G. A. YANOCHOWSKI.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED OCT. 2, 1916.

1,376,371.

Patented Apr. 26, 1921.

4 SHEETS—SHEET 1.

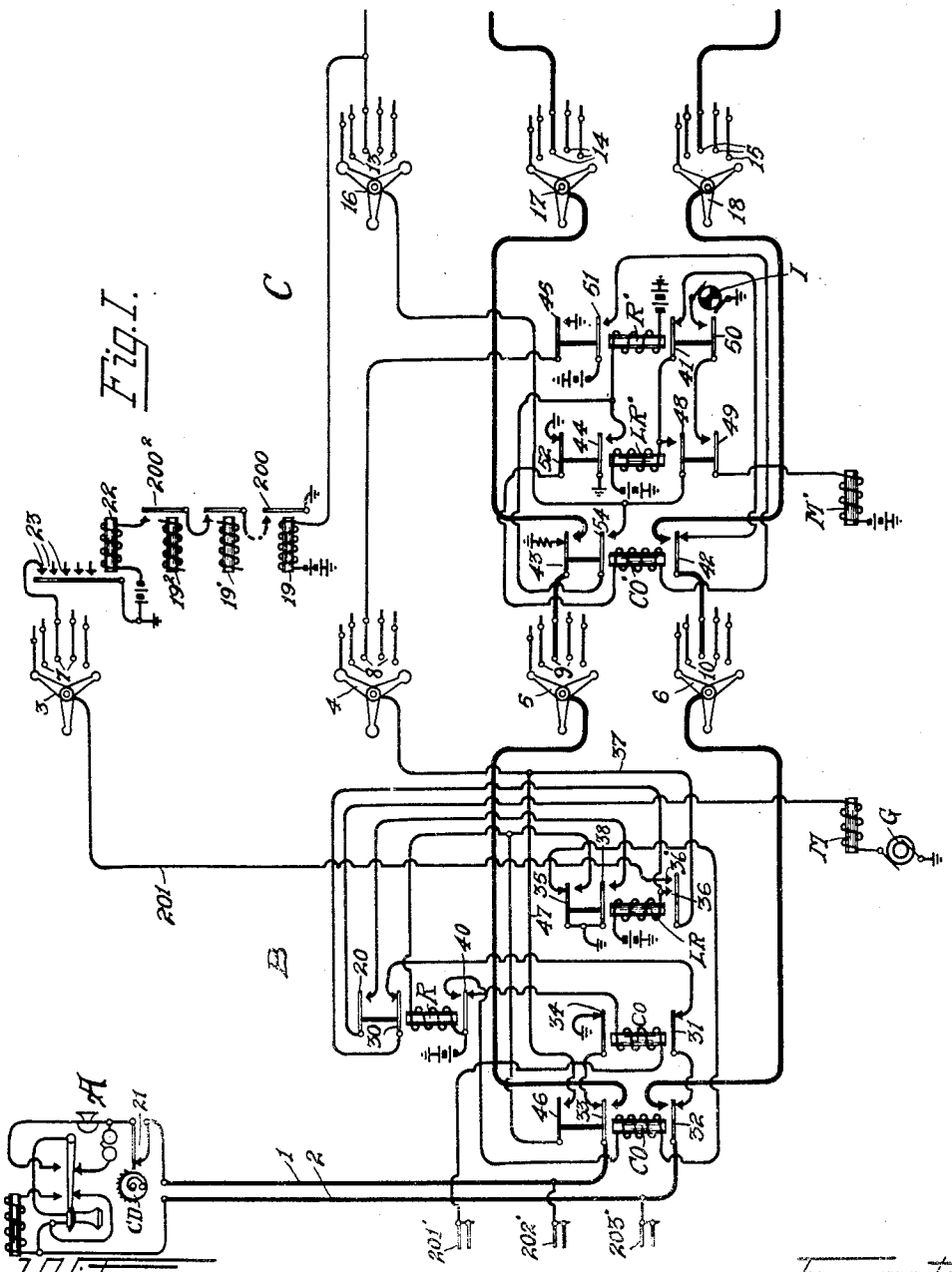

Fig. 1.

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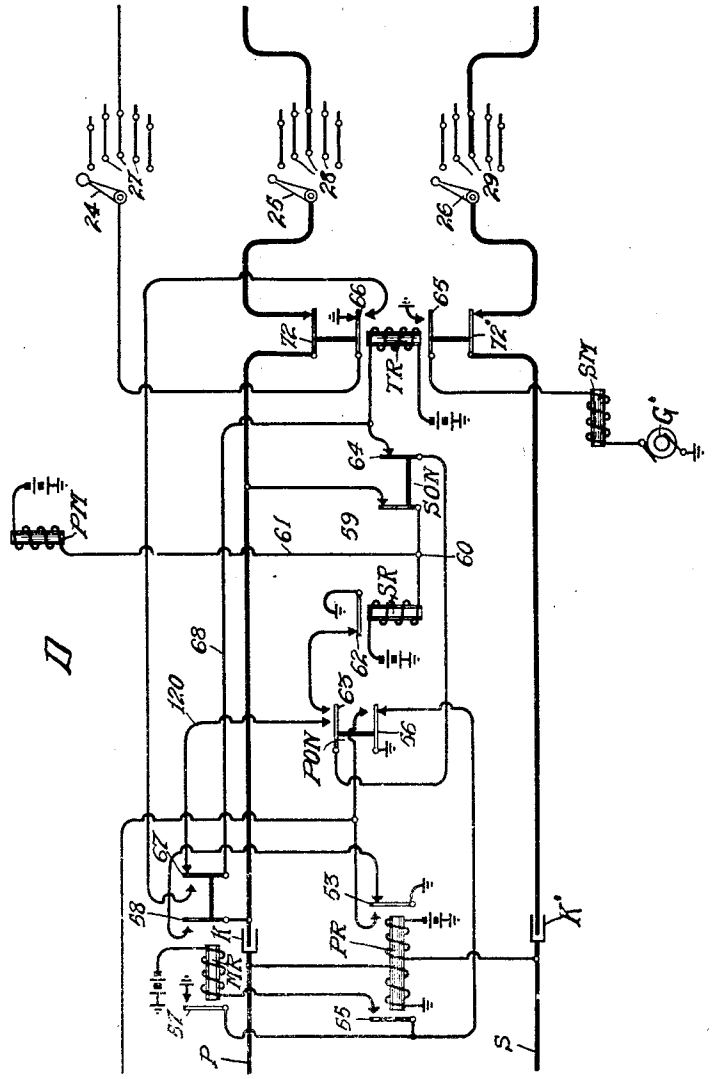
4 SHEETS—SHEET 2.

Fig. 2.



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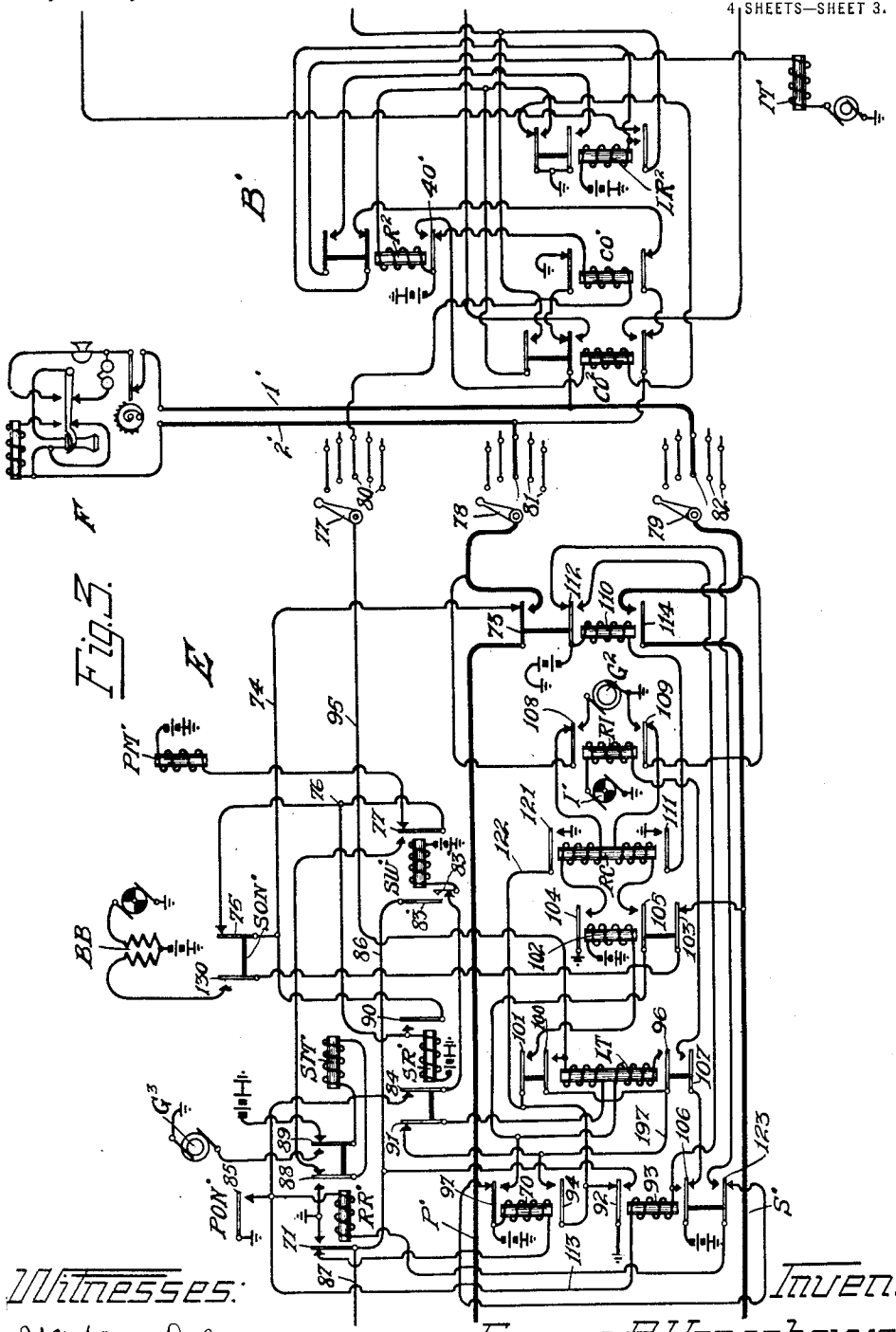

