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

TELEPHONE SYSTEM.

APPLICATION FILED DEC. 5, 1913.

1,278,282.

Patented Sept. 10, 1918

3 SHEETS—SHEET 1.

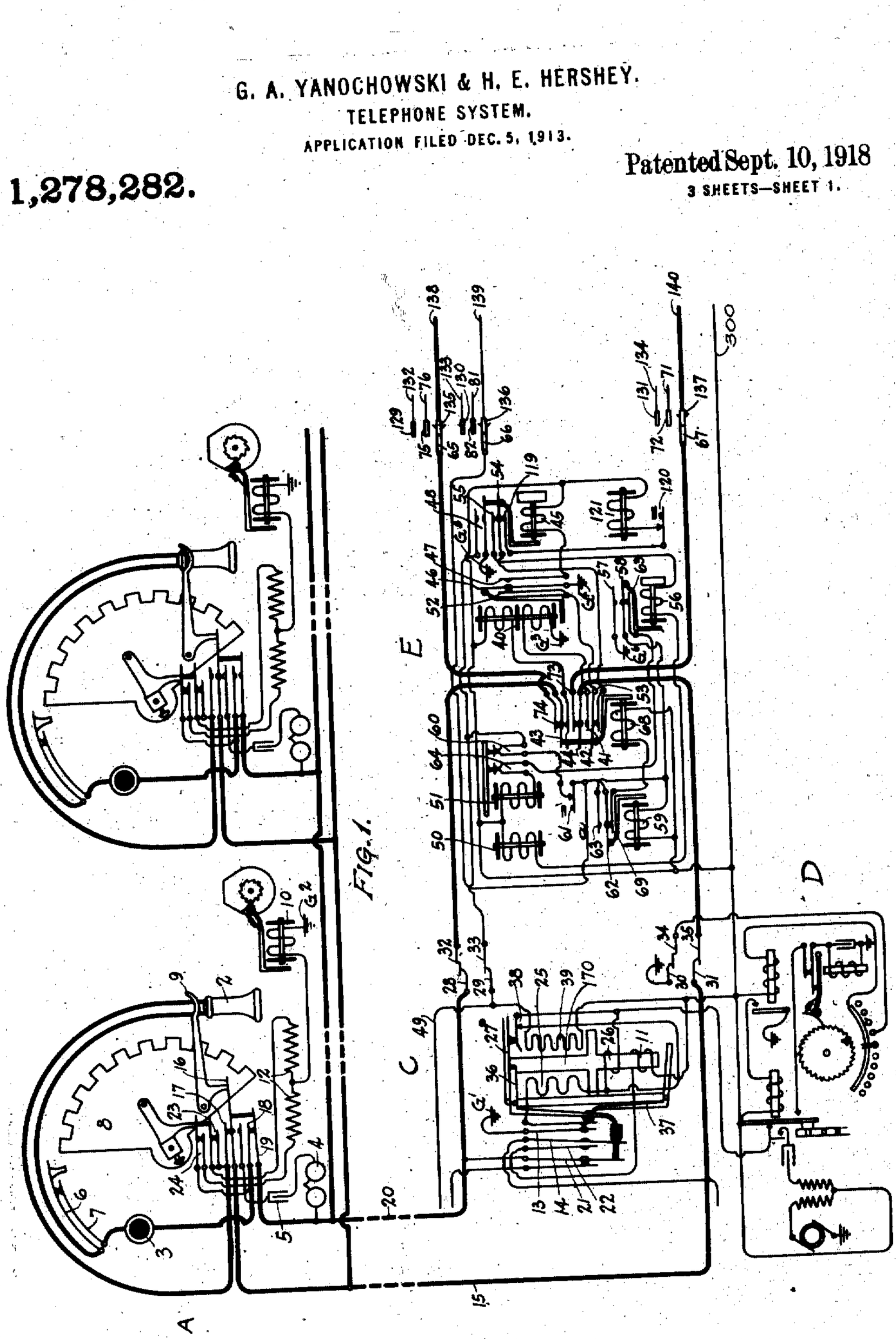

FIG. 1.

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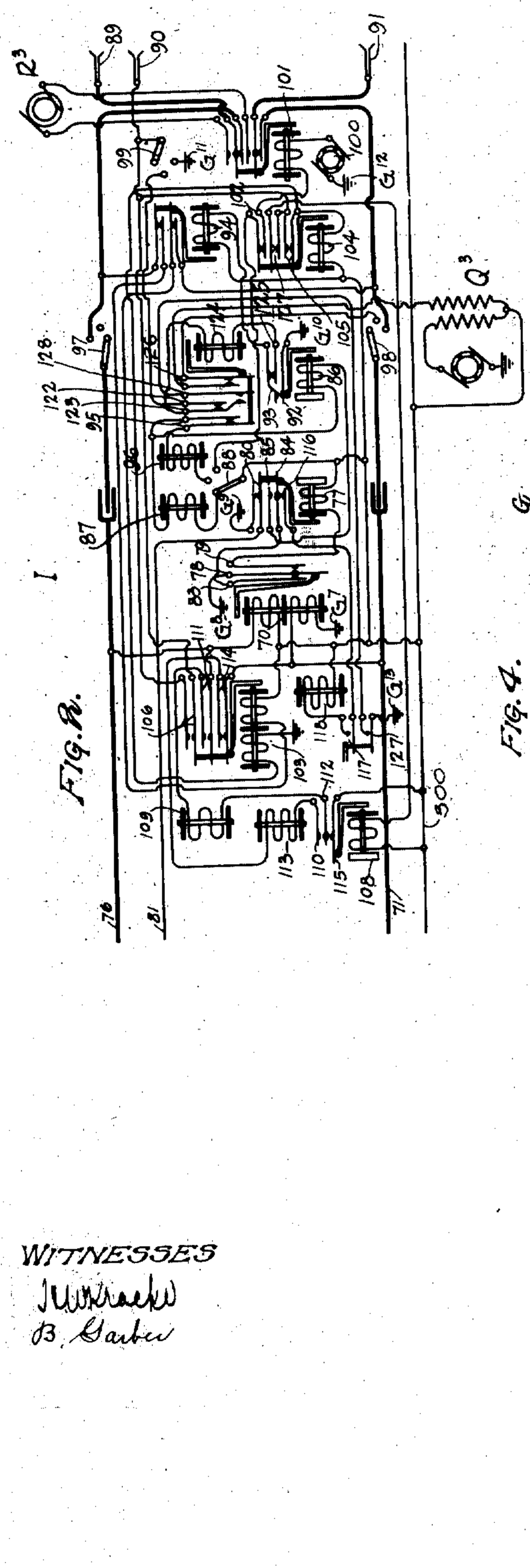

FIG. 3.

