Dec. 22, 1942. G. KINER 2,305,968

TELEPHONE TRUNKING SYSTEM

Filed May 5, 1941 3 Sheets-Sheet 1

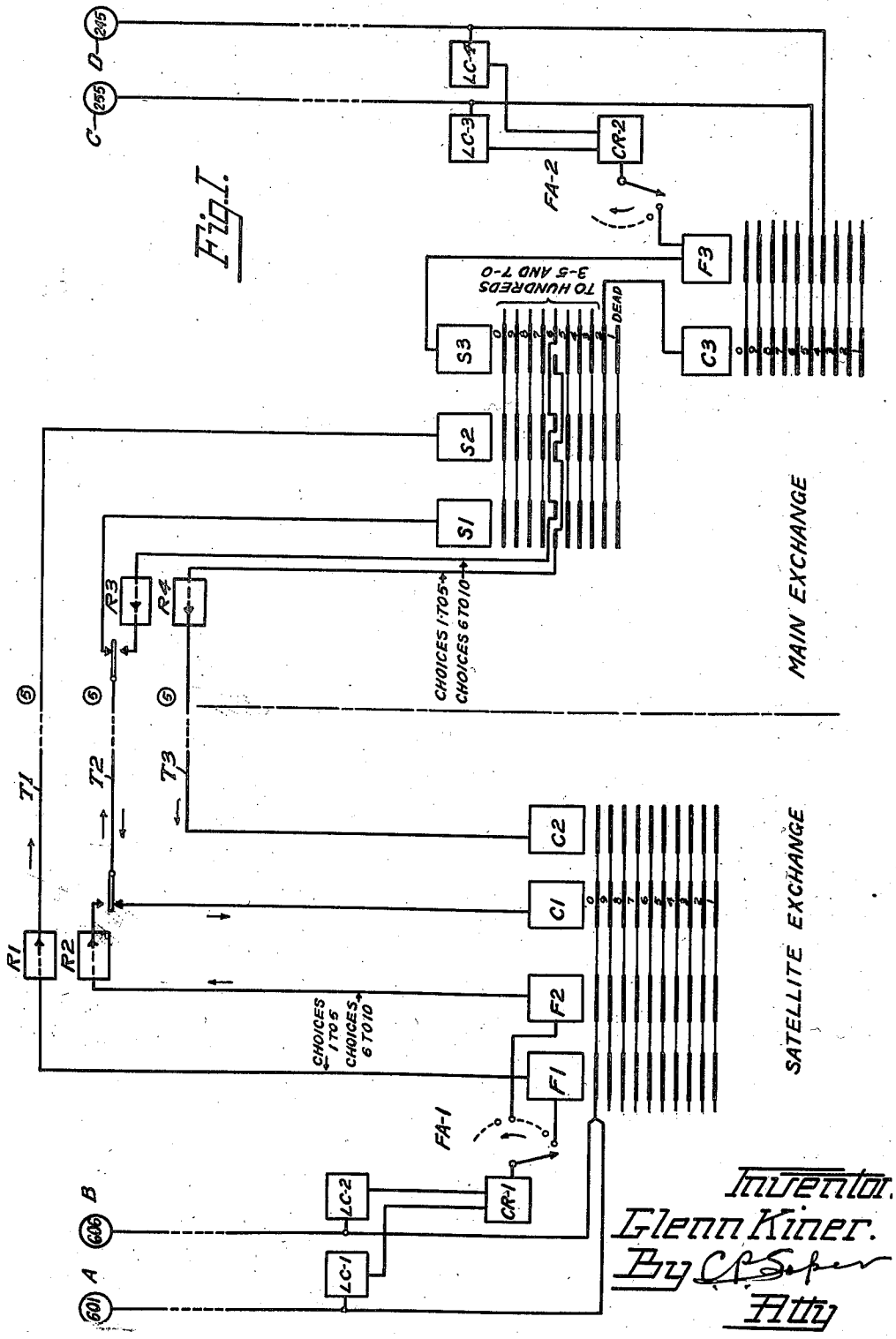

Fig. 1.

Inventor.
Glenn Kiner.
By C. A. Soper
Atty

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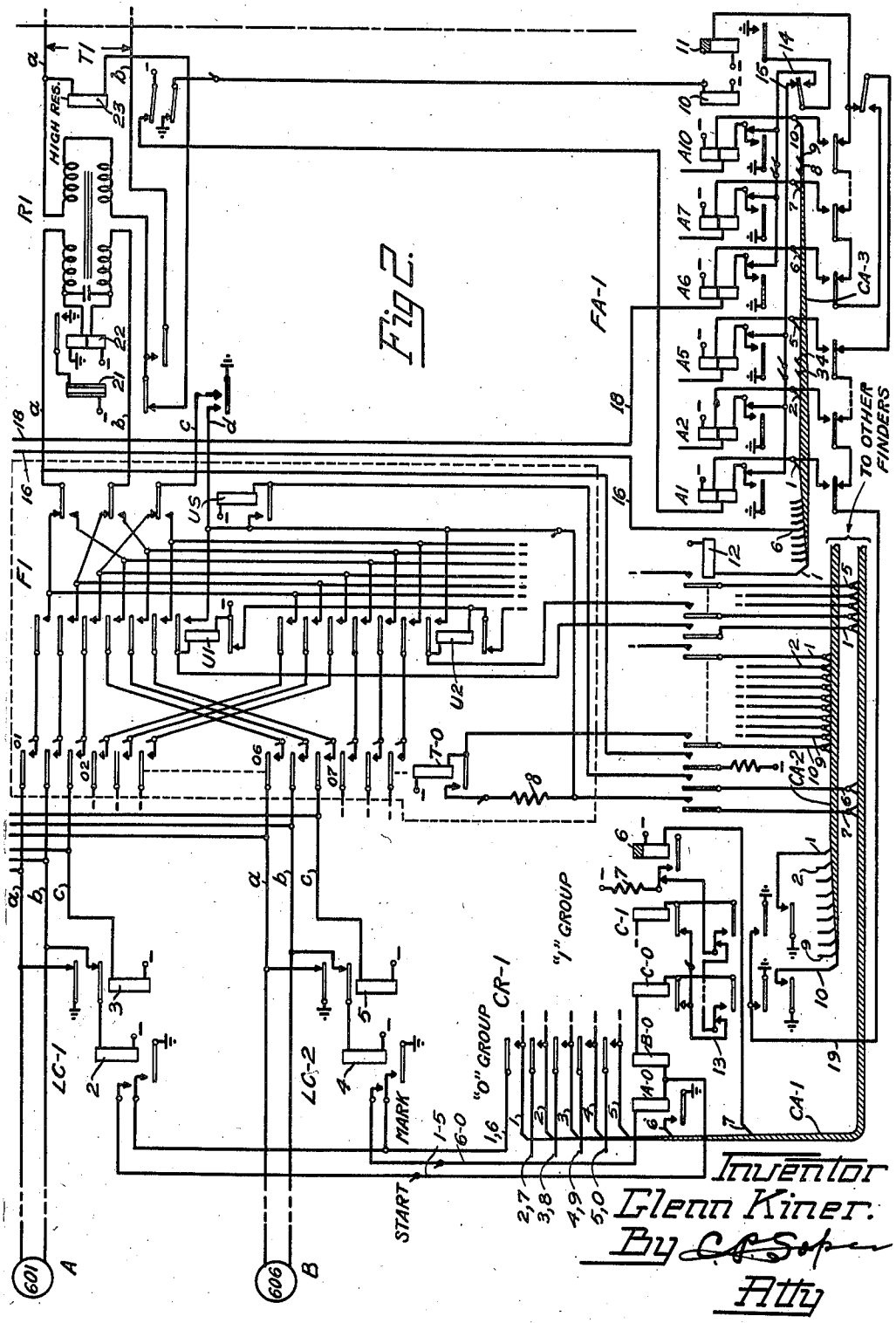

