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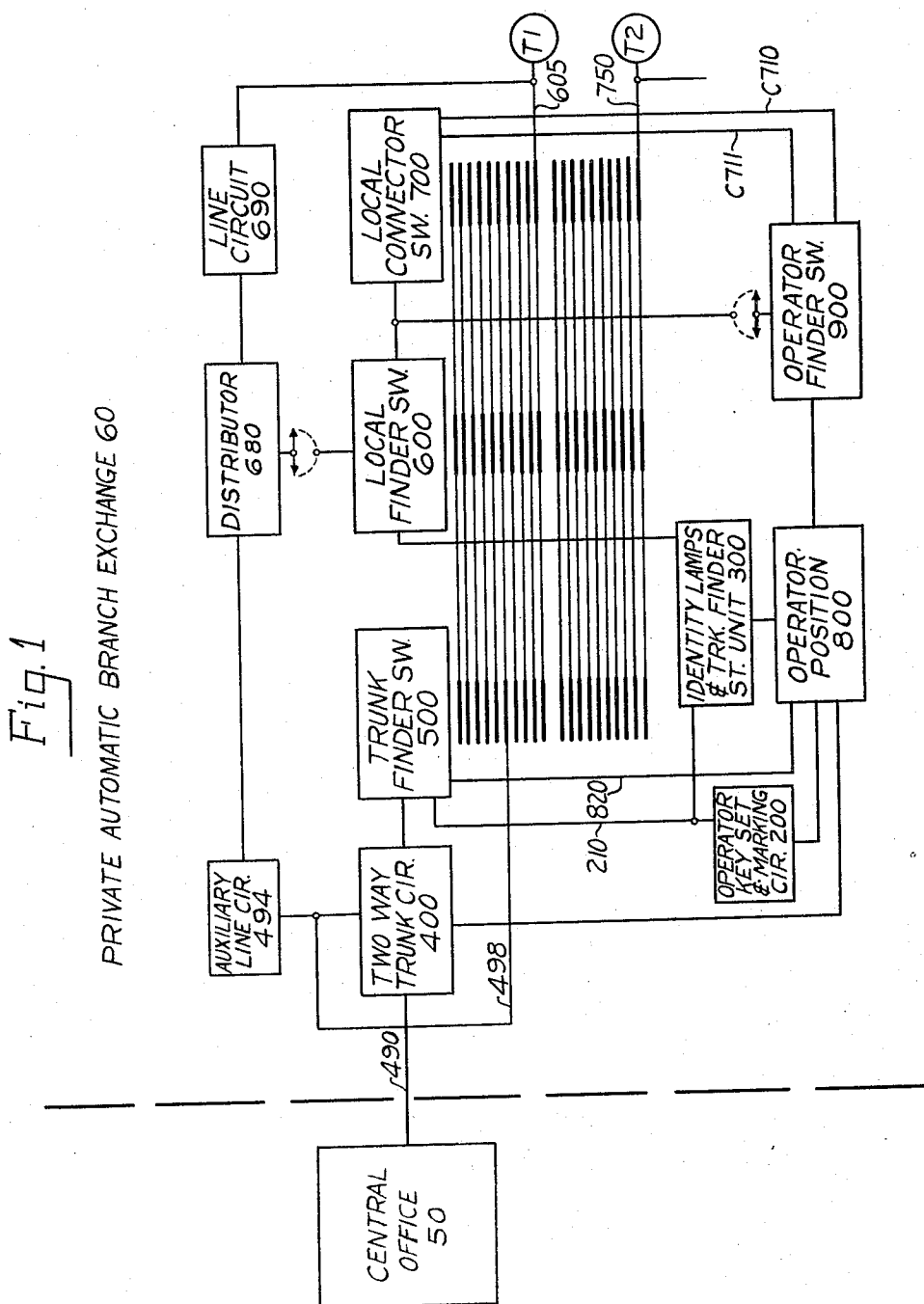
T. F. CROCKER

2,265,151

TELEPHONE SYSTEM

Filed April 11, 1940

9 Sheets-Sheet 1



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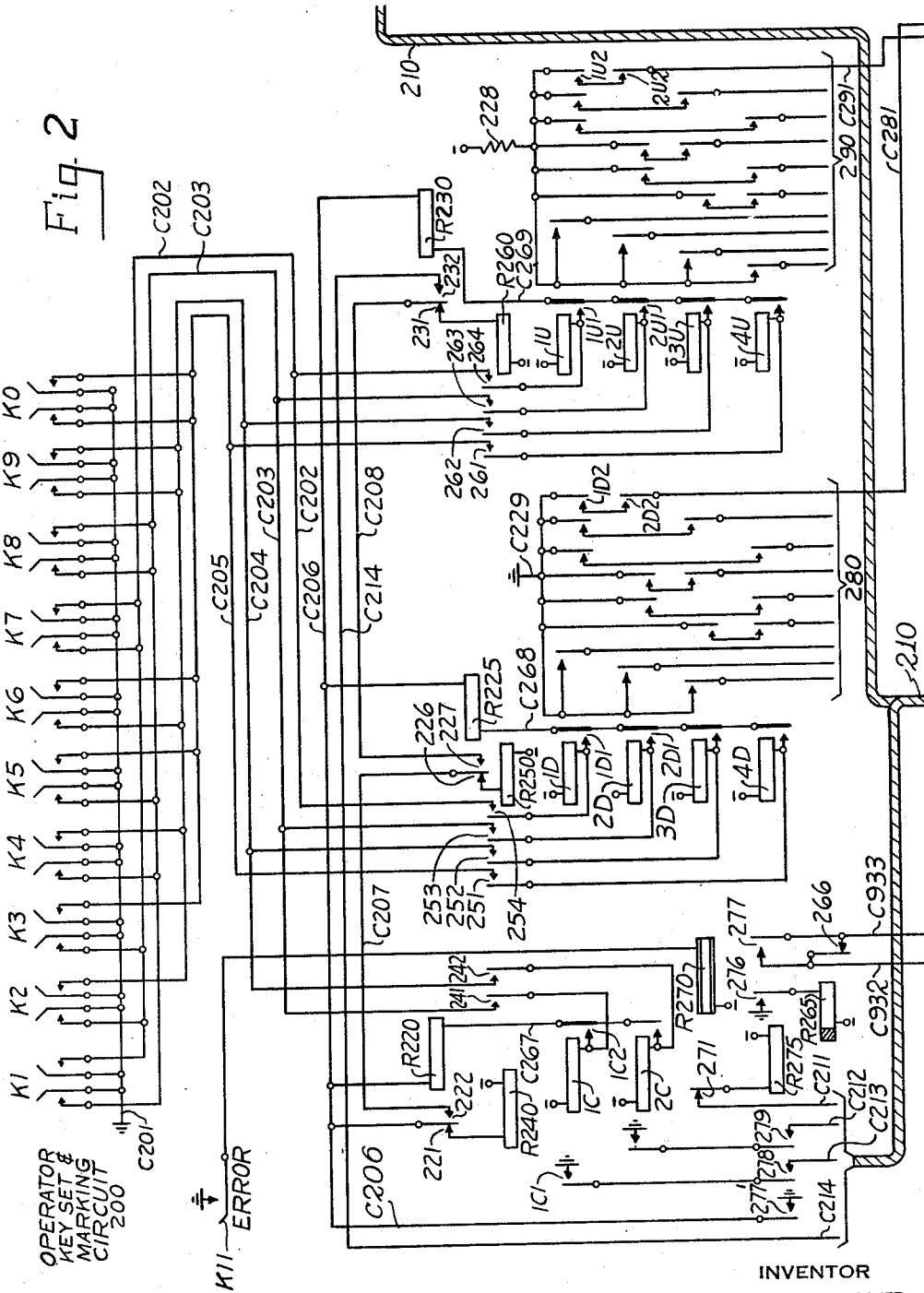
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TELEPHONE SYSTEM

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9 Sheets-Sheet 2



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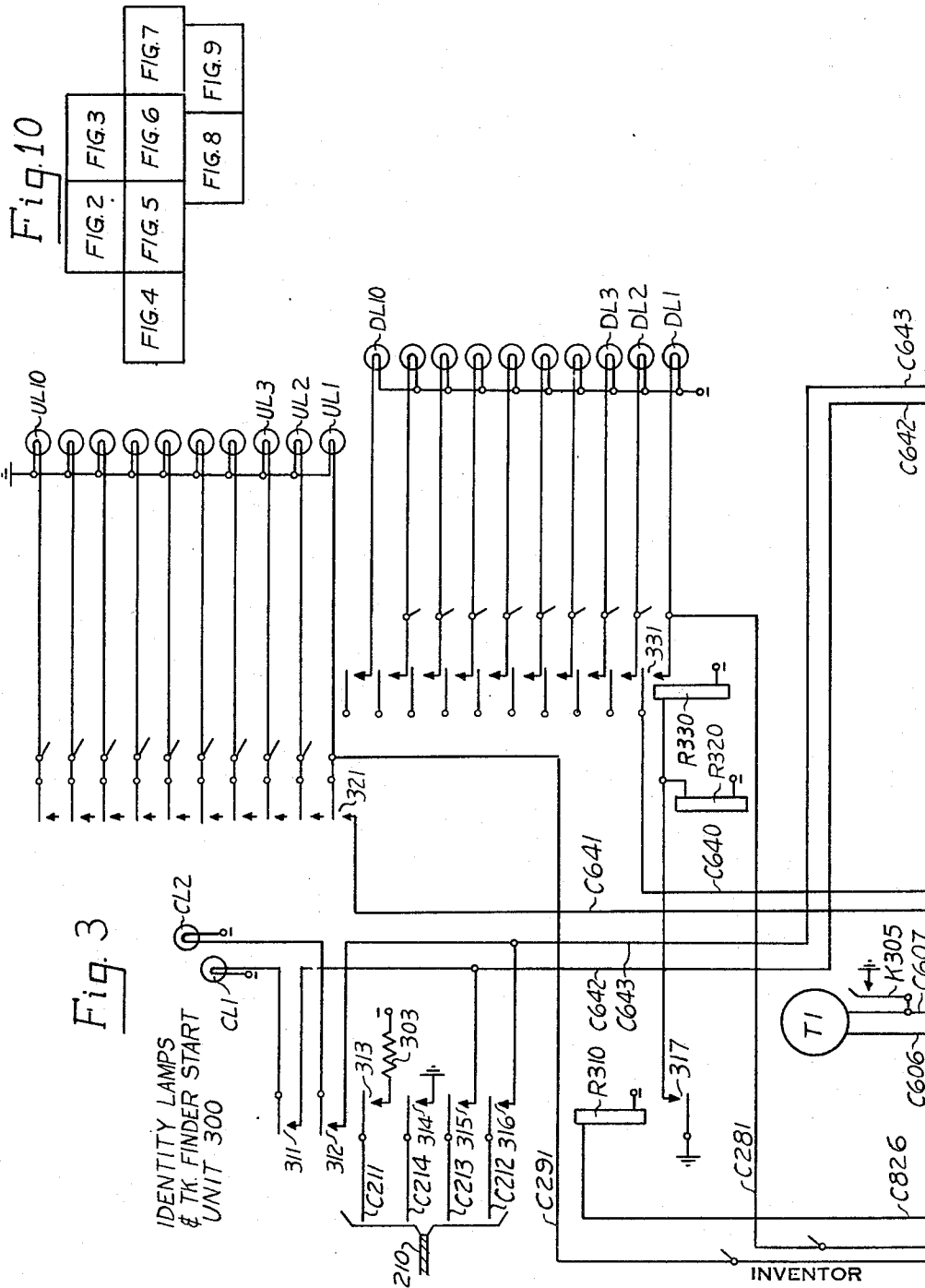
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TELEPHONE SYSTEM

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9 Sheets-Sheet 3



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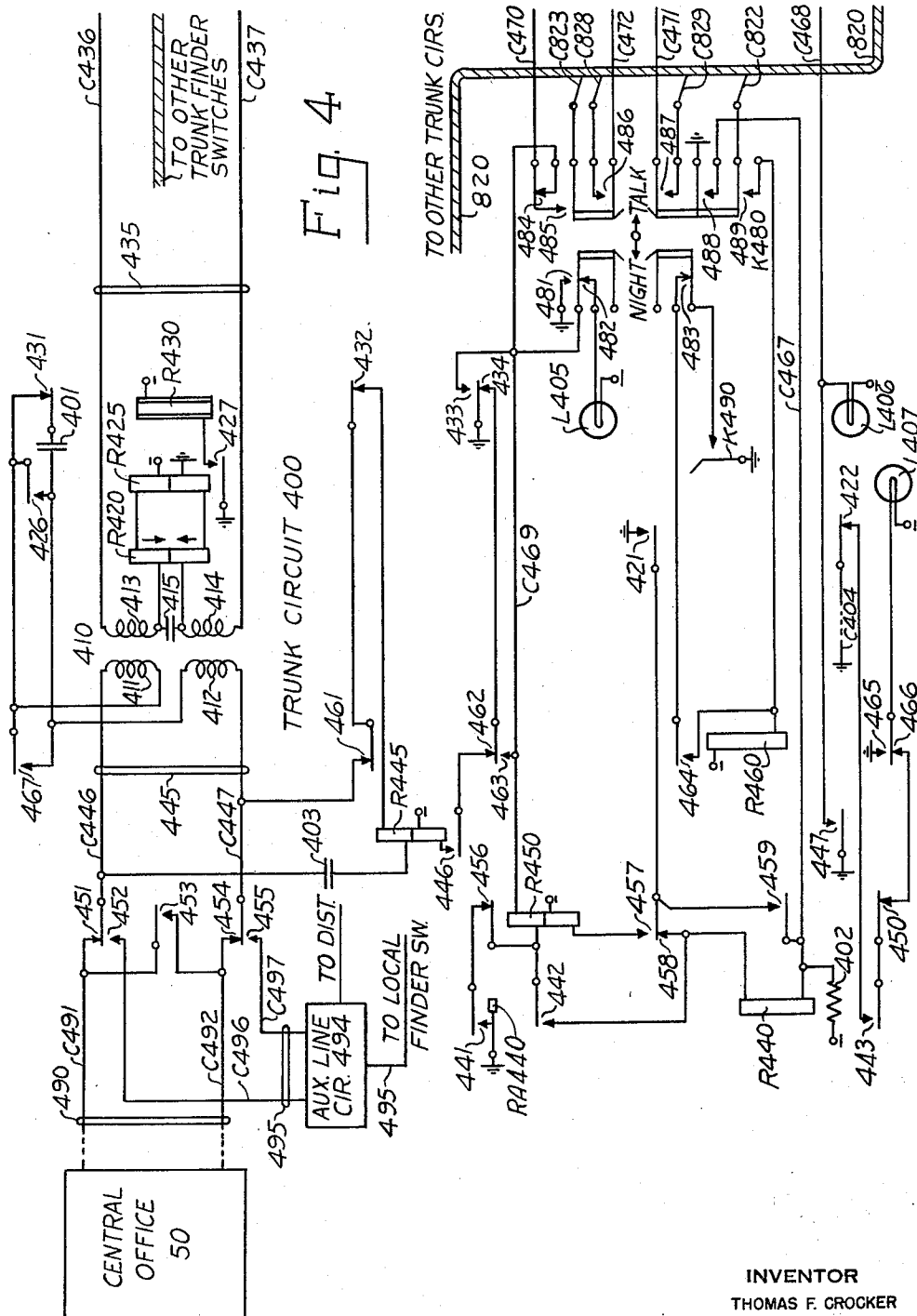
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9 Sheets-Sheet 4



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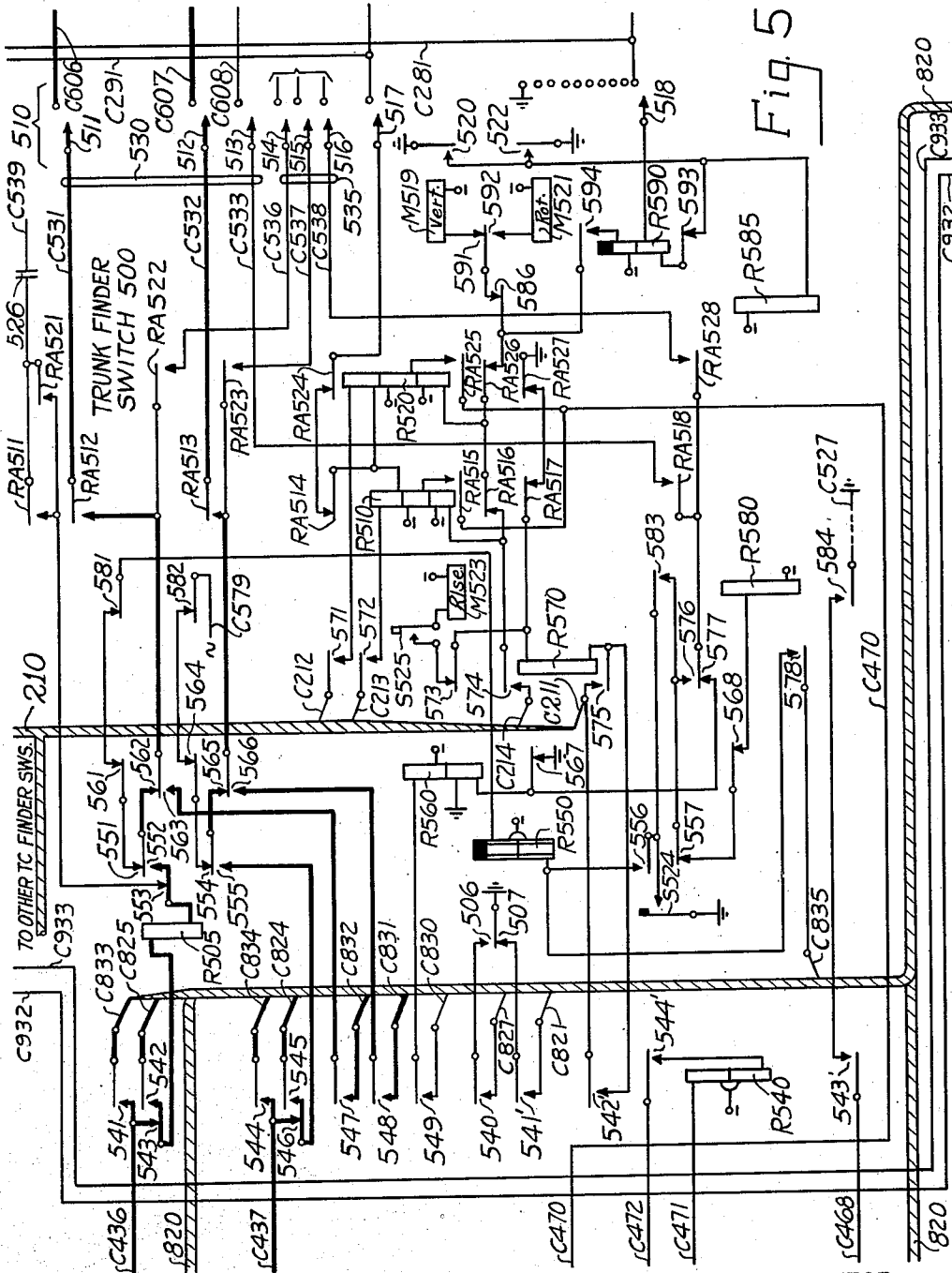
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TELEPHONE SYSTEM

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9 Sheets-Sheet 5



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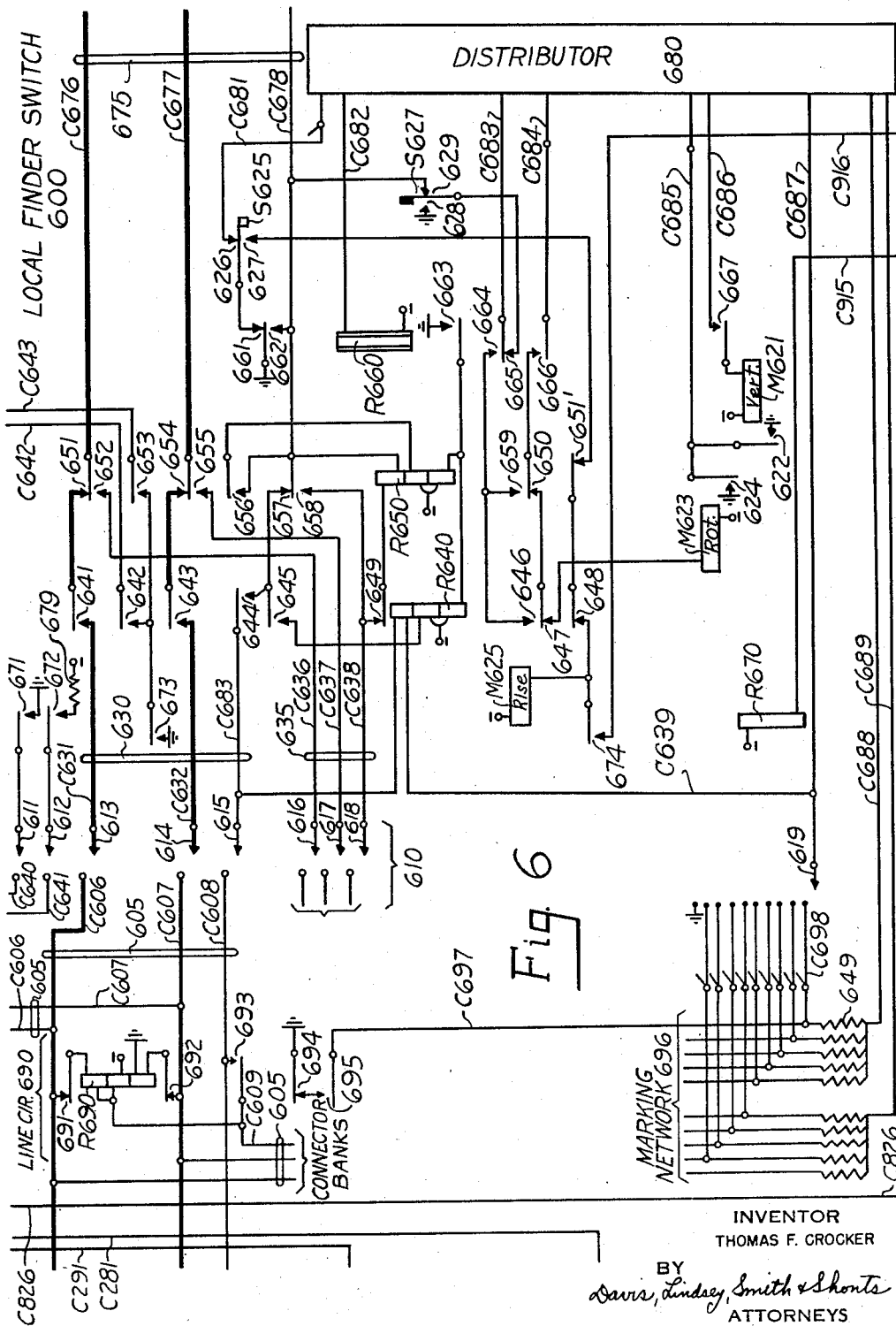
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TELEPHONE SYSTEM

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9 Sheets-Sheet 6



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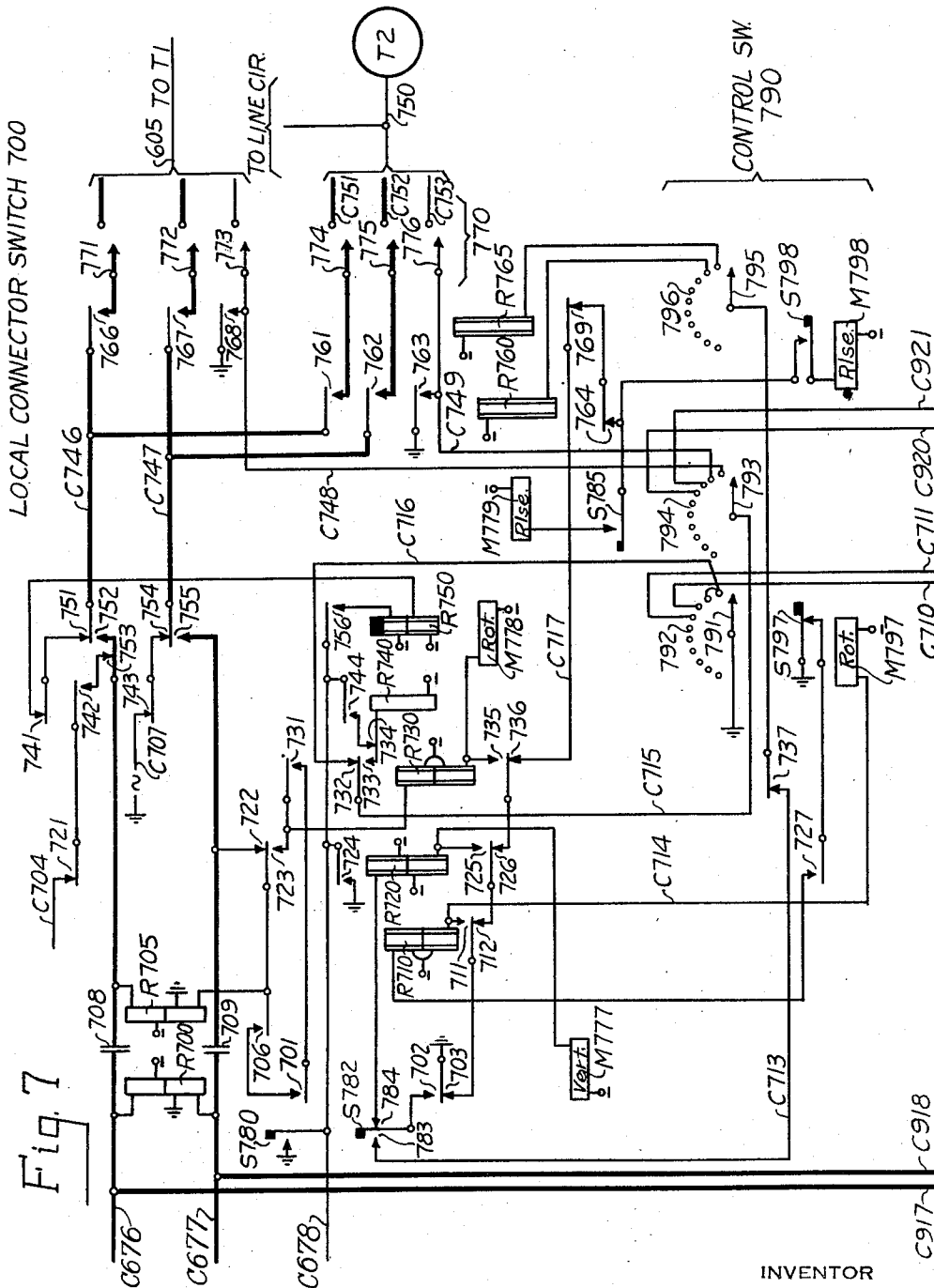
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TELEPHONE SYSTEM

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9 Sheets-Sheet 7



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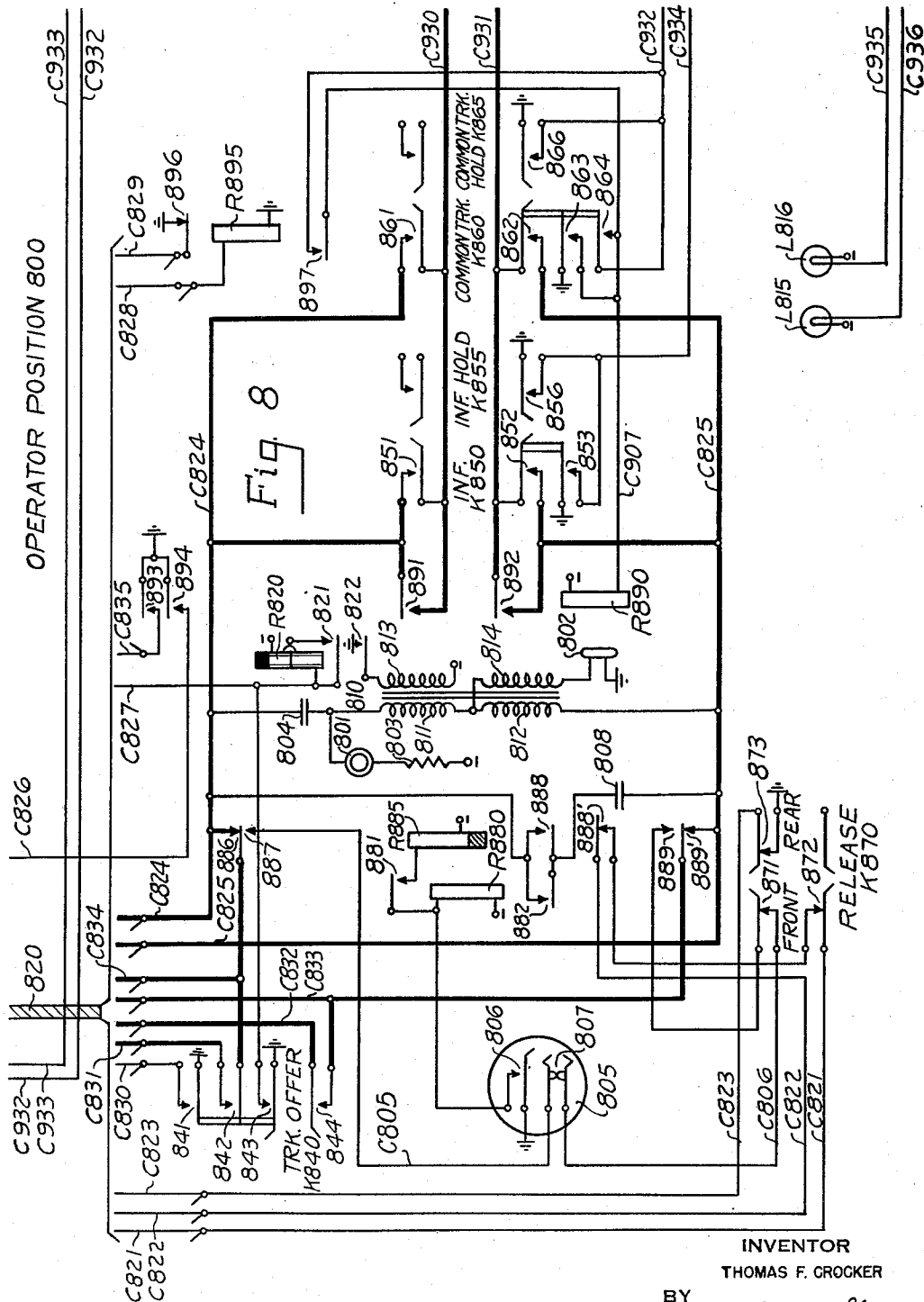
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TELEPHONE SYSTEM

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9 Sheets-Sheet 8



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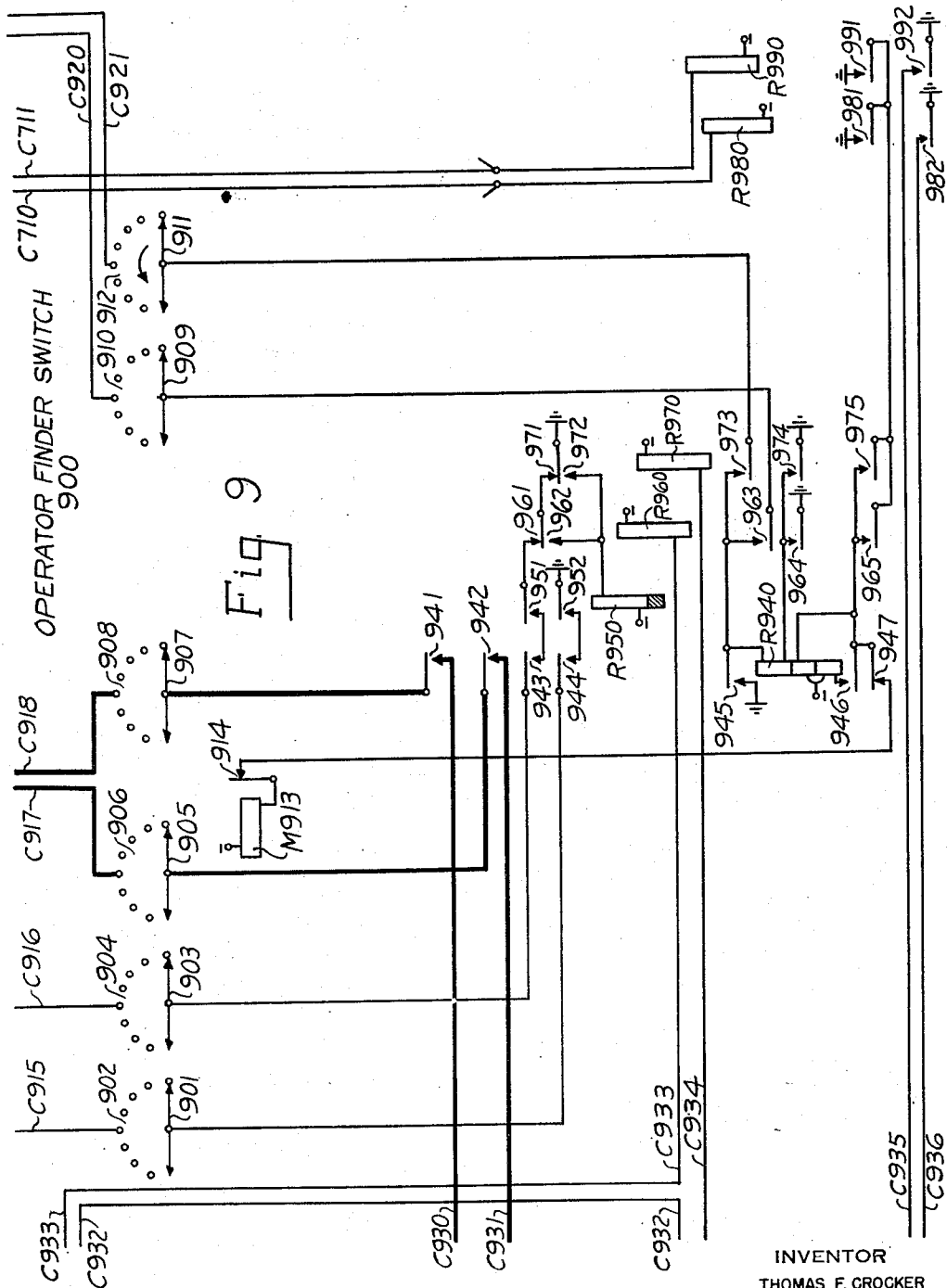
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TELEPHONE SYSTEM

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9 Sheets-Sheet 9



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UNITED STATES PATENT OFFICE

2,265,151

TELEPHONE SYSTEM

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Application April 11, 1940, Serial No. 329,071

56 Claims. (Cl. 179—27)

The present invention relates to telephone systems and more particularly to improvements in private automatic branch exchanges.

