H. E. HERSHEY & G. A. YANOCHOWSKI.

MEASURED SERVICE TELEPHONE SYSTEM.

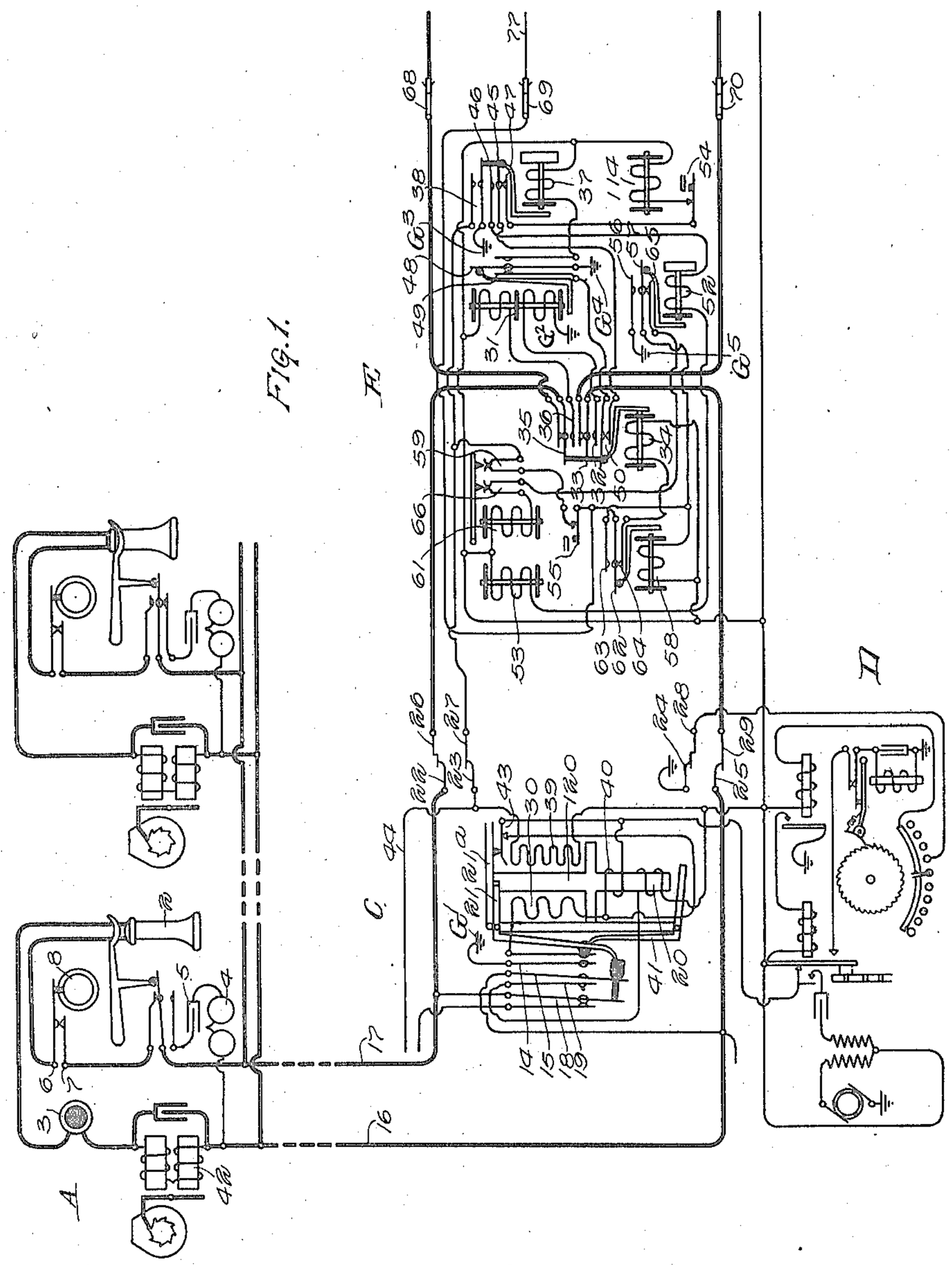
APPLICATION FILED NOV. 28, 1913.

1,264,183.

Patented Apr. 30, 1918.

2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES

H. W. Kracke

A. Oswald

INVENTORS,

HARRY E. HERSHEY

& GEORGE A. YANOCHOWSKI.