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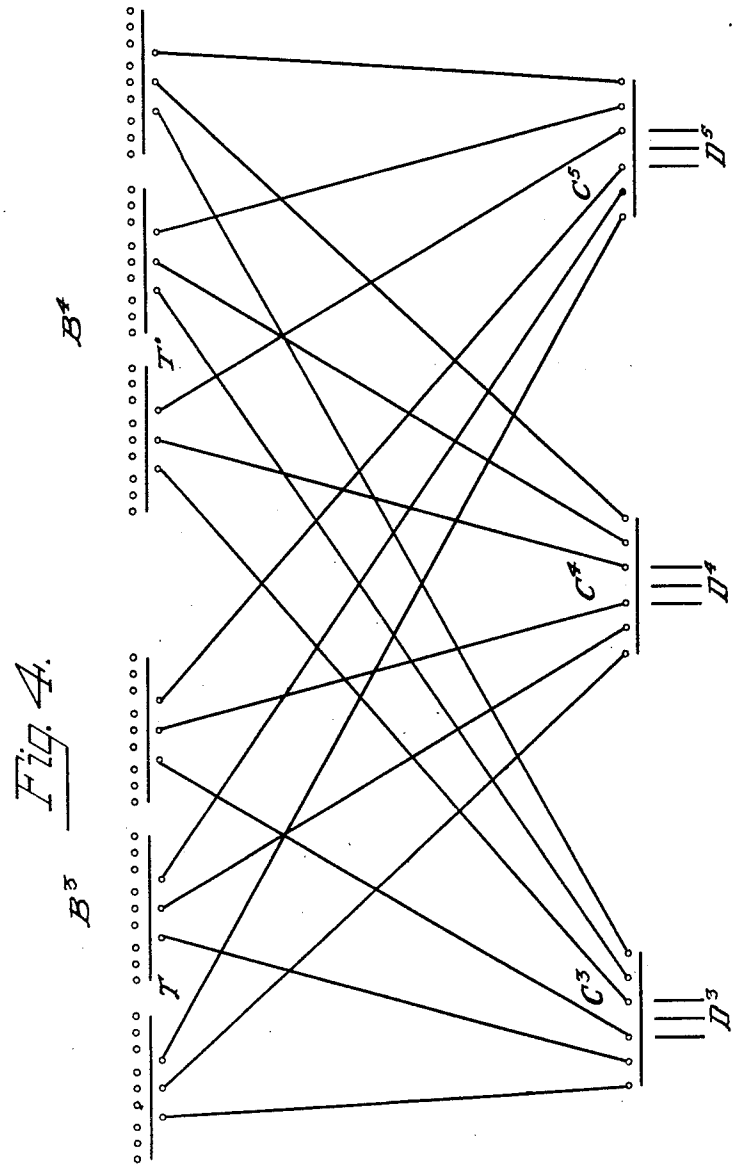

Fig. 4.

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UNITED STATES PATENT OFFICE.

GEORGE A. YANOCHOWSKI, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,376,371. Specification of Letters Patent. Patented Apr. 26, 1921.

Application filed October 2, 1916. Serial No. 123,267.

To all whom it may concern:

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

My invention relates to telephone exchange systems and more particularly to automatic telephone systems of the two-wire or metallic line type of that kind in which the subscribers' lines are provided with primary or individual line switches which have access to trunks that terminate in secondary line switches which in turn have access to trunks that terminate in first selector switches, thereby causing at least two non-numerical trunking operations before the call reaches the first selector switch or other apparatus.

The object of my invention is the provision of a system of the above type which is provided with rotary primary and secondary line switches, that is, primary and secondary line switches which are each provided with their own individual operating mechanism.

One of the features of my invention is the use of rotary primary and secondary line switches of the type in which the wipers of the switches do not return to normal when a connection is released but remain upon the terminals used in extending the connection from a subscriber's line to a first selector. Another feature of my invention is the provision of means in the primary and secondary line switches to permit their wipers to remain stationary in connection with the last bank terminals used when a subscriber initiates a call, providing that the trunks extending from the contacts engaged by the primary and secondary line switch wipers are idle ones, thus providing a system in which a calling subscriber may extend a call through to an idle first selector without moving either the primary or secondary line switches but allowing them to remain in their antecedent position. The provision of switches of this type greatly decreases the average time taken for connecting a subscriber's line to an idle first selector switch.

Still another feature of my invention is the provision of means for rendering all of the trunks extending from primary line switch groups to a secondary line switch group busy as soon as the first selectors associated with the secondary line switch group become busy. The features as above described and others will be more fully described in the ensuing specification.

For a more complete understanding of my invention reference is to be made to the accompanying drawings which illustrate diagrammatically the apparatus used in establishing a connection from a calling to a called line, and in which—

Figure 1 shows a calling line and its primary line switch B, and a secondary line switch to which it has access.

Fig. 2, which is placed to the right of Fig. 1, shows a first selector switch.

Fig. 3, which is placed to the right of Fig. 2, shows a connector switch, a called line and part of its primary line switch circuit.

Fig. 4 illustrates diagrammatically one method of extending the trunks from the primary line selectors to the secondary line selectors.

Referring to Fig. 1, I show a substation A which is of a well known form of apparatus, and comprises a calling device CD in addition to the usual substation apparatus. The line conductors 1 and 2 connect the substation A with the primary line switch B. The line switch B is preferably a ten point rotary switch comprising ten sets of contacts 7, 8, 9 and 10, circularly disposed in a well known manner and having coöperating wipers 3, 4, 5 and 6, respectively, each wiper being preferably arranged with three extending arms, while the associated contacts are so disposed with relation to these arms that when one wiper arm leaves the last contact the adjacent wiper arm will engage the first contact of the bank. The wipers 3, 4, 5, 6 are secured to a shaft and controlled by the usual motor magnet M and ratchet pawl mechanism. For each actuation of magnet M the wipers 3, 4, 5, and 6 are moved from one contact set to the next. In the selecting operation of the switch B, the wipers are advanced to an idle set of contacts and after conversation is completed they remain in connection with the said contacts until another selecting operation of the switch. The wiper 3 may be

called an auxiliary wiper and each contact 7 leads to a normally open contact 23 of a relay 22, the said relay 22 controlling certain operations as will be more fully described in the ensuing specification. The primary line switch B also includes a line relay LR which is adapted to be energized upon the initiation of a call to close a circuit for the motor magnet M. A cut-off relay CO is also included in the switch being adapted to be energized when switch B connects with an idle secondary line selector to extend the circuit of the calling line to said selected secondary line selector. A second cut-off relay *co* is also provided for the switch B, the said relay being adapted to be operated only upon connection to the line of substation A as a called line. The operation of this relay *co* removes the substation control of its line switch B. A relatively slow-acting relay R is also provided for the line switch B, the said relay being adapted to be energized upon energization of its associated line relay LR to control certain operations, as will be more particularly pointed out in the ensuing specification. Each line A is multiply connected to contacts 201^1, 202^1, 203^1 of ten connector switches which have access thereto.

