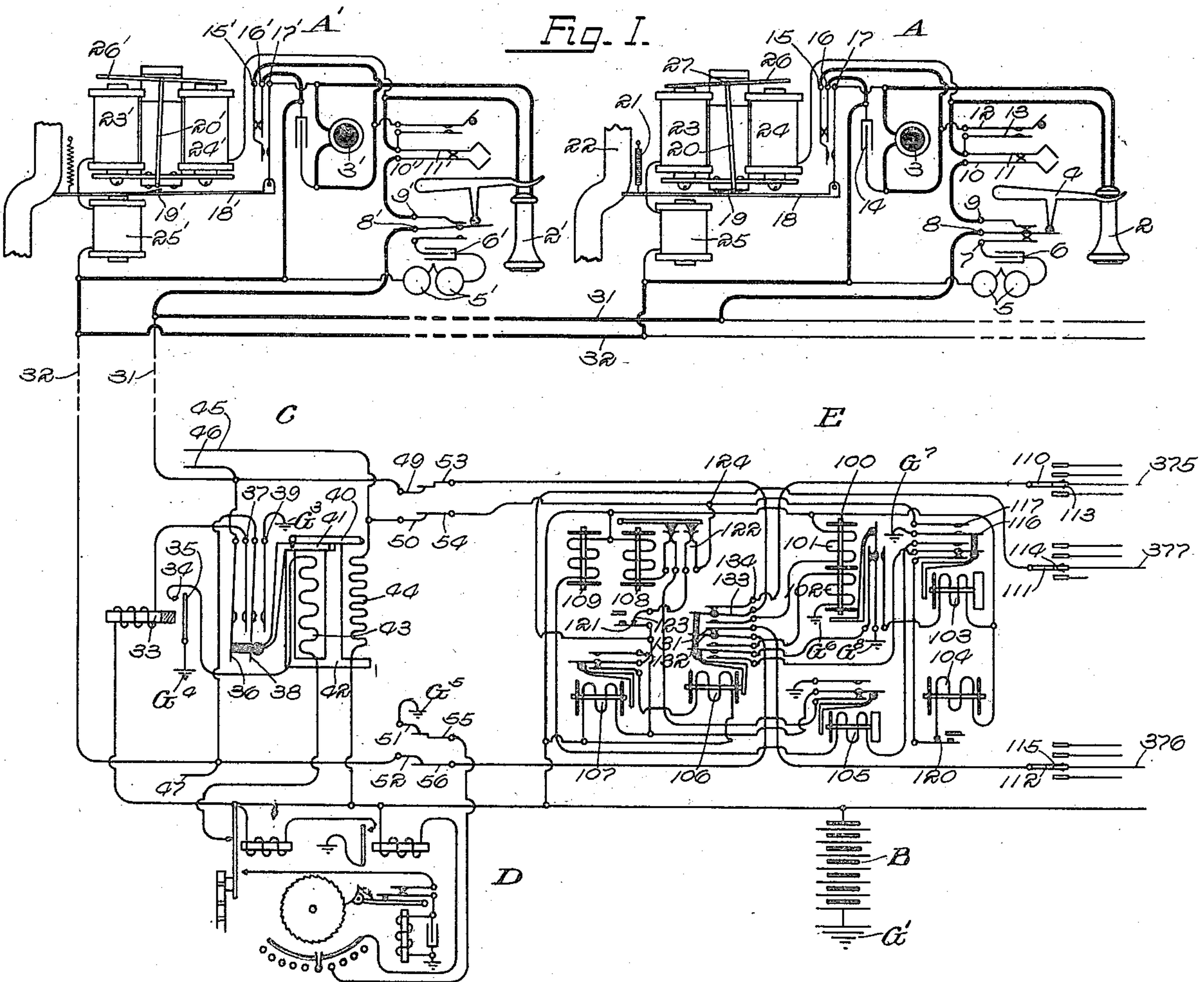


1,293,620.

W. T. POWELL,
AUTOMATIC TELEPHONE SYSTEM.
APPLICATION FILED FEB. 14, 1916. RENEWED JUNE 15, 1918.

Patented Feb. 4, 1919.
2 SHEETS—SHEET 1.



