May 10, 1927. 1,627,929

R. G. RICHARDSON

AUTOMATIC TELEPHONE SYSTEM

Original Filed Oct. 13, 1917 2 Sheets-Sheet 1

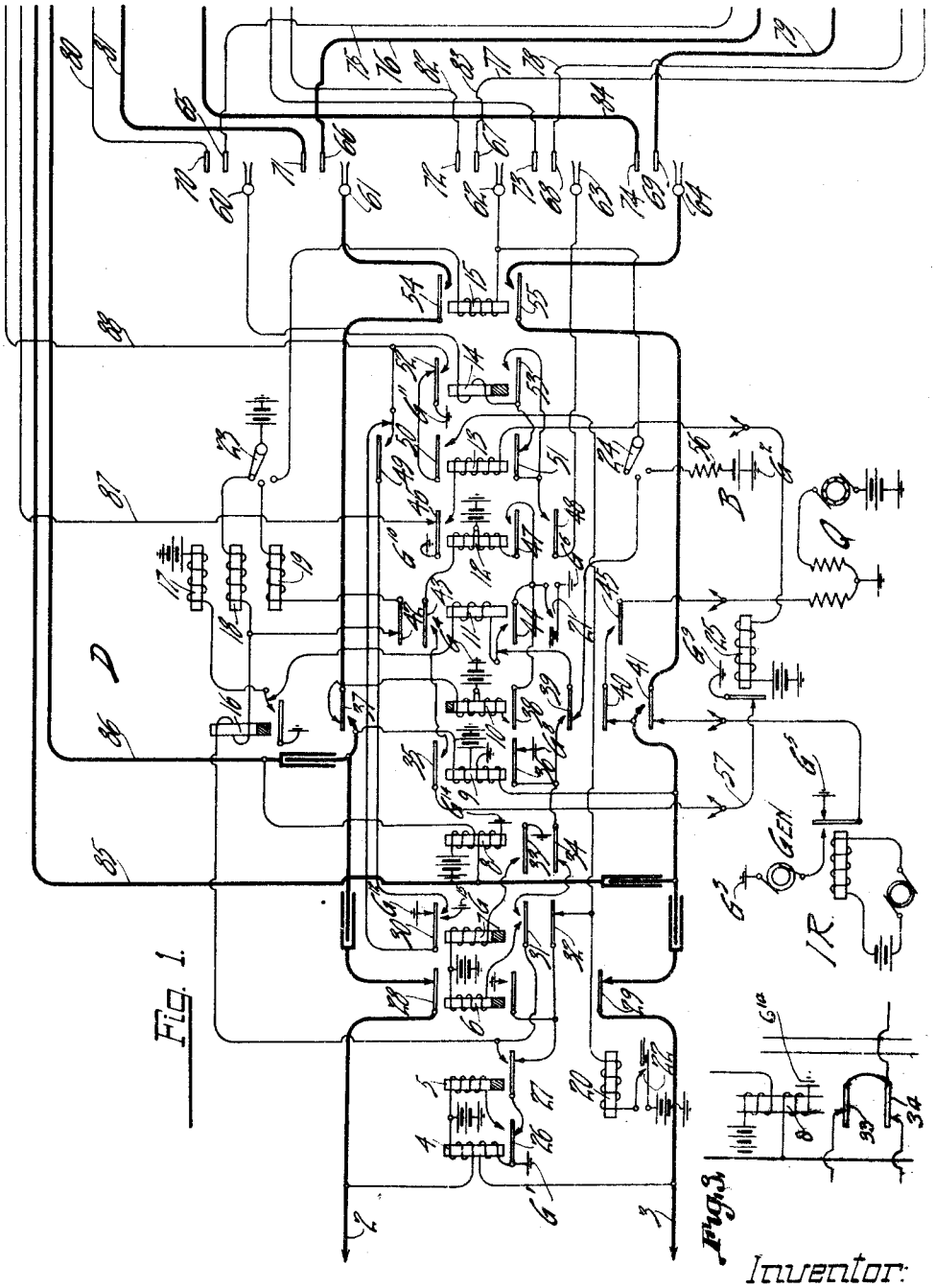


Fig. 1.

Fig. 3.

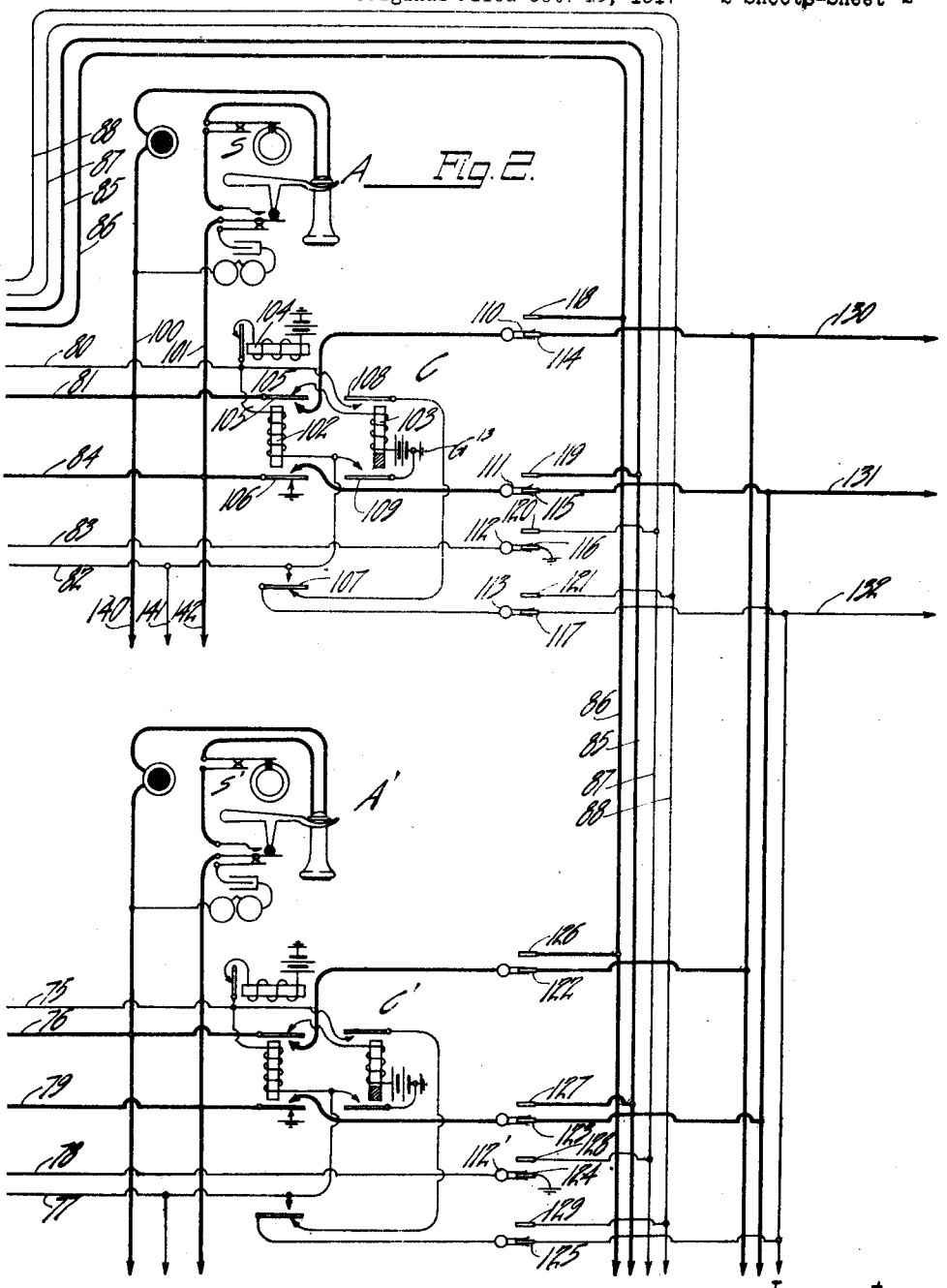
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Original Filed Oct. 13, 1917 2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

RODNEY G. RICHARDSON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

AUTOMATIC TELEPHONE SYSTEM.

