May 25, 1926. 1,586,308

J. H. HOMRIGHOUS

TELEPHONE SYSTEM

Original Filed May 2, 1919 3 Sheets-Sheet 1

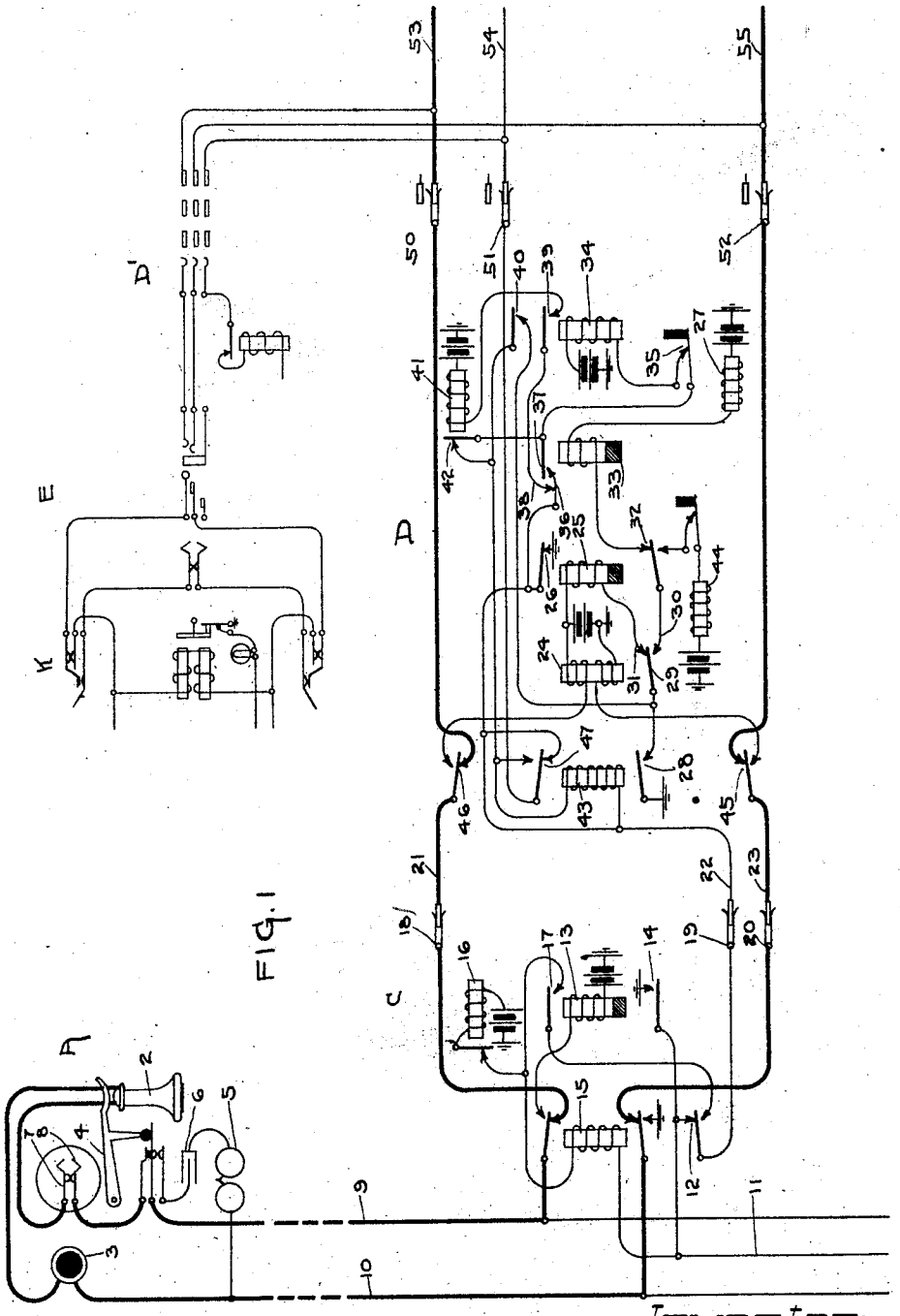


FIG. 1

Inventor
John H. Homrighous
By Fisher
Atty.

