

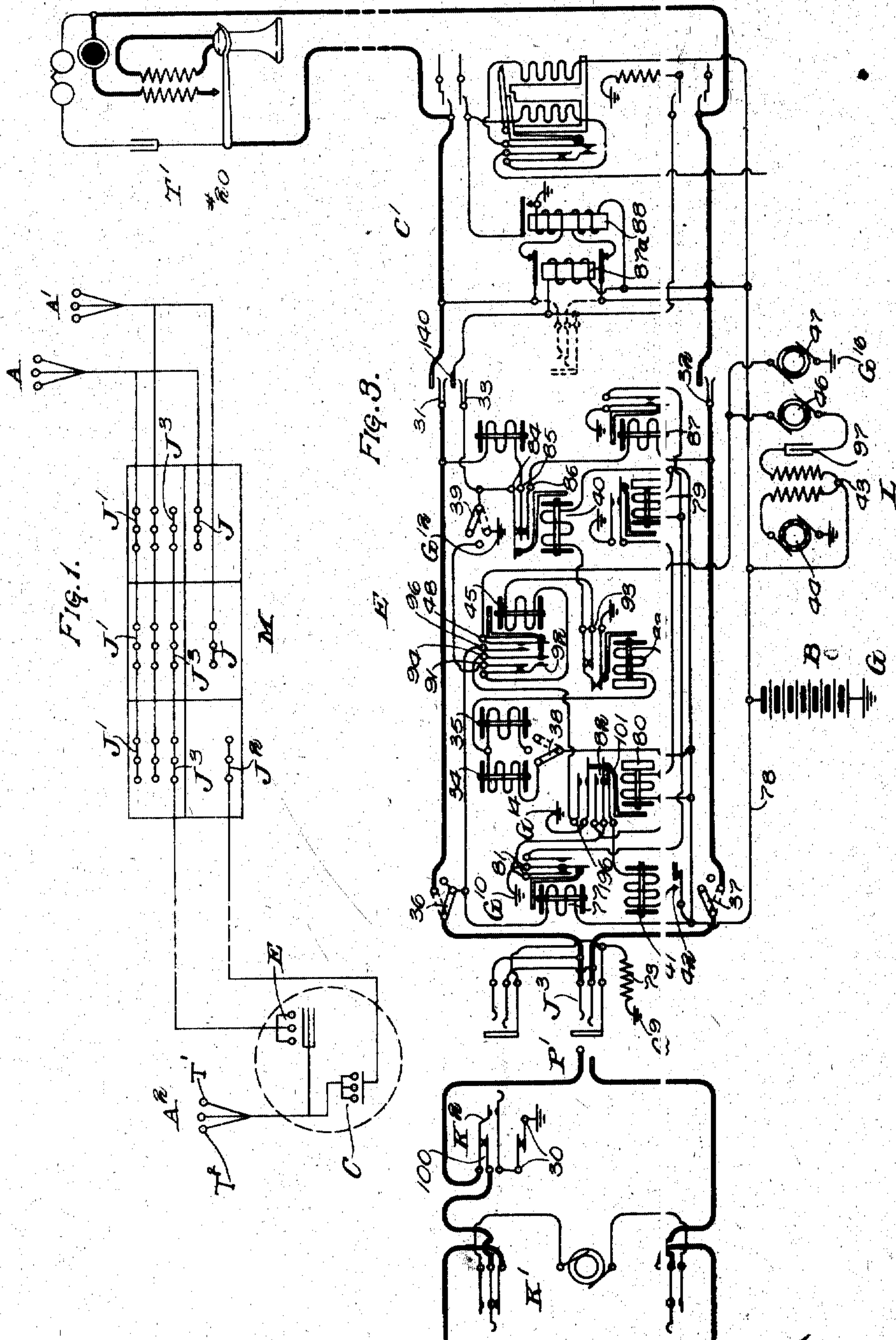
T. G. MARTIN.
TELEPHONE SYSTEM.

APPLICATION FILED MAR. 17, 1913.

Patented Mar. 20, 1917.

2 SHEETS—SHEET 1.

1,219,656.