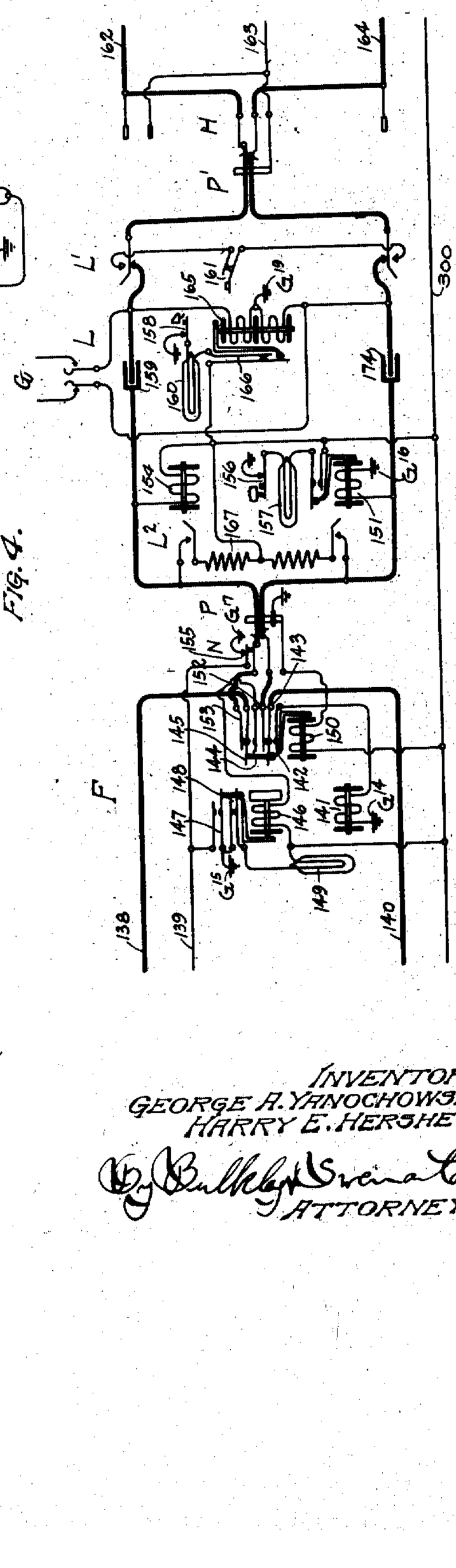

FIG. 4.

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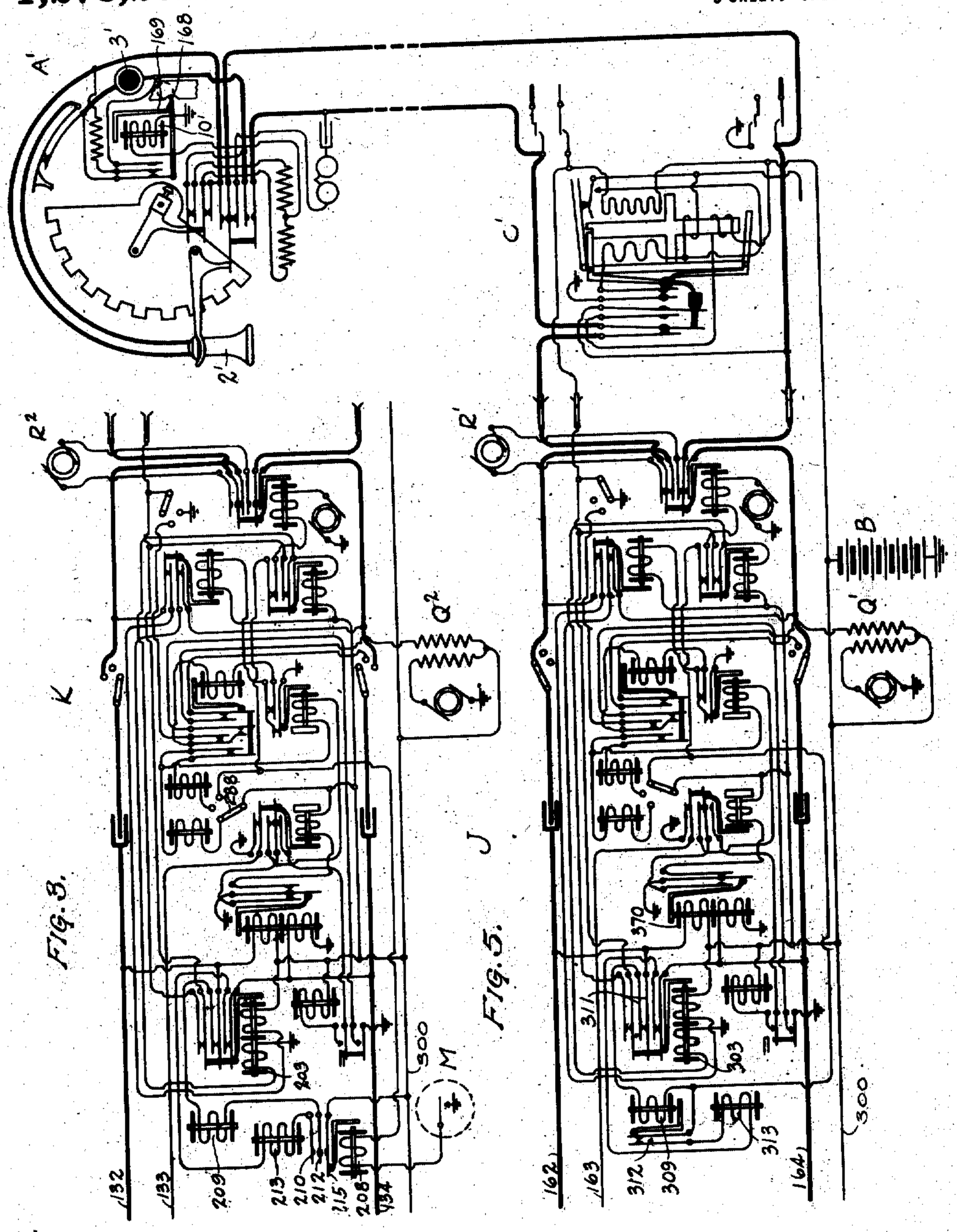
3 SHEETS—SHEET 3.

