

March 30, 1943.

H. N. NEWSTEDT

2,315,008

TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 1

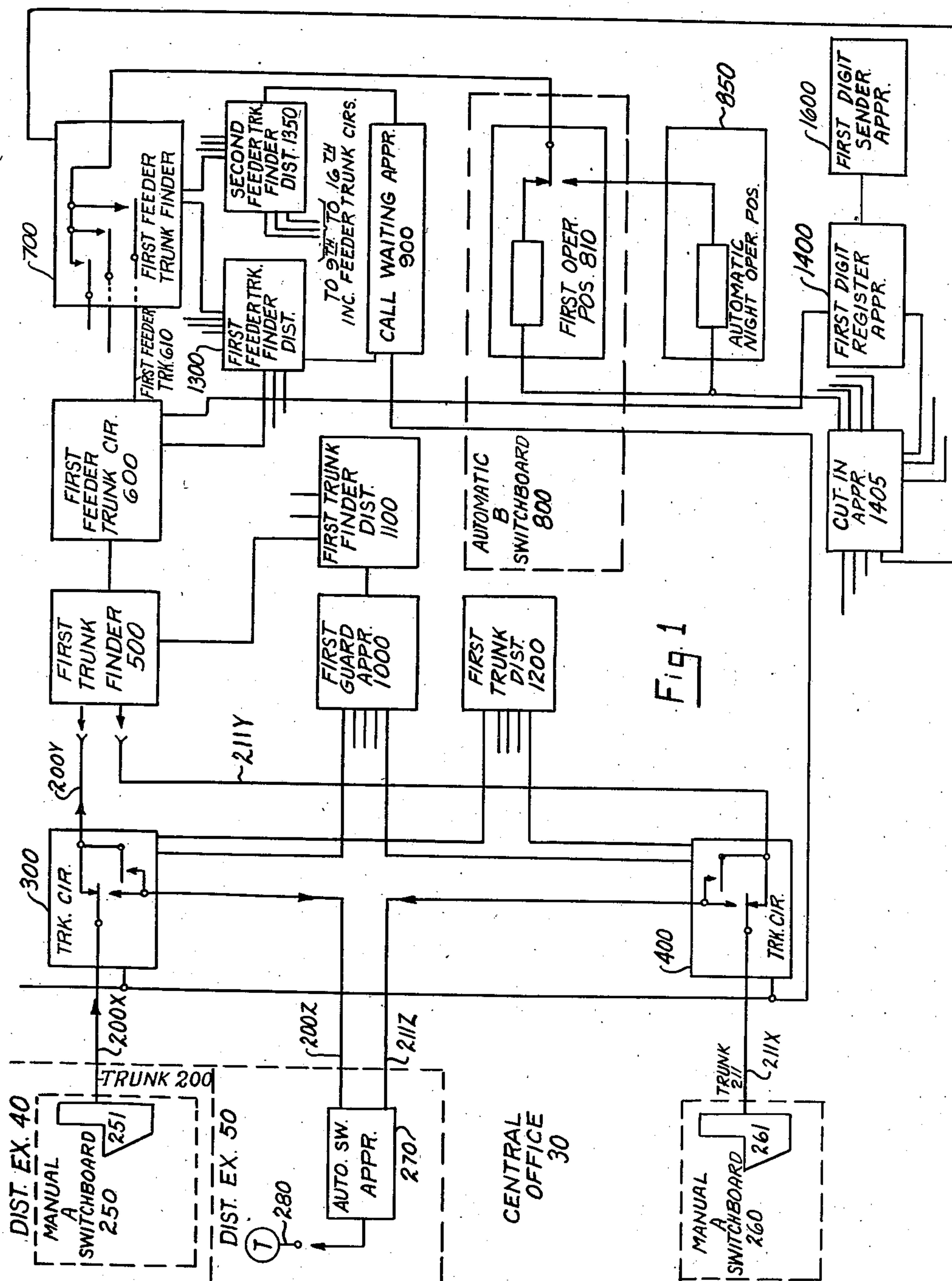


Fig. 1

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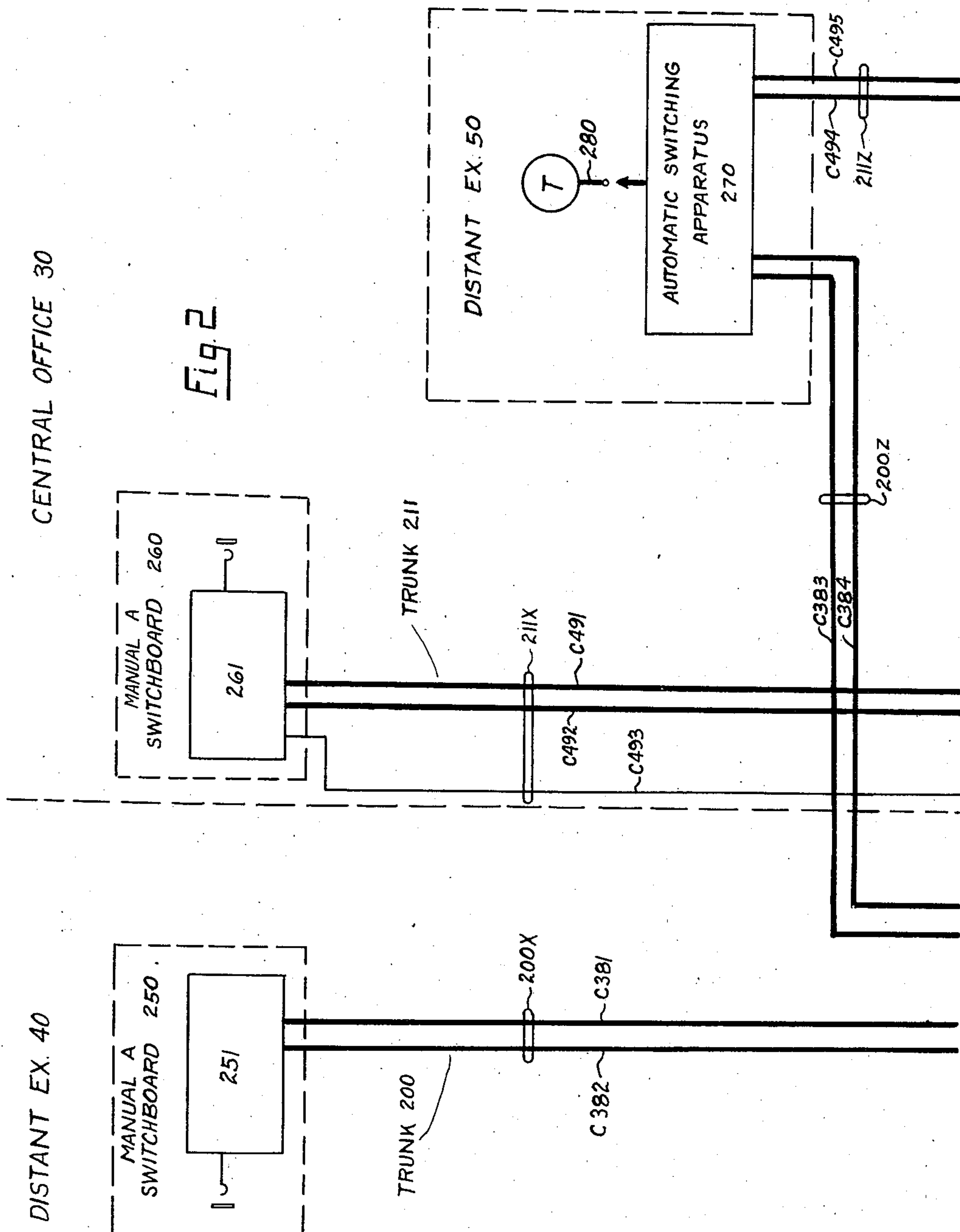
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18 Sheets-Sheet 2



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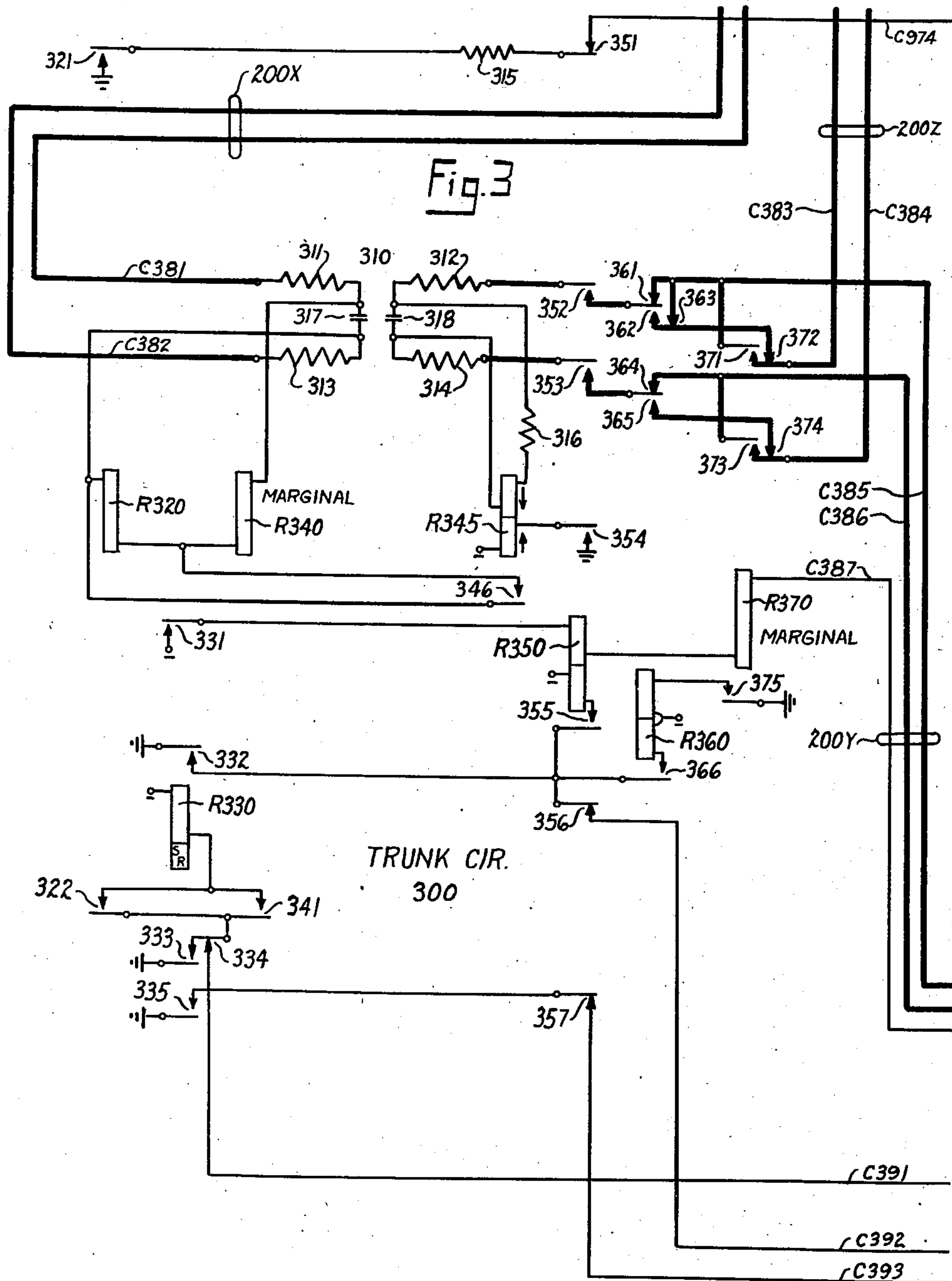
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TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 3



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TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 4

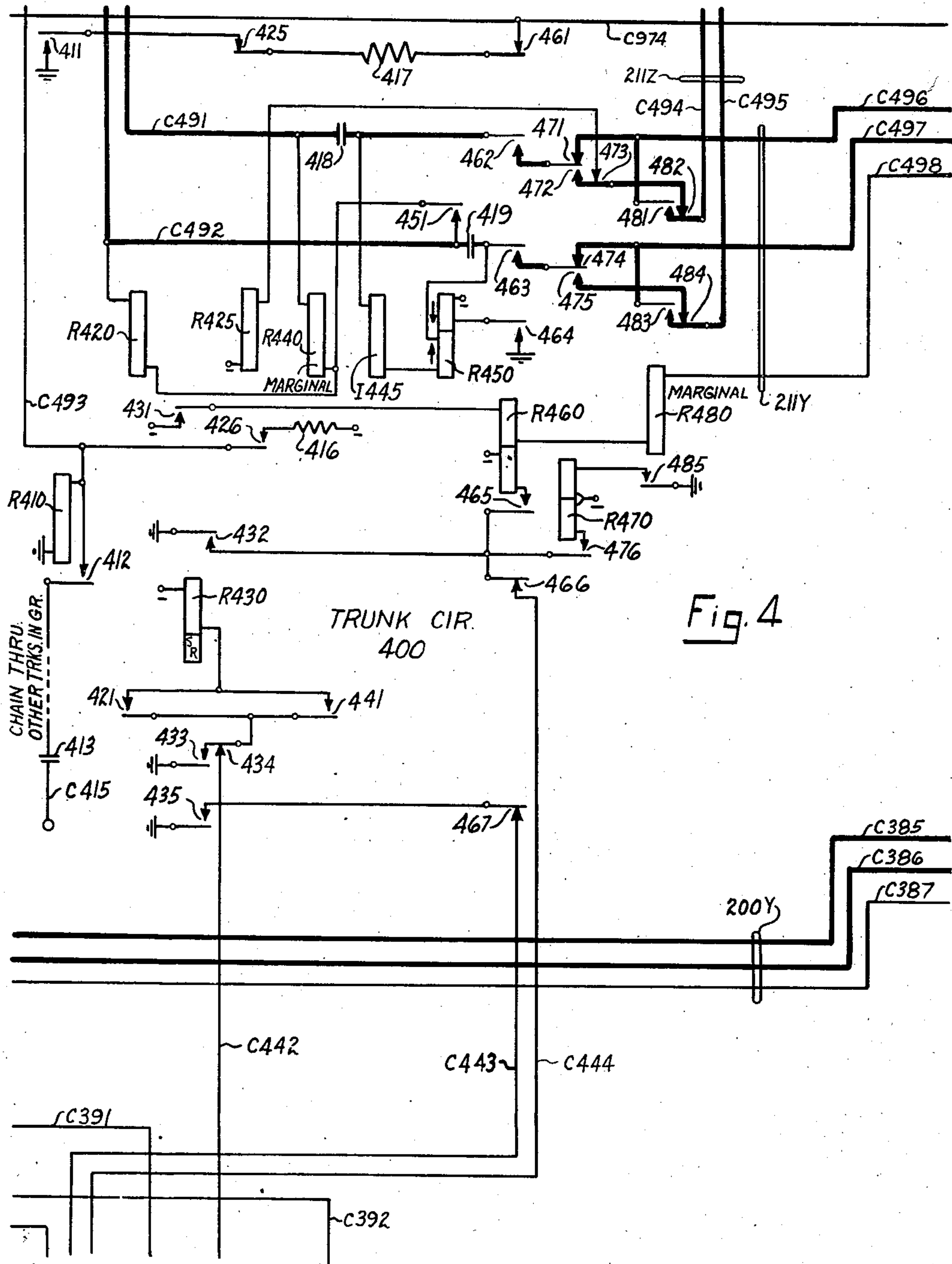


Fig. 4

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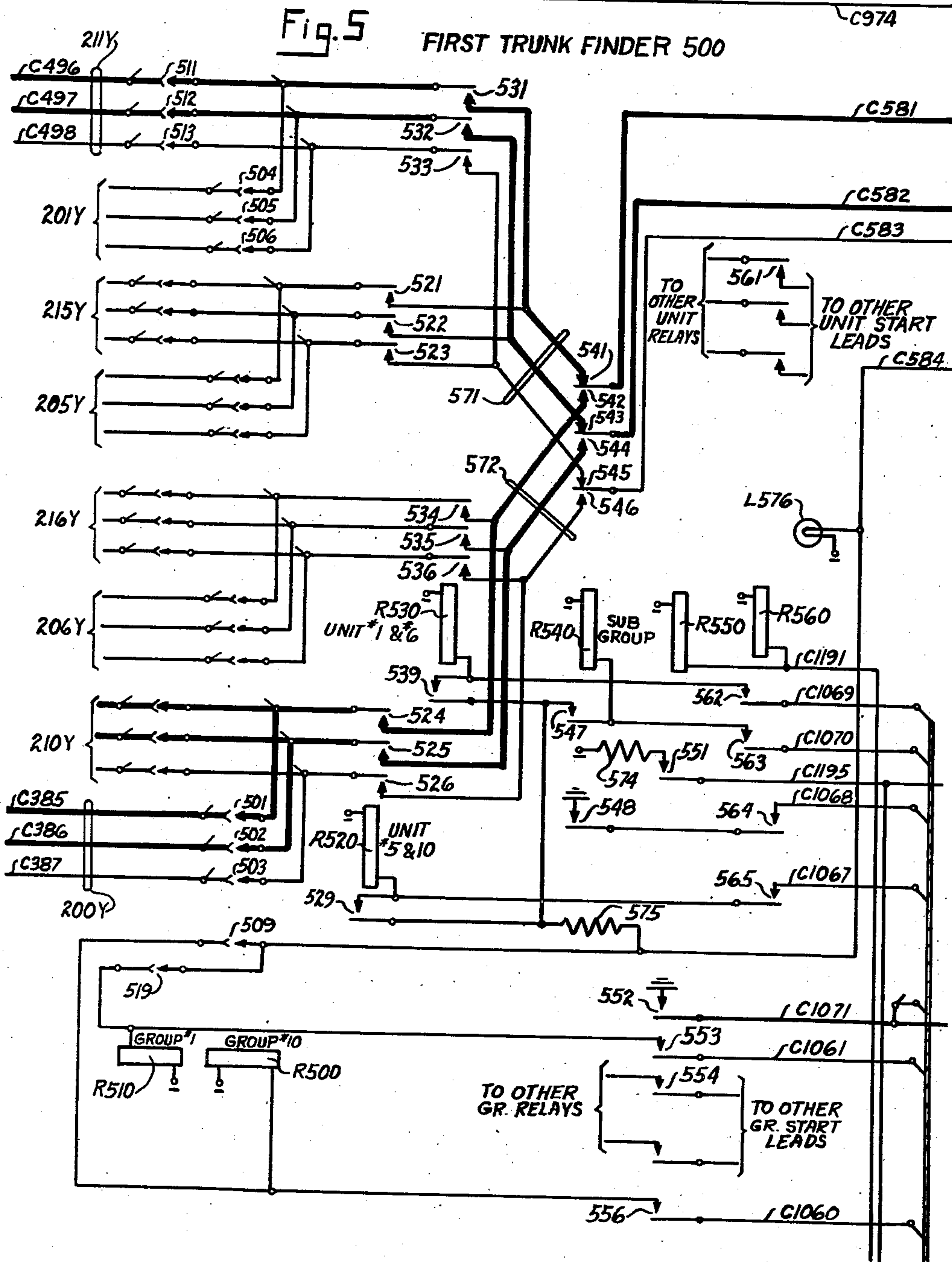
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TELEPHONE SYSTEM

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18 Sheets-Sheet 5



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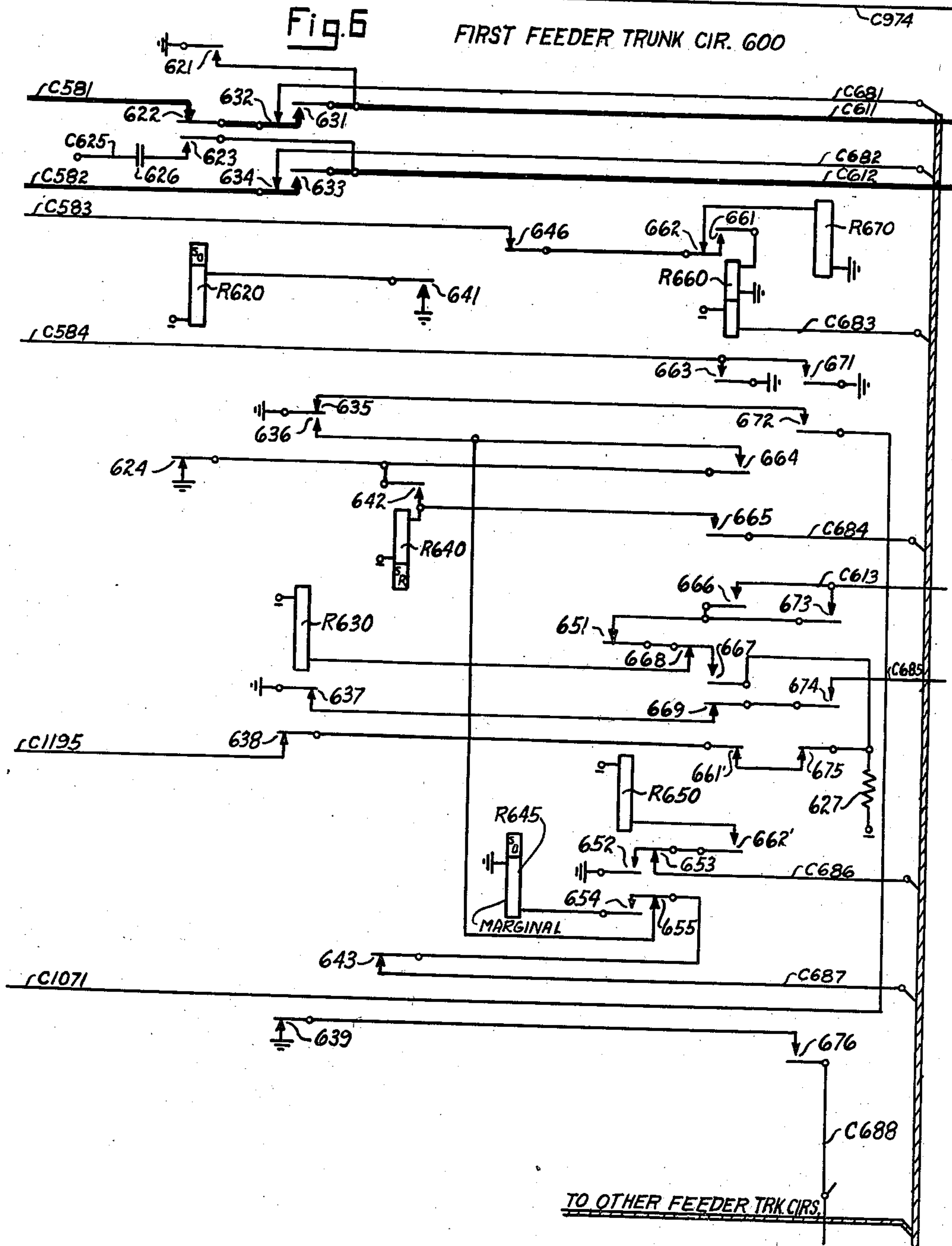
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2,315,008

TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 6



2,315,008

18 Sheets-Sheet 7



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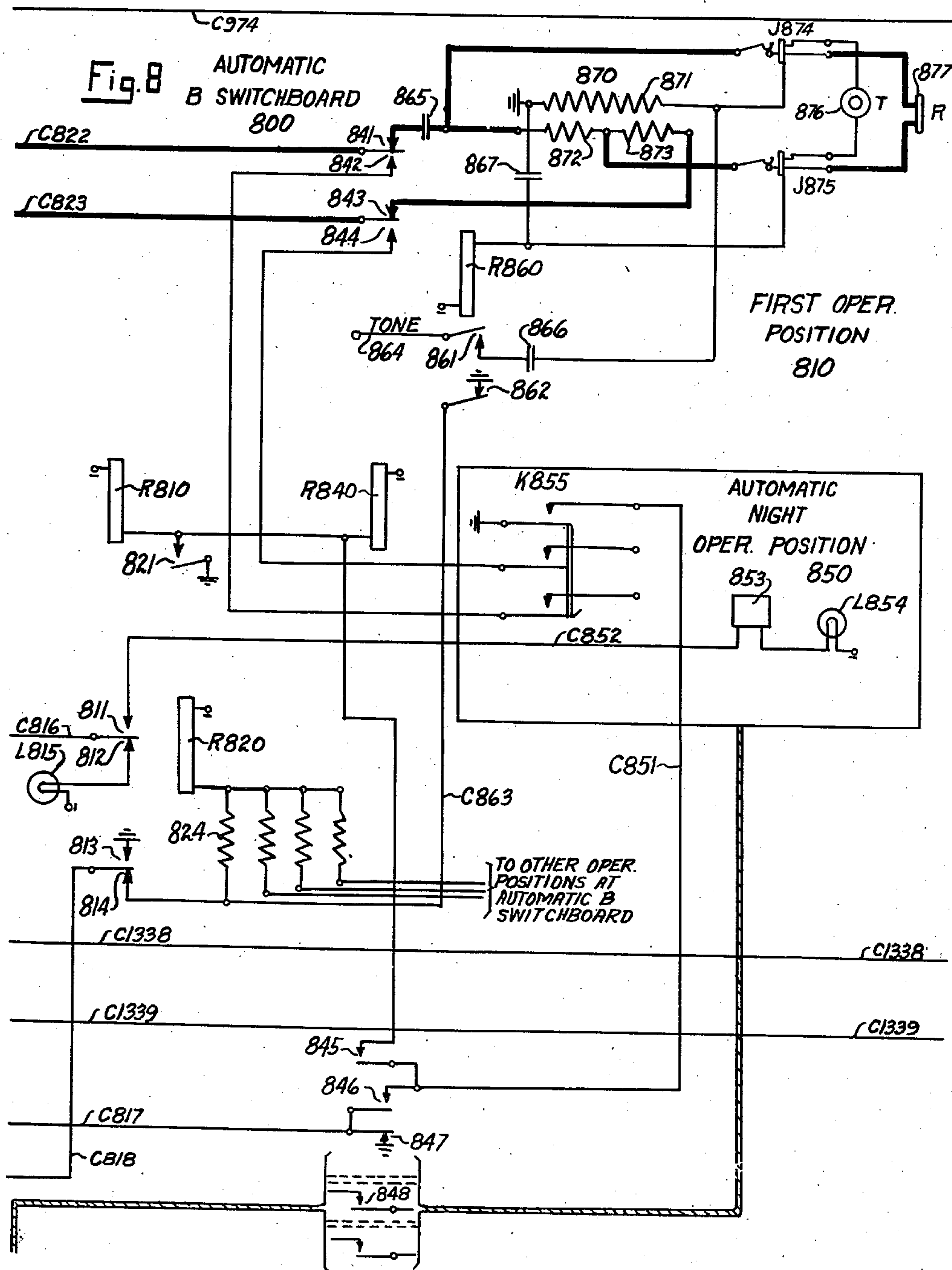
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TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 8