The secondary line switch D is similar in construction to that of the primary line switch B, and in addition a train of relays 19, 19^1, 19^2 is provided. The said chain of relays is associated with a group of secondary switches and is adapted to busy the incoming trunks from the primary groups to the secondary groups when all of the trunks leading from the group of secondary line switches to the first selector switches are busy. The train of relays 19, 19^1, 19^2 brings about the energization of relay 22 to place a ground on conductors 23 to bring about the above result, and their operation will be more fully described in the ensuing specification.

The first selector D illustrated in Fig. 2 comprises a set of wipers 24, 25 and 26, and coöperating sets of contacts 27, 28 and 29, divided into ten groups of ten contacts each. The ten groups of contacts are arranged in ten rows, each row containing ten sets of contacts. The wipers are so arranged that in the operation of the switch they are primarily adjusted in one direction to select a row of contacts, and then secondarily adjusted to select a contact in the selected row. For adjusting the wipers in a primary direction the primary magnet PM and associated ratchet pawl mechanism are provided, while for adjusting the wipers in a secondary direction a secondary magnet SM and associated ratchet mechanism are provided. Primary off normal springs PON are adapted to be moved to their alternate position upon the first primary step of the wipers, while the secondary off normal springs SON are adapted to be moved to their alternate position upon the first secondary step of the wipers. For controlling the operation of the magnets a primary relay PR is connected in bridge of the primary and secondary conductors P and S, the said relay being energized upon connection made with its associated first selector switch by current flowing over the calling line. The relay PR being connected in bridge of the line as stated is responsive to any interruption of its circuit as by means of the calling device CD. A slow-acting secondary relay SR is provided which controls the starting of the secondary movement of the switch. A slow-acting main release relay MR is also provided and is adapted to control the release of the switch. A test relay TR is adapted to be energized after the primary movement of the switch and controls the secondary movement of the switch in selecting an idle set of contacts. In the release of the first selector D, secondary magnet SM is again actuated to advance wipers 24, 25 and 26 beyond the last contact in the selected group, whereby a release pawl is actuated to allow the wipers to be restored by a spring, the restoring movement of the wipers taking a different path from the actuating movement. In restoring they return from their primary adjustment first and thereafter from their secondary adjustment. From this it will be seen that in a complete operation of the switch, that is, in a selecting and releasing operation, the wipers are first moved in a horizontal plane, but in a rotary direction, to a certain row or group of contacts, and thereafter moved in a vertical plane, but also in a rotary direction, to select a contact in the selected group. Then when released, this secondary vertical movement is continued until the wiper passes the last contact in the selected row whereby a release pawl is operated to allow the wiper to restore by a spring first backward in a rotary horizontal direction and thereafter downward in a rotary vertical direction, to normal.

The connector switch E as illustrated in Fig. 3 comprises a switch structure similar to the switch structure of first selector D. The relays, operating magnets and off-normal contacts of the connector switch E which are similar to the corresponding parts of the first selector D have similar reference characters but with the suffix prime added. The connector switch E also includes a line test relay LT which is adapted, following the connection of the wipers to the terminals of the called line, to cause ringing current to be applied through the medium of an interrupter relay RI to the terminals of the called line if

idle, while if the called line is busy a characteristic busy signal from busy back apparatus BB is transmitted to the calling substation A. A ringing control relay RC is adapted upon response of the called subscriber to cause disconnection of ringing current. A switching relay SW^1 is arranged to disconnect primary magnet PM^1 after it has been operated and to connect the secondary magnet SM^1 in circuit whereby it will be operated. I have not illustrated the mechanical switch adapted for use with the selector and connector circuits, but I preferably employ such a switch as is disclosed in patent to William Kaisling for "automatic switch for telephone systems," No. 1,131,140.

The called substation F is equipped similar to substation A and is connected by means of line conductors 1^1 and 2^1 to the primary line switch B^1 at the central office.

Having described in general the apparatus used in the system of my invention a complete operation thereof in establishing a connection from the calling substation A to the called substation F will now be described, and we will assume that the number of the called substation F is 243.

To initiate a call the subscriber at the substation A removes his receiver from its switch hook whereby a circuit for line relay LR is established, the circuit being traced from battery through the winding of line relay LR, the normal contact 30 of relay R, normal contact 31 of relay *co*, the normal contact 32 of relay CO, the line conductor 2, through the substation A, back over line conductor 1, normal contact 33 to ground at normal contact 34. The closing of alternate contact 35 of relay LR closes an energizing circuit for the relay R from battery through the winding of the relay R to ground at alternate contact 35. As the primary line switch is of the rotary non-restoring type, one of its wipers is always engaging a contact leading to a secondary line switch, and should the contact 8 that is engaged lead to a busy secondary line switch a locking circuit is established for the relay LR, when it energizes, from battery through the winding of the said relay LR, its alternate contact 36, conductor 37 to the grounded contact 8. The circuit for motor magnet M is thus established from the ungrounded pole of the generator G through the winding of the magnet M, and the alternate contact 20 of relay R to ground at alternate contact 38 of relay LR. The motor magnet is thus energized to step the wipers 3, 4, 5 and 6 into connection with the next set of contacts. If this next set of contacts is busy, the wipers are stepped until an idle secondary line switch is encountered, and as soon as this takes place the locking circuit of relay LR is interrupted due to the wiper 4 engaging an idle contact 8 leading to an idle secondary line switch. The relay LR in restoring opens the circuit of relay R, but relay R being slow to release remains operated until a substitute circuit is established for it as will now be described.

The opening of alternate contact 38 of relay LR opens the circuit of motor magnet M thus preventing further operation of the wipers. Upon the deënergization of relay LR relay CO is energized over a circuit traced from battery through the alternate contact 40 of relay R, through the winding of the said relay CO to ground at the normal contact 35 of relay LR. The closing of alternate contacts 32 and 33 of relay CO extends the calling line to the selected secondary line switch. As soon as the relay CO of the primary line switch B is energized a circuit for line relay LR^1 of the selected secondary line switch C is established from battery through the winding of the said relay LR^1, normal contact 41 of relay R^1, normal contact 42 of relay CO^1, contact 10, wiper 6, alternate contact 32, the line conductor 2 through the substation A, back over the line conductor 1, alternate contact 33, wiper 5, contact 9 to ground at normal contact 43 of relay CO^1. The closing of alternate contact 44 of relay LR^1 establishes a circuit for the relay R^1 traced from battery through the winding of the said relay R^1 to ground at alternate contact 44 of relay LR^1. The closing of alternate contact 45 of relay R^1 closes the substitute circuit for relay R of primary line switch B, the said circuit being traced from battery through the winding of the said relay R, alternate contact 46 of relay CO, conductor 47, the wiper 4, and bank contact 8 to ground at alternate contact 45 of relay R^1. The energization of the relay R^1 opens the initial energizing circuit of relay LR^1 at contact 41 but should the test wiper 16 of the secondary line switch C be engaging a busy contact 13 a locking circuit is established for the relay LR^1 traced from battery through the winding of the said relay LR^1, alternate contact 48 of relay LR^1 to the busy grounded contact 13 which leads to a busy first selector D. The relay LR^1 and relay R^1 are thus energized establishing an energizing circuit for the motor magnet M^1 traced from battery through the alternate contact 49 of relay LR^1, alternate contact 50 of relay R^1 and through the interrupter I to ground. The wipers 16, 17 and 18 are thus stepped from one contact to the next, by the motor magnet M^1 until an idle first selector has been encountered. When this takes place the locking circuit for the relay LR^1 is interrupted at the idle contact 13 which has been engaged by the test wiper 16 and the restoration of the said line relay LR^1 opens the circuit of the motor magnet M^1

thus preventing further stepping of the wipers.

The restoration of the line relay LR^1 closes a circuit for the cut-off relay CO^1 traced from battery through the alternate contact 51 of relay R^1, and through the winding of the cut-off relay CO^1 to ground at normal contact 52 of relay LR^1. The circuit of relay R^1 is interrupted upon the restoration of relay LR^1, but it being slow to release remains energized until a substitute circuit is established for it as will now be described.