WITNESSES

Arthur J. Ray
Edward H. Hall

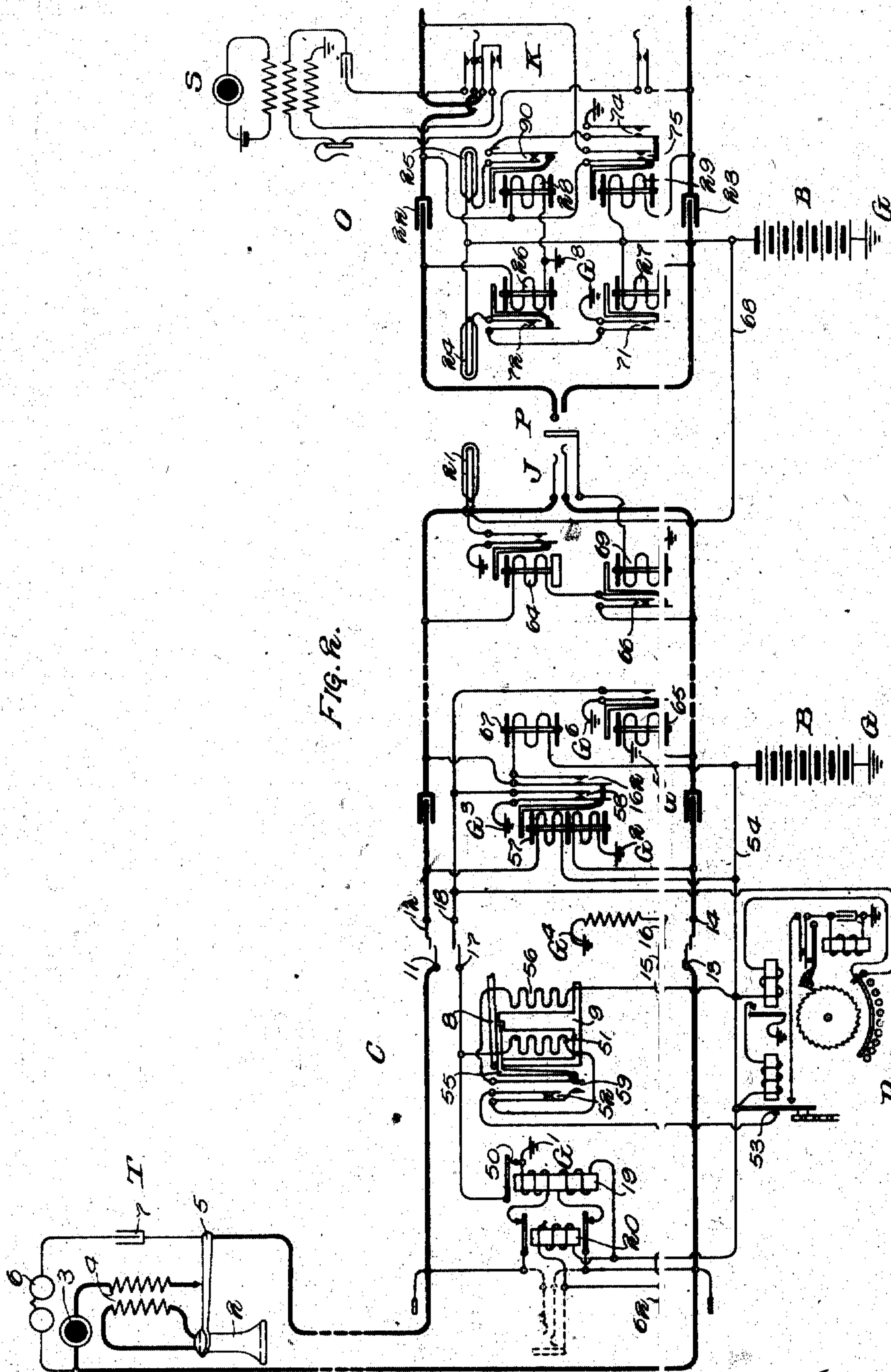
INVENTOR

T. G. Martin
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Arthur J. Ray
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UNITED STATES PATENT OFFICE.

TALBOT G. MARTIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

1,219,656.

Specification of Letters Patent.

Patented Mar. 20, 1917.

Application filed March 17, 1913. Serial No. 754,801.

To all whom it may concern:

Be it known that I, TALBOT G. MARTIN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification:

My invention relates to improvements in telephone systems, and more particularly to a system of the semi-automatic type—that is, a system in which both manual and automatic means are employed in establishing a connection between a calling and a called subscriber's line. In such systems, when an operator connects with the called line through the medium of an automatic switch, it has heretofore been customary to provide means for transmitting a busy signal back over the calling line in case the called line was busy. In such instances, however, the operator would not receive such busy signal unless she operated her listening key so as to connect her talking and listening set with the talking circuit.

An object of my invention is to give to the operator a busy signal the operation of which is not dependent upon any special act of the operator, such as the operating of her listening key as in former practice.

More specifically, my invention relates to the provision of means for giving this busy signal by causing a periodic flashing of the calling supervisory lamp of the cord circuit when the connector switch lands on a busy line.

A further feature of my invention relates to an improved arrangement of the individual line equipment. By this feature the line switch, which is individual to a subscriber's line, comprises only an actuating magnet, but has no line or cut-off relays. Associated with each line, however, there are separate and distinct relays, one a line relay and the other a cut-off relay, which are similar to the line and cut-off relays of the well-known manual systems. The object of this arrangement is to provide a simple and economical manner in which a manual line can be converted into an automatic or a semi-automatic line, as in the present arrangement the same line and cut-off relays that were used in the manual system may be used in the automatic or semi-automatic system.

A still further feature of my invention is

the improved arrangement of the connector switch which is employed to connect with the subscriber's line. This connector switch is provided with but a single line relay which is controlled by impulses over one side of the line only, which line relay controls both the vertical and rotary motions of the switch.

These and other objects of my invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 represents diagrammatically the lay-out of a telephone system embodying the principles of my invention.

Figs. 2 and 3 taken together represent diagrammatically the apparatus by which a connection may be established between a calling telephone T (Fig. 2) and a called telephone T' (Fig. 3).

In Fig. 1 there is represented a manual telephone switchboard M, together with two groups of telephones A and A', each of which groups is provided at the switchboard M with a group of answering jacks J on one operator's position and a group of multiple jacks J' on other operators' positions. At A² there is shown a group of lines which, instead of terminating in answering jacks on the central office switchboard, terminate in automatic trunk-selecting switches C, by means of which switches idle trunk lines leading to answering jacks J² may be selected. These subscribers' lines A², instead of being provided with the usual multiple jacks for being called, are provided with multiple calling terminals in a plurality of automatic connector switches E, which switches are connected with the central office switchboard by means of trunk lines which terminate in multiple jacks J³.