Witnesses
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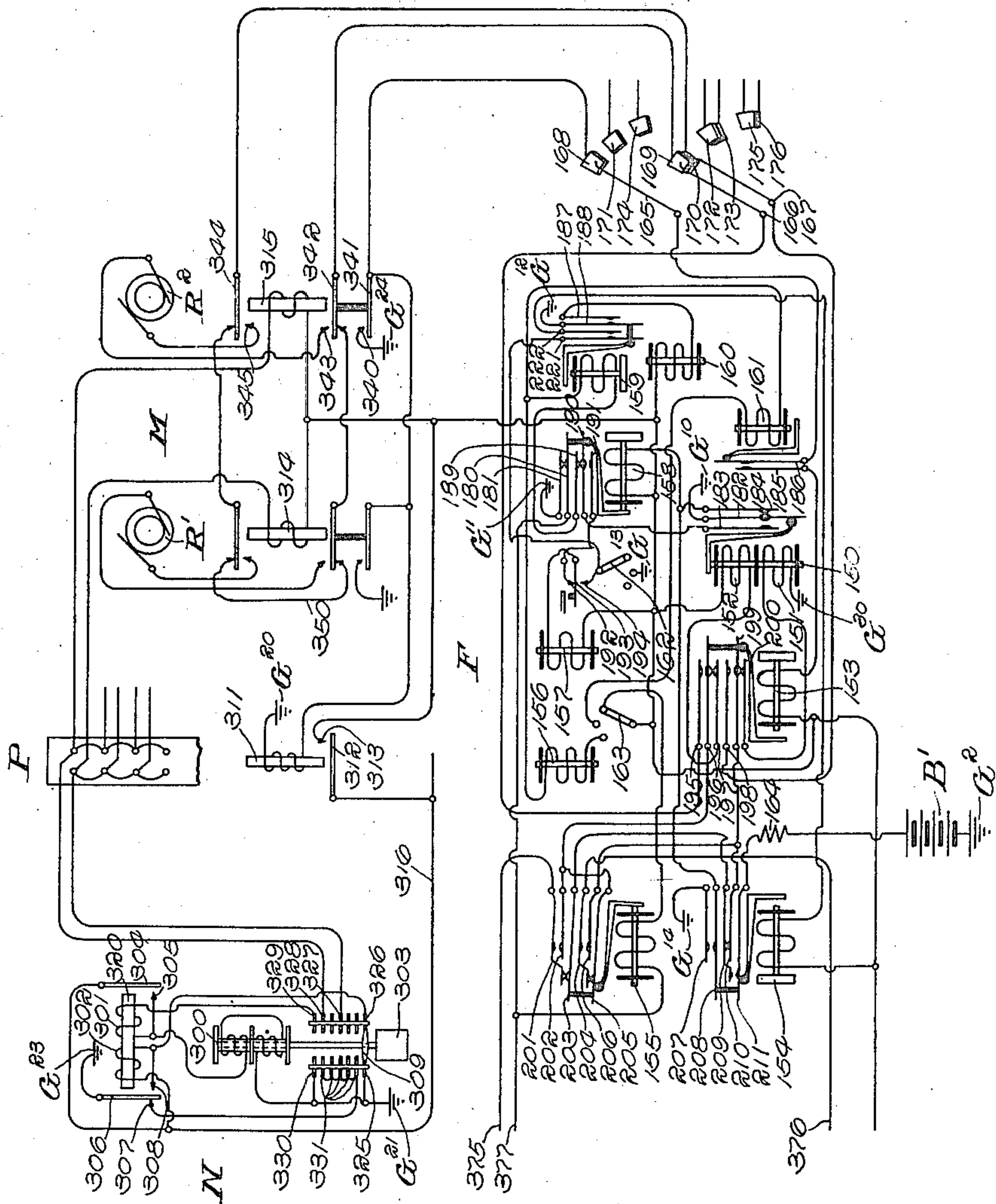
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2 SHEETS—SHEET 2.

Fig. 2.



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AUTOMATIC TELEPHONE SYSTEM.

1,293,620.

Specification of Letters Patent.

Patented Feb. 4, 1919.

Application filed February 14, 1916, Serial No. 78,164. Renewed June 15, 1918. Serial No. 240,250.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States of America, and a resident of Chicago, Cook county, and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to automatic telephone systems and more particularly to those systems which are made up, in part at least, of poly-station lines equipped for prepayment service.

In systems of the above character it is customary to use coin collecting devices provided with a polarized relay which is operated by reversing the direction of current flow in the line at the proper time in order to render the telephone instrument inoperative for talking purposes. The reversal of current flow is generally brought about by the response of the called subscriber; and, while the calling telephone is, as before stated, rendered inoperative, it is not completely so, for the calling subscriber is enabled to hear the called subscriber answer. He may then deposit a coin of the correct denomination whereby his instrument is restored to its original operative condition.

The above described method of collecting for telephone calls is well suited to systems composed entirely of individual lines, or systems composed partly of polystation lines where it is not required to collect for conversations between two subscribers on the same line. If, however, in the latter system, it is desired to collect for all calls, certain difficulties appear which it is the object of my invention to overcome.

The problem to be solved arises from the fact that in a talking connection between two subscribers on the same line, both instruments are in the same relation to the line extending to the exchange. It follows that if the direction of current flow in the line is reversed both instruments will ordinarily be affected in the same way and both calling and called subscribers will be required to deposit a coin. Such a condition would clearly be very objectionable; for, aside from the fact that the connection would be paid for twice, the called subscriber would not often be willing to pay for a connection which he did not originate.

My invention provides simple and efficient

means whereby a poly-station subscriber, having been signaled by another subscriber on his line, is enabled to answer and converse without depositing a coin, the calling subscriber, however, being required to deposit his coin in the regular manner.

To accomplish the foregoing and other useful ends my invention comprises means which will be hereinafter fully described, reference being had to the accompanying drawings which, when taken in order with the lines at the ends thereof in alinement, represent diagrammatically the apparatus and circuits used for completing a talking connection between two substations on the same poly-station line in a system embodying the principles of my invention.

Referring now to Figure 1, I have shown diagrammatically at A and A' two substations which may be of the general type of substation shown in British patent to T. G. Martin, No. 1419 of 1910. The substation A consists essentially of the receiver 2, transmitter 3, switch hook 4, ringer 5, and condenser 6. Being an automatic substation it is also provided with a pair of impulse springs 10 and 11 controlled through the medium of an impulse cam and finger hole dial (not shown). A pair of shunt springs 12 and 13, closed whenever the finger hole dial is moved from its normal position, is provided for the purpose of shunting the transmitter and receiver while sending impulses. Associated with the substation A is shown a coin collecting device which comprises among other details a polarized relay having the windings 23 and 24, a marginal magnet 25, and a coin chute 22. The lever 18 is normally held by the spring 21 against the upper edge of a slot in the coin chute 22 through which it projects, in which position the arm 20 is adapted to engage the detent 19 on the lever 18. Arm 20 is rigidly attached to the armature 26 which is pivoted at 27 and which is controlled by the windings 23 and 24 of the polarized relay. The lever 18, when moved to the left by arm 20 through the medium of detent 19, is adapted to close contact springs 15 and 17 and to separate contact springs 15 and 16. The magnet 25, when sufficiently energized, is capable of attracting the lever 18 against the tension of spring 21, thereby removing the detent 19 from the path of arm 20.

Substation A' may be substantially like

substation A, except for the ringer 5' which is somewhat different from ringer 5, the two ringers being adapted to respond to different kinds of ringing current. The principle of selection depends preferably on what is commonly known as the "harmonic system," in which the ringers are tuned to respond to different frequencies of ringing current.

The line conductors 31 and 32, to which the two substations are connected in parallel, extend to the exchange where they terminate in the individual line switch C, which is of the general type disclosed in British patent to R. W. James, No. 26301 of 1906; being, however, more nearly of the particular type shown in U. S. Letters Patent No. 1,078,690, granted Jan. 17th, 1912 to Frank Newforth.

