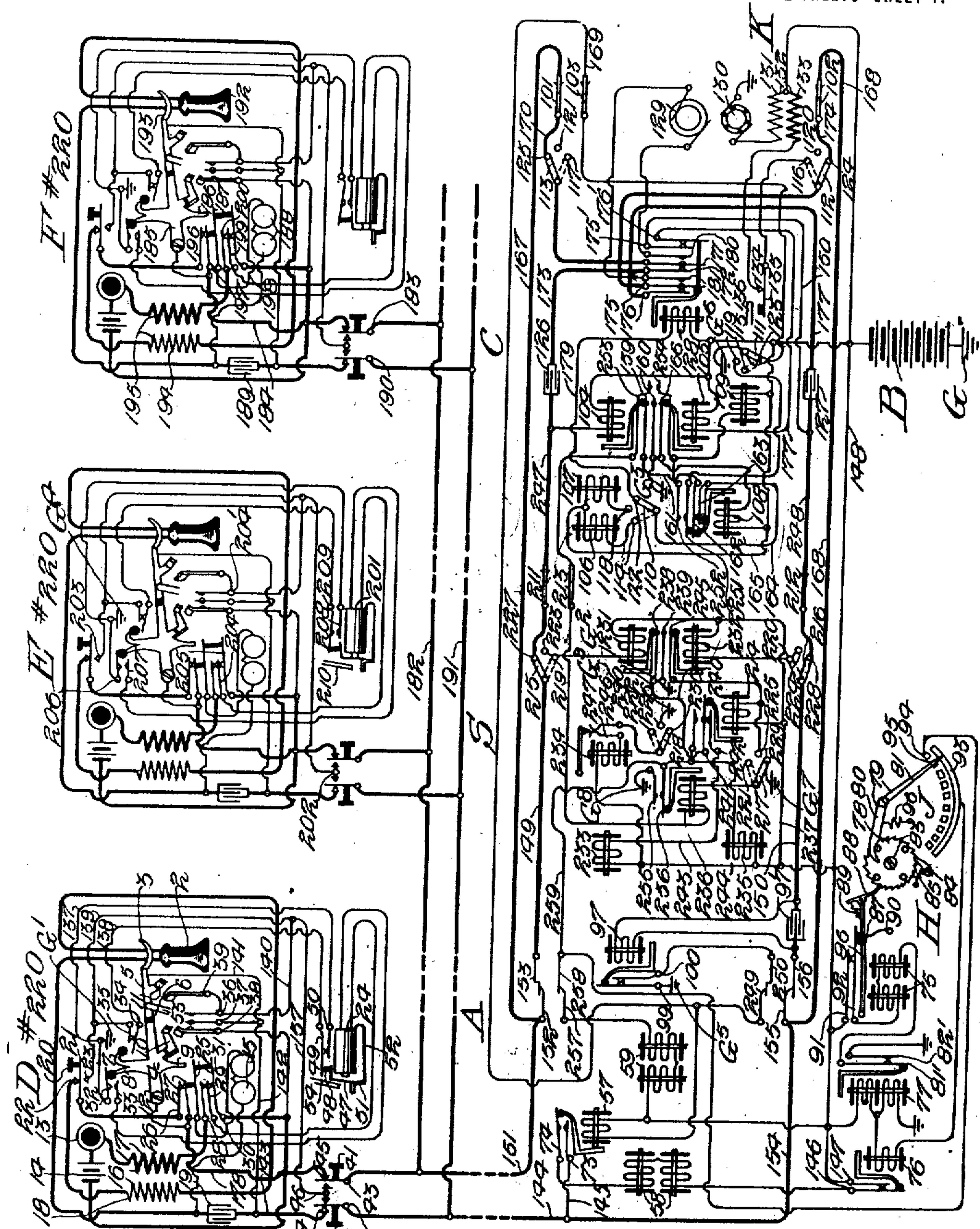


1,269,453.

Patented June 11, 1918.
 2 SHEETS—SHEET 1.



Witnesses:
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Fig. 1.

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1,269,453.

A. E. KEITH.
AUTOMATIC PARTY LINE TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED AUG. 20, 1906.

Patented June 11, 1918.

2 SHEETS—SHEET 2.

Fig. 2.