The apparatus shown in Figs. 2 and 3 is the apparatus brought into use when a connection is made between two telephones of the group A² which are associated with the branch office. The substations T and T' are ordinary common battery manual substations comprising a receiver 2, transmitter 3, induction coil 4, switch hook 5, ringer 6 and condenser 7. The trunk-selecting switch C is of the general type of trunk-selecting switch shown and described in British Patent to R. W. James No. 26,301 of 1906 and British Patent to T. G. Martin No. 1,419 of 1910. As shown herein, this switch comprises among other details a plunger (not shown) attached to the end of a so-called

plunger arm 8 which, when attracted by an electromagnet 9, thrusts said plunger into some one of a plurality of groups of contact springs 11, 12, 13, 14, 15, 16, 17 and 18, each of which groups forms the terminal of a trunk line leading to a jack J at the manual switchboard. The plungers of a group of line switches C are controlled by a master switch D in such a manner that said plungers, when idle, always stand opposite the terminal of an idle trunk line. The master switch D is of the well-known type fully described in said British Patent No. 1419 of 1910. In addition to the line switch C there is allotted to the line of the substation T a line relay 19 and a cut-off relay 20. These line and cut-off relays are similar to the line and cut-off relays of a well-known manual telephone system. In fact, when it is desired to convert a manual line of this character into a semi-automatic line of the character shown herein, or into a full automatic line, it is only necessary to remove the usual jacks and line lamp from said line and add the trunking switch C, which, unlike the usual trunking switches, has no line or cut-off relays. In this manner the line and cut-off relays which were used in the manual system may be very readily used in an automatic or semi-automatic system.

Allotted to the trunk line leading to the jack J there are a line lamp 21 and a plurality of circuit-controlling relays, the operation of which will be hereinafter fully described.

At O there is shown an operator's cord circuit comprising a pair of plugs P and P' connected together through the usual cord strands including the condensers 22 and 23. The usual answering and calling supervisory lamps 24 and 25 are controlled through the medium of the supervisory relays 26, 27, 28 and 29 in a manner which will be fully described. At K and K' are shown the usual listening and ringing keys. At K² there is shown a key by means of which an automatic calling device may be connected with one side of the cord circuit. This calling device may be of any suitable type and is herein represented simply by a pair of springs 30 which may be momentarily separated any number of times desired to call any digit. At E there is represented a connector switch which is of the general type of connector switch shown and described in United States Letters Patent No. 815,176, issued March 13, 1906, to Keith, Erickson and Erickson. This connector comprises essentially a set of wipers 31, 32 and 33 carried upon a rotatably and vertically movable shaft (not shown), the movements of which shaft are controlled by the so-called vertical and rotary magnets 34 and 35. The usual side switch comprising the wipers 36, 37, 38 and 39 is controlled by the private

magnet 40 in a well-known manner. The usual release magnet 41 is adapted to be connected with the battery through a contact 42 which is closed only when the switch shaft is not in normal position. Unlike the usual connector switch, the switch E has no ringing relay, the ringing current being supplied to the called line from the operator's cord O, just as in an ordinary manual system. At L there is shown a busy signaling machine comprising an induction coil 43 and an interrupter 44. The secondary winding of the induction coil 43 is adapted to be intermittently connected with a spring of the relay 45 through the medium of a second interrupter 46 which has a comparatively low period of interruption. At 47 there is shown a third interrupter which connects the spring 48 to ground during the periods in which the induction coil 43 is disconnected from said spring by the interrupter 46. It is to be understood, of course, that the busy signaling machine and interrupters are represented herein only diagrammatically, and that it is within the scope of my invention to employ any suitable and known type of busy signaling machine and interrupter.

The line switch C' and substation T' are in all respects the same as the line switch C and substation T shown in Fig. 2.

In the drawings there is shown a plurality of batteries B for supplying the necessary current for the operation of the system. If desired, only one battery need be used, or, preferably, one battery in each exchange when the apparatus is situated in two or more separate exchanges.

Having given a general description of the apparatus, it will now be explained how a connection is extended from the substation T to the substation T'. The subscriber at the substation T, upon removing his receiver from the switch hook, closes the circuit of the line relay 19 in the usual manner. The relay 19, upon energizing, closes a circuit extending from ground G' through the contact 50, winding 51 of the magnet 9, contact 52 and the contact 53 to the battery lead 54, thence through the battery B to ground G. The winding 51, upon energizing, attracts the plunger arm 8 and armature 55. The armature 55 operates to insert the winding 56 in series with the winding 51, so as to reduce the current consumption of the switch after it has been once operated. The plunger arm 8, upon being attracted, operates to cause its plunger to force the springs 11, 12, 13, 14, 15, 16, 17 and 18 into contact in pairs. The engagement of the springs 11 and 13 with the springs 12 and 14 extends the line connection to the jack J and closes an energizing circuit for the relay 57. The circuit for the relay 20 is closed by the engagement