A private automatic branch exchange or P. A. B. X is usually associated with a central office by way of a number of two-way trunk lines extending therebetween and conventionally comprises an operator position, a number of telephone stations having lines extending thereto and switching apparatus. Ordinary local calls between the various telephone stations in the P. A. B. X are completed by the switching apparatus under the control of the subscribers at the telephone stations without the assistance of the operator at the operator position; while both incoming and outgoing trunk calls are completed between the central office and the various telephone stations in the P. A. B. X either directly by or with the assistance of the operator at the operator position.

It is an object of the present invention to provide in a telephone system of the character noted an improved arrangement for selectively connecting a number of trunks to an operator position and for selectively controlling the operation of a number of trunk switches individually associated with the trunks to seize a number of lines accessible thereto.

Another object of the invention is to provide in a telephone system of the character noted an improved switching arrangement selectively operative to establish local and trunk connections and to hold trunk connections.

Another object of the invention is to provide in a telephone system an improved arrangement for selectively marking a number of lines and for causing switching apparatus to seize marked ones of the lines.

Another object of the invention is to provide in a telephone system an improved arrangement for selectively marking any one of a number of lines for selection by switching apparatus having access thereto, which marking arrangement is selectively controlled by both manual means and automatic means.

A further object of the invention is to provide in a telephone system an improved arrangement for releasing a first switch train operated to establish a connection to a given line when a second switch train is operated to establish a connection to the given line.

A further object of the invention is to provide in a telephone system an improved arrangement for identifying a calling line included in an es-

tablished connection extending to an operator position.

A further object of the invention is to provide in a telephone system an improved switching arrangement for establishing connections between calling lines and an operator position, which switching apparatus is selectively controlled in accordance with the classes of calls on the lines.

A further object of the invention is to provide in a telephone system improved switching apparatus for completing connections between any two of a number of lines in the system and between any line in the system and an operator position.

The features of the present invention are illustrated as being incorporated in a telephone system comprising a central office, a P. A. B. X and a number of two-way trunk lines extending therebetween; wherein the P. A. B. X comprises an operator position, a number of telephone stations having telephone lines extending thereto and switching apparatus. The switching apparatus provided in the P. A. B. X comprises a number of trunk switches individually associated with the trunk lines, a number of local links and a position switch associated with the operator position.

In accordance with one feature of the invention, the P. A. B. X comprises an operator position, a plurality of groups of lines each including a plurality of subgroups of lines, an automatic switch associated with the operator position and having access to the lines, and a key set associated with the operator position and including a number of keys. Also, the arrangement comprises means controlled by initial operation of one of the keys in the key set for marking a corresponding one of the groups of lines, means controlled by further operation of one of the keys in the key set for marking a corresponding one of the subgroups of lines in the marked group of lines, means controlled by a final operation of one of the keys in the key set for marking a corresponding one of the lines in the marked subgroup of lines in the marked group of lines and for initiating operation of the switch, means for causing the switch to select the marked line in the marked subgroup of lines in the marked group of lines, means controlled when the last-mentioned line is selected by the switch for arresting operation of the switch, and means including the switch for establishing a connection between the operator position and the selected line.

In accordance with another feature of the in-

vention, the P. A. B. X comprises a number of trunk switches individually terminating the trunks extending between the central office and the P. A. B. X, the lines extending to the telephone stations in the P. A. B. X being accessible to each of the trunk switches. Also, the arrangement comprises means controllable from the operator position for associating any one of the trunks with the operator position, means controlled when one of the trunks is associated with the operator position for preventing the other of the trunks from being associated with the operator position, means controllable from the operator position for causing the one of the trunk switches terminating the one trunk to seize any one of the lines, thereby to complete a connection between the one trunk and the one line including the operator position, and means controllable from the operator position for disassociating the one trunk from the operator position, thereby to complete a connection between the one trunk and the one line excluding the operator position.

In accordance with another feature of the invention, each of the trunks extending between the central office and the P. A. B. X comprises normally connected central office and branch exchange sections; and a trunk circuit and a line circuit are individually associated with each trunk, the trunk circuit being operative in a first manner to disconnect the central office and branch exchange sections of the trunk and to connect a bridge to the central office section of the trunk and to connect the branch exchange section of the trunk to the line circuit and operative in a second manner to reconnect the central office and branch exchange sections of the trunk and to disconnect the bridge from the central office section of the trunk and to disconnect the branch exchange section of the trunk from the line circuit. Also, the arrangement comprises means for completing a connection between the central office and any one of the telephone stations including the trunk, means at the one telephone station for selectively controlling over the trunk the manner of operation of the trunk circuit, and means controlled when a bridge is connected to the central office section of the trunk for retaining the connection to the central office. Also, the P. A. B. X comprises a number of switching links, means controlled when the branch exchange section of the trunk is connected to the line circuit for causing the one of the switching links to seize the line circuit and for retaining the one switching link operated, and means controllable from the one telephone station over the trunk and the line circuit for causing the switching link to seize another of the telephone stations, thereby to complete a connection between the one telephone station and the other telephone station. Also, the trunk circuit is operative in a further manner to cause a signal to be transmitted to the operator position, thereby to indicate the presence of a recall on the established connection between the central office and the one telephone station; and means is provided at the one telephone station for operating the trunk circuit in the further manner over the trunk.

In accordance with another feature of the invention, the P. A. B. X comprises a marking network which is so connected and arranged that it is manually controllable from the key set associated with the operator position and automati-

cally controllable by the operation of one of the switching links to seize a calling one of the lines in order respectively to cause any one of the lines to be marked for selection or to cause the line seized by the operated switching link to be marked for selection.

In accordance with a further feature of the invention, the switching links are so connected and arranged that when a line is marked for selection by the marking network due to the seizure of the line by an operated one of the switching links, the one switching link is automatically released when the trunk switch terminating one of the trunks operates to seize the marked line.

In accordance with a further feature of the invention, the arrangement comprises a link distributor adapted to connect the switching links to calling ones of the lines in a predetermined order, each of the switching links including control apparatus governable over a calling one of the lines connected to the switching link and a register, the control apparatus included in each of the switching links being selectively governable to cause the link to be connected to any one of the called lines and selectively to operate the register included in the switching link, the register included in each of the switching links being selectively operative to mark the link as occupied by different classes of calls. Also, a position switch is associated with the operator position and has access to the switching links. Control means is provided at the operator position which is operative in a first manner to cause the position switch to seize one of the switching links marked as occupied by a call of a first class and operative in a second manner to cause the position switch to seize one of the switching links marked as occupied by a call of a second class.

In accordance with a further feature of the invention, an identity device is associated with the operator position which is so connected and arranged that it is controlled jointly by the operation of one of the switching links to seize a calling line and the operation of the position switch to seize the one link in order to identify the calling line in the event the calling line has a call thereon of a first class. Furthermore, when the trunk switch associated with one of the trunks is operated to seize the calling line previously seized by the switching link mentioned, the identity device is released.

Further features of the invention pertain to the particular arrangement of the circuit elements thereof whereby the above-outlined and additional operating features are attained.

The novel features believed to be characteristic of 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 following specification taken in connection with the accompanying drawings in which Figure 1 illustrates the general arrangement of a telephone system, including a central office and a private automatic branch exchange, embodying the present invention; Figs. 2 to 9, inclusive, taken together, illustrate the details of a system having incorporated therein the features of the invention, as briefly outlined above; and Fig. 10 illustrates the mode of combining Figs. 2 to 9, inclusive, of the drawings to form a unified system.

Description of the apparatus incorporated in the telephone system.

Referring now more particularly to Fig. 1 of the drawings the telephone system there illustrated comprises a central office 50, a private automatic branch exchange or P. A. B. X 60 and a plurality of two-way trunk lines, including the trunk line 490, extending therebetween. The central office 50 and the P. A. B. X 60 are of the automatic dial type, the P. A. B. X 60 comprising an operator position 800 and a number of telephone stations including the stations T1 and T2. Further the P. A. B. X 60 comprises a number of local links, including the local link illustrated, and a distributor 680 for assigning idle ones of the local links to the use of the telephone stations. For example, the local link illustrated includes a local finder switch 600 and a local connector switch 700. Also a trunk circuit and a trunk finder switch are individually associated with each of the trunk lines, the trunk circuit 400 and the trunk finder switch 500 being individually associated with the trunk line 490.

A telephone line having a line circuit individually associated therewith extends to each telephone station in the P. A. B. X; the telephone lines 605 and 750 respectively extending to the telephone stations T1 and T2 and the line circuit 690 being individually associated with the telephone line 605. Further an auxiliary line circuit is individually associated with each trunk circuit, the auxiliary line circuit 494 being individually associated with the trunk circuit 400. Finally an operator key set and marking circuit 200, an identity lamp and trunk finder start circuit 300, and an operator finder switch 900 are associated with the operator position 800.

Each of the local finder switches, such, for example, as the local finder switch 600, each of the local connector switches, such, for example, as the local connector switch 700, and each of the trunk finder switches, such, for example, as the trunk finder switch 500, has access to each telephone line in the P. A. B. X. Also the operator position 800 has direct access to each trunk line extending between the central office and the P. A. B. X and to each trunk finder switch. Further the operator position 800 has access by way of the operator finder switch 900 to each local link.

Preferably each of the local links in the P. A. B. X is identical to the local link illustrated which comprises a local finder switch 600 and a local connector switch 700, as previously noted. The finder switch 600, as best shown in Fig. 6, comprises a switching mechanism 610 of the 200-point Strowger type including a carriage provided with a first wiper set, including the wipers 613, 614 and 615, a second wiper set, including the wipers 616, 617 and 618, and three control wipers 611, 612 and 619. It is noted that the wipers 613, 614 and 615 of the first wiper set and the wipers 616, 617 and 618 of the second wiper set are capable of both vertical and rotary movements; the control wipers 611 and 619 are capable of vertical movements; and the control wiper 612 is capable of rotary movement. Further the mechanism 610 comprises a circumferentially disposed main contact bank provided with two sections respectively associated with the first and second wiper sets, two vertical control contact banks associated with the control wipers 611 and 619, and a rotary control contact bank associated with the control wiper 612. Accordingly, in the mechanism 610 the first and second wiper sets respectively have access to first and second groups of one hundred lines each respectively terminated by the first and second sections of the main contact bank. Also the mechanism 610 is provided with a vertical magnet M621 for moving the first and second wiper sets thereof in the vertical direction, a rotary magnet M623 for moving the first and second wiper sets thereof in the rotary direction, and a release magnet M625 for releasing the first and second wiper sets thereof and for causing these wiper sets to be returned to their normal positions. Finally the mechanism 610 has two sets of switch springs S625 and S627 operatively associated therewith which are controlled in accordance with the movements of the first and second wiper sets thereof in a manner more fully described subsequently.

Also the finder switch 600 comprises a number of relays including two switching relays R640 and R650, a hold relay R660 and an identity relay R670 connected and arranged in a manner more fully described subsequently.

The connector switch 700, as best shown in Fig. 7, comprises a switching mechanism 770 of the 200-point Strowger type including a carriage provided with a first wiper set, including the wipers 771, 772 and 773, and a second wiper set, including the wipers 774, 775 and 776. It is noted that the wipers 771, 772 and 773 of the first wiper set and the wipers 774, 775 and 776 of the second wiper set are capable of both vertical and rotary movements. Further the mechanism 770 comprises a circumferentially disposed main contact bank provided with two sections respectively associated with the first and second wiper sets. Accordingly, in the mechanism 770, the first and second wiper sets respectively have access to first and second groups of one hundred lines each respectively terminated by the first and second sections of the main contact bank. Also the mechanism 770 is provided with a vertical magnet M777 for moving the first and second wiper sets thereof in the vertical direction, a rotary magnet M778 for moving the first and second wiper sets thereof in the rotary direction, and a release magnet M779 for releasing the first and second wiper sets thereof and for causing these wiper sets to be returned to their normal positions. Finally, the mechanism 770 has a number of sets of switch springs S780, S782 and S785 operatively associated therewith which are controlled in accordance with the movements of the first and second wiper sets thereof, in a manner more fully described subsequently.

Also the connector switch 700 includes a control switch 790 of the Minor type including three rotary wipers 791, 793 and 795 provided with individually associated rotary contact banks 792, 794 and 796. Also the control switch 790 is provided with a rotary magnet M797 for moving the wipers noted in the rotary direction and a release magnet M798 for releasing the wipers noted and for causing these wipers to be returned to their normal positions. Finally the control switch 790 includes two sets of switch springs S797 and S798 which are controlled in accordance with the movements of the wipers noted in a manner more fully described subsequently.

Also the connector switch 700 comprises a number of relays including a line relay R700, a battery supply relay R705, three transfer relays R710, R720 and R730, a busy relay R740, a cut-off relay R750 and two switching relays R760 and

R765 connected and arranged in a manner more fully described subsequently.

The distributor 680 illustrated in Fig. 6 has access to each of the local links in the P. A. B. X and is operative to assign an idle one of the local links to the use of any one of the telephone stations in the P. A. B. X. The details of the connection and arrangement of the distributor 680 are not disclosed as they form no part of the present invention. However, for reference purposes it is noted that the connection and arrangement of a distributor of the type of the distributor 680 is shown in the copending application of Edward S. Peterson, Serial No. 233,021, filed October 3, 1938. Also a marking network 696, shown in Fig. 6, is associated with the distributor 680 in order to initiate operation thereof when a call is initiated on one of the telephone lines extending to a telephone station in the P. A. B. X.

Preferably each of the trunk finder switches is identical to the trunk finder switch 500 individually associated with the trunk line 490, shown in Fig. 5, which comprises a switching mechanism 510 of the 200-point Strowger type including a carriage provided with a first wiper set, including the wipers 511, 512 and 513, a second wiper set, including the wipers 514, 515 and 516, and two control wipers 517 and 518. It is noted that the wipers 511, 512 and 513 of the first wiper set and the wipers 514, 515 and 516 of the second wiper set are capable of both vertical and rotary movements; the control wiper 518 is capable of vertical movement; and the control wiper 517 is capable of rotary movement. Further the mechanism 510 comprises a circumferentially disposed main contact bank provided with two sections respectively associated with the first and second wiper sets, a vertical control contact bank associated with the control wiper 518 and a rotary control contact bank associated with the control wiper 517. Accordingly, in the mechanism 510 the first and second wiper sets respectively have access to first and second groups of one hundred lines each, respectively terminated by the first and second sections of the main contact bank. Also the mechanism 510 is provided with a vertical magnet M519 for moving the first and second wiper sets thereof in the vertical direction, a rotary magnet M521 for moving the first and second wiper sets thereof in the rotary direction, and a release magnet M523 for releasing the first and second wiper sets thereof and for causing these wiper sets to be returned to their normal positions. Finally, the mechanism 510 has two sets of switch springs S524 and S525 operatively associated therewith, which are controlled in accordance with the movements of the first and second wiper sets thereof in a manner more fully described subsequently.

Also the finder switch 500 comprises a number of relays including a hold relay R505, a connect relay R540, a cutoff relay R550, a trunk offer relay R560, a start relay R570, a busy relay R580, two switching relays R510 and R520, a step relay R585 and a transfer relay R590 connected and arranged in a manner more fully described subsequently.

Preferably each of the trunk circuits is identical to the trunk circuit 400 individually associated with the trunk line 490, shown in Fig. 4, which comprises a repeater 410, first and second branches 445 and 435, and a number of relays including a line relay R425, a hold relay R430, a ring-up relay R445, a transfer relay R450, a

timer relay R440, an answer relay R460 and a control relay R420, connected and arranged in a manner more fully described subsequently. Further the trunk circuit 400 comprises a line lamp L406, a busy lamp L405 and a hold lamp L407.

Preferably, each of the line circuits is identical to the line circuit 690 individually associated with the telephone line 605 extending to the telephone station T1, shown in Fig. 6, which comprises a line and cutoff relay R690 connected and arranged in a manner more fully described subsequently. Preferably, each of the auxiliary line circuits is identical to the auxiliary line circuit 494 individually associated with the trunk circuit 400, shown in Fig. 4, which auxiliary line circuit is connected and arranged in any suitable manner, such, for example, as the line circuit 690 individually associated with the telephone line 605 extending to the telephone station T1.

Each of the telephone stations in the P. A. B. X 60 is provided with station equipment including a telephone instrument, a ringer, a push button and a calling device or dial.

The operator position 800 comprises, as shown in Figs. 4 and 8, a trunk circuit provided with a set of position keys including an information key K850, an information hold key K855, a common trunk key K860, a common trunk hold key K865, a trunk offer key K840 and a release key K870. Also the trunk circuit at the operator position 800 is provided with an individual trunk key and an individual trunk hold key individual to each trunk line extending between the central office 50 and the P. A. B. X 60, the individual trunk key K480 and the individual trunk hold key K490 being individual to the trunk line 490 extending between the central office 50 and the P. A. B. X 60. Also the trunk circuit at the operator position 800 comprises a telephone instrument including a transmitter 801 and a receiver 802, a calling device or dial 805, a repeater 810, and a number of relays including a dial relay R880, a control relay R885, a tone relay R820, a trunk relay R890 and a talk relay R895. Also associated with the operator position 800 are an information lamp L815 and a trunk lamp L816.

The operator finder switch 900, shown in Fig. 9, is of the rotary type and comprises six rotary wipers 901, 903, 905, 907, 909 and 911 provided with individually associated rotary contact banks 902, 904, 906, 908, 910 and 912 and a rotary magnet M913 for driving the wipers noted. Further the operator finder switch 900 comprises a number of relays including a stop relay R940, a control relay R950, a trunk relay R960, an information relay R970 and two pilot relays R980 and R990, connected and arranged in a manner more fully described subsequently.

The operator key set and marking circuit 200, shown in Fig. 2 and associated with the operator position 800, comprises ten respective digit keys K1 to K0, inclusive, an error key K11 and a number of relays including three transfer relays R220, R225 and R230, an error relay R270, three control relays R240, R250 and R260, a start relay R275, a release relay R265, a first group of marking relays 1C and 2C, a second group of marking relays 1D, 2D, 3D and 4D, and a third group of marking relays 1U, 2U, 3U and 4U. It is noted that the digit keys K1 to K0, inclusive, are operated successively to set up a hundred digit, a ten digit and a unit digit, thereby

to cause the first group of marking relays including the marking relays 1C and 2C to register the hundred digit, to cause the second group of marking relays including the marking relays 1D, 2D, 3D and 4D to register the ten digit, and to cause the third group of marking relays including the marking relays 1U, 2U, 3U and 4U to register the unit digit. Further the operator key set and marking circuit 200 is connected and arranged with respect to the trunk circuit at the first operator position 800 in a manner more fully described subsequently.

The identity lamp and trunk finder start unit 300, shown in Fig. 3 and associated with the operator position 800, comprises a first group of identity lamps including the identity lamps CL1 and CL2, a second group of identity lamps including the identity lamps DL1 to DL10, inclusive, and a third group of identity lamps including the identity lamps UL1 to UL10, inclusive. It is noted that the first group of identity lamps including the identity lamps CL1 and CL2, the second group of identity lamps including the identity lamps DL1 to DL10, inclusive, and the third group of identity lamps including the identity lamps UL1 to UL10, inclusive, respectively correspond to the hundred, ten and unit digits of the directory number of a calling telephone station in the P. A. B. X. Finally the identity lamp and trunk finder start unit 300 comprises a number of relays including a start relay R310 and two marking relays R320 and R330 connected and arranged in a manner more fully described subsequently.

A better understanding of the connection and arrangement of the apparatus incorporated in the telephone system will be facilitated from a consideration of the detailed operation of the various pieces of apparatus incident to the completion of different calls and the handling of various calls at the operator position 800, as will appear hereinafter.

Local call from one station to another station in the P. A. B. X

A local call which is to be extended from one station to another station in the P. A. B. X is initiated at the calling station by removing the receiver of the telephone instrument thereat from its switchhook. For example, in extending a call from the telephone station T1 to the telephone station T2 the call is first initiated at the station T1 by removing the receiver of the telephone instrument thereat from its switchhook, thereby to complete a bridge path including the receiver of the telephone instrument between the line conductors C606 and C607 of the telephone line 605 extending to the telephone station T1. When this bridge path is completed between the line conductors of the telephone line 605 a circuit is completed for energizing in series the windings of the line and cutoff relay R690 included in the line circuit 690 individually associated with the telephone line 605. This circuit extends from ground by way of the lower winding of R690, the contacts 692, C607, the bridge path between the line conductors C607 and C606, C606, the contacts 691, and the upper and intermediate windings of R690 to battery. When energized over the above-traced circuit the line and cutoff relay R690 operates partially, thereby to complete, at the contacts 695, an obvious path for applying ground potential to the start conductor C697 and to complete, at the contacts 693, an obvious connection between the control con-

ductors C608 and C609 of the telephone line 605. The application of ground potential to the start conductor C697 completes an obvious path for applying ground potential by way of the resistor 649 of the marking network 696 to the start conductor C688 extending to the distributor 680, and an obvious path for applying direct ground potential by way of the conductor C698 to the first contacts in the vertical control contact banks of the local finder switches. The application of ground potential to the start conductor C688 initiates operation of the distributor 680 and the application of direct ground potential to the first contacts in the vertical control contact banks of the local finder switches marks the telephone line 605 as terminating in the first level of the main contact banks of the local finder switches.

The distributor 680 is of the preselective type and operates to select another idle local link as soon as the finder switch of a previously selected local link operates to find a calling telephone line after it has been taken for use. Assuming that the distributor 680 has previously selected the local link illustrated to be taken for use at this time, the distributor 680 operates to cause ground potential to be applied to the start conductor C682, thereby to complete an obvious circuit for energizing the winding of the hold relay R660. The hold relay R660 then operates to interrupt, at the contacts 661, a point in a multiple path for applying ground potential to the all-link-busy conductor C681, and to complete, at the contacts 662, an obvious path for applying ground potential to the control conductor C678 of the trunk 675. The previously mentioned path for applying ground potential to the all-link-busy conductor C681 in the local finder switch 600 extends, when completed, from ground by way of the contacts 661 and 626 to the all-link-busy conductor C681. Also the hold relay R660 completes, at the contacts 663, obvious multiple circuits for energizing the lower windings of the switching relays R640 and R650, thereby to render each of the switching relays extremely fast to operate in the event the upper winding thereof is energized. Further the hold relay R660 prepares, at the contacts 667, a circuit traced hereinafter for energizing the vertical magnet M621 and prepares, at the contacts 666, a circuit traced hereinafter for energizing the rotary magnet M623. The distributor 680 then operates to cause ground potential to be applied to the vertical conductor C686, thereby to complete the previously mentioned circuit for energizing the vertical magnet M621, this circuit extending from the grounded vertical conductor C686 by way of the contacts 667 and M621 to battery. When energized over the above-traced circuit the vertical magnet M621 operates to drive the first and second wiper sets of the mechanism 610 one step in the vertical direction and to complete, at the contacts 622, an obvious path for applying ground potential to the interrupter conductor C685. The application of ground potential to the interrupter conductor C685 causes the distributor 680 to interrupt the application of ground potential to the vertical conductor C686, whereupon the vertical magnet M621 restores to interrupt, at the contacts 622, the previously mentioned path for applying ground potential to the interrupter conductor C685. Accordingly, the vertical magnet M621 operates intermittently, thereby to drive the first and second wiper sets of the mechanism 610 step by step in the vertical direction until the control wiper 619

engages a contact in the associated vertical control contact bank having direct ground potential thereon, whereupon an obvious path is completed for applying ground potential to the test conductor C687 extending to the distributor 680. In the present instance, the first and second wiper sets of the mechanism 610 are driven only one step in the vertical direction, whereupon the vertical control wiper 619 engages the first contact in the associated vertical control contact bank having ground potential thereon. The application of ground potential to the test conductor C687 causes the distributor 680 to operate, thereby to interrupt the application of ground potential to the vertical conductor C686 and to apply ground potential to the rotary conductor C684.

The application of ground potential to the rotary conductor C684 completes the previously mentioned circuit for energizing the rotary magnet M623, this circuit extending from the grounded rotary conductor C684 by way of the contacts 666, 650 and 647 and M623 to battery. When energized over the above-traced circuit the rotary magnet M623 operates to drive the first and second wiper sets of the mechanism 610 one step in the rotary direction and to complete, at the contacts 624, an obvious path for applying ground potential to the interrupter conductor C685. This application of ground potential to the interrupter conductor C685 causes the distributor 680 to remove the application of ground potential to the rotary conductor C684, whereupon the rotary magnet M623 restores to interrupt, at the contacts 624, the previously mentioned path for applying ground potential to the interrupter conductor C685. Accordingly, the rotary magnet M623 operates intermittently, thereby to drive the first and second wiper sets of the mechanism 610 step by step in the rotary direction until either the control wiper 615 or the control wiper 618 of the respective first and second wiper sets engages the control conductor of a calling telephone line having battery potential thereon. In the present example the telephone line 605 is included in the first section of the main contact bank of the mechanism 610. Accordingly, when the control wiper 615 of the first wiper set of the mechanism 610 engages the contact of the contact set in the first section of the main contact bank of the mechanism 610 terminating the control conductor C608 of the telephone line 605, a circuit is completed for energizing the upper winding of the switching relay R640. This circuit extends from ground by way of the contacts 694 and 695, the start conductor C697, C698, the vertical control wiper 619, C639, the upper winding of R640, the control wiper 615, C608, the contacts 693 and the intermediate winding of R690 to battery. When energized over the above-traced circuit the switching relay R640 operates exceedingly fast, thereby to complete, at the contacts 645, a holding circuit for energizing the intermediate winding thereof, this circuit extending from ground by way of the contacts 662, the control conductor C678 of the trunk 675, the contacts 657 and 645 and the intermediate winding of R640 to battery. Also, upon operating, the switching relay R640 interrupts, at the contacts 647, a point in the previously traced circuit for energizing the rotary magnet M623, thereby positively to arrest further operation of the mechanism 610. Further the switching relay R640 interrupts, at the contacts 649, a point in a circuit for energizing the

upper winding of the switching relay R650, thereby positively to prevent operation of the latter relay at this time. Also the switching relay R640 interrupts, at the contacts 648, a point in a circuit traced hereinafter for energizing the release magnet M625 and completes, at the contacts 646, a connection between the rotary conductor C684 and the guard conductor C683, this connection extending from the rotary conductor C684 by way of the contacts 666, 650, 646 and 664 to the guard conductor C683. When the rotary conductor C684 is connected to the guard conductor C683, operation of the distributor 680 to control the local finder switch 600 is arrested, whereupon the distributor 680 operates automatically to select for use another idle one of the local links.

Finally, upon operating, the switching relay R640 completes, at the contacts 641, 643 and 644, connections between the conductors of the trunk 630 extending to the first wiper set of the mechanism 610 and the trunk 675 extending between the local finder switch 600 and the local connector switch 700. When the trunks 630 and 675 are connected a low resistance circuit is completed for energizing the intermediate winding of the line and cutoff relay R690, this circuit extending from the grounded control conductor C678 of the trunk 675 by way of the contacts 657 and 644, C633, the wiper 615, the control conductor C608 of the telephone line 605, the contacts 693 and the intermediate winding of R690 to battery. When the intermediate winding of the line and cutoff relay R690 is thus energized this relay operates completely, thereby to interrupt, at the contacts 624, the previously traced path for applying ground potential to the start conductor C697 extending to the marking network 696 in order to arrest operation of the distributor 680. Further the line and cutoff relay R690 interrupts, at the contacts 691 and 692, the previously traced circuit for energizing the windings thereof across the line conductors C606 and C607 of the telephone line 605, thereby to clear the telephone line 605 of impedance elements. At this time ground potential appearing upon the control conductor C608 of the telephone line 605 is applied to the control conductor C609 thereof, thereby to mark the telephone line 605 as busy to the local connector switches and the trunk finder switches having access thereto.

