

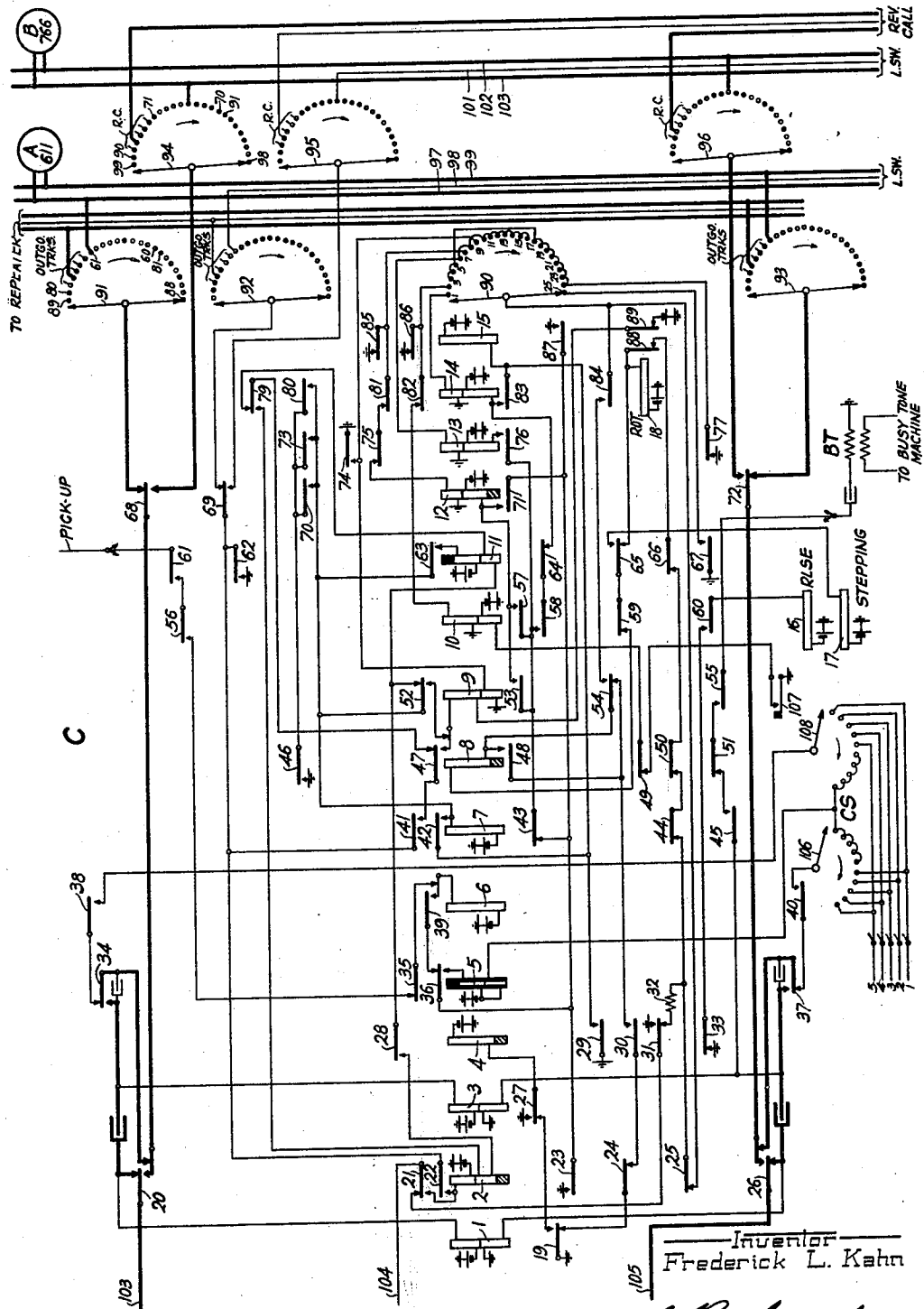
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AUTOMATIC TELEPHONE SYSTEM

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AUTOMATIC TELEPHONE SYSTEM

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The present invention relates in general to automatic telephone systems but is more particularly directed to small automatic systems of the type which are commonly known as community automatic exchanges, although certain features of the invention may be found to be of value in larger systems.

The object of the invention is the production of a new and improved connector switch which responds to the controlling impulses to set up telephone connections, which is of simple construction, having only a rotary movement, and is positioned in accordance with the received impulses and restored to normal position by the same operating magnet.

One feature of the invention is the provision of a switch which is stepped, in response to certain first digits, in accordance with the sum of the impulses of the first and second digits. In the case of other first digits, the switch is stepped in accordance with the impulses received and is then automatically rotated to a predetermined position, from which it is advanced in accordance with the impulses of the second digit.

Another feature of the invention is the provision of a switch with more than one set of wipers and corresponding bank contacts, with some of the subscribers' lines connected to the bank contacts of one set, and other subscribers' lines connected to another set of bank contacts. The wipers of the switch are all stepped simultaneously over the several sets of banks, the wiper set to be used in completing the connection being determined by the first digit used for setting the switch. To accomplish the wiper selection the subscribers' lines corresponding to certain first digits are grouped and connected to one set of banks and other subscribers' lines corresponding to other first digits are grouped and connected to another set of banks.

A further feature of the invention is the provision of a switch with a controlling wiper which is stepped simultaneously with the regular wipers of the switch, over its associated bank contacts. The controlling operations such as, selection of wipers, automatic advancement of the wipers are not de-

pendent on the value of the received first digit, and automatic restoration of the wipers to normal due to the release of the switch, are all performed over circuits including the controlling wiper and associated bank contacts.

A still further feature of the invention is the provision of a release relay in the switch which is held in its operated position to hold all preceding switches up and also to busy the switch as long as either the calling or called subscriber holds the connection.

The foregoing objects and features together with others not specifically mentioned at this time will be further discussed in connection with the detailed description of the operation of the various circuits.

The accompanying drawing comprising one figure only shows by means of the usual circuit diagrams a sufficient amount of equipment in a telephone system embodying the invention to permit the same to be readily described and understood.

The drawing shows an improved rotary lineswitch type connector C which is one of a plurality of connectors accessible to individual subscribers' lineswitches (not shown), over conductors 103, 104, and 105. The lineswitches may be the same as the lineswitch shown in the application of V. S. Tharp, Serial No. 510,680, filed January 23, 1931.

The connector is provided with two sets of wipers and associated bank contacts, with an additional wiper and associated bank contacts for controlling various operations of the switch. The normally connected set of wipers 91, 92, and 93 have access to twenty lines, which are numbered 61—60 and 81—80, over their associated bank contacts. Five trunk lines connecting the sub-exchange with the main automatic exchange are accessible over bank contacts 3—7, an idle one of which may be automatically selected by dialling 11. The normally disconnected set of wipers 94, 95, and 96 have access to twenty lines, which are numbered 71—70 and 91—90, over their associated bank contacts. Five trunks extending to reverting call switches are accessible over bank contacts 100

3-7, an idle one of which may be automatically selected by dialling 21. The reverting call switches themselves are not shown and may be similar to the reverting call switches shown in the Norman H. Saunders Patent, 1,805,726, issued May 19, 1931.

