F. NEWFORTH, Jr.

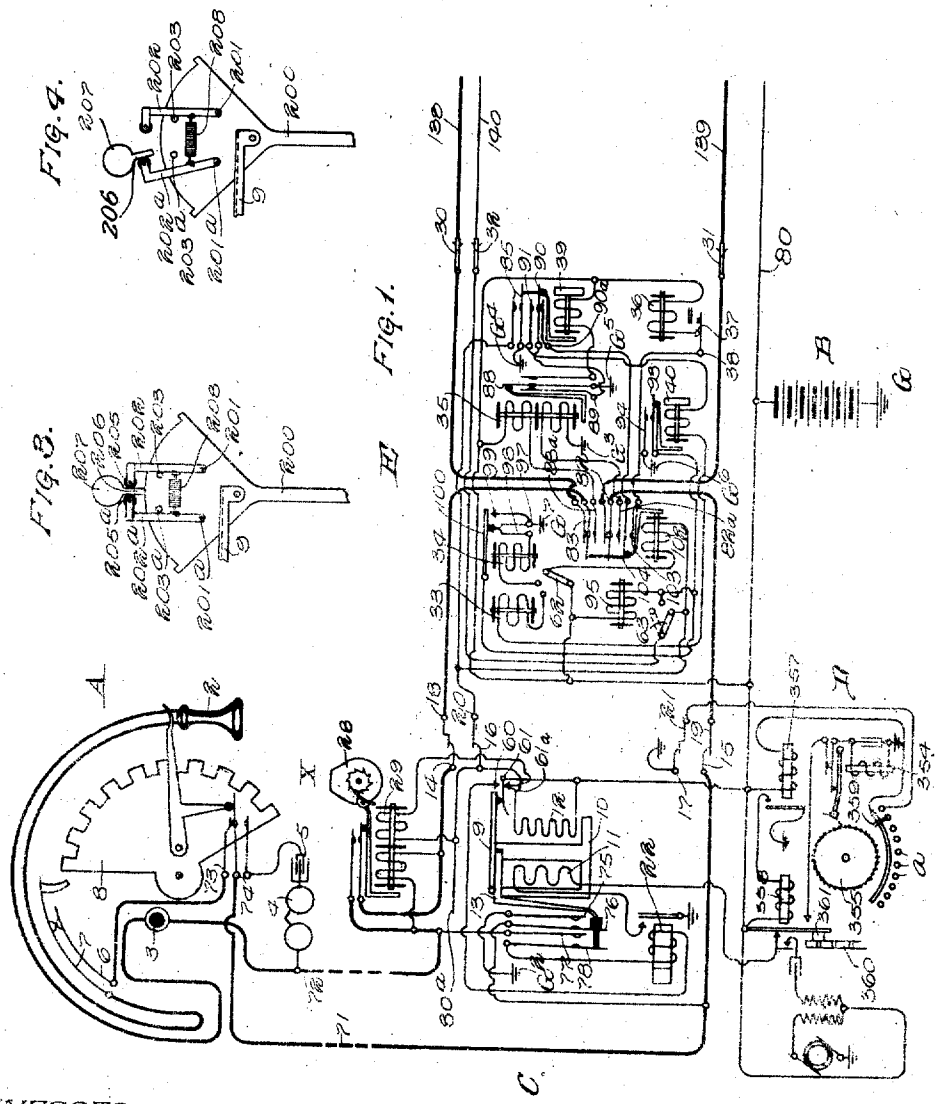
AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED SEPT. 18, 1914.

1,256,817.

Patented Feb. 19, 1918.

3 SHEETS—SHEET 1.



WITNESSES

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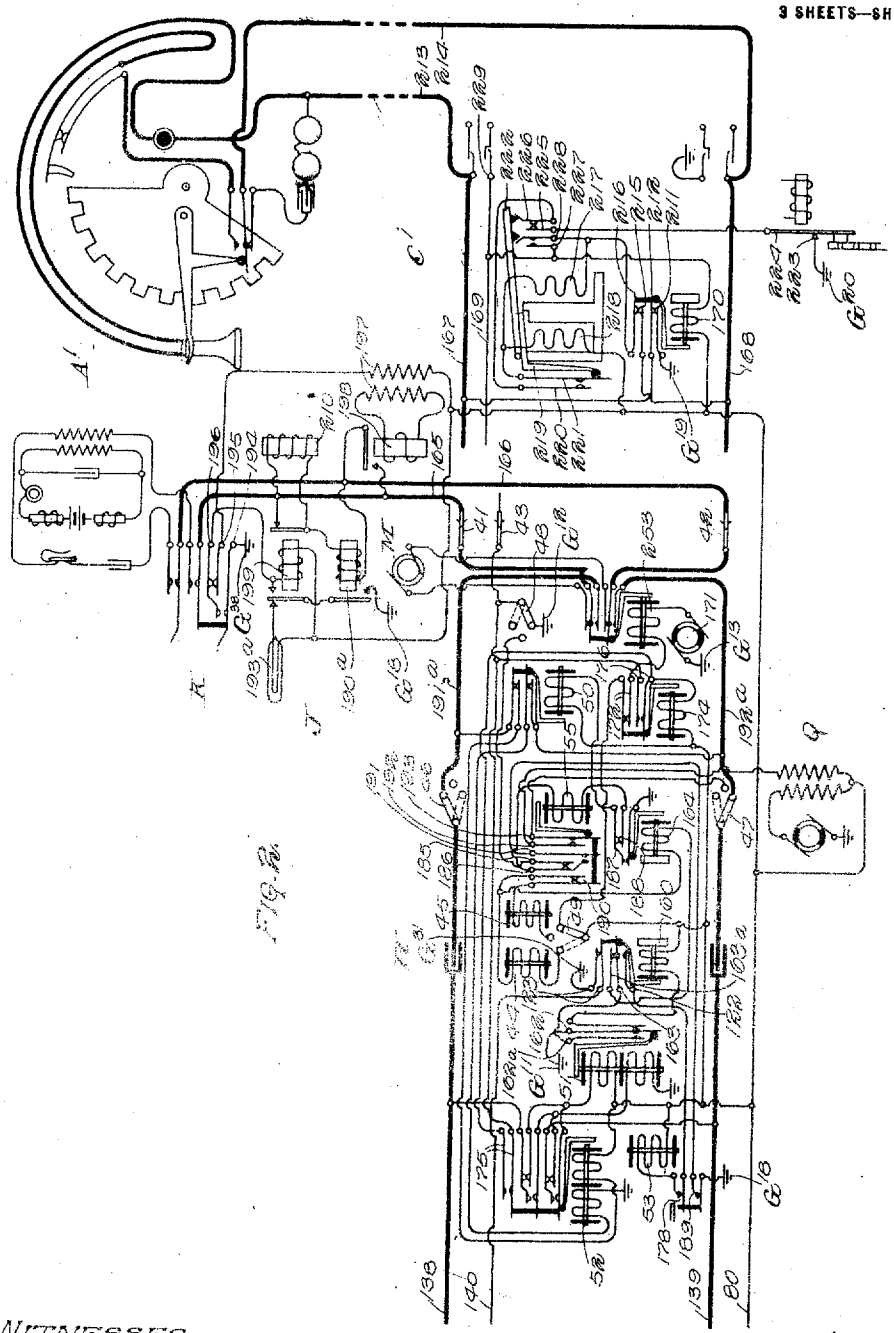