Also it is noted that when the carriage of the mechanism 610 is driven one step in the vertical direction the set of switch springs S625 and S627 are actuated. More particularly, the contacts 626 and 627 of the set of switch springs S625 are respectively actuated into disengagement and into engagement; while the contacts 629 and 628 of the set of switch springs S627 are respectively actuated into disengagement and into engagement.

Further it is noted that the distributor 680 operates in order to select another idle local link for use only in the event ground potential appears upon the all-link-busy conductor C681 and in at least one of the local finder switches, ground potential being removed from the all-link-busy conductor C681 in the local finder switch 600 at this time due to the operated condition of the set of switch springs S625, as previously noted. Also ground potential is applied to the guard conductor C683 in the local finder switch 600, thereby to prevent the distributor 680 from preselecting the local link illustrated at this time

due to the busy condition of the local finder switch 600. The path for applying ground potential in the finder switch 600 to the guard conductor C683 extends from ground by way of the contacts 628 of the set of switch springs S627 and the contacts 665 to the guard conductor C683, the hold relay R660 being restored at this time. Further it is noted that the hold relay R660 is of the slow-to-release type and restores shortly after the distributor 680 is released. Upon restoring, the hold relay R660 interrupts, at the contacts 662, the previously traced path for applying ground potential to the control conductor C678 of the trunk 675, ground potential being applied to the control conductor C678 of the trunk 675 in the local connector switch 700 at this time. Further the hold relay R660 interrupts, at the contacts 663, the previously mentioned multiple circuits for energizing the lower windings of the switching relays R640 and R650, the switching relay R640 being retained in its operated position at this time due to the completed holding circuit for energizing the intermediate winding thereof.

When the trunks 630 and 675 are connected a loop circuit is completed for energizing in series the upper and lower windings of the line relay R700 in the local connector switch 700, this circuit extending from ground by way of the lower winding of R700, the line conductor C677 of the trunk 675, the contacts 654 and 643, C632 and the wiper 614 to the line conductor C607 of the telephone line 605, and from battery by way of the upper winding of R700, the line conductor C676 of the trunk 675, the contacts 651 and 641, C631 and the wiper 613 to the line conductor C606 of the telephone line 605, the line conductors C606 and C607 of the telephone line 605 being connected together by way of the bridge path at the telephone station T1. When the upper and lower windings of the line relay R700 are thus energized this relay operates to complete, at the contacts 702, a circuit for energizing the upper winding of the transfer relay R720, this circuit extending from ground by way of the contacts 702, the contacts 784 of the set of switch springs S782 and the upper winding of R720 to battery. When the upper winding of the transfer relay R720 is thus energized this relay operates to complete, at the contacts 724, an obvious multiple path for applying ground potential to the control conductor C678 of the trunk 675, as previously noted. Also, upon operating, the transfer relay R720 completes, at the contacts 723, a circuit for energizing in series the lower winding of the battery supply relay R705 and the upper winding of the transfer relay R730, this circuit extending from ground by way of the lower winding of R705, the contacts 723 and the upper winding of R730 to battery. When the lower winding of the battery supply relay R705 and the upper winding of the transfer relay R730 are thus energized these relays operate. Further the transfer relay R720 completes, at the contacts 727, a circuit for energizing the upper winding of the transfer relay R710, this circuit extending from ground by way of the set of switch springs S797, the contacts 727 and the upper winding of R710 to battery. When the upper winding of the transfer relay R710 is thus energized this relay operates. Upon operating the battery supply relay R705 completes, at the contacts 706, a holding circuit for energizing the lower winding

thereof in series with the upper winding of the transfer relay R730, this holding circuit extending from ground by way of the lower winding of R705, the contacts 706, 701 and 731, and the upper winding of R730 to battery. Upon operating, the transfer relay R710 prepares, at the contacts 711, a circuit traced hereinafter for energizing in multiple the lower winding thereof and the rotary magnet M797 of the control switch 790; upon operating, the transfer relay R720 prepares, at the contacts 725, a circuit traced hereinafter for energizing in multiple the lower winding thereof and the vertical magnet M777 of the mechanism 770; and upon operating, the transfer relay R730 prepares, at the contacts 735, a circuit traced hereinafter for energizing in multiple the lower winding thereof and the rotary magnet M778 of the mechanism 770. At this time the local connector switch 700 has been rendered responsive to digits to be transmitted thereto from the telephone station T1.

In view of the above description of the operation of the local finder switch 600 under the control of the distributor 680 to find the calling telephone line 605 and the subsequent operation of the local connector switch 700 incident to the seizure of the calling telephone line by the local finder switch 600, it will be understood that these pieces of apparatus operate in substantially the same manner regardless of the one hundred line group including the calling telephone line. In the present example the switching relay R640 in the local finder switch 600 is operated due to the fact that the calling telephone line 605 is included in the first group of one hundred lines accessible to the local finder switch 600. On the other hand, in the event the calling telephone line 605 had been in the second group of one hundred lines the switching relay R650 would have been operated in a similar manner.

The subscriber at the telephone station T1 then dials the first digit of the directory number of the called telephone station T2, thereby to transmit a first series of impulses by way of the subscriber loop circuit to the line relay R700 in the local connector switch 700. It is noted that the first digit of the directory number of any telephone station in the P. A. B. X, either 1 or 2, depending upon which one hundred line group includes the telephone line extending to the telephone station. In the present example the telephone line 750 extending to the telephone station T2, is included in the second group of one hundred lines; accordingly, the first digit dialed is the digit 2. The line relay R700 follows the dialed impulses in the usual manner, restoring each time the loop circuit is interrupted and operating each time the loop circuit is completed. Each time the line relay R700 restores it interrupts, at the contacts 702, the previously traced circuit for energizing the upper winding of the transfer relay R720 and completes, at the contacts 703, the previously mentioned circuit for energizing in multiple the lower winding of the transfer relay R710 and the rotary magnet M797 of the control switch 790. The circuit for energizing in multiple the lower winding of the transfer relay R710 and the rotary magnet M797 extends from ground by way of the contacts 703 and 711 and the lower winding of R710 to battery, and from the contacts 711 and R797 to battery. On the other hand, each time the line

relay R700 operates it interrupts, at the contacts 703, the previously traced circuit for energizing in multiple the lower winding of the transfer relay R710 and the rotary magnet M797, and completes, at the contacts 702, the previously traced circuit for energizing the upper winding of the transfer relay R720. Thus, during impulsing the transfer relays R710 and R720, being of the slow-to-release type, remain operated.

Each time the rotary magnet M797 is energized it operates to drive the wipers noted of the control switch 790 one step in the counterclockwise direction. Also when the wipers noted of the control switch 790 are driven one step in the counterclockwise direction away from their normal positions, the sets of switch springs S797 and S798 are actuated. More particularly, the set of switch springs S797 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the upper winding of the transfer relay R710; while the set of switch springs S798 is actuated into engagement, thereby to prepare a circuit traced hereinafter for energizing the release magnet M798. In the present instance the first digit comprises two impulses, thereby to cause the rotary magnet M797 to drive the wipers noted of the control switch 790 two steps in the counterclockwise direction.

At the conclusion of the first digit the line relay R700 reoperates, thereby to cause the transfer relay R710 to restore shortly thereafter. Upon restoring the transfer relay R710 interrupts, at the contacts 711, a further point in the previously traced circuit for energizing in multiple the lower winding thereof and the rotary magnet M797, and prepares, at the contacts 712, the previously mentioned circuit for energizing in multiple the lower winding of the transfer relay R720 and the vertical magnet M777.

The subscriber at the telephone station T1 then dials the second digit of the directory number of the called telephone station T2, thereby to transmit a second series of impulses by way of the subscriber loop circuit to the line relay R700 in the local connector switch 700 in the manner previously explained. As previously noted the line relay R700 follows the impulses. Each time the line relay R700 restores it completes, at the contacts 703, the previously mentioned circuit for energizing in multiple the lower winding of the transfer relay R720 and the vertical magnet M777. The circuit for energizing in multiple the lower winding of the transfer relay R720 and the vertical magnet M777 extends from ground by way of the contacts 703, 712 and 725 and the lower winding of R720 to battery, and from the contacts 725 by way of the vertical magnet M777 to battery. On the other hand, each time the line relay R700 operates it interrupts, at the contacts 703, the previously traced circuit for energizing in multiple the lower winding of the transfer relay R720 and the vertical magnet M777. Thus the transfer relay R720 remains operated during impulsing, this relay being of the slow-to-release type. Each time the vertical magnet M777 is energized it operates to drive the first and second wiper sets of the mechanism 770 one step in the vertical direction. When the first and second wiper sets of the mechanism 770 are driven one step in the vertical direction away from their normal positions the sets of switch springs S780, S782 and S785 are actuated. More particularly, the set of switch springs S780 is actuated into

engagement, thereby to complete an obvious multiple path for applying-ground potential to the control conductor C678 of the trunk 675; while the set of switch springs S785 is actuated into engagement, thereby to prepare a circuit traced hereinafter for energizing the release magnet M779. The contacts 784 of the set of switch springs S782 are actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the upper winding of the transfer relay R720; while the contacts 783 of the set of switch springs S782 are actuated into engagement, thereby to prepare a circuit traced hereinafter for energizing the winding of the switching relay R760.

At the conclusion of the second digit the line relay R700 reoperates, thereby to cause the transfer relay R720 to restore shortly thereafter. Upon restoring the transfer relay R720 interrupts, at the contacts 725, a further point in the previously traced circuit for energizing in multiple the lower winding thereof and the vertical magnet M777, and prepares, at the contacts 726, a point in the previously mentioned circuit for energizing in multiple the lower winding of the transfer relay R730 and the rotary magnet M778.

The subscriber at the telephone station T1 then dials the third digit of the directory number of the called telephone station T2, thereby to transmit a third series of impulses by way of the subscriber loop circuit to the line relay R700 in the local connector switch 700 in the manner previously explained. As previously noted the line relay R700 follows the impulses. Each time the line relay R700 restores it completes, at the contacts 703, the previously mentioned circuit for energizing in multiple the lower winding of the transfer relay R730 and the rotary magnet M778. The circuit for energizing in multiple the lower winding of the transfer relay R730 and the rotary magnet M778 extends from ground by way of the contacts 703, 712, 726 and 735 and the lower winding of R730 to battery, and from the contacts 735 by way of the rotary magnet M778 to battery. On the other hand, each time the line relay R700 operates it interrupts, at the contacts 703, the previously traced circuit for energizing in multiple the lower winding of the transfer relay R730 and the rotary magnet M778. Thus the transfer relay R730 remains operated during impulsing, this relay being of the slow-to-release type. Further it is noted that when the line relay R700 restores upon the first impulse of the third digit it interrupts, at the contacts 701, the previously traced holding circuit for energizing in series the lower winding of the battery supply relay R705 and the upper winding of the transfer relay R730, the original circuit for energizing in series the lower winding of the battery supply relay R705 and the upper winding of the transfer relay R730 being interrupted at the contacts 723 due to the restored condition of the transfer relay R720 at this time. Also upon restoring, the transfer relay R720 interrupts, at the contacts 724, the previously mentioned path for applying ground potential to the control conductor C678 of the trunk 675, ground potential being applied to the control conductor C678 of the trunk 675 due to the operated condition of the set of switch springs S780 at this time.

Each time the rotary magnet M778 is energized it operates to drive the first and second wiper sets of the mechanism 770 one step in the rotary direction.

At the conclusion of the third digit the line

relay R700 reoperates, thereby to cause the transfer relay R730 to restore shortly thereafter. Prior to the restoration of the transfer relay R730 and at the conclusion of the third digit the first and second wiper sets of the mechanism 770 engage corresponding lines in the first and second sections of the main contact bank, whereupon a test circuit for the busy relay R740 is completed. This test circuit extends from battery by way of the winding of R740, the contacts 733, C715, the wiper 793 and engaged second contact in the associated contact bank 794 of the control switch 790, C749 and the control wiper 776 of the second wiper set to the control conductor C753 of the telephone line 750 extending to the telephone station T2. In the event the telephone station T2 is busy at this time, ground potential appears upon the control conductor C753 of the telephone line 750, thereby to complete a circuit identical to the test circuit previously traced for energizing the winding of the busy relay R740, thereby to cause the latter relay to operate. Upon operating, the busy relay R740 prepares, at the contacts 744, a holding circuit traced hereinafter for energizing the winding thereof. Upon restoring the transfer relay R730 interrupts, at the contacts 733, the previously traced operating circuit for energizing the winding of the busy relay R740 and completes, at the contacts 734, the previously mentioned holding circuit for energizing the winding of the busy relay R740. The holding circuit for energizing the winding of the busy relay R740 extends from the grounded control conductor C678 of the trunk 675 by way of the contacts 744 and 734 and the winding of R740 to battery.

Also upon operating, the busy relay R740 interrupts, at the contacts 741 and 743, points in a circuit traced hereinafter for projecting ringing current over the telephone line 750 extending to the called telephone station T2. Finally upon operating, the busy relay R740 completes, at the contacts 742, a circuit for returning busy tone current over the loop circuit to the calling telephone station T1, this circuit extending from the ungrounded terminal of a grounded source of busy current by way of the conductor C704, the contacts 721, 742 and 753 and the condenser 708 to the line conductor C676 of the trunk 675 and from ground by way of the lower winding of the line relay R700 to the line conductor C677 of the trunk 675, the receiver of the telephone instrument at the calling telephone station T1 being included in the loop circuit extending between the line conductors C676 and C677 of the trunk 675. Accordingly, the receiver of the telephone instrument at the calling telephone station T1 produces busy tone at this time, thereby to indicate to the subscriber thereat that the connection cannot immediately be had due to the busy condition of the called telephone station T2.

The subscriber at the calling telephone station T1 then releases the line circuit 690, the local finder switch 600 and the local connector switch 700 by replacing the receiver of the telephone instrument thereat upon its switchhook in a manner more fully described hereinafter.

On the other hand, in the event the called telephone station T2 is idle when the local connector switch 700 operates to seize the telephone line 750 extending thereto in the manner previously explained, battery potential appears upon the control conductor C753 of the telephone line 750, thereby to complete a circuit identical to the test circuit previously traced for short-

circuiting the winding of the busy relay R740. Accordingly, the busy relay R740 does not operate at this time. Hence, when the transfer relay R730 restores it interrupts, at the contacts 733, the previously traced test circuit for the busy relay R740 and completes, at the contacts 732, a path for applying ground potential to the control conductor C753 of the telephone line 750 extending to the called telephone station T2, this path extending from ground by way of the wiper 791 and engaged second contact in the associated contact bank 792 of the control switch 790, C716, the contacts 732, C715, the wiper 793 and engaged second contact in the associated contact bank 794 of the control switch 790, C749 and the control wiper 776 to the control conductor C753 of the telephone line 750. This application of ground potential to the control conductor C753 of the telephone line 750 causes the line circuit individually associated therewith to operate, thereby to mark the telephone line 750 extending to the called telephone station T2 as busy. Also upon restoring, the transfer relay R730 completes, at the contacts 737, a circuit for energizing the winding of the switching relay R760, this circuit extending from ground by way of the contacts 702, the contacts 783 of the set of switch springs S782, C713, the contacts 737, the wiper 795 and engaged second contact in the associated contact bank 796 of the control switch 790 and the winding of R760 to battery. When energized over the above-traced circuit the switching relay R760 operates to complete, at the contacts 763, an obvious alternative path for applying ground potential to the control conductor C753 of the telephone line 750 and to interrupt, at the contacts 764, a point in the previously mentioned circuit for energizing in multiple the release magnets M779 and M798. Also upon operating, the switching relay R760 completes, at the contacts 761 and 762, the previously mentioned circuit for projecting ringing current over the telephone line 750 extending to the called telephone station T2, this circuit extending from the ungrounded terminal of a grounded source of ringing current by way of the conductor C707, the contacts 743 and 754, C747, the contacts 762 and the wiper 775 to the line conductor C752 of the telephone line 750, and from battery by way of the lower winding of the cutoff relay R750, the contacts 741 and 751, C746, the contacts 761 and the wiper 774 to the line conductor C751 of the telephone line 750, the ringer at the called telephone station T2 being connected across the line conductors C751 and C752 of the telephone line 750. Accordingly, the ringer at the called telephone station T2 is operated at this time.

When the subscriber at the called telephone station T2 answers the call by removing the receiver of the telephone instrument thereat from its switchhook a circuit substantially identical to that previously traced for projecting ringing current over the telephone line 750 is completed for energizing the lower winding of the cutoff relay R750. When the lower winding of the cutoff relay R750 is thus energized this relay operates shortly thereafter, this relay being of the combination slow-to-operate and slow-to-release type. Upon operating, the cutoff relay R750 completes, at the contacts 756, an obvious holding circuit for energizing the upper winding thereof including the grounded control conductor C678 of the trunk 675. Also, the cutoff relay R750 interrupts, at the contacts 751 and 754, the previously traced circuit for projecting

ringing current over the telephone line 750 extending to the called telephone station T2 and completes, at the contacts 752 and 755, a loop circuit between the battery supply relay R705 and the called telephone station T2. This loop circuit extends from ground by way of the lower winding of R705, the contacts 722 and 755, C747, the contacts 762 and the wiper 775 to the line conductor C752 of the telephone line 750 and from battery by way of the upper winding of R705, the contacts 752, C746, the contacts 761 and the wiper 774 to the line conductor C751 of the telephone line 750, the telephone instrument at the called telephone station T2 being connected across the line conductors C751 and C752 of the telephone line 750 at this time. Accordingly, talking battery is supplied to the telephone instrument at the calling telephone station T1 from the line relay R700, while talking battery is supplied to the telephone instrument at the called telephone station T2 from the battery supply relay R705. Finally, it is noted that the loop circuit extending to the calling telephone station T1 is interconnected with a loop circuit extending to the called telephone station T2 by the condensers 708 and 709, thereby to complete a two-way communication connection between the calling telephone station T1 and the called telephone station T2.

The release of the established connection between the calling telephone station T1 and the called telephone station T2 is primarily under the control of the subscriber at the calling telephone station T1 and when the receiver of the telephone instrument at the calling telephone station T1 is replaced upon its switchhook the previously traced loop circuit for energizing the windings of the line relay R700 is interrupted, thereby to cause the latter relay to restore. Also, when the receiver of the telephone instrument at the called telephone station T2 is replaced upon its switchhook the previously traced loop circuit for energizing the windings of the battery supply relay R705 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the line relay R700 interrupts, at the contacts 702, the previously traced circuit for energizing the winding of the switching relay R760, thereby to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the switching relay R760 completes, at the contacts 764, the previously mentioned circuit for energizing in multiple the release magnet M779 and the release magnet M798, this circuit extending from ground by way of the contacts 703, 712, 726, 736, 769 and 764, the set of switch springs S785 and the release magnet M779 to battery, and from the contacts 764 by way of the set of switch springs S798 and the release magnet M798 to battery. When thus energized the release magnets M779 and M798 operate.

Upon operating the release magnet M798 releases the wipers noted of the control switch 790 and causes these wipers to be returned to their normal positions. When the wipers noted of the control switch 790 are returned to their normal positions the sets of switch springs S797 and S798 are actuated. More particularly, the set of switch springs S797 is actuated into engagement, thereby to prepare the previously traced circuit for energizing the upper winding of the transfer relay R710; while the set of switch springs S798 is actuated into disengagement, thereby to inter-

rupt the previously traced circuit for energizing the release magnet M798.

Upon operating, the release magnet M779 releases the first and second wiper sets of the mechanism 770, thereby to cause these wiper sets to be returned to their normal positions. When the wiper sets of the mechanism 770 are returned to their normal positions the sets of switch springs S780, S782 and S785 are actuated. More particularly, the set of switch springs S780 is actuated into disengagement, thereby to interrupt the previously mentioned path for applying ground potential to the control conductor C678 of the trunk 675; while the set of switch springs S785 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the release magnet M779. Finally the contacts 783 and 784 of the set of switch springs S782 are respectively actuated into disengagement and into engagement, thereby respectively to interrupt a further point in the previously traced circuit for energizing the winding of the switching relay R760 and to prepare a point in the previously traced circuit for energizing the upper winding of the transfer relay R720. When ground potential is removed from the control conductor C678 of the trunk 675 the previously traced holding circuit for energizing the upper winding of the cutoff relay R750 is interrupted, thereby to cause the latter relay to restore.

When the control switch 790 is released and the switching relay R760 restores the previously traced paths for applying ground potential to the control conductor C753 of the telephone line 750 are interrupted, thereby to cause the line circuit individually associated with the telephone line 750 to operate in order to mark the telephone line 750 as idle. Also when ground potential is removed from the control conductor C678 of the trunk 675 the previously traced holding circuit for energizing the intermediate winding of the line and cutoff relay R690 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the line and cutoff relay R690 interrupts, at the contacts 693, a further point in the previously traced path for applying ground potential to the control conductor C609 of the telephone line 605 extending to the telephone station T1, thereby to mark the telephone line 605 as idle.

Finally, when ground potential is removed from the control conductor C678 of the trunk 675 the previously traced holding circuit for energizing the intermediate winding of the switching relay R640 is interrupted, thereby to cause the latter relay to restore, and complete, at the contacts 648, the previously mentioned circuit for energizing the release magnet M625, this circuit extending from ground by way of the contacts 661, the contacts 627 of the set of switch springs S625, the contacts 651' and 648 and the release magnet M625 to battery. When thus energized the release magnet M625 operates to release the first and second wiper sets of the mechanism 610, thereby to cause these wiper sets to be returned to their normal positions. When the first and second wiper sets of the mechanism 610 are returned to their normal positions the sets of switch springs S625 and S627 are actuated. More particularly, the contacts 627 of the set of switch springs S625 are actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the release magnet M625; while the contacts 626 of the set of switch springs S625 are actuated into engagement, thereby to complete the

previously traced path for applying ground potential to the all-link-busy conductor C681 extending to the distributor 680. This application of ground potential to the all-link-busy conductor C681 extending to the distributor 680 renders the distributor 680 operative to preselect for use an idle one of the local links. Also the contacts 628 of the set of switch springs S627 are actuated into disengagement, thereby to interrupt the previously traced path for applying ground potential to the guard conductor C683 extending to the distributor 680. The removal of ground potential from the guard conductor C683 extending to the distributor 680 renders the distributor 680 operative to select for use the local link illustrated. Finally the contacts 629 of the set of switch springs S627 are actuated into engagement, thereby to connect the control conductor C678 of the trunk 675 to the guard conductor C683 extending to the distributor 680.

At this time the local finder switch 600 and the local connector switch 700 of the local link illustrated are completely released, thereby to render this local link available for further use. Also the line circuit 690 individually associated with the telephone line 605 is restored, thereby to mark the telephone line 605 extending to the telephone station T1 as idle. Similarly, the line circuit individually associated with the telephone line 750 is restored, thereby to mark the telephone line 750 extending to the telephone station T2 as idle.

Information call from a station to the operator position in the P. A. B. X

An information call which is to be extended from one of the stations to the operator position in the P. A. B. X is initiated at the calling station by removing the receiver of the telephone instrument thereat from its switchhook. For example, in extending an information call from the telephone station T1 to the operator position 800 the call is first initiated at the station T1 by removing the receiver of the telephone instrument thereat from its switchhook, thereby to cause the line circuit 690 individually associated with the telephone line 605 extending to the calling telephone station T1 to operate as previously explained. Upon operating, the line circuit 690 initiates operation of the distributor 680, whereupon the distributor 680 assigns the previously selected local link, such, for example, as the local link illustrated, to the use of the calling telephone station T1 and causes the local finder switch 600 of the local link illustrated to seize the telephone line 605 extending to the calling telephone station T1 in the previously described manner. After the local finder switch 600 of the local link illustrated seizes the telephone line 605 extending to the calling telephone station T1, the distributor 680 operates to preselect another one of the idle local links to the use of a calling telephone station as previously explained. Also, when the local finder switch 600 seizes the telephone line 605 extending to the calling telephone station T1, a loop circuit is completed between the line relay R700 in the local connector switch 700 and the calling telephone station T1 as previously explained, whereupon the local connector switch 700 is rendered responsive to digits transmitted from the calling telephone station T1.

At this time the line and cut-off relay R690

in the line circuit 690 occupies its operated position; while the switching relay R640 in the local finder switch 600 occupies its operated position. Also, in the local connector switch 700 the line relay R700, the transfer relays R710, R720 and R730 and the battery supply relay R705 occupy their operated positions, as previously explained.

The subscriber at the telephone station T1 then dials the single information digit 3, thereby to transmit a single series of impulses by way of the previously traced loop circuit to the line relay R700 in the local connector switch 700. The line relay R700 follows the dialed impulses in the usual manner, restoring each time the loop circuit is interrupted and operating each time the loop circuit is completed. Each time the line relay R700 restores, it interrupts, at the contacts 702, the previously traced circuit for energizing the upper winding of the transfer relay R720 and completes, at the contacts 703, the previously traced multiple circuit for energizing the lower winding of the transfer relay R710 and the rotary magnet M797 of the control switch 790. On the other hand, each time the line relay R700 operates, it interrupts, at the contacts 703, the previously traced circuit for energizing in multiple the lower winding of the transfer relay and the rotary magnet M797 and completes, at the contacts 702, the previously traced circuit for energizing the upper winding of the transfer relay R720. Thus, during impulsing, the transfer relays R710 and R720 remain operated.

Accordingly, at this time, the rotary magnet M797 is successively energized three times, thereby to cause the wipers noted of the control switch 790 to be driven in the counterclockwise direction into engagement with the third contacts in the associated contact banks. Also, when the wipers noted of the control switch 790 are driven one step in the counterclockwise direction away from their normal positions, the sets of switch springs S797 and S798 are actuated. More particularly, the set of switch springs S797 is actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the upper winding of the transfer relay R710; while the set of switch springs S798 is actuated into engagement, thereby to prepare the previously traced circuit for energizing the release magnet, M798 of the control switch 790.

At the conclusion of the single digit, the line relay R700 reoperates, thereby to cause the transfer relay R710 to restore shortly thereafter. At this time no further digits are dialed at the calling telephone station T1 and the operation of the control switch 790 is effective to complete a circuit for energizing the winding of the pilot relay R980 and a path for applying battery potential to the marking conductor C921 included in a group of conductors extending between the local link illustrated and the operator finder switch 900. The circuit for energizing the winding of the pilot relay R980 extends from ground by way of the wiper 791 and engaged third contact in the associated contact bank 792 of the control switch 790, C710 and the winding of R980 to battery; and the path for applying battery potential to the marking conductor C921 extends from battery by way of the winding of the busy relay R740, the contacts 733, C715 and the wiper 793 and engaged third contact in the associated contact bank 794 of the control switch 790 to the marking conductor C921. The application of battery potential to the marking conductor C921

marks the position of the previously mentioned group of conductors extending to the local link illustrated and accessible to the operator finder switch 900. When thus energized, the pilot relay R980 operates to complete, at the contacts 982, an obvious circuit for illuminating the information lamp L815 associated with the operator position 800. The illumination of the information lamp L815 indicates to the operator at the operator position 800 that an information call has been initiated at one of the telephone stations in the P. A. B. X and is waiting to be answered.

Assuming that the operator position 800 is idle at this time, the information call initiated at the telephone station T1 is answered by operating the information key K850 away from its normal position. When the information key K850 is operated away from its normal position there is completed, at the contacts 853 thereof, an obvious circuit for energizing the winding of the information relay R970, thereby to cause the latter relay to operate. Upon operating, the information relay R970 completes, at the contacts 972, an obvious circuit for energizing the winding of the control relay R950, thereby to cause the latter relay to operate. Also, upon operating, the information relay R970 completes, at the contacts 975, a circuit for energizing the intermediate winding of the stop relay R940 in multiple with the rotary magnet M913 of the operator finder switch 900, this circuit extending from ground by way of the contacts 981 and 975 and the intermediate winding of R940 to battery, and from the contacts 975 by way of the contacts 947 and 944 and the rotary magnet M913 to battery. When the intermediate winding of the stop relay R940 is thus energized, this relay is rendered exceedingly fast to operate when the upper winding thereof is subsequently energized. Also, upon operating, the information relay R970 completes, at the contacts 974 and 973, a path for applying ground potential to the wiper 911 of the operator finder switch 900, this path extending from ground by way of the contacts 974, the upper winding of R940 and the contacts 973 to the wiper 911 of the operator finder switch 900.

When the rotary magnet M913 is thus energized, it operates to interrupt, at the contacts 914, the previously traced circuit for energizing the rotary magnet M913, thereby to cause the rotary magnet M913 to restore and recomplete, at the contacts 914, the previously traced circuit for energizing the rotary magnet M913. Accordingly, the rotary magnet M913 operates intermittently, thereby to drive the wipers noted of the operator finder switch 900 step by step in the counterclockwise direction until the wiper 911 engages the contact in the associated contact bank 912 terminating the marking conductor C921, whereupon a series circuit is completed for energizing the winding of the busy relay R740 and the upper winding of the stop relay R940. The last-mentioned circuit extends from ground by way of the contacts 974, the upper winding of R940, the contacts 973, the wiper 911 and engaged contact in the associated contact bank 912 of the operator finder switch 900, the marking conductor C921, the wiper 793 and engaged third contact in the associated contact bank 794 of the control switch 790, C715, the contacts 733 and the winding of R740 to battery. When the upper winding of the stop relay R740 is thus energized, this relay operates exceedingly fast, thereby to complete, at the contacts 946, a holding circuit for energizing the lower winding thereof, this circuit extending from ground by way of the con-

tacts 981, 975 and 946, and the lower winding of R940 to battery. Also, the stop relay R940 interrupts, at the contacts 947, the previously traced circuit for energizing the rotary magnet M913, thereby positively to arrest further operation of the operator finder switch 900 at this time. Also, the stop relay R940 completes, at the contacts 945, an obvious path for short-circuiting the upper winding thereof, thereby to render the stop relay R940 slightly slow to release when the previously traced holding circuit for energizing the lower winding thereof is interrupted. Further, the stop relay R940 completes, at the contacts 946, a low resistance circuit, substantially identical to that previously traced, for energizing the winding of the busy relay R740, thereby to cause the latter relay to operate, the operation of the busy relay R740 being productive of no useful result at this time. Furthermore, the stop relay R940 completes, at the contacts 944, a circuit for energizing the winding of the identity relay R670, this circuit extending from ground by way of the contacts 952 and 944, the wiper 901 and engaged contact in the associated contact bank 902 of the operator finder switch 900, C915 and the winding of R670 to battery. When thus energized, the identity relay R670 operates, the operation thereof being productive of no useful result at this time. Finally, upon operating, the stop relay R940 completes, at the contacts 941 and 942, a connection between the trunk 675 extending between the local finder switch 600 and the local connector switch 700 and the repeater 810, this circuit extending from the line conductor C676 of the trunk 675 by way of C917, the wiper 905 and engaged contact in the associated contact bank 906 of the operator finder switch 900, the contacts 942, C931, the contacts 852 of the information key K850, C825, the windings 812 and 811 of the repeater 810, the condenser 804, C824, the contacts 851 of the information key K850, C930, the contacts 941, the wiper 907 and engaged contact in the associated contact bank 908 of the operator finder switch 900, and C918 to the line conductor C677 of the trunk 675. Further, it is noted that the line conductors C676 and C677 of the trunk 675 are included in the loop circuit extending between the calling telephone station T1 and the line relay R700 in the local connector switch 700; while the receiver 802 and the transmitter 801 at the operator position 800 are operatively connected to the repeater 810. More particularly, the last-mentioned connection extends from ground by way of the receiver 802, the windings 814 and 811 of the repeater 810, the transmitter 801 and the resistor 803 to battery, the windings 812 and 814 of the repeater 810 being inductively coupled. Accordingly, at this time, a two-way communication connection is established between the calling telephone station T1 and the operator position 800. The operator at the operator position 800 then proceeds to give the subscriber at the calling telephone station T1 the desired information.

