G. E. MUELLER.

PAY STATION FOR TELEPHONE SYSTEMS.

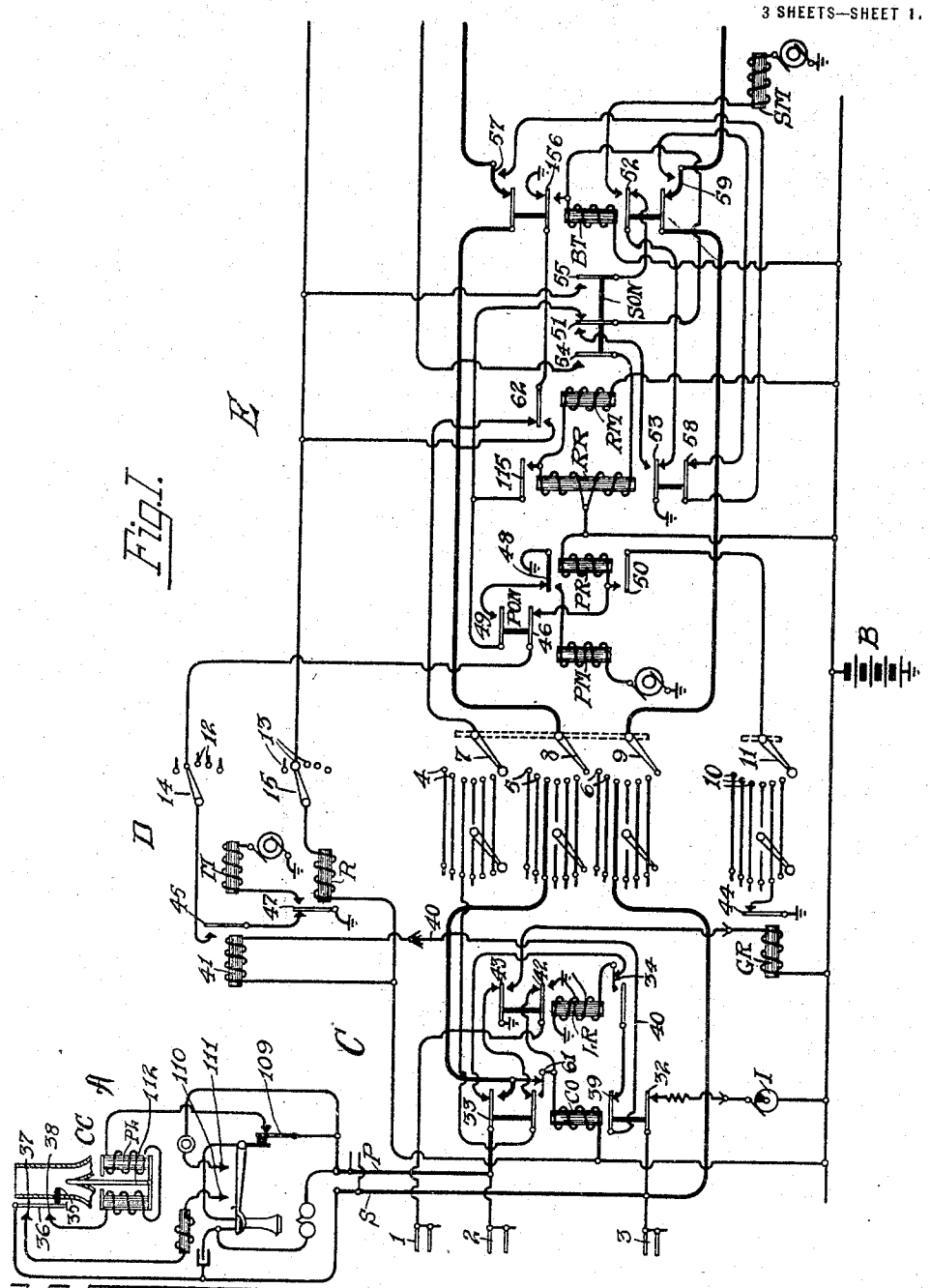
APPLICATION FILED FEB. 25, 1915.

1,203,239.

Patented Oct. 31, 1916.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

G. A. Yanochowski.

Wm Berghahn

Inventor:

George E. Mueller.

By Curtis B. Camp.

Attorney.

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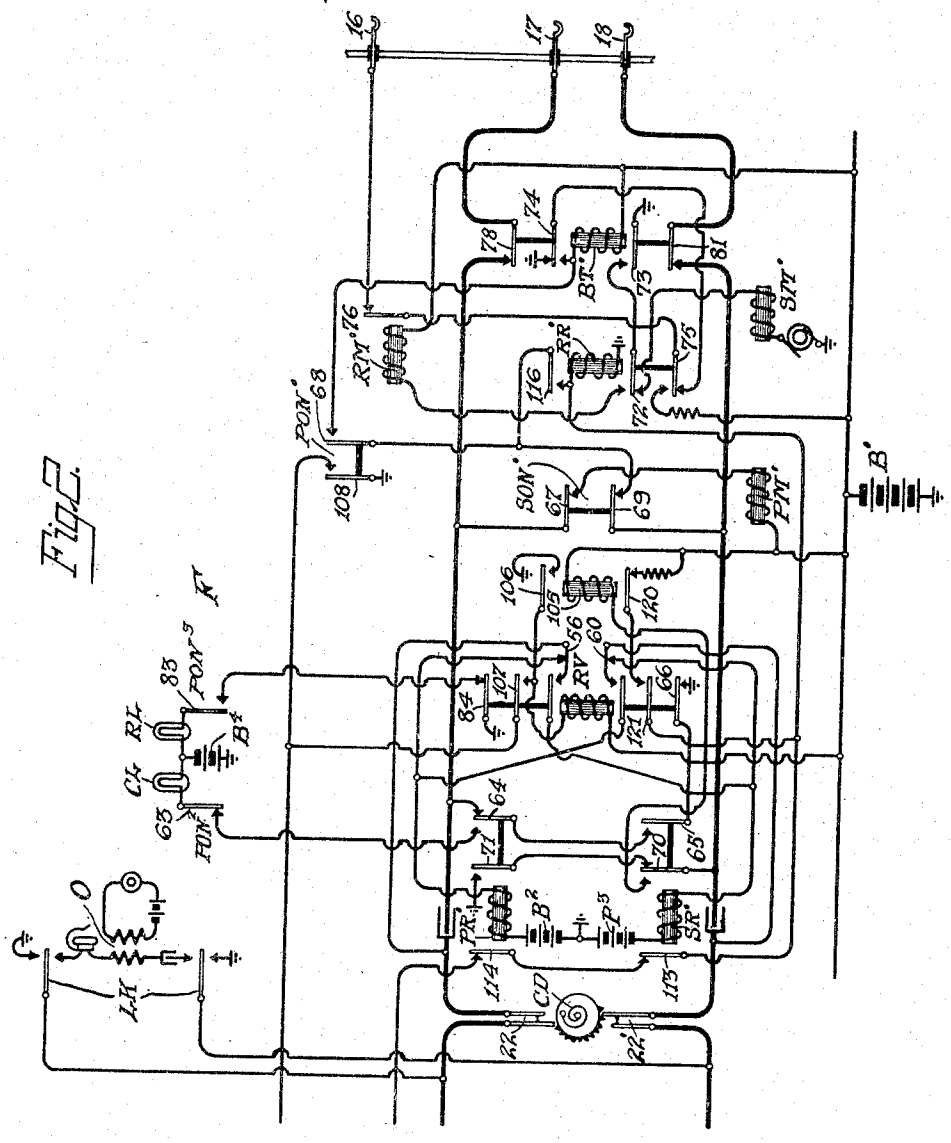
3 SHEETS—SHEET 2.