Application filed October 13, 1917. Serial No. 196,380.

My invention relates in general to automatic telephone systems, but more particularly to such systems as comprise main and branch exchanges interconnected by trunk lines, the branch exchanges being of the type at present used in large numbers to supply telephone service to large manufacturing establishments, department stores, and the like; and the principal object of the invention is to provide means whereby main to branch exchange calls may be transferred automatically from one station to another at a branch exchange while the main exchange subscriber waits on the line.

Ordinarily if it should be desired to transfer a call from one station to another at the branch the main exchange subscriber would have to hang up his receiver and release the entire trunking connection, after which the connection would be reestablished precisely as before with the sole exception, in accordance with the usual practice, of the two final digits which control the final connector at the branch. It is extremely desirable to avoid the necessity of thus releasing the trunking portion of the connection, for to do so involves great inconvenience and waste of time on the part of the main exchange subscriber, and may also result in the loss of the trunk line during busy periods; and it will be apparent that a system in which incoming calls at a branch exchange can be transferred without releasing the trunk line in use will be very advantageous in practice.

With this object in view, therefore, I have designed a simple and effective method of transferring calls automatically, under local control, the essential features of which are fully described and explained in the following specification, and illustrated in the drawings forming a part thereof.

The drawings, comprising Figs. 1 and 2, should properly be arranged in order with corresponding lines at the adjacent edges thereof in alignment; and when so positioned show diagrammatically a trunk line 2—3 terminating in the incoming connector D (Fig. 1) at a branch exchange, two substations A and A′ (Fig. 2) which are accessible to the incoming connector, and individual line or trunk selecting switches C and C′ which are associated with the line of substations A and A′, respectively. There is also shown to the right of Fig. 2 a trunk line comprising conductors 130, 131 and 132 which terminates in a local connector switch (not shown).

Fig. 3 shows a modification of the connection of relay 8 of Fig. 2. This modification arranges the circuit so that the first called party is automatically disconnected from the connection after he has transferred the call to another called party in accordance with one of the objects of this invention.

The subscribers' stations such as the substations A and A′ are of the usual common battery type in which the transmitter and receiver are connected in series. Each substation is also provided with a calling device which is preferably of the type in which a reciprocating dial is operated by the subscriber to produce series of interruptions in the line circuit in accordance with the digits in called numbers. A calling device which is suitable for the purpose is shown in the British patent to Dicker #29,654 of 1910.

The individual line switches, such as the line switches C and C′, are of the well known rotary type in which the wipers have no normal position. A rotary line switch of suitable construction is described in the patent to Lamb, No. 1,193,160, granted August 1st, 1916.

The connector switches including both the incoming connectors and the local connectors are mechanically of the type disclosed in the patent to Keith, Erickson and Erickson, No. 815,176, granted March 13, 1906. The circuits are modified, however, in accordance with the two-wire system of control and the circuits of the incoming connectors are further modified to accomplish the objects of this invention as will be fully explained hereinafter. In regard to the local connectors these switches are preferably of the type commonly known as selector connectors, the construction and utility of which are explained fully in the patent to Deakin No. 1,164,479, granted December 14, 1915.

The main exchange is assumed to be of the modern two-wire type well known in the art and needs no detailed description. Reference is made, however, to the patent to A. H. Blessing, No. 1,176,269, granted March 21, 1916, which shows two-wire se-

lector, connector and repeater circuits. The trunk line comprising conductors 2 and 3 may be one of a group of trunk lines which terminate in a certain second or third selector level at the main exchange, and which extend through repeaters to the branch exchange, terminating there in incoming connectors like the connector D (Fig. 1). As shown herein the trunk line terminating in the incoming connector D is adapted for use in one direction only, that is, it can only be used on calls from the main exchange to the branch exchange. Connections in the reverse direction may be handled by a separate group of trunk lines (not shown) which are accessible to the local selector connectors. It will be understood of course that by the usual expedients the trunk line shown can be adapted for two way service. But since my invention is not particularly concerned with this it has been considered advisable to show the trunk line in the simplest form possible.

Considering the local trunking in the branch exchange somewhat more in detail, the banks of all the individual line switches are connected in multiple and contain terminals of trunk lines extending to the local selector connectors as is usual and also in accordance with this invention contain terminals of special trunks which extend to the incoming connectors. Thus in Fig. 2 there is shown a local connector trunk comprising conductors 130 to 132, inclusive, which is multipled to the contact set comprising contacts 114 to 117 in the bank of the line switch C and also to a contact set comprising contacts 122 to 125, inclusive, in the bank of the line switch C'. A special trunk extending to the incoming connector D is also shown comprising conductors 85 to 88, inclusive, which terminate in the contact set comprising bank contacts 118 to 121, inclusive, of line switch C, being also multipled to corresponding contact sets in the line switch C' and the other line switches. Sufficient local selector connectors will of course be provided to handle the maximum number of simultaneous local and branch to main exchange calls. Likewise the incoming connectors and associated trunk lines will also be provided in sufficient number to handle the main to branch exchange calls. Ordinarily more local connectors will be required than incoming connectors, and if we assume that there are ten of the former and 5 of the latter every third contact set in the line switch banks may be assigned to a special incoming connector trunk. This means of course that the two kinds of trunks which terminate in the line switch banks are not segregated but on the contrary are arranged alternately. It will be observed that the line switches are provided with fourth wipers which in the case of line switches C and C' are indicated by reference characters 112 and 112'. All test contacts engaged by these wipers and corresponding wipers in other line switches which are associated with local trunk lines are permanently grounded.

All the lines in the branch exchange are of course accessible both to the local connectors and to the incoming connectors. Considering the line of substation A it will be seen that a group of normal conductors including conductors 80 and 84, inclusive, extend from the individual line switch C to a contact set comprising bank contacts 70 to 74, inclusive, in the bank of the incoming connector, being multipled in the usual way to corresponding contact sets in the banks of the other incoming connectors. There is also shown a group of normal conductors comprising conductors 140 to 142, inclusive, which it will be understood extend to multiple contact sets in the banks of the local connectors. The line of substation A' and the other lines in the branch exchange are similarly connected.

While I have shown throughout the drawings a plurality of batteries it will be understood that there is preferably but one battery having its positive pole grounded. In order not to encumber the drawings unnecessarily, reference characters have not been applied to the separate batteries shown, and it will be understood that where in the specification a circuit is traced "to battery" it extends to the live or ungrounded pole of the main battery at the branch exchange. There is also provided a small auxiliary battery B shown near the bottom of Fig. 1 whose function will be explained hereinafter. The reference characters Q and IR indicate, respectively, a busy signalling machine and intermittent ringing equipment which are of the usual type common in other automatic telephone systems.