1,278,282.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,278,282. Specification of Letters Patent. Patented Sept. 10, 1918.

Application filed December 5, 1913. Serial No. 804,894.

To all whom it may concern:

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

Our invention relates to improvements in telephone systems, and it relates particularly to improved means for operating measured service devices or supervisory signals in automatic or semi-automatic systems.

The object of our invention is to provide, in connection with a telephone system, a simplex circuit—that is, a circuit which includes two sides of the line in multiple with a ground return—which circuit may be employed for either operating meters or pay-station apparatus in automatic systems, or can be employed for supervisory purposes in semi-automatic systems. In these systems the talking current and operating impulses pass over the two sides of the line in series and thus the impulse or impulses which pass over the simplex circuit do not in any way interfere with the talking current or operating impulses.

A further feature of our invention is the provision of a time-controlled mechanism associated with the simplex circuit for closing the same at predetermined time intervals, whereby a measured service device at the substation may be operated a number of times in accordance with the length of time any connection is established. Thus this timing mechanism can be regulated so as to operate every few seconds, and in that event the registering mechanism at the substation will accurately record the exact length of time of conversation and charges can be made accordingly, or, if desired, this timing mechanism can be so regulated as to close the simplex circuit once every three minutes, in which event the subscriber's meter would be operated one step for every three minutes a connection is established.

A further feature of our invention relates to the application of this simplex circuit to a coin-collecting device, whereby a magnet is provided at the substation which is energized over this simplex circuit to prevent conversation until a coin has been deposited.

These and other objects and features of our invention will be more clearly understood by reference to the accompanying drawings, in which we have illustrated our invention in connection with automatic and manual apparatus of well-known types, although its application to other forms of automatic and semi-automatic systems will be readily apparent to those skilled in the art.

Figure 1 shows a subscriber's substation A attached to a party-line, the line conductors of said party-line terminating in an individual or line switch C. The line switch shown at C is one of a group of similar line switches the plunger (not shown) of which engage a shaft and are controlled by the operation of a master switch, shown at D in such a manner that they are, when in normal position, held directly in front of the terminals of a trunk line leading to a selector such as shown at E.

Fig. 2 shows a connector switch embodying the principles of our invention.

Fig. 3 shows a second connector switch adapted to be used in connection with our invention.

Fig. 4 shows a manual operator's cord circuit for connecting a trunk line extending from the selector E with a trunk line extending to the connector J (Fig. 5).

Fig. 5 shows a subscriber's substation A′, together with a line switch C′ with which a connector J is shown connected.

For the purpose of supplying battery current for operating the apparatus and for talking purposes, there is shown a battery B, one terminal of which is grounded. The busy signaling machines Q′, Q² and Q³, as represented herein, comprise 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 this interrupter a current is supplied to the primary winding, which induces an alternating current in the secondary winding, whereby when said winding is connected with a subscriber's line, a buzzing sound is heard in the receiver.

The automatic telephone or substation represented at A comprises the usual receiver 2, transmitter 3, ringer 4 and con-

denser 5. Being an automatic substation it is also provided with an automatic calling device which may be of the same type as that shown in British patent to S. G. S. Dicker No. 29,654 of 1910. At the substation A the calling device is shown diagrammatically by a pair of impulse springs 6 and 7 and a toothed impulse wheel 8, which latter is controlled by the subscriber through the medium of a dial (not shown) provided with finger holes for convenience in turning. The switch-hook 9 controls a set of springs in such a manner that when the receiver is on the hook, the ringer 4 in series with the condenser 5 is bridged directly across the line, both sides of said line being opened beyond said bridge. When the receiver is removed from the hook, the springs assume a position in which the bridge above referred to is disengaged from one side of the line, and at the same time the receiver 2 is bridged across the line in series with the impulse springs 6 and 7 and the transmitter 3. An impedance coil 12 is also bridged across the line and a magnet 10 is connected between the mid point of this impedance coil and ground G^2. The armature of this magnet 10 is designed to operate a counting or registering mechanism each time the magnet is energized. The impulse wheel 8 controls a set of springs in such a manner that when it is at any other position but normal, the impedance coil 12 is disengaged from both sides of the line. For this reason it will be seen that the impedance coil 12 will not affect the impulses delivered by the impulse springs 6 and 7.

The substation A′ is similar to the substation A, except that the magnet 10′, instead of operating a counting mechanism, is arranged to control a set of springs in such a manner that when the magnet 10′ is energized, a shunt is placed around the receiver 2′ and the transmitter 3′ is directly short-circuited. Means are also provided so that when a proper coin is dropped in the slot, the said springs are restored to normal.