The present invention has been described in general, and will now be described in connection with the detailed description of the operations of the apparatus shown on the drawing. For this purpose, it will be assumed that an automatic subscriber desires to obtain connection with a subscriber located at substation A. The customary subscriber's substation, and individual lineswitch as used by an automatic subscriber in completing connection, are well understood by those skilled in the art and form no part of the present invention. It will, therefore, suffice to say that in response to the removal of the receiver by the calling subscriber, his individual lineswitch seizes an idle trunk line leading to a connector switch. Let us assume that the calling subscriber in removing his receiver has caused his individual lineswitch to come to rest on bank contacts connected to the conductors 103, 104, and 105 of the connector switch C. When the connector C is seized by the subscriber's individual lineswitch a momentary ground potential is applied to conductor 104 but does not affect the rotary stepping magnet 18 of the connector C due to the resistance 32 in the circuit. However, a circuit is completed for energizing the line relay 1 of the connector switch C as follows: from earth by way of the lower winding of line relay 1, armature 26 and its resting contact, conductor 105, over the intervening lineswitch and the subscriber's loop back to conductor 103, armature 20 and its resting contact, and through the upper winding of line relay 1, to battery. At armature 19 and its front contact, line relay 1 completes an energizing circuit for the slow-to-release relay 4, from ground, armature 19 and its front contact, armature 27 and its resting contact, winding of slow-to-release relay 4, to battery. At armature 31 and its front contact, the slow-to-release relay 4 connects earth to the release trunk conductor 104. This earth completes a holding circuit for the lineswitch to maintain it in its operated position. In addition, it maintains the trunk line leading to the connector busy to all other lineswitches having access thereto. At armature 29 and its front contact, relay 4 closes an energizing circuit for relay 15 from ground, armature 29 and its front contact, winding of relay 15 to battery. Relay 4 also prepares the impulsing circuit for the rotary magnet 18 of the connector at armature 30 and its front contact and at armature 33 and its resting contact it opens a point in the circuit for the release magnet

16 of the code selector CS. The connector switch C is now prepared for dialling.

The calling subscriber may now manipulate his calling device in accordance with the digits of the telephone number of the wanted subscriber. It will be assumed that the calling subscriber desires to establish a connection with the subscriber at substation A, whose telephone number is 611. It might be well to mention at this time that the first two digits of the subscriber's number indicates the number of the line called and the last figure of the number selects the ringing code to be transmitted for signalling the wanted subscriber.

When the first digit is dialled, which in this case is the digit 6, the circuit of the line relay 1 is interrupted six times by the calling device at the calling station. Upon each deenergization of the line relay a circuit is closed from ground, armature 19, and its resting contact, armature 24 and its resting contact, armature 30 and its front contact, armature 54 and its resting contact, winding of the slow-to-release series relay 8, armatures 59 and 65 and their respective resting contacts, winding of the rotary magnet 18, to battery. The rotary magnet 18 advances its wipers 90-96 step-by-step each time the above circuit is completed. Relay 8 also energizes in series with the rotary magnet in the above-traced circuit and at armature 48 and its front contact places a short circuit around armature 54 and its front contact, so that when relay 9 energizes the circuit for relay 8 will not be opened. Due to the copper slug on relay 8 it does not fall back each time the circuit is opened at armature 19 and its resting contact, but remains energized throughout the series of impulses. Relay 4 is also a slow-to-release relay and remains energized during the impulse series. At armature 50 and its resting contact, relay 8 opens the point in the circuit from wiper 90 to the rotary magnet 18. The operations of the remaining contacts of this relay are of no importance at this time. At the end of the first series of impulses, relay 8 falls back again and at armature 50 and its resting contact closes a circuit for the rotary magnet 18. The wiper 90 of the rotary switch has been advanced to contact 6 of its associated bank. A circuit is closed, after relay 8 falls back, from ground at the upper winding of relay 13, contact 6 of the bank associated with the wiper 90, wiper 90, armature 25 and its resting contact, armature 44 and its resting contact, armature 50 and its resting contact, armature 66 and its resting contact, self-interrupting contact 88 of the rotary magnet 18, winding of the rotary magnet 18, to battery. Relay 13 and the rotary magnet energize in series over this circuit. At armature 76 and its front contact, relay 13 closes a locking circuit for its lower winding from battery, lower winding of relay 13, armature 76 and its front contact,

armature 43 and its resting contact, armature 87 and its front contact, to ground. The circuit of the rotary magnet 18 is opened at its self-interrupting contacts 88 advancing its wipers 90-96 to their respective seventh bank contacts.

It might be well to mention at this time that if the first digit dialled had been the digit eight the wipers 90-96 would have come to rest on their associated eighth bank contacts. Relay 13 and the rotary magnet 18 energize in series, as is the case when the digit six is dialled as the first digit, advancing the wipers 90-96 to their associated ninth bank contacts, however, at armature 74 and its front contact, relay 13 grounds contact 9 associated with wiper 90 again energizing the rotary magnet 18. The self-interrupting contacts 88 of the rotary magnet 18 open the circuit of the rotary magnet 18 and causes it to advance the wipers 90-96 to their associated tenth bank contacts. The bank contacts 10 to 16 associated with wiper 90 are all multiplied together and are grounded through the upper winding of relay 13. This causes the rotary magnet 18 to advance wipers 90-96 step-by-step to their respective seventeenth bank contacts. The second digit of the subscriber's number will advance the wipers to any subscriber's line in the eighty group.

The operation of the connector after the wipers of the switch were advanced responsive to the dialling of the digit six will now be resumed.

The switch is now in a position to receive the second digit of the wanted subscriber's number, which in this case is assumed to be the digit 1. When the circuit for line relay 1 is open in response to the operation of the subscriber's dial the above-traced circuit for operating the rotary magnet 18 and the series relay 8 is again completed. The rotary magnet 18 advances its wipers 90-96 one step to their respective eighth bank contacts. As has been mentioned before, relay 8 energizes in series with the rotary magnet 18 and at armature 48 and its front contact places a short circuit around armature 54 and its front contact so that when relay 9 is energized the circuit for relay 8 is not opened. At armature 46 and its front contact, relay 8 closes a circuit from ground, armature 46 and its front contact, armature 73 and its front contact (of the previously operated relay 13), winding of relay 7, to battery. Relay 7 operates over this circuit, prepares a busy test circuit for relay 9 at armature 41 and its front contact, opens the locking circuit for relay 13 at armature 43 and its resting contact, opens a point in the automatic stepping circuit for the rotary magnet 18 at armature 44 and its resting contact, and at armature 45 and its front contact prepares a circuit for transmitting the busy-tone signal to the calling subscriber should the called subscriber's

line be busy. Relay 13 falls back and opens the initial energizing circuit for relay 7 at armature 73 and its front contact. Inasmuch as only one impulse has been transmitted, relay 1 is again energized and opens the circuit for the slow-to-release relay 8. However, relay 8 does not fall back at this time due to the copper slug around its core. The wipers 90-96 have been advanced to their respective eighth bank contacts in which position the wipers 91-93 are associated with the called subscriber's line, which in this case is line 61. By referring to armatures 68, 69, and 72 associated with the wiper switching relay 12 it will be noted that the wipers 91, 92, and 93 are normally connected and the wipers 94, 95, and 96 are normally disconnected.