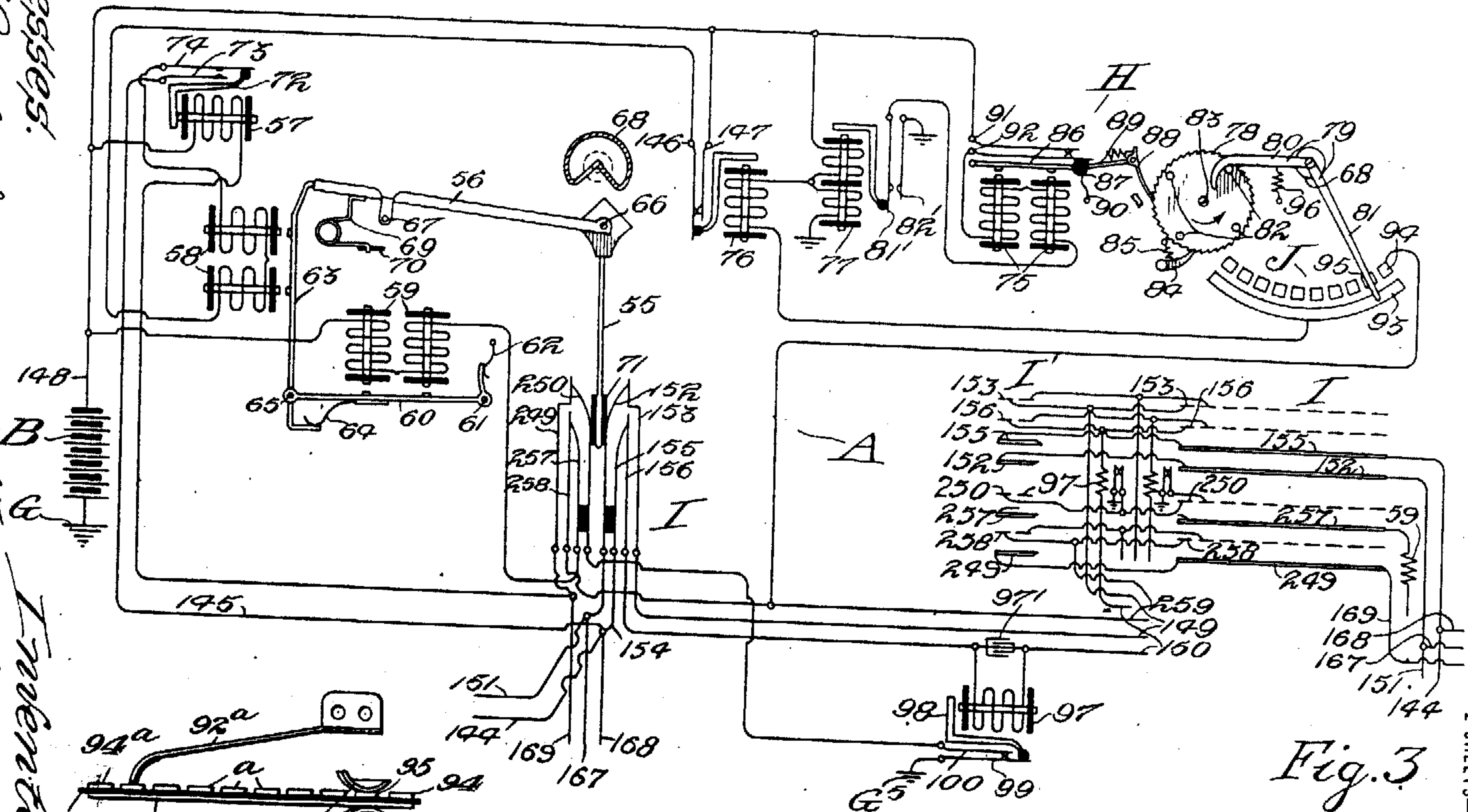


Fig. 3

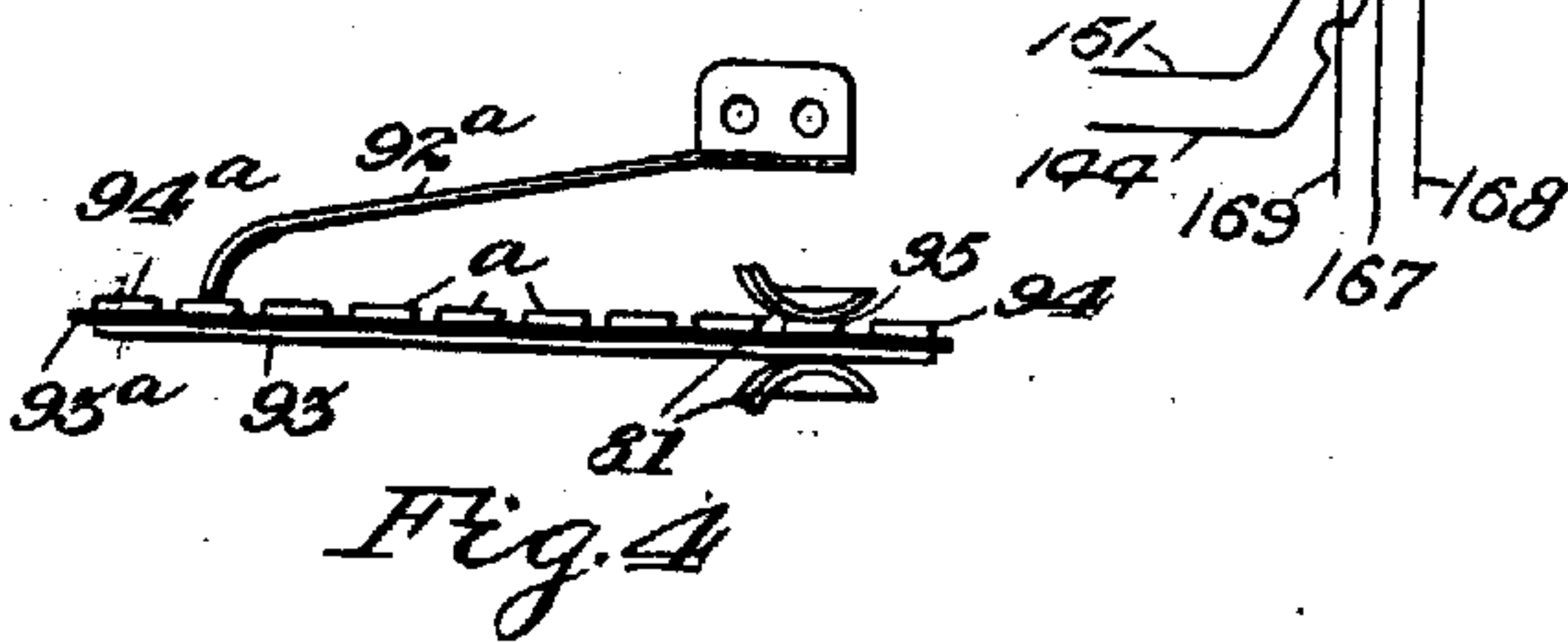


Fig. 4

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UNITED STATES PATENT OFFICE.

ALEXANDER E. KEITH, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS,
TO AUTOMATIC ELECTRIC COMPANY, A CORPORATION OF ILLINOIS.

AUTOMATIC PARTY-LINE TELEPHONE-EXCHANGE SYSTEM.

1,269,453.

Specification of Letters Patent.

Patented June 11, 1918.

Application filed August 20, 1906. Serial No. 331,343.

To all whom it may concern:

Be it known that I, ALEXANDER E. KEITH, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Automatic Party-Line Telephone-Exchange Systems, of which the following is a specification.

My invention relates to telephone systems in which automatic switching machinery is placed under the control of the subscribers to enable a calling subscriber to automatically connect his line with that of the called subscriber, and in which several subscribers' stations are located on one and the same line, lines of this character being ordinarily known as party lines; and it relates more particularly to telephone exchange systems in which the automatic switching machinery comprises selectors and connectors, and in which these automatic switches or machines are controlled or operated by electrical impulses transmitted from the calling subscriber's substation; and it contemplates more especially a telephone exchange system in which party line substations are combined with selectors and connectors for trunking and connecting in accordance with any called number, and with preliminary trunking mechanism by which preliminary trunking operations are performed in advance of any trunking or connecting operations relative to the called number.

The object of my invention is the provision of a telephone exchange system in which the party lines terminate in preliminary trunking machinery, and in which the requisite trunking and connecting operations are performed relative to the called number and subsequent to the preliminary trunking operation; and the provision of certain details and features of improvement and combinations tending to increase the general efficiency and improve the service of a telephone exchange system of this particular character.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings, Figure 1 is a diagram of a party line in which one of the subscribers has called back upon his own line, so to speak, to signal another subscriber on the same line, the signaled or

called subscriber having answered. The central office apparatus comprised in the connection is indicated in this figure. The substations of the party line are also shown. In the said Fig. 1 the line switch allotted to the party line is indicated at A, the central battery at B, the first-selector switch S, the connector-switch C, the first party line station at D, the second station at E, and the third station at F, only three substations being shown.

A central battery is shown in each of the various drawings, but in practice there is but one battery B having its positive terminal preferably grounded at G.

The master switch for controlling all of the line switches of the group to which the line switch A belongs is shown at H.

Fig. 2 is a more complete diagrammatic view of the line switch A and of its master switch H.

Fig. 3 is a diagram of the line switch bank-wiring, two banks I and I' being indicated, the left-hand section only of the latter being shown.

Fig. 4 is an enlarged view of the master switch bank J.

In connection with the line switch A (Fig. 1) only one of the trunk line terminals is shown, but ten of these trunk line terminals comprise the line switch bank I.

The substation may be of any suitable or approved general type, but the substation D (Fig. 1) is an improvement upon the substation equipments heretofore employed. It is provided with a receiver 2 and a switch-hook 3, which is composed of two parts 4 and 5 fastened together with the insulating fiber 6 between the two parts. The member 4 has radiating from its body a number of cam-arms 7, 8, 9, and 10 and from the member 5 the cam-arm 11 extends, said hook being pivotally secured to the keyboard frame (not shown) by the screw 12 about which it rotates when the receiver is removed. The rotation is due to the tension of a spring (not shown) and the hook is pushed up for the purpose of changing certain circuit connections, as will be explained. In addition, the substation has a transmitter 13, a local battery 14, a ringer 15, an induction-coil 16 with a primary winding 17 and a secondary winding 18, a condenser 19, a signaling device composed of a push button 20, spring 21, two contact points 22 and 23,

and a lock-out magnet 24. When the switch-hook is down the cam-arm 9 is held in contact with the spring 25, which spring, therefore, is normally in contact with the arm 9 and thus completes the ringing circuit which includes the ringer 15 and the condenser 19, said circuit being normally bridged across the line. Associated with the spring 25 are two sets of springs 26, 27, and 28, 29, 30. Members of each of these sets, when left to their own tension—that is, when the switch-hook is up—engage in contact with each other; the springs 26 and 27 are then in contact and the springs 28, 29, and 30 are in contact. But when the switch-hook is down the cam 9 depresses the spring 25, and this spring now permits the springs 26 and 27 to separate and at the same time forces the springs 28, 29 and 30 apart through the medium of an insulating bushing 31 located between the springs 25 and 30. The arm 8 when raised forces the spring 32 away from the spring 33, while the arm 7 permits the spring 34, which is normally separated from the spring 35, to close in contact with the latter. Whenever the switch-hook is drawn down the three springs 36, 37 and 38, which are known as release springs, are forced into engagement by the arm 10. This arm engages a laterally projecting piece at the top extremity of the spring 38 of this group of release springs; moreover, when the switch-hook nears its lowermost position the said arm disengages from the said spring and permits the three release springs to break apart and regain their normal positions. The switch-hook in rising brings the arm 11 in contact with the spring 39, but only momentarily, for as the switch-hook nears its uppermost position the arm 11 and spring 39 disengage. The calling device is represented by two push-buttons 40 and 41, two springs 42 and 43, two contact points 44 and 45, and the ground post 46. The lock-out magnet consists of the coil 24 mounted upon the keyboard by a bracket, not shown. The armature 47, which carries at its extremity an insulating bushing 48, is so constructed mechanically that whenever the magnet is energized the springs 49 and 50, which are normally in contact, are then disengaged. Furthermore, said magnet carries on its under side an armature locking device which consists preferably of a brass piece 51 which is riveted to a spring 52 and which latter is in turn fastened to the rear end of the magnet frame. The front end of this brass piece 51 is bent upwardly at a right angle and then at a right angle to the front, so that when the armature 47 is attracted by the magnet the spring tension in the spring 52 forces the piece 51 upwardly until the angled section rises in front of the armature 47 and accordingly locks the armature in its attracted position.

The switch-hook also carries a slim rod 53, the lower end 54 of which works in front of the armature 47 and is bent at a right angle horizontally and in a plane parallel with the surface of the armature. When the switch-hook is down the said rod is lowered enough to drive the lock 51 below the edge of the armature 47. The armature then, providing the magnet is not energized, returns to its normal position, allowing the springs 49 and 50 to come into contact, as shown in Fig. 1.