The line switch comprises among other details a plunger (not shown) attached to the end of a so-called plunger arm 40. The plunger arm 40 and the cut-off armature 41 are controlled by the magnet 42 which has two windings; one of which, the pull in winding 43, operates both the plunger arm and the cut-off armature; while the other, the holding winding 44, is only strong enough to operate the cut-off armature and to hold the plunger arm in an operated position after it has been operated by the pull in winding. When the plunger arm is operated, the plunger is forced into a bank of contact springs forcing the springs 49, 50, 51, and 52 into engagement with contacts 53, 54, 55, and 56, respectively. Although only one set of springs and contacts (49 to 56 inclusive) is shown, it is understood that each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line extending to a selector switch. Each trunk line is connected in multiple with the corresponding contacts of all the line switches of the group which is controlled by the master switch D. The conductors 45, 46, and 47, are normal wires provided for the purpose of enabling other lines in the exchange to connect with the line to which line switch C is individual. These conductors extend to multiple contact sets in the banks of connector switches (not shown) adapted to connect with the group of lines of which the line of substation A is one. The line switch C is initially controlled by the subscriber through the medium of the line relay 33.

The master switch D is of the general type disclosed in British patent to R. W. James, No. 26,301 of 1906; being, however, more nearly of the particular type disclosed in British patent to T. G. Martin, No 1419 of 1910. The function of the master switch, as is well known, is to maintain the plungers of all the idle line switches in position before the terminals of an idle trunk line.

The line switch C has access, through its bank of contact springs, to a group of se-

lector switches, one of which is shown at E. The selector E may be of the general type of selector switch disclosed in U. S. Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson; except that the so-called side switch is omitted, and the circuits are modified to enable 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. 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 110, 111, and 112 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 109, and a rotary movement controlled by the rotary magnet 108. The operation of the various parts of the switch is controlled through the medium of the double wound line relay 100. Means for permitting the switch to be restored to normal position is provided in the release magnet 104 which, upon energizing, withdraws the retaining pawls from the shaft. The contacts 120 and 121 are closed only when the shaft has been raised one or more steps from its normal position. The relays 103 and 105 are slow acting.

The selector switch E has access through certain of its bank levels to similar selectors by means of which connections may be extended toward the lines of other subscribers in the exchange, and it also has access through a separate bank level to a group of frequency selectors one of which is shown at F (Fig. 2). The frequency selector F has access in common with others of the same group, to the ringing relays shown at M which are controlled by the solenoid interrupter N. The ringing equipment comprising the frequency selector F, the ringing relays M, and the interrupter N, is similar to the ringing equipment shown in Australian Patent No. 13399 of 1914, although the circuits of the frequency selector F are modified somewhat to enable it to operate in accordance with the principles of my invention.

Among other details the frequency selector F comprises a plurality of sets of contacts arranged in a horizontal circular bank and which are adapted to be engaged by the wipers 165, 166, and 167 carried upon a shaft (not shown) which has a rotary movement controlled by the rotary magnet 156. The operation of the various parts of the switch is controlled by the double wound line relay 150. A side switch comprising the wipers 162 and 163 is controlled by the private magnet 160 in the usual manner. Means for permitting the switch to be restored to its normal position is provided in the release magnet 157 which, upon energizing, withdraws the retaining pawl from

the shaft and restores the side switch to its first or normal position. The relays 153, 154, 158, and 159 are slow acting and together with relay 155 will be more fully described later.

Each set of contacts in the bank of the frequency selector F is extended over a set of three conductors to a group of ringing relays such as the relays M (Fig. 2). The ringing current generators R' and R² deliver ringing currents of different frequencies corresponding to the frequencies to which the ringers 5 and 5' of the substations A and A' will respond. Since I have shown but two substations one set of ringing relays will be sufficient to enable the subscribers at these substations to signal each other, but it is understood that a poly-station line may have more than two substations connected thereto; and I have shown therefore two additional sets of contacts indicated by reference characters 171, 172, and 173, and 174, 175, and 176, for the purpose of giving the frequency selector F access to additional ringing current combinations.

At N I have shown a solenoid interrupter which comprises among other details a solenoid 300 which is adapted to raise a contactor 309 to the level of its uppermost set of contacts, after which the energizing circuit of the solenoid is broken and the contactor descends to the bottom level of contacts, whereupon the operation is repeated. The reference character 303 indicates a dash pot or equivalent device for retarding the movement of the contactor. At P I have shown a connecting block by means of which the interrupter N may be made common to a number of groups of ringing relays.

At B I have shown a battery for supplying operating and talking current having its positive pole grounded at G'. At B' I have shown a second battery having its negative pole grounded at G². The purpose of battery B' will be explained in the detailed specification.

Having given a general description of the apparatus I will now explain the operation of the system shown herein. It will be explained how the subscriber at substation A may, by suitable manipulation of his instrument, actuate the signal bell at substation A'. It will be explained further how the subscriber at substation A' may remove his receiver and converse with the subscriber at substation A without having to deposit a coin; the latter subscriber, however, being required to deposit his coin in the regular manner. Since much of the automatic apparatus shown herein is well known in the art, having been fully described in the publications above referred to, its operation will be described in a more

or less general manner, the details being given only where they have to do with the operation of my invention.

Referring now to Fig. 1, the subscriber at substation A, upon removing his receiver to initiate a call, completes an energizing circuit for the line relay 33 of the individual switch C over the following path: ground at G³, contact springs 39 and 38, and line conductor 32 to one terminal of magnet 25, substation A, where the circuit divides, one branch extending by way of magnet 25 and coils 23 and 24 of the polarized relay to impulse spring 11, and the other branch extending by way of contact springs 16 and 15, transmitter 3 and receiver 2 to impulse spring 11, where the two branches unite and extend by way of impulse springs 11 and 10, switch hook springs 9 and 8, line conductor 31, contact springs 36 and 37, and winding of line relay 33 to battery B. The line relay 33 is energized over the above circuit and, upon attracting its armature 35, completes a circuit for the pull-in winding 43. The pull-in winding, upon energizing its core, attracts the plunger arm 40 and the cut-off armature 41; the former, by means of its plunger, forcing the springs 49—52, inclusive, into engagement, respectively, with contacts 53—56, inclusive; and the latter disconnecting the line conductors 32 and 31 from ground and battery, respectively, by separating contact springs 38 and 39, and 36 and 37.

