

Feb. 15, 1927.

L. A. MORTIMER
TELEPHONE SYSTEM

Filed Oct. 11, 1923

1,617,413

2 Sheets-Sheet 1

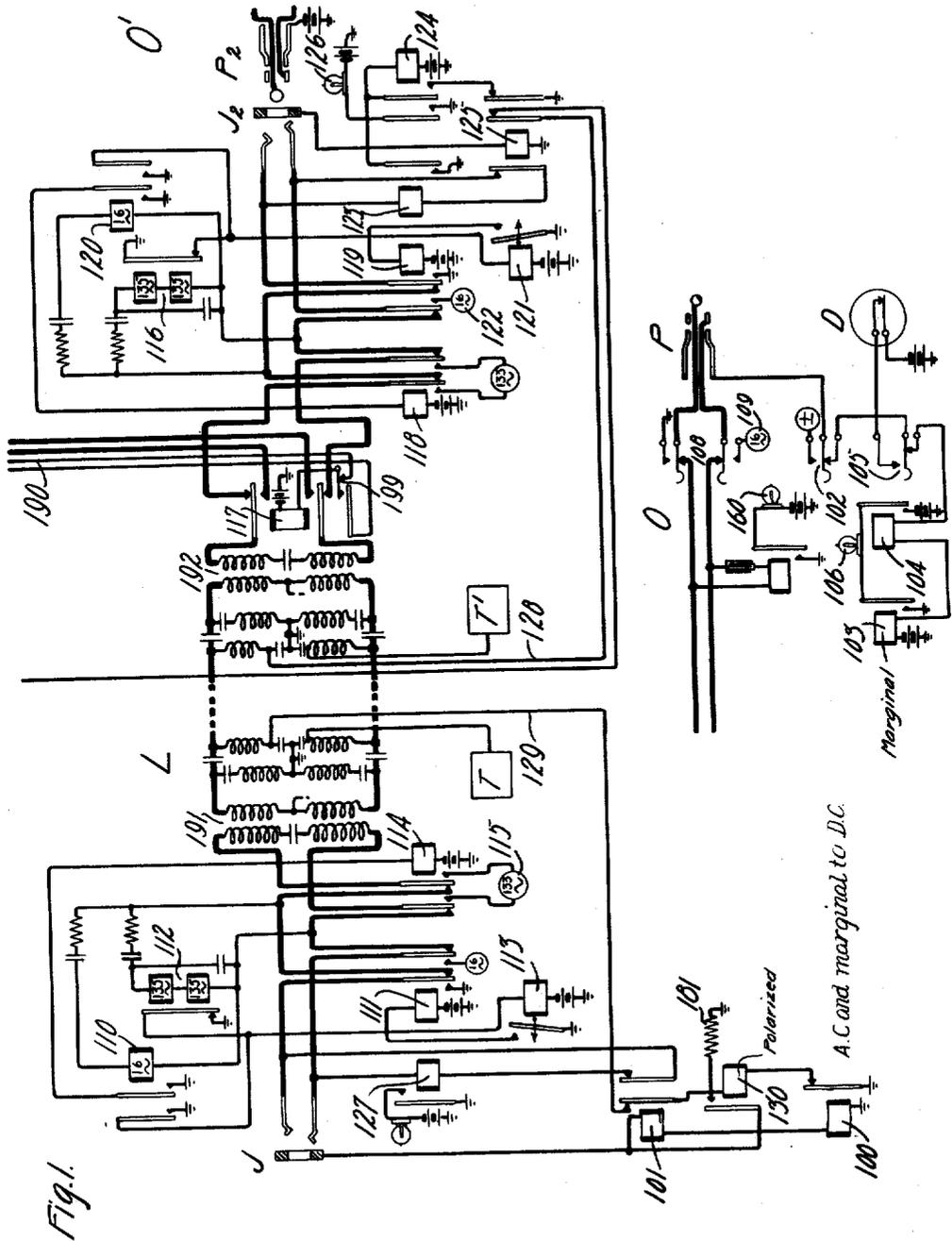


Fig. 1.