of springs 15 and 16 and extends from the battery lead 54 through the relay 20 and the springs 15 and 16 to ground G^4 . The circuit for the relay 57 extends from ground G^2 through the lower winding of said relay, springs 14 and 13, telephone T, back over the other side of the line, through the springs 11 and 12 and the upper winding of the relay 57 to the battery lead 54. The closure of the contact 58 by the energization of the relay 57 provides a holding circuit for the switch C, which circuit extends from ground G^3 through said contact 58, springs 18 and 17, winding 51, contact 59 and the winding 56 to the battery lead 54. This circuit maintains the switch C in its operated position after its original energizing circuit is broken by the deenergization of the line relay 19, which is disconnected from the line by the energization of the cut-off relay when the springs 16 and 15 are forced into contact by the plunger of the switch. The engagement of the springs 15 and 16 not only closes an energizing circuit for the cut-off relay 20, but extends a guarding potential from ground G^4 to the connector private bank contact 62 of the calling line in the banks of all connectors which have access to it. By the closure of the contact 162 of the relay 57 a circuit is closed through the line signal relay 64 at the jack J. This circuit extends from ground G^5 through the relay 65, contact 66, relay 64, contact 162 and impedance coil 67 to the battery B. The relay 64, upon energizing, closes the circuit of the line lamp 21. The relay 65, which is included in the circuit just traced, is also energized and provides another holding ground from ground G^6 for the switch C. After the line switch C has operated, as above explained, to connect the calling line with an idle trunk line, the master switch D operates in a well-known manner to advance the plungers of the idle line switches to a position in front of the next idle trunk line. Upon noting the signal displayed by the lamp 21 the operator inserts the plug P of the cord O into the jack J, throws the listening key K to bridge the talking set S across the cord O and inquires the number of the station desired. Upon the insertion of the plug P into the jack J a circuit is closed extending from the battery lead 68 at the cord O through the relay 27 to the sleeve of the plug P, thence to the sleeve and ring conductors of the jack J and through the relays 69 and 65 in multiple to ground. The relay 69, upon energizing, opens the circuit of the signal relay 64. The relay 27 of the cord, upon energizing, closes the contact 71 in the circuit of the lamp 24, but said lamp is not lighted because at practically the same time its circuit is broken by the opening of the contact 72 of the relay 26, which is ener-

gized over a circuit extending from ground G^8 through said relay, tip of the plug P and jack J, contact 162 and impedance coil 67.

After ascertaining the number of the substation desired, and on finding that it is a station of the semi-automatic branch office, the operator inserts the plug P' into a jack J³ of an idle trunk line leading to a connector switch E. Upon the engagement of the sleeve of the plug with the sleeve of the jack a circuit is closed extending from ground G^9 through the resistance 73, sleeve of the jack and plug and through the supervisory relay 29 of the cord to the battery lead 68. The relay 29, upon energizing closes the contact 74 in the circuit of the lamp 25 and bridges the listening key contact in the tip side of the cord by the contact 75. The relay 28 is energized over a circuit extending from ground G^8 through the said relay, tip of the plug P', jack J³ and the relay 77 to the battery lead 78. The relay 77, upon energizing, closes a circuit through the slow acting relay 79. The relay 79, upon energizing, closes the circuit of a second slow acting relay 80. The operator now operates the key K², whereby the relay 28 is disconnected from the tip side of the plug P' and a connection is completed to ground through the calling device springs 30 without interrupting the circuit of the connector line relay 77. The operator now operates her calling device for the successive digits of the number of the substation T', which will be assumed to be 20. Upon the operation of the calling device for the first digit 2 the impulse springs 30 are opened twice momentarily, causing the connector line relay 77 to be momentarily deenergized twice. Since the relay 79 is slow acting, it does not have time to deenergize during the momentary interruption of its circuit by the relay 77, and, therefore, each time said relay 77 deenergizes a circuit is closed from ground G^{10} through the contact 81, contact 82, relay 83, vertical magnet 34 and side switch wiper 38 to the battery lead 78. The magnet 34 operates in response to the two impulses received over this circuit to raise the wipers of the switch E to a position opposite the second row or level of its bank contacts. The relay 83, which is included in circuit in series with the magnet 34, is a slow acting relay and remains in its energized position to close the circuit of the private magnet 40 during the entire time the impulses are being transmitted. After the last impulse is delivered the relay 83 deenergizes and breaks the circuit of the private magnet 40, allowing it to deenergize to trip the side switch to second position. The side switch wiper 38, in moving from first to second position, disconnects the battery from the vertical magnet 34 and establishes a battery connection

for the rotary magnet 35. The operator now operates her calling device for the second digit O, whereby the connector line relay 77 is momentarily deenergized ten times. Each time the relay 77 deenergizes in this instance an impulse is transmitted through the relay 83 and the rotary magnet 35. The rotary magnet operates in response to these impulses to rotate the wipers 31, 32 and 33 ten steps onto the contacts of the called line, after which the relay 83 operates in the same manner as for the previous digit to cause the private magnet 40 to advance the side switch a second step—that is, from second to third position—providing the called line is idle. The side switch wiper 39, upon passing to third position, closes an energizing circuit through the cut-off relay 87^a of the called line, said circuit extending from ground G¹² through said side switch wiper, private wiper 33, bank contact 140 and the relay 87^a to the battery lead 78. The relay 87^a, upon energizing, disconnects the line relay 88 from the line in the usual manner. The side switch wipers 36 and 37, upon passing to third position, complete the line connection through the cord to the called line and the wiper 36 cuts off the line relay 77. As soon as the side switch wiper 37 engages its third-position contact a circuit is closed extending from ground G¹² through the side switch wiper 39, springs 84, 85 and 86, relay 87, side switch wiper 37, jack J³, plug P' and the relay 29 in the cord O to the battery lead 68. The relay 87, upon energizing, provides a new holding circuit for the relay 79 after its former energizing circuit is broken by the deenergization of the line relay 77. After calling the last digit the operator at the cord O restores the key K² and operates the ringing key K' in the usual manner to ring the called subscriber. Upon the response of the called subscriber his telephone is supplied with talking current through the supervisory relays 28 and 29 in the cord O in the usual manner. The relay 28 now energizes for the first time since it was disconnected by the calling device key K², and by opening the contact 90 breaks the circuit of the lamp 25 to signify to the operator that the called subscriber has answered.