FIG. 2.

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3 SHEETS—SHEET 3.

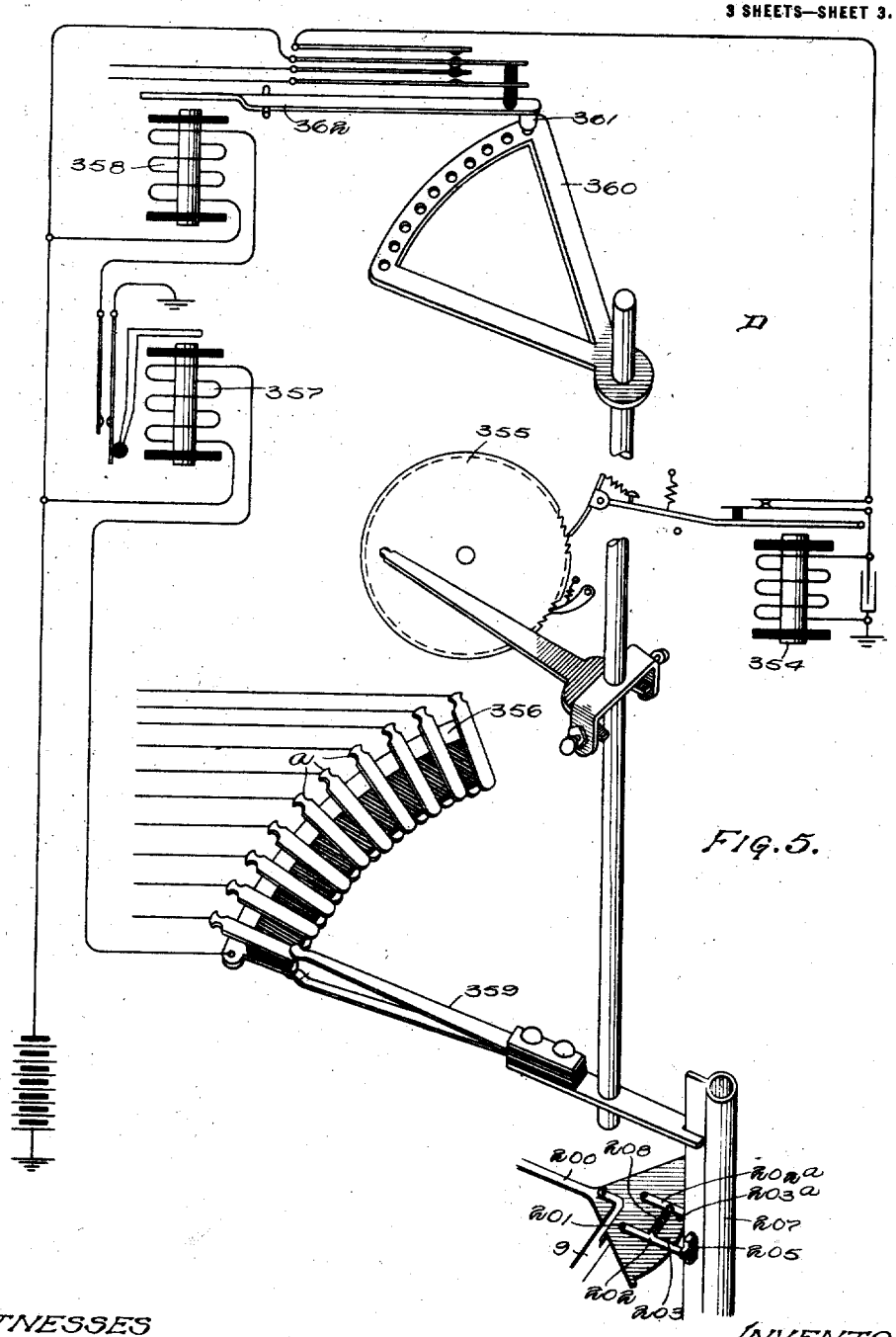

FIG. 5.

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AUTOMATIC TELEPHONE SYSTEM.

1,256,817. Specification of Letters Patent. **Patented Feb. 19, 1918.**

Application filed September 18, 1914. Serial No. 862,292.

