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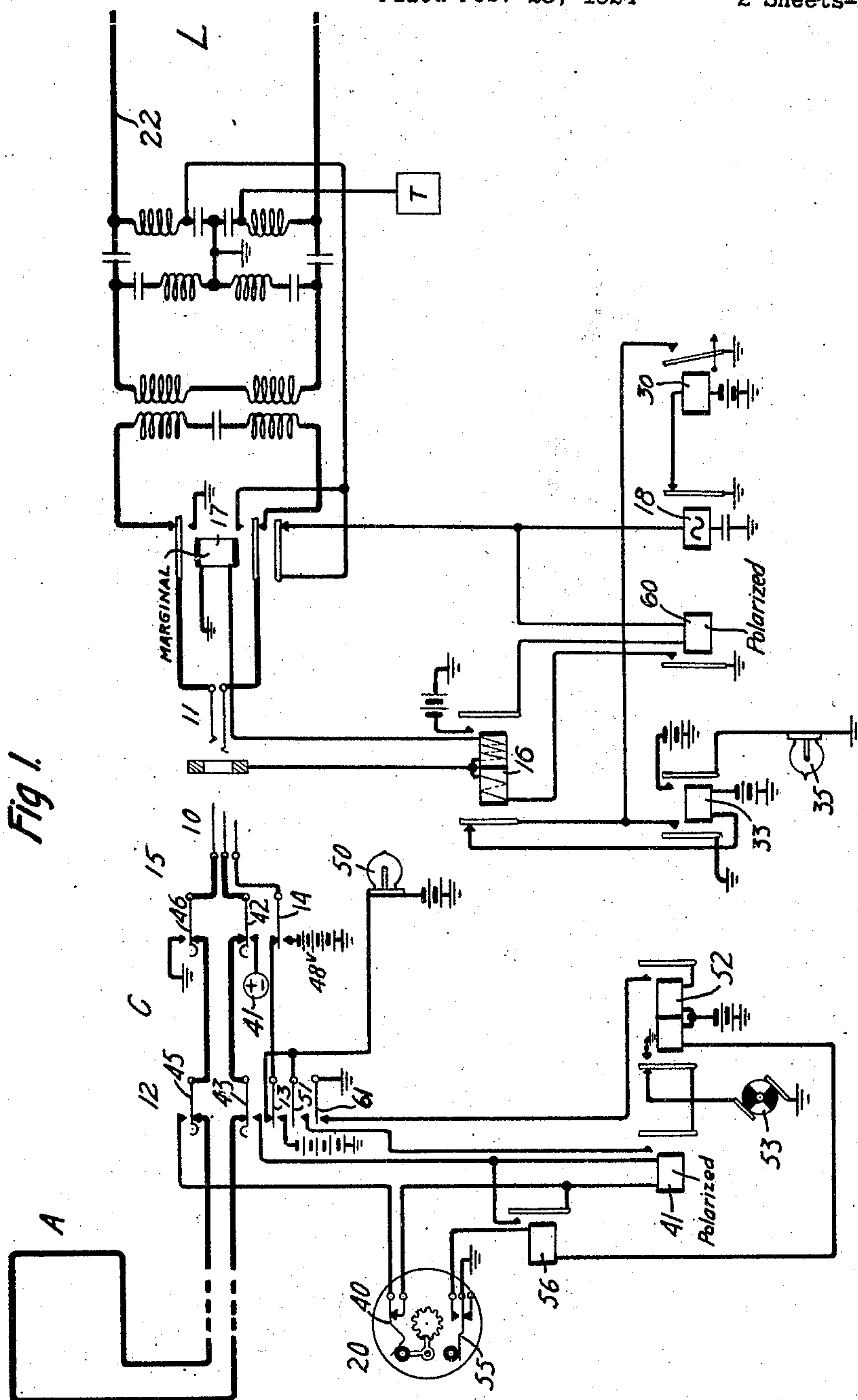
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TELEPHONE SYSTEM

