Feb. 18, 1947. J. H. VOSS 2,416,131

AUTOMATIC TELEPHONE SYSTEM

Filed Nov. 10, 1944 6 Sheets-Sheet 1

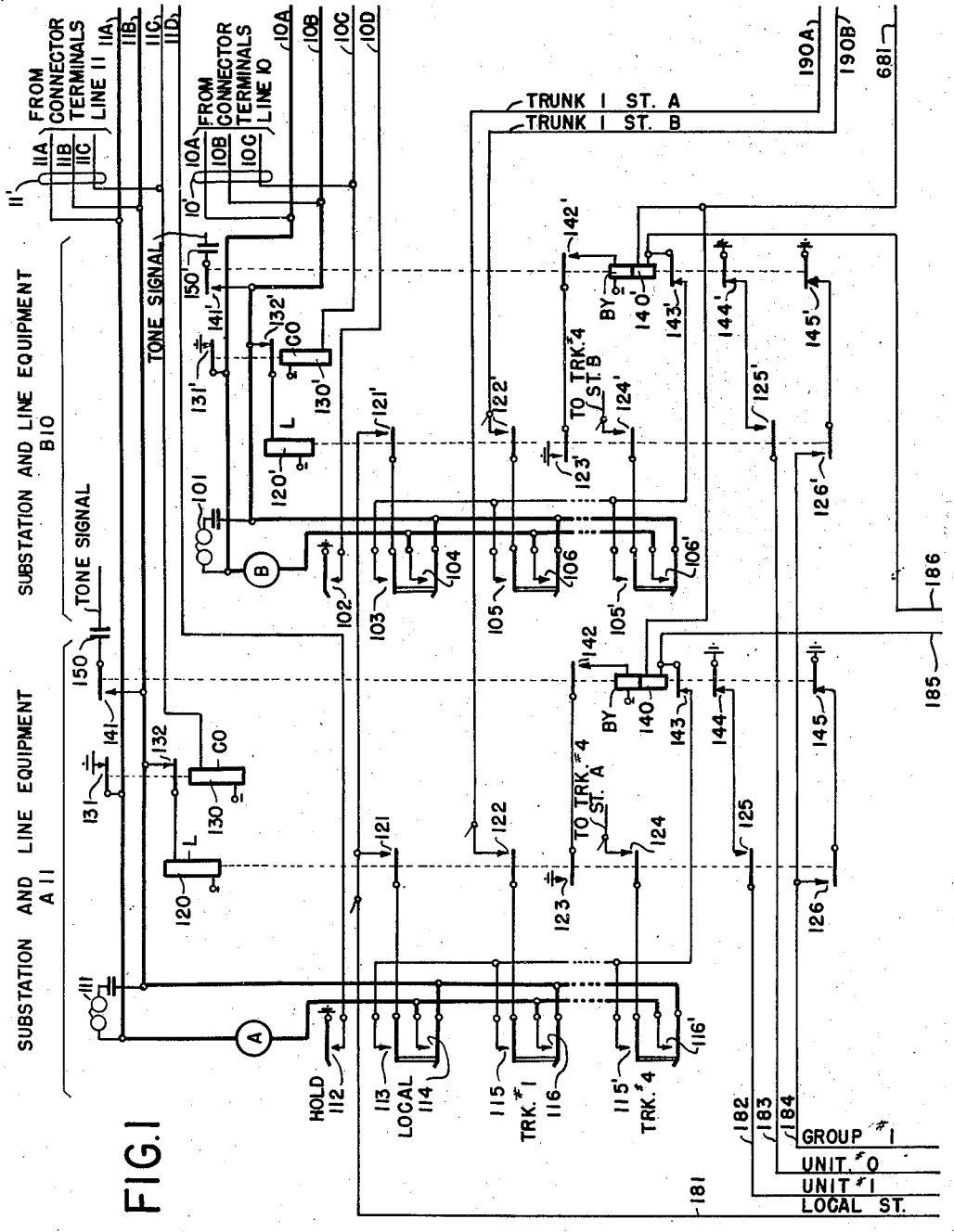


FIG. 1

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AUTOMATIC TELEPHONE SYSTEM

Filed Nov. 10, 1944 6 Sheets-Sheet 2

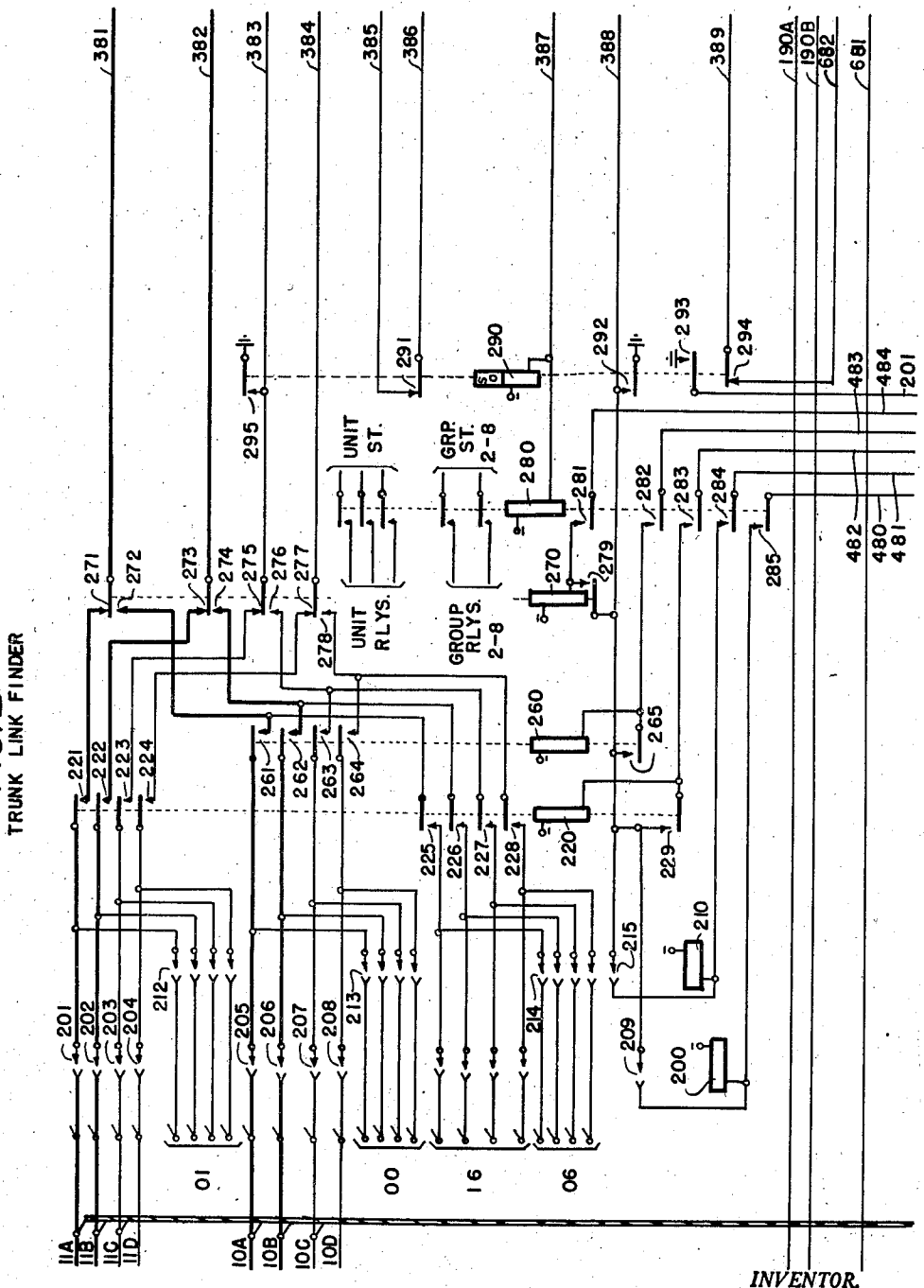


FIG. 2
TRUNK LINK FINDER

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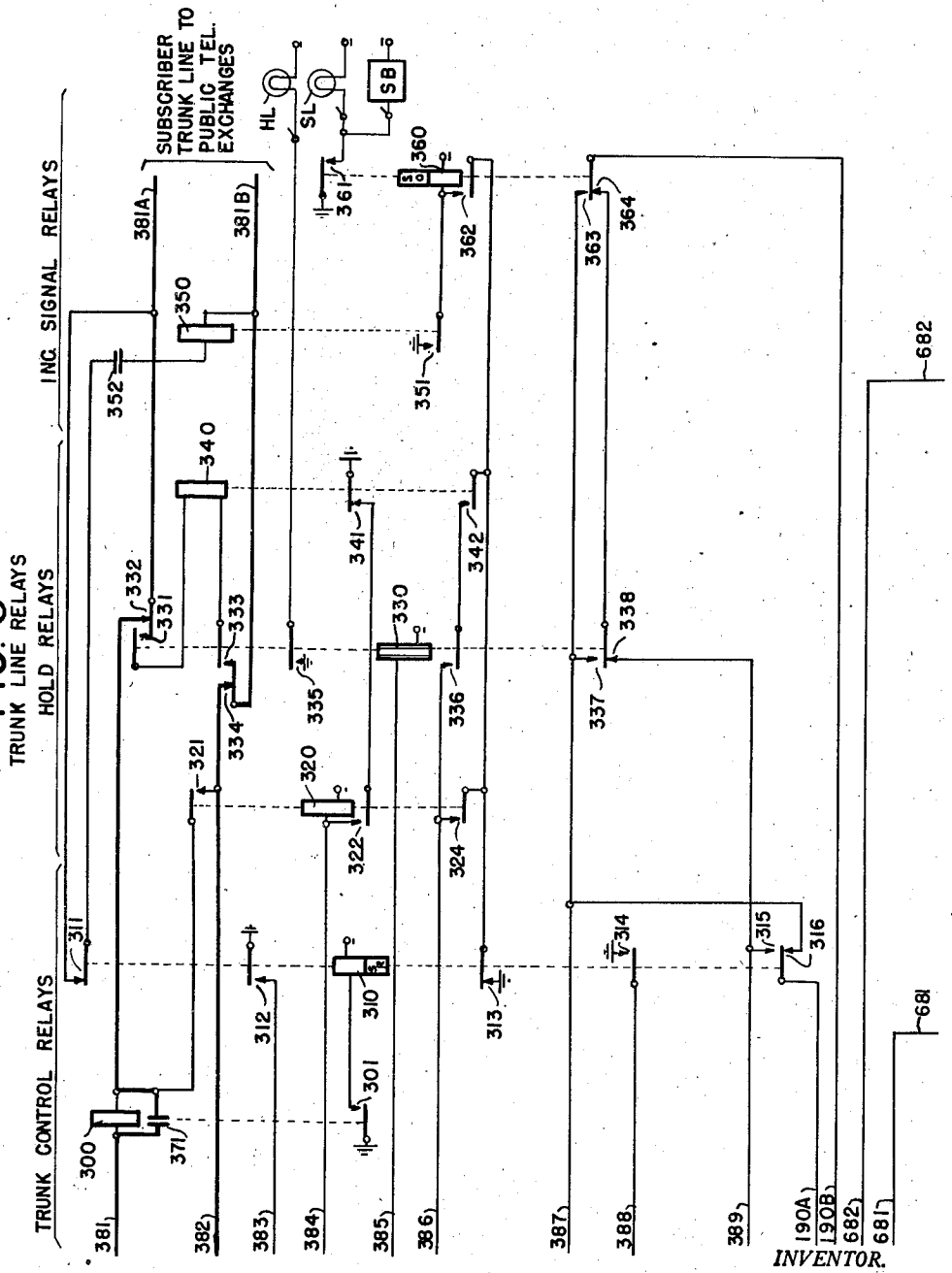
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AUTOMATIC TELEPHONE SYSTEM

