T. E. MEYER.

TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED NOV. 30, 1907.

1,239,205.

Patented Sept. 4, 1917.

2 SHEETS—SHEET 1.

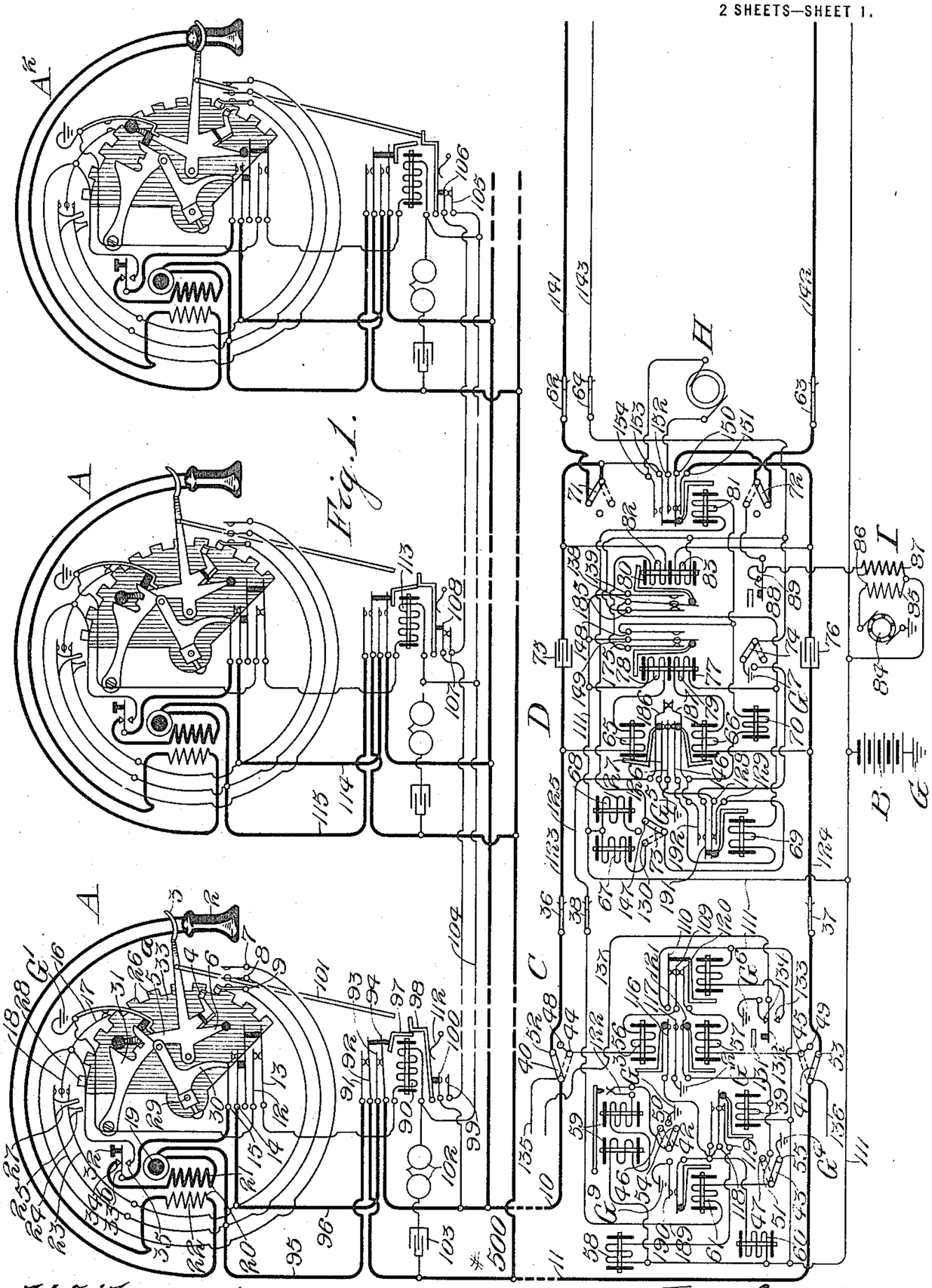

Fig. 1.

Witnesses.
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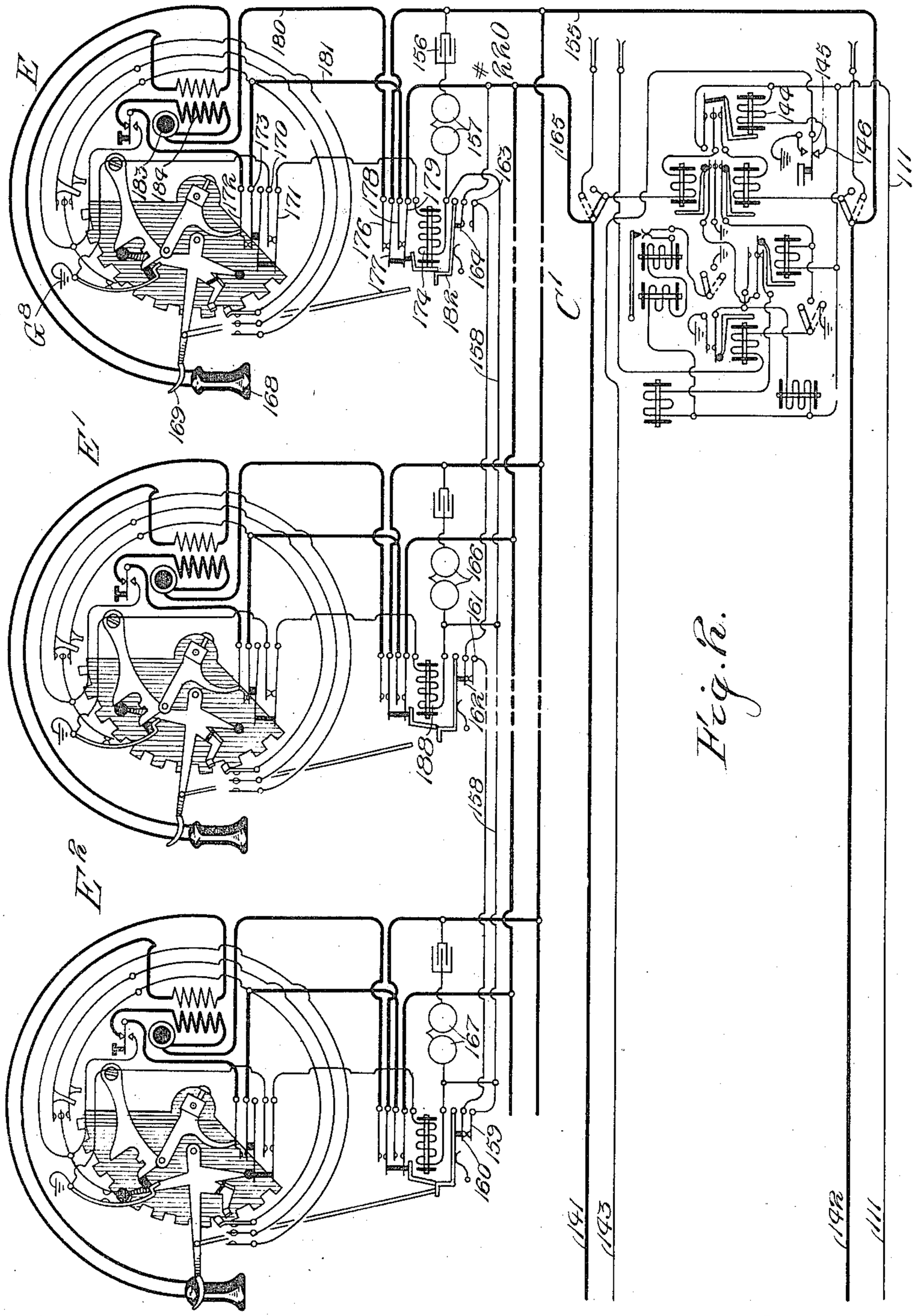