Fig. 2.



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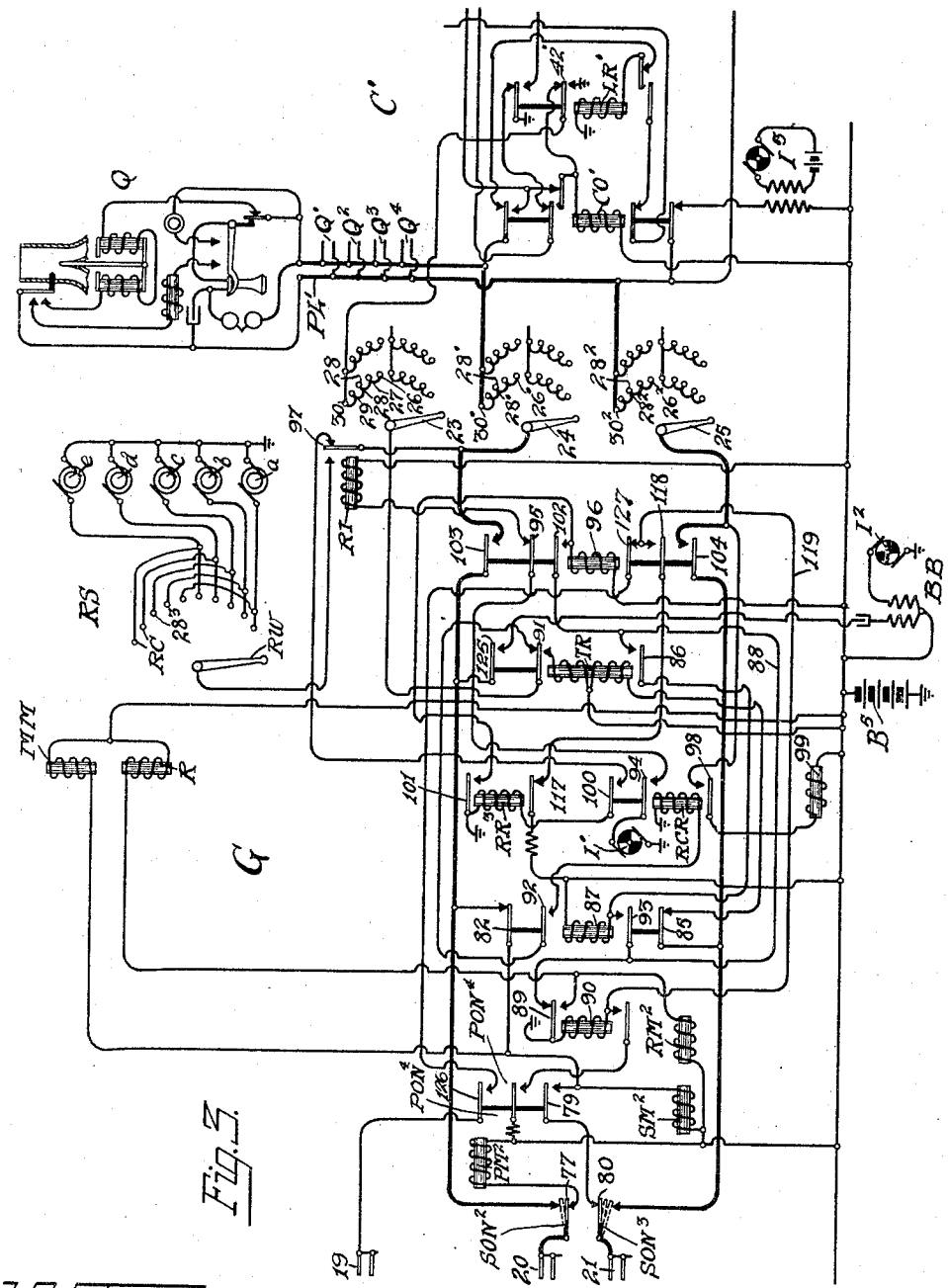

Fig. 3.

Witnesses:

G. A. Yanochowski.

Wm Borghalm

Inventor:

George E. Mueller.

By Curtis B. Camp.

Attorney.

UNITED STATES PATENT OFFICE.

GEORGE E. MUELLER, OF LA GRANGE, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PAY-STATION FOR TELEPHONE SYSTEMS.

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To all whom it may concern:

Be it known that I, GEORGE E. MUELLER, a citizen of the United States of America, residing at La Grange, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pay-Stations for Telephone Systems, of which the following is a specification.