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FIG. 3



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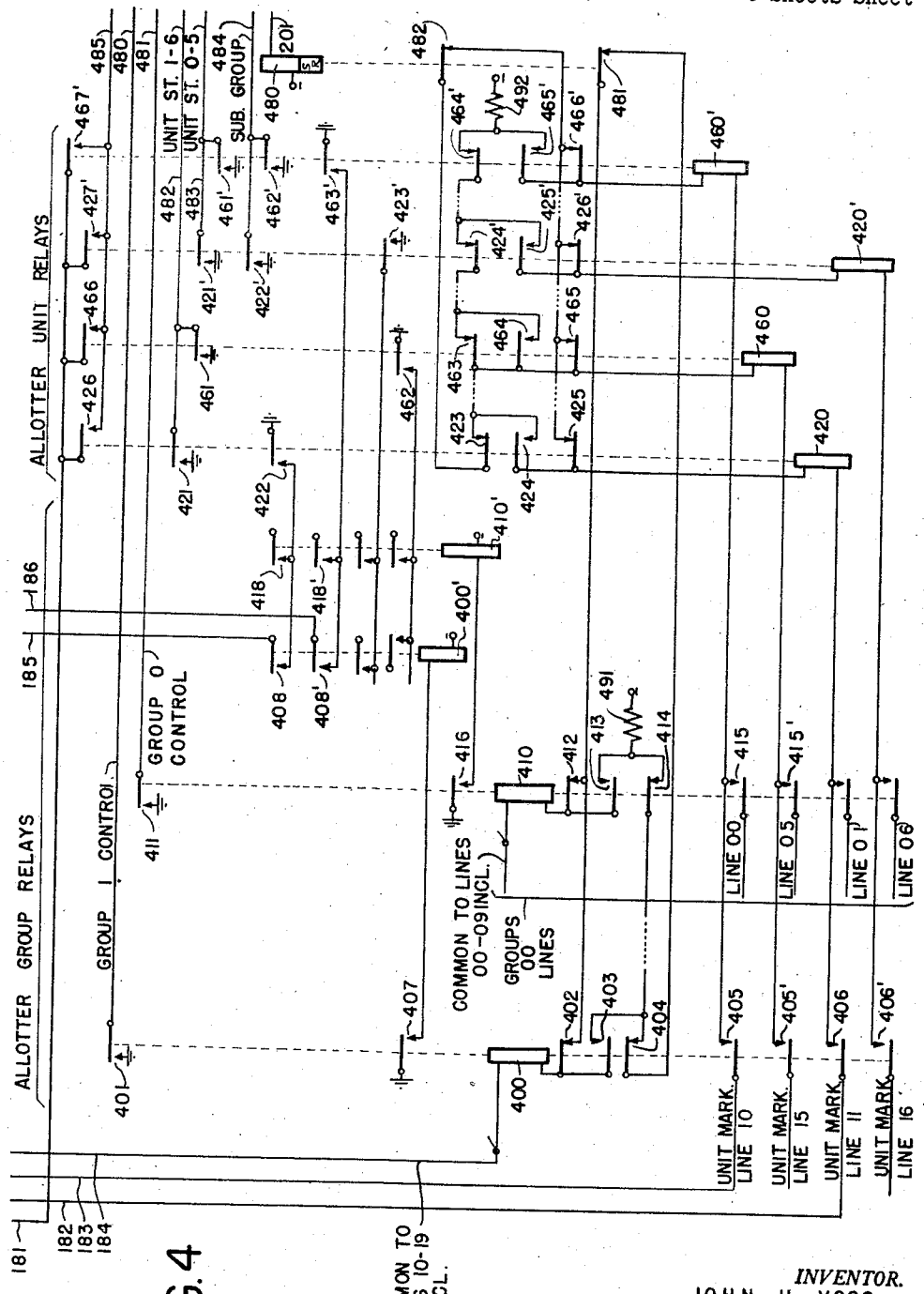


FIG. 4

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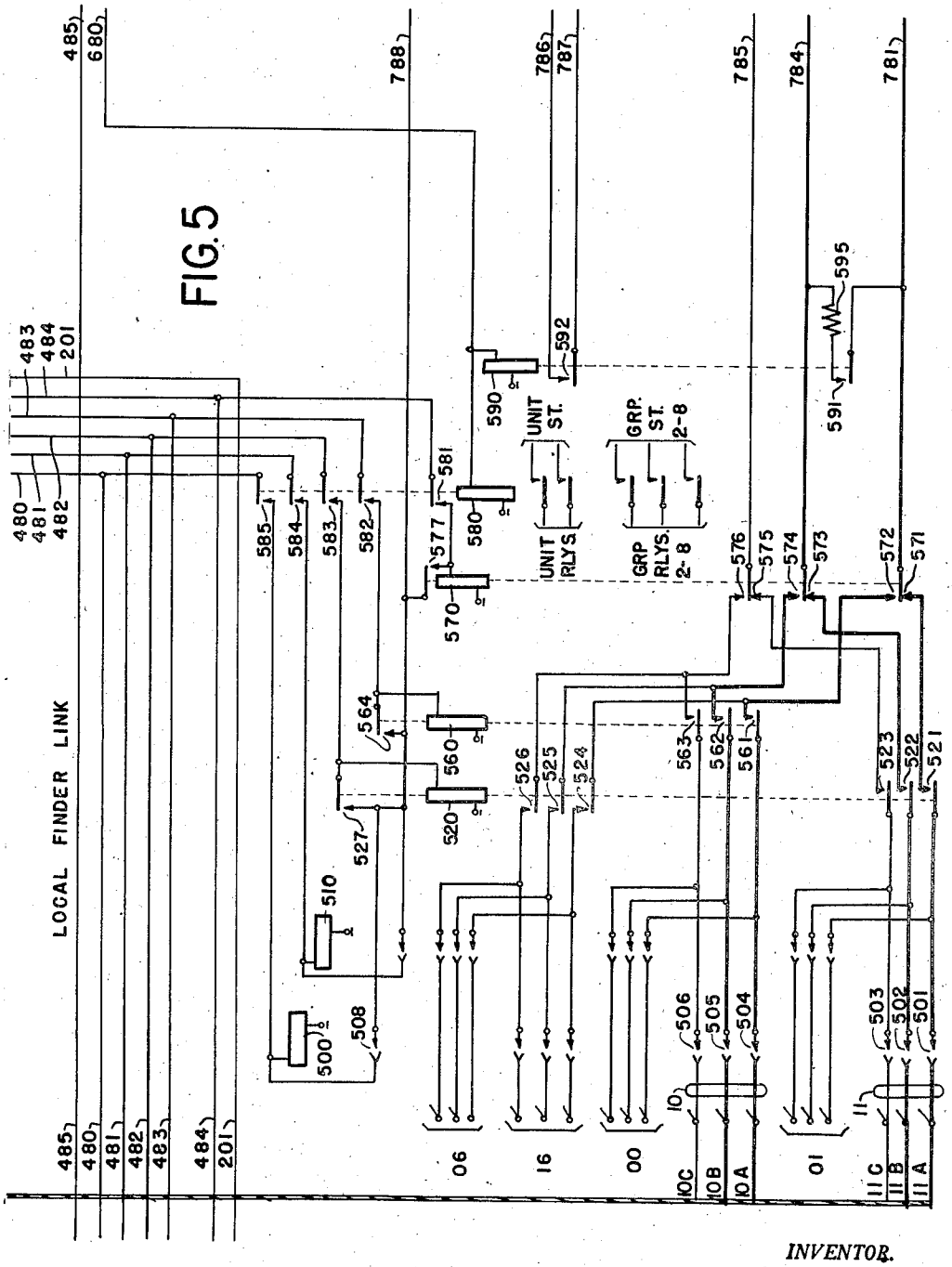
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AUTOMATIC TELEPHONE SYSTEM

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FIG. 5



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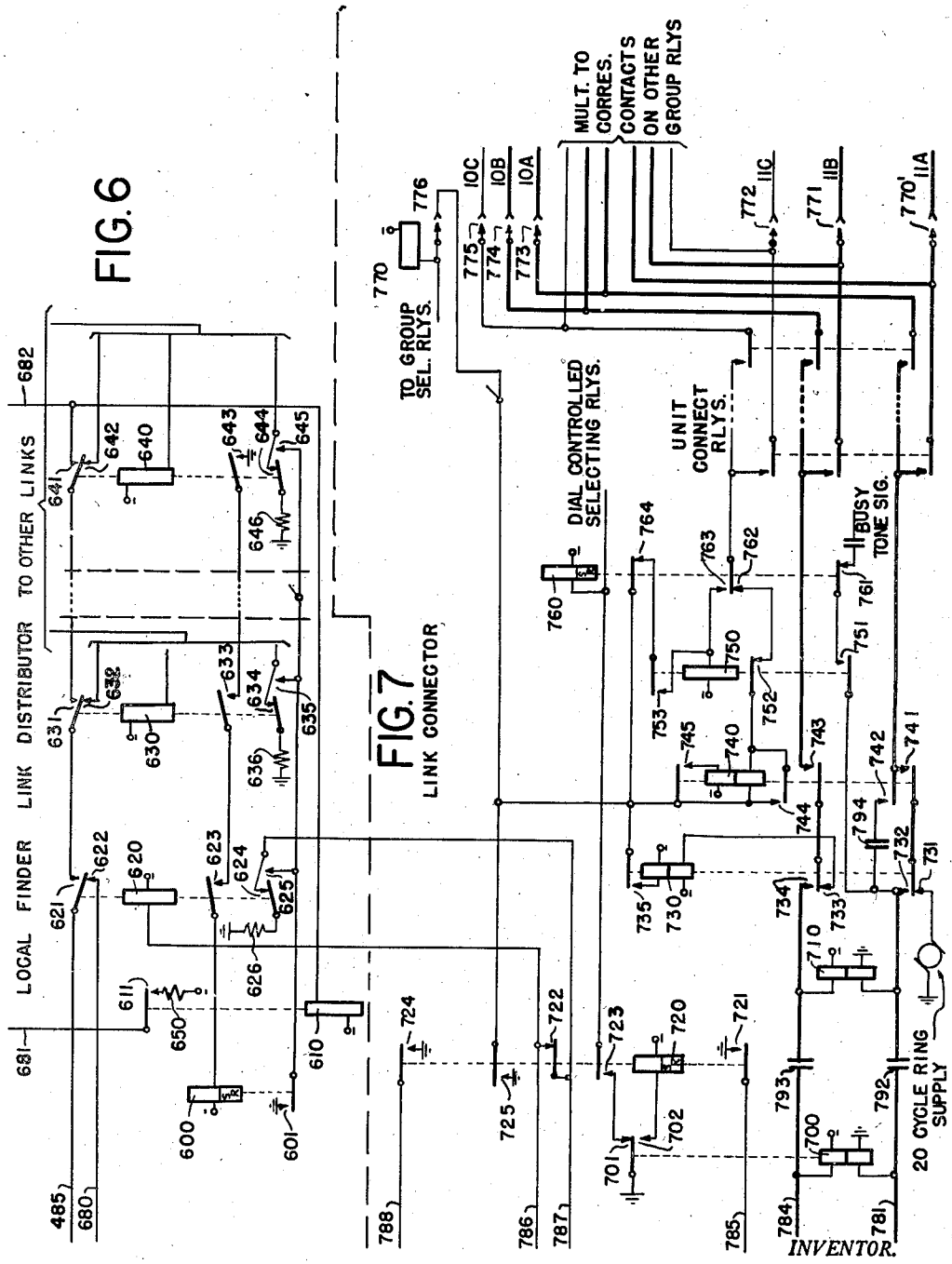
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AUTOMATIC TELEPHONE SYSTEM

