

June 16, 1942.

I. MOLNAR ET AL

2,286,431

TELEPHONE SYSTEM

Filed Feb. 12, 1940

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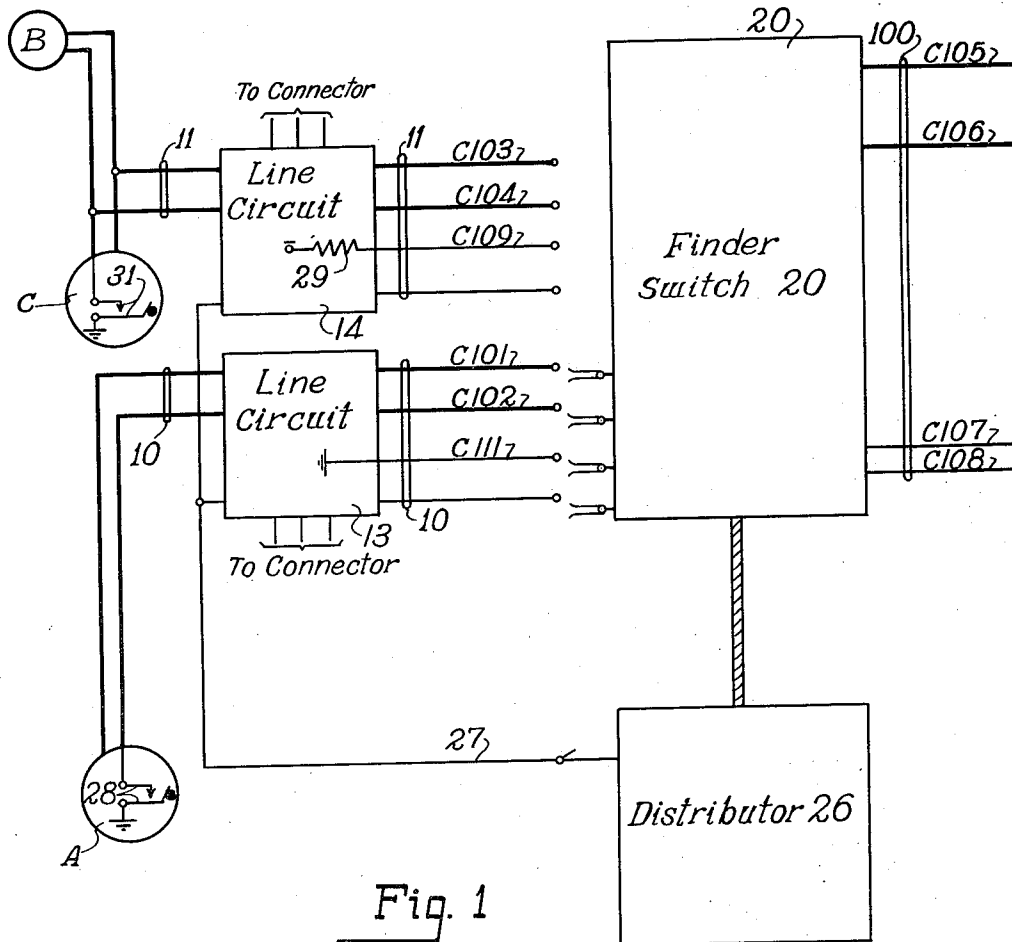


Fig. 1

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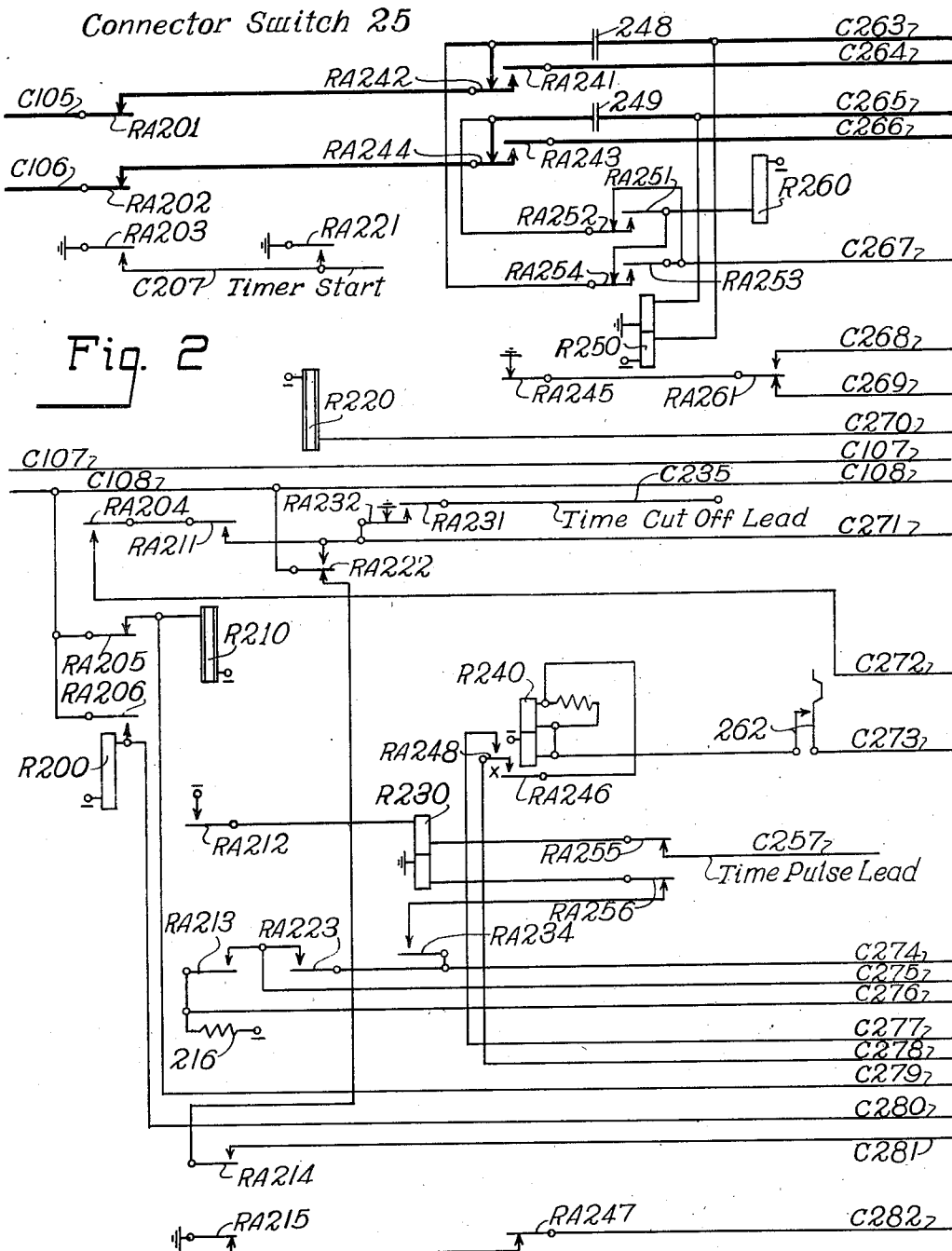
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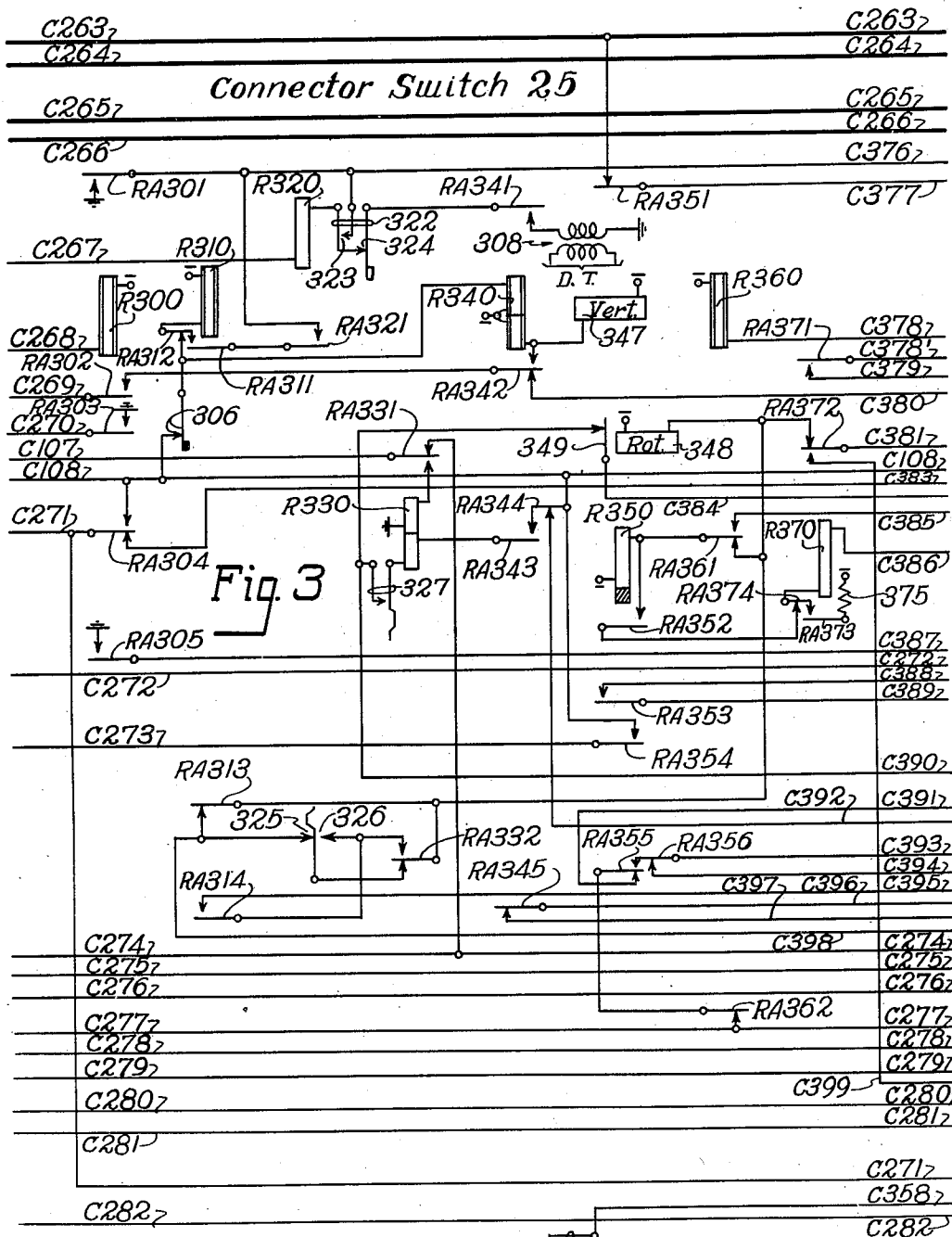
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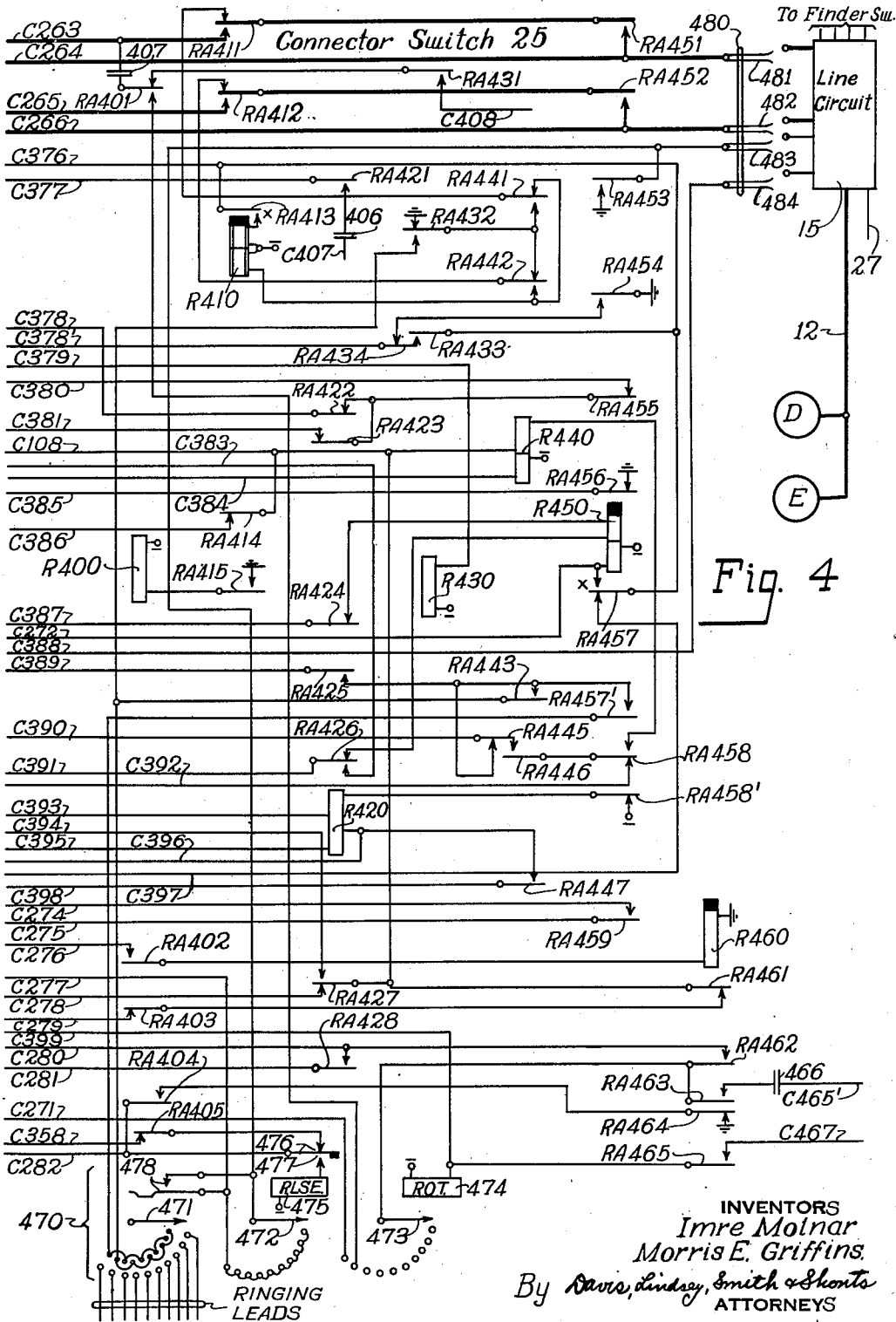
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TELEPHONE SYSTEM

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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,286,431

TELEPHONE SYSTEM

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32 Claims. (Cl. 179-17)

The present invention relates to telephone systems and more particularly to improved automatic line switching equipment which is controllable in a simple and reliable manner to provide different classes of service to subscribers paying different rates.