By Bulkley & Swenata

ATTORNEYS,

H. E. HERSHEY & G. A. YANOCHOWSKI.

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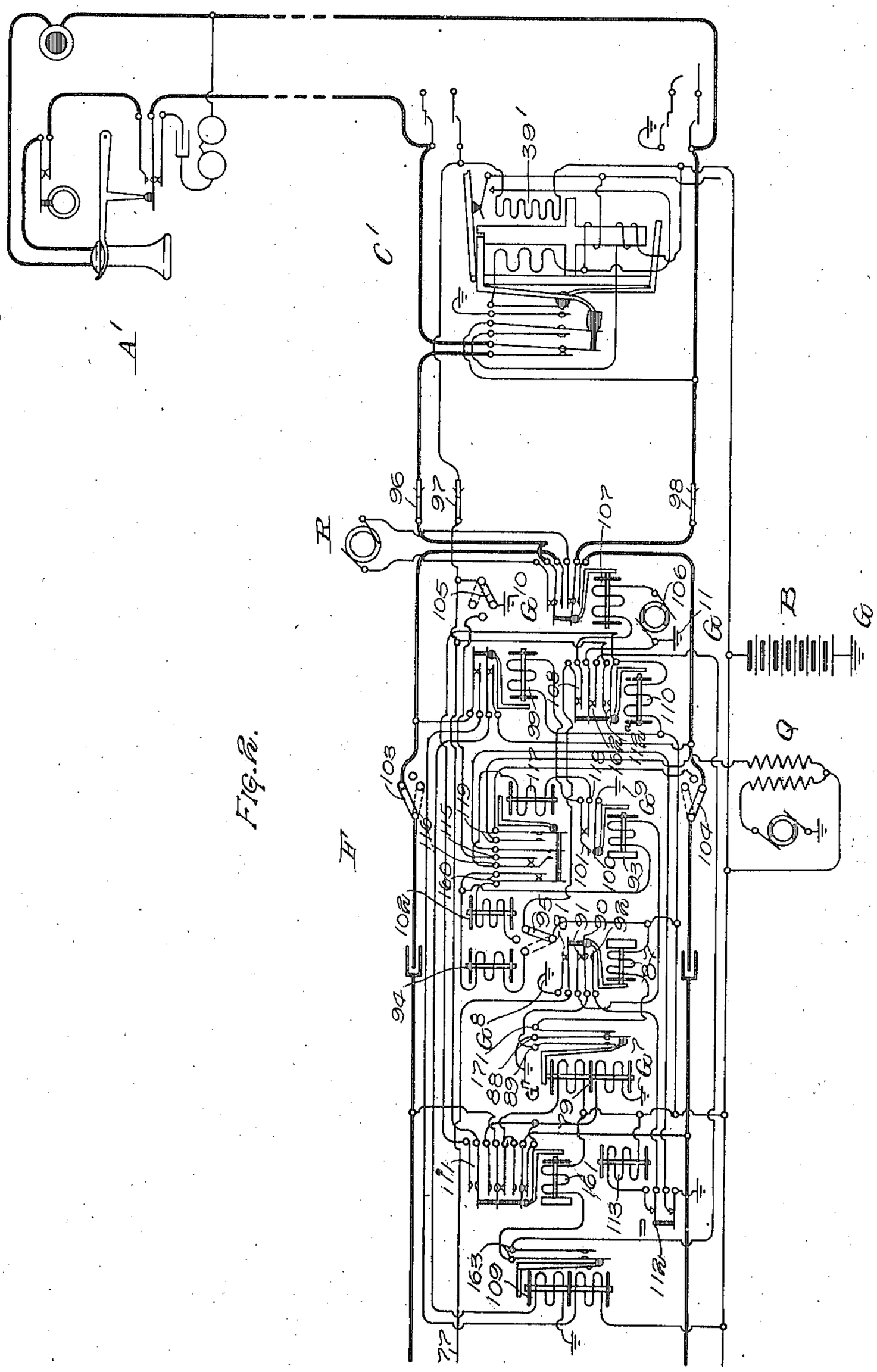

Fig. 2.

WITNESSES
H. W. Kracke
A. Oswald

INVENTORS,
HARRY E. HERSHEY &
GEORGE A. YANOCHOWSKI,
By Bulkley & Swanton
ATTORNEYS,

UNITED STATES PATENT OFFICE.

HARRY E. HERSHEY, OF WHITE WATER, KANSAS, AND GEORGE A. YANOCHOWSKI, OF CHICAGO, ILLINOIS, ASSIGNORS TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

MEASURED-SERVICE TELEPHONE SYSTEM.

1,264,183. Specification of Letters Patent. Patented Apr. 30, 1918.

Application filed November 28, 1913. Serial No. 803,527.

To all whom it may concern:

Be it known that we, HARRY E. HERSHEY and GEORGE A. YANOCHOWSKI, both citizens of the United States of America, and residents of White Water, Butler county, Kansas, and Chicago, Cook county, Illinois, respectively, have invented certain new and useful Improvements in Measured-Service Telephone Systems, of which the following is a specification.