Fig. 2.

Witnesses.

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

1,239,205. Specification of Letters Patent. Patented Sept. 4, 1917.

Application filed November 30, 1907. Serial No. 404,511.

To all whom it may concern:

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

My invention relates to telephone systems in general, but more particularly to automatic or semi-automatic telephone exchange systems, and especially to systems in which party-lines are employed.

Generally stated the object of my invention is to provide improved means for preventing interference between the different subscribers on a party-line.

Special objects are to provide an automatic or semi-automatic party-line system in which the different subscribers are provided with individual devices or mechanisms for locking out all other subscribers on the line when any subscriber thereon takes down his telephone—that is to say, for preventing any of the other subscribers from either talking or listening or calling; to provide means by which the raising of any switch-hook on the party-line will serve to automatically connect the substation thereof with the line, and to at the same time automatically render all of the other substations on the same line inoperative to connect with said line until after the first subscriber is through using it; to provide a series of relays, one for each substation on the party-line, each relay adapted when energized to connect its allotted telephone and calling device and hook-switch with the line; to provide a series of relays, one for each substation on the party-line, and a conductor which is common to the energizing circuits of all of said relays, the switch-hook of each substation being provided with means for opening said conductor when the telephone receiver is removed therefrom, whereby an energizing current is prevented from flowing through any of said relays; and to provide certain details and features of improvement and combinations tending to increase the general efficiency 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 Figures 1 and 2 taken together represent diagrammatically a telephone exchange system embodying the principles of my invention.

In Fig. 1 the substations A, A′ and A² are shown allotted to the same line which terminates in the first-selector C. Said first-selector C is of the type described in United States Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, and the connector represented at D is of the general type described in United States Patent No. 815,176, also granted March 13, 1906, to Keith, Erickson and Erickson, but with modifications which adapt it to common battery work.

In Fig. 2 are shown the substations E, E′ and E² allotted to the line which terminates in the first-selector switch C′.

In Figs. 1 and 2 the substation A on the line #500 is shown as having operated the central office switches and established connection with the substation E on the line #220.

As thus illustrated, there is provided a central battery B having its positive terminal preferably grounded at G. At H and I there are shown a ringer generator and busy-signal machine.

The substations may be of any suitable or approved type. As shown at A (Fig. 1) the stations in connection with which I have elected to explain my invention comprise a receiver 2 and a switch-hook 3 for controlling the substation circuits through the medium of such means as the cam-arms 4, 5 and 6. As the switch-hook is lowered the cam-arm 4 momentarily presses the release springs 7, 8 and 9 into engagement, whereby the main line conductors 10 and 11 may be grounded simultaneously. When the switch-hook is down the cam-arm 6 separates the springs 12 and 13 and the springs 14 and 15. The substation ground circuit is normally broken between the coöperating ground springs 16 and 17 by the cam-arm 5; but when the said springs are together ground is provided to the ground post 18 and to the release spring 7, as is usually the case in telephones of this type. Said substation comprises the usual transmitter 19 and induction-coil 20 with a primary winding 21 and secondary winding 22. Being an automatic substation it is provided with the usual vertical and rotary impulse springs 23

and 24. The vertical impulse spring is provided with an oblique projection 25 (on its under side) which the vertical impulse teeth 26 are adapted to engage for intermittently driving the spring 23 against the ground post 18. The rotary impulse spring 24, in a similar manner, is provided with the oblique projection 27 which is in turn engaged by the rotary impulse tooth 28 and thrust against the ground post 18. Said substation is, of course, providing with a dial (not shown) which is secured to the shaft 29 together with a locking dog 30. Furthermore, there is a locking cam 31 that locks the dog 30 while the receiver is on the switch-hook, to prevent a rotation of the dial. For operating the impulse springs 23 and 24 the substation is provided with an impulse wheel 33[a] which is secured to the shaft 29. This impulse wheel carries on its periphery the so-called vertical impulse teeth 26 and one rotary impulse tooth 27. Said impulse teeth are so arranged that when the dial is drawn down the impulse springs are not carried into contact with the ground post 18; but as the dial returns, first the vertical teeth 26 engage the vertical impulse springs 23, and after they have completed their work the rotary impulse tooth 28 operates the rotary impulse spring 24. In this operation the subscriber's vertical line conductor 10 is given a number of ground impulses, and then the rotary line conductor 11 is given one ground impulse. It will be seen that as long as the dial is out of normal position the dog 30 permits the primary circuit springs 14 and 15 to separate, thus preventing the impulses that are delivered to either line conductor from passing to the other. The means whereby one subscriber may signal another, after connecting with his line, comprises a push-button 32 which, when pressed, carries the spring 33[b] out of engagement with the contact point 34 and into engagement with the contact point 35, thereby grounding the vertical line conductor 10. Furthermore, the substation is provided with a connecting relay 90 which, when energized, operates to place the springs 91 and 92, and 93 and 94 into contact, whereby the substation conductors 95 and 96 are connected with the main line conductors 11 and 10, respectively. The relay 90 is provided with an armature 97 which, when attracted, permits the locking arm 98 to slide over the end and lock the armature 97 in the position shown at substation A. The normal position of the relay 90 and its armature 97 is shown by the connecting relay of the substation A'. Also, when the relay 90 becomes energized, and is locked by the arm 98, the springs 99 and 100 separate. Secured to the switch-hook 3 there is a rod 101 which, when the receiver is returned to the switch-hook, carries the locking arm 98 out of engagement with the armature 97, as shown at substation A[2]. The substation is also provided with a ringer 102 connected in series with the condenser 103.