Having given a brief description of the apparatus involved I will now proceed to explain the operation of the invention. For this purpose it will first be assumed that a calling subscriber in the main exchange desires to obtain a connection with the branch exchange subscriber at substation A and it will be further assumed that the calling subscriber has operated a series of automatic switches in the main exchange to establish connection with the trunk line comprising conductors 2 and 3 which terminate at the branch exchange in the incoming connector D. When connection with the trunk line is established a bridge is closed across the trunk conductors in the usual manner at the repeater in the main exchange and the line relay 4 of the incoming connector is energized in the well understood manner. Upon attracting its armature relay 4 completes the usual circuit for the slow acting release re-

lay 5, which upon energizing in turn, prepares the usual circuit for the vertical and rotary magnets 18 and 19. The calling subscriber may now operate his calling device in accordance with the first of the two digits which are to control the operation of the connector D. A series of interruptions is accordingly produced in his line circuit which are repeated in the well known manner by the main exchange repeater into the energizing circuit of the line relay 4. The line relay will therefore be deenergized a number of times and at each deenergization transmits an impulse of current to the vertical magnet over the following path: ground at G^1, armature 26 and its resting contact, armature 27 and its working contact, winding of the low resistance slow acting private control relay 16, winding of the vertical magnet 18, and the side switch wiper 23 in first position to battery. By the operation of the vertical magnet the shaft of the incoming connector is raised step by step until the wipers 60 to 64, inclusive, arrive opposite the required horizontal level of bank contacts. Relay 16 is energized in series with the vertical magnet, and being slow acting, retains its armature during the series of impulses to close an energizing circuit for the private magnet 17. At the end of the vertical movement of the switch, relay 16 and the private magnet are deenergized, the latter controlling the side switch in the usual manner to advance its wipers to their second position.

The calling subscriber may now operate his calling device in accordance with the final digit, thereby producing another series of interruptions in his line circuit which are repeated as before to cause deenergizations of the line relay 4. Now, however, the side switch wiper 23 being in its second position, the line relay sends at each deenergization an impulse to the rotary magnet 19 in the well understood manner. In response to these impulses the rotary magnet is operated to rotate the wipers 60 to 64, inclusive, until they come into engagement with bank contacts 70 to 74, inclusive, these contacts being the ones comprising the contact set which is allotted to the line of substation A. The slow acting relay 16 and the private magnet 17 are operated during the second series of impulses as before and at the end of the rotary movement of the switch if the called line is idle the private magnet is deenergized to advance the side switch wipers to their third position.

When the side switch wiper 24 comes into engagement with its third position contact point a circuit is completed for the combined cut off and switching relay 102 of the individual line switch C as follows: ground at G^2, auxiliary battery B, resistance 56, side switch wiper 24 in third position, test wiper 62, test contact 72, conductor 82, winding of relay 102, and the winding of the stepping magnet 104 to battery. Relay 102 is operated over the above circuit to cause its armatures to break away from their back contacts thus clearing the line of substation A of its normal battery and ground connections in the line switch. Owing to the interlocking arrangement between the armatures of relays 102 and 103, however, relay 102 is not able to fully attract its armature and the wipers of the line switch accordingly remain disconnected. Ground potential (as increased by the auxiliary battery B) extends to multiples of test contact 72 in the banks of the other incoming connectors and also by way of conductor 141 to the multiple test contacts in the banks of the local connectors in order to render the line of substation A busy. At the connector D the switching relay 15 is energized in parallel with the relay 102 of the line switch C over a branch circuit which may be traced from the test wiper 62 by way of the winding of the said relay 15 and the side switch wiper 23 in third position to battery. Upon energizing the said relay 15 completes a signalling circuit over the called line as follows: ground at G^3, ringing generator Gen, contact of the ringing interrupter IR, resting contact of armature 41 and the said armature, armature 55 and its working contact, wiper 64, bank contact 74, conductor 84, line conductor 101, through the ringer at substation A, line conductor 100, conductor 81, bank contact 71, wiper 61, working contact of armature 54 and the said armature, armature 37 and its resting contact, upper winding of the ring cut off relay 10, and the main battery to ground at G^4. By the operation of the ringing equipment IR the ringing generator Gen is intermittently cut out of the above circuit and the ground connection at G^3 is substituted therefor from which it follows that the ringer at substation A will be sounded at intervals to call the subscriber to the telephone. The ring cut off relay 10 is so adjusted that it does not energize as long as the receiver at the called station remains on the hook.

The required connection has now been completed and the bell at the called station is being operated intermittently. When the receiver is removed the cut off relay 10 at the connector D is instantly energized either by current from the main battery alone or by current from the battery and ringing generator in series, and upon attracting its armature establishes a locking circuit for itself as follows: ground at G^6, off normal contact 21 (closed at the first upward movement of the switch shaft), armature 38 and its working contact, and the lower winding of the cut off relay 10 to battery. The ring cut off relay 10 also opens a contact in the busy signalling circuit at its armature 40, prepares a circuit for the relay 11 at its

armature 39, and at its armatures 37 and 41 disconnects its own upper winding and the lead from the ringing machine and closes the talking circuit. The back bridge relay 9 is now connected in bridge of the called line and is energized in the usual way over the called line circuit. At this point it should be mentioned that the ring cut off relay 10 is so adjusted that armatures 37 and 41 engaged their working contacts before the armature 39 engages its working contact. This adjustment is made in order to connect the back bridge relay 9 across the called line and permit it to energize before the contact in the circuit of relay 11 is closed at armature 39. Relay 11 is given a stiff adjustment and may be permitted to receive a slight impulse of current during the energization of relays 10 and 9 without ill effect, it being understood that it remains inoperative at this time. In addition to opening the circuit of relay 11 at its armature 36 as explained, the back bridge relay 9 prepares at its armature 35 a circuit for relay 12 which will be described later.

The required connection has now been established. Talking current for the transmitter at the calling station may be supplied in any suitable manner at the main exchange, preferably through the windings of the line relay of the repeater; while talking current for the transmitter at the called substation A is supplied through the windings of the back bridge relay 9. The voice currents follow the path shown in heavy lines which will be apparent without further explanation.

So far there has been nothing unusual in the process of setting up the connection. The release of the connector D is under the control of the calling subscriber who by replacing his receiver will deenergize the relays 4 and 5 and thus close the circuit of the release magnet 20, off normal contact 22 now being closed and relay 7 being deenergized. We will suppose, however, that before finishing with the business he has in hand the calling subscriber finds it necessary to communicate with some other person or official of the concern served by the branch exchange. The necessity for calling a second party may arise from various reasons with which we are not especially concerned, perhaps the right party was not obtained in the first place; but however this may be, occasions on which calls must be transferred will arise quite frequently. Assuming then that connection with another party is desired, the subscriber at substation A′ for instance, the party at substation A will offer to transfer the call and this being agreeable to the calling subscriber will proceed to do so in the following manner.