Filed Feb. 28, 1924

2 Sheets-Sheet 1



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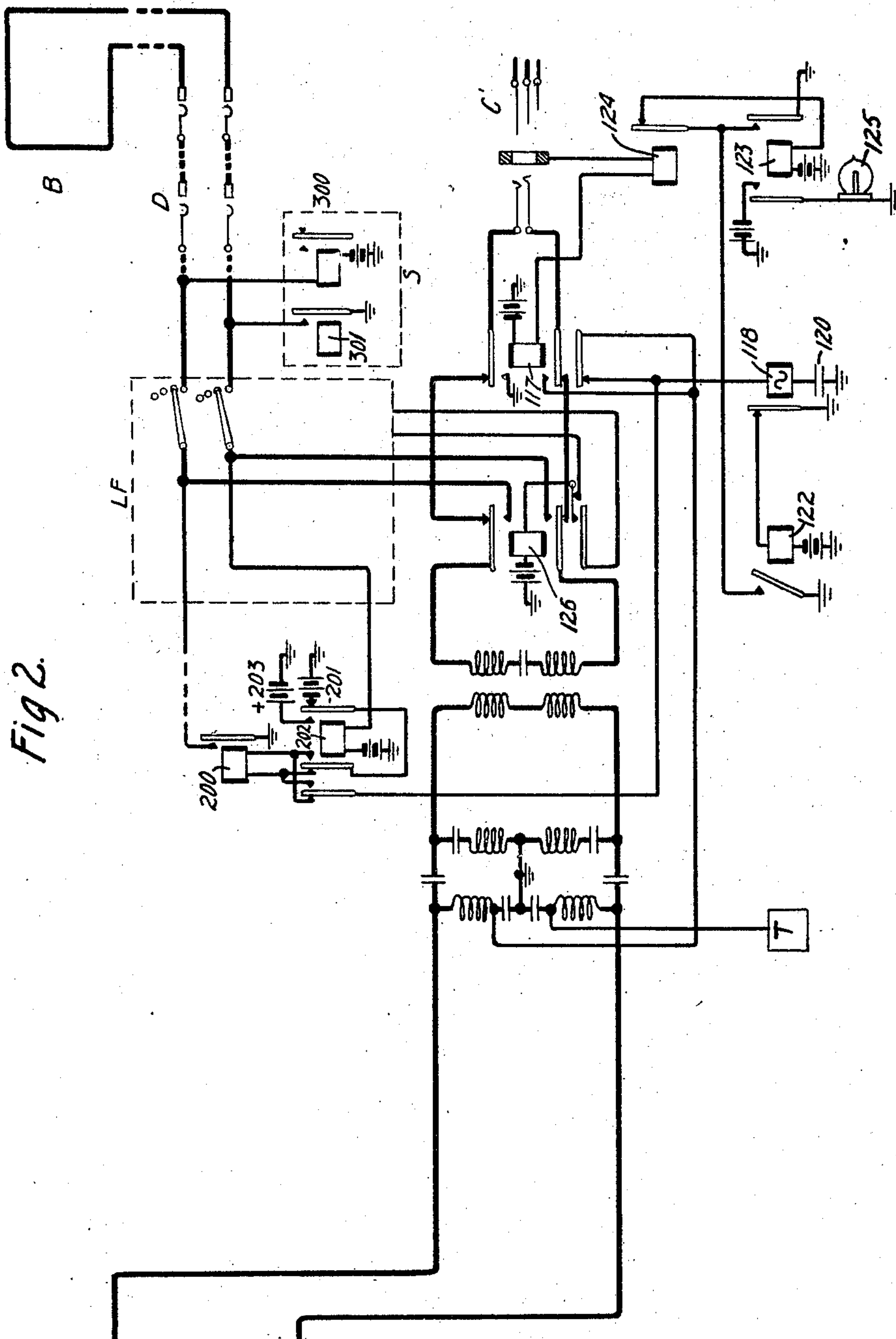


Fig. 2.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed February 23, 1924. Serial No. 695,775.

This invention relates to telephone systems and more particularly to such systems adapted for simultaneous telephony and telegraphy.