My invention relates to pay-station telephone systems and has to do more particularly with pay-station systems in which a coin or token must be deposited at the substation before a connection can be established through the central office, the said coin being collected in case the connection is completed and returned to the subscriber in case the connection is not completed.

One of the features of my invention resides in the provision of a substation without ground connections wherein the deposit of a coin establishes a direct current path across the line conductors to cause the operation of an automatic switch to connect the calling line and an idle link circuit.

Another feature of my invention enables it to be used for party line work.

To this end I provide a characteristic signal normally connected to the line at the central office and effective upon the receiver of a calling substation when removed from the switch-hook, if the line is idle. The deposit of a coin will then connect the line conductors in circuit in order to cause the actuation of an automatic switch to extend the calling line to an idle link circuit.

There are other features of my invention but these will be more particularly referred to in the ensuing specification and claims.

For the purpose of illustrating my invention, I have shown my improved pay station operating in connection with semi-automatic telephone system in which, when a coin is deposited, the calling line is automatically selected and an operator apprised of the call. The operator completes a connection by operating a calling device to step automatic switches to select a called line.

For a better understanding of my invention reference may be had to the accompanying drawings in which—

Figures 1, 2 and 3 illustrate diagrammatically a system in accordance with my invention. Fig. 1 is placed to the left of Fig. 2 and Fig. 3 is a placed to the right of Fig. 2.

Referring now in general to the system illustrated, I have shown at the left a well-known manual substation A connected by the line limbs P and S with a line circuit C at the exchange. The substation A comprises the usual substation apparatus and in addition I have shown a coin collecting device CC adapted for receiving a coin or token which is to be deposited before the subscriber at the calling substation can initiate a call. A polarized relay PL is also associated with the device CC and is operated automatically by a flow of battery in a certain direction to either collect the deposited coin in the event that the call was successful or operated by a flow of battery in a reverse direction to return the coin if the called line did not answer or is busy. Magnet PL is not cut in circuit until the receiver is replaced.

The line circuit C comprises the multiple called contacts 1, 2, and 3 appearing in the banks of a suitable number of connectors along with similar contacts of other telephone lines. A cut-off relay CO and line relay LR are also provided. A slowly rotating interrupter I is also provided which produces a distinctive tone and should a calling subscriber wish to initiate a call and upon the removal of his receiver hear this tone he knows his line is idle. If the tone is not heard he knows the line is busy.

Multiple calling contacts 4, 5, and 6 are provided for each calling line and with calling contacts of other lines, terminate in contact blanks before the wipers 7, 8 and 9 of a suitable number of line selectors E. The contacts 4, 5 and 6 are divided into 10 subgroups of 10 sets each and a primary horizontal movement caused by the energization of a primary magnet PM steps wipers 7, 8, and 9 of a line selector E to select a subgroup of contacts containing those of the calling line and thereafter a secondary vertical movement caused by the energization of a secondary magnet SM steps the wipers 7, 8, and 9 to select the contacts of the want-

ed line. Each group of contacts at a line selector E is provided with its individual group contact 10, a group wiper 11 being provided to control the primary movement of the line selector E to select the group. Thus travel of the wiper 11 is simultaneous with that of wipers 7, 8 and 9 in a primary direction but when the said wipers begin their secondary travel the said wiper 11 remains at rest in contact with the selected group terminal. The secondary travel of the line selector E is controlled by the private wiper 7 engaging the private contacts 4, and as soon as the ungrounded contact of the calling line is encountered, the wipers come to rest.

A master switch D is provided preferably for each group of 100 subscribers' lines as calling lines, said switch having as many sets of terminals 12, 13 as there are line selectors serving a group, there being preferably ten such selectors to each 100 lines. Upon the initiation of a call over any line of the group the master switch will start travel of an idle line selector E to select the calling line. The master switch mechanism also comprises the wipers 14 and 15 driven step-by-step by a motor magnet M.

Each line selector E is connected to a first selector F which comprises wipers 16, 17, 18 which have before them multiple contacts 19, 20, 21 leading to connectors G. The wipers 16, 17 and 18 are stepped in a primary direction upon the energization of primary magnet PM^1 to select a sub-group of contacts and then are adapted to move automatically in a secondary direction by the energization of a secondary magnet SM^1 to step the wipers along the contacts of the selected sub-group to select an idle set of contacts leading to an idle connector as G. In addition to the usual apparatus of the first selector F, I provide a calling lamp CL and a ringing lamp RL, the said lamps being located at an operator's position. I also show a listening key LK which when thrown connects the operator's set O with the calling line. An operator's calling device CD is provided having impulse springs 22 and 22^1 connected to the upper and lower talking conductors.

The connector switch G comprises as usual 100 sets of bank contacts 28, 28^1, 28^2 and a set of coöperating wipers 23, 24, 25, said wipers being adapted to be advanced in a primary direction by the energization of a primary magnet PM^2 to select a group of ten contacts and thereafter advanced in a secondary direction upon the energization of a secondary magnet SM^2, to be stepped into engagement with the contacts of the wanted line.

As shown in Fig. 3 the telephone line PL is a party line having five substations Q, Q^1, Q^2, Q^3, and Q^4 connected thereto. The call bells at the said substations are preferably of the well-known harmonic type, the rate of vibration being in harmony with the frequencies of the five generators, *a*, *b*, *c*, *d*, and *e*. Each party line such as PL is multiply connected to as many sets of bank contacts as there are stations on the line, there being five stations and five sets of bank terminals 26, 27, 28, 29, 30 so that connection to the said line PL may be made through any of the five sets of contacts. To select the proper ringing current to ring the bell of the called substation, I provide a ringing switch RS which comprises contacts RC equal in number to the sets of bank contacts in the rows of a connector, and a coöperating wiper RW. The wiper is mounted upon a shaft in a suitable manner the said shaft carrying a suitable ratchet wheel rotatable by a motor magnet MM and associated pawl mechanism. The usual restoring spring is associated with the wiper shaft as is also a check pawl, the shaft being advanced against the tension of the spring. The switch is restored by energization of the release magnet R. The last step of impulses which steps the connector switch into engagement with the contacts of the wanted line also effects the operation of the magnet MM so that the wiper RW is advanced a number of steps equal to the number of secondary steps taken by the connector switch wipers. Therefore the last set of impulses determines the selection of a generator *a*, *b*, *c*, *d*, or *e* of the proper frequency which will be connected to the contacts of the called line and is adapted to ring selectively the bell of the called substation. To the right of Fig. 3 I have shown a line circuit C^1 similar to that of C and bearing the same reference numerals with the suffix prime added. The busy tone device I^3 serves the same purpose as I.