In the event the operator at the operator position 800 should desire to disconnect the trunk circuit including the repeater 810 at her position from the local link illustrated and the calling telephone station T1 and at the same time hold the connection extending from her position to the calling telephone station T1, this may be accomplished by operating the information hold key K855 away from its normal position and then returning the information key K850 to its

normal position. When the information hold key K855 is operated away from its normal position there is completed, at the contacts 856 thereof, an obvious alternative circuit for energizing the winding of the information relay R970, thereby to retain the latter relay in its operated position. When the information key K850 is returned to its normal position the previously traced original circuit for energizing the winding of the information relay R970 is interrupted at the contacts 853 thereof. Finally, at the contacts 851 and 852 of the information key K850, the previously traced circuit for connecting the repeater 810 to the conductors C930 and C931 extending to the wipers 907 and 905, respectively, of the operator finder switch 900 is interrupted. Accordingly, at this time, the trunk circuit including the repeater 810 at the operator position 800 is disconnected from the calling telephone station T1, while the connection to the telephone station T1 is held.

Subsequently the operator at the operator position 800 may again communicate with the subscriber at the calling telephone station T1 by reoperating the information key K850 away from its normal position and returning the information hold key K855 to its normal position. When the information key K850 is again operated away from its normal position the previously traced connection between the calling telephone station T1 and the repeater 810 at the operator position 800 is recompleted.

After the operator at the operator position 800 has rendered the subscriber at the telephone station T1 the desired information she may release the connection between the operator position 800 and the calling telephone station T1 by returning the information key K850 to its normal position, thereby to interrupt, at the contacts 851 and 852, the previously traced connection between the repeater 810 and the calling telephone station T1. Also, when the information key K850 is returned to its normal position the previously traced circuit for energizing the winding of the information relay R970 is interrupted, at the contacts 853 thereof, thereby to cause the information relay R970 to restore. Upon restoring, the information relay R970 interrupts, at the contacts 972, the previously mentioned circuit for energizing the winding of the control relay R950; however, the latter relay does not immediately restore, it being of the slow-to-release type. Also, upon restoring, the information relay R970 completes, at the contacts 971, a circuit for energizing the release magnet M625 of the local finder switch 600, this circuit extending from ground by way of the contacts 971, 961, 951 and 943, the wiper 903 and engaged contact in the associated contact bank 904 of the operator finder switch 900, C916, the contacts 674 and F625 to battery. When thus energized, the release magnet M625 operates, thereby to cause the first and second wiper sets of the local finder switch 600 to be released and returned to their normal positions, whereupon both the local finder switch 600 and the local connector switch 700 are released as previously explained.

Also, upon restoring, the information relay R970 interrupts, at the contacts 975, the previously traced holding circuit for energizing the lower winding of the stop relay R940, thereby to cause the latter relay to restore and interrupt, at the contacts 941 and 942, the previously traced connection between the conductors C930 and

C931 in the trunk circuit at the operator position 800 and the wipers 907 and 905 of the operator finder switch 900. Also, when the local connector switch 700 is released, the previously traced circuit for energizing the winding of the pilot relay R980 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the pilot relay R980 interrupts, at the contacts 982, the previously mentioned circuit for illuminating the information lamp L815.

At this point it is noted that the pilot relay R980 restores incident to the release of the local connector switch 700, as explained above, only in the event there are no other information calls which have not been answered by the operator at the operator position 800 at this time. On the other hand, in the event there are other information calls which have not been answered by the operator at the operator position 800 at this time, an obvious multiple circuit is completed for energizing the winding of the pilot relay R980, thereby to prevent restoration of the latter relay. Accordingly, the information lamp L815 remains illuminated in order to indicate to the operator at the operator position 800 that there are other information calls waiting to be answered.

At this time the local link illustrated and the apparatus at the operator position 800 are completely released. Also, the line circuit 690 is completely released, thereby to mark the telephone line 605 extending to the telephone station T1 as idle in the event the subscriber at the telephone station T1 has replaced the receiver of the telephone instrument thereat upon its associated switchhook at this time.

Trunk call from a station to the operator position in the P. A. B. X and trunk call from the operator position in the P. A. B. X to the central office

A trunk call which is to be extended from one of the stations to the operator position in the P. A. B. X is initiated at the calling telephone station by removing the receiver of the telephone instrument thereat from its switchhook. For example, in extending a trunk call from the telephone station T1 to the operator position 800, the call is first initiated at the station T1 by removing the receiver of the telephone instrument thereat from its switchhook, thereby to cause the line circuit 690 individually associated with the telephone line 605 extending to the calling telephone station T1 to operate as previously explained. Upon operating, the line circuit 690 initiates operation of the distributor 680, whereupon the distributor 680 assigns the previously selected local link, such, for example, as the local link illustrated, to the use of the calling telephone station T1 and causes the local finder switch 600 of the local link illustrated to seize the telephone line 605 extending to the calling telephone station T1. After the local finder switch 600 of the local link illustrated seizes the telephone line 605 extending to the calling telephone station T1, the distributor 680 operates to preselect another one of the idle links to the use of a calling telephone station as previously explained. Also, when the local finder switch 600 seizes the telephone line 605 extending to the calling telephone station T1, a loop circuit is completed between the line relay R700 in the local connector switch 700 and the calling telephone station T1 as previously explained, whereupon the local connector switch 700 is rendered

responsive to digits transmitted from the calling telephone station T1.

The subscriber at the telephone station T1 then dials the single trunk digit 4, thereby to transmit a single series of impulses by way of the previously traced loop circuit to the line relay R700 in the local connector switch 700. The line relay R700 follows the dialed impulses in the usual manner, thereby to cause the wipers noted of the control switch 790 to engage the fourth contacts in the associated contact banks in the manner previously explained. When the control switch 790 is thus operated, a circuit is completed for energizing the winding of the pilot relay R990 and a path is completed for applying battery potential to the marking conductor C920 included in the group of conductors extending between the operator finder switch 900 and the local link illustrated. The circuit for energizing the winding of the pilot relay R990 extends from ground by way of the wiper 791 and engaged fourth contact in the associated contact bank 792 of the control switch 790, C711 and the winding of R990 to battery; and the path for applying battery potential to the marking conductor C920 extends from battery by way of the winding of the busy relay R740, the contacts 733, C715 and the wiper 793 and engaged fourth contact in the associated contact bank 794 of the control switch 790 to the marking conductor C920.

The application of battery potential to the marking conductor C920 marks the position of the previously mentioned group of conductors extending to the local link illustrated and accessible to the operator finder switch 900. When thus energized, the pilot relay R990 operates to complete, at the contacts 992, an obvious circuit for illuminating the trunk lamp L816. The illumination of the trunk lamp L816 indicates to the operator at the operator position 800 that a trunk call has been initiated at one of the telephone stations in the P. A. B. X and is waiting to be answered.

In order to answer the call initiated at the telephone station T1 the operator at the operator position 800 operates the common trunk key K860 away from its normal position, thereby to complete, at the contacts 863 thereof, an obvious circuit for energizing the winding of the trunk relay R890, in order to cause the latter relay to operate. Also, at the contacts 863 and 864 of the common trunk key K860, there is completed a circuit for energizing the winding of the trunk relay R960, this circuit extending from ground by way of the contacts 863 and 864 of the common trunk key K860, C932, the contacts 266, C933 and the winding of R960 to battery. When thus energized, the trunk relay R960 operates to complete, at the contacts 962, an obvious circuit for energizing the winding of the control relay R950, thereby to cause the latter relay to operate. Also, upon operating, the trunk relay R960 completes, at the contacts 965, a circuit for energizing the intermediate winding of the stop relay R940, this circuit extending from ground by way of the contacts 991 and 965 and the intermediate winding of R940 to battery. When the intermediate winding of the stop relay R940 is thus energized, this relay is rendered extremely fast to operate when the upper winding thereof is subsequently energized. Also, upon operating, the trunk relay R960 completes, at the contacts 964 and 963, a path for applying ground potential to the wiper 909 of the operator

finder switch 900, this path extending from ground by way of the contacts 964, the upper winding of R940 and the contacts 963 to the wiper 909 of the operator finder switch 900. Finally, upon operating, the trunk relay R960 completes, at the contacts 965, a circuit for energizing the rotary magnet M913, this circuit extending from ground by way of the contacts 991, 965, 947 and 914, and the rotary magnet M913 to battery.

The rotary magnet M913 operates intermittently in order to drive the wipers noted of the operator finder switch 900 step by step in the counterclockwise direction, as previously explained, until the wiper 909 thereof engages the contact in the associated contact bank 910 terminating the marking conductor C920, whereupon a circuit is completed for energizing in series the winding of the busy relay R740 and the upper winding of the stop relay R940. This circuit extends from ground by way of the contacts 964, the upper winding of R940, the contacts 963, the wiper 909 and engaged contact in the associated contact bank 910 of the operator finder switch 900, the marking conductor C920, the wiper 793 and engaged fourth contact in the associated contact bank 794 of the control switch 790, C715, the contacts 733 and the winding of R740 to battery. When the upper winding of the stop relay R740 is thus energized, this relay operates exceedingly fast to complete, at the contacts 946, a holding circuit for energizing the lower winding thereof, this circuit extending from ground by way of the contacts 991, 965 and 946, and the lower winding of R940 to battery. Also, upon operating, the stop relay R940 interrupts, at the contacts 947, the previously traced circuit for energizing the rotary magnet M913, thereby positively to arrest further operation of the operator finder switch 900 at this time. Further, the stop relay R940 completes, at the contacts 945, an obvious path for short-circuiting the upper winding thereof, thereby to render this relay slightly slow to release when the previously traced holding circuit for energizing the lower winding thereof is interrupted. Also, the stop relay R940 completes, at the contacts 945, a low resistance circuit, substantially identical to that previously traced, for energizing the winding of the busy relay R740, thereby to cause the latter relay to operate, the operation of this relay being without effect at this time. Further, the stop relay R940 completes, at the contacts 941 and 942, a connection between the trunk 675 extending between the local finder switch 600 and the local connector switch 700 and the repeater 810 at the operator position 800, this connection extending from the line conductor C676 of the trunk 675 by way of C917, the wiper 905 and engaged contact in the associated contact bank 906 of the operator finder switch 900, the contacts 942, C931, the contacts 862 of the common trunk key K860, C825, the windings 812 and 811 of the repeater 810, the condenser 804, C824, the contacts 861 of the common trunk key K860, C930, the contacts 941, the wiper 907 and engaged contact in the associated contact bank 908 of the operator finder switch 900 and C918 to the line conductor C677 of the trunk 675, the line conductors C676 and C677 of the trunk 675 being included in the previously traced loop circuit extending between the calling telephone station T1 and the line relay R700 in the local connector switch 700. Accordingly, at this time, a two-way communication connection is com-

pleted between the operator position 800 and the calling telephone station T1.

Also, upon operating, the stop relay R940 completes, at the contacts 944, the previously traced circuit for energizing the winding of the identity relay R670, thereby to cause the latter relay to operate. Upon operating, the trunk relay R890 completes, at the contacts 891 and 892, connections between the conductors C930 and C931 and the repeater 810 at the operator position 800 independently of the contacts 861 and 862 of the common trunk key K860. Also, upon operating, the trunk relay R890 completes, at the contacts 894, a circuit for energizing the winding of the start relay R310 in the identity lamps and trunk finder start unit 300, this circuit extending from ground by way of the contacts 894, C826 and the winding of R310 to battery. When thus energized, the start relay R310 operates to complete, at the contacts 317, an obvious circuit for energizing in multiple the windings of the marking relays R320 and R330, thereby to cause the latter relays to operate.

Also, upon operating, the start relay R310 completes, at the contacts 311 or 312, a circuit for illuminating the identity lamp CL1 or CL2, depending upon which of the switching relays R640 or R650 in the local finder switch 600 is operated, which, in turn, depends upon which group of one hundred lines includes the calling line seized by the local finder switch 600. In the present instance the telephone line 605 extending to the calling telephone station T1 is included in the first group of one hundred lines, thereby to complete the previously mentioned circuit for illuminating the identity lamp CL1, the switching relay R640 in the local finder switch 600 being operated at this time. The circuit for illuminating the identity lamp CL1 extends from ground by way of the contacts 673 and 642, C642, the contacts 311 and the identity lamp CL1 to battery. Upon operating, the marking relay R330 completes a circuit for illuminating one of the identity lamps DL1 to DL10, inclusive, depending upon the particular group of ten lines including the telephone line seized by the local finder switch 600. In the present instance the telephone line 605 extending to the calling telephone station T1 is included in the first group of ten lines. Accordingly, operation of the marking relay R330 is effective to complete, at the contacts 331, a circuit for illuminating the identity lamp DL1, this circuit extending from ground by way of the contacts 671, the vertical control wiper 611, C640, the contacts 331 and the identity lamp DL1 to battery. Upon operating, the marking relay R320 completes a circuit for illuminating one of the identity lamps UL1 to UL10, inclusive, depending upon the particular position of the telephone line seized by the local finder switch 600 in the associated group of ten lines. In the present instance the telephone line 605 extending to the calling telephone station T1 occupies the first position in the associated group of ten lines. Accordingly, operation of the marking relay R320 is effective to complete, at the contacts 321, a circuit for illuminating the identity lamp UL1, this circuit extending from ground by way of the identity lamp UL1, the contacts 321, C641, the rotary control wiper 612, the contacts 672 and the resistor 679 to battery.

The illumination of the identity lamps CL1, DL1 and UL1 in the identity lamps and trunk finder start unit 300 associated with the operator

position 800 indicates to the operator thereat that the directory number of the calling telephone station in the P. A. B. X is 111, this directory number identifying the telephone station T1.

At this point it is noted that the operator at the operator position 800 may immediately select an idle trunk extending between the central office 50 and the P. A. B. X 60 for the use of the calling telephone station T1 and cause the trunk finder switch of the selected trunk to seize the telephone line 605 extending to the calling telephone station T1 or she may first converse with the subscriber at the calling telephone station T1 and then subsequently select an idle trunk for the use of the subscriber thereat. Further, it is noted that after an idle trunk extending between the central office 50 and the P. A. B. X 60 has been associated with the telephone line 605 extending to the calling telephone station T1, either the operator at the operator position 800 or the subscriber at the calling telephone station T1 may dial the number in order to cause the desired connection to be completed at the central office 50 as explained more fully herein-after.

In the event all of the trunk lines extending between the central office 50 and the P. A. B. X 60 are busy at this time, the operator at the operator position 800 answers the call and so advises the subscriber at the calling telephone station T1. Under these conditions the operator at the operator position 800 may desire to hold the connection to the calling telephone station T1 and at the same time free the trunk circuit at her position of this connection. This may be accomplished by operating the common trunk hold key K865 away from its normal position and then operating the common trunk key K860 back to its normal position. When the common trunk hold key K865 is operated away from its normal position an alternative circuit is completed, at the contacts 866 thereof, for energizing the winding of the trunk relay R960, this circuit extending from ground by way of the contacts 866 of the common trunk hold key K865, C932, the contacts 266, C933 and the winding of R960 to battery. The operated trunk relay R960 holds the connection to the calling telephone station T1. When the common trunk key K860 is returned to its normal position the previously mentioned circuit for energizing the winding of the trunk relay R890 is interrupted at the contacts 863 thereof and the previously traced original circuit for energizing the winding of the trunk relay R960 is interrupted at the contacts 863 and 864 thereof. Finally, at the contacts 861 and 862 of the common trunk key K860, the previously traced connection between the repeater 810 and the operator finder switch 900 is interrupted. The trunk relay R890 then restores to interrupt, at the contacts 894, the previously traced circuit for energizing the winding of the start relay R310, thereby to cause the latter relay to restore. Upon restoring, the start relay R310 interrupts, at the contacts 317, the previously traced circuit for energizing in multiple the windings of the marking relays R320 and R330, thereby to cause the last-mentioned relays to restore. When the start relay R310 and the marking relays R320 and R330 restore, the previously traced circuits for illuminating the identity lamps CL1, DL1 and UL1 are interrupted, thereby to cause the last-mentioned lamps to be extinguished.

Subsequently, when one of the trunk lines ex-

tending between the central office 50 and the P. A. B. X 60 becomes idle, the operator at the operator position 800 may reestablish the connection between her position and the calling telephone station T1 by operating the common trunk key K860 away from its normal position and by returning the common trunk hold key K865 to its normal position. When the common trunk key K860 is again operated away from its normal position, the previously traced connection between the repeater 810 at the operator position 800 and the calling telephone station T1 is recompleted. Also, the trunk relay R890, the start relay R310 and the marking relays R320 and R330 reoperate. Upon reoperating, the start relay R310 and the marking relays R320 and R330 recomplete the previously traced circuits for illuminating the identity lamps CL1, DL1 and UL1.

The operator at the operator position 800 then selects an idle trunk line extending between the central office 50 and the P. A. B. X 60, such, for example, as the trunk line 490, by operating the individual trunk key K480 individually associated with the trunk line 490 to its talk position, the trunk line 490 being marked as idle at this time as the busy lamp L405 individually associated therewith is extinguished. When the individual trunk key K480 is operated to its talk position there is completed, at the contacts 487 thereof, a circuit for energizing the upper winding of the connect relay R540 in the trunk finder switch 500 individually associated with the trunk line 490. The circuit for energizing the upper winding of the connect relay R540 extends from ground by way of the contacts 896, the conductor C829 in the cable 820, the contacts 487 of the individual trunk key K480, C471 and the upper winding of R540 to battery. When the upper winding of the connect relay R540 is thus energized, this relay operates to complete, at the contacts 544', a holding circuit for energizing the lower winding thereof in series with the winding of the talk relay R895, this circuit extending from ground by way of the winding of R895, the conductor C828 in the cable 820, the contacts 486 of the individual trunk key K480, C472, the contacts 544' and the lower winding of R540 to battery. When this series circuit is completed the talk relay R895 operates to interrupt, at the contacts 896, the previously traced circuit for energizing the upper winding of the connect relay R540. More particularly, the talk relay R895 interrupts, at the contacts 896, the previously traced path for applying ground potential to the conductor C829 in the cable 820, thereby positively to prevent operation of the connect relay in any of the other trunk finder switches at this time in the event the individual trunk key associated with another trunk finder switch and trunk line is inadvertently operated. In other words, the operation of the talk relay R895 prevents any of the other trunk lines extending between the central office 50 and the P. A. B. X 60 from being connected to the trunk circuit at the operator position 800 at this time. Also, upon operating, the talk relay R895 completes, at the contacts 897, an alternative circuit for energizing the winding of the trunk relay R890 in the event the common trunk hold key K865 is operated at this time. The alternative circuit for energizing the winding of the trunk relay R890 extends, when completed, from ground by way of the contacts 866 of the common trunk hold key K865 by way of C932, the

contacts 897, C907 and the winding of R890 to battery.

Also, upon operating, the connect relay R540 completes, at the contacts 541 and 544, a loop circuit between the windings of the line relay R425 in the trunk circuit 400 and the calling telephone station T1. This loop circuit extends from ground by way of the lower winding of the line relay R425, the lower winding of the control relay R420, the winding 414 of the repeater 410, C437, the contacts 544, the conductor C834 in the cable 820 and the contacts 886 to the conductor C824, and from battery by way of the upper winding of the line relay R425, the upper winding of the control relay R420, the winding 413 of the repeater 410, C436, the contacts 541, the conductor C833 in the cable 820 and the contacts 889' to the conductor C825, the conductors C824 and C825 being connected by way of the previously traced circuit including the operator finder switch 900, the local finder switch 600 and the telephone line 605 to the calling telephone station T1. Also, it is noted that the windings 811 and 812 of the repeater 810 at the operator position 800 are connected across the conductors C824 and C825. When this loop circuit is completed, the windings of the line relay R425 and the windings of the control relay R420 are energized. The line relay R425 operates; however, the control relay R420 does not operate, the latter relay being of the differential type. Upon operating, the line relay R425 completes, at the contacts 427, an obvious circuit for energizing the winding of the hold relay R430, thereby to cause the latter relay to operate. Upon operating, the hold relay R430 completes, at the contacts 433, a circuit for illuminating the busy lamp L405, this circuit extending from ground by way of the contacts 433, the contacts 482 of the individual trunk key K480, and the busy lamp L405 to battery. The illumination of the busy lamp L405 indicates to the operator at the operator position 800 that the individually associated trunk line 490 extending between the central office 50 and the P. A. B. X 60 is busy.

Also, upon operating, the line relay R425 completes, at the contacts 426, a bridge path between the line conductors C491 and C492 of the trunk line 490 extending between the central office 50 and the P. A. B. X 60, this bridge path extending from the line conductor C491 of the trunk line 490 by way of the contacts 451, C446, the winding 411 of the repeater 410, the contacts 426, the winding 412 of the repeater 410, C447 and the contacts 454 to the line conductor C492 of the trunk line 490. When this bridge path between the line conductors C491 and C492 of the trunk line 490 is completed, the switching apparatus in the central office 50 is seized and is rendered responsive to impulses transmitted over the trunk line 490.

Also, upon operating, the connect relay R540 completes, at the contacts 542', a circuit for energizing the winding of the start relay R570 in the trunk finder switch 500, this circuit extending from ground by way of the contacts RA527, RA517, the winding of R570, the contacts 542' the conductor C211 in the cable 210, the contacts 313 and the resistor 303 to battery. When thus energized, the start relay R570 operates to complete, at the contacts 575, an obvious holding circuit for energizing the winding thereof independently of the contacts 542' of the connect relay R540. Also, upon operating, the start relay R570 interrupts, at the contacts 573, a further

point in a circuit, traced hereinafter, for energizing the release magnet M523 of the mechanism 510 and completes, at the contacts 574, a circuit for energizing in multiple the lower windings of the switching relays R510 and R520, this circuit extending from ground by way of the contacts 314, the conductor C214 in the cable 210, the contacts 574 and the lower winding of R510 to battery, and from the contacts 574 by way of the contacts RA516 and the lower windings of R520 to battery. When the lower windings of the switching relays R510 and R520 are thus energized, these relays are rendered exceedingly fast to operate when the upper windings thereof are energized. Further, the start relay R570 completes, at the contacts 575, a circuit for energizing in series the winding thereof and the winding of the start relay R275 in the operator key set and marking circuit 200, this circuit extending from ground by way of the contacts RA527, RA517, the winding of R570, the contacts 575, the conductor C211 in the cable 210, the contacts 271 and the winding of R275 to battery. When thus energized, the start relay R275 operates to complete, at the contacts 276, an obvious circuit for energizing the winding of the release relay R265, thereby to cause the latter relay to operate. Also, upon operating, the start relay R275 completes, at the contacts 277, an alternative connection between the conductors C932 and C933 in the trunk circuit at the operator position 800; while the release relay R265 interrupts, at the contacts 266, the previously traced connection between the conductors C932 and C933.

Further, the start relay R570 completes, at the contacts 578, a circuit for energizing the lower winding of the cut-off relay R550, this circuit extending from ground by way of the contacts 893, the conductor C835 in the cable 820, the contacts 578 and the lower winding of R550 to battery. When thus energized, the cut-off relay R550 operates for a purpose more fully explained subsequently. Also, the start relay R570 completes, at the contacts 574, a circuit for energizing the vertical magnet M519 of the mechanism 510, this circuit extending from the grounded conductor C214 in the cable 210 by way of the contacts 574, RA516, RA526, 586 and 591, and M519 to battery. When the vertical magnet M519 is thus energized, it operates to drive the first and second wiper sets of the mechanism 510 one step in the vertical direction and to complete, at the contacts 520, an obvious circuit for energizing the winding of the step relay R585, thereby to cause the latter relay to operate. Upon operating, the step relay R585 interrupts, at the contacts 586, the previously traced circuit for energizing the vertical magnet M519, thereby to cause the vertical magnet M519 to restore and interrupt, at the contacts 520, the previously mentioned circuit for energizing the winding of the step relay R585, whereupon the step relay R585 restores and re completes, at the contacts 586, the previously traced circuit for energizing the vertical magnet M519.

The vertical magnet M519 and the step relay R585 interact in the above described manner until the vertical control wiper 518 of the mechanism 510 engages a contact in the associated vertical control contact bank terminating a conductor having ground potential thereon. In the present example the first and second wiper sets of the mechanism 510 are driven one step in the vertical direction, whereupon the vertical con-

trol wiper 518 engages the first contact in the associated vertical control contact bank having ground potential thereon, whereupon a circuit is completed for energizing in series the lower winding of the transfer relay R590 and the winding of the step relay R585, this circuit extending from ground by way of the contacts 671, the vertical control wiper 611, C640, the contacts 331, C281, the vertical control wiper 518 and engaged first contact in the associated vertical control contact bank, the lower winding of R590, the contacts 593 and the winding of R585 to battery. When the lower winding of the transfer relay R590 is thus energized, this relay operates to complete, at the contacts 594, a holding circuit for energizing the upper winding thereof, this circuit extending from the grounded conductor C214 in the cable 210 by way of the contacts 574, RA516, RA526 and 594, and the upper winding of R590 to battery. Also, upon operating, the transfer relay R590 interrupts, at the contacts 591, a further point in the previously traced circuit for energizing the vertical magnet M519, thereby positively to arrest further operation of the vertical magnet M519 at this time. Further, the transfer relay R590 prepares, at the contacts 592, a circuit, traced hereinafter, for energizing the winding of the rotary magnet M521 of the mechanism 510 and interrupts, at the contacts 593, the previously traced series circuit for energizing the lower winding thereof and the winding of the step relay R585, thereby to cause the step relay R585 to restore. Upon restoring, the step relay R585 completes, at the contacts 586, the previously mentioned circuit for energizing the rotary magnet M521, this circuit extending from the grounded conductor C214 in the cable 210 by way of the contacts 574, RA516, RA526, 586 and 592, and M521 to battery. When thus energized, the rotary magnet M521 operates to drive the first and second wiper sets of the mechanism 510 one step in the rotary direction and to complete, at the contacts 522, an obvious circuit for energizing the winding of the step relay R585, thereby to cause the latter relay to operate. Accordingly, the rotary magnet M521 and the step relay R585 interact in a manner similar to that previously explained, thereby to cause the first and second wiper sets of the mechanism 510 to be driven step by step in the rotary direction until the rotary control wiper 517 engages a contact in the associated rotary control contact bank having battery potential thereon, at which time a circuit is completed for energizing the upper winding of the switching relay R510 or the upper winding of the switching relay R520, depending upon which of the switching relays R640 or R650 in the local finder switch 600 is operated at this time. In the present instance the switching relay R640 in the local finder switch 600 is operated due to the fact that the telephone line 605 extending to the calling telephone station T1 is included in the first group of one hundred lines. Accordingly, when the rotary control wiper 517 engages the first contact in the associated rotary control contact bank a circuit is completed for energizing the upper winding of the switching relay R510, this circuit extending from ground by way of the contacts 673 and 642, C642, the contacts 315, the marking conductor C213 in the cable 210, the contacts 572, the upper winding of R510, the contacts RA514 and RA524, the rotary control wiper 517, C291, the contacts 321, C641, the ro-

tary control wiper 612, the contacts 672 and the resistor 679 to battery.

When the upper winding of the switching relay R510 is thus energized, this relay operates to complete, at the contacts RA515, a holding circuit for energizing the intermediate winding thereof, this circuit extending from ground by way of the contacts 873 of the release key K870, the conductor C823 in the cable 820, the contacts 485 of the individual trunk key K480, C470, the contacts RA515 and the intermediate winding of R510 to battery. Also, upon operating the switching relay R510 interrupts, at the contacts RA516, the previously traced circuit for energizing the rotary magnet M521, thereby positively to arrest further operation of the rotary magnet M521 at this time. Also, the switching relay R510 interrupts, at the contacts RA517, a point in the previously mentioned circuit for energizing the release magnet M523 and interrupts, at the contacts RA514, a point in a circuit, substantially identical to that previously traced, for energizing the upper winding of the switching relay R520, thereby positively to prevent operation of the switching relay R520 at this time.

Also, it is noted that when the first and second wiper sets of the mechanism 510 are driven one step in the vertical direction the sets of switch springs S524 and S525 are actuated into engagement, thereby respectively to complete an obvious holding circuit for energizing the lower winding of the cut-off relay R550 and to prepare a further point in the previously mentioned circuit for energizing the release magnet M523.

Also, upon operating, the switching relay R510 interrupts, at the contacts RA517, the previously traced series circuit for energizing the winding of the start relay R570 and the winding of the start relay R275, thereby to cause these relays to restore. Upon restoring, the start relay R570 interrupts, at the contacts 572, the previously traced circuit for energizing the upper winding of the switching relay R510, prepares, at the contacts 573, a further point in the previously mentioned circuit for energizing the release magnet M523, interrupts, at the contacts 574, the previously traced circuit for energizing in multiple the lower windings of the switching relays R510 and R520, and interrupts, at the contacts 575, a further point in the previously traced holding circuit for energizing the winding thereof. Finally, the start relay R570 completes, at the contacts 577, an alternative path for applying ground potential to the control conductor C608 of the telephone line 605, this path extending from ground by way of the contacts 567, 577 and RA516, C533 and the wiper 513 to the control conductor C603 of the telephone line 605. The application of ground potential to the control conductor C608 of the telephone line 605 retains the line and cut-off relay R690 in the line circuit 690 in its fully operated position and marks the telephone line 605 as busy to the switches having access thereto as previously explained.

Also, it is noted that, upon operating, the switching relay R510 interrupts, at the contacts RA516, the previously traced holding circuit for energizing the upper winding of the transfer relay R590, thereby to cause the latter relay to restore. Finally, upon restoring, the start relay R570 interrupts, at the contacts 578, the previously traced original circuit for energizing the lower winding of the cut-off relay R550.