The mechanical details of the first-selector switches C and C' are, in general, well known, involving the switch shaft (not shown) which carries the line wipers 36 and 37 and the private wiper 38. The side switch is controlled by the private magnet 39, and when the side switch is in normal or first position the side switch wipers 40, 41, 42 and 43 engage the contact points 44, 45, 46 and 47, respectively. In second position the side switch wipers engage the contact points 48, 49, 50 and 51, respectively, while in third position they occupy the contact points 52, 53, 54 and 55, respectively. The first-selector is under the control of the calling subscriber through the medium of the vertical and rotary line relays 56 and 57. While the side switch is in first position the calling subscriber controls the vertical magnet 58 which operates to give the switch shaft a vertical motion. By means of the rotary line relay 57, and while the side switch is in first or second position, the subscriber controls the private magnet 39 and, therefore, the side switch. When the side switch is in second position the rotary magnet 59 is energized, and the switch shaft which carries the wipers 36, 37 and 38 is thereby caused to rotate. The vertical and rotary line relays 56 and 57, acting conjointly, provide means by which the release magnet 60 is operated by the subscriber while the side switch is in first or second position. After the side switch passes to third position, however, (since the selector C is of the trunk-release type) the release magnet 60 is then controlled through the connector D by way of the private wiper 38 and by means of the back-release relay 61.

The mechanical details of the connector and selector, as is well known, are very much the same. For instance, the connector switch shaft (not shown), like the selector switch shaft, carries the line wipers 62 and 63 and the private wiper 64. The connector switch is also controlled by the calling subscriber through the medium of the vertical and rotary line relays 65 and 66. The vertical line relay 65 directly controls the vertical magnet 67 and also the rotary magnet 68. The purpose of the vertical magnet 67 is to give the shaft and shaft wipers a vertical motion, and that of the rotary magnet 68 to impart to the shaft wipers a rotary or circular motion. The rotary line relay 66 controls the private magnet 69 which, under certain conditions, controls in turn the vertical and rotary magnets 67 and 68, the release magnet 70, and also the side switch wipers 71, 72, 73 and 74. The said side switch, like the side switch of the selector C,

has a normal or first position, a second position and a third position. The release magnet 70 is also controlled by the vertical and rotary line relays 65 and 66 conjointly. By the use of the condensers 75 and 76 the circuit through the connector is divided into two sections. The connector is provided with a differentially-wound relay 77 which is composed of the windings 78 and 79. The function of this relay is to provide the calling subscriber with talking battery current when the back-bridge relay 80 is energized, and also, in conjunction with the vertical line relay 65, to control the ringer relay 81 by means of which the ringer generator H is placed across the terminals of the called line to signal the called subscriber. The back-bridge relay 80, comprising the windings 82 and 83, provides the called subscriber with talking battery current when the primary circuit of the called subscriber is bridged across the line.

The busy-signaling apparatus I may be of any suitable design, as, for example, the one comprising an interrupter 84 in series with the primary winding 85 of the induction-coil 86, whereby a busy-signaling current is induced in the secondary winding 87 of the said induction-coil. When the side switch is in first position, and when the connector shaft is raised one or more steps, the secondary winding 87 is connected with the side switch wiper 72 through the normal springs 88 and 89.

The operation of my improved party-line arrangement may be more clearly understood from a description of its operation, as follows:

To signal the subscriber at substation E on the line #220 the subscriber at substation A removes his receiver from the switch-hook and operates the calling device once for each digit in the well-knownn manner. When the dial returns to normal position for the first digit the first-selector switch C is operated to establish connection with the connector switch D. The impulses for the last two digits are directed toward the connector D which operates to place its wipers in connection with the contacts corresponding to the desired line. It will be assumed that the main line conductors 10 and 11 are idle, and hence when the subscriber removes the receiver 2 from the switch-hook 3 an energizing circuit is established through the connector relay 90. When the switch-hook rises the springs 12 and 13 engage, thereby closing an energizing circuit extending from ground G′ through the springs 12 and 13, connecting relay 90, conductor 104, springs 105 and 106 at the substation A^2, springs 107 and 108 at the substation A′, through the springs 99 and 100 at substation A to the vertical line conductor 10, through the side switch wiper 40, contact point 44, vertical line relay 56, through the bridge-cut-off relay springs 109 and 110 to the battery lead 111, thence through battery B to ground G. The relay 90 thereupon energizes, attracting its armature 97 which operates to close the springs 91 and 92, and 93 and 94 in contact. When the armature 97 is attracted the locking arm 98 slides up behind the armature 97, locking the said armature in the position shown. The locking arm 98 is retained in this position by the spring 112. Also, when the relay 90 operates, as explained, the springs 99 and 100 disengage, thereby breaking the energizing circuit traced through the connecting relay 90. It will be seen that the circuit through the connecting relay 90 also includes the vertical line relay 56 of the selector C, but the winding of the relay 90 being of much higher resistance, sufficient current does not flow to operatively energize the vertical line relay 56. When the springs 91 and 92 engage, the substation conductor 95 is extended to the main line conductor 11; also, the engagement of the springs 93 and 94 extends the substation conductor 96 to the main line conductor 10. By this operation of the connecting relay 90 the substation A is connected with the main line conductors 10 and 11, while the remaining substations A′ and A^2 are disconnected from the main line conductors. Before either substation A′ or A^2 can be connected with the main line the connecting relay must operate as explained in connection with substation A. However, since the relay 90 has operated, and the springs 99 and 100 are disengaged, another energizing circuit cannot be formed through the connecting relays when the receiver is removed from the switch-hook, since the circuit for all of the relays is broken at the springs 99 and 100. As shown at substation A′, the receiver is removed from the switch-hook, but the connecting relay 113 does not energize, since the springs 99 and 100 are disengaged, hence the substation conductors 114 and 115 cannot become connected with the main line conductors while the substation A is in possession of the main line. In a similar manner the substation A^2 is prevented from becoming connected with the main line conductors while either of the substations A and A′ are in use. Thus the substation which first becomes connected with the main line conductors is insured against interference by other substations on the same line, and remains in undisputed possession of the main line conductors until the substation apparatus is restored to normal position. The substation conductors 95 and 96 having been extended to the main line conductors 11 and 10, then when the dial returns to normal position for the first digit 2 the impulse spring 23 is pressed onto the ground post 18 twice. As a