To all whom it may concern:

Be it known that I, FRANK NEWFORTH, Jr., a citizen of the United States of America, and resident of Chicago, Cook county, 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 in general. More particularly it relates to systems in which trunk selecting apparatus is employed and in which traffic trunks are used in connection therewith. Among the special objects of my invention are the following:—

To provide in a measured service reverse battery telephone system a traffic line terminating in an operator's position, which operator upon responding automatically cuts off the ringing current in the calling connector without operating the meter associated with the calling circuit; to provide an improved type of trunking switch; and to provide certain details and features of improvement tending to increase the efficiency and serviceability of a system of the above character.

The means to accomplish the foregoing and other useful ends are hereinafter set forth and claimed.

In the accompanying drawings Figures 1 and 2 taken together show a connection established between a calling automatic substation A and the lines of a called automatic substation A'.

In Fig. 1 there is shown the automatic substation A, line switch C, a meter X associated with the line and a first selector switch E.

In Fig. 2 there is shown a connector switch H, and line switch C' of substation A'. There is also shown at J a group of relays which may be located in a manual board and are for the purpose of allowing an operator to answer an information call or the like without operating the meter of the calling line as will be hereinafter more fully explained.

Figs. 3 and 4 represent in detail a portion of a so-called self alining line switch plunger, that is a line switch plunger which will at all times return to its normal position on the controlling shaft regardless of the position of the shaft.

Fig. 5 represents in detail a portion of a master switch showing the association of the line switch plungers therewith.

The automatic substation A (Fig. 1) comprises the usual receiver 2, transmitter 3, ringer 4 and condenser 5. Being an automatic substation, it is also provided with a suitable impulse sending mechanism for controlling the automatic switches, which mechanism is represented diagrammatically by a pair of impulse springs 6 and 7 and an impulse wheel 8, which may be controlled in a well known manner through the medium of a dial (not shown) provided with finger holes in such a way that the impulse springs may be momentarily separated a number of times corresponding to the respective digits of the number of the called subscriber.

The subscriber's individual switch C is of the general type of subscriber's switch shown in British patent to R. W. James, #26,301 of 1906, more closely resembling, however, the particular type shown in British patent to T. G. Martin, #1419 of 1910. This line switch comprises, among other details, a plunger 200 shown in Figs. 4 and 5 pivotally attached to the end of a so-called plunger arm 9. The back portion of this plunger 200 is fan shaped. Pivotally mounted on this fan shape portion at the points 201 and 201^a there are two arms, 202 and 202^a. These arms 202 and 202^a are limited in their rotation by two pins 203 and 203^a, at their outer ends they are provided with rollers 205 and 205^a which engage the flange 206 on the usual shaft 207, when the plunger 200 is in normal position. The arms 202 and 202^a are held in this position by means of a spring 208, one end of which is secured to each arm. When the plunger is operated as shown in Fig. 3 the shaft 207 is rotated in the usual and well known manner and operates to force the arm 202^a away from the retaining pin 203^a. The arm 202 however is prevented from rotating by means of the pin 203. Thus it will be seen that when the shaft 207 is rotated, at the

time the plunger is in an operated position, the spring 208 will be placed under tension and the plunger held against rotation and, when the plunger is released, it operates through the medium of the arms 202 and 202ª, to bring the plunger back to its normal position, that is, until the arms 202 and 202ª engage their respective stop pins 203 and 203ª. The plunger arm 9 is controlled by a magnet 10, which comprises an operating winding 11 and a holding winding 12. This magnet also controls the cut-off armature 13. The winding 11 operates both the plunger arm 9 and armature 13, while the winding 12 is strong enough only to operate the armature 13 and to hold the plunger arm 9 in its operated position. When the plunger arm 9 is operated its plunger is forced into a bank of contact springs, forcing the springs 14, 15, 16 and 17 into engagement with the springs 18, 19, 20 and 21, respectively. Although only one set of springs 14—21 is shown, each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line leading to a first selector switch E. Each trunk line is connected in multiple to the corresponding springs of all the line switches of the group which is controlled by the master switch D. The switch C is controlled by the subscriber through the medium of the line relay 22, which relay is preferably slow acting, that is, slow to release its armature upon deënergizing. This relay instead of being connected directly to battery as is usually the case is connected to battery through the springs 60, 61 controlled by the plunger arm 9. The purpose of connecting relay 9 in this manner will be hereinafter pointed out.

The master switch D is of the general type of master switches shown in British Patents #26,301 of 1906, and #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 to engage the terminals of an idle trunk line. Referring to Fig. 5, the master switch D consists essentially of a motor magnet 354 which operates the ratchet wheel 355, a bank of contacts comprising a number of individual segments *a* and one common segment 356, a busy trunk relay 357, and a locking relay 358. The wiper 359 is adapted to always keep some one of the individual segments in an electrical connection with the common segment 356. By means of a suitable mechanical connection the rotary motion of the ratchet wheel 355 is transmitted to the plunger shaft to give said shaft a reciprocating motion to move the idle plungers back and forth in front of the bank contacts. To the plunger shaft there is also secured a cam 360 having in its surface a number of circular openings which are engaged by the pin 361 on the armature 362. The openings in the cam 360 are so spaced that the pin 361 can engage an opening only when the plungers that are in locking engagement with the plunger shaft are directly in front of a trunk terminal.

Associated with the line A there is shown a call register 28, which is controlled by a double wound magnet 29. The windings of the magnet 29 are so proportioned that it requires the energization of both windings in the same direction to attract the armature, said armature being unaffected by the energization of either winding alone, or by the energization of the two windings in opposition to each other.

The first selector switch E is of the general type of selector switches disclosed in U. S. Letters Patent to Keith, Erickson and Erickson, #815,321 granted March 13, 1906. Among other details, the selector E comprises a bank of contacts arranged in horizontal rows or levels, which are adapted to be engaged by a set of wipers 30, 31 and 32 carried upon a shaft (not shown), which has a vertical movement controlled by the vertical magnet 33 and a rotary motion controlled by the rotary magnet 34. The operations of the switch are controlled through the medium of the double wound line relay 35. Means for permitting the switch to be restored to normal position are provided in the release magnet 36, which, upon energizing, withdraws the retaining pawls from the shaft. The spring contacts 37 and 38 are permitted to close only when the switch shaft has been raised one or more steps from its lowest position. The relays 39 and 40 are slow acting relays, that is, relays which deënergize slowly after their energizing circuits are broken. This slow action is usually obtained by placing a ring of copper around one end of the core of the relay.