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J. H. HOMRIGHOUS

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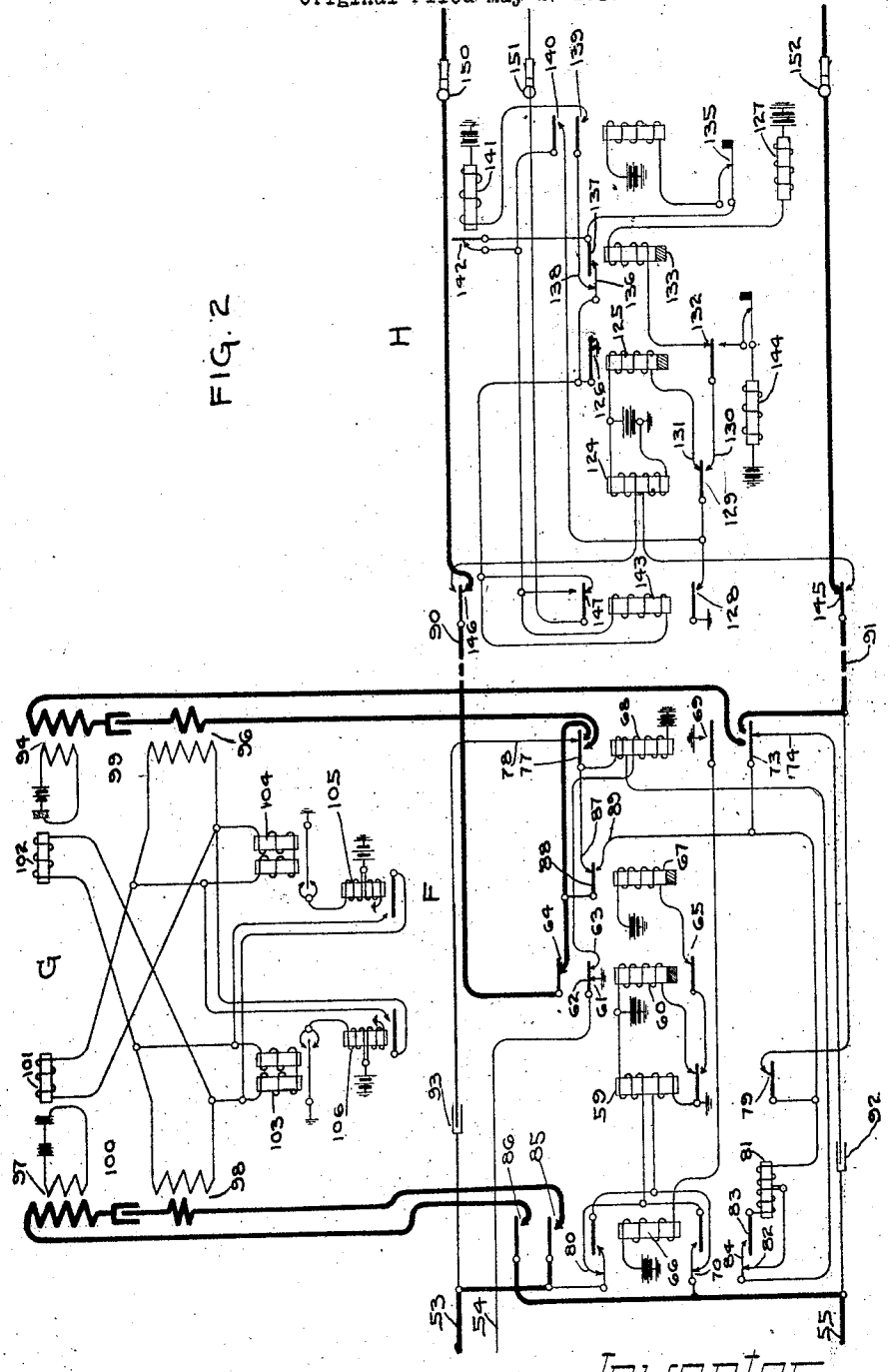
FIG. 2




Inventor
John H. Homrighous
By Fales
Atty.