If the line to substation A is busy at this particular time, there will be a ground potential on the test contact to which conductor 98 is connected, either by another connector whose wipers are in engagement with contacts similar to the bank contacts which wipers 91, 92, and 93 are associated with and multiplied with them, or by way of the line-switch accessible to subscribers on line 61, as is well known in the art. It will be assumed for the present that the called line 61 is busy and ground potential is encountered when wiper 92 becomes associated with the bank contact to which conductor 98 is connected. A circuit will be closed from ground by way of conductor 98, wiper 92 and its associated eighth bank contact, armature 69 and its resting contact, armature 41 and its front contact, armature 47 and its front contact, upper winding of relay 9, self-interrupting contacts 89 of the rotary magnet 18, to battery. Relay 9, upon energizing, prepares a locking circuit for itself at armature 52 and its front contact, opens the initial impulsing circuit for the rotary magnet 18 at armature 54 and its resting contact, and prepares the busy-tone circuit from the busy-tone transformer BT at armature 55 and its front contact. After a short interval relay 8, which has been held in its energized position due to the copper slug on its core, falls back, and at armature 47 and its front contact opens the initial energizing circuit for relay 9. However, relay 9 does not fall back but remains energized over a circuit from battery, self-interrupting contacts 89 of the rotary magnet 18, upper winding of relay 9, normally closed contacts controlled by the front contact of armature 47, armature 52 and its front contact, armature 42 and its front contact, armature 29 and its front contact, to ground. As soon as relay 8 falls back busy-tone signal is connected to the called subscriber at armature 51 and its resting contact from the secondary winding of the busy-tone transformer BT whose primary winding is connected to the busying machine not shown,

armature 55 and its front contact, armature 51 and its resting contact, armature 45 and its front contact, the talking condenser in the lower line conductor, armature 26 and its resting contact, lower line conductor 105 to the calling subscriber. Relay 7 and relay 9 are both locked up to ground at armature 29 and its front contact and cannot release until the calling subscriber hangs up to release the connection. The busy-tone is reproduced in the calling subscriber's receiver and notifies the calling subscriber that the desired line is busy. The calling subscriber will thereupon replace his receiver, wait an interval, and make another trial to obtain the desired connection.

It will now be assumed that line 61 is idle when the wipers 91, 92, and 93 of the connector were advanced to their respective eighth bank contacts, therefore, no ground potential is encountered on conductor 98. If ground is not encountered by the test wiper 92 when line 61 is reached, the busy-test relay 9 is not operated. It should be remembered, however, that series relay 8 is maintained in its operated position by the copper slug around its core. After a short interval relay 8 falls back and at armature 47 and its resting contact closes a circuit for energizing relay 11. The circuit for operating relay 11 is as follows: ground, armature 29 and its front contact, armature 42 and its front contact, armature 52 and its resting contact, lower winding of relay 11, armature 79 and its resting contact, armature 47 and its resting contact, armature 41 and its front contact, armature 69 and its resting contact, wiper 92 and its associated eighth bank contact, conductor 98, to battery through the cut-off winding of the called subscriber's line-switch (not shown). The bridge-cut-off relay of the lineswitch associated with the called line now operates and clears the talking conductors of the called line of attachment. Upon energizing, relay 11 closes a locking circuit for itself over its upper winding from battery, upper winding of relay 11, armature 63 and its front contact, armature 42 and its front contact, armature 29 and its front contact, to ground. Upon energizing, relay 11 also prepares the pick-up circuit at armature 61 and its front contact so that the desired code ringing may be transmitted over the called subscriber's line at the proper time, at armature 62 and its front contact places ground on conductor 98 by way of armature 69 and its resting contact and wiper 92 of the connector to guard the called line by making it busy to all other subscribers having access thereto, at armatures 65 and 66 and their respective resting contacts it disconnects the circuit for the rotary magnet 18, and at armature 65 and its front contact it prepares a circuit for the stepping magnet 17 of the code selector CS. The operation of arma-

tures 64 and 67 of relay 11 have no effect on the circuit at this time.

When the final digit of the wanted subscriber's number is dialled, the resulting impulses are delivered now to the stepping magnet 17 of the code selector CS, owing to the operated condition of the armature 65 of relay 11, with the result that the wipers 106 and 108 of the code selector CS are advanced to a position corresponding to the code of the called substation. It may be pointed out here that the code selector CS is arranged to signal any one of ten parties on a called line, it being assumed that half of the ringers are connected between one conductor of the line and ground and the other half connected between the opposite conductor of the line and ground. In this way, ten parties may be signalled by means of five codes, the selected code being applied to one conductor of the line or the other depending upon the station called. In the present case, it is assumed that the digit 1 is the final digit of the wanted subscriber's number. The result is that the No. 1 code is placed on the upper talking conductor of the called line due to the position of wiper 108, and the lower conductor 99 of the called line is extended by way of wiper 106 on its first contact to the lower winding of ring-cut-off relay 5. The completion of the two connections just described is, of course, dependent on the subsequent operation of pick-up relay 6.

When the wipers of the code selector CS come to rest and relay 8 falls back, relay 10 is operated through armature 49 and its resting contact and through the off-normal contacts 107 of the code selector CS. Relay 10 opens the impulsing circuit to the magnet 17 at armature 59 and its resting contact, prepares a point in the release circuit for release magnet 16 at armature 60 and its front contact and connects the pick-up conductor to the pick-up relay 6 at armature 56 and its front contact. The ringing interrupter and tone equipment is not a part of this invention and has not been shown. This equipment, however, is disclosed in the Norman H. Saunders Patent, No. 1,805,726, issued May 19, 1931, and is shown on Figs. 7 and 8. It will suffice to state that during the operation of the ringing interrupter the pick-up conductor is grounded prior to the application of the codes of ringing current, resulting in the operation of pick-up relay 6. Relay 6 closes a locking circuit for itself and opens its initial energizing circuit at armature 39 and its front contact, while at armatures 38 and 40 and their respective front contacts it completes the ringing circuit from the called line to the wipers 106 and 108 of the code selector CS. The ringing circuit in this case may be traced from grounded generator (see the above-mentioned application), code conductor No. 1, first contact of the bank en-

gaged by wiper 108 of the code selector CS, armature 38 and its front contact, armature 34 and its resting contact, normally closed contacts controlled by the front contact of armature 20, upper line conductor, armature 68 and its resting contact, wiper 91 and its associated eighth bank contact, conductor 97, through the bells and condenser at substation A, to ground. Ring-back-tone is transmitted to the calling subscriber by way of armatures 34 and 20 and their respective resting contacts and the intervening condensers to indicate that the called subscriber is being signalled.