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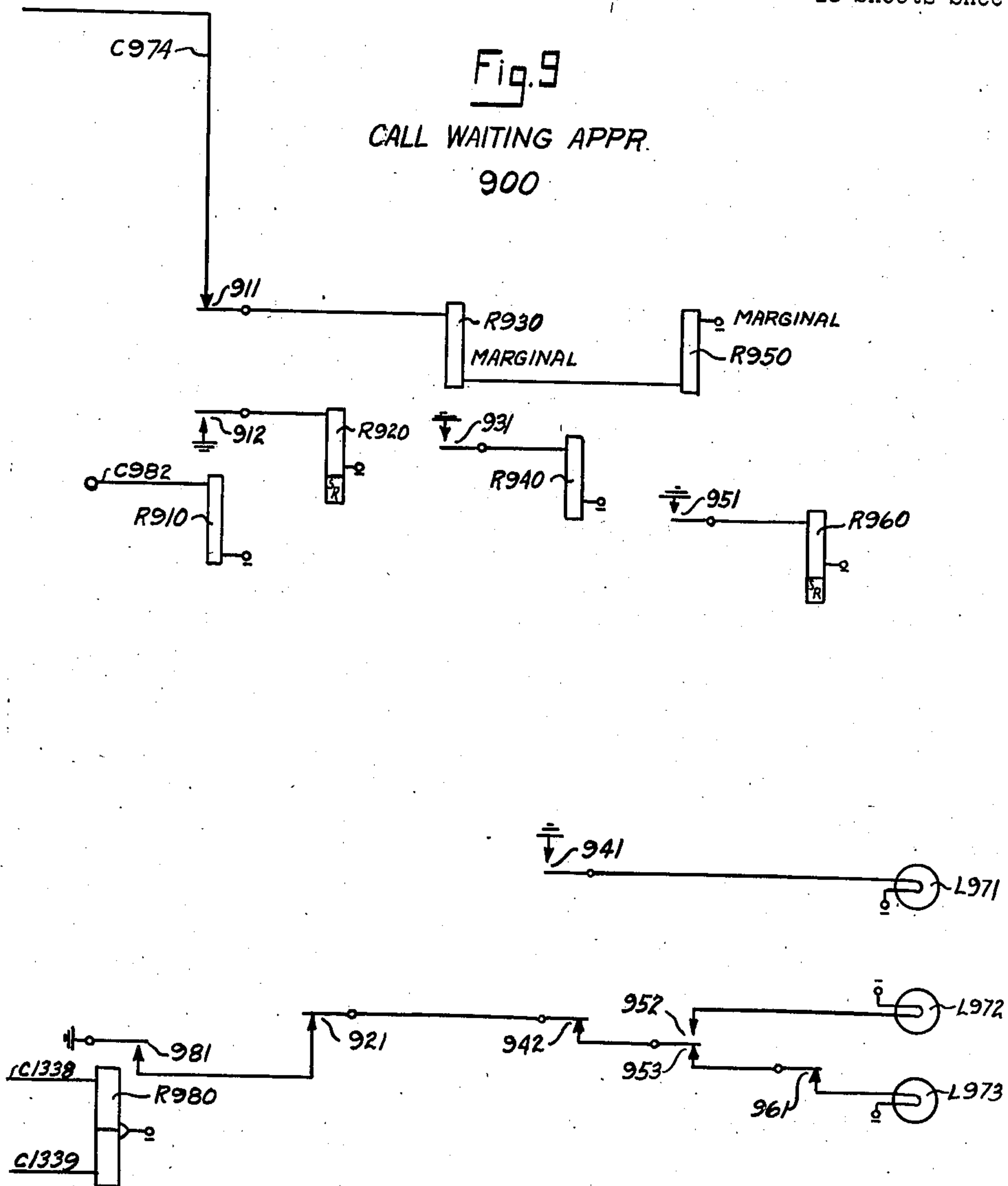
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18 Sheets-Sheet 9

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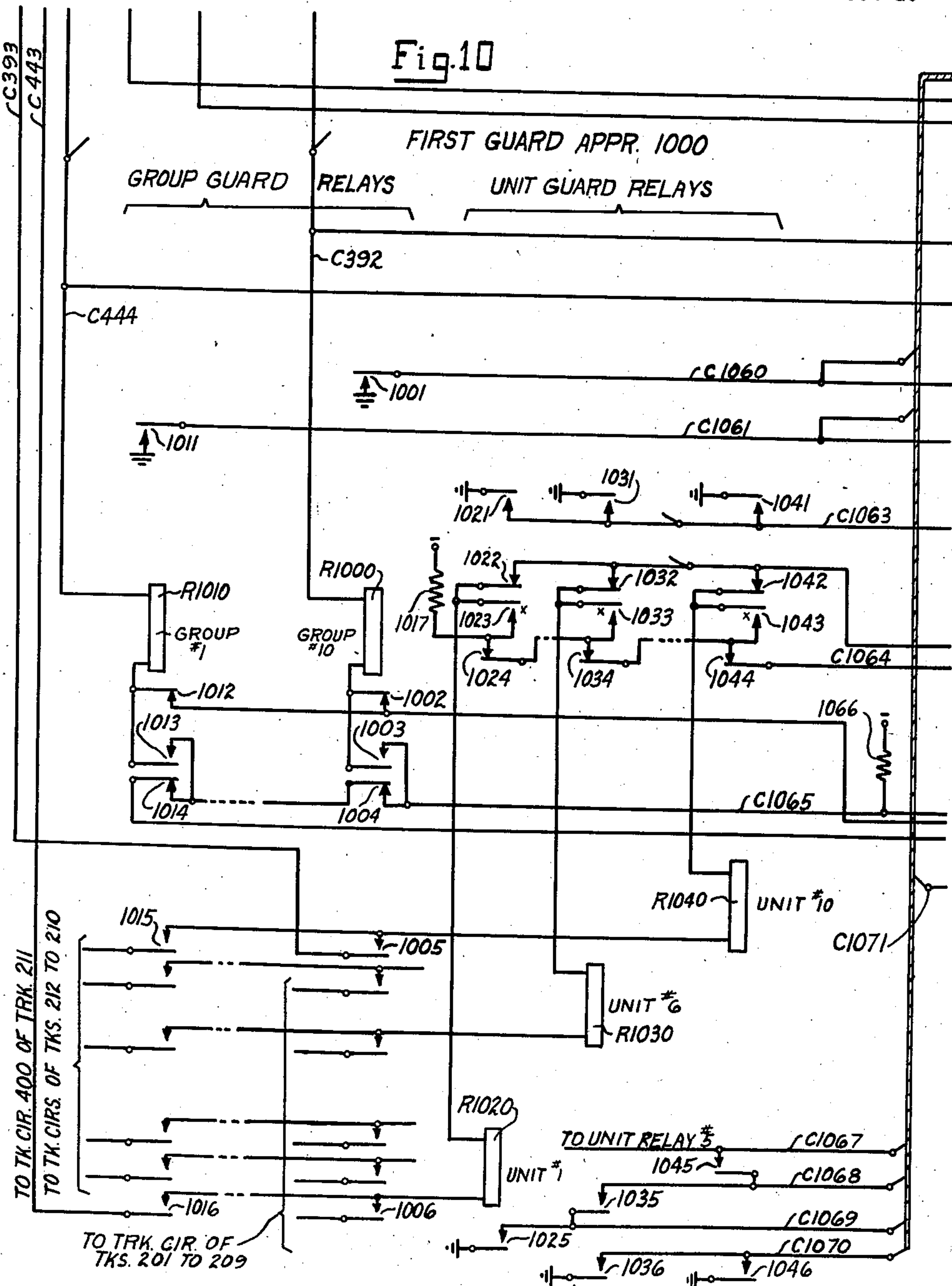
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TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 10



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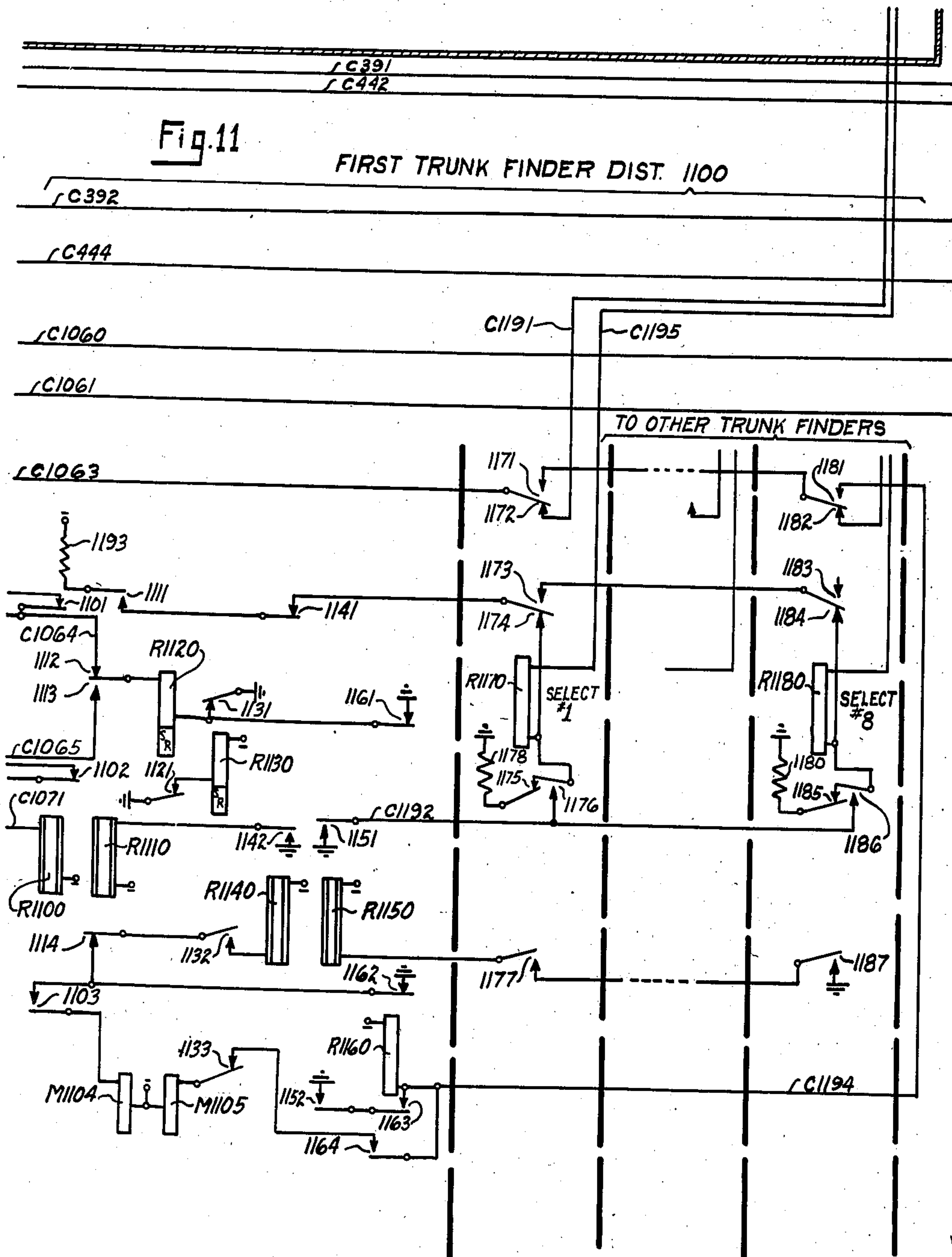
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TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 11



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2,315,008

TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 12

Fig.12

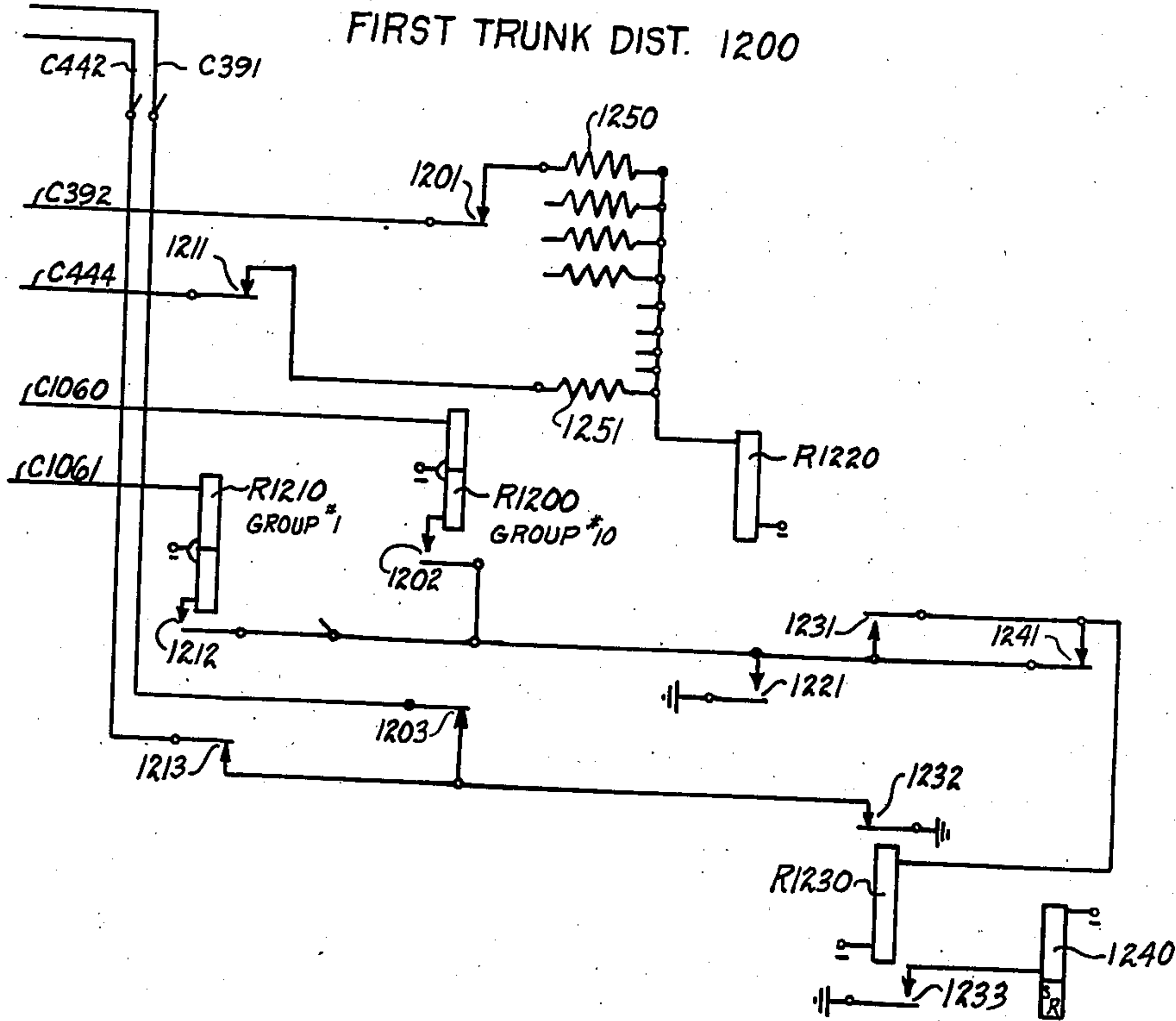
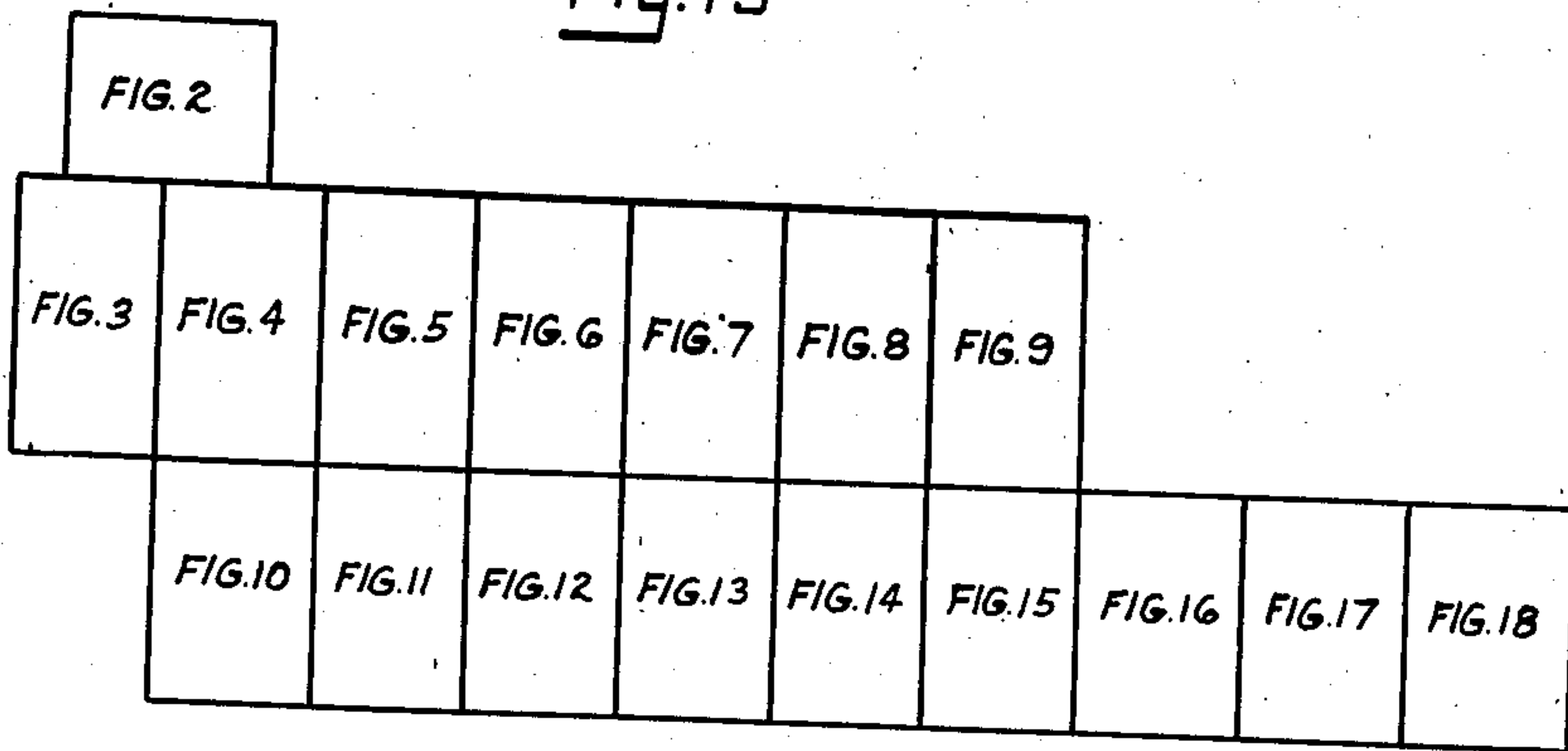


Fig. 19



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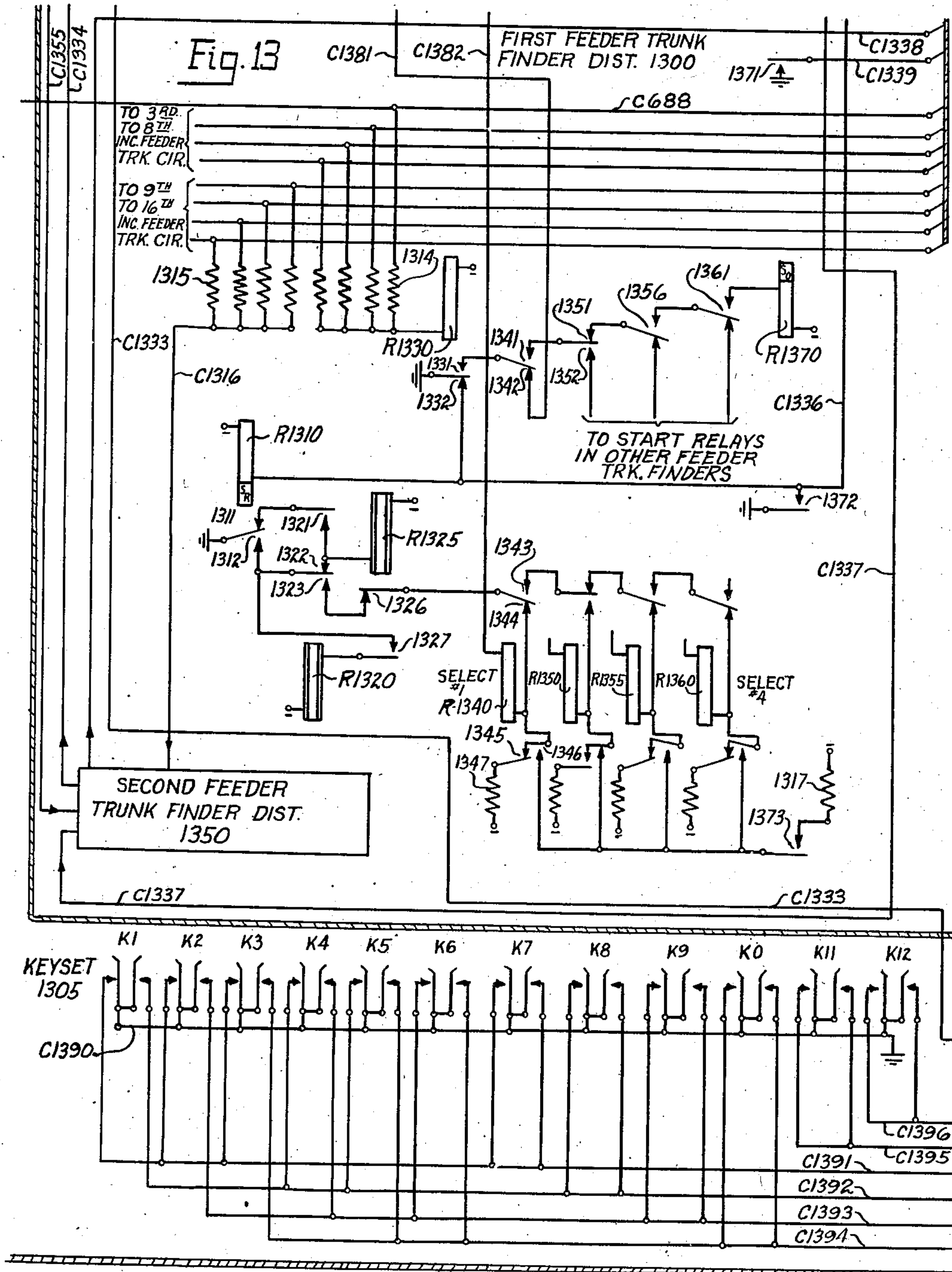
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TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 13



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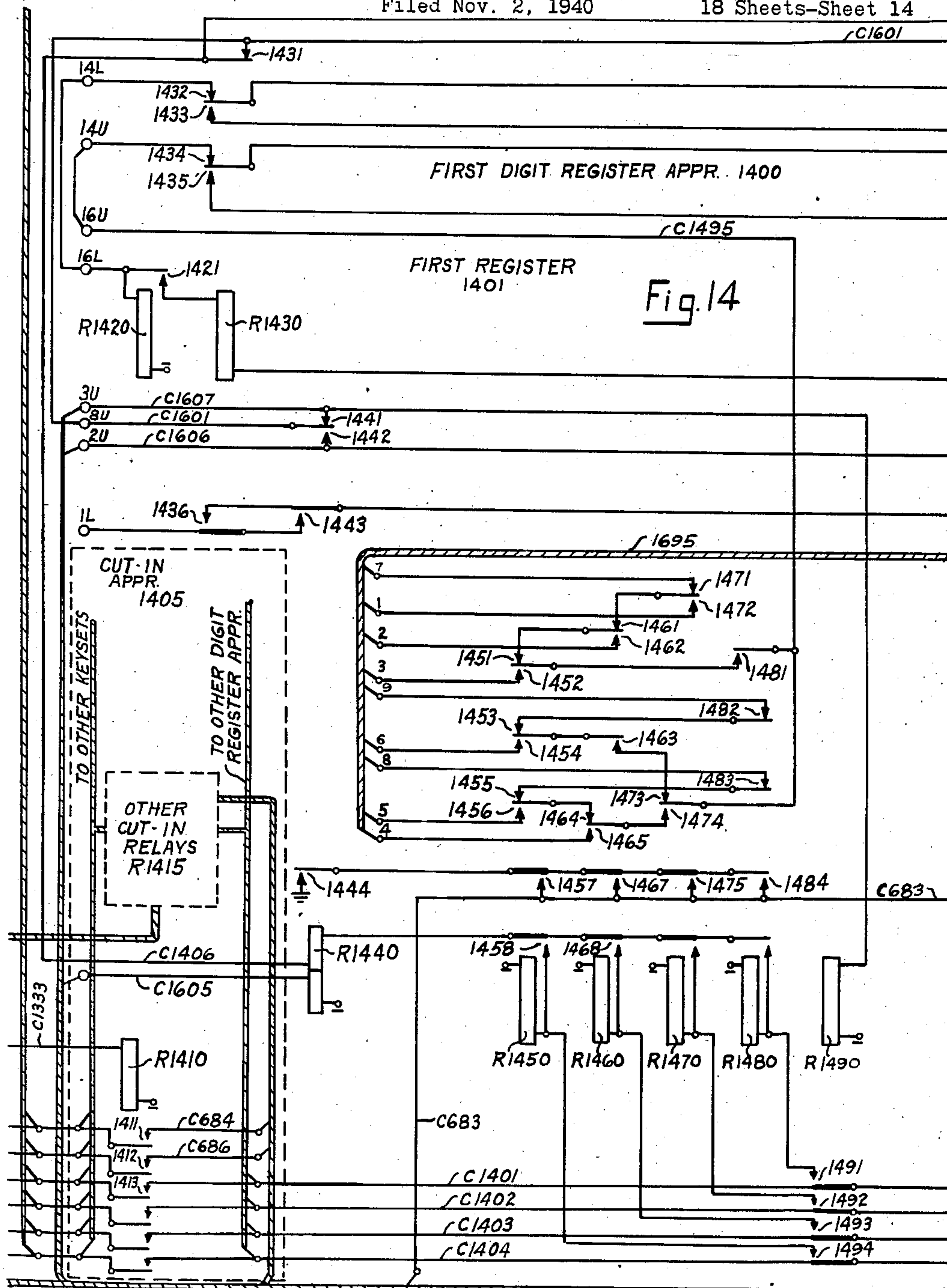
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TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 14