The line switch A, shown diagrammatically in Figs. 1 and 2, is of the general type described in my copending application for improvement in telephone systems and apparatus, Serial No. 311,327. It is built about a metallic base or frame (not shown) and consists of a plunger 55 and plunger arm 56, cut-off relay 57, trip magnet 58 and switch release magnet 59. The said switch release magnet is provided with an armature 60 pivotally held by the pin 61 which rises from the base or frame of the switch. This armature is held normally away from the magnet cores by any suitable spring 62. The said armature 60 carries, pivotally secured at its end, a second armature 63 that is controlled by the trip magnet 58, and which is normally held away from the magnet cores of the trip magnet by any suitable spring 64. The pin 65 about which the armature oscillates is carried on the end of the armature 60. The plunger 55 is pivotally secured by the pin 66 to the plunger arm 56, which latter is in turn pivoted to the pin 67 which rises from the base or frame of the switch. Normally the plunger 55 is retained out of engagement with the bank I and retained in engagement with the plunger controlling shaft 68 which is operated by the master switch H of the group to which this line switch A belongs. The force that causes the plunger 55 to be thrust into the bank I whenever the trip magnet 58 is energized is supplied by the spring 69, one end of which spring is secured to the switch frame by means of the flange 70 while the other end is suitably retained at the rear end of the plunger arm 56. The plunger thus brought into service may be restored by a momentary energization of the switch release magnet 59 (when the subscriber replaces his receiver upon the hook), causing said magnet 59 to attract its armature 60, thereby raising the armature 63 which then slips over the end of the plunger arm 56. As soon as the magnet becomes deenergized the retracting spring 62 restores the switch release armature 60 to its normal position, at which time, of course, the plunger arm is also drawn into normal position and moved back into engagement with the plunger shaft 68. It will be understood that the rotary motion of the plunger shaft is oscillatory, and at no time does the longitudinal groove in the shaft

pass to such a position that any plunger, after it has left the shaft, may not return to the said groove. As soon as the plunger bushing 71 enters the bank I the cut-off relay 57 becomes energized, attracting its armature 72, which opens the contact formed by the springs 73 and 74.

The master switch H is built upon a metallic frame or base and consists of a motor relay or magnet 75, an auxiliary relay 76 and a differential relay 77, a cam-controlling ratchet-wheel 78, and a wiper arm 79 comprising a cam 80 and a wiper 81. The ratchet-wheel 78 has four projecting cam-lugs 82. Said ratchet-wheel is pivotally supported by a pin 83. There is also a pawl 84 operating in connection with the ratchet which is kept in engagement with the teeth thereof by a retracting spring 85. The object of this pawl is to retain the ratchet-wheel always in its advanced position and prevent any backward rotation thereof. The power for rotating said ratchet-wheel is provided by a motor magnet 75 which comprises two coils. It is provided with the armature 86 that carries the insulating bushing 87 for automatically operating the motor magnet circuit interrupter comprising the springs 90, 91 and 92, and is also provided with an extending arm on the end of which is pivotally mounted the pawl 88. Said pawl is normally held in position by the retracting spring 89, one end of which is secured to the pawl supporting arm and the other to the rear end of the pawl itself. The armature 86 is normally retained away from the magnet cores by any suitable spring (not shown). When in this normal position the spring 90 holds the springs 91 and 92 in contact. The energizing circuit of said motor magnet comprises in series the springs 91 and 92, and when energized the magnet, of course, attracts its armature 86, at which time the bushing 87 drives the spring 90 from under the spring 92, which latter then disengages from the spring 91, thereby destroying the continuity of the energizing circuit through the motor magnet coils. At once the armature 86 returns to its normal position, the bushing 87 raising the spring 92 in contact with the spring 91 and permitting the spring 90 to hold the circuit closed through the motor magnet. The same operation occurs again and again as long as the battery that energizes the said motor magnet is retained in series with the motor magnet coils and the springs 91 and 92. It is obvious that each time the armature 86 is attracted the pawl 88 drives the ratchet-wheel 78 around one step in the direction indicated by the arrow, in which position said ratchet-wheel is retained by the pawl 84. The interrupter here described and shown in Figs. 1 and 2 is of any suitable form or character. Each move-

ment of the ratchet-wheel 78 imparts motion to the cam 80 by means of the cam lug 82, which in turn gives to the plunger shaft 68 an oscillatory motion. Secured upon the same shaft there is also the wiper arm 81 70 which has its end adapted to slide over the bank contacts J. Said arm engages one of the bank contacts at each step and also the common contact plate, and thus the engaged contact of J is always kept in electrical connection with the common plate 93 by the wiper 81. As shown in Fig. 4, the master switch bank J comprises the individual segments α separated from the common plate 93 by the fiber insulating strip 93^a. The insulated spring 92^a is so arranged that when the wiper 81 moves to the last contact 94^a, and then on the next step is carried to the contact 94 on the right, the upper part of the wiper 81 slides upon the guide spring 92^a. This provision is made so that the wiper 81, in passing from one extreme position to the other, will not place the segments α in contact with the common member 93, whereby some interference might be experienced with the master switch H. The cam arm 80 and wiper arm 81 are so adjusted upon the plunger shaft 68 that if one of the pins 82 engages the cam arm at a point so that the wiper arm 81 engages one of the bank contacts 94, then when the ratchet-wheel advances one step the wiper arm, by means of the cam 80 and lug 82, is advanced to engage the next bank contact 95, and for each consecutive position of the ratchet-wheel the wiper arm engages a succeeding bank contact. The construction is such that after the cam lug 82 has traveled to the end of the cam, then at the next step of the ratchet-wheel the said cam disengages from the said lug and falls into engagement with the next succeeding lug. The force for thus carrying the cam onto the next lug 82 is supplied by the coil spring 96. The action of the master switch is in general as follows: If the subscriber D by means of his line switch seizes on a preselected idle trunk line corresponding, for example, to the bank segment 94 upon which it will be assumed the master switch wiper 81 is resting, he causes a guarding potential to be established at the contact point 94 at the instant that the plunger 55 seizes the said trunk line. The differential relay 77 then becomes energized, pressing the springs 81' and 82' into contact, and closing a series circuit through the springs 91 and 92 and the motor magnet 75 and the differential relay springs 81' and 82'. The motor magnet becomes energized and rotates the ratchet-wheel one step, thereby moving the wiper arm 81 to the next contact 95. The motor magnet is thus again deenergized and the armature 86 and interrupter springs 91 and 92 resume their normal position. It will be seen 130

that the function of the master switch is to at all times maintain the idle plungers in a position opposite an idle trunk line, and to cause all plungers that are released to
5 instantly take a similar position.

The first-selector switch may be of any suitable or approved type, such as the general form of selector described in Patent No. 815,321, granted March 13, 1906, to Keith,
10 Erickson and Erickson. The mechanical details of the first-selector are well known, involving the first-selector switch-shaft (not shown) which carries the line wipers 211 and 212 and the private wiper 213. The side
15 switch is controlled by the private magnet 214, and in the normal or first position of the side switch the side switch wipers 215, 216, 217 and 218 engage the contact points 219, 220, 221 and 222, respectively. In the
20 second position the contact points 223, 224, 225 and 226 are engaged, and in the third position the wipers engage the contact points 227, 228, 229 and 230, respectively. After the line switch has operated and a
25 trunk leading to a first-selector has been seized the first-selector is then under control of the calling subscriber through the medium of the vertical and rotary line relays 231 and 232. While the side switch is in the first
30 position the calling subscriber controls the vertical magnet 233 which operates to give the switch-shaft a vertical motion. By means of the rotary line relay 232, and while the side switch is in the first or second position,
35 the subscriber controls the private magnet 214 and, therefore, the side switch. When the side switch is in second position the rotary magnet 234 is energized and the switch-shaft that carries the wipers 211, 212
40 and 213 is operated in a rotary direction. The vertical and rotary line relays 231 and 232 acting conjointly provide the means by which the release magnet 235 is operated by the subscriber while the side switch is in
45 first or second position. If the side switch passes to the third position, however, (since the selector S is of the trunk release type) the release magnet 235 is then controlled through the connector C, and by way of the
50 private wiper 213 and by means of the back-release relay 236.

The connector-switch C may be of any suitable or approved form, such as the general type described in Patent No. 815,176,
55 granted March 13, 1906, to Keith, Erickson and Erickson. The mechanical details of the connector and selector, as is well known, are very much the same, although there is some material difference in the circuits. The
60 connector-switch-shaft (which is not shown) like the selector carries the line wipers 101 and 102 and the private wiper 103. The connector-switch is also controlled by the calling subscriber through the medium of the
65 vertical and rotary line relays 104 and 105.