When the called subscriber answers a direct current bridge is closed across the line at the substation and relay 5 operates over the called loop from ground superimposed on the ringing current. The direct current bridge for energizing relay 5 is completed over the line conductor 99, wiper 93 and its associated eighth bank contact, armature 72 and its resting contact, normally closed contact controlled by front contact of armature 26, armature 37 and its resting contact, armature 40 and its front contact, wiper 106 and its associated first bank contact, lower winding of relay 5 to battery. Relay 5 operates, disconnects the ringing current from the called subscriber's line at armatures 34 and 37 and their respective resting contacts, locks itself at armature 36 and its front contact, and at the same time opens the locking circuit for relay 6 at its resting contact, opens the initial energizing circuit for relay 6 at armature 35 and its resting contact, and at armatures 34 and 37 and their respective front contacts it completes the connection to the called subscriber's line. The ringing circuit is also disconnected due to the release of relay 6 at armatures 38 and 40 and their respective front contacts.

The calling and called subscriber may now hold conversation as desired. The closing of the front contacts of armatures 34 and 37 by relay 5 also closes a circuit for the upper and lower winding of the battery-feed relay 3 over the called subscriber's loop for the purpose of furnishing talking battery to the called subscriber's line and also to transfer the holding circuit for release relay 4 at armature 27 and its front contact. As relay 1 is energized over the calling subscriber's loop and relay 3 is energized over the called subscriber's loop it can readily be seen that the release of the switch is controlled by the last party to hang up, that is, if the calling subscriber should hang up first the release relay 4 will not fall back until ground is removed at armature 27 and its front contact by the battery-feed relay 3, and if the called subscriber should hang up first the connector would not fall back until ground is removed from the release relay 4 at armature 19 and the front contact of line relay 1.

The talking circuit through the connector to the called subscriber's line is as follows: conductor 103, by way of the calling subscriber's line and associated lineswitch, armature 20 and its resting contact, armature 34 and its front contact, normally closed contacts controlled by the front contacts of armature 20, armature 68 and its resting contact, wiper 91 of the connector and its associated eighth bank contact connected to conductor 97, called subscriber's substation A, conductor 99 connected to the associated eighth bank contact engaged by wiper 93, armature 72 and its resting contact, normally closed contacts controlled by the front contacts of armature 26, armature 37 and its front contact, armature 26 and its resting contact, and conductor 105 to the calling subscriber's line by way of his associated lineswitch. Talking battery is supplied to the calling subscriber's line by line relay 1, and talking battery is supplied to the called subscriber's line by battery feed relay 3.

When the conversation is completed, both subscribers replace their receivers. When the receiver is replaced at the called substation, relay 3 falls back and at armature 27 and its front contact removes the holding ground from the release relay 4. However, release relay 4 being a slow-to-release relay does not immediately fall back and at the resting contact of armature 27 a circuit is again completed from relay 4 from ground at armature 19 and its front contact.

When the receiver is replaced at the calling substation, the line relay 1 of the connector C falls back and at armature 19 and its front contact opens the holding circuit for the release relay 4. A moment later release relay 4 falls back and at armature 29 and its front contact opens the holding circuit for relays 7, 11, and 15. Also at armature 30 and its front contact, relay 4 opens the impulsing circuit for rotary magnets 17 and 18, and at armature 31 and its front contact removes ground from the release trunk 104. However, the connector is still maintained busy to subscribers having access thereto due to the ground which is supplied over the wiper 90 of the connector. Relay 7 upon falling back prepares the automatic stepping circuit for the rotary magnet 18 to restore the wipers to normal at armature 44 and its resting contact, and relay 11 at armature 66 and its resting contact completes the automatic stepping circuit for rotary magnet 18 so the switch can be automatically restored to its normal resting position. At armature 87 and its front contact relay 15 removes the holding ground from relay 5, relay 5 falls back and at armatures 34 and 37 opens the talking connection over the line conductors. Referring again to the automatic stepping circuit of rotary magnet 18, which was mentioned above. The wiper 90 of the connector is

resting on bank contact 8 as has been mentioned before, and as soon as relays 7 and 11 fall back a circuit is completed from ground, upper winding of relay 13, wiper 90 and its associated eighth bank contact, armatures 25, 44, 50, and 66 and their respective resting contacts, self-interrupting springs 88 of the rotary magnet 18, winding of the rotary magnet 18, to battery. The rotary magnet operates over this circuit opening its own circuit at its self-interrupting contacts 88 and advancing the wipers 90 to 96 to their respective ninth bank contacts.

It might be well to mention at this time that all the contacts of the bank associated with wiper 90 are grounded except for the normal resting contact 25. Contact one of the bank to which wiper 90 is associated is grounded through the upper winding of relay 14. Should the wiper 90 be standing on this contact the rotary magnet and relay 14 will energize in series while relay 14 falls back when the wiper is stepped because there will be no holding ground to lock the relay up over its lower winding. Contact 2 is grounded at armature 86 and its resting contact, contacts 3 to 5 and 17 to 24 and grounded at armature 77 and its resting contact, and contacts 6, 8, and 10 to 16 are grounded through the upper winding of relay 13. This relay operates in series with the rotary magnet but falls back after each energization due to the absence of a holding ground for its lower winding. Contact 7 is grounded at armature 85 and its resting contact, contact 9 is grounded through the lower winding of relay 9 which energizes in series with the rotary magnet as is the case with relays 13 and 14 but does not remain energized because there is no holding circuit for its upper winding.

Wiper 90 upon finding ground for each of the bank contacts as it is advanced by the rotary magnet completes another energizing circuit for the magnet to step it onto the next bank contact. When the wiper 90 is advanced to bank contact 25, upon which no ground is placed, the stepping circuit for the rotary magnet 18 is opened and the switch is restored to its home position.

By referring again to the operation of relay 10 from ground at the off-normal contacts 107 of the code selector CS it will be noted that when the release relay 4 falls back, both parties having replaced their receivers, a circuit is closed from ground at armature 33 and its resting contact, armature 60 and its front contact, winding of the release magnet 16 of the code selector CS, to battery. Upon operating the release magnet 16 permits the wipers 106 and 108 to restore to their normal position. The restoring of the wipers 106 and 108 to their normal position opens the off-normal contacts 107, thereby opening the energizing circuit of relay 10 which falls back and at armature 60 and its front contact

opens the initial energizing circuit for release magnet 16 at armature 60 and its front contact.

During the period required to restore the wipers 90-96 to their associated twenty-fifth bank contacts or normal resting contacts, ground has been maintained on conductor 104 from the bank contacts associated with the wiper 90, armature 25 and its resting contact, resistance 32, armature 31 and its resting contact, armature 21 and its resting contact, to conductor 104. This ground is not removed from the conductor 104 until the switch has finally reached its home position, therefore, the switch is maintained busy until the connector is entirely restored to normal.