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J. H. HOMRIGHOUS

TELEPHONE SYSTEM

Original Filed May 2, 1919 3 Sheets-Sheet 3

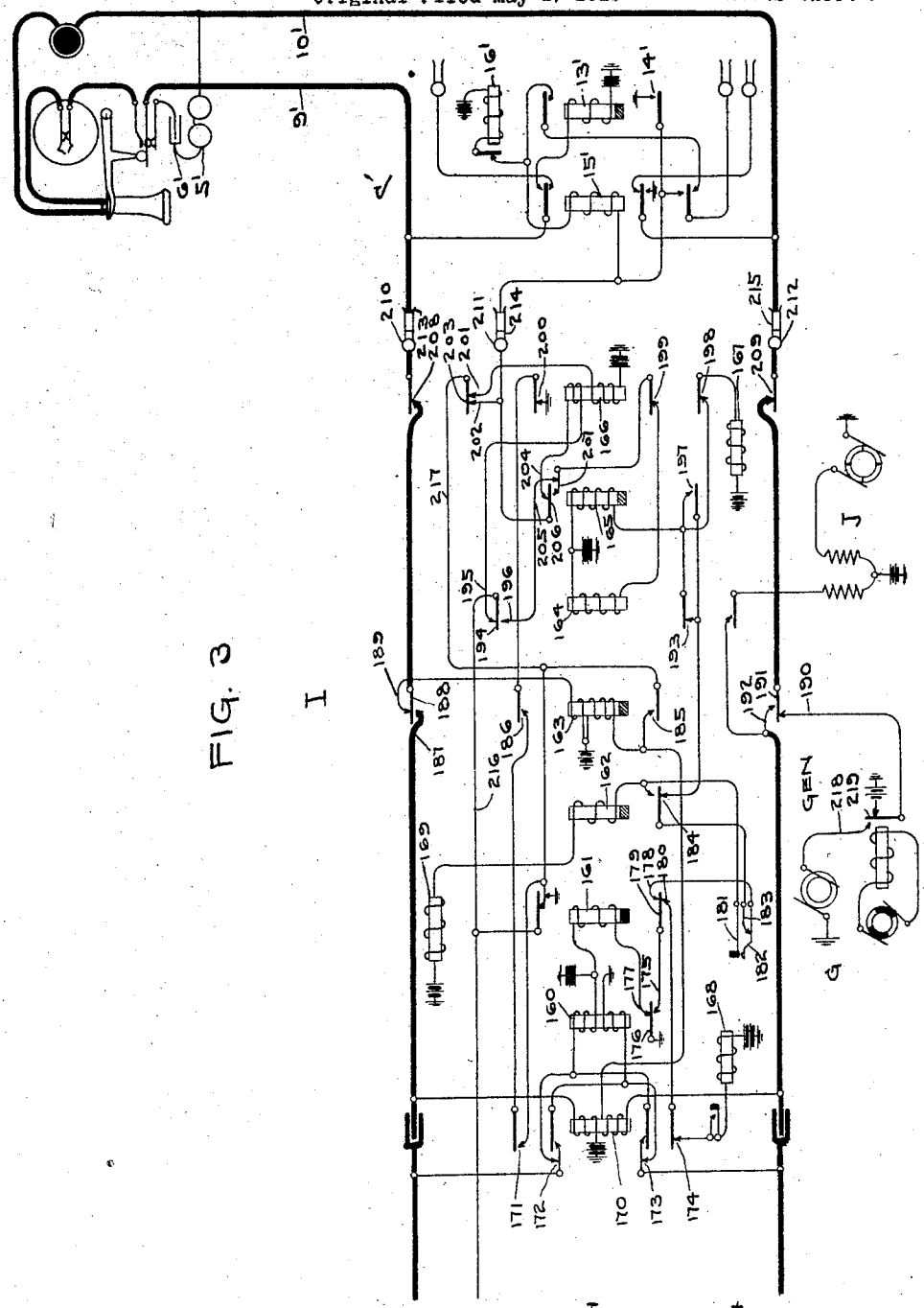


FIG. 3

Inventor
John H. Homrighous
By Fales
Atty.

Patented May 25, 1926. 1,586,308

# UNITED STATES PATENT OFFICE.

JOHN H. HOMRIGHOUS, OF OAK PARK, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

## TELEPHONE SYSTEM.

Application filed May 2, 1919, Serial No. 294,173. Renewed October 24, 1924.

My invention relates in general to telephone systems but is concerned more particularly with the use of a voice current repeater in automatic telephone systems. The object of the invention may be said to consist broadly in the provision of automatic means for cutting a voice current repeater in a trunk circuit and especially in a trunk circuit over which connections are established automatically. This and other objects of my invention will be more fully described hereinafter.

Of the accompanying drawings, to which reference will be made in the specification, Figures 1, 2 and 3 when arranged in order with corresponding lines at the ends thereof in alignment, represent diagrammatically a connection between a calling substation A in one exchange and a called substation A′ in another exchange, in a system embodying the principles of my invention.

Referring to Figure 1, the substation A may be of any approved automatic type, such for example as the substation shown in the British patent to Martin #1419 of 1910. As represented herein, it comprises essentially the receiver 2, transmitter 3, switch-hook 4, ringer 5, and condenser 6. Being an automatic substation, it is also provided with a pair of impulse springs 7 and 8, which may be controlled by an impulse wheel through the medium of a finger hole dial (not shown). The lines 9 and 10 of substation A extend to the exchange where they terminate in an individual switch C. The line switch C may be of the general type of line switch shown in U. S. Letters Patent No. 1,126,727 granted February 2, 1915 to Dietl. Through the medium of the line switch C the line of substation A when calling, is given access to a plurality of trunk lines extending to selector switches.

One of the trunk lines to which the line switch C has access is shown extending to the first selector switch D. The selector switch D may be of the general type of selector switch disclosed in U. S. Letters Patent No. 815,321 granted March 13, 1906, to Keith, Erickson & Erickson. The side switch and private magnet are omitted, however, and the circuits are modified in accordance with the two wire system of control. The first selector switch D may have access to other selector switches similar to the switch D, also on certain levels it may have access to trunk lines extending to another exchange through the medium of repeating apparatus such as shown at F, Fig. 2. These trunk lines are also accessible to other switches such as the switch D′, which switch D′ is similar to the switch D and controlled by an operator through the medium of the cord circuit E, of which only the calling end is shown.

