Sept. 12, 1944. F. KESSLER 2,358,013

TELEPHONE SYSTEM

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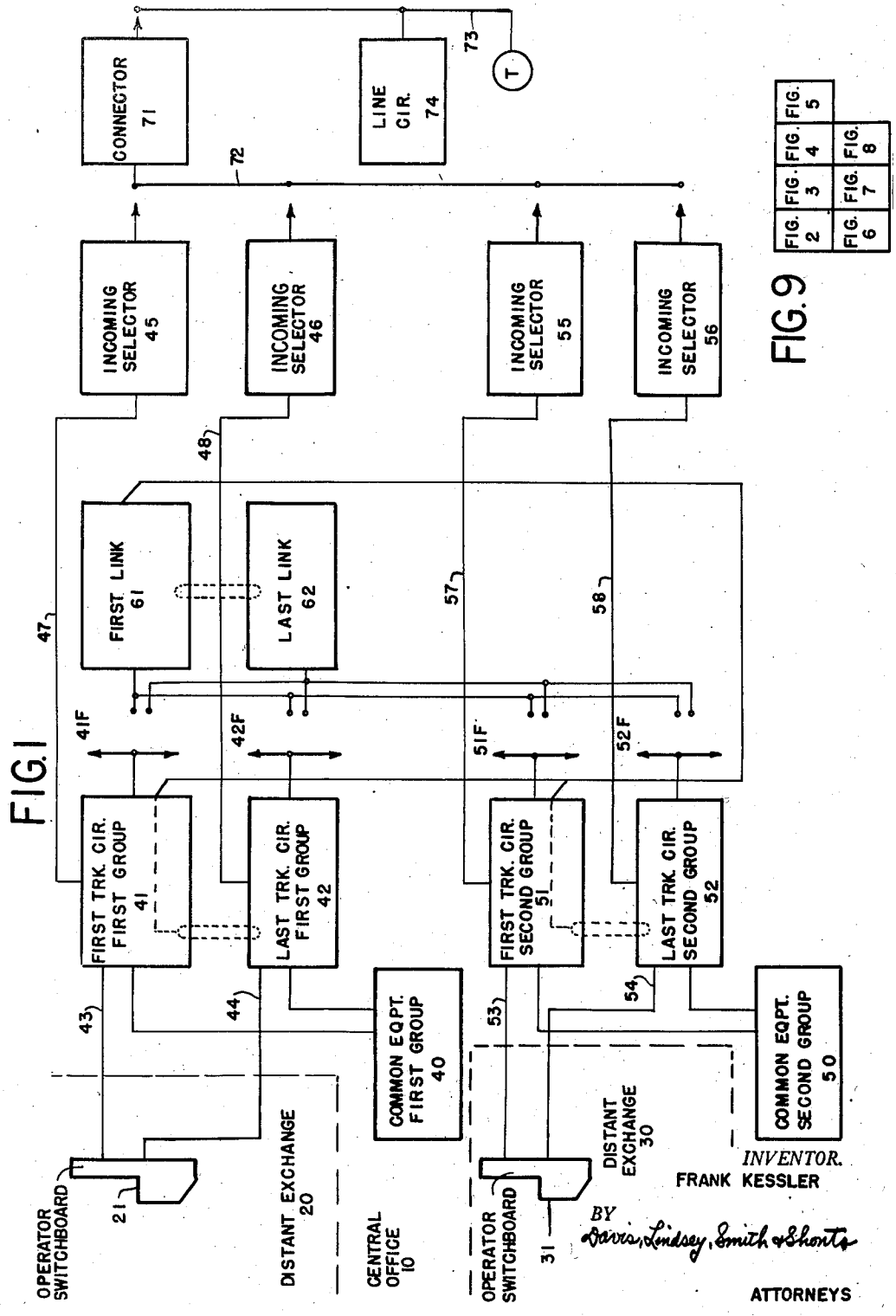


FIG. 1

FIG. 9

FIG. 2	FIG. 3	FIG. 4	FIG. 5
FIG. 6	FIG. 7	FIG. 8	

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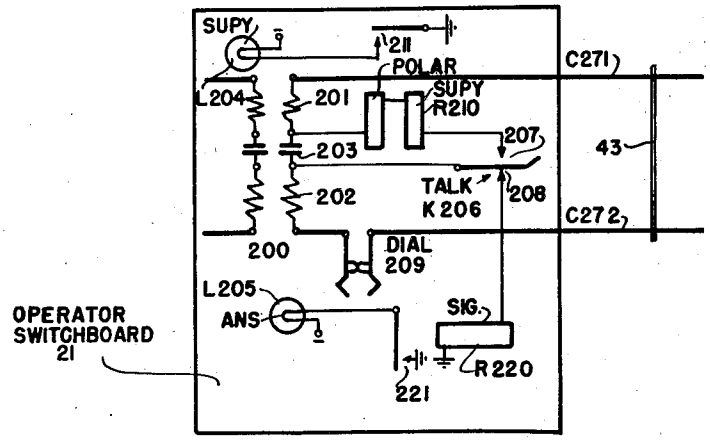
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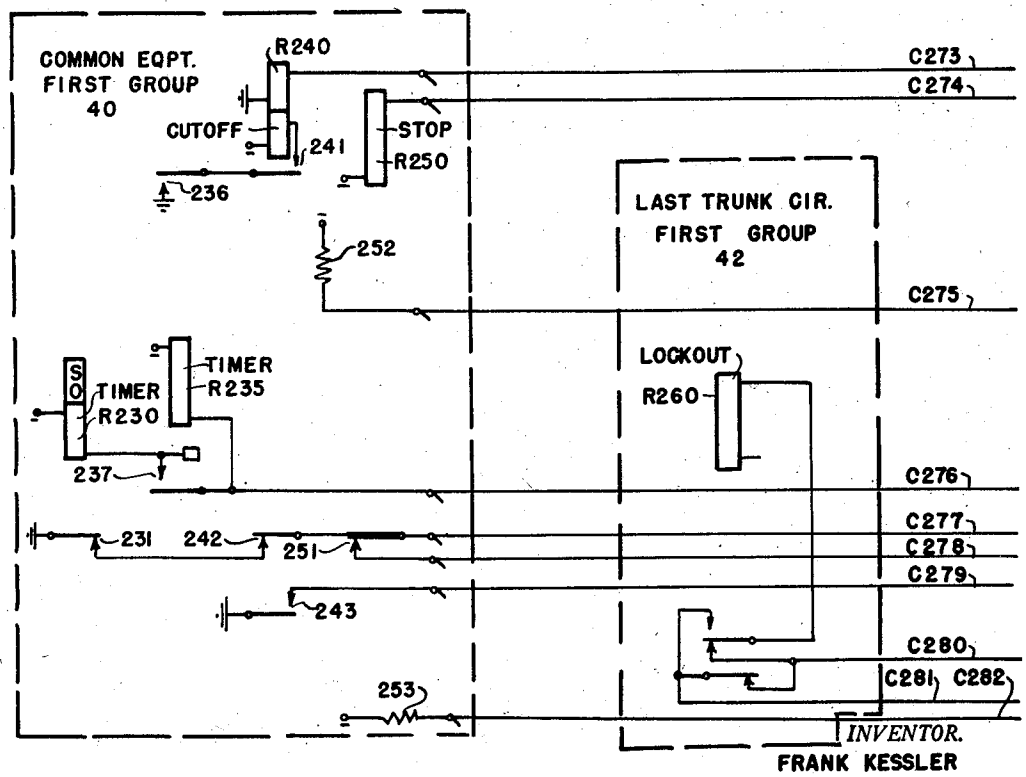
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FIG. 2



DISTANT EXCHANGE 20

CENTRAL OFFICE 10



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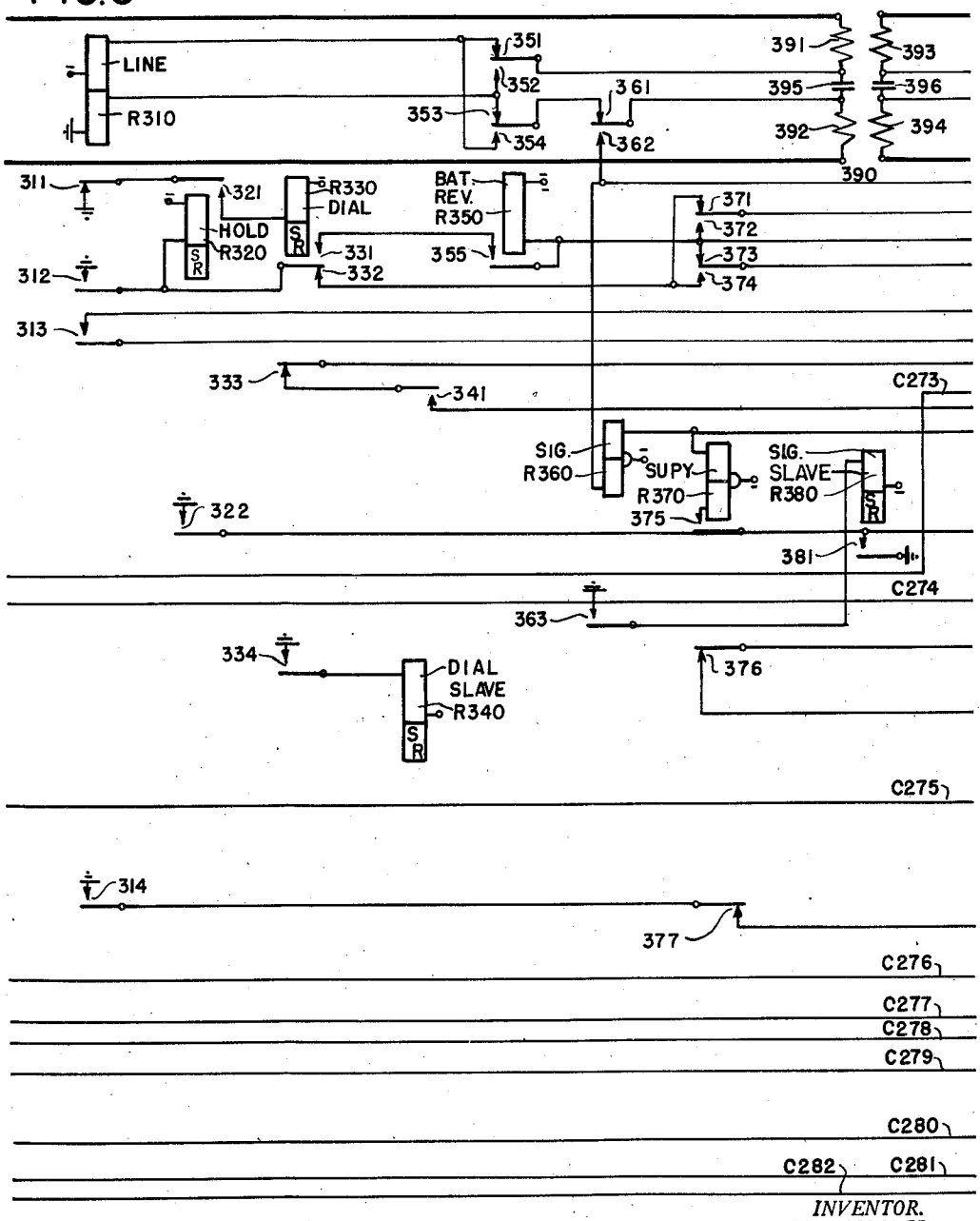
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TELEPHONE SYSTEM

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FIG.3 FIRST TRUNK CIRCUIT FIRST GROUP 41