The connector shown at H (Fig. 2) is of the general type of connector switch disclosed in U. S. Letters Patent to Keith, Erickson and Erickson, #815,176, the circuits, however, being modified to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. Like the selectors, the connector is provided with a shaft (not shown), carrying the wipers 41, 42 and 43, and which is controlled by the vertical magnet 44 and rotary magnet 45. The usual side switch comprising the wipers 46, 47, 48 and 49 is controlled by the private magnet 50 in the usual and well known manner. Magnet 53 is the usual release magnet. The line relay 51 is connected with the line through the reversing springs of a so-called back bridge relay 52, through the windings of which lat-

ter relay the called line is provided with talking current. The ringer relay 253 is the means through which the application of ringing current to the called line is controlled. At Q there is shown a busy signaling machine which is connected to springs of relay 55, the function of which is to send a busy tone under certain conditions back over the line. The complete operation of this relay will be described later. The busy signaling machine as represented herein, comprises an induction coil or transformer, the primary winding of which is included in a local circuit with a battery and an interrupter. Through the medium of this interrupter an intermittent interrupted current is supplied to the primary winding which induces an intermittent alternating current in the secondary winding whereby when said winding is connected to the subscriber's line an intermittent buzzing sound is heard in the receiver.

The line switch C′ is similar to the line switch C the circuits, being modified, however, as will be hereinafter more fully explained.

The substation A′ is similar in all respects to the substation A.

For the purpose of supplying current for operating the central office apparatus and for talking purposes there is shown a battery B having one terminal grounded at G.

In the event of a subscriber having his telephone removed or taken out of service for non-payment or other numerous reasons, his line is disconnected from the central office apparatus and the contacts of the connector bank constituting the terminals of said subscribers' lines are wired to what is known as a traffic trunk as shown at J in Fig. 2, said trunks being designated by the reference numerals 165 and 166. Therefore, upon the subscriber at substation A attempting to call a subscriber whose telephone it has been assumed has been taken out of service he will signal an operator who will give him the necessary information. It is desirable that such a call be not charged to the calling substation, therefore, arrangements are provided in the group of relays shown at J Fig. 2, for the preventing of the operation of the meter of the calling substation when a call similar to that above mentioned is made.

A general description of the apparatus having been given it will now be explained how a connection may be established between a calling automatic substation A and a called automatic substation A′, the number of which we will assume to be 220, and also how the meter is prevented from being operated when the subscriber at substation A attempts to call substation A^2 (not shown) whose line has been connected to the above mentioned traffic trunk. Upon the removal of the receiver from the switch hook at the calling substation preparatory to making a call, the talking circuit of the substation is bridged across the line conductors 71 and 72 by the hook switch springs 73 and 74, whereby the circuit of the line relay 22 of the switch C is closed. This circuit extends from ground G^2 through the springs 75 and 76, line 71, substation A, line 72, springs 77 and 78, relay 22, springs 60 and 61 to the battery lead 80. The relay 22, upon energizing, closes the circuit of the operating winding 11, which operates to disconnect the relay 22 from the line through the medium of the armature 13 and springs 60 and 61, and to thrust the plunger of the switch into the terminal of the trunk before which it is being held by the master switch, whereby the line circuit is extended through the springs 14 and 18, and 15 and 19 to an idle first selector switch E. The line relay 35 of the selector switch E is thereupon energized over a circuit extending from ground G^3 through the lower winding of said relay, springs 82 and 82^a, thence over the heavy conductors to and through the substation A and back over the other side of the line through the left hand winding of the meter magnet 29, springs 83 and 83^a and upper winding of line relay 35 to the battery lead 80. The relay 35, upon energizing, closes the circuit of the relay 39, which, in turn, upon energizing closes a circuit extending from ground G^4 through the springs 85, line switch bank springs 20 and 16 and holding winding 12 to the battery lead 80. The energization of this winding serves to hold the switch C in its operated position after the circuit of the winding 11 is broken by the relay 22, which deënergizes shortly after it is disconnected from the line. The energization of the relay 39 at the selector E also completes a circuit extending from ground G^4 through springs 85, springs 20 and 16, through the right hand winding of the meter magnet 29 and the springs 61^a and 61 to the battery lead 80. The current in this winding is in opposition to the current flowing through the line winding, and the magnet is, therefore, not operated at this time. At the same time, a guarding potential is extended from ground G^4 at the selector via conductor 80^a to the connector private bank contact of the calling line in the bank of each of the connector switches which have access thereto.

The springs 60 and 61 disengage immediately upon the operating of the plunger arm 9 which prevents the circuit of the line relay 22 from again being closed until the plunger arm 9 is again restored to normal position in front of an idle terminal.

Upon the closure of the springs 17 and 21

by the operation of the switch C, the master switch D operates in a well known manner to advance the plungers of the idle line switches to a position opposite an idle trunk line.