result the vertical line relay 56 of the first-selector C is energized each time by a flow of current from the substation ground G′ through the springs 16 and 17, ground post 18, impulse spring 23 to the substation conductor 96, and through the springs 93 and 94 to the vertical line conductor 10, side switch wiper 40, contact point 44, vertical line relay 56, bridge-cut-off relay springs 109 and 110 to the battery lead 111, thence through battery B to ground G. Each time that the vertical line relay 56 energizes, the line relay spring 116 is pressed onto the ground spring 117. The vertical magnet 58 is thereby energized and the wipers 36, 37 and 38 of the selector C are raised to the second bank level opposite the first contact. The energizing circuit for the said vertical magnet extends from ground G^2 through the springs 117 and 116, private magnet springs 118 and 119, through the vertical magnet 58 to the battery lead 111, thence through battery B to ground G. Following the vertical impulses the rotary impulse spring 24 is pressed onto the ground post 18, grounding the rotary line conductor 11 and energizing the rotary line relay 57 of the selector C. The energizing current passes from ground G′ through the springs 16 and 17, ground post 18 to the rotary impulse spring 24, substation conductor 95, through the springs 91 and 92 to the rotary line conductor 11, thence through the side switch wiper 41, contact point 45, rotary line relay 57, bridge-cut-off springs 120, 109 and 110 to the battery lead 111, thence through battery B to ground G. The rotary line relay, upon energizing, presses the line relay spring 121 onto the ground spring 117, thereby establishing a circuit from ground G^2 through the springs 117 and 121 to the private magnet 39, and through said magnet to the battery lead 111, thence through battery B to ground G. The private magnet, upon energizing and de-energizing, permits the selector side switch to pass from first to second position, permitting the side switch wipers 42 and 43 to engage the contact points 50 and 51, respectively. The contact between the side switch wiper 42 and the contact point 50 completes an energizing circuit through the rotary magnet 59 from ground G^3 to the contact point 50, side switch wiper 42, through the interrupter spring 122, thence through the rotary magnet 59 to the battery lead 111, and through battery B to ground G. The said rotary magnet 59 then operates to rotate the wipers 36, 37 and 38 of the selector C into engagement with the first contact of the second level of the selector C, from which contact it is assumed that the trunk conductors 123, 124 and 125 lead to the connector D. If the first trunk line is busy, however, and the wipers have to pass over busy trunk-lines, then as soon as the private wiper 38 engages the first private bank contact the private magnet 39 energizes again, retaining the side switch in second position. The energizing circuit for the said private magnet extends from the grounded terminal of battery B through an occupying switch (not shown) to the private wiper 38, then through the back-release relay 61, side switch wiper 43, contact point 51, private magnet 39, thence through the said magnet to the battery lead 111, and through battery B to ground G. The private magnet 39, upon thus becoming energized, locks the side switch wiper 42 in engagement with the contact point 50, whereby the rotary magnet 59 will be energized step by step until the wipers are carried beyond the last busy trunk-line. At the instant that the private wiper leaves the last busy contact point the energizing circuit through the private magnet 39 is destroyed, and as a result the selector side switch passes to third position. If, however, there are no busy trunk-lines the private magnet 39 releases the side switch to third position as soon as the wipers are carried into engagement with the first trunk-line. As soon as the side switch passes to third position, as stated, the substation conductors 95 and 96 are extended to the conductors 124 and 123 which, in this case, it is assumed lead to the connector switch D. The extension of the line occurs, of course, as soon as the side switch wipers 40 and 41 engage the contact points 52 and 53, respectively. Not only is the subscriber's line thus extended, but a guarding potential is established at the private wiper 38, when the side switch wiper 43 passes onto the grounded contact point 55, for protecting the seized trunk-line from interference by other calling subscribers. This guarding potential extends from ground G^4 to the contact point 55, side switch wiper 43, back-release relay 61 to the private shaft wiper 38. It will be seen, of course, that the energizing circuit for the rotary magnet 59, to which reference has already been made, is destroyed when the idle trunk-line is seized—that is, when the side switch wiper 42 leaves the contact point 50. Furthermore, when the first-selector shaft is raised the normal arm 131 permits the spring 132 to pass from the contact point 133 to the contact point 134, whereby a guarding potential is established at the connector bank to prevent a calling subscriber from establishing connection with the normal conductors 135 and 136 while the selector C is busy. This guarding potential extends from ground G^6 to the contact point 134, spring 132, normal conductor 137, thence to the connector bank contact corresponding to the line conductors 10 and 11. The grounding of the main line conductors 10 and 11 for the last two digits affects the connector by operating