Our invention relates to improvements in measured service telephone systems, and more particularly to measured service systems which are adapted for use with party-lines. Heretofore, in measured service systems in which the meter has been operated by a reversal of current, if this meter were located on a party-line and a second subscriber should come in on that line after this reversal has occurred, his meter would be operated.

The object of our invention is to practically prevent this false operation of the meter by causing the operation of the meter to be brought about by a momentary reversal of current in the calling line. Thus the only chance of the subscriber falsely operating the meter would be if he came in on the line during the instant of this momentary impulse.

These and other objects of our invention will be more readily understood by reference to the accompanying drawings, in which we have illustrated our invention in connection with a well-known type of automatic system.

Figures 1 and 2 taken together show a complete connection between a calling substation A and a called substation A′ in a telephone system embodying the principles of our invention.

The telephone system shown herein is a party-line automatic system of the well-known type in which the connections are established between the calling and called lines through the medium of individual preselector or line switches, first selector switches and connectors. The connection shown is established through the medium of the line switch C, first selector E and the connector F. At D there is shown the usual master switch for controlling the line switch C. At B there is shown a central office battery for supplying current for operating the switches and for talking purposes. At R is represented a ringing current generator and at Q is shown a busy signaling machine.

Although only two stations are shown upon the calling line, branches are shown leading over from the line conductors to which other stations may be connected in the same manner as those shown. Any desired arrangement may be employed in order that the different stations on the same line may be signaled selectively.

The automatic substations A and A′ comprise the usual receiver 2, transmitter 3, ringer 4 and condenser 5. Being an automatic substation it is also provided with a suitable call-sending mechanism for controlling the automatic switches, which mechanism is represented diagrammatically by a pair of impulse springs 6 and 7 and an impulse wheel 8, which latter may be controlled in the well-known manner through the medium of a dial provided with finger holes in such a way that the impulse springs may be momentarily separated a number of times corresponding to the respective digits of the number of the called substation. There is also shown a polarized relay the armature of which is adapted to actuate a counting mechanism.

The line switches C and C′ are of the general type of subscriber's switch shown in British patent to R. W. James No. 26,301 of 1906, resembling more closely, however, the particular type shown in British patent to T. G. Martin No. 1419 of 1910. This line switch comprises, among other details, a plunger (not shown) attached to the end of a so-called plunger arm 21ª controlled by a magnet 120. The magnet 120 comprises four windings, namely, a pull-down winding 30, a cut-off or holding winding 39, a line winding 20 and an auxiliary winding 40. The core of the magnet 120 is so constructed that the magnetic circuit of the windings 20 and 40 is separate from that of the windings 30 and 39. The winding 30 operates both the plunger arm 21ª and the armature 21, while the winding 39 is only strong enough to operate the cut-off armature 21 and to hold the plunger arm 21ª in its operated position after it has been operated. When the plunger arm 21ª is operated, the plunger is forced into the bank of contact springs, forcing the springs 22, 23,

24 and 25 into engagement, respectively, with the springs 26, 27, 28 and 29. Although only one set of springs (22 to 29, inclusive) is shown, each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line leading to a first selector switch E. Each trunk line is connected in multiple with the corresponding springs of all the line switches of the group which is controlled by the master switch D. The switch C is controlled by the subscriber through the medium of the line relay 20, as will hereinafter be more fully explained.

The master switch D is of the general type of master switch shown in British Patent No. 26,301 of 1906, referred to above, being, however, of the particular type disclosed in British Patent No. 1419 of 1910, also referred to above. The function of the master switch, as is well known, is to maintain the plungers of all the idle line switches in position to engage the terminal of an idle trunk line.

The first selector switch E is of the general type of selector switch disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, except that the so-called side switch is omitted. Among other details, the selector E comprises a bank of contacts arranged in horizontal rows or levels, which contacts are adapted to be engaged by a set of wipers 68, 69 and 70 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 53 and a rotary motion controlled by the rotary magnet 61. The operations of the switch are controlled through the medium of the double-wound line relay 31. Means for permitting the switch to be restored to normal position are provided in the release magnet 114, which, upon energizing, withdraws the retaining pawls from the shaft. The spring contacts 54 and 55 are permitted to close only when the switch shaft has been raised one or more steps from its lowest position. The relays 37 and 52 are slow acting relays—that is, they deënergize slowly after their energizing circuits are broken.