Although the opening of alternate contact 44 of relay LR^1 interrupts the energizing circuit for said relay R^1 the relay R^1 being slow to release does not immediately restore due to its slow to release action, and therefore upon the energization of relay CO^1 the calling subscriber's line is extended to the idle first selector bringing about the operation of the primary relay PR, the circuit of said relay PR being traced from ground through the left hand winding of the said relay PR, the primary conductor P, contact 14, wiper 17, alternate contact 43, contact 9 and wiper 5, alternate contact 33, the line conductor 1, through the substation back over the line conductor 2, alternate contact 32, wiper 6, contact 10, alternate contact 42, wiper 18, contact 15, secondary conductor S and through the right hand winding of the relay PR to battery. Relay PR upon energizing, causes the closing of its alternate contact 53 whereby a locking circuit for relay R^1 is established, traced from battery through the winding of the said relay R^1, alternate contact 54 of relay CO^1, wiper 16, contact 13, and through the alternate contact 53 of relay PR to ground, thus maintaining the said relay R^1 energized. This ground connection at alternate contact 53 also places a busy or ground potential upon the multiple contacts 13, thereby preventing any other secondary line switch from connecting with the selected first selector D. Also responsive to the energization of relay PR, a circuit for the main release relay MR is established from battery through the winding of the said relay MR, and through alternate contact 55 of relay PR to ground at normal contact 56 of the primary off-normal switch PON, relay MR is thereupon energized and establishes a substitute circuit for itself through its alternate contact 57, this circuit being provided to take the place of its initial energizing circuit which is interrupted upon the first movement of the primary off-normal switch PON. It will thus be seen that the substation now is connected to a first selector D and that relay PR is energized over a metallic circuit including the line conductors and the calling substation A.

The closing of alternate contact 53 of relay PR places a ground upon the test contact 13, as before described, and this ground brings about the operation of the relay 19—one of the relays in the train of relays 19, 19^1 19^2, etc. The circuit for relay 19 extends from ground at contact 53 of relay PR at the first selector through the winding of said relay 19 to battery. The last relay of the train of relays has ground connected to its contact and upon the energization of all the relays of the series a circuit is closed for relay 22 over a circuit extending from battery through the relay 22 and through the alternate contacts of the chain of relays to ground. There is such a relay 19 associated with each first selector of the group of first selectors associated with a group of secondary line switches. Should all of the first selectors of the group of secondary switches become busy the said ground is connected through the alternate contacts of relays 19, etc., to the relay 22 and to battery. The relay 22, upon energizing, closes its alternate contacts 23, placing ground upon all of the trunks leading from the groups of primary line switches to this group of secondary line selectors.

Assuming now that a subscriber associated with one of the primary groups having access to this secondary group initiates a call and should the subscriber's primary switch be standing in connection with a trunk leading to this particular secondary group, it will find the bank contact 7 grounded and the relay LR of the said primary switch will cause the primary switch to step to the next contact. The said circuit for relay LR extends from ground at relay 22, through contact 7, wiper 3, conductor 201, alternate contact 36^1, alternate contact 36, and through the winding of the relay LR to battery, thus bringing about the stepping of the primary line switch wipers to the next set of contacts which lead to another group of secondary line switches. If the next contact 7 now engaged by the wiper 3 be idle, and should the contact 8 engaged by the test wiper 4 be idle, the relay LR will be deënergized thus extending the calling line to an idle secondary line selector. But if the test wiper 4 engages a busy contact 8, or should the wiper 3 engage a busy contact 7, the wipers 3, 4, 5 and 6 are stepped to the next set of contacts. From the foregoing it is apparent that a ground from either bank contacts 7 or a ground from a bank contact 8 brings about the movement of the wipers of the primary line switch from one contact set to the next until an idle trunk leading to an idle secondary line switch in an idle group is encountered. When this takes place the relay LR deënergizes as before stated and extends the calling line to the idle secondary line switch.

Now assuming that upon the initiation of a call by the calling subscriber A that both the primary line switch B and secondary line switch C wipers are resting on idle contacts leading to an idle secondary line switch and an idle first selector, respectively, the operation of the primary and secondary switches is as follows: The subscriber upon the removal of the receiver at the calling substation A brings about the energization of the line relay LR of the primary line switch B, as previously described, and the said relay, upon energizing closes a circuit for the relay R. Relay R, upon energizing opens the circuit for relay LR and as wipers 3—4 are in engagement with idle contacts relay LR immediately deënergizes. The contacts 20 and 30 relay R are so adjusted that the normal contact 30 breaks before contact 20 makes, and as the relay LR is a quick-acting relay it immediately restores and opens its contact 38 before contact 20 of relay R completes the circuit for the motor magnet M. LR restoring opens the initial circuit for relay R, but a substitute circuit is established as described in the previous description of the operation of the circuit. Immediately upon the deënergization of relay LR, an energizing circuit for relay CO is established as previously traced and closes its alternate contacts 32 and 33 to extend the calling subscriber's line to the secondary line switch. Upon the energization of relay CO, of primary line switch B, a circuit for the line relay LR^1 of secondary line switch C is established, as previously traced. Relay LR^1 upon energizing closes the circuit for relay R^1 as before described. Immediately upon the energization of the relay R^1 the circuit of relay LR^1 is opened at contact 41 and the wiper 16 being on an idle contact no substitute locking circuit is established for relay LR^1. The relay LR^1 deënergizes due to the fact that contact 41 opens before contact 50 is closed, and therefore no circuit for motor magnet M^1 is established.

The closure of alternate contact 45 of relay R^1 closes a substitute circuit for relay R of the switch B. The relay R^1 is slow to release and remains operated until a substitute circuit is established from ground at the alternate contact 53 of relay PR of the first selector D. Upon the deënergization of relay LR^1 a circuit for relay CO^1 is established, and the closure of the alternate contacts 42 and 43 extends the circuit of the calling subscriber to the idle first selector upon which the wipers 16, 17 and 18 are resting. From the foregoing it is apparent that a subscriber may connect his line through his individual line switch and a secondary switch to a first selector switch without moving the wipers of either switch.

The calling subscriber having seized an idle first selector switch by either connecting them without moving either primary or secondary line switches, or by moving both or by moving only one, either the primary or secondary, is now ready to operate his dial to call the first digit of the called number.

It will be remembered that the number assigned to the called substation F is 243, and therefore, the first act of the calling subscriber to complete the call is to operate the calling device CD to cause two interruptions of its contacts 21 which results in two deënergizations of relay PR. Although the deënergization of the relay PR causes the interruption of the circuit of main release relay MR at contact 55, relay MR being a sluggish relay does not retract its armature until a continued deënergization of relay PR is effected as that of replacing the receiver upon the switch hook at the calling substation A. The said operations of relay PR which are effected by the calling device as stated will cause two current impulses to be transmitted to the primary magnet PM and secondary relay SR over a path traced from ground at normal contact 53 through alternate contact 58 of relay MR, over conductor P, normal contact 59 of secondary off-normal springs SON to the point 60, the current dividing, one path continuing over conductor 61 and through the winding of the primary magnet PM to battery, the other path passing through the secondary relay SR to battery. Relay SR being a sluggish relay is energized responsive to the first impulses and maintains its armature attracted until the cessation of the impulses, thus maintaining its normal contact 62 interrupted during the transmission of the impulses. Two operations of magnet PM affect two primary steps of the wipers 24, 25 and 26 to the second row of contacts which are the contacts 27, 28 and 29 which lead to the connector E which is adapted to extend the connection to the called line in a well known manner. After the said two impulses have been transmitted the secondary relay SR restores, thus closing its normal contact 62 and as the primary off-normal springs PON have moved to their alternate position upon the first primary step of the wipers, the circuit for test relay TR is established from ground at said normal contact 62, through alternate contact 63 of the primary off-normal springs PON, the normal contact 64 of the secondary off normal springs SON and through the winding of the relay TR to battery. The relay TR is thereupon energized closing its alternate contact 65 to establish an energizing circuit for secondary magnet SM whereby the wipers 24, 25 and 26 are stepped into engagement with the first set of contacts 27, 28 and 29 of the group selected.

Upon the first secondary step of the wipers the secondary off-normal springs SON move to their alternate position and the opening of normal contact 64 interrupts the initial energizing circuit of the relay TR, but assuming that the first set of contacts 27, 28 and 29 lead to a busy connector and the test contact 27 grounded, relay TR does not deënergize as a substitute maintaining circuit is established from the said grounded contact 27, through the wiper 24, alternate contact 66 of relay TR, alternate contact 67 of relay MR, conductor 68 and through the winding of the relay TR to battery, thus maintaining the operating circuit for the secondary magnet SM. The magnet SM is again operated to advance the wipers 24, 25 and 26 and continues to do so until an idle set of contacts is reached, and the circuit for relay TR is interrupted, thereby allowing it to deënergize and open the circuit of magnet SM. Upon the deënergization of relay TR ground is connected to the multiple contacts 27 from normal contact 66, thereby rendering the selected set of contacts 27, 28 and 29 busy and preventing any other switch from connecting thereto. The closing of normal contact 66 of relay TR establishes a circuit for the relay 70 of the connector switch E traced from battery, through the winding of the said relay 70, the normal contact 71 of release relay RR^1, contact 27 and wiper 24 to ground at normal contact 66. The operation of the relay 70 at this time is only incidental.