Filed Nov. 10, 1944 6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,416,131

AUTOMATIC TELEPHONE SYSTEM

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Application November 10, 1944, Serial No. 562,797

37 Claims. (Cl. 179—18)

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This invention relates to automatic telephone systems in general and is more particularly concerned with improvements in trunk selecting equipment for private branch automatic exchanges of the all relay type.

A private branch automatic exchange, usually located within a subscriber's premises, provides intercommunicating service between a group of local telephone stations. In addition, the local stations usually serve as extension stations to the subscriber's city exchange lines that provide the public telephone system connections.

In private exchanges, where an attendant is not provided to supervise or extend connections between the public exchange trunks and local extension stations, the usual means for extending the local stations to the city exchange trunk lines is through the local link equipment. Only a small portion of a large unit of the local connecting equipment is actually used for each trunk connection. To reduce the cost of trunk connecting equipment, various arrangements have been used, such as a multiple of all the trunk lines to key equipments at the local stations. However, except in very small establishments which use the conventional house telephone wiring plans, a large multiple of trunk talking conductors is not desirable or practical from a transmission or cost point of view.

Further, the existing systems require special equipment to provide for additional trunk service facilities that are desired by many business establishments, such as, no unauthorized interference with an established connection, and the restriction of some of the local stations from originating outgoing trunk calls.

The object of the present invention is to provide improved means whereby the minimum amount of switching equipment is required for a station to selectively connect a local line station to a city trunk line without sacrificing the desirable service facilities that are usually provided in a more costly type of private exchange.

A feature of the improvement, relating to the reduction in equipment requirements, is that the local exchange connecting link equipments are divided into two separate service groups, a local group and a trunk group which are directively connected to any local line by allotter equipment that is common to all the link equipments in the local exchange.

Other features of the present invention relate to the novel circuit arrangements between station operated trunk select keys and the common allotter to make an operated key effective only

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at a station that corresponds to the line marked in the allotter. The allotter, being held only during the brief period required to directively extend a link to a calling line, will successively extend a plurality of calling lines, therefore by these circuit arrangements false link assignment due to the simultaneous operation of keys at several stations is prevented.

Another feature of the present invention relates to the circuit arrangement for transferring trunk calls between local extension stations, whereby an answering extension station transfers the trunk circuit to a self locked trunk hold condition which releases the connected answering station link relays permitting the answering station to secure the local line to extend calls over the local links and permitting another station to seize the trunk link equipment to establish a telephone connection with the call on the held trunk.

Other features of the invention relate to the simplified circuit arrangements for special trunk services, such as restricting specified stations to local calls and incoming trunk calls, while other stations have an additional privilege of initiating trunk calls. In conjunction with these stated trunk services, a tone signal, individual to each line indicates to a calling line when the line is not being extended to a selected trunk.

Other features not specifically mentioned, together with the features and objects previously outlined, will be explained hereinafter. Reference will be made to the accompanying circuit diagrams, Figures 1 through 7, inclusive. These diagrams illustrate the features of the present invention as being incorporated in a dial controlled local exchange, of the all relay type, having an ultimate capacity of 100 lines, 10 local links, and 4 city trunk links. The drawings illustrate only sufficient apparatus and wiring details for the invention to be clearly described and understood.

Fig. 1 illustrates the individual station equipment for two stations designated A and B connected to lines 11 and 10 respectively at the local exchanges. Station A is connected to illustrate a nonrestricted station and station B illustrates the connections for a station restricted from originating outgoing calls to another exchange.

Fig. 2 illustrates a trunk finder link for extending a trunk (Fig. 3) to any one of the local lines.

Fig. 3 illustrates a trunk circuit for a main exchange connection.

Fig. 4 illustrates the common allotter equipment for directively connecting a selected link to the calling line.

Fig. 5 illustrates a local finder link for extending the local connector (Fig. 7) to any of the local lines.

Fig. 6 illustrates the link distributor relays wherein the local links (Figs. 5 and 7) are preselected and successively assigned to extend loca calls.

Fig. 7 illustrates the incomplete connector on the local link. This circuit is well known, therefore the equipment shown covers the seizure, ring, busy test and control relays used to complete the operating description of the connecting equipment.

Referring to the drawings in general, the system illustrated thereon has a plurality of finder links which are divided into two groups, a trunk group, Fig. 2, and a local group, Fig. 5. The trunk links are selected by the manual operation of the substation set trunk keys shown in Fig. 1. The local links are automatically preselected by the finder distributor relays shown in Fig. 6. The initial operation of the finder links, Fig. 2 or Fig. 5, is controlled from the common equipment, Fig. 4, in conjunction with a line operated relay equipment shown in Fig. 1. The operation of the link relay equipment will be described in detail in a subsequent description, but for the present it is only necessary to know that a combination of associated line connecting relays, operated, will extend the calling line conductors to an associated dial controlled switch; the local finder link, Fig. 5, extends the line conductors to a local connector, Fig. 7, which is dial controlled to further extend the connection to a called local station; the trunk link, Fig. 2, serves to connect the calling local line to an associated trunk line circuit, Fig. 3, leading to a city exchange of either a manual or dial controlled type.

We will now proceed to give a more specific description of the equipment and wiring shown on drawings Figs. 1 to 7, inclusive. Fig. 1 illustrates two of the local exchange lines 10 and 11 terminating, respectively, at station B, a station that is restricted from making outgoing trunk calls, and at station A that does not have restricted trunk service. The stations designated A and B together with ringers 111 and 101, respectively, indicate conventional dial telephone instruments wherein a handset, when lifted from the cradle, closes switchhook springs, bridging the telephone transmission circuit across the line talking conductors and which, in series with normally closed dial springs will close a direct current control circuit over the stated talking conductors to the local exchange. Such telephones are so well known that detailed circuit and equipment are not shown. The combined station and line equipments shown are given a general reference designation A11 and B10, respectively. The key equipments are part of the telephone instrument and are of the locking type that are mechanically interlocked with each other and with the telephone switchhook lever similar to that disclosed in Patent No. 1,783,310, issued December 2, 1943. As illustrated, each station has a local key and a trunk hold key in addition to an individual key for each trunk. Two of the indicated four trunk keys shown are sufficient equipment to illustrate the wiring between keys. It should be noted that the only differences between the station equipments are in the terminations of the various conductors at the local exchange.

The line designations 10 and 11 are part of the exchange numbering plan as the 100 lines in the system are divided into 10 groups of 10 lines each, for example, the first group, lines 10 to 19, inclusive, includes lines 10 and 11, and hence the two stations illustrated are shown with a common group marking conductor. The unit marking conductors are indicated as being common to corresponding lines in the other groups that are not shown.

The local lines, such as 10 and 11, are each associated at the local exchange with line equipment having conventional general functional designations L, CO and BY. For example, relay 120 (L) is a line operated relay and marks the calling line on the common allotter, Fig. 4, which starts the exchange equipment functioning to extend a link to line 11; relay 130 (CO) is operated after the link is extended to line 11 and disconnects relay 120 which permits other calling stations to use the common equipment, Fig. 4, to extend another link to that line; relay 140 (BY) is operated when the call is not extended, due to all local links or trunk links being busy or due to the calling station attempting to make an unauthorized outgoing trunk call. Relay 140 (BY) operated, an audible tone signal is connected to the associated line and the common equipment is released.

Fig. 2 illustrates a finder link having access to 100 lines and is used for the purpose of extending a city exchange trunk, Fig. 3, to one of the possible 100 lines. One unit of link equipment is provided for each city trunk. The finder portion of each link comprises ten group relays, two of which are shown as 200 (group 1) and 210 (group 0) and five unit relays 220—260 each of which extends the conductors of two lines from each of the ten groups of lines. Thus, for example, relay 220 operated in conjunction with any one of the group relays extends the lines having unit designations of 1 and 6 such as lines 11, 16, 01 and 06. Similarly the relay 260 extends the conductors for the lines 5 and 0 such as lines 15, 10, 05 and 00. In order to connect only one of the two lines thus selected by the group and unit relays, there is provided a subgroup relay 270 which is energized when the calling line number ends in digits 6 to 0 inclusive and disconnects the conductors for lines 1 to 5. For the purpose of associating the stated line and unit relays of the finder switch with the common equipment illustrated in Fig. 4, there are provided a pair of connect relays 280 and 290.

Fig. 3 trunk circuit illustrates the relay control equipment for a local extension station to control a connection over a trunk leading to a city exchange. More specifically, 300 is a series relay, controllable over a loop circuit between the local telephone and city telephone exchange equipment. Relay 300 in conjunction with condenser 371 will provide a low impedance path for the transmission circuit and for the operation of the main exchange equipment. Relay 310 is slow-to-release and will remain in the operated position if subsequent dial pulses should cause relay 300 to flutter. Relays 320, 330, 340 are the hold control relays, and 350 is an A. C. relay responsive to the ringing current from the city exchange. Relay 360 is slow to operate and will not respond to momentary line surges that may operate relay 350. The signal lamp SL, hold lamps HL, and audible signal SB are provided

for each trunk having sufficient multiple appearances to be visible or audible at each local extension station. The signals for each trunk are distinguishable from the signals for the other trunks.