Associated with the apparatus F, Fig. 2, is a two-way voice current repeater G, which is adapted to be inserted in the trunk line upon the response of the called party. The voice current repeater G is similar to that disclosed in Patent No. 1,460,814, issued to John H. Homrighous, July 3, 1923. But it is to be understood that any voice current repeater known in the art may be used.

The trunk line shown in the accompanying drawings terminates at the second exchange in a selector switch H, which switch H may be similar to the switch D. Accessible to the selector H I have shown a connector switch I, Fig. 3. The switch I may be of the general type of connector switch disclosed in U. S. Letters Patent No. 815,176, granted March 13, 1906 to Keith, Erickson & Erickson.

The substation A′ and the line switch C′ may be in all respects similar to the substation A and the line switch C.

Having briefly described the apparatus involved I will now proceed to explain more in detail the operation of the same.

When the subscriber at substation A removes his receiver, a circuit is closed at the switch hook springs for the line relay 13 of the line switch C in series with the line circuit. Relay 13, upon energizing, closes a circuit at springs 14, including switching relay 15, and the rotary magnet 16 in series, and at the same time prepares a circuit for the magnet 16 at springs 17 to the private wiper 19. Suppose the trunk line upon which the wipers 18, 19 and 20 are resting is busy, then a ground potential is present on the private contact corresponding to that trunk. This ground potential will short circuit the high resistance relay 15 and energize the rotary magnet 16 to step the wipers to the contacts of the next trunk line. If this trunk is busy the rotary magnet will again be energized and this operation

will continue until an idle trunk is reached, at which time there will be no potential present at the contact which the private wiper meets. Relay 15 will be no longer shorted out and will immediately energize over the series circuit hereinbefore traced, to extend the line of substation A to a trunk line leading to a selector switch.

Suppose the first idle trunk line is the trunk line 21, 22 and 23 leading to the selector switch D. Relay 15, upon energizing, closes a circuit for the double wound line relay 24 of the switch D, in series with the line circuit and wipers 18 and 20. Relay 24, upon energizing, closes a circuit for the slow acting release relay 25. Relay 25, upon energizing, closes a holding circuit for the relay 15 of the line switch C which may be traced as follows: From ground through springs 26, conductor 22, wiper 19, springs 12, winding of relay 15, winding of magnet 16 to battery. Since the line relay 13 is slow acting it retains its armature to maintain the winding 15 energized until after the above holding circuit has been established. A branch of the holding circuit extends by way of the conductor 11 to multiple test contacts in the banks of connector switches having access to the line of substation A, where by a ground potential on these test contacts the said line is made busy.

The foregoing operations have occurred in response to the removal of the receiver at substation A. The calling subscriber may now manipulate his calling device in accordance with the first digit of the desired number, thereby producing in the usual and well known manner a series of interruptions in the line circuit. At each interruption the line relay 24 deenergizes momentarily and sends an impulse of current to the vertical magnet 27 over the following path: From ground through springs 28, springs 29 and 30, springs 32, winding of slow acting relay 33, and winding of vertical magnet 27 to battery. In response to these impulses the vertical magnet operates to raise the shaft step by step until the wipers 50, 51 and 52 arrive at the desired level of contacts in which are located terminals of trunk lines extending to the second exchange. Relay 33 is energized in series with magnet 27 and operates to close a circuit at springs 36 and 37, for the rotary interrupter relay 34. Relay 34, upon energizing, prepares a circuit for the rotary magnet 41 at springs 39, and closes a locking circuit for itself through spring 40. As soon as relay 33 deenergizes after the impulses cease, a circuit for the rotary magnet is closed at springs 36 and 38. The magnet 41, therefore, operates to rotate the wipers 50, 51 and 52 onto the first contact of the elected level and opens the locking circuit of relay 34 at springs 42. Relay 34 then deenergizes and opens the circuit of magnet 41 at springs 39, which magnet deenergizes and prepares a new circuit for relay 34 to the private wiper 51. If the first trunk is busy, the relay 34 will again be energized by the guarding potential on the contact engaged by the wiper 51 to again close the circuit of magnet 41. The rotary magnet again operates to step the wipers to the next trunk line. When the first idle trunk is reached, no potential is present at the contact engaged by wiper 51, and relay 43 which has heretofore been short circuited, is energized in series with relay 34 from ground potential at springs 26. Relay 34 being of lower resistance than relay 43, does not energize at this time. Relay 43, upon energizing, prepares a locking circuit for itself at springs 47, which will be completed over wiper 51 from the repeating apparatus associated with a trunk line such as that shown at F, also by means of springs 45 and 46, extends the line circuit to a trunk line leading to a repeater. Suppose the first idle trunk line is the trunk line 53, 54 and 55 leading to the repeater F. Then a circuit for the line relay 59 is completed as follows: From ground through lower winding of relay 59, springs 70, conductor 55, wiper 52, springs 45, conductor 23, wiper 20, to and through sub-station A, wiper 18, conductor 21, springs 46, wiper 50, conductor 53, springs 80, upper winding of relay 59 to battery. Relay 59, upon energizing, closes a circuit for slow release relay 60. Relay 60, upon energizing, places ground potential through springs 61 and 62 to the release trunk to render the repeater F busy to other calls and to hold relays 15 and 43 of switches C and D respectively, energized, closes a circuit for the lower winding of relay 68 at springs 61 and 63, prepares a circuit for slow relay 67 at springs 65, and at springs 64 closes a point in the circuit of line relay 124 of selector switch H. Relay 124 will now energize over the following path: From ground through lower winding of relay 124, trunk conductor 91, impulse springs 79, right hand winding of impedance coil 81, springs 82 and 84, upper winding of relay 68, springs 87 and 88, springs 64, trunk conductor 90, upper winding of relay 124 to battery. Relay 68 does not operate at this time as its two windings oppose each other.