The subscriber at the calling substation A now actuates his calling device to transmit four impulses of current which brings about four deënergizations of the primary relay PR. Four deënergizations of the relay PR bring about the operation of the primary magnet PM^1 and the secondary relay SR^1 of the connector switch E, the circuit thereof being traced from ground to normal contact 53, alternate contact 58 of relay MR, conductor P, normal contact 72 of relay TR, wiper 25, contact 28, conductor P^1, normal contact 73 of relay 110, conductor 74, normal contact 75 of the secondary off-normal springs SON^1 to the point 76, the current dividing, one path continuing to the normally closed contact 77 of the switching relay SW^1 and through the winding of the primary magnet PM^1 to battery, the other path continuing from point 76 through the winding of secondary relay SR^1 to battery and ground. Responsive to the first impulse, the secondary relay SR^1 is energized and being a sluggish relay maintains its armature attracted until the cessation of the four impulses. The four impulses of current flowing through the magnet PM^1 causes four operations of the said primary magnet PM^1 and effects four primary steps of the wipers 77, 78 and 79 to the fourth row of contacts which includes contacts 80, 81 and 82, this row of contacts including the terminals of the line of the called substation F. Following the cessation of the said four impulses, secondary relay SR^1 deënergizes closing a path for current through the switching relay SW^1, the circuit being traced from battery through the winding of the relay SW^1, normal contact 83 of switching relay SW^1, the normal contact 84 of the relay SR^1 to ground at alternate contact 85 of the primary off-normal contact PON^1. The relay SW^1, upon energizing, closes a locking circuit for itself established through its alternate contact 83^1 over the conductor 86 to the grounded private conductor 87. The operation of relay SW^1 disconnects the primary magnet PM^1 and connects secondary magnet SM^1 in circuit with the conductor P^1 to take the next set of impulses. The calling subscriber now actuates the calling device CD to effect three interruptions of the calling device springs 21 thereby causing three operations of the primary relay PR. Responsive to these three operations three impulses of current are transmitted through the secondary relay SR^1 and secondary magnet SM^1 traced from ground at normal contact 53 of relay PR over the previously traced path over conductor P^1 to normal contact 73, conductor 74, normal contact 75 to the point 76, the circuit dividing, one path continuing through alternate contact 77 of relay SW normal contact 88 of release relay RR^1, through the winding of the magnet SM^1 and normal contact 89 to battery and ground. The other path of current continues from the point 76 through the winding of the relay SR^1 to battery. Relay SR^1 is energized upon the first impulse closing its alternate contact 90. Upon the first secondary step of the switch the secondary off-normal switch contacts SON^1 are moved to their alternate position, and the contact 75 assumes its alternate position thereby interrupting the initial path for the current impulses through the said normal contact 75. However, a new path for impulses flowing through magnet SM^1 is provided, extending from conductor 74, through alternate contact 90 of relay SR^1 to the point 76, the current dividing part passing through alternate contact 77 of SW^1 to normal contact 88 and through the winding of magnet SM^1 to battery and ground at normal contact 89, and part passing through relay SR^1 to battery. The result of these three impulses of current is that magnet SM^1 steps wipers 77, 78 and 79 into engagement with the desired set of contacts 80, 81 and 82 which are the contacts connected with the called subscriber's line. Following the last impulse relay SR^1 deënergizes closing its normal contact 91 thereby connecting the upper winding of the line test relay L/T to the terminal 80 of the

called line for the purpose of testing said line for its idle or busy condition.

Up to this period in the operation of the system, the operation is the same whether connecting to an idle or busy line. Assuming that the called line is idle, a path for current through the upper winding of relay LT is provided by the closing of normal contact 91, the circuit being traced from ground at normal contact 92 of relay 93, through the alternate contact 94 of relay 70, the normal contact 91 of relay SR^1, through the upper winding of the relay LT, the conductor 95, the wiper 77, contact 80, and through the winding of the relay co^1 of switch B^1 to battery and ground at normal contact 40^1 of relay R^2. The relay LT upon energizing closes a locking circuit for itself through its alternate contact 96, over a circuit traced from battery through the alternate contact 97 of relay 70, the lower winding of the relay LT, the alternate contact 96 of relay LT, conductor 197, alternate contact 94 of relay 70, and the normal contact 92 of relay 93 to ground. The closing of alternate contact 100 of relay LT shunts its upper winding and places a direct ground from the conductor 197 through alternate contact 100, over conductor 95, to test wiper 77 maintaining the relay co^1 energized and also preventing any other connector switch from establishing connection with the terminals of the called line F. The closing of alternate contact 101 of the relay LT establishes an energizing circuit for the relay 102 traced from battery through the winding of relay 102, the alternate contact 101 of said relay LT to ground at normal contact 92, bringing about the energization of the said relay thereby interrupting its normal contact 103 to disconnect the busy back apparatus BB from the secondary conductor S^1. The closing of contacts 104 and 105 of relay 102 connects battery and ground to the terminals of the ringing control relay RC. Also upon the energization of the relay LT an energizing circuit for the ringing interrupter relay RI is established, the circuit being traced from battery through the normal contact 106 of relay 93, the alternate contact 107 of relay LT and through the winding of the relay RI through the interrupter I^1 to ground. The relay R1 is thus intermittently energized and deënergized to connect ringing generator G^2 with the terminals of the called line, the path of the ringing current being traced from the ungrounded pole of the generator G^2, through alternate contact 108 of relay RI, the wiper 78, bank contact 81, through the condenser and call bell of the called substation F, back through bank contact 82, wiper 79 to the grounded pole of the generator G^2 through the alternate contact 109 of the relay RI. The bell of the called substation F is thus intermittently rung, and upon the response of the called subscriber at the substation F a circuit for the ringing control relay RC is established, traced from ground through the alternate contact 104, the upper winding of the relay RC, the normal contact 108 of relay RI (when relay RI is in its deënergized position), the wiper 78, contact 81 through the now closed contacts of the substation switch hook back through contact 82, wiper 79, normal contact 109, through the lower winding of the relay RC, and alternate contact 105 to battery at alternate contact 97 of relay 70.

Upon the energization of relay RC an energizing circuit for the relay 110 is closed, said circuit being traced from battery through the winding of the said relay 110 to ground at alternate contact 111 of the relay RC. The closing of alternate contact 112 of relay 110 establishes an energizing circuit for the relay 93, said circuit being traced from battery through the alternate contact 112 of relay 110, through the winding of the relay 93, the conductor 113, to ground at alternate contact 85 of the primary off-normal springs PON^1. The relay 93, upon energizing, closes a locking circuit for itself traced from battery through its alternate contact 106 and through the winding of the said relay 93 to ground at contact 85 of the primary off normal springs PON^1. The opening of normal contact 106 interrupts the circuit of the relay RI thus preventing further application of ringing current. The energization of the relay 110 brings about the closing of contacts 73 and 114 which establishes the continuity of the talking conductors to the called subscriber at substation F. The talking circuit between the calling subscriber A and the called subscriber F may now be traced over the heavily marked conductors, the said conductors having the condensers K at K^1 interposed at the first selector D.

After the subscribers have finished conversation, they may cause the restoration of the switches used in establishing the connection, the calling subscriber A controlling the restoration of the first selector D, while the subscriber at the called substation F controls the restoration of the connector switch E. Assuming that the subscriber at A is first to replace his receiver upon the switch hook, the circuit of the primary relay PR is interrupted causing the restoration of the said relay and bringing about the interruption of the alternate contact 55 allowing the deënergization of the main release relay MR. The deënergization of the main release relay MR establishes a circuit for the test relay TR effecting the restoration of the switch D in the following manner. The circuit of relay TR established by the deëner-

gization of the relay MR is traced from ground at normal contact 62 of relay SR, alternate contact 63 of the primary off-normal springs PON to conductor 120, the normal contact 67 of relay MR, the conductor 68 and through the winding of the relay TR to battery. Following the energization of the relay TR, the circuit is again closed for the secondary magnet SM due to the closure of alternate contact 65. The wipers 24, 25 and 26 are stepped ahead by the operation of the magnet SM until they have passed one step beyond the last contact set in the row. Upon reaching this position, a release pawl is automatically tripped whereby the wipers restore from their primary adjustment by a spring whereby switch PON is restored interrupting its alternate contact 56 to effect the restoration of the switch D from its secondary adjustment as will be described. Upon the wipers being restored from their primary adjustment, a second pawl is tripped whereby they are restored by a spring from their secondary adjustment to normal causing the restoration of the switch SON.