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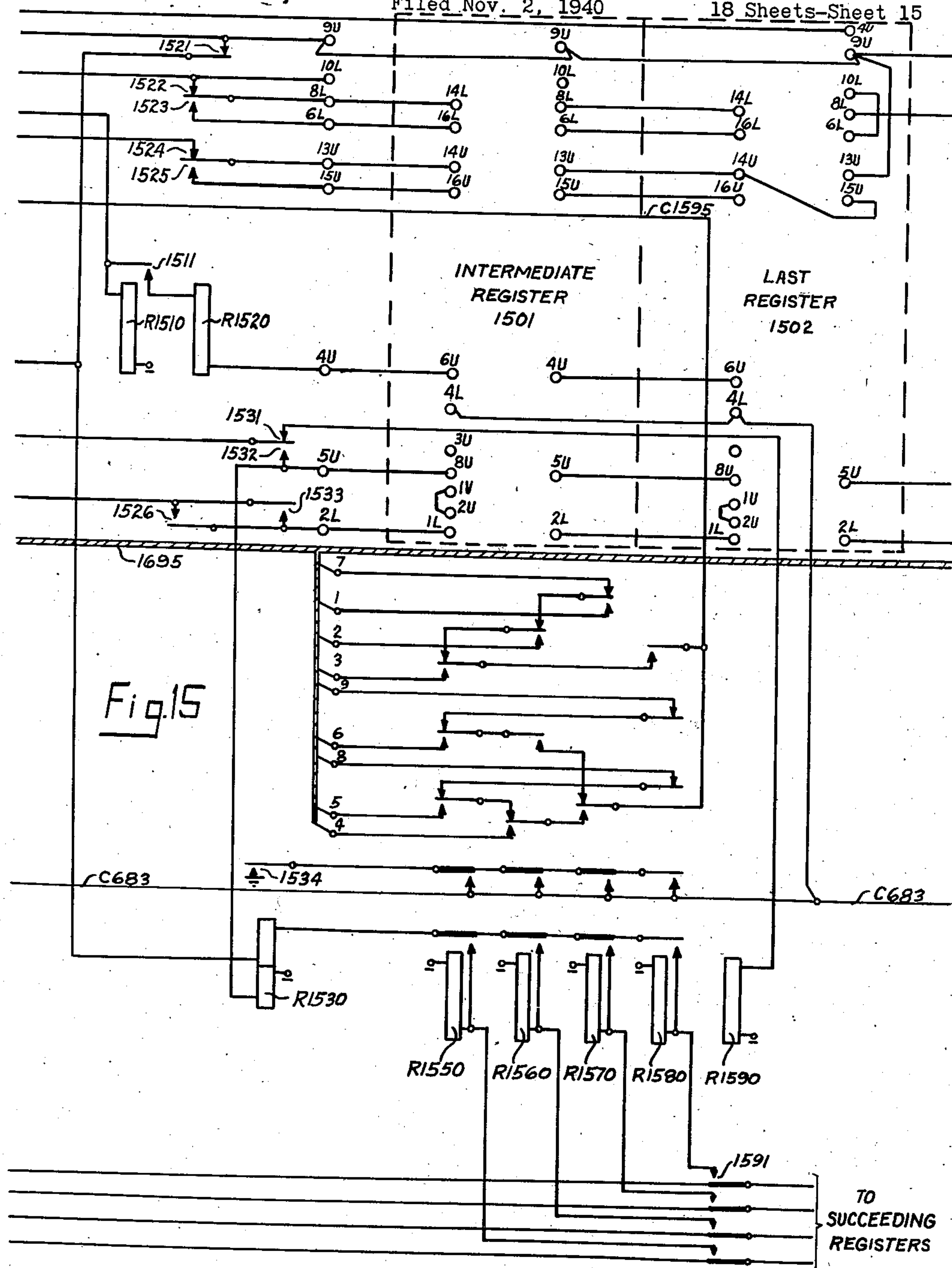
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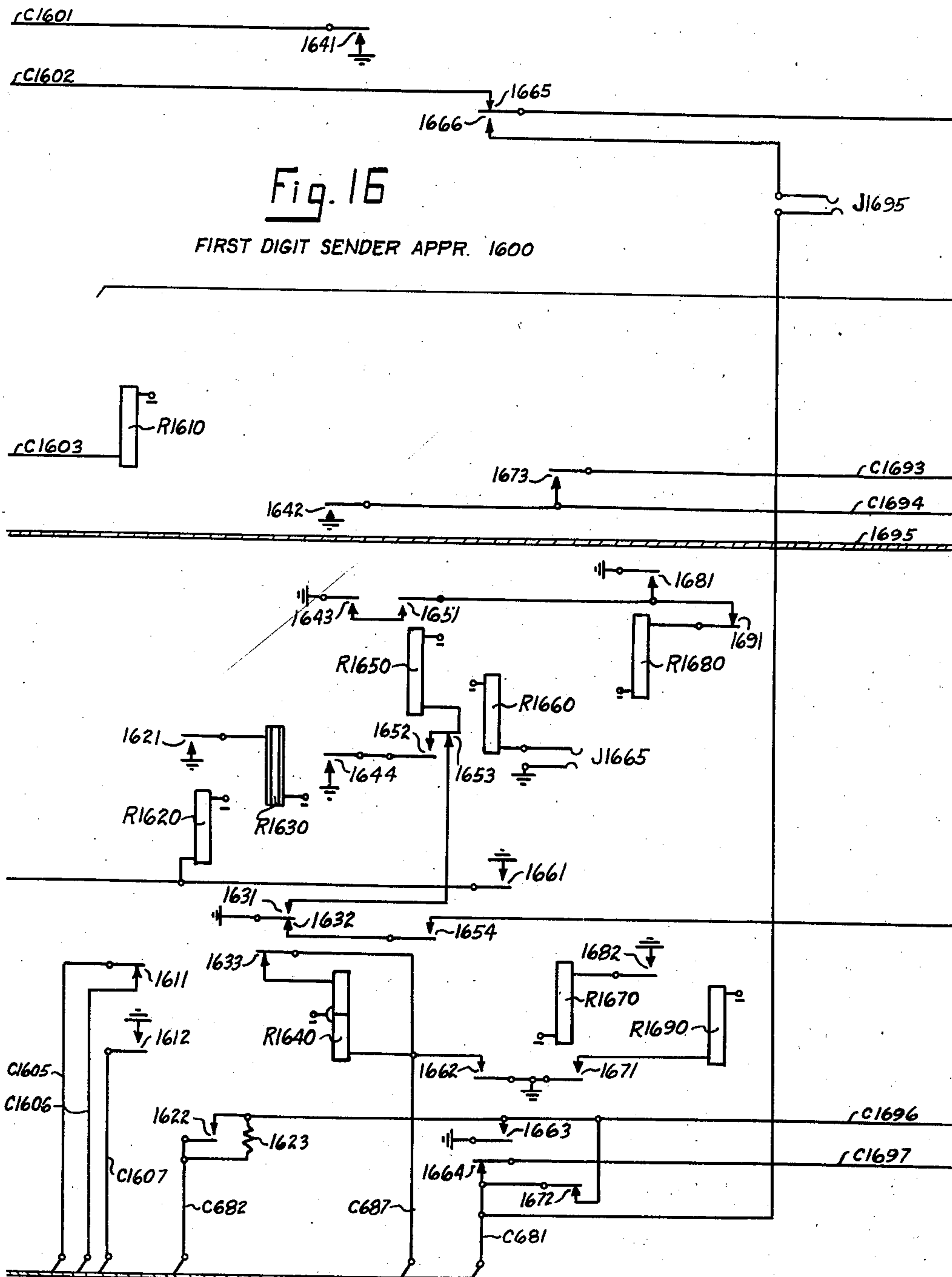
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Filed Nov. 2, 1940

18 Sheets-Sheet 16



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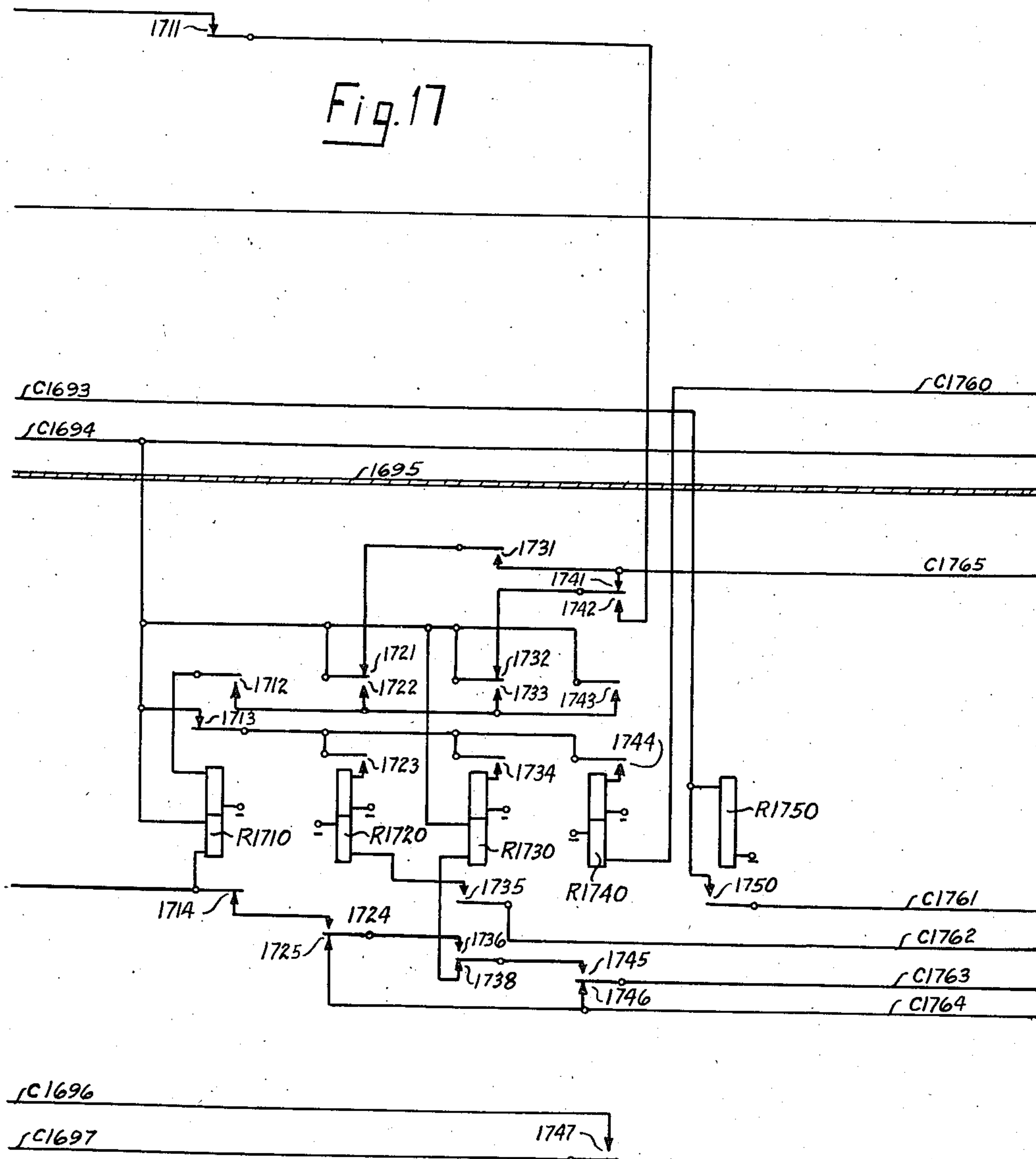
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Filed Nov. 2, 1940

18 Sheets-Sheet 17



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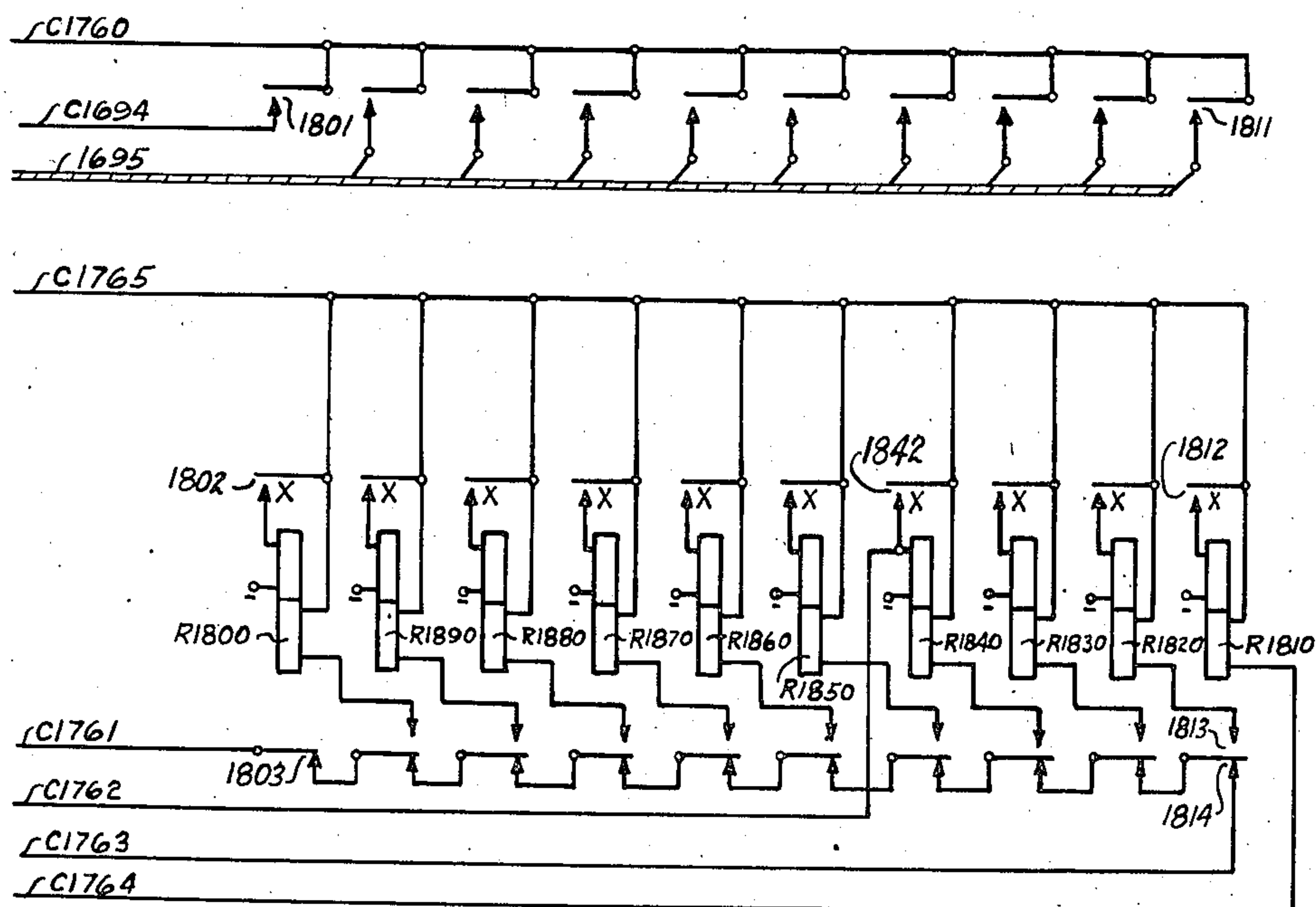
2,315,008

TELEPHONE SYSTEM

Filed Nov. 2, 1940

18 Sheets-Sheet 18

Fig. 18



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UNITED STATES PATENT OFFICE

2,315,008

TELEPHONE SYSTEM

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Application November 2, 1940, Serial No. 363,960

65 Claims. (Cl. 179—27)

The present invention relates to telephone systems, and more particularly to improved switching apparatus for distributing calls to a plurality of operator positions at a switchboard.

A semiautomatic telephone system including both manual and automatic exchanges conventionally comprises a manual A switchboard, an automatic B switchboard, automatic switching apparatus for setting up connections from the A switchboard to the B switchboard and an automatic switch train controllable from the B switchboard to extend connections therefrom. In a telephone system of the type noted, the switching apparatus usually comprises one or more ranks of finder switches of the hunting type, which are set into operation incident to the initiation of calls at the A switchboard and which then operate to search for idle paths to the B switchboard. While switching apparatus of the character noted has adequate call handling capacity when traffic is moderate, the call handling capacity thereof is frequently exceeded during peak traffic, causing undesirable delays in handling calls under this condition.

Accordingly, it is an object of the present invention to provide in a telephone system including a switchboard, improved switching apparatus of the fast operating, fully directive type for extending calls thereto.

Another object of the invention is to provide in a telephone system an improved arrangement for distributing calls to a plurality of switching links which positively prevents subsequently initiated calls from obtaining switching link access positions preferred over the switching link access positions of previously initiated calls.

Another object of the invention is to provide in a telephone system an improved method of distributing calls to a plurality of switching links, whereby the obtaining by subsequently initiated calls of switching link access positions preferred over the switching link access positions of previously initiated calls is positively prevented.

Another object of the invention is to provide, in a telephone system including a plurality of groups of lines and a plurality of switching links having access thereto, an improved distributor for marking calling ones of the lines batch by batch to idle ones of the links and for causing the switching links to seize group by group calling ones of the lines in a marked batch.

A further object of the invention is to provide, in a telephone system including a plurality of groups of lines and a plurality of switching links,

an improved distributor for allotting the ones of the groups including calling lines in a predetermined order to idle ones of the switching links, whereby the calling lines in the groups are seized by idle ones of the switching links in group-by-group rotation.

A further object of the invention is to provide, in a telephone system including a plurality of groups of lines and a plurality of switching links, an improved method of allotting the ones of the groups including calling lines in a predetermined order to idle ones of the switching links, whereby the calling lines in the groups are seized by idle ones of the switching links in group-by-group rotation.

A further object of the invention is to provide, in a telephone system including a plurality of groups of lines and a switchboard, an improved distributor for allotting in a predetermined order to idle ones of the operator positions at the switchboard the ones of the groups including calling lines, whereby the calls on the calling lines in the groups are answered at idle ones of the operator positions at the switchboard in group-by-group rotation.

A further object of the invention is to provide, in a telephone system including a plurality of groups of lines and a switchboard, an improved method of allotting in a predetermined order to idle ones of the operator positions at the switchboard the ones of the groups including calling lines, whereby the calls on the calling lines in the groups are answered at idle ones of the operator positions at the switchboard in group-by-group rotation.

An additional object of the invention is to provide, in a telephone system including one or more trunks and a switchboard provided with one or more operator positions, an improved arrangement of digit register-sender device or devices and digit register-sender controller or controllers therefor.

An additional object of the invention is to provide, in a telephone system including a plurality of trunks and a switchboard provided with a plurality of operator positions, wherein each trunk has a digit register-sender device individually associated therewith and each operator position has a digit register-sender controller individually associated therewith, an improved arrangement for connecting the trunks to the various operator positions at the switchboard and for connecting the digit register-sender controllers to the digit register-sender devices.

A still further object of the invention is to

provide, in a telephone system including a switchboard, an improved trunk adapted to extend a call to the switchboard to be answered and then to extend a call revertively thereover to associated switching apparatus to be subsequently completed.

A still further object of the invention is to provide, in a telephone system including a plurality of lines, a switchboard and a distributor for allotting calls on the lines to the switchboard to be answered, an improved indicator associated with the switchboard for registering the number of calls waiting to be answered at the switchboard.

A still further object of the invention is to provide, in a telephone system including a plurality of lines, a switchboard provided with a plurality of operator positions and an auxiliary operator position, an improved arrangement for distributing calls to staffed ones of the operator positions at the switchboard and for distributing calls to the auxiliary operator position when none of the operator positions at the switchboard is staffed.

The features of the present invention are illustrated as being incorporated in a telephone system comprising a central office including a manual A switchboard and an automatic B switchboard, a first distant exchange including a manual A switchboard, a second distant exchange including an automatic switch train, and automatic switching apparatus in the central office for routing calls straightforward from the manual A switchboards to the automatic B switchboard and then for extending calls from the automatic B switchboard to the automatic switch train.

In accordance with one feature of the invention, the trunks utilized in the system comprise incoming branches accessible to the A switchboards, answering branches accessible to the automatic switching apparatus and outgoing branches associated with the automatic switch train; and the automatic switching apparatus comprises a plurality of primary switches of the fully directive type having access to the answering branches of the trunks, a plurality of feeder trunks individually associated with the primary switches, and a plurality of secondary switches of the fully directive type having access to the feeder trunks and individually associated with the operator positions at the automatic B switchboard. More particularly, each trunk is provided with a trunk circuit individual thereto and the various branches of the trunk are normally mutually disconnected; and the trunk circuit includes a number of relays operative in different combinations to connect each two of the branches of the trunk, and a control network for the relays governable over the primary switches of the automatic switching apparatus.

In accordance with another feature of the invention, calls on the trunks are distributed to the primary switches in accordance with an improved method, whereby there are allotted to idle ones of the primary switches during a given cycle of distributions calls accumulated during a prior cycle of distribution, and there are accumulated calls initiated during the given cycle of distribution to be allotted during a subsequent cycle of distribution. Also, an improved cyclically operative primary switch distributor is provided for allotting the calls in the manner noted.

In accordance with another feature of the invention, an improved trunk distributor is provided which is operative cyclically to control the marking of calling ones of the trunks to the pri-

mary switches. More particularly, the arrangement comprises a plurality of marking relays individually associated with the trunks, means responsive to the operation of the marking relay associated with any one of the trunks for causing the primary switch distributor to operate an idle one of the primary switches to seize the one trunk, means responsive to the initiation of a call on any one of the trunks for preparing a point in the operating circuit of the associated one of the marking relays, and means governed by the trunk distributor to prepare cyclically a common point in the operating circuits of the marking relays, whereby each marking relay having a previously prepared operating circuit is operated.

In accordance with a further feature of the invention, calls on the feeder trunks are distributed to the secondary switches, and consequently to the operator positions at the automatic B switchboard, in accordance with an improved method. More particularly, the feeder trunks are arranged in two groups; and a given secondary switch is allotted repeatedly as it becomes idle intermittently to one of the groups including a calling feeder trunk in the event the other of the groups includes no calling feeder trunk, or is allotted alternately as it becomes idle intermittently to the two groups in the event each of the groups includes a calling feeder trunk; and the secondary switch is connected to a calling feeder trunk in either of the groups to which it is allotted. Also, an improved secondary switch distributor is provided for allotting the secondary switches, and consequently the operator positions at the automatic B switchboard, in the manner noted.

In accordance with a further feature of the invention, an improved call waiting indicator is associated with the automatic B switchboard which comprises a control network including a control conductor, means responsive to the presence of a call on any one of the trunks for causing the associated one of the trunk circuits to connect resistance potential therein to the control conductor, means responsive to the seizure of any one of the trunks by a primary switch for causing the associated one of the trunk circuits to disconnect resistance potential therein from the control conductor, a plurality of relays of the marginal type provided with a series operating circuit including the control conductor, whereby the relays are operated in accordance with different numbers of connections of resistance potential in the trunk circuits to the control conductor, and means for selectively operating the call waiting indicator in accordance with the operation of the relays.

In accordance with a further feature of the invention, a plurality of digit register-sender devices are individually associated with the feeder trunks and a plurality of digit register-sender controllers are individually associated with the operator positions at the automatic B switchboard, each of the digit register-sender devices being adapted to register and to send over the associated one of the feeder trunks one or more digits, and each of the digit register-sender controllers being adapted to control any one of the digit register-sender devices. Also, there is provided means controlled when any one of the secondary switches is operated to connect any one of the feeder trunks to the associated operator position at the automatic B switchboard for connecting the associated one of the digit register-sender controllers to the associated one of the digit register-sender devices.

In accordance with a still further feature of the invention, an automatic night operator position is provided which is associated with the automatic B switchboard, the automatic night operator position including a digit register-sender controller adapted to control any one of the digit register-sender devices. Also, an arrangement is provided for selectively connecting one of the secondary switches either to the first operator position at the automatic B switchboard or to the automatic night operator position, whereby the secondary switch mentioned is normally connected to the first operator position at the automatic B switchboard and is automatically connected to the automatic night operator position when the automatic B switchboard is not staffed. Further, an arrangement is provided which is controlled in accordance with the connection of the secondary switch mentioned either to the first operator position at the automatic B switchboard or to the automatic night operator position for controlling the connection of the digit register-sender controller at the appropriate operator position to the digit register-sender device individually associated with the feeder trunk seized by the secondary switch mentioned.

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

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the 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 18, inclusive, taken together, illustrate the details of the system having incorporated therein the features of the invention, as briefly outlined above; and Fig. 19 illustrates the mode of combining Figs. 2 to 18, inclusive, in order to form a unified system.

Description of the apparatus incorporated in the telephone system

Referring now more particularly to Fig. 1 of the drawings, the telephone system there illustrated comprises a central office 30 of the manual type serving a number of subscriber substations, not shown, a distant exchange 40 of the manual type serving a number of subscriber substations, not shown, and a distant exchange 50 of the automatic type serving a number of subscriber substations, including the subscriber substation T. The central office 30 comprises a manual A switchboard 260 including an operator position 261, an automatic B switchboard 800 including four operator positions, the first operator position being illustrated at 810, and an automatic night operator position 850; the distant exchange 40 comprises a manual A switchboard 250 including an operator position 251; and the distant exchange 50 comprises automatic switching apparatus 270 having access to the subscriber line 280 extending to the subscriber substation T. A group of one-way trunks, including the trunk 211, extends from the manual A switchboard 260 in the central office 30 by way of the automatic B switchboard 800 in the central office 30 to the automatic switching apparatus 270 in the distant exchange 50; and a group of one-way trunks, in-

cluding the trunk 200, extends from the manual A switchboard 250 in the distant exchange 40 by way of the automatic B switchboard 800 in the central office 30 to the automatic switching apparatus 270 in the distant exchange 50. Each of these one-way trunks is provided with a trunk circuit individual thereto in the central office 30 and comprises an incoming branch X, an answering branch Y and an outgoing branch Z. For example, the trunk 211 is provided with a trunk circuit 400 individual thereto and comprises an incoming branch 211X, an answering branch 211Y and an outgoing branch 211Z; while the trunk 200 is provided with a trunk circuit 300 individual thereto and comprises an incoming branch 200X, an answering branch 200Y and an outgoing branch 200Z.

The trunks extending by way of the automatic B switchboard 800 in the central office 30 are arranged in two divisions, each division of trunks comprising ten groups and each group of trunks comprising ten trunks. For example, the trunk 211 comprises the first trunk in the first group in the first division; while the trunk 200 comprises the tenth trunk in the tenth group in the first division.

Also, the central office 30 comprises two groups of trunk finders, each group of trunk finders comprising eight individual trunk finders. More particularly, the first eight trunk finders, including the first trunk finder illustrated at 500 comprise the first group; and the second eight trunk finders comprise the second group. Further, the central office 30 comprises a first trunk finder distributor 1100 for assigning idle ones of the trunk finders in the first group in a predetermined order, a second trunk finder distributor, not shown, for assigning idle ones of the trunk finders in the second group in a predetermined order, first guard apparatus 1000 operatively associated with the trunk circuits of the trunks in the first division for marking the answering branches of the individual trunks therein to be seized by the individual trunk finders in the first group, second guard apparatus, not shown, operatively associated with the trunk circuits of the trunks in the second division for marking the answering branches of the individual trunks therein to be seized by the individual trunk finders in the second group, a first trunk distributor 1200 for controlling the order in which the answering branches of the individual trunks in the first division are marked by the first guard apparatus 1000, and a second trunk distributor, not shown, for controlling the order in which the answering branches of the individual trunks in the second division are marked by the second guard apparatus.

Further, the central office 30 comprises two groups of feeder trunk circuits, each group of feeder trunk circuits comprising eight individual feeder trunk circuits. More particularly, the first eight feeder trunk circuits, including the first feeder trunk circuit illustrated at 600, comprise the first group; and the second eight feeder trunk circuits comprise the second group. Further, the central office 30 comprises a group of sixteen digit register-sender apparatus, the first digit register-apparatus being illustrated at 1400 and the first digit sender apparatus being illustrated at 1600. At this point, it is noted that the feeder trunk circuits in the two groups are individually associated with corresponding ones of the trunk finders in the two groups, the first feeder trunk circuit 600 in the first group being individually

associated with the first trunk finder 500 in the first group; and the digit register-sender apparatus in the group are individually associated with corresponding ones of the feeder trunk circuits in the two groups, the first digit register apparatus 1400 and the first digit sender apparatus 1600 being individually associated with the first feeder trunk circuit 600 in the first group.

Further, the central office 30 comprises a group of feeder trunk finders, the first feeder trunk finder being illustrated at 700. The feeder trunk finders are individually associated with the operator positions at the automatic B switchboard 800, the first feeder trunk finder 700 being individually associated with the first operator position 810 at the automatic B switchboard 800.

It is pointed out that the individual trunk finders in the first group have access to each of the one hundred trunks in the first division; the individual trunk finders in the second group have access to each of the one hundred trunks in the second division; while each of the feeder trunk finders has access to first and second groups of feeder trunks. The first group of feeder trunks including the first feeder trunk 610 comprises eight feeder trunks, which are individually associated with the feeder trunk circuits in the first group; while the second group of feeder trunks comprises eight feeder trunks which are individually associated with the feeder trunk circuits in the second group.

Also, the central office 30 comprises a first feeder trunk finder distributor 1300 and a second feeder trunk finder distributor 1350. The first feeder trunk finder distributor 1300 is individually associated with the first group of feeder trunk circuits, including the first eight feeder trunk circuits; and the second feeder trunk finder distributor 1350 is individually associated with the second group of feeder trunk circuits, including the second eight feeder trunk circuits. Each of the feeder trunk finder distributors is responsive to the presence of a call on a feeder trunk in the associated group to cause a pre-selected feeder trunk finder individually associated with an idle operator position at the automatic B switchboard 800 to seize the calling feeder trunk in the associated group.

Further, the central office 30 comprises cut-in apparatus 1405 commonly associated with the group of feeder trunk finders, the group of digit-register sender apparatus, the various operator positions at the automatic B switchboard 800 and the automatic night operator position 850. The cut-in apparatus 1405 is so connected and arranged that, when one of the feeder trunk finders corresponding to an idle operator position at the automatic B switchboard 800 seizes a calling feeder trunk in either group, it operates to associate the corresponding digit register sender apparatus with the feeder trunk circuit individually associated with the seized feeder trunk and to associate the key set at the idle operator position with the corresponding digit register sender apparatus.

The apparatus at the first operator position 810 at the automatic B switchboard 800 is so connected and arranged that, when all of the operator positions at the automatic B switchboard 800 are vacant, this apparatus is automatically switched to the automatic night operator position 850, whereby all incoming traffic to the automatic B switchboard 800 is handled at the automatic night operator position 850. Finally, the central office 30 comprises call waiting ap-

paratus 900 commonly associated with the trunk circuits of the trunks in the two divisions and the automatic B switchboard 800 in order to indicate to the operators at the operator positions thereat the number of calls on incoming trunks in the two divisions waiting to be answered at the automatic B switchboard 800.

Preferably, the manual A switchboard 250 in the distant exchange 40 and the manual A switchboard 260 in the central office 30, shown in Fig. 2, are of conventional connection and arrangement; the automatic switching apparatus 270 in the distant exchange 50, shown in Fig. 2, is of conventional connection and arrangement, including a number of tandem related automatic switches of the Strowger type; and the subscriber substations in the central office 30, the distant exchange 40 and the distant exchange 50, shown in Fig. 2, are provided with conventional line circuits and substation equipment, in accordance with established practice.