The calling subscriber now operates his calling device for the first digit 2 of the called number, whereby the substation impulse springs 6 and 7 are separated twice momentarily, each time breaking the circuit of the selector line relay 35. The relay 39 of the selector, being slow acting, does not deënergize during the momentary interruptions of its circuit by the relay 35, and consequently each time the latter relay deenergizes an impulse is transmitted over the circuit extending from ground G^5 through the springs 88 and 89, 90 and 91, relay 40, vertical magnet 33 and side switch wiper 62 to the battery lead 80. The vertical magnet receives two impulses over this circuit and operates to raise the switch shaft and wipers two steps to a position opposite the second row or level of bank contacts, and at the same time the shaft controlled contacts 37 and 38 are closed. The slow acting relay 40 is maintained in its energized position continuously while impulses are being transmitted to the vertical magnet through it, and in its energized position closes a circuit from ground G^6 through the springs 94 and 93 and private magnet 95 to the battery lead 80. The relay 40, upon deënergizing, opens the circuit of the private magnet 95, which, in turn, deënergizes and allows the side switch to pass from first to second position. The wiper 62, upon passing, from first to second position closes an energizing circuit for the rotary magnet 34. This circuit extends from ground G^7 through interrupter springs 97 and 98, rotary magnet 34, wiper 62 to battery B. The rotary magnet, upon energizing, operates to rotate the shaft and shaft wipers one step onto the first bank contact of the level in which the trunk lines leading to a connector H terminate. The rotary magnet upon energizing operates to break its own circuit at the interrupter springs 97 and 98 and to again close the circuit of the private magnet. The circuit for the private magnet extends from ground G^7 through springs 99 and 100, and the private magnet 95 to battery B. If the first trunk line leading from the second level of bank contacts of the selector E is in use, the private wiper 32 will find the first private bank contacts supplied with a guarding ground potential. a circuit will then be closed through the private magnet 95 after the rotary magnet deënergizes, extending from said ground at the private wiper through the side switch wiper 63 (in second position), and then through magnet 95 to battery. The side switch is thus held in second position and the rotary magnet upon deënergizing again closes its own circuit at springs 97 and 98 and operates to step the shaft wipers to the next bank contacts. If the next contacts are also busy the operation will be repeated, the rotary magnet operating in a manner similar to that of a buzzer to rotate the shaft wipers onto bank contacts connected to an idle trunk line, at which time the private magnet deënergizes and allows the side switch to pass from second to third position. The wiper 62, upon passing to third position shifts the battery connection from the rotary magnet 34 to the line switching relay 102, thus closing a circuit through the relay 102. This circuit extends from ground G^4 through springs 85, relay 102 and wiper 62 to battery B. A circuit also extends from springs 85 through wiper 63 (in third position) to the private wiper 32. The relay 102, upon energizing, operates to disconnect the line relay 35 from the line and to connect the calling line through to the line relay 51 of the connector H, and also operates to open the circuit of the release magnet 36 at springs 103 and 104. The line relay, upon being disconnected from the line deënergizes and allows the relay 39 to deënergize. The relay 39, being slow acting, does not fall back however, until a ground has been supplied to the release trunk conductor 140 by the relay 160 of the connector switch H as will be later more fully explained.

The line relay 51 of the connector thereupon becomes energized and closes the circuit of the relay 160. The relay 160, upon energizing, provides a holding circuit for the line switching relay 102 of the selector switch E, and for the hold in winding 12 of the line switch C. The circuit for the line switching relay 102 extends from ground G^{31} through the springs 123, conductor 140, wiper 32, side switch wiper 63, relay 102 and the side switch wiper 62 to battery B. The circuit for the hold in winding 12 extends over the above traced circuit to side switch wiper 63, thence through bank contacts 20 and 16 and the said hold in winding to battery B.

When the substation calling device is operated for the digit 2, the circuit of the connector line relay 51 is broken twice. Since the relay 160 is slow acting, it does not deenergize during the momentary interruptions of its circuit by the relay 51, so that each time the latter relay is deënergized a circuit is closed extending from ground G^{11} through the springs 162 and 162^a, springs 163 and 163^a, relay 164, vertical magnet 44 and side switch wiper 49 to the battery lead 80. The vertical magnet 44 receives two impulses over this circuit and operates to raise the switch shaft wipers 41, 42, and 43 to a

position opposite the second level of bank contacts. The relay 164, which is included in series with the vertical magnet remains in its energized position during the entire time impulses are being transmitted through it and operates to close the circuit of the private magnet 50. After the last impulse is delivered the relay 164 opens the circuit of the private magnet 50, which, upon deënergizing, permits the side switch to advance from first to second position. The movement of the side switch wiper 49 from first to second position transfers the battery connection from the vertical magnet 44 to the rotary magnet 45. The calling subscriber now operates his calling device for the last digit 0 in response to which the connector line relay 51 operates to transmit ten impulses through the rotary magnet 45, in series with the relay 164, whereby the shaft wipers are rotated onto the contacts of the desired line. The relay 164 operates in response to this digit in the same manner as for the previous digit, to cause the private magnet 50 to advance the side switch one more position, that is, from second to third position after the last impulse for the digit is transmitted. By the engagement of the side switch wipers 46 and 47 with their third position contact points the line connection is finally completed to the called number.

I will first give a description of the operations that take place, assuming that connection was established to the called telephone in which case the wipers 41, 42 and 43 would be in engagement with conductors 167, 168 and 169 respectively. The circuit of the relay 170 of the called party's line switch is closed by the side switch wiper 48 passing to third position, said circuit extending from ground G^{12} through side switch wiper 48, private wiper 43, conductor 169 and through the relay 170 to battery. The connection of ground G^{12} with the connector private bank contact of the called line over the portion of the circuit just traced provides said contact with a guarding potential to prevent the busy line from being connected with by other connector switches. By the engagement of the side switch wiper 49 with its third position contact point the circuit of the ringing relay 253 is closed, which circuit extends from ground G^{13}, through the interrupter 171, relay 253, springs 172 and side switch wiper 49 to the battery B. The ringing relay 253, upon energizing, disconnects the calling from the called line and bridges the ringing current generator M across the called line to signal the called subscriber. The ringing relay is energized only intermittently through the medium of the interrupter 171. Upon the response of the called subscriber his line is provided with talking current through the windings of the back bridge relay 52 of the connector switch, which relay, upon energizing, closes the circuit of the ringer cut-out relay 174. This circuit extends from ground G^{12} through the wiper 48, springs 175, and the said relay 174 to battery B. The relay 174, upon energizing, opens the circuit of the ringing relay 253 at the springs 172 and closes a locking circuit for itself through its own springs 176 independent of the springs of the back bridge relay 52. A further result of the energization of the relay 52, upon the response of the called subscriber, is the transposition of the connection between the windings of the line relay 51 and trunk conductors 138 and 139, whereby the direction of current in the calling line is reversed. This reversal of the current in the left hand winding of the subscriber's meter relay 29 (Fig. 1) causes the two windings to assist one another to operate the meter to register the call.