It will be noted that while wipers 24, 25 and 26 are being adjusted to their normal position, the line conductors are open at normal contacts 72 and 72^1 thus preventing interference with any existing connections. When the wipers restore from their primary adjustment, the primary off-normal springs PON restore bringing about the opening of the off-normal contact 63 thus interrupting the circuit of relay TR which restores. As soon as alternate contact 56 of switch PON is interrupted as stated, the locking circuit for relay R^1 of the secondary line switch C is interrupted as it will be remembered that relay R^1 has been maintained energized by current flowing over the test conductor to the grounded alternate contact 56. Therefore, relay R^1 restores opening its alternate contact 51 thus interrupting the circuit of the relay CO^1 which is deënergized and switch C is again available for use in establishing other connections. The opening of alternate contact 45 of relay R^1 of secondary switch C brings about the restoration of the relay R of primary switch B and the opening of alternate contact 40 of the relay R opens the circuit of the relay CO of primary switch B, permitting the relay CO to restore, the switch C being again available for use in establishing other connections.

To release the connector switch E, the subscriber at the substation F restores his receiver whereby the circuit for ringing control relay RC is interrupted causing its deenergization. Its contact 121 is therefore interrupted, disconnecting ground from the conductor 122 thereby interrupting the circuits for relays 102 and LT of connector E, and relay co^1 of the primary selector B^1 associated with the called substation F causing their restoration. The restoration of the cut-off relay co^1 restores the substation control of the primary line switch B^1. Also, upon the deënergization of relay RC, its alternate contact 111 is interrupted, allowing the restoration of relay 110 whereby a circuit for release relay RR^1 is established from battery at normal contact 112, alternate contact 123 of relay 93 through the winding of the relay RR^1 to ground at alternate contact 85 of the primary off-normal springs PON^1. Upon the energization of the said relay RR^1, its normal contact 71 is interrupted allowing relay 70 to restore while the closing of its alternate contacts 88 and 89 establishes a circuit for secondary magnet SM^1 from ground at alternate contact 88, through the winding of the secondary magnet SM^1 through alternate contact 89 and through the generator G^3, whereby magnet SM^1 is operated by current impulses from said generator to advance wipers 77, 78 and 79 beyond the last contact in the row whereby they are automatically restored by spring tension as in the case of the first selector. Upon retraction of the primary off-normal springs PON^1, the circuit of relays 93, RR^1, and SW^1 are interrupted causing their restoration. The switch E now being at normal is available for use in establishing other connections.

Assuming now that the called line is busy, the operation of the system will proceed as previously described up to the final deënergization of the secondary relay SR^1 of the connector switch E. It will be remembered that at the final deënergization of relay SR^1 after the wipers have connected to the terminals of line F, relays SW^1 and 70 are in an energized condition. Therefore, upon the deënergization of relay SR^1 the upper winding of relay LT is connected in circuit with the test wiper 77 of the test contact 80 of the called line as before.

Assuming the line F busy as a calling line, its test contact 80 is on open circuit as relay R^2 is energized or if the line F is busy as a called line, its test contacts are connected to ground back over conductor 95 as previously described. Therefore, when the upper winding of relay LT is connected in circuit with the test contact 80, there will be no energizing circuit for the said winding as its left hand terminal is connected to ground at normal contact 92 and there will be no flow of battery and therefore relay LT does not energize. Relay LT failing to energize, neither relays 102 nor RI are energized so that the busy back signal BB remains in connection with the secondary conductor S^1 through alternate contact 130 of the switch SON^1 and normal contact 103 of relay 102 to the heavily marked conductor

S^1 back over the said conductor and out over line conductor 2, through the receiver of the substation returning over line conductor 1 and over the heavily marked primary conductor P to the left hand winding of the relay PR of the first selector D to ground. The subscriber upon replacing his receiver upon the switch hook causes the restoration of the apparatus used in establishing the connection in the following manner.

Due to the replacing of the receiver at substation A, the circuit of relay PR is interrupted causing its deënergization followed by the deënergization of the main release relay MR thereby causing the restoration of the switch D followed by the restoration of the switches C and B as previously described. It will be remembered in a previously described connection that the connector E is restored by the subscriber at the called sub-station F, but in this instance its restoration is controlled by the calling subscriber. It will be remembered that relays 70 and SW^1 are the only relays energized in switch E, in this instance being locked up over a circuit including test conductor 87 and the ground at normal contact 66 of relay TR of selector D. Therefore, upon the energization of relay TR and the restoration of switch D as described, its normal contacts 66 being interrupted, relays 70 and SW^1 are deënergized. Following the deënergization of relay 70, a circuit for release relay RR^1 is established from ground at alternate contact of PON^1, through the winding of said relay RR^1, normal contacts 123 and 97 to battery. Relay RR^1, upon enërgizing, closes its contact 71 connecting ground to its test conductor 87 and contacts 27, preventing any other switch from making connection with connector E during its release. Although relay SW^1 deenergizes as just stated at the time its energizing circuit is interrupted at relay TR it immediately energizes again upon the closing of its normal contact 83 due to the main connection for PON^1, and is again locked up through its alternate contact 83^1 to ground at alternate contact 71, remaining so until the restoration of PON^1.

Returning now to relay RR^1 the closing of its alternate contacts 88 and 89 causes the releasing operation of magnet SM^1 as previously described whereby switch F is restored to normal causing the restoration of the primary off normal contacts PON^1 and relays RR^1 and SW^1. Switch E is now at normal and available for use in establishing other connections.

Having given the description of the operation of the system in extending a call from a calling substation to a called substation, I will now describe one method which may be employed in distributing the trunks between the primary and secondary line switches. However, it is to be understood that various other methods of distributing the primary and secondary trunks are applicable to my invention, one method being shown for illustrative purposes only. The primary line switches are arranged in groups of one hundred each and each group is usually provided with ten trunks leading to ten secondary line switches. The secondary line switches are also divided into ten groups. In Fig. 4 I illustrate diagrammatically two groups B^3 and B^4 of primary switches, each group containing 1,000 line switches. This illustration is made on the basis of three equals ten. That is, ten line switches are shown by three small circles, and three groups of three small circles equal ten times ten or one hundred line switches and so on. At T and T^1, I show two groups of primary trunks, each group comprising three groups of ten trunks, that is one hundred trunks, each trunk leading to three groups C^3, C^4 and C^5 of secondary switches, each group of secondary switches comprising two groups of ten each of said secondary line switches, making twenty secondary line switches in a group for each of the ten groups of secondary line switches. With each of these three groups of secondary switches, I show a group of first selectors D^3, D^4 and D^5, each group comprising ten first selectors. As herein shown, the first trunk of the first primary group leads to the first switch of the first secondary group, the second trunk of the first primary group leads to the first secondary switch of the second secondary group and the third trunk of the first primary group leads to the first secondary switch of the third secondary group, etc., for the ten trunks. The first trunk of the second hundred primary switches in the first group B^3 leads to the second secondary switch of the first secondary group and the second trunk of the second hundred group of the first group B^3 leads to the second secondary switch C and so on. The first trunk associated with the first one hundred primary switches of the second group B^4 leads to the eleventh secondary switch of the first group of secondary selectors. It is thought that the scheme of trunking of the diagram as illustrated in Fig. 4 may be readily followed out from the above description. It may also be readily seen that a method of ten per cent. trunking is maintained, and in the above description the trunks of each group of one hundred subscribers have access to one hundred first selectors making a system of this kind more flexible and distributing the load among all of the one hundred first selectors. Should all of the selectors of the first group D^3 be busy, the train of relays 19, 19^1, etc., associated with this first group D^3 would operate

to energize relay 22, as previously described, and all of the idle trunks leading to the first group C of secondary selectors would be made busy.

While I have illustrated my invention operating in connection with a certain form of selector and connector, it is to be understood that my invention is readily adaptable to other systems and that changes and modifications may readily suggest themselves, and I therefore do not wish to be limited to the exact structure and method of trunking as illustrated, but aim to cover all such changes and modifications which come within the spirit and scope of the appended claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. A telephone system including groups of primary switches, secondary switches accessible to said primary switches and divided into groups, said primary and secondary switches being provided with contact makers adapted to remain in their antecedent progressive positions, a group of first selector switches for each group of secondary switches, and means for preventing any primary switch from connecting to an idle secondary switch in a group where all the first selector switches are busy.

2. A telephone system including a subscriber's telephone line, a first selector switch, a secondary progressively movable non-restoring trunk selecting rotary switch provided with an individual driving magnet and wipers for directly connecting to a trunk leading to said first selector switch, a primary progressively movable non-restoring trunk selecting rotary switch provided with an individual driving magnet and with wipers for directly connecting said calling subscriber's line to a trunk extending to said secondary switch, said switches being arranged to directly connect the calling subscriber to the first selector switch without moving said switch wipers if said switches are idle at the time the calling subscriber initiates a call, and means for afterward operating said first selector switch in accordance with the first digit of the called number.