Further, upon operating, the switching relay

R510 completes, at the contacts RA512 and RA513, a loop circuit between the line relay R425 in the trunk circuit 400 and the calling telephone station T1 including the trunk circuit at the operator position 800. This loop circuit extends from ground by way of the lower winding of R425, the lower winding of R420, the winding 414 of the repeater 410, C437, the contacts 544, the conductor C834 in the cable 820, the contacts 886, the conductor C824 in the cable 820, the contacts 545, 555, 565 and RA513, C532 and the wiper 512 to the line conductor C607 of the telephone line 605, and from battery by way of the upper winding of R425, the upper winding of R420, the winding 413 of the repeater 410, C436, the contacts 541, the conductor C833 in the cable 820, the contacts 889', the conductor C825 in the cable 820, the contacts 542, the winding of the hold relay R505, the contacts 552, 562 and RA512, C531 and the wiper 511 to the line conductor C606 of the telephone line 605, the line conductors C606 and C607 of the telephone line 605 being connected together by way of the bridge path at the calling telephone station T1. When this loop circuit is completed, the hold relay R505 in the trunk finder switch 500 operates.

Upon restoring, the start relay R275 interrupts, at the contacts 276, the previously mentioned circuit for energizing the winding of the release relay R265, thereby to cause the latter relay to restore shortly thereafter, the latter relay being of the slow-to-release type. Also, upon restoring, the start relay R275 interrupts, at the contacts 277, the previously traced connection between the conductors C932 and C933 in the trunk circuit at the operator position 800, thereby to interrupt the previously traced circuit for energizing the winding of the trunk relay R960, whereupon the latter relay restores, the restoration of the trunk relay R960 is effective to cause the release of the local link illustrated in a manner more fully explained hereinafter.

It is noted that just prior to the release of the local link illustrated alternative loop circuits are completed between the calling telephone station T1 and the line relay R425 in the trunk circuit 400, one of these loop circuits including the local finder switch 600, the other of these loop circuits including the trunk finder switch 500, and both of these loop circuits including the trunk circuit at the operator position 800. When the loop circuit including the trunk finder switch 500 is completed the winding of the hold relay R505 is energized, thereby to cause the latter relay to operate as previously noted. Upon operating, the hold relay R505 completes, at the contacts 506, a circuit for energizing in series the upper and lower windings of the tone relay R820, this circuit extending from ground by way of the contacts 506 and 540, the conductor C827 in the cable 820 and the lower and upper windings of R820 to battery. When the lower and upper windings of the tone relay R820 are thus energized, this relay operates shortly thereafter, this relay being of the combination slow-to-operate and slow-to-release type, to complete, at the contacts 821, an obvious path for short-circuiting the lower winding thereof. When the lower winding of the tone relay R820 is thus short-circuited, this relay restores shortly thereafter. Accordingly, the tone relay R820, being of the combination slow-to-operate and slow-to-release type, operates and restores at a relatively slow rate. Each time the tone relay R820 operates,

it completes, at the contacts 822, an obvious circuit for energizing the winding 813 of the repeater 810; and each time the tone relay R820 restores, it interrupts, at the contacts 822, the previously mentioned circuit for energizing the winding 813 of the repeater 810. Accordingly, the winding 813 of the repeater 810 is intermittently energized, thereby to cause corresponding voltages to be intermittently induced in the winding 811 of the repeater 810. The intermittent voltages induced in the winding 811 of the repeater 810 cause corresponding operations of the receiver 802 at the operator position 800 and the receiver of the telephone instrument at the calling telephone station T1, thereby to indicate to the operator at the operator position 800 and the subscriber at the calling telephone station T1 that a connection has been established between the calling telephone station T1 and the trunk line 490 extending to the central office 50 and that the apparatus at the central office 50 is prepared to receive the digits to be dialed therein.

When the operator at the operator position 800 receives the tone produced by the receiver 802 she operates the common trunk key K860 back to its normal position, thereby to interrupt, at the contacts 863 and 864, further points in the previously traced circuit for energizing the winding of the trunk relay R960, thereby positively to prevent reoperation of this relay at this time.

The restoration of the trunk relay R960 is effective to cause the release of the local link illustrated, as previously noted. More particularly, upon restoring, the trunk relay R960 interrupts, at the contacts 962, the previously traced circuit for energizing the winding of the control relay R950; however, the latter relay, being of the slow-to-release type, does not immediately restore. Also, the trunk relay R960 completes, at the contacts 961, a circuit for energizing the release magnet M625 of the mechanism 610, this circuit extending from ground by way of the contacts 971, 961, 951 and 943, the wiper 903 and engaged contact in the associated contact bank 904 of the operator finder switch 900, C916, the contacts 674 and M625 to battery. When the release magnet M625 is thus operated, the first and second wiper sets of the mechanism 610 are released and returned to their normal positions, whereupon the local finder switch 600 and the local connector switch 700 are released in the manner previously explained. Also, upon restoring, the trunk relay R960 interrupts, at the contacts 965, the previously traced holding circuit for energizing the lower winding of the stop relay R940, thereby to cause the latter relay to restore. Upon restoring, the stop relay R940 interrupts, at the contacts 941 and 942, the previously traced connection between the conductors C930 and C931 in the trunk circuit at the operator position 800 and the operator finder switch 900. Also, when the local connector switch 700 is released, the previously traced circuit for energizing the winding of the pilot relay R990 is interrupted, thereby to cause the latter relay to restore and interrupt, at the contacts 992, the previously mentioned circuit for illuminating the trunk lamp L816.

At this point it is noted that the pilot relay R990 does not restore in the event there are other trunk calls waiting to be answered by the operator at the operator position 800 at this time, the trunk lamp L816 being extinguished only in the event the pilot relay R990 restores.

Also, when the common trunk key K860 is operated back to its normal position, the previously

traced circuit for energizing the winding of the trunk relay R890 is interrupted at the contacts 863 thereof, thereby to cause the latter relay to restore. Upon restoring, the trunk relay R890 interrupts, at the contacts 893, the previously traced original circuit for energizing the lower winding of the cut-off relay R550, the previously traced holding circuit for energizing the lower winding of the cut-off relay R550 being completed at this time. Further, the trunk relay R890 interrupts, at the contacts 894, the previously traced circuit for energizing the winding of the start relay R310, thereby to cause the latter relay to restore and interrupt, at the contacts 317, the previously traced circuit for energizing in multiple the windings of the marking relays R320 and R330, whereupon the latter relays restore. When the start relay R310 and the marking relays R320 and R330 restore, the previously traced circuits for illuminating the identity lamps CL1, DL1 and UL1 are interrupted, thereby to cause the last-mentioned lamps to be extinguished.

As previously noted, the number which is to be dialed over the trunk line 490 in order to cause the switching apparatus at the central office 50 to set up the desired connection may be dialed either by the operator at the operator position 800 or by the subscriber at the calling telephone station T1. Assuming that the digits are to be dialed by the operator at the operator position 800, this is accomplished by operating the dial 805. When the dial 805 is operated away from its normal position an obvious circuit is completed, at the contacts 806 thereof, for energizing the winding of the dial relay R880, thereby to cause the latter relay to operate and complete, at the contacts 881, an obvious circuit for energizing the winding of the control relay R885. When the winding of the control relay R885 is thus energized, this relay operates to interrupt, at the contacts 886 and 889', the previously traced connections between the conductors C833, C834 and C825, C824 in the cable 820 and to complete, at the contacts 887 and 889, an alternative loop circuit between the line relay R425 in the trunk circuit 400 and the dial 805. The alternative loop circuit between the line relay R425 in the trunk circuit 400 and the dial 805 extends from ground by way of the lower winding of R425, the lower winding of R420, the winding 414 of the repeater 410, C437, the contacts 544, the conductor C834 in the cable 820, the contacts 887, C805, the impulsing contacts 807 of the dial 805, C806, the contacts 871 of the release key K870, the contacts 889, the conductor C833 in the cable 820, the contacts 541, C436, the winding 413 of the repeater 410, the upper winding of R420 and the upper winding of R425 to battery. Accordingly, the upper and lower windings of the line relay R425 are energized at this time. Also, upon operating, the dial relay R880 and the control relay R885 complete, at the contacts 882 and 888, respectively, obvious multiple connections between the conductors C824 and C825 in the trunk circuit at the operator position 800, the conductors C824 and C825 being connected by way of the previously traced circuit to the telephone instrument at the calling telephone station T1 at this time. When the dial 805 is released, the impulsing contacts 807 thereof are actuated alternately into disengagement and engagement a predetermined number of times corresponding to the digit to be transmitted, thereby to cause a corresponding number of impulses to be transmitted therefrom to the line relay R425 in the

trunk circuit 400. The line relay R425 follows the impulses transmitted thereto, restoring each time the loop circuit is interrupted and operating each time the loop circuit is recompleted. Each time the line relay R425 restores, it interrupts, at the contacts 426, the previously traced bridge path extending between the line conductors C491 and C492 of the trunk line 490 and interrupts, at the contacts 427, the previously mentioned circuit for energizing the winding of the hold relay R430; and each time the line relay R425 operates, it completes, at the contacts 426, the previously traced bridge path between the line conductors C491 and C492 of the trunk line 490 and completes, at the contacts 427, the previously mentioned circuit for energizing the winding of the hold relay R430. Accordingly, impulses are transmitted over the trunk line 490 to the switching apparatus in the central office 50; and the hold relay R430 remains in its operated position during impulsing, this relay being of the slow-to-release type. When the dial 805 is returned to its normal position the contacts 806 thereof are actuated into disengagement, thereby to interrupt the previously traced circuits for energizing the winding of the dial relay R880 in multiple with the winding of the control relay R885. The dial relay R880 restores immediately; however, the control relay R885, being of the slow-to-release type, does not immediately restore. Accordingly, the dial 805 may be actuated a number of times corresponding to the number of digits in the number, thereby to transmit the number to the central office 50, the control relay R885 remaining in its operated position during the dialing interval.

After all of the digits of the number have been transmitted the dial 805 is operated back to its normal position, thereby to interrupt, at the contacts 806 thereof, the previously traced multiple circuit for energizing the winding of the dial relay R880 and the winding of the control relay R885. The dial relay R880 restores immediately and the control relay R885 restores shortly thereafter. Upon restoring, the control relay R885 interrupts, at the contacts 887 and 889, the previously traced alternative loop circuit between the dial 805 and the line relay R425 in the trunk circuit 400 and re completes, at the contacts 886 and 889, the previously traced loop circuit between the line relay R425 and the calling telephone station T1. The switching apparatus in the central office 50 responds to the digits comprising the number transmitted over the trunk line 490, thereby to cause a connection to be set up in the central office 50 in the usual manner. When the connection is completed in the central office 50 a three-way communication connection is established including the called telephone station in the central office 50, the calling telephone station T1 and the operator position 800. Hence, it will be understood that the operator at the operator position 800 may converse with either the subscriber at the calling telephone station T1 or the subscriber at the telephone station in the central office 50, or she may merely monitor the established connection, as conditions require.

Completion of a direct connection between a station in the P. A. B. X and the central office

In the event the operator at the operator position 800 should desire to free the trunk circuit at her position from the established connection between the calling telephone station T1 and the

central office 50 and complete a direct connection between the calling telephone station T1 and the central office 50, this may be accomplished by merely returning the individual trunk key K480 individually associated with the trunk line 490 to its normal position, thereby to interrupt, at the contacts 486 thereof, the previously traced holding circuit for energizing the lower winding of the connect relay R540 in series with the winding of the talk relay R895, whereupon the relays mentioned restore. Also, when the individual trunk key K480 is returned to its normal position an alternative holding circuit is completed, at the contacts 484 thereof, for energizing the intermediate winding of the switching relay R510, this circuit extending from ground by way of the contacts 433, the contacts 484 of the individual trunk key K480, C470, the contacts RA515 and the intermediate winding of R510 to battery. Upon restoring, the connect relay R540 interrupts, at the contacts 540, the previously traced circuit for energizing the winding of the tone relay R820, thereby to cause the latter relay to restore. Further, the connect relay R540 interrupts, at the contacts 541, 542, 544 and 545, the previously traced loop circuit between the calling telephone station T1 and the line relay R425 in the trunk circuit 400 including the trunk circuit at the operator position 800 and completes, at the contacts 543 and 546, a direct loop circuit between the calling telephone station T1 and the line relay R425 in the trunk circuit 400. This direct loop circuit extends from ground by way of the lower winding of R425, the lower winding of R420, the winding 414 of the repeater 410, C437, the contacts 546, 555, 565 and RA513, C532, and the wiper 512 to the line conductor C607 of the telephone line 605, and from battery by way of the upper winding of R425, the upper winding of R420, the winding 413 of the repeater 410, C436, the contacts 543, the winding of R505, the contacts 552, 562 and RA512, C531, and the wiper 511 to the line conductor C606 of the telephone line 605, the line conductors C606 and C607 of the telephone line 605 being connected together by way of the bridge path at the calling telephone station T1. Also, it is noted that the condenser 415 is connected between the windings 413 and 414 of the repeater 410, thereby to cause voice frequency currents to by-pass the windings of the control relay R420 and the windings of the line relay R425. Accordingly, it will be understood that signal currents will be repeated in either direction by the repeater 410 between the branches 445 and 435 of the trunk circuit 400 and consequently between the central office 50 and the calling telephone station T1.

Upon restoring, the talk relay R895 re completes, at the contacts 896, the previously traced path for applying ground potential to the conductor C829 in the cable 820, thereby to prepare the previously mentioned circuits for energizing the connect relays in the trunk finder switches, thereby to permit any one of the trunk finder switches to be associated with the trunk circuit at the operator position 800 at this time. Upon restoring, the tone relay R820 interrupts, at the contacts 822, the previously traced circuit for energizing the winding 813 of the repeater 810.

Accordingly, at this time a connection is established between the calling telephone station T1 and the central office 50 excluding the operator position 800. It is noted that this connection may be released under the control of the subscriber at the calling telephone station T1 without the

assistance of the operator at the operator position 800 merely by replacing the receiver of the telephone instrument thereat upon its switchhook. When the receiver of the telephone instrument at the telephone station T1 is replaced upon its switchhook the bridge path between the line conductors C606 and C607 of the telephone line 605 is interrupted, thereby to interrupt the loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400, whereupon the line relay R425 restores. Upon restoring, the line relay R425 interrupts, at the contacts 426, the loop circuit extending between the repeater 410 and the central office 50 including the trunk line 490, thereby to cause the switching apparatus in the central office 50 to be released. Also, upon restoring, the line relay R425 interrupts, at the contacts 427, the previously mentioned circuit for energizing the winding of the hold relay R430, thereby to cause the latter relay to restore shortly thereafter, this relay being of the slow-to-release type. Upon restoring, the hold relay R430 interrupts, at the contacts 433, the previously traced circuit for illuminating the busy lamp L405 and the previously traced alternative holding circuit for energizing the intermediate winding of the switching relay R510, thereby to cause the busy lamp L405 to be extinguished and the switching relay R510 to restore. When the busy lamp L405 is extinguished the trunk line 490 extending between the central office 50 and the P. A. B. X 60 and the trunk circuit 400 individually associated therewith are marked as idle.

Upon restoring, the switching relay R510 completes, at the contacts RA517, the previously mentioned circuit for energizing the release magnet M523 of the mechanism 510, this circuit extending from ground by way of the contacts RA527, RA517 and 573, the set of switch springs S525 and the winding of the release magnet M523 to battery. When thus energized, the release magnet M523 operates to release the first and second wiper sets of the mechanism 510 and to cause these wiper sets to be returned to their normal positions. When the first and second wiper sets of the mechanism 510 are returned to their normal positions the sets of switch springs S524 and S525 are actuated into disengagement, thereby respectively to interrupt the previously traced holding circuit for energizing the lower winding of the cut-off relay R550 and the previously traced circuit for energizing the release magnet M523. The release magnet M523 immediately restores and the cut-off relay R550 restores shortly thereafter, the latter relay being of the combination slow-to-operate and slow-to-release type. Also, when the loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400 is interrupted, the hold relay R505 restores. Accordingly, at this time, the trunk finder switch 500 is completely released and the trunk line 490 extending between the central office 50 and the P. A. B. X 60 is available for further use. Finally, upon restoring, the switching relay R510 interrupts, at the contacts RA518, the previously traced path for applying ground potential to the control conductor C608 of the telephone line 605, thereby to interrupt the previously traced holding circuit for energizing the intermediate winding of the line and cut-off relay R690 in the line circuit 690, whereupon the latter relay restores. At this time the line circuit 690 is completely released and the telephone line 605 extending to the telephone station T1 is

marked as idle to the switches having access thereto.

Trunk call from the central office to the operator position in the P. A. B. X and from the operator position to a station in the P. A. B. X

Calls from the central office 50 are normally extended by way of one of the trunk lines extending between the central office 50 and the P. A. B. X 60 to the operator position 800 in the P. A. B. X 60 to be answered when the operator is on duty in the P. A. B. X 60. In order to extend a call from the central office 50 to the operator position 800 in the P. A. B. X 60 the switching apparatus in the central office 50 is controlled, thereby to cause it to seize an idle one of the trunk lines, such, for example, as the trunk line 490 extending between the central office 50 and the P. A. B. X 60. After the switching apparatus in the central office 50 seizes the idle trunk line 490 ringing current is projected thereover, thereby to complete a circuit for energizing the upper winding of the ring-up relay R445 in the trunk circuit 400 individually associated with the trunk line 490. This circuit extends from the line conductor C491 of the trunk line 490 by way of the contacts 451, C446, the condenser 403, the upper winding of R445, the contacts 432 and 461, C447 and the contacts 454 to the line conductor C492 of the trunk line 490, the line conductors C491 and C492 of the trunk line 490 being connected to the terminals of a source of ringing current by way of the switching apparatus in the central office 50. It is noted that ringing current is projected by way of the switching apparatus in the central office 50 over the trunk line 490 only momentarily, whereupon the upper winding of the ring-up relay R445 is energized, thereby to cause this relay to operate. Upon operating, the ring-up relay R445 completes, at the contacts 446, a holding circuit for energizing the lower winding thereof, this circuit extending from ground by way of the contacts 434, 462 and 446, and the lower winding of R445 to battery. Also, upon operating, the ring-up relay R445 completes, at the contacts 447, an obvious circuit for illuminating the line lamp L406, the illumination of this lamp indicating to the operator at the operator position 800 that a call has been extended from the central office 50 to the P. A. B. X 60 by way of the individually associated trunk line 490.

In the event the operator position 800 is idle at this time the operator thereat may answer the call from the central office 50 to the P. A. B. X 60 on the trunk line 490 extending therebetween merely by operating the individual trunk key K480 individually associated with the trunk circuit 400 and the trunk line 490 away from its normal position to its talk position. When the individual trunk key K480 is operated away from its normal position to its talk position there is completed, at the contacts 487 thereof, the previously traced circuit for energizing the upper winding of the connect relay R540 in the trunk finder switch 500 individually associated with the trunk circuit 400 and the trunk line 490. The connect relay R540 then operates to complete, at the contacts 544', the previously traced holding circuit for energizing the lower winding thereof in series with the winding of the talk relay R895, thereby to cause the talk relay R895 to operate. Also, upon operating, the connect relay R540 completes, at the contacts 541', a circuit for energizing the winding of the answer relay R460, this circuit extending from ground by way of the

contacts 507 and 541', the conductor C821 in the cable 820, the contacts 872 of the release key K870, the contacts 888', the conductor C822 in the cable 820, the contacts 889 of the individual trunk key K480 and the winding of the answer relay R460 to battery. When thus energized, the answer relay R460 operates to interrupt, at the contacts 461, the previously traced circuit for energizing the upper winding of the ring-up relay R445 and to interrupt, at the contacts 462, the previously traced holding circuit for energizing the lower winding of the ring-up relay R445. Accordingly, the ring-up relay R445 restores to interrupt, at the contacts 446, a further point in the previously traced holding circuit for energizing the lower winding thereof and to interrupt, at the contacts 447, the previously mentioned circuit for illuminating the line lamp L406, whereupon the line lamp L406 is extinguished. Further, the answer relay R460 completes, at the contacts 467, a direct metallic connection including the windings 411 and 412 of the repeater 410 between the line conductors C491 and C492 of the trunk line 490, this circuit extending from the line conductor C491 of the trunk line 490 by way of the contacts 451, C446, the winding 411, the contacts 467, the winding 412, C447 and the contacts 454 to the line conductor C492 of the trunk line 490. When this direct metallic connection is completed between the line conductors C491 and C492 of the trunk line 490 the switching apparatus in the central office 50 operates to interrupt the projection of ringing current over the trunk line 490, in the event it has not already performed this operation, and to complete a connection between the calling telephone station in the central office 50 and the repeater 410. Finally, the answer relay R460 completes, at the contacts 463, a circuit for illuminating the busy lamp L405 and completes, at the contacts 465, an obvious circuit for illuminating the hold lamp L407. The circuit for illuminating the busy lamp L405 extends from ground by way of the contacts 434 and 463, C469, the contacts 482 of the individual trunk key K480 and the busy lamp L405 to battery. The illumination of the busy lamp L405 indicates to the operator at the operator position 300 that the trunk line 490 is busy; while the illumination of the hold lamp L407 indicates to the operator at the operator position 300 that the call on the trunk line 490 is being held.

Also, upon operating, the connect relay R540 completes, at the contacts 541 and 544, the previously traced connection between the line relay R425 in the trunk circuit 400 and the windings 811 and 812 of the repeater 810, this connection including the conductors C833 and C834 in the cable 820 and the windings 413 and 414 of the repeater 410. Accordingly, at this time, the calling telephone station in the central office 50 is operatively connected by way of the repeater 410 in the trunk circuit 400 to the repeater 810 at the operator position 300, thereby to complete a two-way communication connection between the calling telephone station in the central office 50 and the operator position 300. The subscriber at the calling telephone station in the central office 50 then advises the operator at the operator position 300 concerning the extension of the call.

Assuming that the call is to be extended to the telephone station T1 in the P. A. B. X 60 the operator at the operator position 300 initiates the extension of the call by operating the digit

keys in the operator key set and marking circuit 200 associated with the operator position 300. As previously noted, the directory number of the called telephone station T1 in the P. A. B. X 60 is 111. Accordingly, the digit key K1 is operated three times or in accordance with the directory number of the called telephone station T1. Before proceeding with the operation of the marking relays in the operator key set and marking circuit 200 incident to the operation of the digit key K1, it is further noted that, upon operating, the connect relay R540 completes, at the contacts 542', a circuit for energizing in series the winding of the start relay R570 and the winding of the start relay R275, this circuit extending from ground by way of the contacts RA527 and RA517, the winding of R570, the contacts 542', the conductor C211 in the cable 210, the contacts 271 and the winding of R275 to battery. When thus energized, the start relays R275 and R570 operate. Upon operating, the start relay R570 completes, at the contacts 575, an obvious holding circuit for energizing in series the winding of the start relay R275 and the winding of the start relay R570 independently of the contacts 542' of the connect relay R540. Also, the start relay R570 prepares, at the contacts 574, a circuit, traced hereinafter, for energizing the vertical magnet M519 of the mechanism 510. Upon operating, the start relay R275 completes, at the contacts 276, an obvious circuit for energizing the winding of the release relay R265, thereby to cause the latter relay to operate. Also, upon operating, the start relay R275 completes, at the contacts 277, an alternative connection between the conductors C932 and C933 included in the trunk circuit at the operator position 300; while the release relay R265 interrupts, at the contacts 268, the normally completed connection between the conductors C932 and C933. Finally, upon operating, the start relay R275 completes, at the contacts 277', a circuit for energizing the winding of the control relay R240, this circuit extending from ground by way of the contacts 277', C206, the contacts 221 and the winding of R240 to battery. When thus energized, the control relay R240 operates to prepare, at the contacts 241 and 242, circuits, traced hereinafter, for respectively energizing the windings of the marking relays 1C and 2C.

Continuing now with the operation of the operator key set and marking circuit 200, when the digit key K1 is operated, there is completed, at the left-hand contacts thereof, a circuit for energizing the winding of the marking relay 1C, this circuit extending from ground by way of C201, the left-hand contacts of the digit key K1, C203, the contacts 241 and the winding of 1C to battery. When thus energized, the marking relay 1C operates to prepare, at the contacts 1C2, a holding circuit for energizing the winding thereof in series with the winding of the transfer relay R220. When the digit key K1 is returned to its normal position the previously mentioned holding circuit for energizing the winding of the marking relay 1C in series with the winding of the transfer relay R220 is completed, this circuit extending from ground by way of the contacts 277', C206, the winding of R220, the contacts 1C2 and the winding of 1C to battery. When this holding circuit is completed the marking relay 1C remains in its operated position, while the transfer relay R220 operates.

Upon operating, the transfer relay R220 interrupts, at the contacts 221, the previously traced circuit for energizing the winding of the control relay R240, thereby to cause the latter relay to restore. Also, the transfer relay R220 completes, at the contacts 222, a circuit for energizing the winding of the control relay R250, this circuit extending from ground by way of the contacts 277', C206, the contacts 222, C207, the contacts 226 and the winding of R250 to battery. When thus energized, the control relay R250 operates to prepare, at the contacts 251, 252, 253 and 254, respectively, circuits for energizing the windings of the marking relays 4D, 3D, 2D and 1D. When the digit key K1 is again operated, there is completed, at the left-hand contacts thereof, a circuit for energizing the winding of the marking relay 2D, this circuit extending from ground by way of C201, the left-hand contacts of the digit key K1, C203, the contacts 253 and the winding of 2D to battery. When thus energized, the marking relay 2D operates to prepare, at the contacts 2D1, a holding circuit, traced hereinafter, for energizing the winding thereof in series with the winding of the transfer relay R225. Also, when the digit key K1 is operated, a circuit is completed, at the right-hand contacts thereof, for energizing the winding of the marking relay 1D, this circuit extending from ground by way of C201, the right-hand contacts of the digit key K1, C202, the contacts 254 and the winding of 1D to battery. When thus energized, the marking relay 1D operates to prepare, at the contacts 1D1, a holding circuit, traced hereinafter, for energizing the winding thereof in series with the winding of the transfer relay R225. When the digit key K1 is returned to its normal position the previously mentioned holding circuits for energizing the windings of the marking relays 1D and 2D in series with the winding of the transfer relay R225 are completed. One of these holding circuits extends from ground by way of the contacts 277', C206, the winding of R225, C268, the contacts 1D1 and the winding of 1D to battery; and the other of these holding circuits extends from ground by way of the contacts 277', C206, the winding of R225, C268, the contacts 2D1 and the winding of 2D to battery. When these holding circuits are completed the marking relays 1D and 2D remain in their operated positions, while the transfer relay R225 operates.

Upon operating, the transfer relay R225 interrupts, at the contacts 226, the previously traced circuit for energizing the winding of the control relay R250, thereby to cause the latter relay to restore. Also, upon operating, the transfer relay R225 completes, at the contacts 227, a circuit for energizing the winding of the control relay R260, this circuit extending from ground by way of the contacts 277', C206, the contacts 222, C207, the contacts 227, C208, the contacts 231 and the winding of R260 to battery. When thus energized, the control relay R260 operates to prepare, at the contacts 261, 262, 263 and 264, circuits for respectively energizing the windings of the marking relays 4U, 3U, 2U and 1U. When the digit key K1 is again operated there is completed, at the left-hand contacts thereof, a circuit for energizing the winding of the marking relay 2U, this circuit extending from ground by way of C201, the left-hand contacts of the digit key K1, C203, the contacts 263 and the winding of 2U to battery. When thus energized, the

marking relay 2U operates to prepare, at the contacts 2U1, a holding circuit, traced hereinafter, for energizing the winding thereof in series with the winding of the transfer relay R230. Also, when the digit key K1 is operated there is completed, at the right-hand contacts thereof, a circuit for energizing the winding of the marking relay 1U, this circuit extending from ground by way of C201, the right-hand contacts of the digit key K1, C202, the contacts 264 and the winding of 1U to battery. When thus energized, the marking relay 1U operates to prepare, at the contacts 1U1, a holding circuit, traced hereinafter, for energizing the winding thereof in series with the winding of the transfer relay R230. When the digit key K1 is returned to its normal position the previously mentioned holding circuit for energizing the winding of the marking relay 1U in series with the winding of the transfer relay R230 is completed, this circuit extending from ground by way of the contacts 277', C206, the winding of R230, C269, the contacts 1U1 and the winding of 1U to battery. Also, when the digit key K1 is returned to its normal position, the previously mentioned holding circuit for energizing in series the winding of the marking relay 2U and the winding of the transfer relay R230 is completed, this circuit extending from ground by way of the contacts 277', C206, the winding of R230, C269, the contacts 2U1 and the winding of 2U to battery. When these holding circuits are completed the marking relays 1U and 2U remain in their operated positions, while the transfer relay R230 operates.

Upon operating, the transfer relay R230 interrupts, at the contacts 231, the previously traced circuit for energizing the winding of the control relay R260, thereby to cause the latter relay to restore. Also, upon operating, the transfer relay R230 completes, at the contacts 232, the previously mentioned circuit for energizing the winding of the vertical magnet M519 of the mechanism 510, this circuit extending from ground by way of the contacts 277', C206, the contacts 222, C207, the contacts 227, C208, the contacts 232, the conductor C214 in the cable 210, the contacts 574, RA516, RA526, 586 and 591 and the vertical magnet M519 to battery. When thus energized, the vertical magnet M519 operates, thereby to initiate operation of the mechanism 510 in the trunk finder switch 500 in a manner more fully described hereinafter.

Accordingly, at this time, in the operator key set and marking circuit 200 associated with the operator position 800, the transfer relays R220, R225 and R230, and the marking relays 1C, 1D, 2D, 1U, 2U, the start relay R275 and the release relay R265 occupy their operated positions. The operated marking relay 1C completes, at the contacts 1C1, a path for applying ground potential by way of the contacts 278 to the marking conductor C213 in the cable 210; the operated marking relays 1D and 2D complete, at the contacts 1D2 and 2D2, an obvious path for applying ground potential to the first marking conductor C281 in the group of marking conductors C280; while the operated marking relays 1U and 2U complete, at the contacts 1U2 and 2U2, an obvious path for applying battery potential by way of the resistor 228 to the first marking conductor C291 in the group of marking conductors 290. The application of ground potential to the marking conductor C213 in the cable 210 prepares a circuit for energizing the upper winding of the switching relay R510, thereby to mark the tele-

phone line 605 extending to the called telephone station T1 as being included in the first group of one hundred lines; the application of ground potential to the first marking conductor C281 in the group of marking conductors 280 marks the first contact in the vertical control contact bank associated with the vertical control wiper 518, thereby to mark the telephone line 605 extending to the called telephone station T1 as being included in the first group of ten lines in the associated group of one hundred lines; while the application of battery potential to the first marking conductor C291 in the group of marking conductors 290 completes a path for applying battery potential to the first contact in the rotary control contact bank associated with the rotary control wiper 517, thereby to mark the telephone line 605 extending to the called telephone station T1 as occupying the first position in the associated group of ten lines.