The vertical line relay 104 directly controls the vertical magnet 106 and also the rotary magnet 107. The office of the magnet 106 is to give the shaft and shaft wipers their vertical
70 movements, and the rotary magnet 107 imparts to said shaft and wipers a rotary or circular movement. The rotary line relay 105 controls the private magnet 108, which latter under certain conditions in turn controls the vertical and rotary magnets 106 and
75 107, the release magnet 109 and also the side switch wipers 110, 111, 112 and 113. The side switch has a normal or first position, a second and a third position. In the normal position the respective side switch wipers
80 engage the contact points 114, 115, 116 and 117; in second position the wipers engage the contact points 118, 119, 120 and 121; and in third position they engage the contact points 122, 123, 124 and 125. The release
85 magnet 109 is also controlled by the line relays 104 and 105 acting together. The connector divides the circuit that passes through it into two sections by the condensers 126 and 127. In addition the connector has a
90 ringer relay 128 by means of which the ringer generator 129 is bridged across the terminals of the called line to signal the called subscriber. Each exchange has a busy signaling apparatus K of any suitable de-
95 sign, as, for example, the one comprising an interrupter 130 in series with the primary winding 131 of an induction-coil 132. The secondary winding 133 is connected to the contact point 134 which presses against the
100 switch shaft springs 135 when the normal post arm 136 rises.

The calling operation by which the subscriber D, for example, would call and signal the subscriber F is as follows: He (the
105 calling subscriber) removes the receiver 2 from the switch-hook 3, thereby allowing the switch-hook to rise and the cam 11 to engage the spring 39 momentarily. This engagement permits the trip magnet 58 to become energized momentarily, thus attract-
110 ing the armature 63, which allows the plunger 55 to seize an idle trunk line leading to the first-selector. The circuit of this preliminary impulse is as follows: from ground
115 G¹ through the conductor 137, contact springs 50 and 49, conductor 138, springs 34 and 35, conductors 139 and 140 to the spring 39, cam-arm 11, conductors 141, 142 and 143
120 to the contact point 44, spring 42, conductors 144 and 145, bridge-cut-off relay springs 73 and 74 to the trip magnet 58, thence to the springs 146 and 147 to the battery lead 148, to the non-grounded terminal of battery
125 B and to ground G. When the plunger closes the springs 250 and 249 a guarding potential is established at the connector bank for the protection of the line allotted to the line switch A. This potential extends from
ground G², springs 99 and 100, bank springs 130

250 and 249 to the private normal conductor 169, which leads to the connector private bank. Also, an energizing circuit through the cut-off relay 57 is completed, thereby operating the said relay. The armature of said relay separates the springs 73 and 74 and thus disconnects the rotary line conductor 144 from the line switch A. Furthermore, the line switch release magnet 59 is connected with the first-selector release relay spring 256, by way of the bank springs 257 and 258 and conductor 259, when the said springs 257 and 258 are pressed into engagement by the plunger. The calling subscriber's substation is now connected to the first-selector switch terminals or conductors 149 and 150 as follows: The vertical line extends from the spring 43 of the calling device over the conductor 151, through the bank springs 152 and 153 to the vertical terminal 149 of the first-selector. The rotary line extends from the spring 42 of the calling device over the conductors 144 and 154, through the bank springs 155 and 156 to the relay 97, through the winding of this relay to the rotary terminal 150 of the first-selector. Assume the number of this particular line to be #220; then to call the substation F the number 220 must be called by the subscriber D, since F occupies the line #220 in common with D, as also does E.

The first digit of the called number being 2, and the receiver 2 having been removed from the switch-hook, the springs 26 and 27 close in contact, likewise the springs 28, 29 and 30, and the ground post 46 is in connection with the substation ground G^1 by the closing together of springs 34 and 35. The subscriber at substation D then proceeds to press the button 41 twice, corresponding to the numerical value of the digit. Hence, each time that the button 41 is pressed the spring 43 leaves the contact point 45 and is grounded on the ground post 46, and as a result the vertical line relay 231 of the first-selector S is energized once. The current for energizing said relay flows from ground G^1 through the conductor 137 and springs 50 and 49, conductor 138, springs 34 and 35, conductors 139 and 157 to the calling device ground post 46, conductor 151 and through the bank springs 152 and 153 and conductor 149 to the vertical line relay 231, through the winding of said relay and conductor 237 to the battery lead 148, to the non-grounded terminal of battery B and to ground G. Each time the vertical line relay 231 is energized the line relay springs 238 and 239 are pressed into contact and an energizing circuit is thereby established each time through the vertical magnet 233. The circuit in said magnet flows from ground G^2 through the line relay springs 239 and 238, conductor 240 to the private magnet springs 241 and 242, through the conductor 243,

through the winding of the vertical magnet 233, conductor 244 to the battery lead 148, to the non-grounded terminal of battery B and to ground G. The vertical magnet operates to raise the switch-shaft (not shown) and wipers 211, 212 and 213. The vertical magnet being operated twice the first-selector shaft is raised two steps and said wipers 211, 212 and 213 are carried to a level with the contact points that constitute the terminals of the trunk line leading to the connector-switch C. After operating the vertical button 41 with the above result the subscriber then presses the rotary button 40 once, grounds the rotary line conductor and as a result operates the rotary line relay 232 of the first-selector S. The path of the energizing current may be traced as follows: from the substation ground G^1 to the conductor 137, through the springs 50 and 49, conductor 138, springs 34 and 35, conductors 139 and 157 to the calling device ground post 46, through the spring 42 to the conductors 144 and 154, through the bank springs 155 and 156, through the winding of relay 97, conductor 150 to the rotary line relay 232, through the winding of said relay to conductor 237, thence to the battery lead 148, to the non-grounded terminal of battery B and to ground G. The rotary line relay 232 upon energizing presses the line relay springs 239 and 245 into contact, establishing an energizing circuit through the private magnet 214. The current through said magnet passes from ground G^2 through the springs 239 and 245, through the private magnet winding to the battery lead 148, thence to the non-grounded terminal of battery B and to ground G. The private magnet being energized for a moment the side switch of the first-selector switch passes to the second position, permitting the side switch wiper 218 to engage the contact point 226 and thus closing a circuit through the rotary magnet. The current flows from ground G^2 through the side switch wiper 218 to the interrupter springs 246 and 247, to the winding of the rotary magnet 234, to the battery lead 148, to the non-grounded terminal of battery B and to ground G. The rotary magnet is energized one step and the wipers 211, 212 and 213 carried into engagement with the bank contacts that constitute the terminals of a trunk line leading to the connector-switch C, assuming that the trunk leading to said connector leads off from the first set of contacts of the second level. But if the first trunk line is busy an energizing circuit is established through the private magnet 214 when the private wiper 213 strikes a grounded private bank contact, thereby retaining the side switch in the second position and also maintaining a circuit through the rotary magnet. The rotary magnet by intermittent energizing

thus causes the shaft to rotate step by step and carry the wipers past the last busy trunk line. However, as soon as the private magnet deenergizes, the side switch is then tripped into third position. But if there are no busy contacts to be passed over, as assumed in the first instance, the rotary magnet 234, as is well known, trips the side switch to third position, with the result that the side switch wipers 215 and 216 engage their respective contact points 227 and 228, and the subscribers' line conductors 149 and 150 are extended to the connector C. Also, since the side switch wiper 217 at the same time engages the grounded contact point 229, a guarding potential is established at the private wiper 213 for protecting the seized trunk line from being molested by any other switch.