The subscriber's individual switch C is of the general type of subscriber's switch shown in British patent to R. W. James No. 26,301 of 1906, being, however, of the particular type disclosed 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 27 which is controlled by the magnet 170. The magnet 170 comprises four windings, namely, a pull-down winding 25, a cut-off or holding winding 39, a line winding 11 and an auxiliary winding 26. The core of the magnet 170 is so constructed that the magnetic circuit of the windings 25 and 39 is separate from that of the windings 11 and 26. The winding 25 operates both the plunger arm 27 and the armature 36, while the winding 39 is only strong enough to operate the cut-off armature 36 and to hold the plunger arm 27 in its operated position. When the plunger arm 27 is operated, the plunger is forced into a bank of contact springs, forcing the springs 28, 29, 30 and 31 into engagement with the springs 32, 33, 34 and 35, respectively. Although only one set of springs (28 to 35) 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 D is controlled by the subscriber through the medium of the line relay 11, as will hereinafter be more fully explained.

The master switch D is of the same general type as that disclosed in British Patent No. 26,301 of 1906, referred to above, being, however, of the particular type disclosed in said British Patent No. 1419 of 1910. The function of the master switch, as is well known, is to maintain the plungers of all idle switches in position to engage the terminals 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, and its circuits are modified to adapt the switch to operate in a system in which the impulses are delivered over the sides of the line in series. 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 65, 66 and 67 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 50 and a rotary motion controlled by the rotary magnet 51. The operations of the switch are controlled through the medium of the double-wound line relay 40. Means for permitting the switch to be restored to normal position are provided in the release magnet 121, which, upon energizing, withdraws the retaining pawls from the shaft. The springs 61 and 120 are permitted to close only when the switch shaft has been raised one or more steps from its lowest position. The relays 45 and 56 are slow acting relays, *i. e.*, they deënergize slowly after their energizing circuits are broken.

The connector switch I (Fig. 2) 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 impulses are delivered over the two sides of the line in series. The connector is provided with a shaft (not shown) carrying the wipers 89, 90 and 91, which shaft is controlled by the vertical magnet 87 and the rotary magnet 96. The usual side switch comprising the wipers 88, 97, 98 and 99 is controlled by the private magnet 94 in the usual and well-known manner. The magnet 118 is the usual release magnet which, upon energizing, removes the retaining pawls from the shaft. The springs 117 and 127 are permitted to close only when the switch shaft has been raised one or more steps from its lowest position. The operations of the switch are controlled by the line relay 70, and the application of ringing current to the called line is controlled by the ringer relay 101. The relay 103 is the so-called back-bridge relay which feeds battery current to the called line. This relay controls the circuit of a pair of impedance coils which are adapted to be connected in bridge of the trunk line 71, 76. The battery B is adapted to be connected to this bridge, which battery connection is controlled by the slow acting relay 108, which in turn is controlled by the ring cut-off relay 104 in such a manner that battery is connected to this bridge for a short interval of time when the subscriber responds, in a manner to be hereinafter more fully described.

The connector K (Fig. 3) is similar to the connector I (Fig. 2), except for the fact that the relay 208, which controls the bridge through the impedance coils 209 and 213, which correspond in turn to the impedance coils 109 and 113 of the connector I, is controlled by a time mechanism M. This construction is such that the simplex circuit through the coils 209 and 213 in parallel is closed intermittently by this time mechanism instead of being closed but a single time, as described in connection with the connector I.

The connector J is similar to the connector I, except that in place of the impedance coils 109 and 113 and the relay 108, this connector J is provided with a relay 309 whose circuit is controlled by the back-bridge relay 303, which relay 309 in turn controls the circuit of the impedance coil 313. This construction is such that when the back-bridge relay is energized, the relay 309 and impedance coil 313 are bridged across the conductors of the talking circuit and the battery B is connected to a mid point of this bridge and remains so connected until the back-bridge relay deënergizes, in this manner distinguishing from the construction of the connectors I and K, in which the battery was connected to this bridge only momentarily.

The cord circuit G (Fig. 4) is a well-known type of cord circuit, comprising the usual answering and calling plugs P and P', respectively, inductively connected together through the medium of the condensers 159 and 174. The usual supervisory lamps 157 and 160 are controlled by the well-known plug seat switches shown at 156 and 158. The key L is a listening key for connecting the operator's talking set with the cord G. The key L' is a calling device key, the purpose of which is to connect a calling device with the cord circuit, through the medium of which the operator may control the automatic switches to set up the proper connection. The calling device may be of any desired type, such, for instance, as that shown in British Patent No. 29,654 of 1910, above referred to, through the medium of which calling device the operator may interrupt the bridge across the trunk line a desired number of times for each of the digits of the number of the called subscriber.

Having given a general description of the apparatus, it will now be explained how a subscriber, such as the subscriber A, may establish connection with various subscribers who are accessible, first, through the connector I and then through the connector K. The connector I, for example, can be considered one which has access to local subscribers, as when connection is made through this connector, the meter of the calling subscriber's line is operated but a single time for each call. The connector K can be considered one which has access to subscribers at a more distant point, and when connection is established through such connector, the subscriber's meter is operated once for every predetermined period during which the connection is established.

Since the automatic switching apparatus disclosed is of a well-known type and is in general well known in the art, and is fully described in the patents and publications referred to, it is not thought necessary to describe the operations in detail, but their operations will be described in a more or less general manner.

When the subscriber at substation A removes his receiver from the switch-hook preparatory to making a call, the line winding 11 of the line switch C is closed in the well-known manner, and this line switch is then operated to connect with an idle trunk line extending to the selector E. This operation is well understood and is fully described in the British patents referred to, and it is accordingly thought unnecessary to describe its operation further. Upon this line switch seizing an idle trunk line, which we will assume to be the trunk line 32, 35, the line relay 40 of the selector E is energized over the following circuit: from ground G^3 through the lower half of the