It is an object of the present invention to provide, in a telephone system, an improved arrangement for automatically rendering different classes of service to different subscribers served by the same multiparty line.

It is another object of the invention to provide improved automatic line switching apparatus of the character indicated which is so arranged that any substation of the system may be converted from one service class to another by the simple expedient of substituting a calling device of one character for an installed calling device of another character.

It is a further and more specific object of the invention to provide automatic switching apparatus of the character described which is so arranged that the subscribers of one class and served by multiparty lines are prevented from using certain specified trunks, such, for example, as central office trunks, while other subscribers served by the same multiparty lines are permitted to use the trunks.

It is a further object of the invention to provide automatic switching apparatus of the character described which is so arranged that local call connections routed therethrough and resulting from calls originating at substations having only restricted service are automatically released after they have been established for a predetermined time interval, while local call connections resulting from calls originating at substations having unrestricted or semirestricted service are only released under the control of the calling subscribers.

It is still another object of the invention to provide automatic switching apparatus of the character described which serves to provide reverting call signaling service and is so arranged that the switches utilized in setting up a reverting call connection are automatically released a predetermined time interval after they are seized in the event they are not released under the control of the calling or called subscriber before the predetermined time interval expires.

It is a still further object of the invention to provide improved line switching equipment of the character described which includes apparatus operative automatically to release the operated switches involved in partially established connec-

tions resulting from line permanents, or the like, and which is so arranged that the switch release apparatus is rendered inactive when the switches involved in a partially established connection are seized over a line arranged for local calls of unlimited duration.

In the illustrated embodiment of the invention there are provided a plurality of subscribers' lines, certain of which are of the multiparty type individually having a plurality of substations associated therewith, and automatic switching apparatus in the form of finder-connector links for setting up connections between the lines of the system. The connector switches of the links also have access to one or more groups of trunks which are provided to serve only the substations arranged for unrestricted service and may extend, for example, to one or more distant suburban or central exchanges. The finder-connector links are provided with apparatus for giving service of one class to certain of the subscribers served by the multiparty lines and service of a different class to other subscribers served by the same multiparty lines. More particularly, this apparatus includes call blocking means for preventing the subscribers in one of the restricted service classes from obtaining access to the interoffice trunks mentioned above. The trunk call blocking means is controlled in accordance with the types of calling devices provided at the substations of different class; calling devices of special character being provided at the substations arranged for non-restricted service which are operative to render the trunk call blocking means of the automatic switching equipment ineffective; and calling devices of conventional character being provided at the substations arranged for restricted service. The latter calling devices are not effective to prevent the call blocking means of the automatic switching apparatus from operating. Each of the finder-connector links also includes a link release relay which is operative under the control of timing apparatus common to the links to release the associated link in the event the link is seized over a line having a calling condition thereon and a talking circuit is not established by way of the link within a predetermined time interval following its seizure. The circuit arrangement of the link is such that the link release relay also functions to release the associated link when occupied with a reverting call initiated on one of the multiparty subscribers' lines in the event a loop circuit is not established by way of this line within a predetermined time interval after the link is seized. As indicated above, the

subscribers' lines served by the finder-connector links are divided into two groups, the lines of the respective groups being arranged for different classes of service. In accordance with another feature of the present invention, timing devices are provided in the links for automatically releasing connections involving calling lines in one of the two groups after the connections have been established for a predetermined time interval and means individual to the lines in the other group are provided for preventing the operation of the timing means. More specifically, each link includes a timing device having a start timing relay embodied therein, each timing device being operative under the control of its start timing relay to release a connection routed through the associated link a predetermined time interval after the connection is established. The circuit wiring of the links is such that the start timing and link release relays of any link are prevented from operating to perform their assigned functions when the associated link is seized over a calling line arranged for nonrestricted service.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof will best be understood by reference to the specification taken in connection with the accompanying drawings in which Figures 1, 2, 3 and 4, when placed side by side in the order named, illustrate an automatic telephone system having embodied therein the features of the invention as briefly outlined above.

Referring to the drawings, the telephone lines and automatic switching apparatus there illustrated may comprise, for example, a small exchange designed to serve a suburban area of limited population which is geographically adjacent a larger city or town served by a central exchange. The subscribers' substations served by the automatic switching apparatus illustrated may be arranged for three different classes of service. For example, the line 10 which serves only the substation A and terminates in the exchange in a line circuit 13 is arranged for unlimited central exchange trunk service and also for local calls of unlimited duration. To this end, the calling device provided at the substation A is equipped with an extra set of shunt springs 28 which are arranged to connect the positive side of the line 10 to ground during each operation of the device, and the multiplied extra control contacts of the contact sets, individual to the finder switches and to which the conductors of this line are connected, are grounded in the line circuit 13. All other lines which are to provide unrestricted service of the character just described, are arranged in a similar manner. The two other subscribers' lines illustrated in the drawings, namely, the lines 11 and 12 which terminate in the exchange in line circuits 14 and 15, are of the multiparty type, the line 11 being arranged to serve two substations B and C and the line 12 being arranged to serve two additional substations D and E. The substation C is similar to the substation A in that it is equipped with a calling device having an extra pair of shunt springs 31 which are arranged to connect the positive side of the line 11 to ground, whereby the subscriber at the substation C is permitted to obtain access to the central exchange trunks for the purpose of setting up connections directly to the central exchange sub-

scribers without resorting to the expedient of routing such connections through a toll operator's position. The substations B, D and E, on the other hand, are not equipped with calling devices of the character provided at the substations A and C but with calling devices of conventional construction and, accordingly, users of these three substations can only directly complete local call connections. Moreover, the arrangement of the line circuit 14 is such that all local connections can only be used for a predetermined time interval, after which they are automatically released. Thus, the subscriber at the substation C is restricted as to the duration of local calls but is provided with central exchange toll trunk service. The substations B, D and E, on the other hand, are restricted both as to the period of using local call connections and in the making of central exchange calls. From the foregoing explanation it will be apparent that in order to provide central exchange trunk service to any substation associated with one of the multiparty subscribers' lines of the system, it is only necessary to substitute at the substation a calling device of special character for an installed calling device of conventional character. If all of the substations associated with a particular line are to have central exchange trunk service, the line circuit terminating this line may be modified for this purpose without changing the calling devices provided at the substations associated with the line. To this end, the extra control conductor of the line circuit terminating the line is connected to the negative terminal of the exchange battery through a resistor of appropriate resistance. This expedient, which is shown by way of illustration as being incorporated in the line circuit 14, may also be used in the line circuits terminating incoming trunks from another suburban exchange or a private branch exchange.

The automatic switching apparatus provided in the exchange for setting up connections between the various lines terminating thereat comprises a plurality of finder-connector links of one hundred lines capacity, one of which is illustrated as comprising the finder switch 20 and the connector switch 25. For the purpose of assigning these links to the use of calling lines in a definite order there is provided a distributor 26, preferably of the preselecting type and arranged to initiate the operation of the finder portion of a preselected link to search for a calling line in response to the grounding of the distributor start lead 27 in the line circuit associated with the calling line. Since the finder switch 20 and the distributor 26 may be of conventional arrangement, these switching units have been only schematically illustrated. The line circuits 13, 14 and 15, with the exceptions pointed out above, may also be of conventional arrangement and accordingly the details thereof have not been shown. The connector switch 25 is illustrated in Figs. 2, 3 and 4 as being of the well-known Strowger type having its contact field divided into ten levels of bank contacts, the lowermost levels of which are reserved for the termination of subscribers' lines, branch exchange trunk lines and one or more central exchange trunk lines extending to a toll operator's switchboard in a distant central exchange. The uppermost levels of the connector switch are used to terminate the regular central exchange trunks over which the subscribers having unrestricted service may route connections to the central office subscribers

without the intervention of a toll operator. For example, the tenth level of bank contacts in the connector switch 25 may be reserved for the termination of trunks of the last-mentioned group.

Neglecting for the present the details of the circuit wiring of the connector switch 25 and considering the operation of the system generally, if a subscriber at the substation B, for example, initiates a local call intended for the substation D, the line circuit 14 associated with the calling line 11 operates in the usual manner to mark the calling line as busy in the bank contacts of the connector switches having access thereto and connects the distributor start conductor 27 to ground. In response to the latter operation, the apparatus of the distributor 26 initiates the operation of the finder switch embodied in a selected link to seize the calling line. Assuming, for example, that the link illustrated, namely, that comprising the finder switch 20 and the connector switch 25 is assigned to the use of the calling line 11, the finder portion of this link upon seizing the calling line extends the calling loop circuit to the connector portion of the link and releases the distributor 26. When the connector switch 25 is thus seized, the control apparatus thereof functions to return the usual dial tone signal to the calling subscriber. In order to extend the connection to the desired called line the calling subscriber dials the three digits of the directory number identifying the desired substation D. The first digit is utilized for the purpose of causing the connector switch 25 to elevate its wipers to a position opposite the level of bank contacts terminating the group of ten lines in which the called line 12 is included. The second digit is utilized to direct the wipers of the connector switch 25 into engagement with the contacts terminating the conductors of the desired line 12. The third digit is utilized for the purpose of selecting ringing current of the frequency or code designating the desired substation D. In the arrangement illustrated provisions are only made for harmonic ringing, but it will be apparent to those skilled in the art that the ringing arrangement disclosed may be modified to include provisions for code ringing without departing from the scope of the present invention. The arrangement of the control apparatus embodied in the connector switch 25 is such that the called line is not tested until shortly following the end of the ringing digit. If this line tests busy, the usual busy tone signal is returned to the calling subscriber. On the other hand, if the line is idle ringing current of the selected frequency or code is transmitted over the calling line for the purpose of signaling the subscriber at the substation D that his substation is being called. The ringing operation is terminated and the desired talking circuit is fully established when the call is answered at the called substation. The answering of the call also serves to initiate the operation of a conversation timing device which, in the case under consideration, functions to release the operated switches 20 and 25 in the event the call is not terminated and the connection released under the control of the calling subscriber within a predetermined time interval after it is completed. The normal release of the connection is under the control of the calling subscriber, the operated switches 20 and 25 and the line circuit 14 being restored to normal when the calling loop circuit is interrupted at the calling substation B. Had the call originated at a substation, such, for ex-

ample, as the substation A, arranged for fully unrestricted service, operation of the above-mentioned conversation timing apparatus is not initiated in response to the answering of the call at the called substation. Accordingly, in such case the connection would endure until released at the calling end thereof. The arrangement of the connector switch is such that if a calling subscriber at a substation, such, for example, as the substation B, arranged to provide only restricted service, attempts to obtain access to one of the central office trunks over which connections may be routed directly to the central office subscribers, the call is blocked in the connector switch and a busy signal is returned to the calling subscriber. As indicated above, the call blocking means provided in the connector switch 25 is rendered inactive under the control of the calling devices provided at the substations equipped for unrestricted central office trunk service. Accordingly, if a central office trunk call originates at the substation A, for example, the call may proceed through the automatic switching apparatus illustrated and the automatic switching apparatus of the central exchange without being routed through a toll operator's position. In this connection it is pointed out that the connector switch 25 is arranged for switching-through operation on central office trunk calls. Reverting call connections are completed by directory number dialing, the arrangement of the switching apparatus being such that any link occupied with a reverting call is released under the control of the timing apparatus common to the links in the event the busy link is not released in the normal manner within a predetermined time interval after it is seized.

Referring now in greater detail to the connector switch 25, the Strowger switching mechanism of this switch comprises a set of wipers 480 and the usual vertical and rotary magnets 347 and 348, respectively, which are operative in conjunction with their associated ratchet and pawl mechanisms, not shown, to impart vertical and rotary movement to the wiper set. This mechanism is also equipped with vertical off-normal springs 306, 322 and 357 which perform various circuit control operations described with particularity hereinafter. The switching mechanism further comprises a release magnet 346 which, when energized, permits the wipers 480 to be returned to vertical and rotary normal in the usual manner, and normal post springs 262, 325, 326 and 327 which perform additional circuit control operations described with particularity hereinafter and are arranged to be moved off-normal from the normal positions shown in the drawings in response to elevation of the wipers 480 to one or more predetermined vertical off-normal positions. The equipment for controlling the vertical, rotary and release magnets of the switching mechanism and for performing the auxiliary control operations required incident to the setting up of the various types of connections referred to above includes a pair of line relays R260 and R320 which are arranged to be energized in series over the two talking conductors of the trunk 100 incoming to the connector switch 25. This equipment further comprises a slow-acting hold relay R300, a slow-acting relay R220 which is a slave to the hold relay, a pair of relays R200 and R210 which are utilized in setting up reverting call connections between two substations associated with any one of the multi-party lines of the system, a link release relay R230, a switching-

through relay R240 and a back bridge relay R250. Additional relays embodied in the connector switch and shown in Fig. 3 of the drawings include a pair of control relays R310 and R330 which are utilized in providing the different classes of service described above; a pulse circuit transfer relay R340 of the slow-acting type; a pair of pulse responsive control relays R350 and R360 also of the slow-acting type and a second pulse circuit transfer relay R370. The relay equipment illustrated in Fig. 4 and also embodied in the connector switch 25 comprises a slow-acting ring cut-off relay R410, a relay R400 which is a slave to the ring cut-off relay, a busy test relay R420, a pair of ringing control relays R430 and R440 and a slow-to-operate line switching relay R450. Selection of the frequency of ringing current which is to be projected over a called line is accomplished through the provision of a minor switch 470 of the eleven point type which includes three wipers 471, 472 and 473, the usual operating and release magnets 474 and 475, respectively, and off-normal contact springs 476 and 477. This minor switch also functions as a timing device for determining the duration of local call connections established by way of the connector switch 25, operation of the switch 470 for this purpose being initiated under the control of a slow-to-operate start timing relay R460.

Local calls

Referring now more particularly to the operation of the connector switch 25, when the finder switch 20 operates in the manner outlined above to seize a calling line, such, for example, as the line 11, a ground connection extending from the finder switch 20 to the control or release conductor C108 is completed in the usual manner. When this conductor is grounded, the relays R210, R310 and R340 are energized and operate. The circuit for energizing the relay R210 extends by way of the grounded conductor C108, RA205 and the winding of R210 to battery. The circuit for energizing the relay R310 extends by way of the grounded conductor C108, the off-normal springs 306, RA312 and the winding of R310 to battery. The circuit for energizing the relay R340 extends by way of the grounded conductor C108, the off-normal springs 306 and the upper winding of R340 to battery. The relay R340 upon operating completes a loop circuit which extends through the windings of the two relays R260 and R320 and the finder switch 20 to the calling substation. Assuming that the call was initiated at the substation B, this circuit extends from ground by way of the secondary winding of the transformer 308, RA341, the off-normal springs 324, the winding of R320, C267, RA252, RA244, RA202, C106, C104, the direct current bridge across C103 and C104 at the calling substation B, C103, C105, RA201, RA242, RA254 and the winding of R260 to battery. When energized over this circuit the two relays R260 and R320 both operate. Further, the dial tone voltage introduced in this circuit through the transformer 308 is reproduced by the receiver provided at the calling substation B to inform the calling subscriber that the dialing operation may be started.