After the conversation is completed the connection is released by the hanging up of the receiver at the calling substation in the following manner: When the receiver at the substation A is restored to the switch hook, the separation of the hook switch springs 73 and 74 destroys the energizing circuit of the line relays 51 (Fig. 2). The relay 51, thereupon deënergizes, and opens the circuit of the relay 160. The relay 160, upon energizing, opens the holding circuits of the relay 102, of the switch E and of the hold in winding 12 of line switch C and at the same time closes the circuit of the release magnet 53 of the connector H. The latter circuit extends from ground G^{11} through the springs 162 and 162^a, springs 163 and 122, shaft controlled springs 178 and the said release magnet 53 to the battery B. The magnet 53, upon energizing, restores the connector switch shaft and side switch to normal position, and its own circuit is interrupted at the springs 178 when the shaft reaches its lowest position. The deënergization of the relay 102 of the switch E serves to close the circuits of the release magnet 36. The circuit for the said magnet extends from ground G^5 through the springs 88' and 89, springs 90 and 90^a, springs 104 and 103, off normal springs 38 and 37 and the magnet 36 to battery B. When the shaft reaches its lowest position the circuit of the magnet 36 is opened by the separation of the off normal springs 38 and 37. The hold in winding 12, upon deënergizing allows the plunger arm 9 and cut-off armature 13 to return to normal. Thus it will be seen that everything is released and in readiness for another call.

If the called line had been in use the calling subscriber would have received the busy signal in the following manner: The private wiper 43 upon coming to rest upon

the private bank contact of the called line would have found said contact grounded, whereby a circuit would have been closed extending from said ground, through wiper 43, side switch wiper 48, (in second position) springs 185 and 186, relay 55, springs 188 and 187, and the private magnet 50 to battery B. The relay 55, upon operating, opens the circuit of the rotary magnet at the springs 190 and closes a locking circuit for itself extending from ground G^{18} through springs 189, springs 191 and 186, and over the circuit above traced to battery B. The engagement of springs 192 and 193 places a busy signal from the machine Q onto the calling line. The calling subscriber, upon receiving the busy signal replaces his receiver upon the hook thereby releasing the connection in the manner similar to that hereinbefore explained.

It will now be explained how the calling subscriber can, after obtaining connection with the lines of the substation A^2, whose telephone has been discontinued, converse with an operator without having the call registered. As has been explained if the service of the called substation has been discontinued, then the lines of said substation, will be disconnected from the telephone and connected to the traffic trunks 165 and 166. Thus when the connector comes to rest upon the called number, that is, when the wipers 41 and 42 come to rest on the terminals of the traffic trunk 165 and 166 the relay 190^a is bridged across the conductors 191^a and 192^a, thereby being placed in the circuit with the back bridge relay 52. The relay 190^a energizes over this circuit, but is of sufficient resistance to prevent the relay 52 from operatively energizing. The relay 190^a, upon energizing, closes a circuit through the lamp 193^a. The operator, upon noting the glowing of the lamp 193^a operates the key K thereby placing the talking set across the conductors 165 and 166 and also, due to the make before break arrangement of the springs 194, 195 and 196, sends one impulse from ground G^{38} through the primary of the induction coil 197 to battery. This impulse induces an impulse in the secondary of the coil 197, which is in series with the coil 198. The relay 198 is energized by this impulse and operates to momentarily short circuit the conductors 165 and 166. The back bridge relay 52 is momentarily energized due to this short circuiting of conductors 165 and 166 and operates to close the circuit of the ringer lock-out relay 174, which, in turn operates, as has been explained to open the circuit of the ringing relay 253, thereby disconnecting the ringing current from the line. The momentary reversal of current by the operating of relay 52, however, is not of sufficient duration to operate the meter, thus preventing the call from being registered. The engagement of the springs 194 and 196 closes a circuit through the relay 199, which, in turn operates to break the circuit of the lamp 193^a and to also place the relay 210 in series with the relay 190^a, this is to increase the impedance across the conductors 165 and 166.

The release of this connection is made in the same manner as hereinbefore explained.

The line switch shown at C′ (Fig. 2) operates over a circuit slightly different from that explained for line switch C. When the receiver at substation A′ is removed preparatory to making a call a circuit is closed extending from ground G^{19} through springs 211 and 212, conductor 213, thence through substation A′, conductor 214, springs 215 and 216, windings 217 and 218 in series to the battery B. The current through these windings is not of sufficient strength to attract the plunger arm 222 but however, does attract the armature 219 and is sufficient to hold the plunger in its attracted position when once operated. The operation of the armature 219 closes a circuit for the coil 218 extending from ground G^{20} through springs 223 and 224, which are controlled by the master switch, thence through springs 225 and 226, springs 220 and 221, and the winding 218 to battery B. The arm 222 is now attracted and operates to force the plunger into the bank of contacts as described for switch C, separates the springs 225 and 226 and causes the engagement of springs 227 and 228. The separating of contact springs 225 and 226 disconnects the ground from winding 218. The engagement of springs 227 and 228 again places the windings 217 and 218 in series, over a circuit extending from the ground at the release trunk conductor 229 through springs 227 and 228 and the said windings 217 and 218 to battery B, thereby retaining the arm 222 in an operated position. It will be seen that when the plunger arm breaks the contact of springs 225 and 226, thereby disconnecting ground G^{20} from the winding 218, the plunger is held in its operated position by the original energizing circuit from ground G^{19} over the substation line and through the windings 218 and 217 in series to battery B until the release relay of the selector has time to energize and connect ground to conductor 169. The energization of the relay 170, disconnects the windings 217 and 218, and ground G^{19} from the line. The relay 170, being slow acting prevents the line switch from again immediately operating until the plunger has had time to return to normal position after the calling subscriber has released.