Inventor
Glenn Kiner.
By C. A. Soper
Atty

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TELEPHONE TRUNKING SYSTEM

Filed May 5, 1941 3 Sheets-Sheet 3

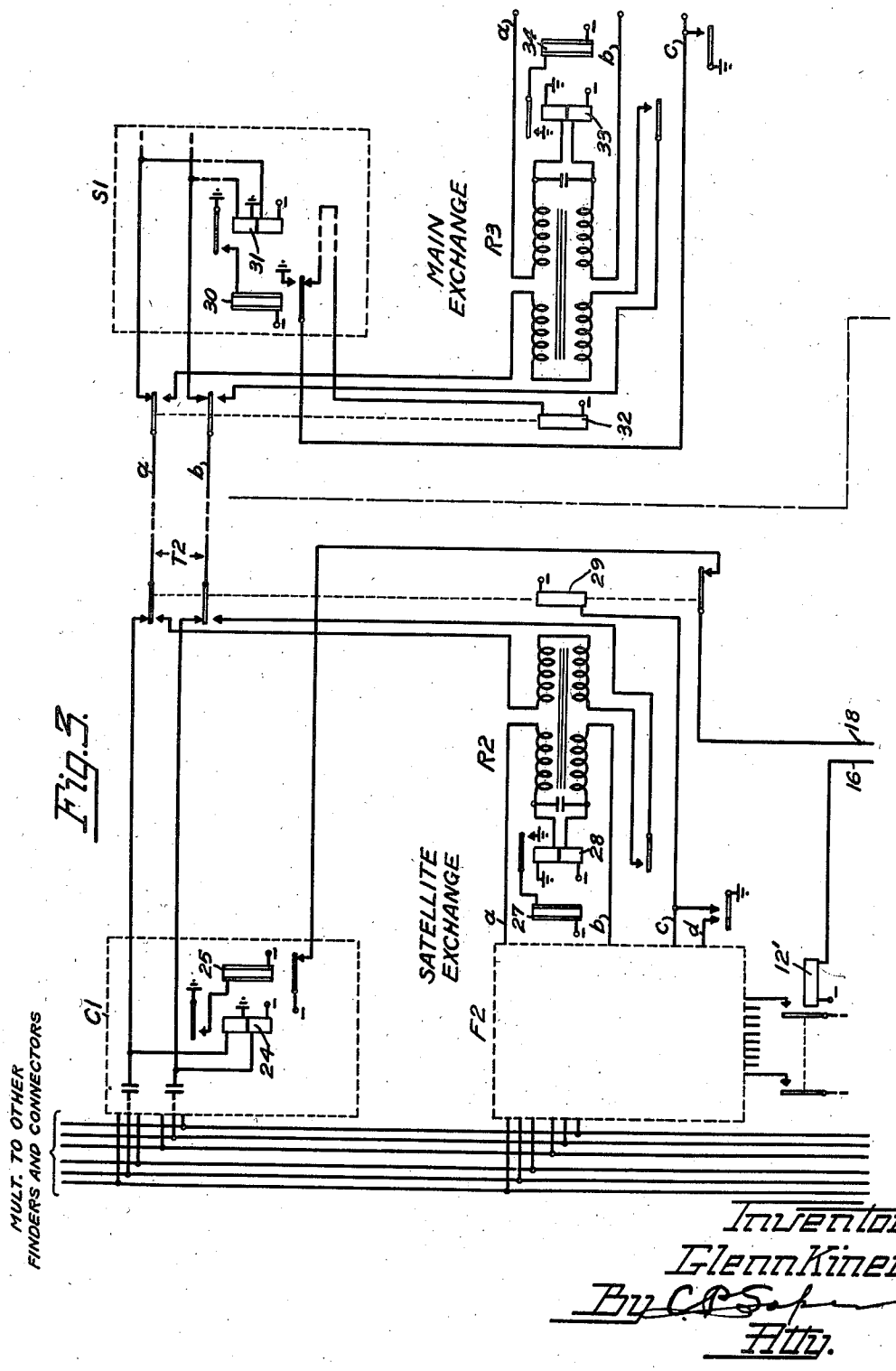

Fig. 3.

Inventor:
Glenn Kiner.
By C. C. Sofield
Atty.

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UNITED STATES PATENT OFFICE

2,305,968

TELEPHONE TRUNKING SYSTEM

Glenn Kiner, Markham, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill., a corporation of Illinois

Application May 5, 1941, Serial No. 391,823

10 Claims. (Cl. 179—18)

The present invention relates to telephone trunking systems, being concerned more particularly with telephone trunking systems used in automatic telephone systems employing line finders.

One object of the invention is the provision of a simple circuit arrangement for allotting idle finders for use.

A further object is the production of a new and improved finder allotter for allotting finders associated with two-way trunks only when all of the finders associated with one-way trunks are in use.

A feature of the invention is that, even though the allotter relays of the finders associated with the two-way trunks are in a position to cause the two-way-trunk finders to be allotted, the allotment thereof is prevented by a group relay as long as any finder associated with a one-way trunk is idle.

A further feature is that arrangements are provided for actuating and locking all the allotter relays associated with idle finders, and for unlocking and restoring them successively as the finders are taken for use.

Other objects and features of the invention will appear as the description progresses.

General Description

It has been chosen to illustrate the invention as applied to an automatic telephone system including a main exchange and a satellite exchange. In such a telephone system trunk lines are provided to extend connections from the satellite exchanged to the main exchange, and other trunk lines are provided to extend connections from the main exchange to the satellite exchange.

In the satellite exchange, switching equipment is automatically responsive to the removal of the receiver at any calling substation thereof to extend a connection from the calling line to a trunk line leading from the satellite exchange to the main exchange. When line finders are employed in the satellite exchange, this extension of the connection is accomplished by a line finder linked with a trunk line leading from the satellite exchange to the main exchange.

In order to reduce to a minimum the number of trunks required between the satellite exchange and the main exchange for handling calls in the two directions, it is desirable that some of the trunks between the two exchanges be arranged for two-way operation. The overall trunking efficiency is increased greatly when the two-way trunks are used at either exchange only when all of the one-way trunks leading from that exchange to the other are in use. To this end, circuit arrangements are provided for so controlling the satellite-exchange finders, some of which are linked to one-way trunks, and some to two-way trunks, that a finder linked to a two-way trunk is used in extending a connection to the main exchange only when all of the finders linked to the one-way trunks are in use.

The drawings

Referring now to the accompanying drawings, comprising Figures 1 to 3, they illustrate sufficient of the equipment included in an automatic telephone system embodying the invention to enable the invention to be understood.

Figure 1 is a trunking diagram illustrating the paths taken by connections set up through the main and satellite exchanges; and

Figures 2 and 3 are circuit drawings of the portion of the switching equipment with which the invention is concerned.

The trunking layout

The trunking layout shown in Figure 1 will now be described. The main exchange has a nominal capacity of one thousand lines, with one of the hundreds groups (the sixth) served by the satellite exchange. The portion to the right of the vertical broken line represents equipment of the main exchange, while the portion to the left of the vertical broken line represents equipment in the satellite exchange. These two exchanges are interconnected by trunk lines indicated at T1, T2, and T3. In the example illustrated, the trunk T1 is one of a group of five one-way satellite-to-main, trunks; the trunk T3 is one of five one-way, main-to-satellite, trunks; and the trunk T2 is one of five two-way trunks. With the fifteen trunks arranged in this manner, there can be a maximum of ten connections established in one direction (and five in the other direction) at any one given time.

Of the main exchange subscriber lines, the lines of substations C and D (telephone numbers 255 and 245) are illustrated, being two lines 55 and 45, respectively, of the second hundreds group. These lines are provided with individual line circuits LC—3 and LC—4, associated with the control relays CR—2. The control relays CR—2 control the finder allotter FA—2, associated with a group of finders, including F3, having access to the hundred-line group including the lines of substations C and D. It will be understood, of course, that a separate group of finders may be provided for each hundred-line group.

The finder F3 is linked with the hundreds selector S3, each of the finders being similarly linked to a separate selector.

The selector S3 has access to groups of connectors corresponding respectively to the assigned hundreds digits. The selector terminals through which the separate connector groups are reached are indicated under the rectangle representing the selector S3 by a heavy horizontal line section. The lowermost such line section indicates the trunk group reached when the digit 1 is dialed; the next higher one indicates the trunk group reached when the digit 2 is dialed; etc., to the uppermost one, which indicates the trunk group reached when the digit 0 is dialed. In the usual construction, a selector has ten choices in any trunk group. Accordingly, each of the said heavy horizontal line sections may be taken to indicate the terminals of ten trunks accessible to the selector. The fainter lines interconnecting the trunk terminals of the selector S3 with the corresponding ones of the selector S2 are intended to indicate multipling between the trunk terminals of the selectors S2 and S3, and the same holds true for the conductors extending horizontally between the trunk terminals of the selectors S1 and S2. It will be understood, of course, that the same multiple may extend to the other selectors, in accordance with the usual practice.