Calling subscriber at substation B

It will be assumed that a calling subscriber desires to establish a connection with a subscriber at substation B and has in response to the removal of the receiver caused his individual lineswitch to seize an idle trunk leading to the connector C shown on the drawing. As has been hereinbefore described the seizure of the connector over conductors 103, 104, and 105 by the calling subscriber's lineswitch causing the line relay 1 and the slow-to-release relay 4 to energize. The release relay 4 returns ground over the release conductor 104 to maintain the calling subscriber's lineswitch operated and also to ground the connector bank terminals of the connectors having access to the calling subscriber's line. The slow-to-release relay 4 also closes a circuit for operating relay 15, prepares the impulsing circuit for the rotary magnet 18, and opens a point in the circuit for release magnet 16 of the code selector CS. The connector is now prepared for dialling and the calling subscriber may now manipulate his calling device in accordance with the digits of the telephone number of the wanted subscriber, whose substation in this case is assumed to be substation B and whose telephone number is 766. As has been mentioned before the first two digits of the subscriber's telephone number indicates the number of the line called on the last figure selects the ringing code to be transmitted for signalling the wanted subscriber.

When the digit 7 is dialled the circuit of the line relay 1 is interrupted and causes the rotary magnet 18 to advance its wipers 90-96 to their respective seventh bank contacts. The circuit for operating the rotary magnet is exactly the same as described hereinbefore. However, when the wiper 90 engages its seventh bank contact, a circuit is closed from ground, upper winding of relay 12, armature 75 and its resting contact, armature 81 and its resting contact, wiper 90 and its associated seventh bank contact, over the previously traced circuit through the self interrupter springs 88 and the winding of the rotary mag-

net 18 to battery. The resistance of relay 12 prevents the rotary magnet 18 from energizing over this circuit. However, relay 12 energizes and at armature 71 and its front contact closes a locking circuit for itself from ground at armature 87 and its front contact. At armatures 68, 69, and 72 and their respective front contacts, relay 12 connects up wipers 94, 95, and 96 of the connector. At armature 70 and its front contact, relay 12 prepares a circuit for relay 7. The circuit is not completed at this time because relay 8 is restored to its normal position before relay 12 can energize, therefore, the circuit for energizing relay 7 is opened at armature 46 and its front contact.

It might be well to mention at this time that if the first digit dialled had been digit 9 the wiper 90 would have come to rest on its associated ninth bank contact. With the wiper 90 associated with its ninth bank contact a circuit is closed from ground at the lower winding of relay 9, wiper 90 and its associated ninth bank contact, over the previously traced circuit to the self-interrupting contacts 88 and winding of the rotary magnet 18 to battery. The rotary magnet 18 and the relay 9 energize in series over this circuit. At armature 53 and its front contact, relay 9 closes a circuit for relay 12, from ground at armature 87 and its front contact, armature 43 and its resting contact, armature 53 and its front contact, lower winding of relay 12 to battery. Relay 12 upon energizing switches wipers and closes a locking circuit for itself at armature 71 and its front contact, from ground at armature 87 and its front contact. The energization of the rotary magnet 18 opens its initial energizing circuit at its self-interrupting contacts 88, thereby immediately opening the energizing circuit for relay 9 which immediately falls back, and at the same time the rotary magnet 18 advances its wipers 90-96 to their respective tenth bank contacts. It will be noted that contacts 10 to 16 associated with wiper 90 of the connector are all grounded by way of the upper winding of relay 13, therefore as soon as wiper 90 is engaged therewith a circuit is closed from ground at the upper winding of relay 13, through the multiple contacts mentioned above, wiper 90, to the rotary magnet 18 by way of self-interrupting springs 88. Upon energizing, relay 13 closes a locking circuit for its lower winding by way of armature 76 and its front contact, armature 43 and its resting contact, to ground at armature 87 and its front contact. At armature 77 and its resting contact, relay 13 removes ground from contacts 17 to 24 of the bank contacts associated with wiper 90. Due to the ground of all the contacts from 10 to 16, the rotary magnet 18 advances the wipers 90-96 step-by-step until the wiper 90 is advanced to its associated

seventeenth bank contact at which contact ground has been removed, opening the stepping circuit for the rotary magnet. The second digit of the subscriber's number will advance the wipers to any subscriber's line in the ninety group.

The operation of the connector after the wipers 94, 95, and 96 have been selected in response to the operation of relay 12 due to the dialling of the first digit seven will now be resumed.

The switch is now in a position to receive the second digit of the wanted subscriber's number, which in this case, as we have mentioned before, is the digit 6. When the circuit of the line relay 1 is interrupted in response to the operation of the subscriber's dial the previously traced circuit for operating the rotary magnet 18 and relay 8 is again completed. Relay 8 operates immediately upon the closure of this circuit and at armature 46 and its front contact closes a circuit from ground, armature 46 and its front contact, armature 70 and its front contact, winding of relay 7, to battery. The rotary magnet 18 advances its wipers 90-96 to their respective thirteenth bank contacts, at which position the wipers 94, 95, and 96 are associated with the calling subscriber's line, which in this case is line 76. Referring again to the operation of relay 7, it will be noted that it completes a locking circuit for itself at armature 42 and its front contact, prepares a circuit for the busy test relay 9 at armature 41 and its front contact, and at armature 45 and its front contact prepares a circuit transmitting the busy-tone signal to the calling subscriber. It should be remembered, however, that wipers 91, 92, and 93 have been disconnected from the connector by the operation of the wiper switching relay 12.

If the line to which substation B is connected is busy at this particular time, there will be a ground potential on test conductor 101. It will be assumed for the present that the called line 76 is busy and ground is encountered when wiper 95 becomes associated with the bank contact to which conductor 101 is connected. Due to the grounding of wiper 95, the busy-test relay 9 is energized and is locked up, after the slow-to-release relay 8 falls back, over a circuit including its upper winding, the normally closed contacts controlled by armature 47, armature 52 and its front contact, armature 42 and its front contact, to armature 29 and its front contact, to ground. Relay 9 also opens the initial impulsing circuit for the rotary magnet 18 at armature 54 and its resting contact, and prepares a busy-tone circuit from the busy-tone transformer BT at armature 55 and its front contact. As soon as relay 8 falls back the busy-tone signal is connected to the called subscriber at arma-

ture 51 and its resting contact over the previously traced circuit to the calling subscriber. The busy tone is reproduced in the calling subscriber's receiver to notify him that the desired line is busy. The calling subscriber will thereupon replace his receiver, and make another trial to obtain the desired connection later.

By referring again to the operation of the connector after the wipers 94, 95, and 96 have been advanced to their respective thirteenth bank contacts it will be assumed at this time that no ground potential is encountered on the test conductor 101. When no ground potential is encountered by the test wiper 95 when the called line is reached the busy-test relay 9 is not operated, therefore, after a short interval relay 8, which has been maintained energized in its operated position by the copper slug around its core subsequently falls back. When relay 8 falls back a circuit is closed for operating relay 11, from ground, armature 29 and its front contact, armature 42 and its front contact, armature 52 and its resting contact, lower winding of relay 11, armature 79 and its resting contact, armature 47 and its resting contact, armature 41 and its front contact, armature 69 and its front contact, wiper 95 and its associated thirteenth bank contact, conductor 101, to battery through the cut-off winding of the called subscriber's lineswitch (not shown). Upon energizing relay 11 closes a locking circuit for itself over its upper winding at armature 63 and its front contact, prepares the pick-up circuit at armature 61 and its front contact so that the desired code ringing may be transmitted to the called subscriber's line at the proper time, grounds conductor 101 and at armature 62 and its front contact to guard the called line by making it busy to all other subscribers having access thereto, completely disconnects the rotary magnet 18 from the circuit at armatures 65 and 66, and at armature 65 and its front contact prepares the circuit for the stepping magnet 17 of the code-selector CS.