3. A telephone system including subscribers' telephone lines, a first selector switch, a secondary non-restoring automatic trunk selecting switch provided with wipers for directly connecting to a trunk leading to said first selector switch, a primary non-numerical automatic trunk selecting switch provided with wipers for directly connecting a calling one of said subscriber's lines to said secondary switch, said switches being adapted to remain in their antecedent progressive positions at the time of release and to extend connections without moving their wipers if said wipers are in engagement with idle contacts, and substation-controlled means for operating said first selector switch in accordance with a digit of the called number to extend a connection in the direction of the called subscriber.

4. A telephone system including subscribers' telephone lines. non-restoring rotary trunk selecting primary switches, non-restoring rotary trunk selecting secondary switches, contact makers for each of said primary switches normally in engagement with the last secondary switch used, contact makers for each of said secondary switches normally in engagement with the last first selector switch used, first selector switches, operating mechanism for said rotary switches, and substation controlled means for operating the mechanisms of said primary and secondary rotary switches to connect idle first selectors with calling lines, said actuations of the switches to connect calling lines with first selector switches being established without operating the motor magnets of the primary and secondary switches if the wipers of the same are in engagement with idle trunks.

5. A telephone system including subscribers' telephone lines, non-restoring rotary primary switches, non-restoring rotary secondary switches, contact makers for said primary switches normally in engagement with the last secondary switches used, contact makers for said secondary switches normally in engagement with the last first selector used, first selector switches, operating mechanism for said rotary switches, substation controlled means for operating the mechanisms of said primary and secondary rotary switches to connect idle first selectors with calling lines, said connections being effected without operating the motor mechanism of the primary and secondary switches if the wipers of the primary and secondary switches are in engagement with idle trunks at the time that calls are initiated, and means for disassociating said calling subscribers' lines and said first selector switches while maintaining said rotary switches in their antecedent progressive positions.

6. A telephone system including subscribers' telephone lines, a first selector switch, a secondary non-numerical non-restoring trunking switch having movable contact makers normally in engagement with a trunk directly connected to said first selector switch, a primary non-restoring non-numerical trunking switch having contact makers directly in connection with a trunk leading to said secondary switch, said primary and secondary switches being for use in effecting connection between a calling one of said lines and said first selector switch, and means controlled by the removal of the receiver at the substation of said calling line for effecting said connection while maintain-

ing said non-numerical switches in their antecedent progressive positions, without moving the contact makers of said trunking switches.

7. A telephone system including a subscriber's telephone line, an individual switch for said line, secondary switches accessible to said individual switch, first selector switches accessible to said secondary switches, trunks inter-connecting said individual and said secondary switches, contact makers for said individual switch normally in engagement with its bank contacts connected to said secondary switches, contact makers for said secondary switches normally in engagement with bank contacts connected directly to said first selector switches, trunks interconnecting said secondary and said first selector switches, and means controlled over the calling subscriber's line for operating said individual switch and an idle one of said secondary switches to extend a connection to an idle first selector switch while maintaining said individual and secondary switches in their antecedent progressive positions if they are in connection with idle trunks.

8. An automatic progressively movable switch, a pair of test wipers for said switch, banks of coöperating contacts for coöperation with said wipers, a control relay for said switch, means for energizing said relay, and means controlled by said test contacts and wipers to maintain the said control relay in energized position if either of said wipers are in engagement with busy contacts.

9. An automatic progressively movable trunk selecting switch, a pair of test wipers for said switch, coöperating bank contacts for said wipers, a control relay, means for energizing said control relay, and means for maintaining said relay energized as long as either of said wipers engages busy bank contacts.

10. A telephone system including subscribers' telephone lines, groups of primary rotary non-restoring switches for said subscribers' lines, contact makers for said primary switches adapted to always be rotated in the same direction, secondary rotary non-restoring switches accessible to said primary rotary switches, a group of first selector switches for each group of secondary switches, and means for preventing a primary switch from connecting to an idle secondary switch in a group where all the first selector switches are busy.

11. A telephone system including subscribers' telephone lines divided into groups, individual rotary non-restoring switches divided into groups corresponding to the groups of subscribers' lines, groups of secondary switches accessible to said individual switches, contact makers for said secondary switches adapted to always be rotated in the same direction, a group of first selector switches for each group of secondary switches, said first selector switches of any group being less in number than the number of secondary switches in a group, and means for preventing a primary switch from connecting to an idle secondary switch in a group where all the first selector switches are busy.

12. A telephone system including a calling and a called subscriber's line, a rotary non-restoring trunk selecting primary switch, a rotary non-restoring trunk selecting secondary switch, contact makers for said primary and secondary switches adapted to always rotate in the same direction, a numerical switch, means controlled by the calling subscriber for connecting to said numerical switch via said primary and secondary switches, and substation controlled means for operating said numerical switch in accordance with the first digit of the called number to extend the connection in the direction of the called line.

13. A telephone system including a calling subscriber's line, a first selector switch, a secondary trunk selecting switch having its wipers normally in engagement with a trunk extending to said first selector switch, a primary switch having its wipers normally in engagement with a trunk extending to said secondary switch, means for connecting said calling subscriber's line to said first selector switch via said primary and secondary switches while maintaining the wipers of said primary and secondary switches in connection with said trunks, and means for disconnecting said calling line from said first selector switch while maintaining said primary and secondary switches in their antecedent positions.

14. A telephone system including subscribers' telephone lines divided into groups, primary switches likewise divided into groups and individual to the subscribers' lines, secondary switches divided into groups, contact makers for said primary switches always in engagement with secondary switches, a group of first selector switches for each group of secondary switches, and means common to a group of first selector switches for rendering busy all idle secondary switches associated with said group of first selector switches when said first selector switches all become busy.

15. A telephone system including primary switches divided into groups, secondary switches divided into groups and accessible to said primary switches, a group of first selector switches for each group of secondary switches, contact makers for said secondary switches always in engagement with said first selector switches, means for including all the first selector switches in one group in conversational circuits, and means for pre-

venting primary switches from connecting with any idle secondary switch associated with said group of first selector switches.

16. An automatic switch having a pair of test wipers and a pair of line wipers, cooperating contacts for said wipers, a relay individual to said switch, means for energizing said relay, and means for maintaining said relay energized as long as either of said test wipers engages busy bank contacts.

17. A telephone system including a subscriber's line, an automatic switch individual thereto provided with a pair of test wipers, passive bank contacts for said test wipers, a test relay for said switch, and means for maintaining said relay in its operative position as long as either of said wipers engages busy passive contacts.

18. A telephone system including a subscriber's telephone line provided with an individual primary switch, a secondary trunking switch having only three movable contact makers accessible to said primary switch, a first selector switch accessible to said secondary switch, bank contacts for said secondary switch having conductors connected thereto and directly extending to said first selector switch, and subscriber controlled means for extending a connection through said primary and secondary switches to said first selector switch without moving the wipers of said primary and secondary switches.

19. A telephone system including a subscriber's telephone line, a trunk selecting switch individual thereto, a secondary trunk selecting switch, having only three contact makers, bank contacts for said secondary trunk selecting switch, a first selector switch, trunk conductors connecting the bank contacts of the secondary switch directly to said first selector switch, movable contact wipers for said individual switch, means for extending a connection from said subscriber's line through said individual and secondary switches to said first selector switch, and means for releasing said connection without altering the antecedent progressive positions of said individual and secondary switches.

20. A telephone system including a subscriber's telephone line, a trunk selecting switch individual thereto, a secondary trunk selecting switch provided with only three contact wipers, a pair of talking wipers and a test wiper, a first selector switch, bank contacts for said secondary trunk selecting switch conductors extending directly from said bank contacts to said first selector switch, individual contact wipers for said individual switch, means for extending a connection from said subscriber's line through said individual and secondary switches to said first selector switch, means for releasing said connection, and means for reëstablishing said connection without moving the wipers of said individual and secondary switches.

21. A telephone system including a group of primary switches, secondary switches divided into groups accessible to said primary switches, contact makers for said primary switches always in engagement with secondary switches, a group of first selector switches associated with each group of secondary switches, contact makers for said secondary switches always in engagement with the first selector switches, and means for preventing any one of said primary switches from connecting to a secondary switch in a group associated with a group of busy first selectors.