I will now describe briefly the operation of the system illustrated.

The calling subscriber at substation A to initiate a call removes his receiver and if he hears the tone from device I, he knows that the line is idle and deposits a coin. The line relay LR is thus operated which brings about circuit changes to operate the line selector E to select the calling line. The calling line having been selected causes apparatus to be energized to light the calling lamp CL. The operator noting the signal operates her listening key and ascertains the number of the called subscriber and operates the calling device CD which brings about the selection of the called line by the operation of the first selector F and connector G. The ringing switch is also operated to select the proper ringing frequency to ring the bell of the called subscriber. The subscriber in answering brings about circuit changes which cause a reversal of battery over the calling line so that when the calling sub-

scriber replaces his receiver the said battery reversal will operate the coin device to collect the deposited coin. The calling subscriber upon replacing his receiver upon the termination of conversation brings about the restoration of the line selector E and first selector F. The replacing of the receiver at the called substation brings about the release of the connector G.

Having described in general the operation of the circuit, I will now describe more in detail the operation of the circuit in establishing a connection between calling and called substations.

Should the subscriber at the substation A wish to initiate a call and assuming that it is the substation Q, that is wanted, the calling subscriber removes his receiver and listens to find whether his line is idle or busy. Assuming that the line is idle, he receives a distinctive tone traced from battery B through the slowly rotating interrupter I, normal contact 32, the line limb S, through substation apparatus including the condenser, receiver, switch-hook contacts and transmitter, the line limb P, normal contact 33, normal contact 34 and winding of LR to ground. The line relay LR does not energize due to the condenser which is interposed in the above traced circuit. The subscriber hearing the distinctive tone which indicates the idle condition of the line now deposits a token or coin into the coin chute of the coin collecting apparatus CC. The coin travels downwardly in the chute until arrested by the vertically disposed armature 112, of the polarized magnet PL and in this position the coin engages an insulated buffer 35 on the contact 36, moving it to the left to close the contacts 37, and 38. The closure of contact 37 closes a direct current path around the condenser and receiver, energizing line relay LR. The line relay LR closes a locking circuit for itself traced from ground through the winding of said relay, the alternate contact 34, normal contact 39 of relay CO, common conductor 40, relay 41, to battery B. It is to be understood that the conductor 40 is common having branches, one to each contact 39 of cut-off relays CO of the lines served by master switch D. The contact 42 of LR places ground upon contacts 1 at the connectors making them busy while contact 43 disconnects ground from private contacts 4 of the calling line at the line selectors making them selectable. Upon the energization of LR a circuit for the group relay GR is also established traced from battery B through the winding of said relay, alternate contact 43 to ground. The opening of the normal contact 44 of the relay GR removes ground from the group contacts 10 of the group among which line A has its contacts 4, 5, and 6. Since wipers 14 and 15 of D engage the contacts 12 and 13 of an idle line selector the now attracted armature 45 of relay 41 closes an energizing circuit for the primary relay PR of this line selector E, traced from battery B through the winding of the primary relay PR, normal contact 46, contact 12, wiper 14 of the master switch, alternate contact 45, to ground at normal contact 47. The closing of alternate contact 48 of relay PR establishes an energizing circuit for the primary magnet PM traced from the generator, winding of PM to ground at alternate contact 48. The primary magnet PM now steps the wipers 7, 8, 9, 10 in a primary direction to select the group of contacts with which the calling line is associated. Upon the first step of the wipers off normal, the primary off-normal contacts 46 and 49 of PON assume their alternate position, opening the initial energizing circuit for the relay PR, but relay PR depends upon its continued energization by a circuit traced from battery B through its winding, alternate contact 50, the wiper 11 to the successive grounds through the contacts 10 of sub-groups whose relays GR are not operated. The primary magnet PM continues to step the wipers in a primary direction until the group wiper 11 engages the second contact 10, which is ungrounded and with which the calling line is associated, thus opening the circuit for the relay PR allowing it to deënergize and open the circuit of PM. Upon the deënergization of the relay PR, an energizing circuit for the relay BT is established traced from battery B through the winding of the said relay, normal contact 51, alternate contact 49 to ground at normal contact 48. Upon the energization of relay BT an energizing circuit for the secondary magnet SM is established from the generator through the winding of said magnet, alternate contact 52 to ground at normal contact 53. The secondary magnet SM now steps the wipers 7, 8, 9 in a secondary direction to select the contact of the calling line. The wiper 11 of the group switch only travels in a primary direction and remains in its selected position while the wipers take their secondary travel. Upon the first step of the wipers in a secondary direction the secondary off-normal contacts 51, 54 and 55 of SON assume their alternate position, opening the initial energizing circuit for the relay BT, but relay BT remains energized by circuit traced from battery B through relay BT, alternate contact 156 which now connects the relay with private wiper 7, the relay continuing energized over successive locking circuits established by the wiper 7 in engaging the contacts of non-calling lines which will be grounded. Magnet SM therefore steps the wipers in a secondary direction until wiper 7 engages the ungrounded contact of the calling line. The locking circuit of the relay BT is therefore

interrupted, causing its deënergization and opening the circuit of the secondary magnet SM preventing further advance of the wipers.