At RA342, the relay R340 prepares a circuit for energizing its lower winding in parallel with the vertical magnet 347 and opens a point in the circuit for energizing the rotary magnet 348 in parallel with the relays R350 and R360. The relay R210, upon operating, opens, at RA215, a point in the circuit for energizing the release

magnet 346 and at its other armatures prepares certain operating and holding circuits described more fully hereinafter.

The relay R260 in operating, completes a circuit for energizing the slow-acting hold relay R300, this circuit extending from ground by way of RA245, RA261, C268 and the winding of R300 to battery. At RA261, the relay R260 also opens a point in the circuit for energizing the relay R340 and the vertical magnet 347 in parallel. The relay R320, upon operating, prepares, at RA321, a holding circuit for the relay R310. The relay R300 in operating, completes the last-mentioned circuit, this circuit extending from ground by way of RA301, RA321, RA311, RA312 and the winding of R310 to battery. At RA302, the relay R300 further prepares the circuit for energizing the lower winding of the relay R340 and the vertical magnet 347 in parallel. At RA303, the relay R300 completes a circuit extending by way of C270 for energizing the slow-acting slave relay R220. At RA304, the relay R300 completes a multiple path for impressing ground potential upon the control conductor C108 and in so doing completes locking circuits for the two relays R210 and R340. This path extends from ground by way of RA232, C271 and RA304 to the control conductor C108 and the completion thereof serves to prevent the release of the operated finder switch 20 and the line circuit 14, in the usual manner. At RA305, the relay R300 prepares a circuit for energizing the upper winding of the line switching relay R450. The relay R310 in operating, opens, at RA313, a point in one branch of the automatic cut-in circuit, described hereinafter, for energizing the rotary magnet 348 in parallel with the relay R350. At RA314, the relay R310 prepares a second branch of the automatic cut-in circuit. The relay R220 in operating, completes, at RA221, an obvious path for grounding the timer start lead C207, and at RA222, completes an obvious multiple path for grounding the control or release conductor C108. Following the relay operations just described the connector switch is conditioned to respond to the impulses of the first digit dialed at the calling substation B.

Assuming that the substation D is desired by the calling subscriber, three digits are dialed at the calling substation B, the first two digits being utilized in the manner briefly described above to direct the wipers 480 of the connector switch 25 into engagement with the contacts terminating the conductors of the called line 12 and the third digit being utilized to select the frequency of the ringing current which corresponds to the desired substation D. The line relays R260 and R320 follow the impulses of the three digits and the relay R260 functions to repeat the impulses of the first digit to the vertical magnet 347 and the relay R340 in parallel over the above-mentioned pulsing circuit. This circuit extends from ground by way of RA245, RA261, C269, RA302 to RA342, where it divides, one branch extending through the lower winding of R340 to battery and the other branch extending through the winding of the magnet 347 to battery. Each time the relay R320 restores, it opens the above-traced holding circuit for the control relay R310, but the latter relay, due to its slow-to-release characteristic, remains operated during pulsing. Each time the vertical magnet 347 is energized it operates to elevate the wipers 480 one step. When

these wipers are elevated to the first vertical off-normal position, the off-normal springs 324 are disengaged, the off-normal springs 323 are moved into engagement, the off-normal springs 306 are disengaged and the off-normal springs 357 are moved into engagement. At the off-normal springs 323 and 324 the secondary winding of the dial tone transformer 308 is excluded from the loop circuit extending to the calling substation in an obvious manner. At the off-normal springs 357 the operating circuit for the release magnet 346 is prepared. At the off-normal springs 306 the operating circuits for the relays R310 and R340 are interrupted. Due to the slow-to-release characteristic of the relay R340, this relay remains operated until the first series of impulses is terminated. For the same reason the slow-acting hold relay R300 remains in its operated position during impulsing.

During the interdigit pause between the first and second digits, the relay R340 restores, to open, at RA341, a further point in the initially completed loop circuit extending to the calling substation and to open, at RA342, a point in the above-traced circuit for energizing its lower winding in parallel with the vertical magnet 347. At RA342, the relay R340 further prepares the above-mentioned circuit for energizing the rotary magnet 348 in parallel with the relays R350 and R360. At its other armatures, the relay R340 performs certain additional circuit control operations referred to in detail hereinafter.

During the impulses of the second digit, the relay R260 functions to complete the last-mentioned circuit during the open circuit period of each impulse. This circuit extends from ground by way of RA245, RA261, C269, RA302, RA342 and C380 to RA455 where it divides, one branch extending by way of RA422, C378 and the winding of R360 to battery, a second branch extending by way of RA423, C381, RA372 and the winding of the magnet 348 to battery, and a third branch extending by way of RA423, C381, RA372, RA361 and the winding of R350 to battery. The relay R360 operates when the circuit just traced is initially completed, and due to its slow-to-release characteristic, remains operated for the duration of the second series of impulses. In operating, the relay R360 completes, at RA361, a holding circuit for the relay R350, which circuit extends from ground by way of RA456, C385, RA361 and the winding of R350 to battery. At RA362, the relay R360 opens a point in the circuit for energizing the busy test relay R420. The relay R350, upon operating, opens, at RA351, a point in the circuit for impressing the voltage of the busy tone current source upon the established loop circuit extending to the calling substation. At RA352, the relay R350 completes a path for short-circuiting the winding of the relay R370, this path extending by way of the grounded conductor C385, RA361, RA352, RA374, the winding of R370, C386 and RA414 back to ground as connected to the control conductor C108. At RA353, the relay R350 prepares a circuit for energizing the trunk hunting relay R440. At RA355, the relay R350 opens a point in the operating circuit for the line switching relay R450 and prepares the operating circuit for the busy test relay R420. At RA354, the relay R350 prepares a circuit for energizing the relay R240. Each time the rotary magnet 348 is energized in response to an impulse of the

second digit it functions to rotate the wipers 480 one step so that at the conclusion of the second digit these wipers are positioned in engagement with the contacts terminating the conductors of the called line 12.

During the interdigit pause between the second and third digit, the relay R360 releases to interrupt, at RA361, the holding circuit for the relay R350 and the above-traced path short-circuiting the winding of R370. At RA362, the relay R360 further prepares the circuit for energizing the busy test relay R420. When the path short-circuiting the winding of the relay R370 is interrupted this relay is energized in series with the relay R350 over a circuit extending by way of the grounded control conductor C108, RA414, C386, the winding of R370, RA374, RA352 and the winding of R350 to battery. When energized over this circuit the relay R370 operates to complete a holding circuit for itself, which holding circuit extends by way of the grounded conductor C108, RA414, C386, the winding of R370, RA374, RA373 and the resistor 375 to battery. After this circuit is completed the relay R370 opens its operating circuit as traced above and in so doing deenergizes the relay R350. At RA371, the relay R370 prepares the operating circuit for the ringing control relay R430. At RA372, the relay R370 opens the pulsing circuit to the relay R350 and the rotary magnet 348, and prepares a circuit for energizing the operating magnet 474 of the minor switch 470 in accordance with the impulses of the third digit, thereby to select the frequency of the ringing current to be transmitted over the selected line 12. This circuit is completed during the open circuit period of each impulse of the third digit and extends from ground by way of RA245, RA261, C269, RA302, RA342, C380, RA455, RA423, C381, RA372, C399 and the winding of the magnet 474 to battery. The branch of this circuit which extends by way of RA422, C378 and the winding of R360 is also completed each time the pulsing relay R260 restores at the beginning of an impulse. Accordingly, the relay R360 is reoperated at the beginning of the first impulse of the third digit and remains operated until the digit is ended. Upon reoperating, the relay R360 re completes the previously traced circuit for energizing the relay R350 and opens the operating circuit for the busy test relay R420. The relay R350, upon reoperating, performs the circuit control operations previously described. Each time the operating magnet 474 of the switch 470 is energized over its operating circuit as traced above it functions to advance the wipers 471 to 473, inclusive, one step so that at the conclusion thereof these wipers stand in engagement with the contacts corresponding to the frequency of the ringing current to which the signal device provided at the desired substation D is tuned to respond. As explained in greater detail hereinafter, operation of the switch 470 also serves to select the side of the line over which the ringing current is to be projected in the event divided ringing is used. This is accomplished by including the multiplied second, fourth, sixth, eighth and tenth contacts of the inner contact set associated with the wiper 471 in the operating circuit for the control relay R440 so that this control relay will be energized in the event a third digit comprising an even number of impulses is dialed at the calling substation. These multiplied contacts are also included in the circuit for transmitting ringing current of the selected frequency over the called line. The multiplied odd num-

bered contacts of the inner contact set associated with the wiper 471 are not included in the operating circuit for the control relay R440, being utilized solely for the purpose of transmitting ringing current over the called line. Accordingly, the relay R440 is not energized in the event a third or ringing digit comprising an odd number of impulses is dialed at the calling substation. When the wipers of the switch 470 are stepped to the first off-normal position in response to the first impulse of the third digit, the off-normal contact springs 476 are disengaged to open a further point in the operating circuit for the release magnet 346 and the contact springs 477 are engaged to prepare a circuit for energizing the release magnet 475 of the switch 470. When the wiper 472 is moved off-normal in response to the first impulse of the third digit it engages the first contact of the associated contact multiple, thereby further to prepare the operating circuit for the busy test relay R420.

The relay R360, which is deenergized in the manner previously explained at the end of the third digit, restores shortly thereafter to complete the operating circuit for the busy test relay R420 and to open the circuit for energizing the slow-to-release relay R350. If the selected line 12 is busy, guarding ground potential is impressed upon the private conductor thereof in the usual manner. Accordingly, the busy test relay R420 is energized over its operating circuit which extends by way of the grounded private wiper 483, the wiper 472 and one of its associated multiplied contacts, C277, RA362, RA355, RA356, C393, the upper winding of R420 and RA458' to battery. When energized over this circuit the relay R420 operates, to open, at RA424, a point in the operating circuit for the line switching relay R450. At RA427, the relay R420 prepares a holding circuit for itself, this holding circuit being completed in response to the release of the relay R350 which occurs shortly following operation of the relay R420 and extending by way of the grounded control conductor C108, RA427, C394, RA356, C393, the upper winding of R420 and RA458' to battery. At RA422 and RA423, the relay R420 further opens the previously traced operating circuits for the relays R360 and R350, the rotary magnet 348 and the operating magnet 474 of the minor switch 470, thereby to prevent further operation of the calling device provided at the calling substation B from effecting further operation of the control apparatus embodied in the connector switch 25. At RA425, the relay R420 prepares a circuit for energizing the control relay R440 during an automatic trunk hunting operation on the part of the connector switch 25. At RA421, the relay R420 completes the circuit for transmitting busy tone current over the established loop extending to the calling substation. The circuit traversed by this current extends from one terminal of the busy tone current source, not shown, by way of C407, the condenser 406, RA421, C377, RA351, C263, the condenser 248, RA242, RA201, C105, C103, the receiver at the substation B, C104, C106, RA202, RA244, RA252, C267, the winding of R320, the off-normal springs 323 and RA301 to the opposite terminal of the busy tone current source. Energization of the receiver provided at the calling substation by the busy tone current traversing this circuit serves to inform the calling subscriber that the desired connection cannot be obtained. The manner in which the operated switch train is released when

the call is abandoned at the calling substation is fully described hereinafter.

In the event the selected line 12 is idle, battery potential is impressed upon the private wiper 483, so that the busy test relay R420 is not energized over its operating circuit as traced above. When, therefore, the relay R350 restores shortly following the end of the third digit, the operating circuit for the slow-to-operate line switching relay R450 is completed. This circuit extends from ground by way of RA306, C387, RA424, the upper winding of R450, RA426, C391, RA355, RA362, C277, the wiper 472, the private wiper 483 and through the winding of the cut-off relay embodied in the line circuit 15 to battery. When energized over this circuit the relay R450 operates to complete, at the "X" contacts associated with RA457, a locking circuit for itself, this locking circuit extending from ground by way of RA301, C376, RA457 and the lower winding of R450 to battery. After this circuit is completed, the relay R450 connects the private wiper 483 to ground at RA453, thereby to mark the line 12 as busy in the bank contacts of the other connector switches having access thereto and to cause the operation of the cut-off relay embodied in the line circuit 15 in the usual manner. At RA451 and RA452, the relay R450 further prepares the talking circuit to the called substation D. At RA454, the relay R450 completes a circuit extending by way of RA434, C378', RA371 and C379 for energizing the ringing control relay R430. At RA455, the relay R450 opens a point in the common portion of the previously traced operating circuits for the relays R360 and R350, the rotary magnet 348 and the operating magnet 474 of the minor switch 470, thereby to prevent further operation of the calling device provided at the calling substation from effecting further operation of the control apparatus embodied in the connector switch 25. At RA456, the relay R450 opens a point in one of the previously traced circuits for energizing the relay R360. At RA457', the relay R450 further prepares the circuit for transmitting ringing current to the signal device associated with the called substation. At RA458, the relay R450 prepares a locking circuit for the relay R440. At RA458', the relay R450 opens a further point in the previously traced operating and holding circuits for the busy test relay R420. Finally, the relay R450 prepares, at RA459, a circuit for energizing the link release relay R230. The relay R430, upon operating, further prepares the ringing circuit at RA432 and completes at RA433 and RA444 a locking circuit for itself. This locking circuit extends from ground at RA301 by way of C376, RA433, RA434, C378', RA371, C379 and the winding of R430 to battery. At RA431, the relay R430 completes a path for projecting ringing current by way of the loop circuit extending to the calling substation, whereby the usual ring-back tone signal is reproduced by the receiver provided at this substation. The path traversed by the ring-back tone current extends from one terminal of one of the ringing current sources by way of C408, RA431, RA401, the condenser 407, C263, the condenser 248, RA242, RA201, C105, C103, the receiver at the calling substation B, C104, C106, RA202, RA244, RA252, C267, the winding of R320, the off-normal springs 323 and RA301 to the other terminal of the ringing current source. Following the operation of the ringing relay R430, ringing current of the selected frequency is transmitted over the called