22. A telephone system including subscribers' telephone lines, non-restoring rotary primary switches, non-restoring rotary trunk selecting secondary switches, trunks leading from the banks of the primary switches directly to the said secondary switches, connective links, trunks leading directly from the banks of the secondary switches to said connective links, individual operating mechanism for said rotary switches, substation controlled means for operating the mechanisms of said primary and secondary rotary switches to connect idle connective links with calling lines, means for disassociating said calling subscribers' lines and said connective links while maintaining said rotary switches in their antecedent progressive positions and without actuating said operating mechanism, said switches now being effective to extend other connections from the calling lines to the connective links without actuating the operating mechanism of the switches whereby said connections are completed without moving the active contacts of the rotary switches.

23. A telephone system including groups of primary trunks selecting non-numerical progressively movable switches of the non-restoring type adapted to remain in their antecedent progressive positions, secondary trunk selecting progressively movable non-numerical switches accessible to said primary switches divided into groups, a group of first selector switches for each group of secondary switches, trunks leading directly from the banks of the secondary switches to said first selector switches, and means for preventing any primary switch from connecting to an idle secondary switch in a group where all the first selector switches are busy.

24. A telephone system including subscribers' telephone lines, a connective link, a plurality of non-numerical trunking switches for extending a connection from a calling one of said lines to said connective link, movable contact makers for said non-

numerical switches, means controlled by the removal of the receiver at the substation of said calling line for effecting said connection while maintaining said non-numerical switches in their antecedent progressive positions, and means for disconnecting said line from said connecting link while maintaining said contact makers in their selective positions.

25. A telephone system including a group of primary switches, secondary switches of the non-restoring type adapted to remain in their antecedent progressive positions and divided into groups accessible to said primary switches, a group of first selector switches associated with each group of secondary switches, and means for preventing any of said primary switches from connecting to a secondary switch in a group of secondary switches where all the first selector switches associated therewith are busy.

26. A telephone system including a calling subscriber's line provided with an individual non-numerical trunk selecting rotary switch, a secondary non-numerical trunk selecting rotary switch accessible to said individual rotary switch, motor mechanism for each of said switches, a connective link, trunk conductors extending directly from said connective link to bank contacts of said secondary switch, and means under the control of the calling subscriber for operating the individual motor mechanisms of said rotary switches to operatively connect the calling line with said connective link, said switches being operative to extend a second connection from said calling line to said connective link without operating the motor mechanisms of the switches if said switches are on idle contacts when the second connection is effected.

27. A telephone system including a calling subscriber's line, an automatic non-numerical trunk selecting switch individual thereto, a secondary automatic non-numerical trunk selecting switch accessible to said first automatic switch, motor mechanism for each of said switches, a connective link, conductors extending directly from the bank of said secondary switch to said connective link, means responsive to the removal of the receiver at the calling substation to connect said connective link with said calling line via said rotary switches without operating the motor mechanisms of said rotary switches, and means for extending a connection from said connective link to a called subscriber's line, thereby completing a talking connection involving the said primary and secondary switches and the said connective link.

28. A telephone system including subscribers' telephone lines, non-restoring primary rotary trunk selecting switches, non-restoring secondary rotary trunk selecting switches, connecting circuits, trunk connections extending directly from the banks of the rotary switches to the connecting circuits, individual operating mechanisms for said switches, substation controlled means for operating the mechanisms of said primary and secondary switches to connect idle connecting circuits with calling lines and for disconnecting subscribers' lines from said connecting circuits without operating said operating mechanisms, said switches being operable to now extend other connections from calling lines to idle connected circuits without operating the mechanism of the switches, and means for completing connections from said connecting circuits to called subscribers' lines, said connections including primary and secondary trunking switches and one of said connecting circuits.

29. A telephone system including a calling subscriber's line, a connective link, a secondary trunk selecting non-numerical switch having its wipers normally in engagement with a trunk extending to said connective link, a primary trunk selecting non-numerical switch having its wipers normally in engagement with a trunk extending to said secondary switch, means for connecting said calling subscriber's line to said connective link via said primary and secondary switches while maintaining the wipers of said primary and secondary switches in connection with said trunks, and means for extending a connection from the connective link to a called subscriber's line, the completed connection including the primary and secondary switches and the connective link.

30. A telephone system including subscribers' telephone lines, groups of primary non-restoring switches for said subscribers' lines provided with individual motor mechanisms, secondary non-restoring switches accessible to said primary switches, a group of connective links for each group of secondary switches, and means for preventing a primary switch from connecting to an idle secondary switch in a group where all the connective links are busy.

31. A telephone system including a group of primary switches, secondary switches divided into groups accessible to said primary switches, individual step-by-step mechanism for each of said secondary switches, a group of connective lines for each group of secondary switches, and means for preventing any one of said primary switches from connecting to an idle secondary switch in a group where all the connective links are busy.

32. A telephone system including a calling subscriber's line, a connective link, a secondary trunk selecting non-numerical switch having its wipers normally in engagement with a trunk extending to said

connective link, a primary trunk selecting non-numerical switch having its wipers normally in engagement with a trunk extending to said secondary switch, means for connecting said calling subscriber's line to said connective link via said primary and secondary switches while maintaining the wipers of said primary and secondary switches in connection with said trunks, means for disconnecting said calling line from said connective link while maintaining said primary and secondary switches in their antecedent positions, and means for completing a talking connection between said calling subscriber's line and a called subscriber's line, said talking connection when completed including said connective link and said primary and secondary trunking switches.

33. A telephone system including a subscriber's telephone line, connective links, primary and secondary rotary switches for connecting said calling line to an idle connective link, said primary and secondary switches being of the non-restoring type and provided with movable contact makers to always rotate in the same direction, and substation controlled means for connecting said calling line to an idle one of said connective links and for operating the switch adjusting mechanisms of said primary and secondary switches only if the trunks that they are in connection with are busy.

34. A telephone system including a subscriber's telephone line, an individual non-numerical trunking switch for said line, secondary switches accessible to said individual switch, connective links accessible to said secondary switches, trunks interconnecting said individual and said secondary switches, trunks interconnecting said secondary switches and said connective links, means controlled over the calling subscriber's line for operating said individual switch and an idle one of said secondary switches to extend a connection to an idle connective link while maintaining contact makers of said individual and secondary switches in their antecedent progressive positions if they are in connection with idle trunks, and means for directly extending the talking connection from an idle connective link to a called subscriber's line.

35. A telephone system including primary switches divided into groups, secondary switches divided into groups and accessible to said primary switches, individual step-by-step motor mechanism for each of said primary and secondary switches, a group of connective links for each group of secondary switches, means for including all of the connective links in one of said groups in conversational circuits, and means for preventing primary switches from connecting with secondary switches associated with said group of busy connective links.

36. A telephone system including an automatic trunk selecting switch provided with a line wiper and a pair of test wipers, individual motor mechanism for said switch, coöperating bank contacts for said wipers, test means for said switch, and means for maintaining said test means in an operated position as long as either of said test wipers engages busy bank contacts.

37. A telephone system including an automatic switch provided with a line wiper and with a pair of test wipers, individual motor mechanism for said switch, coöperating bank contacts for said wipers, test means for said switch, means for operating said test means and for maintaining said test means operated as long as either of said test wipers engages busy bank contacts.

38. A telephone system including a subscriber's telephone line, connective links, primary and secondary non-restoring trunk selecting switches for connecting said telephone line to an idle one of said connective links, contact makers for said switches, trunks extending directly from the bank of the primary switch to the secondary switch and from the bank of the secondary switch to the said connective links, substation controlled means for disconnecting said subscriber's line from said connective link while maintaining the contact makers of said switches in their antecedent progressive positions, and means for completing talking connections from the calling telephone line through the primary and secondary trunking switches and the selected connective link to a called subscriber's line, said completed connection including the idle connective link, and subscriber-controlled means for releasing the idle connective link.

39. A telephone system including a subscriber's telephone line provided with an individual non-numerical trunk selecting primary switch, a non-numerical secondary trunking switch accessible to said primary switch, a connecting link accessible to said secondary switch, a trunk extending directly from the bank of the secondary switch to the connecting link, subscriber controlled means for extending a connection through said primary and secondary switches to said connecting link without moving the wipers of said primary and secondary switches, means for extending a connection directly from the connecting link to a called subscriber's line, and subscriber-controlled means for disconnecting the connecting link from the called subscriber's line.

40. A telephone system including a subscriber's line, a link circuit, a primary and

a secondary non-numerical trunk selecting switch for extending connection from said line to said link circuit, a trunk extending directly from said primary to said secondary switch and a second trunk extending directly from the bank of said secondary switch to said link circuit, movable contact makers for each of said switches, subscriber-controlled means for connecting said line to said link circuit without moving the contact makers of said switches, means for completing a talking connection with a called subscriber's line, and subscriber-controlled means for disconnecting the link circuit from the called subscriber's line.

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

GEORGE A. YANOCHOWSKI.

Witnesses:

MARIE F. C. BREEN,

M. R. ROCHFORD.