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2 Sheets-Sheet 2

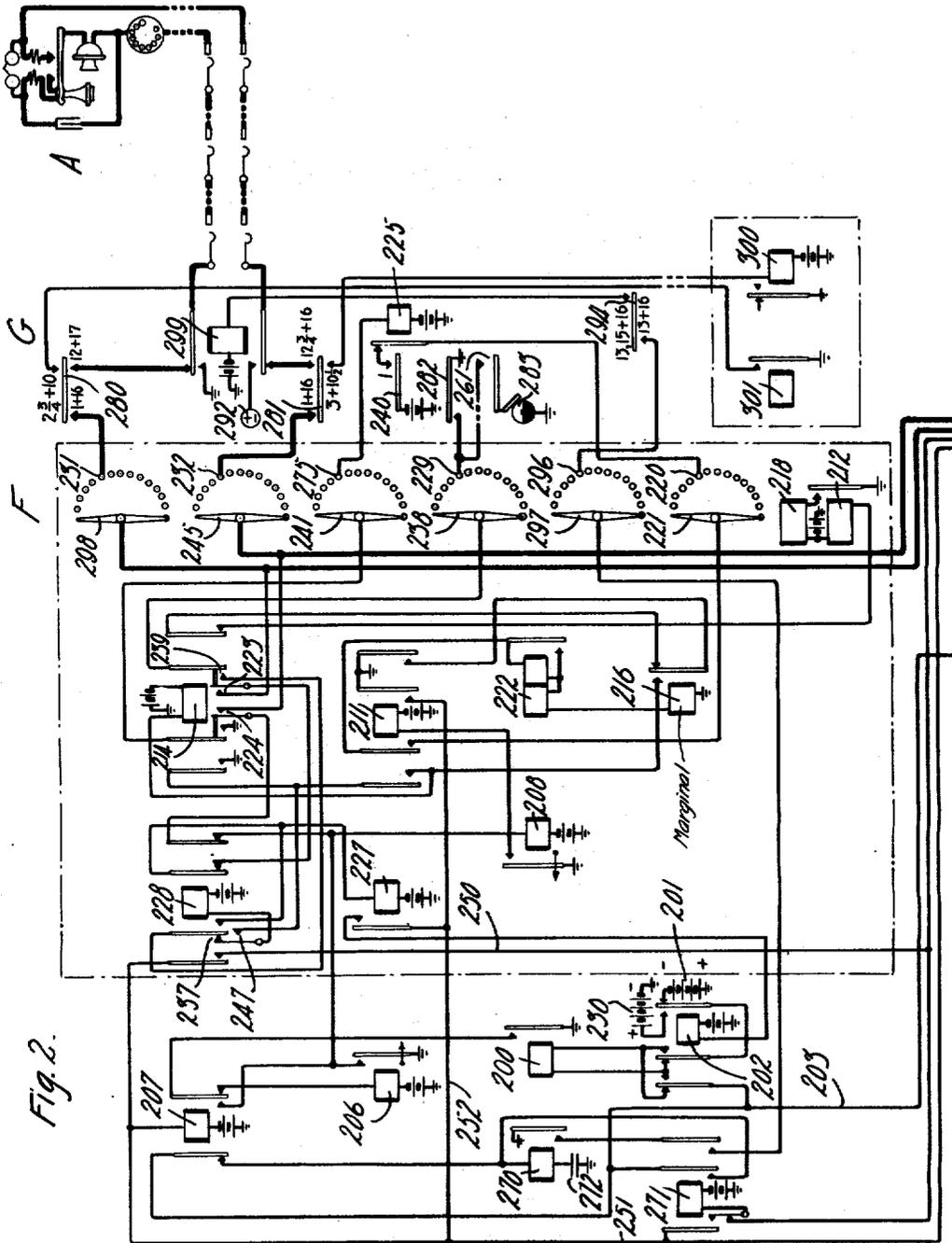


Fig. 2.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed October 11, 1923. Serial No. 667,788.

This invention relates in general to telephone systems and more particularly to the establishment of connections over long transmission lines composited for simultaneous telephony and telegraphy.

It has long been common practice in systems of the above general character to utilize long distance lines for both telegraphic and telephonic transmission of intelligence, the telephone connections being established manually. The general advancement of the telephone art towards automatic operation requires that the equipment originally employed in manual systems be readily adaptable for automatic service.

It is therefore an object of this invention to satisfy the foregoing requirement by providing an improved system for carrying out dialing, ringing, and supervisory operations over toll lines composited for simultaneous telephony and telegraphy.

In accordance with the features of this invention, a composited toll line is provided, the composite leg of which is utilized for the transmission of first, dial impulses from a toll line operator's position to a distant machine switching exchange for the purpose of setting automatic switches; second, ringing current impulses from the originating exchange to a distant machine switching exchange to effect the automatic application of ringing current to a subscriber's line; and third, supervisory signals from a called machine switching station to an originating toll line operator's position. The toll line is also designed for manual ring-down operations in both directions between an originating toll line operator's position and a manual operator's position located at the distant exchange.

It is believed the invention will be readily understood from the following detailed description made with reference to the accompanying drawings in which Fig. 1 shows the toll line L composited for simultaneous telephony and telegraphy and equipped with the necessary composite ringer equipment, and a toll line operator's cord circuit together with portions of the associated dialing equipment for one of them. The rectangles indicated at T and T' represent the telegraph equipments at the two exchanges O and O' respectively. Fig. 2 shows partly in full and partly diagrammatically the circuits and equipment which are employed in

the establishment of a connection to the machine switching subscriber's line A. The batteries 201 and 230 shown in Fig. 2 are of a higher voltage than the battery used for operating the other relays of the telephone equipment.

When the composited toll line L is to be employed for regular ringdown operation on a connection between the operator's position O at one exchange and the operator's position O' at another exchange the procedure is as follows: The operator at O inserts plug P into jack J of the toll line L whereupon relays 101 and 104 operate in a circuit extending from grounded battery, through the windings of marginal relay 103 and relay 104, normal contacts of dial key 105 and of ringing key 102, sleeve contacts of plug P and jack J, to ground through the windings of relays 101 and 100. Relay 100 is of such a type as to operate on alternating current and strong direct current only and does not operate at this time. The operation of relay 104 in the circuit just traced prepares a circuit for the supervisory lamp 106 which will be later described. Relay 101 at its outer armature disconnects relay 127 from the tip and ring conductors of the outgoing end of the toll line L. At its inner armature, relay 101 connects ground, associated with the armature of relay 100, to the composite leg of the toll line L which causes certain relays in Fig. 2 to function. These relays, however, do not enter into the establishment of the present connection and are only employed in the establishment of a connection to a machine switch subscriber's station A as will hereinafter appear.