The first operation is to pull down the receiver hook at substation A for an instant and then release it. When the receiver hook is pulled down the circuit of the called line is broken and the back bridge relay 9 is deenergized to complete a circuit for relay 11 as follows: ground at G^8, resting contack of armature 36 and the said armature, working contact of armature 39 and the said armature, contact springs controlled by armature 44 of relay 11, the winding of the said relay, contact springs controlled by the armature of relay 16, and the winding of the private magnet 17 to battery. Relay 11 is sufficiently high in resistance to prevent the operation of the private magnet. Upon energizing, relay 11 closes a locking circuit for itself at its armature 44 in an obvious manner and at its armature 43 prepares a circuit for the upper winding of relay 12. The operation of armatures 42 and 45 of relay 11 is without particular function at this time. The receiver hook at substation A is held down momentarily and as soon as it rises the back bridge relay 9 is again energized. A circuit for relay 12 is now completed as follows: ground at G^9, armature and resting contact of the common relay 25, common conductor 57, armature 35 and its working contact, working contact of armature 43 and the said armature, and the upper winding of relay 12 to battery. Upon energizing, relay 12 closes a locking circuit through its lower winding by way of its armature 47; at the resting contact of armature 46 disconnects ground G^{10} from conductor 87 and from test contact 120 and its multiples in the banks of the individual line switches; at the working contact of the same armature completes an energizing circuit through the relay 13 in series with the common relay 25; and at its armature 48 closes a circuit for the stepping magnet 104 of the line switch C as follows: grounded test contact engaged by the test wiper 112 (test contact 116 or similar test contact associated with some other trunk), test wiper 112, conductor 83, bank contact 73, wiper 63, armature 48 and its working contact, armature 51 and its resting contact, winding of the low resistance slow acting relay 14, wiper 60, bank contact 70, conductor 80, interrupter contact of the stepping magnet 104, and the winding of said stepping magnet to battery. Before proceeding it will be necessary to know certain relay adjustments that are necessary to insure correct operation. Armature 48 of relay 12 is adjusted to close the circuit including relay 14, the circuit just traced, before armature 46 closes the circuit of relay 13, thereby permitting relay 14 to energize slightly before relay 13. The attainment of this result may also be facilitated by giving relay 13 a stiff adjustment so that it will not operatively energize until its core is nearly saturated. Relay 13 need be only slightly

behind relay 14 in operating, but some difference is necessary in order to permit relay 14 to close its own circuit at its armature 53 before it is opened at the armature 51 of relay 13. It is also necessary to have armature 52 separate from its resting contact before armature 50 of relay 13 engages its working contact. The necessary adjustments are readily made and cause no difficulty whatever in practice. In its energized position relay 14 connects ground G^{11} to the conductor 88 in order to maintain the test contact 121 in the bank of the line switch C and its multiples in the banks of the other line switches grounded after ground G^{12} is disconnected by the operation of armature 49 of relay 13.

An energizing circuit has now been completed for the stepping magnet 104 of the line switch C, which includes the test wiper 112 of the line switch and the slow acting relay 14 of the incoming connector. Since the stepping magnet 104 interrupts its own circuit, it will operate intermittently and the line switch C will be advanced, similar to a finder switch, in search of the special trunk line extending back to the incoming connector D. The hunting movement of the line switch C is under the control of the test wiper 112 and will continue as long as this test wiper engages grounded test contacts such as the test contact 116. Inasmuch as all test contacts engaged by the wiper 112 which are associated with local trunk lines are permanently grounded, and inasmuch as all such test contacts which are associated with the other special trunks are also grounded, the advance of the line switch C will continue until the test wiper 112 arrives at the test contact 120 from which ground potential has been removed by the operation of relay 12 of the incoming connector. It should be noted at this point that the cut off relay 102 of the line switch C is held energized while the line switch is operating as a finder switch by current flow from the auxiliary battery B. When the test wiper 112 arrives at test contact 120 then since it finds no ground potential the circuit of the relay 14 at the connector and the stepping magnet 104 of the line switch will be broken and the line switch C will come to rest with its wipers 110 to 113, inclusive, in engagement with bank contacts 118 to 121, inclusive. Slow acting relay 14 which during the operation of the line switch C has maintained its armatures continuously attracted is now deenergized and at the working contact of armature 52 disconnects ground G^{11} from conductor 88 while at the resting contact of the same armature a circuit is closed for the release magnet 20 as follows: ground at G^{11}, armature 52 and its resting contact, armature 50 and its working contact, winding of the release magnet 20, and the off normal contact 22 to battery.

By the operation of the release magnet 20 the incoming connector D is restored to normal position in the usual manner. At the beginning of the release of the switch the energizing circuit of the cut off relay 102 of line switch C is opened at the side switch wiper 24 of the connector (or at test wiper 62, it is immaterial which), and this relay immediately deenergizes. The receiver being off at substation A the line relay 103 is now energized in the usual manner over the line circuit and upon attracting its armature closes a new energizing circuit for the relay 102 as follows: ground at G^{13}, armature 109 and its working contact, winding of the relay 102, interrupter contact of the stepping magnet 104, and the winding of the stepping magnet to battery. At the same time that the above circuit is closed the line relay also connects the test wiper 113 to the junction of relay 102 and the stepping magnet as follows: test wiper 113, armature 107 and its resting contact, armature 108 and its working contact to the said junction point. There being no ground potential upon the test contact 121, it having been removed by the deenergization of the relay 14 of the incoming connector, the stepping magnet 104 will not be operated and the relay 102 will instantly energize to extend the line conductors 100 and 101 by way of its armatures 105 and 106 to the line wipers 110 and 111, respectively. An energizing circuit is thus completed for the relay 8 of the incoming connector as follows: ground at G^{14}, lower winding of relay 8, conductor 85, bank contact 119, wiper 111, working contact of armature 106 and the said armature, line conductor 101, to and through the substation A, line conductor 100, armature 105 and its working contact, wiper 110, bank contact 118, conductor 86, and the upper winding of relay 8 to battery. Upon energizing, relay 8 completes a circuit for the slow acting relay 7 at its armature 33. The relay operations at line switch C by which the line of substation A is connected to the special trunk are initiated at the beginning of the release of the incoming connector and since they take place very rapidly the relay 8 of the connector will be energized some time before the connector has been entirely restored to normal position. When relay 7 energizes therefore in response to the closure of its circuit by the line relay a holding circuit will be completed for the relay 102 of the line switch C as follows: ground at G^{15}, working contacts of armature 30, armature 49 and its working contact, conductor 88, bank contact 121, test wiper 113, armature 107 and its working contact, winding of relay 102, and the winding of the stepping magnet 104 to battery. As soon as

the connector D becomes completely restored the off normal contacts are broken and at off normal contact 21 the locking circuits of relays 10, 11 and 12 are opened. These relays accordingly deenergize and relay 12 breaks the circuit including the relay 13 and the common relay 25. When the relay 13 deenergizes the holding circuit for the relay 102 of the line switch C is altered slightly without being opened, however, the springs controlled by the armature 49 being of the make before break type. By the deenergization of the common relay 25 the common conductor 57 is again connected to ground G^9 and calls may now be transferred at other connectors in the group. It will be understood of course that the function of the relay 25 is to prevent two line switches from being operated as finder switches simultaneously.

The foregoing operation by which the line of substation A has been extended into connection with the special trunk leading back to the incoming connector and whereby the said connector has been released have occurred automatically in response to the momentary pulling down of the receiver hook at the substation. These operations take place with great rapidity and are completed within not more than one seconds time. The subscriber at substation A may now proceed to call the number of substation A'. At the first operation of the dial a series of interruptions is produced in the circuit of the relay 8 of the incoming connector, thereby causing this relay to deenergize momentarily a corresponding number of times. At each deenergization of this line relay a circuit is completed for the vertical magnet 18 as follows: ground at G^8, resting contact of armature 36 and the said armature, armature 34 and its resting contact, working contact of armature 31 and the said armature, winding of the vertical magnet 18 and the side switch wiper 23 in first position to battery. The above circuit of the vertical magnet is substantially the same as the one previously described except that it is controlled by the relays 8 and 7 of the connector rather than by the relays 4 and 5. Evidently then, the connector switch D is operated in response to these series of impulses and a subsequent series of impulses to establish connection with the line of substation A'. The operation of the connector under these circumstances being precisely like its operation in the first instance it will be unnecessary to again explain it in detail. It should be mentioned, however, that while the connector is operating under control of the substation A the slow acting relay 6 will be energized in parallel with the operating magnets to open the incoming line conductors at its armatures 28 and 29. This is done in order that the main exchange subscriber who is waiting on the line may not be disturbed by the interruptions produced by the calling device at substation A.