The connector switch F is of the general type of connector switch disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, the circuits being modified, however, to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. Like the selector, the connector is provided with a shaft (not shown) carrying the wipers 96, 97 and 98, which shaft is controlled by the vertical magnet 94 and the rotary magnet 102. The usual side switch controlling the wipers 95, 103, 104 and 105 is controlled by the private magnet 99 in the usual and well-known manner. The magnet 113 is the usual release magnet. The line relay 79 provides the calling line with talking current and the so-called back-bridge relay 109 supplies the called line with talking current. The application of ringing current to the called line is controlled by the ringer relay 107. At Q there is shown a busy signaling machine, the function of which is to send, under certain conditions, a busy tone back over the line. The complete operation will be described later. The busy signaling machine, as represented herein, comprises an induction coil or transformer the primary winding of which is included in a local circuit with a battery and an interrupter. Through the medium of the interrupter current is supplied to the primary winding, which induces an intermittent alternating current in the secondary winding whereby, when said winding is connected with the subscriber's line, an intermittent buzzing sound is heard in his receiver.

A general description of the apparatus having been given, it will now be explained how connection can be established between the line of substation A and the line of the substation A′. It will be assumed that the number of the substation A′ is 222. Since the automatic switching apparatus disclosed herein is in general well known in the art and is described in the publications herein referred to, its operation will be explained in a more or less general manner.

Upon removal of the receiver from the switch-hook at the substation A preparatory to making a call, an energizing circuit is closed through the line winding 20 of the individual switch C, the circuit being from ground G′ through the springs 14 and 15, conductor 16, substation A, conductor 17, springs 18 and 19 and the winding 20 to battery B. The winding 20, being energized, closes a circuit through the pull-down winding 30 in series with the auxiliary winding 40. The pull-down coil, upon energizing, attracts the plunger arm 21ª, thereby operating to close circuits through the bank of springs 22 to 29, inclusive. It also operates the cut-off armature 21, thereby disconnecting the line winding 20 from the line. The armature 41 does not fall back immediately, however, owing to the fact that the winding 40 is still in series with the pull-down winding 30. Upon the plunger arm 21ª being attracted, the springs 43 are brought together to short-circuit the auxiliary winding 40, thus permitting the armature 41 to fall back. This slow action of the armature 41 allows sufficient time for a holding circuit to be closed in the switch ahead for the cut-off or holding winding 39. The engagement of the springs 22 and 25 with the springs 26 and 29, respectively, extends the

subscribers' lines to the line relay 31 of the selector E. The line relay 31 of the selector E is thereupon energized, through a circuit extending from ground G^2 through the lower winding of the line relay 31, springs 32 and 33 of the relay 34, springs 29 and 25, conductor 15 to and through the substation A, conductor 17, springs 22 and 26, springs 35 and 36 and the upper winding of the line relay 31 to battery B. The current flowing through the substation A at this time does not operate the polarized relay 42 because it is flowing in the wrong direction. The line relay 31, upon becoming energized, closes a circuit through the relay 37, which in turn closes a circuit from ground G^3 through the springs 38, springs 27 and 23 and the holding winding 39 of the line switch C to battery B. The winding 39, upon energizing, holds the armature 21 and the plunger arm 21^a in their operated positions after the circuit of the pull-down winding 30 is broken by the falling back of the line armature 41. From the same point G^3 a guarding potential is supplied to the connector private bank contacts of the calling line by way of the conductor 44. This circuit extends over the circuit just traced to the bank spring 23, thence over the normal conductor 44 to said private bank contact. The energization of the relay 37 also prepares a circuit for the vertical magnet by bringing into engagement the springs 45 and 46, and opens the circuit of the release magnet 114 at the springs 45 and 47.