The operator at O now actuates ringing key 108 thereby causing ringing current from the source 109 to energize relay 110 in a circuit extending from the 16 cycle current source 109, lower alternate contacts of key 108, ring contacts of plug P and jack J, outer armature and back contact of relay 111, winding of relay 110, back contact and inner armature of relay 111, tip contacts of jack J and plug P to ground at the upper alternate contacts of key 108. Relay 112 is connected in parallel with relay 110 but is responsive to 135 cycle current only, and therefore does not operate at this time. Relay 110 in attracting its outer armature connects an auxiliary ground to the winding of slow releasing normally energized relay 113

to maintain this relay operated independently of relay 112. This holding circuit is necessary since it is found in practice that although relay 112 may be electrically and mechanically tuned to operate only on 135 cycle current, the 16 cycle current impressed on the tip and ring conductors of the toll line L may cause a momentary opening of the normal contact of relay 112 thereby causing relay 113 to release and relay 111 to operate in an obvious circuit. Without such an arrangement as this, relay 111 in operating would interrupt the tip and ring conductors of the toll line and cause the discontinuance of the 16 cycle ringing current, thereby permitting relay 112 to definitely close its contact and reoperate relay 113 thereby causing the release of relay 111 and the reconnection of 16 cycle current to the tip and ring conductors of the toll line. This would cause relay 112 to again momentarily open its contacts and the action just described will be repeated and surging would result. Relay 110 at its inner armature causes relay 114 to operate in an obvious circuit and to connect the 135 cycle current source 115 to the tip and ring conductors of the toll line to cause relay 116 to operate in a circuit extending from the source 115, through the front contacts and armatures of relay 114, tip and ring conductors of the toll line L, left-hand winding of repeating coil 191, whence an induced current of the same frequency is induced in the right-hand winding of repeating coil 191 and passes over the tip and ring conductors of the toll line to the left-hand winding of repeating coil 192 whence an induced current in the right-hand windings of this repeating coil passes over the upper and inner lower armatures and back contacts of relay 117, armatures and back contacts of relay 118 through the winding of relay 116. Relay 120 which is connected in parallel with relay 116 being responsive only to 16 cycle current does not operate at this time. Relay 116, upon energizing, opens its normal contact thereby causing the slow to release relay 121 to release its armature and establish an obvious circuit for relay 119. Relay 119, in operating, connects the 16 cycle current source 122 to the tip and ring conductors of the incoming end of the toll line, causing relay 123 to operate in an obvious circuit and effect the operation of relay 124 over an obvious circuit. Relay 124 locks under the control of relay 125 and establishes an obvious circuit for lamp 126. The illumination of lamp 126 indicates to the operator at O' that a call on the trunk line L is awaiting her attention and she proceeds to answer it by inserting plug P² of one of her cord circuits into jack J² of the toll line L. As a consequence of the insertion of plug P² into jack J², relay 125 operates in an obvious

sleeve circuit, thereby disconnecting relay 123 from the tip and ring conductors of the incoming end of the toll line L and opening the locking circuit for relay 124 whereupon this relay releases its armatures, causing lamp 126 to be extinguished. Relay 125 in attracting its inner right hand armature disconnects the automatic equipment (Fig. 2) from the toll line whereupon the relays of Fig. 2 that were energized upon the insertion of plug P into jack J at the outgoing end of the toll line and which will be later referred to are released. Relay 123 in retracting its armature opens the original energizing circuit for relay 124.

The operator at O' now connects her headset (not shown) to the cord circuit employed in answering the call in order to converse with the operator at O, it being understood that in regular ring-down operation the operator at O actuates key 108 only for a period of approximately two seconds and then connects her headset to the cord circuit to await the operator at O'. When key 108 is released, the toll line conductors are again rendered electrically continuous by the release of relays 114 and 119 which were operated during the ringing period.

At the termination of the conversation, the operator at O' will actuate a ringing key (not shown) which will cause lamp 160 to light. The operator at O noting this signal removes plug P from jack J. The withdrawal of plugs P and P² from jacks J and J² respectively, restores all apparatus to normal.

It is apparent from the disclosure that the incoming and outgoing ends of the toll line L are duplicates so that the operator at O' may signal the operator at O in the same manner as pointed out in the foregoing description.

The following description will be directed to the establishment of an automatic connection over the composited toll line, originating at the operator's position O and terminating at the machine switching subscriber's station A.

The operator at O tests for an idle toll line in the well known manner, and assuming the line L to be the first idle line encountered, inserts plug P into jack J whereupon relays 104 and 101 operate in a circuit extending from grounded battery, through the winding of marginal relay 103, winding of relay 104, normal contacts of dial key 105, normal contacts of ringing key 102, sleeve contacts of plug P and jack J to ground through the windings of relays 101 and 100. Relays 103 and 100 do not operate at this time, the former being marginal and the latter being responsive to low frequency signaling current and strong direct current only. The relay 104 in operating prepares a circuit for the supervisory lamp 106, whereas relay 101 at its outer armature disconnects relay 127