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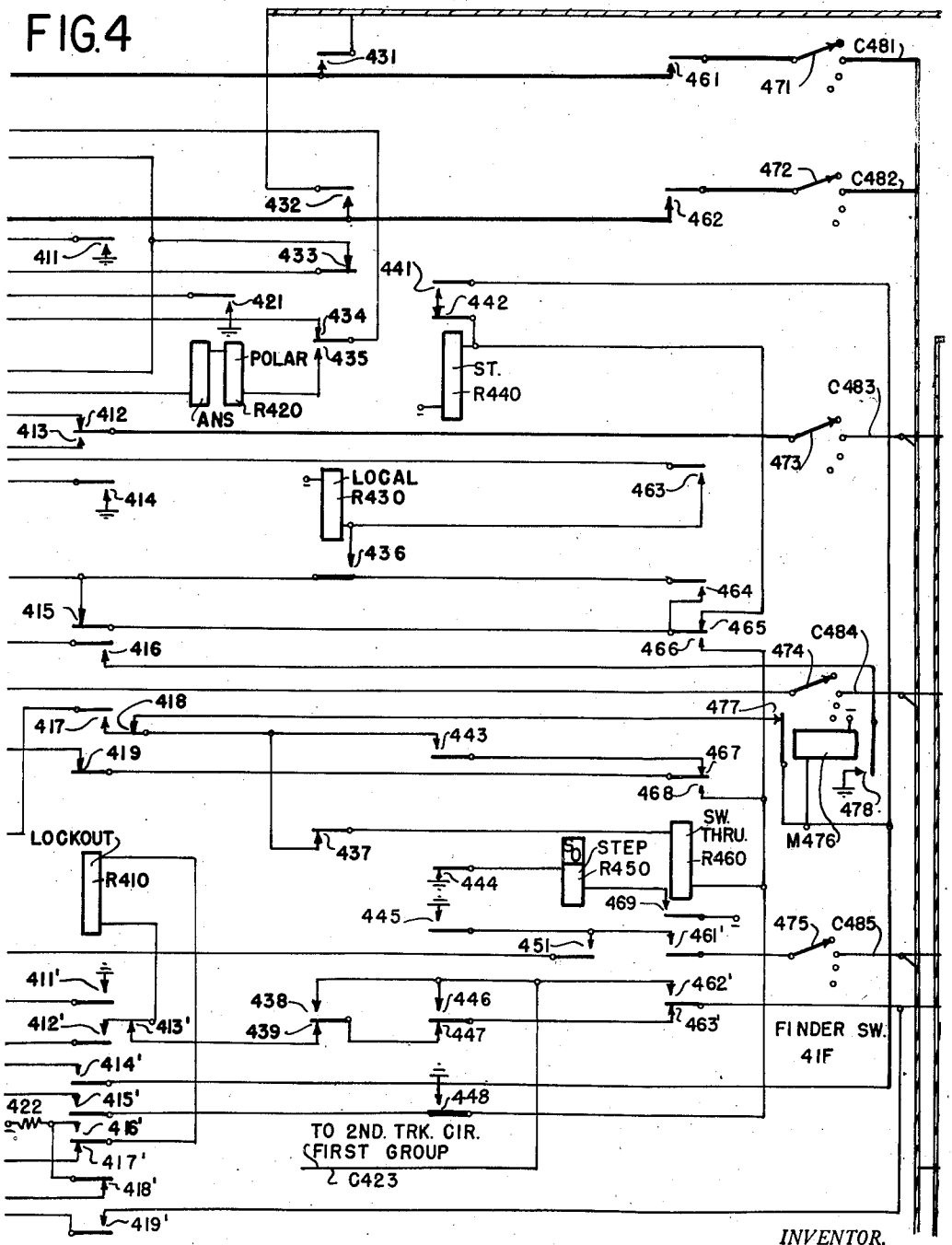
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FIG. 4



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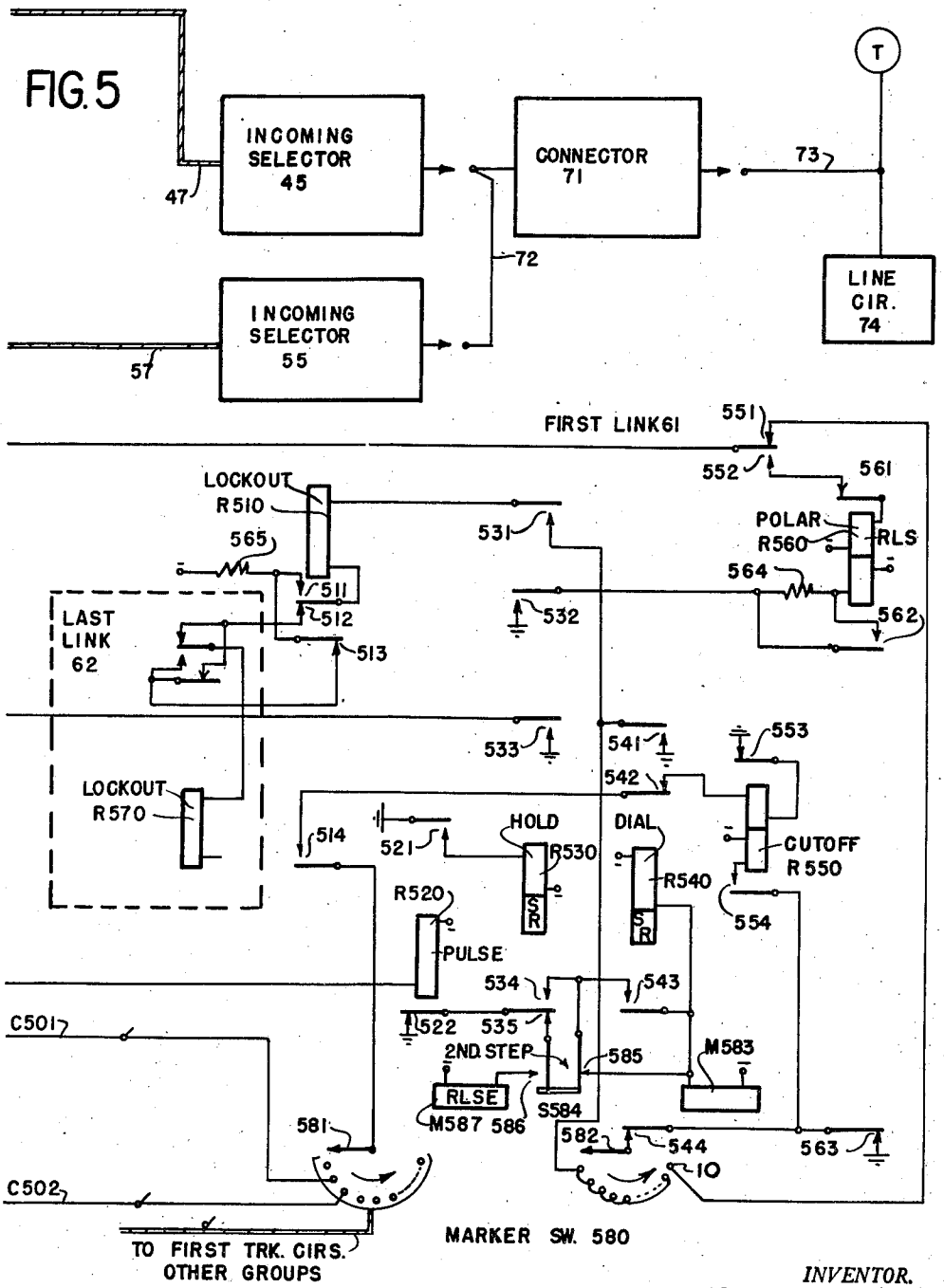
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TELEPHONE SYSTEM

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FIG. 5



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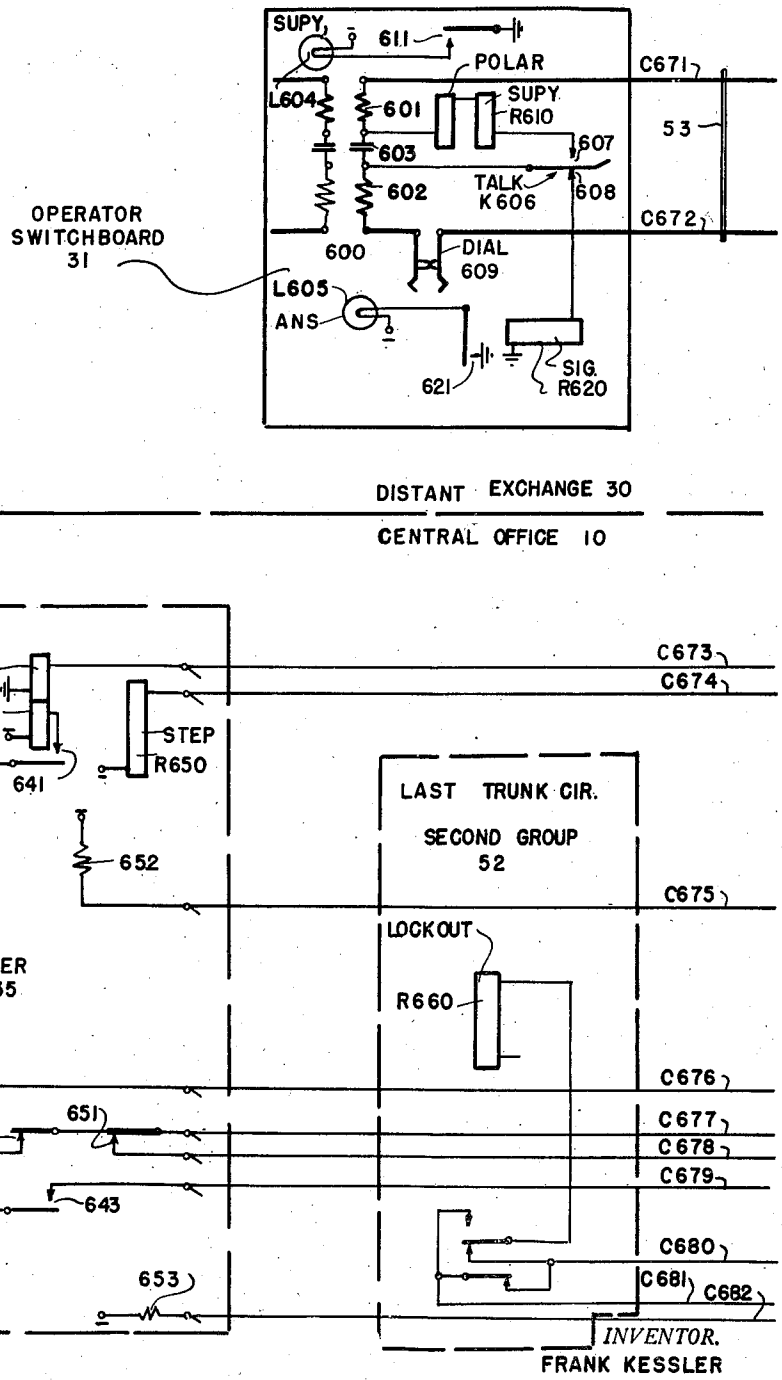
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TELEPHONE SYSTEM

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FIG. 6



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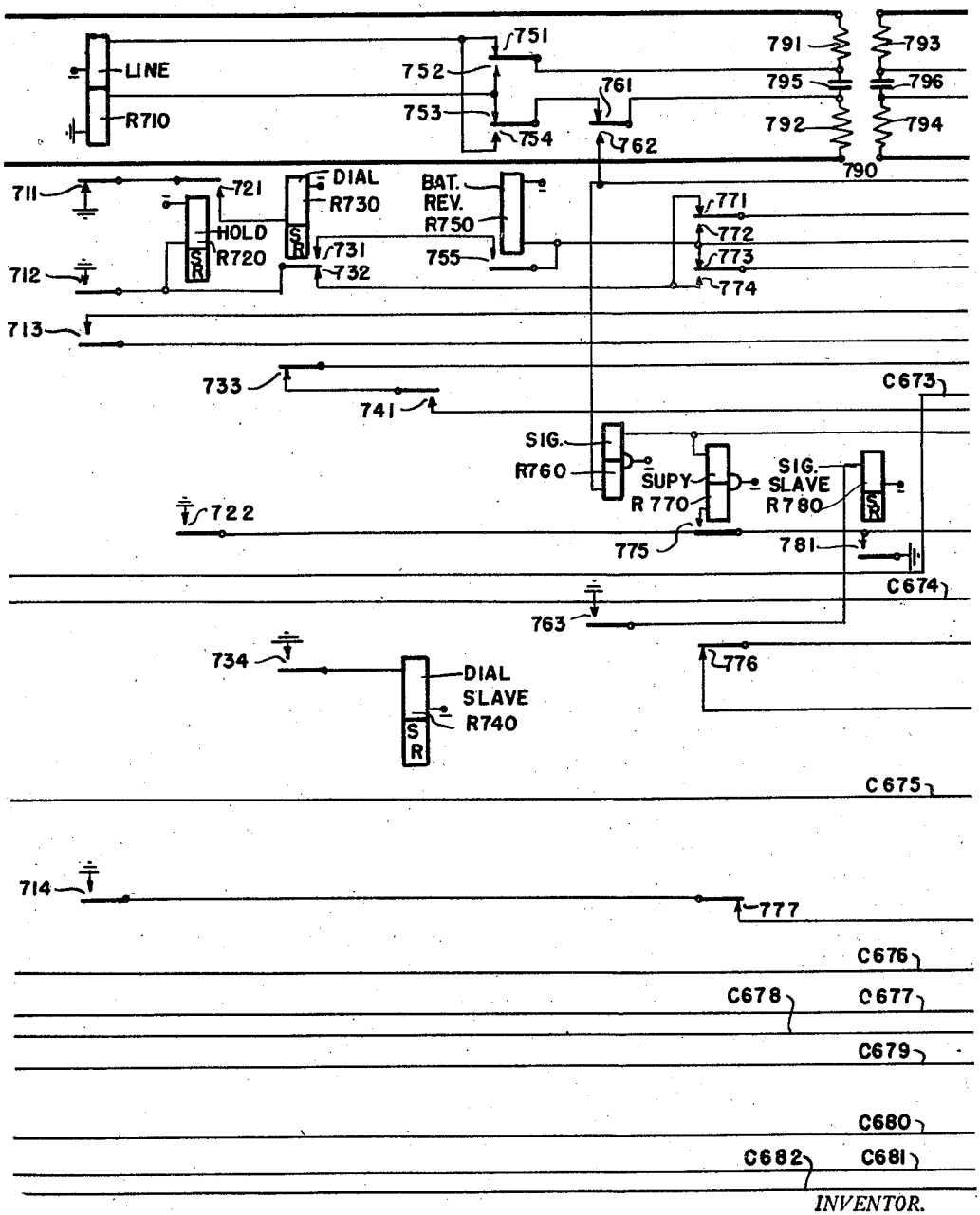
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TELEPHONE SYSTEM

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FIG. 7 FIRST TRUNK CIRCUIT SECOND GROUP 51