It is common practice to leave unassigned all telephone numbers beginning with the digit 1, because of the frequency with which a false or preliminary impulse is delivered during the removal of the receiver. This explains the placing of the word "dead" opposite the digit-1 group of selector contacts.

The second group of selector contacts is indicated as containing a trunk extending to the connector C3, the latter being one connector of the group having access to the second hundreds group, including lines 255 and 245. In the connector C3, each of the short horizontal lines shown thereunder indicates a group of ten lines, each reached responsive to the dialing of a separate one of the tens digits 1 to 0. These short horizontal lines are joined by fainter horizontal lines to those of the finder F3, indicating the usual finder-connector multiple between the finders and connectors having access to the same lines.

The short faint lines extending to the right from the heavy lines indicative of other hundreds groups accessible from the selector S3 are intended to represent conductors extending to the connectors in the hundreds groups 3, 4, and 5 and 7, 8, 9, and 0. It will be observed that the sixth trunk group of the selectors S1 to S3 is illustrated somewhat differently from the other trunk groups. The sixth hundreds group is the one located in the satellite exchange, and reached from the main exchange over the one-way and two-way trunks including T2 and T3. The showing at the selectors S1 to S3 with respect to the sixth trunk group is intended to indicate that the first five choices of any one of the selectors are trunk conductors leading by way of repeaters, such as R4, to the five one-way main-to-satellite trunks, of which the trunk T3 is one, and to indicate that the last five choices of any one of the selectors are trunk conductors leading through repeaters, such as R3, to the five two-way trunks, of which the trunk T2 is one.

The selector S1 is an incoming selector normally connected with the main-exchange end of the trunk T2, which trunk is capable of being switched over to the repeater R3 when the repeater is seized to complete a call over the trunk T2 from the main exchange to the satellite exchange. The selector S2 is an incoming selector in which the trunk T1 terminates. It will be understood, of course, that there are ten incoming selectors in all, one for each of the five one-way incoming trunks illustrated by the trunk T1, and one for each of the five two-way trunks illustrated by the trunk T2.

In the satellite exchange, the lines of substations A and B are shown, to which telephone numbers 601 and 606 are respectively assigned. These lines have the line circuits LC—1 and LC—2 associated respectively therewith to exercise control over the control relays CR—1, in turn controlling the finder allotter FA—1. In the illustrated example the finder allotter has access to ten finders, including finders F1 and F2. The finders F1 and F2, along with the other eight finders, have access to all of the subscriber lines of the satellite exchange in multiple with the contacts through which the connectors C1 and C2 have access to these lines.

As in the case of the switches described in the main exchange, each of the short horizontal lines below the rectangle indicating any of the finders and connectors in the satellite exchange, indicates a group of ten contacts. Since lines 601 and 606 are in the "0" group of the sixth hundred, these lines are indicated as coming out of the tenth or uppermost contact group of the illustrated finders and connectors. It will be understood that these are only two of the lines (the first and the sixth) included in the tenth contact group.

The finder F1 is linked with the one-way repeater R1, individual to the trunk T1 leading from the satellite exchange to the main exchange. It will be understood that there are four other finders similarly linked, through other repeaters, to the four other one-way trunks included in the same group with the trunk T1.

The finder F2 is linked through the repeater R2, which, upon seizure, may be connected with the two-way trunk T2. There are four other finders similarly linked through repeaters such as R2 to the other four two-way trunks.

The connector C2 terminates the incoming one-way trunk T3, and is one of five connectors reached by way of the five one-way incoming trunks. The connector C1 is one of five connectors normally connected with the two-way trunks, of which the trunk T2 is one.

Extending connections

With further reference to the trunking diagram shown in Figure 1, a few examples will be given of how connections are extended between the subscriber lines.

Assuming that the subscriber at substation D (telephone number 245) in the main exchange desires to call the subscriber at substation C (telephone number 255), the line circuit LC—4 operates upon the removal of the receiver to cause a finder allotted by the finder FA—2 to make connection with the calling line. Assuming that the finder F3 is the one allotted, this finder is the one used, thereby placing the selector S3 under the control of the calling line.

When the first digit 2 of the desired number is dialed, the selector S3 associates itself with the connectors in the second hundred group, including the connector C3, and selects the first idle

one of them found. Assuming that the selected one is connector C3, the calling line is now extended to the connector C3.

Responsive to the dialing of the second digit 5 in the desired number, the connector C3 associates itself with the fifth tens group of contacts, and it makes connection with the fifth line in the selected fifth tens group when the final digit 5 is dialed. The usual ringing operation follows, and the conversation may ensue when the subscriber at the called substation C (telephone number 255) removes his receiver. The switches included in this connection (between the lines of substations D and C) are the finder F3, the hundreds selector S3, and the connector C3.

In a similar way, a connection can be extended from any line in the main exchange to any other line therein.

Let it be assumed that the subscriber at substation D desires to converse with the subscriber at substation A (telephone number 601) in the satellite exchange, and that the finder F3 is the one which makes connection with the calling line. In this case the selector S3 is under the control of the calling line, and it responds to the first digit 6 in the desired number to associate itself with the sixth hundreds group of trunks accessible thereto and proceeds to select the first idle one found. If any one of the first five trunks is idle, one of the five one-way trunks is selected. It may be assumed that the one-way trunk T3 is selected, in which case the connection is extended from the selector S3, by way of the repeater R4 and the trunk T3, to the connector C2 in the satellite exchange.

In this event, the connector C2 responds to the tens digit 0 to associate itself with the tenth group of lines accessible thereto, and it responds to the final digit 1 to make connection with the first line in the group.

In the event that all of the one-way trunks leading from the main exchange to the satellite exchange are in use when a selector is searching in the sixth group, a connection may then be completed over one of the two-way trunks (such as by way of the repeater R3, and the two-way trunk T2, to the connector C1) in the satellite exchange. The connector in the satellite exchange then responds, as explained before, to the tens and units digits in the number to complete the connection to the called line.

In case the subscriber at substation A, for example, in the satellite exchange desires to converse with the subscriber at substation D, for example, in the main exchange (telephone number 245), the removal of the receiver at the calling substation in the satellite exchange results in the operation of one of the finders (F1, for example) to extend a connection to a selector in the main exchange. This operation results from a control being exercised over the control relays CR—1, through the calling line circuit LC—1, to cause the finder F1 to make connection with the calling line. A connection is thereby extended from the line of substation A, through the finder F1, and the repeater R1, and over the one-way trunk T1, to the incoming selector S2 in the main exchange.

The selector S2 responds to the dialing of the hundreds digit 2 by selecting the corresponding hundreds group, and by then selecting and connecting with the first idle connector found in that group. It may be assumed that the connector C3 is the first one found to be idle, in which case the connection is extended from the selector S2 to the connector C3. The connector C3 may then respond to the tens and units digits (4 and 5) in the called number to complete the connection to the line of substation D.

In the event that a call is made in the satellite exchange at the time all of the finders, such as F1, associated with the one-way satellite-to-main exchange trunks are in use, the finder allotter FA—1 allots the first idle one of the finders (F2, for example), associated with the two-way trunks. The finder F2 is thereby caused to make connection with the calling line, and to extend this line through the repeater R2, and thence by way of the two-way inter-exchange trunk T2 to the incoming selector S1 in the main exchange. The selector S1 then responds to the dialed hundreds digit to extend the connection to an idle connector in the desired hundreds group, following which the connection is completed to the called line responsive to the dialing of the tens and units digits.

With respect to the completion of connections between two lines of the satellite exchange, it may be pointed out that in the trunking diagram as herein given each such connection requires a trunk from the satellite exchange to the main exchange and another trunk from the main exchange back to the satellite exchange. It will be understood, of course, that well-known switching devices may be used for freeing both of the inter-exchange trunks and completing the connection locally, when the calling and called lines both terminate in the satellite exchange. This feature, however, has nothing to do with the present invention and has not been illustrated herein.

The circuit drawings

Referring now particularly to Figures 2 and 3, the equipment indicated by the circuit diagrams will be described generally. The equipment in Figure 3 to the right of the generally vertical broken line is located in the main exchange, while the equipment in Figure 3 to the left of this line, together with all the equipment in Figure 2, is in the satellite exchange.