The calling subscriber may now dial the final digit of the wanted subscriber's number in order to select the proper code ringing to signal the substation B. The operation of the code selector CS is exactly the same as has been hereinbefore described except in this case the digit 6 is dialled and advances the wiper 106 and 108 of the code selector CS to the associated sixth bank contact. The code ringing is transmitted over the lower line conductor, due to the connection of the banks associated with wipers 106 and 108, and signals the subscriber at substation B. The subscriber at substation B upon hearing his code being transmitted by the ringing of the bell removes his receiver to answer the call and thereby causes the ring-cut-off relay 5 to energize over the called loop.

When the calling and called subscribers hang up the receivers after the conversation is completed and the wipers 90-96 of the connector are restored to their normal resting positions by the grounding of the bank contacts associated with the wiper 90. This causes the rotary magnet 18 to advance all the wipers step-by-step until the twenty-fifth bank contact or home position is reached, at which position the stepping action will be stopped. The releasing of the code-selector switch CS and the operated relays has been explained in detail hereinbefore and it is not thought necessary to go into the operation of the circuit for releasing these again.

Calling a subscriber on line 88

If the calling subscriber should dial 88 to call a subscriber on that line the wipers 90-96 would come to rest on bank contacts 25. With the switch in this position the call is extended over wipers 91, 92, and 93 to the called subscriber. When the switch is released the contact 25 associated with the wiper 90 is grounded by way of ground at armature 67. Ground is maintained on contact 25, over wiper 90 to guard the connector after relay 4 falls back until relay 11 releases. When relay 11 releases ground is removed from contact 25 associated with wiper 90 and the switch will remain in this position, inasmuch as, it is the home or resting position for the wipers of the switch.

Calling a subscriber on line 98

If the calling subscriber calls the line 98, relay 12 is eventually energized to switch the connection to the normally disconnected set of wipers 94, 95, and 96. As has been mentioned before, relay 11 has been maintained energized in order to ground contact 25 associated with wiper 90, thereby maintaining the switch busy while it is releasing. When the conversation is completed and the subscribers hang up their receivers, relay 11 is released before the wiper-switching relay 12. The releasing of relay 11 before relay 12 falls back is to prevent the switch from interfering with a call accessible over wipers 91, 92, and 93 when the wipers are switched back to normal connected set of wipers.

Switching-through service

The circuit of the connector is shown with two groups of five trunks, one group of five trunks being accessible over one set of wipers of the switch, and the other group of five trunks being accessible over the other set of wipers. In practical use it may be advisable to have two groups of five trunks each extending from the C. A. X. exchange to the main exchange or it may be advisable to have one group of five trunks extending to the main exchange and the other group of five trunks extending to reverting call equipment

so that the party line subscribers in the C. A. X. may dial a predetermined number to have a second subscriber on his line signalled as well as his own substation after he has replaced his receiver. In the present case we have assumed that the five trunks extending from the banks accessible to the normally connected set of wipers 91, 92, and 93 terminate in the main office (not shown). It will be assumed further that the other five trunks are wired to reverting call equipment (not shown) in the sub-exchange and terminates in the bank accessible to the normally disconnected set of wipers 94, 95, and 96.

When the calling subscriber in the C. A. X. desires to establish a connection with a subscriber in the main exchange, the subscriber dials the number eleven, the switch is so arranged that it will select any one of the five trunks that happens to be idle and will then switch the subscriber through to the main exchange.

If, however, a calling subscriber desires to establish a connection with another subscriber on his own line he will dial the digit 21 and the switch will automatically select one of five trunks connected to reverteive call equipment.

The calling subscriber in the C. A. X. desiring to establish connections to the main office, dials the digit 1, and the rotary magnet 18 is operated to advance the wipers 90-96 one step, into engagement with the first bank contacts. After a short interval, relay 8 falls back and a circuit is closed from ground at the upper winding of relay 14, wiper 90 and its associated first bank contact over the previously traced circuit to the rotary magnet 18. Both the rotary magnet and relay 14 will energize in series over this circuit. Relay 14 locks itself over its lower winding by way of armature 83 and its front contact, and ground at armature 29 and its front contact. The rotary magnet advances all the wipers to their associated second bank contacts. Relay 14 also opens the circuits of relays 12 and 10 at armatures 81 and 82, respectively, prepares a circuit for relay 7 at armature 80 and its front contact, and at armature 79 and its front contact it prepares a circuit for relay 2. It should be noted, however, that at armature 79 and its resting contact, relay 14 opens the circuit for relay 11. At armature 84 and its front contact, relay 14 also prepares an automatic stepping circuit for the rotary magnet which will be hereinafter described.

The subscriber may now dial the second digit required for establishing a connection to the main exchange which is the digit 1. The rotary magnet follows the impulse from the dial and advances the wipers 90-96 to their associated third bank contacts. Relay 8 energizes in series with the rotary magnet and immediately closes a circuit for relay 7 at armature 46 and its front contact. If the first

trunk is busy ground is encountered by wiper 92 and is forwarded by way of armature 69 and its resting contact, armature 41 and its front contact, armature 47 and its front contact, upper winding of relay 9, self-interrupting contacts 89 of the rotary magnet 18, and battery to energize relay 9. Upon operating, relay 9 completes a circuit for automatically advancing the wipers of the connector to the next bank contact. The automatic stepping circuit for the rotary magnet 18 is as follows: ground at armature 77 and its resting contact, contacts 3 to 5 and 17 to 24 of the banks associated with wiper 19, wiper 90 which is positioned to the third bank contact, armature 84 and its front contact, armature 54 and its front contact, winding of relay 8, armature 59 and its resting contact, armature 65 and its resting contact, winding of the rotary magnet 18 to battery. Both the rotary magnet 18 and the series relay 8 energize in series again, the rotary magnet advancing its wipers 90-96 to their associated fourth bank contacts.

We will assume, at this time, that the second trunk leading to the main exchange is idle. When the trunk is idle, battery is encountered by test wiper 92, and a circuit is completed for relay 2 as follows: wiper 92, armature 69 and its resting contact, armature 41 and its front contact, armature 47 and its resting contact (relay 8 having fallen back shortly after the wipers were advanced by the rotary magnet 18), armature 79 and its front contact, lower winding of relay 2, armature 28 and its front contact, armature 52 and its resting contact, armature 42 and its front contact, armature 29 and its front contact, to ground. Relay 2 operates over this circuit and at armatures 20 and 26 and their respective front contacts connects the calling line through to the repeater (not shown) which is included in the trunk line according to the usual practice. The line relay in the repeater operates over the calling loop. The repeater then disconnects battery from the test conductor and connects ground thereto. Relay 2, also opens the circuit for line relay 1 at the armatures 20 and 26 and their respective resting contacts, and at armature 22 and its front contact prepares a locking circuit for its upper winding. The locking circuit for the upper winding of relay 2 is completed when the repeater returns ground over the test conductor, wiper 92, armature 69 and its resting contact, armature 22 and its front contact, upper winding of relay 2, to battery. This same ground is also extended over the release conductor 104 by way of armature 21 and its front contact to hold the preceding switches operated and also to busy the connector to other switches having access thereto. Due to the falling away of line relay 1 the holding circuit for release relay 4 is opened which in turn falls

back and opens the holding or locking circuit for relays 7, 14, and 15. The C. A. X. subscriber is now connected to the main exchange and the connector is held under control of relay 2.