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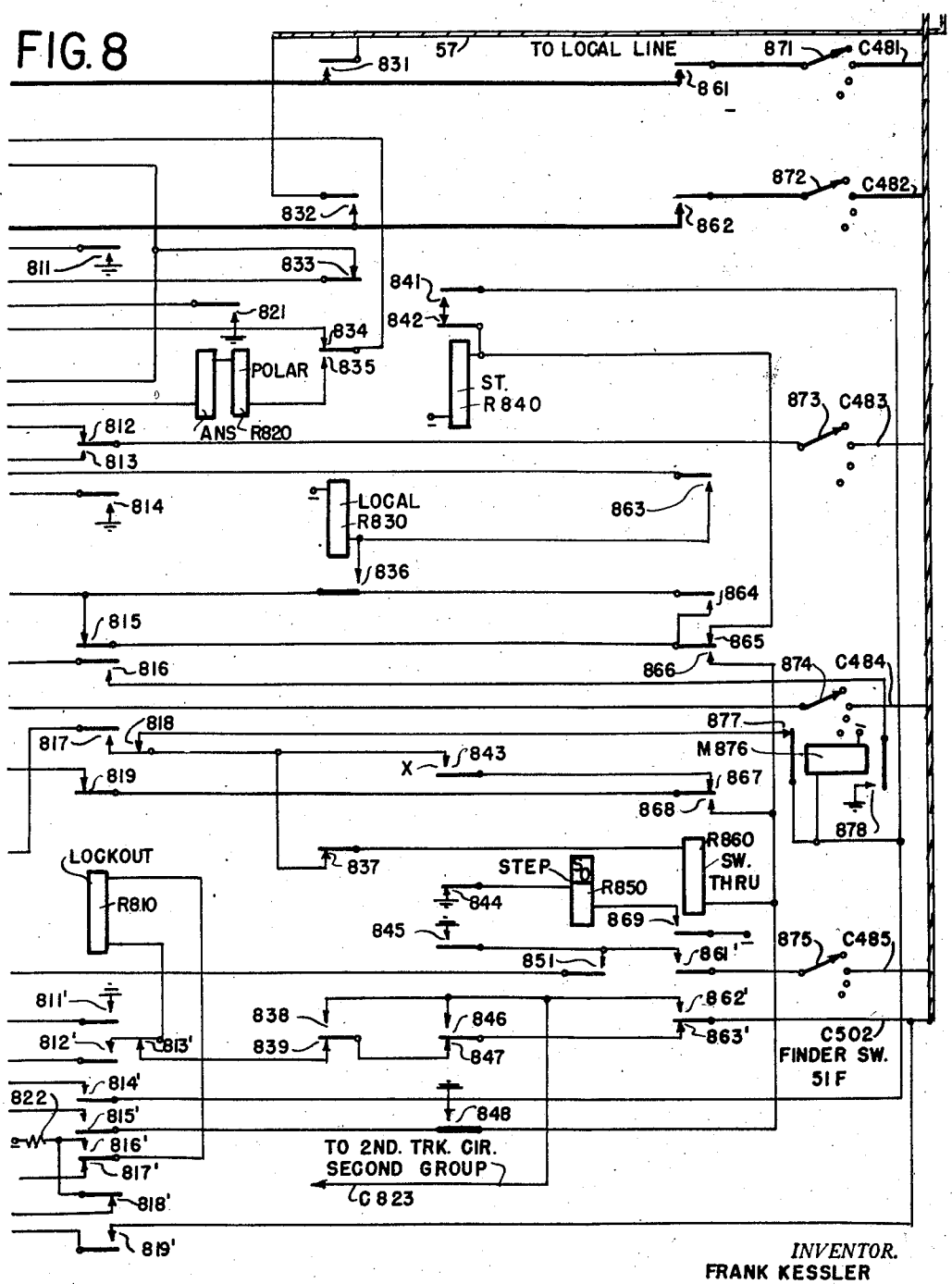
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TELEPHONE SYSTEM

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FIG. 8



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Patented Sept. 12, 1944

2,358,013

UNITED STATES PATENT OFFICE

2,358,013

TELEPHONE SYSTEM

Frank Kessler, Lombard, Ill., assignor to Automatic Electric Laboratories, Inc., a corporation of Delaware

Application February 1, 1943, Serial No. 474,233

16 Claims. (Cl. 179—27)

The present invention relates to telephone systems and more particularly to tandem switching systems.

A conventional telephone system of the type noted comprises a plurality of exchanges each including an operator switchboard, a switching center including switching apparatus and terminating a plurality of lines, and a plurality of groups of trunks individually extending between the operator switchboards in the exchanges and the switching apparatus in the switching center; wherein the switching apparatus is selectively controllable over the different trunks to complete both trunk-to-trunk calls and trunk-to-line calls.

It is an object of the present invention to provide in a telephone system of the type noted improved switching apparatus in the form of switches individual to the trunks, whereby the two switches individual to calling and called trunks are operative to seize a common link in order to set up a connection between the calling and called trunks.

Another object of the invention is to provide in a telephone system of the type noted improved switching apparatus in the form of switches individual to the trunks and switching mechanism common to the trunks, whereby the two switches individual to calling and called trunks are operative to seize a common link in order to set up a connection between the calling and called trunks, and whereby the switching mechanism common to the trunks is controllable over a calling trunk to seize a called line in order to set up a connection between the calling trunk and the called line independently of the switch individual to the calling trunk.

A further object of the invention is to provide in a telephone system including a line having a finder switch individual thereto, an improved arrangement for selectively controlling the operation of the finder switch, whereby the finder switch is operative to set up both an outgoing call from the line and an incoming call to the line.

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

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 embodying the present invention; Figs. 2 to 8, inclusive, taken together, illustrate the details of a system having incorporated therein the features of the invention as briefly outlined above; and Fig. 9 illustrates the mode of combining Figs. 2 to 8, inclusive, of the drawings to form a unified system.

Description of the apparatus incorporated in the system

Referring now more particularly to Fig. 1 of the drawings, the telephone system there illustrated comprises a central office **10** of the automatic type and a plurality of distant exchanges **20**, **30** etc. of any suitable type, the central office **10** constituting a switching center for the system. The central office **10** and each of the distant exchanges are interconnected by a group of trunks; the group of trunks interconnecting the central office **10** and the distant exchange **20**, including the first trunk **43** and the last trunk **44**, and the group of trunks interconnecting the central office **10** and the distant exchange **30**, including the first trunk **53** and the last trunk **54**. Each of the distant exchanges comprises an operator switchboard of any suitable type terminating the group of trunks extending thereto; the operator switchboard **21** being provided in the distant exchange **20** and terminating the group of trunks, including the trunks **43** and **44**, and the operator switchboard **31** being provided in the distant exchange **30** and terminating the group of trunks, including the trunks **53** and **54**.

Each trunk in each group is terminated in a trunk circuit individual thereto provided in the central office **10**; the first and last trunks **43** and **44**, respectively, in the first group being provided with the first and last trunk circuits **41** and **42**, respectively, in the first group and the first and last trunks **53** and **54**, respectively, in the second group being provided with the first and last trunk circuits **51** and **52**, respectively, in the second group. Also each group of trunk circuits is provided with common equipment in the central office **10**; the first and last trunk circuits **41** and **42**, respectively, in the first group being provided with the common equipment first group **40** and the first and last trunk circuits **51** and **52**, respectively, in the second group being provided with the common equipment second group **50**. Each of the trunk circuits comprises a finder switch; the first trunk circuit first group **41**, the last trunk circuit first group **42**, the first trunk circuit second group **51** and the last trunk circuit second group **52** being respectively provided with the finder switches **41F**, **42F**, **51F** and **52F**. Also each

of the trunk circuits comprises an incoming selector of any suitable type; the first trunk circuit first group 41, the last trunk circuit first group 42, the first trunk circuit second group 51 and the last trunk circuit second group 52 being respectively provided with the incoming selectors 45, 46, 55 and 56, respectively connected thereto by the trunks 47, 48, 57 and 58.

Also the central office 10 comprises a group of links, including the first link 61 and the last link 62; each link in the group being accessible to the finder switch of each trunk circuit in each group and being operatively associated with each trunk circuit in each of the groups, for a purpose more fully explained hereinafter. Further the central office 10 comprises switching apparatus, including not only the incoming selectors 45, 46, 55, 56 etc. but a number of connectors 71 etc. of any suitable type accessible to the incoming selectors. For example, the connector 71 is accessible by way of the trunk 72 extending thereto to the incoming selectors 45, 46, 55, 56 etc. Finally the central office 10 serves a number of local subscriber substations, including the subscriber substation T of any suitable type. The subscriber substation T has a subscriber line 73 extending thereto which is provided with an individual line circuit 74 of any suitable type.

Preferably, each of the trunk circuits is identical to the first trunk circuit first group 41 terminating the first trunk first group 43 extending between the central office 10 and the distant exchange 20, and to the first trunk circuit second group 51 terminating the first trunk second group 53 extending between the central office 10 and the distant exchange 30.

More particularly, the first trunk circuit first group 41 comprises, as shown in Figs. 3 and 4, a relay group, including a line relay R310, a hold relay R320, a dial relay R330, a dial slave relay R340, a battery reverse relay R350, a signal relay R360, a supervisory relay R370, a signal slave relay R380, a lockout relay R410, an answer relay R420, a local relay R430, a start relay R440, a step relay R450 and a switch-through relay R460. Also the first trunk circuit first group 41 comprises a repeating coil 390 and a control network connected and arranged in a manner more fully explained hereinafter. Further the finder switch 41F individual to the first trunk circuit first group 41 is of the rotary type, including five wipers 471 to 475, inclusive, provided with individually associated contact banks and a magnet M476 for driving the wipers noted step by step in the clockwise direction. It will be understood that the last trunk circuit first group 42, indicated in Fig. 2, will comprise similar equipment including a relay group, this relay group including the lockout relay R260 illustrated.

Similarly, the first trunk circuit second group 51 comprises, as shown in Figs. 7 and 8, a relay group including a line relay R710, a hold relay R720, a dial relay R730, a dial slave relay R740, a battery reverse relay R750, a signal relay R760, a supervisory relay R770, a signal slave relay R780, a lockout relay R810, an answer relay R820, a local relay R830, a start relay R840, a step relay R850 and a switch-through relay R860. Also the first trunk circuit second group 51 comprises a repeating coil 790 and a control network connected and arranged in a manner more fully explained hereinafter. Further the finder switch 51F individual to the first trunk circuit second group 51 is of the rotary type, including five wipers 871 to 875, inclusive, provided with individually associated contact banks, and a magnet M876 for driving the wipers noted step by step in the clockwise direction. It will be understood that the last trunk circuit second group 52, indicated in Fig. 6, will comprise similar equipment including a relay group, this relay group including the lockout relay R660 illustrated.

Preferably, each common equipment is identical to the common equipment first group 40 individually associated with the trunk circuits in the first group and to the common equipment second group 50 individually associated with the trunk circuits in the second group. More particularly, the common equipment first group 40 comprises, as shown in Fig. 2, a relay group, including two timer relays R230 and R235, a cutoff relay R240 and a step relay R250; and a control network connected and arranged in a manner more fully explained hereinafter. Similarly, the common equipment second group 50 comprises, as shown in Fig. 6, a relay group, including two timer relays R630 and R635, a cutoff relay R640 and a step relay R650; and a control network connected and arranged in a manner more fully explained hereinafter.

As previously noted, each operator switchboard in each distant exchange is of any suitable type, and preferably the operator switchboards 21, 31 etc. are identical. Each operator switchboard comprises position equipment which may be operatively connected to the trunks extending thereto. The position equipment provided at the operator switchboard 21 in the distant exchange 20 is illustrated in Fig. 2 as being connected to the first trunk first group 43 and as comprising a repeating coil 200, a supervisory relay R210, a signal relay R220, a talk key K206, a dial 209, a supervisory lamp L204, an answer lamp L205, and a control network connected and arranged in a manner more fully explained hereinafter. The position equipment provided at the operator switchboard 31 in the distant exchange 30 is illustrated in Fig. 6 as being connected to the first trunk second group 53 and as comprising a repeating coil 600, a supervisory relay R610, a signal relay R620, a talk key K606, a dial 609, a supervisory lamp L604, an answer lamp L605, and a control network connected and arranged in a manner more fully explained hereinafter.

Preferably, each of the links is identical to the first link 61 which comprises, as shown in Fig. 5, a marker switch 580 of the minor type, including two wipers 581 and 582 provided with individually associated contact banks, a rotary magnet M583 for driving the wipers noted step by step in the counterclockwise direction, and a release magnet M587 for releasing the wipers noted and for causing them to be returned to their normal rotary positions. Also associated with the marker switch 580 is a set of switch springs S584 which is actuated when the wipers noted are operated two steps away from their normal rotary positions. Also the first link 61 comprises a relay group, including a lockout relay R510, a pulse relay R520, a hold relay R530, a dial relay R540, a cutoff relay R550 and a release relay R560; and a control network connected and arranged in a manner more fully explained hereinafter. It will be understood that the last link 62, indicated in Fig. 5, will comprise similar equipment including a relay group, this relay group including the lockout relay R570 illustrated.

A better understanding of the connection and arrangement of the telephone system will be fa-

cilitated from a consideration of the detailed operation of the various pieces of apparatus incorporated therein incident to the completion of the various calls between the various distant exchanges and from the various distant exchanges to the central office, as will appear hereinafter.