The satellite-exchange finder F1 of Figure 1 is indicated in the circuit diagram in Figure 2 by the equipment inside the broken-line enclosure. The finder F1 includes ten tens relays, associated respectively with the tens groups 1 to 9 and 0. For convenience only the 0-group tens relay T—0 is shown. The conductors to the right of the contacts of relay T—0 are multiplied to the similar contacts of each of the other tens relays. Additionally, while each tens relay has ten sets of contacts, each set including three contact pairs, only four such sets have been indicated on the tens relays T—0 in order to conserve drawing space.

The finder F1 also has five units relays, of which the units relays U1 and U2 are shown. The units relays U3 to U5 are assumed to be located below the relay U2. With the exception of the series operating-chain contacts, a pair of which is shown below each of the relays U1 and U2, the contacts of units relays are connected in multiple to the two sets of conductors incoming thereto from the units switching relay US. The units switching relay US is arranged to be operated, or not, depending upon whether the units digit is from 1 to 5 or from 6 to 0. This is the usual arrangement employed in order to reduce the number of units relays from ten

to five. Each set of conductors controlled by a units relay leads to a separate contact set of each of the tens relays, as indicated.

Each of the finders has a connecting relay associated therewith which is operated under the control of the finder allotter to place the finder under the control of the group control relays when connection is to be made with a calling line. The connecting relay 12 is the one associated with the finder F1. The connecting relay 12', Figure 3, is similarly associated with the finder F2, whose circuits are not shown because they are similar to those of the finder F1.

The line circuits LC—1 and LC—2 of Figure 1 are shown in detail in Figure 2. The line circuit LC—1 includes line relay 2 and cutoff relay 3, while the line circuit LC—2 includes line and cutoff relays 4 and 5. Each of the line relays is arranged, when operated, to ground a marking conductor and a start conductor when energized, whereby the currently allotted finder is controlled to make connection with the calling line. Line relay 2 being associated with line 601, the first line in the "0" group, grounds the 0-group mark conductor 1, 6, common to lines 1 and 6 of the "0" group, and it grounds the 0-group start conductor 1—5, common to lines 1 to 5 in the "0" group.

Line relay 4 of the line circuit LC—2, being associated with line 606, the sixth line in the "0" group, is arranged, when operated, to ground the mark conductor 1, 6 (common to lines 1 and 6 in the same tens group) and to ground the start conductor 6—0 common to lines 6 to 9 and 0 in the same tens group.

For each group of tens lines there are two start conductors, such as the start conductors 1—5 and 6—0 for the "0" group, and there are five mark conductors, such as the mark conductors 1, 6; 2, 7; 3, 8; 4, 9; and 5, 0 of the "0" group.

The control relays CR—1 of Figure 1 are illustrated in Figure 2. Each group of ten lines has three control relays assigned thereto, the control relays for the "0" group of lines being the illustrated relays A—0, B—0, and C—0. Relay C—0 is the guard relay, and it operates to disconnect the corresponding relays associated with the other tens groups when there is a calling condition in the associated tens group of lines. The operating circuit for the relays A—0 to C—0, therefore, includes chain contacts on relay C—0, as well as on the other similar relays associated with the other tens groups. Relay C—1, associated with the "1" tens group is illustrated, in order that the chain-contact arrangement may be shown more fully. The tens-group guard relays C—2 to C—9 are not shown, but are interconnected in the chain circuit between the relays C—1 and C—0 at the portion thereof indicated by the dotted lines.

It is to be noted that cable CA—1 contains a number of conductors extending from the control relay CR—1 and multiplied to contacts of the connecting relays (such as 12) of the finders, and that the cable CA—2 carries ten conductors associated respectively with the contacts of the "C" relays (such as C—0 of the tenth tens group and C—1 of the first tens group) to other contacts of the finder-connecting relays, such as relay 12 of the finder F1.

The finder allotter FA—1 of Figure 1 is shown in circuit diagram in Figure 2. This allotter includes ten allotter relays indicated as relays A1 to A10, each of which is associated with a separate one of the ten finders, including finders F1 and F2. Relays A3 and A4 and A8 and A9 have been omitted from the drawings to conserve drawing space, as these relays are similar to the respective preceding and succeeding relays.

The allotter relays A1 to A5 are associated respectively with the five finders, such as finder F1, which are associated with the one-way trunks, such as T1, extending from the satellite exchange to the main exchange. The allotter relays A6 to A10 are associated, respectively, with the five finders (of which the finder F2, Figures 1 and 3, is one) associated respectively with the five two-way trunks extending between the satellite and main exchanges.

The finder allotter FA—1 includes also the group relay 10, common to the five one-way trunks and normally operated, as indicated, to insure that no finder associated with a two-way trunk is allotted as long as there is at least one idle finder associated with a one-way trunk. The finder allotter also includes pick-up relay 11 which serves to transmit energizing pulses at the proper times to the allotter relays A1 to A5 and A6 to A10.

The repeater R1 of Figure 1 is shown in Figure 2. This repeater has four conductors, *a* to *d*, linking it with the finder F1, and it includes the line and release relays 22 and 21, as well as the high-resistance trunk relay 23, normally energized over the outgoing conductors *a* and *b* of the trunk T1 in series, whereby this relay is restored at any time the trunk T1 is in use or is out of order.

The two-way trunk T2 of Figure 1 is shown in Figure 3 as a two-conductor inter-exchange trunk, comprising the usual *a* and *b* talking conductors. These conductors normally extend at the satellite exchange to ground and battery through normally closed contacts of transfer relay 29, and the upper and lower windings of line relay 24 in the connector C1. The conductors of the trunk T1 normally extend in the main exchange to ground and battery, through contacts of transfer relay 32 and the upper and lower windings of line relay 31 of the connector S1. The circuit arrangements of the connector C1 and the selector S1 are only fragmentarily shown, for they may be of any well-known, suitable type.

The circuits of the repeaters R2 and R3, associated with the trunk T2 in the satellite exchange and in the main exchange respectively, are shown and will be described hereinafter.

It is to be noted that the *a*, *b*, and *c* conductors of the lines of substations A and B, Figure 2, in addition to extending to contacts of the illustrated tens relay T—0 of the finder F1, are shown as multiplied to the finder F2 and to the connector C1 of Figure 3. As indicated by the notation at the top part of Figure 3, these conductors are multiplied to the other finders and connectors. It will be understood, of course, that the same arrangement applies to each of the other subscriber lines in the satellite exchange.

Detailed Description

The invention having been described generally, a detailed description of the operation of the apparatus shown will now be given.

A calling B

Let it be assumed now that the subscriber at substation A, whose telephone number is 601, de-

sires to converse with the subscriber at substation B, whose telephone number is 606. Both of the lines concerned terminate in the satellite exchange.

When the receiver (not shown) is removed at substation A, line relay 2, Figure 2, operates over the calling line through contacts of cutoff relay 3. Upon operating, relay 2 places ground potential on the 1, 6 marking conductor of the associated "0" group, and also places ground potential on the start conductor 1—5 of the associated "0" group. The grounding of the marking conductor 1, 6 has no immediate effect, but the grounding of start conductor 1—5 extends ground potential to the junction of the windings of the A—0 and the B—0 relays. Assuming that no call is being initiated in another one of the tens groups, all of the ten C relays, such as C—0 and C—1, are in normal condition at the time. Under this condition, the placing of ground potential on the start conductor 1—5 completes a circuit through mark-control conductor B—0, through guard relay C—0, and the innermost armature and resting contact of relay C—0, to the common guard conductor 13. From thence, under the condition of all of the C relays being restored, the circuit extends through normally closed chained contacts controlled by the armatures of the C relays, and thence to battery through normally closed contacts controlled by the armatuer of the slow-operating recycle relay 6, by way of resistor 7. Relays B—0 and C—0 operate over the above circuit. Relay B—0 connects the five mark conductors (1, 6; 2, 7; 3, 8; 4, 9; and 5, 0) of the "0" group to conductors 1 to 5, respectively, of the cable CA—1. As is indicated by the conductors extending a short way to the right of the contacts of relay B—0, the conductors 1 to 5 of the cable CA—1 extend to similar contacts of the B relays (not shown) in the other tens groups.