line 12 to energize the signal device provided at the called substation D each time the ringing interrupter conventionally embodied in the ringing apparatus, not shown, operates to connect the selected ringing current source to the selected ringing lead. Assuming that the line 12 is arranged for bridged ringing and further that the wipers of the switch 470 stand in engagement with their associated first contacts, the path traversed by the ringing current may be traced as extending by way of the No. 1 ringing current lead, the wiper 471 and its associated first contact, RA432, RA442, RA412, RA452, the wiper 482, the signal device provided at the substation D and bridged between the line conductors of the line 12, the wiper 481, RA451, RA411, RA441, the lower winding of the ring cut-off relay R410 and the exchange battery to ground. Obviously, portions of this ringing current also traverse the signal devices individually provided at the other substations connected to the line 12. Since, however, these other signal devices are tuned to respond to ringing currents having frequencies different from that of the ringing voltage impressed on the first ringing lead associated with the wiper 471 of the switch 470, they do not operate. The signal device provided at the substation D responds to the ringing current traversing its windings over the circuit just traced and operates to indicate an incoming call. In the event the line 12 is arranged for divided ringing and the signal device at the called substation D is connected between the positive conductor of the line 12 and ground, the ringing current is conducted to the windings of the signal device provided at the substation D over a circuit substantially similar to that traced above, but in this case the return path to the grounded side of the ringing current source is obtained directly through the grounded terminal of the signal device. In the event the line 12 is arranged for divided ringing, the signal device provided at the substation D is connected between the negative conductor of the line 12 and ground and the frequency of the ringing current to which this signal device responds is the frequency of the signal voltages impressed on one of the second, fourth, sixth, eighth or tenth ringing leads associated with the wiper 471, the relay R440 is operated during the first ringing cycle which follows operation of the relay R450. More specifically, the relay R440 is, in this case, energized over a circuit extending from ground through the selected ringing current source over the selected even numbered ringing lead, the wiper 471 and two of its associated even numbered contacts, RA457', RA445, C390, the armature 349, C384 and the lower winding of R440 to battery. When energized over this circuit the relay R440 operates to complete a locking circuit for itself, which locking circuit extends by way of the grounded control conductor C108, the upper winding of R440, RA458, RA446, RA445, C390, the armature 349, C384 and the lower winding of R440 to battery. At its armatures RA441, RA442 and RA443, the relay R440 completes a circuit for projecting ringing current of the selected frequency over the called line 12. In this case the circuit traversed by the ringing current extends by way of one of the even numbered ringing leads, the wiper 471 and two of its associated even numbered contacts, RA457', RA443, RA432, RA441, RA411, RA451, the negative line wiper 481 and the negative side of the line 12 to one terminal of the signal device provided at

the substation D. Assuming that this signal device is connected between the negative conductor of the line 12 and ground, the current after traversing the windings of this device, is returned directly to the grounded terminal of the selected ringing current source. On the other hand, if the signal device provided at the substation D is bridged across the conductor of the line 12 in series with a condenser the ringing current is returned to the grounded terminal of the selected ringing current source over a path including the positive conductor of the line 12, the positive line wiper 482, RA452, RA412, RA442, the lower winding of R410 and the exchange battery. From the foregoing explanation it will be apparent that the control relay R440 determines the side of a selected called line over which ringing current is to be projected in accordance with the odd or even number of the ringing digit dialed at a calling substation.

The desired talking circuit between the calling and called substations is completed when the call is answered at the called substation. More particularly, when the hook switch provided at the called substation D is operated to establish a direct current bridge between the conductors of the line 12, the ring cut-off relay R410 is energized over a circuit the character of which depends upon whether the line 12 is arranged for bridged or divided ringing. Assuming the line 12 is arranged for bridged ringing and that an odd numbered ringing lead has been selected, the circuit for energizing the relay R410 extends by way of the selected grounded ringing lead, the wiper 471, RA432, RA442, RA412, RA452, the positive line wiper 482, the positive side of the line 12, the bridge across the conductors of the line 12, the negative side of the line 12, the negative line wiper 481, RA451, RA411, RA441 and the lower winding of R410 to battery. Assuming that an even numbered ringing lead has been selected, the circuit for energizing the relay R410 extends by way of the selected grounded ringing lead, the wiper 471, RA457', RA443, RA432, RA441, RA411, RA451, the negative line wiper 481, the negative side of the line 12, the direct current bridge across the conductors of the line 12, the positive side of the line 12, the positive line wiper 482, RA452, RA412, RA442 and the lower winding of R410 to battery. In the event a call is initiated at one of the substations associated with the line 12 substantially simultaneously with the operation of the line switching relay R450, the ring cut-off relay is energized over a circuit extending from ground by way of RA432, RA442, RA412, RA452, the positive line wiper 482, the positive conductor of the line 12, the established bridge across the conductors of this line, the negative side of the line 12, the negative line wiper 481, RA451, RA411, RA441 and the lower winding of R410 to battery. When energized over any one of the circuits traced above, the relay R410 first operates to complete a locking circuit for itself at the "X" contacts associated with RA413, this locking circuit extending from ground by way of RA301, C376, RA413 and the upper winding of R410 to battery. At RA411 and RA412, the relay R410 opens two points in each of its three operating circuits as traced above and in so doing interrupts the established ringing current circuit and completes the desired talking circuit between the calling and called lines. At RA414, the relay R410 opens the previously traced locking circuit for the relay R370, causing the latter relay to re-

store. At RA415, the relay R410 completes an obvious circuit for energizing its slave relay R400.

The relay R400, upon operating, opens, at RA401, the above-traced circuit for transmitting ringing current over the calling end of the connection and prepares a circuit for transmitting a special signal current over the established connection after a predetermined time interval has elapsed. At RA402, the relay R400 completes a circuit for energizing the slow-to-operate timer start relay R460, this circuit extending from ground through the winding of R460 and by way of RA402, C276 and the resistor 216 to battery. At RA403, the relay R400 opens one of the multiple operating circuits for the relay R210. At RA405, the relay R400 further opens the operating circuit for the release magnet 346. Finally, at RA404, the relay R400 completes a circuit for energizing the release magnet 475 of the minor switch 470. This circuit extends from ground at RA464 by way of RA404, the off-normal springs 477 and the winding of the magnet 475 to battery. When energized over this circuit the release magnet operates in the usual manner to restore the wipers 471, 472 and 473 to normal.

When the ring cut-off relay R410 operates in the manner explained above, it functions to establish a loop circuit extending from the called substation through the windings of the back bridge relay R250. More particularly, the relay R250 is energized over a circuit extending from ground through its upper winding and by way of C265, RA412, RA452, the positive line wiper 482, the positive side of the line 12, the bridge across the conductors of this line, the negative side of the line 12, the negative line wiper 481, RA451, RA411, C263 and the lower winding of R250 to battery. When thus energized, the relay R250 operates and at its armatures RA251 to RA254, inclusive, reverses the direction of current flow over the loop circuit extending to the calling substation in the usual manner. This current reversal may be utilized for various supervisory or control purposes with which the present invention is not concerned. At RA255 and RA256, the relay R250 opens points in the operating and holding circuits for the link release relay R230. Following operation of the relay R250 the connection between the calling and called substations is fully established, talking battery being supplied to the loop extending to the calling substation through the windings of the line relays R250 and R320, and to the loop extending to the called substation through the windings of the back bridge relay R250.

The normal release of the established connection is under the control of the calling subscriber at the substation B. Thus, when the connection is released at the called substation the loop circuit extending through the windings of the back bridge relay R250 is interrupted and this relay restores to again reverse the direction of current flow over the calling loop circuit and to reprepare the operating and holding circuits for the link release relay R230. When the connection is released at the calling end thereof the two line relays R260 and R320 are deenergized and restore in the usual manner, the first of these relays functioning to open the operating circuit for the hold relay R300 and the second thereof operating to open the holding circuit for the relay R310. Thus, the four relays R260, R300, R310 and R320 are deenergized and restore. The relay R300 in releasing, opens, at RA301, the previously traced holding circuits for the relays R410 and R450.

At RA303, the relay R300 interrupts the operating circuit for the relay R220. At RA305, the relay R300 opens a point in the previously traced operating circuit for the relay R450. The relay R410, upon restoring, opens, at RA415, the operating circuit for the slave relay R400, and the relay R450, in releasing, opens, at RA458, the holding circuit for the relay R440. Thus, the relays R220, R400 and R440 are deenergized and restore. At RA453, the relay R450 disconnects ground from the private wiper 483, thereby to cause the release of the cut-off relay embodied in the line circuit 15 in the usual manner. As a result, the line 12 is again marked as idle in the bank contacts of the connector switches having access thereto. The relay R400 in restoring, opens, at RA402, the previously traced operating circuit for the relay R460 causing the latter relay to restore. The relay R220, upon restoring in response to the release of the hold relay R300, disconnects ground from the control conductor C108 at its armature RA222 and in so doing opens the holding circuit for the relay R210, thus causing the latter relay to restore. At RA221, the relay R220 opens one of the multiple paths for impressing ground potential upon the timer start conductor C207. When the control conductor C108 is disconnected from ground, the finder switch 20 and the line circuit 14 are released in the usual manner. Following the release of these two switching units, the calling line 11 is marked as idle in the bank contacts of the connector switches to which it extends. The relay R210 in releasing, opens, at RA212, the prepared operating circuit for the link release relay R230 and completes, at RA215, one of the operating circuits for the release magnet 475. This circuit extends from ground by way of RA215, RA241, C282, the off-normal springs 477 and the winding of the magnet 475 to battery. When energized over this circuit the release magnet 475 operates, permitting the wipers 471 to 473, inclusive, to be restored to normal in the usual manner. When these wipers are returned to their respective home positions the off-normal springs 477 are disengaged to deenergize the release magnet 475 and the off-normal springs 476 are moved into engagement to complete the prepared operating circuit for the release magnet 346. The latter circuit extends from ground by way of RA215, RA241, C282, the off-normal springs 476, RA405, C358, the off-normal springs 357 and the winding of the magnet 346 to battery. When the release magnet 346 is thus energized, the wipers 480 of the Strowger switching mechanism are restored to normal in a well-known manner. At this time the off-normal springs 357 are disengaged to deenergize the release magnet 346 and the off-normal springs 306 and 322 are restored to normal. Following the release of the Strowger switching mechanism the connector switch 25 is fully restored to normal.

As indicated previously, the arrangement of the apparatus is such that the relay R460 in cooperation with the minor switch 470 and the pulse generating equipment, not shown, functions to time a connection which results from a call originating on the line 11, for example, arranged for restricted service, and to release the connection a predetermined time interval after it is established in the event the connection is not released under the control of the calling subscriber before the time interval elapses. More specifically, the relay R460, upon operating, opens at RA461, a further point in one of the multiple

operating circuits for the relay R210 and interrupts at RA464 the previously traced operating circuit for the release magnet 475. At RA462 and RA463, the relay R460 further prepares the above-mentioned path for impressing a warning signal voltage on the established connection from a source of tick-tone current, not shown. At RA462, the relay R460 also prepares one of the operating circuits for the line switching relay R200. At RA465, the relay R460 prepares an alternative circuit for energizing the operating magnet 474 of the minor switch 470. Following the operation of the relay R460, this alternative circuit is periodically completed through the application of ground potential to the time pulse lead C467 by a pulse generator, not shown. These ground pulses may be applied to the time pulse lead C467 at intervals of any desired spacing from a ground pulse generator of conventional construction and arrangement. Each time the lead C467 is grounded, the magnet 474 is energized and operates to advance the wipers of the switch 470 one step. After nine current pulses have been delivered to the magnet 474 such that the wipers of the switch 470 are operated to engage their associated ninth contacts, the above-mentioned path for impressing the voltage of tick-tone current source upon the established connection is completed, this path extending from the ungrounded terminal of the current source by way of C465', the condenser 466, RA463, the wiper 473 and its associated ninth contact, RA401 and the condenser 407 to the negative side of the established loop circuit extending to the called substation. The current flowing over this path is projected over the calling and called ends of the connection to energize the receivers respectively provided at the calling and called substations and thus indicate to the subscribers conversing over the established connection that the connection is about to be forcibly released. In the event the calling subscriber does not immediately hang up to initiate the release of the connection in the normal manner prior to operation of the wipers of the switch 470 to their respective tenth off-normal positions, the relay R200 is energized and operates to interrupt the established talking circuit. More particularly, when the magnet 474 receives the tenth ground pulse from the pulse generating equipment it operates to advance the wiper 473 into engagement with its associated tenth contact, thereby to complete the above-mentioned operating circuit for the relay R200. This circuit extends from ground at RA232 by way of C271, the wiper 473, RA462, C280 and the winding of R200 to battery. When energized over this circuit, the relay R200 operates to complete a locking circuit for itself, this locking circuit extending from ground by way of RA232, RA222, C108, RA206 and the winding of R200 to battery. At RA203, the relay R200 connects multiple ground to the timer start lead C267. At RA204, the relay R200 completes a multiple holding circuit for the relay R450, this circuit extending from ground by way of RA232, RA211, RA204, C272 and the lower winding of R450 to battery. At RA205, the relay R200 opens the operating circuit for the relay R210 causing the latter relay to restore after an interval. At RA201 and RA202, the relay R200 opens two points in the established loop circuit extending from the calling substation through the windings of the line relays R260 and R320. When these two line relays restore, the operated relays of the connector switch 25 are

caused to release in the manner previously explained. In this case the release of the minor switch 470 and of the Strowger switching mechanism occurs concurrently with the release of the operated relays. Thus, when the relay R210 restores shortly following operation of the relay R200, it completes the previously traced operating circuit for the release magnet 475, whereby the wipers of the switch 470 are permitted to restore to normal. During the homing operation of these wipers and when the wiper 473 is disengaged from its associated tenth contact, the above-traced operating circuit for the relay R200 is released. Also, the off-normal springs 477 are disengaged to deenergize the release magnet 475 and the off-normal springs 476 are engaged to complete the operating circuit for the release magnet 346. When the magnet 346 is energized, the wipers 480 of the Strowger switching mechanism are restored to normal, at which time the off-normal springs 357 are opened to deenergize the release magnet 346. During the movement of the wipers 480 to normal and when these wipers are disengaged from the contacts of the conductors terminating the line 12, the back bridge relay R250 is deenergized and restores. During the release of the operated relays embodied in the connector switch 25 and when the relay R220 restores to disconnect ground from the control conductor C108, the relay R200 is deenergized and restores. The removal of ground potential from the control conductor C108 also results in the release of the operated finder switch 20 and the line circuit 14 in the usual manner. Aside from the differences pointed out, the sequence in which the operated relays of the connector switch 25 are released in response to operation of the relay R200 is exactly the same as previously described with reference to the normal release of this switch.