The calling subscriber now operates his calling device for the first digit 2 of the called number, whereby the substation impulse springs 6 and 7 are separated twice momentarily, each time breaking the circuit of the selector line relay 31. The relay 37 of the selector being slow acting does not deënergize during the momentary interruptions of its circuit by the relay 31 and consequently each time the latter relay deënergizes, an impulse is transmitted over the circuit extending from ground G^4 through the springs 48 and 49, springs 50, springs 45 and 46, relay 52 and the vertical magnet 53 to battery B. The vertical magnet receives two impulses over the circuit and operates to raise the switch shaft and wipers two steps to a position opposite the second row or level of bank contacts and at the same time the shaft-controlled contacts 54 and 55 are closed. The slow acting relay 52 is maintained in its energized position continuously while impulses are being transmitted to the vertical magnet through it, and in its energized position closes a circuit extending from ground G^5 through the springs 56 and 57 and the relay 58 to battery B. The relay 58, upon energizing, forms a locking circuit for itself extending from ground G^3 at the relay 37, through springs 38, springs 59 (which are controlled by the rotary magnet 61), shaft contact 55, springs 62 and 63 and the relay 58 to battery B. Thus, upon the deënergization of the relay 52 after the last impulse is delivered to the vertical magnet, the relay 58 remains energized and the circuit of the rotary magnet 61 is closed, which circuit extends from ground G^3 through the springs 38, springs 59, springs 55, springs 62 and 63, springs 57 and 65, springs 66 and the rotary magnet 61 to battery B. The magnet 61, upon energizing, rotates the wipers one step and, by opening the spring contacts 66 and 59, disconnects ground G^3 from itself and from the relay 58. If the first trunk line of the second level is idle, the relay 58 deënergizes as soon as the spring contact 59 is opened. If this trunk line is busy, however, the private wiper 69 finds the contact with which it engages provided with a guarding ground potential which is transmitted to the relay 58 through its springs 62 and 63 and thereby prevents it from deënergizing. The magnet 61, however, deënergizes when the spring contact 66 is broken, regardless of whether the relay 58 remains energized or not. If the relay 58 remains energized, the circuit of the rotary magnet will be again closed as soon as its armature drops back far enough to close the contacts 66 and 59. The rotary magnet will therefore operate in a manner similar to that of a buzzer to advance the wipers step by step over the contacts until the non-grounded contact of an idle trunk line is reached by the wipers 69, whereupon the relay 58 deënergizes. The relay 58, upon deënergizing, whether after one or several operations of the rotary magnet, permanently breaks the circuit of the magnet 61 and closes the circuit of the switching relay 34, which circuit extends from ground G^3 through the springs 38, springs 59, springs 55, springs 62 and 64 and the relay 34 to battery B. The relay 34, upon energizing, disconnects the line relay 31 from the line and extends the connection over the heavy conductors shown through the wipers 68 and 70 to the connector F. The line relay 79 of the connector thereupon becomes energized over a circuit extending from ground G^7 through the lower winding of the line relay 79, over the heavy conductor to and through the substation A and over the other heavy conductor through the upper winding of the line relay 79 to battery B. The energization of the relay 79 closes a circuit through the relay 87 from ground G^{17} through the springs 88 and 171 and the relay 87 to battery B. The energization of the relay 87 provides a holding circuit for the relay 34 of the selector E and holding winding 39 of the line switch C. The circuit extends from ground G^8

through the springs 81, conductor 77, private wiper 69 of the selector E, springs 62 and 64 and the relay 34 to battery B, and also through the springs 55, springs 59, springs 27 and 23 and the holding winding 39 to battery B, and also through the conductor 44 to place a guarding potential upon the connector private bank contact of the substation A. Also, the relay 87, upon energizing, prepares the circuit of the vertical magnet and at the same time opens the circuit of the release magnet.

When the substation calling device is operated for the second digit 2, the circuit of the connector line relay 79 is broken twice. Since the relay 87 is slow acting it does not deënergize during the momentary interruptions of its circuit by the line relay 79, so that each time the latter relay is deënergized, a circuit is closed extending from ground G^{17} through the springs 88 and 89, springs 90 and 91, relay 93, vertical magnet 94 and the side switch wiper 95 (in first position) to battery B. The vertical magnet 94 receives two impulses over this circuit and operates to raise the switch wipers 96, 97 and 98 to a position opposite the second level of bank contacts. The relay 93, which is included in series with the vertical magnet, remains in its energized position during the entire time that impulses are being transmitted through it and operates to close the circuit of the private magnet 99. The circuit for the private magnet extends from ground G^{9} through the springs 100 and 101 and the private magnet 99 to battery B. After the last impulse is delivered, the relay 93 opens the circuit of the private magnet 99, which, upon deënergizing, permits the side switch to advance from first to second position. The movement of the side switch wiper 95 from first to second position transfers the battery connection from the vertical magnet 94 to the rotary magnet 102. The calling subscriber now operates his calling device for the last digit 2, in response to which the connector line relay operates to transmit two impulses through the rotary magnet 102 in series with the relay 93, whereby the shaft wipers are rotated onto the contacts of the desired line. This circuit extends from ground G^{17} through the springs 88 and 89, springs 90 and 91, relay 93, springs 160, rotary magnet 102 and the side switch wiper 95 (in second position) to battery B. The relay 93 operates in response to the impulses for this digit in the same manner as for the previous digit to cause the private magnet 99 to advance the side switch to third position. By the engagement of the side switch wipers 103 and 104 with their third-position contact points, the line connection is completed with the called line. Upon the engagement of the wiper 105 with its third-position contact point, a circuit is completed through the cut-off winding 39′ of the called line switch. The circuit extends from ground G^{10} through the side switch wiper 105 (in third position), private wiper 97 and the cut-off winding 39′ to battery B. The cut-off winding of the called line switch, upon energizing, operates to disconnect the line winding 20′ from the called substation. The connection of ground G^{10} with the connector private bank contact of the called line prevents the called line from being seized by some other connector switch. By the engagement of the side switch wiper 95 with its third-position contact point, the circuit of the ringer relay 107 is closed. This circuit extends from ground G^{11} through the interrupter 106, ringer relay 107, springs 108 and the side switch wiper 95 (in third position) to battery B. The ringing relay disconnects the calling line from the called line and bridges the ringing current generator R across the called line to signal the called subscriber. The ringing relay is energized only intermittently through the medium of the interrupter 106. Upon the response of the called subscriber his line is provided with talking current through the windings of the back-bridge relay 109. The back-bridge relay 109, upon energizing, closes a circuit through the relay 161, which circuit is traced from ground G^{11} through the springs 162, springs 163 and the relay 161 to battery B. The relay 161, upon energizing, reverses the flow of current to the calling line. It also closes a circuit through the ringer cut-off relay 110 from ground G^{10} through the side switch wiper 105 (in third position), springs 111 and the ringer cut-off relay 110 to battery B. The energization of the relay 110 interrupts the circuit of the ringer relay 107 at the springs 108 and closes a locking circuit for itself through its springs 112^{a} independent of the springs 111. It will also be seen that the relay 110, upon energizing, permanently opens the circuit of the relay 161 at the springs 162, the relay 161 being made slow acting so that it will remain energized an instant after the relay 110 opens its circuit. This impulse of current in the reverse direction over the calling line causes the polarized relay 42 at the substation A to be energized and its armature to operate the registering mechanism.