The called subscriber at substation A' is signalled in the usual way and when he responds the ring cut off relay 10 and the back bridge 9 of the incoming connector are energized as before. The call has now been transferred from substation A to substation A' and the talking circuit which has been established including the latter substation is precisely the same as though substation A' were the station first called. The subscriber at substation A is still in on the connection, however, in fact all three subscribers are now connected together in what may be termed a three party talking circuit. If necessary for the proper transaction of the matter under consideration the subscriber at substation A may remain connected; ordinarily, however, as soon as he perceives that the conversation has started satisfactorily on the main connection he will replace his receiver in order to disconnect his own line from the talking circuit. When the receiver is replaced at substation A the energizing circuit of the relay 8 is broken and this relay deenergizes without, however, affecting relay 6 in any way for ground G^8 is disconnected at armature 36 of the back bridge relay 9. But at armature 33 of the relay 8 the circuit of the slow acting relay 7 is broken and this relay upon deenergizing momentarily interrupts the holding circuit of the relay 102 of the line switch C. The holding circuit is only broken momentarily while the armature 30 of relay 7 is passing from its working to its resting contact but this break is sufficient to permit relay 102 to deenergize at least partially, whereupon it breaks its own circuit at its armature 107. By the deenergization of relay 102 the line switch C is restored to normal position ready for another call. In case the receiver should again be removed at substation A the line switch C will not again establish connection with the special trunk line for the test contact 121 is now connected to ground G^{12} at the resting contact of armature 30 of the incoming connector; the line switch will therefore operate in the usual manner to select a trunk line leading to an idle local connector switch.

If it should be necessary to transfer the call to still another substation this can be done by the subscriber at substation A' in the same way that it was accomplished by the subscriber at substation A as already described. Otherwise when the conversation is finished both subscribers will replace their receivers and the incoming connector D will be released in the usual manner upon the deenergizations of the relays 4 and 5. It will be noted that while a call is being transferred as by the substation A in the case just explained for example, the release magnet cir-

cuit is opened at the armature 32 of the slow acting relay 7. This is done in order to prevent the release of the connector in case the calling subscriber at the main exchange should accidentally break the connection or through some misunderstanding should hang up his receiver. It is desirable to prevent any interference with the branch subscriber who is transferring the call to another station.

In the operation of transferring calls as above explained the branch exchange subscriber first called and who transfers the connection to another station is permitted to remain in on the connection as long as he desires. Ordinarily this is the preferred method of operating, but it may happen in some installations that it is considered best not to have more than two subscribers connected together simultaneously. In other words, it may be desired to prevent a subscriber who has transferred a call to another subscriber from listening to the subsequently ensuing conversation. In order to accomplish this, direct ground is removed from the armature 33 of the relay 8 and the said armature is connected with armature 34 as shown in Fig. 3, both armatures being supplied with ground by way of the armature 36 of the back bridge relay 9. The incoming connectors being wired in this manner, when a call is transferred from one station to another at the branch, upon the response of the party to whom the call is transferred and the consequent energization of the back bridge relay of the connector, relay 9 of the connector D for example, ground will be disconnected from the relay 7 of the same connector which controls the holding circuit for the line switch associated with the line of the party first called and the line switch is accordingly released to cut this party out of the conversation.

An alternative method of transferring the call which may be mentioned consists in the operation of the incoming connector by the main exchange subscriber rather than by the subscriber at the branch exchange. Ordinarily of course it will be most convenient for the branch exchange subscriber to transfer the call, as he is generally more familiar with the local numbers at the branch exchange than the main exchange subscriber would be. But at times the called subscriber at the branch exchange may be too busy to bother with the connection and in such cases he will merely operate his receiver hook to bring about the release of the incoming connector and will then advise the main exchange subscriber of the proper number to call. He will then replace his receiver and the main exchange subscriber can complete the connection as previously described.

In the foregoing no attention has been paid to the possibility of the called line being busy and a brief explanation will now be given of the operation of the incoming connector D under such conditions. If in the connection first described the substation A had been busy there would have been a ground potential upon the test contact 72. This being the case when the connector D is operated to establish connection with the line and the slow acting relay 16 deenergizes at the end of the rotary movement of the switch a circuit is completed for the test relay 11 as follows: ground on test contact 72 (either direct or by way of auxiliary battery B as explained) test wiper 62, side switch wiper 24 in second position, resting contact of armature 39 and the said armature, contact springs controlled by armature 44 of relay 11, winding of the said relay, contact springs controlled by the armature by relay 16, and the winding of the private magnet 17 to battery. The above circuit is completed at relay 16 just before the usual energizing circuit of the private magnet is broken and serves to maintain the private magnet energized to hold the side switch wipers in their second position. Upon energizing, relay 11 locks itself at its armature 44 to ground G^6, at its armature 42 opens the rotary magnet circuit, and at its armature 45 connects a lead from the busy signalling machine Q to one side of the calling line. A distinctive tone is thus transmitted to the calling subscriber who will be advised thereby that the desired connection is for the present unobtainable. He will therefore replace his receiver and the automatic switches used in the connection will restore to normal position.

In the event that the substation A is busy at the time that the subscriber at A attempts to transfer a call thereto, busy potential will be present upon the associated test contacts, such as 67, which are encountered by the connector test wiper 62. The operation of the connector to apply busy tone in this case is the same as just described, except that the busy tone is conducted to both the calling subscriber and the called subscriber at A. Upon hearing this busy tone the subscriber at A replaces his receiver, thereby breaking the circuit previously described for relay 8, which restores and at armature 33 opens the circuit for relay 7. Relay 7, upon restoring, closes the circuit to the release magnet 20 at armature 32, thereby causing the release magnet to operate and release the switch in the well known manner. Relay 7 also opens the circuit of relay 6 which is a slow to release relay and which remains in operated position long enough to permit magnet 20 to release the switch. The calling subscriber then again removes his receiver, operating his line switch C to again connect him to the special trunks 85 and 86 in the manner

previously described. He may then inform the calling subscriber of the condition encountered, and instruct him to wait while he tries the connection again, or he may transfer the call to another local station.

It will be seen that I have devised a simple and practical method of transferring calls at a branch exchange without making it necessary for the calling subscriber at the main exchange to release the trunking connection, the transfer being accomplished by the subscriber first called at the branch who is enabled by my invention to operate his line switch as a finer switch to locate the incoming connector in use and release it, whereupon the said connector is again operated to establish connection with another station. While I have described the invention in its preferred form it will be understood that modifications may be made by persons skilled in the art and I do not therefore wish to limit myself to the exact form shown and illustrated in the drawings but wish to include and have protected by Letters Patent all forms and modifications thereof which come within the scope of the appended claims.

What I claim as my invention is:

1. In a telephone system, calling and called shbscribers' lines, an automatic connector switch controlled by the calling subscriber to connect said lines, and means controlled by the called subscriber for releasing and reoperating said connector to connect the said calling line with another called line.

2. In a telephone system, a calling subscriber's line, an automatic connector switch controlled over said line to extend a connection to a called line, and means controlled over the said called line for releasing and reoperating said switch to transfer the call to another called line.

3. In a telephone system, subscribers' lines, an automatic switch operable to extend a connection to any one of said lines as a called line, and means under control of the subscriber on the connected called line for releasing and reoperating said switch to transfer the call to another called line.