Preferably, each of the trunks in the group extending from the manual A switchboard 250 in the distant exchange 40 by way of the central office 30 to the automatic switching apparatus 270 in the distant exchange 50 is identical to the trunk 200 and is provided with a trunk circuit individual thereto identical to the trunk circuit 300. As best shown in Fig. 3, the trunk circuit 300 comprises a repeater 310, a line relay R320, a marking relay R330, a hold relay R340, an answer relay R345, a cutoff relay R350, a switch-through relay R360, a cut-in relay R370 and a control network.

Preferably, each of the trunks in the group extending from the manual A switchboard 260 in the central office 30 to the automatic switching apparatus 270 in the distant exchange 50 is identical to the trunk 211 and is provided with a trunk circuit individual thereto identical to the trunk circuit 400. As best shown in Fig. 4, the trunk circuit 400 comprises a sleeve relay R410, a line relay R420, a busy relay R425, a marking relay R430, a hold relay R440, an answer relay R450, a cutoff relay R450, a switch-through relay R470, a cut-in relay R480 and a control network.

Preferably, each of the trunk finders in the two groups is identical to the trunk finder 500, which, as best shown in Fig. 5, has access to one hundred trunks, and comprises ten group relays including the first group relay R510, eight group relays, not shown, and the tenth group relay R500; five unit relays, including the first and sixth unit relay R520, three unit relays, not shown, and the fifth and tenth relay R520; and a subgroup relay R540. Also, the first trunk finder 500 comprises two start relays R550 and R560 and a control network. In the first trunk finder 500, the ten group relays are of unique construction; while the five unit relays and the subgroup relay are of conventional construction. More particularly, each of the group relays is preferably of the construction and arrangement disclosed and claimed in U. S. Patent No. 2,135,832, Herbert F. Obergfell, granted November 11, 1938.

Preferably, each of the feeder trunk circuits in the two groups is identical to the first feeder trunk circuit 600 which comprises, as best shown in Fig. 6, a switch-through relay R630, an error relay R640, a release relay R645, a send relay R660, a start relay R670, two control relays R620 and R650 and a control network.

Preferably the two guard apparatus are identical. The first guard apparatus 1000, as best

shown in Fig. 10, is adapted to guard one hundred trunks and comprises ten group relays including the first group relay R1010, eight group relays, not shown, and the tenth group relay R1000; and ten unit relays including the first unit relay R1020, four unit relays, not shown, the sixth unit relay R1030, three additional unit relays, not shown, and the tenth unit relay R1040.

Preferably, the two trunk finder distributors are identical. The first trunk finder distributor 1100 comprises, as best shown in Fig. 11, a lock-out relay R1100, a hold relay R1120, three timing relays R1110, R1130 and R1140, a reset relay R1150, a busy relay R1160, a peg count meter M1104 and an overflow meter M1105. Also, the first trunk finder distributor 1100 comprises eight select relays, including the first select relay R1170, six select relays, not shown, and the eighth select relay R1180, and a control network.

Preferably, the two trunk distributors are identical. The first trunk distributor 1200, as best shown in Fig. 12, comprises ten group relays including the first group relay R1210, eight group relays, not shown, and the tenth group relay R1200, a start relay R1220, a lockout relay R1230, a timing relay R1240 and a control network.

Preferably, each of the feeder trunk finders is identical to the first feeder trunk finder 700 which, as best shown in Fig. 7, has access to sixteen feeder trunks, and comprises eight connect relays including the first and second connect relay R710, six connect relays, not shown, and the fifteenth and sixteenth connect relay R720, and a subgroup relay R730. Also, the first feeder trunk 700 comprises a switch-through relay R750, two start relays R740 and R760, two preference relays R770 and R780, two tone relays R785 and R790 and a control network.

Preferably, the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350 are identical. The first feeder trunk finder distributor 1300 comprises, as best shown in Fig. 13, a hold relay R1310, two timing relays R1320 and R1325, a start relay R1330, a reset relay R1370, four select relays R1340, R1350, R1355 and R1360 and a control network.

Preferably, each operator position at the automatic B switchboard 800 is substantially identical to the first operator position 810, which comprises position equipment, as best shown in Fig. 8, including a repeater 870, a transmitter 876, a receiver 877, a position relay R860, a control network and a key set 1305. Also, the first operator position 810 comprises certain unique equipment in view of the fact that it alone at the automatic B switchboard 800 is associated with the automatic night operator position 850, this unique equipment comprising two switching relays R810 and R840, a hold relay R820 and a control network. The key set 1305 provided at the first operator position 810 comprises, as best shown in Fig. 13, ten digit keys K1 to K0, inclusive, a clear-out key K11 and an error key K12. The automatic night operator position 850 comprises, as best shown in Fig. 8, position equipment including an answer key K855, and a repeater, a transmitter, a receiver and a key set, not shown; this position equipment being connected and arranged in a manner substantially identical to that at the first operator position 810 at the automatic B switchboard 800.

The call waiting apparatus 900 comprises, as best shown in Fig. 9, a start relay R980, a reset relay R910, a timing relay R920, two waiting re-

lays R930 and R950, two control relays R940 and R960, three call waiting lamps L971, L972 and L973 and a control network.

The cut-in apparatus 1405 comprises, as best shown in Fig. 14, four groups of cut-in relays individually associated with the feeder trunk finders in the group, each group of cut-in relays including sixteen cut-in relays individually corresponding to the sixteen feeder trunks in the two groups. For example, the first group of cut-in relays in the cut-in apparatus 1405 individually associated with the first feeder trunk finder 700 comprises sixteen cut-in relays individually associated with the sixteen feeder trunks in the group, the first cut-in relay in the first group individually associated with the first feeder trunk 610 being illustrated at R1410.

Preferably, each of the digit register apparatus is identical to the first digit register apparatus 1400, which comprises, as best shown in Figs. 14 and 15, a first register 1401, an intermediate register 1501 and a last register 1502. Preferably, each of the registers is identical to the first register 1401, which is adapted to register the first and second digits, and comprises two hold relays R1420 and R1510, two impulse transfer relays R1430 and R1520, two register transfer relays R1440 and R1530, a first group of four marking relays including the marking relays R1450, R1460, R1470 and R1480, a second group of four marking relays including the marking relays R1550, R1560, R1570 and R1580, two select relays R1490 and R1590 and a control network.

Preferably, each of the digit sender apparatus is identical to the first digit sender apparatus 1600, which comprises, as best shown in Figs. 16, 17 and 18, a seizure relay R1610, a hold relay R1620, a start relay R1640, a pulse relay R1670, a test relay R1660, two control relays R1630 and R1650, two cycle relays R1680 and R1690, three spacing relays R1710, R1720 and R1730, a pulse start relay R1750, a pulse stop relay R1740, ten counting relays R1810 to R1800, inclusive, and a control network.

A better understanding of the connection and arrangement of the apparatus incorporated in the telephone system will be facilitated from a consideration of the general operation of the various pieces of apparatus incorporated therein incident to the extension of a call from the manual A switchboard 250 in the distant exchange 40 by way of the automatic B switchboard 800 in the central office 30 to the subscriber substation T in the distant exchange 50, and incident to the extension of a call from the manual A switchboard 250 in the central office 30 by way of the automatic B switchboard 800 in the central office 30 to the subscriber substation T in the distant exchange 50, as will appear hereinafter.

General operation of the system

Considering now the general operation of the system with reference to Fig. 1 of the drawings, it is noted that, when the operator at the operator position 251 at the manual A switchboard 250 in the distant exchange 40 answers a local call which is to be extended to the subscriber substation T in the distant exchange 50, she first selects an idle trunk in the group extending by way of the central office 30 to the distant exchange 50, such, for example, as the trunk 200. The operator at the operator position 251 then inserts the calling plug of the cord circuit in use into the jack terminating the incoming branch 200X of the trunk 200, thereby to cause operation

of the trunk circuit 300 individually associated with the trunk 200, in a manner more fully explained hereinafter.

Similarly, when the operator at the operator position 261 at the manual A switchboard 260 in the central office 30 answers a local call which is to be extended to the subscriber substation T in the distant exchange 50, she first selects an idle trunk in the group extending to the distant exchange 50, such, for example, as the trunk 211. The operator at the operator position 261 then inserts the calling plug of the cord circuit in use into the jack terminating the incoming branch 211X of the trunk 211, thereby to cause operation of the trunk circuit 400 individually associated with the trunk 211, in a manner more fully explained hereinafter.

More particularly, the trunk circuit 300 operates, thereby to initiate operation of the first guard apparatus 1000; whereupon the first guard apparatus 1000 operates to mark the answering branch 200Y of the trunk 200 as a calling trunk branch to the trunk finders in the first group having access thereto, and to initiate operation of both the first trunk finder distributor 1100 and the first trunk distributor 1200. Similarly, the trunk circuit 400 operates, thereby to initiate operation of the first guard apparatus 1000; whereupon the first guard apparatus 1000 operates to mark the answering branch 211Y of the trunk 211 as a calling trunk branch to the trunk finders in the first group having access thereto, and to initiate operation of both the first trunk finder distributor 1100 and the first trunk distributor 1200.

The first guard apparatus 1000 operates in order to mark the answering branches of the trunks in the first division to be seized by the trunk finders in the first group in a predetermined order; and the first trunk distributor 1200 operates in order to control the operation of the first guard apparatus 1000, whereby the answering branches of the calling trunks in the various groups in the first division are marked in a predetermined order. The first trunk finder distributor 1100 operates in order to cause idle ones of the trunk finders in the first group to be preselected in a predetermined order and to cause a preselected trunk finder in the first group to operate and seize the answering branch of a marked calling trunk in the first division.

When a trunk finder in the first group, such, for example, as the first trunk finder 500, seizes the answering branch of any calling trunk in the first division, the first feeder trunk 600 individual thereto operates, thereby to initiate operation of the associated first feeder trunk finder distributor 1300. Similarly, when a trunk finder in the second group seizes the answering branch of any calling trunk in the second division, the feeder trunk circuit individual thereto operates, thereby to initiate operation of the associated second feeder trunk finder distributor 1350.

The first feeder trunk finder distributor 1300 preselects idle ones of the feeder trunk finders in the associated group, marks the calling feeder trunks in the first group in a predetermined order and initiates operation of a preselected feeder trunk finder, such, for example, as the first feeder trunk finder 700. Upon operating, the first feeder trunk finder 700 seizes the marked calling feeder trunk; extends a connection therefrom to the associated first operator position 810 at the automatic B switchboard 800, and initiates operation of the cut-in apparatus 1405;

whereupon the cut-in apparatus 1405 operates in order to cut the key set 1305 at the first operator position 810 into the digit register apparatus in the group individually associated with the feeder trunk circuit individually associated with the feeder trunk seized by the first feeder trunk finder 700.

In a similar manner, the second feeder trunk finder distributor 1350 preselects idle ones of the feeder trunk finders in the associated group, marks the calling feeder trunks in the second group in a predetermined order, and initiates operation of a preselected feeder trunk finder, such, for example, as the first feeder trunk finder 700; whereupon the first feeder trunk finder 700 operates in the manner previously explained.

When the first feeder trunk finder 700 operates in order to extend a call to the first operator position 810 at the automatic B switchboard 800, tone current is transmitted to the first operator position 810 in order to advise the operator thereat that a call has arrived to be answered, and tone current is transmitted over the feeder trunk seized by the first feeder trunk finder 700 and over the associated feeder trunk circuit and the associated trunk finder, such, for example, as the first trunk finder 500. The tone current transmitted over the first trunk finder 500 is transmitted over the answering branch of the trunk seized thereby, the associated trunk circuit and the associated incoming branch of the trunk to the operator position to which the incoming branch of the trunk terminates, thereby to advise the operator at the operator position at the manual A switchboard in either the central office 30 or in the distant exchange 40 that the call on the associated trunk has been answered at the automatic B switchboard in the central office 30.

The calling operator at the operator position at the manual A switchboard in either the central office 30 or in the distant exchange 40 then passes the directory number of the called subscriber substation T in the distant exchange 50 to the operator at the answering operator position at the automatic B switchboard 800 in the central office 30, such, for example, as the operator at the first operator position 810.

The operator at the first operator position 810 at the automatic B switchboard 800 in the central office 30 then actuates the key set at her position, thereby to cause the appropriate digits corresponding to the directory number of the called subscriber substation T in the distant exchange 50 to be registered in the digit register apparatus individually associated with the feeder trunk circuit which is individually associated with the feeder trunk seized by the first feeder trunk finder 700. After the operator at the first operator position 810 has registered the digits in the associated digit register, she actuates the clear-out key of the key set, whereupon the first feeder trunk finder 700 is released and the position apparatus at the first operator position 810 is restored to its normal position; whereupon the first feeder trunk finder 700 is marked as idle to both the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350, for further use.

The digit sender apparatus individually associated with the digit register apparatus in use operates in order to transmit the digits registered over the individually associated feeder trunk circuit and the individually associated trunk finder, such, for example, as the first trunk finder 500. The digits transmitted over the first trunk

finder 500 are transmitted over the answering branch of the trunk seized thereby, by way of the trunk circuit associated with the trunk and the outgoing branch of the trunk, to the automatic switching apparatus 270 in the distant exchange 50, thereby to cause the automatic switching apparatus 270 to operate and seize the subscriber line 280 extending to the called subscriber substation T. When all of the digits have been transmitted from the digit sender apparatus in use, the digit sender apparatus, the associated digit register apparatus, the associated feeder trunk circuit and the associated trunk finder are released for further use. When the first trunk finder 500 is released, it is rendered again accessible to the first trunk finder distributor 1100.

After the subscriber at the calling subscriber substation T in the distant exchange 50 answers the call, an operative connection is completed to the operator position at the manual A switchboard in either the central office 30 or in the distant exchange 40. For example, such a connection from the operator position 251 at the manual A switchboard 250 in the distant exchange 40 may be completed to the subscriber substation T in the distant exchange 50 by way of the incoming branch 200X of the trunk 200, the trunk circuit 300, the outgoing branch 200Z of the trunk 200, the automatic switching apparatus 270 and the subscriber line 280; similarly, such a connection from the operator position 251 at the manual A switchboard 250 in the central office 30 may be completed to the subscriber substation T in the distant exchange 50 by way of the incoming branch 211X of the trunk 211, the trunk circuit 400, the outgoing branch 211Z of the trunk 211, the automatic switching apparatus 270 and the subscriber line 280.

The call waiting apparatus 900 is operative to indicate to the operators at the operator positions at the automatic B switchboard 800 in the central office 30 the number of trunk calls waiting to be answered; while the automatic night operator position 850 is adapted to be connected in multiple with the first operator position 810 at the automatic B switchboard 800, whereby, when all of the operator positions at the automatic B switchboard 800 are vacant, the traffic which is normally handled at the automatic B switchboard 800 is handled at the automatic night operator position 850.

Extension of a call from the distant exchange 40 to the distant exchange 50

When the operator at the operator position 251 at the manual A switchboard 250 in the distant exchange 40 answers a local call which is to be extended to the subscriber substation T in the distant exchange 50, she first selects an idle trunk in the group extending from the distant exchange 40 by way of the central office 30 to the distant exchange 50, such, for example, as the trunk 200. The operator at the operator position 251 then inserts the calling plug of the cord circuit in use into the jack terminating the incoming branch 200X of the trunk 200, whereupon a series circuit is completed for energizing the winding of the line relay R320 and the winding of the hold relay R340. This circuit extends from ground and battery in the cord circuit in use at the operator position 251 to the line conductors C332 and C331, respectively, of the incoming branch 200X of the trunk 200, and therefrom to the windings 311 and 313 of the repeater 310, the winding of the line relay R320 and the

winding of the hold relay R340 being connected in series bridge to the windings 311 and 313 of the repeater 310. When thus energized, the line relay R320 operates; however, the hold relay R340 does not operate due to the high series resistance of the winding of the line relay R320. Upon operating, the line relay R320 completes, at the contacts 322, a circuit for energizing the winding of the marking relay R330, this circuit extending from ground by way of the contacts 1232 of the lockout relay R1230 in the first trunk distributor 1200, the contacts 1203, the tenth group marking conductor C391, the contacts 334 and 322 and R330 to battery. When thus energized, the marking relay R330 operates to complete, at the contacts 333, an obvious holding circuit for energizing the winding thereof independently of the tenth group marking conductor C391, and prepares, at the contacts 331, a circuit traced hereinafter for energizing in series the upper winding of the cutoff relay R350 and the winding of the cut-in relay R370. Also, upon operating, the line relay R320 completes, at the contacts 321, an obvious path for applying resistance ground potential in the trunk circuit 300 to the call waiting conductor C974 extending to the call waiting apparatus 900, for a purpose more fully explained hereinafter.

At this point, it is noted that the trunk 200 comprises the tenth trunk in the tenth group in the first division. Accordingly, upon operating, the marking relay R330 completes, at the contacts 332, an obvious path for applying ground potential in the trunk circuit 300 to the tenth group marking conductor C392 extending to the first guard apparatus 1000, and completes, at the contacts 335, an obvious path for applying ground potential in the trunk circuit 300 to the tenth unit marking conductor C393 extending to the first guard apparatus 1000.

Neglecting for the present the detailed operation of the first guard apparatus 1000, it is pointed out that the first guard apparatus 1000 causes an idle one of the trunk finders in the first group to seize the answering branch 200Y of the trunk 200, in a manner more fully explained hereinafter. When the answering branch 200Y of the trunk 200 is seized by one of the trunk finders in the first group, the previously mentioned circuit for energizing in series the upper winding of the cutoff relay R350 and the winding of the cut-in relay R370 is completed, this circuit extending from resistance ground in the feeder trunk circuit in the first group individually associated with the seizing trunk finder in the first group by way of the control conductor C387 of the answering branch 200Y of the trunk 200, the winding of R370, the upper winding of R350 and the contacts 331 to battery. When thus energized, the cutoff relay R350 operates; however, the cut-in relay R370 does not operate due to the high series resistance of the circuit. Upon operating, the cut-off relay R350 completes, at the contacts 355, an obvious holding circuit for energizing the lower winding thereof, interrupts, at the contacts 351, the previously mentioned path for applying resistance ground potential to the call waiting conductor C974 extending to the call waiting apparatus 900, for a purpose more fully explained hereinafter, and completes, at the contacts 354, an obvious circuit for energizing the lower winding of the answer relay R345. However, the answer relay R345 does not operate at this time as it is of the polarized type. Also, the cutoff relay R350 interrupts, at the

contacts 356, the previously mentioned path for applying ground potential in the trunk circuit 300 to the tenth group marking conductor C392 extending to the first guard apparatus 1000, and interrupts, at the contacts 357, the previously mentioned path for applying ground potential in the trunk circuit 300 to the tenth unit marking conductor C393 extending to the first guard apparatus 1000. When ground potential in the trunk circuit 300 is removed from the tenth group marking conductor C392 and the tenth unit marking conductor C393 extending to the first guard apparatus 1000, the first guard apparatus 1000 is released for further use, in a manner more fully explained hereinafter.

Further, the cut-off relay R350 completes, at the contacts 352 and 353, an operative connection between the incoming branch 200X and the answering branch 200Y of the trunk 200. More particularly, the line conductors C385 and C386 of the answering branch 200Y of the trunk 200 are connected by way of the contacts 361, 364 and 352, 353, respectively, to the windings 312 and 314 of the repeater 310, the upper winding of the answer relay R345 and the resistor 316 being bridged in series across the windings 312 and 314 of the repeater 310. Accordingly, the windings 311, 313 and 312, 314 of the repeater 310 are respectively connected to the incoming branch 200X and the answering branch 200Y of the trunk 200; and the incoming branch 200X and the answering branch 200Y of the trunk 200 are respectively connected to the operator position 251 at the manual A switchboard 250 in the distant exchange 40, and to an answering operator position at the automatic B switchboard 800 in the central office 30, assuming that the feeder trunk finder individually associated with an idle operator position at the automatic B switchboard 800 has seized the feeder trunk individual to the feeder trunk circuit in the first group individual to the seizing trunk finder in the first group. Further, it is noted that a voice frequency current path, including the condenser 317, is completed between the windings 311 and 313 of the repeater 310; and a voice frequency current path, including the condenser 318, is completed between the windings 312 and 314 of the repeater 310. Hence, at this time, a communication connection is completed between the operator position 251 at the manual A switchboard 250 in the distant exchange 40 and the answering operator position at the automatic B switchboard 800 in the central office 30, whereupon a splash of tone current is transmitted over the seizing trunk finder in the first group to the answering branch 200Y of the trunk 200 and repeated by the repeater 310 over the incoming branch 200X of the trunk 200 to the operator position 251 at the manual A switchboard 250 in order to advise the operator thereat that she may pass the directory number of the desired subscriber substation.

The operator at the operator position 251 at the manual A switchboard 250 then passes the directory number of the subscriber substation T in the distant exchange 50 to the operator at the answering operator position at the automatic B switchboard 800. The operator at the answering operator position at the automatic B switchboard 800 then operates the key set at her position, thereby to cause a series of digits to be transmitted by way of the seizing trunk finder in the first group over the answering branch 200Y of the trunk 200, in a manner more fully explained hereinafter. When the operator at the answer-

ing operator position at the automatic B switchboard 800 operates the key set at her position, as noted, a path is completed for applying direct ground potential by way of the seizing trunk finder in the first group to the control conductor C387 of the answering branch 200Y of the trunk 200, thereby to complete a low resistance circuit identical to that previously traced for energizing in series the winding of the cut-in relay R370 and the upper winding of the cutoff relay R350. When thus energized, the cut-in relay R370 operates. Upon operating, the cut-in relay R370 completes, at the contacts 375, an obvious circuit for energizing the upper winding of the switch-through relay R360. When thus energized, the switch-through relay R360 operates to complete, at the contacts 366, an obvious holding circuit for energizing the lower winding thereof. Also, upon operating, the switch-through relay R360 interrupts, at the contacts 361 and 364, the previously traced connection between the answering branch 200Y and the incoming branch 200X of the trunk 200, thereby to prevent the digits transmitted over the answering branch 200Y of the trunk 200 from being transmitted over the incoming branch 200X of the trunk 200 to the operator position 251. Also, the cut-in relay R370 completes, at the contacts 371 and 373, obvious connections between the line conductors C385 and C386 of the answering branch 200Y of the trunk 200 and the respective line conductors C383 and C384 of the outgoing branch 200Z of the trunk 200, whereby the digits transmitted over the answering branch 200Y of the trunk 200 are also transmitted over the outgoing branch 200Z of the trunk 200 to the automatic switching apparatus 270 in the distant exchange 50.

The automatic switching apparatus 270 in the distant exchange 50 operates in response to the digits transmitted thereto over the outgoing branch 200Z of the trunk 200 in order to seize the subscriber line 280 extending to the called subscriber substation T, in accordance with conventional practice. After all of the digits have been transmitted by way of the seizing trunk finder in the first group over the answering branch 200Y and the outgoing branch 200Z of the trunk 200, the seizing trunk finder in the first group is automatically released in a manner more fully explained hereinafter, thereby to interrupt the previously traced series circuit for energizing the winding of the cut-in relay R370 and the upper winding of the cutoff relay R350, whereupon the cut-in relay R370 restores. Upon restoring, the cut-in relay R370 interrupts, at the contacts 371 and 373, the previously traced connection between the answering branch 200Y and the outgoing branch 200Z of the trunk 200, and completes, at the contacts 372 and 374, a connection between the outgoing branch 200Z of the trunk 200 and the repeater 310. More particularly, the line conductors C383 and C384 of the outgoing branch 200Z of the trunk 200 are connected by way of the contacts 372, 374, 362, 365, and 352, 353 to the windings 312 and 314, respectively, of the repeater 310. Accordingly, at this time, an operative connection is completed between the operator position 251 at the manual A switchboard 250 in the distant exchange 40 and the called subscriber substation T in the distant exchange 50 by way of the incoming branch 200X of the trunk 200, the repeater 310, the outgoing branch 200Z of the trunk 200, the automatic switching apparatus 370 and the subscriber line 280.

At this time, a circuit substantially identical to that previously traced is completed for energizing the upper winding of the answer relay R345, the upper winding of the answer relay R345 and the resistor 316 being bridged in series across the windings 312 and 314 of the repeater 310 which are connected in turn by way of the outgoing branch 200Z of the trunk 200 to the automatic switching apparatus 270. When thus energized the answer relay R345 does not operate as it is of the polarized type.

At this time, in the event the called subscriber substation T in the distant exchange 50 is busy, busy tone current is returned from the automatic switching apparatus 270 over the previously traced connection to the operator position 251 at the manual A switchboard 250 in the distant exchange 40; on the other hand, in the event the called subscriber substation T is idle, ring-back tone current is returned from the automatic switching apparatus 270 over the previously traced connection to the operator position 251, and ringing current is projected from the automatic switching apparatus 270 over the subscriber line 280 to the called subscriber substation T. In the event the called subscriber substation T in the distant exchange 50 is busy, the operator at the operator position 251 at the manual A switchboard 250 in the distant exchange 40 releases the connection, in a manner more fully described hereinafter, and advises the local calling subscriber that the connection cannot be had immediately due to the busy condition of the called subscriber substation T. On the other hand, in the event the called subscriber substation T in the distant exchange 50 is idle, when the subscriber thereat answers the call by removing the receiver of the telephone instrument at the subscriber substation T from its associated switchhook, the automatic switching apparatus 270 is operated to cause battery to be reversed over the outgoing branch 200Z of the trunk 200. When the answer relay R345 is thus energized it operates to complete, at the contacts 346, an obvious path for short-circuiting the winding of the line relay R320, whereupon the line relay R320 restores. Also, when the winding of the line relay R320 is thus short-circuited the winding of the hold relay R340 is adequately energized in order to cause this relay to operate. Upon operating, the hold relay R340 completes, at the contacts 341, an obvious alternative holding circuit for energizing the winding of the marking relay R330. Further, it is noted that when the winding of the line relay R320 is thus short-circuited the series resistance between the line conductors C381 and C382 of the incoming branch 200X of the trunk 200 is appreciably increased, thereby to cause the apparatus at the operator position 251 at the manual A switchboard 250 in the distant exchange 40 to operate and give the operator thereat answering supervision; whereupon the operator at the operator position 251 cuts the connection through between the local calling subscriber substation in the distant exchange 40 and the called subscriber substation T in the distant exchange 50. At this time, an operative two-way communication connection is completed between the local calling subscriber substation in the distant exchange 40 and the called subscriber substation T in the distant exchange 50 by way of the cord circuit at the operator position 251 at the manual A switchboard 250, the incoming branch 200X of the trunk 200,

the repeater 310, the outgoing branch 200Z of the trunk 200, the automatic switching apparatus 270 and the subscriber line 280.

The release of the established connection between the local calling subscriber substation in the distant exchange 40 and the called subscriber substation T in the distant exchange 50 is initiated by the subscriber at the called subscriber substation T; and when the subscriber at the called subscriber substation T initiates the release of the connection by replacing the receiver of the telephone instrument thereat upon its associated switchhook, the automatic switching apparatus 270 operates in order to reverse battery over the outgoing branch 200Z of the trunk 200, whereupon the answer relay R345 restores. Upon restoring, the answer relay R345 interrupts, at the contacts 346, the previously mentioned path for short-circuiting the winding of the line relay R320, thereby to cause the line relay R320 to reoperate and the hold relay R340 to restore. Upon reoperating, the line relay R320 re completes, at the contacts 322, the original holding circuit for energizing the winding of the marking relay R330. Also, when the previously mentioned path for short-circuiting the winding of the line relay R320 is interrupted, the series resistance between the line conductors C381 and C382 of the incoming branch 200X of the trunk 200 is appreciably increased, thereby to cause the apparatus at the operator position 251 at the manual A switchboard 250 in the distant exchange 40 to operate and give the operator thereat release supervision; whereupon the operator at the operator position 251 withdraws the plugs of the cord circuit in use in order to release both the connection between the operator position 251 and the local calling subscriber substation and the connection between the operator position 251 and the incoming branch 200X of the trunk 200. When the connection between the operator position 251 at the manual A switchboard 250 in the distant exchange 40 and the incoming branch 200X of the trunk 200 is thus released, the previously traced circuit for energizing the winding of the line relay R320 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the line relay R320 interrupts, at the contacts 322, the previously mentioned holding circuit for energizing the winding of the marking relay R330, thereby to cause the marking relay R330 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the marking relay R330 interrupts, at the contacts 332, the previously mentioned multiple holding circuits for energizing the lower winding of the cutoff relay R350 and the lower winding of the switch-through relay R360, thereby to cause the latter relays to restore. Upon restoring, the cutoff relay R350 interrupts, at the contacts 354, the previously mentioned circuit for energizing the lower winding of the answer relay R345, and interrupts, at the contacts 352 and 353, a further point in the previously traced circuit for energizing the upper winding of the answer relay R345. At this time, the trunk circuit 300 is completely released and the trunk 200 is available for further use. Also, incident to the release of the connection at the called subscriber substation T in the distant exchange 50, the automatic switching apparatus 270 is released and the subscriber line 280 extending to the subscriber substation T is marked as idle thereto.