At this point it is noted that should the operator at the operator position 800 make an error in registering the digit in the operator key set and marking circuit 200, the operator key set and marking circuit 200 may be cleared of any digit or digits registered therein by momentarily operating the error key K11. When the error key K11 is momentarily operated an obvious circuit is completed for energizing the winding of the error relay R270, thereby to cause the latter relay to operate and remain operated for a short interval of time, this relay being of the slow-to-release type. Upon operating, the error relay R270 interrupts, at the contacts 271, the previously traced circuit for energizing in series the winding of the start relay R275 and the winding of the start relay R570, thereby to cause these relays to restore. Upon restoring, the start relay R275 interrupts, at the contacts 277', the previously traced path for applying ground potential to the conductor C206, thereby to cause any of the operated transfer relays R220, R225 and R230 and any of the operated marking relays 1C, 2C, 1D to 4D, inclusive, and 1U to 4U, inclusive, to restore. The restoration of the marking relays mentioned interrupts the previously traced paths for marking the telephone line extending to the called telephone station in the P. A. B. X 60. When the error relay R270 restores, it re completes, at the contacts 271, the previously traced series circuit for energizing the winding of the start relay R275 and the winding of the start relay R570, thereby to cause reoperation of these relays. Upon reoperating, the start relay R275 reconditions the operator key set and marking circuit 200 again to be operative to register digits; while the reoperation of the start relay R570 conditions the trunk finder switch 500 again to be operative to seize the telephone line extending to the called telephone station in the P. A. B. X.

Continuing now with the operation of the trunk finder switch 500 to seize the telephone line 605 extending to the called telephone station T1, upon operating, the vertical magnet M519 drives the first and second wiper sets of the mechanism 510 one step in the vertical direction, whereupon the vertical control wiper 518 engages the first contact in the associated vertical control contact bank marked with ground potential by way of the first marking conductor C281 in the group of marking conductors 280, thereby to complete the previously traced circuit for energizing the lower winding of the transfer relay R590 in series with the winding

of the step relay R588, whereupon the transfer relay R590 operates and the step relay R588 is retained in its operated position. Upon operating, the transfer relay R590 interrupts, at the contacts 591, the previously traced circuit for energizing the vertical magnet M519 and prepares, at the contacts 592, a circuit for energizing the rotary magnet M521, which is completed when the transfer relay R590 restores and which is substantially identical to that previously traced. The rotary magnet M521 then operates to drive the first and second wiper sets of the mechanism 510 one step in the rotary direction, whereupon the rotary control wiper 517 engages the first contact in the associated rotary control contact bank marked with battery potential by way of the first marking conductor C291 in the group of marking conductors 290, whereupon a circuit is completed for energizing the upper winding of the switching relay R510. The circuit for energizing the upper winding of the switching relay R510 extends from ground by way of the contacts 1C1 and 278, the marking conductor C213 in the cable 210, the contacts 572, the upper winding of R510, the contacts RA514 and RA524, the rotary control wiper 517 and engaged first contact in the associated rotary control contact bank, the marking conductor C291, the contacts 2U2 and 1U2 and the resistor 228 to battery.

When the upper winding of the switching relay R510 is thus energized, this relay operates to complete, at the contacts RA515, the previously traced holding circuit for energizing the intermediate winding thereof and to interrupt, at the contacts RA516, the previously traced circuit for energizing the rotary magnet M521. Also, upon operating, the switching relay R510 interrupts, at the contacts RA517, the previously traced series circuit for energizing the winding of the start relay R570 and the winding of the start relay R275, thereby to cause these relays to restore. Upon restoring, the start relay R275 interrupts, at the contacts 276, the previously mentioned circuit for energizing the winding of the release relay R265, thereby to cause the latter relay to restore shortly thereafter, this relay being of the slow-to-release type. Also, upon restoring, the start relay R275 interrupts, at the contacts 277', the previously traced holding circuits for energizing the windings of the transfer relays R220, R225 and R230, and the windings of the marking relays 1C, 1D, 2D, 1U and 2U, thereby to cause the transfer and marking relays mentioned to restore. At this time the apparatus in the operator key set and marking circuit 200 is completely released.

Immediately the switching relay R510 operates, and prior to the restoration of the start relay R570, it completes, at the contacts RA518, a test circuit for the busy relay R580, this circuit extending from battery by way of the winding of R580, the contacts 568, 557, 576 and RA518, C533, and the wiper 513 to the control conductor C608 of the telephone line 605. In the event the telephone station T1 is busy at this time, ground potential appears upon the control conductor C608 of the telephone line 605, thereby to complete a circuit identical to the previously traced test circuit for energizing the winding of the busy relay R580, whereupon the busy relay R580 operates. Upon operating, the busy relay R580 completes, at the contacts 583, a holding circuit for energizing the winding thereof, this circuit extending from ground by way of the

set of switch springs S524, the contacts 553, 557 and 558, and the winding of R580 to battery. Also, upon operating, the busy relay R580 interrupts, at the contacts 581 and 582, a circuit, traced hereinafter, for projecting ringing current over the telephone line 605 extending to the telephone station T1. Finally, the busy relay R580 completes, at the contacts 584, a circuit for intermittently illuminating the line lamp L406, this circuit extending from ground by way of C527, an interrupter, not shown, the contacts 584 and 543', C468 and the line lamp L406 to battery. The consequent flashing of the line lamp L406 indicates to the operator at the operator position 800 that the called telephone station T1 is busy at this time. The operator at the operator position 800 may offer the incoming call from the central office 50 to the subscriber at the busy telephone station T1, hold the incoming call from the central office 50, or advise the calling subscriber in the central office 50 to abandon the call, as will be explained more fully hereinafter.

On the other hand, in the event the telephone station T1 is idle, when the trunk finder switch 500 seizes the telephone line 605 extending thereto, the previously traced test circuit for the busy relay R580 is not completed due to the fact that no potential is present upon the control conductor C608 of the telephone line 605. Accordingly, the busy relay R580 does not operate, and shortly following the operation of the switching relay R510, the start relay R570 restores, thereby to interrupt, at the contacts 576, the previously traced test circuit for the busy relay R580. Also, when the start relay R570 restores, it completes, at the contacts 577, the previously traced path for applying ground potential by way of the wiper 513 to the control conductor C608 of the telephone line 605 extending to the called telephone station T1, thereby to mark the telephone line 605 as busy.

Also, upon operating, the switching relay R510 completes, at the contacts RA512 and RA513, the previously mentioned circuit for projecting ringing current over the telephone line 605 to the called telephone station T1, this circuit extending from the ungrounded terminal of a source of grounded ringing current, not shown, by way of C579, the contacts 582, 564, 554, 565 and RA513, C532 and the wiper 512 to the line conductor C607 of the telephone line 605, and from battery by way of the upper winding of the cut-off relay R550, the contacts 581, 561, 551, 562 and RA512, C531 and the wiper 511 to the line conductor C606 of the telephone line 605, the ringer at the called telephone station T1 being bridged across the line conductors C606 and C607 of the telephone line 605. Accordingly, the ringer at the called telephone station T1 is operated at this time. When the subscriber at the called telephone station T1 answers the call by removing the receiver of the telephone instrument thereat from its associated switchhook, a circuit, substantially identical to that previously traced, is completed for energizing the upper winding of the cut-off relay R550, thereby to cause the cut-off relay R550 to operate shortly thereafter, this relay being of the combination slow-to-operate and slow-to-release type. Upon operating, the cut-off relay R550 completes, at the contacts 556, the previously mentioned holding circuit for energizing the lower winding thereof and interrupts, at the contacts 551 and 554, the previously traced circuit for

projecting ringing current over the telephone line 605 to the called telephone station T1. Finally, the cut-off relay R550 completes, at the contacts 552 and 555, a loop circuit between the called telephone station T1 and the line relay R425 in the trunk circuit 400, this loop circuit including the trunk circuit at the operator position 800 as previously noted.

At this point it is noted that prior to the operation of the cut-off relay R550 a circuit is completed for returning ring-back tone current over the trunk line 490 to the central office 50, this circuit extending from the ungrounded terminal of a grounded source of ring-back tone current, not shown, by way of C539, the condenser 526, the contacts RA511 and 553, the winding of R505, the contacts 542, the conductor C825 in the cable 820, the contacts 889', the conductor C833 in the cable 820, the contacts 541, C436, the winding 413 of the repeater 410, the upper winding of R420 and the upper winding of R425 to battery. The ring-back tone current traversing the winding 413 causes a similar current to be induced in the winding 411 of the repeater 410 and the loop circuit extending between the central office 50 and the windings 411 and 412 of the repeater 410. Finally, upon operating, the cut-off relay R550 interrupts, at the contacts 553, the previously traced circuit for returning ring-back tone current over the trunk line 490 to the central office 50.

When the previously traced loop circuit is completed between the telephone station T1 and the line relay R425 in the trunk circuit 400 including the trunk circuit at the operator position 800 the winding of the hold relay R505 and the winding of the line relay R425 are energized, thereby to cause these relays to operate. Upon operating, the line relay R425 completes, at the contacts 427, the previously mentioned circuit for energizing the winding of the hold relay R430, thereby to cause the latter relay to operate. Also, the line relay R425 completes, at the contacts 426, the previously traced alternative connection between the windings 411 and 412 of the repeater 410. Upon operating, the hold relay R430 completes, at the contacts 433, the previously traced alternative circuit for illuminating the busy lamp L405.

Upon operating, the hold relay R505 interrupts, at the contacts 507, the previously traced circuit for energizing the winding of the answer relay R460, thereby to cause the latter relay to restore. Upon restoring, the answer relay R460 interrupts, at the contacts 465, the previously mentioned circuit for illuminating the hold lamp L407, thereby to indicate to the operator at the operator position 800 that the call on the trunk line 490 extending to the central office 50 is not being held at this time. Also, the hold relay R505 completes, at the contacts 506, the previously traced circuit for energizing in series the windings of the tone relay R820, thereby to cause intermittent operation of the tone relay R820 as previously explained. The intermittent operation of the tone relay R820 causes a distinct tone to be transmitted over the connection including the calling telephone station in the central office 50, the called telephone station T1 in the P. A. B. X 60 and the operator position 800, thereby to indicate to the calling party at the telephone station in the central office 50 and the called party at the telephone station T1 in the P. A. B. X 60 that the established connection is being monitored.

As previously noted, the operator at the operator position 800 may continue to monitor the connection or she may release the trunk circuit at the operator position 800 from the established connection. In order to release the trunk circuit at the operator position 800 from the established connection it is only necessary to operate the individual trunk key K480 from its talk position to its normal position. When the individual trunk key K480 is operated back to its normal position the previously traced holding circuit for energizing in series the lower winding of the connect relay R540 and the winding of the talk relay R895 is interrupted, thereby to cause these relays to restore as previously explained. Upon restoring, the connect relay R540 completes the previously traced direct loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400, thereby to complete a direct connection between the telephone station T1 in the P. A. B. X 60 and the telephone station in the central office 50, excluding the operator position 800. Upon restoring, the talk relay R895 re-completes, at the contacts 896, the previously traced path for applying ground potential to the conductor C829 in the cable 820, thereby again rendering any one of the trunk lines extending between the central office 50 and the P. A. B. X 60 connectable to the operator position 800.

At this time the apparatus at the operator position 800 is completely released and the release of the direct established connection between the telephone station T1 in the P. A. B. X 60 and the telephone station 50 is under the control of the subscriber at the telephone station T1 as previously explained.

After the operator at the operator position 800 answers an incoming call from the central office 50 on one of the trunk lines, such, for example, as the trunk line 490, in the manner previously explained, she may immediately extend the call to a telephone station in the P. A. B. X 60 or hold the call on the trunk line 490. Furthermore, the operator at the operator position 800 may hold the call on the trunk line 490 after attempting to extend it to a telephone station in the P. A. B. X which is found to be busy at this time. In order to hold the call on the trunk line 490 the operator at the operator position 800 operates the individual trunk hold key K490 away from its normal position before operating the individual trunk key K480 from its talk position back to its normal position. When the individual trunk hold key K490 is operated away from its normal position there is completed a holding circuit for energizing the winding of the answer relay R460, this circuit extending from ground by way of the individual trunk hold key K490, the contacts 483 of the individual trunk key K480, the contacts 464 and the winding of R460 to battery. The operated answer relay R460 retains completed, at the contacts 467, the previously traced connection between the line conductors C491 and C492 of the trunk line 490, thereby to retain the switch train in the central office 50 in its operated position. After operating the individual trunk hold key K490, the individual trunk key K480 is operated from its talk position back to its normal position, thereby to interrupt the previously traced holding circuit for energizing in series the lower winding of the connect relay R540 and the winding of the talk relay R895. Upon restoring the talk relay R895 renders each of the trunk lines extending between the central office 50 and the P. A. B. X 60 connectable to the operator position 800 as previously explained.

At this point it is noted that in the event the operator at the operator position 800 desires to hold the call on the trunk line 490 after operating the individually associated trunk finder switch 500 and finding the called telephone station in the P. A. B. X busy, she first operates the release key K870 after operating the individual trunk hold key K490 and before operating the individual trunk key K480 from its talk position back to its normal position. More particularly, the release key K870 is operated to its rear position, thereby to interrupt, at the contacts 873 thereof, the previously traced holding circuit for energizing the intermediate winding of the switching relay R510, whereupon the latter relay restores. Upon restoring, the switching relay R510 completes, at the contacts RA517, the previously traced circuit for energizing the release magnet M523, whereupon the release magnet M523 operates and causes the first and second wiper sets of the mechanism 510 to be released and returned to their normal positions. The release key K870 is then operated from its rear position to its normal position and the individual trunk key K480 is then operated from its talk position back to its normal position. At this time the trunk finder switch 500 is completely released and the call on the trunk line 490 is held.

When the operator at the operator position 800 is again ready to handle the call on the trunk line 490 the individual trunk key K480 is operated from its normal position to its talk position and the individual trunk hold key K490 is returned to its normal position. When the individual trunk hold key K490 is returned to its normal position, the previously traced holding circuit for energizing the winding of the answer relay R460 is interrupted thereat; and when the individual trunk key K480 is operated from its normal position to its talk position, the trunk line 490 is connected to the trunk circuit at the operator position 800 as previously explained.

Offering a trunk call from the central office to a busy station in the P. A. B. X

After the operator at the operator position 800 answers a call from the central office 50 on one of the trunk lines, such, for example, as the trunk line 490, she operates the digit keys in the operator key set and marking circuit 200, thereby to cause the trunk finder switch 500 associated with the trunk line 490 to seize the telephone line extending to the called telephone station, such, for example, as the telephone station T1, whereupon the trunk finder switch 500 operates in the previously described manner in the event the called telephone station T1 is busy at this time. More particularly, in the event the called telephone station T1 is busy at this time, after the trunk finder switch 500 seizes the telephone line 605 extending thereto, the switching relay R510, the busy relay R580 and the connect relay R540 in the trunk finder switch 500 occupy their operated positions as previously explained. More particularly, the busy relay R580 completes, at the contacts 584, the previously traced circuit for intermittently illuminating the line lamp L406, thereby to cause the line lamp L406 to flash. At this time the operator at the operator position 800 may offer the incoming call from the central office 50 on the trunk line 490 to the subscriber at the busy telephone station T1 by operating the trunk offer key K840. When the trunk offer key K840 is operated away from its normal position, a circuit is completed, at the contacts 481

thereof, for energizing the upper winding of the trunk offer relay R560, this circuit extending from ground by way of the contacts 841 of the trunk offer key K840, the conductor C830 in the cable 820, the contacts 549 and the upper winding of R560 to battery. When thus energized, the trunk offer relay R560 operates to complete, at the contacts 563 and 566, a loop circuit between the line relay R425 in the trunk circuit 400 and the telephone station T1, this circuit extending from ground by way of the lower winding of R425, the lower winding of R420, the winding 414 of the repeater 410, C437, the contacts 544, the conductor C834 in the cable 820, the contacts 842 of the trunk offer key K840, the conductor C831 in the cable 820, the contacts 548, 566 and RA513, C532 and the wiper 512 to the line conductor C607 of the trunk line 605, and from battery by way of the upper winding of R425, the upper winding of R420, the winding 413 of the repeater 410, C436, the contacts 541, the conductor C833 in the cable 820, the contacts 844 of the trunk offer key K840, the conductor C832 in the cable 820, the contacts 547, 563 and RA512, C531 and the wiper 511 to the line conductor C606 of the telephone line 605, the line conductors C606 and C607 of the telephone line 605 being connected together by way of the bridge path at the telephone station T1.

Also, upon operating, the trunk offer relay R560 interrupts, at the contacts 568, the previously traced holding circuit for energizing the winding of the busy relay R580, thereby to cause the latter relay to restore and interrupt, at the contacts 584, the previously traced circuit for intermittently illuminating the line lamp L406. Further, the trunk offer relay R560 interrupts, at the contacts 567, an obvious normally completed path for short-circuiting the lower winding thereof.

Also, when the trunk offer key K840 is operated away from its normal position there is completed, at the contacts 843 thereof, an obvious circuit for energizing in series the lower and upper windings of the tone relay R820, thereby to cause the latter relay to operate intermittently as previously explained. The intermittent operation of the tone relay R820 completes intermittently, at the contacts 822, the previously mentioned circuit for energizing the winding 813 of the repeater 810, thereby to cause tone current to be projected to the telephone station T1 over the previously traced loop circuit extending between the telephone station T1 and the line relay R425 in the trunk circuit 400 and including the operator position 800.

The operator at the operator position 800 then advises the subscriber at the telephone station T1 that there is an incoming call from the central office 50 for him, whereupon the subscriber advises the operator whether he wishes to accept the call at the present time. In the event the subscriber at the telephone station T1 wishes to accept the call at this time, the operator at the operator position 800 advises him to replace the receiver of the telephone instrument thereat upon its associated switchhook. When the subscriber at the telephone station T1 replaces the receiver of the telephone instrument thereat upon its associated switchhook, the local link associated with the telephone line 605 extending to the telephone station T1 is released and a holding circuit is completed for energizing in series the lower winding of the trunk offer relay R560 and the intermediate winding of the line and cut-off

relay R690. This circuit extends from ground by way of the lower winding of R560, the contacts 577 and RA518, C533, the wiper 513, the control conductor C608 of the telephone line 605, the contacts 693 and the intermediate winding of R690 to battery. When this holding circuit is completed the line and cut-off relay R690 is retained in its operated position. However, due to the high resistance thereof, the lower winding of the trunk offer relay R560 is not sufficiently energized over this holding circuit to retain the trunk offer relay R560 operated when the previously traced circuit for energizing the upper winding of the trunk offer relay R560 is interrupted.

The operator at the operator position 800 then restores the trunk offer key K840 to its normal position, whereupon the previously traced circuit for energizing the upper winding of the trunk offer relay R560 is interrupted at the contacts 841 thereof, thereby to cause the latter relay to restore. Also, the previously traced circuit for energizing in series the lower and upper windings of the tone relay R820 is interrupted at the contacts 843 of the trunk offer key K840, thereby to cause the latter relay to restore. Finally, the conductors C831 and C832 in the cable 820 are disconnected from the conductors C834 and C833 in the cable 820 at the contacts 842 and 844 of the trunk offer key K840. Also, when the subscriber at the telephone station T1 replaces the receiver of the telephone instrument thereat upon its associated switchhook, the previously traced loop circuit between the line relay R425 in the trunk circuit 400 and the telephone station T1 is interrupted, thereby to cause the line relay R425 to restore.

Upon restoring, the trunk offer relay R560 completes, at the contacts 561, 562, 564 and 565, the previously traced circuit for projecting ringing current over the telephone line 605 to the telephone station T1, thereby to cause the ringer at the telephone station T1 to operate. When the subscriber at the telephone station T1 answers the call by removing the receiver of the telephone instrument thereat from its associated switchhook, the previously traced circuit for energizing the upper winding of the cut-off relay R550 is completed, thereby to cause the latter relay to operate. Upon operating, the cut-off relay R550 completes, at the contacts 556, the previously traced holding circuit for energizing the lower winding thereof and interrupts, at the contacts 551 and 554, the previously traced circuit for projecting ringing current over the telephone line 605 to the telephone station T1. Finally, the cut-off relay R550 completes, at the contacts 552 and 555, the previously traced loop circuit between the line relay R425 in the trunk circuit 400 and the telephone station T1 including the operator position 800, thereby to cause the line relay R425, the hold relay R505 and the hold relay R430 to reoperate in the manner previously explained.

At this time the operator at the operator position 800 may monitor the established connection between the telephone station T1 and the central office 50 or she may free the trunk circuit at the operator position 800 therefrom by operating the individual trunk key K480 from its talk position back to its normal position as previously explained.

On the other hand, when the incoming call from the central office 50 on the trunk line 490 is offered to the subscriber at the telephone sta-

tion T1, in the event the subscriber at the telephone station T1 cannot accept the call at this time, the operator at the operator position 800 advises the subscriber at the telephone station in the central office 50 and holds the connection from the central office 50 on the trunk line 490 in the event the subscriber at the telephone station in the central office 50 so desires. This may be accomplished by operating the individual trunk hold key K490 away from its normal position and then operating the release key K370 from its normal position to its rear position, thereby to cause the trunk finder switch 500 to be released as previously explained. The release key K370 is then operated from its rear position back to its normal position and the individual trunk key K480 is then operated from its talk position back to its normal position. At this time the call from the central office 50 on the trunk line 490 is held, while the trunk circuit at the operator position 800 is rendered idle as previously explained.

Recalling the operator position in the P. A. B. X over an established connection between the central office and a station in the P. A. B. X

After a call has been extended from the central office 50 to a telephone station in the P. A. B. X 60 and a direct connection established therebetween, or after a call has been extended from a telephone station in the P. A. B. X 60 to the central office 50 and a direct connection established therebetween, the subscriber at the telephone station in the P. A. B. X may recall the operator at the operator position 800 by operating the switch at his station for a short time interval. For example, assuming that a direct connection has been established between the central office 50 and the telephone station T1 in the P. A. B. X by way of the trunk line 490, the subscriber at the telephone station T1 may recall the operator at the operator position 800 by operating the key K305 at the telephone station T1 for a short time interval. When the key K305 at the telephone station T1 is thus operated a path is completed for short-circuiting in series the lower winding of the control relay R420 and the lower winding of the line relay R425 in the trunk circuit 400, this path extending from ground by way of the key K305, the line conductor C607 of the telephone line 605, the wiper 512, C532, the contacts RA513, 565, 555 and 546, C437, the winding 414 of the repeater 410, the lower winding of R420 and the lower winding of R425 to ground. When the lower winding of the line relay R425 is thus short-circuited, this relay remains in its operated position; and when the lower winding of the control relay R420 is thus short-circuited, this relay operates. Upon operating, the control relay R420 completes, at the contacts 421, a circuit for energizing the winding of the time relay R440, this circuit extending from ground by way of the contacts 421 and 458, the winding of R440 and the resistor 402 to battery. When thus energized, the timer relay R440 operates to prepare, at the contacts 442, a holding circuit for energizing the winding thereof and to set the vibratory armature RA440 into vibration. The vibratory armature RA440 intermittently completes, at the contacts 441, the previously mentioned holding circuit for energizing the winding of the timer relay R440, this circuit extending, when completed, from ground by way of the contacts 441, 456 and 442, the winding of R440 and the resistor 402 to battery. It is

noted that after a predetermined time interval the vibratory armature RA440 comes to rest, thereby to complete the previously traced holding circuit for energizing the winding of the timer relay R440 steadily. Further, it is noted that the upper winding of the transfer relay R450 is short-circuited when the vibratory armature RA440 comes to rest, the path for short-circuiting the upper winding of the transfer relay R450 extending from ground by way of the contacts 441 and 456, the upper winding of R450, C469 and the contacts 433 to ground. When the upper winding of the transfer relay R450 is thus short-circuited, operation of this relay is positively prevented. Also, upon operating, the control relay R420 interrupts, at the contacts 422, a circuit, traced hereinafter, for intermittently energizing the hold lamp L407.

After the key K305 at the telephone station T1 has been operated away from its normal position a predetermined time interval it is released, thereby to interrupt the previously traced path for short-circuiting in series the lower winding of the control relay R420 and the lower winding of the line relay R425, whereupon the control relay R420 restores and the line relay R425 remains in its operated position. Upon restoring, the control relay R420 interrupts, at the contacts 421, the previously traced original circuit for energizing the winding of the timer relay R440 and completes, at the contacts 422, the previously mentioned circuit for intermittently illuminating the hold lamp L407, this circuit extending from ground by way of C404, an interrupter, not shown, the contacts 422, 443, 450 and 466, and the hold lamp L407 to battery. The flashing of the hold lamp L407 indicates to the operator at the operator position 800 that there is a recall upon the established connection including the trunk line 490 extending between the central office 50 and a telephone station in the P. A. B. X 60.

In order to answer the recall on the established connection including the trunk line 490 the operator at the operator position 800 operates the individual trunk key K480 from its normal position to its talk position, thereby to complete the previously traced loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400 including the conductors C833, C825, C834 and C824 in the cable 820 and the trunk circuit at the operator position 800. At this time the operator at the operator position 800 may converse with either the subscriber at the telephone station in the central office 50 or the subscriber at the telephone station T1 in the P. A. B. X 60. Also, when the individual trunk key K480 is operated from its normal position to its talk position there is completed, at the contacts 488 thereof, a path for short-circuiting the winding of the timer relay R440, this path extending from ground by way of the contacts 488 of the individual trunk key K480, C467, the winding of R440 and the contacts 442, 456 and 441 to ground. When the winding of the timer relay R440 is thus short-circuited, this relay restores to interrupt, at the contacts 441 and 442, further points in the previously traced path for short-circuiting the winding thereof and to interrupt, at the contacts 443, the previously traced circuit for intermittently illuminating the hold lamp L407.

At this time, in the event the subscriber at the telephone station T1 should desire another con-

nection in the central office 50, the operator at the operator position 800 is so advised, whereupon the operator advises the subscriber at the telephone station T1 to replace the receiver of the telephone instrument thereat upon its associated switchhook for a short time interval, in order to interrupt the previously traced loop circuit for energizing the windings of the line relay R425 and the winding of the hold relay R505. The line relay R425 and the hold relay R505 then restore. Upon restoring, the hold relay R505 re-completes, at the contacts 507, the previously traced circuit for energizing the winding of the answer relay R460, thereby to cause the latter relay to operate. Upon restoring, the line relay R425 interrupts, at the contacts 426, the previously traced alternative connection between the line conductors C491 and C492 of the trunk line 490; and upon operating, the answer relay R460 re-completes, at the contacts 467, the previously traced original connection between the line conductors C491 and C492 of the trunk line 490. In order positively to insure that the connection between the line conductors C491 and C492 of the trunk line 490 is interrupted, the operator at the operator position 800 operates the release key K870 from its normal position to its front position, thereby to interrupt, at the contacts 872 thereof, the previously traced circuit for energizing the winding of the answer relay R460, whereupon the latter relay restores to interrupt, at the contacts 467, the previously traced original circuit between the line conductors C491 and C492 of the trunk line 490. When the connection between the line conductors C491 and C492 of the trunk line 490 is interrupted, the switching apparatus in the central office 50 restores.

The operator at the operator position 800 then restores the release key K870 from its front position to its normal position, whereupon the previously traced circuit for energizing the winding of the answer relay R460 is re-completed in order to cause the latter relay to reoperate. When the subscriber at the telephone station T1 again removes the receiver of the telephone instrument thereat from its associated switchhook, the previously traced loop circuit between the telephone station T1 and the relay R425 in the trunk circuit 400 including the operator position 800 is re-completed. As previously explained, either the operator at the operator position 800 or the subscriber at the telephone station T1 may dial the digits comprising the number, thus causing the switching apparatus in the central office 50 to set up the new connection. In the event the subscriber at the telephone station T1 is to dial the number over the trunk line 490 to the central office 50, the operator at the operator position 800 operates the individual trunk key K480 from its talk position back to its normal position, thereby to disconnect the trunk line 490 from the operator position 800, as previously explained. At this time the line conductors C491 and C492 of the trunk line 490 are connected together by way of the previously traced alternative path including the contacts 426 of the line relay R425. Accordingly, when the subscriber at the telephone station T1 dials the digits of the number the line relay R425 follows the digits dialed and repeats impulses corresponding to the digits by way of the contacts 426 thereof over the trunk line 490 to the central office 50, thereby to control the operation of the

switching apparatus in the central office 50 in a well known manner.

In the event the subscriber at the telephone station in the central office 50 desires a connection to another telephone station in the P. A. B. X 60, when the operator at the operator position 800 answers the recall on the established connection including the trunk line 490 extending between the central office 50 and the telephone station T1 in the P. A. B. X 60, the operator at the operator position 800 operates the release key K810 from its normal position to its rear position and back to its normal position, thereby momentarily to interrupt, at the contacts 873 thereof, the previously traced holding circuit for energizing the intermediate winding of the switching relay R510 in the trunk finder switch 500. The switching relay R510 then restores, thereby to cause the trunk finder switch 500 individually associated with the trunk line 490 to be released. When the trunk finder switch 500 is thus released the line and cut-off relay R690 in the line circuit 690 associated with the telephone line 605 extending to the telephone station T1 restores, thereby to mark the telephone station T1 as idle, assuming that the subscriber at the telephone station T1 has replaced the receiver of the telephone instrument thereat upon its associated switchhook.

The operator at the operator position 800 then re-operates the digit keys in the operator key set and marking circuit 200 in accordance with the directory number of the desired telephone station in the P. A. B. X in order to cause re-operation of the trunk finder switch 500 and the completion of a connection from the telephone station in the central office 50 to the desired telephone station in the P. A. B. X 60 in the manner previously explained.

Call from one station to another station in the P. A. B. X while holding a trunk call to the central office

A subscriber at a telephone station in the P. A. B. X 60 may call another telephone station therein while holding a trunk call to the central office 50. For example, assume that a connection is established between the central office 50 and the telephone station T1 by way of the trunk line 490 and that the subscriber at the telephone station T1 desires to hold the trunk call to the central office 50 and extend a local call to the telephone station T2 in the P. A. B. X 60. In order to hold the trunk call on the trunk line 490 to the central office 50 and initiate a local call in the P. A. B. X 60, the subscriber at the telephone station T1 momentarily operates the key K305 at the telephone station T1. When the key K305 is thus momentarily operated, the previously traced path for short-circuiting in series the lower winding of the control relay R420 and the lower winding of the line relay R425 is completed and subsequently interrupted, thereby to cause the control relay R420 to operate momentarily and then restore. Upon operating, the control relay R420 completes, at the contacts 421, the previously traced circuit for energizing the winding of the timer relay R440, thereby to cause the latter relay to operate. Upon operating, the timer relay R440 completes, at the contacts 442, a path for short-circuiting the upper winding of the transfer relay R450, this path extending from ground by way of the contacts 421, 458 and 442, the upper winding of R450, C469 and the contacts 433 to

ground. Also, the timer relay R440 sets the vibratory armature RA440 into vibration. However, the previously traced path for short-circuiting the upper winding of the transfer relay R450, extending from ground by way of the contacts 441 over the previously traced connection to ground at the contacts 433, is not steadily completed at this time prior to the restoration of the control relay R420. Upon restoring, the control relay R420 interrupts, at the contacts 421, the previously traced circuit for energizing the winding of the timer relay R440 and the previously traced path for short-circuiting the upper winding of the transfer relay R450, whereupon a series holding circuit for energizing the upper winding of the transfer relay R450 and the winding of the timer relay R440 is completed, this circuit extending from ground by way of the contacts 433, C469, the upper winding of R450, the contacts 442, the winding of R440 and the resistor 402 to battery. When the upper winding of the transfer relay R450 is thus operated, this relay operates to interrupt, at the contacts 456, the previously traced path for intermittently short-circuiting the upper winding thereof, to prepare, at the contacts 457, a holding circuit for energizing the lower winding thereof, and to prepare, at the contacts 459, a path, traced hereinafter, for short-circuiting the winding of the timer relay R440. Also, upon operating, the transfer relay R450 completes, at the contacts 453, an obvious connection between the line conductors C491 and C492 of the trunk line 490, thereby to retain the switching apparatus in the central office 50 in its operated position in order to hold the call to the central office on the trunk line 490. Further, the transfer relay R450 interrupts, at the contacts 451 and 454, the previously traced connection between the trunk line 490 and the windings 411 and 412 of the repeater 410 and completes, at the contacts 452 and 455, a connection between the auxiliary line circuit 494 and the windings 411 and 412 of the repeater 410. The last-mentioned connection extends from the line conductor C496 of the trunk 495 by way of the contacts 452, C446, the winding 411 of the repeater 410, the contacts 426, the winding 412 of the repeater 410, C447 and the contacts 455 to the line conductor C497 of the trunk 495, the line conductors C496 and C497 of the trunk 495 being connected together by way of apparatus in the auxiliary line circuit 494.