from the outgoing end of the toll line, and at its inner armature causes relay 200 to operate in a circuit extending from the negative terminal of battery 201, back contact and right hand armature of relay 202, inner left hand armature and back contact of relay 202, winding of relay 200, back contact and outer left hand armature of relay 202, conductor 203, back contact and inner right hand armature of relay 125, conductor 128, over the tip conductor toll line L, conductor 129, front contact and inner armature of relay 101, winding of polarized relay 130, and back contact and armature of relay 100 to ground. The direction of current in this circuit is such as to prevent polarized relay 130 from operating at this time. Relay 200, however, operates in this circuit causing slow-to-release relay 206 to energize in an obvious circuit. Relay 206 causes slow-to-release relay 208 to operate, which in turn establishes an obvious energizing circuit for relay 211. At its inner right hand armature, relay 211 establishes a circuit for relay 207 which may be traced from grounded battery through the winding of relay 207, conductors 251 and 252 to ground over the front contact and inner right hand armature of relay 211. Relay 207 in attracting its left hand armature disconnects the ringing relay 270 from the toll line during the dialing period, and at its right hand armature opens the original energizing circuit for relay 206 which relay thereupon releases, removing the ground from the winding of relay 208 which, however, remains operated in a circuit extending from grounded battery through the winding of relay 208, front contact and right hand armature of relay 207 to ground over the front contact and armature of relay 200. At its outer left hand armature, relay 211 prepares a circuit for relay 214 and at its inner left hand armature prepares a circuit for relays 222 and 216. At its outer right hand armature, relay 211 causes the start magnet 212 to operate in a circuit extending from grounded battery through the winding of magnet 212, back contact and outer right hand armature of relay 214, back contact and armature of relay 216 to ground over the front contact and outer right hand armature of relay 211. Magnet 212 causes the rotary magnet 218 to operate in an obvious circuit. The rotary magnet 218 in operating causes the line switch F to start hunting for an idle district sender in a manner well known in the art. A description of the operation of a district sender similar to that shown in part to the right of Fig. 2^A and indicated by the letter G may be had by referring to Patent 1,395,977 to Stearn and Scudder issued November 1, 1921, and since this apparatus does not form part of the invention, no complete description of the operation has been made here but only such as is necessary for

the proper understanding of the invention.

When an idle district switch such as diagrammatically indicated at G is reached, the idle condition thereof being designated by the presence of battery on the test terminal thereof, relay 222 operates in a circuit extending from grounded battery, contacts of sequence switch spring 240, contacts of relay 225, terminal 220 and wiper 221 of line switch F, front contact and inner left hand armature of relay 211, both windings of relay 222 to ground through the winding of relay 216. Relay 222 in attracting its armature short-circuits its own right hand winding thereby reducing the resistance in the circuit just traced, sufficiently to permit marginal relay 216 to operate in series with relay 222. Relay 216 upon energizing opens at one point an energizing circuit for magnet 212, whereupon this magnet restores causing the rotary magnet 218 to release. This relay 216 also causes cut-off relay 214 to energize in a circuit extending from grounded battery through the winding of cut-off relay 214, front contact and armature of relay 216 to ground over the front contact and outer right hand armature of relay 211.

Relay 214 in attracting its outer right hand armature opens at another point the energizing circuit for magnet 212 to prevent it from operating later. At its inner right hand armature relay 214 prepares a circuit for relay 227 for supervisory purposes which will hereinafter appear. In attracting its outer left hand armature, relay 214 locks up under the control of relay 211, and at its two inner armatures closes through the tip and ring leads to corresponding terminals of switch F for purposes hereinafter to be set forth. At its inner left hand armature, relay 214 causes relay 225 to operate in a circuit extending from grounded battery, through the winding of relay 225, terminal 275 and wiper 241 of line switch F to ground through the inner left hand armature and front contact of relay 214. Relay 225 in attracting its armature removes battery from the test terminal 220 of line switch F, whereupon relays 216 and 222 release, the former opening the original energizing circuit for relay 214 which, however, remains locked up to ground at its own outer left hand armature and front contact.

The operation of the control relay 225 of the selected district switch causes an idle sender to be selected in the well known manner whereupon relay 300 operates causing relay 301 to operate through intermediary relays (not shown) to cause a dialing signal to be given to the operator in the following manner. Relay 301 in operating places a ground on the tip conductor of the line switch F. This ground causes relay 227 to operate in a circuit extending from grounded battery through the winding of

relay 227, inner right hand armature and back contact of relay 228, contacts 223 of relay 214, wiper 298 and contact 231 of switch F, lower left hand contacts of sequence switch spring 230 (1+16), upper right hand contacts of said spring (2 $\frac{3}{4}$ +10) to ground at the contacts of relay 301. Relay 227, in operating, causes relay 202 to operate in a circuit which may be traced from grounded battery through the winding of relay 202, front contact and armature of relay 227 to ground over the front contact and inner right hand armature of relay 211. Relay 202 in operating substitutes the positive pole of battery 230 for the negative pole of battery 201 thereby reversing the current through the circuit including the winding of relay 200, conductor 203, back contact and inner right hand armature of relay 125, conductor 128, composite leg of the toll line L, conductor 129, front contact and inner armature of relay 101, winding of polarized relay 130 and ground over the back contact and armature of relay 100. The direction of current in this circuit is now such as to cause polarized relay 130 to operate, thereby connecting the resistance element 181 in parallel with the windings of relays 101 and 100 thereby reducing the resistance of the sleeve circuit to such an extent as to cause marginal relay 103 in the operator's cord circuit to operate and establish an obvious circuit for the supervisory lamp 106 which thereupon illuminates, indicating to the operator that she may proceed to dial. The reduction of the resistance in the sleeve circuit does not affect relay 101 which remains operated.

In response to the illumination of lamp 106, the operator at O actuates the dial key 105 thereby removing the supervisory equipment from the cord circuit and causing lamp 106 to be extinguished. Relay 101 is now maintained operated from the battery associated with the dial D.

