, lower armature and front contact of relay 110, left-hand armature and back contact of relay 111 upper armature and front contact of relay 103 to ground. The circuit for rotary magnet 111 is completed as soon as relay 105 is released from battery, winding of secondary magnet 111, left armature and front contact of relay 110, armature and back contact of relay 105, outer right armature and front contact of relay 103 to ground. This circuit causes the rotary magnet to take one step bringing the brushes 107 in contact with terminals 113 of the first trunk in the group leading to the set of second selector switches E selected by the first digit. The operation of secondary magnet 111 opens the circuit for relay 110 at its left-hand armature and back contact and relay 110 in releasing opens the circuit

for the rotary magnet 111 at its left armature and front contact and relay 110 is not again energized as the original energizing circuit for this relay at the contact of relay 105 is not closed. The secondary magnet 111 will, therefore, not receive a second impulse from the ground at the outer right armature and front contact of relay 103 unless the terminals 113 on which the brushes 107 are resting are those of a busy trunk which will be indicated by ground on the test terminal 114. This ground would be due to the operation of a relay similar to 26 in another selector D and trunk at C. In this case, a circuit will be closed for relay 110 as follows: battery, winding of relay 110, upper closed contacts at 109, right-hand armature and back contact of secondary magnet 111, outer right armature and back contact of relay 106, outer left armature and back contact of relay 122, brush 115, terminal 114 to ground. In this case relay 110 will operate and again close a circuit for the energizing circuit of rotary magnet 111 which, in operating, advances the brushes 107 to the terminals of the next trunk. This operation is repeated until an idle trunk is found which is indicated by the absence of ground on the terminal 14 and the relay 110 will, therefore, be permanently released permitting the brushes 107 to come to rest on the terminals of this idle trunk. When therefore, no ground is found on terminal 114, relay 106 will be operated over the following circuit: battery, winding of relay 110, upper closed contact at 109, right-hand armature and back contact of secondary magnet 111, winding of relay 106, inner left armature and front contact of relay 103 at right-hand armature at front contact of relay 26 to ground. Relay 110 does not, however, operate in this circuit as it does not receive sufficient current due to the inclusion in circuit of the winding of relay 106. The operation of relay 106 opens at its inner left armature and back contact the pulsing circuit for the vertical magnet 104 so that this magnet will be permanently removed from control of relay 100. Relay 106 also closes a circuit for the talking conductors of the selector D to the windings of relay 101 to battery and ground through its inner right-hand armature and front contact and its outer left-hand armature and front contacts respectively. The purpose of this connection will hereinafter appear. In addition, relay 106 also opens the original energizing circuit for relay 110 at its outer right-hand armature and back contact and at its left middle armature and contact extends a pulsing circuit for an impulse responsive relay 200 in the second selector E as follows: battery, winding of impulse responsive relay 200, terminal 118, brush 119, left middle armature and front contact of relay 106, outer left armature and front contact of relay 100 to ground. It is evident then that when the operator dials the second and third digits the cord circuit and trunk circuit relays will function in the same manner as previously described in connection with the sending of the first digit and that impulse responsive relay 100 in the first selector D simply repeats the impulses directly to the similarly arranged impulse responsive relay 200 in the second selector E and the corresponding impulse responsive relay in connector F thereby causing the connection to be extended to the wanted subscriber's line G.

The supervisory lamp 25 will, of course, be lighted between each series of impulses and when it is lighted after the sending of the last digit the operator knows that the wanted line has been found and releases her dialing key 30 thereby disconnecting her impulse sender 31 from the cord circuit B, and the ringing of the wanted subscriber may now take place.

Ringing.

She consequently operates her ringing key 20 thereby releasing relay 21 and extinguishing the lamp 25. Ringing current is now induced from the ringing source at the outer contacts of the key through the trunk circuit repeating coil 18 and through relay 120 at selector D. Relay 120 operates and closes a circuit for relay 122 from battery, winding of relay 122, armature and front contact of relay 120 to ground. The operation of relay 122 closes a circuit from ground at its right-hand armature and front contact to the ringing brush 123 and terminal 124 and to the succeeding switches for the actuation of ringing apparatus that need not be further described; it being sufficient to say that the wanted subscriber is called by the establishing of this circuit.

In order not to have a battery connection on the trunk and cord circuits during the ringing operations, a relay 35 is included in series with the talking conductors of the trunk circuit which operates from the ringing source the moment the ringing key is operated and the operation of this relay causes an energizing circuit to be established for relay 15 from battery, winding of relay 15, armature and front contact of relay 35 to ground. Relay 15 is thereby operated to cut off the battery supply to the talking conductors of the trunk and cord circuits. Relay 17 is also operated momentarily from the ringing source at the lower operated contacts of ringing key 20 over an obvious circuit and the operation of relay 17 closes the circuit for relay 23 which in operating would interrupt the circuit for the impulse responsive

relay 100 was it not for the ground on the upper operated contacts of the ringing key 20 which ground maintains the circuit for the relay 100 through the make-before-break contact of relay 23. As the operations of relays 17 and 23 are only momentary, relay 22, which is slow acting, does not operate.