By the engagement of springs 49 and 52 with contacts 53 and 56, respectively, the line conductors 31 and 32 are extended to the double wound line relay 100 of the selector E. The line relay 100 thereupon is energized over a path which includes contact springs of the line switching relay 106, bank contacts and springs of the individual switch C, and the previously described circuit through substation A. Upon attracting its armature, the line relay 100 completes a circuit from ground at G⁸ for the slow acting relay 103, which relay, upon energizing, prepares circuits for the vertical and rotary magnets 108 and 109 in the well known manner, and also completes a holding circuit for the line switch C which may be traced as follows: ground at G⁷, contact springs 116 and 117, contact 54, spring 50 and holding winding 44 of line switch C to battery B. Although the circuit of the line relay 33 has already been broken it retains its armature until after the above described circuit has been established. A branch of the holding circuit extends over conductor 45 to multiple test contacts in the banks of connectors having access to the line of substation A, whereby a ground potential is established on these test contacts making said line busy. By the engagement of spring 51 with con-

tact 55 ground at G^5 is extended to the contact in the master switch bank which corresponds to the trunk line seized by the line switch C, thereby operating the master switch to move the plungers of the other idle line switches of the group to the next idle trunk in the well known manner.

The foregoing operations have all occurred in response to the removal of the receiver from the hook. The subscriber at substation A may now operate his dial in accordance with the digit corresponding to the level of the selector E in which are located contacts which are terminals of the groups of frequency selectors, thereby breaking the continuity of his loop a number of times at the impulse springs 10 and 11. As a result of these interruptions the line relay 100 is deenergized a corresponding number of times, sending an impulse at each deenergization from ground at G^8 to the slow acting relay 105 and the vertical magnet 109 in series. The vertical magnet, in response to these impulses, steps up the shaft until the wipers stand opposite the desired horizontal level. The relay 105, being slow acting, retains its armature during the series of impulses and closes a circuit for the test relay 107, which relay locks itself from ground at G^7 and closes contact springs in the rotary magnet circuit. At the end of the series of impulses the relay 105 deenergizes, thereby completing the circuit for the rotary magnet 108, whereupon the wipers 110, 111, and 112 are started rotating in search of a trunk line extending to an idle frequency selector. As is well known, the rotary magnet interrupts its own circuit and also the locking circuit of the test relay at every energization, the contacts in the latter circuit, however, being short circuited by the test wiper 111 while passing over busy or grounded test contacts. As soon, therefore, as the test wiper reaches an ungrounded test contact the test relay 107 falls back and opens the rotary magnet circuit, thereby bringing the wipers to rest upon the contacts of an idle frequency selector, assumed in this case to be the one shown at F (Fig. 2). The test relay 107, upon deenergizing, completes a circuit for the line switching relay 106, which latter relay, upon energizing, disconnects the line conductors from the line relay 100 and extends them, by way of wipers 110 and 112, bank contacts 113 and 115, conductors 375 and 376, and contact springs of relays 155 and 153 to the double wound line relay 150 of the frequency selector F.

The line relay 150 thereupon energizes over the previously traced circuit through the subscriber's loop and by attracting its armature completes a circuit from ground at G^{10} to the slow acting relay 158. Relay 158, upon energizing, prepares a circuit for the rotary magnet 156, and also completes a

new holding circuit which may be traced as follows: ground at G^{11} , contact springs 181 and 180, conductor 377, bank contact 114, and wiper 111 to off normal contact spring 121, where the circuit divides, one branch extending by way of contact springs of the test relay 107 and winding of the line switching relay 106 to battery B, and the other branch extending by way of contact 123 and interrupter contact 122 to wire junction 124, where it joins the previously described holding circuit for line switch C.

The subscriber at substation A may now operate his dial in accordance with the digit which corresponds to the position of the required set of contacts in the bank of the frequency selector. It is understood of course, that each poly-station subscriber has been instructed as to the proper numbers to call to signal each of the other parties on his line. As before, the operation of the dial results in interruptions of the line circuit, which interruptions result, in this case, in corresponding deenergizations of the line relay 150. At each deenergization the line relay sends an impulse to the slow acting relay 159 and the rotary magnet 156 in series over the following path: ground at G^{10} , contact springs 182 and 183, contact springs 190 and 189, winding of relay 159, winding of rotary magnet 156, and side switch wiper 163 in its first position to battery B. Since the ringing relays shown herein are connected to the first set of bank contacts, the final digit to be called is 1, and the rotary magnet receives one impulse, in response to which the wipers 165, 166 and 167 are rotated into engagement, respectively, with bank contacts 168, 169, and 170. The slow acting relay 159, as before stated, is energized in series with the rotary magnet and, upon attracting its armature, completes a circuit for the private magnet 160 as follows: ground at G^{12} , contact springs 188 and 187, and winding of private magnet 160 to battery B. At the end of the impulse or series of impulses, as the case may be, the slow acting relay 159 deenergizes, thereby breaking the circuit of the private magnet which in turn deenergizes and allows the side switch wipers to advance to their second position in the well known manner.

Connection has now been established with the group of ringing relays M. The next act of the subscriber at substation A is to hang up his receiver, thereby breaking the circuit of the line relay 150 by opening switch hook contact springs 8 and 9. Upon deenergizing, the line relay 150 completes a circuit for relays 161 and 159 which may be traced as follows: ground at G^{10} , contact springs 182 and 183, contact springs 190 and 189, winding of slow acting relay 159, winding of relay 161, and side switch wiper

163 in its second position to battery B. Upon energizing, relay 159 again completes the energizing circuit of the private magnet, and also (side switch wiper 162 being in its second position) completes a circuit including relay 154 as follows: ground at G^{18} , side switch wiper 162 in its second position, contact springs 221 and 222, and winding of relay 154 to battery B. Relay 154, upon energizing, completes a new circuit from ground at G^{14} for slow acting relay 158, and also prepares a circuit for the booster battery B'.