Initiation of a call in a distant exchange

Considering now the initiation of a call at an operator switchboard in a distant exchange, such, for example, as the operator switchboard **21** in the distant exchange **20**, the operator at the switchboard **21** first selects an idle trunk in the group terminated thereat and connects the associated position equipment thereto. For example, the operator at the switchboard **21** may select the first trunk first group **43** and connect the associated position equipment thereto, as illustrated. Next, the operator at the switchboard **21** operates the talk key **K206** individual to the first trunk first group **43**, whereby there is completed, at the contacts **207** thereof, a series circuit for energizing the winding of the supervisory relay **R210** in the associated position equipment and the upper and lower windings of the line relay **R310** in the first trunk circuit first group **41** via the first trunk first group **43**. The above-mentioned circuit extends from ground by way of the lower winding of **R310**, the contacts **353** and **361**, the winding **392** of the repeating coil **390**, the line conductor **C272** of the first trunk **43**, the dial **209**, the winding **202** of the repeating coil **200**, the contacts **207** of the talk key **K206**, the winding of the supervisory relay **R210**, the winding **201** of the repeating coil **200**, the line conductor **C271** of the first trunk **43**, the winding **391** of the repeating coil **390**, the contacts **351** and the upper winding of **R310** to battery. When the above-traced series circuit is completed the supervisory relay **R210** in the position equipment at the operator switchboard **21** does not operate as it is of the polarized type, while the line relay **R310** in the first trunk circuit **41** operates.

Upon operating, the line relay **R310** completes, at the contacts **312**, an obvious circuit for energizing the winding of the hold relay **R320**, thereby to cause the latter relay to operate. Upon operating, the hold relay **R320** completes, at the contacts **322**, a circuit, including the contacts **415** and **465**, for energizing the winding of the start relay **R440**, thereby to cause the latter relay to operate. Upon operating, the start relay **R440** first completes, at the contacts **441**, and then interrupts, at the contacts **442**, a circuit, including the contacts **465**, **415** and **322**, for energizing the magnet **M476** of the finder switch **41F**, whereby the latter magnet operates and restores. Upon operating, the magnet **M476** conditions the wipers noted of the finder switch **41F** to be driven one step in the clockwise direction; and, upon restoring, the magnet **M476** drives the wipers noted one step in the clockwise direction. Also the start relay **R440** interrupts, at the contacts **447**, a normally completed connection, including the contacts **463'**, **439** and **413'**, between the first marking conductor **C501** and the winding of the lockout relay **R410**, thereby to mark the first trunk circuit **41** in the first group as busy to the marker switches of the various links. Also the start relay **R440** completes, at the contacts **446**, an obvious connection, including the contacts **463'**, between the first marking conductor **C501** and the chain conductor **C423** extending to the second trunk circuit in the first group, thereby to render the second trunk circuit in the first group selectable by the marker switches of the various links. Further the start relay **R440** completes, at the contacts **443** and **448**, a test connection between the winding of the switch-through relay **R460** and the control wiper **474** of the finder switch **41F**. At this time the wipers noted of the finder switch **41F** engage the conductors extending to one of the links **61**, **62** etc. and the link mentioned is either idle or busy and the idle or busy condition thereof is tested by the switch-through relay **R460** in the first trunk circuit **41**. More particularly, in the event the engaged link is respectively busy or idle, ground potential or no potential is respectively connected to the control wiper **474** of the finder switch **41F**.

Assuming that the engaged link is busy, ground potential appears upon the control conductor thereof and is connected to the control wiper **474** of the finder switch **41F**, thereby to complete a path, including the contacts **376**, **419**, **467**, **443**, **437** and **448**, for short-circuiting the winding of the switch-through relay **R460** in order positively to prevent operation of the latter relay at this time. Also the application of ground potential to the control wiper **474** of the finder switch **41F** completes a circuit, including the contacts **376**, **419**, **467**, **443**, **418** and **477**, for energizing the magnet **M476**, thereby to cause the latter magnet to operate. Upon operating, the magnet **M476** conditions the wipers noted of the finder switch **41F** to be driven an additional step in the clockwise direction and interrupts, at the contacts **477**, the previously traced circuit for energizing the magnet **M476**, whereby the latter magnet restores. Upon restoring, the magnet **M476** drives the wipers noted of the finder switch **41F** an additional step in the clockwise direction to engage the conductors extending to the next link **61**, **62** etc., whereby the idle or busy condition thereof is tested in the manner explained above. Accordingly, the magnet **M476** operates intermittently, thereby to drive the wipers noted of the finder switch **41F** step by step in the clockwise direction until an idle link **61**, **62** etc. is tested by the switch-through relay **R460** in the first trunk circuit **41**.

Assuming that the first link **61** illustrated is the first idle link tested by the switch-through relay **R460** in the first trunk circuit **41**, when the wipers noted of the finder switch **41F** engage the conductors **C481** to **C485**, inclusive, extending to the first link **61**, no ground potential appears upon the control conductor **C484** in view of the fact that the hold relay **R530** in the first link **61** occupies its restored position. At this time, no ground potential appears upon the control conductor **C484** and consequently upon the control wiper **474** of the finder switch **41F**, whereby the previously traced path for short-circuiting the winding of the switch-through relay **R460** in the first trunk circuit **41** is not completed. At this time, a series circuit is completed for energizing the winding of the switch-through relay **R460** and the magnet **M476**; this circuit extending from ground by way of the contacts **448**, the winding of **R460**, the contacts **437**, **418** and **477** and the magnet **M476** to battery. When this series circuit is completed the switch-through relay **R460** operates; however, the magnet **M476** does not operate due to the high series resistance of the winding of the switch-through relay **R460**.

Upon operating, the switch-through relay R460 completes, at the contacts 464 and 466, an alternative holding circuit, including the contacts 322, 437, 418 and 477, for energizing the winding thereof in series with the magnet M476; interrupts, at the contacts 467, a further point in the previously traced circuit, including the control wiper 474 of the finder switch 41F, for energizing the magnet M476. Also the switch-through relay R460 completes, at the contacts 464, 466 and 468, an obvious path, including the contacts 322, 419 and 376, for applying ground potential to the control wiper 474 of the finder switch 41F and consequently to the control conductor C484 extending to the first link 61. This application of ground potential to the control conductor C484 extending to the first link 61 marks the first link 61 as busy to the other finder switches in the various groups having access thereto, as previously explained. Further the switch-through relay R460 interrupts, at the contacts 463', the previously traced path, including the contacts 446, between the first marking conductor C501 and the chain conductor C423; and completes, at the contacts 462', an obvious alternative connection between the first marking conductor C501 and the chain conductor C423, thereby to maintain the second trunk circuit in the first group selectable by the marker switches of the various links. Further the switch-through relay R460 completes, at the contacts 461', an obvious path, including the contacts 445, for applying ground potential to the control wiper 475 of the finder switch 41F. Further, the switch-through relay R460 interrupts, at the contacts 465, the previously traced circuit for energizing the winding of the start relay R440, thereby to cause the latter relay to restore. Finally the switch-through relay R460 completes, at the contacts 461 and 462, obvious connections between the windings 393 and 394 of the repeating coil 390 and the line wipers 471 and 472 of the finder switch 41F, for a purpose more fully explained hereinafter.

Upon restoring, the start relay R440 interrupts, at the contacts 445, the previously traced path for applying ground potential to the control wiper 475 of the finder switch 41F and completes, at the contacts 444, an obvious circuit, including the contacts 469, for energizing the winding of the step relay R450, whereupon the latter relay operates shortly thereafter, the step relay R450 being of the slow-to-operate type. Upon operating, the step relay R450 completes, at the contacts 451, an alternative path, including the contacts 314, 377 and 461', for applying ground potential to the control wiper 475 of the finder switch 41F. Accordingly, ground potential is applied to the control wiper 475 of the finder switch 41F incident to the operation of the switch-through relay R460; is then removed therefrom incident to the restoration of the start relay R440; and is then reapplied thereto incident to the operation of the step relay R450. The application of ground potential to the control wiper 475 of the finder switch 41F completes an obvious circuit, including the conductor C485, for energizing the winding of the pulse relay R520 in the first link 61; whereby the pulse relay R520 operates, restores and then reoperates, in an obvious manner. Upon operating, the pulse relay R520 completes, at the contacts 521, an obvious circuit for energizing the winding of the hold relay R530, thereby to cause the latter relay to operate. Upon restoring, the pulse relay R520 interrupts, at the contacts 521, the previously mentioned circuit for energizing the winding of the hold relay R530; however, the latter relay does not restore during the impulse as it is of the slow-to-release type. Also, upon restoring, the pulse relay R520 completes, at the contacts 522, an obvious circuit, including the contacts 534 and the contacts 585 of the set of switch springs S584, for energizing in multiple the winding of the dial relay R540 and the rotary magnet M583, whereby the dial relay R540 and the rotary magnet M583 operate. Upon operating, the rotary magnet M583 drives the wipers noted of the marker switch 580 one step in the counterclockwise direction. Upon operating, the dial relay R540 prepares, at the contacts 541, a circuit for energizing the winding of the lockout relay R510; which circuit is completed in the event the lockout relays in all of the links occupy their restored positions at this time. Assuming that the lockout relays in all of the links occupy their restored positions at this time, the circuit for energizing the winding of the lockout relay R510 in the first link 61 is completed and extends from ground by way of the contacts 541 and 531, the winding of R510, the contacts 512, the contacts of the other lockout relays, the contacts 513 and the resistor 565 to battery. When thus energized the lockout relay R510 operates to complete, at the contacts 511, an obvious holding circuit for energizing the winding thereof, and to interrupt, at the contacts 512, a point in the previously traced original circuit for energizing the winding thereof. Also the lockout relay R510 interrupts, at the contacts 513, a common point in the circuits for energizing the windings of the lockout relays in the other links, thereby positively to prevent operation of the other lockout relays at this time. When the pulse relay R520 reoperates it interrupts, at the contacts 522, the previously traced circuit for energizing in multiple the winding of the dial relay R540 and the rotary magnet M583, whereby the rotary magnet M583 restores immediately and the dial relay R540 restores shortly thereafter, the dial relay R540 being of the slow-to-release type. Upon restoring, the dial relay R540 completes, at the contacts 544, an obvious alternative holding circuit, including the contacts 563, the wiper 582 of the marker switch 580 and the engaged first contact in the associated contact bank, the contacts 531 and 511 and the resistor 565, for energizing the winding of the lockout relay R510. Also the dial relay R540 interrupts, at the contacts 541, the previously traced original holding circuit for energizing the winding of the lockout relay R510. Accordingly, at this time, the pulse relay R520, the hold relay R530 and the lockout relay R510 in the first link 61 occupy their operated positions; the lockout relays in the other links are positively retained in their restored positions; and the first link 61 is in readiness to receive a digit dialed over the connected finder switch 41F of the first trunk circuit 41 via the first trunk 43 at the operator switchboard 21 in the distant exchange 20. Accordingly, at this time, the position equipment at the operator switchboard 21 in the distant exchange 20 is operatively connected to the first link 61 and the operator at the operator switchboard 21 may proceed with the setting up of the connection either to a called subscriber substation in the central office 10 or to a called operator switchboard in one of the distant exchanges 30, etc., as explained more fully below.

Completion of a call to a subscriber substation in the central office

Now assume that the call initiated at the operator switchboard 21 in the distant exchange 20 and extended via the first trunk first group 43, the first trunk circuit first group 41 and the finder switch 41F individual to the first trunk circuit 41 to the first link 61 is to be completed to a subscriber substation in the central office 10, such, for example, as the subscriber substation T. In this event, the operator at the switchboard 21 in the distant exchange 20 first proceeds to dial the corresponding group digit for the central office 10, such, for example, as the digit 9 at the dial 209. The impulses of the digit 9 are transmitted from the dial 209 at the operator switchboard 21 over the first trunk 43 to the line relay R310 in the first trunk circuit 41, in an obvious manner, whereby the line relay R310 follows the impulses of the digit mentioned and repeats them, at the contacts 314, in the form of ground impulses to the control wiper 475 of the finder switch 41F. More particularly, each time the line relay R310 restores and then reoperates it interrupts and then recompletes, at the contacts 314, the previously traced circuit, including the contacts 377, 451 and 461', the control wiper 475 of the finder switch 41F and the engaged contact in the associated contact bank and the control conductor C485, for energizing the winding of the pulse relay R520 in the first link 61, whereby the pulse relay R520 restores and then reoperates. Accordingly, at this time, the pulse relay R520 restores and reoperates nine times in accordance with the digit 9. The first time the pulse relay R520 restores and then reoperates it completes and then interrupts, at the contacts 522, the previously traced circuit, including the contacts 534 and the contacts 585 of the set of switch springs S584, for energizing in multiple the winding of the dial relay R540 and the rotary magnet M583, whereby the dial relay R540 and the rotary magnet M583 reoperate. Upon reoperating, the dial relay R540 completes, at the contacts 543, an obvious path in multiple with the contacts 585 of the set of switch springs S584. When the wipers noted of the marker switch 580 are driven two steps in the counterclockwise direction away from their normal rotary positions, the set of switch springs S584 is actuated, thereby to interrupt, at the contacts 585 thereof, a point in the previously traced original circuit for energizing in multiple the winding of the dial relay R540 and the rotary magnet M583, and to prepare, at the contacts 586 thereof, a point in a circuit traced hereinafter for energizing the release magnet M587. The hold relay R530 and the dial relay R540 remain operated during impulsing as both of these relays are of the slow-to-release type, as previously noted. Accordingly, at the conclusion of the digit 9, the wipers noted of the marker switch 580 engage the tenth contacts in the associated contact banks; the pulse relay R520 and the hold relay R530 are retained in their operated positions; and, shortly thereafter, the dial relay R540 restores.