The second digit of the called number being 2 the subscriber presses the button 41 twice, as a result grounding the vertical conductor two times and operating the vertical line relay 104 of the connector-switch two times. The current through the said line relay flows through the following path: from the substation ground G^1 to the conductor 137, springs 50 and 49, conductor 138, springs 34 and 35, conductors 139 and 157 to the line conductor 151, bank springs 152 and 153, trunk conductor 149, side switch wiper 215 to the vertical line relay 104, battery lead 148 to the non-grounded terminal of battery B and to ground G. The vertical line relay 104 presses the line relay springs 159 and 160 into contact, and as a result the vertical magnet 106 is energized each time. The current flows through said vertical magnet 106 over the following circuit: from ground G^2 to the line relay springs 160 and 159, to the private magnet springs 162 and 163, conductor 164, to the side switch wiper 110, contact point 114, through the winding of the vertical magnet 106, conductor 165, battery lead 148 to the non-grounded terminal of battery B and to ground G. Each time the vertical magnet is energized it raises the shaft and shaft wipers 101, 102 and 103 one step at a time until said wipers are carried two steps to a level in which are located the terminals of line #220. The subscriber at substation D again presses the rotary button 40 and grounds the rotary line relay 105, the circuit of which is as follows: from the substation ground G^1 to the conductor 137, through the springs 50 and 49, conductor 138, springs 34 and 35, conductors 139 and 157 to the calling device ground post 46, through the spring 42 to the conductors 144 and 154, through the bank springs 155 and 156, through the winding of the relay 97, conductor 150 to the side switch wiper 216, contact point 228 to the shaft wiper 212, conductor 248 to the ringer relay springs 175' and 176', to the rotary line relay 105, then through the winding of said relay to the battery lead 148, thence to the non-grounded terminal of battery B and to ground G. The energization of said relay 105 causes the energization of the private magnet 108, which latter then permits the release of the side switch from first to second position, thus placing the side switch wipers 110, 111, 112 and 113 in contact with the points 118, 119, 120 and 121, respectively.

The third digit of the called number being 0 the subscriber presses the button 41 ten times, as a result grounding the vertical conductor 151 ten times and operating the vertical line relay 104 of the connector-switch C ten times. The current through the said line relay flows through a path previously described. The vertical line relay presses the springs 159 and 160 into contact, each time energizing the rotary magnet 107 over the following circuit: from ground G^2 to the line relay springs 160 and 159, to the private magnet springs 162 and 163, conductor 164 to the side switch wiper 110, contact point 118, through the winding of the rotary magnet 107, conductor 165 to the battery lead 148, to the non-grounded terminal of battery B, thence to ground G. Each time the rotary magnet is energized it rotates the shaft and shaft wipers 101, 102 and 103 one step at a time until said wipers are carried into engagement with the normal conductors 167, 168 and 169 that lead to the line switch of the called subscriber. The subscriber at substation D again presses the rotary button 40 and grounds the rotary line conductor 144 with one of two results, namely either the release of the side switch to third position, or the busy release of the connector C if the line to which the connector-shaft wipers have rotated is busy. Busy lines may be either calling or called, and the manner by which protecting guarding potentials are established is as follows: The calling line is protected, as previously described, by a guarding potential established by the line switch at the instant that the line switch operates to seize an idle trunk line. This occurs when the plunger 55 (Fig. 2) forces the bank springs 249 and 250 together, thereby placing a ground on the private normal 169 which leads to the connector-bank. The called line is protected by a guarding potential established by the connector-switch when the side-switch is in third position and the shaft wipers come in contact with the called line. This guarding potential extends from ground G^2 to contact point 123, side switch wiper 111, to the shaft private wiper 103, thence to the connector bank contact; but in this case the calling and called lines are identical and special provision is made to enable a subscriber

to call his own line. By means of the relay 97 the subscriber D is permitted to call back on his own line, because the rotary impulse energizes the relay 97 and separates the springs 99 and 100, thereby removing the guarding potential, momentarily, which allows the connector side switch to pass to third position instead of releasing the connector-switch on the last rotary impulse, thus placing the side switch wipers 110, 111, 112 and 113 in contact with the points 122, 123, 124 and 125, respectively. In this particular instance the called subscriber and the calling subscriber occupy the same line, and the first-selector switch and connector switch employed by the calling subscriber in response to the calling device select the line #220.

To signal the called subscriber the calling subscriber presses his signaling button 20, placing the spring 21 in contact with ground and thereby energizing the vertical line relay 104. The path of the energizing current is known. It will be remembered that the connector side switch has passed from the second to the third position, and the side switch wiper 110 is in engagement with contact 122, thereby placing the vertical line relay 104 in control of the ringer relay 128 in the same manner that the rotary magnet 107 came under the control of the vertical line relay when the side switch wipers passed from first to second position. Therefore, when the vertical line relay 104 presses the springs 159 and 160 into contact the ringer relay 128 is energized by a flow of current from ground G^3 through the springs 160 and 159, conductor 164, side switch wiper 110, contact point 122, conductor 179, through the ringer relay winding to the battery lead 148, thence through battery B to ground G . The ringer relay 128 upon energizing shifts the springs 171 and 175 from the springs 172 and 176 onto the springs 180 and 181, respectively. This results in separating the lines of the calling and called subscribers and bridging across the line of the latter the ringer generator 129. A signaling current is, therefore, sent from the generator 129 through the springs 180 and 171 and side switch wiper 113, contact point 125, conductor 170, shaft wiper 101, normal conductor 167, conductors 151 and 182 to the impulse spring 183 of the signaling device, conductor 184 to the switch-hook 185 and cam-arm 186 to the spring 187, then through the substation bell 188, condenser 189, through the rotary impulse spring 190 of the calling device, conductors 191, 144 and 154, normal conductor 168, shaft wiper 102, side switch wiper 112 to the ringer relay springs 175 and 181 and to the ringer generator 129. As soon as the calling subscriber ceases to press the signaling button 20 the ringer relay becomes de-

energized and the springs 171 and 175 again come in contact with springs 172 and 176, respectively. It will be remembered that both substations E and F are in normal condition and that the signaling current which passed through substation F also passes through substation E. A series of signals, say one ring for D, two ring for E and three rings when substation F is called, has been previously understood between the different subscribers, and the subscriber at F when the bell rings three times removes the receiver 192 from the switch-hook 193, thus bridging the secondary circuit that includes the said receiver and the secondary winding 194 of the induction-coil 195 across the line. The lock-out relay becomes energized with results similar to those when the receiver at substation E is removed, a description of which is hereinafter given. The bridging circuit is completed as soon as the switch-hook permits the springs 196 and 197 to come in contact. The local transmitter circuit is closed when the springs 198, 199 and 200 engage in contact. The two subscribers F and D are now placed in communication over a circuit which is entirely independent of the central office apparatus, the central office equipment in this particular case serving only to signal the called subscriber.

An intruding subscriber will be locked out. He can listen-in, but cannot disturb the connections or use the line.

The connection described being established, if a subscriber at substation E removes his receiver from the switch-hook, the lock-out relay 201 will be operated so as to prevent a connection between the ground post 202 or signaling button contact 203 or ground release spring 204' and ground terminal G^4 . The switch-hook springs are so adjusted that the springs 204 and 205 which are normally disengaged when the switch-hook is down are thrown into contact as the switch-hook rises, before the spring 206 is separated from the spring 207. There is, therefore, an instant when the switch-hook is rising in which a circuit through the lock-out relay 201 is completed. Current then flows which energizes said relay, causing its armature to be attracted and locked, as previously described, thus separating the springs 208 and 209 even after the energizing current of the lock-out relay has ceased to flow. The circuit of the energizing current may be traced from ground G^4 to the springs 206 and 207, through the winding of the relay 201, springs 204 and 205, vertical conductors of the calling device, conductors 182 and 151, line switch bank springs 152 and 153, conductor 149, side switch wiper 215, shaft wiper 211, conductor 247, the vertical line relay 104 to the battery lead 148, thence to battery B and to ground G . The sub-station ground G^4 is then entirely cut

off from the calling device ground post 202, signaling button contact 203 and ground release spring 204'. Consequently, the subscriber at E may work his calling device or press his signaling button or hang up his receiver without interfering with the connection existing at the time. The subscriber D upon returning the receiver to the switch-hook restores the lock-out relay 201 to its normal condition by means of the rod 210, as previously described.

The front release occurs when the calling subscriber restores the receiver 2 to the switch-hook 3, thereby pressing into connection for a moment the release springs 36, 37 and 38. The engagement of said release springs grounds the vertical and rotary line conductors 151 and 144 simultaneously, thereby simultaneously energizing over well known circuits the vertical and rotary line relays 104 and 105 of the connector C. This results in bringing the springs 253 and 254 into contact, closing a release circuit through the back release relay 236 of the first-selector S and through the release magnet 109 of the connector C. The path of this circuit is as follows: from ground G' to the side switch wiper 217, to the back release relay winding 236, to the shaft private wiper 213 of the first-selector to the connector relay release springs 253 and 254, release magnet 109 of the connector to the battery lead 148, thence through battery B to ground G. When the connector release magnet 109 is thus supplied with current it energizes, and as a result the connector switch shaft and side switch are restored to normal position, thus breaking connection between the connector switch shaft wipers 101, 102 and 103 and the normal conductors 167, 168 and 169. The back release relay 236 of the first-selector S being in the same circuit with the release magnet 109 (as shown) energizes simultaneously with the latter. The back release relay 236 of the first-selector upon energizing places the springs 255 and 256 in contact, thereby closing a circuit through the first-selector release magnet 235 and the line switch release magnet 59. The circuit of the release magnet 235 extends from ground G' through the springs 255 and 256 to the winding of the release magnet 235, to the battery lead 148, thence through battery B to ground G. The line switch release magnet 59 is closed through a circuit extending from ground G', back release springs 255 and 256, conductor 259, bank springs 258 and 257, through the winding of the line switch release magnet 59 to the battery lead 148, thence through battery B to ground G. All of these release relays and magnets attract their respective armatures and remain in readiness to release the switches as soon as the substation release springs 36,

37 and 38 separate and break the ground connection to the line conductors 151 and 144. The calling subscriber thus restores all the switching apparatus which he originally brought into use.