When relay C—0 operates it locks itself to the battery-supply chain, at the same time opening the chain and also disconnecting its winding from guard conductor 13. Battery potential is now removed from guard conductor 13 but guard relay C—0 is now disconnected from this guard conductor and is locked up independently thereof. In this way the operation of any of the ten C relays results in the removal of battery potential from guard conductor 13 to prevent an operation of a further C relay, and consequently the operation of any other A and B relay, as long as the operated C (guard) relay remains in operated condition.

At its lowermost armature, relay C—0 grounds conductor 10 of the cable CA—2, preparatory to operating the "0" tens relay in the finder allotted to make connection with the calling line. Additionally, relay C—0 places ground potential on the allotter-start conductor 19.

Let it be assumed that in the allotter A1 the relays A1 to A5 are in the indicated restored condition at the time allotter-start conductor 19 is grounded by relay C—0, and that group relay 10 is in the indicated energized condition, because one or more of the one-way satellite-to-main trunks are idle. Under this condition, the ground potential on conductor 19 is extended through normally closed contacts of relays A1 to A5, and the lower armature of the actuated group relay 10, to the winding of the slow-operating pick-up relay 11. When relay 11 operates and extends ground potential, through contacts of the operated group relay 10, to pick-up conductor 15. Conductor 15 is associated with the allotter relays A1 to A5, associated respectively with the one-way trunks. Each of the relays A1 to A5 whose associated one-way trunk is not in use at the moment operates when conductor 15 is thus grounded. The circuit for operating relay A1 is from ground on conductor 15, through normally closed contacts controlled by the inner armature of relay A1, through the winding of relay A1, and thence to battery through the middle armature of the high resistance, normally energized trunk relay 23. This circuit is closed unless the trunk T1 is in use or is out of order, in which case relay 23 is in a restored condition. Assuming that the trunk T1 is idle, relay 23 is operated, and the circuit for the relay A1 is closed as above traced. Upon the closure of the above circuit, relay A1 operates and locks itself to ground through its innermost armature, at the same time disconnecting its winding from conductor 15 in order to avoid making an additional ground connection to pick-up conductor 15. Each of the other relays A2 to A5 whose associated trunk is idle operates with similar results.

Upon the operation of any one of the relays A1 to A5, the chain circuit for pick-up relay 11 is broken, permitting relay 11 to restore after a slight interval and remove ground potential from pick-up conductor 15.

Upon the operation of allotter relay A1, the grounded allotter-start conductor 19 is transferred to the first conductor of the cable CA—3, thereby allotting the finder F1 by operating connecting relay 12 associated therewith. A branch holding circuit for the upper winding of relay A1 is closed at the same time. Upon the operation of relay 12, the conductors in cables CA—1 and CA—2 are connected respectively with conductors of the finder F1.

Battery potential, through resistor 9, and contacts of relay 12, is now applied to the *a* conductor in the link between the finder F1 and the repeater R1, thereby closing a circuit to ground, through the upper left-hand repeating coil winding, and the upper winding of line relay 22. Line relay 22 thereupon operates and closes an operating loop across the conductors *a* and *b* of the trunk T1, through the right-hand repeating coil windings in series, thereby operating the line relay (not shown) of the selector S2, Figure 1, which line relay is unable to operate in series with the high resistance trunk relay 23. The selector S2 in the main exchange is thereby prepared for operation in the usual manner.

Line relay 22 also closes a circuit at its upper armature for slow-acting release relay 21. Release relay 21 now operates, and it disconnects the high-resistance trunk relay 23 at its inner armature, while at its lower armature it applies a ground potential to the associated *c* and *d* leads. Trunk relay 23 now restores. At its lower armature relay 23 opens one point in the circuit of group relay 10, but relay 10 remains operated as long as the relay corresponding to 23 is operated in any other repeater associated with a one-way outgoing trunk. At its inner armature, relay 23 disconnects battery potential from the lower winding of the relay A1, thereby deenergizing such lower winding. Relay A1, however, remains operated for the time being because the upper winding thereof is energized in parallel with the winding of connecting relay 12, as previously pointed out. In this way, the allotter is maintained in association with the finder F1 until the finder has completed its operation.

When ground potential is applied to the hold lead *d* by the above-mentioned operation of release relay 21, a circuit is closed, through the outermost contacts of the operated connecting relay 12, and thence over conductor 7 of the cable CA—1, for the slow-operating recycle relay 6. Relay 6 does not have time to operate during normal finder operation, but is provided to open the battery connection to the associated group relays to restore them to permit recycling of the group relays, and the transfer of the allotter to the next finder, in case there are overlapping calls in the same group.

With the tenth conductor in cable CA—2 grounded, at the lower contacts of relay C—0, the operation of connecting relay 12 closes a circuit through contacts thereof for the "0" tens relay T—0 of the finder F1. Relay T—0 thereupon operates and locks itself to the associated common locking conductor, connected by way of resistor 8 to the associated *d* lead, grounded at the lower armature of release relay 21.

With the grounded 1, 6 mark conductor associated with the line circuits LC—1 and LC—2 connected through the upper contacts of relay B—0 to the first conductor in the cable CA—1, the operation of relay 12 results in the closure of a circuit through contacts thereof, for the first units relay U1 of the finder F1. Relay U1 now operates and locks itself to the associated *d* lead, at the same time removing battery potential from the succeeding units relays so as to prevent simultaneous operation of two of the units relays in the event that a further line in the "0" tens group is simultaneously calling, and has grounded a further one of the work conductors 2, 7 to 5, 0.

The units switching relay US, although connected with the sixth conductor in the cable CA—1, by contacts of the operated connecting relay 12, is not operated at this time because the calling line is one whose start conductor goes directly to the winding of relay B—0 and has not, therefore, operated relay A—0, wherefore the sixth conductor in the cable CA—1 is not grounded.

With the units switching relay US not operated, and with relays U1 and T—0 operated, the *a*, *b*, and *c* leads of the line of substation A are now extended through contacts of the relays T—0, U1, and US to the *a*, *b*, and *c* leads linking the finder F1 with the repeater R1. The ground potential placed on the associated *c* lead by release relay 21 is effective at this time to apply a guarding potential to the *c* lead of the line circuit LC—1, to guard the calling line against intrusion, and to operate cutoff relay 3. Cutoff relay 3 disconnects ground potential and the winding of line relay 2 from the associated *a* and *b* conductors of the calling line, whereupon the line relay 2 restores.

When line relay 2 restores it removes ground potential from the mark conductor 1, 6, thereby opening the initial circuit of units relay U1, but relay U1 remains operated in its described locking circuit, including the grounded hold lead *d* and the lower armature of the operated release relay 21.

Relay 2 also removes ground potential from the 1—5 start lead thereby permitting relays B—0 and C—0 to restore, unless a call has been originated on another line in the same tens group following the described operation of relays B—0 and C—0. In the latter event, the one or the other of the start conductors 1—5 or 6—0 is grounded at the newly calling line circuit, causing relays B—0 and C—0 to remain operated. In the latter event, the control relays CR—1 are not cleared out responsive to the restoration of the line relay 2 and the described circuit for the slow-operating unlock relay 6 remains established sufficiently long for relay 6 to operate. Upon operating, relay 6 opens the battery connection to relays C—1 to C—0, whereupon relays B—0 and C—0 restore.

When relay C—0 restores, whether from the removal of ground potential from start lead 1—5 by the restoration of line relay 2, or from the above-mentioned operation of unlock relay 6, it removes ground potential from the 10th conductor in cable CA—2, thereby opening the initial circuit of the operated tens relay T—0. Relay T—0, however, remains operated in its described locking circuit, including the lower armature of the relay, current limiting resistor 8, and the grounded hold lead *d*.

Relay C—0 also removes ground potential from the allotter-start conductor 19, thereby opening the circuit of the finder-connecting relay 12 and the circuit of the upper winding of allotter relay A1. Relays 12 and A1 thereupon restore, the lower winding of relay A1 having been opened by the described restoration of relay 23. The restoration of relay 12 disconnects the conductors of the cables CA—1 and CA—2 from the now-operated finder F1. When this occurs the circuit for recycle relay 6 is opened at the outermost armature of relay 12, permitting relay 6 (if operated) to restore after an interval to permit a further operation of the control relays to cause the next calling line to be connected with by another finder.