After the conversation is completed, the connection is released by the hanging up of the receiver at the calling substation in the following manner: When the receiver at the substation A is restored to the switch-hook, the separation of the switch-hook springs destroys the energizing circuit of the connector line relay 79. The relay 87, upon deenergizing, opens the holding circuit for the switching relay 34 of the selector E and the holding winding 39 of the line-switch C at

the springs 81 and completes a circuit extending from ground G^{17} through the springs 88 and 89, springs 91 and 92, off-normal springs 112 and the release magnet 113 to battery B. The release magnet 113, upon energizing, restores the switch shaft and side switch wipers to normal position and its own circuit is broken at the off-normal springs 112 when the shaft reaches its lowest position. The switching relay 34 of the selector E, upon deënergizing, completes a circuit extending from ground G^4 through the springs 48 and 49, springs 50, springs 48 and 47, off-normal springs 54 and the release magnet 114 to battery B. The release magnet 114, upon energizing, restores the switch shaft to normal position and its own circuit is broken at the normal springs 54 when the shaft reaches its lowest position. The holding winding 39 of the line switch C, upon becoming deënergized, allows the plunger arm 21^a to return to normal position.

It having been described how one subscriber establishes connection and releases the same, it will now be explained how a connection is prevented from being made with a busy line. If the called number is busy, there will be a guarding potential upon the connector private bank contact, just as explained in connection with the line switch C. The connector private wiper, upon engaging this guarding contact, closes a circuit as follows: ground from the private bank contact through the private wiper 97, side switch wiper 105 (in second position), springs 115 and 116, busy relay 117, springs 118 and 101 and the private magnet 99 to battery B. The relay 117, upon energizing, closes a locking circuit for itself and for the magnet 99 independent of the ground at the private wiper. The circuit of the rotary magnet is opened at the springs 160 to prevent a further rotation of the shaft and wipers. A further result of the energizing of the busy relay 117 is to close the contact of springs 119, whereby a busy tone is sent back to the calling subscriber from the busy machine Q by way of the side switch wiper 104 (in second position), thence through the calling substation A and the upper winding of the line relay 79 to battery B, whereupon the receiver is replaced upon the switch-hook and the connection is released in practically the same manner as described above.

From the foregoing it will be seen that we have devised a very efficient means for registering all successful calls by any one substation upon a line to which a plurality of substations is connected. Furthermore, the said calls may be assessed against the calling subscriber without fear of registering the call to any other substation upon the said line if the subscriber should happen to remove his receiver in an attempt to make a call while the line is in use.

While we have illustrated our invention in connection with an automatic system of a well-known type, it will be understood that it is, of course, equally as well adapted for use with other forms of automatic or semi-automatic systems, and that we do not wish to limit ourselves to the particular type of system employed.

What we claim as our invention is:—

1. In a telephone system, a battery, a calling and a called subscriber's line, means for establishing connection between said lines and for supplying current from said battery to the calling line for talking, a registering device for the calling line, and means for producing a momentary impulse of reversed current over the two sides of the talking circuit of the calling line from said battery for operating said device, said last means comprising a circuit responsive for operating said device always immediately upon the closure of said circuit.

2. In a telephone system, a battery, a calling and a called line, means for establishing connection between said lines and for supplying current from said battery to the calling line for talking, a measured service device on said calling line, means for momentarily reversing the current in said calling line, and means for producing a momentary impulse of reversed current over the two sides of the talking circuit of the calling line from said battery for operating said device, said last means comprising a circuit responsive for operating said device always immediately upon the closure of said circuit.