Fig. 4 allotter relays illustrate the equipment common to the links and comprise 10 group relays, 10 auxiliary group relays, 10 unit relays and 1 slow-to-release trunk lockout relay. The first and last relays of each type are shown. The additional intervening relays, consisting of 8 additional tens group relays, 8 auxiliary group relays, 6 unit relays and the 8 additional sets of contacts on each of the group relays are not shown.

The tens group relays **400**, **410** and unit relays **420—460'** are the common control relays for extending a marking corresponding to any of the calling lines, to corresponding relays in any of the links. Relays **400'**, **410'** are the common control for making an operated calling station key effective only at the station of the particular line that is to be extended whereby a finder link, Fig. 2 or Fig. 5, depending on the service desired, can be connected to this allotter. The operated tens and units relays operate corresponding tens and units relays in the connected link to complete the connection. The unit relays **420'—460'** operated, when the calling station line numbers end in 6–0 also operate the subgroup relay **270** or **570**.

The operating circuits for each group of tens and units relays are individually chained in a series circuit which prevents more than one tens relay and one units relay from operating at the same time, and which in conjunction with a continuation of the stated chain through the trunk lockout relay **480** prevents establishing a local call when a trunk call is being connected.

Fig. 5, local finder link, illustrates a group of line connecting relays having equipment similar to that described in Fig. 2 trunk link finder except that it is used for local service and is associated with a local link connector, Fig. 7, of the all relay type.

Fig. 6, local finder distributor, illustrates a group of link distributor relays which individually correspond to the local links and in conjunction with the slow-to-release reset relay **600**, operate in a cyclic manner, marking idle local links and successively assigning the corresponding links to local calls. Relay **610** operates only when all trunks are busy or the call is blocked due to a restricted extension station attempting to make an outgoing call.

Fig. 7, local link connector, illustrates a partial group of relays that are dial controlled to extend a connection from one local station to another local station. Relay **700** is responsive to dial pulses and controls relay **720** which, being slow to release, holds during pulsing and is used as a master release control relay. Relay **730**, for ring cut off, is responsive only to direct current closed when the call is answered, relay **740** for cut thru to an idle called line, relay **750** for busy test, and is operated when the called line is busy. Relay **760** is operated during a series of dial pulses to prevent false operations on the busy test or cut thru during dialing. Relay **770** is one of the tens connecting relays. The units relays, the counting chain for selecting the tens, units relays are well known and are not shown in these drawings.

Having briefly described the purpose of the equipment shown on each figure of the drawings, a detailed circuit description, of the illustrated system, will be given. For this purpose, the operation can be better understood if the description

is based on the extension of typical connections, therefore it will be assumed that station A, line 11 establishes a local call with station B, line 10, station A establishes an outgoing city trunk call, and station B answers a city trunk call and transfers the call to station A.

Local connection Figures 1, 4, 5, 6, 7

For explanatory purposes, it will now be assumed that station A, line 11 is extending a local connection to station B, line 10. The call is initiated by station A lifting the telephone handset from the support and then operating the local key. A line loop circuit is completed at contacts **114**, between telephone set A and line conductors **11A** and **11B**, whereby relay **120** is energized as follows; from ground, relay contacts **131**, line conductor **77A**, telephone instrument A, key contacts **114**, conductor **11B**, contacts **132** and winding of relay **120** to battery. Relay **120** energizes and closes contacts **121—126** of which contacts **125** and **126** are the respective control points for energizing the associated allotter group relay **400** and unit relay **420**. The primary energizing circuit for relay **400** is traceable as follows; from ground, contact **145**, contacts **126**, conductor **184**, coil of relay **400**, contacts **402**, **481**, through a series of chain connected contacts that start at springs **404** and ends at **414**, to resistance **491** and battery. Relay **400**, in operating, will close a holding circuit through contacts **403** to battery at resistance **491** before the stated primary energizing circuit is opened at contacts **402** and **404**. The primary energizing circuit is opened to all other group relays such as **410** at contacts **404** and **402**, therefore an operating ground from other subsequently operated line relays will not be effective at this time.

Relay **400** energizes and closes contacts **405** to **406'** of which contacts **406** complete a primary energizing circuit for relay **420** as follows; ground, contacts **144**, contacts **125**, conductor **182**, contacts **406**, coil of relay **420**, contacts **425** and **482**, through a series of chain connected contacts that starts at **423** and ends at contact **464'**, through the resistance **492** to battery. Relay **420** in operating closes a holding circuit at contact **424** to battery at resistance **492** before the stated primary circuit is opened at contacts **423** and **425**. Any subsequent ground from other stations in the same group cannot operate other unit relays because battery thru the primary operating circuit is opened at contacts **423** and **425**.

Before continuing with the circuit description for the operated relays **400** and **420** controlling the operation of the corresponding link relays **500** and **520**, it will be necessary to briefly describe the circuit means for associating an idle link with the common allotter equipment. The local links are preselected by the well-known link relay distributor or allotter that operates in a cyclic manner and will be herein briefly described. Each local connector link (Fig. 7) has an associated finder distributor relay in Fig. 6 such as **620**, **630**, or **640**. A primary energizing circuit from a common operating ground at contacts **601** is closed when relay **600** is energized through a closed chain of series connected contacts starting at ground at contacts **643** and ending at contacts **623**. Ground at **601** will energize all distributor relays **620—640** that are associated with an idle link. For example, the circuit for energizing relay **620** is traceable as follows; ground contacts **601**, contacts **625**, contacts **722**, coil of relay **620** to battery. Relay **620** operates and

locks to an individual ground thru resistance 626 at contacts 624 and opens the start ground at contact 625. Relay 620, energized, extends the common control circuit conductor 485 through contacts 622, conductor 689, coils of relays 590 and 580 in multiple to battery. Each of the other finder distributor relays 630—640 operate in a like manner and prepare a circuit that will extend the individual link start conductor such as 689 to the common start conductor 485 through back contacts of the preceding deenergized finder distributor relay. Relay 620 deenergized when the link is connected to the calling line and the common start conductor 485 is extended through contacts 621 to contact 632 and link #2. Each of the distributor relays 620 and 630 when deenergized further extends the common start control conductor 485 to the succeeding preenergized relay. When the last preenergized relay is deenergized the chain ground at contacts 643 is again extended thru contacts 633, 623 to relay 600 and the cycle is repeated. The operation which takes place when all links are busy and the distributor relays cannot reoperate will be fully described under a separate heading "Call blocked signal."

Reverting to the previous description wherein relays 400 and 420 were operated in response to the operation of line relay 120. Relay 400' is operted responsive to closure of contacts 407, and this relay at contacts 408 completes an energizing circuit for relays 580 and 590 that is traceable as follows; contacts 422, 408, conductor 485, contacts 143, local key contacts 113, relay contacts 121, local common start conductor 181, relay contacts 426, conductor 485, contacts 622, conductor 680 through coils of relays 580 and 590 to battery. Contacts 591 and 592 are closed responsive to relay 590 being energized and serve the following purposes; contacts 592 close a multiple circuit over conductors 786, 787 to contacts 722 for holding relay 620 energized until the common equipment is released, as will be described in a subsequent paragraph, and contacts 591 energize relay 700 through resistance 595 conductors 781 and 784. Relay 700 operates and contacts 702 close an operating ground to relay 720. Relay 720 operates to control the individual link holding relays as follows; contacts 724 prepare a ground circuit over conductor 788 for holding the link group and unit relays energized after a call is established, contacts 725 prepare a holding circuit for the subsequently operated connector link relays, such as 730, 740, 750, 770, etc., contacts 721 prepare a ground circuit over conductor 785 for guarding the calling line, and contacts 723 prepare a circuit to the dial controlled relays embodied in the connector.

Relay 580 is operated in multiple with relay 590 and contacts 581—585 close circuits from the common equipment conductors 480, 481 to the tens group relays 500—510 and from conductors 482, 483 to the unit relays 520—560 of which the first group relay 500 and the first unit relay 520 are energized from the operating ground on conductor 480 at contacts 401 and from ground on conductor 482 at contacts 421. Relays 500 and 520 lock to ground on conductor 788 and extend the conductors 781, 784, 785 to the line conductors 11A, 11B, and 11C, respectively, which establishes the following circuit condition: conductor 11A contacts 501, 521, 571, conductor 781 lower coil of relay 700 to ground; conductor 11B contacts 502, 522, 573 conductor 784 upper coil of relay 700 to battery; and conductor 11C contacts 503, 523, 575 conductor 785 to ground at closed contacts 721. Relay 130 is energized by way of ground at contacts 721 conductor 785, contacts 575, 523, 503, and conductor 11C. Relay 130 at contacts 131 and 132 opens the circuit of line relay 120 which deenergizes and opens contacts 121—126. Contacts 121 disconnect ground from the common start conductors 181, 485, 680, releasing relays 580 and 590. The holding circuit to relay 620 is opened at contacts 592, and in conjunction with the open contacts 722 relay 620 is deenergized, transferring the common start control to the next preselected link through contacts 621 and 632. Relays 400 and 420 are deenergized when their circuits are opened at contacts 126 and 125 and restore all common allotter contacts to the normal position. The series chain circuits between group relays and the unit relays is reestablished, and the common equipment Fig. 4 is available for extending the next call. Relays 500 and 520 remain energized from ground on conductor 788 from contacts 724.

Relay 700 initially energized over contacts 591 is now held over the calling subscriber loop, therefore when relay 590 deenergizes and contacts 591 open, relay 700 does not release as it is controllable over the subscriber line loop. The operation of an all relay link connector in response to dial pulses is well known and this connector link in Fig. 7, in response to the receipt of the dialled digits 1 and 0, will energize relay 770 together with the unit relays (not shown) to connect with line 10. Line 10 is now connected through closed contacts 773, 774, 775 to the control circuits for seizing and signalling line 10 and extending the called line conductors 10A and 10B to relay 710 and condensers 792, 793, where the voice current transmission circuit is completed to the calling line 11. Transmitter current is supplied to line 10 from relay 710. This connector operation, relating to the operation of the line equipment 10, will be briefly summarized as follows:

Relay 700 follows dial pulses and each time contacts 701 are closed a ground pulse is extended by way of contacts 723 to the pulse counting relays (not shown). Relay 760 is operated during each series of dial pulses and will remain operated momentarily after the selected group and unit relays are operated to complete a test circuit which extends from battery, coil of relay 750, contacts 763, closed contacts on the operated unit relays, and contacts 775 to conductor 10C. If the called line is busy, the ground circuit that holds the cut-off relay 130' energized, as previously described, is extended over conductor 10C to energize relay 750. Relay 750 operates and locks through contacts 753, 764 to ground at 725 after relay 760 returns to the normal position and before contacts 763 are opened. A line busy tone signal is returned to the calling line by way of contacts 751 and the circuit to relay 740 is opened at contacts 752 preventing connection with the called line if the line becomes free before the calling party disconnects.