5 In a copending application of L. A. Mortimer, Serial No. 667,788, filed October 11, 1923, there is shown a system of the above type wherein a composite leg of a toll line is employed for the transmission of dial
10 impulses and ringing and supervisory signals between a machine switching operator's position and a machine switching subscriber's line. In this copending application, interrupted direct current is transmit-
15 ted over the composite leg to effect the ringing of a wanted subscriber.

An object of this invention is to improve systems of the type disclosed in the above mentioned copending application by substituting an arrangement whereby a low frequency alternating current may be applied
20 directly to a composite leg of a toll line for ringing purposes, in place of the rather expensive equipment commonly used whereby the low frequency alternating current has
25 to be translated into a high frequency current suitable for transmission over the line to effect the ringing. By this invention the ordinary low frequency ringing current
30 source common in standard cord circuits may be used to effect the ringing operations at the distant end of a toll circuit.

Another object is to combine in greatly simplified cord and toll line circuits such a
35 ringing arrangement with means for transmitting dialing impulses and supervisory signals over a composite leg of a toll line. This circuit involves a minimum amount of apparatus and operates in a reliable and efficient manner to produce a number of easily
40 identified supervisory signal indications.

Another object is the provision in a toll line circuit of this type whereby the dialing impulses received from the cord circuit are transmitted directly over the composite leg
45 of the toll line thus eliminating pulsing relay or other impulse repeating means commonly employed in circuits of this type.

50 It is believed that a clear understanding of the invention will be had from the following description made with reference to the accompanying drawing in which Figure 1 shows diagrammatically a calling subscriber's line A and a portion of a toll line oper-

ator's cord circuit C equipped for transmitting supervisory signals, dialing impulses and A. C. signaling current over a composited toll line L, the outgoing end of which is shown in this figure. Fig. 2 shows the incoming end of the composited toll line
55 L terminating in a jack at the incoming toll operator's position C', and in a line finder equipment LF shown diagrammatically. The circuits and equipment employed in the establishment of a connection from the line
60 finder LF to a machine switching subscriber B are also indicated diagrammatically; at D to indicate the automatic switches involved in the connection, and at S to indicate a sender equipment such as is used for
65 the reception of impulses and for the control of the setting up of a connection as is well known in the art. As this portion of the circuit forms no part of the invention reference may be had, for a fuller disclo-
70 sure thereof, to the above mentioned copending application.

The invention will be described in connection with this disclosure; first, by describing the operation when the composite
75 toll line is employed for a regular ring down operation, that is, when it is used to extend a connection to a manual operator; and second, by describing the operation when the toll line is employed for extending a connec-
80 tion to a machine switching subscriber.

When the composite toll line is to be employed for regular ring down operation, that is, in this case for extending a connection
85 between a subscriber at A to the toll operator's position C at one exchange and the incoming toll operator's position C' at another exchange, the procedure is as follows: After a connection has been established
90 from the calling subscriber A to the toll operator C in any well known manner, the operator inserts plug 10 in jack 11 of toll line L and operates the ringing key 15 where-
95 upon relays 16 and 17 operate over a circuit extending from the high voltage battery 100 48 connected at spring 14 of key 15, sleeve contacts of plug 10 and jack 11, high resistance winding of relay 16 and winding of marginal relay 17 to ground. The operation of relay 16 performs no useful function
105 at this time while the operation of relay 17 connects the ring conductor, from the alternating current ringing source 41 at

spring 42 of ringing key 15 to the composite leg of toll line L, at its inner lower armature and front contact. This application of ringing current 15 causes the alternating current relay 118 at the distant exchange to operate over the following circuit from the ringing source through the above mentioned contact of relay 17, the composite leg 22 of toll line L, lower armature and back contact of relay 117, winding of alternating current relay 118, condenser 120 to ground. The operation of alternating current relay 118 breaks the obvious circuit for relay 122 and the release of this relay causes a circuit for relay 123 to be closed from battery, winding of relay 123, armature and back contact of relay 124, armature and back contact of relay 122 to ground. The operation of relay 123 closes an obvious circuit for the line lamp 125 which lights and notifies the toll operator at C' that a manual connection is wanted and the operator C' thereupon extends the connection in the usual manner.