the vertical and rotary line relays 65 and 66. When the said vertical line conductor 10 is grounded the vertical line relay 65 is energized by a flow of current from the substation ground G′ through the vertical impulse spring 23, substation conductor 96 to the main line conductor 10, through the side switch wiper 40, contact point 52, shaft wiper 36, trunk conductor 123, through the vertical line relay 65, winding 78 of the differential relay 77 to the battery lead 111, thence through battery B to ground G. The winding 78 of the relay 77 being included in this circuit said relay energizes, but its operation at this particular time is without effect. Each time that the vertical line relay operates for the second digit the vertical magnet 67 operatively energizes to carry the shaft wipers 62, 63 and 64 in a vertical direction, one step at a time, until the said wipers are carried two steps and thus brought opposite a level in which are located the terminals of the line #220. The circuit through the vertical magnet extends from ground G^5 through the springs 126 and 127, private magnet springs 128 and 129, side switch wiper 73, contact point 130, vertical magnet 67 to the battery lead 111, thence through battery B to ground G. When the rotary line conductor 11 is grounded, following the grounding of the vertical line conductor, the connector rotary line relay 66 becomes energized over a circuit extending from the substation ground G′ to the impulse spring 24, substation conductor 95, then to the rotary line conductor 11, side switch wiper 41, contact point 53, shaft wiper 37 to the trunk conductor 124, rotary line relay 66 and winding 79 of the differential relay 77, through the springs 138 and 139 to the battery lead 111, thence through battery B to ground G. As shown, the relay 80 is in an operated position, but the said relay does not energize until the called subscriber answers, as will be explained; hence, at this stage of the call the springs 138 and 139 are in contact. The winding 79 of the differential relay 77 being included in this circuit, as is the winding 78 in the vertical line relay circuit, the said relay energizes, but without effect. The rotary line relay 66, upon energizing, operates to close an energizing circuit through the private magnet 69, which latter in turn operates to release the side switch from first to second position. The energizing circuit through the private magnet 69 extends from ground G^5 through the springs 126 and 146, through the private magnet 69, thence through the springs 138 and 139 to the battery lead 111, and through battery B to ground G. For the last digit the subscriber operates the dial as previously described, grounding the vertical line conductor 10 ten times and the rotary line conductor 11 once. The connector vertical and rotary line relays 65 and 66 are operated over previously traced circuits. However, when the vertical line relay operates a circuit is closed through the rotary magnet 68 instead of through the vertical magnet 67, since the side switch wiper 73 has passed from first to second position. Each time that the rotary magnet 68 is energized the shaft wipers 62, 63 and 64 are rotated one step at a time until the said wipers are carried into engagement with the normal conductors 141, 142 and 143, the first two of which lead to the main line terminals of the desired substation. The rotary line relay 66, upon energizing, completes an energizing circuit through the private magnet 69 as before. This latter now operates with one of two results, namely the release of the side switch from second to third position, or the so-called busy-release of the connector. It will be assumed that the former result occurs, and that the side switch passes to third position, whereby the side switch wipers 71 and 72 are placed in connection with the shaft wipers 62 and 63, respectively. Furthermore, when the side switch passes to third position a guarding potential is established for protecting the called line. This potential extends from ground G^7 through the side switch wiper 74 to the shaft wiper 64, which latter engages the private contact of the called line. Also, when the shaft wiper 64 engages the private contact, and the side switch wiper 74 passes to third position, an energizing circuit is established through the bridge-cut-off relay 144 of the first-selector C′ (Fig. 2). This circuit extends from ground G^7 through the side switch wiper 74, private shaft wiper 64, conductor 143, through the normal springs 145 and 146, through the bridge-cut-off relay 144 to the battery lead 111, thence through battery B to ground G. In order to signal the called subscriber, the subscriber at substation A presses the signaling button 32, whereby the vertical line conductor 10 is grounded and the connector vertical line relay 65 and differential relay 77 become energized as before. It will be remembered that the connector side switch has passed from second to third position, and that the side switch wiper 73 now engages the contact point 147, thereby placing the vertical line relay 65 in control of the ringer relay 81, in the same manner that the rotary magnet 68 came under the control of the vertical line relay when the side switch passed from first to second position. Therefore, when the vertical line relay presses the springs 127 and 126 into contact, the ringer relay 81 is energized by a flow of current from ground G^5 through the springs 126 and 127, and 128 and 129 to the side switch wiper 73, contact point 147, thence through the ringer relay

81, springs 148 and 149 (bearing in mind that the differential relay 77 is energized) to the battery lead 111, and through battery B to ground G. The ringer relay, upon energizing, shifts the spring 150 from the spring 151 to the spring 152, and the spring 153 is shifted into engagement with the spring 154. This results in bridging the terminals of the ringer generator H across the called line. The signaling current is, therefore, sent from the generator H to the ringer relay springs 152 and 150, side switch wiper 72, shaft wiper 63, normal conductor 142 to the main line conductor 155, condenser 156, ringer 157, conductor 158, springs 159 and 160, 161 and 162, and 163 and 164 to the main line vertical conductor 165, normal conductor 141, shaft wiper 62, side switch wiper 71, through the ringer relay springs 153 and 154 back to the ringer generator H. Signaling current also passes through the ringers 166 and 167 of the substations E′ and E², in multiple with the ringer 157 of the substation E. As soon as the calling subscriber ceases to press the signaling button 32 the ringer relay 81 becomes deënergized, and the springs 150 and 153 return to the normal positions. The subscribers at substations E, E′ and E² recognizing the ring, which may be two short rings, understand that the subscriber at substation E is signaled. In response to the signal the subscriber at substation E removes the receiver 168 from the switch-hook 169, whereby the switch-hook rises and permits the springs 170 and 171, and 172 and 173 to engage. The engagement of the springs 170 and 171 closes an energizing circuit through the connecting relay 174, said circuit extending from the substation ground G⁸ through the springs 170 and 171, connecting relay 174, conductor 158, through the springs 159 and 160, 161 and 162, 163 and 164, main line conductor 165, normal conductor 141, shaft wiper 62, side switch wiper 71, winding 82 of the relay 80, through the springs 175 and 149 to the battery lead 111, and through battery B to ground G. The connecting relay 174, upon energizing, operates to close the springs 176 and 177, and 178 and 179 in contact, whereby the substation conductors 180 and 181 become connected with the main line conductors 155 and 165, respectively. Also, when the relay 174 energizes, the locking arm 182 rises and locks the relay in its operated position, as shown at substation E. When the locking arm 182 operates, the springs 163 and 164 disengage, thereby breaking the energizing circuit for the connecting magnet 174. By this operation of the relay 174, the substations A and E are placed in connection when the subscriber removes the receiver from the switch-hook. Also, when the springs 172 and 173 engage an energizing circuit is closed through both windings of the relay 80 at the connector D. This circuit extends from ground G⁷ through the side switch wiper 74 to the winding 83 of the relay 80, through the ringer relay springs 151 and 150, side switch wiper 72, shaft wiper 63, normal conductor 142, rotary line conductor 155, through the springs 177 and 176 to the substation conductor 180, transmitter 183, primary winding 184, through the springs 172 and 173, substation conductor 181, springs 178 and 179 to the vertical line conductor 165, normal conductor 141, shaft wiper 62, side switch wiper 71, through the winding 82 of the relay 80, through the springs 175 and 149 to the battery lead 111, thence through battery B to ground G. The relay 80, upon energizing, operates to shift the spring 138 from the spring 139 (which latter is connected to the battery lead 111) to the spring 185, which latter is connected to ground. The reversal of the polarity of the spring 138 sets up a circuit which provides the calling substation with battery current for talking purposes. This circuit may be traced from ground G⁷ through the side switch wiper 74, through springs 185 and 138, through the winding 79 of the differential relay 77, rotary line relay 66, conductor 124, shaft wiper 37, side switch wiper 41, rotary conductor 11, through the springs 92 and 91, substation conductor 95, transmitter 19, primary winding 21, contact 34, spring 33ᵇ, through the springs 15 and 14, and 93 and 94, vertical line conductor 10, side switch wiper 40, shaft wiper 36, conductor 123, vertical line relay 65, winding 78 of the differential relay 77 to the battery lead 111, thence through battery B to ground G. Both windings of the relay 77 now carry current, but the windings are so arranged that the said relay does not operatively energize. The vertical and rotary line relays 65 and 66, being included in the above circuit, operatively energize and place the springs 126, 127 and 146 in contact. Also, the release springs 186 and 187 are brought into contact, but the simultaneous action of these relays at this particular time is without effect, since no energizing circuits are thereby established. The two substations A and E being thus provided with battery current for talking purposes, conversation may be carried on over circuits shown by the heavy line conductors in Figs. 1 and 2. Suppose that while the two substations are thus connected the subscriber at substation A′ (Fig. 1) removes his receiver from the switch-hook preparatory to making a call. It will be seen that since the connecting relay 90 has operated and separated the springs 99 and 100 the energizing circuit for the connecting relay 113 is broken and the relay does not energize, hence the substation conductors 114 and 115 are not connected