In the above description it has been assumed that the called line was idle at the time the connector E attempted to make connection therewith. If said line had been busy no connection could have been made therewith, and the calling subscriber and the operator would have been given a busy signal in the following manner: Whenever a line is busy, either on account of having made a call or on account of having been called, there is a guarding ground potential upon its connector private bank contact. Assuming that there is a ground potential upon the contact 140 at the time when the

wiper 33 is brought into engagement therewith, it will be seen that, since the side switch is then in second position, said ground potential is extended through said wiper 33, side switch wiper 39, springs 91 and 92 and the relay 45 to the spring 93 of the private magnet relay 83. This being the case, the circuit of the private magnet is not broken when the relay 83 deenergizes after the last digit is called, but said magnet becomes included in a locking circuit in series with the relay 45. Since the private magnet 40 does not deenergize, the side switch remains locked in second position and the connection between the calling and the called lines is maintained open at the side switch wipers 36 and 37. The relay 45, upon energizing, transfers the holding ground for itself and the private magnet 40 from the guarded private bank contact of the busy line to the ground G¹⁴ by way of the springs 92, 94 and 196. Upon the closure of the contact between the springs 48 and 96 by the relay 45, the busy signaling machine L is connected with one side of the cord O and the calling line through the side switch wiper 36. By means of the interrupters 46 and 47 the busy signaling machine and the ground G¹⁶ are alternately connected with the line. Each time the busy signaling machine is connected with the line, busy signaling current is transmitted to the calling substation over a circuit extending from the battery lead 78 through the secondary winding of the induction coil 43, condenser 97, interrupter 46, springs 48 and 96, side switch wiper 36, jack J³, plug P', contact 100 (the key K² having been released as soon as the last digit was called), thence over the heavy conductors to and through the calling substation and back over the other side of the line, through the various relays connected thereto to ground, and thence through the battery to the battery lead 78. This busy signaling current is sufficient to notify the calling subscriber that the called line is busy, but unless the operator should operate her listening key K this signal gives her no indication of the fact. It will be seen, however, that at the cord circuit the circuits of both the relays 28 and 29 are closed, as was described when the plug P' was first inserted into the jack J³. When, however, the interrupter 47 (Fig. 3) comes into position to ground the tip side of the trunk it short-circuits the relay 28 at the cord circuit. The relay 28 thereupon deenergizes and closes the circuit of the lamp 25. It will thus be seen that as long as the connector switch remains locked in this busy position, the lamp 25 will be periodically flashed, which serves as a visual signal to the operator that the called line is busy and that connection has not been completed therewith.

Upon the termination of the conversation

the operator is given the usual disconnect signals by the hanging up of the receivers at the calling and called substations in the following manner: When the receiver at the calling substation T is replaced upon the switch hook the circuit of the relay 57 is broken. The relay 57, upon deenergizing, breaks the circuit of its cord supervisory relay 26 at the contact 162. The relay 27 in the cord, however, remains energized through the relays 65 and 69, and therefore, when the contact 72 is closed by the deenergization of the relay 26, the circuit of the answering supervisory lamp 24 is closed. When the receiver at the called substation T' is hung up the energizing circuit of the relay 28 in the cord circuit is broken, while the relay 29 remains energized through the resistance 73 at the jack J³ and through the relay 87 at the connector E. The relay 28, upon deenergizing, therefore completes the circuit of the calling supervisory lamp 25 at the contact 90. All the automatic apparatus employed in the connection is released upon the removal of the plugs from the jacks by the operator. Upon the removal of the answering plug P from the jack J the circuits of the relays 27, 69 and 65 are broken. The relay 65, upon deenergizing, destroys the holding circuit of the switch C, since the relay 57 has already deenergized and disconnected the ground G³. Upon the interruption of its holding circuit the magnet 9 deenergizes and permits the plunger to be withdrawn from its bank to disconnect the calling line from the jack J. Upon the removal of the calling plug P' from the jack J³ by the operator the circuit of the relay 29 in the cord and the relay 87 in the connector is broken. Upon the deenergization of the relay 87 in the connector the circuit of the relay 79 is broken, which latter relay, upon energizing, in turn breaks the circuit of the relay 80. The relay 80, upon deenergizing, completes the circuit of the release magnet 41, said circuit extending from ground G¹⁰ through the contact 81 of the line relay, contact 101 of the relay 80, magnet 41 and the contact 42 to the battery lead 78. The magnet 41, upon energizing, immediately restores the connector switch to its normal position, and when the shaft of said switch reaches its lowest position it opens the contact 42, whereby the release magnet 41 is permitted to deenergize.

It will thus be seen that I have devised very efficient means for indicating to an operator the fact that a called line is busy. While I have illustrated this invention in connection with a semi-automatic telephone system, it will, of course, be understood that in certain broader aspects my invention is not limited to such a system, but that certain features might be useful in connection with a manual system. Furthermore, in connection with the improvements which I have

made in the line switch and the connector switch, it is, of course, understood that these features are equally as well adapted for use in connection with a full automatic system—that is, a system in which a connection is established wholly by automatic means. Various other modifications will readily suggest themselves to those skilled in the art.