Extension of a call from the central office 30 to the distant exchange 50

When the operator at the operator position 261 at the manual A switchboard 260 in the central office 30 answers a local call which is to be extended to the subscriber substation T in the distant exchange 50, she first selects an idle trunk in the group extending from the central office 30 to the distant exchange 50, such, for example, as the trunk 211. The operator at the operator position 261 then inserts the calling plug of the cord circuit in use into the jack terminating the incoming branch 211X of the trunk 211, whereupon a series circuit is completed for energizing the winding of the line relay R420 and the winding of the hold relay R440. This circuit extends from ground and battery in the cord circuit in use at the operator position 261 to the line conductors C492 and C491, respectively, of the incoming branch 211X of the trunk 211, the winding of the line relay R420 and the winding of the hold relay R440 being connected in series bridge across the line conductors C491 and C492. When thus energized, the line relay R420 operates; however, the hold relay R440 does not operate due to the high series resistance of the winding of the line relay R420. Upon operating, the line relay R420 completes, at the contacts 421, a circuit for energizing the winding of the marking relay R430, this circuit extending from ground by way of the contacts 1232 of the lockout relay R1230 in the first trunk distributor 1200, the contacts 1213, the first group marking conductor C442, the contacts 434 and 421 and the winding of R430 to battery. When thus energized, the marking relay R430 operates to complete, at the contacts 433, an obvious holding circuit for energizing the winding thereof independently of the first group marking conductor C442, and prepares, at the contacts 431, a circuit traced hereinafter for energizing in series the upper winding of the cutoff relay R460 and the winding of the cut-in relay R480. When the calling plug of the cord circuit in use at the operator position 261 is inserted into the jack terminating the incoming branch 211X of the trunk 211, a path is completed for applying battery potential in the cord circuit to the control conductor C493 of the incoming branch 211X of the trunk 211, thereby to complete an obvious circuit for energizing the winding of the sleeve relay R410. When thus energized, the sleeve relay R410 operates to complete, at the contacts 411, an obvious path for applying resistance ground potential in the trunk circuit 400 to the call waiting conductor C974 extending to the call waiting apparatus 900, for a purpose more fully explained hereinafter. Also, upon operating, the sleeve relay R410 prepares, at the contacts 412, a point in an obvious series chain circuit, including the tone conductor C415 and the condenser 413, for applying tone current to the control conductor C493 of the incoming branch 211X of the trunk 211; which series chain circuit is completed when all of the trunks in the group, including the trunk 211, are busy. This arrangement permits the operator at the operator position 261 at the manual A switchboard 260 in the central office 30 to test only the first trunk 211 in the group in order to determine whether there are idle trunks in the group extending from the central office 30 to the distant exchange 50, in an obvious manner.

At this point, it is noted that the trunk 211

comprises the first trunk in the first group in the first division. Accordingly, upon operating, the marking relay R430 completes, at the contacts 432, an obvious path for applying ground potential in the trunk circuit 400 to the first group marking conductor C444 extending to the first guard apparatus 1000, and completes, at the contacts 435, an obvious path for applying ground potential in the trunk circuit 400 to the first unit marking conductor C443 extending to the first guard apparatus 1000.

Neglecting for the present the detailed operation of the first guard apparatus 1000, it is pointed out that the first guard apparatus 1000 causes an idle one of the trunk finders in the first group to seize the answering branch 211Y of the trunk 211, in a manner more fully explained hereinafter. When the answering branch 211Y of the trunk 211 is seized by one of the trunk finders in the first group, the previously mentioned circuit for energizing in series the upper winding of the cutoff relay R460 and the winding of the cut-in relay R480 is completed, this circuit extending from resistance ground in the feeder trunk circuit in the first group individually associated with the seizing trunk finder in the first group by way of the control conductor C498 of the answering branch 211Y of the trunk 211, the winding of R480, the upper winding of R460 and the contacts 431 to battery. When thus energized, the cutoff relay R460 operates; however, the cut-in relay R480 does not operate due to the high series resistance of the circuit. Upon operating, the cutoff relay R460 completes, at the contacts 465, an obvious holding circuit for energizing the lower winding thereof, interrupts, at the contacts 461, the previously mentioned path for applying resistance ground potential to the call waiting conductor C974 extending to the call waiting apparatus 900, for a purpose more fully explained hereinafter, and completes, at the contacts 464, an obvious circuit for energizing the upper winding of the answer relay R450. However, the answer relay R450 does not operate at this time as it is of the polarized type. Also, the cutoff relay R460 interrupts, at the contacts 466, the previously mentioned path for applying ground potential in the trunk circuit 400 to the first group marking conductor C444 extending to the first guard apparatus 1000, and interrupts, at the contacts 467, the previously mentioned path for applying ground potential in the trunk circuit 400 to the first unit marking conductor C443 extending to the first guard apparatus 1000. When ground potential in the trunk circuit 400 is removed from the first group marking conductor C444 and the first unit marking conductor C443 extending to the first guard apparatus 1000, the first guard apparatus 1000 is released for further use, in a manner more fully explained hereinafter.

Further, the cutoff relay R460 completes, at the contacts 462 and 463, an operative connection between the incoming branch 211X and the answering branch 211Y of the trunk 211. More particularly, the line conductors C496 and C497 of the answering branch 211Y of the trunk 211 are connected by way of the contacts 471, 474 and 462, 463, respectively, to the condensers 418 and 419; which condensers 418 and 419 are respectively connected to the line conductors C491 and C492 of the incoming branch 211X of the trunk 211; and the incoming branch 211X and the answering branch 211Y of the trunk 211 are respectively connected to the operator position

261 at the manual A switchboard 260 in the central office 30 and to an answering operator position at the automatic B switchboard 800 in the central office 30, assuming that the feeder trunk finder individually associated with an idle operator position at the automatic B switchboard 800 has seized the feeder trunk individual to the feeder trunk circuit in the first group individual to the seizing trunk finder in the first group. Hence, at this time, a communication connection is completed between the operator position 261 at the manual A switchboard 260 in the central office 30 and the answering operator position at the automatic B switchboard 800 in the central office 30, whereupon a splash of tone current is transmitted over the seizing trunk finder in the first group to the answering branch 211Y of the trunk 211 and over the incoming branch 211X of the trunk 211 to the operator position 261 at the manual A switchboard 260 in order to advise the operator thereat that she may pass the directory number of the desired subscriber substation.

The operator at the operator position 261 at the manual A switchboard 260 then passes the directory number of the subscriber substation T in the distant exchange 50 to the operator at the answering operator position at the automatic B switchboard 800. The operator at the answering operator position at the automatic B switchboard 800 then operates the key set at her position, thereby to cause a series of digits to be transmitted by way of the seizing trunk finder in the first group over the answering branch 211Y of the trunk 211, in a manner more fully explained hereinafter. When the operator at the answering operator position at the automatic B switchboard 800 operates the key set at her position, as noted, a path is completed for applying direct ground potential by way of the seizing trunk finder in the first group to the control conductor C493 of the answering branch 211Y of the trunk 211, thereby to complete a low resistance circuit identical to that previously traced for energizing in series the winding of the cut-in relay R480 and the upper winding of the cutoff relay R460. When thus energized, the cut-in relay R480 operates.

Upon operating, the cut-in relay R480 completes, at the contacts 485, an obvious circuit for energizing the upper winding of the switch-through relay R470. When thus energized, the switch-through relay R470 operates to complete, at the contacts 476, an obvious holding circuit for energizing the lower winding thereof. Also, upon operating, the switch-through relay R470 interrupts, at the contacts 471 and 474, the previously traced connection between the answering branch 211Y and the incoming branch 211X of the trunk 211, thereby to prevent the digits transmitted over the answering branch 211Y of the trunk 211 from being transmitted over the incoming branch 211X of the trunk 211 to the operator position 261. Also, the cut-in relay R480 completes, at the contacts 481 and 483, obvious connections between the line conductors C496 and C497 of the answering branch 211Y of the trunk 211 and the respective line conductors C494 and C495 of the outgoing branch 211Z of the trunk 211, whereby the digits transmitted over the answering branch 211Y of the trunk 211 are also transmitted over the outgoing branch 211Z of the trunk 211 to the automatic switching apparatus 270 in the distant exchange 50.

The automatic switching apparatus 270 in the distant exchange 50 operates in response to the

digits transmitted thereto over the outgoing branch 211Z of the trunk 211 in order to seize the subscriber line 280 extending to the called subscriber substation T, in accordance with conventional practice. After all of the digits have been transmitted by way of the seizing trunk finder in the first group over the answering branch 211Y and the outgoing branch 211Z of the trunk 211, the seizing trunk finder in the first group is automatically released, in a manner more fully explained hereinafter, thereby to interrupt the previously traced series circuit for energizing the winding of the cut-in relay R480 and the upper winding of the cutoff relay R460, whereupon the cut-in relay R480 restores. Upon restoring, the cut-in relay R480 interrupts, at the contacts 481 and 483, the previously traced connection between the answering branch 211Y and the outgoing branch 211Z of the trunk 211, and completes, at the contacts 482 and 484, a connection between the outgoing branch 211Z of the trunk 211 and the condensers 418 and 419. More particularly, the line conductors C494 and C495 of the outgoing branch 211Z of the trunk 211 are connected by way of the contacts 482, 484, 472, 475 and 462, 463 to the condensers 418 and 419, respectively. Accordingly, at this time, an operative connection is completed between the operator position 261 at the manual A switchboard 260 in the central office 30 and the called subscriber substation T in the distant exchange 50 by way of the incoming branch 211X of the trunk 211, the condensers 418 and 419, the outgoing branch 211Z of the trunk 211, the automatic switching apparatus 270 and the subscriber line 280.

At this time, a circuit substantially identical to that previously traced is completed for energizing the lower winding of the answer relay R450, the lower winding of the answer relay R450 and the impedance element I445 being bridged in series to the condensers 418 and 419 which are connected in turn by way of the outgoing branch 211Z of the trunk 211 to the automatic switching apparatus 270. When thus energized, the answer relay R450 does not operate as it is of the polarized type.

At this time, in the event the called subscriber substation T in the distant exchange 50 is busy, busy tone current is returned from the automatic switching apparatus 270 over the previously traced connection to the operator position 261 at the manual A switchboard 260 in the central office 30; on the other hand, in the event the called subscriber substation T is idle, ring-back tone current is returned from the automatic switching apparatus 270 over the previously traced connection to the operator position 261, and ringing current is projected from the automatic switching apparatus 270 over the subscriber line 280 to the called subscriber substation T. In the event the called subscriber substation T in the distant exchange 50 is busy, the operator at the operator position 261 at the manual A switchboard 260 in the central office 30 releases the connection, in a manner more fully described hereinafter, and advises the local calling subscriber that the connection cannot be had immediately due to the busy condition of the called subscriber substation T. On the other hand, in the event the called subscriber substation T in the distant exchange 50 is idle, when the subscriber thereat answers the call by removing the receiver of the telephone instrument at the subscriber substation T from its associated switch-

hook, the automatic switching apparatus 270 is operated to cause battery to be reversed over the outgoing branch 211Z of the trunk 211. When the answer relay R450 is thus energized it operates to complete, at the contacts 451, an obvious path for short-circuiting the winding of the line relay R420, whereupon the line relay R420 restores. Also when the winding of the line relay R420 is thus short-circuited the winding of the hold relay R440 is adequately energized in order to cause this relay to operate. Upon operating, the hold relay R440 completes, at the contacts 441, an obvious alternative holding circuit for energizing the winding of the marking relay R430. Further, it is noted that, when the winding of the line relay R420 is thus short-circuited, the series resistance between the line conductors C491 and C492 of the incoming branch 211X of the trunk 211 is appreciably decreased, thereby to cause the apparatus at the operator position 261 at the manual A switchboard 260 in the central office 30 to operate and give the operator thereat answering supervision; whereupon the operator at the operator position 261 cuts the connection through between the local calling subscriber substation in the central office 30 and the called subscriber substation T in the distant exchange 50. At this time, an operative two-way communication connection is completed between the local calling subscriber substation in the central office 30 and the called subscriber substation T in the distant exchange 50 by way of the cord circuit at the operator position 261 at the manual A switchboard 260, the incoming branch 211X of the trunk 211, the condensers 418 and 419, the outgoing branch 211Z of the trunk 211, the automatic switching apparatus 270 and the subscriber line 280.

The release of the established connection between the local calling subscriber substation in the central office 30 and the called subscriber substation T in the distant exchange 50 is initiated by the subscriber at the called subscriber substation T; and when the subscriber at the called subscriber substation T initiates the release of the connection by replacing the receiver of the telephone instrument thereat upon its associated switchhook, the automatic switching apparatus 270 operates in order to reverse battery over the outgoing branch 211Z of the trunk 211, whereupon the answer relay R450 restores. Upon restoring, the answer relay R450 interrupts, at the contacts 451, the previously mentioned path for short-circuiting the winding of the line relay R420, thereby to cause the line relay R420 to reoperate and the hold relay R440 to restore. Upon reoperating, the line relay R420 reoperates, at the contacts 421, the original holding circuit for energizing the winding of the marking relay R430. Also, when the previously mentioned path for short-circuiting the winding of the line relay R420 is interrupted the series resistance between the line conductors C491 and C492 of the incoming branch 211X of the trunk 211 is appreciably increased, thereby to cause the apparatus at the operator position 261 at the manual A switchboard 260 in the central office 30 to operate and give the operator thereat release supervision; whereupon the operator at the operator position 261 withdraws the plugs of the cord circuit in use in order to release both the connection between the operator position 261 and the local calling subscriber substation and the connection between the operator position 261 and the incoming branch 211X of the trunk 211. When the connection be-

tween the operator position 261 at the manual A switchboard 260 in the central office 30 and the incoming branch 211X of the trunk 211 is thus released, the previously traced circuits for energizing the winding of the line relay R420 and the winding of the sleeve relay R410 are interrupted, thereby to cause the latter relays to restore. Upon restoring, the line relay R420 interrupts, at the contacts 421, the previously mentioned holding circuit for energizing the winding of the marking relay R430, thereby to cause the marking relay R430 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the marking relay R430 interrupts, at the contacts 432, the previously mentioned multiple holding circuits for energizing the lower winding of the cutoff relay R460 and the lower winding of the switch-through relay R470, thereby to cause the latter relays to restore. Upon restoring, the cutoff relay R460 interrupts, at the contacts 464, the previously mentioned circuit for energizing the upper winding of the answer relay R450, and interrupts, at the contacts 462 and 463, a further point in the previously traced circuit for energizing the lower winding of the answer relay R450. At this time, the trunk circuit 400 is completely released and the trunk 211 is available for further use. Also, incident to the release of the connection at the called subscriber substation T in the distant exchange 50, the automatic switching apparatus 270 is released and the subscriber line 280 extending to the subscriber substation T is marked as idle thereto.

Also, an arrangement is provided in connection with the trunk 211, whereby this trunk may be rendered busy from the distant exchange 50. In order to accomplish this end, the exchange attendant at the distant exchange 50 operates a busy key in the automatic switching apparatus 270, thereby to cause ground potential to be applied to the line conductor C494 of the outgoing branch 211Z of the trunk 211 when the trunk 211 is idle. This application of ground potential to the line conductor C494 of the outgoing branch 211Z of the trunk 211 completes an obvious circuit, including the contacts 482 and 473, for energizing the winding of the busy relay R425. When thus energized the busy relay R425 operates to interrupt, at the contacts 425, a point in the previously mentioned path for applying resistance ground potential in the trunk circuit 400 to the call waiting conductor C974 extending to the call waiting apparatus 900, thereby to prevent the call waiting apparatus 900 from indicating a false call on the busy trunk 211. Also, the busy relay R425 completes, at the contacts 426, an obvious circuit, including the resistor 416, for energizing the winding of the sleeve relay R410 and for applying battery potential to the control conductor C493 of the incoming branch 211X of the trunk 211, whereupon the sleeve relay R410 operates, as previously explained. The application of battery potential to the control conductor C493 of the incoming branch 211X of the trunk 211 marks the trunk 211 as busy at the operator position 261 at the manual A switchboard 260 in the central office 30, thereby to prevent the operator at the operator position 261 from seizing the busy trunk 211 in order to initiate the extension of the call to the distant exchange 50.

In order again to place the trunk 211 in service, the exchange attendant at the distant exchange 50 restores the busy key in the automatic switching apparatus 270, thereby to remove the application of ground potential to the line conductor

C494 of the outgoing branch 211Z of the trunk 211, whereupon the previously mentioned circuit for energizing the winding of the busy relay R425 is interrupted. The busy relay R425 then re-stores, whereupon the trunk 211 is again marked as idle at the operator position 261 at the manual A switchboard 260 in the central office 30.

Operation of the first guard apparatus 1000 and the first trunk finder distributor 1100 and the preselected first trunk finder 500

Assuming that the first trunk finder 500 in the first group is idle and has been preselected by the first trunk finder distributor 1100 at this time, the first select relay R1170 in the first trunk finder distributor 1100 occupies its operated position, the first select relay R1170 being held in its operated position by a completed holding circuit extending from ground by way of the resistor 1178, the contacts 1175, R1170, the guard conductor C1195, the contacts 638, 661' and 675 and the resistor 627 to battery in the first feeder trunk circuit 600 individually associated with the first trunk finder 500. Also, at this time, other of the select relays, including the eighth select relay R1180, in the first trunk finder distributor 1100, corresponding to the idle trunk finders in the first group, occupy their operated positions. The first trunk finder distributor 1100 operates to preselect idle ones of the trunk finders in the first group in a predetermined order, the first trunk finder 500 in the first group being preselected for use at this time due to the operated position of the first select relay R1170.

When a call is initiated on the trunk 200 the trunk circuit 300 individually associated therewith operates in order to cause ground potential to be applied to both the tenth group marking conductor C392 and the tenth unit marking conductor C393, in the manner previously explained, the trunk 200 being the tenth trunk in the tenth group in the first division, as previously noted. The application of ground potential to the tenth group marking conductor C392 completes a circuit for energizing the winding of the tenth group relay R1000 in the first guard apparatus 1000; and the application of ground potential to the tenth unit marking conductor C393 prepares a circuit traced hereinafter for energizing the winding of the tenth unit relay R1040 in the first guard apparatus 1000. The circuit for energizing the winding of the tenth group relay R1000 extends from the grounded tenth group marking conductor C392 by way of R1000, the contacts 1002, 1102, 1014, etc., and the contacts 1004, C1065 and the resistor 1066 to battery. When thus energized the tenth group relay R1000 operates to complete, at the contacts 1003, an obvious holding circuit for energizing the winding thereof, including the resistor 1066 and the grounded tenth group marking conductor C392. Also, the tenth group relay R1000 interrupts, at the contacts 1002, a point in the previously traced original circuit for energizing the winding thereof, and interrupts, at the contacts 1004, a point in the multiple circuits for energizing the windings of the other nine group relays R1010, etc. Further, the tenth group relay R1000 completes, at the contacts 1005, a circuit for energizing the winding of the tenth unit relay R1040, this circuit extending from the grounded tenth unit marking conductor C393 by way of the contacts 1005, R1040, the contacts 1042 and 1101, C1064, the contacts 1044, etc., 1034, etc., and 1024, and the resistor 1017 to battery. When thus ener-

gized the tenth unit relay R1040 operates to complete, at the contacts 1043, a holding circuit for energizing the winding thereof, this circuit extending from the grounded tenth unit marking conductor C393 by way of the contacts 1005, R1040, the contacts 1043, etc., 1034, etc., and 1024, and the resistor 1017 to battery. Also, the tenth unit relay R1040 interrupts, at the contacts 1042, a point in the previously traced original circuit for energizing the winding thereof, and interrupts, at the contacts 1044, a point in the multiple circuits for energizing the windings of the other nine unit relays, including the first unit relay R1020 and the sixth unit relay R1030.

The tenth group relay R1000 also completes, at the contacts 1001, an obvious path for applying ground potential to the tenth group marking conductor C1060; and the tenth unit relay R1040 completes, at the contacts 1045, an obvious connection between the subgroup conductor C1068 and the fifth and tenth unit marking conductor C1067, and completes, at the contacts 1046, an obvious path for applying ground potential to the subgroup conductor C1070. Finally, the tenth unit relay R1040 completes, at the contacts 1041, an obvious path for applying ground potential to the common start conductor C1063, thereby to complete an obvious circuit, including the contacts 1172 of the operated first select relay R1170 and the start conductor C1191, for energizing in multiple the windings of the start relays R550 and R560 in the first trunk finder 500, thereby to cause operation of the relays mentioned.

Upon operating, the start relay R550 completes, at the contacts 556, an obvious circuit, including the grounded tenth marking conductor C1060, for energizing the winding of the tenth group relay R500. When thus energized the tenth group relay R500 prepares, at the contacts 501, 502, 503; 504, 505, 506; etc.; connections between the first trunk finder 500 and the answering branch of each of the trunks in the tenth group, including the trunks 201 to 200, inclusive, in the first division. For example, the tenth group relay R500 prepares, at the contacts 501, 502 and 503, a connection between the first trunk finder 500 and the answering branch 200Y of the trunk 200, the trunk 200 being the tenth trunk in the tenth group in the first division.

Upon operating, the start relay R560 completes, at the contacts 563, an obvious circuit, including the grounded subgroup conductor C1070, for energizing the winding of the subgroup relay R540, thereby to cause the latter relay to operate. Upon operating, the subgroup relay R540 completes, at the contacts 548, a circuit for energizing the winding of the fifth and tenth unit relay R520, this circuit extending from ground by way of the contacts 542 and 564, the subgroup conductor C1068, the contacts 1045, the fifth and tenth unit marking conductor C1067, the contacts 565 and R520 to battery. When thus energized the fifth and tenth unit relay R520 operates to prepare, at the contacts 521, 522, 523 and 524, 525 and 526, respectively, connections between the first trunk finder 500 and the answering branches of the fifth and tenth trunks in the tenth group in the first division.

Accordingly, at this time, the tenth group relay R500, the fifth and tenth unit relay R520 and the subgroup relay R540 occupy their operated positions, thereby to complete a connection be-

tween the answering branch 200Y of the trunk 200 and the first feeder trunk circuit 600 individually associated with the first trunk finder 500. More particularly, at this time, the line conductors C385 and C386 of the answering branch 200Y of the trunk 200 are respectively connected by way of the contacts 501, 502, 524, 525 and 542, 544 to the line conductors C581 and C582 of the trunk extending into the first feeder trunk circuit 600; while the control conductor C387 of the answering branch 200Y of the trunk 200 is connected by way of the contacts 503, 526 and 546 to the control conductor C583 of the trunk extending into the first feeder trunk circuit 600. At this time, battery potential in the trunk circuit 300 is fed by way of the upper winding of the cutoff relay R350 and the winding of the cut-in relay R370 to the control conductor C387 of the answering branch 200Y of the trunk 200; while ground potential in the first feeder trunk circuit 600 is fed by way of the winding of the start relay R670 and the contacts 662 and 646 to the control conductor C583 of the trunk extending between the first trunk finder 500 and the first feeder trunk circuit 600. Accordingly, at this time, the previously mentioned path for applying resistance ground potential to the control conductor C387 of the answering branch 200Y of the trunk 200 is completed, this path including the high resistance winding of the start relay R670. When thus energized, the start relay R670 operates to complete, at the contacts 671, an obvious path for applying ground potential to the hold conductor C584, thereby to complete an obvious circuit for illuminating the supervisory lamp L576. The illumination of the supervisory lamp L576 indicates to the exchange attendant in the central office 30 that the first trunk finder 500 is busy at this time. Also, the application of ground potential to the hold conductor C584 completes an obvious holding circuit, including the contacts 509, for energizing the winding of the tenth group relay R500, an obvious multiple holding circuit, including the resistor 575 and the contacts 529, for energizing the winding of the fifth and tenth unit relay R520, and an obvious multiple holding circuit, including the resistor 575 and the contacts 547, for energizing the winding of the subgroup relay R540. Accordingly, at this time, the tenth group relay R500, the fifth and tenth unit relay R520 and the subgroup relay R540 are retained in their operated positions.

Also, the start relay R550 completes, at the contacts 551, an obvious multiple path, including the resistor 574, for applying battery potential to the guard conductor C1195, thereby to retain the first select relay R1170 in the first trunk finder distributor 1100 in its operated position; while the start relay R670, upon operating, interrupts, at the contacts 675, the previously traced original path for applying battery potential by way of the resistor 627 to the guard conductor C1195. Further, the start relay R550 completes, at the contacts 552, an obvious circuit, including the conductor C1071, for energizing the winding of the lockout relay R1100 in the first trunk finder distributor 1100; while the start relay R670 completes, at the contacts 672, an obvious multiple circuit, including the contacts 635, for energizing the winding of the lockout relay R1100. When thus energized the lockout relay R1100 operates to interrupt, at the contacts 1102, a further point in the previously mentioned multiple original circuits for energizing the wind-

ings of the ten group relays R1010, etc., in the first guard apparatus 1000, and to interrupt, at the contacts 1101, a further point in the previously mentioned multiple original circuits for energizing the windings of the ten unit relays R1020, etc., in the first guard apparatus 1000; thereby positively to prevent further operation of the first guard apparatus 1000 at this time. Also, the lockout relay R1100 completes, at the contacts 1103, an obvious circuit, including the contacts 1162, for energizing the winding of the peg count meter M1104, thereby to cause the peg count meter M1104 to operate and register the extension of a call by way of one of the trunk finders in the first group.

When any one of the unit relays in the first guard apparatus 1000 operates it interrupts a normally completed circuit for energizing the winding of the hold relay R1120 in the first trunk finder distributor 1100. For example, upon operating, the tenth unit relay R1040 interrupts, at the contacts 1044, the previously mentioned normally completed circuit for energizing the winding of the hold relay R1120; this circuit extends, when completed, from ground by way of the contacts 1131, R1120, the contacts 1112, C1064, the contacts 1044, etc., 1034, etc., and 1024 and the resistor 1017 to battery. When this circuit is interrupted the hold relay R1120 restores shortly thereafter, the latter relay being of the slow-to-release type, in order to initiate a timing operation of the first trunk finder distributor 1100, in a manner more fully explained hereinafter.

As previously explained, when the first trunk finder 500 seizes the answering branch 200Y of the trunk 200, the cutoff relay R350 in the trunk circuit 300 individual thereto operates in order to remove the application of ground potential to both the tenth group marking conductor C392 and the tenth unit marking conductor C393, thereby to interrupt the previously traced holding circuits for energizing the windings of both the tenth group relay R1000 and the tenth unit relay R1040 in the first guard apparatus 1000, whereupon the latter relays restore. Upon restoring, the tenth unit relay R1040 interrupts, at the contacts 1041, the previously mentioned path for applying ground potential to the common start conductor C1063, thereby to interrupt the previously traced multiple circuit for energizing the windings of the start relays R550 and R560, whereupon the latter relays restore. Upon restoring, the start relay R550 interrupts, at the contacts 551, the previously mentioned path for applying battery potential to the guard conductor C1195, thereby to interrupt the previously traced holding circuit for energizing the winding of the first select relay R1170 in the first trunk finder distributor 1100, whereupon the latter relay restores. Upon restoring, the first select relay R1170 transfers the common start conductor C1063 to the next idle trunk finder in the first group, the last-mentioned trunk finder being preselected at this time due to the operated position of the corresponding select relay in the first trunk finder distributor 1100.