It will thus be seen that I have provided an improved automatic telephone system of the measured service common battery type

in which the meter is operated by the reversal of the current when the called subscriber answers. With this improved form of system a discontinued subscriber at the central office can be connected with a traffic trunk associated with an operator and the operator can answer and thereby cut off the ringing current at the connector without permitting the current of the calling side of the line to be reversed for a sufficient length of time to operate the meter. It will be noted that when a call is extended to a traffic trunk or trouble operator the momentary reversal and restoration of the current in the calling line will give a double click or signal in the calling subscriber's receiver in place of the customary single click which occurs when the call is extended to a called subscriber. The calling man may be instructed to note this signal and hang up in case the double signal is received.

I have further provided an improved form of self alining trunking switch which enables a subscriber to release a connection and immediately remove his receiver without causing the switch to establish a connection with a busy trunk.

Furthermore I provide an improved form of self alining plunger type switch in which the plunger is always in engagement with the plunger shaft regardless of whether the plunger is holding the line in engagement with a trunk or not and which is more positive and efficient in its action.

While I have illustrated my invention in connection with a special or particular type of apparatus and circuits, I do not wish to be limited to the exact structure shown and described.

What I claim as my invention is:—

1. In a telephone system, an automatic connector switch provided with bank contacts, a plurality of subscribers' lines connected with certain of said contacts, a traffic trunk connected with other of said contacts, an operator's set adapted to be connected with said traffic trunk, a source of ringing current, means for automatically connecting said ringing current with said contacts when said connector establishes connection therewith, a relay in said connector, means for causing a continuous flow of current through said relay to energize the same when connection is made with a subscriber's line and said subscriber responds, means for energizing said relay only momentarily upon the response of the operator when connection is established with the traffic trunk, and means controlled by the energization of said relay for disconnecting the ringing current from said contacts.

2. In a telephone system, an automatic connector switch, a line with which said switch is adapted to make connection, a relay in said switch, a second relay bridged across said line and adapted to be connected in series with said first relay when said connector establishes connection with said line, said second relay being of high resistance to prevent energization of said first relay, a talking set adapted to be connected with said line, and means operated automatically when said talking set is connected with said line for short-circuiting said second relay to thereby cause the operation of said first relay.

3. In a telephone system, an automatic connector switch, a line with which said switch is adapted to make connection, a relay in said switch, a second relay bridged across said line and adapted to be connected in series with said first relay when said connector establishes connection with said line, said second relay being of high resistance to prevent energization of said first relay, a talking set adapted to be connected with said line, and means operated automatically when said talking set is connected with said line for short-circuiting said second relay to thereby cause the operation of said first relay.

4. In a telephone system, an automatic connector switch, a line with which said switch is adapted to make connection, a relay in said switch, a second relay bridged across said line and adapted to be connected in series with said first relay when said connector establishes connection with said line, said second relay being of high resistance to prevent energization of said first relay, a talking set adapted to be connected with said line, and means operated automatically when said talking set is connected with said line for short-circuiting said second relay to thereby cause the operation of said first relay, means for applying ringing current to said line when connection is established therewith, and means controlled by the energization of said first relay for disconnecting said ringing current from the line.

5. In a telephone system, an automatic connector switch, a line with which said switch is adapted to make connection, a relay in said switch, a second relay bridged across said line and adapted to be connected in series with said first relay when said connector establishes connection with said line, said second relay being of high resistance to prevent energization of said first relay, a talking set adapted to be connected with said line, and means operated automatically when said talking set is connected with said line for momentarily short-circuiting said second relay to thereby cause the operation of said first relay, means for automatically connecting ringing current to said line when connection is established therewith, a trunk line extending to said switch, and means con-

trolled by the energization of said first relay for disconnecting said ringing current from the line.

6. In a telephone system, a trunk line terminating in an automatic connector switch provided with bank contacts, a plurality of subscribers' lines connected with certain of said contacts, a traffic trunk connected with other of said contacts, an operator's set adapted to be connected with said traffic trunk, a source of ringing current, means for automatically connecting said ringing current with said contacts when said connector establishes connection therewith, a relay in said connector, means for causing a continuous flow of current through said relay to energize the same when connection is made with a subscriber's line and said subscriber responds, means for energizing said relay only momentarily upon the response of the operator when connection is established with the traffic trunk, and means controlled by the energization of said relay for disconnecting the ringing current from said contacts.

7. In a telephone system, an automatic connector switch, a line with which said switch is adapted to make connection, a relay in said switch, a second relay bridged across said line and adapted to be connected in series with said first relay when said connector establishes connection with said line, said second relay being of high resistance to prevent energization of said first relay when the two are connected in series, a third relay controlling a short-circuit about said second relay, a talking set adapted to be connected with said line, and means controlled by the connection of said talking circuit with said line for transmitting an induced impulse through said third relay to thereby cause it to momentarily close said short-circuit to thereby cause the operation of said first relay.

8. In a telephone system, an automatic connector switch, a line with which said switch is adapted to make connection, a relay in said switch, a second relay bridged across said line and adapted to be connected in series with said first relay when said connector establishes connection with said line, said second relay being of high resistance to prevent energization of said first relay when the two are connected in series, a third relay controlling a short-circuit about said second relay, a talking set adapted to be connected with said line, and means controlled by the connection of said talking circuit with said line for transmitting an induced impulse through said third relay to thereby cause it to momentarily close said short-circuit to thereby cause the operation of said first relay, means for applying ringing current to said line when connection is established therewith, and means controlled by the energization of said first relay for disconnecting said ringing current from the line.

9. In a telephone system, a plurality of lines, a plurality of trunks common to said lines at the central office, a trunk selecting device for said lines comprising switching means common to all the lines and switching means individual to each line including two magnets for one of said lines, a circuit for each magnet, a controlling point for each circuit, said common means controlling one of said points and said individual means controlling the other of said points, said common and individual means having different time constants, and a telephone for each line provided with a switch hook.