What I claim as my invention is:—

1. In a telephone system, a calling and a called subscriber's line, means including an operator's cord circuit for establishing a connection between said lines, means for giving the calling subscriber an audible signal, a visual signal for indicating to the operator that the called line is busy, separate operating circuits for said signals, and an automatic progressively movable switch for testing the called line, said signals operated alternately.
2. In a telephone system, a calling and a called subscriber's line, means including an operator's cord circuit for establishing a connection between said lines, means for giving the calling subscriber a signal when the called line is busy, a separate signal for indicating to the operator that the called line is busy, separate operating circuits for said signals, and an automatic progressively movable switch for testing the called line, said signals operated alternately.
3. In a telephone system, a calling and a called subscriber's line, means including an operator's cord circuit for establishing a connection between said lines, a supervisory lamp in said cord circuit, means for giving the calling subscriber an audible signal when the called line is busy, means for operating said supervisory lamp to indicate to the operator that the called line is busy, and separate operating circuits for operating said busy signals alternately.
4. In a telephone system, a calling and a called subscriber's line, means including an operator's cord circuit for establishing a connection between said lines, a supervisory circuit in said cord circuit comprising a lamp whereby the operator may supervise said connection, means for intermittently operating said lamp to indicate that the called line is busy, and a separate busy signaling circuit, said signals operated alternately.
5. In a telephone system, a called line, an operator's cord circuit, a connector switch adapted to be connected with said cord circuit, means for controlling said connector switch to extend the connection to said called line, and means comprising a circuit for giving said operator a visual signal if the called line is busy, and a separate busy signaling circuit, said signals operated alternately.
6. In a telephone system, a called line, an operator's cord circuit, an automatic switch

adapted to be connected therewith, means for controlling said switch to extend a connection to said called line, a circuit in said cord circuit comprising a lamp, means for intermittently operating said lamp if the called line is busy, and a separate busy signaling circuit, said signals operated alternately.

7. In a telephone system, a calling and a called subscriber's line, means including a cord circuit for establishing a connection between said lines, a supervisory relay in said cord circuit, means for energizing said relay, means for intermittently shunting said relay when the called line is busy, and a signal controlled by said relay.

8. In a telephone system, a calling and a called subscriber's line, means including an operator's cord circuit for establishing a connection between said lines, a pair of relays bridged across said cord circuit, a supervisory signal controlled by the conjoint action of said relays, means for energizing both of said relays, and means for intermittently short-circuiting one of said relays when the called line is busy to thereby intermittently operate said signal.

9. In a telephone system, a calling and a called subscriber's line, means for establishing a connection between said lines, means including two separate circuits for giving two distinct busy signals when the called line is busy, and an automatic progressively movable switch for testing the called line, said signals operated alternately.

10. In a telephone system, a calling and a called subscriber's line, means for extending a connection from said calling line to said called line, a busy signal machine for sending an interrupted signal to said calling subscriber when an attempt is made to establish connection with a busy called line, means for grounding the line between said interruptions, and a visual busy signal controlled by said grounding.

11. In a telephone system, a calling and a called subscriber's line, means including an operator's cord circuit and an automatic switch for extending a connection from said calling line to the called line, a busy signaling machine associated with said switch for transmitting a busy signal back over the line through said cord circuit to the calling line, an interrupter associated with said busy signaling machine for intermittently interrupting said busy signaling current, a second interrupter for grounding the line between the periods of busy signaling current, and a signal at said cord circuit operated by the grounding of said line to thereby give a busy signal to said operator.

12. In a telephone system, a called line, a cord circuit, an automatic switch controllable through said cord circuit for establishing a connection with said line, a relay in

said cord adapted to be energized when connection is established between said cord circuit and said switch, means for short-circuiting said relay when an attempt is made to establish a connection with a busy line to thereby deenergize said relay, and a signal controlled by the deenergization of said relay.

13. In a telephone system, a calling and a called line, means including a cord circuit, an automatic switch adapted to be connected thereto for extending a connection from the calling to the called line, a pair of relays in said cord circuit, means for energizing said relays when said cord circuit is connected with said automatic switch, means for intermittently short-circuiting one of said relays when an attempt is made to connect with a busy called line, whereby said relay is deenergized, and a signal displayed by the deenergization of said relay.

14. In a telephone system, a calling and a called subscriber's line, means including a cord circuit, an automatic switch adapted to be connected thereto for extending a connection from the calling to the called line, a busy signaling machine for transmitting signaling current over one side of said cord circuit back to the calling line, an interrupter for intermittently interrupting said busy signaling current, a second interrupter for grounding the same side of the cord between the impulses of signaling current, a relay in said cord circuit adapted to be energized when connection is made between the cord and said switch, said relay adapted to be deenergized when the side of the cord circuit is grounded through said second interrupter, and a signal controlled by the deenergization of said relay.

15. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having one motion to select groups and a second motion to find the called line in the selected group, means comprising a circuit for giving the operator a visual signal if the called line is busy, and a separate busy signaling circuit, said signals operated alternately.

16. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having one motion to select groups and a second motion to find the called line in the selected group, a circuit including a lamp, in said cord circuit, means for intermittently operating said lamp if the connector attempts to make connection with a called line which is busy, and a separate busy signaling circuit, said signals operated alternately.