Assume the line is free, the terminal 10C will have a battery potential extending from relay 130' therefore relay 750 is not operated and after relay 760 releases, battery on 10C is extended through contacts 775, contacts on the operated units relays, contacts 762, 752, lower winding of relay 740 to ground at contacts 725. Relays 740 and 130' operate in series. Relay 130' operates and at contacts 131' and 132' disconnects ground from conductor 10A and battery through coil of line relay 120' from line conductor 10B. Relay 140, in the connector, energizes in series with

relay 130' and completes a locking circuit through its upper winding at contacts 745 to ground at contacts 725. At contacts 743 the line conductor 10B is extended by way of contacts 733 to the lower winding of ringing control relay 730 and at contacts 741 line conductor 10A is extended by way of contacts 731 to a twenty cycle ringing current source. The telephone bell 101 at station B is responsive to the stated 20 cycle ringing current. The call is answered at station B by lifting the telephone handset and operating the local key which completes a circuit through the telephone instrument and local key contacts 104 which will close the loop from ground at the ringing supply source to battery at relay 730. Relay 730 operates and at contacts 735 completes a locking circuit through its upper winding before the ringing circuit is opened at contacts 733 and 731. The line conductors 10A and 10B are further extended at contacts 732 and 734 to the talking condensers 792 and 793 and to the talking conductors 781, 784, 11A and 11B and a voice current transmission circuit is completed between telephones A and B.

The release of the established local connection is controllable from relay 720, which is responsive to the calling subscriber controlled relay 700. When the handset at the calling station is restored to the cradle of the telephone instrument, the switchhook springs open the line loop in a well-known manner. Relay 700 is deenergized and contacts 702 are opened, deenergizing relay 720 which opens contacts 721, 724, and 725 and closes contacts 722. Contacts 725 open the holding ground to the connector relays 730, 740, etc., and the operated connector relays release. Contact 721 opens the holding ground to relay 130, and contact 724 opens the holding circuit to relays 500 and 520, which, after deenergizing disconnect the link from the line.

All trunk busy call blocked signal

In the preceding description, that related to the preselection of the local links, the operation of the finder distributor relays Fig. 6 was described when idle links were available for reassignment. Briefly stated relays 620—640 energized and allocated the links for successive local calls. Each energized relay is deenergized when the associated link is seized. After all the stated relays are normal, a chain connected ground is closed to relay 600 and contacts 601 are closed.

Assume now that all links are busy and station A attempts to initiate a local call. The relays 620—640 cannot reenergize when contacts 601 are closed because contacts 722 and corresponding contacts in the other busy links are opened. The local common start conductor 485 is extended to relay 610 through contacts 621, 631, 641, etc. The operation of the equipment with station A initiating a call, has been previously described whereby key contacts 113, 114 are closed, line relay 120 is energized and group relay 400, 400' and unit relay 420, together with contacts 408, 422 and 426, are operated. Ground at contacts 422 is extended through contacts 408 to conductor 185 and lower winding of relay 140 to conductor 681 to the open contacts 611. Ground on conductor 185 also energizes relay 610 as follows; ground on conductor 185, through contacts 143, key contacts 113, relay contacts 121, conductor 181, contacts 426, conductor 485, contacts 621, 631, 641 to coil of relay 610 and battery. Relay 610 is energized and battery through resistance 650 and closed contacts 611 is extended to conductor 681, energizing relay 140. Relay 140 energizes and locks at contacts 142 to ground at contacts 123. An audible tone signal is connected at contacts 141 to conductor 11B, and contacts 143, 144 and 145 are opened. Contacts 143 open the energizing circuit of relay 610 which deenergizes to disconnect battery from conductor 681. Contacts 144 and 145 open the circuits of relays 400 and 420 which now deenergize. The circuit for relay 400' is opened at contacts 407. All allotter relays Fig. 4 are now in the normal position, conductor 185 is open at contacts 408 and 422, and the common equipment is now available for a call from another station. Relay 140 remains locked to ground at contacts 123 until the line loop is opened and relay 120 is deenergized by station A restoring the handset or by restoring the local key. It is obvious that station A cannot initiate a new call unless relay 120 is first deenergized to deenergize relay 140.

Outgoing trunk call

For explanatory purposes we will assume station A (line 11) will initiate a trunk call and that trunk #1 is available for a call.

The handset at station A is lifted from the cradle and trunk key #1 is operated, closing contacts 115 and 116. A loop is completed between conductors 11A and 11B through key contacts 116 and telephone instrument, over which relay 120 is energized from ground at contacts 131 through contacts 132 to battery at relay 120, closing contacts 121—126. The operating circuits for Fig. 4 relays 400, 400' and 420 controllable from contacts 125 and 126 were fully described hereinbefore, and in a like manner contacts 126 operated extend a ground for energizing 400 from ground, contacts 145 and 126, conductor 184, coil of relay 400, contact 402, 481, 404—414, and resistance 491 to battery. Relay 400 operates and locks at contacts 403. Relay 400' is energized at contacts 407. Relay 400 operates contacts 406 and an energizing circuit to relay 420 is closed from ground, contacts 144 and 125, conductor 182, contact 406, coil of relay 420, contacts 425, 482, 423—464, and resistance 492 to battery. Relay 420 operates and extends a ground from contacts 422 to the trunk start conductor 190A over which relays 280 and 290 are energized as follows: ground, contacts 422, 408, conductor 185, contacts 143, trunk key contacts 115, relay contacts 122, conductor 190A, contacts 316, conductor 387, windings of relays 280 and 290 to battery. Group relays 200—210 and unit relays 220—260 operate in a like manner to corresponding relays in Fig. 5 as hereinbefore described. Briefly described relay 280 prepares operating circuits for the tens and units relays of which only relays 200 and 220 are energized. The operating circuit for relay 200 is from ground, contacts 401, closed when 400 is operated, conductor 480, contacts 285 and relay 200 to battery. The operating circuit for 220 is traceable as follows: ground, contact 421, conductor 482, contacts 283 and coil of relay 220 to battery. Relay 200 operated, in conjunction with relay 220 operated, and relay 270 normal, extends line conductors 11A, 11B, 11C, 11D to conductors 381, 382, 383, and 384, through operated contacts 201—204, 221—224, and closed contacts 271, 273, 275 and 277 respectively. Relay 290 operates in multiple with relay 280 and contacts 292 close a circuit for holding relays 200 and 220 energized through operated contacts 209 and 229. Contacts 293 close and extend a

ground over conductor 201 to energize the slow to release relay 480, which further opens the primary energizing circuits for group relays 400—410 and unit relays 420—460'. Contacts 295 extend a ground circuit over the line conductor 11C through contacts 275, 223, and 203, to relay 130. Relay 130 is energized to open contacts 131 and 132. At the open contacts 131 and 132 ground and battery are removed from the talking conductors 11A and 11B and relay 120 is deenergized and the control circuits to relays 400, 420, 280 and 290 are opened at contacts 125, 126, 122. Relays 400 and 420 deenergize and restore the common equipment to the normal condition except that relay 480 being slow to release and controllable from slow to release relay 290 will remain in the operated position for a fraction of a second, which will prevent establishing new calls until all previously operated common relays have had sufficient time to restore to a normal position. Before relay 290 is restored to the normal position, after contacts 122 are opened, relay 310 is energized as will be described hereinafter and a ground is closed from contacts 312 to conductor 383 and from contacts 314 to conductor 388, respectively, in multiple with contacts 295 and 292. Relay 310 is energized in the following manner. When the conductors for line 11 were extended to conductors 381 and 382, the subscriber's loop circuit was extended to the trunk circuit leading through the coil of relay 300, contacts 332 and contacts 334, to the city exchange line conductors 381A and B. Battery and ground is supplied to conductors 381A and B from the control relays of the city exchange equipment, which in conjunction with the closed loop at the subscriber's station A, causes relay 300 to energize, closing contacts 301 and energizing 310. Relay 310 operates contacts 314, 312, and 311. Ground at contacts 314 is extended to conductor 388 to hold relays 200, 220 energized. Ground at contacts 312 is extended to conductor 383, contacts 275, 223, 203 to hold relay 130 operated. Contacts 311 open the operating circuit for A. C. relay 350 to improve transmission and to prevent false incoming line signals. Relay 310 transfers the start conductor 190A to conductor 389 at contacts 315 leading to the busy relay 610 through contacts 294 and conductor 682. The control circuit for relay 610 is not closed because the operating ground to conductor 190A, is open at relay contacts 122 before relay 290 can deenergize and reclose contacts 294.

In the described circuit operations, a connection has been established from the calling station to the connecting exchange over a thru line comprising conductors 11A, 11B, 381, 382, 381A and 381B. The terminating line equipment at the connecting exchange, previously mentioned as the termination for line 381, is of the same character as other terminating subscriber line equipments. This line circuit together with relay 300 is energized in series with the telephone instrument at the calling station. The method of operation for extending a call within a telephone exchange is well known and is not included in this description. It is understood that the battery and ground supply to the line is maintained from the connecting exchange and relay 300 remains in the energized position. As previously described, relay 310 controlled by relay 300 is also operated, holding the connection at the local exchange by maintaining the hold ground to the energized connect relays 200, 220 and line cut off relay 130, and as will be described in a subsequent paragraph, relay 310 prevents other lines from seizing the busy trunk.

The connection is released when the line is opened by the calling party disconnecting in the well known manner. Relay 300 deenergizes, and the operated local exchange trunk is restored to normal by relay 310 disconnecting ground from conductors 383 and 388 which releases relays 200, 220 and 130. The connecting exchange is released when the above mentioned line is opened in the usual manner in response to a disconnect by a calling subscriber.

In a like manner, a subsequent trunk start ground can be extended to conductor 190A by other stations making a call on trunk #1, but since the trunk is busy, contacts 315 are closed as previously described, and the busy relay 610 is energized from ground on conductor 190A through closed contacts 315 conductor 389, contacts 294, conductor 682, winding of relay 610 to battery. The operation of relay 610 was fully described hereinbefore under the heading "All trunk busy blocked call signal." Relay 610 extends battery through resistance 650, contacts 611 to the common side of relays 140, 140' etc., of which, the busy relay 140 associated with the calling line 11 operates from the common start ground on conductor 185. Relay 140 locks itself at contacts 142 and opens the control ground at contacts 145, 144 and 143 extending to the group relay 400, unit relay 420 and busy relay 610. Relays 400, 420 and 610 deenergize and restore the common equipment to normal condition. The line lockout busy relay 140 remains in the energized condition until the associated line relay 120, controllable from the calling station, is deenergized.

It is obvious that a restricted station such as B10 cannot originate an outgoing trunk call as the trunk key is connected to conductor 190B instead of 190A. Conductor 190B (Fig. 3) is only connected to conductor 387 and relays 280 and 290 on incoming calls. Conductor 190B is normally connected thru contacts 364, 338 to relay 610. If station B attempts to initiate an outgoing trunk call the operation of the line relays and common equipment is similar to station A11 except relays 120' and 460' are operated instead of relays 120 and 420 and the start ground is connected to conductor 190B at key contacts 105 and relay contacts 122'. Relay 610 is operated over the above mentioned circuit and extends battery to relay 140'. Relay 140' is operated in a like manner to relay 140, releases the common equipment and connects a tone signal to the calling party.