Relay 161, energized in series with relay 159, as before stated, completes a circuit for the starting relay 311 as follows: ground at G^{20} , winding of relay 311, bank contact 168, wiper 165, contact springs 186 and 185, and winding of relay 153 to battery B. Relay 153 is a marginal relay and will not operate in series with relay 311, which is preferably of high resistance. Relay 311, upon attracting its armature, completes an initial energizing circuit for winding 302 of relay 320 of the interrupter N over the following path: ground at G^{21} , contact 325, contactor 309, contact 326, winding 302 of relay 320, common conductor 316, armature 312, and contact 313 to battery B. Relay 320, upon energizing, completes an independent circuit for its winding 302 by means of armature 306 and contact 308, and also completes a circuit for the solenoid 300 as follows: ground at G^{21} , windings of solenoid 300, contact 305, armature 304, common conductor 316, armature 312, and contact 313 to battery B. Upon energizing the solenoid 300 raises the contactor 309, thereby short circuiting in succession each of the sets of opposite interrupter contacts, but without effect at this time, however, for the multiple contacts 331 are dead.

As the contactor reaches its extreme upward position it connects contacts 329 and 330, thereby completing a circuit for the winding 301 of relay 320 as follows: ground at G^{21} , contact 330, contactor 309, contact 329, winding 301 of relay 320, contact 305, armature 304, common conductor 316, armature 312, and contact 313 to battery B. Relay 320 is differentially wound and accordingly retracts its armature thereby breaking the circuits of both its windings and also the circuit of the solenoid 300. Upon the cessation of current flow in the solenoid 300, the contactor 309 descends to its normal position.

In passing contact 328 a circuit is momentarily completed for the ringing relay 315 as follows: ground at G^{23} , armature 306, contact 307, multiple contact 331, contactor 309, contact 328, connecting block P, and winding to relay 315 to battery B. Upon energizing, relay 315 short circuits the high resistance relay 311 by means of contact 340

and armature 341 thereby energizing relay 153 over a circuit which has been described. At the same time relay 315 completes a circuit including the ringing current generator R^2 which may be traced as follows: upper brush of ringing generator R^2 , contact 345, armature 344, bank contact 170, wiper 167, contact springs 198 and 199, contact springs 206 and 204, conductor 376, bank contact 115, wiper 112, contact springs 131 and 132, contact 56, spring 52, line conductor 32, ringers 5 and 5' and condensers in series therewith in parallel (both receivers being hung up), line conductor 31, spring 49, contact 53, contact springs 133 and 134, wiper 110, bank contact 113, conductor 375, contact springs 201 and 202, contact springs 196 and 195, wiper 166, bank contact 169, armature 342, and contact 343 to the lower brush of ringing generator R^2 . Ringer 5' responds to ringing current in the above circuit thereby signaling the subscriber at substation A'.

As the contactor 309 passes contact 327 ringing relay 314 is energized momentarily, whereby the above described ringing circuit is again completed, with the exception, however, that the ringing generator R' is substituted for the ringing generator R^2 . In this latter instance the ringer 5 responds, thereby signaling the calling subscriber who is thus informed that the ringing operation is proceeding satisfactorily. When the contactor 309 reaches its bottom or normal position the circuit of winding 302 of relay 320 is again completed, whereupon the entire ringing cycle repeats itself.

It will be seen from the foregoing that the ringing relays 314 and 315 are energized alternately, each relay serving to connect its associated ringing generator to the set of bank contacts upon which the wipers 166 and 167 are resting, and at the same time sending a direct ground by way of wiper 165 to relay 153, which relay operates to disconnect the two sides of the line from the line and connect them to the wipers 166 and 167. In order to allow the condensers 6 and 6' at the substations to discharge after each application of the ringing current to the line the relay 153 is made slow acting with the result that each time one of the ringing relays deenergizes the line is momentarily short circuited by the conductor 350. This is done to guard against a possible actuation of relay 150 by condenser discharge immediately after relay 153 deenergizes.

Before proceeding with the operation it will be advisable to consider the condition of the polarized relays at the substations A and A'. When the receiver was removed at substation A preparatory to making the call, a circuit was completed by the hook springs 8 and 9, which circuit included as one of its branches the magnet 25 and windings 23 and 24 of the polarized relay in series, as has

already been described. The direction of current flow in the above circuit is such that the arm 20 is moved to the right until it reaches the position shown in the drawing.

5 The magnet 25 is marginal and is unable at this time to attract the lever 18 against the tension of the spring 21. The position of the arm 20' at substation A' will depend upon the direction of the current which last
10 flowed through the windings of the polarized relay. The position of arm 20' is, however, immaterial at this time.

Returning now to the frequency selector F, it has been explained how the relays 158,
15 159, 161, and 154 remain energized after the calling subscriber at substation A has replaced his receiver. In addition it has been explained how the side switch wipers are held in their second position by the private
20 magnet while the relay 153 operates intermittently in conjunction with the ringing relays M to ring the calling and called substations alternately.