The operator now actuates the dial D in accordance with the number of the desired line whereupon relay 101 follows the interruptions of the dial contacts to intermittently connect and disconnect ground from the composite leg of the toll line whereupon relay 200 is intermittently energized and de-energized. The intermittent operation of relay 200 causes ground to be intermittently applied to the ring side of the connection in a circuit extending from ground, over the armature and front contact of relay 200, right hand armature and front contact of relay 207, back contact and outer right hand armature of relay 228, contacts 224 of relay 214, ring wiper 245 and contact 232 of line switch F, upper left hand contacts of sequence switch spring 281 (1+16), lower right hand contacts of said spring (3+10 $\frac{1}{2}$), winding of pulsing relay 300 to ground.

This pulsing relay thereupon follows the interruptions of the dial contacts and effects the setting of the automatic switches in the well known manner.

When relay 200 operates in accordance with the interruptions of the dial contacts, the ground is removed from the winding of relay 208. However, this relay remains operated during the dialing period owing to its slow releasing characteristic. Relay 130 also follows the dial pulses but performs no function at this time, since the supervisory equipment is disconnected from the sleeve circuit by the operation of the dial key 105. When all the digits corresponding to the number of the desired line have been dialled, the operator at O restores the dial key 105 thereby connecting the supervisory equipment with the cord circuit and causing lamp 106 to be again illuminated, it being understood that polarized relay 130 is now in its operated position.

When all the pulses are registered in the sender, the ground is removed from the tip lead thereof, thereby causing relay 227 to release which in turn opens the circuit for relay 202, whereupon battery 201 is again connected to the composite leg of the toll line to cause polarized relay 130 to release thereby removing the resistance element 181 from the sleeve circuit and permitting marginal relay 103 to restore and open the circuit for supervisory lamp 106 which is thereupon extinguished.

When the called line A is reached a ground will be connected to the contact 229 and wiper 238 of line switch F whereupon relay 228 operates in a circuit which may be traced from grounded battery through the winding of relay 228, contacts 237 of relay 228, contacts 239 of relay 214, wiper 238 and terminal 229 of switch F and contacts 261 to ground. Relay 228 locks through its contacts 247 under the control of relay 214. At its inner right hand armature relay 228 disconnects relay 227 from the tip conductor of the connection and at its inner left hand armature and front contact it connects the relay 227 to the wiper 238 of line switch F. At its outer left hand armature, relay 228 establishes a circuit for relay 117 which may be traced from grounded battery through the winding of relay 117, contacts 199 of relay 117, conductor 190, conductor 250, front contact and outer left hand armature of relay 228, conductors 251 and 252 to ground through the front contact and inner right hand armature of relay 211. Relay 271 also operates in parallel with relay 117 as a result of the operation of relay 228 and the circuit for this relay is obvious. Relay 117 in operating connects the tip and ring conductors of the toll line L to corresponding terminals of the line switch F and relay 228 clears

the tip and ring conductors of the toll line of the manual equipment.

Relay 271 in attracting its left hand armature locks to ground at the inner right hand armature of relay 211, thereby removing itself from the control of relay 228. At its inner right hand armature, relay 271 prepares a circuit for the ringing relay 270 and at its outer right hand armature prepares a circuit for relay 299 as will hereinafter appear.

If the called line is idle, a steady ground will be connected to the contact 229 whereupon relay 227 will operate over a path including grounded battery, winding of relay 227, front contact and inner left hand armature of relay 228, contacts 239 of relay 214, wiper 238, to ground on terminal 229 of switch F. Relay 227 in operating causes relay 202 to operate over a circuit previously traced. Relay 202 in operating connects the positive pole of battery 230 to the composite leg of the toll line, causing lamp 106 to light as previously described.

With the toll line extended to the idle line of station A, the called subscriber is signaled in the manner well known in the art.

When the called subscriber in response to this signal removes the receiver from the switchhook, ground is removed from the contact 229 of the switch F, thereby interrupting the circuit previously traced for relay 227. Relay 227 thereupon releases, opening the circuit for relay 202, whereupon the negative terminal of battery 201 is substituted for the positive terminal of battery 230 thereby causing current from the battery 201 to flow back over the composite leg of the toll line and through the winding of polarized relay 130. Relay 130 in response to the current from battery 201 de-energizes, thereby disconnecting the resistance element 181 from the sleeve circuit and so increasing the resistance of the sleeve circuit that relay 103 does not receive sufficient current to energize, whereupon this relay releases, opening the circuit for supervisory lamp 106 which is thereupon extinguished. The extinguishment of lamp 106 notifies the operator at O that the called party has responded.

At the termination of the conversation, the subscriber at A upon replacing the receiver on the switchhook, again causes ground to be placed on terminal 229 of switch F thereby causing the energization of relay 227 as hereinbefore described. Relay 227 in operating, causes the energization of relay 202, whereupon battery 230 is again substituted for the battery 201 so that the current in the circuit including the composite leg of the toll line and the winding of polarized relay 130 is reversed

whereupon relay 130 operates to again connect the resistance element 181 in the sleeve circuit so that marginal relay 103 operates to cause the illumination of lamp 106.