As explained in the introductory portion of the specification, on local calls originating on lines having unrestricted local call service and routed by way of the connector switch 25, the timing apparatus comprising the relay R460 and the minor switch 470 is prevented from operating to release the connection a predetermined time interval after it is established. To this end, the extra control contact of each finder switch contact set terminating a line of this character is connected directly to ground, so that a path is completed for short-circuiting the timer start relay R460 when the slave relay R400 operates. Thus, the line 10 is illustrated as being arranged for unrestricted local call service, the extra control contact of the contact set in the finder switch 20 which terminates this line being connected to ground in the line circuit 13 over the conductor C111. With the line circuit 13 wired in this manner if a call which has been routed from the line 10 through the finder switch 20 and the connector switch 25 to the substation D, for example, is answered at this substation to cause the operation of the relays R410 and R400 in the manner just explained, the timer start relay R460 is short-circuited. The path for short-circuiting this relay extends from ground through the winding of R460 by way of RA402, C276, RA213, C275, RA459, C274, RA331, C107, the extra control wiper of the finder switch 20 and C111 back to ground. With the relay R460 short-circuited, operation of the minor switch 470 is prevented and, accordingly, the connection may be held from the calling substation for an unrestricted time interval.

In the event the called line 12 is busy at the time it is selected, only the relays R210, R220, R260, R300, R310, R320, R370 and R420 are operated at the time the connection is released at the calling end thereof. During the release of the enumerated relays, the relays R370 and R420 are deenergized and restore when the control conductor C108 is disconnected from ground in response to the release of the relay R220. The other enumerated relays of the connector switch are released in the exact sequence described above.

Reverting calls

The arrangement of the connector switch 25 is such that in setting up reverting call connections the selective signaling of called substations is accomplished by directory number dialing. More particularly, if the above-described call originating at the substation B is intended for another substation, such, for example, as the substation C, also connected to the line 11, the calling subscriber after initiating the call in the manner previously described dials the directory number of the desired substation C. The first two digits of this directory number designate or identify the line 11, while the third digit is utilized to select ringing current of the particular frequency to which the signal device provided at the substation C is responsive. The manner in which the connector switch 25 responds to the three digits is exactly the same as described above with reference to the call routed to the substation D. In this case since the line selected, namely, the line 11, is marked as busy, due to the operated condition of the line circuit 14, the usual busy tone signal is reproduced by the receiver provided at the calling substation B shortly following the end of the third digit. Upon receiving the busy tone signal, the calling subscriber must hang up in order to initiate the ringing operation necessary to signal the called substation. In response to this release operation performed at the substation B, the calling loop circuit is interrupted to cause the release of the two line relays R260 and R320 followed by the release of the hold relay R300 and the relays R310 and R220. In releasing, the relay R300 opens, at RA301, a point in the previously traced locking circuits for the relays R410 and R450 in addition to interrupting the holding circuit for the relay R310. At RA305, the relay R300 opens a point in the previously traced operating circuit for the relay R450. At RA302, the relay R300 interrupts the common portion of the previously traced pulsing circuits extending to the magnets 347, 348 and 474. At RA304, the relay R300 opens the initially completed path for impressing ground potential upon the control conductor C108 and completes an alternative path for maintaining ground potential upon this control conductor and for holding the private wiper 483 grounded. This alternative path extends from ground by way of RA232, C271, RA304, C383, RA426, C391, RA355, RA362, C277 and the wiper 472 to the private wiper 483. From this point the ground connection is extended through the line circuit 14 and the finder switch 20 to the control conductor C108 to hold operated the relays R210, R370 and R420. The busy test relay D420 is held operated pending operation of the line switching relay R450. The relay R220, upon releasing in response to restoration of the hold relay R300, completes the operating circuit for the relay R200, this circuit extending by way of the grounded control conductor C108, RA222, 75

RA214, C281, RA428, C280 and the winding of R200 to battery. The relay R200 in operating, completes, at RA206, an obvious locking circuit for itself and opens, at RA205, one of the multiple operating circuits for the relay R210. At RA203, the relay R200 completes one of the multiple paths for grounding the timer start conductor C207. At RA201 and RA202, the relay R200 opens two additional points in the calling loop circuit as initially established through the finder switch 20. At RA204, the relay R200 completes an alternative circuit for energizing the line switching relay R450, this circuit extending from ground by way of RA232, RA211, RA204, C272 and the lower winding of R450 to battery. When energized over this circuit the relay R450 completes the prepared operating circuit for the ringing relay R430 and prepares at RA451 and RA452 the ringing circuit to the line 11. At RA453, the relay R450 completes an obvious multiple path for grounding the private wiper 483. At RA457, the relay R450 prepares the previously traced operating circuit for the relay R440, whereby the latter relay is caused to operate and lock if an even numbered ringing current lead has been selected by the minor switch 470. At RA458, the relay R450 interrupts the locking circuit for the busy test relay R420, causing the latter relay to restore. At RA433 and RA434, the relay R430, upon operating, completes an alternative locking circuit for itself, this circuit extending from ground at RA232 by way of RA211, RA204, C272, RA457, RA433, RA434, C378, RA371, C379 and the winding of R430 to battery. Upon restoring, the relay R420 opens, at RA423, the above-traced operating circuit for the relay R200 and at RA427 a further point in its own holding circuit.

Following operation of the line switching relay R450, the ringing control relay R430 and possibly the relay R440, ringing current of the selected frequency is transmitted by way of the line 11 to energize the signal device provided at the substation C over one of the three ringing current circuits traced previously with reference to the local call routed to the substation D. When the call is answered at the called substation, the previously traced circuit for energizing the ring cut-off relay R410 is completed. At RA413, the relay R410 first completes an alternative holding circuit for itself, this alternative circuit extending from ground at RA232 by way of RA211, RA204, C272, RA457, RA413 and the upper winding of R410 to battery. At RA415, the relay R410 completes the operating circuit for the slave relay R400. At RA414, the relay R410 opens the holding circuit for the relay R370, causing the latter relay to release and open, at RA371, the locking circuit for the ringing relay R430. The relay R400 in operating, opens, at RA403, the only completed circuit for energizing the relay R210. The relay R210 now releases to open, at RA211, the previously traced operating circuit for the relay R450 and the holding circuit for the relay R410, thereby to cause the release of the relays R450, R440, if operated, R410 and R400 in the order named. The relay R450 in releasing, disconnects the private wiper 483 from ground at RA453. Since the control conductor C108 is connected through the finder switch 20 and the line circuit 14 to the private wiper 483, this conductor is also disconnected from ground in response to the release of the relay R450. Accordingly, the relay R200 is deenergized and restores. The relay R210 in releasing, also com-

pletes, at RA215, the previously traced operating circuit for the release magnet 475, whereby the wipers of the minor switch 470 and the wipers 480 of the Strowger switching mechanism are sequentially restored to normal in the manner previously explained.

When ground potential is removed from the private wiper 483 in response to the release of the line switching relay R450, the cut-off relay conventionally embodied in the line circuit 14 restores to reconnect the line relay of this line circuit across the conductors of the line 11. Accordingly, this line relay reoperates to complete a locking circuit for the lockout relay conventionally embodied in the line circuit 14. With the line and lockout relays operated in the line circuit 14, the line 11 is locked out of service, ground potential is maintained upon the private conductor of this line to mark the line as busy, and the ground marking path to the distributor start conductor 27 is interrupted. Thus, the automatic switching apparatus utilized in setting up the connection is fully released and the connection is guarded against seizure for the duration of the call due to the operated condition of the line and lockout relays embodied in the line circuit 14. It will be understood that the calling subscriber after hanging up his receiver in order to initiate the ringing operation in the manner explained above, waits a reasonable time interval during which the called substation is signaled and then again removes his receiver from its supporting hook or cradle in order to ascertain if the call has been answered. If the call has been answered at the called substation, the desired conversational circuit is immediately established when the calling subscriber removes his receiver from its supporting hook, talking battery being supplied to the two substations over the line 11 through the windings of the line relay embodied in the line circuit 14. This line circuit is released when the calling and called subscribers hang up to terminate the connection. More particularly, when the direct current paths bridging the line 11 at the calling and called substations B and C, respectively, are both interrupted, the line relay embodied in the line circuit 14 is deenergized and restores to open the locking circuit for its associated lockout relay. When this lockout relay is deenergized and restores the line circuit 14 is fully released.

Trunk call—Three-digit trunk selection

The connector switch 25 is arranged to have access to groups of trunks which may be selected in response to either single digit or three-digit calling operations at the various substations. The trunks in the group or groups which are selected in response to three series of impulses transmitted to the connector switch may comprise, for example, ring-down trunks extending to one or more manual exchanges. For the purpose of providing automatic selection of idle trunks of these groups, each trunk of each group is terminated in the contact field of the connector switching mechanism at a set of contacts comprising the usual private contact and an extra control contact, and these private and extra control contacts of each contact set except that terminating the last trunk of the group are strapped together.

In order to select an idle trunk of a desired group arranged for three-digit selection a calling subscriber, such, for example, as a subscriber at the substation B, dials a first digit which desig-

nates the level of contacts at which the trunks of the desired group are terminated, a second digit which designates the first trunk of the group and a third or ringing digit. The manner in which the control apparatus of the connector switch responds to these three digits is exactly the same as described previously with reference to the local call originating at the substation B. At the end of the second digit the wipers 480 are positioned in engagement with the contacts terminating the first trunk of the group. If this trunk is busy at the time it is thus selected, ground potential is present upon the private contact thereof and, due to the strapping between this contact and the extra control contact, is also impressed upon the extra control wiper 484. At the time the first trunk of the group is thus selected, the relays R210, R220, R260, R300, R310, R320, R350, R360 and R370 are all operated.

The third or ringing digit is utilized in the manner pointed out above to step the wipers of the minor switch 470 to one of its off-normal positions. Shortly following the end of the third digit, the relay R360 restores to open the holding circuit for the relay R350 and to complete at RA362 the previously traced operating circuit for the busy test relay R420. Assuming that the first trunk of the selected group is busy, the relay R420 now operates to prepare the previously traced circuit for transmitting busy tone current over the calling loop circuit and to prepare its locking circuit. At RA422, the relay R420 opens a further point in the operating circuit for the relay R360. At RA423, the relay R420 interrupts the pulsing circuit extending to the rotary magnet 348. At RA425, the relay R420 completes a circuit for energizing the lower winding of R440, this circuit extending by way of the grounded extra control wiper 484, C388, RA353, C389, RA425, RA445, C390, the armature 349, C384 and the lower winding of R440 to battery. Obviously, this circuit and the operating circuit for the busy test relay R420 are not energized if the first trunk of the selected group is idle such that negative battery potential is impressed upon the private and extra control wipers 483 and 484. When energized over this test circuit the relay R440 operates and completes a locking circuit for itself, this locking circuit extending by way of the grounded control conductor C108, RA344, C392, RA458, RA446, RA445, C390, the armature 349, C384 and the lower winding of R440 to battery. At RA447, the relay R440 completes a circuit for energizing the rotary magnet 348 in parallel with the relay R350, this circuit extending from ground at RA301 by way of C376, RA457, C397, RA345, C396, RA447, C398 and the normal post springs 325 to RA332 where it divides, one branch extending through the winding of the magnet 348 to battery and the other branch extending by way of RA361 and the winding of R350 to battery. When thus energized, the rotary magnet 348 operates to step the wipers 480 one step in the rotary direction, thereby to select the second trunk of the selected group. At its armature 349, the magnet 348 interrupts the above-traced operating and holding circuits for the relay R440. The relay R440 now restores to open its holding circuit and the circuit for energizing the relay R350 and the magnet 348 in parallel. The magnet 348 in releasing, re completes the test circuit through the lower winding of the relay R440. Assuming that the second trunk of the selected

group is also busy, ground potential is held on the private and extra control wipers 493 and 494, respectively, so that energization of the relay R420 is maintained and the relay R440 is again energized. The relay R440 in reoperating, performs the functions described above. The interrelated operation of this relay and the rotary magnet 348 continues until an idle trunk of the selected group is found or until all of the trunks of the selected group have been tested and found to be in a busy condition. During this trunk hunting operation, the relay R350, due to its slow-to-release characteristic, remains operated.

Assuming that an idle trunk in the selected group is available, the wipers 480 are operated step by step until the contacts terminating the idle trunk are engaged thereby. As indicated above, an idle trunk is identified by the presence of battery potential upon the private and extra control contacts in the contact set at which it is terminated. Accordingly, when an idle trunk is selected the lower winding of the relay R440 is short-circuited and, hence, does not reoperate. Due to the presence of battery potential upon the private wiper 483, the upper winding of the busy test relay R420 is also deenergized when the idle trunk of the selected group is found. Accordingly, the relay R420 immediately restores to reprepare the operating circuit for the line switching relay R450. Shortly following the release of the relay R420, the relay R350 also restores to complete the operating circuit for the relay R450. From this point on, the manner in which ringing current of the selected frequency is transmitted over the selected idle trunk to signal the operator attending the switchboard at which the distant end of this trunk terminates is exactly the same as described previously with reference to the local call originating at the substation B. Moreover, the operation of the connector switch 25 incident to the answering of the call at the called end of the connection and incident to the release of the connection at the calling substation are the same as described above with reference to the setting up and releasing of a local call connection.

It will be understood from the foregoing explanation that if the first trunk of the selected group is idle the relays R420 and R440 are not caused to operate. In such case the relay R350 is deenergized and restores to complete the operating circuit for the line switching relay R450 shortly following the end of the third digit. The relay R450 in operating initiates the ringing operation in the manner previously explained.

If all of the trunks of the selected group are busy, the wipers 480 are, through the interrelated operation of the relay R440 and the rotary magnet 348, operated into engagement with the contacts of the contact set terminating the last trunk in the group. In this contact set, the extra control contact is not wired. Hence, the extra control wiper 484 is open-circuited when the last trunk of the group is selected. Accordingly, the relay R440 remains in its restored position and the trunk hunting operation of the connector switch is arrested. Since ground potential is, under the conditions stated, present on the private wiper 483 the busy test relay R420 is not deenergized and remains in its operated position. Shortly following the selection of the last trunk, the relay R350 restores to

complete the previously traced holding circuit for the busy test relay R420 and to complete, at RA351, the previously traced path over which the busy tone current source is connected to the upper side of the talking circuit extending back to the calling subscriber's substation. When this path is completed the usual busy tone signal is reproduced by the receiver provided at the calling substation, whereby the calling subscriber is informed that the connection cannot be obtained. It will be noted that at this time the condition of the connector switch is exactly the same as previously described with reference to the selection of a busy subscriber's line. Accordingly, the manner in which this connector switch, the preceding finder switch 20 and the line circuit terminating the calling line are released when the call is abandoned at the calling substation will be apparent from the previous explanation.