with the main line conductors 10 and 11. Therefore, the subscriber at substation A′ can in no manner operate his telephone to interfere with the established connection, since the substation conductors 114 and 115 remain disconnected from the main line conductors 10 and 11 whenever the energizing circuit through the connecting relay 113 is broken. In a similar manner the subscriber at substation E′ (Fig. 2) is rendered powerless to interfere with the established connection, since the circuit through the connecting relay 188 is broken at the springs 163 and 164. The subscribers at substations A and E having once obtained possession of their respective main line conductors, as explained, remain in undisputed possession thereof until their receivers are restored to their respective switch-hooks.

The release of the central office switching apparatus is brought about when the calling subscriber restores the receiver 2 to the switch-hook 3, thereby pressing the release springs 7, 8 and 9 into engagement for a moment. The contact of the said release springs connects the vertical and rotary line conductors 10 and 11 simultaneously with ground G′ through the release springs 7, 8 and 9. The grounding of the rotary line conductor 11 produces a short-circuit of the rotary line relay 66 in series with the winding 79 of the differential relay 77. The said circuit extends from ground G⁷ to the side switch wiper 74, springs 185 and 138, through the winding 79, relay 66, conductor 124 to the rotary line conductor 11, through the springs 92 and 91, thence through the release springs 8 and 7 to the substation ground G′. Therefore, since the winding 78 of the differential relay 77 alone carries current, the said relay becomes energized and attracts its armature, which shifts the spring 149 out of engagement with the spring 175 and into engagement with the spring 148. The disengagement of the springs 149 and 175 destroys the energizing circuit through the relay 80, and the spring 138 passes out of engagement with the spring 185 and into engagement with the spring 139. This removes the said short-circuit of the rotary line relay 66 and the winding 79, and establishes an energizing circuit instead which extends from the substation ground G′ through the release springs 7 and 8 to the rotary line conductor 11, thence to the rotary line relay 66 and winding 79 of the differential relay 77, through the springs 138 and 139 to the battery lead 111, and through battery B to ground G. The rotary line relay 66 now operates and the springs 186 and 187 come into contact, thereby establishing an energizing circuit through the release magnet 70 of the connector D in series with the release relay 61 of the selector C. However, the current now in passing, as above stated, through the winding 79 aids the winding 78 in maintaining the springs 149 and 148 in contact. The energizing circuit through the release magnet extends from ground G⁴ to the contact point 55, through the side switch wiper 43, release relay 61, shaft wiper 38, conductor 125, through the springs 186 and 187, release magnet 70, springs 148 and 149 to the battery lead 111, thence through battery B to ground G. When the connector release magnet 70 is thus supplied with current it energizes, and as a result the switch shaft and side switch are restored to normal position, thus breaking the connection between the connector switch shaft wipers 62, 63 and 64 and the normal conductors 141, 142 and 143. The back-release relay 61, being in the same circuit with the release magnet, energizes simultaneously with the latter and operates to close the circuit through the selector release magnet 60 by pressing the back-release springs 189 and 190 together. The energizing circuit through the selector release magnet extends from ground G⁹ through the springs 190 and 189, release magnet 60 to the battery lead 111, thence through battery B to ground G. When the ground to the line conductors 10 and 11 is interrupted all of the magnets involved in the release are deënergized and all the switches fully restored. Also, when the receiver 2 is restored the switch-hook 3 carries the rod 101 downward and into engagement with the locking arm 98, whereby the said arm is carried out of locking engagement with the armature 97. This permits the said armature to return to normal position, disconnecting the substation conductors 95 and 96 from the main line conductors and bringing the springs 99 and 100 into contact, whereby the substation A is restored to normal position, as shown at substation A². Also, when the subscriber at substation E restores the receiver 168 to the switch-hook 169 the connecting relay 174 is restored to normal position and the substation conductors 180 and 181 are disconnected from the main line conductors 155 and 165 in the manner explained in connection with substation A. If the called line #220 is busy at the time the calling subscriber at substation A attempts to establish connection, the connector D is released by the last rotary impulse to the rotary line conductor 11, as follows: The said impulse energizes the rotary line relay 66, which relay in turn energizes the private magnet 69, pressing the private springs 191 and 192 into contact after the private wiper 64 has been carried onto the grounded private bank contact. Of course, it is understood that whenever the line #220 is busy the connector private bank contacts connected with the private normal conductor 143 are all connected to ground.