line relay 40, springs 41 and 42 of the relay 68, springs 35 and 31, line conductor 15, springs 16 and 17 at the substation A, receiver 2, impulse springs 6 and 7, transmitter 3, springs 18 and 19, line conductor 20, springs 28 and 32, springs 43 and 44 of the relay 68 and the upper winding of the line relay 40 to battery B. A branch circuit at the substation A is formed from the spring 17 through the springs 23, impedance coil 12 and the springs 24 to the spring 18. A circuit may also be traced from ground G^2 through the relay 10, left-hand half of the impedance coil 12, springs 24, springs 18 and 19, line conductor 20, springs 28 and 32, springs 43 and 44 of the relay 68 and the upper winding of the relay 40 to battery B. The resistance of this circuit is sufficient to prevent the relay 10 from operatively energizing at this time. The line relay 40, upon becoming energized over the above circuits, closes a circuit through the relay 45 from ground G^4 through the springs 46 and 47 and the relay 45 to battery B. The relay 45, upon becoming energized, forms the holding circuit for the switch C, which circuit extends from ground G^5 through the springs 48, springs 33 and 29 and the holding winding 39 to battery B. The winding 39, upon energizing, holds the armature 36 and the plunger arm 27 in their operated positions after the circuit of the pull-in winding 25 is broken by the falling back of the armature 37. From the spring 29 a guarding potential is extended by the conductor 49 to the private bank contacts associated with the line switch C. The energization of the relay 45 also prepares a circuit for the vertical magnet 50 by bringing into engagement the springs 54 and 55 and opens the circuit of the release magnet 121 at the springs 54 and 119.

The calling subscriber now operates his calling device for the first digit 2 of the called number. It will readily be seen that the impedance coil 12, which was heretofore bridged across the line, is cut off at the springs 23 and the springs 24 at the instant that the dial is rotated by the subscriber, and that said impedance coil will not again be bridged across the line until all the impulses for the digit have been delivered. The substation impulse springs 6 and 7 are twice momentarily separated, each time breaking the circuit of the selector line relay 40. The relay 45 of the selector E being slow acting does not deënergize during the momentary interruptions of its circuit by the relay 40 and consequently, each time the latter relay deënergizes, an impulse is transmitted over a circuit extending from ground G^4 through the springs 46 and 52, springs 53, springs 54 and 55, relay 56 and the vertical magnet 50 to battery B. The vertical magnet receives two impulses over this circuit and operates to raise the switch shaft and wipers two steps to a position opposite the second row or level of bank contacts. The slow acting relay 56 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^6 through the springs 57 and 58 and the relay 59 to battery B. The relay 59, upon energizing, forms a locking circuit for itself extending from ground G^5 through the springs 48, springs 60, off-normal springs 61, springs 62 and 63^a and the relay 59 to battery B. Thus upon the deënergization of the relay 56 after the last impulse is delivered to the vertical magnet, the relay 59 remains energized and the circuit of the rotary magnet 51 is closed, which circuit extends from ground G^5 through the springs 48, springs 60, off-normal springs 61, springs 62 and 63^a, springs 58 and 63, springs 64 and the rotary magnet 51 to battery B. The rotary magnet, upon energizing, rotates the wipers one step and, by opening the springs 60 and the springs 64, disconnects ground G^5 from itself and the relay 59. If the first trunk line of the second level is idle, the relay 59 deënergizes as soon as the springs 60 are opened. If this trunk line is busy, however, the private wiper 66 finds the contact which it engages provided with a guarding ground potential which is transmitted through the springs 62 and 63^a of the relay 59 and prevents the relay 59 from deënergizing. The magnet 51, however, deënergizes when the springs 64 are broken, regardless of whether or not the relay 59 remains energized. If the relay 59 remains energized, the circuit of the rotary magnet will be again closed as soon as its armature drops back far enough to close the springs 64. 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 is reached by the wiper 66, whereupon the relay 59 deënergizes. The relay 59, upon deënergizing, whether after one or several operations of the rotary magnet, permanently breaks the circuit of said rotary magnet and closes the circuit of the switching relay 68, which circuit extends from ground G^5 through the springs 48, springs 60, off-normal springs 61, springs 62 and 69 and the relay 68 to battery B. The relay 68, upon energizing, disconnects the line relay 40 from the line and extends the line connection through the wipers 65 and 67 to the connector I. The line relay 70 of the connector I becomes engerized over a circuit extending from ground G^7 through the lower winding of the relay 70, conductor 71, bank contact 72, line wiper 67, springs 73 and 42 of the

relay 68, springs 35 and 31, line conductor 15, springs 16 and 17 of the substation A, receiver 2, impluse springs 6 and 7, transmitter 3, spring 18 and 19, line conductor 20, springs 28 and 32, springs 43 and 74 of the relay 68, line wiper 65, bank contact 75, conductor 76 and the upper winding of the line relay 70 to battery B. At the substation A a branch circuit is formed from the spring 17 through the springs 23, impedance coil 12 and the springs 24 to the springs 18. A circuit may also be traced from ground G^2 through the relay 10, left-hand half of the impedance coil 12, springs 24, springs 18 and 19, line conductor 20, springs 28 and 32, springs 43 and 74 of the relay 68, line wiper 65, bank contact 75, conductor 76 and the upper winding of the line relay 70 to battery B. The resistance of this circuit is sufficient to prevent the relay 10 from operatively energizing at this time. The energization of the line relay 70 closes a circuit through the relay 77 from ground G^8 through the springs 78 and 79 and the relay 77 to battery B. The energization of the relay 77 affords a new holding ground for the relay 68 of the selector E and the holding winding 39 of the line switch C to take the place of ground G^5, which is removed upon the deënergization of the relay 45. This holding circuit extends from ground G^9 through the springs 80, conductor 81, bank contact 82, private wiper 66, springs 62 and 69 and the relay 68 to battery B. A branch of this circuit also extends from the private wiper 66 through the off-normal springs 61, springs 60, springs 33 and 29 and the holding coil 39 to battery B. From the spring 29 the conductor 49 carries the guarding potential to the connector private bank contacts associated with the line switch C. The energization of the relay 77 also prepares the circuit of the vertical magnet 87 at the springs 84 and 85 and opens the circuit of the release magnet 118 at the springs 84 and 116. When the substation calling device is operated for the second digit 2, the circuit of the connector line relay 70 is broken twice. Since the relay 77 is slow acting it does not deënergize during the momentary interruptions of its circuit by the line relay 70, so that each time the latter relay is deënergized, a circuit is closed extending from ground G^8 through the springs 78 and 83, springs 84 and 85, relay 86, vertical magnet 87 and the side switch wiper (in first position) to battery B. The vertical magnet receives two impulses over this circuit and operates to raise the switch shaft and wipers 89, 90 and 91 to a position opposite the second level of bank contacts. The relay 86, which is included in the operating circuit of 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 94 from ground G^{10} through the springs 92 and 93 and the private magnet 94 to battery B. After the last impulse has been delivered, the relay 86 opens the circuit of the private magnet 94, which, upon deënergizing, permits the side switch to pass from first to second position. The movement of the side switch wiper 88 from first to second position transfers the battery connection from the vertical magnet to the rotary magnet.