Trunk call—One-digit trunk selection on switching-through levels

In order to provide one-digit automatic trunk selection on switching-through levels, the Strowger switching mechanism of the connector switch 25 is equipped with normal post springs 262, 327 and 478 which are arranged respectively to be operated into engagement in response to the elevation of the wipers 480 to a position opposite a level of bank contacts terminating trunk groups arranged for this type of selection. In this regard, it will be recalled from the preceding explanation that the groups of trunks arranged for one-digit selection are terminated in the uppermost levels of the connector switch contact bank, whereby the enumerated normal post springs are only moved off-normal when a trunk in one of these groups is to be selected.

With this arrangement if a call originating at the substation A, for example, is routed by way of the finder switch 20 to the connector switch 25 and the calling subscriber dials a single digit designating one of the group of trunks arranged for one-digit selection, the indicated normal post springs are moved into engagement immediately the wipers 480 are elevated to a position opposite the contact level terminating the desired group of trunks. At the springs 262 the operating circuit for the switching-through relay R240 is prepared. At the springs 478 an obvious path shunting the wiper 472 and its associated contact set is completed, thereby to prepare the operating circuit for the relay R420. At the normal post springs 327 a circuit is completed for energizing the lower winding of the relay R440, this circuit extending by way of the grounded control conductor C108, RA344, RA343, the lower winding of R330, the springs 327, the armature 349, C384 and the lower winding of R440 to battery. The relay R440 in operating, prepares its holding circuit at RA445 and RA446, and prepares, at RA447, an automatic cut-in circuit for energizing the rotary magnet 348. The other circuit switching operations performed by the relay R440 are without effect at this time. The relay R330 in operating, prepares a circuit for energizing its upper winding. The purpose of this relay and the circuits controlled thereby is described with particularity in the following portion of the specification dealing with restricted and unrestricted classes of service.

Shortly following the end of the single digit

dialled at the calling substation A, the relay R340 restores in the manner previously explained to complete, at RA344, the above-mentioned holding circuit for the relay R440, this circuit extending by way of the grounded control conductor C108, RA344, C392, RA458, RA446, RA445, C390, the armature 349, C384 and the lower winding of R440 to battery. After this circuit is completed, the relay R340 opens, at RA343 and RA344, the initially completed circuit for energizing the lower winding of R330 in series with the lower winding of R440. Thus, the relay R330 is, in the case under consideration, deenergized and restores shortly following the end of the first digit. At RA345, the relay R340 in releasing, completes the above-mentioned cut-in circuit for energizing the relay R350 in parallel with the rotary magnet 348, this circuit extending from ground by way of RA301, C376, RA457, C397, RA345, C396, RA447, C398 and the normal post springs 325 to RA332 where it divides, one branch extending through the winding of the rotary magnet 348 to battery and the other branch extending by way of RA361 and the winding of R350 to battery. Another branch of this circuit extends by way of RA372, C381, RA423, RA422, C378 and the winding of R360 to battery. The relay R360, upon operating, completes, at RA361, the holding circuit for the relay R350 and opens a point in the operating circuit for the busy test relay R420. The relay R350 in operating, short-circuits the winding of the relay R370; opens, at RA351, the above-traced path for conducting busy tone current to the calling loop circuit; prepares the operating circuit for the busy test relay R420 and completes the operating circuit for the relay R240, this latter circuit extending by way of the grounded control conductor C108, RA354, C273, the normal post springs 262 and the lower winding of R240 to battery. When energized in parallel with the two relays R350 and R360, the rotary magnet 348 operates to step the wipers 480 into engagement with the contacts terminating the first trunk of the selected group. When its lower winding is energized over the above-traced circuit, the relay R240 partially operates to complete, at the "X" contacts associated with RA246, a path for short-circuiting its upper winding, this path extending from the control conductor C108 by way of RA354, C273, the normal post springs 262, the upper winding of R240, RA246, C278 and RA427 back to the control conductor C108. The relay R240 is of the two-step type, being so constructed that it does not complete its operation until its two windings are energized in series.

When the magnet 348 operates it opens, at its armature 349, the above-traced operating circuit for the relay R440. The relay R440 now restores, to open, at RA447, the cut-in circuit for energizing the rotary magnet 348 in parallel with the two relays R350 and R360. Shortly following the release of the relay R440, the relay R360 restores, to open, at RA361, the path short-circuiting the winding of the relay R370. As a result, the relay R370 is energized in series with the relay R350 and operates to complete its locking circuit; following which, it opens, at RA374, the circuit serially including its own winding and the winding of the relay R350. At RA372, the relay R370 opens the above-traced branch circuit for energizing the relay R360 in parallel with the relay R350 and the rotary magnet 348. The relay R360, upon restoring, further prepares the oper-

ating circuit for the busy test relay R420. In the event the first trunk of the selected group is busy such that ground potential is impressed upon the private wiper 483 and the extra control wiper 484 from the trunk circuit associated with this trunk, the previously traced operating circuit for the busy test relay R420 is completed in response to the release of the relay R360. The busy test relay, upon operating, recompletes the previously traced circuit including the grounded wiper 484 for energizing the relay R440. The relay R440 in operating, recompletes the circuit for energizing the relay R350 in parallel with the rotary magnet 348, whereby the wipers 480 are stepped a second step into engagement with the contacts terminating the second trunk of the selected group. From this point on, the manner in which the relay R440 interacts with the rotary magnet 348 to step the wipers 480 successively into engagement with the contact sets terminating succeeding trunks of the selected group until an idle trunk is found or all of the trunks have been tested is exactly the same as described previously with reference to three-digit trunk selection. In the event none of the trunks of the selected group are idle, the wipers are advanced to engage the contacts terminating the last trunk of the group at which time the last is tested, the stepping operation of the wipers 480 is arrested and busy tone current is returned over the calling loop circuit for reproduction by the receiver provided at the calling substation.

Assuming that an idle trunk in the selected group is available, the trunk hunting operating is arrested when the wipers 480 are moved into engagement with the contacts terminating the conductors of the idle trunk. More specifically, when the wipers 483 and 484 encounter contacts having battery potential thereon indicating an idle trunk, no further circuit is available for energizing the relay R440 and this relay remains in its restored position. In addition, the operating winding of the busy test relay R420 is short-circuited, causing this relay to restore. Shortly following the release of the relay R420, the relay R350 restores, to open, at RA355 and RA356, the prepared operating circuit for the busy test relay R420 and to prepare, at RA355, the operating circuit for the line switching relay R450. At RA354, the relay R350 opens the path short-circuiting the upper winding of the relay R240 permitting the two windings of the latter relay to be energized in series over a circuit which extends by way of the grounded control conductor C108, RA427, C278, RA246 and the two windings of R240 in series to battery. The relay R240 now fully operates to complete, at RA248, a path for short-circuiting the operating winding of the relay R450, this path extending from ground at RA395 by way of C387, RA424, the upper winding of R450, RA426, C391, RA355, RA362, C277, RA248, C278 and RA427 to the grounded control conductor C108. Thus, the line switching relay R450 is prevented from operating. At RA248, the relay R240 also completes a path for impressing ground potential upon the private wiper 483, this path extending by way of the grounded control conductor C108, RA427, C278, RA248, C277 and the normal post springs 478 to the private wiper 483. When this path is completed, the selected trunk line is marked as busy in the bank contacts of the other connector switches having access thereto and the repeater associated with this trunk line is seized in the usual manner.

The relay R240 in operating, opens, at RA247, a further point in the above-traced operating circuits for the release magnets 475 and 346. At RA245, the relay R240 interrupts the operating circuit for the hold relay R300. At its armatures RA241 to RA244, inclusive, the relay R240 connects the talking conductors C264 and C266 of the trunk 100 to the conductors of the calling line, thereby to establish a full metallic loop circuit between the calling substation and the repeater associated with the selected trunk line. In response to the extension of the calling loop circuit to the repeater associated with the selected trunk line, the line and hold relays embodied in this repeater operate in the usual manner to connect multiple ground potential to the private conductor of the trunk and thus ground the private wiper 483. As a result, a multiple holding circuit is completed for the relay R240, this holding circuit extending by way of the grounded wiper 483, the normal post springs 478, C277, RA248, RA246 and the two windings of R240 in series to battery. In addition, multiple ground is impressed upon the control conductor C108 in response to operation of the line and hold relays embodied in the repeater associated with the selected trunk line. This multiple ground path extends from the grounded wiper 483 by way of the normal post springs 478, C277, RA248, C278 and RA427 to the control conductor C108. Thus, the relays R210, R240 and R370 of the connector switch 25, the finder switch 20 and the line circuit 13 are prevented from releasing until the repeater associated with the selected trunk line has been released.

The relay R240 in operating, opens, at its armatures RA241 to RA244, inclusive, the loop circuit as initially extended through the windings of the line relays R260 and R320, causing these two relays to restore. The relays R320 and R300 in releasing open the holding circuit for the relay R310. The relay R300 in restoring, also disconnects multiple ground from the control conductor C108 and interrupts the operating circuit for the relay R220. Thus, the relays R220, R250, R300, R310 and R320 are caused to restore in response to the switching-through operation of the relay R240. Following the release of these relays no further operation of the apparatus embodied in the connector switch 25 occurs until the repeater associated with the selected trunk line has been released.

It will be understood from the foregoing explanation that if the first trunk of the selected group is idle, the busy test relay R420, the rotary magnet 348 and the relay R360 are not further energized after the wipers 480 are rotated to engage the set of bank contacts terminating this trunk. Accordingly, no trunk hunting operation occurs. Shortly following the selection of the first trunk the relays R360 and R350 sequentially restore, the latter functioning to open the path short-circuiting the upper winding of the switching-through relay R240. The relay R240 now completes its operation to perform the functions described above.

After the loop circuit has been extended to the repeater associated with the selected trunk line, the calling subscriber at the substation A may proceed to dial the additional digits of the directory number designating the desired substation, assuming that this repeater is associated with a trunk extending to a distant exchange of the automatic type. The manner in which the connection is further extended to the de-

sired line and the talking circuit is ultimately established is entirely conventional and well understood in the art. When the connection is cleared out at the calling substation A, the control apparatus of the repeater associated with the selected trunk operates to disconnect the private conductor of this trunk from ground. As a result, ground potential is removed from the control conductor C108, causing the deenergization and release of the relays R210, R240 and R370. The relays R210 and R240 in releasing, complete the previously traced operating circuit for the release magnet 346, whereby the wipers 480 of the Strowger switching mechanism are restored to normal in the manner previously explained. When these wipers are restored to normal, the normal post springs 262, 327 and 478 are respectively disengaged. The removal of ground potential from the control conductor C108 also causes the release of the finder switch 20 and the line circuit 13 in the usual manner.

Restricted service

As pointed out previously, provisions are made in the system for providing restricted service, which excludes free central office trunk calls, to certain subscribers of the system who pay a low flat fee for service and for providing unrestricted central office trunk service to other subscribers who pay a higher flat fee for the service rendered. In order to prevent the restricted service subscribers from gaining access to the trunks of certain specified groups, such, for example, as the trunks extending to the central automatic exchange, the connector switch 25 is provided with normal post springs 325 and 326 which are arranged to be operated to the off-normal position to open the above-traced automatic cut-in circuit when the wipers 480 are positioned opposite a level of contacts terminating trunks of a restricted group.

Assuming that a subscriber at the restricted substation B, after initiating a call and being assigned the link comprising the finder switch 26 and the connector switch 25, dials the digit designating a group of restricted trunks, the wipers 480 of the connector switch are elevated to a position opposite this group of trunks in the exact manner previously explained. When the wipers 480 are moved to this position the normal post springs 325 are disengaged and the springs 326 are moved into engagement. In addition, the normal post springs 262 are engaged to prepare the operating circuit for the relay R240, the normal post springs 327 are engaged to complete the previously traced circuit for energizing the lower winding of the relay R330 in series with the lower winding of the relay R440, and the normal post springs 478 are engaged to prepare the previously traced control circuits. In the case under consideration it is assumed that the extra control contact of the contact set terminating the line 11 in the finder switch 20 is not wired. Accordingly, no holding circuit is completed for the relay R330 when this relay operates. With the normal post springs 325 disengaged, the previously traced automatic cut-in circuit for energizing the rotary magnet 348 in parallel with the two relays R350 and R360 is interrupted, and with the springs 326 in engagement a circuit is prepared for energizing the lower winding of the busy test relay R420 in series with the parallel connected windings of the relay R350 and the rotary magnet 348. Shortly following the end of the digit, the relay

R340 restores, to complete, at RA344, the previously traced locking circuit for the relay R440. At RA343 and RA344, the relay R340 opens the circuit for energizing the lower winding of the relay R330, causing the latter relay to restore. At RA345 and RA332, the relays R340 and R330 complete the above-mentioned circuit for energizing the busy test relay R420. This circuit extends from ground by way of RA301, C376, RA457, C397, RA345, C396, the lower winding of R420, C395, RA314 and the normal post springs 326 to RA332 where it divides, one branch extending through the winding of the magnet 348 to battery and the other branch extending by way of RA361 and the winding of R350 to battery. Due to the relatively high resistance of the lower winding of the busy test relay R420, the rotary magnet 348 and the relay R350 are insufficiently energized to operate when this circuit is completed. The busy test relay R420, however, operates to complete, at RA427, the previously traced locking circuit for itself. At RA422 and RA423, the relay R420 opens the pulsing circuits to the rotary magnet 348 and the operating magnet 474 of the minor switch 470. At RA424 and RA426, the relay R420 opens two points in the previously traced operating circuit for the line switching relay R450. At RA428, the relay R420 prepares the operating circuit for the relay R200. At RA421, the relay R420 completes the previously traced path for connecting the busy tone current source to the talking conductors of the established connection extending back to the calling substation B, whereby the usual busy tone signal is reproduced by the receiver provided at this substation to inform the calling subscriber that the connection cannot be obtained. The manner in which the connection is released when the call is abandoned at the calling substation will be apparent in view of the preceding explanation.