17. In a telephone system, subscribers'

lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having one motion to select groups and a second motion to find the called line in the selected group, an operator's talking set associated with said cord circuit, a switch for connecting and disconnecting said set from said cord circuit, and means comprising a circuit operating irrespective of the position of said switch for indicating to the operator that the called line is busy, and a separate busy signaling circuit, said signals operated alternately.

18. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having one motion to select groups and a second motion to find the called line in the selected group, and means for giving two distinct busy signals when the connector attempts to make connection with a called line which is busy, said signals operated alternately.

19. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having one motion to select groups and a second motion to find the called line in the selected group, a busy signaling machine associated with said connector for transmitting a busy signal back over the line through said cord circuit to the calling line, an interrupter associated with said busy signaling machine for intermittently interrupting said busy signaling current, a second interrupter for grounding the line between the periods of busy signaling current, and a signal at said cord circuit operated by the grounding of said line to thereby give a busy signal to said operator.

20. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having one motion to select groups and a second motion to find the called line in the selected group, a relay in said cord adapted to be energized when connection is established between said cord circuit and said switch, means for short-circuiting said relay when an attempt is made to establish a connection with a busy line to thereby deenergize said relay, and a signal controlled by the deenergization of said relay.

21. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch hav-

ing one motion to select groups and a second motion to find the called line in the selected group, a pair of relays in said cord circuit, means for energizing said relays when said cord circuit is connected with said automatic switch, means for intermittently short-circuiting one of said relays when an attempt is made to connect with a busy called line, whereby said relay is deenergized, and a signal displayed by the deenergization of said relay.

22. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having one motion to select groups and a second motion to find the called line in the selected group, a busy signaling machine for transmitting signaling current over one side of said cord circuit back to the calling line, an interrupter for intermittently interrupting said busy signaling current, a second interrupter for grounding the same side of the cord between the impulses of signaling current, a relay in said cord circuit adapted to be energized when connection is made between the cord and said connector, said relay adapted to be deenergized when the side of the cord circuit is grounded through said second interrupter, and a signal controlled by the deenergization of said relay.

23. In a telephone system, calling and called subscribers' lines, means including an automatic switch having two separate selecting motions for establishing a connection between said lines, and a relay in said switch controlled by ground impulses over one side of the line only for controlling the two motions of said switch.

24. In a telephone system, an automatic switch having vertical and rotary motions, and a single line relay for successively controlling both motions, one terminal of the relay being connected to one side of the line, and the other terminal being connected to battery.

25. In a telephone system, an automatic switch, a trunk line extending to said switch, a relay in said switch, means for energizing said relay over one side of said trunk line and ground, and means for intermittently breaking the circuit of said relay, said switch having motion in two intersecting planes, both controlled by said relay.

26. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of

said switch, and means for giving the operator a visual signal if the called line is busy.

27. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, a lamp in said cord circuit, and means for intermittently operating said lamp if the connector attempts to make connection with a called line which is busy.

28. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, a supervisory signal in said cord-circuit, means for displaying said signal when a called subscriber responds after connection has been established with an idle called line, and means for displaying said signal if the connector attempts to make connection with a called line which is busy.

29. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, a supervisory signal in said cord circuit, means for displaying said signal when a called subscriber responds after connection has been established with an idle called line, and means for intermittently displaying said signal if the connector attempts to make connection with a called line which is busy.

30. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two mo-

tions of said switch, an operator's set normally disconnected from said cord circuit, a key switch for connecting said set with said cord circuit, and means independent of said set for giving a signal to the operator if the called line is busy.

31. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, an operator's talking set associated with said cord circuit, a switch for connecting and disconnecting said set from said cord circuit, and means operating irrespective of the position of said switch for indicating to the operator that the called line is busy.

32. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, and means for giving two distinct busy signals when the connector attempts to make connection with a called line which is busy.

33. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, a busy signaling machine associated with said connector for transmitting a busy signal back over the line through said cord circuit to the calling line, an interrupter associated with said busy signaling machine for intermittently interrupting said busy signaling current, a second interrupter for grounding the line between the periods of busy signaling current, and a signal at said cord circuit operated by the grounding of said line to thereby give a busy signal to said operator.

34. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch hav-

ing motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, a relay in said cord adapted to be energized when connection is established between said cord circuit and said switch, means for short-circuiting said relay when an attempt is made to establish a connection with a busy line to thereby deenergize said relay, and a signal controlled by the deenergization of said relay.

35. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, a pair of relays in said cord circuit, means for energizing said relays when said cord circuit is connected with said automatic switch, means for intermittently short-circuiting one of said relays when an attempt is made to connect with a busy called line, whereby said relay is deenergized, and a signal displayed by the deenergization of said relay.

36. In a telephone system, subscribers' lines divided into groups, means including an operator's cord circuit and a connector switch for establishing a connection between two of said lines, said connector switch having motion in one plane to select groups and motion in a plane at right-angles thereto to find the called line in the selected group, a relay controlled by ground impulses over one side of a line for controlling two motions of said switch, a busy signaling machine for transmitting signaling current over one side of said cord circuit back to the calling line, an interrupter for intermittently interrupting said busy signaling current, a second interrupter for grounding the same side of the cord between the impulses of signaling current, a relay in said cord circuit adapted to be energized when connection is made between the cord and said connector, said relay adapted to be deenergized when the side of the cord circuit is grounded through said second interrupter, and a signal controlled by the deenergization of said relay.