When allotter relay A1 restores, at its inner armature it opens a further point in the previously existing locking circuit for its lower winding, and at its lower armature it disconnects the now ungrounded allotter-start conductor from its own upper winding and the winding of relay 12 and extends it through the illustrated allotter chain circuit, and through the armature of the next operated one of the relays A2 to A5 to the associated finder-connecting relay, such as relays 12 and 12', Figures 2 and 3.

With cutoff relay 3 operated, and with resistor 9 having been disconnected from the *a* lead between the finder F1 and the repeater R1, by the restoration of relay 12, the line relay 22 in the repeater R1 is now held operated over the calling line and in series with the substation telephone A.

The calling subscriber at substation A may now operate his calling device in accordance with the digits (6, 0, and 6) in the number of the desired substation B.

As a result of the operation of the calling device (not shown) at substation A in accordance with the first digit 6 of the desired number, the line relay 22 of the repeater R1 is restored momentarily six times. Each time it restores, line relay 22 opens the circuit of the associated slow-acting release relay 21, but relay 21 remains operated throughout the series of restorations. Also, each time it restores, line relay 21 opens the bridge across the conductors of the trunk T1 at its lower armature. As a result, the selector S2, Figure 1, in the main exchange is operated in the usual manner to associate itself with the sixth trunk group and automatically to select the first idle set. It may be assumed that the contact set associated with the trunk T3, Figure 1, and the repeater R4 is the first one found to be idle. Under this condition, the repeater R4 is seized and it operates substantially as described in connection

with the repeater R1 to close a loop across the conductors of the trunk T3 to prepare the connector C2, shown in Figure 1, for operation.

When the second digit 0 in the desired number is dialed, line relay 22 of the repeater R1 restores ten times momentarily, thereby interrupting the bridge across the outgoing conductors of the trunk T1 ten times. With the connection having been extended by way of the selector R1 to the repeater R4, Figure 1, the ten interruptions are repeated by the repeater R4, to the connector C2 in the satellite exchange, causing the connector C2 to select the tenth associated group.

When the final digit 6 is dialed, the resulting series of six interruptions is repeated by the repeated R1, Figures 2 and 1, to the repeater R4, Figure 1, and thence to the connector C2, to cause the connector to select the sixth line in the tenth group, being the line of substation B, Figures 1 and 2. In Figures 2 and 3, the connection is extended to the line by way of the vertical multiple between the finders and connectors, bearing the label at the top thereof, "Mult. to other finders and connectors."

When connection is extended to the called line, the line of substation B, a guarding ground potential is applied by the calling connector to the *c* lead thereof, resulting in the energization of cutoff relay 5 to clear the called line for ringing and talking purposes.

When the subscriber at substation A replaces his receiver, line relay 22 opens the control circuit established through the selector S1, Figure 1, to the repeater R4, whereupon the line relay (not shown) in the repeater R4 restores and opens the control circuit extending over the trunk T3 to the connector C2, permitting the connector C2 to clear out and free the line of substation B. When the line is freed, cutoff relay 5 restores.

The selector S1 in the main exchange is released when the release relay (not shown) in the repeater R4 restores and removes ground potential from the associated *c* lead.

In the repeater R1, release relay 21 restores shortly after the restoration of line relay 22. When it does so, it again bridges the high-resistance trunk relay 23 across the conductors *a* and *b* of the trunk T1, permitting relay 23 to reoperate. The releasing operation in the main exchange is not interfered with because of the high resistance of relay 23. Upon reoperating, relay 23 again closes a point in the multiple operating circuit of the normally energized group relay 10, and it reapplies battery potential to the upper terminal of the lower winding of the allotter relay A1. Relay A1 does not reoperate responsive to this operation, but waits until the circuit of the lower winding is closed by an operation of pick-up relay 11, as previously described. In this way, the finder F1 is not again allotted until each of the finders associated with allotter relays A2 to A5 has had its turn.

Release relay 21 of the repeater R1 also disconnects ground potential from the associated leads *c* and *d*. When lead *c* is ungrounded, cutoff relay 3 in the line relay LC—1 restores and again connects up the line relay 2 for operation. The removal of ground potential from the hold lead *d* opens the locking circuit of the operated relays U1 and T—0 in finder F1, whereupon these relays restore, clearing out the finder F1 and breaking the connection between the line of substation A and the repeater R1.

B calls

Let it be assumed that the subscriber at substation B desires to make a call and accordingly removes his receiver (not shown). Let it be assumed further that the call is originated as the next call following the one previously described which used the finder F1 and the repeater R1, and resulted in the restoration of allotter relay A1, leaving the allotter relays A2 to A5 operated as the result of having been operated as previously explained responsive to the initiation of the call over the line of substation A.

When line relay 4 operates over the line of substation B upon the removal of the receiver thereat, it grounds the mark conductor 1, 6, as in the case of line relay 2. The start conductor grounded by line relay 4, however, is the start conductor 6—0 common to the 6th and 10th lines in the "0" group. As a result, relay A—0 energizes in circuit with relays B—0 and C—0. Relay A—0 grounds the associated sixth conductor in the cable CA—1. Relays B—0 and C—0 operate with the previously described results. The grounding of the allotter-start conductor 19 at this time does not result in an operation of relay 11, because allotter relays A2 and A5 are still operated under the conditions now assumed. A circuit is, therefore, closed, through the lower armature of the restored relay A1, and through the lower armature of the operated relay A2, for the upper winding of the relay A2 to hold this relay operated until the associated finder has completed its operation. At the same time, a parallel circuit is closed through the second conductor in the cable CA—3 for the connecting relay (similar to relay 12) of the finder associated with relay A2. This connecting relay thereupon operates to connect the conductors of cables CA—1 and CA—2 to such finder, resulting in the operation of the 0 tens relay therein (similar to relay T—0) and in the operation of the first units relay therein (similar to relay U1). At this time, since the sixth conductor in cable CA—1 has been grounded by the operation of relay A—0, a circuit is closed for the units switching relay (similar to units switching relay US of the finder F1) in the now active finder. As a result, the finder makes connection with the line of substation B through contacts of the operated relays corresponding to US, U1, and T—0 of the finder F1. This connection is made over the previously mentioned vertical multiple shown extending from Figure 1 across Figure 2.

When this connection is made, cutoff relay 5 is operated to disconnect and restore the line relay 4.

After the connection has been made and the relays A—0, B—0, and C—0 have cleared out as previously explained, the removal of ground potential from conductor 19 permits relay A2 to restore and extend the control to the A3 relay (not shown) of the allotter FA—1. The restoration of relay A2 takes place at this time because the circuit of the lower winding thereof has been opened by the restoration of the relay similar to relay 23 associated with the finder and repeater with which relay A2 is associated.

The further operations in connection with a call from substation B may be similar to those described in connection with the call from substation A.

Picking up idle allotter relays

Let it be assumed now that other calls have

been initiated sufficient to cause each of the five one-way outgoing trunks (such as T1, Figures 1 and 2) to be taken for use in turn. Let it be assumed further that these calls are sufficiently separated that one or more of the trunks first used have become idle by the time the last one has been taken for use. It may be assumed that the trunk T1 is one of those which has become idle, in which case trunk relay 23, Figure 2, has reoperated as pointed out. Under this condition, group relay 10 has not been restored. Then, when the next call is initiated in the satellite exchange, the resultant grounding of allotter-start conductor 19 results in the closure of a circuit, through the lower armatures of the restored relays A1 to A5, and the lower armature of the operated group relay 10, for pick-up relay 11. Relay 11 again grounds conductor 15, through the armature of the operated group relay 10. The placing of ground potential on conductor 15 completes a circuit for the lower winding of each of the relays A1 to A5 which is associated with an idle finder and repeater. The circuit for the lower winding of relay A1 includes the normally closed contacts controlled by the inner armature of relay A1, the said lower winding, and the inner armature of the operated trunk relay 23. Relay A1 now operates and locks the lower winding energized independent of the conductor 15, at the same time disconnecting the lower winding from this conductor. Relay 11 restores as a result of the operation of relay A1 and of any other ones of the relays A1 to A5, and again removes ground potential from conductor 15, leaving the operated ones of the relays A1 to A5 in their operated and locked condition.

The ground potential on start conductor 19 is now extended to the upper winding of relay A1, and also through the No. 1 conductor in cable CA—3 to the winding of finder-connecting relay 12, causing relay 12 to operate, and relay A1 to remain operated, as previously described.