Answering a trunk call

When a subscriber in the city exchange desires to extend a call to a subscriber's line in the private exchange, twenty cycle generator together with battery and ground is connected to the selected trunk line. Assuming that the trunk line shown in Fig. 3 is the trunk line taken into use then relay 350 is energized in response to the application of alternating current to trunk line conductors 381A and 381B by way of condenser 352 and contacts 311. Relay 350 at contacts 351 completes the circuit for energizing relay 360. Relay 360 operates and locks through contacts 362 to ground at contacts 313 and transfers conductor 190B, leading to restricted subscriber stations, such as B11, from contacts 364 to contacts 363, conductor 387 to relays 280, and

290. Contacts 361 close a ground circuit to the visual and audible signals that are individual to each trunk but have a plurality of appearances at the local exchange. Any station may answer the trunk call. If the answering station is in the non-restricted group such as station A (line 11), the answering station is extended in an identical manner as previously described for station A making an outgoing call. In practice it is customary to instruct a clerical station to answer trunk calls.

Restricted stations and call transfer

For explanatory purposes we will briefly describe a restricted station B (line 10) as answering the trunk call, transferring it to the hold condition, releasing the trunk link, extending a local call to A (line 11) and then have station A pick up the call on the held trunk. Station B answers the trunk call by lifting the handset and operating the associated trunk key which closes an operating loop circuit to relay 120' from ground, contacts 131', conductor 10A, subset A, trunk #1 key contacts 106 and conductor 10B, contacts 132' coil of relay 120' to battery. The line 10 is extended in a like manner to that previously described for station A making an outgoing call except that relay 460' is responsive to ground at contacts 144' and 125', conductor 183, contacts 405 coil of relay 460', chain contacts to battery through resistance 492. A common start ground is closed at contacts 463' and 408', conductor 186, contact 143' to trunk #1 key contacts 105, contacts 122', conductor 190B. Conductor 190B is further extended by the incoming signal relay 360, contacts 363, to conductor 387 and relays 280 and 290 to battery. Relays 280 and 290 operate and extend the control circuits from the common group and unit relays equipment to the link group and unit relays as previously described. Group relay 200 is responsive to ground at contacts 401 and extends the associated line conductors to the unit relays. Unit relay 260 is responsive to ground at contacts 461' and further extends lines 10 and 16. Sub-group relay 270 is responsive to ground at contacts 462' and contacts 271, 273, 275, 277 are opened and contacts 272, 274, 276, 278 are closed which completes the circuit from line 10 to the trunk circuit. Relays 200, 260 and 270 are locked to ground at contacts 292 through contacts 209, 265 and 279, respectively. Relay 130' energizes from ground at contacts 295 over conductor 19C and opens contacts 131' and 132' and relay 120' is deenergized. Contacts 122' are opened by relay 120' which deenergizes relays 280 and 290. Relays 130', 200, 260 and 270 remain operated from a multiple holding ground at contacts 312 and 314 as will be explained presently. When line 10 was extended to the trunk, a local subscriber controlled loop was extended to conductors 381 and 382 and the city exchange. The city exchange equipment responsive to a closed subscriber loop disconnects the ringing signal and a transmission circuit with direct current supply is completed, wherein relay 300 is energized. Relay 300 energizes relay 310 and the previously explained holding grounds at contacts 312 and 314 are extended to conductors 383 and 388. Contacts 313 open and deenergize relay 360 which opens the incoming signal circuit at contacts 361 and transfers conductor 190B back to contacts 364 leading to the busy relay 610. It is obvious, that any other station attempting to seize a busy trunk will operate the busy relay 610 as described hereinbefore. Contacts 125' and 126' are opened after relay 120' deenergized and the common allotter equipment relays 400, 460' and 400' are deenergized. It is obvious that the common equipment operating grounds are open and the common equipment is now ready for another call.

Transferring a trunk call

Continuing the preceding explanation wherein station B has answered a city exchange call. We will assume that the station wanted is A (line 11). Station B first places a hold condition on the trunk by operating the station key 102 and relay 320 is energized from ground, key contacts 102, conductor 10D, contacts 208, 264, 278, conductor 384 coil of relay 320 to battery. Relay 320 operates and locks through contacts 322 to ground at contacts 341. The station hold key, when operated, mechanically released the trunk key and the local station line loop is opened at contacts 106. The city exchange is held in the answered condition from a bridge circuit at closed contacts 321 and relay 300 is deenergized. Relay 300 deenergizes, opening contacts 301, and relay 310 is deenergized after a slight delay due to its slow release characteristics. The holding ground for the finder link is opened at contacts 314 and the link relay equipment is released, and holding ground is removed at contacts 312 to release relay 130'. Contacts 324 of relay 320 prepare an energizing circuit for relay 330 which is completed when relay 310 deenergizes, from ground. contacts 313 and 324, conductor 386, closed contacts 291, conductor 385 to battery through the coil of relay 330. Relay 340 is now bridged across the exchange line at contacts 331 and 333 before the line is further opened at contacts 332 and 334. Relay 340 energizes responsive to direct current from the city exchange, opening contacts 341 and completing a holding circuit for relay 330 from grounded contacts 313, contacts 342 and 336, conductor 386, contacts 291 and conductor 385. Relay 320 deenergizes when its locking circuit is opened at contacts 341. Relay 330 at contacts 335 lights the hold lamp HL and at contacts 337 connects conductor 190B to conductor 387 by way of contacts 364 to enable a restricted subscriber to answer and connect with this held trunk line.

The local station B, desiring to have station A pick up the trunk call, operates the local station key. Station B extends a local call to station A in a like manner to that described hereinbefore under the heading "Local call." The deviations due to station B establishing a local call instead of A are obvious. Station A is requested to pick up the call in trunk #1 and station B disconnects releasing the local call. Station A picks up the held trunk by operating trunk key #1 which releases the local key operated when the local call was answered and completes a circuit over which relays 120 and 130 are energized. Line 11 is extended to trunk #1 in an identical manner to that described under the heading "Outgoing trunk call." Relay 290 is operated as previously described and at contacts 291 opens the circuit of relay 330 which deenergizes and transfers the city exchange line from relay 340 to the line conductors leading to station A.

Relay 330 at contacts 335 extinguishes the hold lamp HL and at contacts 338 transfers conductor 190B to conductor 389 to prepare the circuit to relay 610. It is obvious that relays 300 and 310 are reenergized. Contacts 312 and 314 are closed to extend ground over conductors 383 and 388 to hold operated link relays and relay 130 until station A

disconnects or the call is again transferred to another station.

It is obvious that the trunk link equipment can be adapted to any conventional all relay local exchange by means of adding contacts to existing line, line relay and allotter equipment and providing the station key equipment for such trunk lines. Further the number of trunks provided is controllable by the key equipment and contacts on the line relays, therefore the number of links can be increased or decreased from the number of trunks indicated by the illustrations and herein described.

What is thought to be new and novel and is desired to have protected by Letters Patent will be pointed out in the appended claims.

What is claimed is:

1. In a telephone system, a plurality of lines, subscriber's station on each line, a plurality of relay type linefinders having common access to said lines for extending connections therefrom, a plurality of keys at each station, means responsive to the operation of one of said keys at a calling station for causing any one of a plurality of said relay type linefinders to be connected to the line of said calling station and means responsive to the operation of another of said keys for causing only a particular one of said relay type linefinders to be connected to the line of the calling station.

2. In a telephone system, an exchange, subscriber lines therein, a preselected relay type local link linefinder for extending local connections from said lines, a relay type trunk link linefinder for extending connections from said lines to another exchange, a control equipment common to said local and trunk link linefinders controlled over any one of said lines to directively operate either of said linefinders to connect with said one line.

3. In a telephone system, an exchange, subscriber's local stations therein, a preselected relay type local link and linefinder circuit for extending connections from a local station to another local station, a relay type trunk link and linefinder circuit for extending connections from said local stations to another exchange, a plurality of keys at each station including a local select key and a trunk select key, a control circuit common to said link circuits and responsive to the operation of any one of said keys, means in said common control circuit for causing either the local or the trunk link and linefinder circuit to be connected to the calling station in accordance with the key operated thereat.

4. In a telephone system, an exchange, a plurality of stations therein including a communication path for each station, a plurality of trunks terminating in different traffic areas and having means for establishing a connection to each of said communicating paths, a control path for each traffic area common to all of said communication paths, keys at each station for each control path, a setting circuit on each communication path responsive to the operation of any of the station keys at a calling station to extend said control paths thereto, means controlled by said setting circuit responsive to the operation of a particular key to make one of the control paths effective to cause a trunk to a particular traffic area to be connected to the communication path of the calling station, and means responsive to said connection for controlling said setting circuit to disconnect said control paths from the calling station thereby permitting other stations to establish connections to other trunks.

5. In a telephone system, subscribers' lines, a plurality of local links each including local connecting means for completing local connections between subscriber's lines, trunk lines, a plurality of trunk links each including trunk connecting means for completing connections between said subscriber's lines and said trunk lines, a local key individual to each subscriber's line, a trunk key for each trunk line at each subscriber's line, an allotter common to both said local and trunk links, means for operating said allotter to control the operation of the local connecting means in an idle one of said local links to complete the connection between the calling line and said one link in response to the initiation of a call by one of said subscribers' lines and the actuation of the individual local key, and said last means being effective to operate said allotter to control the operation of the trunk connecting means in the trunk link corresponding to the actuated trunk key to complete the connection between the calling line and the corresponding trunk line in response to the initiation of a call by one of said subscriber's lines and the actuation of a trunk key.

6. In a telephone system, a local exchange including a two-way trunk to another exchange for extending connections thereto, subscriber lines in said local exchange, a portion of said lines being restricted from originating outgoing calls to said trunk, a common primary control circuit responsive to any calling line to control the setting of connections thereto, a setting means in said trunk controllable over said primary control circuit, means controlled by a calling subscriber to connect said trunk setting means to said primary control circuit to operate said setting means to cause a connection between the trunk and the line of the calling subscriber, said last mentioned means normally ineffective to complete outgoing trunk calls from restricted lines and effective responsive to incoming calls for completing incoming trunk calls to restricted lines.

7. In a telephone system, a plurality of subscriber lines, a line circuit individual to each line including a relay operated in response to the initiation of a call thereover, a plurality of trunks having access to each line, a setting means common to said trunks operated in response to said operated relay to cause a predetermined one of said trunks to be connected to the calling line, a first and second means in said line circuit to release said operated setting means, said first means responsive to said connection and said second means effective if said predetermined trunk is busy.

8. In a telephone system, a distant exchange, a local exchange, a two-way trunk connecting said exchanges, non-restricted and restricted subscriber lines at said local exchange, a first control path common to said restricted subscriber lines, a second control path common to said non-restricted subscriber lines, a subscriber key controlled means associated with each of said lines to provide each subscriber with an individual control of one of said paths, and means common to said subscriber lines controlled over said subscriber controlled paths for permitting connection of said trunk to non-restricted lines for both incoming and outgoing trunk calls and for permitting connection of said trunk to said restricted subscriber lines only on incoming trunk calls.