3. In a telephone system, a calling and a called line, means for establishing connection between said lines, a measured service device on said calling line, means for momentarily reversing the current in two sides of the talking circuit of said calling line for operating said measured service device, said last means comprising a circuit under the control of the called subscriber responsive for operating said device always immediately upon the closure of said circuit.

4. In a telephone system, a calling and a called subscriber's line, means for establishing connection between said lines, a polarized magnet on said calling line, a measured service device controlled by said magnet, and automatic means for transmitting a reverse current impulse over said calling line, said reverse impulse being adapted to operate said magnet to cause the operation of said measured service device, said automatic means normally disconnected from the calling line, and automatic means for connecting it with the line.

5. In a telephone system, a calling and a called subscriber's line, means for establishing connection between said lines, said means

including an automatic connector switch, means for supplying current to the calling line through said connector switch, means controlled by the response of the called subscriber for momentarily reversing the direction of current in said calling line, and a measured service device responsive to said momentary reversal of current, said connector normally disconnected from the calling line.

6. In a telephone system, a calling and a called subscriber's line, means for establishing connection between said lines, said means including an automatic connector switch, means for supplying current to the calling line through said connector switch, a back-bridge relay in said connector, means for energizing said relay upon the response of the called subscriber, a second relay controlled by said back-bridge relay, means controlled by said second relay for momentarily reversing the direction of current in said calling line, and a service meter on said calling line controlled by said momentary reversal of current, said connector normally disconnected from the calling line.

7. In a telephone system, a calling and a called subscriber's line, means for establishing connection between said lines, said means including an automatic connector switch, means for supplying current to the calling line through said connector switch, a back-bridge relay in said connector, means for energizing said relay upon the response of the called subscriber, a current-reversing relay controlled by said back-bridge relay, a third relay controlled by said current-reversing relay, the energizing of said third relay opening the circuit of said current-reversing relay, whereby when said back-bridge relay is energized the current-reversing relay is momentarily energized to transmit a reverse current impulse to the calling line, and a measured service device on the calling line controlled by said reverse current impulse.

8. In a telephone system, a battery, a calling and a called subscriber's line, means for establishing connection between said lines and for supplying current from said battery to the calling line for talking, a registering device for the calling line, and means for producing a momentary impulse of reversed current from said battery over the two sides of the talking circuit of the calling line for operating said device, a controller for controlling said last means, said last means responsive for operating said device always immediately upon the operation of said controller when operated for that purpose.

9. In a telephone system, a calling and a called subscriber's line, means for establishing connection between said lines, a registering device for the calling line, and means for producing a momentary impulse of reversed current over the two sides of the talking circuit of the calling line for operating said device, said means normally disconnected from the calling line and automatic means for connecting the same with the calling line.

10. In a telephone system, a calling and a called subscriber's line, means for establishing connection between said lines, a registering device for the calling line, and means for producing a momentary impulse of reversed current over the two sides of the talking circuit of the calling line for operating said device, a controller in the line of the called subscriber for controlling said last means, said last means responsive for operating said device always immediately upon the operation of said controller when operated for that purpose.

11. In a telephone system, a calling line having two conductors, talking apparatus in series with said conductors for talking over said line, a meter associated with said line, an automatic switch for extending connection from said line to another line, and automatic means in said other line for producing a momentary variation and restoration of current in the calling line for operating said meter over the two conductors of said line in series.

12. In a telephone system, a calling line, a meter associated with said line, an automatic switch for extending connection from said line to another line, and automatic means in said other line for producing a momentary reversed current impulse in the two conductors of the talking circuit of the calling line for operating said meter.

13. In a telephone system, a calling line having two conductors, talking apparatus in series with said conductors for talking over said line, a meter associated with said line, an automatic switch for extending connection from said line to another line, and electromagnetic means in said other line for producing a momentary variation and restoration of current in the calling line for operating said meter over said two conductors in series.

14. In a telephone system, a calling line, a meter associated with said line, an automatic switch for extending connection from said line to another line, and electromagnetic means in said other line for producing a momentary reversed current impulse in the two conductors of the talking circuit of the calling line for operating said meter.

15. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said

magnet, and means for controlling said magnet thereover to control said measured service means over a circuit including two sides of said line in series.

16. In a telephone system, a pair of lines, an automatic switch for connecting said lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow while said connection is established, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, and means for controlling said magnet thereover to control said measured service means over a circuit including two sides of said line in series.

17. In a telephone system, a pair of lines, a progressively movable switch for connecting said lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow controlled over the second line, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, and means for controlling said magnet thereover to control said measured service means over a circuit including two sides of said line in series.

18. In a telephone system, a pair of lines, an automatic switch for connecting said lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means over a circuit including two sides of said line in series, a circuit for said magnet, and a second magnet for controlling the circuit of said first magnet to control said measured service means.

19. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, and a second magnet controlled over the second line for controlling the circuit of said first magnet to control said measured service means over a circuit including two sides of said line in series.

20. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet for rendering said first magnet inoperative.

21. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet controlled by said second magnet for rendering said first magnet inoperative.

22. In a telephone system, a pair of lines, each having two conductors, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for varying and restoring said flow while said connection is established, means responsive to said variation and restoration to control said measured service means over a circuit including the two conductors of said line in series, a circuit for said magnet, and means for controlling said magnet thereover to control said measured service means.

23. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for varying and restoring said flow controlled over the second line, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, and means for controlling said magnet thereover to control said measured service means over a circuit including two sides of said line in series.

24. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, and a second magnet for controlling the circuit of said first magnet to control said measured service means over a circuit including two sides of said line in series.

25. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, and a second magnet controlled over the second line for controlling the cir-

cuit of said first magnet to control said measured service means over a circuit including two sides of said line in series.

26. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet for rendering said first magnet inoperative.

27. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for varying and restoring said flow, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet controlled by said second magnet for rendering said first magnet inoperative.

28. In a telephone system, a pair of lines, an automatic progressively movable switch for connecting the two, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow while said connection is established controlled over the second line, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, and means for controlling said magnet thereover to control said measured service means over a circuit including two sides of said line in series.

29. In a telephone system, a pair of lines each having two conductors, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow while said connection is established, means responsive to said variation and restoration to control said measured service means over a circuit including the two conductors of said line in series, a circuit for said magnet, and a second magnet controlled over the second line for controlling the circuit of said first magnet to control said measured service means.

30. In a telephone system, a pair of lines each having two conductors, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow while said connection is established, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet for rendering said first magnet inoperative.

31. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow while said connection is established, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet for rendering said first magnet inoperative.

32. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow while said connection is established, means responsive to said variation and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet controlled by said second magnet for rendering said first magnet inoperative.

33. In a telephone system, a pair of lines each having two conductors, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for varying and restoring said flow controlled over the second line, means responsive to said variation and restoration to control said measured service means over a circuit including the two conductors of said line in series, a circuit for said magnet, and a second magnet for controlling the circuit of said first magnet to control said measured service means.

34. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet controlled over one of said lines, and means for controlling said magnet thereover to control said measured service means.

35. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and means for controlling said

magnet thereover to control said measured service means.

36. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow while said connection is established, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet controlled over one of said lines, and means for controlling said magnet thereover to control said measured service means.

37. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow controlled over the second line, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet controlled over one of said lines, and means for controlling said magnet thereover to control said measured service means.

38. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and a second magnet controlled over one of said lines for controlling the circuit of said first magnet to control said measured service means.

39. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and a second magnet controlled over the second line for controlling the circuit of said first magnet to control said measured service means.

40. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet for rendering said first magnet inoperative.

41. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet controlled by said second magnet for rendering said first magnet inoperative.

42. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow while said connection is established, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and means for controlling said magnet thereover to control said measured service means.

43. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow controlled over the second line, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and means for controlling said magnet thereover to control said measured service means.

44. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and a second magnet for controlling the circuit of said first magnet to control said measured service means.

45. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and a second magnet controlled over the second line for controlling the circuit of said first magnet to control said measured service means.

46. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, a second magnet for

controlling the circuit of said first magnet to control said measured service means, and a third magnet for rendering said first magnet inoperative.

47. In a telephone system, a pair of lines, means for measuring charges for the use of a line, an automatic progressively movable switch for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet controlled by said second magnet for rendering said first magnet inoperative.

48. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow while said connection is established controlled over the second line, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet controlled over one of said lines, and means for controlling said magnet thereover to control said measured service means.

49. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow while said connection is established, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet controlled over one of said lines, and a second magnet for controlling the circuit of said first magnet to control said measured service means.

50. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow while said connection is established, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, and a second magnet controlled over the second line for controlling the circuit of said first magnet to control said measured service means.

51. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow while said connection is established, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet for rendering said first magnet inoperative.

52. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for reversing and restoring said flow while said connection is established, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and a third magnet controlled by said second magnet for rendering said first magnet inoperative.

53. In a telephone system, a pair of lines, means for measuring charges for the use of a line, means for establishing a current flow over one of said lines, a magnet for directly reversing and restoring said flow controlled over the second line, means responsive to said reversal and restoration to control said measured service means, a circuit for said magnet, a second magnet for controlling the circuit of said first magnet to control said measured service means, and means for thereafter removing said magnet from the control of said second line.

Signed by us at Chicago, Cook county, Illinois, this 20th day of November, 1913.

HARRY E. HERSHEY.
GEORGE A. YANOCHOWSKI.

Witnesses:
H. W. KRACKE,
ALICE OSWALD.