From the foregoing, it will be seen that the relays A1 to A5 are operated over and over to reallot the associated finders and one-way outgoing trunks, with no calls being transferred to the finders and two-way trunks associated with allotter relays A6 to A10, so long as at least one one-way outgoing trunk remains idle, and group relay 10 consequently remains operated.

Using the two-way trunks for satellite-to-main calls

Let it be assumed now that all of the five one-way trunks, including the trunk T1, Figures 1 and 2, are in use. At the same time, all of the allotter relays A1 to A5 will have been restored as a result of the restoration of all of the trunk relays, such as 23, associated with the repeater R1. Additionally, with all of the one-way trunks from the satellite exchange to the main exchange in use, and all of the relays, such as 23, in restored condition, the multiple circuit is open at all points for the group relay 10, causing this relay to restore.

Under the above conditions, when the next call is originated in the satellite exchange, the resultant grounding of allotter-start conductor 19 completes a circuit, through the lower armatures of the restored relays A1 to A5, and thence by way of the lower armature of the now-restored group relay 10, and through contacts of the unoperated relays A6 to A10, for pick-up relay 11. Relay 11 now operates and extends ground through the inner armature and resting contact of the restored group relay 10 to conductor 15, thereby completing a circuit through the lower winding of each of the relays A6 to A10 (associated with the two-way trunks) provided in each case that the two-way trunk associated therewith is idle. In the case of relay A6, if the two-way trunk T2 is not in use in a call incoming to the satellite exchange the connector C1, Figures 1 and 3, is not in use, and the release relay 25 therein is restored. Also, if the trunk T2 is not in use in completing a call from the satellite exchange to the main exchange, the repeater R2, Figures 1 and 3, is idle and transfer relay 29 therein is restored. Under this condition, the application of ground potential to conductor 14 results in the closure of a circuit through the normally closed contacts associated with the inner armature of relay A6 for the lower winding of the relay, over conductor 18, and through the lower contacts of relays 29 and 25 to battery. Relay A6 thereupon operates and closes a locking circuit for itself at its lower armature independent of the continued grounded condition of conductor 14, at the same time disconnecting its lower winding from conductor 14. Each other one of the allotter relays A7 to A10 (relays A8 and A9 not being illustrated) which operates similarly closes a local locking circuit for its lower winding.

With relay 10 in a restored condition, the operation of relay A6 extends the ground potential incoming over conductor 19 to the upper winding of relay A6 to hold this relay operated until the associated finder F2, Figure 3, has been operated to connect the calling line with the repeater R2. At the same time, a branch circuit is extended over conductor 6 of the cable CA—3, and thence by way of conductor 16 to the finder-connecting relay 12' of the finder F2, whereupon relay 12' operates to connect the control conductors in cables CA—1 and CA—2 with the finder F2, to cause this finder to be operated as explained in connection with the finder F1.

Upon the operation of any one of the allotter relays A6 to A10, the extended circuit of pick-up relay 11 is now broken because the circuit of relay 11 includes contacts of relays A6 to A10 when group relay 10 is in restored condition. Relay 11 restores shortly thereafter and again removes ground potential from operating conductor 14.

With further reference to the finder F2 and the repeater R2, the upper winding of line relay 28 of the repeater R2 is energized, first in a local circuit through contacts of finder-connecting relay 12' as previously explained in connection with the finder F1 and the repeater R1, and then over the calling line after the finder F2 has made connection therewith. Upon energizing, line relay 28 operates the associated slow-acting release relay 27, and relay 27 grounds the associated *c* and *d* leads with results in the finder F2 as previously pointed out in connection with the finder F1. In the repeater R2, the grounding of the *c* lead has the further effect of closing an energizing circuit for transfer relay 29. When relay 29 operates, it transfers the *a* and *b* leads of the trunk T2 from the corresponding leads of the connector C1 to the outgoing *a* and *b* leads of the repeater R2. When this results, a loop circuit is closed across the *a* and *b* leads of the trunk T2, by way of the right-hand windings of the repeating coil of the repeater R2, and the lower contacts of operated line relay 28. This results in the operation of the line relay 31 in the selector S1 in the main exchange. When line relay 31

operates it closes a circuit for the associated release relay 30. Release relay 30 disconnects the associated c lead of the repeater R3 from transfer relay 32 and connects it to ground, thereby guarding the repeater R3 and the trunk T2 against seizure in the main exchange. By the operation of line and release relays 31 and 30 of the selector S1, the selector S1 is prepared for operation in the usual manner to extend the connection when the calling subscriber dials the first digit in the desired number.

A further result of the operation of transfer relay 29 in the repeater R2 is the opening of the previously established circuit over conductor 18 for the lower winding of the associated allotter relay A6. As a result, relay A6 restores along with relay 12' when the finder F2, Figure 3, has made connection with the calling line.

When the calling subscriber subsequently replaces his receiver (after having dialed to cause the connection to be extended as desired) the resultant restoration of line relay 28 of the repeater R2 results in the opening of the loop across the conductors of the trunk T2 at the lower contacts of the relay, permitting the operated switching equipment in the main exchange to clear out in the usual manner. The restoration of relay 28 also permits release relay 27 to restore and remove ground potential from the associated c and d leads to permit the finder F2 to clear out and free the called line. The removal of ground potential from the c lead permits transfer relay 29 to restore and again connect the conductors of the trunk T2 with the connector C1. Relay 29 also again prepares a circuit over conductor 18 for reenergizing the lower winding of allotter relay A6 the next time pick-up conductor 14 becomes grounded.

Assuming that the one-way trunks all remain busy for a time and that another call is initiated in the satellite exchange during this time, the consequent grounding of allotter-start conductor 19 results in the closure of a circuit through the contacts of the restored relays A1 to A5, through the contacts of the restored relays 10 and A6, and thence by way of the remaining portion of the allotter chain circuit to the upper winding of the next one of the relays A7 and A10 which is in operated condition, thereby causing this relay to be held and the associated finder-connecting relay (similar to 12) to be operated.

As soon as one of the one-way trunks outgoing from the satellite exchange to the main exchange becomes idle, group relay 10 is again operated, when its circuit is closed at the first one of the trunk relays (such as relay 23 of the repeater R1, Figure 2) to reoperate. Upon reoperating, group relay 10 again prepares for the allotting of any one of the five finders associated with the one-way outgoing trunks and respectively with the alotter relays A1 to A5, as previously explained.

The next time all of the one-way trunks become busy and relay 10 restores as a result thereof, it may well be that one or more of the relays A6 to A10 associated respectively with the two-way trunks, are still in operated condition. Under this condition, the grounding of the allotter-start conductor 19 does not cause a reoperation of allotter-control relay 11 but closes the chain circuit through contacts of any restored ones of the relays A6 to A10 and through the lower armature of the first operated one of such relays for the upper winding of the relay and a parallel circuit for the associated finder-connecting relay, to cause the finder to be operated as previously pointed out. The finders associated with the two-way trunks are, therefore, taken for use in turn.

Using the two-way trunks for main-to-satellite calls

As previously explained, the five one-way trunks leading from the main exchange to the satellite exchange, of which the trunk T3, Figure 1, is one, are the first five choices of the selectors (such as S1 to S3) in the main exchange, while the five two-way trunks, of which the trunk T2, Figure 1, is one, are the choices 6 to 10 of the selectors in the main exchange.

Let it be assumed that all of the one-way trunks leading from the main exchange to the satellite exchange are in use, and that one of the selectors (the selector S3, Figure 1, for example) is operated in accordance with the hundreds digit 6, in a call from the main exchange to the satellite exchange. Under this condition, the searching operation of the selector S3 continues until all of the five busy one-way trunks have been tested and the two-way trunks are reached. It may be assumed that the two-way trunk T2 is idle and that this is the one selected. The trunk T2 is shown also in Figure 3. Referring particularly to Figure 3, the trunk T2 is accessible in the main exchange by way of the a, b, and c leads of the repeater R3. The testing of the trunk T2 in the main exchange occurs over the c lead of the repeater R2, which lead is in an ungrounded condition when the trunk is idle. When the repeater R3 is seized by the selector in the main exchange, ground potential is applied temporarily by the seizing selector to the c lead to render the trunk busy in the local selector multiple. The ground potential thus applied closes an operating circuit for transfer relay 32 of the repeater R2, which includes the lower armature and resting contact of release relay 30 of the selector S1. When transfer relay 32 operates it disconnects the a and b conductors of the trunk T2 from the selector S1 and transfers them to the outgoing conductors of the repeater R3.