Upon the deënergization of relay BT, an energizing circuit for the relay R of the master switch D is established, traced from battery B through the winding of the relay R, wiper 15, contact 13, the alternate contact 55 normal contact 52 to ground at normal contact 53. The closing of the alternate contact 47 of relay R closes an energizing circuit for the magnet M traced from generator through the winding of said magnet to ground, at alternate contact 47, thus stepping the wipers 14, 15 to the next contact leading to an idle line selector or if the next selector is busy the wiper will be stepped until an idle one is found. Upon the said energization of the relay BT a circuit for the primary relay PR^1 and the secondary relay SR^1 was established to simultaneously energize them, said circuit being traced from battery B^2 through the winding of relay PR^1, normal contact 56, alternate contact 57, normal contact 58, alternate contact 59, normal contact 60 through the winding of relay SR^1 to battery B^3 and ground. Upon said deënergization of relay BT, an energizing circuit for the cut-off relay CO was established, traced from battery B^2, through the winding of relay PR^1, normal contact 56, normal contact 57, wiper 8, contacts 5, normal contact 61, through relay CO to battery B and ground. The relay CO energizes and establishes a locking circuit for itself, traced from battery B through the winding of the relay CO, alternate contact 61, contact 4 and wiper 7, normal contact 62 to ground at normal contact 156. The energization of relay CO permits the continued energization of relay PR^1 and relay SR^1 by way of alternate contact 33 and through the substation back over the lower heavily marked conductor to the other side of the battery B^3. Upon said energization of relays PR^1 and SR^1, a circuit for the signal lamp CL is established, traced from battery B^4 through the said lamp, normal contact 63, alternate contact 64, the alternate contact 65 to ground at normal contact 66 of relay RV. The operator at O noting the lighted signal CL throws her listening key LK to connect her operator's set O to converse with the calling subscriber at the substation A. Assuming that substation Q whose number is 228 is wanted, the operator throws the listening key LK in the opposite direction to connect ground to both sides of the line, short-circuiting the calling line, although the relays PR^1 and SR^1 remain energized. The operator now actuates the calling device CD to send the proper number of impulses to operate the first selector and connector to select the contacts of the called line. The operator first actuates the calling device to send two impulses of current which operation causes the contact 22 to be opened and closed twice to energize and deënergize the primary relay PR^1 twice. Upon the first deënergization of relay PR^1 an energizing circuit for the primary magnet PM^1 is established traced from battery B^1 through the winding thereof, normal contact 67, normal contact 64, alternate contact 65 to ground at normal contact 66. The primary magnet PM^1 is thus energized and deënergized to step the wipers 16, 17 and 18 of first selector F in a primary direction to select the sub-group of contacts of the second hundred group, which is the group with which the calling line is associated. Upon the first step off normal, primary off-normal contact PON^1 PON^2 and PON^3 assume their alternate positions. The opening of normal contact 63 or PON^2 extinguishes lamp CL and the closing of alternate contact 83 of PON^3 closes a circuit for ringing lamp RC traced from battery B^4, alternate contact 83 of PON^3 to ground at normal contact 84. After the calling device has sent the last primary impulse of the first digit a single break in the circuit of the secondary relay SR^1 is caused by the opening of the contact 22^1. The momentary deenergization of the relay SR^1 closes an energizing circuit for the busy test relay BT^1 tracted from battery B^1 through the winding thereof, alternate contact 68, normal contact 69, normal contact 70 to ground at alternate contact 71. Upon energization of relay BT^1, circuit for secondary magnet SM^1 is closed traced from the generator through the winding of the magnet SM^1, normal contact 72 of relay RR^1 to ground at alternate contact 73. The secondary magnet SM^1 now steps the wipers 16, 17, and 18 in a secondary direction to select a set of idle contacts in the selected group. Upon the first step of the wipers in a secondary direction, the secondary off-normal contacts SON^1 assume their alternate position opening the initial energizing circuit of the relay BT^1 but said relay BT^1 is maintained energized over a locking circuit traced from battery B^1 through the winding of the said relay, its alternate contact 74, normal contact 75, contact 76 to the grounded contacts 19 of busy connectors. As soon as the private wiper 16 engages an ungrounded contact the energizing circuit of the relay BT^1 is interrupted the said relay restoring and opening the circuit of the secondary magnet SM^1. The operator now actuates the calling device CD for the second time which operation causes the contact 22 to be opened and closed twice to energize and deënergize the primary relay PR^1 twice. Upon the first deënergization an energizing circuit for primary magnet PM^2 of connector G is established from battery B^5 through the winding of the primary

magnet PM^2, normal contact 77, multiple contacts 20, wiper 17, normal contact 78, normal contact 64, alternate contact 65 to ground at normal contact 66. The two interruptions of the primary relay PR^1 energize and deënergize primary magnet PM^2 to step wipers 23, 24, 25 of the selected connector to the second group of contacts, which group contains the contacts of the wanted line.

After the calling device has sent the last impulse of the second digit, a single break in the circuit of the secondary relay SR^1 is caused by the opening of contact 22^1. The said momentary deënergization of the relay SR^1 closes an energizing circuit for secondary magnet SM^2 and the motor magnet MM of ringing switch RS traced from battery B^5 through the winding of the magnet SM^2, alternate contact 79 normal contact 80, contact 21 and wiper 18, normal contact 81, normal contact 70 to ground at alternate contact 71. The circuit of the motor magnet MM is traced from battery B^5 through the winding of magnet MM, alternate contact 79 of primary off-normal contacts PON^4, normal contact 80 and over the above traced circuit to ground at alternate contact 71. The secondary magnet SM^2 and the motor magnet MM are energized a single time to step wipers 23, 24, 25 a step toward the selected group of contacts.