9. In a telephone system, an exchange, sub-

scriber lines therein, a line circuit individual to each line, a trunk accessible to said lines, a common control equipment for controlling the connection of said trunk to said lines, means in said line circuit responsive to the initiation of a call for operating said common control equipment to control the establishment of a connection from said trunk in an idle condition to the calling line, means responsive to the establishment of said connection to release said first means, a relay in said line circuit, means effective on a call to a trunk in a busy condition to operate said relay, said relay operated to release said common control equipment, and means in said line circuit to hold said relay operated under control of the calling line to permit other lines to use said common control equipment.

10. A system as set forth in claim 9 including a source of audible signalling current, and means responsive to the operation of said relay for connecting said source to said calling line to audibly signal the calling subscriber.

11. In a telephone system, a plurality of subscribers' lines; a line circuit for each subscriber's line including a line relay, a cut-off relay and a busy relay; a plurality of links having access to said lines, means responsive to a calling line initiating a call for operating the line relay in the calling subscriber's line circuit, a setting means common to said subscribers' lines and said links responsive to the operation of said line relay for seizing one of said links in case said one link is idle or for causing the operation of the busy relay in the line circuit of said calling line in case said one link is busy, means in said seized link operated by said setting means for extending a connection to said calling line, means for operating the cut-off relay of said calling line in response to said connection, means responsive to the operation of said cut-off relay for releasing said line relay to in turn release said setting means for common use, and means operative in case said busy relay is operated for releasing said setting means for common use.

12. In a telephone exchange, a plurality of subscriber stations, a trunk line terminating in an all relay trunk finder, tens and units relays in said finder common to all said subscriber stations, and subscriber controlled means for selectively operating said tens and units relays to connect said trunk line to said subscribers stations in response to said stations originating outgoing trunk calls to said trunk line and in response to said stations answering trunk calls incoming over said trunk line.

13. In a telephone exchange, a plurality of subscribers stations, a plurality of all relay local finders for extending local calls from said stations, a plurality of all relay trunk finders for completing trunk calls from and to said stations, tens and units relays in each of said local and trunk finders common to all of said subscribers stations, subscriber controlled means for selectively operating said tens and units relays in said local finders to connect such local finders with said subscribers stations in response to said stations originating outgoing local calls, and subscriber controlled means for selecting any one of said trunk finders and for selectively operating the tens and units relays in the selected trunk finder to connect such trunk finder with said subscribers stations in response to said stations originating outgoing trunk calls over such trunk finders and in response to said stations answering trunk calls incoming over such trunk finders.

14. In a telephone exchange, a plurality of subscriber stations, a plurality of all relay trunk finders for completing trunk calls from and to said stations, tens and units relays in said trunk finders common to all said stations, and subscriber controlled means for selecting any one of said trunk finders and for selectively operating the tens and units relays in the selected trunk finder to connect such trunk finder with said subscribers stations in response to said subscriber stations originating outgoing trunk calls over such trunk finders and in response to said subscriber stations answering trunk calls incoming over such trunk finders.

15. In an all relay exchange, groups of subscribers' lines, each different group having a different tens designation and each line in any one group having the same tens designation, each line in any one group having a different unit designation and corresponding lines in different groups having the same units designation, an all relay trunk finder having access to said lines, tens and units relays in said finder corresponding to said tens and units designations, and means responsive to a subscriber on one of said lines initiating an outgoing trunk call over said finder or responsive to said one subscriber answering an incoming trunk call incoming over said finder for operating the tens relay corresponding to the group containing said one subscriber's line and for operating the units relay corresponding to the units designation of said one subscriber's line to complete a connection between said one subscriber's line and said trunk finder.

16. In an all relay exchange, groups of subscribers' lines each having a group and a units designation, an all relay trunk finder having access to said subscribers' lines, group and units relays in said finder corresponding to said group and unit designations, and means including individual subscriber controlled means for operating the group relay corresponding to the group containing such subscriber's line and for operating the units relay corresponding to the unit designation of such subscriber's line to complete a connection between such subscriber's line and said trunk finder in case such subscriber either originates an outgoing trunk call to said finder or answers an incoming trunk call on said finder.

17. In a telephone system, a plurality of subscribers' lines, a busy relay individual to each line, local links for extending calling lines in local connections, trunk links for extending calling lines in trunk connections to different traffic areas, a relay common to said lines and links for controlling the operation of said individual busy relays during the initiation of local and trunk calls, means for operating said common relay in response to the initiation of a local call in the event all said local links are busy, means for operating said common relay in response to the initiation of a trunk call in the event the desired trunk link is busy, means for operating the busy relay individual to the calling line in response to the operation of said common relay, and means responsive to the operation of said busy relay for transmitting a busy tone over the calling line.

18. In a telephone system, a plurality of subscribers' lines, a busy relay individual to each line, local links for extending calling lines in local connections, trunk links for extending calling lines in trunk connections to different traffic areas, means for operating the busy relay individual to the calling line in response to the initiation of a local call in the event all said local links

are busy, means for operating the busy relay individual to a line in the event a subscriber attempts to connect such line to a busy trunk link, and means responsive to the operation of said busy relay for transmitting a busy tone over the corresponding subscriber's line.

19. In a telephone system, a plurality of subscribers' lines, a busy relay individual to each line, local links for extending calling lines in local connections, trunk links for extending calling lines in trunk connections to different traffic areas, means for operating the busy relay individual to the calling line in response to the initiation of a local call in the event all said local links are busy, means for operating the busy relay individual to a subscriber's line in the event a subscriber attempts to connect such line to a busy trunk link, certain of said subscribers lines being restricted from initiating trunk calls over said trunk links, means for operating the busy relay individual to a restricted subscribers line in the event such restricted subscriber attempts a trunk call, and means responsive to the operation of said busy relay for transmitting a busy tone over the corresponding subscriber's line.

20. In a telephone system, subscribers' lines, local links for use in local connections, trunk links for use in trunk connections, an allotter common to said lines and links, local and trunk keys at each subscriber's line, means responsive to a subscriber on one of said lines operating one of said keys and removing his receiver for transmitting line designation markings corresponding to said one line to said allotter, means in said allotter responsive to the receipt of said line designation markings for retransmitting corresponding line markings to said links and for extending a local link marking or a trunk link marking dependent upon the key actuated during said call, and means responsive to the extension of said link marking for operating a corresponding one of said links in accordance with said retransmitted line markings to complete a connection between said corresponding one link and said one line.

21. In a telephone system, a plurality of subscribers' lines, a plurality of local links for extending local calls from said subscribers' lines, a plurality of trunk links for extending trunk calls from said subscribers lines, line connecting means in said local and trunk links for completing connections to said subscribers lines, an allotter common to said local and trunk links, a plurality of numerical marking leads extending from said allotter to said local and trunk links, link seizing means in said local and trunk links for connecting said numerical marking leads to said line connecting means, subscriber controlled means for extending calling line marking designations and local link marking designations in case a calling one of said lines initiates a local call or for extending calling line marking designations and trunk link marking designations in case said calling line initiates a trunk call, and means in said allotter responsive to said line marking designations for operating said link seizing means of a local link or a trunk link dependent upon said link marking designations and for energizing said numerical marking leads in accordance with said calling line designations to operate said line connecting means over said energized marking leads to extend said calling line to a local link or a trunk link.

22. In a telephone system, a plurality of subscribers' lines, a plurality of local links having access to said lines for completing local connections, a plurality of trunk lines extending to different traffic areas, a trunk link for each trunk line having access to said subscribers lines, a distributor including means for assigning idle ones of said local links for use in completing local connections, a local key and a line relay individual to each subscriber's line, a trunk key for each trunk line at each subscriber's line, an allotter common to said local and trunk links, means for operating the line relay individual to the calling line in response to the calling subscriber initiating a local call by operating said local key or in response to the calling subscriber initiating a trunk call by operating one of said trunk keys, and means in said allotter responsive to the operation of said line relay for operating the assigned idle local link to complete a local connection with said calling line in case said local key is operated or for operating the trunk link corresponding to the operated trunk key to complete a trunk connection between the corresponding trunk line and said calling line in case one trunk key is operated.

23. In a telephone system, a plurality of subscribers' lines, a plurality of local links having access to said lines for completing local connections, a plurality of trunk lines extending to different traffic areas, a trunk link for each trunk line having access to said subscribers lines, a distributor including means for assigning idle ones of said local links for use in completing local connections, a local key and a line relay individual to each subscriber's line, a trunk key for each trunk line at each subscriber's line, an allotter common to said local and trunk links, means for operating the line relay individual to the calling line in response to the calling subscriber initiating a local call by operating said local key or in response to the calling subscriber initiating a trunk call by operating one of said trunk keys, means in said allotter responsive to the operating of said line relay for operating the assigned idle local link to complete a local connection with said calling line in case said local key is operated or for operating the trunk link corresponding to the operated trunk key to complete a trunk connection between the corresponding trunk line and said calling line in case said one trunk key is operated, and a cut-off relay individual to said calling line operated in response to either said local or trunk connection for releasing said line relay whereby said allotter means reverts to common use for extending other calls.

24. In a telephone system, a plurality of subscribers' lines, a plurality of local links having access to said lines for completing local connections, a plurality of trunk lines extending to different traffic areas, a trunk link for each trunk line having access to said subscribers lines, a distributor including means for assigning idle ones of said local links for use in completing local connections, a local key and a line relay individual to each subscriber's line, a trunk key for each trunk line at each subscriber's line, an allotter common to said local and trunk links, means for operating the line relay individual to the calling line in response to the calling subscriber initiating a local call by operating said local key or in response to the calling subscriber initiating a trunk call by operating one of said trunk keys, means in said allotter responsive to the operation of said line relay for operating the assigned idle local link to complete a local connection with said calling line in case said local

key is operated or for operating the trunk link corresponding to the operated trunk key to complete a trunk connection between the corresponding trunk line and said calling line in case said one trunk key is operated, a busy relay individual to each subscriber's line, means for operating the busy relay individual to the calling line in response to the operation of said line relay in case all said local links are busy during the initiation of a local call by the calling subscriber and in case said corresponding trunk line is busy during the initiation of a trunk call to said corresponding trunk line by the calling subscriber, and means for transmitting a busy tone to said calling subscriber in response to the operation of said busy relay.