Upon restoring, the dial relay R540 interrupts, at the contacts 541, the previously traced original holding circuit for energizing the winding of the lockout relay R510, whereby the latter relay restores at this time. Upon restoring, the lockout relay R510 reprepares, at the contacts 513, the common point in the circuits for energizing the windings of the lockout relays in the other links.

Also, upon restoring, the dial relay R540 completes, at the contacts 544, a path, including the contacts 563, the wiper 582 of the marker switch 580 and the engaged tenth contact in the associated contact bank and the contacts 551, for applying ground potential to the control conductor C483 and consequently to the control wiper 473 of the finder switch 41F. Also the restoration and reoperation of the line relay R310 following the impulses of the digit 9 repeat the impulses thereof, at the contacts 311, by way of the contacts 321 to the winding of the dial relay R330 in the first trunk circuit 41. Further each time the line relay R310 restores and then reoperates it interrupts and then recompletes, at the contacts 312, the previously traced circuit for energizing the winding of the hold relay R320. The hold relay R320 and the dial relay R330, both being of the slow-to-release type, remain operated during impulsing; and, at the conclusion of the digit 9, the line relay R310 and the hold relay R320 remain operated and the dial relay R330 restores shortly thereafter. Upon operating, the dial relay R330 completes, at the contacts 334, an obvious circuit for energizing the winding of the dial slave relay R340, thereby to cause the latter relay to operate.

Shortly following the conclusion of the digit 9 the dial relay R330 restores, as previously noted, thereby to complete, at the contacts 333, a circuit for energizing the winding of the local relay R430. The last-mentioned circuit extends from the grounded wiper 473 of the finder switch 41F by way of the contacts 412, 333, 341 and 463 and the winding of R430 to battery. When thus energized the local relay R430 operates to complete, at the contacts 436, an obvious holding circuit, including the contacts 322, for energizing the winding thereof. Also, upon restoring, the dial relay R330 interrupts, at the contacts 334, the previously mentioned circuit for energizing the winding of the dial slave relay R340, thereby to cause the latter relay to restore shortly thereafter, the dial slave relay R340 being of the slow-to-release type. Upon restoring, the dial slave relay R340 interrupts, at the contacts 341, the previously traced connection between the winding of the local relay R430 and the control wiper 473 of the finder switch 41F.

Also, upon operating, the local relay R430 interrupts, at the contacts 437, the previously traced holding circuit for energizing the winding of the switch-through relay R460 in series with the magnet M476, thereby to cause the switch-through relay R460 to restore. Also the local relay R430 interrupts, at the contacts 439, a further point in the previously traced connection between the first marking conductor C501 and the winding of the lockout relay R410, and prepares, at the contacts 438, a point in an alternative connection traced hereinafter between the first marking conductor C501 and the chain conductor C423. Further the local relay R430 completes, at the contacts 431, 432 and 435, a bridge connection including the winding of the answer relay R420 between the line conductors of the trunk 47 extending to the incoming selector 45 individual to the first trunk circuit 41. The above-mentioned bridge connection extends from one of the line conductors of the trunk 47 by way of the contacts 431, the winding 393 of the repeating coil 390, the contacts 435, the winding of the answer relay R420, the contacts 313, the winding 394 of the repeating coil 390 and the

contacts 432 to the other line conductor of the trunk 47. When the above-traced bridge circuit is completed the winding of the answer relay R420 is energized and the incoming selector 45 is rendered responsive to the transmission of a digit over the trunk 47 thereto. However, the answer relay R420 does not operate at this time as it is of the polarized type.

Upon restoring, the switch-through relay R460 interrupts, at the contacts 469, the previously traced circuit for energizing the winding of the step relay R450, thereby to cause the latter relay to restore. Also the switch-through relay R460 interrupts, at the contacts 462', the previously traced alternative connection between the first marking conductor C501 and the chain conductor C423, and completes, at the contacts 463', the previously mentioned alternative connection including the contacts 447 and 438 between the first marking conductor C501 and the chain conductor C423. Further the switch-through relay R460 interrupts, at the contacts 461', the previously traced circuit for energizing the winding of the pulse relay R520 in the first link 61, thereby to cause the latter relay to restore. Upon restoring, the pulse relay R520 interrupts, at the contacts 521, the previously mentioned circuit for energizing the winding of the hold relay R530, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the hold relay R530 completes, at the contacts 535, an obvious circuit, including the contacts 522 and the contacts 586 of the set of switch springs S584, for energizing the release magnet M587, whereby the latter magnet operates and releases the wipers noted of the marker switch 580, whereby the wipers thereof are returned to their normal rotary positions. When the marker switch 580 is thus released the set of switch springs S584 is actuated, thereby to interrupt, at the contacts 586 thereof, the previously traced circuit for energizing the release magnet M587, whereupon the latter magnet restores. Also, upon restoring, the hold relay R530 interrupts, at the contacts 533, the previously traced path for applying ground potential to the control conductor C484, thereby to mark the first link 61 as idle to the finder switches of the various trunk circuits having access thereto. At this time, the first link 61 is completely released and available for further use.

At this time the operator switchboard 21 is connected by way of the first trunk 43 to the first trunk circuit 41; and the first trunk circuit is connected by way of the trunk 47 to the incoming selector 45, as previously noted. The operator at the operator switchboard 21 then proceeds to dial the directory number of the called subscriber substation T in the central office 10; which directory number comprises three digits. The three digits are dialed at the dial 209 at the operator switchboard 21 and are transmitted over the first trunk 43 to the line relay R310 in the first trunk circuit 41; which line relay repeats the impulses of the three digits mentioned, at the contacts 313, over the trunk 47 to the incoming selector 45 in an obvious manner. The incoming selector 45 responds to the first digit mentioned to select a corresponding group of trunks and then operates automatically to select an idle trunk in the previously selected group. For example, the incoming selector 45 may operate to select the trunk 72 extending to the connector 71, assuming that the connector 71 is idle at this time. The connector 71 then responds to the second and third digits mentioned to select the subscriber line 73 extending to the called subscriber substation T.

The connector 71 then operates in order to test the idle or busy condition of the called subscriber substation T, whereby busy tone is returned over the incoming selector 45 and the trunk 47 in the event the called subscriber substation T is busy; and ringing current is projected over the subscriber line 73 to the called subscriber substation T and ring-back tone current is returned over the incoming selector 45 and the trunk 47 in the event the called subscriber substation T is idle. The tone current returned over the trunk 47 traverses the windings 393 and 394 of the repeating coil 390 and the condenser 396 and induces corresponding tone current in the windings 391 and 392 of the repeating coil 390 which traverses the condenser 395, the first trunk 43 and the windings 201 and 202 of the repeating coil 200 and the condenser 203. The tone current traversing the windings 201 and 202 of the repeating coil 200 causes tone current to traverse the telephone instrument at the operator switchboard 21, in an obvious manner.

Assuming that the called subscriber substation T is idle, ringing current is projected over the subscriber line 73 thereto and the line circuit 74 is controlled in order to mark the subscriber line 73 as busy to the other connectors having access thereto. When the subscriber at the called subscriber substation T answers the call the connector 71 operates in order to cause battery potential to be reversed over the incoming selector 45 and the trunk 47, whereby the winding of the answer relay R420 is energized in the opposite direction in order to cause the latter relay to operate. Upon operating, the answer relay R420 completes, at the contacts 421, an obvious circuit for energizing the winding of the battery reverse relay R350, thereby to cause the latter relay to operate. Upon operating, the battery reverse relay R350 interrupts, at the contacts 351 and 353, the previously traced loop circuit extending between the supervisory relay R210 at the operator switchboard 21 and the line relay R310 in the first trunk circuit 41, and recompletes, at the contacts 352 and 354, an obvious alternative loop circuit between the supervisory relay R210 and the line relay R310; whereby battery potential is reversed over the line conductors of the first trunk 43 in order to cause the winding of the supervisory relay R210 to be energized in the opposite direction. The supervisory relay R210 then operates to complete, at the contacts 211, an obvious circuit for illuminating the supervisory lamp L204, thereby to indicate to the operator at the switchboard 21 that the subscriber at the called subscriber substation T in the central office 10 has answered the call. At this time an established connection is completed between the calling operator switchboard 21 in the distant exchange 20 and the called subscriber substation T in the central office 10; this connection including the previously traced loop circuit between the repeating coil 200 and the repeating coil 390; and the previously traced bridge circuit between the repeating coil 390 and the connector 71; the connector 71 being connected by way of the subscriber line 73 to the called subscriber substation T.

Subsequently, in the event the release of the established connection is initiated by the subscriber at the called subscriber substation T, when the subscriber thereat replaces the receiver of the

telephone instrument upon its associated switchhook the connector 71 operates in order again to reverse battery potential over the incoming selector 45 and the trunk 47, whereby the answer relay R420 restores. Upon restoring, the answer relay R420 interrupts, at the contacts 421, the previously mentioned circuit for energizing the winding of the battery reverse relay R350, thereby to cause the latter relay to restore and reverse battery potential over the first trunk 43, whereupon the supervisory relay R210 restores. Upon restoring, the supervisory relay R210 interrupts, at the contacts 211, the previously mentioned circuit for illuminating the supervisory lamp L204, thereby to indicate to the operator at the switchboard 21 that the release of the established connection has been initiated at the called subscriber substation T in the central office 10.

The operator at the switchboard 21 then effects the further release of the established connection by restoring the talk key K206, thereby to interrupt, at the contacts 207 thereof, the previously traced loop circuit for energizing in series the upper and lower windings of the line relay R310, whereupon the latter relay restores. Upon restoring, the line relay R310 interrupts, at the contacts 312, the previously mentioned circuit for energizing the winding of the hold relay R320, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the hold relay R320 interrupts, at the contacts 322, the previously traced holding circuit for energizing the winding of the local relay R430, thereby to cause the latter relay to restore. Upon restoring, the local relay R430 interrupts, at the contacts 431 and 432, the previously traced bridge circuit between the repeating coil 390 and the connector 71, whereby the connector 71 is released in order to effect the release of the incoming selector 45. When the connector 71 is thus released the line circuit 74 is operated in order to mark the subscriber line 73 as idle, assuming that the subscriber at the called subscriber substation T has replaced the receiver of the telephone instrument upon its associated switchhook at this time. At this time the first trunk 43 is disengaged and the first trunk circuit 41 is marked as idle to the marker switches of the various links having access thereto. More particularly, upon restoring, the local call relay R430 interrupts, at the contacts 438, the previously traced connection between the first marking conductor C501 and the chain conductor C423, and recompletes, at the contacts 439, the normal connection between the first marking conductor C501 and the winding of the lockout relay R410, rendering the first trunk circuit 41 selectable via the first marking conductor C501 to the marker switches of the various links.

In view of the foregoing explanation of the mode of operation of the first trunk circuit first group 41 in conjunction with the first link 61 to extend a connection from the operator switchboard 21 in the distant exchange 20 via the first trunk first group 43, the trunk 47, the incoming selector 45 individual to the first trunk circuit 41 and the connector 71 to the called subscriber substation T in the central office 10, it will be understood that the other trunk circuits in the first group are operative in a similar manner in conjunction with any one of the links to extend a connection from the operator switchboard 21 in the distant exchange 20 via the associated trunk in the first group, the trunk extending to the individually associated incoming selector, the last-mentioned incoming selector and the connector 71 to the called subscriber substation T. Similarly, the other trunk circuits in the other groups are operative in conjunction with any one of the links to extend a connection from the operator switchboard in the corresponding distant exchange via the associated trunk in the corresponding group, the trunk extending to the individually associated incoming selector, the last-mentioned incoming selector, and the connector 71 to the called subscriber substation T.

Completion of a call to an operator switchboard in a distant exchange

Now assume that the call initiated at the operator switchboard 21 in the distant exchange 20 and extended via the first trunk first group 43, the first trunk circuit first group 41 and the finder switch 41F individual to the first trunk circuit 41 to the first link 61 is to be completed to an operator switchboard in one of the distant exchanges, such, for example, as the operator switchboard 31 in the distant exchange 30. In this event, the operator at the switchboard 21 in the distant exchange 20 first proceeds to dial the corresponding group digit for the distant exchange 30, such, for example, as the digit 2 at the dial 209. The impulses of the digit 2 are transmitted from the dial 209 at the operator switchboard 21 over the first trunk 43 to the line relay R310 in the first trunk circuit 41, in an obvious manner, whereby the line relay R310 follows the impulses of the digit mentioned and repeats them, at the contacts 314, in the form of ground impulses to the control wiper 475 of the finder switch 41F. More particularly, each time the line relay R310 restores and then reoperates it interrupts and then recompletes, at the contacts 314, the previously traced circuit for energizing the winding of the pulse relay R520 in the first link 61, whereby the pulse relay R520 follows the two impulses of the group digit 2. In the present example, the pulse relay R520 restores and then reoperates twice, whereby the dial relay R540 is reoperated and the rotary magnet M583 is operated and restored twice in order to drive the wipers noted of the marker switch 580 two additional steps in the counterclockwise direction and into engagement with the third contacts in the associated contact banks. When the wipers noted of the marker switch 580 are driven two steps away from their normal rotary positions the set of switch springs S584 is actuated, as previously explained.