In the event the above-described call intended for a trunk of a restricted group originates at a substation arranged for unrestricted service, the relay R320 is caused to restore during the dialing of the trunk selecting digit at the calling substation, whereby the relay R310 is released to provide a path in shunt with the normal post springs 325. As a consequence, the automatic cut-in of the wipers 480 followed by the trunk hunting operation previously described proceeds in the exact manner explained above. Thus, the substation A, which is arranged for unrestricted service, is provided with a calling device comprising an extra pair of shunt springs 28 which are arranged to connect the positive side of the line 10 to ground when the dial of the calling device is moved off-normal. With this arrangement if a call intended for extension over a restricted trunk originates at the substation A and is routed by way of the link comprising the finder switch 20 and the connector switch 25, the calling subscriber upon dialing the digit designating the desired group of trunks completes a path for short-circuiting the winding of the relay R320 immediately the dialing operation is started. This path may be traced as extending from ground by way of the shunt springs 28, the positive conductor C102 of the line 10, the positive line wiper of the finder switch 20, C106, RA202, RA244, RA252, C267, the winding of R320, the off-normal springs 324, RA341 and the secondary winding of the transformer 308 to ground. When thus short-circuited, the relay R320 restores, to open, at RA321, the prepared

holding circuit for the relay R310. When thereafter the wipers 480 of the connector switch are elevated one step in the vertical direction, the off-normal springs 306 are disengaged to interrupt the operating circuit for the relay R310. The relay R310 now restores, to open, at RA314, a point in the above-traced circuit for energizing the lower winding of the busy test relay R420 in series with the multiple connected windings of the rotary magnet 348 and the relay R350, thereby to prevent the busy test relay R420 from operating when the relay R340 releases shortly following the end of the digit. At RA313, the relay R310 completes an obvious path in shunt with the normal post springs 325. With this branch path completed the automatic cut-in circuit for energizing the relay R360, the relay R350 and the rotary magnet 348 in multiple is completed shortly following the end of the first digit and in response to the release of the relay R340. This circuit now extends from ground at RA301 by way of C376, RA457, C397, RA345, C396, RA447 and C398 to RA313 where it divides, one branch extending through the winding of the magnet 348 to battery, the second branch extending by way of RA361 and the winding of R350 to battery and the third branch extending by way of RA372, C381, RA423, RA422, C378 and the winding of R360 to battery. These three circuit controlling devices operate to perform the functions previously described, among which is the operation of the wipers 480 into engagement with the first contact set of the selected level through operation of the rotary magnet 348. From this point on the manner in which the automatic trunk hunting proceeds, the connection is ultimately established and the operated switch train is released are exactly the same as described previously.

From the above explanation it will be apparent that the relay R310 is caused to restore in response to the dialing of a first digit at any calling substation connected with the connector switch 25 and arranged for unrestricted central office trunk service, regardless of the character of the digit. In the operation of the connector switch 25 to set up a local call connection or a connection involving an unrestricted trunk, however, the release of the relay R310 is without effect.

It is desirable to arrange the switching equipment so that certain lines, such, for example, as the incoming trunks from a distant automatic exchange, have access only to the subscribers' lines terminating in the bank contacts of the finder-connector link illustrated and the other similar links. It may also be desirable to restrict certain of the local lines terminating at these links or certain of the substations on such local links from all trunk calls. For example, it may be desirable to restrict the substation B and other substations associated with the line 11 so that only local call connections can be completed therefrom without the assistance of an operator. As explained previously, the extra control contact terminating the conductor C109 of the line 11 is, for this purpose, connected to the negative terminal of the exchange battery through a resistor 29. With the line circuit 14 arranged in this manner, if a one-digit trunk call is initiated on the line 11 and extended to the connector switch 25 through the finder switch 20 and the single digit designating the desired group of trunks is dialed at the calling substation, the wipers 480 of the Strowger switching

mechanism are elevated to a position opposite the level of bank contacts terminating the desired group of trunks in the manner previously described. When the wipers 480 are moved to this position, the normal post springs 262, 327 and 478 are respectively operated into engagement. At the springs 327, the previously traced circuit is completed for energizing the lower winding of the relay R330 in series with the lower winding of the relay R440. The relay R330 in operating, completes a holding circuit for itself, this circuit extending from ground through the upper winding of R330 and by way of RA331, C107, the extra control wiper of the finder switch 20, C109 and the resistor 29 to battery. When this circuit is completed the relay R330 is held operated until the finder switch 20 is released. At RA332, the relay R330 in operating, opens the previously traced automatic cut-in circuit for energizing the rotary magnet 348 in parallel with the two relays R350 and R360 and prepares an alternative circuit for energizing the lower winding of the busy test relay R420 in series with the parallel connected windings of the magnet 348 and the relay R350. This latter circuit is completed shortly following the end of the digit when the relay R340 restores and extends from ground by way of RA301, C376, RA451, C397, RA345, C396, the lower winding of R420, C395 and RA314 to RA332 where it divides, one branch extending through the winding of the magnet 348 to battery and the other branch extending by way of RA361 and the winding of R350 to battery. As indicated above, the magnet 348 and the relay R350 do not operate when energized in series with the lower winding of the busy test relay R420. The busy test relay, however, operates to perform the functions previously described, among which is the transmission of the usual busy tone signal to the calling substation. The manner in which the two operated switches 20 and 25 are released when the call is abandoned at the calling substation will be clearly apparent from the preceding explanation, it being pointed out that the relay R330 is deenergized and restores during the release of the finder switch 20 when the extra control conductor C109 is disconnected from the conductor C107 to interrupt the holding circuit for this relay.

If the above-described trunk call initiated on the subscriber's line 11 is initiated at a substation, such, for example as the substation C arranged for unrestricted trunk call service, the line relay R320 is short-circuited during the dialing of the trunk selecting digit through operation of the extra shunt springs 31 to ground the positive line conductor C104 of the line 11. The relay R320 in releasing, opens the holding circuit for the relay R310 so that when the wipers 480 are elevated one step in the vertical direction to cause disengagement of the off-normal springs 306 the relay R310 is deenergized and restores. This relay in releasing, opens, at RA314, the above-traced circuit for energizing the lower winding of the busy test relay R420 in series with the parallel connected windings of the rotary magnet 348 and the relay R350, and completes, at RA313, the path in shunt with the break contacts controlled by the armature RA332 of the relay R330. With this path completed, operation of the relay R330 is without effect to open the automatic cut-in circuit and thus prevent the connector switch 25 from seizing an idle one of the trunk lines of the selected group in the manner previously explained.

Release on permanents

As indicated previously, provisions are made in the connector switch 25 for forcibly releasing this switch and the preceding finder switch 20 in the event it is seized over a line having a permanent calling condition thereon or over a line having a call initiated thereon and the calling subscriber fails to complete dialing; fails to receive an answer from the called substation and to abandon the call; fails to release the connection after the called subscriber has disconnected; fails to abandon the connection after receiving a busy tone signal; and in the case of reverting calls, fails to receive an answer within a specified period or to release the connection by establishing an answering loop circuit over the line involved. These provisions include the usual time cut-off and time pulse generating apparatus, which is common to the several links, and a link release relay R230. More specifically, the time cut-off and time pulse generating apparatus is arranged to be started in operation in response to the application of ground potential to the timer start conductor C207. This apparatus functions periodically to impress ground pulses upon the time pulse lead C257 and normally maintains ground potential upon the time cut-off lead C235. A predetermined time interval after each ground pulse is applied to the time pulse lead C257, the apparatus functions in a well-known manner to disconnect ground from the time cut-off lead C235 for a predetermined period which is in excess of that required for any operated connector switch fully to release.

From the foregoing explanation it will be recalled that when the finder switch 20 and the connector switch 25 are seized over a calling line, the relay R210 operates to prepare the operating circuit for the link release relay R230 and the relay R220 operates to impress ground potential upon the timer start lead C207, thereby to initiate operation of the time cut-off and time pulse generating equipment in the event this apparatus is not already operating. If the desired connection is fully established between the calling substation and the called substation before a ground pulse is impressed upon the time pulse lead C257, the back bridge relay R250 is operated, to open, at RA255 and RA256, the operating and holding circuits for the link release relay R230. Accordingly, the link release relay is rendered ineffective forcibly to release the connection. Moreover, if the connector switch 25 is seized over a calling line, such, for example, as the line 10, which is arranged for unrestricted service, the link release relay is rendered ineffective forcibly to release the operated switch train. In this case the time cut-off and time pulse generating apparatus, upon operating to impress ground potential upon the time pulse lead C257, completes an obvious circuit for energizing the upper winding of the link release relay R230. This relay in operating, completes a path for short-circuiting its lower winding, which path extends by way of the grounded extra control conductor C111, the extra control wiper of the operated finder switch 20, the conductor C107, RA331, C274, RA234, RA256 and the lower winding of R230 back to ground. At RA231 and RA232, the relay R230 provides a substitute holding ground on the conductors C271 and C108, which substitute ground is derived from the grounded time cut-off lead C235. When, however, the ground pulse impressed on the time pulse lead C257 is terminated, the link

release relay R230 is deenergized and restores due to the short-circuited condition of its lower winding. Accordingly, ground as derived from the back contact associated with RA232 is again connected to the conductors C271 and C108 in lieu of the ground connection to the time cut-off lead C235. Thus, when the connector switch 25 is seized over a line arranged for unrestricted service the link release relay R230 periodically operates, but its operation is without effect.

In the event the connector switch 25 is seized over a line arranged for restricted service, the ground connection to the extra control conductor C107 is not established when the finder switch 20 operates to seize the calling line. Accordingly, if a ground pulse is applied to the time pulse lead C257 following seizure of the connector switch 25, thereby to cause the operation of the link release relay R230, this relay completes a locking circuit for itself which extends from the negative terminal of the exchange battery by way of the resistor 216, RA213, RA223, RA234, RA256 and the lower winding of R230 to ground. At RA231 and RA232, the relay R230 connects the conductors C108 and C271 to ground over a path including the time cut-off lead C235. In the event the back bridge relay R250, which is energized in response to operation of the ring cut-off relay R410 when the call is answered, operates before the time cut-off lead C235 is disconnected from ground following operation of the link release relay R230, the link release relay is caused to restore and the connection is not released. More specifically, the relay R250 in operating, opens, at RA256, the above-traced holding circuit for the relay R230, causing the latter relay to release and again connect the conductors C108 and C271 to ground at RA232 and its associated back contact.

In the event the link release relay R230 is held operated for the predetermined time interval which elapses between the application of ground to the time pulse lead C257 and the removal of ground potential from the time cut-off lead C235, the operated switch train comprising the finder switch 20 and the connector switch 25 is released. More specifically, when the time cut-off lead C235 is disconnected from ground the finder switch 20 is caused to release in the usual manner and ground potential is disconnected from the private conductor individual to the calling line. When the release conductor C108 is thus disconnected from ground the cut-off relay embodied in the line circuit associated with the calling line is deenergized and restores to again connect the windings of the associated line relay across the conductors of the calling line in series with the exchange battery, whereby this line relay is energized over the loop circuit established by way of the calling line. The line relay associated with the calling line now reoperates to complete a holding circuit for its associated line lockout relay. With the line and lockout relays of the line circuit associated with the calling line operated, this line is marked as busy in the bank contacts of the connector switches having access thereto and the path individual to the line for connecting the distributor start conductor 27 to ground is held open. Since these line circuit operations are well understood in the art they will be apparent without illustration or further explanation. During the release of the finder switch 20 the cut-through relay conventionally embodied therein restores to open the loop circuit extending through the windings of the line relays R260 and R320. Thus, the relays R260,

R300, R310, R320, R220 and R340, if operated, are deenergized and restore. The removal of ground potential from the control conductor C108 also results in the deenergization and release of the relay R210 and the deenergization and release of any operated ones of the relays R370, R420, R430 and R440 in an obvious manner. The release of the hold relay R300 also results in the deenergization and release of any operated ones of the relays R410, R400 and R450 in an obvious manner. When the relay R210 restores, the release magnets 475 and 346 are sequentially energized in the manner previously explained, whereby the wipers of the minor switch 470 and the wipers 480 of the Strowger switching mechanism are restored to normal. Thus, the finder switch 20 and the connector switch 25 are fully released. The line circuit associated with the calling line which has been locked out of service is held operated until the calling condition present on the line is terminated. More particularly, when the loop circuit established by way of this line is interrupted, the line and lockout relays embodied in the associated line circuit are caused sequentially to release in the usual manner, whereby the line is marked as idle and incoming or outgoing calls may be routed thereover.

It will be apparent from the above explanation that if a connection is established by way of the finder switch 20 and the connector switch 25, the link release relay is, due to the operated position occupied by the back bridge relay R250, rendered inactive so long as the connection is not released at the called end thereof. When, however, the called subscriber hangs up to cause the deenergization and release of the relay R250, the operating and locking circuits for the link release relay R230 are again prepared. Hence, if the calling subscriber fails to hang up within a reasonable time interval, the link release relay in cooperation with the associated time cut-off and time pulse generating apparatus functions to initiate the release of the operated switches 20 and 25 and to cause the calling line to be locked out of service, all in the manner described above.

From the foregoing explanation with reference to reverting calls routed by way of the connector switch 25 it will be recalled that when this connector switch is engaged in setting up a reverting call connection, the relays R200, R210, R450, R430 and possibly R440 are operated after the calling subscriber hangs up to initiate the ringing operation. It will also be recalled that when the calling subscriber hangs up to initiate the ringing operation the relays R220, R260, R300, R310 and R320 are restored. In this case, if the link release relay R230 is energized by a ground pulse transmitted over the time pulse lead C257 while the ringing operation is in progress, it operates to complete a locking circuit for itself which extends from the negative terminal of the exchange battery by way of the resistor 216, RA213, C275, RA459, C274, RA234, RA256 and the lower winding of R230 to ground. It will be noted that this locking circuit is only completed if the call originates at a substation arranged for restricted local call service, since otherwise the lower winding of the relay R230 is shortcircuited over the previously traced path extending to ground at the extra control wiper of the finder switch 20. Following the operation of the link release relay, if the time cut-off lead C235 is disconnected from ground before the finder switch 20 and the connector switch 25 are released in response to the answering of the call at the called substation or

the recompletion of a loop circuit over the calling line at the calling substation, the finder switch 20 and the connector switch 25 and the line circuit associated with the calling line are all released in a manner which will be apparent from the previous explanation.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is contemplated to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a telephone system, a plurality of lines including a multiparty subscriber's line, subscriber controlled automatic switching apparatus for setting up connections between said lines, and subscriber controlled means for automatically controlling said automatic switching apparatus to give service of one class to one of the subscribers served by said multiparty line and service of a different class to another of the subscribers served by said multiparty line.

2. In a telephone system, a plurality of lines including a multiparty subscriber's line and a group of trunk lines, automatic switching apparatus for setting up connections between said lines, and subscriber controlled service restricting apparatus for dividing the subscribers served by said multiparty line into two classes and including means automatically operative incident to the extension of connections from said multiparty line through said automatic switching apparatus for preventing the subscribers of one class from obtaining access to said trunk lines through said automatic switching apparatus.

3. In a telephone system, a plurality of lines including a multiparty subscriber's line having at least two substations associated therewith, calling apparatus of one character provided at one of said substations, calling apparatus of a different character provided at the other of said substations, and automatic switching apparatus for setting up connections between said lines, said automatic switching apparatus comprising means automatically controlled over said multiparty line in accordance with the character of the calling apparatus respectively provided at said substations for giving service of one class to one of said substations and service of a different class to the other of said substations.