5 When the calling subscriber hangs up, the line relay in the repeater falls back and ground is removed from the test conductor and wiper 92, thereby opening the locking circuit for the upper winding of relay 2. At
10 armature 25 and its resting contact relay 2 completes the automatic stepping circuit for the rotary magnet 18 by way of the grounded contacts associated with wiper 90. The rotary magnet operates as an interrupter and
15 automatically advances the wipers 90-96 step-by-step to the normal resting position of the switch. The switch has now been restored to normal and is available for completing a further connection desired by a
20 C. A. X. subscriber.

When the C. A. X. subscriber dials 11 to establish a connection with the main exchange, and all the trunks to the main
25 exchange are busy, the connector will automatically rotate the wipers 90-96 to their associated seventh bank contacts. If all the five trunks are busy the switch cannot rotate beyond the seventh or last trunk of the
30 group because ground is removed from the contact 7 associated with wiper 90, thereby removing the controlling ground for automatically stepping the rotary magnet 18. When this condition occurs the series relay
35 8 which is energized in series with the rotary magnet each time the rotary magnet is operated subsequently falls back and at the normally closed contacts controlled by the front contact of armature 47 closes a locking
40 circuit for relay 9 over armature 52 and its front contact, armature 42 and its front contact, ground at armature 29 and its front contact. The busy-tone signal is transmitted to the calling subscriber to notify him
45 that all the trunks to the main exchange are busy and are not available at this particular time.

Reverting call

If a subscriber in a C. A. X. exchange desires to establish a connection with another
50 subscriber on his line it is necessary for him to dial the digit 21. By dialling the digit 21 the connector C will automatically rotate and select one of five reverting call equip-
55 ments.

In response to the dialling of the digit 2 the rotary magnet advances its wipers 90-96 to their associated second bank contacts in the same manner as has been hereinbefore
60 described. A circuit is closed from the upper winding of relay 10, armature 82 and its resting contact, wiper 90 and its associated second bank contact, over the previously traced circuit to the rotary magnet 18. The
65 rotary magnet does not energize over this cir-

cuit, but relay 10 energizes completing an energizing circuit for the lower winding of wiper switch relay 12 at armature 57 and its front contact, and completing an energizing circuit for the lower winding of relay 14 and
70 at armature 58 and its front contact. Wiper switching relay 12, upon energizing, completes a locking circuit for itself at armature 71 and its front contact by way of ground at armature 87 and its front contact. Relay 14,
75 upon energizing, completes a locking circuit for its lower winding at armature 83 and its front contact, to ground at armature 29 and its front contact. Relay 12, also switches wipers at armatures 68, 69, and 72 and their
80 respective front contacts so that the connection will now be completed over wipers 94, 95, and 96. Relay 14 performs the same functions as has been hereinbefore explained, that is, preparing the circuit for the switch-
85 through relay 2, and the automatic stepping circuit for the rotary magnet 18. In addition relay 14 opens the circuit for relay 10 at armature 82 and its resting contact. Relay 10 falls back and at armature 59 and its
90 resting contact prepares the circuit for operating relay 8 in series with the rotary magnet by way of the grounded contacts associated with wiper 90 if any of the trunks to reverting call equipment are busy. When the second
95 digit of the number, which is the digit 1, is dialled the rotary magnet advances all the wipers one step to their associated third bank contacts. If the test wiper 95 encounters ground, relay 9 energizes and the rotary
100 magnet is operated to advance all the wipers to the associated fourth bank contacts as has been hereinbefore described. When an idle reverting call equipment is found, battery is encountered by the test wiper 95 causing the
105 relay 2 to energize, as has been explained in connection with the trunk hunting feature for selecting idle trunks to the main exchange. The calling subscriber's line is switched straight through to the reverting call
110 equipment by the operation of relay 2 simultaneously disconnecting the line relay 1 in the connector which causes the release of relay 4. Relay 4 on releasing opens the hold-
115 ing circuit for relays 7, 14, and 15. The wiper-switching relay 12 does not fall back, however, because of the release of relay 15, inasmuch as, a new holding circuit is provided by the operation of relay 2, at armature 23 and its front contact.

The switching through of the calling line to the reverting call equipment operates a relay therein and causes battery to be removed from the test wiper 95 which is immediately replaced by ground. Ground is
120 forwarded over wiper 95, armature 69 and its front contact, to the upper winding of relay 2 which is permanently locked to this circuit until the reverting call equipment is released. The ground which is forwarded from revert-
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ing call equipment is also forwarded over conductor 104 by way of armature 21 and its front contact to the preceding switches as a holding circuit and also as a busying circuit to prevent other switches having access to the connector C from seizing the same.

The operation of the reverting call equipment is not a part of this invention and is not thought necessary to be described as the operation is well known to those familiar with the art.

When the calling subscriber has registered the wanted subscriber's number as well as his own number upon the reverting call equipment he replaces his receiver. Upon replacing his receiver the reverting call equipment sends out the code ringing required for ringing the called subscriber's bell as well as the calling subscriber's bell. When the called subscriber answers, ringing is disconnected from both of the called and calling subscribers' bells thereby notifying the called subscriber that the wanted subscriber on his line has answered. The two subscribers may now converse with each other in the usual manner, the transmitters of the two stations being supplied with talking current from the reverting call equipment.

When the two subscribers replace their receivers at the end of the conversation the reverting call equipment is released and the holding ground is removed from the test wiper 95 of the connector C, thereby opening the holding circuit for relay 2 which subsequently falls back. At armature 25 and its resting contact, relay 2 completes the automatic stepping circuit for restoring the wipers of the connector to their normal positions. The wiper-switching relay 12 being slightly slow-to-release it does not fall back immediately but subsequently falls back and restores the normally connected wipers to the line. The connector is maintained busy during the restoration of the wipers from the grounded contacts associated with the wiper 90, armature 25 and its resting contact, resistance 32, armature 31 and its resting contact, armature 21 and its resting contact, to the release conductor 104. As soon as the switch has been restored to normal, however, the ground is no longer connected to the wiper 90 of the switch to maintain the connector busy. The switch is now available to any subscriber in the C. A. X. who desires to establish a connection.

If all the reverting call equipments are busy the wipers of the connector will be advanced to the seventh bank contacts and busytone will be transmitted to the calling subscriber in the same manner as has been hereinbefore described.