In a similar manner the incoming calls to the toll operator C from the toll operator C' causes the operation of the alternating current relay 18 which releases relay 30 and operates relay 33 thus lighting the line lamp 35 and notifying the operator C that a manual connection accessible from this exchange is wanted. It is apparent from this disclosure that the outgoing and incoming ends of the toll line L may be identical, that is, as far as the equipment for extending calls manually in either direction is concerned and that the ordinary low frequency ringing current source, such as 41 of a standard cord circuit, may be employed to affect the ringing operations.

The following description will be directed to the establishment of a connection over the composite toll line from a manual subscriber A to a machine switching subscriber B over the line finder indicated at LF and the intermediate automatic switches D.

Assuming, as in the regular ring down operations of the system, that the subscriber A has been connected to the toll operator's cord circuit C and the operator at this position has received the number of the wanted subscriber B, the operator at C will, after having inserted plug 10 in jack 11, operate dialing key 12. The following circuit is thereby established from a high voltage battery now connected to the spring 13 of the dialing key 12, normal contact at spring 14 of ringing key 15, sleeve contacts of plug 10 and jack 11, high resistance winding of relay 16, winding of relay 17 to ground. This circuit operates relays 16 and 17 and as other contacts of the dialing key 12 have connected the dialing circuit through the pulsing contacts of dial 20 and through the winding of polarized winding 41, the opera-

tion of relay 17 now extends this circuit as follows: from the negative pole of battery 201, the right-hand armature and back contact of relay 202, inner left-hand armature and back contact of relay 202, winding of the pulsing relay 200, outer left-hand armature and back contact of relay 202, lower outer armature and back contact of relay 117, composite leg 22, inner lower armature and front contact of relay 17, ring contacts of jack 11 and plug 10, normal contact of spring 42 of ringing key 15, operated contact at spring 43 of dialing key 12, winding of polarized relay 41, pulsing contacts of dial 20, operated contact at spring 45 of dialing key 12, normal contact at spring 46 of ringing key 15, tip contacts of plug 10 and jack 11, upper armature and front contact of relay 17 to ground. It will be noted that this circuit is a direct pulsing circuit through the dial contacts 40, and not repeated or relayed in the toll circuit, but extended over the composite leg 22 directly to the pulsing relay 200. Pulsing relay 200 is therefore operated immediately upon closing up this circuit and, as shown in the above mentioned copending application, the line finder LF is thereby caused to connect with an idle district switch and a district sender equipment, such as S this equipment being shown merely in diagrammatic form as it does not form part of this invention. The details indicated are thought to be sufficiently clear for the explanation of the functions of the pulsing circuit as above traced. It should be noted that the direction of the current in this circuit is such as not to operate the pulsing relay 41 and that when the sender S has been found, relay 300 thereof is operated causing relay 301 to be operated through intermediate equipment (not shown) which in turn causes a dialing signal to be given to the operator at C in the following manner: Relay 301 through intermediate equipment (not shown) will bring about the operation of relay 202 and the operation of this relay substitutes the positive pole of battery 203 for the negative pole of battery 201 thereby reversing the current through the dial circuit just traced and the direction of the current in this circuit is now such as to cause the polarized relay 41 to operate. The operation of relay 41 will therefore close a circuit for supervisory lamp 50 as follows: from battery, lamp 50, operated contact at spring 51 of dialing key 12, armature and front contact of polarized relay 41, left-hand armature and back contact of relay 52, interrupter 53 to ground. The circuit through supervisory lamp 50 will therefore be interrupted and the lamp alternately lighted and extinguished to indicate to the operator C that she may proceed to dial.