Neglecting for the present the detailed operation of the first feeder trunk finder distributor 1300 in response to the initial operation of the first feeder trunk circuit 600 in the first group, it is pointed out that the first feeder trunk finder distributor 1300 operates at this time in order to cause a preselected one of the feeder trunk

finders to seize the first feeder trunk 610 extending to the first feeder trunk circuit 600, whereupon a circuit traced hereinafter is completed for energizing the winding of the switch-through relay R530 in the first feeder trunk circuit 600, whereupon the latter relay operates. Upon operating, the switch-through relay R530 interrupts, at the contacts 535, the previously traced circuit for energizing the winding of the lockout relay R1100, thereby to cause the lockout relay R1100 in the first trunk finder distributor 1100 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the lockout relay R1100 reprepares, at the contacts 1102, a point in the multiple original circuits for energizing the windings of the ten group relays R1010, etc., in the first guard apparatus 1000, and reprepares, at the contacts 1101, a point in the multiple original circuits for energizing the windings of the ten unit relays R1020, etc., in the first guard apparatus 1000. Also, the tenth unit relay R1040 completes, at the contacts 1044, the previously traced circuit for energizing the winding of the hold relay R1120, thereby to cause the latter relay to operate and arrest the cycle of operation of the timing relays R1110, R1130 and R1140, in a manner more fully explained hereinafter. Finally, the lockout relay R1100 interrupts, at the contacts 1103, the previously traced circuit for energizing the winding of the peg count meter M1104, thereby to cause the peg count meter M1104 to be released. At this time, the first guard apparatus 1000 and the first trunk finder distributor 1100 are completely released and available for further use.

In view of the above explanation of the mode of operation of the first guard apparatus 1000 and the first trunk finder distributor 1100 to cause the first trunk finder 500 to seize the answering branch 200Y of the trunk 200, the tenth trunk in the tenth group in the first division, it will be understood that the first guard apparatus 1000 and the first trunk finder distributor 1100 are operative, in a substantially identical manner, to cause the first trunk finder 500 to seize the sixth, seventh, eighth and ninth trunks in any group in the first division; however, the first guard apparatus 1000 and the first trunk finder distributor 1100 are operative, in a slightly different manner, to cause the first trunk finder 500 to seize the first, second, third, fourth and fifth trunks in any group in the first division. For example, when a call is initiated on the trunk 211, the first trunk in the first group in the first division, the trunk circuit 400 individually associated therewith is operative to cause ground potential to be applied both to the first group marking conductor C444 and to the first unit marking conductor C443, whereby operating circuits substantially identical to those previously traced are completed for energizing the windings of the first group relay R1010 and the first unit relay R1020 in the first guard apparatus 1000, whereupon the relays mentioned operate. Upon operating, the first group relay R1010 completes, at the contacts 1011, an obvious path for applying ground potential to the first group marking conductor C1061; and, upon operating, the first unit relay R1020 completes, at the contacts 1025, an obvious path for applying ground potential to the first and sixth marking conductor C1069. Also, the first guard apparatus 1000 causes operation of the first trunk finder distributor 1100 and the start relays R550 and R560 in the first trunk finder 500, in the

manner previously explained. At this time, upon operating, the start relay R550 completes, at the contacts 553, an obvious circuit, including the first group marking conductor C1061, for energizing the winding of the first group relay R510; and, upon operating, the start relay R560 completes, at the contacts 562, an obvious circuit, including the first and sixth unit marking conductor C1069, for energizing the winding of the first and sixth unit relay R530, whereupon both the first group relay R510 and the first and sixth unit relay R530 operate. It is noted that the first guard apparatus 1000 is not operative at this time to cause ground potential to be applied to the subgroup conductor C1070; hence, the subgroup relay R540 is not operated at this time. Thus, in the first trunk finder 500, only the first group relay R510 and the first and sixth unit relay R530, in addition to the start relays R550 and R560, occupy their operated positions, whereby the answering branch 211Y of the trunk 211 is connected to the first feeder trunk circuit 600. More particularly, at this time, the line conductors C496 and C497 of the answering branch 211Y of the trunk 211 are respectively connected by way of the contacts 511, 512, 531, 532 and 541, 543 to the line conductors C581 and C582 of the trunk extending into the first feeder trunk circuit 600; while the control conductor C498 of the answering branch 211Y of the trunk 211 is connected by way of the contacts 513, 533 and 545 to the control conductor C583 of the trunk extending into the first feeder trunk circuit 600.

The further operations of the first feeder trunk circuit 600 and the trunk circuit 400 incident to the seizure of the answering branch 211Y of the trunk 211 by the first trunk finder 500 are the same as previously described; furthermore, the subsequent release of the first guard apparatus 1000 and the first trunk finder distributor 1100, after one of the feeder trunk finders has seized the first feeder trunk 610 extending to the first feeder trunk circuit 600, is the same as previously explained.

In view of the foregoing explanation of the mode of operation of the first guard apparatus 1000 and the first trunk finder distributor 1100 in order to control the first trunk finder 500, it will be understood that this apparatus is operative, in a similar manner, to control any trunk finder in the first group, which has been pre-selected by the first trunk finder distributor 1100, to seize any calling trunk in the first division.

In the foregoing explanation of the mode of operation of the first trunk finder distributor 1100 in order to cause the first trunk finder 500 to seize the answering branch of a calling trunk in the first division, it was assumed that the first trunk finder 500 operated promptly to seize the answering branch of the calling trunk and that shortly thereafter the first feeder trunk 610 extending to the first feeder trunk circuit 600 was seized by an idle first feeder trunk finder; however, it may occur that the first trunk finder 500 does not operate properly and promptly to seize the answering branch. In this event, the hold relay R1120 in the first trunk finder distributor 1100 remains in its restored position throughout a considerable time interval, as the tenth unit relay R1040 in the first guard apparatus 1000 is not promptly restored. Accordingly, in this event, the previously mentioned

timing operation of the apparatus in the first trunk finder distributor 1100 is completed.

More particularly, when the tenth unit relay R1040 operates it interrupts, at the contacts 1044, the previously traced normally completed circuit for energizing the winding of the hold relay R1120, thereby to cause the hold relay R1120 to restore shortly thereafter, the latter relay being of the slow-to-release type, as previously noted. Upon restoring, the hold relay R1120 interrupts, at the contacts 1121, an obvious normally completed circuit for energizing the winding of the timing relay R1130, thereby to cause the timing relay R1130 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the timing relay R1130 completes, at the contacts 1132, an obvious circuit, including the contacts 1162 and 1114, for energizing the winding of the timing relay R1140, thereby to cause the latter relay to operate. Upon operating, the timing relay R1140 completes, at the contacts 1142, an obvious circuit for energizing the winding of the timing relay R1110, thereby to cause the latter relay to operate. Upon operating, the timing relay R1110 completes, at the contacts 1113, an alternative circuit for energizing the winding of the hold relay R1120, this circuit extending from ground by way of the contacts 1161, R1120, the contacts 1113, C1065 and the resistor 1066 to battery. When thus energized, the hold relay R1120 operates to complete, at the contacts 1121, the previously mentioned circuit for energizing the winding of the timing relay R1130, thereby to cause the latter relay to operate. Upon operating, the timing relay R1130 interrupts, at the contacts 1132, the previously mentioned circuit for energizing the winding of the timing relay R1140, thereby to cause the timing relay R1140 to restore shortly thereafter, the latter relay being of the slow-to-release type.

Upon restoring, the timing relay R1140 completes, at the contacts 1141, a path for short-circuiting the winding of the first select relay R1170, this circuit extending from battery by way of the resistor 1193, the contacts 1111, 1141 and 1174, R1170, the guard conductor C1195, the contacts 551 and the resistor 574 to battery. When the winding of the first select relay R1170 is thus short-circuited the latter relay restores, thereby to interrupt, at the contacts 1172, the previously traced path for applying ground potential to the start conductor C1191 and, consequently, the previously traced circuit for energizing in multiple the windings of the start relays R550 and R560, whereupon the latter relays restore in order to effect the release of the partially operated first trunk finder 500. Also, the first select relay R1170 transfers, at the contacts 1171, the grounded common start conductor C1063 to the start conductor extending to the next preselected idle trunk finder in the first group corresponding to the next operated select relay, whereupon operation of the preselected trunk finder is initiated in the manner previously explained.

Also, upon restoring, the timing relay R1140 interrupts, at the contacts 1142, the previously mentioned circuit for energizing the winding of the timing relay R1110, thereby to cause the timing relay R1110 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the timing relay R1110 interrupts, at the contacts 1111, the previously traced path for short-circuiting the winding of the first select relay R1170, and interrupts, at the contacts 1113, the previously traced alternative cir-

cuit for energizing the winding of the hold relay R1120, whereupon the hold relay R1120 begins to restore in order to initiate a new timing cycle, in the manner described above. The lockout relay R1100, being of the slow-to-release type, does not restore incident to the release of the first trunk finder 500 and the selection of the next trunk finder, as explained above.

In view of the above explanation of the mode of operation of the first trunk finder distributor 1100, it will be understood that idle ones of the trunk finders in the first group are first selected and then preselected for use in rotation, incident to the operation of the various select relays R1170, etc., and the subsequent restoration of the various select relays R1170, etc., in rotation. When the eighth trunk finder, having been preselected, is rendered busy, the eighth select relay R1180 restores, thereby to complete, at the contacts 1187, a circuit for energizing the winding of the reset relay R1150, this circuit extending from ground by way of the contacts 1187, etc., and 1177 and R1150 to battery. When thus energized, the reset relay R1150 operates to complete, at the contacts 1151, an obvious path for applying ground potential to the reset conductor C1192, whereupon multiple circuits for energizing the winding of each select relay R1170, etc., corresponding to an idle trunk finder in the first group is recompleted. For example, at this time, in the event the first trunk finder 500 in the first group is idle when ground potential is applied to the reset conductor C1192, a circuit is completed for energizing the winding of the first select relay R1170, this circuit extending from the grounded reset conductor C1192 by way of the contacts 1176, R1170, the guard conductor C1195, the contacts 638, 661', 675 and the resistor 627 to battery. When thus energized the select relay R1170 operates to complete, at the contacts 1175, the previously traced holding circuit for energizing the winding thereof. However, in the event the first trunk finder 500 is busy at this time, the above-traced circuit for energizing the winding of the first select relay R1170 is not completed due to the absence of battery potential upon the guard conductor C1195, at least one of the relays R530, R560 or R670 in the first feeder trunk circuit 600 individually associated with the first trunk finder 500 being operated at this time in order to interrupt the previously traced path for applying battery potential to the guard conductor C1195.

In the event one of the select relays R1170, etc., operates, the previously traced circuit for energizing the winding of the reset relay R1150 is interrupted at the contacts 1177, etc., thereby to cause the reset relay R1150 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the reset relay R1150 interrupts, at the contacts 1151, the previously mentioned path for applying ground potential to the reset conductor C1192, whereby the first trunk finder distributor 1100 is rendered operative to assign in rotation the selected idle trunk finders in the first group.

As previously noted, in the event all of the trunk finders in the first group are busy when the reset relay R1150 operates, none of the select relays R1170, etc., is operated. At this time, a circuit is prepared for energizing the winding of the busy relay R1160, which circuit is completed in the event a call arrives on one of the trunks in the first division and initiates opera-

tion of the first guard apparatus 1000. For example, should a call arrive at this time, one of the unit relays R1020, etc., and the first guard apparatus 1000 operates in order to complete, at the contacts 1021, etc., the previously traced path for applying ground potential to the common start conductor C1063. This application of ground potential to the common start conductor C1063 completes the previously mentioned circuit for energizing the winding of the busy relay R1160, this circuit extending from the grounded common start conductor C1063 by way of the contacts 1171, etc., and 1181, C1194 and R1160 to battery. When thus energized, the busy relay R1160 operates to complete, at the contacts 1163, an obvious holding circuit for energizing the winding thereof. Also, the busy relay R1160 completes, at the contacts 1164, a circuit for energizing the winding of the overflow meter M1105, this circuit extending from the grounded conductor C1194, the contacts 1164 and 1133 and M1105 to battery. When thus energized, the overflow meter M1105 operates, thereby to register the overflow condition of the first trunk finder distributor 1100. Further, the busy relay R1160 interrupts, at the contacts 1162, the previously mentioned circuit for energizing the winding of the peg count meter M1104. Also, the busy relay R1160 interrupts, at the contacts 1162, the previously mentioned circuit for energizing the winding of the timing relay R1140, and interrupts, at the contacts 1161, a further point in the previously mentioned alternative circuit for energizing the winding of the hold relay R1120, thereby to prevent the timing cycle of the hold relay R1120 and the timing relays R1110, R1130 and R1140, while the overflow condition persists.

Subsequently, when one of the trunk finders in the first group is rendered idle, the corresponding select relay R1170, etc., in the first trunk finder distributor 1100 operates, thereby to interrupt the previously traced circuit for energizing the winding of the reset relay R1150 and the previously traced original circuit for energizing the winding of the busy relay R1160, whereupon the reset relay R1150 restores shortly thereafter. Upon restoring, the reset relay R1150 interrupts, at the contacts 1152, the previously mentioned holding circuit for energizing the winding of the busy relay R1160, thereby to cause the latter relay to restore. At this time, the first trunk finder distributor 1100 is in readiness to initiate operation of the preselected trunk finder in the first group, in the manner previously explained.

In view of the foregoing explanation of the mode of operation of the first guard apparatus 1000 in response to calls on the trunks in the first division and the mode of operation of the first trunk finder distributor 1100 to assign idle ones of the trunk finders in the first group, it will be understood that the second guard apparatus, not shown, is operative in a substantially identical manner in response to calls on the trunks in the second division and the second trunk finder distributor, not shown, is operative in a substantially identical manner to assign idle ones of the trunk finders in the second group.

Operation of the first trunk distributor 1200

When a call is initiated on the trunk 200 the trunk circuit 300 individually associated therewith operates in order to cause ground potential to be applied to the tenth group marking con-

ductor C392, as previously explained, the trunk 200 being in the tenth group in the first division, as previously noted. This application of ground potential to the tenth marking conductor C392 completes an obvious circuit, including the contacts 1201 and the resistor 1250, for energizing the winding of the start relay R1220 in the first trunk distributor 1200, thereby to cause the latter relay to operate. Upon operating, the start relay R1220 completes, at the contacts 1221, an obvious circuit, including the contacts 1241, for energizing the winding of the lockout relay R1230, thereby to cause the latter relay to operate. Upon operating, the lockout relay R1230 completes, at the contacts 1231, an obvious holding circuit for energizing the winding thereof, and completes, at the contacts 1233, an obvious circuit for energizing the winding of the timing relay R1240. When thus energized, the timing relay R1240 operates to interrupt, at the contacts 1241, the previously mentioned original operating circuit for energizing the winding of the lockout relay R1230. Finally, the lockout relay R1230 interrupts, at the contacts 1232, the previously traced paths for applying ground potential to the ten group marking conductors, including the first group marking conductor C391 and the tenth group marking conductor C442, thereby to prevent operation of the marking relays in the trunk circuits individually associated with the other ninety-nine trunks in the first division.

Subsequently, the tenth guard relay R1000 in the first guard apparatus 1000 operates to complete, at the contacts 1001, the previously mentioned path for applying ground potential to the tenth group marking conductor C1060, thereby to complete an obvious circuit for energizing the upper winding of the tenth group relay R1200 in the first trunk distributor 1200. When thus energized, the tenth group relay R1200 operates to complete, at the contacts 1202, an obvious holding circuit for energizing the winding thereof; to interrupt, at the contacts 1203, a further point in the previously mentioned path for applying ground potential at the contacts 1232 of the lockout relay R1230 to the tenth group marking conductor C391; and to interrupt, at the contacts 1201, the previously mentioned circuit for energizing the winding of the start relay R1220, thereby to cause the latter relay to restore. Upon restoring, the start relay R1220 interrupts, at the contacts 1221, the previously mentioned holding circuit for energizing the lower winding of the tenth group relay R1200; however, the tenth group relay R1200 remains in its operated position at this time due to the completed operating circuit for energizing the upper winding thereof. Further, the start relay R1220 interrupts, at the contacts 1221, the previously mentioned holding circuit for energizing the winding of the lockout relay R1230, thereby to cause the latter relay to restore and interrupt, at the contacts 1231, a further point in the previously mentioned holding circuit for energizing the winding thereof. Also, the lockout relay R1230 interrupts, at the contacts 1233, the previously mentioned circuit for energizing the winding of the timing relay R1240, thereby to cause the timing relay R1240 to restore shortly thereafter, the latter relay being of the slow-to-release type. Finally, the lockout relay R1230 completes, at the contacts 1232, the previously traced paths for applying ground potential to each of the group marking conductors with the exception of the

tenth group marking conductor C391. When ground potential is reapplied to the nine group marking conductors mentioned, including the first group marking conductor C442, each of the trunks in each group in the first division, with the exception of the tenth group, having a call thereon, is marked for subsequent selection due to the operation of a marking relay in each trunk circuit associated with a trunk in any one of the groups of trunks mentioned. At this time, there may be one or more calls on each of one or more of the groups in the first division, excluding the tenth group, which are marked for subsequent selection.

The trunks mentioned above which are marked for subsequent selection constitute a first batch of trunks, the call on each of which in this first batch of trunks must be answered before a call on a trunk included in a second batch of trunks may be answered, in a manner more fully explained hereinafter. When the marking relays in the trunk circuits individually associated with the trunks in the first batch operate, paths are completed for applying ground potential therein to the corresponding group marking conductors, whereupon one or more alternative circuits, including the grounded group marking conductors, are completed for energizing the winding of the start relay R1220, thereby to cause reoperation of the latter relay. Upon reoperating, the start relay R1220 reprepares, at the contacts 1221, the previously traced original circuit for energizing the winding of the lockout relay R1230; however, this circuit is not immediately recompleted until the timing relay R1240 restores. Upon restoring, the timing relay recompletes, at the contacts 1241, the previously traced original circuit for energizing the winding of the lockout relay R1230, whereupon the lockout relay R1230 reoperates. Upon reoperating, the lockout relay R1230 recompletes, at the contacts 1231, the previously traced holding circuit for energizing the winding thereof, and recompletes, at the contacts 1233, the previously mentioned circuit for energizing the winding of the timing relay R1240, thereby to cause the latter relay to reoperate. Further, the lockout relay R1230 interrupts, at the contacts 1232, the previously traced paths for applying ground potential to the ten group marking conductors, including the first group marking conductor C442. When the lockout relay R1230 thus reoperates, the first batch of trunks is positively closed, whereby subsequently initiated calls on the trunks not included in the first batch of trunks will be included in the second batch of trunks previously mentioned.

Subsequently, when the first guard apparatus 1000 is released to interrupt the previously traced circuit for energizing the upper winding of the tenth group relay R1200 in the first trunk distributor 1200, the latter relay restores, thereby to prepare, at the contacts 1203, a point in the previously traced path for applying ground potential to the tenth group marking conductor C391, whereby calls previously initiated and now subsequently initiated on the trunks in the tenth group may be included in the second batch, previously mentioned.

At this time, the first guard apparatus 1000 and the first trunk finder distributor 1100 operate in order to cause a preselected finder in the first group to seize the lowest trunk in the highest group in the first batch previously mentioned. For example, if the first batch of trunks includes the second and fifth trunks in the first

group and the sixth and eighth trunks in the fourth group, the call on the sixth trunk in the fourth group will be answered in preference to the call on any other trunk. Subsequently, the first guard apparatus 1000 and the first trunk finder distributor 1100 are operative to control preselected trunk finders to cause the calls, using the example noted above, on the eighth trunk in the fourth group, and then the call on the second trunk in the first group, and, finally, the call on the fifth trunk in the first group to be answered sequentially.

Thus, it will be understood that the calls on the trunks in the first batch are answered sequentially in accordance with both the positions of the trunks in a given group and the positions of the trunks with respect to the different groups, whereby all of the calls on the trunks in the first batch are answered in a predetermined order before any calls on the trunks in the second batch are answered.

When the call on the last trunk in the first batch is answered, the corresponding group relay in the first guard apparatus 1000 and the corresponding group relay in the first trunk distributor 1200 operate, whereby the preselected trunk finder seizes the calling trunk and the last multiple circuit for energizing the winding of the start relay R1220 is interrupted. The start relay R1220 then restores to interrupt, at the contacts 1221, the previously traced holding circuit for energizing the winding of the lockout relay R1230, thereby to cause the latter relay to restore. Upon restoring, the lockout relay R1230 interrupts, at the contacts 1233, the previously mentioned circuit for energizing the winding of the timing relay R1240, thereby to cause the latter relay to restore shortly thereafter. Further, the lockout relay R1230 recompletes, at the contacts 1232, the previously traced paths for applying ground potential to each of the group marking conductors C442, etc., with the exception of the group marking conductor corresponding to the operated group relay in the first trunk distributor 1200, in the manner previously explained, whereby the marking relays and the trunk circuits individually associated with the trunks in the second batch are operated in order to mark the trunks in the second batch for subsequent selection. When the trunks in the second batch are marked for subsequent selection, additional multiple circuits are completed for energizing the winding of the start relay R1220, thereby to cause reoperation thereof, whereupon the lockout relay R1230 is again reoperated, thereby positively to close the second batch of trunks and to initiate the beginning of the third batch of trunks.

In view of the foregoing explanation of the mode of operation of the first trunk distributor 1200, it will be understood that calls on successive batches of trunks are answered in rotation; that the calls on the trunks in a given batch of trunks are answered in rotation, both as to the different groups in the batch and as to the positions of the trunks in a given group in the batch.

In view of the foregoing explanation of the mode of operation of the first trunk distributor 1200 to cause calls on the trunks in the first division to be seized batch by batch, it will be understood that the second trunk distributor, not shown, is operative in a substantially identical manner to cause calls on the trunks in the second division to be seized batch by batch.

Further operation of the first trunk finder 500, operation of the first feeder trunk circuit 600, the first feeder trunk finder 700, the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350

Assuming that the first feeder trunk finder 700 and the individually associated first operator position 810 at the automatic B switchboard 800 are idle, and that the first feeder trunk finder 700 has been preselected by the first feeder trunk finder distributor 1300 at this time, the first select relay R1340 in the first feeder trunk finder distributor 1300 occupies its operated position, the first select relay R1340 being held in its operated position by a completed holding circuit extending from ground by way of the contacts 862 of the operated position relay R860 at the first operator position 810, C863, the contacts 814, C818, the contacts 759, 784, 769, the first guard conductor C1382, R1340, the contacts 1345 and the resistor 1347 to battery. Also, at this time, other of the select relays, including the fourth select relay R1360 in the first feeder trunk finder distributor 1300 corresponding to the fourth feeder trunk finder, occupy their operated positions. The first feeder trunk finder distributor 1300 operates to preselect idle ones of the feeder trunk finders in a predetermined order, the first feeder trunk finder 700 being preselected for use at this time due to the operated position of the first select relay R1340.

At this point, it is noted that, when the plugs associated with the transmitter 876 and the receiver 877 at the first operator position 810 occupy their inserted positions with respect to the associated jacks J874 and J875, a circuit is completed for energizing the winding of the position relay R860 and for supplying current to the transmitter 876. This circuit extends from ground by way of the winding 871 of the repeater 870, the jack J874 and the associated plug, the transmitter 876, the jack J875 and the associated plug, and the winding of R860 to battery. When thus energized, the position relay R860 operates to complete, at the contacts 862, the previously traced path for applying ground potential to the first guard conductor C1382 and also a multiple path for applying ground potential to the second guard conductor C1355 extending to the second feeder trunk finder distributor 1350, the last-mentioned path extending from ground by way of the contacts 862, C863, the contacts 814, C818, the contacts 759, 773 and 749 to the second guard conductor C1355. The application of ground potential to the second guard conductor C1355 extending to the second feeder trunk finder distributor 1350 also marks the first feeder trunk finder 700 as idle to the second feeder trunk finder distributor 1350. Also, upon operating, the position relay R860 completes, at the contacts 862, an obvious circuit, including the conductor C863 and the resistor 824, for energizing the winding of the hold relay R820, thereby to retain the latter relay in its operated position. Also, it is noted that multiple circuits substantially identical to that mentioned above are completed at the other operator positions at the automatic B switchboard 800 for energizing the winding of the hold relay R820. More particularly, a multiple circuit for energizing the winding of the hold relay R820 is completed at each operator position at the automatic B switchboard 800 whereat the position relay occupies its operated position; the position relay at each operator position at the

automatic B switchboard which is staffed occupies its operated position. Also, it is noted that a voice frequency current circuit is completed at this time, which includes the winding 871 of the repeater 870 and the transmitter 876, and excludes the winding of the position relay R860, this circuit extending from one terminal of the winding 871 of the repeater 870 by way of the jack J874 and the associated plug, the transmitter 876, the jack J875 and the associated plug, and the condenser 867 to the other terminal of the winding 871 of the repeater 870. Also, an operating circuit for the receiver 877 is completed, which extends from one terminal of the receiver 877 by way of the jack J874 and the associated plug, the winding 872 of the repeater 870, and the jack J875 and associated plug to the other terminal of the receiver 877. Finally, a connection is prepared between the first feeder trunk finder 700 and the windings 872 and 873 of the repeater 870, this prepared connection extending from the line conductor C822 by way of the contacts 841, the condenser 865 and the windings 872 and 873 of the repeater 870, and the contacts 843 to the line conductor C823, the line conductors C822 and C823 extending into the first feeder trunk finder 700.

As previously explained, the sixteen feeder trunk circuits are divided into two groups, the first group including the first eight feeder trunk circuits and the second subgroup including the second eight feeder trunk circuits. Accordingly, when a trunk finder in the first group associated with a feeder trunk circuit in the first group operates to seize the answering branch of a calling trunk in the first division, the associated feeder trunk circuit in the first group operates to initiate operation of the first feeder trunk finder distributor 1300. Similarly, when a trunk finder in the second group associated with a feeder trunk circuit in the second group operates to seize the answering branch of a calling trunk in the second division, the associated feeder trunk circuit in the second group operates to initiate operation of the second feeder trunk finder distributor 1350.

For example, assuming that the first trunk finder 500 in the first group has just operated to seize the answering branch of a calling trunk in the first division, such as the answering branch 211Y of the trunk 211, the first feeder trunk circuit 600 in the first group individually associated with the first trunk finder 500 in the first group operates in order to initiate operation of the first feeder trunk finder distributor 1300. More particularly, when the first trunk finder 500 seizes the answering branch 211Y of the trunk 211 the start relay R670 in the first feeder trunk circuit 600 operates, as previously explained. Upon operating, the start relay R670 completes, at the contacts 671, the previously mentioned path for applying ground potential to the hold conductor C584, extending into the first trunk finder 500, completes, at the contacts 672, the previously traced circuit for energizing the winding of the lockout relay R1100 in the first trunk finder distributor 1100, and interrupts, at the contacts 675, the previously traced path for applying battery potential to the guard conductor C1105, as previously explained. Also, the start relay R670 prepares, at the contacts 673, a circuit traced hereinafter for energizing the winding of the switch-through relay R630, completes, at the contacts 674, an obvious path for applying ground potential to the test conductor C605, thereby to

mark the first feeder trunk 610 as being included in an add subgroup to the feeder trunk finders having access thereto, and completes, at the contacts 676, an obvious path for applying ground potential to the first and second start conductor C688. The application of ground potential to the first and second start conductor C688 marks either the first feeder trunk 610 or the second feeder trunk 710 as the calling feeder trunk to the feeder trunk finders, and completes an obvious circuit, including the resistor 1314, for energizing the winding of the start relay R1330 in the first feeder trunk finder distributor 1300.