4. In a telephone system, a plurality of lines including a group of trunk lines and a multiparty subscriber's line having at least two substations associated therewith, calling apparatus of one character provided at one of said substations, calling apparatus of a different character provided at the other of said substations, and automatic switching apparatus for setting up connections between said lines, said automatic switching apparatus comprising means automatically controlled over said multiparty line in accordance with the character of the calling apparatus respectively provided at said substations for giving one of said substations access to said trunk lines and for preventing the other of said substations from obtaining access to said trunk lines.

5. In a telephone system, a plurality of lines including a group of trunk lines and a multiparty subscriber's line having a plurality of substations associated therewith, and automatic switching apparatus for setting up connections between said lines, said automatic switching apparatus including call blocking means normally opera-

tive to prevent connections from being set up between said subscriber's line and said trunk lines, and means controllable from at least one but not all of said substations for automatically rendering said call blocking means ineffective to block the setting up of connections between said subscriber's line and said trunk lines.

6. In a telephone system, a plurality of lines including a group of trunk lines and a multiparty subscriber's line having a plurality of substations associated therewith, at least one of said substations being provided with a calling device operative to impress a predetermined potential upon one side of said subscriber's line, and automatic switching apparatus for setting up connections between said lines, said automatic switching apparatus including call blocking means normally operative to prevent connections from being set up between said subscriber's line and said trunk lines, and means operative in response to the application of said predetermined potential to said one side of said subscriber's line for rendering said call blocking means ineffective to block the setting up of a connection between said subscriber's line and one of said trunk lines.

7. In a telephone system, a plurality of lines including a group of trunk lines and a multiparty subscriber's line having a plurality of substations associated therewith, at least one of said substations being provided with a calling device operative to ground one side of said subscriber's line, and automatic switching apparatus for setting up connections between said lines, said automatic switching apparatus including call blocking means normally operative to prevent connections from being set up between said subscriber's line and said trunk lines, and means operative in response to the grounding of said one side of said subscriber's line for rendering said call blocking means ineffective to block the setting up of a connection between said subscriber's line and one of said trunk lines.

8. In a telephone system, a plurality of lines including a group of trunk lines and a multiparty subscriber's line having a plurality of substations associated therewith, automatic switching apparatus for setting up connections between said lines and including a trunk hunting line selecting switch having access to said group of trunk lines, said line selecting switch comprising an automatic cut-in circuit including means for initiating the trunk hunting operation of said switch when said circuit is completed, switching means operative to open said circuit in response to operation of said line selecting switch to select said group of trunk lines, thereby to prevent said line selecting switch from selecting an idle one of said trunk lines, and means controllable over said subscriber's line from at least a portion of said substations for completing said circuit independently of said switching means.

9. In a telephone system, a plurality of lines including a group of trunk lines and a multiparty subscriber's line having a plurality of substations associated therewith, automatic switching apparatus for setting up connections between said lines and including a trunk hunting line selecting switch having access to said group of trunk lines, said line selecting switch comprising an automatic cut-in circuit having two branches and including means operative to initiate the trunk hunting operation of said switch when said circuit is completed, a pair of line relays connected to be energized in series over a connection

routed from said subscriber's line to said line selecting switch, a control relay operative to open one of the branches of said cut-in circuit in response to seizure of said switch and released under the control of one of said line relays, switching means operative to open the other branch of said cut-in circuit in response to operation of said switch to select said group of trunk lines, whereby said switch is prevented from selecting an idle one of said trunk lines when both said control relay and said switching means are operated, and means individually associated with at least a portion of said substations for short-circuiting said one line relay, thereby to cause the sequential release of said one line relay and said control relay and the completion of said cut-in circuit.

10. In a telephone system, a plurality of lines including a group of trunk lines and a multiparty subscriber's line having a plurality of substations associated therewith, automatic switching apparatus for setting up connections between said lines and including a trunk hunting line selecting switch having access to said group of trunk lines, said line selecting switch comprising an automatic cut-in circuit having two branches and including means operative to initiate the trunk hunting operation of said switch when said circuit is completed, a pair of line relays connected to be energized in series over a connection routed from said subscriber's line to said line selecting switch, a control relay operative to open one of the branches of said cut-in circuit in response to seizure of said switch and released under the control of one of said line relays, switching means operative to open the other branch of said cut-in circuit in response to operation of said switch to select said group of trunk lines, whereby said switch is prevented from selecting an idle one of said trunk lines when both said control relay and said switching means are operated, and a calling device provided at one of said substations and operative to ground one side of said subscriber's line, whereby said one line relay is short-circuited and releases to cause the release of said control relay and the completion of said cut-in circuit.

11. In a telephone system, a plurality of subscribers' lines each having at least one substation associated therewith, a group of trunk lines, and impulse responsive automatic switching apparatus for setting up connections between said lines, at least a portion of said substations including impulse transmitting devices for directly controlling said automatic switching apparatus and each comprising means for impressing a predetermined potential upon one side of the associated line during operation thereof, said automatic switching apparatus including call blocking means normally operative to prevent connections from being set up between said subscribers' lines and said trunk lines, and means responsive to the application of said predetermined potential to said one side of a calling one of said lines for rendering said call blocking means ineffective to block the setting up of a connection between said calling line and one of said trunk lines.

12. In a telephone system, a plurality of subscribers' lines each having at least one substation associated therewith, a group of trunk lines, and impulse responsive automatic switching apparatus for setting up connections between said lines, at least a portion of said substations including impulse transmitting devices for directly controlling said automatic switching apparatus and

each comprising means for grounding one side of the associated line during operation thereof, said automatic switching apparatus including call blocking means normally operative to prevent connections from being set up between said subscribers' lines and said trunk lines, and means responsive to the grounding of said one side of a calling one of said lines for rendering said call blocking means ineffective to block the setting up of a connection between said calling line and one of said trunk lines.

13. In a telephone system, a plurality of subscribers' lines each having at least one substation associated therewith, a group of trunk lines, automatic switching apparatus for setting up connections between said lines and including a trunk hunting line selecting switch having access to said group of trunk lines, said line selecting switch comprising an automatic cut-in circuit including means for initiating the trunk hunting operation of said switch when said circuit is completed, switching means operative to open said circuit in response to operation of said switch to select said group of trunk lines, and means including additional switching means individually provided at certain of said substations for completing said circuit independently of said first-named switching means.

14. In a telephone system, a plurality of subscribers' lines each having at least one substation associated therewith, a group of trunk lines, automatic switching apparatus for setting up connections between said lines and including a trunk hunting line selecting switch having access to said group of trunk lines, said line selecting switch comprising an automatic cut-in circuit having two branches and including means operative to initiate the trunk hunting operation of said switch when said circuit is completed, a pair of line relays connected to be energized in series over a connection routed from a calling one of said subscribers' lines to said switch, a control relay operative to open one branch of said circuit in response to seizure of said switch and released under the control of one of said line relays, switching means operative to open the other branch of said cut-in circuit in response to operation of said switch to select said group of trunk lines, whereby said switch is prevented from selecting an idle one of said trunk lines when both said switching means and said control relay are operated, and means comprising additional switching means individually provided at certain of said substations for short-circuiting said one line relay, thereby to cause the release of said control relay and the completion of said cut-in circuit.

15. In a telephone system, a plurality of subscribers' lines each having at least one substation associated therewith, a group of trunk lines, automatic switching apparatus for setting up connections between said lines and including a trunk hunting line selecting switch having access to said trunk lines, each of said substations including a calling device for directly controlling said automatic switching apparatus, said line selecting switch comprising an automatic cut-in circuit having two branches and including means operative to initiate the trunk hunting operation of said switch when said circuit is completed, a pair of line relays connected to be energized in series over a connection routed from a calling one of said subscriber's line to said switch, a control relay operative to open one branch of said circuit in response to seizure of said switch and con-

ected to be deenergized in response to release of one of said line relays, switching means operative to open the other branch of said cut-in circuit in response to operation of said switch to select said group of trunk lines, whereby said switch is prevented from selecting an idle one of said trunk lines when both said switching means and said control relay are operated, and means individually controlled by the calling devices provided at certain of said substations for short-circuiting said one line relay, thereby to cause the release of said one line relay and said control relay and the completion of said cut-in circuit.

16. In a telephone system, a plurality of subscribers' lines including a multiparty line having a plurality of substations associated therewith, automatic switching apparatus for setting up a connection between two of said lines and including a final selector operative to transmit ringing current over said multiparty line in setting up a reverting call connection between two of said substations, means responsive to a call answering operation performed at either of said two substations for releasing said selector, and means for automatically releasing said selector in the event said selector is not released from one of said two substations within a predetermined time interval after the selector is seized.

17. In a telephone system, a plurality of subscribers' lines including a multiparty line having a plurality of substations associated therewith, automatic switching apparatus for setting up a connection between two of said lines and including a final selector operative to transmit ringing current over said multiparty line in setting up a reverting call connection between two of said substations, means responsive to a call answering operation performed at either of said two substations for releasing said selector, and means for automatically releasing said selector in the event a call answering circuit including said multiparty line is not established within a predetermined time interval after the selector is seized.

18. In a telephone system, a plurality of subscribers' lines including a multiparty line having a plurality of substations associated therewith, automatic switching apparatus for setting up a connection between two of said lines and including a final selector operative to transmit ringing current over said multiparty line in setting up a reverting call connection between two of said substations, means at each of said substations for establishing a call answering circuit including said multiparty line, said selector including release means operative in response to the completion of a call answering circuit including said multiparty line, and means including said release means for automatically releasing said selector in the event a call answering circuit including said multiparty line is not established within a predetermined time interval after the selector is seized.

19. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, automatic switching apparatus for setting up connections between said lines, timing means for automatically releasing connections involving calling lines included in one of said groups after a predetermined time interval, and means associated with the lines in the other group for rendering said timing means ineffective to release connections involving calling ones thereof.

20. In a telephone system, a plurality of lines divided into two groups arranged for different

classes of service, automatic switching apparatus for setting up connections between said lines, timing means for automatically releasing connections involving calling lines included in one of said groups after such connections have been established for a predetermined time interval, and means individual to the lines in the other group for preventing the operation of said timing means.

21. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, automatic switching apparatus including directly controllable final selectors for setting up connections between said lines, each of said final selectors including timing means for automatically releasing a connection routed therethrough from a calling line in one of said groups a predetermined time interval after the connection is established, and means associated with the lines in the other group for preventing said last-named means from operating.

22. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, automatic switching apparatus including directly controllable final selectors for setting up connections between said lines, each of said final selectors including a timing device for automatically releasing a connection routed therethrough a predetermined time interval after the connection is established, each of said timing devices including a start timing relay, and means individually associated with the lines in one of said groups for preventing said start timing relays from operating, thereby to render said timing devices inactive.

23. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, a finder-conductor link for setting up connections between said lines, said link including a timing device operative to release a connection routed through said link a predetermined time interval after the connection is established, said timing device including a start timing relay, and means individually associated with the lines in one of said groups for controlling said start timing relay through the finder portion of said link to prevent the operation of said timing device.

24. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, a finder-conductor link for setting up connections between said lines, said link including a timing device operative to release a connection routed through said link a predetermined time interval after the connection is established, said timing device including a start timing relay, and means individually associated with the lines in one of said groups for short-circuiting said start timing relay over a path extending through said finder switch, thereby to prevent said timing device from operating.

25. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, automatic switching apparatus for setting up connections between said lines, first timing means for automatically releasing partially completed connections after the elapse of a predetermined time interval, second timing means for releasing fully completed connections after they have been completed for a predetermined time interval, and means associated with the lines in one of said groups for preventing said first and second timing means from effecting re-

lease of partially or fully completed connections routed through said switching apparatus.

26. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, automatic switching apparatus for setting up connections between said lines, first timing means for automatically releasing partially completed connections after the elapse of a predetermined time interval, second timing means for releasing fully completed connections after they have been completed for a predetermined time interval, and means individually associated with the lines in one of said groups for preventing said first and second timing means from effecting release of partially or fully completed connections routed through said switching apparatus from calling lines in said one group.

27. In a telephone system, a plurality of lines divided into two groups arranged for different classes of service, a finder-connector link for setting up connections between said lines, said link including a link release relay operative to initiate the release of said link in the event a connection routed to said link is not fully completed within a predetermined time interval after said link is seized, and a timing device operative to release a connection routed through said link a predetermined time interval after the connection is established, said timing device including a start timing relay, and means individually associated with the lines in one of said groups for controlling said relays through the finder portion of said link to prevent said link from being released under the control of said timing device or said link release relay.

28. In a telephone system which includes restricted and non-restricted lines and a group of trunks, a line selecting switch having access to said trunks and including trunk hunting facilities, an automatic cut-in circuit including means for initiating the trunk hunting operation of said switch when said circuit is completed, service restricting means operative to open said circuit in response to a predetermined trunk group selecting operation of said switch, thereby to prevent said restricted lines from obtaining access to said trunks, and means controllable over the trunk line incoming to said switch for completing said circuit independently of said switching means, thereby to permit said non-restricted lines to obtain access to said trunks.

29. A line selecting switch having trunk hunting facilities and comprising an automatic cut-in circuit having two branches and including means operative to initiate the trunk hunting operation of said switch when said circuit is completed, a pair of line relays connected to be en-

energized over the respective talking conductors of the trunk line incoming to said switch, a control relay operative to open one of the branches of said cut-in circuit in response to seizure of said switch and deenergized under the control of one of said line relays, switching means operative to open the other branch of said cut-in circuit in response to a predetermined trunk group selecting operation of said switch, whereby said switch is prevented from trunk hunting when both said switching means and said control relay are operated, and means for controlling said one line relay over one of said talking conductors to deenergize said control relay and thus complete said cut-in circuit.

30. In a telephone system, a pair of lines, means including a link for setting up a connection between said lines, said link including an automatic switch having access to one of said lines, a timer operative to cause the release of said link when held over a line having a sustained calling condition thereon, a conversation timer also operative to cause the release of said link, a marking path individual to said one line and extending to one of the outlet contacts of said switch, and means controlled over said marking path for preventing either of said timers from operating to cause the release of said link.

31. In a telephone system, a subscriber's line, a plurality of trunks, means including a link for setting up connections between said line and said trunks, said link including an automatic switch having access to said line, timing means operative to cause the release of a connection routed to said link, a marking path extending to one of the outlet contacts of said switch, means controlled over said path for permitting said line to gain access to said trunks through said link, and additional means controlled over said path for rendering said timing means ineffective to release a connection routed from said line to said link.

32. In a telephone system which comprises a plurality of lines including a multiparty subscriber's line, subscriber controlled automatic switching apparatus for setting up connections between said lines and including means controlled over said multiparty line incident to the operation of said automatic switching apparatus to extend connections from said multiparty line for automatically controlling said switching apparatus to give service of one class to one of the subscribers served by said multiparty line and service of a different class to another of the subscribers served by said multiparty line.

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