As a further result of the seizure of the repeater R3, the calling subscriber's loop is extended to the incoming conductors a and b thereof, thereby closing a circuit for line relay 33. Line relay 33 actuates the slow-acting release relay 34 to ground and maintain grounded the associated c lead at the repeater. Additionally, line relay 33 bridges the left-hand windings of the associated repeating coil across the associated outgoing talking conductors, thereby closing a loop across the now transferred a and b leads of the trunk T2, establishing a circuit through contacts of the unoperated transfer relay 29 of the repeater R2, for the line relay 24 of the connector C1 in the satellite exchange.

Line relay 24 now operates and closes a circuit for release relay 25. Release relay 25 operates to prepare the connector for the usual operation in response to the further dialing on the part of the calling subscriber. Additionally, relay 25 disconnects battery potential from conductor 18, normally applied thereto through contacts of transfer relay 29. The circuit of the lower winding of relay allotter A6 is thereby opened at one point, preventing operation of relay A6 in the event that pick-up conductor 14 becomes grounded as previously described while the trunk T2 is in use, or restoring relay A6 if currently locked up and held over conductor 18.

When the calling subscriber dials the two remaining digits in the desired number, the connector C1 of Figure 3 operates in the usual manner to extend the connection to the desired line. The dial pulses are repeated by line relay 33 of the repeater R3 to line relay 24 of the connector C1 for this purpose. The slow-acting release relays 34 and 25, of course, do not restore during the dialing operation.

When the calling subscriber replaces his receiver, the resultant restoration of line relay 33 permits line relay 24 of the connector C1 to restore. Release relay 23 restores shortly thereafter and again replaces battery potential through contacts of transfer relay 29 on conductor 18 to prepare a circuit for relay A6 in the allotter FA—1, thereby rendering the two-way trunk T2 accessible again from the satellite exchange, subject to the previously described condition of all of the one-way trunks being in use to bring about the restoration of group relay 16.

In the main exchange, release relay 34 shortly restores responsive to the restoration of line relay 33, thereby removing ground potential from the associated *c* lead to restore transfer relay 32. Transfer relay 32 transfers the *a* and *b* conductors of the trunk T2 back to the corresponding conductors of the incoming selector S1. The removal of ground potential from the *c* lead of the repeater R3 marks associated trunk multiple as idle in the banks of the selectors having access thereto.

What is claimed is:

1. In a telephone system, a first telephone exchange and a second telephone exchange, a group of one-way trunk lines extending from the first exchange to the second exchange, a group of two-way trunk lines interconnecting said exchanges and available in each exchange for extending connections to the other, two groups of finders in the first exchange, the finders of the first group being linked respectively to the said one-way trunk lines extending from the first exchange to the second, the finders of the second group being linked respectively to the first-exchange end of said two-way trunk lines, lines of the first exchange accessible to all said finders, a finder allotter associated with said finders and effective to allot idle ones of said finders successively for use to extend calling ones of said lines to the second exchange, and means for causing said allotter to allot an idle finder of the second group only in the event all of the trunks to which the finders of the first group are linked are in use.

2. In a telephone system, a first telephone exchange and a second telephone exchange, a group of one-way trunk lines extending from the first exchange to the second exchange, a group of two-way trunk lines interconnecting said exchanges and available in each exchange for extending connections to the other, two groups of finders in the first exchange, the finders of the first group being linked respectively to the said one-way trunk lines extending from the first exchange to the second, the finders of the second group being linked respectively to the first-exchange end of said two-way trunk lines, lines of the first exchange accessible to all said finders, a finder allotter associated with said finders and effective to allot idle ones of said finders successively for use to extend calling ones of said lines to the second exchange, and means for causing said allotter to allot an idle finder of the second group only in the event all of the trunks to which the finders of the first group are linked are in use, said means including a group relay controlled according to the busy or idle condition of each of said one-way trunks.

3. In a trunking system, two groups of finders, lines directly accessible to all said finders, any of said finders being operable when in idle condition and when allotted to extend any calling one of said lines, an allotter associated with said finders and operable to allot any idle one of them to extend the next calling line, means for controlling said allotter to allot an idle finder in the second group only in case all of the finders in the first group are in use, said means including a group relay and means for actuating it directly responsive to the condition of all finders in the first group being in use.

4. In a switching system, two groups of finders, lines accessible to all said finders, an allotter comprising a series of relays, means for causing said relays to respond successively to allot idle ones of said finders, the first relays in the series being associated respectively with the finders of the first group, the remaining relays in the series being associated respectively with the finders of the second group, and means including a group relay responsive to the condition of all finders in the first group being busy for rendering the said relays of the series associated with the second group of finders initially responsive to allot finders in the second group.

5. In a switching system, two groups of finders, lines accessible to all said finders, two series of allotter relays associated respectively with said groups of finders, the first series of relays being normally operative to allot idle finders in the first group, and means responsive to the condition of all finders in the first group being busy for joining the second series of allotter relays to the first, the relays in the second series being thereupon rendered effective to allot idle finders in the second group.

6. In a switching system, a group of line finders, normally closed control contacts individual respectively to said finders, lines accessible in common to all said finders, a series of allotter relays, said relays being individual respectively to said finders, means including a starting chain circuit extending through contacts of said relays for allotting the finder associated with the first operated relay, such operated relay being held operated in a self-locking circuit including the said control contact individual to the associated finder, and means effective when the allotted finder is taken for use for opening the said individual contact to unlock and restore the said operated relay to thereby allot the finder associated with the next succeeding operated one of said relays.

7. In a switching system, a group of line finders, normally closed control contacts individual respectively to said finders, lines accessible in common to all said finders, a series of allotter relays, said relays being individual respectively to said finders, means including a starting chain circuit extending through contacts of said relays for alloting the finder associated with the first operated relay, such operated relay being held operated in a self-locking circuit including the said control contact individual to the associated finder, means effective when the allotted finder is taken for use for opening the said individual contact to unlock and restore the said operated relay to thereby allot the finder associated with the next succeeding operated one of said relays, the said control contact individual to any finder

becoming closed again when the finder again becomes idle, a pick-up relay associated with said allotter relays and means for operating it over the said chain circuit when all of said allotter relays are in restored condition, said pick-up relay being effective when operated to reoperate all of said relays whose associated finders are in idle condition, whereby such relays again become self-locked.

8. In a switching system, a group of line finders, normally closed control contacts individual respectively to said finders, lines accessible in common to all said finders, a series of alloter relays, said relays being individual respectively to said finders, means including a starting chain circuit extending through contacts of said relays for allotting the finder associated with the first operated relay, such operated relay being held operated in a self-locking circuit including the said control contact individual to the associated finder, means effective when the allotted finder is taken for use for opening the said individual contact to unlock and restore the said operated relay to thereby allot the finder associated with the next succeeding operated one of said relays, and independent means controlled over the said starting chain circuit for maintaining operated the allotter relay associated with the currently allotted finder after the opening of the said unlocking contacts until the finder has completed its operation.

9. In a switching system, a group of line finders, normally closed control contacts individual respectively to said finders, lines accessible in common to all said finders, a series of allotter relays, said relays being individual respectively to said finders, means including a starting chain circuit extending through contacts of said relays for allotting the finder associated with the first operated relay, such operated relay being held operated in a self-locking circuit including the said control contact individual to the associated finder, means effective when the allotted finder is taken for use for opening the said individual contact to unlock and restore the said operated relay to thereby allot the finder associated with the next succeeding operated one of said relays, each of said allotter relays having a first winding over which it is maintained operated through the said contacts individual thereto in the associated finder, each of said relays having also a second winding thereon, and means effective when an allotted finder is being operated to connect with a calling line for energizing the second winding of the operated allotter relay associated with the currently allotted finder to thereby maintain such relay operated after the said individual control contacts have been opened and until the operation of the associated finder has been completed.

10. In an inter-exchange trunking system, two-way trunk lines extending between a first exchange and a second exchange, each of said trunk lines having an incoming branch and an outgoing branch in the first exchange, line finders in the first exchange linked respectively to said outgoing branches, a separate allotter relay assigned to each of said finders, and a separate control circuit for each of said relays including two contacts individual respectively to the said branches of the associated trunk.

GLENN KINER.