At the conclusion of the group digit 2, the pulse relay R520 and the hold relay R530 remain in their operated positions and, shortly thereafter, the dial relay R540 restores. Upon restoring, the dial relay R540 interrupts, at the contacts 543, the previously traced multiple circuit for energizing the winding thereof and the rotary magnet M583, thereby positively to prevent further operation of the marker switch 580 in view of the fact that the set of switch springs S584 is operated at this time. Also the dial relay R540 interrupts, at the contacts 541, the previously traced original holding circuit for energizing the winding of the lockout relay R510 and recompletes, at the contacts 544, the previously traced alternative holding circuit for energizing the winding of the lockout relay R510. Further the dial relay R540 completes, at the contacts 542, a circuit, including the contacts 553 and 514, for applying ground potential by way of the upper winding of

the cutoff relay R550 to the wiper 581 of the marker switch 580 and the engaged third contact in the associated contact bank and consequently to the second marking conductor C502. The second marking conductor C502 extends to the first trunk circuit second group 51 and is normally connected to the winding of the lockout relay R810 in the first trunk circuit 51 in the event the last-mentioned trunk circuit is idle at this time. On the other hand, in the event the first trunk circuit second group 51 is busy at this time, the second marking conductor C502 is connected to the chain conductor C823 due to the operated position of one of the relays in the first trunk circuit 51. More particularly, the second marking conductor C502 is adapted to be connected to the chain conductor C823 by the local relay R830, the start relay R840 or the switch-through relay R860 under the conditions previously discussed in conjunction with the operation of the first trunk circuit first group 41. Accordingly, it will be understood that the second marking conductor C502 is connected to the winding of the lockout relay R810 when the first trunk circuit second group 51 is idle and is connected to the chain conductor C823 extending to the second trunk circuit in the second group, when the first trunk circuit second group 51 is busy.

Now assuming that the first trunk circuit second group 51 is idle at this time, the application of resistance ground potential to the second marking conductor C502 completes a circuit for energizing the winding of the lockout relay R810. The last-mentioned circuit extends from the grounded second marking conductor C502 by way of the contacts 863', 847, 839 and 813', the winding of R810, the contacts 817', C680, the contacts of the lockout relays in the other trunk circuits, C681, the contacts 818' and the resistor 822 to battery. When thus energized the lockout relay R810 operates to interrupt, at the contacts 813' and 817', points in the previously traced original circuit for energizing the winding thereof, and completes, at the contacts 816' and 812', a holding circuit, including the contacts 631, 642, the conductor C677 and the resistor 822, for energizing the winding thereof. Also the lockout relay R810 interrupts, at the contacts 818', a common point in the circuits for energizing the windings of the lockout relays in the other trunk circuits in the second group, thereby positively to prevent operation of the lockout relays in the other trunk circuits in the second group at this time. Also the lockout relay R810 completes, at the contacts 811', an obvious circuit, including the conductor C676, for energizing the winding of the timer relay R635 in the common equipment second group 50 in order to cause the latter relay to operate. Upon operating, the timer relay R635 sets its armature into vibration, whereby there is completed intermittently at the contacts 637 an obvious circuit, including the contacts 811' and the conductor C676, for energizing the winding of the timer relay R630, whereby the latter relay is energized intermittently. However, the timer relay R630 is of the slow-to-operate type and does not operate until after a predetermined time interval, for a purpose more fully explained hereinafter.

Further the lockout relay R810 completes, at the contacts 819', a path, including the conductor C682, for applying battery potential by way of the resistor 653 to the second marking conductor C502, thereby to complete a low resistance circuit substantially identical to that previously traced for energizing the upper winding of the cutoff relay R550 in the first link 61. When thus energized the cutoff relay R550 operates to complete, at the contacts 554, an obvious holding circuit, including the contacts 563, for energizing the lower winding thereof, and to interrupt, at the contacts 553, the previously traced original path for applying resistance ground potential to the second marking conductor C502. Also the cutoff relay R550 completes, at the contacts 552, an obvious path, including the contacts 561, for applying battery potential by way of the upper winding of the release relay R560 to the control conductor C483, for a purpose more fully explained hereinafter. Also at this point it is noted that the operated hold relay R530 retains completed, at the contacts 532, an obvious circuit, including the resistor 564, for energizing the lower winding of the release relay R560, thereby to render the latter relay exceedingly fast to operate when the upper winding thereof is subsequently energized, the release relay R560 being of the polarized type.

Continuing now with the operation of the first trunk circuit second group 51, upon operating, the lockout relay R810 also completes, at the contacts 814', a circuit, including the contacts 631, 642 and 651 and the conductor C678, for energizing the magnet M876, thereby to cause the latter magnet to operate and condition the wipers noted of the finder switch 51F individual to the first trunk circuit second group 51 to be driven one step in the clockwise direction. Also the magnet M876, upon operating, completes, at the contacts 878, an obvious circuit, including the contacts 816 and the conductor C674, for energizing the winding of the step relay R650 in the common equipment second group 50. When thus energized the step relay R650 operates to interrupt, at the contacts 651, the previously traced circuit for energizing the magnet M876, thereby to cause the latter magnet to restore and drive the wipers noted of the finder switch 51F one step in the clockwise direction. Also, upon restoring, the magnet M876 interrupts, at the contacts 878, the previously traced circuit for energizing the winding of the step relay R650, thereby to cause the latter relay to restore and reprepare, at the contacts 651, the previously traced circuit for energizing the magnet M876. Accordingly, it will be understood that the magnet M876 and the step relay R650 interact, in the manner described above, whereby the wipers noted of the finder switch 51F are driven step by step in the clockwise direction until they engage the contacts in the associated contact banks terminating the conductors extending to the first link 61, which conductors are also terminated by the contacts engaged by the wipers noted of the finder switch 41F individual to the first trunk circuit first group 41, the conductors mentioned being the conductors C481, C482, C483, C484 and C485 extending to the first link 61.

More particularly, when the wipers noted of the finder switch 51F engage the contacts in the associated contact banks terminating the conductors C481 to C485, inclusive, a series circuit is completed for energizing the upper winding of the release relay R560 in the first link 61 and the upper winding of the cutoff relay R640 in the common equipment second group 50. The above-mentioned circuit extends from ground by way of the upper winding of R640, C673, the contacts 813, the control wiper 873 of the finder switch 51F and the engaged contact in the asso-

ciated contact bank, C483, the contacts 552 and 561 and the upper winding of R560 to battery. When this series circuit is completed the cutoff relay R640 and the release relay R560 operate. Upon operating, the cutoff relay R640 completes, at the contacts 641, an obvious circuit, including the contacts 636, for energizing the lower winding thereof; and, upon operating, the release relay R560 completes, at the contacts 562, an obvious path for short-circuiting the resistor 564 and consequently an obvious holding circuit for energizing the lower winding thereof. Also the release relay R560 interrupts, at the contacts 561, the previously traced path for applying resistance battery potential by way of the upper winding thereof to the control conductor C483, and interrupts, at the contacts 563, the previously traced holding circuit for energizing the lower winding of the cutoff relay R550 and the previously traced multiple holding circuit for energizing the winding of the lockout relay R510, whereupon the cutoff relay R550 and the lockout relay R510 restore. Upon restoring, the lockout relay R510 recompletes, at the contacts 513, the common point in the circuits for energizing the windings of the lockout relays in the other links, whereby the other links in the group may be utilized at this time. However, it is noted that the pulse relay R520 and the hold relay R530 are retained in their operated position, thereby to retain busy the first link 61. More particularly, the operated hold relay R530 retains completed, at the contacts 533, the previously mentioned path for applying ground potential to the control conductor C484, thereby to retain the first link 61 marked as busy to the finder switches of the various trunk circuits in the various groups having access thereto.

Continuing now with the operation of the common equipment second group 50, upon operating, the cutoff relay R640 also interrupts, at the contacts 642, the previously traced circuit for energizing the magnet M876, thereby positively to prevent further operation of the finder switch 51F at this time, whereby the finder switch 51F is arrested while the wipers thereof engage the contacts in the associated contact banks terminating the conductors C481 to C485, inclusive, extending to the first link 61, as previously noted. Also the cutoff relay R640 completes, at the contacts 643, a circuit, including the conductor C679, the contacts 815', 837, 817, the conductor C675 and the resistor 652, for energizing the winding of the switch-through relay R860, whereby the latter relay operates. Upon operating, the switch-through relay R860 completes, at the contacts 862', an obvious connection between the second marking conductor C502 and the chain conductor C823 extending to the second trunk circuit in the second group, thereby to render the other trunk circuits in the second group selectable via the second marking conductor C502 by the marker switches of the other links at this time.

Also when the lockout relay R810 operated it completed, at the contacts 814, obvious multiple circuits for energizing the upper windings of the signal relay R760 and the supervisory relay R770, thereby to cause these relays to operate. Also the lockout relay R810 completed, at the contacts 811, an obvious holding circuit for energizing the lower winding of the signal relay R760, the latter relay being operated at this time. Upon operating, the signal relay R760 completes, at the contacts 763, an obvious circuit for energizing the winding of the signal slave relay R780, thereby to cause the latter relay to operate. Upon operating, the signal slave relay R780 completes, at the contacts 781, an obvious holding circuit, including the contacts 775, for energizing the lower winding of the supervisory relay R770.

Also when the cutoff relay R640 operated it interrupted, at the contacts 642, the previously traced holding circuit for energizing the winding of the lockout relay R810, thereby to cause the latter relay to restore. Upon restoring, the lockout relay R810 interrupts, at the contacts 817, the previously traced circuit for energizing the winding of the switch-through relay R860 and completes, at the contacts 818, an alternative holding circuit for energizing the winding of the switch-through relay R860 in series with the magnet M876. The last-mentioned circuit extends from ground by way of the contacts 781, 864 and 866, the winding of R860, the contacts 837, 818 and 877 and the magnet M876 to battery. When this series holding circuit is completed the switch-through relay R860 is retained in its operated position; however, the magnet M876 does not operate due to the high series resistance of the winding of the switch-through relay R860.

Also when the signal relay R760 operated it completed, at the contacts 762, a path, including the contacts 811, the winding 792 of the repeating coil 790, the line conductor C672 of the first trunk second group 53, the dial 609, the winding 602 of the repeating coil 600 and the contacts 608 of the talk key K606, for short-circuiting the winding of the signal relay R620 in the position equipment at the operator switchboard 31 in the distant exchange 30. Subsequently, when the lockout relay R810 restored it interrupted, at the contacts 811, the above-traced path for short-circuiting the winding of the signal relay R620, whereby a series holding circuit substantially identical to that traced above is completed for energizing the winding of the signal relay R620 and the lower winding of the signal relay R760. When the series holding circuit for energizing the winding of the signal relay R620 and the lower winding of the signal relay R760 is completed the signal relay R620 operates and the signal relay R760 is retained in its operated position. Upon operating, the signal relay R620 completes, at the contacts 621, an obvious circuit for illuminating the answer lamp L605 in the position equipment at the operator switchboard 31, thereby to indicate to the operator thereat that a call is waiting to be answered on the first trunk second group 53.

Also, upon restoring, the lockout relay R810 interrupts, at the contacts 814, the previously traced multiple circuits for energizing the upper windings of the signal relay R760 and the supervisory relay R770. However, the latter relays are retained in their operated position at this time due to the previously traced holding circuits for energizing the lower windings thereof. Also, upon restoring, the lockout relay R810 recompletes, at the contacts 818', the common point in the circuits for energizing the windings of the lockout relays in the other trunk circuits in the second group, thereby to render the other trunk circuits in the second group selectable over the second marking conductor C502 by the marker switches of the other links at this time. Also the lockout relay R810 interrupts, at the contacts 811', the previously traced circuit for energizing the winding of the timer relay R635 in the common equipment second group 50, thereby

to cause the latter relay to restore. Upon restoring, the timer relay R635 interrupts, at the contacts 636, the previously traced holding circuit for energizing the lower winding of the cut-off relay R640, thereby to cause the latter relay to restore. Further the timer relay R635 interrupts, at the contacts 637, the previously traced circuit for intermittently energizing the winding of the timer relay R630, thereby positively to prevent operation of the latter relay at this time.

Also, upon operating, the switch-through relay R860 completes, at the contacts 861 and 862, an obvious connection between the windings 793 and 794 of the repeating coil 790 and the line wipers 871 and 872 of the finder switch 51F; and completes, at the contacts 862, a circuit for energizing the winding of the battery reverse relay R750. The last-mentioned circuit extends from ground by way of the contacts 312, 332, 371 and 433, the winding 394 of the repeating coil 390, the contacts 462, the wiper 472 of the finder switch 41F and the engaged contact in the associated contact bank, C482, the wiper 872 of the finder switch 51F and the engaged contact in the associated contact bank, the contacts 862, the winding 794 of the repeating coil 790, the contacts 833 and 772 and the winding of R750 to battery. When thus energized the battery reverse relay R750 operates to condition the line relay R710 to supply reversed battery over the first trunk second group 53, in a manner more fully explained hereinafter.