Therefore, since the connector side switch is in second position, when the private magnet springs 191 and 192 are brought into contact an energizing circuit is established through the release magnet 70 from the said grounded private bank contact to the private wiper 64, thence to the side switch wiper 74 (which is in second position) to the private magnet springs 191 and 192, to the release magnet 70, through the springs 148 and 149 to the battery lead 111, thence through battery B to ground G. When the release magnet is energized the connector switch shaft and side switch are released and connection is not established with the called line. Now, when the calling subscriber presses the signaling button the vertical line relay 65 becomes energized and operates to close a circuit through the vertical magnet 67. The vertical magnet operates to carry the switch shaft vertically, whereby the off-normal springs 88 and 89 engage to permit the busy-signaling current to pass to the calling subscriber in the usual way. Of course, when the subscriber hangs up his receiver after receiving the busy-signal, he grounds the line relays 65 and 66 of the connector E, as already explained, causing the release of the switching apparatus as formerly.

From the foregoing it will be seen that I provide each party-line subscriber with an individual device or mechanism for connecting his substation with the telephone line, either when he calls or when he answers, and for at the same time rendering all of the other substations on said line inoperative for either talking or listening or calling. The hook-switches and telephones and calling devices are all normally and totally disconnected from the line, so that unless the taking down of a receiver results in the closure of a circuit through the associated relay, it follows that neither the telephone nor the calling device nor the hook-switch will be connected with the line. The conductor which includes the contacts 99 and 100, 107 and 108, and 105 and 106 is common to the energizing circuits of all of the different relays, so that when any subscriber opens this conductor at his substation he thereby prevents an energizing current from flowing through any of said relays. The taking down of the receiver at the calling or called substation momentarily energizes the relay thereof in the manner explained, but the separation of the contacts 99 and 100, for example, which immediately follows, serves to then deprive all of said relays of energizing current, but not until after the momentarily energized relay has been locked in condition to maintain the connection with the line. It will be seen, therefore, that only the bells or ringers and relays of the different substations are normally connected with the line. The ground connection for each substation, together with the entire telephone apparatus and hook-switch mechanism and calling mechanism, are normally and totally disconnected from the line.

What I claim as my invention:—

1. In a telephone system, a party-line, a telephone and a ground connection for each substation thereon, a relay for each substation, means for energizing the relay when the associated telephone is taken down, means including said relay operated by the taking down of said telephone for preventing the other relays from energizing, said relays when energized serving to connect the telephones with the line, and switching means responsive to electrical impulses through said ground connections.

2. In a telephone system, a party-line, a telephone and a calling device for each substation thereon, an individual mechanism for each substation, automatic switches responsive to said calling devices, and means for so operating the mechanism at a substation by taking down the telephone thereof that all other substations are rendered inoperative to either talk or listen or call.

3. In a telephone system, a party-line, a plurality of telephones and hook-switches normally disconnected from both sides of the line at the substations thereof, and relays normally connected with the line and provided with means for connecting the telephones and hook-switches therewith.

4. The combination, in a telephone system, of a party-line, a telephone and a ground connection for each substation thereon, a relay for each substation, means for energizing the relay when the associated telephone is taken down, means operated by the taking down of said telephone for preventing the other relays from energizing, said relays when energized serving to connect the telephones and ground connections with the line, switching means responsive to electrical impulses through said ground connections, and means for supplying current over the subscribers' lines of the system for talking purposes.

5. The combination, in a telephone system, of a party-line, a telephone and a ground connection for each substation thereon, relays serving when energized to connect the telephones and ground connections with the line, there being one relay for each substation, parallel circuits for said relays including said ground connections, means for opening all of said circuits when any telephone is taken down, and means for supplying current over the subscribers' lines of the system for talking purposes.

6. The combination, in a telephone system, of a party-line, substations having nor-

mally open connections therewith, a relay for each substation thereon, means for energizing only one relay when a substation calls, means by which the said one relay is immediately deënergized and all other relays prevented from energizing, said relays when energized serving to connect the substations with the line, and means for supplying current over the subscribers' lines of the system for talking purposes.

7. The combination, in a telephone system, of a party-line, substations having normally open connections therewith, devices operated by the taking down of any telephone for connecting that telephone with the line and preventing use of all other telephones for either talking or listening purposes, and means for supplying current over the subscribers' lines of the system for talking purposes.

8. The combination, in a telephone system of a party-line, a plurality of calling devices on said line, automatic switches responsive to said calling devices, a telephone for each calling device, said devices and telephones all normally disconnected from the line, devices operated by the taking down of any telephone for connecting that telephone and its associated calling device with the line and preventing connection therewith of any other telephone or calling device, and means for supplying current over the subscribers' lines of the system for talking purposes.

9. The combination, in a telephone system, of a party-line, a telephone and a calling device for each substation thereon, an individual mechanism for each substation, automatic switches responsive to said calling devices, means for so operating the mechanism at a substation by taking down the telephone thereof that all other substations are rendered inoperative to either talk or listen or call, and means for supplying current over the subscribers' lines of the system for talking purposes.

10. The combination, in a telephone system, of a party-line, a plurality of hook switches and telephone receivers and transmitters and calling devices normally disconnected therefrom, electromagnetic means for automatically connecting the same thereto, switching means responsive to said calling devices, and means for supplying current over the subscribers' lines of the system for talking purposes.

11. The combination, in a telephone system, of a party-line, a plurality of telephone receivers and transmitters and hook switches normally disconnected from both sides of the line, at the substations thereof, relays normally connected with the line and provided with means for connecting the telephones and hook switches, and means for supplying current over the subscribers' lines of the system for talking purposes.

12. The combination, in a telephone system, of a party-line, telephone receivers and transmitters and hook switches and calling devices normally disconnected from said line at the substations thereof, relays for connecting the telephones and hook switches with the line, and means for supplying current over the subscribers' lines of the system for talking purposes.

13. In a telephone system, a party-line, a telephone and a ground connection for each substation thereon, a relay for each substation, means for energizing the relay when the associated telephone is taken down, means operated by the taking down of said telephone for preventing the other relays from energizing, said relays when energized serving to connect the telephones with the line, switching means responsive to electrical impulses through said ground connections, and means controlled at the substation of one line in the system for supplying talking current to another line.

14. In a telephone system, a party-line, a telephone and a ground connection for each substation thereon, relays serving when energized to connect the telephones and ground connections with the line, there being one relay for each substation, parallel circuits for said relays including said ground connections, means for opening all of said circuits when any telephone is taken down, and means controlled at the substation of one line in the system for supplying talking current to another line.