When thus energized, the start relay R1330 operates to complete, at the contacts 1331, a circuit for energizing the winding of the first start relay R740 in the preselected first feeder trunk finder 700, the first feeder trunk finder 700 being preselected at this time due to the operated position of the first select relay R1340 in the first feeder trunk finder distributor 1300, as previously noted. The circuit for energizing the winding of the first start relay R740 extends from ground by way of the contacts 1331 and 1342, the first start conductor C1381, R740, the contacts 747, 746 and 766 and the resistor 777 to battery. When thus energized, the first start relay R740 operates to complete, at the contacts 745, a holding circuit substantially identical to that previously traced for energizing the winding thereof, interrupts, at the contacts 747, a point in the previously traced original circuit for energizing the winding thereof, and interrupts, at the contacts 746, a point in a circuit traced hereinafter for energizing the winding of the second start relay R760, thereby positively to prevent operation of the second start relay R760 at this time. Also, the first start relay R740 completes, at the contacts 740, an alternative path for applying ground potential to the first guard conductor C1382, this circuit extending from ground by way of the contacts 862, C863, the contacts 814, C818 and the contacts 740 to the first guard conductor C1382, thereby to complete an alternative holding circuit for energizing the winding of the first select relay R1340. Further, the first start relay R740 interrupts, at the contacts 749, the previously traced path for applying ground potential to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350. Further, the first start relay R740 completes, at the contacts 742, an obvious circuit, including the grounded first and second start conductor C688 for energizing the lower winding of the first and second connect relay R710, thereby to cause the latter relay to operate. Also, the first start relay R740 completes, at the contacts 744, an obvious circuit, including the grounded test conductor C685, for energizing the upper winding of the subgroup relay R730, thereby to cause the latter relay to operate.

Upon operating, the first and second connect relay R710 prepares, at the contacts 711, 712 and 713, a connection between the first feeder trunk finder 700 and the first feeder trunk 610, and prepares, at the contacts 714, 715 and 716, a connection between the first feeder trunk finder 700 and the second feeder trunk 710. Upon operating, the subgroup relay R730 completes, at the contacts 732, 734 and 736, a connection between the first feeder trunk finder 700 and the first feeder trunk 610. More particularly, the subgroup relay R730 completes, at the contacts 736, a series circuit for energizing the winding of the switch-through relay R630 in the first

feeder trunk circuit 600 and the winding of the switch-through relay R750 in the first feeder trunk finder 700, this circuit extending from ground by way of the winding of R750, the contacts 771, 781, 743, 736 and 713, the control conductor C613 of the first feeder trunk 610, the contacts 673, 651 and 668, and the winding of R630 to battery. When thus energized, both the switch-through relay R630 and the switch-through relay R750 operate. Upon operating, the switch-through relay R750 completes, at the contacts 753, an obvious holding circuit substantially identical to that previously traced for energizing the winding thereof in series with the winding of the switch-through relay R630, and completes, at the contacts 756, an obvious path for applying ground potential to the hold conductor C785, thereby to complete obvious multiple holding circuits for energizing the upper winding of the first and second connect relay R710 and the lower winding of the subgroup relay R730.

Upon operating, the switch-through relay R630 interrupts, at the contacts 635, the previously traced circuit for energizing the winding of the lockout relay R1100 in the first trunk finder distributor 1100, thereby to cause the latter relay to restore shortly thereafter, in the manner previously explained. Also, the switch-through relay R630 completes, at the contacts 636, a path for applying ground potential to the register start conductor C687, for a purpose more fully explained hereinafter, this path extending from ground by way of the contacts 636, 655 and 643 to the register start conductor C687. Further, the switch-through relay R630 interrupts, at the contacts 637, the previously traced path for applying ground potential to the test conductor C685, thereby to interrupt the previously traced circuit for energizing the upper winding of the subgroup relay R730 in the first feeder trunk finder 700, and interrupts, at the contacts 639, the previously mentioned path for applying ground potential to the first and second start conductor C688, thereby to interrupt the previously traced original operating circuit for energizing the lower winding of the first and second connect relay R710 in the first feeder trunk finder 700, and to interrupt the previously mentioned circuit for energizing the winding of the start relay R1330 in the first feeder trunk finder distributor 1300, whereupon the latter relay restores. Finally, the switch-through relay R630 completes, at the contacts 631 and 633, a connection between the first trunk finder 500 and the first operator position 810 at the automatic B switchboard 800. More particularly, at this time, the line conductors C496 and C497 of the answering branch 411Y of the trunk 411 seized by the first trunk finder 500 are connected respectively by way of the contacts 511, 512, 531, 532 and 541, 543, the line conductors C581, C582, the contacts 631, 633, the line conductors C611 and C612 of the first feeder trunk 610, the contacts 711, 712, 732, 734 and 751, 752 to the line conductors C822 and 823, the line conductors C822 and C823 being operatively connected to the windings 872 and 873 of the repeater 870 at the first operator position 810, as previously explained. Accordingly, at this time, an operative connection is completed between the operator position 261 at the manual A switchboard 260 in the central office 30 and the first operator position 810 at the automatic B switchboard 800 in the central office 30.

Continuing now with the operation of the first feeder trunk finder 700, upon operating, the

switch-through relay R750 completes, at the contacts 754, an obvious circuit for illuminating the supervisory lamp L815 at the first operator position 810, thereby to advise the operator thereat that a call has been extended to her position to be answered. Also, the switch-through relay R750 completes, at the contacts 758, a path, including the contacts 733 and 717, for applying ground potential to the cut-in conductor C1333 extending into the cut-in apparatus 1405, for a purpose more fully explained hereinafter, and interrupts, at the contacts 759, a point in the previously traced original multiple paths for applying ground potential to the first guard conductor C1382 extending into the first feeder trunk finder distributor 1300 and to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350. Finally, the switch-through relay R750 completes, at the contacts 757, a circuit for energizing the winding of the tone relay R790, this circuit extending from ground by way of the contacts 847, C817, the contacts 757, 774 and 789 and R790 to battery. Shortly after the tone relay R790 is thus energized, the tone relay R790 operates, this relay being of the slow-to-operate type, to complete, at the contacts 794, an obvious circuit for energizing the winding of the tone relay R785. Shortly after the tone relay R785 is thus energized, the tone relay R785 operates, this relay being of the slow-to-operate type. Upon operating, the tone relay R785 interrupts, at the contacts 789, the previously traced circuit for energizing the winding of the tone relay R790, thereby to cause the latter relay to restore. Upon restoring, the tone relay R790 interrupts, at the contacts 794, the previously mentioned circuit for energizing the winding of the tone relay R785, thereby to cause the latter relay to restore.

Also, upon operating, the switch-through relay R750 completes, at the contacts 755, a circuit for energizing the winding of the preference relay R780, this circuit extending from ground by way of the contacts 755 and 749 and R780 to battery. When thus energized the preference relay R780 operates to complete, at the contacts 783, an obvious holding circuit for energizing the winding thereof, and to interrupt, at the contacts 784, a further point in the previously traced path for applying ground potential to the first guard conductor C1382 extending into the first feeder trunk finder distributor 1300. Also, the preference relay R780 interrupts, at the contacts 782, an obvious path for short-circuiting the upper winding of the preference relay R770, thereby to render the preference relay R770 fast to operate. As previously pointed out, when the tone relay R785 operates, the tone relay R790 restores, thereby to cause the tone relay R785 to restore. However, the tone relay R790 restores prior to the restoration of the tone relay R785, thereby to complete, at the contacts 793, an obvious circuit for energizing the lower winding of the preference relay R770, whereupon the preference relay R770 operates immediately. Upon operating, the preference relay R770 completes, at the contacts 772, an obvious holding circuit for energizing the lower winding thereof, and interrupts, at the contacts 773, a point in the previously traced path for applying ground potential to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350. Also, the preference relay R770 interrupts, at the contacts 774, the previously traced circuit for energizing the winding of the tone relay R790, thereby to pre-

vent further interaction of the tone relays R790 and R785. Also, it is noted that, upon operating, the tone relay R790 completes, at the contacts 796, an obvious path for applying ground potential to the hold conductor C1336 extending into the first feeder trunk finder distributor 1300, thereby to complete an obvious holding circuit for energizing the winding of the hold relay R1310, and completes, at the contacts 795, an obvious path for applying ground potential to the hold conductor C1337 extending into the second feeder trunk finder distributor 1350, thereby to complete a similar circuit for energizing the winding of the hold relay therein. The hold relays in the first feeder trunk finder distributor 1300 and in the second feeder trunk finder distributor 1350 are thus reoperated in the event they have restored or are held in their operated positions, thereby to check the timing operation of the timing relays in the two feeder trunk finder distributors, in a manner more fully explained hereinafter.

The operation of the tone relay R790, while the tone relay R785 is restored, completes, at the contacts 792, an obvious path for applying tone potential by way of the tone conductor C776 and the condenser 775 to the line conductor C823. Upon operating, the tone relay R785 interrupts, at the contacts 786, while the tone relay R790 occupies its operated position, the previously mentioned path for applying tone potential to the line conductor C823. Upon restoring, the tone relay R790 completes, at the contacts 791, while the tone relay R785 occupies its operated position, an obvious alternative path, including the tone conductor C776 and the condenser 775, for applying tone potential to the line conductor C823. Finally, upon restoring, the tone relay R785 interrupts, at the contacts 787, while the tone relay R790 occupies its restored position, the previously mentioned alternative path for applying tone potential to the line conductor C823. Accordingly, the operation and subsequent restoration of the tone relays R790 and R785 cause tone potential to be twice connected to and disconnected from the line conductor C823, whereby a distinct zip-zip tone is produced in the receiver 877 at the first operator position 810 at the automatic B switchboard 800 and in the receiver at the operator position 261 at the manual A switchboard 260, thereby further to advise the operator at the operator position 810 that a call has arrived and to advise the operator at the operator position 261 that she may pass the call to the operator at the answering operator position 810. The operator at the operator position 261 at the manual A switchboard 260 passes the directory number of the desired subscriber substation in the distant exchange 50 to the operator at the first operator position 810, whereupon the operator at the first operator position 810 proceeds to set up the connection, in a manner more fully described hereinafter.

As previously pointed out, upon operating, the first feeder trunk finder 700 causes ground potential to be applied to the cut-in conductor C1333 extending into the cut-in apparatus 1405, thereby to complete an obvious circuit for energizing the winding of the first cut-in relay R1410. When thus energized, the first cut-in relay R1410 operates to complete, at the contacts 1411, 1412, etc., an operative connection between the key sender 1305 at the first operator position 810 at the automatic B switchboard 800 and both the first feeder trunk circuit 600 and the first digit

register apparatus 1400. More particularly, the cut-in relay R1410 prepares, at the contacts 1411, a circuit traced hereinafter for energizing the error relay R540 in the first feeder trunk circuit 600, prepares, at the contacts 1412, a circuit traced hereinafter for energizing the winding of the control relay R650 in the first feeder trunk circuit 600, and completes, at the contacts 1413, etc., a connection between the four marking conductors C1391 to C1394, inclusive, associated with the ten digit keys of the key set 1305 and the respective four marking conductors C1401 to C1404, inclusive, extending into the first digit register apparatus 1400. Accordingly, at this time, the first digit register apparatus 1400 individually associated with the first feeder trunk circuit 600 is operatively connected thereto and the key set 1305 at the first operator position 810 is operatively connected to the first digit register apparatus 1400. Hence, the operator at the first operator position 810 may proceed, to set up the connection, by operating the key set 1305, in a manner more fully explained hereinafter.

In view of the foregoing explanation of the mode of operation of the first feeder trunk finder 700 to seize the first feeder trunk 610 in the first group of feeder trunks, it will be understood that the first feeder trunk finder 700 is operative in a substantially identical manner to seize any odd feeder trunk in the first group of feeder trunks; while the operation of the first feeder trunk finder 700, to seize an even feeder trunk in the first group of feeder trunks, is somewhat different from that described. For example, the operation of the first feeder trunk finder 700 to seize the second feeder trunk 710, which feeder trunk is also in the first group, is controlled by the first feeder trunk finder distributor 1300 and is substantially the same as that previously described. However, in connection with the second feeder trunk 710, it is noted that the second feeder trunk circuit, not shown, individually associated therewith, does not comprise a test conductor, corresponding to the test conductor C685 provided in the first feeder trunk circuit 600. Accordingly, in the first feeder trunk finder 700, only the first and second connect relay R710 is operated, the subgroup relay R730 remaining in its restored position. In this event, upon operating, the first and second connect relay R710 completes, at the contacts 714, 715 and 716, a connection between the second feeder trunk 710 and the first operator position 810 at the automatic B switchboard 800. More particularly, the line conductors of the second feeder trunk 710 are connected by way of the contacts 714, 715, 731, 733 and 751, 752 to the line conductors C822 and C823 which are operatively connected to the repeater 870 at the first operator position 810.

In view of the foregoing explanation of the mode of operation of the first feeder trunk finder 700 to seize either an odd or an even feeder trunk in the first group under the control of the first feeder trunk finder distributor 1300, it will be understood that the first feeder trunk finder 700 is operative, in a similar manner, to seize either an odd or an even feeder trunk in the second group under the control of the second feeder trunk finder distributor 1350. For example, when the sixteenth trunk finder, not shown, in the second group seizes the answering branch of a calling trunk in the second division, the associated sixteenth feeder trunk circuit in the second group operates in order to cause ground potential to be applied to the fifteenth and six-

teenth start conductor, thereby to complete a circuit, including the resistor 1315 and the conductor C1316 extending into the second feeder trunk finder distributor 1350, for energizing the winding of the start relay therein. Upon operating, the start relay in the second feeder trunk finder distributor 1350 initiates operation of the preselected feeder trunk finder, such, for example, as the first feeder trunk finder 700.

Assuming that the operation of the first feeder trunk finder 700 is under the control of the second feeder trunk finder distributor 1350, the start relay in the second feeder trunk finder distributor 1350 operates in order to cause ground potential to be applied to the second start conductor C1334, thereby to complete a circuit for energizing the winding of the second start relay R760. This circuit extends from the grounded second start conductor C1334 by way of R760, the contacts 767, 746 and 766, and the resistor 777 to battery. When thus energized, the start relay R760 operates to complete, at the contacts 765, an obvious holding circuit for energizing the winding thereof, to interrupt, at the contacts 767, a point in the previously traced original circuit for energizing the winding thereof, and to interrupt, at the contacts 766, a point in the previously traced circuit for energizing the winding of the first start relay R740, thereby positively to prevent operation of the first start relay R740 at this time. Also, upon operating, the second start relay R760 completes, at the contacts 768, an alternative path for applying ground potential to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350, this circuit extending from ground by way of the contacts 862, C863, the contacts 814, C818 and the contacts 768 to the second guard conductor C1355.

Also, the second start relay R760 interrupts, at the contacts 769, the previously traced path for applying ground potential to the first guard conductor C1382 extending into the first feeder trunk finder distributor 1300, thereby to interrupt the previously traced circuit for energizing the winding of the first select relay R1340 therein. The first select relay R1340 then restores, thereby to transfer, at the contacts 1341 thereof, the start circuit of the first feeder trunk finder distributor 1300 to the next idle feeder trunk finder, thereby to preselect the last-mentioned feeder trunk finder. Further, the second start relay R760 completes, at the contacts 761, a circuit, not shown, for energizing the lower winding of the fifteenth and sixteenth connect relay R720, thereby to cause the latter relay to operate. Further, the second start relay R760 completes, at the contacts 763, a circuit substantially identical to that previously traced for energizing the winding of the switch-through relay R750, thereby to cause the latter relay to operate. Finally, the second start relay R760 prepares, at the contacts 764, a test circuit, including the test conductor C778, for energizing the winding of the subgroup relay R730. However, the subgroup relay R730 is not operated at this time as the sixteenth feeder trunk constitutes an even feeder trunk in the second group, as previously noted.

The operation of the fifteenth and sixteenth connect relay R720 is effective to complete a connection between the sixteenth feeder trunk and the repeater 870 at the first operator position 810, in the manner previously explained. Subsequently, the switch-through relay R750 operates

in the manner previously explained, thereby to cause operation of the tone relays R785 and R790, as previously pointed out. At this point, it is noted that the preference relay R780 does not occupy its operated position at this time. However, the interaction of the tone relays R785 and R790 is effective to cause operation of the preference relay R770, in the manner previously explained, in spite of the fact that the preference relay R770 is rendered slow to operate, due to the normally completed path for short-circuiting the upper winding thereof; which path is interrupted only when the preference relay R780 occupies its operated position. Also, it is noted that the operation of the sixteenth connect relay R720 is effective to cause operation of the sixteenth cut-in relay, not shown, in the cut-in apparatus 1405, which latter relay is operative to cause the key set 1305 at the first operator position 810 at the automatic B switchboard 800 to be operatively connected both to the sixteenth feeder trunk circuit, not shown, individually associated with the sixteenth feeder trunk, and to the sixteenth digit register apparatus, not shown, individually associated with the sixteenth feeder trunk circuit. Accordingly, at this time, the apparatus at the first operator position 810 is in condition to receive the information concerning the extension of the call over the sixteenth feeder trunk and then to control the extension of the connection over the sixteenth feeder trunk, in a manner more fully explained hereinafter.

It is noted that the modes of operation of the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350 are substantially identical. Considering further the operation of the first feeder trunk finder distributor 1300, it is noted that, upon operating, the start relay R1330 interrupts, at the contacts 1332, an obvious normally completed holding circuit for energizing the winding of the hold relay R1310, thereby to cause the hold relay R1310 to restore shortly thereafter, the latter relay being of the slow-to-release type. The restoration of the hold relay R1310 initiates a cycle of operation of the timing relays R1320 and R1325, whereby the first feeder trunk finder distributor 1300 operates to preselect another idle feeder trunk finder and to operate the last-mentioned feeder trunk finder in the event the presently assigned first feeder trunk finder 700 does not operate to seize the calling feeder trunk within a predetermined time interval in order to cause restoration of the start relay R1330, in the manner previously explained. As previously noted, in the event the first feeder trunk finder 700 operates properly and promptly to seize the first feeder trunk 610, the switch-through relay R630 in the first feeder trunk circuit 600 individually associated with the first feeder trunk 610 operates shortly after operation of the first feeder trunk finder 700 is initiated, thereby to interrupt the previously traced circuit for energizing the winding of the start relay R1330 and to cause the latter relay to restore. However, assuming that the first feeder trunk finder 700 does not operate promptly to seize the first feeder trunk 610, shortly after the start relay R1330 operates the hold relay R1310 restores, as previously noted. Upon restoring, the hold relay R1310 completes, at the contacts 1312, an obvious circuit, including the contacts 1323, for energizing the winding of the timing relay R1325, thereby to cause the latter relay to operate. Upon operating, the timing relay R1325 completes, at the

contacts 1327, an obvious circuit, including the contacts 1312, for energizing the winding of the timing relay R1320, thereby to cause the latter relay to operate. Upon operating, the timing relay R1320 interrupts, at the contacts 1322, the previously mentioned circuit for energizing the winding of the timing relay R1325, thereby to cause the timing relay R1325 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the timing relay R1325 interrupts, at the contacts 1327, the previously traced circuit for energizing the winding of the timing relay R1320, thereby to cause the timing relay R1320 to restore shortly thereafter, the latter relay being of the slow-to-release type. Incident to the restoration of the timing relay R1325 and prior to the restoration of the timing relay R1320, a path is completed for short-circuiting the winding of the first select relay R1340, this path extending from ground by way of the contacts 1312, 1323, 1326 and 1344, R1340, the first guard conductor C1382, the contacts 740, C818, the contacts 214, C863 and the contacts 862 to ground. When the winding of the first select relay R1340 is thus short-circuited this relay restores, thereby to transfer, at the contacts 1341 thereof, the start circuit of the first feeder trunk finder distributor 1300 to the next idle feeder trunk finder, whereupon the last-mentioned feeder trunk finder is preselected by the first feeder trunk finder distributor 1300 and operation thereof is initiated, in the manner previously explained.

Also, upon restoring, the first select relay R1340 interrupts, at the contacts 1342, the previously traced path for applying ground potential to the first start conductor C1381 extending into the first feeder trunk finder 700, thereby to effect the release of the first feeder trunk finder 700, in a manner more fully explained hereinafter. When the timing relay R1320 restores it interrupts, at the contacts 1323, the previously traced path for short-circuiting the winding of the first select relay R1340, and re completes, at the contacts 1322, an alternative circuit, including the contacts 1312, for energizing the winding of the timing relay R1325, thereby to cause the latter relay to reoperate, whereby a new cycle of operation of the timing relays R1325 and R1320 is initiated. When the first feeder trunk finder 700 seizes the first feeder trunk 610 the first feeder trunk circuit 600 operates, thereby to cause ground potential to be removed from the first and second start conductor C688, thereby to interrupt the previously traced circuit for energizing the winding of the start relay R1330 in order to cause the latter relay to restore, as previously explained. Upon restoring, the start relay R1330 completes, at the contacts 1332, the previously mentioned holding circuit for energizing the winding of the hold relay R1310, thereby to cause the latter relay to operate and interrupt, at the contacts 1312, the previously traced circuit for energizing the winding of the timing relay R1325 or the previously traced circuit for energizing the winding of the timing relay R1320, whereby further operation of the timing relays mentioned is arrested.

In view of the above description of the mode of operation of the first feeder trunk finder distributor 1300, it will be understood that the feeder trunk finders are preselected in rotation from the first feeder trunk finder 700 toward the fourth feeder trunk finder, not shown. When the fourth feeder trunk finder, not shown, is operated in the manner previously explained, the

fourth select relay R1360 in the first feeder trunk finder distributor 1300 restores, thereby to prepare, at the contacts 1361, a chain circuit traced hereinafter for energizing the winding of the reset relay R1370; which chain circuit is completed incident to the reoperation of the start relay R1330 when operation of the next feeder trunk circuit in the first group is initiated. Upon operating, the start relay R1330 completes, at the contacts 1331, the previously mentioned circuit for energizing the winding of the reset relay R1370, this circuit extending from ground by way of the contacts 1331, 1341, 1351, 1356 and 1361, and R1370 to battery. Shortly after the reset relay R1370 is thus energized the reset relay R1370 operates, this relay being of the slow-to-operate type. Upon operating, the reset relay R1370 completes, at the contacts 1372, an obvious multiple holding circuit for energizing the winding of the hold relay R1310, thereby to retain the latter relay in its operated position. Also, the reset relay R1370 completes, at the contacts 1373, multiple circuits for energizing the winding of each of the select relays R1340, etc., corresponding to an idle feeder trunk finder. For example, in the event the first feeder trunk finder 700 is idle at this time, the circuit for energizing the winding of the first select relay R1340 extends from ground by way of the contacts 862, C863, the contacts 814, C818, the contacts 759, 784, 769, the first guard conductor C1382, R1340, the contacts 1346 and 1373 and the resistor 1317 to battery. When thus energized, the first select relay R1340 operates to complete, at the contacts 1345, the previously traced holding circuit for energizing the winding thereof. When one or more of the select relays R1340, etc., operate, the circuit for energizing the winding of the reset relay R1370 is interrupted at the contacts 1341, etc., thereby to cause the latter relay to restore. Upon restoring, the reset relay R1370 interrupts, at the contacts 1372, the previously mentioned alternative holding circuit for energizing the winding of the hold relay R1310, thereby to cause the latter relay to restore shortly thereafter, as previously explained.

Neglecting for the present the detailed operation of the apparatus at the first operator position 810 in order to extend the call answered on the answering branch 211Y of the trunk 211 over the outgoing branch 211Z of the trunk 211, it is pointed out that, incident to the operation of the key set 1305 at the first operator position 810, the various digits of the directory number of the desired subscriber substation in the distant exchange 50 are registered in the first digit register apparatus 1400, whereupon ground potential is applied to the hold conductor C683 extending into the first feeder trunk circuit 600, thereby to complete an obvious circuit for energizing the lower winding of the send relay R560. When thus energized, the send relay R560 operates to complete, at the contacts 661, an obvious circuit for energizing the upper winding thereof and to interrupt, at the contacts 662, the previously traced circuit for energizing the winding of the start relay R670, thereby to cause the latter relay to restore. More particularly, upon operating, the send relay R560 substitutes the upper winding thereof for the winding of the start relay R670 in the previously traced circuit for energizing in series the winding of the cut-in relay R480 and the upper winding of the cutoff relay R460 in the trunk circuit 400 individually associated with the trunk 211, whereby the cut-in relay

R480 operates, the upper winding of the send relay R660 being of appreciably lower resistance than the winding of the start relay R670, in the manner previously explained. Upon operating, the send relay R660 completes, at the contacts 663, an obvious alternative path for applying ground potential to the hold conductor C584 extending into the first trunk finder 500, completes, at the contacts 664, an obvious alternative path, including the contacts 624, for applying ground potential to the register start conductor C687, prepares, at the contacts 665, a point in a circuit traced hereinafter for energizing the winding of the error relay R640, and completes, at the contacts 667, an alternative holding circuit for energizing the winding of the switch-through relay R750 in the first feeder trunk finder 700. The last-mentioned circuit extends from ground by way of R750, the contacts 753, 736 and 713, the control conductor C613 of the first feeder trunk 610, the contacts 666, 651 and 667 and the resistor 627 to battery. Finally, the send relay R660 prepares, at the contacts 662', a circuit traced hereinafter for energizing the winding of the control relay R650.

Upon restoring, the switch-through relay R630 interrupts, at the contacts 631 and 633, the previously traced connection between the first trunk finder 500 and the first feeder trunk 610, and completes, at the contacts 632 and 634, a connection between the first trunk finder 500 and the first digit sender apparatus 1600. More particularly, at this time, the line conductors C494 and C495 of the outgoing branch 211Z of the trunk 211 are respectively connected by way of the contacts 481, 483, the line conductors C496, C497 of the answering branch 211Y of the trunk 211, the contacts 511, 512, 531, 532 and 541, 543, the line conductors C581, C582 and the contacts 632, 634 to the line conductors C681 and C682, the line conductors C681 and C682 being connected to an impulsing bridge in the first digit sender apparatus 1600, in a manner more fully explained hereinafter. Accordingly, at this time, an operative connection is completed between the first digit sender apparatus 1600 in the central office 30 and the automatic switching apparatus 270 in the distant exchange 50, including the answering branch 211Y and the outgoing branch 211Z of the trunk 211.

At this time, the first digit register apparatus 1400 operates to cause the associated first digit sender apparatus 1600 to control the impulsing bridge therein extending between the line conductors C681 and C682, whereby the registered digits are transmitted to the automatic switching apparatus 270 in the distant exchange 50, in a manner more fully explained hereinafter.

Should the operator at the first operator position 810 at the automatic B switchboard 800 make an error in registering the digits in the first digit register apparatus 1400, she clears the first digit register apparatus 1400 and releases the automatic switching apparatus 270 in the distant exchange 50 by operating the error key K12 of the key set 1305, in a manner more fully explained hereinafter, whereby ground potential is applied to the error conductor C684. This application of ground potential to the error conductor C684 completes an obvious circuit, including the contacts 665, for energizing the winding of the error relay R640. When thus energized, the error relay R640 operates to complete, at the contacts 642, an obvious holding circuit, including the contacts 624, for energizing

the winding thereof, and interrupts, at the contacts 643, the previously traced alternative path for applying ground potential to the register start conductor C687. When ground potential is removed from the register start conductor C687 the digits registered in the first digit register apparatus 1400 are cleared out, in a manner more fully explained hereinafter. Finally, the error relay R640 completes, at the contacts 641, an obvious circuit for energizing the winding of the control relay R620, thereby to cause the control relay R620 to operate shortly thereafter, the latter relay being of the slow-to-operate type. When operating, the control relay R620 interrupts, at the contacts 624, a further point in the previously traced alternative path for applying ground potential to the register start conductor C687, and interrupts, at the contacts 622, the loop circuit extending by way of the first trunk finder 500, the answering branch 211Y and the outgoing branch 211Z of the trunk 211 to the automatic switching apparatus 270 in the distant exchange 50, whereby the automatic switching apparatus 270 is released. Also, the control relay R620 completes, at the contacts 621, an obvious path for applying ground potential to the line conductor C611 of the first feeder trunk 610, and completes, at the contacts 623, an obvious path, including the tone conductor C625 and the condenser 626, for applying tone potential to the line conductor C612 of the first feeder trunk 610, whereby tone current is transmitted to the repeater 870 at the first operator position 810, thereby to indicate to the operator thereat that the digit keys of the key set 1305 should not be operated at this time as the apparatus is not completely released incident to the operation of the error key K12 of the key set 1305.