The calling subscriber now operates his calling device for the last digit 2, in response to which the connector line relay 70 operates to transmit two impulses through the rotary magnet 96 in series with the relay 86 over a circuit extending from ground G^8 through the springs 78 and 83, springs 84 and 85, relay 86, springs 95, rotary magnet 96 and the side switch wiper 88 (in second position) to battery B. The rotary magnet thereupon rotates the shaft wipers onto the contacts of the called line, which called line we will assume is similar to the line to which the substation A is connected and is provided with a line switch similar to the switch C. The relay 86 operates in response to the impulses for this digit in the same manner as for the previous digit to cause the private magnet 94 to advance the side switch to third position. By the engagement of the side switch wipers 97 and 98 with their third-position contact points, the line connection is completed with the called line. Upon the engagement of the wiper 99 with its third-position contact point, a circuit is completed through the cut-off winding of the called line switch. The said circuit extends from ground G^{11} through the side switch wiper 99 (in third position), private wiper 90 and the cut-off winding of the called line switch to battery B. The cut-off winding of the called line switch, upon energizing, operates to disconnect the line relay from the called substation. The connection of ground G^{11} with the connector 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 88 with its third-position contact point, the circuit of the ringer relay 101 is closed. This circuit extends from ground G^{12} through the interrupter 100, ringer relay 101, springs 102 and the side switch wiper 88 (in third position) to battery B. The ringer relay disconnects the calling line from the called line and bridges the ringing current generator R^3 across the called line to signal the called subscriber. The ringer relay is energized only intermittently through the medium of the interrupter 100. Upon the response of the called subscriber his line is provided with talking

current through the windings of the back-bridge relay 103, which relay, upon energizing, closes a circuit through the ringer cut-off relay 104, the circuit extending from ground G^{11} through the side switch wiper 99 (in third position), springs 106 and the relay 104 to battery B. The relay 104, upon energizing, interrupts the circuit of the ringing relay at the springs 102 and closes a locking circuit for itself through the springs 105 independent of the springs 106. The instant that the side switch passes to third position a circuit is closed through the slow acting relay 108 as follows: from ground G^{11} through the side switch wiper 99 (in third position), springs 107 and the relay 108 to battery B. The relay 108, upon energizing, connects the coils 109 and 113 in series and connects battery B with a point between them. The back-bridge relay 103 being energized at this time, these coils 109 and 113 are bridged across the conductors of the talking circuit. A circuit is therefore closed from battery B, contact springs 115, 112 and 110, through the coils 109 and 113 in parallel, thence over the two sides of the talking circuit in parallel to the calling substation A, thence through the coils 12 to their mid point and then through the relay 10 to ground G^2. Sufficient current flows over this parallel circuit to cause the relay 10 to energize and it therefore operates to advance the counting mechanism one step. It will be seen that when the ring cut-off relay 104 energizes, the circuit of the relay 108 is broken at the springs 107. The relay 108 is made slow acting so that it may remain energized long enough to send an impuse of current over the simplex circuit sufficient to operate the meter at the substation A. Upon the deënergization of the relay 108 the simplex circuit is broken at the springs 110, 112 and 115 and the relay 10 at the substation A returns to normal.

After the conversation is completed, the connection is released by the hanging up of the receiver at the calling substation in the usual and well-known manner, which it is not thought necessary to here describe in detail.

If the called line had been busy when the connector wipers landed on the bank contacts of the called line, then the side switch would not have passed to third position and connection therefore would not have been established with the called line. The busy machine Q^3 would also have been connected with the calling line, all in a manner well understood in the art. The calling subscriber, upon hearing the busy signal, replaces the receiver upon the hook, whereupon the switches are released in the regular manner.

Should, now, the subscriber at substation A wish to establish connection with a line which is accessible from the connector K (Fig. 3), he would proceed in the same manner as above outlines, except that he would operate his calling dial for a first digit 3 instead of 2, thereby raising the first selector to the third level of bank contacts which are connected to a group of connectors, one of which is indicated at K. Upon the subscriber at the substation A calling the last two digits of the called number, the action of the connector K is the same as explained for the connector I, except that as soon as the side switch 288 passes to third position, a circuit is closed through the relay 208, said circuit extending from ground through the relay 208 and the side switch wiper 288 (in third position) to battery B. By means of clockwork M the ground connection to the relay 208 is broken at regular intervals of time. When the back-bridge relay 203 becomes energized, due to the called subscriber removing his receiver, the coils 209 and 213 are connected one to each side of the calling line in the same manner as is described in connection with the coils 109 and 113 of the connector I. Each time the mechanism M completes the circuit of the relay 208, the springs 210, 212 and 125 will be closed, thus completing the circuit between the coil 209 and the coil 213 and placing battery B between them. As a result the relay 10 at the substation A is energized over the simplex circuit and causes the counting mechanism to advance one step for each impulse sent out from the mechanism M. In this way the meter at the substation A will be operated in proportion to the length of time that the subscriber at the substation A converses with the called subscriber, instead of being operated but once, as in connection with the connector I.