The illumination of lamp 106 at this time 70 serves as a disconnect signal to the operator at O and she proceeds to take down the connection by withdrawing plug P from jack J of the toll line L. As a result of the disconnection of plug P from jack J, relays 104 75 and 101 release. The release of relay 104 restores the cord circuit equipment to normal. Relay 101 in releasing opens up the composite leg of the toll line thereby causing the release of relay 200. Relay 200 in releasing 80 removes the ground from relay 208 which after an interval, releases and opens the circuit for relay 211. Relay 211 in retracting its outer left hand armature opens the locking circuit for relay 214 which relay 85 thereupon releases. At its inner right hand armature, relay 211 disconnects ground from the windings of relays 207 and 271 whereupon these relays restore. Relay 271 in restoring, disconnects ringing relay 270 90 from the composite leg of the toll line and also opens the normal energizing circuit for relay 299. The restoration of the automatic equipment takes place in a manner well known in the art. 95

If, in the course of completing the connection, a busy line is encountered, intermittent ground from interrupter 270 will be applied to the contact 229. The first of the ground impulses will operate relay 228. The 100 following ground impulses operate relay 227 over a path including wiper 238, contacts 239 of relay 214, inner left hand armature and front contact of relay 228 to grounded battery at the winding of relay 227. Relay 105 227 will therefore be intermittently energized to alternately close and open the circuit for relay 202. Relay 202 will thereupon alternately connect and disconnect the sources 230 and 201 to the composite leg of 110 the toll line whereupon polarized relay 130 will be intermittently operated to cause the flashing of lamp 106 in a manner which is believed to be obvious. The flashing of lamp 106 indicates to the operator at position O 115 the busy condition of the line.

If the operator at position O desires to re-ring the called subscriber or if for any reason the ringing current has been prematurely tripped, she actuates the ringing key 120 102 to apply ringing current to the sleeve of the cord circuit and cause relay 100 to intermittently open and close the composite leg of the toll line. The operation of key 102 disconnects the supervisory equipment from the 125 cord circuit during the ringing period.

It will be noted that relays 200 and 270 are connected in parallel to the composite leg of the toll line so that when relay 100 disconnects ground from the composite leg the con- 130

condenser 272 associated with the winding of relay 270 will charge from the battery 230 associated with the armature of relay 202 through the windings of relays 200 and 270, and when ground is reconnected to the composite leg by the deenergization of relay 100 the condenser 272 will discharge through relay 270 to ground on the composite leg, so that relay 270 will be intermittently energized but it is designed to remain operated as long as the ringing current is applied to the line. Relay 270 in operating causes relay 299 to operate in a circuit extending from grounded battery through the winding of relay 299, upper left hand contacts of sequence switch spring 294, lower left hand contacts of said spring (13 and 16), terminal 296 and wiper 297 of line switch F, front contact and outer right hand armature of relay 271 to ground over the front contact and armature of relay 270. Relay 299 in operating causes the application of ringing current from the source 292 to the established connection to cause the signaling of the called subscriber at station A.

What is claimed is:

1. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, and means controlled over the composite leg of said line for setting said switches, and signaling said station, a direct current source and means for transmitting supervisory signals from said source to said exchange over the composite leg operative on the response of the subscriber's station.

2. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said exchange, means controlled over the composite leg of said line for setting said switches and signaling said station, sources of battery of different potentials, and means controlled by said station including the transmission of current from one source of battery by way of the composite leg of said line for the actuation of the signal and the transmission of current from a second source of battery by way of the composite leg of said line for effecting the restoration of the signal to normal condition.

3. In a telephone system, a telephone exchange, supervisory apparatus thereat, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, and a path, including the composite leg of said line, for the trans-

mission of dial impulses for setting said switches and signaling current for signaling said station and means including sources of battery and the composite leg for transmitting signaling current from said sources for controlling the supervisory apparatus at said exchange in different manners.

4. In a telephone system, two exchanges, a two-way line circuit extending between said exchanges, an automatic exchange, automatic switches thereat, means for establishing a connection between said first exchanges over said line, and means for controlling said switches at said automatic exchange over one side of said line comprising a source of battery, a dial and a relay responsive to impulses of current from said battery by the actuation of said dial, a second source of battery, contacts and a control relay included in said side of the line said contacts being controlled by said first relay to cause the actuation of the control relay in accordance with operations of the dial.

5. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said station, a signal at said exchange, means at said exchange for controlling said switches over the composite leg of said line, means at said exchange for controlling the signal at said station over the composite leg of said line, and means controlled over the composite leg of said line, from said station for actuating the signal at said exchange to indicate when the subscriber at said station answers, when he has completed conversation and when he recalls the exchange by the manipulation of the subscriber's switchhook.

6. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said exchange, a signal at said station, means at said exchange for controlling said switches over the composite leg of said line, means at said exchange for controlling the signal at said station over the composite leg of said line, and means responsive to switchhook actuations at said station for transmitting direct current impulses over the composite leg of said line to flash the signal at said exchange.

7. In a telephone system, two exchanges, a two-way line circuit extending between said exchanges, an automatic exchange, automatic switches thereat, means for establishing a connection between said first exchanges over said line, means at one of said first exchanges for controlling the switches at said automatic exchange over only one

side of said line, a supervisory signal and circuit therefor, means controlled over the same side of said line for varying the resistance of said supervisory circuit and a relay means in said supervisory circuit responsive to the change in resistance to effect said signal in corresponding different manners.

8. In a telephone system, a first exchange, a second exchange, a transmission line, subscriber stations, a signaling device at said first exchange, automatic switches at said second exchange, means at said first exchange for controlling said switches over only one side of said transmission line to connect said first exchange with a subscriber's station, and means controlled over the same side of said line for complete control over the operation of the signaling device at said first exchange during the establishing of a connection.