When the operator releases her ringing key, the relays previously mentioned as energized release and the lamp 25 is lighted over the circuit previously traced to indicate that the ringing operations are successful.

Called subscriber answers.

When the called subscriber answers, the talking conductors are bridged at his telephone set and as they are extended to battery and ground through the windings of relay 101 as previously explained relay 101 is energized. In operating this relay closes a circuit for the left-hand windings of repeating coil 121, short-circuiting the winding for relay 120 at its outer left armature and front contact and at its inner left armature and front contacts opens the circuit for relay 120 to remove it entirely from the talking connection. Relay 101 at its right armature and back contact also removes the short-circuit for the upper winding of impulse responsive relay 100, thereby including the left winding of relay 100 in the circuit therefore extending through the winding of marginal relay 28, thereby causing relay 28 to release due to the decrease in the current supplied from the battery through the upper winding of relay 100. The release of relay 28 closes a circuit from battery, winding of relay 15, outer left-hand armature and front contact of relay 13, armature and back contact of relay 28, left-hand armature and back contact of relay 23 to ground operating relay 15. The operation of relay 15 removes battery and ground from the trunk and cord circuits of the talking conductors as previously explained and relay 21 is thereby released and lamp 25 extinguished to indicate to the operator that the called party has responded. As the talking conductors are now extended from the calling to the called subscriber, conversation may take place, battery being supplied from the calling subscriber's telephone set at A which is, as hereinbefore been stated, of the local battery type.

Release.

When, at the end of the conversation, the caled subscriber hangs up and relay 101 released, the short-circuit for the left winding of relay 100 is restored and consequently relay 28 is again operated causing the release of relay 15 which in turn restores battery and ground to the talking conductors causing the operation of relay 21 and the lighting of lamp 25 which now indicates to the operator that the called subscriber has hung up his receiver. If, now, the operator removes plug 10 from jack 11 lamp 25 is extinguished and relays 12 and 13 release. The release of relay 13 causes the release of relay 26, which opens the trunk group busy contacts and removes one ground connection from the circuit for relay 106. The release of relay 13 also causes the release of relay 28 and impulse responsive relay 100. Relay 100 in turn causes the release of relay 103 which thereby removes the second ground from the circuit for relay 106 which is thereby released causing a circuit to be established for the release magnet 125 as follows: battery, winding of release magnet 125, lower operated contacts at 109, left armature and back contact of relay 103, inner left armature and back contact of relay 106, lower armature and back contact of relay 100 to ground. The operation of release magnet 125 releases the first selector D and the release of relays 100 and 106 also causes the release of impulse responsive relay 200 and the consequent return of the selector E and connector F to normal. At the return of selector D, to normal, the off-normal contacts at 109 are opened and the release magnet 125 deenergized.

When the calling subscriber at A rings off in the usual manner, the relay 36 operated, momentarily causing the operation of relay 37 over an obvious circuit and this relay locks up over a circuit from battery, winding of relay 37, inner armature and front contact of relay 37, armature and front contact of relay 7 to ground at the normally closed contacts of the operator's listening key 9. The operation of relay 37 also causes the lighting of lamp 38 over an obvious circuit to indicate to the operator that the calling subscriber has hung up his receiver. The operator now removes plug 6 from jack 5 and thereby causes the release of relays 3, 7 and 37 and the extinguishing of lamp 38.

What is claimed is:

1. A telephone system comprising a trunk circuit extending from a manual to an automatic central office, a link circuit at the manual office, an impulse sender, means for associating said sender with the link circuit, snbscribers' lines at the automatic office, an automatic switch at the automatic office, an impulse responsive relay for the control of said switch to establish a connection between the trunk circuit and a subscriber's line, and means responsive to the actuation of the sender to the link circuit, the link circuit to the trunk circuit and the operation of the sender for closing a control circuit for said impulse responsive relay including only a portion of one of the talking conductors of said trunk circuit, through said circuits from said impulse sender.

2. A telephone system comprising a trunk

circuit, an impulse sender, means for associating said sender with the circuit. subscribers' lines, an automatic switch associated with said trunk circuit, an impulse responsive relay for the control of said switch to connect the trunk circuit with a subscriber's line, and means responsive to the association of the sender with the trunk circuit and the operation of the sender for establishing a control circuit for said impulse responsive relay from said sender including only one of the talking conductors of said trunk circuit.

3. A telephone system comprising a trunk circuit, an impulse sender, means responsive to the actuation of the sender for associating it with the trunk circuit, an automatic switch associated with said trunk circuit, and means responsive to impulses from said sender for controlling the operation of said switch, and means responsive to the actuation of the sender for establishing a control path from the sender to said first mentioned means over a portion of said trunk circuit.