The wipers 23, 24, 25 of the connector and the wiper RW of the ringing switch RS are normally two steps distant from the edge of their contact bank. Upon the first step of wipers 23, 24, 25, in a secondary direction the secondary off-normal contact 77 of SON^2, assumes its alternate position and the normal contact 80 of secondary off-normal contact SON^3 is opened but not sufficiently to engage its alternate contact, as shown in the intermediate position, two secondary steps of the connector being necessary to close alternate contact 80. The operator now actuates the calling device CD to send eight impulses of current which operation causes the contact 22 to be opened and closed eight times to energize and deënergize the primary relay PR^1, the same number of times. Upon the first deënergization of the primary relay PR^1 an energizing circuit for the secondary magnet SM^2 and the motor magnet MM is established, the circuit for SM^2 being traced from battery B^5 through the winding of the secondary magnet SM^2, normal contact 82, contact 20 and wiper 17, normal contact 78, normal contact 64, alternate contact 65 to ground at normal contact 66. The circuit for motor magnet MM is traced from battery B^5 through winding of said magnet, normal contact 82, over the above traced circuit to ground at alternate contact 66. Upon the first deënergization of relay PR^1 the wipers engage the first set of contacts and also allow the contact 80 of SON^3 to assume its alternate contacting position. The magnets SM^2 and MM are thus energized and deënergized eight times to step the wipers 23, 24, 25 and the wiper RW to the eighth contact position of each switch. The wipers 23, 24, 25 are thus stepped in a secondary direction to select the eighth set of contacts 28, 28^1 and 28^2, which are the contacts of the wanted substation and the wiper RW is also stepped to the eighth contact 28^3 which contact is connected to the proper generator for ringing the call bell of the wanted substation. The single deënergization of the relay SR^1 brought about by the opening of the contact 22^1 of the calling device after the cessation of the series of primary impulses, causes a circuit to be closed for the test relay TR of the connector G traced from battery B^5 through the lower winding of the said relay, normal contact 85, alternate contact 80, contacts 21 and wiper 18, normal contact 81, the normal contact 70 to ground at alternate contact 71. The closing of the alternate contact 86 closes an energizing circuit for the relay 87 traced from battery B^5 through the winding of the said relay, the alternate contact 86 of relay TR, conductor 88 to ground at normal contact 89 of relay 90. The said relay 87 then closes a locking circuit for itself traced from battery B^5 through the winding of the said relay, alternate contact 93 to ground at normal contact 89 of relay 90.

Assuming now that the called line is idle, the private wiper 23 being connected to the private contact 28 of the wanted idle line, causes a circuit to be established traced from battery B^5 through the winding of the cut-off relay CO^1, normal contact 42^1 of line relay LR^1, contact 28, wiper 23, alternate contact 91, through the upper locking winding of the relay TR to battery B^5. This causes the deënergization of TR since its alternate contact 91 connected the upper locking winding with the same side of battery B^5 causing the said relay TR to deënergize. Upon the deënergization of the relay TR, an energizing circuit for the ringing control relay RCR is established, traced from ground through the winding of the said relay, alternate contact 92, normal contact 91, wiper 23, contacts 28, normal contact 42^1, through the winding of cut-off relay CO^1 to battery B^5 thus energizing the relay RCR and cut-off relay CO^1 in series. The energization of the relay CO^1 removes the substation control of its associated line circuit C^1. The closing of the alternate contact 94 of the relay RCR establishes an energizing circuit for the ringing interrupter relay RI traced from battery B^5 through

the winding of the said relay, normal contact 95 of relay 96, the alternate contact 94, through the interrupter I^1 to ground. The alternate contact 94 of relay RCR connects the interrupter I^1 to the relay RI to intermittently energize the said relay to connect the selected generator *c* to the wanted line. The said ringing current is traced from the ungrounded pole of the generator *c*, contact 28^3 of the ringing switch RS, wiper RW, alternate contact 97, wiper 24, contacts 28^1 through the condenser and call bell of the wanted substation, contact 28^2, wiper 25, alternate contact 98 of relay RCR and impedance coil 99 to battery B^5 and ground. The ringing current from the generator *c* is now intermittently connected and disconnected due to the energization and deënergization of relay RI. As soon as the called subscriber answers and the normal contact 97 of RI is closed, an energizing circuit for release relay RR^3 is established, traced from ground through the winding of said relay, alternate contact 100, normal contact 97, wiper 24, contact 28^1, through the substation, contact 28^2, wiper 25, alternate contact 98 through the impedance coil 99 to battery B^5. The closure of alternate contact 101 of relay RR^3 closes an energizing circuit for the relay 96 traced from battery B^5 through the winding of said relay 96 to ground at alternate contact 101 of relay RR^3. The relay 96 then establishes a locking circuit for itself, traced from battery through the winding of the said relay, its alternate contact 102, conductor 88 to ground at normal contact 89 of relay 90. The opening of contact 95 disconnects the relay RI preventing the further application of ringing current. The closing of the alternate contacts 103 and 104 establishes the continuity of the talking conductors. As soon as the relay 96 is energized a circuit is established for the relay 105 of first selector F traced from ground through relay RR^3, alternate contact 100 normal contact 97, wiper 24, contact 28^1, through the now closed switch-hook contacts at the called substation back to the contact 28^2, wiper 25, alternate contact 104, off-normal contact 80, contact 21, wiper 18, alternate contact 70, through the winding of relay 105 to battery B^1, the relays RR^3 and 105 remaining energized in series. Relay 105 closes an energizing circuit for the reversing relay RV traced from battery B^1 through the winding of the said relay to ground at alternate contact 106, the reversing relay RV then closing a locking circuit for itself traced from battery B^1 through winding of relay RV, its alternate contact 107 to ground at alternate contact 108. The reversing relay by closing its alternate contacts 56, 60 reverses the connection of the batteries B^2 and B^3 to the upper and lower conductors of the talking circuit of the first selector F, current now flowing from the positive side of the battery B^2 through the winding of relay PR^1, alternate contact 60 over the lower talking conductor, line limb S through the closed switch-hook contacts at the calling substation A, the line limb P back over the upper heavily marked conductor through alternate contact 56, relay SR^1 to the negative side of the battery B^3, the said batteries B^2 and B^3 being grounded at their intermediate points. Thus the direction of current flow in the calling line is automatically reversed when the called subscriber answers and it is this reversal of battery flow which I employ in connection with the coin controlling mechanism at the substations, as will be described. Upon the energization of relay RV its normal contact 84 is opened extinguishing the ringing or supervisory lamp RL notifying the operator that the called party has answered. The calling and called substations A and Q are now in conversational circuit, the talking circuit being traced over the heavily marked conductors.