15. In a telephone system, a party-line, a relay for each substation thereon, means for energizing only one relay when a substation calls, means by which the said one relay is immediately deënergized and all other relays prevented from energizing, said relays when energized serving to connect the substations with the line, and means controlled at the substation of one line in the system for supplying talking current to another line.

16. In a telephone system, a party-line, a plurality of telephones on said line, devices operated by the taking down of any telephone for connecting that telephone with the line and preventing use of all other telephones for either talking or listening purposes, and means controlled at the substation of one line in the system for supplying talking current to another line.

17. In a telephone system, a party-line, a plurality of calling devices on said line, automatic switches responsive to said calling devices, a telephone for each calling device, said devices and telephones all normally disconnected from the line, devices operated by the taking down of any telephone for connecting that telephone and its associated

calling device with the line and preventing connection therewith of any other telephone or calling device, and means controlled at the substation of one line in the system for supplying talking current to another line.

18. In a telephone system, a party line, a telephone and a calling device for each substation thereon, an individual mechanism for each substation, automatic switches responsive to said calling devices, means for so operating the mechanism at a substation by taking down the telephone thereof that all other substations are rendered inoperative to either talk or listen or call, and means controlled at the substation of one line in the system for supplying talking current to another line.

19. In a telephone system, a party-line having a plurality of substations thereon, telephones and hook-switches normally disconnected from said line at the different substations thereof, means for automatically connecting the same thereto, and means controlled at the substation of one line in the system for supplying talking current to another line.

20. In a telephone system, a party-line, a plurality of telephones and hook-switches normally disconnected from the line at the substations thereof, relays normally connected with the line and provided with means for connecting the telephones and hook-switches therewith, and means controlled at the substation of one line in the system for supplying talking current to another line.

21. In a telephone system, a party-line, telephones and hook-switches and calling devices normally disconnected from said line at the substations thereof, relays for connecting the telephones and hook-switches with the line, and means controlled at the substation of one line in the system for supplying talking current to another line.

22. The combination, in a telephone system in which the subscribers' lines are divided into groups, of a party line, a telephone and a ground connection for each substation thereon, a relay for each substation, means for energizing the relay when the associated telephone is taken down, means operated by the taking down of said telephone for preventing the other relays from energizing, said relays when energized serving to connect the telephones and ground connections with the line, switching means responsive to electrical impulses through said ground connections, and means for supplying current over the subscribers' lines of the system for talking purposes, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called line in any selected group.

23. In a telephone system in which the subscribers' lines are divided into groups, a partv line, a telephone and a ground connection for each substation thereon, a relay for each substation, means for energizing the relay when the associated telephone is taken down, means operated by the taking down of said telephone for preventing the other relays from energizing, said relays when energized serving to connect the telephones and ground connections with the line, switching means responsive to electrical impulses through said ground connections, and means controlled at the substation of one line in the system for applying talking current to another line, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called line in any selected group.

24. The combination, in a telephone system in which the subscribers' lines are divided into groups, of a party line, substations having normally open connections therewith, a relay for each substation thereon, means for energizing only one relay when a substation calls, means by which the said one relay is immediately deënergized and all other relays prevented from energizing, said relays when energized serving to connect the substations with the line, and means for supplying current over the subscribers' lines of the system for talking purposes, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called line in any selected group.

25. The combination, in a telephone system in which the subscribers' lines are divided into groups, of a party line, substations having normally open connections therewith, devices operated by the taking down of any telephone for connecting that telephone with the line and preventing use of all other telephones for either talking or listening purposes, and means for supplying current over the subscribers' lines of the system for talking purposes, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called line in any selected group.

26. In a telephone system in which the subscribers' lines are divided into groups, a party line, a plurality of telephones and hook switches normally disconnected from the line at the substations thereof, and relays normally connected with the line and provided with means for connecting the telephones and hook switches therewith, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called line in any selected group.

27. The combination, in a telephone system in which the subscribers' lines are divided into groups, of a party line, a plurality of telephone receivers and transmit-

ters and hook switches normally disconnected from the line, at the substations thereof, relays normally connected with the line and provided with means for connecting the telephones and hook switches thereto, and means for supplying current over the subscribers' lines of the system for talking purposes, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called line in any selected group.

28. The combination, in a telephone system in which the subscribers' lines are divided into groups, of a party line, telephone receivers and transmitters and hook switches and calling devices normally disconnected from said line at the substations thereof, relays for connecting the telephones and hook switches with the line, and means for supplying current over the subscribers' lines of the system for talking purposes, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called line in any selected group.

29. In a telephone system, a party-line having a plurality of substations thereon, telephones and impulse-transmitting springs normally disconnected from said line at the different substations thereof, and relays normally connected with the line and provided with means for connecting the telephones and impulse-transmitting springs therewith.

30. In a telephone system, a party-line, a telephone and a calling device for each substation thereon, an individual mechanism for each substation, automatic switches responsive to said calling devices, and electromagnetic means for so operating the mechanism at a substation by taking down the telephone thereof that all other substations are rendered inoperative to either talk or listen or call.

31. The combination, in a telephone system in which the subscribers' lines are divided into groups, of a party line, substations having normally open connections therewith, electromagnetic devices operated by the taking down of any telephone for connecting that telephone with the line and preventing use of all other telephones for either talking or listening purposes, and means for supplying current over the subscribers' lines of the system for talking purposes, said system provided with switch wipers having vertical motion to select groups and then rotary motion to find the called-line in any selected group.

32. In a telephone system in which the subscribers' lines are divided into groups, a party line, telephone receivers, transmitters, hook switches and calling devices normally disconnected from said line at the substations thereof, and relays for connecting the telephones and hook switches with the line, said system provided with switch wipers having one motion to select groups and another motion to find the called line in any selected group.

33. In a telephone system, a series of relays and means for energizing any one of them initially, said means comprising, in part a circuit passing through normally closed pairs of contacts, one pair in each relay, said pairs in series in said circuit, and said circuit passing thence to windings of all of said relays, in multiple.

Signed by me at Chicago, Cook county, Illinois, this 25th day of November, 1907.

TRYGVE E. MEYER.

Witnesses:

EDWARD D. FALES,

HARRIETT M. MERRIAM.