9. In a telephone system, a first exchange, a second exchange, a transmission line, automatic switches at said second exchange, means at said first exchange for controlling said switches over one side of the line, a source of alternating current at said first exchange, means at said first exchange for controlling said side of the line to transmit signaling impulses thereover comprising a relay, a key for applying alternating current from said source to said relay to cause it to alternately respond and release in accordance with said alternating current, a second source of battery and contacts included in said side of the line and controlled by said relay to cause the line to be alternately opened and closed and means at the second exchange in said side of the line responsive to said signaling impulses.

10. In a telephone system, a first exchange, a second exchange, a transmission line, a subscriber's line, a signaling device thereat, automatic switches at said second exchange, means at said first exchange for controlling said switches over one side of the transmission line, a source of alternating current at said first exchange, a means for controlling said side of the line to transmit signaling impulses thereover comprising a relay, a key for applying alternating current from said source to said relay to cause it to alternately respond and release in accordance with said alternating current, a second source of battery and contacts included in said side of the line controlled by said relay to cause the line to be alternately opened and closed and means responsive to said impulses of current over said side of the line for actuating said signaling device at said subscriber's line.

11. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for establishing a connection between said exchange and said station, a signal at said exchange connected in the sleeve circuit of said line, sources of currents of different characteristics, and means associated with the composited leg of said line and responsive to currents from said sources for varying the resistance of said sleeve circuit whereby said signal is actuated to indicate in different manner the progress of the establishing of a connection.

In witness whereof, I hereunto subscribe my name this 27th day of September A. D., 1923.

LOUIS A. MORTIMER.

side of said line, a supervisory signal and circuit therefor, means controlled over the same side of said line for varying the resistance of said supervisory circuit and a relay means in said supervisory circuit responsive to the change in resistance to effect said signal in corresponding different manners.

8. In a telephone system, a first exchange, a second exchange, a transmission line, subscriber stations, a signaling device at said first exchange, automatic switches at said second exchange, means at said first exchange for controlling said switches over only one side of said transmission line to connect said first exchange with a subscriber's station, and means controlled over the same side of said line for complete control over the operation of the signaling device at said first exchange during the establishing of a connection.

9. In a telephone system, a first exchange, a second exchange, a transmission line, automatic switches at said second exchange, means at said first exchange for controlling said switches over one side of the line, a source of alternating current at said first exchange, means at said first exchange for controlling said side of the line to transmit signaling impulses thereover comprising a relay, a key for applying alternating current from said source to said relay to cause it to alternately respond and release in accordance with said alternating current, a second source of battery and contacts included in said side of the line and controlled by said relay to cause the line to be alternately opened and closed and means at the second exchange in said side of the line responsive to said signaling impulses.

10. In a telephone system, a first exchange, a second exchange, a transmission line, a subscriber's line, a signaling device thereat, automatic switches at said second exchange, means at said first exchange for controlling said switches over one side of the transmission line, a source of alternating current at said first exchange, a means for controlling said side of the line to transmit signaling impulses thereover comprising a relay, a key for applying alternating current from said source to said relay to cause it to alternately respond and release in accordance with said alternating current, a second source of battery and contacts included in said side of the line controlled by said relay to cause the line to be alternately opened and closed and means responsive to said impulses of current over said side of the line for actuating said signaling device at said subscriber's line.

11. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for establishing a connection between said exchange and said station, a signal at said exchange connected in the sleeve circuit of said line, sources of currents of different characteristics, and means associated with the composited leg of said line and responsive to currents from said sources for varying the resistance of said sleeve circuit whereby said signal is actuated to indicate in different manner the progress of the establishing of a connection.

In witness whereof, I hereunto subscribe my name this 27th day of September A. D., 1923.

LOUIS A. MORTIMER.

DISCLAIMER

1,617,413.—*Louis A. Mortimer*, New York, N. Y. TELEPHONE SYSTEM. Patent dated February 15, 1927. Disclaimer filed November 28, 1930, by the assignee, *Western Electric Company, Incorporated*.

Hereby enters this disclaimer to the said claims of said Letters Patent which are in the following words, to wit:

"9. In a telephone system, a first exchange, a second exchange, a transmission line, automatic switches at said second exchange, means at said first exchange for controlling said switches over one side of the line, a source of alternating current at said first exchange, means at said first exchange for controlling said side of the line to transmit signaling impulses thereover comprising a relay, a key for applying alternating current from said source to said relay to cause it to alternately respond and release in accordance with said alternating current, a second source of battery and contacts included in said side of the line and controlled by said relay to cause the line to be alternately opened and closed and means at the second exchange in said side of the line responsive to said signaling impulses.

"10. In a telephone system, a first exchange, a second exchange, a transmission line, a subscriber's line, a signaling device thereat, automatic switches at said second exchange, means at said first exchange for controlling said switches over one side of the transmission line, a source of alternating current at said first exchange, a means for controlling said side of the line to transmit signaling impulses thereover comprising a relay, a key for applying alternating current from said source to said relay to cause it to alternately respond and release in accordance with said alternating current, a second source of battery and contacts included in said side of the line controlled by said relay to cause the line to be alternately opened and closed and means responsive to said impulses of current over said side of the line for actuating said signaling device at said subscriber's line."

[*Official Gazette December 16, 1930.*]

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Hereby enters this disclaimer to the said claims of said Letters Patent which are in the following words to wit:

"1. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, and means controlled over the composite leg of said line for setting said switches, and signaling said station, a direct current source and means for transmitting supervisory signals from said source to said exchange over the composite leg operative on the response of the subscriber's station.