37. In a telephone system a calling and a called line, means including an operator's cord circuit for establishing connection between said lines, said means including also an automatic progressively movable switch between the cord circuit and the called line, means for giving the calling subscriber an

audible signal, a visual signal for indicating to the operator that the called line is busy, and separate operating circuits for operating said signals alternately.

38. In a telephone system, a calling and a called line, means including an operator's cord circuit for establishing connection between said lines, said means including also an automatic progressively movable switch between the cord circuit and the called line, means for giving the calling subscriber a signal when the called line is busy, another signal for indicating to the operator that the called line is busy, and separate operating circuits for operating said signals alternately.

39. In a telephone system, a calling and a called subscriber's line, means including an operator's cord circuit for establishing a connection between said lines, a supervisory lamp in said cord circuit, means for giving the calling subscriber an audible signal when the called line is busy, means for operating said supervisory lamp to indicate to the operator that the called line is busy, said signal and lamp operated alternately over separate circuits, and an automatic progressively movable switch for testing the called line.

40. In a telephone system, a talking circuit for connecting a calling and a called line, means for testing the called line, and means responsive thereto for operating two signals alternately over the talking circuit.

41. In a telephone system, a talking circuit for connecting a calling and a called line, means for testing the called line, and means responsive thereto for operating two signals alternately over the talking circuit, one signal on the calling line and one in the central office.

42. In a telephone system, a calling line, a called line, a link for connecting the two lines in a talking circuit, a signal individual to the calling line, and one individual to the link, a busy test circuit for the called line and means controlled thereover for operating the two signals alternately.

43. In a telephone system, a calling line, a called line, a link for connecting the two lines in a talking circuit, a signal individual to the calling line, and one individual to the link, a busy test circuit for the called line and means controlled thereover for operating the two signals alternately, one over the line circuit and the other over the local circuit.

44. In a telephone system, a calling line, a called line, a link for connecting the two lines in a talking circuit, a signal individual to the calling line, and one individual to the link, a busy test circuit for the called line and means controlled thereover for operating the two signals alternately, one over the

line circuit and the other over the local circuit, both over a section of the talking circuit.

45. In a telephone system, a calling line, 5
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for the called line
and means controlled thereover for operat-
10 ing the two signals, said means including a
relay and a circuit for directly operating
one of the signals, said circuit under the control of the relay.

46. In a telephone system, a calling line, 15
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for the called line
and means controlled thereover for operat-
20 ing the two signals, said means including a
relay and a circuit under the control of said
relay for directly operating one of the signals, and means for short-circuiting said relay.

47. In a telephone system, a calling line, 25
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for the called line,
30 and means controlled thereover for operat-
ing the two signals, one over the line circuit
and the other over the local circuit, said
means including a relay and a circuit under
the control of said relay for directly operat-
35 ing one of the signals.

48. In a telephone system, a calling line, 40
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for the called line,
and means controlled thereover for operat-
ing the two signals, one over the line circuit
and the other over the local circuit and both
over a section of the talking circuit, said
45 means including a relay and a circuit under
the control of said relay for directly operat-
ing one of the signals.

49. In a telephone system, a calling line, 50
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for determining if
the called line is busy, a progressively mov-
able switch for controlling said circuit,
55 means for operating the two signals alter-
nately, and other means controlled over the
test circuit for controlling such operation.

50. In a telephone system, a calling line, 60
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to
the link, a busy test circuit for determining
if the called line is busy, a progressively
movable switch for controlling said circuit,

means for operating the two signals alter- 65
nately, one over the line circuit and one over
the local circuit, and means controlled over
the test circuit for controlling such opera-
tion.

51. In a telephone system, a calling line, 70
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for determining if
the called line is busy, a progressively mov- 75
able switch for controlling said circuit
means for operating the two signals alter-
nately, one over the line circuit and one over
the local circuit, both over a section of the
talking circuit, and other means controlled 80
over the test circuit for controlling said op-
eration.

52. In a telephone system, a calling line, 85
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to
the link, a busy test circuit for determining
if the called line is busy, a progressively
movable switch for controlling said circuit
and means controlled over said test circuit 90
for operating the two signals, said means
including a relay and a circuit under the
control of said relay for directly operating
one of the signals.

53. In a telephone system, a calling line, 95
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for determining if
the called line is busy, a progressively mov- 100
able switch for controlling said circuit and
means controlled over said test circuit for
operating the two signals, said means in-
cluding a relay and a circuit under the control of said relay for directly operating one 105
of the signals, and means for short-circuit-
ing said relay.

54. In a telephone system, a calling line, 110
a called line, a link for connecting the two
lines in a talking circuit, a signal individual
to the calling line, and one individual to the
link, a busy test circuit for determining if
the called line is busy, a progressively mov-
able switch for controlling said circuit and
means controlled over said test circuit for 115
operating the two signals, one over the line
circuit and the other over the local circuit,
said means including a relay and a circuit
under the control of said relay for directly
operating one of the signals. 120

55. In a telephone system, a calling line, 125
a called line, a link for connecting the two
lines in a talking circuit, a signal individ-
ual to the calling line, and one individual
to the link, a busy test circuit for deter-
mining if the called line is busy, a progres-
sively movable switch for controlling said
circuit and means controlled over said test

circuit for operating the two signals, one over the line circuit and the other over the local, both over a section of the talking circuit, said means including a relay and a circuit under the control of said relay for directly operating one of the signals.

Signed by me at Chicago, Cook county,
Illinois, this 8th day of March, 1913.
TALBOT G. MARTIN.

Witnesses:

ARTHUR J. RAY,
EDWARD D. FALE.