Assuming now that the subscribers have finished conversation and that the calling subscriber at A is the first to hang up, the replacing of the receiver thereat releases the line selector switch E and the first selector F and by the replacement of the receiver by the subscriber at the called substation Q, the connector G is released. When the subscriber A replaces his receiver upon the switch-hook contact 109 associated with the switch-hook is closed before the switch-hook contacts 110, 111 are opened, causing battery current from B^2, B^3 to flow through the polarized magnet PL. The flow of current is in such a direction through the windings of the polarized magnet PL as to tilt the armature 112 to the left to collect the deposited coin. The opening of the contacts 110 and 111 of the switch-hook followed by the interruption of contacts 36, 38 when the coin is released, interrupts the energizing circuit for the relays PR^1 and SR^1 restoring them simultaneously. An energizing circuit for the relay RR^1 of the first selector F is then established traced from ground through the winding of the relay RR^1, normal contacts 113, 114, alternate contact 54, the lower winding of the release relay RR to battery B. The energization of the relay RR closes an energizing circuit for the release magnet RM of the line selector E traced from battery B through the winding of the magnet, alternate contacts 115, 49, to ground at normal contact 48. The relay RM energizing withdraws the retaining pawls of the line selector E whose wipers and off-normal contacts are restored to normal. The relay BT is held energized through the alternate contact 53 to ground while the switch is restoring to open its con-

tacts 57, 59, placing the wipers 8 and 9 on open circuit. The relay RR^1 of F locks itself through its alternate contact 116, alternate contact 68, through winding of relay BT^1 to battery B^1. Upon the energization of the relays RR^1 and BT^1 an energizing circuit for the release magnet RM^1 is established traced from battery B^1 through the winding of the relay RM^1, alternate contact 72, of relay RR^1 to ground at alternate contact 73 of relay BT^1. The magnet upon its energization withdraws the retaining pawls of the first selector F allowing the switch to restore to normal. The primary off-normal contacts PON^1, PON^2, and PON^3 restore to normal as do also the secondary off-normal contacts SON^1. The called subscriber Q replacing his receiver deënergizes the relay RR^3 closing an energizing circuit for relay 90 traced from battery B^5, normal contact 117, alternate contact 118, conductor 119 through the winding of the relay 90 to ground. The relay 90 then closes a locking circuit for itself traced from battery B^5 through the closed contacts of PON^4, alternate contact of relay 90 to ground. Upon the energization of the relay 90 an energizing circuit for release magnet RM^2 is established from battery B^5 through the said relay, to ground at alternate contact 89. The release magnet RM^2 now withdraws retaining pawls of the connector G which allows the connector to restore to normal and also allows the primary off-normal contacts PON^4 and secondary off-normal contacts SON^2 and SON^3 to return to normal. Upon the energization of relay 90 an energizing circuit for the magnet R of the ringing switch RS is also established traced from battery B^5 through the winding of relay R to ground at alternate contact 89 of relay 90. The energization of magnet R^1 withdraws the retaining pawl releasing the wiper RW.

If the called subscriber Q is the first to replace his receiver after conversation has terminated the connector G and first selector F are restored and the replacing of the receiver by the calling subscriber at A releases the line selector E. The replacing of the receiver at the substation Q prior to A opens the line circuit PL^1 causing the deënergization of relay RR^3 and also the relay 105 at F which was held energized in series with relay RR^3 whereupon the retracted armature 120 of relay 105 of first selector F would close circuit for battery B^1 through the attracted armature 121, release relay RR^1 to ground whereafter the release of the first selector F and connector G would proceed as before described. It will be observed that although selector F restored, the reversed connections of battery B^2 and B^3 to the calling line are still maintained, since the relay RV is held locked by current through the alternate contact 107, contact 55 at E and contacts 52, 53 to ground. When the subscriber at A now replaces the receiver, the polarized magnet PL of the coin collecting mechanism will receive the battery reversal as before described to collect the coin. The relays PR^1 and SR^1 will also be deënergized and the release of the line selector will be the same as before described.

Assuming now that the subscriber at substation A is calling the subscriber at the substation Q and assuming further that the called line is busy, the operation of the system is the same as described in the preceding description up to and including the energization of the relay TR. The wipers 23, 24, 25 having engaged the contacts 28, 28^1, 28^2, of the wanted line, there will be a ground upon the private contact 28 from the alternate contact 42^1 of relay LR^1 of C^1, or a connector switch G, and this ground closes a locking circuit for the said relay TR traced from battery B^5 through the upper winding of the relay TR, its alternate contact 91 to ground at private contact 28. The busy signal BB is therefore connected to the calling line by the closure of the alternate contact 125 of relay TR. The said signal is effected by a circuit traced from the battery B^5 through the primary winding of the induction coil through the interrupter I^2 to ground. This induces current into the secondary winding of the induction coil through the alternate contact 125 over the upper heavily marked conductor, through the substation A back over the lower heavily marked conductor and through the relay SR^1 to battery B^3 and ground. The calling subscriber at A hearing the characteristic busy signal replaces his receiver and the switches E and F will be restored as before described. The connector G will also be released because relay 96 remained deënergized and the attracted armature of relay RR^1 of first selector F closes a circuit from battery B^1, alternate contact 75 of relay RR^1, normal contact 76 of relay RM^1, wiper 16, multiple contacts 19, alternate contact 126 of primary off-normal contacts PON^4, normal contact 127, conductor 119 through winding of relay 90 to ground. Relay 90 upon energization closes an energizing circuit for the release magnet RM^2 of connector G and the release magnet R of the ringing switch RS causing the restoration of the switches as above described. When the subscriber at substation A replaces his receiver in response to the above described busy signal, the contact 109 of the switch-hook makes before the switch-hook contacts 110 and 111 are broken. The relay RV has not energized so the battery flow through the polarized magnet PL at the substation A is in a direction to cause the armature 112 to tilt to the right allowing the coin to drop into the

left hand chute to be refunded to the subscriber. Should the subscriber at the called substation Q fail to respond the relay RR^3 fails to energize preventing the relay 105 from energizing and thus the reversing relay RV also remains deënergized, so the battery flow to operate the polarized magnet PL at the calling substation is the same as just described to refund the coin to the calling subscriber for an uncompleted connection.