At this point it is noted that the auxiliary line circuit 494 is individually associated with the trunk circuit 400 and the trunk line 490 and that when the previously traced connection is completed between the line conductors of the trunk 495 the auxiliary line circuit 494 operates, thereby to cause ground potential to be applied to the start conductor C499 extending to the distributor 680. The application of ground potential to the start conductor C499 initiates operation of the distributor 680, thereby to cause the distributor 680 to assign a previously selected idle local link to the use of the call on the trunk 495. Assuming that the distributor 680 assigns the local link illustrated to the use of the call on the trunk 495, the local finder switch 600 thereof is controlled, thereby to cause the mechanism 610 of the local finder switch 600 to seize the trunk 495 in the manner previously explained. When the trunk 495 is seized by the local finder switch 600 the local connector switch 700 is conditioned to be responsive to digits

transmitted thereto, whereupon a loop circuit is completed between the windings 411 and 412 of the repeater 410 by way of the auxiliary line circuit 494 and the trunk 495 to the line relay R700 in the local connector switch 700. Accordingly, the subscriber at the telephone station T1 may dial a digit over the previously traced loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400, thereby to cause the line relay R425 to follow the digit and repeat the digit over the previously mentioned loop circuit extending between the repeater 410 and the line relay R700 in the local connector switch 700. Accordingly, the subscriber at the telephone station T1 may control the local connector switch 700, thereby to cause it to seize the telephone line 750 extending to the telephone station T2. The operation of the local connector switch 700 subsequent to the seizure of the telephone line 750 extending to the telephone station T2 is the same as that previously explained, a connection being routed between the telephone station T1 and the telephone station T2 in the event the latter station is idle at this time.

After the conversation is terminated between the telephone station T1 and the telephone station T2 in the P. A. B. X 60 the subscriber at the telephone station T1 may release the connection extending between the telephone station T1 and the telephone station T2 and re-complete the connection between the telephone station T1 and the central office 50 by again momentarily operating the key K305 at the telephone station T1. The momentary operation of the key K305 at the telephone station T1 causes the previously traced path for short-circuiting in series the lower winding of the control relay R420 and the lower winding of the line relay R425 to be momentarily completed, thereby to cause the control relay R420 to operate momentarily and again restore. Upon operating, the control relay R420 completes, at the contacts 421, a holding circuit for energizing the lower winding of the transfer relay R450, this circuit extending from ground by way of the contacts 421 and 457 and the lower winding of R450 to battery. Also, upon operating, the control relay R420 completes, at the contacts 421, the previously mentioned path for short-circuiting the winding of the timer relay R440 in series with the upper winding of the transfer relay R450, this path extending from ground by way of the contacts 421 and 459, the winding of R440, the contacts 442, the upper winding of R450 and the contacts 433 to ground. When the winding of the timer relay R440 is thus short-circuited, this relay restores to interrupt, at the contacts 442, the previously traced holding circuit for energizing the winding of the timer relay R440 in series with the upper winding of the transfer relay R450. The control relay R420 then restores to interrupt, at the contacts 421, the previously traced holding circuit for energizing the lower winding of the transfer relay R450, thereby to cause the latter relay to restore.

Upon restoring, the transfer relay R450 interrupts, at the contacts 452 and 455, the previously traced loop circuit between the windings 411 and 412 of the repeater 410 and the line relay R700 in the local connector switch 700, thereby to cause the local finder switch 600 and the local connector switch 700 of the local link illustrated to be released. When the local link illustrated is released, the auxiliary line circuit

494 individually associated with the trunk 495 operates, thereby to mark the trunk 495 as idle; and the line circuit individually associated with the telephone line 750 operates, thereby to mark the telephone line 750 as idle.

Further, the transfer relay R450 re completes, at the contacts 451 and 454, the previously traced connection between the line conductors C491 and C492 of the trunk line 490 and the windings 411 and 412 of the repeater 410 and interrupts, at the contacts 453, the previously mentioned bridge connection between the line conductors C491 and C492 of the trunk line 490. Accordingly, at this time, the telephone station T1 is operatively connected to the windings 413 and 414 of the repeater 410 and the telephone station in the central office 50 is operatively connected by way of the trunk line 490 to the windings 411 and 412 of the repeater 410. Hence, the subscriber at the telephone station T1 in the P. A. B. X 60 and the subscriber at the telephone station in the central office 50 may again converse with each other.

Delayed call from the operator position in the P. A. B. X to the central office and from the operator position to a station in the P. A. B. X

A delayed call which is to be extended from the operator position 800 in the P. A. B. X 60 to the central office 50 and from the operator position 800 to a telephone station, such, for example, as the telephone station T1 in the P. A. B. X 60, is first extended from the operator position 800 to the telephone station in the central office 50 and then extended from the operator position 800 to the telephone station T1.

More particularly, the operator at the operator position 800 first selects an idle one of the trunk lines, such, for example, as the trunk line 490, extending between the central office 50 and the P. A. B. X 60 and operates the individual trunk key K480 thereof from its normal position to its talk position, thereby to cause the connect relay R540 in the trunk finder switch 500 individually associated with the trunk line 490 and the talk relay R895 to operate in the manner previously explained. When the individual trunk key K480 is thus operated, the previously traced circuit for energizing the winding of the answer relay R460 is completed at the contacts 489 thereof, thereby to cause the latter relay to operate. Upon operating, the answer relay R460 completes, at the contacts 467, the previously traced connection between the line conductors C491 and C492 of the trunk line 490, thereby to mark the trunk line 490 as busy to the switching apparatus and to seize the switching apparatus in the central office 50 as previously explained. Upon operating, the connect relay R540 completes, at the contacts 541 and 544, the previously traced connection between the repeater 410 in the trunk circuit 400 individually associated with the trunk line 490 and the trunk circuit at the operator position 800 and completes, at the contacts 542 and 545, the previously traced connection between the trunk finder switch 500 and the trunk circuit at the operator position 800.

The operator at the operator position 800 then operates the dial 805, thereby to cause operation of the dial relay R880 and the control relay R885 as previously explained. Upon operating, the control relay R885 completes, at the contacts 887 and 889, the previously traced loop circuit between the line relay R425 in the trunk circuit 400 and the dial

805, thereby to cause the line relay R425 to operate and complete, at the contacts 426, the previously traced alternative connection between the line conductors C491 and C492 of the trunk line 490. Also, the control relay R885 interrupts, at the contacts 888', the previously traced circuit for energizing the winding of the answer relay R460, thereby to cause the latter relay to restore and interrupt, at the contacts 467, the previously traced original connection between the line conductors C491 and C492 of the trunk line 490. The dial 805 then operates, thereby to cause the impulsing contacts 807 thereof to be actuated alternately into engagement and disengagement, thereby to cause the line relay R425 to follow the impulses comprising the digit transmitted. The line relay R425 then follows the impulses comprising the digit transmitted and repeats the impulses by way of the contacts 426 over the trunk line 490 to the central office 50 in order to cause the switching apparatus therein to be operated. The operator at the operator position 800 operates the dial 805 repeatedly in accordance with the number to be transmitted, thereby to cause a corresponding number to be transmitted over the trunk line 490 to the switching apparatus in the central office 50.

After the number has been transmitted over the trunk line 490 to the central office 50, the dial 805 is returned to its normal position, thereby to interrupt, at the contacts 806 thereof, the previously traced multiple circuit for energizing the windings of the dial relay R880 and the control relay R885, whereupon the latter relays restore. Upon restoring, the control relay R885 re completes, at the contacts 888', the previously traced circuit for energizing the winding of the answer relay R460, thereby to cause the latter relay to operate and re complete, at the contacts 467, the previously traced original connection between the line conductors C491 and C492 of the trunk line 490. Also, upon restoring, the control relay R885 interrupts, at the contacts 887 and 889, the previously traced loop circuit between the line relay R425 in the trunk circuit 400 and the dial 805, thereby to cause the line relay R425 to restore and interrupt, at the contacts 426, the previously traced alternative connection between the line conductors C491 and C492 of the trunk line 490.

At this time the operated answer relay R460 retains completed, at the contacts 467, the previously traced connection between the repeater 410 and the switching apparatus in the central office 50; and the switching apparatus in the central office 50 operates in the usual manner, causing ringing current to be projected over the telephone line extending to the called telephone station in the central office 50 in the event the last-mentioned telephone station is idle at this time. Assuming that the called telephone station in the central office 50 is idle at this time, when the subscriber thereat answers the call by removing the receiver of the telephone instrument thereat from its associated switchhook, the switching apparatus in the central office 50 switches through, thereby to complete the previously traced connection between the called telephone station in the central office 50 and the repeater 410 in the trunk circuit 400 including the trunk line 490 extending between the central office 50 and the P. A. B. X 60. Also, at this time, the trunk circuit at the operator position 800 is operatively connected with the repeater

410, thereby to complete a two-way communication connection between the called telephone station in the central office 50 and the operator position 800 as previously noted.

The operator at the operator position 800 then advises the subscriber at the called telephone station in the central office 50 that a delayed call connection is to be established between his telephone station and the telephone station T1 in the P. A. B. X 60, whereupon the operator at the operator position 800 then actuates the digit keys in the operator key set and marking circuit 200, thereby to cause the trunk finder switch 500 to seize the telephone line 605 extending to the telephone station T1 in the manner previously explained. When the subscriber at the telephone station T1 answers the call the cut-off relay R550 operates, thereby to complete the previously traced loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400 including the operator position 800. Accordingly, at this time, a connection is established including the telephone station in the central office 50 and the telephone station T1 and the operator position 800 in the P. A. B. X 60. The operator at the operator position 800 may monitor the established connection or free the trunk circuit at her position therefrom by operating the individual trunk key K480 from its talk position back to its normal position in the manner previously explained.

Night service in the P. A. B. X

At night, prior to vacating the operator position 800 in the P. A. B. X 60, the operator thereat institutes night service by switching the trunk lines extending between the central office 50 and the P. A. B. X 60 directly to selected ones of the telephone stations in the P. A. B. X 60. For example, the operator at the operator position 800 may switch the trunk line 490 extending between the central office 50 and the P. A. B. X 60 directly to the telephone station T1. This is accomplished by operating the individual trunk key K480 from its normal position to its talk position, thereby to cause operation of the connect relay R540 in the trunk finder switch 500 individually associated with the trunk line 490 in the manner previously explained. Upon operating, the connect relay R540 completes, at the contacts 544', the previously traced holding circuit for energizing the lower winding thereof in series with the winding of the talk relay R895, thereby to cause operation of the latter relay. Also, upon operating, the connect relay R540 completes the previously traced connection between the repeater 410 in the trunk circuit 400 and the trunk finder switch 500 including the trunk circuit at the operator position 800, thereby to associate the trunk line 490 with the operator position 800 at this time; and upon operating, the talk relay R895 prevents any of the other trunk circuits from being associated with the operator position 800 at this time in the manner previously explained. Also, upon operating, the connect relay R540 causes operation of the start relay R570, thereby to condition the trunk finder switch 500 to be operative in response to operation of the operator key set and marking circuit 200 as previously explained. The operator at the operator position 800 then operates the digit keys in the operator key set and marking circuit 200, thereby to cause the trunk finder switch 500 to seize the telephone line 605 extending to the telephone station T1 in the manner previously

explained. When the trunk finder switch 500 seizes the telephone line 605 extending to the telephone station T1 ringing current is projected over the telephone line 605 to the telephone station T1, thereby to operate the ringer thereat as previously explained. When the subscriber at the telephone station T1 answers the call, the previously traced circuit for energizing the upper winding of the cut-off relay R550 is completed, thereby to cause the latter relay to operate. Upon operating, the cut-off relay R550 completes, at the contacts 556, the previously traced holding circuit for energizing the lower winding thereof, interrupts, at the contacts 551 and 554, the previously traced circuit for projecting ringing current over the telephone line 605, and completes, at the contacts 552 and 555, the previously traced loop circuit between the line relay R425 in the trunk circuit 400 and the telephone station T1 including the operator position 800.

The operator at the operator position 800 advises the subscriber at the telephone station T1 that night service has been instituted and operates the individual trunk key K480 from its talk position to its night position, thereby to complete, at the contacts 481 of the individual trunk key K480, an alternative holding circuit for energizing the intermediate winding of the switching relay R510, this circuit extending from ground by way of the contacts 481 of the individual trunk key K480, C469, the contacts 484 of the individual trunk key K480, C470, the contacts RA515 and the intermediate winding of R510 to battery. Also, it is noted that when the previously traced loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400 is completed, the line relay R425 operates, thereby to cause the hold relay R430 to operate as previously explained. At this time, when the subscriber at the telephone station T1 replaces the receiver of the telephone instrument thereat upon its associated switchhook, the previously traced loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400 is interrupted, thereby to cause the line relay R425 and the hold relay R430 to restore. Upon restoring, the hold relay R430 interrupts, at the contacts 433, the previously traced original holding circuit for energizing the intermediate winding of the switching relay R510; however, the previously traced alternative holding circuit for energizing the intermediate winding of the switching relay R510 remains completed at the contacts 481 of the individual trunk key K480. Accordingly, the trunk finder switch 500 remains in its operated position, thereby to maintain the connection between the trunk line 490 extending between the central office 50 and the P. A. B. X 60 and the telephone station T1 in the P. A. B. X 60 in spite of the fact that the subscriber at the telephone station T1 has replaced the receiver of the telephone instrument thereat upon its associated switchhook at this time. Also, a holding circuit is completed for energizing the intermediate winding of the line and cut-off relay R690, this circuit extending from ground by way of the contacts 567, 577 and RA518, C533, the wiper 513, the control conductor C608 of the telephone line 605, the contacts 693 and the intermediate winding of R690 to battery. Hence, the line and cut-off relay R690 remains in its operated position, thereby to retain completed, at the contacts 693, the previously mentioned connection between the control conductors C608 and C609 of

the telephone line 605, in order to mark the telephone station T1 as busy at this time. When night service is in effect at the telephone station T1 and the receiver of the telephone instrument thereat is positioned upon its associated switchhook, the previously traced loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400 is interrupted. Accordingly, the trunk line 490 extending between the central office 50 and the P. A. B. X 60 is marked as idle to the switching apparatus in the central office 50.

At this time a connection may be extended from the central office 50 to the telephone station T1 in the P. A. B. X 60 by causing the switching apparatus in the central office 50 to operate and seize the trunk line 490, whereupon ringing current is projected thereover and traverses the windings 411 and 412 of the repeater 410. The path for projecting ringing current over the trunk line 490 extends from the line conductor C491 of the trunk line 490 by way of the contacts 451, C446, the winding 411 of the repeater 410, the contacts 431, the condenser 401, the winding 412 of the repeater 410, C447 and the contacts 454 to the line conductor C492 of the trunk line 490, the line conductors C491 and C492 of the trunk line 490 being connected to the previously mentioned source of ringing current in the central office 50. The ringing current traversing the windings 411 and 412 of the repeater 410 induces ringing current in the windings 413 and 414 of the repeater 410, which induced ringing current causes operation of the ringer at the telephone station T1 by way of the previously traced circuit between the telephone station T1 and the repeater 410. The operation of the ringer at the telephone station T1 advises the subscriber thereat that a call has been extended to the telephone station T1, whereupon the subscriber removes the receiver of the telephone instrument thereat from its associated switchhook, thereby to complete the previously traced loop circuit between the telephone station T1 and the line relay R425 in the trunk circuit 400. The line relay R425 then operates to complete, at the contacts 426, the previously traced metallic connection between the line conductors C491 and C492 of the trunk line 490, thereby to cause the circuit for projecting ringing current over the trunk line 490 to be interrupted in the central office 50. Accordingly, at this time, the subscriber at the telephone station in the central office 50 may converse with the subscriber at the telephone station T1 over the previously traced connection extending between the central office 50 and the P. A. B. X 60. The release of this established connection is primarily under the control of the subscriber at the telephone station T1 and when the receiver of the telephone instrument thereat is replaced upon its associated switchhook the previously traced loop circuit between the telephone station T1 and the line relay R425 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the line relay R425 interrupts, at the contacts 426, the previously traced metallic connection between the line conductors C491 and C492 of the trunk line 490, thereby to cause the switching apparatus in the central office 50 to be released.

Prior to the release of the established connection between the telephone station T1 and the central office 50 the subscriber at the telephone station T1 may hold the central office call and make a local call to another telephone station

in the P. A. B. X 60 by momentarily operating the key K305 at the telephone station T1 in the manner previously explained. Further, the subscriber at the telephone station T1 may release the established connection between the telephone station T1 and another telephone station in the P. A. B. X 60 and recomplete the connection between the telephone station T1 and the central office 50 by again momentarily operating the key K305 at the telephone station T1 in the manner previously explained.

In order to extend a call from the telephone station T1 to the central office 50, when night service is in effect, it is only necessary for the subscriber at the telephone station T1 to remove the receiver of the telephone instrument thereat from its associated switchhook, thereby to complete the previously traced loop circuit between the telephone station T1 and the line relay R425. The line relay R425 then operates to complete, at the contacts 426, the previously traced metallic connection between the line conductors C491 and C492 of the trunk line 490, thereby to condition the switching apparatus in the central office 50 to be responsive to digits transmitted over the trunk line 490. The subscriber at the telephone station T1 then operates the dial thereat, thereby to cause the line relay R425 to follow the impulses of the digit dialed and repeat the impulses over the trunk line 490 to the switching apparatus in the central office 50 in the manner previously explained. Also, it is noted that the release of the connection between the telephone station T1 and the central office 50 is the same as that previously explained.

In order to complete a connection between the telephone station T1 and another telephone station, such, for example, as the telephone station T2, in the P. A. B. X 60, when night service is in effect, the subscriber at the telephone station T1 first removes the receiver of the telephone instrument thereat from its associated switchhook and then momentarily operates the key K305 at the telephone station T1. When the receiver of the telephone instrument at the telephone station T1 is removed from its associated switchhook, the previously traced loop circuit between the telephone station T1 and the line relay R425 is completed, thereby to cause operation of the line relay R425; and when the key K305 is momentarily operated at the telephone station T1 the previously traced path for short-circuiting the lower winding of the control relay R420 is completed, thereby to cause the latter relay to operate. The operation of the control relay R420 while the line relay R425 is operated is effective to cause operation of the transfer relay R450, thereby to connect the repeater 410 to the auxiliary line circuit 494 in the manner previously explained. When the repeater 410 is connected to the auxiliary line circuit 494, operation of the distributor 680 is initiated, thereby to cause the finder switch of a local link, such, for example, as the local link illustrated, to seize the trunk 495 extending to the auxiliary line circuit 494. When the local finder switch 600 of the local link illustrated seizes the trunk 495 extending to the auxiliary line circuit 194, the local connector switch 700 is rendered responsive to digits dialed thereinto. The subscriber at the telephone station T1 then dials the directory number of the called telephone station T2, thereby to cause the local connector switch 700 to seize the telephone line 750 extending to the telephone station T2 in the manner previously

ly explained. The subsequent operation of the connector switch 700 is the same as that previously explained, depending upon the idle or busy condition of the telephone station T2. In order to release the established connection between the telephone stations T1 and T2 in the P. A. B. X 60, the subscriber at the telephone station T1 again momentarily operates the key K305 at the telephone station T1 and then replaces the receiver of the telephone instrument thereat upon its associated switchhook, the release of this connection being the same as that previously explained.

Finally, it is noted that the subscriber at the telephone station T1 may render the trunk line 490 extending from the central office 50 to the P. A. B. X 60 busy by removing the receiver of the telephone instrument at the telephone station T1 from its associated switchhook, by then momentarily operating the key K305 at the telephone station T1, and then by replacing the receiver of the telephone instrument at the telephone station T1 upon its associated switchhook. When the receiver of the telephone instrument at the telephone station T1 is removed from its associated switchhook and the key K305 is then momentarily operated, as noted above, the line relay R425 operates and the control relay R420 momentarily operates, as previously explained. Upon operating and restoring, the control relay R420 completes the previously traced circuit for energizing the winding of the timer relay R440 in series with the upper winding of the transfer relay R450, thereby to cause operation of the timer relay R440 and the transfer relay R450. The operated transfer relay R450 retains completed, at the contacts 453, the previously traced connection between the line conductors C491 and C492 of the trunk line 490, thereby to render the trunk line 490 busy to the switching apparatus in the central office 50 and to retain completed, at the contacts 452 and 455, the previously traced connection between the repeater 410 and the auxiliary line circuit 494. Accordingly, at this time, in the event the receiver of the telephone instrument at the telephone station T1 is replaced upon its associated switchhook without momentarily operating the key K305 at the telephone station T1, the timer relay R440 and the transfer relay R450 remain in their operated positions, while the line relay R425 and the hold relay R430 restore. The operated transfer relay R450 retains the trunk line 490 extending between the central office 50 and the P. A. B. X 60 marked as busy and retains the local link associated with the auxiliary line circuit 494 in its operated position.

In order again to render the trunk line 490 extending between the central office 50 and the P. A. B. X 60 idle, it is only necessary for the subscriber at the telephone station T1 to remove the receiver of the telephone instrument thereat from its associated switchhook, momentarily to operate the key K305 at the telephone station T1, and then to replace the receiver of the telephone instrument at the telephone station T1 upon its associated switchhook. At this time, when the receiver of the telephone instrument at the telephone station T1 is removed from its associated switchhook, the previously traced loop circuit between the telephone station T1 and the line relay R425 is recompleted. Accordingly, when the key K305 at the telephone station T1 is momentarily operated at this time, the timer relay R440 and the transfer relay R450 are re-

stored, thereby to cause the release of the local link associated with the auxiliary line circuit 494 and to reconnect the repeater 410 to the trunk line 490 as previously explained. When the receiver of the telephone instrument at the telephone station T1 is then replaced upon its associated switchhook, the previously traced loop circuit between the telephone station T1 and the line relay R425 is interrupted, thereby to cause the latter relay to restore and effect the release of the switching apparatus in the central office 50 in the manner previously explained.

Conclusions

From the foregoing, it is apparent that a telephone system is provided which comprises a central office and a P. A. B. X including an operator position and a number of telephone stations and incorporating an arrangement for establishing connections including the central office and the operator position and the telephone stations and for supervising the established connections at the operator position and for rendering different services at the operator position in an improved and efficient manner.

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 intended 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 telephone station, a group of lines including a plurality of subgroups of lines, an automatic switch associated with said station and having access to said lines, a key set associated with said station and including a number of keys, means controlled by a given operation of any one of the keys in said key set for marking a corresponding one of the subgroups of lines in said group of lines, means controlled by a subsequent operation of any one of the keys in said key set for marking a corresponding one of the lines in said marked subgroup of lines and for initiating operation of said switch, means for causing said switch to select said marked line in said marked subgroup of lines in said group of lines, means controlled when said last-mentioned line is selected by said switch for arresting operation of said switch, and means including said switch for establishing a connection between said station and said selected line.

2. In a telephone system, a telephone station, a group of lines including a plurality of subgroups of lines, an automatic two-directional switch associated with said station and having access to said lines, a key set associated with said station and including a number of keys, means controlled by a given operation of any one of the keys in said key set for marking a corresponding one of the subgroups of lines in said group of lines, means controlled by a subsequent operation of any one of the keys in said key set for marking a corresponding one of the lines in said marked subgroup of lines and for initiating operation of said switch in one of said directions, means for causing said switch to select said marked subgroup of lines in said group of lines, means controlled when said last-mentioned subgroup of lines is selected by said switch for arresting operation of said switch in said one direction and for initiating operation of said switch in the other of said directions, means for causing

said switch to select said marked line in said selected subgroup of lines, means controlled when said last-mentioned line is selected by said switch for arresting operation of said switch in said other direction, and means including said switch for establishing a connection between said station and said selected line.

3. In a telephone system, a telephone station, a plurality of groups of lines each including a plurality of subgroups of lines, an automatic switch associated with said station and having access to said lines, a key set associated with said station and including a number of keys, means controlled by an initial operation of one of the keys in said key set for marking a corresponding one of said groups of lines, means controlled by a further operation of one of the keys in said key set for marking a corresponding one of the subgroups of lines in said marked group of lines, means controlled by a final operation of one of the keys in said key set for marking a corresponding one of the lines in said marked subgroup of lines in said marked group of lines and for initiating operation of said switch, means for causing said switch to select said marked line in said marked subgroup of lines in said marked group of lines, means controlled when said last-mentioned line is selected by said switch for arresting operation of said switch, and means including said switch for establishing a connection between said station and said selected line.

4. In a telephone system, a telephone station, a plurality of groups of lines each including a plurality of subgroups of lines, an automatic switch having access to said lines, a key set associated with said station and including a number of keys, each of said keys having a normal position and an operated position, a marking network, means for associating said switch with said station, means controlled when said switch is associated with said station for rendering said network operative to mark any one of said groups of lines, means controlled by an initial operation of one of the keys in said key set to its operated position for operating said network to mark a corresponding one of said groups of lines, means controlled by the initial operation of said one key in said key set to its normal position for rendering said network operative to mark any one of the subgroups of lines in said marked group of lines, means controlled by a further operation of one of the keys in said key set to its operated position for operating said network to mark a corresponding one of the subgroups of lines in said marked group of lines, means controlled by the further operation of said one key in said key set to its normal position for rendering said network operative to mark any one of the lines in said marked subgroup of lines in said marked group of lines, means controlled by a final operation of one of the keys in said key set to its operated position for operating said network to mark a corresponding one of the lines in said marked subgroup of lines in said marked group of lines, means controlled by the final operation of said one key in said key set to its normal position for initiating operation of said switch means for causing said switch to select said marked line in said marked subgroup of lines in said marked group of lines, means controlled when said last-mentioned line is selected by said switch for arresting operation of said switch, and means including said switch for establishing a connection between said station and said selected line.

5. In a telephone system, a telephone station, a group of lines including a plurality of subgroups of lines, an automatic switch associated with said station and having access to said lines, a marking network successively operative to mark any one of the subgroups of lines in said group of lines and to mark any one of the lines in a marked subgroup of lines in said group of lines, means including a device associated with said station and repeatedly operative selectively to control the successive operations of said marking network, means controlled by the final operation of said marking network for initiating operation of said switch, means for causing said switch to select a marked line in a marked subgroup of lines in said group of lines, means controlled by the selection of said last-mentioned line by said switch for releasing said marking network and for arresting operation of said switch, and means including said switch for establishing a connection between said station and said selected line.

6. In a telephone system, a telephone station, a group of lines including a plurality of subgroups of lines, an automatic switch associated with said station and having access to said lines, a marking network successively operative to mark any one of the subgroups of lines in said group of lines and to mark any one of the lines in a marked subgroup of lines in said group of lines, means including a device associated with said station and repeatedly operative selectively to control the successive operations of said marking network, means associated with said station and operative to release said marking network prior to the final operation thereof, means controlled by the final operation of said marking network for initiating operation of said switch, means for causing said switch to select a marked line in a marked subgroup of lines in said group of lines, means controlled by the selection of said last-mentioned line by said switch for releasing said marking network and for arresting operation of said switch, means including said switch for establishing a connection between said station and said selected line, and means associated with said station and operative to release said switch, thereby to interrupt the established connection between said station and said selected line.

7. In a telephone system, a telephone station, a group of lines, a plurality of automatic switches each having access to said lines, means for selecting any one of said switches, means controlled when one of said switches is selected for preventing the other of said switches from being selected, a marking network operative to mark any one of the lines in said group of lines, means including a device associated with said station and operative selectively to control the operation of said marking network, means controlled by the operation of said marking network for initiating operation of a selected switch, means for causing said selected switch to select a marked line in said group of lines, means controlled by the selection of said last-mentioned line by said selected switch for releasing said marking network and for arresting operation of said selected switch, and means including said selected switch for establishing a connection between said station and said selected line.

8. In a telephone system, an operator position, a plurality of trunks, a plurality of lines, a plurality of automatic switches individually associated with said trunks and each having access to

said lines, means for associating any one of said trunks with said operator position, means controlled when one of said trunks is associated with said operator position for preventing the other of said trunks from being associated with said operator position, a marking network operative to mark any one of said lines, means including a device at said operator position and operative selectively to control the operation of said marking network, means controlled by the operation of said marking network for initiating operation of the one of said switches individually associated with said one trunk, means for causing said one switch to select a marked one of said lines, means controlled by the selection of said one line by said one switch for releasing said marking network and for arresting operation of said one switch and for completing a connection between said one trunk and said one line including said operator position, and means for disassociating said one trunk from said operator position and for completing a connection between said one trunk and said one line excluding said operator position.

9. In a telephone system, an operator position, a plurality of trunks, a plurality of lines, a plurality of automatic switches individually associated with said trunks and each having access to said lines, a plurality of switch devices at said operator position and individually associated with said trunks, each of said switch devices having a normal position and an operated position, normally effective connect means responsive to the operation of any one of said switch devices to its operated position for connecting the associated one of said trunks to said operator position, means controlled by the operation of said one switch device to its operated position for rendering ineffective said connect means, a marking network operative to mark any one of said lines, means including another device at said operator position and operative selectively to control the operation of said marking network, means controlled by the operation of said marking network for initiating operation of the one of said switches individually associated with said one trunk, means for causing said one switch to select a marked one of said lines, means for completing a connection between said one trunk and said one line including said operator position, and means controlled by the operation of said one switch device to its normal position for disconnecting said one trunk from said operator position and for rendering effective said connect means and for completing a connection between said one trunk and said one line excluding said operator position.

10. A telephone system comprising an exchange including an operator position, a plurality of trunks extending to said exchange, a plurality of trunk switches arranged in said exchange and individually terminating said trunks, a plurality of lines terminating at said exchange and accessible to said trunk switches, means controllable from said operator position for associating any one of said trunks with said operator position, means controlled when one of said trunks is associated with said operator position for preventing the other of said trunks from being associated with said operator position, means controllable from said operator position for causing the one of said trunk switches terminating said one trunk to seize any one of said lines, thereby to complete a connection between said one trunk and said one line including said operator position,

and means controllable from said operator position for disassociating said one trunk from said operator position, thereby to complete a connection between said one trunk and said one line excluding said operator position.