What is claimed is:

1. In a telephone system, a trunk line terminating in an automatic switch, called lines

divided into groups accessible to said switch, an operating magnet for said switch, a first circuit for said operating magnet including a control wiper of said switch, bank contacts adapted to be engaged by said control thereto, another circuit for said magnet independent of said control wiper, means operated responsive to impulses transmitted over said trunk line for directly controlling the operation of said magnet over said other circuit, means effective at the termination of said directive control for closing said first circuit, whereby said magnet is automatically controlled to advance its wipers into selective relation with a certain particular group of said lines, and means included in said first circuit for removing the ground potential from certain of said bank contacts to determine the group of lines.

2. In an automatic telephone system, a one motion selecting switch adapted to take equal steps for each received impulse of two impulse trains, means operated responsive to the position of the wipers of said switch after the first series of impulses for controlling said switch to automatically advance its wipers a variable number of steps, the number of automatic steps being governed by the position of the wipers responsive to the first digit, and means responsive to the second impulse train for again controlling said switch to advance its wipers in accordance with the number of impulses received.

3. In a two-digit connector having access to a plurality of groups of lines, a stepping magnet, a line relay for operating said magnet to advance the wipers of the switch, means including a wiper of said connector for automatically advancing the wipers of said switch a predetermined different number of steps, the number of steps being determined by the position of the wipers after the same has been controlled by said line relay and magnet.

4. In a telephone system, a two-digit connector comprising two sets of wipers and a single magnet, said connector having access to a plurality of groups of lines over each set of wipers, a line relay for operating said magnet to advance the wipers of the switch part of the way to a group of said lines, means operated responsive to the position of the wipers after said advancement for selecting the set of wipers the connection is to be completed over and for automatically advancing the wipers the rest of the way to said group of lines, and means for permitting said line relay to control said magnet to select a line in said group of lines.

5. In a telephone system, a two-digit connector comprising two sets of wipers and a single magnet, said connector having access to a plurality of groups of lines over each set of wipers, a line relay for operating said magnet to advance the wipers of the switch part

of the way to a group of said lines, means operated responsive to the position of the wipers after said advancement for selecting the set of wipers the connection is to be completed over and for automatically advancing the wipers the rest of the way to said group of lines, means for permitting said line relay to control said magnet to select a line in said group of lines, and means for restoring said wipers and wiper-selecting means to normal.

6. In a two-digit connector, a plurality of groups of contacts, two groups of wiper sets each set having access to different groups of contacts, means for advancing said wipers responsive to the first one of said digits, and means determined by the value of said first digit for selecting a group of contacts by automatically advancing said wipers a predetermined number of steps or arresting the wipers in the position reached responsive to said first digit, and means including said last mentioned means for determining the set of wipers to be used for completing the connection to the selected group of contacts.

7. In an automatic telephone system, a two-digit single-motion connector switch having access to subscribers' lines, a line relay operated responsive to the seizure of said switch for controlling the operation of said switch to select a called subscriber's line, a release relay operated by said line relay for preventing the release of said switch and to maintain a potential on a release conductor for holding preceding switches and making the switch busy to any other calling subscribers, and a battery feed relay operated when the call is cut through from the called to the calling subscriber for maintaining said release relay in its energized position as long as the called party maintains a connection.

8. In an automatic telephone system, a two-digit single-motion connector switch having access to subscribers' lines, a line relay operated responsive to the seizure of said switch for controlling the operation of said switch to select a called subscriber's line, a release relay operated by said line relay for preventing the release of said switch and to maintain a potential on a release conductor for holding preceding switches and making the switch busy to any other calling subscribers, a battery feed relay operated when the call is cut through from the called to the calling subscriber for maintaining said release relay in its energized position as long as the called party maintains a connection, and means responsive to the releasing of said connection by either party for maintaining said release relay operated and said potential on said release conductor until the last party hangs up.

9. In a three-digit connector, a plurality of groups of contacts, a magnet and a plurality of wipers, means responsive to the first and second digits for directly operating said magnet to position said wipers to certain

contacts in one of said groups of contacts, means effective between said first and second digits for automatically operating said magnet to advance said wipers to select one of said groups of contacts, the group to be selected being determined by the position of one of said wipers responsive to said first digit, a second magnet and associated wipers, and means responsive to the third digit operating said second magnet to select a particular ringing current for signalling a particular station on the line selected responsive to said second digit.

10. In an automatic telephone system, a connector switch having a single control magnet, two sets of wipers and a control wiper, associated bank contacts for said wipers, means for operating said magnet to advance said wipers step-by-step in accordance with the first digit received, relays operated over said control wiper and associated bank contacts for automatically controlling further advancement of said wipers, and means for again connecting up said means for advancing said wipers in accordance with the first digit for operating said magnet to advance the wipers step-by-step in accordance with the second digit to select the wanted subscriber's line, and means effective over said control wiper and associated bank contacts for restoring the wipers to normal when said switch is released.

11. In a telephone system, a single-level automatic switch, two sets of wipers for said switch, said switch having access to lines arranged in groups, there being a separate two-digit combination assigned to each of said lines, means responsive to the impulses representing the first digit of a two-digit combination for advancing the wipers of the switch a step for each impulse and for selecting one of said wiper sets, means responsive at the termination of said first digit for automatically advancing the wipers of the switch to the group of lines determined by said first digit, and means responsive to the impulses representing the second digit of the combination for advancing the wipers of the switch into association with the line to which the two-digit combination is assigned.

12. In an automatic telephone system, a switch having a driving magnet for advancing its wipers in one direction only, a plurality of trunks accessible to said switch, means for operating said driving magnet to advance the wipers of the switch in accordance with the impulses of the first digit, means effective after said magnet has advanced its wipers in accordance with the first digit for either automatically operating said magnet to advance its wipers an additional predetermined number of steps or for disconnecting said automatic operating means for said magnet, said means being dependent upon the position of the wipers after

said first digit, and means responsive to said second digit for advancing said wipers to the first one of said plurality of trunk lines.

13. In an automatic telephone system, a
5 switch having a driving magnet for advancing its wipers in one direction only, a plurality of trunks accessible to said switch, means for operating said driving magnet to advance the wipers of the switch in accordance with the impulses of the first digit,
10 means effective after said magnet has advanced its wipers in accordance with the first digit for either automatically operating said magnet to advance its wiper an additional predetermined number of steps or
15 for disconnecting said automatic operating means for said magnet, said means being dependent upon the position of the wipers after said first digit, means responsive to said second digit for advancing said wipers
20 to the first one of said plurality of trunk lines, and means effective if the first of said trunks is busy for automatically operating said magnet to advance its wipers until an
25 idle one of said trunks is encountered.

14. In a two-digit single-motion switch, a line relay for feeding talking current to a calling subscriber, a release relay operated by said line relay when said switch is seized,
30 a test conductor, contacts operated by said release relay for holding preceding switches operated over said test conductor by placing a potential thereon, means controlled by a calling subscriber for completing a connection to a called subscriber's line, a battery
35 feed relay operated by said called subscriber, and contacts controlled by said battery feed relay for transferring the control of said release relay from said line relay to said battery feed relay as long as said called party
40 remains connected.

15. In a switch as set forth in claim 14 in which the releasing of the release relay is controlled by the last party to hang up.

45 In witness whereof, I hereunto subscribe my name this 9th day of October, A. D. 1931.

FREDERICK L. KAHN.

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