When the operator at the switchboard 31 in the distant exchange 30 observes the illuminated answer lamp L605 she answers the call on the first trunk second group 53 by operating the talk key K606, thereby to interrupt, at the contacts 608 thereof, the previously traced holding circuit for energizing the winding of the signal relay R620 in series with the lower winding of the signal relay R760 in order to cause these relays to restore. Also when the talk key K606 is thus operated there is completed, at the contacts 607 thereof, a series circuit for energizing the winding of the supervisory relay R610 and the upper and lower windings of the line relay R710. The last-mentioned circuit extends from ground by way of the lower winding of R710, the contacts 752, the windings 791 of the repeating coil 790, the line conductor C671 of the first trunk 53, the winding 601 of the repeating coil 600, the winding of R610, the contacts 607 of the talk key K606, the winding 602 of the repeating coil 600, the dial 609, the line conductor C672 of the first trunk 53, the winding 792 of the repeating coil 790, the contacts 761 and 754 and the upper winding of R710 to battery. When this series circuit is completed the line relay R710 operates; also the supervisory relay R610 operates in view of the reverse direction of the supply of battery current via the upper and lower windings of the line relay R710 to the line conductors of the first trunk 53, the supervisory relay R610 being of the polarized type. Upon operating, the supervisory relay R610 completes, at the contacts 611, an obvious circuit for illuminating the supervisory lamp L604. Upon operating, the line relay R710 completes, at the contacts 712, an obvious circuit for energizing the winding of the hold relay R720, thereby to cause the latter relay to operate and complete, at the contacts 722, a holding circuit substantially identical to that previously traced for energizing the winding of the switch-through relay R860 in series with the magnet M876 and an obvious multiple holding circuit substantially identical to that previously traced for energizing the lower winding of the supervisory relay R770. At this point it is noted that, upon restoring, the signal relay R760 interrupts, at the contacts 763, the previously mentioned circuit for energizing the winding of the signal slave relay R780, thereby to cause the latter relay to restore shortly thereafter, the signal slave relay R780 being of the slow-to-release type. However, the signal slave relay R780 does not restore until subsequent to the operation of the line relay R710 and the hold relay R720, whereby the supervisory relay R770 and the switch-through relay R860 are retained in their operated positions.

Also the line relay R710 completes, at the contacts 712, a circuit for energizing the winding of the battery reverse relay R350 in the first trunk circuit first group 41, the last-mentioned circuit extending from ground by way of the contacts 712, 732, 774 and 834, the winding 793 of the repeating coil 790, the contacts 861, the line wiper 871 of the finder switch 51F and the engaged contact in the associated contact bank, C481, the line wiper 471 of the finder switch 41F and the engaged contact in the associated contact bank, the contacts 461, the winding 393 of the repeating coil 390, the contacts 434 and 373 and the winding of R350 to battery. When thus energized the battery reverse relay R350 operates in order to cause battery potential to be reversed over the first trunk first group 43, in the manner previously explained. At this time the upper and lower windings of the line relay R310 are energized in series with the winding of the supervisory relay R210 and the direction of battery supply over the first trunk 43 is such that the supervisory relay R210 operates, the latter relay being of the polarized type as previously noted. Upon operating, the supervisory relay R210 completes, at the contacts 211, the previously mentioned circuit for illuminating the supervisory lamp L204, thereby to indicate to the operator at the switchboard 21 that the call has been answered by the operator at the switchboard 31.

At this time an established connection is completed between the calling operator switchboard 21 in the distant exchange 20 and the called operator switchboard 31 in the distant exchange 30. More particularly, the position equipment at the calling operator switchboard 21 is operatively connected by way of the previously traced loop circuit, including the first trunk first group 43 and the windings 391 and 392 of the repeating coil 390 to the upper and lower windings of the line relay R310 in the first trunk circuit first group 41; the position equipment at the called operator switchboard 31 is operatively connected by way of the previously traced loop circuit, including the first trunk second group 53 and the windings 791 and 792 of the repeating coil 790 to the upper and lower windings of the line relay R710 in the first trunk circuit second group 51; the windings 393 and 394 of the repeating coil 390 in the first trunk circuit first group 41 are connected by way of the condenser 396 and the contacts 461 and 462 to the line wipers 471 and 472 of the finder switch 41F; the windings 793 and 794 of the repeating coil 790 in the first trunk circuit second group 51 are connected by way of the condenser 796 and the contacts 861 and 862 to the line wipers 871 and 872 of the finder switch 51F; and the line conductors C481 and C482 extending to the first link 61 are terminated by the

contacts engaged by the line wipers 471 and 472 of the finder switch 41F, as well as by the contacts engaged by the line wipers 871 and 872 of the finder switch 51F. Accordingly, at this time, the operator at the calling switchboard 21 in the distant exchange 20 may converse with the operator at the called switchboard 31 in the distant exchange 30.

In the event the operator at the calling switchboard 21 in the distant exchange 20 should desire to resignal the operator at the called switchboard 31 in the distant exchange 30, this may be accomplished by operating the dial 209 in accordance with any digit, thereby to cause the line relay R310 in the first trunk circuit first group 41 to follow the digit mentioned. Each time the line relay R310 restores and then reoperates it interrupts and then recompletes, at the contacts 312, the previously traced circuit for energizing the winding of the battery reverse relay R750 in the first trunk circuit second group 51, thereby to cause the latter relay to follow the impulses of the digit mentioned. Each time the battery reverse relay R750 restores and then reoperates it effects the reversal of battery potential over the line conductors of the first trunk second group 53, whereby the supervisory relay R610 follows the impulses of the digit mentioned, the supervisory relay R610 being of the polarized type, as previously noted. Each time the supervisory relay R610 restores and then reoperates it interrupts and then recompletes, at the contacts 611, the previously mentioned circuit for illuminating the supervisory lamp L604, whereby the supervisory lamp L604 is flashed in accordance with the digit mentioned. The flashing of the supervisory lamp L604 in accordance with the digit mentioned attracts the attention of the operator at the called switchboard 31 in the distant exchange 30.

In the event the operator at the called switchboard 31 in the distant exchange 30 should desire to resignal the operator at the calling switchboard 21 in the distant exchange 20, this may be accomplished by operating the dial 609 in accordance with any digit, thereby to cause the line relay R710 in the first trunk circuit second group 51 to follow the digit mentioned. Each time the line relay R710 restores and then reoperates it interrupts and then recompletes, at the contacts 712, the previously traced circuit for energizing the winding of the battery reverse relay R350 in the first trunk circuit first group 41, thereby to cause the latter relay to follow the impulses of the digit mentioned. Each time the battery reverse relay R350 restores and then reoperates it effects the reversal of battery potential over the line conductors of the first trunk first group 43, whereby the supervisory relay R210 follows the impulses of the digit mentioned, the supervisory relay R210 being of the polarized type, as previously noted. Each time the supervisory relay R210 restores and then reoperates it interrupts and then recompletes, at the contacts 211, the previously mentioned circuit for illuminating the supervisory lamp L204, whereby the supervisory lamp L204 is flashed in accordance with the digit mentioned. The flashing of the supervisory lamp L204 in accordance with the digit mentioned attracts the attention of the operator at the calling switchboard 21 in the distant exchange 20.

The release of the established connection between the calling operator switchboard 21 in the distant exchange 20 and the called operator switchboard 31 in the distant exchange 30 may be initiated at either of the switchboards mentioned. The operator at the calling switchboard 21 may initiate the release of the established connection by restoring the talk key K206 in order to effect the restoration of the supervisory relay R210 and the line relay R310, in an obvious manner; and, upon restoring, the line relay R310 interrupts, at the contacts 312, the previously traced circuit for energizing the winding of the battery reverse relay R750, thereby to cause the latter relay to restore and effect the restoration of the supervisory relay R610, whereby the supervisory lamp L604 is extinguished in order to indicate to the operator at the called switchboard 31 that the release of the established connection has been initiated by the operator at the calling switchboard 21. On the other hand, the operator at the called switchboard 31 may initiate the release of the established connection by restoring the talk key K606 in order to effect the restoration of the supervisory relay R610 and the line relay R710, in an obvious manner; and, upon restoring, the line relay R710 interrupts, at the contacts 712, the previously traced circuit for energizing the winding of the battery reverse relay R350, thereby to cause the latter relay to restore and effect the restoration of the supervisory relay R210, whereby the supervisory lamp L204 is extinguished in order to indicate to the operator at the calling switchboard 21 that the release of the established connection has been initiated by the operator at the called switchboard 31. When the operator at the called operator switchboard 31 receives the release supervision indicated above, she restores the talk key K606; and when the operator at the calling operator switchboard 21 receives the release supervision indicated above, she restores the talk key K206.

Also, upon restoring, the line relay R310 in the first trunk circuit first group 41 interrupts, at the contacts 312, the previously mentioned circuit for energizing the winding of the hold relay R320, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the hold relay R320 interrupts, at the contacts 322, the previously traced holding circuit for energizing the winding of the switch-through relay R460, thereby to cause the latter relay to restore. Upon restoring, the switch-through relay R460 interrupts, at the contacts 469, the previously traced circuit for energizing the winding of the step relay R450, thereby to cause the latter relay to restore. Further, the switch-through relay R460 interrupts, at the contacts 461 and 462, the previously traced connection between the repeating coil 390 and the line wipers 471 and 472 of the finder switch 41F, thereby to interrupt the connection to the line conductors C481 and C482 extending to the first link 61. Further the switch-through relay R460 recompletes, at the contacts 463', the previously traced connection between the first marking conductor C501 and the winding of the lockout relay R410, thereby to mark the first trunk circuit first group 41 as selectable via the first marking conductor C501 by the marker switches of the various links. Further the hold relay R320 interrupts, at the contacts 322, the previously traced path for applying ground potential to the control wiper 474 of the finder switch 41F, thereby to interrupt the path in the first trunk circuit first group 41 for applying ground potential to the control conductor C484 extending to the first link 61. At this time the first trunk circuit first group 41

is completely released and available for further use.

Also when the line relay R310 in the first trunk circuit first group 41 restores it interrupts, at the contacts 314, the previously traced circuit for energizing the winding of the pulse relay R520 in the first link 61, thereby to cause the latter relay to restore and effect the restoration of the hold relay R530 shortly thereafter. Upon restoring, the hold relay R530 interrupts, at the contacts 532, the previously traced holding circuit for energizing the lower winding of the release relay R560, thereby to cause the latter relay to restore. Also, upon restoring, the hold relay R530 completes, at the contacts 535, the previously traced circuit for energizing the release magnet M587, thereby to cause the latter magnet to operate and release the wipers noted of the marker switch 580. When the marker switch 580 is thus released the set of switch springs S584 is operated, thereby to interrupt, at the contacts 586 thereof, the previously traced circuit for energizing the release magnet M587 in order to cause the latter magnet to restore. Further the hold relay R530 interrupts, at the contacts 533, the previously mentioned path for applying ground potential to the control conductor C484, whereby the first link 61 is marked as idle to the finder switches of the various trunk circuits in the various groups having access thereto. At this time the first link 61 is completely released and available for further use.

Also, upon restoring, the line relay R710 in the first trunk circuit second group 51 interrupts, at the contacts 712, the previously mentioned circuit for energizing the winding of the hold relay R720, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the hold relay R720 interrupts, at the contacts 722, the previously traced holding circuit for energizing the winding of the switch-through relay R860, thereby to cause the latter relay to restore. Upon restoring, the switch-through relay R860 interrupts, at the contacts 869, the previously traced circuit for energizing the winding of the step relay R850, thereby to cause the latter relay to restore. Further the switch-through relay R860 interrupts, at the contacts 861 and 862, the previously traced connection between the repeating coil 790 and the line wipers 871 and 872 of the finder switch 51F, thereby to interrupt the connection to the line conductors C481 and C482 extending to the first link 61. Further the switch-through relay R860 recompletes, at the contacts 863', the previously traced connection between the second marking conductor C502 and the winding of the lockout relay R810, thereby to mark the first trunk circuit second group 51 as selectable via the second marking conductor C502 by the marker switches of the various links. Further the hold relay R720 interrupts, at the contacts 722, the previously traced holding circuit for energizing the lower winding of the supervisory relay R770, thereby to cause the latter relay to restore. At this time the first trunk circuit second group 51 is completely released and available for further use.

In view of the foregoing explanation of the mode of operation of the first trunk circuit first group 41 in conjunction with the first link 61 and the first trunk circuit second group 51 to extend a connection from the calling operator switchboard 21 in the distant exchange 20 to the called operator switchboard 31 in the distant exchange 30 via the first trunk first group 43 and the first trunk second group 53, it will be understood that any one of the trunk circuits in the first group is operative in conjunction with any one of the links and any one of the trunk circuits in the second group, in a substantially identical manner, to extend a connection from the calling operator switchboard 21 in the distant exchange 20 to the called operator switchboard 31 in the distant exchange 30 via the corresponding trunk in the first group and the corresponding trunk in the second group. Also, any one of the trunk circuits in any one of the groups is operative in conjunction with any one of the links and any one of the trunk circuits in any other of the groups, in a substantially identical manner, to extend a connection from the calling operator switchboard in the corresponding one distant exchange to the called operator switchboard in the corresponding other distant exchange via the corresponding trunk in the one group and the corresponding trunk in the other group.