11. A telephone system comprising an exchange including an operator position, a plurality of trunks extending to said exchange, a plurality of trunk switches arranged in said exchange and individually terminating said trunks, a plurality of lines terminating at said exchange and accessible to said trunk switches, means controllable from said operator position for associating any one of said trunks with said operator position, means controlled when one of said trunks is associated with said operator position for preventing the other of said trunks from being associated with said operator position, means controllable from said operator position for causing the one of said trunk switches terminating said one trunk to select any one of said lines, testing means included in said one trunk switch and responsive to the selection of one of said lines for testing the idle or busy condition of said one line, ringing means included in said one trunk switch and responsive to the test of an idle condition of said one line by said testing means for causing ringing current to be projected over said one line, means included in said one trunk switch and responsive to an answering condition on said one line for arresting the projection of ringing current over said one line and for establishing a connection between said one trunk and said one line including said operator position, and means controllable from said operator position for disassociating said one trunk from said operator position, thereby to complete a connection between said one trunk and said one line excluding said operator position.

12. A telephone system comprising an exchange including an operator position, a plurality of trunks extending to said exchange, a plurality of trunk switches arranged in said exchange and individually terminating said trunks, a plurality of lines terminating at said exchange and accessible to said trunk switches, means controllable from said operator position for associating any one of said trunks with said operator position, means controlled when one of said trunks is associated with said operator position for preventing the other of said trunks from being associated with said operator position, a marking network arranged in said exchange and operative to mark any one of said lines, means including a device associated with said operator position and operative selectively to control the operation of said marking network, means for causing the one of said trunk switches terminating said one trunk to seize a marked one of said lines, thereby to complete a connection between said one trunk and said one line including said operator position, and means controllable from said operator position for disassociating said one trunk from said operator position, thereby to complete a connection between said one trunk and said one line excluding said operator position.

13. A telephone system comprising an exchange including an operator position, a plurality of trunks extending to said exchange, a plurality of trunk switches arranged in said exchange and individually terminating said trunks, a plurality of lines terminating at said exchange and accessible to said trunk switches, means controllable from said operator position for associating any one of said trunks with said operator position,

means controlled when one of said trunks is associated with said operator position for preventing the other of said trunks from being associated with said operator position, means controllable from said operator position for causing the one of said trunk switches terminating said one trunk to seize any one of said lines, thereby to complete a connection between said one trunk and said one line including said operator position, transfer means associated with said operator position and operative to disassociate said one trunk from said operator position and to complete a connection between said one trunk and said one line excluding said operator position, means controllable from said operator position for releasing said one trunk switch prior to the operation of said transfer means, and means controllable over said one line for releasing said one trunk switch subsequent to the operation of said transfer means.

14. A telephone system comprising an exchange including an operator position, a plurality of trunks extending to said exchange, a plurality of trunk switches arranged in said exchange and individually terminating said trunks, a plurality of lines terminating at said exchange and accessible to said trunk switches, a plurality of control switches commonly associated with said operator position and individually associated with said trunks, each of said control switches having a normal position and an operated position, means controlled by the operation of any one of said control switches to its operated position for connecting the associated one of said trunks to said operator position, means controlled when said one trunk is connected to said operator position for preventing the other of said trunks from being connected to said operator position, means controllable from said operator position for causing the one of said trunk switches terminating said one trunk to seize any one of said lines, thereby to complete a connection between said one trunk and said one line including said operator position, means controlled by the operation of said one control switch to its normal position for disconnecting said one trunk from said operator position and for completing a connection between said one trunk and said one line excluding said operator position, means controllable from said operator position for releasing said one trunk switch when said one control switch occupies its operated position, and means controllable over said one line for releasing said one trunk switch when said one control switch occupies its normal position.

15. A telephone system comprising an exchange including an operator position, a plurality of trunks extending to said exchange, a plurality of trunk switches arranged in said exchange and individually terminating said trunks, a plurality of lines terminating at said exchange and accessible to said trunk switches, means controllable from said operator position for associating any one of said trunks with said operator position, means controlled when one of said trunks is associated with said operator position for preventing the other of said trunks from being associated with said operator position, means controllable from said operator position for causing the one of said trunk switches terminating said one trunk to seize any one of said lines, thereby to complete a connection between said one trunk and said one line including said operator position, transfer means associated with said operator position and operative to disasso-

ciate said one trunk from said operator position and to complete a connection between said one trunk and said one line excluding said operator position, means controllable from said operator position for releasing said one trunk switch prior to the operation of said transfer means, normally effective means controllable over said one line for releasing said one trunk switch subsequent to the operation of said transfer means, and additional means associated with said operator position and operative to render ineffective said last-mentioned means.

16. A telephone system comprising an exchange including an operator position, a plurality of trunks extending to said exchange, a plurality of trunk switches arranged in said exchange and individually terminating said trunks, a plurality of lines terminating at said exchange and accessible to said trunk switches, a plurality of control switches commonly associated with said operator position and individually associated with said trunks, each of said control switches having a normal position and first and second operated positions, means controlled by the operation of any one of said control switches to its first operated position for connecting the associated one of said trunks to said operator position, means controlled when said one trunk is connected to said operator position for preventing the other of said trunks from being connected to said operator position, means controllable from said operator position for causing the one of said trunk switches terminating said one trunk to seize any one of said lines, thereby to complete a connection between said one trunk and said one line including said operator position, means controlled by the operation of said one control switch to its normal position for disconnecting said one trunk from said operator position and for completing a connection between said one trunk and said one line excluding said operator position, means controllable from said operator position for releasing said one trunk switch when said one control switch occupies its first operated position, normally effective means controllable over said one line for releasing said one trunk switch when said one control switch occupies its normal position, and means controlled by the operation of said one control switch to its second operated position for rendering ineffective said last-mentioned means.

17. In a telephone system, a central office, a branch exchange including a plurality of telephone stations and a switching link, a trunk extending between said central office and said branch exchange, said trunk including normally connected central office and branch exchange sections, a trunk circuit and a line circuit individually associated with said trunk, said trunk circuit being operative in a first manner to disconnect the central office and branch exchange sections of said trunk and to connect a bridge to the central office section of said trunk and to connect the branch exchange section of said trunk to said line circuit and operative in a second manner to reconnect the central office and branch exchange sections of said trunk and to disconnect the bridge from the central office section of said trunk and to disconnect the branch exchange section of said trunk from said line circuit, means for completing a connection between said central office and any one of said telephone stations including said trunk, means at said one telephone station for selectively controlling over said trunk the manner of operation of said trunk

circuit, means controlled when a bridge is connected to the central office section of said trunk for retaining the connection to said central office, means controlled when the branch exchange section of said trunk is connected to said line circuit for causing said switching link to seize said line circuit and for retaining said switching link operated, and means controllable from said one telephone station over said trunk and said line circuit for causing said switching link to seize another of said telephone stations, thereby to complete a connection between said one telephone station and said other telephone station.

18. In a telephone system, a central office, a branch exchange including a plurality of telephone stations and an operator position and a plurality of switching links and a link distributor, a plurality of trunks extending between said central office and said branch exchange, each of said trunks including normally connected central office and branch exchange sections, a plurality of trunk circuits individually associated with said trunks, a plurality of signals commonly associated with said operator position and individually associated with said trunks, each of said trunk circuits being selectively operative to disconnect and to connect the central office and branch exchange sections of the associated trunk and to operate the signal associated with the trunk, means controllable from said operator position for completing a connection between any one of said trunks and said operator position, additional means controllable from said operator position for completing a connection between said central office and any one of said telephone stations including said one trunk, means at said one telephone station for selectively controlling over said one trunk the operation of the associated one of said trunk circuits, means controlled when the central office and branch exchange sections of said one trunk are disconnected for connecting a bridge to the central office section of said one trunk and for operating said link distributor, means controlled when a bridge is connected to the central office section of said one trunk for retaining the connection to said central office, means controlled by the operation of said link distributor for causing operation of one of said switching links to seize the branch exchange section of said one trunk, means controlled while the central office and branch exchange sections of said one trunk are disconnected for retaining said one switching link operated, and means controllable from said one telephone station over said one trunk for causing said one switching link to seize another of said telephone stations, thereby to complete a connection between said one telephone station and said other telephone station.

19. In a telephone system, a central office, a branch exchange including an operator position and a plurality of telephone stations, a group of trunks extending between said central office and said branch exchange, a group of trunk circuits individually associated with said trunks, a first group of signals commonly associated with said operator position and individually associated with said trunks, a second group of signals commonly associated with said operator position and individually associated with said trunks, means in said central office for routing a call over any one of said trunks and for causing operation of the associated one of said trunk circuits, means controlled by the operation of said one trunk circuit

for operating the one of the signals in said first group associated with said one trunk, thereby to indicate a call on said one trunk, means for connecting said one trunk to said operator position, thereby to answer the call on said one trunk, means controlled by the connection of said one trunk to said operator position for preventing the other of said trunks from being connected to said operator position, means controllable from said operator position for completing a connection between said one trunk and any one of said telephone stations including said operator position, means controllable from said operator position for completing a connection between said one trunk and said one telephone station excluding said operator position, means controllable from said one telephone station over said one trunk for causing reoperation of said one trunk circuit, and means controlled by the reoperation of said one trunk circuit for operating the one of the signals in said second group associated with said one trunk, thereby to indicate a recall on said one trunk.

20. In a telephone system, a central office, a branch exchange including an operator position and a plurality of telephone stations, a group of trunks extending between said central office and said branch exchange, a group of trunk switches arranged in said branch exchange and individually terminating said trunks, a group of trunk circuits individually associated with said trunks, a group of signals commonly associated with said operator position and individually associated with said trunks, means in said central office for routing a call over any one of said trunks and for causing operation of the associated one of said trunk circuits, means controlled by the operation of said one trunk circuit for operating the one of said signals associated with said one trunk, thereby to indicate a call on said one trunk, means for connecting said one trunk to said operator position, thereby to answer the call on said one trunk, means controlled by the connection of said one trunk to said operator position for preventing the other of said trunks from being connected to said operator position and for arresting the operation of said one signal, means controllable from said operator position for causing the one of said trunk switches associated with said one trunk to select any one of said telephone stations, means included in said one trunk switch for testing the idle or busy condition of said one telephone station, means included in said one trunk switch and controlled in the event said one telephone station is tested as busy for reoperating said one signal and controlled in the event said one telephone station is tested as idle for completing a connection between said one trunk and said one telephone station including said operator position, and means controllable from said operator position for completing a connection between said one trunk and said one telephone station excluding said operator position.

21. In a telephone system, a central office, a branch exchange including an operator position and a plurality of telephone stations, a group of trunks extending between said central office and said branch exchange, a group of trunk switches arranged in said branch exchange and individually terminating said trunks, a group of trunk circuits individually associated with said trunks, a group of signals commonly associated with said operator position and individually associated with said trunks, means in said central office for rout-

ing a call over any one of said trunks and for causing operation of the associated one of said trunk circuits, means controlled by the operation of said one trunk circuit for operating the one of said signals associated with said one trunk, thereby to indicate a call on said one trunk, means for connecting said one trunk to said operator position, thereby to answer the call on said one trunk, means controlled by the connection of said one trunk to said operator position for preventing the other of said trunks from being connected to said operator position and for arresting the operation of said one signal, means controllable from said operator position for causing the one of said trunk switches associated with said one trunk to select any one of said telephone stations, means included in said one trunk switch for testing the idle or busy condition of said one telephone station, means included in said one trunk switch and controlled in the event said one telephone station is tested as busy for re-operating said one signal, switching means included in said one trunk switch and controlled in the event said one telephone station is tested as idle for completing a connection between said one trunk and said one telephone station including said operator position, means controllable from said operator position for completing a connection between said one trunk and said one telephone station including said operator position independently of said switching means, and additional means controllable from said operator position for completing a connection between said one trunk and said one telephone station excluding said operator position.

22. In a telephone system, a plurality of lines, an operator position, a marking network operative to mark any one of said lines, means controlled by the presence of a call on any one of said lines for operating said marking network to mark said one line, additional means controllable from said operator position for operating said marking network to mark any one of said lines, automatic switching apparatus having access to said lines and operative to seize a marked one of said lines, and means controllable from said operator position for operating said switching apparatus.

23. In a telephone system, a plurality of lines, an operator position, a marking network operative to mark any one of said lines, means controlled by the presence of a call on any one of said lines for operating said marking network to mark said one line, additional means controllable from said operator position for operating said marking network to mark any one of said lines, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize a marked one of said lines, means controllable from said operator position and operative selectively to connect said trunk to said operator position and to disconnect said trunk from said operator position, and means controlled when said trunk is connected to said operator position for operating said trunk switch.

24. In a telephone system, a plurality of lines, an operator position, a marking network operative to mark any one of said lines, means controlled by the presence of a call on any one of said lines for operating said marking network to mark said one line, additional means controllable from said operator position for operating said marking network to mark any one of said lines, a plurality of trunks, a plurality of trunk switches individually associated with said trunks, each

of said trunk switches having access to said lines and being operative to seize a marked one of said lines, means controllable from said operator position and operative selectively to connect any one of said trunks to said operator position and to disconnect said one trunk from said operator position, and means for operating the trunk switch associated with any one of said trunks connected to said operator position.

25. In a telephone system, a plurality of lines, an operator position, a plurality of finder switches each having access to said lines, means controlled by the presence of a call on any one of said lines for causing one of said finder switches to operate and seize said one line, means for completing a connection between said operator positions and said one finder switch, a marking network adapted to mark any one of said lines, means controlled by the operation of said one finder switch to seize said one line for causing said marking network to mark said one line, additional means controllable from said operator position for causing said marking network to mark any one of said lines, automatic switching apparatus having access to said lines and operative to seize a marked one of said lines, and means controllable from said operator position for operating said switching apparatus.

26. In a telephone system, a plurality of lines, an operator position, a plurality of finder switches each having access to said lines, means controlled by the presence of a call on any one of said lines for causing one of said finder switches to operate and seize said one line, means for completing a connection between said operator positions and said one finder switch, a marking network adapted to mark any one of said lines, means controlled by the operations of said one finder switch to seize said one line for causing said marking network to mark said one line, additional means controllable from said operator position for causing said marking network to mark any one of said lines, a plurality of trunks, a plurality of trunk switches individually associated with said trunks, each of said trunk switches having access to said lines and being operative to seize a marked one of said lines, means controllable from said operator position and operative selectively to connect any one of said trunks to said operator position and to disconnect said one trunk from said operator position, and means for operating the trunk switch associated with any one of said trunks connected to said operator position.

27. In a telephone system, a plurality of lines, an operator position, a plurality of links each having access to said lines, means controlled by the presence of a call on any one of said lines for causing one of said links to seize said one line, means controlled by the seizure of said one line by said one link for marking said one line as busy to the other of said links, means controllable over said one line for causing said one link to seize any one of said lines marked as idle, means for completing a connection between said operator position and said one link, a marking network adapted to mark any one of said lines for selection, means controlled by seizure of said one line by said one link for causing said marking network to mark said one line for selection, additional means controllable from said operator position for causing said marking network to mark any one of said lines for selection, automatic switching apparatus having access to said lines and operative to seize any one of said

lines marked for selection, and means controllable from said operator position for operating said switching apparatus.

28. In a telephone system, a line, an automatic switch having access to said line and operative to seize said line, means for operating said automatic switch, an operator position, means including said automatic switch for completing a connection between said line and said operator position, a trunk, means controllable from said operator position for completing a connection between said trunk and said line independently of said automatic switch, and means controlled when said trunk is connected to said line for releasing said automatic switch.

29. In a telephone system, a line, an automatic switch having access to said line and operative to seize said line, means for operating said automatic switch, an operator position, means including said automatic switch for completing a connection between said line and said operator position, switching apparatus having access to said line and operative to seize said line, means controllable from said operator position for operating said switching apparatus, and means controlled when said line is seized by said switching apparatus for releasing said automatic switch.

30. In a telephone system, a line, an automatic switch having access to said line and operative to seize said line, means for operating said automatic switch, an operator position, means including said automatic switch for completing a connection between said line and said operator position, a trunk, a trunk switch associated with said trunk and having access to said line, means controllable from said operator position for causing said trunk switch to seize said line, thereby to complete a connection between said trunk and said line, and means controlled when said line is seized by said trunk switch for releasing said automatic switch.

31. In a telephone system, a line, an automatic switch having access to said line and operative to seize said line, means for operating said automatic switch, an operator position, means including said automatic switch for completing a connection between said line and said operator position, a trunk, a trunk switch associated with said trunk and having access to said line, means controllable from said operator position for causing said trunk switch to seize said line, thereby to complete a connection between said trunk and said line, means controlled when said line is seized by said trunk switch for releasing said automatic switch, means selectively operative to connect said trunk to said operator position and to disconnect said trunk from said operator position, and means at said operator position for selectively controlling the operation of said last-mentioned means.

32. In a telephone system, a line, an automatic switch having access to said line and operative to seize said line, means for operating said automatic switch, an operator position, means including said automatic switch for completing a connection between said line and said operator position, a trunk, a trunk switch associated with said trunk and having access to said line, means selectively operative to connect said trunk to said operator position and to disconnect said trunk from said operator position, means at said operator position for selectively controlling the operation of said last-mentioned means, means

controlled when said trunk is connected to said operator position for causing said trunk switch to seize said line, thereby to complete a connection between said trunk and said line, and means controlled when said line is seized by said trunk switch for releasing said automatic switch.

33. In a telephone system, a line, an automatic switch having access to said line and operative to seize said line, means for operating said automatic switch, an operator position, means including said automatic switch for completing a connection between said line and said operator position, a plurality of trunks, a plurality of trunk switches individually associated with said trunks and each having access to said line, means selectively operative to connect any one of said trunks to said operator position and to disconnect said one trunk from said operator position, means at said operator position for selectively controlling the operation of said last-mentioned means, means controlled when said one trunk is connected to said operator position for preventing the other of said trunks from being connected to said operator position and for causing the one of said trunk switches associated with said one trunk to seize said line, thereby to complete a connection between said one trunk and said line, and means controlled when said line is seized by said one trunk switch for releasing said automatic switch.

34. In a telephone system, a plurality of lines, an automatic switch having access to said lines, means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, an operator position, means including said automatic switch for completing a connection between said one line and said operator position, a marking network operative to mark any one of said lines, means controlled by the operation of said automatic switch to seize said one line for causing said marking network to operate and mark said one line, switching apparatus having access to said lines and operative to seize a marked one of said lines, means controllable from said operator position for operating said switching apparatus, and means controlled when said one line is seized by said switching apparatus for releasing said automatic switch and said marking network.

35. In a telephone system, a plurality of lines, an automatic switch having access to said lines, means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, an operator position, means including said automatic switch for completing a connection between said one line and said operator position, a marking network operative to mark any one of said lines, means controlled by the operation of said automatic switch to seize said one line for causing said marking network to operate and mark said one line, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize a marked one of said lines, means controllable from said operator position for operating said trunk switch, thereby to complete a connection between said trunk and said one line, and means controlled when said one line is seized by said trunk switch for releasing said automatic switch and said marking network.

36. In a telephone system, a plurality of lines, an automatic switch having access to said lines,

means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, an operator position, means including said automatic switch for completing a connection between said one line and said operator position, a marking network operative to mark any one of said lines, means controlled by the operation of said automatic switch to seize said one line for causing said marking network to operate and mark said one line, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize a marked one of said lines, means controllable from said operator position for operating said trunk switch, thereby to complete a connection between said trunk and said one line, means controlled when said one line is seized by said trunk switch for releasing said automatic switch and said marking network, means selectively operative to connect said trunk to said operator position and to disconnect said trunk from said operator position, and means at said operator position for selectively controlling the operation of said last-mentioned means.

37. In a telephone system, a plurality of lines, an automatic switch having access to said lines, means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, an operator position, means including said automatic switch for completing a connection between said one line and said operator position, a marking network operative to mark any one of said lines, means controlled by the operation of said automatic switch to seize said one line for causing said marking network to operate and mark said one line, a plurality of trunks, a plurality of trunk switches individually associated with said trunks, each of said trunk switches having access to said lines and being operative to seize a marked one of said lines, means selectively operative to connect any one of said trunks to said operator position and to disconnect said one trunk from said operator position, means at said operator position for selectively controlling the operation of said last-mentioned means, means controlled when said one trunk is connected to said operator position for preventing the other of said trunks from being connected to said operator position and for operating the one of said trunk switches associated with said one trunk, thereby to complete a connection between said one trunk and said one line, and means controlled when said one line is seized by said one trunk switch for releasing said automatic switch and said marking network.

38. In a telephone system, a plurality of lines, an automatic switch having access to said lines, means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, an operator position, means including said automatic switch for completing a connection between said one line and said operator position, an identity device associated with said operator position and operative to identify any one of said lines, means controlled by the operation of said automatic switch to seize said one line for causing said identity device to operate and identify said one line, a trunk, a trunk switch associated with said trunk and having access to said lines, means controllable from said operator position for causing said trunk switch to seize said one line, thereby to complete a connection between said trunk and

said one line, and means controlled when said one line is seized by said trunk switch for releasing said automatic switch and said identity device.

39. In a telephone system, a plurality of lines, an automatic switch having access to said lines, means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, an operator position, means including said automatic switch for completing a connection between said one line and said operator position, a marking network operative to mark any one of said lines, means controlled by the operation of said automatic switch to seize said one line for causing said marking network to operate and mark said one line, an identity device associated with said operator position and operative to identify any one of said lines, means controlled by the operation of said automatic switch to seize said one line for causing said identity device to operate and identify said one line, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize a marked one of said lines, means controllable from said operator position for operating said trunk switch, thereby to complete a connection between said trunk and said one line, and means controlled when said one line is seized by said trunk switch for releasing said automatic switch and said marking network and said identity device.

40. In a telephone system, a plurality of lines, an automatic switch having access to said lines, means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, a marking network operative to mark any one of said lines, means controlled by the operation of said automatic switch to seize said one line for preparing said marking network to operate and mark said one line, an operator position, means controllable from said operator position for completing a connection between said operator position and said automatic switch and for operating said marking network, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize a marked one of said lines, and means controllable from said operator position for operating said trunk switch, thereby to complete a connection between said trunk and said one line.

41. In a telephone system, a plurality of lines, an automatic switch having access to said lines, means for selectively operating said automatic switch, thereby to cause said automatic switch to seize any one of said lines, a marking network operative to mark any one of said lines, means controlled by the operation of said automatic switch to seize said one line for preparing said marking network to operate and mark said one line, an operator position, an identity device associated with said operator position and operative to identify any one of said lines, means controlled by the operation of said automatic switch to seize said one line for preparing said identity device to operate and identify said one line, means controllable from said operator position for completing a connection between said operator position and said automatic switch and for operating said marking network and said identity device, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize a marked one of said lines, and means controllable

from said operator position for operating said trunk switch, thereby to complete a connection between said trunk and said one line.

42. In a telephone system, a plurality of lines, a plurality of line selection switches having access to said lines, means for causing said line selection switches to operate and seize calling ones of said lines in a predetermined order, an operator position, a position switch associated with said operator position and having access to said line selection switches, means controllable from said operator position for causing said position switch to seize an operated one of said line selection switches, thereby to complete a connection between said operator position and the one of said lines seized by said one line selection switch, an identity device associated with said operator position, and means controlled jointly by the operation of said position switch to seize said one line selection switch and the operation of said one line selection switch to seize said one line for causing said identity device to identify said one line.

43. In a telephone system, a plurality of lines, each of said lines being adapted to have different classes of calls thereon, a plurality of line selection switches having access to said lines, means for causing said line selection switches to operate in a predetermined order and seize the ones of said lines having calls thereon, an operator position, a position switch associated with said operator position and having access to said line selection switches, said position switch being operative to seize any operated one of said line selection switches, thereby to complete a connection between said operator position and the one of said lines seized by said one line selection switch, and control apparatus at said operator position and operative in a first manner to cause said position switch to seize any one of said line selection switches occupied by a call of a first class and operative in a second manner to cause said position switch to seize any one of said line selection switches occupied by a call of a second class.

44. In a telephone system, a plurality of lines, a plurality of line selection switches having access to said lines, means for causing said line selection switches to operate in a predetermined order and seize calling ones of said lines, each of said line selection switches including control apparatus governable over a calling one of said lines seized by the line selection switch and a register, the control apparatus included in each of said line selection switches being governable selectively to operate the register included in the line selection switch, the register included in each of said line selection switches being selectively operative to mark the line selection switch as occupied by different classes of calls, an operator position, a position switch associated with said operator position and having access to said line selection switches, and control means at said operator position and operative in a first manner to cause said position switch to seize one of said line selection switches marked as occupied by a call of a first class and operative in a second manner to cause said position switch to seize one of said line selection switches marked as occupied by a call of a second class.

45. In a telephone system, a plurality of lines, a plurality of line selection switches having access to said lines, means for causing said line selection switches to operate in a predetermined order and seize calling ones of said lines, each of said

line selection switches including control apparatus governable over a calling one of said lines seized by the line selection switch and a register, the control apparatus included in each of said line selection switches being governable selectively to operate the register included in the line selection switch, an operator position, the register included in each of said line selection switches being selectively operative to mark the line selection switch as occupied by different classes of calls and to cause different signals to be transmitted to said operator position indicative of the type of call occupying the line selection switch, a position switch associated with said operator position and having access to said line selection switches, and control means at said operator position and operative in a first manner to cause said position switch to seize one of said line selection switches marked as occupied by a call of a first class and operative in a second manner to cause said position switch to seize one of said line selection switches marked as occupied by a call of a second class.

46. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and to cause the link to be marked, an operator position, a position switch associated with said operator position, said position switch having access to said links and being operative to seize any marked one of said links, and means at said operator position for operating said position switch.

47. In a telephone system, a plurality of lines, a plurality of links, a link distributor operative to assign an idle one of said links for use and to cause an assigned one of said links to be connected to a calling one of said lines and then to assign another idle one of said links for use, each of said links including control apparatus governable over a calling one of said lines connected to the link, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and to cause the link to be marked, an operator position, a position switch associated with said operator position, said position switch having access to said links and being operative to seize any marked one of said links, and means at said operator position for operating said position switch.

48. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link and a register, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and selectively to operate the register included in the link, the register included in each of said links being selectively operative to mark the link as occupied by different classes of calls, an operator position, a position switch associated with said operator position and having access to said links, and control means at said operator position and operative in a first manner to cause said position switch to seize one of said links

marked as occupied by a call of a first class and operative in a second manner to cause said position switch to seize one of said links marked as occupied by a call of a second class.

49. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link and a register, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and selectively to operate the register included in the link, the register included in each of said links being selectively operative to mark the link as occupied by different classes of calls, an operator position, means controlled by the operation of the register in any one of said links to mark said one link as occupied by a particular class of call for transmitting a corresponding signal to said operator position identifying said particular class of call, a position switch associated with said operator position and having access to said links, and control means at said operator position and operative in a first manner to cause said position switch to seize one of said links marked as occupied by a call of a first class and operative in a second manner to cause said position switch to seize one of said links marked as occupied by a call of a second class.

50. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link and a register, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and selectively to operate the register included in the link, the register included in each of said links being selectively operative to mark the link as occupied by different classes of calls, an operator position, a position switch associated with said operator position and having access to said links, control means at said operator position and operative in a first manner to cause said position switch to seize one of said links marked as occupied by a call of a first class and operative in a second manner to cause said position switch to seize one of said links marked as occupied by a call of a second class, and an identity device associated with said operator position and operative to identify the particular calling one of said lines to which the one of said links seized by said position switch is connected.

51. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link and a register, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and selectively to operate the register included in the link, the register included in each of said links being selectively operative to mark the link as occupied by different classes of calls, an operator position, a position switch associated with said operator position and having access to said links, control means at said operator position and operative in a first manner to cause said position switch to seize one of said links marked as oc-

cupied by a call of a first class and operative in a second manner to cause said position switch to seize one of said links marked as occupied by a call of a second class, and an identity device associated with said operator position and operative to identify the particular calling one of said lines to which the one of said links seized by said position switch is connected only in the event said one link is marked as occupied by a call of a given class.

52. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link and a register, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and selectively to operate the register included in the link, the register included in each of said links being selectively operative to mark the link as occupied by different classes of calls, an operator position means controlled by the operation of the register in any one of said links to mark said one link as occupied by a particular class of call for transmitting a corresponding signal to said operator position identifying said particular class of call, a position switch associated with said operator position and having access to said links, control means at said operator position and operative in a first manner to cause said position switch to seize one of said links marked as occupied by a call of a first class and operative in a second manner to cause said position switch to seize one of said links marked as occupied by a call of a second class, and an identity device associated with said operator position and operative to identify the particular calling one of said lines to which the one of said links seized by said position switch is connected.

53. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and to cause the link to be marked, an operator position, a position switch associated with said operator position and having access to said links, said position switch being operative to seize any marked one of said links, means at said operator position for operating said position switch, a trunk, a trunk switch associated with said trunk and having access to said lines, and means controllable from said operator position for causing said trunk switch to seize the one of said lines to which the one of said links seized by said position switch is connected.

54. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and to cause the link to be marked, an operator position, a position switch associated with said operator position and having access to said links, said position switch being operative to seize any marked one of said links, means at said operator position for operat-

ing said position switch, a trunk, a trunk switch associated with said trunk and having access to said lines, means controllable from said operator position for causing said trunk switch to seize the one of said lines to which the one of said links seized by said position switch is connected, and means controlled when said one line is seized by said trunk switch for causing said one link to be disconnected from said one line.

55. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and to cause the link to be marked, an operator position, a position switch associated with said operator position and having access to said links, said position switch being operative to seize any marked one of said links, means at said operator position for operating said position switch, a marking network operative to mark any one of said lines, means controlled by the operation of said position switch to seize any one of said links for causing operation of said marking network to mark the one of said lines to which said one link is connected, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize any marked one of said lines,

and means controllable from said operator position for operating said trunk switch.

56. In a telephone system, a plurality of lines, a plurality of links, means for connecting said links to calling ones of said lines in a predetermined order, each of said links including control apparatus governable over a calling one of said lines connected to the link, the control apparatus included in each of said links being selectively governable to cause the link to be connected to any called one of said lines and to cause the link to be marked, an operator position, a position switch associated with said operator position and having access to said links, said position switch being operative to seize any marked one of said links, means at said operator position for operating said position switch, a marking network operative to mark any one of said lines, means controlled by the operation of said position switch to seize any one of said links for causing operation of said marking network to mark the one of said lines to which said one link is connected, a trunk, a trunk switch associated with said trunk, said trunk switch having access to said lines and being operative to seize any marked one of said lines, means controllable from said operator position for operating said trunk switch, and means controlled when said one line is seized by said trunk switch for releasing said marking network and for causing said one link to be disconnected from said one line.

THOMAS F. CROCKER.

CERTIFICATE OF CORRECTION.

Patent No. 2,265,151.

December 9, 1941.

THOMAS F. CROCKER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 35, first column, line 68, claim 4, before "means" insert a comma; page 36, first column, line 13, for "iwth" read --with--: page 41, second column, line 58, for "mary" read --mark--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of January, A. D. 1942.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.