4. In a telephone system, a trunk line for handling incoming calls to a branch exchange, a connector switch in which said trunk terminates, subscribers lines accessible to said switch as called lines, and means controlled by the subscriber on a connected called line for disconnecting the said connector from his line and operating it to transfer the call to another line.

5. In a telephone system, a trunk line for handling incoming calls to a branch exchange, a connector switch in which said trunk terminates and means for operating it to complete connections, and means controlled at the branch exchange independent of the calling subscriber for disconnecting said connector from any called line to which a connection has been completed and for reoperating the said connector to transfer the connection to another line.

6. In a telephone system, a subscriber's line, a connector switch and means for operating it to connect with said line, means controlled by the subscriber on the connected line for connecting his line with said connector over a different path, means for thereafter releasing said connector, and means controlled by said subscriber for then operating said connector to connect with another line.

7. In a telephone system, a connector switch, a called subscriber's line, a calling subscriber's line and means for controlling said switch over the calling line to connect the two lines, means controlled by the called subscriber for connecting his line with said switch over a different path, means for thereafter releasing said connector, and means controlled by the said called subscriber for operating said switch to connect the calling line with a second called line.

8. In a telephone system, subscribers' lines, line switches individual thereto for extending said lines when calling, a connector switch and means for operating it to extend a connection to one of said lines as a called line, means controlled by the subscriber on the connected called line for causing his line switch to connect his line with said connector over a different path, and means for thereafter releasing said connector.

9. In a telephone system, a calling subscriber's line, an automatic connector switch controlled over said line to extend a connection to a called line, means controlled over the said called line for releasing and reoperating said switch to transfer the call to another called line, and means whereby the subscriber who has transferred the call can stay in on the connection or cut himself out at his option.

10. In a telephone system, subscribers' lines, an automatic switch operable to extend a connection to any one of said lines as a called line, means under control of the subscriber on the connected called line for releasing and reoperating said switch to transfer the call to another called line, and means whereby the subscriber who has transferred the call can stay in on the connection or cut himself out at his option.

11. In a telephone system, a trunk line for handling incoming calls to a branch exchange, a connector switch in which said trunk terminates, subscribers' lines accessible to said switch as called lines, means whereby the subscriber on a connected called line can disconnect the said connector from his line and operate it to transfer the call to another line, and means whereby the sub-

scriber who has transferred the call can stay in on the connection or cut himself out at his option.

12. In a telephone system, a subscriber's line, a connector switch and means for operating it to connect with said line, means controlled by the subscriber on the connected line for connecting his line with said connector over a different path, means for thereafter releasing said connector, means controlled by said subscriber for then operating said connector to connect with another line, and means responsive to the replacement of the receiver on the line first called for disconnecting such line from said connector.

13. In a telephone system, a calling subscriber's line, an automatic connector switch controlled over said line to extend a connection to a called line, means controlled over the said called line for releasing and reoperating said switch to transfer the call to another called line, and means for preventing the calling subscriber from releasing said switch while the call is being transferred.

14. In a telephone system, a calling subscriber's line, an automatic connector switch controlled over said line to extend a connection to a called line, means controlled over the said called line for releasing and reoperating said switch to transfer the call to another called line, and means for preventing disturbance in the receiver at the calling station while the call is being transferred.

15. In a telephone system, a trunk line for handling incoming calls to a branch exchange, a connector switch in which said trunk terminates, subscribers' lines accessible to said switch as called lines, means whereby the subscriber on a connected called line can disconnect the said connector from his line and operate it to transfer the call to another line, and means for disconnecting the talking conductors of said trunk line from the talking conductors of said switch while the call is being transferred.

16. In a telephone system, a trunk line for handling incoming calls to a branch exchange, a connector switch in which said trunk terminates and means for operating it to complete connections, means controlled at the branch exchange independent of the calling subscriber for disconnecting said connector from any called line to which a connection has been completed and for reoperating the said connector to transfer the connection to another line, and means for preventing disturbance in the receiver at the calling station while the call is being transferred.

17. In a telephone system comprising main and branch exchanges, a connector at the branch exchange for completing a main to branch exchange connection, automatic means for releasing said connector when any station is called without disturbing the rest of the connection, and means whereby the said connector may be reoperated from either the calling or the called station to transfer the call to another station.

18. In a telephone system comprising main and branch exchanges and an interconnecting trunk line, a connector switch at the end of the trunk line for completing main to branch exchange connections, a circuit for operating said connector including the two sides of said trunk line in series, and a circuit for releasing said connector from any called station and for holding the trunking connection in order to permit a subsequent operation of the same to transfer the call to another station.

19. In a telephone system, an automatic switch and means for starting it from two different points, two groups of trunks accessible to said switch, and electromagnetic means for operating said switch when started from one point to select the first idle trunk in one of said groups, and for operating said switch to pass over idle trunks and select a designated trunk in the other group when started from the other point.

20. In a telephone system, a line terminating in an automatic switch, two groups of trunk lines accessible to said switch, means for operating said switch as a trunk selector to connect said line with the first idle trunk in one of said groups, means for operating said switch as a finder switch to connect said line with a designated trunk in the other group, and suitable test circuits in said switch for controlling its operation in each case.

21. In a telephone system, a subscriber's line circuit, a combined trunk selector and finder switch at the exchange individual to said line, two kinds of trunk lines terminating in fixed contacts in said switch, and means for operating said switch as a trunk selector or as a finder switch depending on the kind of trunk line with which it is desired to connect.

22. In a telephone system, a subscriber's line, trunk lines, a line switch controlled over the line when calling to select and connect with an idle trunk line, other trunk lines normally unselectable, means for connecting with said subscriber's line as a called line, means for then operating said switch to pick out a desired one of said other trunks and render the same selectable, and means for then operating said switch as in the first instance when the line is calling, whereby connection with said trunk is established.

23. In a telephone system, a subscriber's line and line switch individual thereto, two groups of trunk lines accessible to said switch, means for causing said switch to function as a trunk selector in response to the initiation of a call over said line to se-

lect and connect with an idle trunk line in the first group, means for causing said switch to function as a finder switch when the line is called to select a trunk line of the other group, and means for then causing the switch to function as a trunk selector to establish connection with the trunk thus selected.

24. In a telephone system, subscribers' lines and individual line switches, a group of connectors accessible to said line switches when the associated lines are calling and having access to said lines, a second group of connectors also having access to said lines, but inaccessible thereto when the lines are calling, and trunk lines extending to the connectors of said second group, respectively, and terminating in the banks of said line switches.

25. In a telephone system, subscribers' lines and individual line switches, a group of connectors accessible to said line switches when the associated lines are calling and having access to said lines, a second group of connectors also having access to said lines, and trunk lines extending to the connectors of said second group, respectively, and terminating in the banks of said line switches, said trunk lines being unselectable when the said subscribers' lines are calling, and means whereby when a line is called by a connector of the second group the trunk line associated with such connector may be made selectable.

26. In a telephone system, a connector switch having a line or controlling relay, a trunk line terminating in said relay, a plurality of subscribers' lines accessible to said switch, individual switches for said lines, and a second trunk line multipled in said individual switches and terminating in a second controlling relay in said connector.

27. In a telephone system, a connector switch having a line or controlling relay, a trunk line terminating in said relay, a plurality of subscribers' lines accessible to said switch, individual switches for said lines, a second trunk line multipled in said individual switches and terminating in a second controlling relay in said connector, and inductive connections joining the talking conductors of one trunk line, respectively, with the talking conductors of the other.