If, now, the subscriber at the substation A wishes to extend a connection through the manual board L, he proceeds as heretofore described, except that he operates his calling dial for a first digit 1, whereby the selector E is raised to the first level from which extend trunk lines to the manual board L, each of which trunk lines includes a group of relays F. When the selector thus extends a connection to the group of relays F, a circuit may be traced from ground G^{14} through the coil 141, springs 142 and 143, conductor 140, bank contact 137, line wiper 67 to and through the substation A, over the circuit previously traced and back to the line wiper 65, through the bank contact 135, conductor 138, springs 145 and 144 and the relay 146 to battery B. The relay 146, upon energizing, forms a holding circuit for the relay 68 of the selector E and the holding winding 39 of the line switch C from ground G^{15} through the springs 147, conductor 139, bank contact 136, private wiper 66 and continuing over the circuit previously traced to bat-

tery B. The energization of the relay 146 also closes a circuit through the lamp 149 as follows: from ground G^{15} through springs 148 and the lamp 149 to battery B. The operator, upon seeing the lamp 149 lighted, plugs into the jack N with the answering plug P. The engagement of the sleeve of the plug P with the bush of the jack N closes a circuit through the cut-off relay 150. The cut-off relay, upon energizing, cuts off the relay 146 and the coil 141 and extends the lines to the cord circuit G. A circuit may now be traced from ground G^{16} through the relay 151, ring of the plug P and ring spring of the jack N, springs 152 and 143, conductor 140 to and through the substation A, over the circuit previously traced and back to the conductor 138, springs 145 and 153, tip spring of the jack N and tip of the plug P and the coil 154 to battery B. The tip of the plug P also forces the springs 155 into engagement, which connects ground G^{17} in the holding circuit for the relay 68 of the selector E and the holding coil 39 of the line switch C before traced. The relay 146 is made slow acting so that ground G^{15} will not be removed until time has been given for the plug P to be forced clear into the jack N. When the plug P was removed from the plug seat switch 156, the lamp 157 was lighted. The lamp went out, however, as soon as the relay 151 was energized. The operator will now depress her listening key and converse with the subscriber at the substation A. Upon learning that he desires connection with the substation A′, the number of which we will assume to be 22, the operator removes the plug P′ from the plug seat switch 158 and touches the tip of said plug to the bush of the outgoing jack H. If a multiple of the jack H be busy, or should a selector have seized that trunk, the bush will have a guarding potential upon it which will give the operator a click in her receiver when she places the tip of the plug P′ against the bush, due to the discharge of the condenser 159. Assuming that the trunk to which the jack H is connected is idle, the operator then forces the plug P′ into the jack H, which extends the line connection to the connector J over the conductors 162 and 164. Immediately the connector J returns a guarding ground over the conductor 163 to the bush of the jack H. Upon removing the plug P′ from the plug seat switch 158, the lamp 160 is lighted and remains lighted until the called subscriber answers. The operator now operates the key L′ to bridge her calling device 161 across the conductors 162 and 164. She then operates her calling device for the digit 2 twice, as a result of which the connector J operates to extend the connection to the called substation exactly as explained in the description of the connector I. The operator now restores the key L′ to normal, bridging the relay 165 across the conductors 162 and 164. The resistance and construction of the relay 165 is such that it will not operatively energize with the current received through the connector line relay 370, although the said connector line relay is energized over this circuit. When the back-bridge relay 303 energizes, due to the called subscriber removing his receiver, the relay 309, by means of the springs 311, is placed between battery B and the conductor 162 in parallel with the upper winding of the relay 370. The relay 309 immediately energizes and closes the springs 312. It will now be readily seen that the relay 309 in series with the coil 313 is bridged across the conductors 162 and 164 and that the battery B is connected to a point between the relay 312 and the coil 313. As a result, current will flow from ground G^{19} through both windings of the relay 165, both sides of the line in parallel and the relay 309 in parallel with the coil 313 to battery B. The relay 165 will be energized over the above circuit, thus opening the circuit of the lamp 160 at the springs 166. The extinguishing of the lamp 166 notifies the operator that the called subscriber has answered, whereupon the operator depresses the key L^2, which sends an impulse through the impedance coil 167 over the simplex circuit previously traced to operate the meter at the substation A.

When the conversation is completed and the calling subscriber hangs his receiver upon the switchhook, the circuit through the relay 151 is broken. The relay 151, upon deënergizing, again closes the circuit of the lamp 157. When the called subscriber replaces his receiver upon the switchhook, the circuit of the back-bridge relay 303 is broken. The deënergization of the relay 303 removes the relay 309 and the relay 313 from across the line. This causes the relay 165 to deënergize and again light the lamp 160. The operator, noticing the lamps 157 and 160 glowing, knows that the conversation has been completed and removes the plugs P and P′ from their respective jacks N and H. The removal of the plug P takes ground from the relay 68 and the holding coil 39, whereupon the release of the selector E and the line switch C follows, in the manner well understood in the art. The removal of the plug P′ from the jack H likewise causes the connector J to release.

At the substation A′ (Fig. 5) we have shown a modified arrangement in which the magnet 10′, instead of operating a registering or counting mechanism, as does the magnet 10 in Fig. 1, controls a coin-controlled mechanism. This magnet 10′ is connected in the simplex circuit in the same manner as is the magnet 10 heretofore described. Accordingly, when the subscriber

A′ extends a connection through a connector, such as the connector J, this magnet 10′ is included in the simplex circuit as soon as the back-bridge relay 303 of the connector J is operated, in the manner heretofore described. This magnet 10′, upon operating, closes a short-circuit around the transmitter 3′ and a shunt circuit around the receiver 2′. As a result, the subscriber at the substation A can hear the called subscriber answer, but will be unable to converse with him either through the transmitter or the receiver. Thereupon the subscriber at the substation A deposits a coin in the slot, said coin causing the arm 168 to be freed from the armature 169. The freeing of the arm 168 removes the shunt from the receiver 2′ and the short-circuit from the transmitter 3′ even though the relay 10 remains energized, thus allowing the subscribers to converse.