10. In a telephone system, a line, a telephone for said line provided with a switch hook, a plurality of trunks accessible thereto at the central office, a non-numerical automatic trunking switch for said line, means for operating the switch for connecting the line with an idle trunk, said means comprising two magnets, a circuit for each magnet, a controlling point in each circuit and controlling means for each point having different time constants.

11. In a telephone system a line, a telephone for said line provided with a switch hook, a switch for said line, a second line, means in said switch and line for operating the said switch to connect the two lines, said means comprising a line relay in the first line and an auxiliary magnet, a circuit for each magnet, a controlling point in each circuit, and means for controlling each point having different time constants.

12. In a telephone system, a series of lines, a telephone for each line provided with a switch hook, a series of trunks accessible to said lines at the central office, a trunk selecting equipment for said lines for selecting an idle trunk and for connecting a line with said trunk, comprising a circuit controller common to said lines and a circuit controller individual to each line, said individual controller responsive while idle to said common controller to select an idle trunk, means for operating an individual controller to connect a line with a trunk and for rendering the individual controller non responsive to the common controller while the connection is maintained, means for breaking the connection and restoring the individual controller to the control of the common controller and then enabling the individual controller to locate an idle trunk, said first means including a magnet for said line, a circuit for said magnet and a plurality of means for controlling said circuit having different time constants.

13. In a telephone system, a series of lines, a telephone for each line provided with a switch hook, a series of trunks accessible to

said lines at the central office, a trunk selecting equipment for said lines for selecting an idle trunk and for connecting the line with said trunk, comprising a circuit controller common to said lines and a circuit controller individual to each line, said individual controller responsive while idle to said common controller to select an idle trunk, means for operating an individual controller to connect a line with a trunk and for rendering the individual controller non responsive to the common controller while the connection is maintained, means for breaking the connection and restoring the individual controller to the control of the common controller and then enabling the individual controller to locate an idle trunk, said first means including a relay in said line comprising two controlling points and controlling means at each point having different time constants.

14. In a telephone system, a series of lines, a telephone for each line provided with a switch hook, a series of trunks accessible to said lines at the central office, a trunk selecting equipment for said lines for selecting an idle trunk and for connecting the line with said trunk, comprising a circuit controller common to said lines and a circuit controller individual to each line, said individual controller responsive while idle to said common controller to select an idle trunk, means for operating an individual controller to connect a line with a trunk and for rendering the individual controller non responsive to the common controller while the connection is maintained, means for breaking the connection and restoring the individual controller to the control of the common controller and then enabling the individual controller to locate an idle trunk, said first means including a relay in said line comprising two controlling points and controlling means at each point having different time constants for closing one point before the other.

15. In a telephone system, a series of lines, a telephone for each line provided with a switch hook, a series of trunks accessible to said lines at the central office, a trunk selecting equipment for said lines for selecting an idle trunk and for connecting the line with said trunk, comprising a circuit controller common to said lines and a circuit controller individual to each line, said individual controller responsive while idle to said common controller to select an idle trunk, means for operating an individual controller to connect a line with a trunk and for rendering the individual controller non-responsive to the common controller while the connection is maintained, means for breaking the connection and restoring the individual controller to the control of the common controller and then enabling the individual controller to locate an idle trunk, said first means including a relay in said line comprising two controlling points, one in the line and one in the central office, and controlling means at each point having different time constants.

16. In a telephone system, a series of lines, a series of trunks and switches for said lines for connecting the lines with the trunks through the medium of plungers, one for each switch, a shaft common to said plungers for controlling the same, means for making said plungers responsive to said shaft, means for making a plunger non-responsive to the shaft when its line is connected with a trunk, and means for always maintaining the plungers in connection with the shaft and for restoring the plungers to the control of the shaft when the circuit is broken, and means for breaking the circuit.

17. The combination of a bank, a plunger, and a driver, a catch for linking the plunger in engagement with the driver whereby the plunger may be moved from one position to another, and means for moving the plunger into engagement with the bank from any one of said positions, said catch still remaining within the range of the driver, said catch also provided with flexible means to permit the driver to move after the plunger engages the bank.

18. In a telephone system, a line, a plurality of trunks each terminating in a bank terminal, a terminal for said line common to said trunks, a circuit closer for pressing the line terminal into engagement with any one of said trunk terminals whereby the line may be connected with one trunk at a time, a driving element for said circuit closer, means for operating the circuit closer, and means whereby the circuit closer is made to follow the driving element whenever the said element moves provided the circuit closer is not operated, said last means comprising an elastic element whereby the circuit closer may be operated and still remain in engagement with the driving element.

19. In a telephone system, a calling line, a called line, means for connecting the two, a signal for the called line, a source of ringing current controlled through the medium of said means for operating said signal, a source of current for supplying the calling line with current for talking, a relay controlled over the called line for reversing the current in the calling line and for again restoring it when the called subscriber answers to produce a signal in the receiver of the calling line, said relay also for cutting off the ringing current from the called line when the called subscriber answers.

20. In a telephone system, a calling line, a called line, an operator's position, means

for extending connections from the calling line to either the called line or to the operator's position, a signal for the called line, a signal for the operator, a source of ringing current controlled through the medium of said means for operating said signals, a source of current for supplying talking current to the calling line, a signal for the calling line, a relay controlled over the called line upon the response of the called subscriber for disconnecting said ringing current, and for reversing the current in the calling line for operating the signal on the calling line in one manner, said relay also controlled by the response of the operator when a call is extended to the operator's position for disconnecting said ringing current and for reversing the current in the calling line only momentarily for operating the signal on the calling line in another manner.

Signed by me at Chicago, Cook county, Illinois, September eleventh, 1914.

FRANK NEWFORTH, JR.

Witnesses:
HERBERT W. KRACKE,
GEORGE YAVOCHOWSKI.