To call any other subscriber the calling subscriber would bring about the same operations as described in calling #220. The successive digits of the desired number would be called in order, thus operating the first-selector S and connector C step by step, and placing the connector shaft wipers on the terminals of the called line. The energizing, guarding potential and releasing circuits are known—in fact to call any other line an exact repetition of the described operation would be required, and thus it will be seen that any subscriber connected with the central office may place himself in communication with any other subscriber, that any subscriber may call his own line—that is, any subscriber on a party line—inasmuch as the connector switch C used in this case will not be automatically released as when it engages the multiple line terminal connected with the line from which the call came, even if the private bank contact corresponding to the desired line is grounded. Furthermore, if one subscriber is using the party line no other subscriber on the same line can use the line for either switching or signaling purposes. In other words, the two subscribers who are conversing over the line are safe against intrusion or molestation to this extent, namely that no other subscriber can use the line for switching or signaling purposes, nor can any other subscriber on the same line so operate his telephone or switching devices as to endanger the continuity of the circuit established between the two subscribers who are talking. It is always an undesirable thing, of course, to have it possible for one subscriber on a line to listen in and hear the conversation conducted over the line by some other subscribers, but in an automatic or semi-automatic system I deem it of far greater importance to provide against the breaking by a third subscriber of a circuit already established between two other subscribers; for while such listening-in may be a source of more or less annoyance, it is evident that this is not so important a consideration as is the maintenance of the continuity of an established talking circuit. Subscribers may tolerate listening-in, objectionable though it is; but any situation in which a party line subscriber could not use his telephone with safety as against interference on the part of other subscribers on the line would be out of the question. It is evident, however, that my improved lock-out arrangement and devices are of a character to prevent a subscriber from transmitting any signal, and from accomplishing the closure of any cir-

5 cuits at the central station, if the line is already in use. As described, a calling subscriber never finds his own line so protected (by reason of his use of the line) that he may not himself call back upon his line, providing the line is not already in possession of some other subscriber; but if he calls another line said line may be busy, in which event the connector side switch will
 10 not pass to third position and establish the final connection. Instead the connector switch is released at the instant that the calling subscriber grounds his rotary line conductor 144 after the connector wiper 103 has
 15 been carried onto a grounded private contact. In that case the busy release takes place, whereby the connection is restored and the calling subscriber gets the busy signal.

20 The busy release follows as a result of the energization of the rotary line relay 105, if the called line is busy, as follows: The said relay 105 upon energizing energizes the private magnet 108, as previously described, which latter in turn presses the springs 251
 25 and 252 into contact. As soon as the said springs 251 and 252 engage, the release magnet 109 is placed in connection with the private wiper 103 (since the side switch wiper 111 is now in second position and in engagement
 30 with contact point 119), which wiper 103 has been previously rotated onto a grounded contact. As a result a flow of current is sent through the release magnet 109 from the grounded private wiper 103 to the
 35 side switch wiper 111, thence through the contact point 119, private springs 251 and 252 to the release magnet 109, thence to the battery lead 148 and through battery B to ground G. The release magnet upon energizing releases the connector switch shaft
 40 and restores the connector side switch to its first position, returning the vertical magnet 106 to the control of the vertical line relay 104. Therefore, if the calling subscriber
 45 (Fig. 1) presses his signaling button 20 and grounds the vertical line conductor 151, he operates the vertical line relay 104, which latter in turn operates the vertical magnet 106. The vertical magnet raises the switch
 50 shaft so that the normal post arm 136 permits the switch shaft spring 135 to come in contact with the spring 134, and a busy signaling current is sent to the calling subscriber's station. The circuit over which the
 55 busy signal passes is as follows: from the induction coil winding 133 of the busy machine K through the contact springs 134 and 135 to the side switch wiper 112, ringer relay springs 175 and 176, condenser 127, conductor 248, first selector shaft wiper 212, side
 60 switch wiper 216, conductor 150, condenser 97, line switch bank springs 156 and 155, conductors 154, 144, and 143, condenser 19, receiver 2, secondary winding 18 of the induction-coil 16, through the vertical line

conductor bank springs 152 and 153, conductor 149, first-selector side switch wiper 215 to the shaft wiper 211, conductor 247, vertical line relay 104 of the connector to the battery lead 148, and thence again to the
 70 coil 132 of the busy machine K. The calling subscriber upon hearing the busy signal will understand that the desired line is busy and will release the switching apparatus (by hanging up his receiver) over the same circuits
 75 previously described. It will be clear, of course, that if the subscriber E called the subscriber N of any other line the normal conductors 167, 168 and 169 leading from the connector shaft wipers 101, 102 and 103
 80 would not lead back and connect to the calling line switch A and line, but instead to the line switch and line of another and independent subscriber, in a manner well known to those skilled in the art.

85 The construction of the line switch bank I is fully shown in Fig. 3. It comprises a set of springs 249 connected together, or one common plate, and comprises also three other similar plates or sets of springs 257,
 90 152 and 155. Allotted to the common member 249 is a row of individual springs 250 each of which is adapted to be thrust into engagement with the common member 249 separately. Likewise there is another row
 95 of individual springs 258 each adapted to be thrust separately into engagement with a common member 257. Still another row of individual springs 156 is allotted to the common member 155, and another row of individual
 100 springs 153 is allotted to the common member 152. It will be noticed that the several banks have a common member 249 connected in multiple, likewise the common member 257, the common member 152
 105 and the common member 155. Also, similar springs of the various rows of individual springs are connected in multiple, as shown. The object in such a construction is to minimize the number of private normal relays
 110 97.

115 In the system the relays and magnets may be of any suitable resistance, but good results are obtained when the private normal relay 97 is wound to a resistance of about sixty ohms.

120 From the foregoing it will be seen that I combine preliminary trunking machinery with automatic switches or machinery for subsequently trunking or connecting in accordance with all of the digits of any called
 125 number, and with telephone lines having a plurality of subscribers' stations thereon—that is to say, telephone lines which are ordinarily known as party lines, each subscriber on a line being provided with means
 130 for controlling not only the preliminary trunking machinery, which latter, at least as illustrated, comprises trunking switches which are individual to the lines, but also the selectors and connectors constituting the

automatic switches or machinery by which trunking and connecting operations are accomplished in accordance with all of the digits of any called number, each subscriber on a line being also capable of automatically calling any other subscriber on the same line through the medium of the said preliminary trunking machinery or individual switch mechanisms allotted to the different telephone lines. It will also be seen that I have made certain changes and improvements in the substation equipments, in the individual switches or preliminary trunking machinery, and in the selectors, which latter are, of course, in the nature of first-selectors inasmuch as they perform selecting and trunking operations in accordance with the first digit of any called number. With my improved apparatus it will be seen that any subscriber on the line can use the preliminary trunking mechanism for automatically trunking in advance of the subsequent trunking and connecting operations which correspond to the different digits of the called number. Furthermore, when one subscriber is using the line, and the individual switch for the line is in use, no other subscriber on the line can operate his substation equipment in such manner as to disturb the already established connections.

What I claim as my invention is:—

1. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, a preliminary trunking switch allotted to said line, trunk lines leading from said switch, automatic switching machinery to which said trunk lines lead, and mechanism at the substations by which any subscriber on the line can operate said automatic switching machinery in accordance with all of the digits of any called number, and subsequent to the automatic preliminary trunking operation by which the said individual switch extends the telephone line into connection with said automatic switching machinery, said mechanism returnable to normal position after each digit.

2. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, impulse-transmitting mechanism, trunk lines, automatic switches by which any subscriber on the line may establish connections in accordance with all of the digits of any called number, by a separate operation of said impulse-transmitting mechanism by the calling subscriber for each digit, and preliminary trunking machinery by which any calling subscriber on the line seizes an idle trunk to obtain connection with one of said automatic switches.

3. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, trunk lines, auto-

matic means by which any calling subscriber on said line obtains connection with a preselected idle trunk line, means by which each calling subscriber selects the next idle trunk line for use by the next calling subscriber, and suitable means for switching and connecting in accordance with any called number.

4. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, an individual preliminary trunking switch for said line, a master switch controlling the operation of said individual switch, trunk lines, a selector and a connector, means at the substations for controlling the operations of said individual switch and master switch and for controlling the operations of said selector and connector, a lock out relay for each substation, and an energizing circuit for each relay under the control of said individual switch.

5. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, a preliminary trunking switch allotted to said line, trunk lines leading from said switch, automatic switching machinery to which said trunk lines lead, and means at the substations by which any subscriber on the line can operate said automatic switching machinery in accordance with all of the digits of any called number and subsequent to the automatic preliminary trunking operations performed by the said individual switch, together with trunk release circuits, each trunk release circuit including a third conductor of one of said trunk lines.

6. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, trunk lines, automatic switches by which any subscriber on the line may establish connections in accordance with all of the digits of any called number, and preliminary trunking machinery by which any calling subscriber on the line obtains connection with said automatic switches, together with trunk release circuits, each trunk release circuit including a third conductor of one of said trunk lines.

7. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, trunk lines, automatic means by which any calling subscriber on said line obtains connection with a preselected idle trunk line, means by which each calling subscriber selects the next idle trunk line for use by the next calling subscriber, and suitable means for switching and connecting in accordance with any called number, together with trunk release circuits, each trunk release circuit including a third conductor of one of said trunk lines.

8. In a telephone exchange system, the

combination of a telephone line, a plurality of subscribers' substations on said line, an individual preliminary trunking switch for said line, a master switch controlling the operation of said individual switch, trunk lines, a selector and connector, means at the substations for controlling the operations of said individual switch and master switch and for controlling the operations of said selector and connector, together with trunk release circuits, each trunk release circuit including a third conductor of one of said trunk lines, a lock-out relay for each substation, and an energizing circuit for each relay under the control of said individual switch.

9. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, a preliminary trunking switch allotted to said line, trunk lines leading from said switch, automatic switching machinery to which said trunk lines lead, and means at the substation by which any subscriber on the line can operate said automatic switching machinery in accordance with all of the digits of any called number and subsequent to the automatic preliminary trunking operation performed by said individual switch, together with automatic means for permitting any subscriber to call another substation on the same line by projecting ringing current over the two sides of the said telephone line in series.

10. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, trunk lines, automatic switches by which any subscriber on the line may establish connections in accordance with all of the digits of any called number, and preliminary trunking machinery by which any calling subscriber on the line obtains connection with said automatic switches, together with automatic means for permitting any subscriber to call another substation on the same line by projecting ringing current over two sides of said telephone line in series.

11. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, trunk lines, automatic means by which any calling subscriber on said line obtains connection with a preselected idle trunk line, means by which each calling subscriber selects the next idle trunk line for use by the next calling subscriber, and suitable means for switching and connecting in accordance with any called number, together with automatic means for permitting any subscriber to call another substation on the same line.

12. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, an individual preliminary trunking switch for said line, a master switch controlling the op-

eration of said individual switch, trunk lines, a selector and connector, and means at the substations for controlling the operations of said individual switch and master switch and for controlling the operations of said selector and connector, together with automatic means for permitting any subscriber to call another substation on the same line.

13. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, a preliminary trunking switch allotted to said line, means for operating said switch upon the removal of the receiver from the hook, trunk lines leading from said switch, automatic switches to which said trunk lines lead, means at the substations by which any subscriber on the line can operate said automatic switches in accordance with all of the digits of any called number and subsequent to the automatic preliminary trunking operation performed by the said individual switch, and means including relays at the substations for preventing one subscriber on the line from interfering with a connection already established by another subscriber on the same line, said relays controlling the calling circuits.

14. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, trunk lines, automatic switches by which any subscriber on the line may establish connections in accordance with all of the digits of any called number, preliminary trunking machinery operated upon the removal of the receiver from the hook, by which any calling subscriber on the line obtains connection with said automatic switches, and means including relays at the substations for preventing one subscriber on the line from interfering with a connection already established by another subscriber on the same line, said relays controlling the calling circuits.

15. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, trunk lines, automatic means by which any calling subscriber on said line obtains connection with a preselected idle trunk line, means by which each calling subscriber selects the next idle trunk line for use by the next calling subscriber, and suitable means for switching and connecting in accordance with any called number, together with means including relays at the substations for preventing one subscriber on the line from interfering with a connection already established by another subscriber on the same line.

16. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, an individual preliminary trunking switch for

said line, a master switch controlling the operation of said individual switch, trunk lines, a selector and a connector, and means at the substations for controlling the operations of said individual switch and master switch and for controlling the operations of said selector and connector, together with means including relays at the substations for preventing one subscriber on the line from interfering with a connection already established by another subscriber on the same line.

17. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, a preliminary trunking switch allotted to said line, trunk lines leading from said switch, automatic switching machinery to which said trunk lines lead, mechanism at the substations by which any subscriber on the line can operate said automatic switching machinery in accordance with all of the digits of any called number subsequent to the automatic preliminary trunking operation performed by the said individual switch, said mechanism returnable to normal after each digit, and automatic means for preventing one subscriber on the line from disturbing or interfering with a connection already established by some other subscriber on the same line.

18. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, trunk lines, automatic switches by which any subscriber on the line may establish connections in accordance with all of the digits of any called number, said switches having one motion to find a group and then another motion of the same element to find a line in the selected group, preliminary trunking machinery by which any calling subscriber on the line obtains connection with said automatic switches, and automatic means for preventing one subscriber on the line from disturbing or interfering with a connection established by some other subscriber on the same line.

19. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, trunk lines, automatic means by which any calling subscriber on said line obtains connection with a preselected idle trunk line, means by which each calling subscriber selects the next idle trunk line for use by the next calling subscriber, and suitable means for switching and connecting in accordance with any called number, together with automatic means for preventing one subscriber on the line from disturbing or interfering with a connection already established by some other subscriber on the same line.

20. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, an

individual preliminary trunking switch for said line, a master switch controlling the operation of said individual switch, trunk lines, a selector and a connector, and means at the substations for controlling the operations of said individual switch and master switch and for controlling the operations of said selector and connector, together with automatic means for preventing one subscriber on the line from disturbing or interfering with a connection already established by some other subscriber on the same line.

21. In a telephone exchange system, a party-line having a plurality of substations thereon, a line switch common to said substations, a normally open line conductor adapted to be closed by the operation of said line switch, and a relay adapted to be energized over said normally open line conductor after a subscriber at another substation has operated the common line switch and thereby closed the normally open line conductor.

22. In a telephone system, a line, a trunk, a non-numerical switch for connecting said trunk and line, a protecting ground circuit for said line, means for closing it when a connection is made between said trunk and line, and means for breaking said circuit temporarily without breaking the connection.

23. In a telephone system, a plurality of trunk lines, a non-numerical line switch for connecting with any one of said trunks to establish a talking circuit over its conductors, and a relay allotted to each trunk line and individual thereto, said relay connected in series with one of said talking conductors and a shunt circuit around said relay.

24. In a telephone exchange system, a line, a plurality of subscribers' stations on said line, an automatic trunk selecting switch comprising a line switch bank provided with trunk lines leading therefrom, a spring common to all of said trunk lines, individual springs, one for each trunk line, each of said individual springs adapted to be independently pressed into engagement with the common spring, and a spring-actuating element adapted to travel from one spring to another, for the purpose set forth, and a lock-out relay for each substation controlled by said switch.

25. In a telephone exchange system, a line, a plurality of subscribers' substations on said line, an automatic trunk selecting switch comprising a line switch bank provided with trunk lines leading therefrom, a contact common to all of said trunk lines, individual springs, one for each trunk line, each of said springs adapted to be independently pressed into engagement with the common contact, and a spring-actuating element adapted to travel from one spring to another, for the purpose set forth, a lock-out

relay for each substation, and an energizing circuit for each relay under the control of said switch.

26. In a telephone exchange system, a line, 5 a plurality of subscribers' substations on said line, a switch for each line having a bank of contacts provided with trunk lines leading therefrom, a separate group of individual bank springs allotted to each trunk 10 line, circuit controlling switch springs common to all of said trunk lines, a single movable member for each switch for operating said springs, for the purpose set forth, a master switch for controlling said line 15 switches, a lock-out relay for each substation, and an energizing circuit for each relay under the control of said line switch.