It will thus be seen that we have devised a very efficient system in which a simplex circuit can be employed for operating varying forms of measured service devices or for supervisory purposes. While for the purpose of illustration and to more fully describe the application of our invention, we have shown the same in connection with automatic apparatus of well-known types, it will readily be apparent to those skilled in the art that our invention is equally as well adapted for use in connection with many other forms of automatic apparatus: Likewise, the particular form of manual apparatus shown in Fig. 4 could be modified to suit varying requirements.

What we claim as our invention is:—

1. In a telephone system, a plurality of subscribers' lines, means including automatic switches for establishing a talking circuit between two of said lines, said talking circuit including a pair of talking conductors, means controlled by the response of the called subscriber for closing a circuit including the two sides of said talking circuit in parallel, and a measured service device controlled over said circuit.

2. In a telephone system, a plurality of subscribers' lines, means including automatic switches for establishing a talking circuit between two of said lines, said talking circuit including a pair of talking conductors, means controlled by the response of the called subscriber for closing a circuit including the two sides of said talking circuit in parallel, and a coin-controlled device controlled over said circuit.

3. In a telephone system, a plurality of subscribers' lines, means including automatic switches for establishing a talking circuit between two of said lines, said talking circuit including a pair of talking conductors, means controlled by the response of the called subscriber for closing a circuit including the two sides of said talking circuit in parallel, and a counting or registering mechanism controlled over said circuit.

4. In a telephone system, a plurality of normally disconnected subscribers' lines, means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, and means controlled by the response of the called subscriber for automatically connecting battery to a mid point of said second bridge to thereby close an energizing circuit through said magnet, and a measured service device controlled by said magnet.

5. In a telephone system, a plurality of normally disconnected subscribers' lines, means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, a battery adapted to be connected to said second bridge, and means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet, and a measured service device controlled by said magnet.

6. In a telephone system, a plurality of normally disconnected subscribers' lines, means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, a battery adapted to be connected to said second bridge, means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet, a measured service device controlled by said magnet, and means for intermittently breaking the connection of battery to said second bridge.

7. In a telephone system, a plurality of normally disconnected subscribers' lines, means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet, a measured service device controlled by said magnet, and means for momentarily connecting battery to said second bridge.

8. In a telephone system, a plurality of

subscribers' lines, means including automatic switches for establishing a talking circuit between two of said lines, said talking circuit including a pair of talking conductors, electromagnetic means controlled by the response of the called subscriber for closing a circuit including the two sides of said talking circuit in parallel, and a measured service device controlled over said circuit.

9. In a telephone system, a plurality of subscribers' lines, means including automatic switches for establishing a talking circuit between two of said lines, said talking circuit including a pair of talking conductors, electromagnetic means controlled by the response of the called subscriber for closing a circuit including the two sides of said talking circuit in parallel, and a coin-controlled device controlled over said circuit.

10. In a telephone system, a plurality of subscribers' lines, means including automatic switches for establishing a talking circuit between two of said lines, said talking circuit including a pair of talking conductors, electromagnetic means controlled by the response of the called subscriber for closing a circuit including the two sides of said talking circuit in parallel, and a counting or registering mechanism controlled over said circuit.

11. In a telephone system, a plurality of normally disconnected subscribers' lines, means including automatic switches for establishing a talking circuit between two of said lines, said talking circuit including a pair of talking conductors, means controlled by the response of the called subscriber for closing a circuit including the two sides of said talking circuit in parallel, mechanical means controlled over said circuit, and a pay station device controlled by said mechanical means.

12. In a telephone system, a plurality of normally disconnected subscribers' lines, electromagnetic means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, electromagnetic means for automatically connecting battery to a mid point of said second bridge to thereby close an energizing circuit through said magnet, and a meter controlled by said magnet.

13. In a telephone system, a plurality of normally disconnected subscribers' lines, electromagnetic means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, a battery adapted to be connected to said second bridge, electromagnetic means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet, and a coin collecting device controlled by said magnet.

14. In a telephone system, a plurality of normally disconnected subscribers' lines, electromagnetic means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, a battery adapted to be connected to said second bridge, electromagnetic means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet, electromagnetic means for intermittently breaking the connection of battery to said second bridge, and a measured service device controlled by said magnet.

15. In a telephone system, a plurality of normally disconnected subscribers' lines, electromagnetic means for establishing connection between two of said lines, a bridge across the calling line and individual thereto, a magnet connected from the mid point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, electromagnetic means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet, and electromagnetic means for momentarily connecting battery to said second bridge, and a measured service device controlled by said magnet.

16. In a telephone system, a plurality of normally disconnected subscribers' lines, a meter on one of said lines, automatic progressively movable switches for connecting two of said lines, a bridge across the calling line, a magnet connected from the mid-point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, and means for automatically connecting battery to a mid-point of said second bridge to thereby close an energizing circuit through said magnet for controlling said meter.

17. In a telephone system, a plurality of normally disconnected subscribers' lines, a measured service device on one of said lines, automatic progressively movable switches for connecting two of said lines, a bridge across the calling line, a magnet connected from the mid-point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, a battery adapted to be connected to said second

bridge, and means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet for controlling said measured service device.

18. In a telephone system, a plurality of normally disconnected subscribers' lines, a measured service device on one of said lines, automatic progressively movable switches for connecting two of said lines, a bridge across the calling line, a magnet connected from mid-point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, a battery adapted to be connected to said second bridge, means controlled by the response of the called subscriber for closing said second bridge to thereby cause the operation of said magnet for controlling said measured service device, and means for intermittently breaking the connection of battery to said second bridge.

19. In a telephone system, a plurality of normally disconnected subscribers' lines, a coin collecting device on one of said lines, automatic progressively movable switches for connecting two of said lines, a bridge across the calling line, a magnet connected from the mid-point of said bridge to ground, a second bridge adapted to be placed across the conductors of the talking circuit, electromagnetic means for automatically connecting battery to a mid-point of said second bridge to thereby close an energizing circuit through said magnet for controlling said coin collecting device.

Signed by us at Chicago, Illinois, this 25th day of November, 1913.

GEORGE A. YANOCHOWSKI.
HARRY E. HERSHEY.

Witnesses:
H. W. KRACKE,
B. GARBER.