In response to this flashing of lamp 50, the operator at C actuates the dial 20 and upon

the operation thereof from normal the contact 55 closes a circuit for relay 56 as follows: battery, left-hand winding of relay 52, winding of relay 56, off-normal contact 55 to ground. Relay 56, in operating, short circuits at its armature and front contact, the winding of polarized relay 41 which therefore is allowed to release and break the flashing circuit for supervisory lamp 50. The operator at C in manipulating the pulsing contacts 40 in accordance with the wanted subscriber's number intermittently interrupts the pulsing circuit previously traced and thus intermittently releases and operates the pulsing relay 200 which now, in accordance with the description in the above mentioned copending application, causes corresponding operations of relay 300. The manipulation of relay 300 thereupon effects the setting of the automatic switches D in well known manner and when all digits have been dialed the line of the wanted subscriber B is connected through these automatic switches D to equipment in the line finder LF that thereby causes the operation of relay 202. It should be noted that this relay 202 was released during the operation of the setting up of the wanted subscriber's number in the sender S. The operation of relay 202 at this time, as before, substitutes the positive pole of battery 203 for the negative pole of battery 201 in the dialing circuit and as relay 56 is now released due to the off-normal contact 55 being open, this reversal of the current in the dialing circuit will operate the polarized relay 41 and cause the lamp 50 to be lighted. In this instance the lamp 50 will glow with a steady light as relay 52 when first energized by the closing of off-normal contact 55 established a locking circuit for itself from battery, right-hand winding of relay 52, right-hand armature and front contact through the operated contact of spring 61 to ground. The circuit for the line lamp 50 is thereby switched from the interrupter 52 to a ground at the left-hand armature and front contact of relay 52. The steady glow of lamp 50 notifies the operator at C that the wanted subscriber's line has been reached. The operator at C now restores the dialing key 12, and thereby releases relay 52, opens the circuit for lamp 50 and disconnects the dialing circuit at springs 43 and 45. The restoring of dialing key 12 to normal does not, however, extinguish the lamp 50 which is maintained lighted by the following circuit from battery, supervisory lamp 50, normal contact of spring 13 of key 12, sleeve contacts of plug 10 and jack 11, low resistance winding of relay 16, armature and front contact of polarized relay 60 to ground. It should be noted that the above circuit is established directly as a result of the restoration of key 12 as when the high voltage battery at the spring 13 is removed relay 17 is

released thus establishing a circuit over the composite leg through the lower armature and back contact of relay 17, winding of polarized relay 60, right-hand armature and front contact of relay 16 to battery. Relay 16 being comparatively sluggish so as to permit this circuit to be closed and thus allow relay 60 to operate from battery at relay 202. The operation of relay 60 thus provides a ground for maintaining relay 16 operated and lamp 50 to be lighted. It should be mentioned that relay 17 is not again energized by the battery at lamp 50 as it is marginal in its operation and the current in this instance is not sufficient to cause its operation.

When the subscriber at B is automatically signaled in any well known manner and removes his receiver from the hook, the circuit for relay 202 is opened and the relay is released, whereupon the negative pole of battery 201 is substituted for the positive pole of battery 203 causing the current over the composited leg to reverse and polarized relay 60 to release. The ground at the armature and front contact of relay 60 is therefore removed causing the circuit for maintaining relay 16 energized to extend through the high resistance winding of relay 16 and winding of relay 17 to ground. This circuit does not permit sufficient current to pass to maintain lamp 50 lighted. Lamp 50, therefore, by being extinguished at this time, indicates to the operator at C that the subscriber at B has answered the call. Conversation may now take place as a talking circuit over the toll line is established to the called subscriber B by the operation of relay 126 through equipment not shown but described in the above mentioned copending application, and the release of the connection at the end of the conversation may be accomplished in any well known manner.

What is claimed is:

1. In a telephone system two telephone exchanges, subscribers' lines terminating at one of said exchanges, a line composited for simultaneous telephony and telegraphy interconnecting said exchanges, automatic switching means at one of said exchanges for interconnecting said composited line with any one of said subscribers' lines, means at said other exchange including an impulse sender for operating said switching means over one leg of said composited line, a signal at said other exchange, and means at said other exchange for operating said signal in one characteristic manner when a selected subscriber's line has been found and for operating said signal in a different characteristic manner when the subscriber at the selected station answers the call.

2. In a telephone system two telephone exchanges, subscribers' lines terminating at one of said exchanges, a line composited for

simultaneous telephony and telegraphy interconnecting said exchanges, automatic switching means at one of said exchanges for interconnecting said composited line with
 5 any one of said subscribers' lines, means at said other exchange for seizing said composited line, means at said other exchange for sending impulses over one leg of said
 10 composited line to control the operation of said switching means, a signal at said other exchange, and means for operating said signal when the line has been seized and said switching means is ready to be controlled by said impulses to select the subscriber's
 15 line.