In the foregoing explanation of the mode of operation of the first trunk circuit second group 51 in conjunction with the common equipment second group 50 in order to arrest operation of the finder switch 51F of the first trunk circuit 51, when the conductors C481 to C485, inclusive, extending to the first link 61 are selected by the wipers noted of the finder switch 51F, it was assumed that this operation took place in a very short interval of time following the operation of the timer relay R635 in the common equipment second group 50 and prior to the operation of the timer relay R630. However, it may occur that the finder switch 51F operates in the manner previously explained, but is unable to find the marking conductor C483 extending to the first link 61 in order to effect operation of the cutoff relay R640 in the common equipment second group 50, in the manner previously explained. In this event, a predetermined time interval after the operation of the timer relay R635 and after the finder switch 51F has had ample time to find the conductors C481 to C485, inclusive, extending to the first link 61, the timer relay R630 operates. As previously explained, upon operating, the timer relay R635 sets its armature into vibration, whereby the circuit for energizing the winding of the timer relay R630 is completed intermittently at the contacts 637, and the timer relay R630 is of the slow-to-operate type. Upon operating, the timer relay R630 interrupts, at the contacts 631, the previously traced circuit for energizing the magnet M876, thereby positively to arrest further operation of the finder switch 51F at this time. Also the timer relay R630 interrupts, at the contacts 631, the previously traced holding circuit for energizing the winding of the lockout relay R810 in the first trunk circuit second group 51 in order to cause the latter relay to restore.

Upon restoring, the lockout relay R810 effects the release of the first trunk circuit 51 in the manner previously explained. At this time the cutoff relay R550 in the first link 61 occupies its operated position, thereby to interrupt, at the contacts 553, the previously traced path for applying resistance ground potential by way of the upper winding thereof to the second marking conductor C502. Accordingly, reoperation of the first trunk circuit second group 51 is not initiated and the first link 61 is locked out of service. Accordingly, at this time, the connection extended from the calling operator switchboard 21 in

the distant exchange 20 is routed via the first trunk first group 43, the first trunk circuit first group 41, the finder switch 41F and the conductor C481 to C485, inclusive, to the first link 61, and no further operation of the first link 61 takes place at this time. After a brief time interval the operator at the switchboard 21 concludes that the established connection to the called operator switchboard 31 in the distant exchange 30 may not be completed immedately; whereupon the operator at the calling operator switchboard 21 restores the talk key K206, thereby to effect the release of the first trunk circuit 41 and the consequent release of the first link 61, in the manner previously explained.

Conclusions

In view of the foregoing, it is apparent that a telephone system is provided which comprises a central office and a plurality of distant exchanges; which system includes improved apparatus for setting up and for supervising connections from the various distant exchanges to the central office and between the various distant exchanges by way of the central office.

While one embodiment of the invention has been disclosed, it will be understood that various modifications may be made therein which are within the true spirit and scope of the invention.

What is claimed is:

1. In a telephone system, a plurality of trunks, a plurality of switches individually associated with said trunks, a plurality of links accessible to said switches, switching apparatus associated with said trunks, a plurality of lines accessible to said switching apparatus, means controlled over a calling one of said trunks for causing the associated switch to seize an idle one of said links, register means included in said one link for selectively registering a trunk call or a line call, means controlled by said register means in the event a trunk call is registered for causing the switch associated with a called one of said trunks to seize said one link, thereby to complete a connection between said calling trunk and said called trunk, additional means controlled by said register means in the event a line call is registered for rendering operative said switching apparatus, and means for operating said switching apparatus to seize a called one of said lines, thereby to complete a connection between said calling trunk and said called line.

2. In a telephone system, a plurality of trunks, a plurality of switches individually associated with said trunks, a plurality of links accessible to said switches, switching apparatus associated with said trunks, a plurality of lines accessible to said switching apparatus, means controlled over a calling one of said trunks for causing the associated switch to seize an idle one of said links, register means included in said one link for selectively registering a trunk call or a line call, means controlled by said register means in the event a trunk call is registered for causing the switch associated with a called one of said trunks to seize said one link, thereby to complete a connection between said calling trunk and said called trunk, additional means controlled by said register means in the event a line call is registered for rendering operative said switching apparatus, and additional means controlled over said calling trunk for operating said switching apparatus to seize a called one of said lines, thereby to complete a connection between said calling trunk and said called line.

3. In a telephone system, a plurality of trunks, a plurality of switches individually associated with said trunks, a plurality of links accessible to said switches, a plurality of selectors individually associated with said trunks, a plurality of lines accessible to said selectors, means controlled over a calling one of said trunks for causing the associated switch to seize an idle one of said links, register means included in said one link for selectively registering a trunk call or a line call, means controlled by said register means in the event a trunk call is registered for causing the switch associated with a called one of said trunks to seize said one link, thereby to complete a connection between said calling trunk and said called trunk, additional means controlled by said register means in the event a line call is registered for rendering operative the selector associated with said calling trunk, and means for operating said last-mentioned selector to set up a connection to a called one of said lines, thereby to complete a connection between said calling trunk and said called line.

4. In a telephone system, a plurality of trunks, a plurality of finders individually associated with said trunks, a plurality of links accessible to said finders, a plurality of selectors individually associated with said trunks, a plurality of lines accessible to said selectors, means controlled over a calling one of said trunks for causing the associated finder to find an idle one of said links, register means included in said one link for selectively registering a trunk call or a line call, means controlled by said register means in the event a trunk call is registered for causing the finder associated with a called one of said trunks to find said one link, thereby to complete a connection between said calling trunk and said called trunk, additional means controlled by said register means in the event a line call is registered for rendering operative the selector associated with said calling trunk, and means for operating said last-mentioned selector to set up a connection to a called one of said lines, thereby to complete a connection between said calling trunk and said called line.

5. In a telephone system, a plurality of groups of trunks, a plurality of groups of switches individually associated with said groups of trunks, a plurality of links accessible to said groups of switches, switching apparatus associated with said groups of trunks, a plurality of lines accessible to said switching apparatus, means controlled over any calling trunk in any one of said groups for causing the associated switch to seize an idle one of said links, register means included in said one link for selectively registering a call to any one of said groups of trunks or a line call, means controlled by said register means in the event a call to another of said groups of trunks is registered for causing the switch associated with an idle one of the trunks in said other group to seize said one link, thereby to complete a connection between the calling trunk in said one group and the called trunk in said other group, additional means controlled by said register means in the event a line call is registered for rendering operative said switching apparatus, and means for operating said switching apparatus to seize a called one of said lines, thereby to complete a connection between the calling trunk in said one group and said called line.

6. In a telephone system, a plurality of trunks, a plurality of switches individually associated

with said trunks, a plurality of links accessible to said switches, switching apparatus associated with said trunks, a plurality of lines accessible to said switching apparatus, means controlled over a calling one of said trunks for operating the associated switch to seize an idle one of said links, means responsive to the operation of said last-mentioned switch for connecting it to said calling trunk, register means included in said one link and controllable over said calling trunk and the associated switch selectively to register a trunk call or a line call, means controlled by said register means in the event a trunk call is registered for operating the switch associated with a called one of said trunks to seize said one link, means responsive to the operation of said last-mentioned switch for connecting it to said called trunk, whereby a connection is completed between said calling trunk and said called trunk, additional means controlled by said register means in the event a line call is registered for disconnecting said calling trunk from the associated switch and for connecting said calling trunk to said switching apparatus, and additional means controllable over said calling trunk for operating said switching apparatus to seize a called one of said lines, thereby to complete a connection between said calling trunk and said called line.

7. In a telephone system, a plurality of operator switchboards, a plurality of trunks individually extending to said operator switchboards, a plurality of switches individually associated with said trunks, a plurality of links accessible to said switches, means controllable from any calling one of said operator switchboards for initiating a call on the trunk extending thereto, means responsive to the initiation of a call on said last-mentioned trunk for operating the associated switch to seize an idle one of said links, register means included in said one link for registering a call to a called one of said operator switch-boards, means controlled by said register means for operating the switch associated with the trunk extending to said called operator switchboard to seize said one link, thereby to extend the call over said last-mentioned trunk to said called operator switchboard, and means controllable from said called operator switchboard for answering the call extended thereto.

8. In a telephone system, a plurality of operator switchboards, a plurality of trunks individually extending to said operator switchboards, a plurality of switches individually associated with said trunks, a plurality of links accessible to said switches, means controllable from any calling one of said operator switchboards for initiating a call on the trunk extending thereto, means responsive to the initiation of a call on said last-mentioned trunk for operating the associated switch to seize an idle one of said links, register means included in said one link for registering a call to a called one of said operator switchboards, means controlled by said register means for operating the switch associated with the trunk extending to said called operator switchboard to seize said one link, thereby to extend the call over said last-mentioned trunk to said called operator switchboard, means responsive to the operation of said last-mentioned switch for transmitting a call signal to said called operator switchboard, means controllable from said called operator switchboard for answering the call extended thereto, and means responsive to the answering of the call at said called operator switchboard for transmitting an answer signal to said calling operator switchboard.

9. In a telephone system, a plurality of operator switchboards, a plurality of trunks individually extending to said operator switchboards, a plurality of finder switches individually associated with said trunks, a plurality of links accessible to said finder switches, means controllable from any calling one of said operator switchboards for initiating a call on the trunk extending thereto, means responsive to the initiation of a call on said last-mentioned trunk for causing the associated finder switch to find an idle one of said links, register means included in said one link for registering a call to a called one of said operator switchboards, means controlled by said register means for causing the finder switch associated with the trunk extending to said called operator switchboard to find said one link, thereby to extend the call over said last-mentioned trunk to said called operator switchboard, and means controllable from said called operator switchboard for answering the call extended thereto.

10. In a telephone system, a plurality of operator switchboards, a plurality of groups of trunks individually extending to said operator switchboards, a plurality of groups of switches individually associated with said groups of trunks, a plurality of links accessible to said groups of switches, means controllable from any calling one of said operator switchboards for initiating a call on an idle one of the trunks in the group extending thereto, means responsive to the initiation of a call on said last-mentioned trunk for operating the associated switch to seize an idle one of said links, register means included in said one link for registering a call to a called one of said operator switchboards, means controlled by said register means for operating the switch associated with an idle one of the trunks in the group extending to said called operator switchboard to seize said one link, thereby to extend the call over said last-mentioned trunk to said called operator switchboard, and means controllable from said called operator switchboard for answering the call extended thereto.

11. In a telephone system, a plurality of exchanges, a switching center, a plurality of trunks individually extending between said exchanges and said switching center, said switching center including a plurality of switches individually associated with said trunks and a plurality of links accessible to said switches, means included in a calling one of said exchanges for seizing the trunk extending thereto, means responsive to the seizure of said last-mentioned trunk for operating the associated switch to seize an idle one of said links, register means included in said one link for registering a call to a called one of said exchanges, and means controlled by said register means for operating the switch associated with the trunk extending to said called exchange to seize said one link, thereby to complete a connection between said calling exchange and said called exchange.

12. In a telephone system, a first operator position, a first trunk extending to said first operator position, a first trunk circuit terminating said first trunk and including a first line relay and a first control relay, a second operator position, a second trunk extending to said second operator position, a second trunk circuit terminating said second trunk and including a second line relay and a second control relay, means in-

cluding a link for connecting said first and second trunk circuits, thereby to set up a connection between said first and second operator positions, an operating circuit for said first control relay including a first conducter of said link and a contact of said second line relay, an operating circuit for said second control relay including a second conductor of said link and a contact of said first line relay, means governable from either one of said operator positions for controlling over the trunk extending thereto the line relay in the associated terminating trunk circuit, thereby to control the control relay in the trunk circuit terminating the trunk extending to the other of said operator positions, and means responsive to the control of the control relay in either one of said trunk circuits for transmitting a signal over the terminated trunk to the associated operator position.

13. In a telephone system, a line having a switch indiivdual thereto and normally disconnected therefrom, a plurality of links accessible to said switch, means responsive to the initiation of a call outgoing from said line for operating said switch to seize an idle one of said links, means responsive to the extension of a call incoming to said line for operating said switch to seize a particular one of said links, and means responsive to the operation of said switch to seize a link for connecting said line to said switch.

14. In a telephone system, a line having a switch individual thereto and normally disconnected therefrom, a plurality of links accessible to said switch, means responsive to the initiation of a call outgoing from said line for operating said switch to seize an idle one of said links, means responsive to the operation of said switch to seize said one link for connecting said line to said switch, register means included in said one link and controllable over said line and said switch for registering a call, means responsive to the registration of a call incoming to said line in any given one of said links for operating said switch to seize said given link, and means responsive to the operation of said switch to seize said given link for connecting said line to said switch.

15. In a telephone system, a line having a finder switch individual thereto, a plurality of links accessible to said finder switch, means responsive to the initiation of a call outgoing from said line for initiating a first operation of said finder switch to hunt for an idle one of said links, means controlled when said finder switch finds an idle one of said links for arresting the first operation of said finder switch, means responsive to the extension of a call incoming to said line for marking a particular one of said links and for initiating a second operation of said finder switch, and means controlled when said finder switch finds the marked one of said links for arresting the second operation of said finder switch.

16. In a telephone system, a line having a finder switch individual thereto, a plurality of links accessible to said finder switch, means responsive to the initiation of a call outgoing from said line for initiating a first operation of said finder switch to hunt for an idle one of said links, means controlled when said finder switch finds an idle one of said links for arresting the first operation of said finder switch, means responsive to the extension of a call incoming to said line for marking a particular one of said links and for initiating a second operation of said finder switch, means controlled when said finder switch finds the marked one of said links for arresting the second operation of said finder switch, and timing means for arresting the second operation of said finder switch after a predetermined second operation thereof.

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