27. In a telephone exchange system, subscribers' telephone lines, trunk lines less in 20 number than the subscribers' lines, a private normal relay for each trunk line, and a private normal conductor for each subscriber's line, any one of said private normal relays adapted to remove ground from any one of 25 said private normal conductors, for the purpose set forth.

28. An automatic telephone exchange system, comprising a party line, suitable trunks, 30 automatic means for selecting trunks ahead of the calls, means for seizing the preselected trunks, and automatic means for preventing interference between subscribers on the same line in the use of said trunking means, substantially as set forth.

29. In a telephone exchange system, the 35 combination of a telephone line, a plurality of substations on said line, a preliminary trunking switch allotted to said line, trunk lines leading from said switch, automatic 40 switching machinery to which said trunk lines lead, mechanism at the substations by which any subscriber on the line can operate said automatic switching machinery, in accordance with all of the digits of any 45 called number, subsequent to the automatic preliminary trunking operation by which the said individual switch extends the telephone line into connection with said automatic switching machinery, said mechanism 50 returnable to normal after each digit, and automatic means for preventing interference between subscribers on the same line by the transmission of impulses.

30. In a telephone exchange system, the 55 combination of a telephone line, a plurality of subscribers' substations on said line, trunk lines, automatic switches by which any subscriber on the line may establish connections in accordance with all of the 60 digits of any called number, said switches having both rotary and vertical motions, one motion to select a group and the other motion to find a line in the selected group, preliminary trunking machinery by which 65 any calling subscriber on the line seizes an

idle trunk to obtain connection with one or more of said automatic switches, and automatic means for preventing interference between subscribers on the same line by the transmission of impulses. 70

31. In a telephone system, the combination of a party-line with a plurality of subscribers' stations thereon, trunk lines, means by which each subscriber on the line in calling selects an idle trunk line for the next 75 subscriber, and means by which each calling subscriber on the party-line seizes the preselected idle trunk line.

32. In a telephone system, the combination of a party-line with a plurality of subscribers' stations thereon, trunk lines, means by which each subscriber on the line in calling selects an idle trunk line for the next 80 subscriber, means by which each calling subscriber on the party-line seizes the preselected idle trunk line, and automatic means for preventing interference between subscribers on the same line by the transmission of impulses. 85

33. In a telephone system, a party-line 90 having a plurality of subscribers' stations thereon, other telephone lines, trunk lines, a common mechanism by which each calling subscriber selects an idle trunk line for the next subscriber, an individual switch for 95 the party line, subject to the control of all of the party-line subscribers, and means by which each calling subscriber on the party-line causes said individual switch to select the preselected idle trunk line. 100

34. In a telephone system, a party-line having a plurality of subscribers' stations thereon, other telephone lines, trunk lines, a common mechanism by which each calling subscriber selects an idle trunk line for 105 the next subscriber, an individual switch for the party line, subject to the control of all of the party-line subscribers, means by which each calling subscriber on the party-line causes said individual switch to select 110 the preselected idle trunk line, and automatic means for preventing interference between subscribers on the same line by the transmission of impulses.

35. In a telephone exchange system, the 115 combination of a telephone line, a plurality of substations on said line, a preliminary trunking switch allotted to said line, trunk lines leading from said switch, automatic switching machinery to which said trunk 120 lines lead, said machinery having one motion to select groups or divisions of the exchange and another motion to connect with a line in any selected group or division, and mechanism at the substations by which 125 any subscriber on the line can operate said automatic switching machinery, in accordance with all of the digits of any called number, subsequent to the automatic preliminary trunking operation performed by 130

the said individual switch, said mechanism being in normal condition after each digit.

36. In a telephone exchange system, the combination of a telephone line, a plurality of substations on said line, trunk lines, automatic means by which any calling subscriber on said line obtains connection with a preselected idle trunk line, means by which each calling subscriber selects the next idle trunk line for use by the next calling subscriber, and suitable means for switching and connecting in accordance with any called number, said means for switching and connecting having one motion to select groups or divisions of the exchange and another motion to connect with a line in any selected group or division.

37. In a telephone exchange system, the combination of a telephone line, a plurality of subscribers' substations on said line, an individual preliminary trunking switch for said line, a master switch controlling the operation of said individual switch, trunk lines, a selector and a connector, said selector and connector having one motion to select groups or divisions of the exchange and another motion to connect with a line in any selected group or division, means at the substations for controlling the operations of said individual switch and master switch and for controlling the operations of said selector and connector, a lock-out relay for each substation, and an energizing circuit for each relay under the control of said individual switch.

38. In a telephone exchange system, a party line, said line provided with a plurality of subscribers' substations, a trunking switch for said line having a line switch bank provided with trunk lines leading therefrom, a spring common to all of said trunk lines, individual springs, one for each trunk line, each of said individual springs adapted to be independently pressed into engagement with the common spring, a ground at the substation, means controlled by said ground and having one motion to select groups or divisions of the exchange and another motion to connect with a line in any selected group or division, for the purpose set forth, a lock-out relay for each substation, and an energizing circuit for each relay under the control of said trunking switch.

39. In a telephone exchange system, a party line, said line provided with a plurality of subscribers' substations, a trunking switch for said line having a bank of contacts provided with trunk lines leading therefrom, a separate group of individual bank springs allotted to each trunk line, circuit controlling switch springs common to all of said trunk lines, a ground at the

divisions of the exchange and another motion to connect with a line in any selected group or division, for the purpose set forth, a lock-out relay for each substation, and an energizing circuit for each relay under the control of said trunking switch.

40. In a telephone exchange system, the combination of subscribers' lines divided into groups, a private normal for any subscriber in a group, normally grounded, a private normal relay provided with means for removing ground from the private normal of any subscriber in a group, a ground at the substation, means controlled by said ground and having one motion to select groups or divisions of the exchange and another motion to connect with a line in any selected group or division, for the purpose set forth, and a line circuit for said relay.

41. In a telephone exchange system, subscribers' telephone lines, trunk lines less in number than the subscribers' lines, a private normal relay for each trunk line, a private normal conductor for each subscriber's line, any one of said private normal relays adapted to remove ground from any one of said private normal conductors, a ground at the substation, and means controlled by said ground and having one motion to select groups or divisions of the exchange and another motion to connect with a line in any selected group or division for the purpose set forth.

42. The improved automatic party-line telephone exchange system comprising automatic means for selecting trunks ahead of the calls, means for seizing the preselected trunks, automatic means for preventing interference between subscribers on the same line by the transmission of impulses, a ground at the substation, and means controlled by said ground and having one motion to select groups or divisions of the exchange and another motion to connect with a line in any selected group or division, substantially as set forth.

43. In a telephone system, a party-line, a plurality of subscribers' substations on said line, a non-numerical trunking switch individual to said line, common to the different substations thereon, a lock-out relay for each substation, an energizing circuit for each relay under the control of said trunking switch, and means for enabling subscribers on other lines to control said switch.

44. In a telephone system, a party-line, means for preventing interference between different subscribers on said line, a non-numerical trunking switch individual to said line, common to the different subscribers, and means for enabling subscribers on other lines to control said switch.

45. In a telephone system a non-numeri-

abling subscribers on other lines to control said switch and one or more numerical switches, all of said switches controllable over the line by any subscriber thereon.

- 5 46. In a telephone system, a non-numerical trunking switch individual to a party-line, common to all the substations thereon, an automatic busy test for preventing an effective connection with a busy line, means
10 for temporarily rendering the busy-test inoperative when one subscriber calls another on the same line, and means for preventing interference between subscribers on the same line by the transmission of impulses.

- 15 47. In a telephone system, a party-line, a non-numerical trunking switch common to the different subscribers on said party-line, an automatic busy test for preventing an effective connection with a busy line,
20 and means for temporarily rendering the busy-test inoperative when one subscriber calls another on the same line.

- 25 48. In a telephone system, a subscriber's line, a trunk line, means for extending a talking connection from said subscriber's line over said trunk line, a ground connection for preventing a connection being

made with said subscriber's line, and a relay in said trunk controlling said ground connection, said ground connection being
30 permanently connected to a spring of said relay.

49. In a telephone system, a subscriber's line, a trunk line, means for extending a talking connection from said subscriber's
35 line over said trunk line, a ground connection for preventing a connection being made with said subscriber's line, a relay in said trunk controlling said ground connection, and a condenser in shunt of said relay to
40 permit the passage of talking current there-through.

50. In a telephone system, a party-line, means for calling back on said line, means for placing a busy potential on said line,
45 and means common to a plurality of lines for removing said busy potential.

Signed by me at Chicago, Cook county, Illinois, this 15th day of August, 1906.

ALEXANDER E. KEITH.

Witnesses:

EDWARD D. FALES,
MICHAEL SETTER.