3. In a telephone system an operator's cord circuit, a composited line, an impulse circuit including an impulse sender, means for connecting said impulse circuit to the
 20 cord circuit, means operated when the line is seized by said cord circuit for connecting one leg of the composited line to the impulse circuit, a signal, means operated by the reversal of the current on the composited leg
 25 for interruptedly operating said signal, and means operated when the impulse sender is actuated to release said signal from the interrupting means.

4. In a telephone system a composited line,
 30 a cord circuit adapted to be connected thereto, an impulse circuit including a sender, means for completing said circuit to one leg of the composited line, a signal, and means for interruptedly operating said signal responsive to one polarity of current only on
 35 said line.

5. In a telephone system a composited line, a cord circuit adapted to be connected thereto, an impulse circuit including a
 40 sender, means for completing said circuit to one leg of the composited line, a signal, means operated in response to one character of current on said line to cause the signal to be interruptedly actuated and means for
 45 making said signal operating means ineffective when the impulse sender is operated.

6. In a telephone system a composited line, a cord circuit adapted to be connected thereto, an impulse circuit including a
 50 sender, means for completing said circuit to one leg of the composited line, a signal, means operated in response to one character of current on said line, and means controlled by the operation and release of the impulse
 55 sender to cause said signal to be steadily operated when the same character of current is present on the line.

7. In a telephone system a composited line, a cord circuit adapted to be connected
 60 thereto and comprising a signal and means including a key which in operated position maintains said signal operated under control of a current over the composited leg of said line, means in said composited line for
 65 maintaining said signal operated under con-

trol of said current after said key has been released.

8. In a telephone system a composited line, a cord circuit adapted to be connected
 70 thereto and comprising a signal and means including a key which in operated position maintains said signal operated under control of a current over the composited leg of said line, means in said composited line for
 75 maintaining said signal operated under control of said current when said key is released and for relinquishing the control over said signal when the current is removed from the line or reversed thereon.

9. In a telephone system a composited
 80 line, a cord circuit adapted to be connected thereto and comprising a signal and means including a key which in operated position maintains said signal operated under control
 85 of a current over the composited leg of said line, means in said composited line including a polarized relay operated by the same current on the composited leg of said line to maintain said signal operated when said key
 90 is released and when said relay is released on the ceasing of the current on the line to cause said signal to be entirely removed from control of any subsequent currents on the line.

10. In a telephone system a composited
 95 line, a cord circuit adapted to be associated therewith, means including a common relay for disconnecting the line for telephonic purposes and for connecting a composited
 100 leg of said line for signaling purposes, a low frequency alternating current source, and means independent of said disconnecting and connecting means for applying current from said source to said composited leg,
 105 a signal, and means responsive to said current for operating said signal.

11. In a telephone system, a composited line, means for disabling said line for telephonic purposes and for connecting a leg of
 110 the line for signaling purposes comprising a source of low frequency alternating current, a source of direct current, a relay and a key so arranged that the operation of the key causes the operation of the relay by current
 115 from the direct current source, the operation of the relay causes the disabling of the line for telephonic purposes and the connection of the said leg for signaling purposes while the operation of the key and the relay causes
 120 the application of current from the alternating current source to the said leg for signaling purposes.

12. In a telephone system a two conductor telephone line, an impulse sender, means for
 125 connecting said impulse sender to one conductor of said line, an alternating current relay, a signal normally under control of said relay and means operated by said connecting means for removing said signal from the
 130 control of said alternating current relay.

13. In a telephone system a two conductor telephone line, an impulse sender, means for connecting said impulse sender to one conductor of said line, an alternating current relay normally connected to said conductor, 5 an alternating current source, means for operating said relay by the application of currents from said source to said conductor, and means operated by said connecting means for disconnecting said relay from said 10 conductor.

In testimony whereof, I have signed my name to this specification this 25th day of February 1924.

JOHN F. TOOMEY.