The calling subscriber in manipulating his dial in accordance with the second digit of the called number produced as before a series of interruptions in the line circuit. At each interruption the line relay 59 deenergizes momentarily and closes a circuit for slow acting relay 67, which relay maintains its armature in an operated position while each series of impulses are being transmitted, and at springs 88 and 89 closes a

low resistance path in the energizing circuit of line relay 124. Relay 59 at each interruption of its circuit also interrupts the circuit of line relay 124 at springs 79. The line relay 124 controls the vertical magnet 127 which in turn causes the shaft to be raised step by step until the wipers 150, 151 and 152 arrive at the desired level of contacts in which terminate trunk lines extending to a group of connector switches. The switch H being similar to the switch D and as similar reference characters are applied to like parts it is not thought necessary to describe the operations of the switch H in detail.

Suppose the first idle trunk line in the elected line is the trunk line leading to the connector switch I, Fig. 3. Then relay 143, upon energizing, closes a circuit for the line relay 160 of switch I, over the following path: From ground through lower windings of relay 160, springs 173, wiper 152, springs 145, trunk conductor 91, over the previously traced circuit through the repeater F to trunk conductor 90, springs 146, wiper 150, springs 172, upper winding of relay 160 to battery. Relay 160, upon energizing, closes a circuit for the slow acting relay 161. Relay 161, upon energizing, closes a holding circuit for the relay 143 of the switch H. The calling subscriber in manipulating his dial in accordance with the third digit of the called number, produces in the usual and well known manner a series of interruptions in the circuit of the line relay 160. At each interruption of the circuit the relay 160 deenergizes momentarily and sends an impulse of current to the vertical magnet 169 over the following path: From ground through springs 176 and 175, springs 179 and 178, off normal springs 182 and 181, winding of slow relay 162, and winding of vertical magnet 169, to battery. In response to these impulses the vertical magnet operates to raise the shaft step by step until the wipers 210, 211 and 212 arrive at the horizontal level of bank contacts in which are located the terminals of the line of substation A'. Relay 162 is energized in series with the vertical magnet and retains its armature during the series of impulses, thereby preventing the opening of the vertical magnet circuit by the shifting of the off normal springs which operation occurs as soon as the shaft leaves normal position. The calling subscriber may now call the units or final digit in the called number, whereby a series of interruptions is produced in the circuit of relay 160. Now, however, the off normal springs 182 and 183 are closed, and the relay 162 having deenergized, the line relay transmits a series of impulses to the rotary magnet 167, over the following path: From ground through springs 176 and 175, springs 179 and 178, off normal springs 182 and 183, springs 184, springs 193, springs 198, winding of rotary magnet 167 to battery. The rotary magnet responds to the impulses of current in the circuit to rotate the wipers 210, 211 and 212 until they arrive at the bank contacts which form the terminals of the line of substation A'. It will be noted that a branch of the rotary magnet circuit extends through the winding of slow relay 165 to battery. It follows that relay 165 will be energized in parallel with the rotary magnet during the rotation of the switch, and since it is slow acting, it retains its armature attracted during the series of impulses to the rotary magnet. When the relay 165 is energized the private wiper 211 is connected to the winding of test relay 164 as follows: Wiper 211, springs 206 and 207, springs 199, winding of relay 164 to battery. Momentary energizations of relay 164 due to the wiper 211 passing over busy contacts (if there be any such contacts in its path) are of no consequence because of the alternative circuit for the rotary magnet by way of springs 197 to relay 165.