"2. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said exchange, means controlled over the composite leg of said line for setting said switches and signaling said station, sources of battery of different potentials, and means controlled by said station including the transmission of current from one source of battery by way of the composite leg of said line for the actuation of the signal and the transmission of current from a second source of battery by way of the composite leg of said line for effecting the restoration of the signal to normal condition.

"3. In a telephone system, a telephone exchange, supervisory apparatus thereat, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, and a path, including the composite leg of said line, for the transmission of dial impulses for setting said switches and signaling current for signaling said station and means including sources of battery and the composite leg for transmitting signaling current from said sources for controlling the supervisory apparatus at said exchange in different manners.

"4. In a telephone system, two exchanges, a two-way line circuit extending between said exchanges, an automatic exchange, automatic switches thereat, means for establishing a connection between said first exchanges over said line, and means for controlling said switches at said automatic exchange over one side of said line comprising a source of battery, a dial and a relay responsive to impulses of current from said battery by the actuation of said dial, a second source of battery, contacts and a control relay included in said side of the line said contacts being controlled by said first relay to cause the actuation of the control relay in accordance with operations of the dial.

"5. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said station, a signal at said exchange, means at said exchange for controlling said switches over the composite leg of said line, means at said exchange for controlling the signal at said station over the composite leg of said line, and means controlled over the composite leg of said line, from said station for actuating the signal at said exchange to indicate when the subscriber at said station answers, when he has completed conversation and when he recalls the exchange by the manipulation of the subscriber's switchhook.

"6. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said exchange, a signal at said station, means at said exchange for controlling said switches over the composite leg of said line, means at said exchange for controlling the signal at said station over the composite leg of said line, and means responsive to switchhook actuations at said station for transmitting direct current impulses over the composite leg of said line to flash the signal at said exchange."

"8. In a telephone system, a first exchange, a second exchange, a transmission line, subscriber stations, a signaling device at said first exchange, automatic switches at said second exchange, means at said first exchange for controlling said switches over only one side of said transmission line to connect said first exchange with a subscriber's station, and means controlled over the same side of said line for complete control over the operation of the signaling device at said first exchange during the establishing of a connection."

[*Official Gazette* October 7, 1930.]

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"1. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, and means controlled over the composite leg of said line for setting said switches, and signaling said station, a direct current source and means for transmitting supervisory signals from said source to said exchange over the composite leg operative on the response of the subscriber's station.

"2. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said exchange, means controlled over the composite leg of said line for setting said switches and signaling said station, sources of battery of different potentials, and means controlled by said station including the transmission of current from one source of battery by way of the composite leg of said line for the actuation of the signal and the transmission of current from a second source of battery by way of the composite leg of said line for effecting the restoration of the signal to normal condition.

"3. In a telephone system, a telephone exchange, supervisory apparatus thereat, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, and a path, including the composite leg of said line, for the transmission of dial impulses for setting said switches and signaling current for signaling said station and means including sources of battery and the composite leg for transmitting signaling current from said sources for controlling the supervisory apparatus at said exchange in different manners.

"4. In a telephone system, two exchanges, a two-way line circuit extending between said exchanges, an automatic exchange, automatic switches thereat, means for establishing a connection between said first exchanges over said line, and means for controlling said switches at said automatic exchange over one side of said line comprising a source of battery, a dial and a relay responsive to impulses of current from said battery by the actuation of said dial, a second source of battery, contacts and a control relay included in said side of the line said contacts being controlled by said first relay to cause the actuation of the control relay in accordance with operations of the dial.

"5. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said station, a signal at said exchange, means at said exchange for controlling said switches over the composite leg of said line, means at said exchange for controlling the signal at said station over the composite leg of said line, and means controlled over the composite leg of said line, from said station for actuating the signal at said exchange to indicate when the subscriber at said station answers, when he has completed conversation and when he recalls the exchange by the manipulation of the subscriber's switchhook.

"6. In a telephone system, a telephone exchange, a subscriber's station, means including a line composited for simultaneous telephony and telegraphy and a plurality of automatic switches for interconnecting said exchange and said station, a signal at said exchange, a signal at said station, means at said exchange for controlling said switches over the composite leg of said line, means at said exchange for controlling the signal at said station over the composite leg of said line, and means responsive to switchhook actuations at said station for transmitting direct current impulses over the composite leg of said line to flash the signal at said exchange."

"8. In a telephone system, a first exchange, a second exchange, a transmission line, subscriber stations, a signaling device at said first exchange, automatic switches at said second exchange, means at said first exchange for controlling said switches over only one side of said transmission line to connect said first exchange with a subscriber's station, and means controlled over the same side of said line for complete control over the operation of the signaling device at said first exchange during the establishing of a connection."

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"10. In a telephone system, a first exchange, a second exchange, a transmission line, a subscriber's line, a signaling device thereat, automatic switches at said second exchange, means at said first exchange for controlling said switches over one side of the transmission line, a source of alternating current at said first exchange, a means for controlling said side of the line to transmit signaling impulses thereover comprising a relay, a key for applying alternating current from said source to said relay to cause it to alternately respond and release in accordance with said alternating current, a second source of battery and contacts included in said side of the line controlled by said relay to cause the line to be alternately opened and closed and means responsive to said impulses of current over said side of the line for actuating said signaling device at said subscriber's line."

[*Official Gazette December 16, 1930.*]