28. In a telephone system, a line and an automatic switch for connecting said line with other lines, a motor magnet for said switch and a local energizing circuit therefor, a plurality of other switches having access to said line, and means for closing another energizing circuit for said magnet extending through any one of said other switches.

29. In a telephone system, two electromagnets having high and low resistance windings, respectively, connected in series, two batteries or other sources of current also connected in series, there being a closed series circuit through the said batteries and magnets and one of said magnets being inoperative due to the high resistance of the other, and means for connecting the junction of said batteries to the junction of said magnets to operate the normally inoperative magnet.

30. In a telephone system, a series of selector switches, a final connector accessible to the last of said selectors, means for operating said switches over the two sides of a calling line in series to set up a telephone connection, means for releasing said connector while retaining all of said selectors in operated position and while retaining a connection with the called line, and means for reoperating said connector over the calling line to set up a new connection.

31. In a telephone system, a series of selector switches, a final connector accessible to the last of said selectors, means for releasing said switches over the two sides of a calling line in series to set up a telephone connection, means for establishing a substitute for said connection for operating said connector while retaining all of said selectors in operated position, said releasing means controlled by the subscriber on the line called, and means for reoperating said connector over the calling line to set up a new connection.

32. In a telephone system, a series of selector switches, a final connector accessible to the last of said selectors, means for operating said switches over the two sides of a calling line in series to set up a telephone connection, means for releasing said connector and means whereby either party to said connection can reoperate said connector to set up a new connection, while retaining all of said selectors in operated position.

33. In a telephone system, calling and called lines, automatic switches controlled from one of said calling lines for extending a connection to one of said called lines, and means controlled from the said called line for releasing one of said automatic switches and for reoperating it through the medium of a different controlling means in the switch in order to extend the connection to another of said called lines.

34. In a telephone system, telephone lines, automatic switches, means under the control of a subscriber on a calling one of said lines for operating a series of said automatic switches in order to extend a connection to a called one of said telephone lines, and means under the control of the subscriber on the said called line for releasing and reoperating part of said series of automatic switches without relinquishing the control thereof.

35. In a telephone system, telephone lines, automatic switches, means under the con-

trol of a subscriber on a calling one of said lines for operating a series of said automatic switches in order to extend a connection to a called one of said telephone lines, and means under the control of the subscriber on the said called line for releasing part of said series of automatic switches while still maintaining a connection with the said calling line.

36. In a telephone system, telephone lines, automatic switches, means under the control of a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, means under the control of the subscriber on the said called line for releasing part of said series of switches and for extending a connection around the released part of said series of switches.

37. In a telephone system, telephone lines, automatic switches, means under the control of a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, means including an automatic switch under the control of the subscriber on the said called line for releasing part of said series of switches and for extending a connection around the released part of said series of switches.

38. In a telephone system, telephone lines, automatic switches, means under the control of a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, means including a finder switch under the control of the subscriber on the said called line for releasing part of said series of switches and for extending a connection around the released part of said series of switches.

39. In a telephone system, telephone lines, automatic switches, means under the control of a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, a line switch individual to said called line, and means controlled by the subscriber on the called line for causing the operation of said individual switch to release part of said series of automatic switches.

40. In a telephone system, telephone lines, automatic switches, means under the control of a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, a line switch individual to said called line, and means controlled by the subscriber on the called line for causing the operation of said individual switch to release part of said series of automatic switches, while still maintaining a connection with said calling line.

41. In a telephone system, telephone lines, automatic switches, means under the control of a subscriber on a calling one of said lines for operating a series of said automatic switches to extend a connection to a called one of said lines, and means controlled by the subscriber on the called line for establishing a new connection with the calling line before the first established connection is released.

42. In a telephone system, telephone lines, automatic switches, means under the control of a subscriber on a calling one of said lines for operating a series of said automatic switches to extend a connection to a called one of said lines, and means controlled by the subscriber on the called line for establishing a new connection with the calling line and for then releasing said first established connection.

43. In a telephone system, telephone lines, automatic switches, means under the control of a subscriber on a calling one of said lines for operating a series of said automatic switches to extend a connection to a called one of said lines, and an automatic switch controlled by the subscriber on the called line for establishing a new connection with the calling line.

44. In a telephone system, telephone lines, automatic switches, means under the control of a subscriber on a calling one of said lines for operating a series of said automatic switches to extend a connection to a called one of said lines, and an automatic switch controlled by the subscriber on the called line for establishing a new connection with the calling line and for releasing part of said series of switches.

45. In a telephone system, telephone lines, automatic switches, means under the control of a subscriber on a calling one of said lines for operating a series of said automatic switches to extend a connection to a called one of said lines, and an automatic switch controlled by the subscriber on the called line for establishing a new connection with the calling line and for releasing part of said series of switches, the subscriber on said called line having means for then extending a connection to another called one of said lines.

46. In a telephone system, calling and called lines, automatic switches controlled from one of said calling lines for establishing a connection with one of said called lines, means controlled by the subscriber on said called line for breaking said connection by releasing one of said automatic switches, and means for reestablishing a connection with the said calling line before the subscriber thereon hangs up.

47. In a telephone system, calling and called lines, means controlled from one of said calling lines for establishing a connection with one of said called lines, means controlled from the called line for establishing

another connection with the calling line thereby releasing the first established connection, and means for then extending the connection to include a second called line.

48. In a telephone system, calling and called lines, means controlled from one of said calling lines for establishing a connection with one of said called lines, means controlled from the called line for establishing another connection with the calling line, means then operative to release the first established connection, and means controlled by the subscriber on said calling line for then extending the connection to include a second called line.

49. In a telephone system, telephone lines, automatic switches, means controlled from a calling one of said lines for extending the connection to a called one of said lines, by way of a series of said switches, means controlled from the called line for releasing one of said automatic switches while maintaining a connection from the called line thereto, and means controlled from the called line for reoperating the said switch to extend a connection to a second called line after the calling subscriber hangs up.

50. In a telephone system, telephone lines, automatic switches controlled from a calling one of said lines for extending a connection to a called one of said lines, means controlled from the called line for releasing one of said automatic switches and for then reoperating it to extend the connection to a second called one of said lines, and means for releasing the first called line from the extended connection.

51. In a telephone system, telephone lines, automatic switches, means controlled from a calling one of said lines for operating a series of said automatic switches to extend a connection to a called one of said lines, means controlled from the called line for releasing and reoperating part of said series of automatic switches to extend the connection to a second called one of said lines, and means for releasing the first called line from the extended connection.

52. In a telephone system, telephone lines, automatic switches, means controlled from a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, a finder switch, means controlled from the said called line for initiating the operation of said finder switch, and means controlled from the called line for then extending said connection to include another called one of said lines.

53. In a telephone system, telephone lines, automatic switches, means controlled from a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, a finder switch associated with the last switch of said series, means controlled from the called line for initiating the operation of said finder switch to extend a connection to one of said automatic switches, and means for then extending said connection to another called one of said lines.

54. In a telephone system, a telephone line, a non-numerical switch individual to said line, an operating magnet for said switch, a switching relay therefor, a circuit for said magnet, means for energizing said switching relay to open said circuit, and additional means for operating said magnet while said switching relay is maintained energized.

55. In a telephone system, a calling line, a trunk line terminating in an automatic switch, called lines accessible to the said switch, relays for controlling the operation of said switch, means for connecting said line with said trunk line, means controlled from said calling line for operating said relays to cause said switch to connect with one of said called lines, means controlled from the called line for releasing said switch, and other relays in the switch controlled from the said called line for causing said switch to connect with another of said called lines.