The switch wipers having been rotated into connection with the terminals of the desired line, the operations now depend upon whether or not that line is busy. Assuming the line to be idle, the test contact 214 will be clear of ground, the relay 164 will remain inoperative, and upon the deenergization of relay 165 the following circuit will be closed. Grounded conductor 216, springs 194 and 195, upper winding of relay 166, springs 204 and 206, wiper 211, test contact 214, winding of switching relay 15' and winding of rotary magnet 16' to battery. Relays 166 and 15' are energized in series, the latter operating to clear the line of substation A' from battery and ground connections in the line switch. Relay 166, upon energizing, closes a locking circuit for itself by way of grounded conductor 217, springs 203 and 201, lower winding of relay 166 to battery. At the same time at springs 202 and 203 the conductor 217 is connected direct to the test wiper 211. Further results of the energization of relay 166 are the breaking of the previously described test circuit at springs 199. A still further result of the energization of relay 166 is the closure of a signaling circuit at springs 208 and 209 which may be traced as follows: Ground at G, generator Gen., springs 218 and 219, springs 190 and 191, wiper 212, conductor 10', ringer 5', condenser 6', conductor 9', wiper 210, springs 208, springs 189, upper winding of relay 163, to battery. At the connector I by the operation of the interrupter apparatus the generator Gen. is intermittently cut out of the ringing circuit and booster battery substituted therefor. The ring cut off 163 is so adjusted that it will operate on current from generator Gen. and the ex-

change battery in series when the direct current bridge is closed at substation A′ or on current from the exchange battery and the booster battery in series under the same condition; but it will not operate from generator current alone when the condenser at the substation A′ is included in bridge thereof.

When the subscriber at substation A′ responds by removing his receiver, the relay 163 is energized at once irrespective of the position of the interrupter apparatus, and locks itself over the following circuit: Grounded conductor 217, springs 185, lower winding of relay 163 to battery. A branch of the above circuit supplies ground to the lower winding of the back bridge relay 170. The lower winding of relay 170 is connected as shown rather than to ground direct in order that the calling subscriber may detect the operation of the ringing apparatus by the tone which he gets by induction between the windings of relay 163. To proceed, relay 163, upon energizing, disconnects its upper winding and the interrupter apparatus at springs 188 and 189, and springs 190 and 191, and at springs 187 and 188, and springs 191 and 192, completes the talking circuit through the connector I. The back bridge relay is now energized in series over the called line circuit and reverses in the usual and well known manner the incoming trunk conductor as regards their connection to the windings of line relay 160. This causes current to flow in the opposite direction in the trunk line, to in turn operate relay 68 of repeater F. Relay 68, upon operating, disconnects the condenser 92 at springs 73 and 74, and at springs 77 and 78, disconnects the condenser 93, which condensers are provided so that the calling subscriber may detect the operation of the ringing apparatus. Also by the operation of springs 77 and 73 the secondary winding of transformer 94 in series with the condenser 99 and primary winding of transformer 96 of the voice current repeater G are connected in bridge of the trunk conductors 90 and 91. The closure of springs 69 closes a circuit for relay 66. Relay 66, upon energizing, reverses the incoming line conductors as regards their connection to the winding of line relay 59. This causes a reversal of current in the calling line for any desired purpose. At springs 83 and 84 the left hand winding of impedance coil 81 is included in the holding bridge of switch I, also by the closure of springs 85 and 86 the secondary winding of transformer 97 in series with condenser 100 and primary winding of transformer 98 are connected in bridge of the incoming line conductors. Talking battery for the transmitter at substation A is supplied from the windings of relay 59, while the transmitter at substation A′ is supplied from the windings of relay 170. The path for voice currents is indicated by the heavy conductors.

The operation of the voice current repeater G may be stated briefly as follows: When voice currents reach the repeater G via the called line, the electromagnet 101 of repeater G and relay 104 will be energized in multiple through the primary and secondary windings of transformer 96. Relay 104 vibrates its armature to close a circuit for the upper winding of relay 105. Relay 105 will now operate as the two windings assist each other, to short circuit the electromagnet 102 of repeater G in the receiving circuit associated with the calling line. The electromagnet 101 of the repeater G which is energized in multiple with relay 104, will agitate its microphone in a manner well known in the art, to set up variations of current strength in the local circuit consisting of battery and the primary winding of transformer 97. The current changes produced in the primary winding of transformer 97 causes a current of increased strength to be induced in the secondary winding. Therefore amplified voice currents will flow over the calling line.

The operation of the voice current repeater G for voice currents reaching it via the calling line will be similar to the operation just described.