Now when the subscriber at substation A'
25 removes his receiver in response to the ringing of his bell, there is again completed, at the next deenergization of relay 153, an energizing circuit for line relay 150, which circuit may be traced as follows: ground at
30 G³⁰, winding 151 of line relay 150, contact springs 200 and 199, contact springs 206 and 204, conductor 376, bank contact 115, wiper 112, contact springs 131 and 132, contact 56,
35 spring 52, and line conductor 32 to one terminal of magnet 25' where the circuit divides, one branch extending by way of magnet 25' and coils 23' and 24' of the polarized relay to impulse spring 11', and the other branch extending by way of contact springs
40 16' and 15', transmitter 3' and receiver 2' to impulse spring 11', where the two branches unite and extend by way of impulse springs 11' and 10', switch hook springs 9' and 8', line conductor 31, spring 49, contact 53, con-
45 tact springs 133 and 134, wiper 110, bank contact 113, conductor 375, contact springs 201 and 202, contact springs 196 and 197, and winding 152 of relay 150 to battery B. Upon the completion of the above circuit
50 the lower end of arm 20' at substation A' is moved to the right by the polarized relay until it reaches the position in which arm 20 of substation A is shown. Magnet 25' is not sufficiently energized to attract the
55 lever 18'; therefore the detent 19' is in engagement with the lower end of arm 20'. At the exchange the line relay 150 of the frequency selector F is energized and attracting its armature, breaks the circuit of relays
60 159 and 161 and again completes the original energizing circuit of relay 158. Relay 161, upon deenergizing, opens the intermittent energizing circuit of relay 153 at contact springs 185 and 186, these contact

springs being also included in the circuit 65 of the starting relay 311. Relay 159, upon deenergizing, breaks the circuit of the private magnet 160 and also breaks the circuit of the slow acting relay 154. The private magnet 160, upon deenergizing, allows the
70 side switch wipers to advance to their third position in the well known manner. Instantly a circuit is completed for relay 155 as follows: ground at G¹¹, contact springs 181 and 180, winding of relay 155, and side switch
75 wiper 163 in its third position to battery B. Relay 155, upon attracting its armature, reverses the connections of the incoming line conductors 375 and 376, and at the same time, relay 154 still holding its armature at-
80 tracted, the battery B' is momentarily put in series with battery B, the resistance 164 being substituted for the lower winding of the line relay 150. In this manner a booster impulse is transmitted over the line to sub-
85 station A', the circuit being as follows: ground at G², negative pole of battery B', positive pole of battery B', resistance 164, contact springs 211 and 209, contact springs 203 and 201, conductor 375, bank contact
90 113, wiper 110, thence over previously traced circuit to and through substation A' and back to wiper 112, whence it extends by way of bank contact 115, conductor 376, contact springs 204 and 205, contact springs
95 196 and 197, winding 152 of relay 150, negative pole of battery B, positive pole of battery B, ground at G' to ground at G², the starting point. It will be observed that the direction of current flow in the line has
100 been reverse. As a result of the simultaneous reversal of current and booster impulse the lower end of arm 20' is moved to the left and at the same time the lever 18' is attracted by the magnet 25', which now re-
105 ceives enough current to draw the detent 19' from the path of the arm 20'. It follows that the contact springs 15', 16', and 17' in the telephone circuit are not disturbed. It is understood that the booster impulse is but
110 momentary, the battery B' and resistance 164 being cut out as soon as slow acting relay 154 deenergizes and the lower winding of line relay 150 substituted therefor.

The ringing of this bell having ceased, the
115 calling subscriber at substation A is thereby apprised of the fact that the subscriber at substation A' has answered. He will then remove his receiver also, again completing the hereinbefore traced parallel circuits
120 through the magnet 25 and winding of the polarized relay, and the transmitter and receiver. This time, however, the current flow is in the reverse direction, and as a result the lower end of arm 20 is moved to the
125 left carrying with it the lever 18 and thereby closing contact springs 15 and 17 and separating contact springs 15 and 16. By the

closing of contact springs 15 and 17, the transmitter 3 is short circuited, and by the separation of contact springs 15 and 16 the previously described circuit through receiver 2 is opened. Since the contact springs 15 and 16 are shunted by the small condenser 14, however, the calling subscriber is enabled to hear his party although he can not converse with him. The calling subscriber may now drop a suitable coin in the coin chute 22 thereby knocking the detent 19 out of engagement with the arm 20. As soon as the lever 18 is freed it is drawn to the right by the spring 17, which spring separates from spring 15 by its own tension and allows springs 15 and 16 to again make contact thereby restoring the telephone to its operative condition.

The two subscribers may now converse without further effort, the voice currents taking the path shown in the heavy lines. Talking battery for the transmitters is supplied from the double wound line relay 150 of the frequency selector F.

When the conversation is over, both subscribers will hang up their receivers thereby breaking the circuit of the line relay 150 which, upon deenergizing, breaks the circuit of slow acting relay 158. Relay 158, upon deenergizing, removes ground from the holding circuit extending back to the selector E and the line switch C, whereupon these switches are restored to their normal position in the well known manner. Relay 158 also completes a circuit for the release magnet 157 of the frequency selector as follows: ground at G^{10} , contact springs 182 and 183, contact springs 190 and 191, contact 192, off normal spring 193, and release magnet 157 to battery B. Upon energizing the release magnet restores the shaft and side switch wipers to their normal position, the former operation breaking the release magnet circuit at the off normal spring 183. In order to insure the complete restoration of the side switch wipers the contact point 194 is provided. When the shaft returns to normal position, spring 193 makes contact with contact 194 whereby, in case the side switch wipers are still in second position, the release magnet is energized momentarily by ground at G^{13} , thereby moving the side switch wipers to their first or normal position.

It will be seen from the foregoing that I have devised a simple and efficient improvement in automatic telephone systems having the prepayment feature, whereby such systems may include polystation lines as well as individual lines. In my improved system a calling party line subscriber is enabled to connect with every other subscriber in the exchange, including the other subscribers on the same line, and is uni-

formly required to pay for each connection in advance by dropping a coin in a collecting mechanism provided for the purpose it being understood that in no case is the called subscriber required to pay.

While I have described in the foregoing a certain specific embodiment of my invention, I do not wish to be held strictly to the exact form shown herein, for modifications will no doubt suggest themselves to persons skilled in the art. I desire, therefore, to include and have protected by Letters Patent all forms and modifications of my invention which may come within the scope of the appended claims.

What I claim as my invention is:

1. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, and means at said station for preventing the operation of said device.

2. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for reversing the direction of current flow in said line to operate said device, and means at said station for preventing the operation of said device.

3. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, means at said station for preventing the operation of said device, said last means normally inoperative, and manually controlled means for restoring said station to operative condition.

4. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for reversing the direction of current flow in said line to operate said device, means at said station for preventing the operation of said device, said last means normally inoperative, and manually controlled means for restoring said station to operative condition.

5. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, and means at said station for preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line.

6. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for reversing the direction of current flow in said line to operate said device, and means at said station for preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line.

7. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, means at said station for preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line, and means for increasing the current flow in said branch to operate said magnet.

8. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for reversing the direction of current flow in said line to operate said device, means at said station for preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line, and means for increasing the flow of current in said branch to operate said magnet.

9. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, means at said station for

preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line, and coin controlled means for restoring said station to operative condition.

10. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for reversing the direction of current flow in said line to operate said device, means at said station for preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line, and coin controlled means for restoring said station to operative condition.

11. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, and means at each substation for preventing the operation of its associated device.

12. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, means at each substation for preventing the operation of its associated device, said last means normally inoperative, and manually controlled means at each of said stations for rendering its associated station operative for talking purposes.

13. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mecha-

nism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, and means at each substation for preventing the operation of its associated device, said last means comprising a normally inoperative magnet for each of said stations serially connected in a branch of said line.

14. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, means at each substation for preventing the operation of its associated device, said last means comprising a normally inoperative magnet for each of said stations serially connected in a branch of said line, and means for increasing the current flow in said branch to operate one of said magnets.

15. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, means at each substation for preventing the operation of its associated device, said last means comprising a normally inoperative magnet for each of said stations serially connected in a branch of said line, means for increasing the current flow in said branch to operate one of said magnets, and coin controlled means at each of said stations for restoring its associated station to operative condition.

16. In a telephone system, a subscriber's station and a line therefor, a plurality of branches of said line at said station, a microphone and a receiver in one branch, a reverse current controlled magnet in another branch operable to exclude said microphone from said first branch, and a second magnet operative to render ineffectual the operation of said first magnet.

17. In a telephone system, a subscriber's station and a line therefor, a plurality of branches of said line at said station, a micro-

phone and a receiver in one branch, a reverse current controlled magnet in another branch operable to exclude said microphone from said first branch, a second magnet operative to render ineffectual the operation of said first magnet, an automatic switch accessible to said line, and means associated with said switch for operating said magnets.

18. In a telephone system, a subscriber's station and a line therefor, automatic switches controllable over said line from said station, a plurality of branches of said line at said station, a microphone and a receiver in one branch, a magnet in another branch operable through the medium of one of said switches to exclude said microphone from said first branch, and a second magnet controllable through the medium of the same switch for rendering the operation of said first magnet ineffectual.

19. In a telephone system, a subscriber's station and a line therefor, automatic switches controllable over said line from said station, a plurality of branches of said line at said station, a microphone and a receiver in one branch, a magnet in another branch operable through the medium of one of said switches to exclude said microphone from said first branch, a second magnet controllable through the medium of the same switch for rendering the operation of said first magnet ineffectual and manually controlled means for also rendering the operation of said first magnet ineffectual.

20. In a telephone system, a party line and a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering it inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, a normally inoperative magnet in a bridge of said line at each of said stations for preventing the effectual operation of its associated device, means associated with said mechanism for momentarily increasing the current flow in said line to operate the said magnet at a called one of said stations, and means associated with said mechanism for reversing the direction of current flow in said line to operate the said device at the said calling station.

21. In a telephone system, a party line and a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering it inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line

into connection with said mechanism and for initiating the operation thereof, a normally inoperative magnet in a bridge of said line at each of said stations for preventing the effectual operation of its associated device, means associated with said mechanism for momentarily increasing the current flow in said line to operate the said magnet at a called one of said stations, and means associated with said mechanism for reversing the direction of current flow in said line to operate the said device at the said calling station, said current reversing means and said current increasing means controlled by the said called station.

22. In a telephone system, a party line and a plurality of stations in bridge thereof, a reverse current controlled device at each of said stations for rendering its associated station inoperative for talking purposes, a normally inoperative magnet in a bridge at each of said stations for rendering the operation of its associated device ineffectual, a source of current for said line, a selective signaling mechanism accessible to said line, means under the control of a first one of said stations for operating said mechanism to signal a second one of said stations, means associated with said mechanism for increasing the current flow in said line to operate the said magnet at said second station, and means associated with said mechanism for reversing the direction of current flow in said line to operate the said devices at said first and second stations.

23. In a telephone system, a line and a plurality of stations in bridge thereof, a reverse current controlled device in bridge of the line at each station for rendering its associated station inoperative for talking purposes, a normally inoperative magnet in bridge of the line at each station for rendering the operation of its associated device ineffectual, a source of current for said line, a selective signaling mechanism, means controllable from a calling one of said stations for extending said line into connection with said mechanism, means responsive to the opening of said line at the said calling station for operating said mechanism to signal a called one of said stations, and means responsive to the closing of said line at the said called station for momentarily increasing the current flow in said line to operate the said magnet at the called station and for reversing the direction of current flow in said line to operate the said device at the calling station when the line is again closed thereat.

24. In a telephone system, a line and a plurality of stations in bridge thereof, a reverse current controlled device in bridge of the line at each station for rendering its associated station inoperative for talking

purposes, a normally inoperative magnet in bridge of the line at each station for rendering the operation of its associated device ineffectual, a source of current for said line, a selective signaling mechanism, means controllable from a calling one of said stations for extending said line into connection with said mechanism, means responsive to the opening of said line at the said calling station for operating said mechanism to signal a called one of said stations, means responsive to the closing of said line at the said called station for momentarily increasing the current flow in said line to operate the said magnet at the called station and for reversing the direction of current flow in said line to operate the said device at the calling station when the line is again closed thereat, and manually controlled means at the said calling station for rendering it again operative for talking purposes.

25. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, and an electromagnet at said station for preventing the operation of said device.

26. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for reversing the direction of current flow in said line to operate said device, and an electromagnet at said station for preventing the operation of said device.

27. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, means comprising an electromagnet at said station for preventing the operation of said device, said last means normally inoperative, and manually controlled means for restoring said station to operative condition.

28. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mech-

anism, means associated with said mechanism for reversing the direction of current flow in said line to operate said device, an electromagnet at said station for preventing the operation of said device, said last means normally inoperative, and coin controlled means for restoring said station to operative condition.