56. In a telephone system, telephone lines, automatic switches, means controlled from a calling one of said lines for operating a series of said switches to extend a connection to a called one of said lines, a switch individual to the called line, a circuit for operating said individual switch which includes a wiper of the last switch of said series, and means controlled by the subscriber on said called line for closing said circuit.

57. In a telephone system, a calling line, a calling device on the said line, automatic switches, called lines, means controlled by the calling device on the said calling line for operating a series of said switches to extend a connection to one of said called lines, means controlled from the said called line for releasing part of said series of switches while maintaining a connection with the calling line, means controlled by the calling device in the calling line for then extending a connection to a second one of said called lines, and means for preventing the calling impulses from being heard by the subscriber on the first called line during the establishment of the second connection.

58. In a telephone system, a series of selector switches, a final connector switch accessible to the last of said selectors, means for operating said switches over a calling line to set up connection with a called line, means for producing interruptions in the called line, means responsive to one of said interruptions for releasing said connector switch and preventing the release of said selectors, and means for reoperating said connector over the calling line to set up a new connection.

59. In a telephone system, a telephone line, a switch individual to said line, an operating magnet for said switch, a switching relay therefor, a circuit for said magnet, means for energizing said switching relay when an idle trunk is encountered to open said circuit, and an additional means for operating said magnet while said switching relay is maintained energized.

60. In a telephone system, a main and a branch exchange, local connectors in the branch exchange for use in completing local connections, incoming selectors for use in completing main to branch exchange connections, trunk lines leading from the main exchange which terminate directly in said incoming connectors, and individual line switches for the branch exchange lines which have direct access to all of said connectors.

61. In a telephone system, a calling and a called line, a progressively movable switch for connecting said lines, a magnet for operating said switch, two line relays controlled over said calling and called lines, respectively, each relay controlling the circuit of said magnet to operate the switch to extend a connection.

62. In a telephone system, an automatic switch having a line relay controlled over a calling line to operate said switch to connect with a called line, a second line relay in said switch for controlling the operation thereof, a back bridge relay energized over the called line, and means controlled by the subscriber on the called line for substituting said second line relay for said back bridge relay in order to reoperate said switch.

63. In a telephone system, an automatic switch having a line relay controlled over a calling line to operate said switch to connect with a called line, a second line relay in said switch for controlling the operation thereof, a back bridge relay energized over the called line, and means set in motion by the called subscriber by means of said back bridge relay for connecting the called line with said second line relay in place of said back bridge relay in order to enable the said called subscriber to reoperate said switch.

64. In a telephone system, a series of connector switches, a series of finder switches accessible to said connector switches, means in each connector for starting one of said finder switches in operation, and means common to the connector switches for preventing more than one finder from being started at once.

65. In a telephone system, connector switches, called line switches individual to the connector, means for selecting the line and operating the line switch thereto, and means for preventing the operation of more than one [illegible] switch at a time.

66. In a telephone system, a line, terminals for calling to said line and terminals for calling from said line, an automatic switch for said line for moving the last mentioned terminals, and means for connecting another line with said first mentioned terminals for thereby operating said automatic switch to connect the second mentioned terminals with the last mentioned terminals.

67. In a telephone system, telephone lines each having a line switch individual thereto, means for calling to and from each line, and means for operating said line switch as a finder to find the connection extended thereto from another calling subscriber and for operating the line switch to automatically select a trunk when the call is extended from the associated line.

68. In a telephone system, a line, trunk lines divided into groups, a pair of wipers associated with said line and individual thereto, and means for operating said wipers whenever a call is extended to the line to connect with a trunk in one group or for operating the wipers when a call is extended from said line to connect only with a trunk in the other group to complete the connection extended.

69. In a telephone system, a line, a line switch individual thereto, a plurality of trunk lines accessible thereto, part of said trunk lines for use only in calls from said line and others for use only in calls to said line, means for operating said switch to select only an idle outgoing trunk when the call is from the line, and means for operating said switch to select only one of the incoming trunks when a call is extended to said line.

70. In a telephone system, calling and called subscribers, means under the control of a calling subscriber for establishing a connection with a called subscriber through a series of automatic switches, means whereby the called subscriber may disconnect himself from the said connection by releasing one of said automatic switches and then reestablish a connection with the calling subscriber before the calling subscriber hangs up.

71. In a telephone system, calling and called subscribers, means under the control of a calling subscriber for establishing a connection with a called subscriber, means whereby the said called party can release part of said first extended connection and reestablish it before the said calling subscriber hangs up, and means for then extending said last established connection to include a second called subscriber.

72. In an automatic branch exchange, subscribers' lines and individual line switches therefor, incoming and local connectors for use in establishing main to branch and local connections, respectively, means for complet-

ing a call from the main exchange to one of said lines by means of one of said incoming connectors, means including the line switch of the called line for enabling the called subscriber to reoperate the incoming connector in use to transfer the call, and means for enabling the called subscriber to transfer the call to another line in case the line to which it was first attempted to transfer is busy.

73. In a telephone system, telephone lines, automatic switches controlled from a calling one of said lines for extending a connection to a called one of said lines, means controlled from the called line for releasing one of said automatic switches and for then reoperating it to extend the connection to a second called one of said lines, and for also again releasing and reoperating said switch to extend the connection to a third called line in case the second called line is busy.

74. In a telephone system, telephone lines, automatic switches controlled from a calling one of said lines for extending a connection to a called one of said lines, means controlled from the called line for releasing one of said automatic switches and for then reoperating it to extend the connection to a second called one of said lines, and means for enabling the first called subscriber to again release said automatic switch at any time prior to the response of the second called subscriber.

75. In a telephone system, lines, trunk hunting switches for extending said lines when calling, a connector switch and means for operating it to extend a connection to one of said lines as a called line, subscriber controlled means for causing one of said trunk hunting switches to connect his line with said connector over a different path, and means for thereafter releasing said connector, whereby it may be reoperated to connect with a different line.

76. In a telephone system, a calling line, automatic switches, means controlled over the calling line for operating a series of said switches to extend a connection to one of said called lines, means for releasing part of said series of switches while maintaining a connection with the calling line, means controlled over the calling line for then extending a connection to a second one of said called lines, and means for preventing the calling impulses from being heard by the first called subscriber during the establishment of the second connection.

77. In a telephone system, a calling subscriber's line, a connector switch controlled over said line to extend a connection to a called line, means controlled over the said called line for releasing said switch, means controlled over either the calling or called line for then reoperating said switch to transfer the call to another called line, and means for preventing disturbance in the receiver of the line not transferring the call irrespective of which line does the transferring.

78. In a telephone system, a trunk line, means for extending a connection from said trunk line to a called subscriber's line through a plurality of successively operated switches, and means controlled from the called line for extending the connection to a second called party by reoperating one of said switches used in said first established connection.

79. In a telephone system, subscribers' lines, means including a series of automatic switches for establishing a talking circuit from a calling to a called one of said lines, means controlled by the called subscriber for releasing one of the switches in the series and for maintaining said switch under his control.

80. In a telephone system, subscriber's lines, means including a series of automatic switches for establishing a talking circuit from a calling to a called one of said lines, means controlled by the called subscriber for releasing one of the switches in the series and for maintaining said switch under his control, and said switch controlled by the called subscriber to extend a branch of said talking circuit to a second called subscriber.

Signed by me at Chicago, Cook County Illinois, this 11th day of October, 1917.

RODNEY G. RICHARDSON.