When the conversation is finished both subscribers will replace their receivers. By the replacement of the receiver at substation A the circuit of line relay 59 is broken. Upon deenergizing, the line relay 59 breaks the circuit of slow acting relay 60. Relay 60, upon deenergizing, removes ground from the holding circuit extending back to the selector switch D and line switch C, which allows the relays 43 and 15 to deenergize. Relay 43, upon deenergizing, closes a circuit at springs 28 for the release magnet 44, which magnet causes the restoration of switch D to normal position. Also the deenergization of line relay 59 breaks the circuit of relay 160 at springs 79. Relay 160, upon deenergizing, removes ground from the holding circuit extending back to the selector switch H, which causes the switch H to be restored to normal position. The replacement of the receiver at substation A′ allows relay 170 to deenergize, thereby closing a circuit for the release magnet 168 as follows: From ground through springs 176 and 175, springs 179 and 180, springs 174, off normal springs, winding of magnet 168 to battery. The energization of the release magnet 168 results in the restoration of the connector to normal.

It will now be described how the connector I operates when it is attempted to establish connection with a busy line. For

this purpose it will be assumed that the line of substation A' was busy when called, in which case the test contact 214 would have a ground potential upon it. Under these circumstances, when the connector wipers 210, 211 and 212 are rotated into engagement with the contacts 213, 214 and 215, the relay 165 is energized during the rotation as previously described. Then as soon as the test wiper 211 arrives at the contact 214 the relay 164 will be energized over a circuit hereinbefore traced with results which will now be pointed out. At springs 194 and 196 a locking circuit is prepared which, upon deenergization of relay 165, is completed over the following path: Grounded conductor 216, springs 194 and 196, springs 205 and 207, springs 199, winding of relay 164 to battery. Relay 164 is thus locked in energized position until the connector is released. Relay 164, upon energizing, connects a lead from the busy signaling machine J to the lower heavy line conductor. By the transmission of a distinctive tone to the calling subscriber he is informed that the line which he is attempting to connect is busy, whereupon he will replace his receiver and the switches will be released as previously explained.

Referring to Fig. 1, the switch D' is shown accessible to an operator through the medium of the cord circuit E, whereby an operator may establish a connection with a line in the second exchange, in a system embodying the principles of my invention. The operator desiring to connect with a line in the second exchange, inserts the plug of cord circuit E in the jack associated with the switch D', operates the calling device key K, to include the calling device in the circuit of the line relay of switch D'. The operator may now manipulate her calling device in accordance with the digits of the wanted line, which causes the repeating apparatus F and switches H and I to operate in a manner similar to that hereinbefore described.

Having fully described and ascertained the features of my invention and method of accomplishing the desired results, I will point out in the appended claims what I consider to be new and desire to have protected by Letters Patent.

What I claim is:

1. In a telephone system, a calling telephone and a line therefor, a called telephone and a line therefor, a voice current repeater, means for connecting said lines over a talking circuit, and means for thereafter automatically inserting said repeater in said connection, whereby conversation may be carried on between the two telephones through said repeater, said last means controlled over the line of the called telephone.

2. In a telephone system, a calling telephone and a line therefor, a called telephone and a line therefor, a voice current repeater, means for connecting the two lines, said means including a trunk line and an automatic progressively movable switch controlled thereover from the calling telephone, the establishment of the said connection being controlled from the calling telephone through the medium of said automatic switch, said means also for automatically inserting said repeater in said connection after the switch is fully operated, whereby conversation may be carried on between the two telephones through said repeater.

3. In a telephone system, a calling telephone and a line therefor, a called telephone and a line therefor, a voice current repeater, means for connecting the two lines, said means including a trunk line and an automatic progressively movable switch controlled thereover from the calling telephone, the establishment of the said connection being controlled from the calling telephone through the medium of said automatic switch, said means also for automatically inserting said repeater in said connection after the switch is fully operated, whereby conversation may be carried on between the two telephones through said repeater.

4. In a telephone system, a calling telephone and a line therefor, a called telephone and a line therefor, a voice current repeater for amplifying and repeating voice currents in either direction, means for connecting the two lines, said means including a trunk line and an automatic progressively movable switch controlled thereover from the calling telephone, the establishment of the said connection being controlled from the calling telephone through the medium of said automatic switch, and means also for thereafter automatically substituting said repeater in said connection for a portion of said trunk line, whereby conversation may be carried on between the two telephones through said repeater.

5. In a telephone system, an automatic progressively movable switch, a trunk line, a voice current repeater for said trunk line having means for amplifying and repeating voice currents in either direction over said trunk line, means for operating said automatic switch over said trunk line to establish a talking circuit, and means for inserting said repeater in said trunk line after said switch has been fully operated.

6. In a telephone system, an automatic progressively movable switch, a trunk line, a voice current repeater for said trunk line having means for amplifying and repeating voice currents in either direction over said trunk line, means for operating said automatic switch over said trunk line, a bridge across said trunk line for holding said switch in its operated position, and means for in-

serting said repeater in said trunk line after said switch has been operated.