29. In a telephone system, a station and a line therefor, a device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for operating said device, means at said station for preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line, and means including a second source of current for increasing the current flow in said branch to operate said magnet.

30. In a telephone system, a station and a line therefor, a reverse current controlled device for rendering said station inoperative for talking purposes, a source of current for said line, an automatic mechanism, means under the control of said station for extending said line into connection with said mechanism, means associated with said mechanism for reversing the direction of current flow into said line to operate said device, means at said station for preventing the operation of said device, said last means comprising a normally inoperative magnet serially connected in a branch of said line, and means including a second source of current for increasing the flow of current in said branch to operate said magnet.

31. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, and an electromagnet at each substation for preventing the operation of its associated device.

32. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for

initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, electromagnetic means at each substation for preventing the operation of its associated device, said last means normally inoperative, and a coin collecting device at each of said stations for rendering its associated station operative for talking purposes.

33. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, means at each substation for preventing the operation of its associated device, said last means comprising a normally inoperative magnet for each of said stations serially connected in a branch of said line, and a second source of current for increasing the current flow in said branch to operate one of said magnets.

34. In a telephone system, a line, a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering its associated station inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, means associated with said mechanism for reversing the direction of current flow in said line to operate said devices, means at each substation for preventing the operation of its associated device, said last means comprising a normally inoperative magnet for each of said stations serially connected in a branch of said line, a second source of current for increasing the current flow in one of said branches to operate one of said magnets, and coin controlled means at each of said stations for restoring its associated station to operative condition.

35. In a telephone system, a subscriber's station and a line therefor, a plurality of branches of said line at said station, a microphone and a receiver in one branch, a reverse current controlled magnet in another branch operable to exclude said microphone from said first branch, a second magnet operative to render ineffectual the operation of said first magnet, an automatic switch accessible to said line, and relays associated with said switch for operating said magnets.

36. In a telephone system, a subscriber's station and a line therefor, automatic switches controllable over said line from said station, a plurality of branches of said line at said station, a microphone and a receiver in one branch, a magnet in another branch operable through the medium of one of said switches to exclude said microphone from said first branch, a second magnet controllable through the medium of the same switch for rendering the operation of said first magnet ineffectual, and a coin controlled device for also rendering the operation of said first magnet ineffectual.

37. In a telephone system, a party line and a plurality of stations in bridge thereof, a reverse current controlled device at each station for rendering it inoperative for talking purposes, a source of current for said line, a selective signaling mechanism, means under the control of a calling one of said stations for extending said line into connection with said mechanism and for initiating the operation thereof, a normally inoperative magnet in a bridge of said line at each of said stations for preventing the effectual operation of its associated device, a circuit associated with said mechanism for momentarily increasing the current flow in said line to operate the said magnet at a called one of said stations, and a relay associated with said mechanism for reversing the direction of current flow in said line to operate the said device at the said calling station.

38. In a telephone system, a line and a plurality of stations in bridge thereof, a reverse current controlled device in bridge of the line at each station for rendering its associated station inoperative for talking purposes, a normally inoperative magnet in bridge of the line at each station for rendering the operation of its associated device ineffectual, a source of current for said line, a selective signaling mechanism, means controllable from a calling one of said stations for extending said line into connection with said mechanism, means responsive to the opening of said line at the same calling station for operating said mechanism to signal a called one of said stations, relays responsive to the closing of said line at the said called station for momentarily increasing the current flow in said line to operate the said magnet at the called station and for reversing the direction of current flow in said line to operate the said device at the calling station when the line is again closed thereat, and a measured service device at the said calling station for rendering it again operative for talking purposes.

39. In a telephone system, the combination with a subscriber's line and talking set, of a measured service device for controlling the effectiveness of said talking set to in-

force the assessment of a charge on each call and means controllable over said line for rendering the measured service device ineffectual in its control, whereby the subscriber is enabled to converse free of charge.

40. In a telephone system, the combination with a subscriber's line and talking set, of a measured service device for controlling the effectiveness of said talking set to enforce the assessment of a charge on each call and means controllable over said line for rendering the measured service device ineffectual in its control, whereby the subscriber is enabled to converse free of charge, and an automatic progressively movable switch controlled over said line to extend a connection from said line to another line, said automatic switch controlling the operation of said means.

41. In a telephone system, the combination with a subscriber's line and talking set, of a measured service device for controlling the effectiveness of said talking set to enforce the assessment of a charge on each call and electromagnetic means controllable over said line for rendering the measured service device ineffectual in its control, whereby the subscriber is enabled to converse free of charge.

42. In a telephone system, the combination with a subscriber's line and talking set, of a measured service device for controlling the effectiveness of said talking set, electromagnetic means controlled over said line for rendering the measured service device ineffectual in its control, an automatic progressively movable switch controlled over said line to extend a connection from said line to another line, a source of current of one voltage for operating the switch and a source of current of a different voltage for operating said means.

43. In a telephone system, the combination with a subscriber's line and talking set of a measured service device for controlling the effectiveness of said talking set, electromagnetic means controlled over said line for rendering the measured service device ineffectual in its control, an automatic progressively movable switch controlled over said line to extend a connection from said line to another line, said automatic switch controlling the operation of said electromagnetic means, a source of current of one voltage for operating the switch and a source of current of a different voltage for operating said means.

44. In a telephone system, the combination with a subscriber's line and a measured service device associated therewith for assessing a charge against the subscriber every time a call is made, of mechanism associated with said device and controllable over the said line to render said device ineffective when a call is received.

45. In a telephone system, the combination with party lines and exchange equipment for enabling any subscriber to call another subscriber on the same or another line,
5 of a measured service device at each substation for assessing a charge against the subscriber thereat every time a call is made, mechanism associated with each device for rendering the same ineffective, and means

for operating the mechanism at a substation 10 which is called from another substation on the same line to enable the subscriber at the said called substation to converse free of charge.

Signed by me at Chicago, Cook county, 15 Illinois, this 8th day of February, 1916.

WINFRED T. POWELL.