4. A telephone system comprising a trunk circuit, an impulse sender associated with one end thereof, an automatic switch associated with the opposite end of the trunk circuit, an impulse responsive relay for the operation of the switch, and means responsive to the actuation of the sender for establishing a control path for said impulse responsive relay from the sender over a portion of said trunk circuit.

5. In a telephone system comprising a trunk circuit, a link circuit adapted for connection therewith, an impulse sender, a signaling means normally associated with said link circuit, means for associating the sender with and disconnecting the signaling means from the link circuit, an automatic switch associated with said trunk circuit, an impulse responsive relay for the control of said switch, means responsive to the operation of the sender when connected with link and trunk circuits for establishing a control circuit for the impulse responsive relay from said sender over said circuits, and means in said trunk circuit for supplying operating current for said signaling means operative when the sender is disconnected and the signaling means connected with the link circuit.

6. A telephone system comprising a trunk circuit, an impulse sender, means responsive to the actuation of the sender for associating it with the trunk circuit, an automatic switch associated with the trunk circuit, an impulse responsive relay for the actuation of the switch, a control circuit for said relay, and means responsive to the operation of the sender for extending said control circuit under control of the sender over one of the conductors of said trunk.

7. A telephone system comprising a trunk circuit, an impulse sender associated with one end of said trunk circuit, an automatic switch associated with the opposite end of said trunk circuit, an impulse responsive relay for controlling the operation of said switch, a control circuit for said relay, a relay arrangement operated by the actuation of the sender for extending the control circuit over one of the conductors of said trunk circuit to the impulse contacts of said sender.

8. A telephone system comprising a trunk circuit, a link circuit adapted to be associated therewith, an impulse sender, means responsive to the operation of the impulse sender for associating it with the link circuit, an automatic switch associated with the link circuit, an impulse responsive relay for controlling the movements of said switch, a normally open control circuit for said sender, means responsive to the connection of the link circuit to the trunk circuit for closing said control circuit to cause the operation of said impulse responsive relay, and means responsive to the association of said impulse sender to the link circuit and the operation of the sender for transferring the control of the impulse responsive relay to the impulse contacts of the sender via said link circuit and a portion of one of the conductors of said trunk circuit.

9. A telephone system comprising a trunk circuit, a link circuit adapted to be connected to the trunk circuit, an impulse sender adapted to be connected to the link circuit, an automatic switch associated with the trunk circuit, an impulse responsive relay for controlling the operations of the switch, a control circuit for said relay, a relay arrangement in the trunk circuit responsive to the connection of the link circuit to the trunk circuit for closing the control circuit to cause the operation of the impulse responsive relay, a second relay arrangement including a marginal relay in the trunk circuit responsive to the connection of the trunk circuit to the link circuit and the connection and operation of the impulse sender to open said control circuit and extend it directly to the impulse contacts of the sender without releasing the impulse responsive relay.

10. A telephone system comprising a trunk circuit including two talking conductors, an impulse sender associated with one end of said trunk circuit, an automatic switch associated with the opposite end of said trunk circuit, an impulse responsive relay for controlling the operation of said switch, a normally open control circuit for said relay, means for closing said control circuit to operate said impulse responsive relay, means responsive to the operation of the impuse sender for opening said control circuit at a different point and transfer the control over said impulse responsive relay to the impulse contacts of the sender over a portion of said control circuit and one conductor of said trunk circuit to maintain said relay ener-

gized until interrupted by the impulse contacts of the sender.

11. A telephone system comprising a trunk circuit including two talking conductors, an impulse sender associated with one end of said trunk circuit, an automatic switch at the opposite end of said trunk circuit, an impulse responsive relay for controlling the operation of said switch, a normally open control circuit, and means included in circuit with one talking conductor operated in response to the actuation of the impulse sender to connect the control circuit over the other talking conductor to the impulse contacts of the sender for the control thereby of the impulse responsive relay.

12. A telephone system comprising a trunk circuit including two talking conductors, an impulse sender associated with one end of said trunk circuit, an automatic switch at the opposite end of said trunk circuit, an impulse responsive relay for controlling the operation of said switch, a normally open control circuit, means included in circuit with one talking conductor operated in response to the actuation of the impulse sender to connect the control circuit over the other talking conductor to the impulse contacts of the sender for the control thereby of the impulse responsive relay, and means for maintaining said impulse responsive relay operated while the impulse sender is inactive.

13. A telephone system, a trunk circuit, a link circuit associated with one end of said trunk circuit, a signaling means in said link circuit, a direct battery supply for the operation of said signaling means, an impulse sender in said link circuit, an automatic switch associated with said trunk circuit, an impulse responsive relay for the operation of said switch, a control circuit therefor, means for modifying the current supplied for said control circuit, a relay in said control circuit responsive to a modified current therein, and means controlled by said relay when so responsive to cause the release of the signaling means.

In witness whereof, I hereunto subscribe my name this 14 day of December A. D., 1923.

CLARENCE B. FOWLER.