7. In a telephone system, calling and called lines, automatic switches, a trunk line, means for transmitting electrical impulses over said trunk to operate said switches to thereby establish a talking connection between said lines, a voice current repeater adapted to amplify and repeat voice currents in either direction over said trunk, and automatic means for inserting said repeater in said trunk after the connection has been established.

8. In a telephone system, calling and called lines, automatic switches, a trunk line, means for transmitting electrical impulses over said trunk to operate said switches to thereby establish a talking connection between said lines, a voice current repeater adapted to amplify and repeat voice currents in either direction over said trunk, and subscriber controlled means for inserting said repeater in said trunk after the connection has been established.

9. In a telephone system, a trunk line, automatic progressively movable switches controlled over a calling line to establish a connection with a called line via said trunk line, a voice current repeater associated with said trunk line, and means for inserting said repeater in said trunk line after the switches are fully operated, whereby the voice currents from either the calling or the called line are amplified and repeated to the called or calling line, respectively.

10. In a telephone system, an automatic progressively movable switch, a trunk line leading to said switch, means for seizing said trunk line and for operating said switch thereover to establish a talking connection between two telephones, a voice current repeater for amplifying and repeating voice currents in either direction between said telephones, and automatic means for inserting said repeater in said trunk line for said purpose after said switch is fully operated.

11. In a telephone system, a called line, an automatic switch, a trunk line leading to said switch, means for seizing said trunk line and for operating said switch thereover to establish a talking connection between the called line and a calling line, a voice current repeater for amplifying and repeating voice currents in either direction between said lines, means controlled by the called subscriber for reversing the direction of current in the trunk line, and means in said trunk line responsive to said current reversal to insert said repeater in said trunk line for said purpose.

12. In a telephone system, a first exchange, a second exchange, a trunk line connecting the two, a voice current repeater associated with said trunk line, means for reversing the current flow over said trunk line and means controlled by said reversal for inserting said repeater in the trunk.

13. In a telephone system, lines, an amplifying voice current repeater, means for establishing a connection between two of said lines including a series of automatic switches and a repeater for repeating impulses from one switch to the other, together with means for substituting said voice current repeater for said impulse repeater in said connection.

14. In a telephone system, lines, an amplifying voice current repeater, means for establishing a connection between two of said lines including a series of automatic switches and a repeater for repeating impulses from one switch to the other, together with means controlled by the called subscriber for substituting said voice current repeater for said impulse repeater in said connection.

15. In a telephone system, means for establishing a talking circuit between two lines, said means including a series of automatic progressively movable trunking switches and a trunk line having an impulse repeater included therein having bridges across said trunk and condensers one in each side thereof, a voice current repeater, and means controlled by the subscriber on the called line for disconnecting the condensers of said impulse repeater from the talking circuit and substituting said voice current repeater therefor.

16. In a telephone system, a voice current repeater, means for establishing a talking circuit between two lines, an impulse repeater included in said circuit, means controlled by the subscriber on the called line for reversing the current flow in said circuit, and means in said impulse repeater responsive to said reversal of current to insert said voice current repeater in the talking circuit.

17. In a telephone system, lines, an amplifying voice current repeater, means including a series of automatic switches for establishing an inductive connection between two of said lines, and means for substituting said voice current repeater for said inductive connection.

18. In a telephone system, an automatic progressively movable switch, a trunk line, a voice current repeater for said trunk line having means for amplifying and repeating voice current in either direction over said trunk line, means for operating said automatic switch over said trunk line to complete an inductive connection between a calling and a called line, and means rendered operative by the response of a called subscriber for substituting said repeater for the inductive connection.

19. In a telephone system, a first exchange, a second exchange, a trunk line comprising

two inductively connected sections, an amplifying voice current repeater associated with said trunk line, and means controlled over said trunk line for substituting said voice current repeater for the inductive connection.

20. In a telephone system, calling and called subscribers' lines, an amplifying voice current repeater, means including a series of automatic switches for establishing an inductive connection between said lines, and means for automatically substituting said voice current repeater for said inductive connection.

21. In a telephone system, calling and called subscribers' lines, an amplifying voice current repeater, means including a series of automatic switches for establishing an inductive connection between said lines, and means controlled by the called subscriber for causing said voice current repeater to be substituted for the inductive connection.

22. In a telephone system, a trunk line divided into two inductively connected sections, a voice current amplifying repeater, and means for substituting said repeater for said inductive connection.

23. In a telephone system, calling and called subscribers' lines, an amplifying voice current repeater, means including a series of automatic switches for establishing an inductive connection between said lines, and means controlled over one of said lines for causing said voice current repeater to be substituted for the inductive connection.

Signed by me at Chicago, Cook County, Illinois, this 30th day of April, 1919.

JOHN H. HOMRIGHOUS.