From the foregoing it will be seen that as long as a line is idle the characteristic signal through I is connected thereto. As soon as a line is selected either as a calling or called line the cut-off relay is energized thus disconnecting the signal.

Should a subscriber deposit a coin before removing his receiver a metallic circuit through the polarized magnet PL is established by the closing of coin controlled contacts 36, 38 but as the initial flow of current over a line is in the same direction as when initially established through relays B^2 and B^3, the electromagnet PL is operated to restore the coin. Although such premature deposit of a coin will effect the energization of a line relay LR resulting in selection of the line in a manner as previously described, due to the fact that the restoration of the coin has interrupted the direct current path for the substation, when the line is selected no path is present to maintain relays PR^1 and SR^1 energized so that they restore resulting in the restoration of the operated switch in a manner as will be clear from the previous description.

Although the method of operating described in the previous paragraph is the preferred one, if desired the magnet PL may be adjusted so that it will not operate if a coin is deposited prior to the removal of the receiver, and its winding may be made sufficiently high to prevent the operation of the line relay LR. Then a premature deposit of a coin will be without effect upon the circuits involved. In such case the coin would remain in the slot and nothing occur until the receiver is removed at which time a direct current path is provided due to the closing of switch-hook contact 110 and contacts 36, 37 of the coin device resulting in the selection of the line as already described.

Although in describing my invention I have illustrated a preferred embodiment thereof I contemplate employing it in other ways than that shown and described. It will also be apparent that changes and modifications will readily occur to those skilled in the art and therefore I do not desire to be limited to the exact structure as shown and described but aim to cover all that which comes within the spirit and scope of the appended claims.

Having described my invention, what I claim as new and desire to secure by United States Letters Patent, is:

1. A telephone substation including a switch-hook, a receiver, a condenser, a pair of line terminals for the substation adapted for connection to two line conductors, circuit connections effective upon removal of the receiver from the switch-hook to include said condenser in an inductive path across said terminals, a coin or token receptacle responsive to the deposit of a coin or token for establishing a direct current path across said terminals, and electromagnetic means for controlling the disposition of the deposited coin or token.

2. A telephone substation including a switch-hook, receiver and condenser, a pair of line terminals for the substation adapted for connection to two line conductors, means responsive to the removal of the receiver from the switch-hook to include said condenser and receiver in an inductive path across said terminals, a coin or token receptacle, means responsive to the deposit of a coin or token in said receptacle to establish a direct current path across said terminals, and means for refunding or collecting the deposited coin or token.

3. A telephone substation including a switch-hook, a condenser, a receiver, a pair of line terminals for the substation adapted for connection to two line conductors, circuit connections effective upon removal of the receiver from the switch-hook to include said condenser in an inductive path across said terminals, a normally open direct current path across said terminals, a coin or token receptacle responsive to the deposit of a coin or token for closing the last said path in multiple relation to said inductive path, and a progressively movable switch responsive to the establishment of said direct current path.

4. A telephone substation including a switch, a receiver, a pair of line terminals for the substation adapted for connection to two line conductors, an inductive path including the receiver established across said terminals responsive to the removal of the receiver from the switch-hook, a coin depositing device having an actuating electromagnet, circuit connections for the electromagnet including a normally open coin controlled contact, a direct current path across said terminals including a coin controlled contact, said contacts responsive to the deposit of a coin to establish said direct current path across said terminals, and a switch-hook controlled contact effective upon replacing of the receiver to connect said electromagnet across said terminals.

5. A telephone system including a telephone line, link circuits for extending the talking circuit of said line, an automatic

switch adapted for interconnecting said line and link circuits, a characteristic signal normally connected to said line, a switch-hook and receiver at the substation of said line, an inductive path including said receiver and said signal established responsive to the removal of the receiver from the switch-hook, a coin receptacle at the substation of said line, and a direct current path established through said substation and across said line responsive to the deposit of a coin for operating said switch to interconnect said line and an idle link circuit.

6. A telephone system including a telephone line, operator controlled link circuits for extending the talking circuit of said line, line signals, an automatic switch adapted for interconnecting said line and link circuits, a coin receptacle at the substation of said line, a direct current path established responsive to the deposit of a coin in said receptacle, said path including the two line conductors, for operating said switch to interconnect said line and an idle link circuit, and means for operating one of said signals to indicate the call.

7. A telephone system including a subscriber's telephone line, link circuits for extending the talking circuit of said line, an automatic switch for interconnecting said line to the link circuits, a coin receptacle at the substation on said line, a direct current path including the two line conductors in series responsive to the deposit of a coin in said receptacle for operating said switch to automatically select and connect said line with an idle link circuit, and electromagnetic means for controlling the disposition of a deposited coin.

8. A telephone system including a subscriber's telephone line, trunking means associated with said line, a switch-hook and a receiver at the substation of said line, an inductive bridge including said receiver established responsive to the removal of the receiver from the switch-hook, a coin receptacle at the substation of said line, and a direct current path established through said substation across said line responsive to the deposit of a coin for controlling said automatic trunking means.

9. A telephone system including a telephone line, a substation on said line including a switch-hook, a condenser and a receiver, a progressively movable switch associated with said line, circuit connections effective upon the removal of the receiver from the switch-hook to include said condenser in an inductive bridge across the said line, a normally open direct current path at said substation, a coin receiving device responsive to the deposit of a coin for closing said normally open path thereby initiating movement of said progressively movable switch.

10. A telephone system including a calling telephone line and a called telephone line, a substation on said calling line provided with a receiver, a switch-hook and a condenser, means responsive to the removal of the receiver from the switch-hook to include said condenser and receiver in an inductive path across said line, a coin collecting device, means responsive to the deposit of a coin in said device to establish a direct current path across said line, and operator controlled automatic switching means for connecting said calling line with said called line.

11. A telephone system including a subscriber's line, a substation on said line provided with a receiver, a switch-hook and a condenser, means controlled by the receiver for including said condenser and receiver in a bridge across said line, a coin device, means controlled by a deposited coin for connecting a conductive path across said line, and automatic switches for connecting with a called line.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

GEORGE E. MUELLER.

Witnesses:
WM. BERGHAHN,
M. R. ROCHFORD.