25. In a telephone system, a plurality of subscribers' lines, a plurality of local links having access to said lines for completing local connections, a plurality of trunk lines extending to different traffic areas, a trunk link for each trunk line having access to said subscribers lines, a distributor including means for assigning idle ones of said local links for use in completing local connections, a local key and a line relay individual to each subscriber's line, a trunk key for each trunk line at each subscriber's line, an allotter common to said local and trunk links, means for operating the line relay individual to the calling line in response to the calling subscriber initiating a local call by operating said local key or in response to the calling subscriber initiating a trunk call by operating one of said trunk keys, means in said allotter responsive to the operation of said line relay for operating the assigned idle local link to complete a local connection with said calling line in case said local key is operated or for operating the trunk link corresponding to the operated trunk key to complete a trunk connection between the corresponding trunk line and said calling line in case said one trunk key is operated, a busy relay individual to each subscriber's line, means for operating the busy relay individual to the calling line in response to the operation of said line relay in case all said local links are busy during the initiation of a local call by the calling subscriber and in case said corresponding trunk line is busy during the initiation of a trunk call to said corresponding trunk line by the calling subscriber, means for transmitting a busy tone to said calling subscriber in response to the operation of said busy relay, and means controlled by said busy relay for releasing said allotter for common use in extending other calls.

26. In a telephone system, a plurality of subscriber stations, a plurality of local links and trunk links for completing connections to any of said stations, a plurality of station marking leads common to all said links, a local link marking lead common to said stations and said local links, a trunk link marking lead individual to each trunk link and common to said stations, station marking means at each station for selectively conditioning either said local link marking lead or a particular one of said trunk link marking leads, a relay individual to each station, means for operating one of said relays in response to the operation of said station marking means by a station initiating a call, means responsive to the operation of said relay for extending the said conditioned link marking lead in accordance with the selective operation of said station marking means and for extending station designation markings corresponding to said station, means

responsive to the extension of said station designation markings for energizing corresponding ones of said common station marking leads and for energizing said conditioned link marking lead, connect means in the link corresponding to said conditioned link marking lead operated in response to said energization of said conditioned link marking lead, and connect relays in said corresponding link operated over said corresponding energized common station marking leads in response to the operation of said connect means for connecting said corresponding link to said station.

27. In a telephone system, a plurality of subscriber stations, a plurality of local links and trunk links each having a plurality of connect relays for completing connections to any of said stations, a plurality of marking leads common to all said links, connect means in each link common to said stations for extending said common marking leads to said connect relays, station marking means at each station for marking a local link or a particular trunk link for extending a call thereto, a relay individual to each station for extending said local link and said trunk link markings and for extending corresponding station designation markings, means for operating one of said individual station relays in response to the operation of said station marking means by a calling station initiating a call to extend the link marking corresponding to the operated station marking means and to extend said station designation markings, and means responsive to the operation of said one relay for energizing the said extended link marking and for energizing certain of said common marking leads corresponding to said extended station designation markings whereby the connect means in the corresponding link is operated over said energized link marking to thereby operate certain of said connect relays over said corresponding certain energized common marking leads to complete the connection between the corresponding link and said calling station.

28. In a telephone system, a plurality subscribers' lines, a local key individual to each line for use in extending local connections, a plurality of trunk keys individual to each line for use in extending trunk connections to distant areas, a line relay individual to each line, a line circuit for each of said line relays including normally open contacts on the corresponding individual local and trunk keys, means for closing the line circuit of a calling line to operate the calling subscriber's line relay in response to the calling subscriber initiating a call and operating one of said keys, normally open calling line marking contacts closed by the operated line relay for marking the calling line with calling line designations, normally open local connection marking contacts closed by the operated line relay for marking the initiation of a local call in case the operated key on said calling line is a local key, and normally open trunk connection marking contacts closed by the operated line relay for marking the initiation of a trunk call in case the operated key on said calling line is one of said trunk keys.

29. In a telephone system, a plurality of subscribers' lines, a local key individual to each line for use in extending local connections, a plurality of trunk keys individual to each line for use in extending trunk connections to distant areas, a line relay individual to each line, a line

circuit for each of said line relays including normally open contacts on the corresponding individual local and trunk keys, means for closing the line circuit of a calling line to operate the calling subscriber's line relay in response to the calling subscriber initiating a call and operating one of said keys, normally open calling line marking contacts closed by the operated line relay for marking the calling line with calling line designations, normally open local connection marking contacts closed by the operated line relay for marking the initiation of a local call in case the operated key on said calling line is a local key, normally open trunk connection marking contacts closed by the operated line relay for marking the initiation of a trunk call in case the operated key on said calling line is one of said trunk keys, a busy relay individual to said calling line, means for operating said busy relay in case a busy condition is encountered during the initiation of a local or a trunk call, and means controlled by the operation of said busy relay for erasing said markings.

30. In a telephone system, a plurality of subscribers' lines, a local key individual to each line for use in extending local connections, a plurality of trunk keys individual to each line for use in extending trunk connections to distant areas, a line relay individual to each line, a line circuit for each of said line relays including normally open contacts on the corresponding individual local and trunk keys, means for closing the line circuit of a calling line to operate the calling subscriber's line relay in response to the calling subscriber initiating a call and operating one of said keys, normally open calling line marking contacts closed by the operated line relay for marking the calling line with calling line designations, normally open local connection marking contacts closed by the operated line relay for marking the initiation of a local call in case the operated key on said calling line is a local key, normally open trunk connection marking contacts closed by the operated line relay for marking the initiation of a trunk call in case the operated key on said calling line is one of said trunk keys, local links for extending calling lines in local connections, trunk links for extending calling lines in trunk connections to distant areas, an allotter common to said local and trunk links, and means in said allotter resposive to said calling line designation markings for operating one of said local links to connect with said calling line in case the call initiated is a local call or for operating one of said trunk links to connect with said calling line in case the call initiated is a trunk call.

31. In a telephone system, a plurality of subscribers' lines, a local key individual to each line for use in extending local connections, a plurality of trunk keys individual to each line for use in extending trunk connections to distant areas, a line relay individual to each line, a line circuit for each of said line relays including normally open contacts on the corresponding individual local and trunk keys, means for closing the line circuit of a calling line to operate the calling subscriber's line relay in response to the calling subscriber initiating a call and operating one of said keys, normally open calling line marking contacts closed by the operated line relay for marking the calling line with calling line designations, normally open local connection marking contacts closed by the operated line relay for marking the initiation of a local call in case the operated key on said calling line is a local key, normally open trunk connection marking contacts closed by the operated line relay for marking the initiation of a trunk call in case the operated key on said calling line is one of said trunk keys, local links for extending calling lines in local connections, trunk links for extending calling lines in trunk connections to distant areas, an allotter common to said local and trunk links, means in said allotter responsive to said calling line designation markings for operating one of said local links to connect with said calling line in case the call initiated is a local call or for operating one of said trunk links to connect with said calling line in case the call initiated is a trunk call, and means responsive to the connection of said calling line with either a local link or a trunk link for erasing said markings.

32. In a telephone system, a plurality of restricted subscriber lines, a plurality of non-restricted subscriber lines, a trunk line terminating in an all relay finder, a restricted start lead common to said restricted lines terminating in said trunk line, a non-restricted start lead common to said non-restricted lines terminating in said trunk line, means in said finder controlled over said start leads in response to any of said lines answering a trunk call incoming over said trunk line for conditioning said finder to connect with the answering line, said finder conditioning means being operative over said non-restricted start lead in response to any of said non-restricted lines originating an outgoing trunk call over said trunk line for conditioning said finder to connect with the calling line, relays in said finder responsive to the operation of said finder conditioning means for connecting said trunk line to said answering line in case an incoming trunk call is answered and for connecting said trunk line to said calling line in case an outgoing call is originated by said calling line, and circuit connections in said finder and trunk line for preventing the operation of said finder conditioning means over said restricted start lead in case a restricted line attempts to originate an outgoing trunk call over said trunk line.

33. In a telephone system, a plurality of restricted subscriber lines, a plurality of non-restricted subscriber lines, a trunk line terminating in an all relay finder, a restricted start lead common to said restricted lines terminating in said trunk line, a non-restricted start lead common to said non-restricted lines terminating in said trunk line, means in said finder controlled over said start leads in response to any of said lines answering a trunk call incoming over said trunk line for conditioning said finder to connect with the answering line, said finder conditioning means being operative over said non-restricted start lead in response to any of said non-restricted lines originating an outgoing trunk call over said trunk line for conditioning said finder to connect with the calling line, relays in said finder responsive to the operation of said finder conditioning means for connecting said trunk line to said answering line in case an incoming trunk call is answered and for connecting said trunk line to said calling line in case an outgoing call is originated by said calling line, circuit connections in said finder and trunk line for preventing the operation of said finder conditioning means over said restricted start lead in case a restricted line attempts to originate an outgoing trunk call over said trunk line, and means in said trunk line operative in case said

trunk line is busy in another established connection for preventing the operation of said finder conditioning means by subscribers attempting to complete connections thereto.

34. In a telephone system, subscribers' lines, trunk lines, tens and units connecting relays associated with each trunk line, means controlled by one of said subscribers answering an incoming trunk call over one of said trunk lines for directively operating certain of said tens and units connecting relays in said one trunk line to connect said one trunk line to the answering subscriber's line, a holding key associated with each subscriber's line, a holding circuit in each trunk line, means responsive to the operation of the holding key at said answering subscriber's line for completing the holding circuit in said one trunk line to hold said one trunk line and for releasing said operated tens and units connecting relays to disconnect said answering subscriber's line from said one trunk line, and means controlled by another of said subscribers lines upon being informed of a trunk call on said held trunk line for directively operating predetermined ones of said tens and units relays in said held trunk line to connect said held trunk line to said other subscriber's line.

35. In a telephone system, subscribers' lines, trunk lines, tens and units connecting relays associated with each trunk line, means controlled by one of said subscribers' lines for directively operating certain of said tens and units connecting relays associated with one of said trunk lines to connect said one trunk line with said one subscriber's line, means controlled by said one subscriber's line for holding said one trunk line and for releasing said operating tens and units relays to disconnect said one subscriber's line from said one trunk line to thereby enable said one subscriber's line to be connected to another subscriber's line or another trunk line, said first means reoperated by said one subscriber's line in case such subscriber desires to be reconnected to said held trunk line for directively reoperating said certain tens and units connecting relays to reconnect said held trunk line to said one subscriber's line.

36. In a telephone system, subscribers' lines, trunk lines, tens and units connecting relays associated with each trunk line, means controlled by one of said subscribers' lines for directively operating certain of said tens and units connecting relays associated with one of said trunk lines to connect said one trunk line to said one subscriber's line, means controlled by said one subscriber's line for holding said one trunk line and for releasing said operated tens and units relays to disconnect said one subscriber's line from said one trunk line, and means controlled by another of said subscribers' lines for directively operating predetermined ones of said tens and units relays in said associated held trunk line to connect said held trunk line with said other subscriber's line.

37. In a telephone system, subscriber lines, keys for each line, a line relay for each line, a plurality of trunks each having a finder switch individual thereto and each having access to all of said lines, control equipment common to said finder switches, the line relay of each line being operated in response to the initiation of a call over said line and the operation of a key on said line to operate said control equipment, and circuits completed responsive to the operation of said key, said line relay and said control equipment, for causing one of said finder switches to be directively controlled to extend a trunk to the calling line in accordance with the operation of said key.

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