Finally, upon operating, the control relay R620 interrupts, at the contacts 624, the previously mentioned holding circuit for energizing the winding of the error relay R640, thereby to cause the error relay R640 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the error relay R640 interrupts, at the contacts 641, the previously mentioned circuit for energizing the winding of the control relay R620, thereby to cause the latter relay to restore. Upon restoring, the control relay R620 recompletes, at the contacts 624, the previously mentioned alternative path for applying ground potential to the register start conductor C687, completes, at the contacts 622, the previously traced loop circuit between the first digit sender apparatus 1600 and the switching apparatus 270 in the distant exchange 50, and interrupts, at the contacts 621 and 623, the previously traced circuit for projecting tone current to the repeater 870 at the first operator position 810. When the receiver 877 at the first operator position 810 stops producing tone, the operator thereat is advised that she may proceed to register the digits in the first digit register apparatus 1400 by again operating the digit keys of the key set 1305.

After all of the digits of the directory number to be transmitted to the automatic switching apparatus 270 in the distant exchange 50 have been registered in the first digit register apparatus 1400 by the operator at the first operator position 810, she operates the clear-out key K11 of the key set 1305, thereby to complete a path traced hereinafter for applying ground potential to the start conductor C686. The application of ground potential to the start conductor C686 completes an obvious circuit for energizing the winding of the

control relay R650, thereby to cause the latter relay to operate. Upon operating, the control relay R650 completes, at the contacts 652, an obvious holding circuit for energizing the winding thereof, completes, at the contacts 654, an obvious circuit, including the contacts 643, for energizing the winding of the release relay R645, and interrupts, at the contacts 655, the previously traced alternative path for applying ground potential to the register start conductor C687. Accordingly, at this time, ground potential is applied by way of the winding of the release relay R645 and the contacts 654 and 643 to the register start conductor C687, thereby to retain the first digit sender apparatus 1600 in its operated position. However, the release relay R645 does not operate at this time as it is of the marginal type.

Also, upon operating, the control relay R650 interrupts, at the contacts 651, the previously traced alternative holding circuit for energizing the winding of the switch-through relay R750 in the first feeder trunk finder 700, thereby to cause the latter relay to restore. Upon restoring, the switch-through relay R750 interrupts, at the contacts 756, the previously traced multiple holding circuits for energizing the lower winding of the subgroup relay R730 and the upper winding of the first and second connect relay R710, thereby to cause the latter relays to restore. Upon restoring, the first and second connect relay R710 and the subgroup relay R730 interrupt the connection between the first operator position 810 at the automatic B switchboard 800 and the first feeder trunk 610, and interrupt the previously traced circuit for energizing the winding of the cut-in relay R1410 in the cut-in apparatus 1405, thereby to cause the latter relay to restore. Upon restoring, the cut-in relay R1410 interrupts, at the contacts 1411 and 1412, the previously traced connections between the key set 1305 at the first operator position 810 and the first feeder trunk circuit 600, and interrupts, at the contacts 1413, etc., the previously traced connections between the key set 1305 and the first digit register apparatus 1400.

Also, upon restoring, the switch-through relay R750 interrupts, at the contacts 754, the previously traced circuit for illuminating the supervisory lamp L815 at the first operator position 810, thereby to indicate to the operator thereat that the position is now idle. Also, the switch-through relay R750 interrupts, at the contacts 755, the previously traced multiple holding circuits for energizing the lower winding of the preference relay R770 and the winding of the preference relay R780, thereby to cause the preference relay R770 to restore immediately and the preference relay R780 to restore shortly thereafter, the latter relay being of the slow-to-release type. Finally, the switch-through relay R750 prepares, at the contacts 753, the previously traced multiple paths for applying ground potential to the first guard conductor C1332 extending into the first feeder trunk finder distributor 1300, and to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350.

Prior to the restoration of the switch-through relay R750, in the manner previously explained, the previously operated one of the start relays R740 or R760 has restored under the control of the respective start relays in the first feeder trunk finder distributor 1300 and in the second feeder trunk finder distributor 1350, in the manner previously explained. Accordingly, at this time, the first feeder trunk finder 700 has been restored and the first operator position 810 at

the automatic B switchboard 800 is completely released and available for further use, although the first digit register apparatus 1400 and the first digit sender apparatus 1600 are still operatively connected to the first feeder trunk circuit 600, as all of the digits registered in the first digit register apparatus 1400 have not been transmitted by the first digit sender apparatus 1600. Accordingly, it will be apparent that either the first feeder trunk finder distributor 1300 or the second feeder trunk finder distributor 1350 may preselect the first feeder trunk finder 700 for use and, consequently, the first operator position 810 at the automatic B switchboard 800 to answer another call before the first digit register apparatus 1400 and the first digit sender apparatus 1600 complete their operations. Hence, it will be understood that the operator at each operator position at the automatic B switchboard 800 is engaged only momentarily and that the operator in each position may lap one or more calls due to the great handling facility of the operator positions at the automatic B switchboard 800.

Considering now the interaction between the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350, it is noted that these distributors operate independently to control preselected feeder trunk finders in the associated group to seize calling feeder trunks in the respective groups as long as idle feeder trunk finders in the group are plentiful. However, when there is only one idle feeder trunk finder in the associated group, the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350 operate alternatively to preselect the idle feeder trunk finder in the associated group, whereby the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350 have alternative control in order to cause a calling feeder trunk in the first group to be seized by a preselected feeder trunk finder, and then a calling feeder trunk in the second group to be seized by a preselected feeder trunk finder.

This interaction between the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350 is effected by the arrangement of the preference relays in the various feeder trunk finders, as explained more fully below.

For example, when the first feeder trunk finder 700 is operated by the first feeder trunk finder distributor 1300, both the preference relay R770 and the preference relay R780 occupy their operated positions; and when the first feeder trunk finder 700 is released the preference relay R770 restores prior to the restoration of the preference relay R780. Accordingly, the previously traced path for applying ground potential to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350 is completed prior to the completion of the previously traced path for applying ground potential to the first guard conductor C1382 extending into the first feeder trunk finder distributor 1300. Accordingly, at this time, in the event both the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350 are operating to preselect the first feeder trunk finder 700, assuming that the first operator position 810 individually associated with the first feeder trunk finder 700 is the only idle operator position at the automatic B switchboard 800 at this time, only the second feeder trunk finder dis-

tributor 1350 may preselect the first feeder trunk finder 700 as ground potential appears only on the second guard conductor C1355. Hence, the idle first feeder trunk finder 700 will be preselected by the second feeder trunk finder distributor 1350 and operated thereby to seize the calling feeder trunk in the second group in preference to the calling feeder trunk in the first group.

On the other hand, when the first feeder trunk finder 700 is operated by the second feeder trunk finder distributor 1350, only the preference relay R770 occupies its operated position; and when the first feeder trunk finder 700 is released the preference relay R770 restores shortly thereafter, as this relay is rendered slow to release due to the normally completed path for short-circuiting the upper winding thereof when the preference relay R780 occupies its restored position. Accordingly, the previously traced path for applying ground potential to the first guard conductor C1382 extending into the first feeder trunk finder distributor 1300 is completed prior to the completion of the previously traced path for applying ground potential to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350. Accordingly, at this time, in the event both the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350 are operating to preselect the first feeder trunk finder 700, assuming that the first operator position 810 individually associated with the first feeder trunk finder 700 is the only idle operator position at the automatic B switchboard 800 at this time, only the first feeder trunk finder distributor 1300 may preselect the first feeder trunk finder 700 as ground potential appears only on the first guard conductor C1382. Hence, the idle first feeder trunk finder 700 will be preselected by the first feeder trunk finder distributor 1300 and operated thereby to seize the calling feeder trunk in the first group in preference to the calling feeder trunk in the second group.

Continuing now with the operation of the first trunk finder 500, the first feeder trunk circuit 600, the first digit register apparatus 1400 and the first digit sender apparatus 1600, it is noted that, when all of the digits registered in the first digit register apparatus 1400 have been sent by the first digit sender apparatus 1600 over the first feeder trunk circuit 600, the first trunk finder 500, the answering branch 211Y and the outgoing branch 211Z of the trunk 211 to the automatic switching apparatus 270 in the distant exchange 50, the first digit sender apparatus 1600 operates in order to cause low resistance battery potential to be applied to the register start conductor C687. The application of low resistance battery potential to the register start conductor C687 completes a circuit substantially identical to that previously traced for increasing the energization of the winding of the release relay R645 in the first feeder trunk circuit 600, whereupon the release relay R645 operates shortly thereafter, the latter relay being of the slow-to-operate type. Upon operating, the release relay R645 interrupts, at the contacts 646, the previously traced circuit for energizing in series the upper winding of the send relay R660 in the first feeder trunk circuit 600 and the winding of the cut-in relay R480 and the upper winding of the cutoff relay R460 in the trunk circuit 400, thereby to cause the send relay R660 and the cut-in relay R480 to restore. The restoration of the cut-in relay R480 in the trunk circuit 400 is effective to complete the connection

between the incoming branch 211X and the outgoing branch 211Z of the trunk 211, in the manner previously explained.

Upon restoring, the send relay R660 in the first feeder trunk circuit 600 interrupts, at the contacts 663, the previously mentioned path for applying ground potential to the hold conductor C584, thereby to interrupt the previously traced circuit for illuminating the supervisory lamp L576 and the previously traced multiple holding circuits for energizing the winding of the first group relay R510 and the winding of the first and sixth unit relay R530, whereupon the supervisory lamp L576 is extinguished in order to indicate to the exchange attendant that the first trunk finder 500 has been released and the relays mentioned restored. At this time, the first trunk finder 500 is completely released and available for further use. Also, upon restoring, the send relay R660 re completes, at the contacts 661', the previously traced path for applying battery potential to the guard conductor C1195, thereby to mark the first trunk finder 500 as idle to the first trunk finder distributor 1100. Further, the send relay R660 interrupts, at the contacts 662', the previously mentioned holding circuit for energizing the winding of the control relay R650, thereby to cause the latter relay to restore. Upon restoring, the control relay R650 interrupts, at the contacts 654, the previously traced circuit for energizing the winding of the release relay R645, thereby to cause the latter relay to restore. At this time, the first feeder trunk circuit 600 is completely released and available for further use.

Operation of the first digit register apparatus 1400 and the first digit sender apparatus 1600

As previously explained, each feeder trunk circuit has digit register apparatus and digit sender apparatus individually associated therewith, the first digit register apparatus 1400 and the first digit sender apparatus 1600 being individually associated with the first feeder trunk circuit 600. The operation of any digit register apparatus and the associated digit sender apparatus may be controlled from any operator position at the automatic B switchboard 800. However, considering the operation of the first digit register apparatus 1400 and the first digit sender apparatus 1600 from the first operator position 810 at the automatic B switchboard 800, it is noted that the first digit register apparatus 1400 is operatively associated with the key set 1305 at the first operator position 810 and with the first feeder trunk circuit 600 incident to the operation of the cut-in relay R1410 in the cut-in apparatus 1405, in the manner previously explained.

As previously explained, when the first feeder trunk 610 is seized by the first feeder trunk finder 700, the switch-through relay R630 in the first feeder trunk circuit 600 operates in order to complete the previously traced path for applying ground potential to the register start conductor C687. This application of ground potential to the register start conductor C687 completes an obvious circuit for energizing in multiple the upper and lower windings of the start relay R1640 in the first digit sender apparatus 1600. When thus energized, the start relay R1640 operates to complete, at the contacts 1641, an obvious path for applying ground potential to the release conductor C1601, thereby to complete an obvious circuit, including the contacts 1441, for energizing the winding of the first select relay R1490. When thus energized, the first select relay R1490 oper-

ates to prepare, at the contacts 1491, 1492, etc., circuits for energizing the windings of the four marking relays R1450 to R1480, inclusive. At this time, the first register 1401 in the first digit register apparatus 1400 is in readiness to receive the first digit to be keyed at the key set 1305 at the first operator position 810.

The operator at the first operator position 810 then operates the digit keys K1 to K0, inclusive, corresponding to the first digit of the directory number to be transmitted. At this point, it is noted that each of the digit keys K1 to K0, inclusive, is individually operative to mark one or more of the four marking conductors C1391 to C1394, inclusive, with ground potential, thereby to complete one or more obvious circuits, including one or more of the four marking conductors C1401 to C1404, inclusive, for energizing the winding of one or more of the four marking relays R1450 to R1480, inclusive. From an examination of the cross connections between the individual digit keys K1 to K0, inclusive, of the key set 1305 and the four marking conductors C1391 to C1394, inclusive, it will be apparent that, when any digit key is operated, a circuit is completed for energizing either one or two of the four marking relays R1450 to R1480, inclusive, in different combinations.

More particularly, the four marking relays R1450 to R1480, inclusive, are operated in accordance with the following digits and, consequently, the operation of the corresponding digit keys K1 to K0, inclusive, of the key set 1305:

Digit	Digit key	Marking relay operated
1	K1	R1470 and R1480.
2	K2	R1460 and R1480.
3	K3	R1450 and R1480.
4	K4	R1460 and R1470.
5	K5	R1450 and R1470.
6	K6	R1450 and R1460.
7	K7	R1480.
8	K8	R1470.
9	K9	R1460.
0	K0	R1450.

When one or more of the marking relays R1450 are operated they prepare, at the associated contacts 1458, 1460, etc., holding circuits traced hereinafter for energizing the windings thereof, including the upper winding of the first register transfer relay R1440; which holding circuits are completed when the digit key of the key set 1305 is released. For example, when the digit key K9 is operated and released, the marking relay R1450 is operated and locked in series with the upper winding of the first register transfer relay R1440. The holding circuit for energizing in series the upper winding of the first register transfer relay R1440 and the marking relay R1450 extends from the grounded release conductor C1601 by way of the contacts 1431, C1406, the upper winding of R1440, the contacts 1458 and R1450 to battery. When this series holding circuit is completed the marking relay R1450 remains in its operated position and the first register transfer relay R1440 operates. Upon operating, the first register transfer relay R1440 completes, at the contacts 1444, an obvious path, including the contacts 1457, for applying ground potential to the hold conductor C683. This application of ground potential to the hold conductor C683 completes an obvious circuit for energizing the winding of the hold relay R1620 in the first digit sender apparatus 1600, thereby to cause

the latter relay to operate. Upon operating, the hold relay R1620 completes, at the contacts 1621, an obvious circuit for energizing the winding of the control relay R1630, thereby to cause the latter relay to operate. Upon operating, the control relay R1630 completes, at the contacts 1631, an obvious circuit, including the contacts 1653, for energizing the winding of the control relay R1650, thereby to cause the latter relay to operate. Upon operating, the control relay R1650 completes, at the contacts 1652, an obvious holding circuit for energizing the winding thereof. Also, the control relay R1630 interrupts, at the contacts 1633, the previously mentioned circuit for energizing the upper winding of the start relay R1640; however, the start relay R1640 remains operated due to the completed circuit for energizing the lower winding thereof. Also, it is noted that the application of ground potential to the hold conductor C633 completes the previously traced circuit for energizing the lower winding of the send relay R560 in the first feeder trunk circuit 600, thereby to cause the latter relay to operate, as previously explained. Also, upon operating, the first register transfer relay R1440 interrupts, at the contacts 1441, the previously traced circuit for energizing the winding of the first select relay R1490, thereby to cause the latter relay to restore in order to interrupt, at the contacts 1491, etc., the previously prepared circuits for energizing the windings of the four marking relays R1450 to R1480, inclusive. Also, the first register transfer relay R1440 completes, at the contacts 1442, a circuit for energizing the winding of the second select relay R1590, this circuit extending from the grounded release conductor C1601 by way of the contacts 1442, 1531 and R1590 to battery. When thus energized, the second select relay R1590 operates to prepare, at the contacts 1591, etc., obvious circuits, including the four marking conductors C1401 to C1404, inclusive, for energizing the windings of the four marking relays R1550 to R1580, inclusive.

Accordingly, at this time, the first digit is registered in the four marking relays R1450 to R1480, inclusive, in the first register 1401, and the key set 1305 is operatively associated with the four marking relays R1550 to R1580, inclusive, in the first register 1401 in order to condition the last-mentioned marking relays to register the second digit. When the marking relays R1450 to R1480, inclusive, have registered therein any digit between 1 and 9, the corresponding one of the nine marking conductors in the marking cable 1695 is marked with ground potential by way of the grounded marking conductor C1495 having ground potential connected thereto in the last register 1502; and when the marking relays R1450 to R1480, inclusive, have registered therein the digit 0 none of the marking conductors in the marking cable 1695 is marked with ground potential by way of the grounded marking conductor C1495.

In view of the foregoing explanation of the operation of the first digit register apparatus 1400 to register the first digit in the marking relays R1450 to R1480, inclusive, in the first register 1401, it will be understood that the second digit is registered in a similar manner in the marking relays R1550 to R1580, inclusive, in the first register 1401. Similarly, the third and fourth digits are registered in the intermediate

register 1501, and the fifth and sixth digits are registered in the last register 1502.

When the operator at the first operator position 810 at the automatic B switchboard 800 has registered the six digits in the first digit register apparatus 1400 she operates the clear-out key K11 of the key set 1305, thereby to complete an obvious path for applying ground potential by way of the conductor C1395 and the contacts 1412 to the start conductor C686, thereby to complete the previously traced circuit for energizing the winding of the control relay R550 in the first weeder trunk circuit 600 in order to cause operation thereof, in the manner previously explained.

In the event the operator at the first operator position 810 at the automatic B switchboard 800 makes an error in registering the digits in the first digit register apparatus 1400, she operates the error key K12 of the key set 1305, thereby to complete an obvious path, including the conductor C1396 and the contacts 1411, for applying ground potential to the error conductor C684, whereby the previously traced circuit for energizing the winding of the error relay R640 in the first feeder trunk circuit 600 is completed in order to cause the latter relay to operate, in the manner previously explained.

Further considering the operation of the first digit sender apparatus 1600, it is noted that, upon operating, the control relay R1650 also completes, at the contacts 1651, a circuit for energizing the winding of the cycle relay R1680, this circuit extending from ground by way of the contacts 1643, 1651 and 1691 and R1680 to battery. When thus energized the cycle relay R1680 operates to complete, at the contacts 1681, an obvious holding circuit for energizing the winding thereof, and to complete, at the contacts 1682, an obvious circuit for energizing the winding of the pulse relay R1670. When thus energized the pulse relay R1670 operates to complete, at the contacts 1671, an obvious circuit for energizing the winding of the cycle relay R1690. When thus energized the cycle relay R1690 operates to interrupt, at the contacts 1691, the previously mentioned holding circuit for energizing the winding of the cycle relay R1680, thereby to cause the latter relay to restore. Upon restoring, the cycle relay R1680 interrupts, at the contacts 1682, the previously mentioned circuit for energizing the winding of the pulse relay R1670, thereby to cause the latter relay to restore. Upon restoring, the pulse relay R1670 interrupts, at the contacts 1671, the previously mentioned circuit for energizing the winding of the cycle relay R1690, thereby to cause the latter relay to restore. Upon restoring, the cycle relay R1690 re completes, at the contacts 1691, the previously traced original circuit for energizing the winding of the cycle relay R1680, thereby to cause the latter relay to operate and initiate a new cycle of operation of the cycle relay R1680, the pulse relay R1670 and the cycle relay R1690, in the manner described above.

A path is normally completed between the line conductors C681 and C682 extending to the first feeder trunk circuit 600, which path extends from the line conductor C681 by way of the contacts 1672, C1636 and the contacts 1622 to the line conductor C682. Accordingly, each time the pulse relay R1670 operates and restores it interrupts and then re completes, at the contacts 1672, the previously traced path between the line conductors C681 and C682, thereby to cause an impulse to be transmitted to the first feeder trunk

circuit 600. The first time the pulse relay R1670 operates it completes, at the contacts 1673, a circuit for energizing the winding of the pulse start relay R1750, this circuit extending from ground by way of the contacts 1642 and 1673, C1693 and R1750 to battery. When thus energized, the pulse start relay R1750 operates to prepare, at the contacts 1750, a holding circuit for energizing the winding thereof in series with the lower winding of the first counting relay R1810, which holding circuit is completed when the pulse relay R1670 restores. This holding circuit extends, when completed, from ground by way of the contacts 1642, C1694, the contacts 1732 and 1741, C1765, the lower winding of R1810, C1764, the contacts 1746, C1763, the contacts 1814, etc., and 1803, C1761, the contacts 1750 and R1750 to battery. When thus energized, the first counting relay R1810 operates to complete, at the contacts 1812, a holding circuit for energizing the winding thereof, this circuit extending from ground by way of the contacts 1642, C1694, the contacts 1732 and 1741, C1765, the contacts 1812 and the upper winding of R1810 to battery. Also, the first counting relay R1810 interrupts, at the contacts 1814, the previously traced holding circuit for energizing the lower winding thereof in series with the pulse start relay R1750, thereby to cause the latter relay to restore. Finally, the first counting relay R1810 prepares, at the contacts 1811, an obvious test circuit, including the first marking conductor in the marking cable 1695, for energizing the lower winding of the pulse stop relay R1740; which circuit is completed only in the event ground potential appears upon the first marking conductors in the marking cable 1695 corresponding to the registration of the digit 1 in the four marking relays R1450 to R1480, inclusive, in the first register 1401. Assuming that the digit registered in the marking relays R1450 to R1480, inclusive, in the first register 1401 is other than the digit 1, the previously mentioned circuit for energizing the lower winding of the pulse stop relay R1740 is not completed and further operation of the cycle relays R1680 and R1690 and the pulse relay R1670 effect reoperation of the pulse start relay R1750, whereby the second counting relay R1820 is operated in the manner previously explained. Accordingly, the first to the tenth counting relays R1810 to R1800, inclusive, operate sequentially in order to prepare, at the associated upper contacts, obvious test circuits between the various marking conductors in the marking cable 1695 and the lower winding of the pulse stop relay R1740.

When one of the first nine counting relays R1810 to R1890, inclusive, operates and one of the digits 1 to 9, inclusive, is registered in the marking relays R1450 to R1480, inclusive, in the first register 1401, the previously mentioned circuit for energizing the lower winding of the pulse stop relay R1740 is completed; on the other hand, when the digit 0 is registered in the marking relays R1450 to R1480, inclusive, in the first register 1401, an alternative circuit for energizing the lower winding of the pulse stop relay R1740 is completed incident to the operation of the tenth counting relay R1800, this alternative circuit extending, when completed, from ground by way of the contacts 1642, C1694, the contacts 1801, C1760 and the lower winding of R1740 to battery. Hence, the pulse stop relay R1740 operates when one of the ten counting relays R1810 to R1800, inclusive, operates, corresponding to the digit registered in the four marking relays

R1450 to R1480, inclusive, in the first register 1401. Upon operating, the pulse stop relay R1740 completes, at the contacts 1744, a holding circuit for energizing the upper winding thereof, this circuit extending from ground by way of the contacts 1642, C1694, the contacts 1713 and 1744 and the upper winding of R1740 to battery. Also, the pulse stop relay R1740 completes, at the contacts 1747, a multiple path, excluding the contacts 1672 of the pulse relay R1670, between the line conductors C681 and C682 extending into the first feeder trunk circuit 600, thereby positively to prevent further impulsing in the first digit transmitted to the first feeder trunk circuit 600. This path extends, when completed, from the line conductor C681 by way of the contacts 1664, C1697, the contacts 1747, C1696, and the contacts 1622 to the line conductor C682. Also, upon operating, the pulse stop relay R1740 completes, at the contacts 1742, a circuit for energizing the winding of the first hold relay R1420, this circuit extending from ground by way of the contacts 1642, C1694, the contacts 1732, 1742, 1711 and 1665, C1602, the circuits in the last register 1502 and the intermediate register 1501, the contacts 1522, 1432 and R1420 to battery. When thus energized the first hold relay R1420 operates to prepare, at the contacts 1421, a holding circuit for energizing the winding thereof in series with the winding of the first impulse transfer relay R1430, which circuit is completed incident to the operation of the spacing relay R1730 in order to interrupt the previously traced original circuit for energizing the winding of the first hold relay R1420, in a manner more fully explained hereinafter. The holding circuit for energizing in series the winding of the first hold relay R1420 and the winding of the first impulse transfer relay R1430 extends from ground by way of the contacts 1641, C1601, the contacts 1521, R1430, the contacts 1421 and R1420 to battery. When thus energized the first impulse transfer relay R1430 operates to interrupt, at the contacts 1431, the previously traced holding circuit for energizing in series the upper winding of the first register transfer relay R1440 and one or more of the marking relays R1450 to R1480, inclusive, thereby to cause the latter relays to restore. Also, the first impulse transfer relay R1430 prepares, at the contacts 1433, a point in a circuit traced hereinafter for energizing the winding of the second hold relay R1510, and completes, at the contacts 1435, an obvious path for applying ground potential to the marking conductor C1595, thereby to mark with ground potential the marking conductors in the marking cable 1695, in accordance with the operated condition of the marking relays R1550 to R1580, inclusive.

Also, upon operating, the pulse stop relay R1740 interrupts, at the contacts 1741, the previously traced holding circuits for energizing the upper winding of the various counting relays R1810 to R1800, inclusive, thereby to cause the latter relays to restore. Further, the pulse stop relay R1740 prepares, at the contacts 1745, a holding circuit for energizing the winding of the pulse start relay R1750 in series with the lower winding of the spacing relay R1730, which circuit is completed incident to the next operation and subsequent restoration of the pulse relay R1670. The last-mentioned circuit extends, when completed, from ground by way of the contacts 1642, C1694, the lower winding of R1730, the contacts 1738 and 1745, C1763, the contacts 1814, etc., and 1803, C1761, the contacts 1750 and

R1750 to battery. When thus energized, the spacing relay R1730 operates to complete, at the contacts 1734, an obvious holding circuit for energizing the upper winding thereof, and to interrupt, at the contacts 1732, the previously traced circuit for energizing the upper winding of the first hold relay R1420, as previously explained. Also, upon operating, the spacing relay R1730 interrupts, at the contacts 1738, the previously traced holding circuit for energizing the lower winding thereof in series with the winding of the pulse start relay R1750, thereby to cause the latter relay to restore. Finally, the spacing relay R1730 prepares, at the contacts 1736, an alternative holding circuit for energizing the lower winding of the first counting relay R1810 in series with the winding of the pulse start relay R1750, which circuit is completed incident to the operation and subsequent restoration of the pulse relay R1670. The last-mentioned circuit extends, when completed, from ground by way of the contacts 1642, C1694, the contacts 1721 and 1731, C1765, the lower winding of R1810, C1764, the contacts 1725, 1736 and 1745, C1763, the contacts 1814, etc., and 1803, C1761, the contacts 1750 and R1750 to battery. Accordingly, at this time, the first, second, third and fourth counting relays R1810 to R1840, inclusive, operate and lock sequentially, in the manner previously explained.

When the fourth counting relay R1840 operates and locks, a circuit is completed for energizing the lower winding of the spacing relay R1720 which extends from the grounded conductor C1694 by way of the contacts 1721 and 1731, C1765, the contacts 1842, C1762, the contacts 1735 and the lower winding of R1720 to battery. When thus energized the spacing relay R1720 operates to complete, at the contacts 1723, an obvious holding circuit for energizing the upper winding thereof, and to interrupt, at the contacts 1721, the previously traced holding circuits for energizing the upper windings of the counting relays R1810 to R1840, inclusive, thereby to cause the latter relays to restore. Further, the spacing relay R1720 prepares, at the contacts 1724, a holding circuit traced hereinafter for energizing the lower winding of the spacing relay R1710 in series with the winding of the pulse start relay R1750, which circuit is completed incident to the next operation and subsequent restoration of the pulse relay R1670. This circuit extends, when completed, from the grounded conductor C1694 by way of the lower winding of R1710, the contacts 1714, 1724, 1736 and 1745, C1763, the contacts 1814, etc., and 1803, C1761, the contacts 1750 and R1750 to battery. When thus energized, the spacing relay R1710 operates to interrupt, at the contacts 1714, the previously traced holding circuit for energizing the lower winding thereof in series with the winding of the pulse start relay R1750, thereby to cause the latter relay to restore. Also, the spacing relay R1710 completes, at the contacts 1712, a holding circuit for energizing the upper winding thereof, this circuit extending from the grounded conductor C1694 by way of the contacts 1722, 1733, R1743 and R1712 and the upper winding of R1710 to battery. Further, the spacing relay R1710 interrupts, at the contacts 1713, the previously traced holding circuits for energizing the upper windings of the pulse stop relay R1740 and the spacing relays R1730 and R1720, thereby to cause the latter relays to restore. Upon restoring, the pulse stop relay R1740 and the spacing relays R1730 and R1720 interrupt, at the contacts 1743, 1733 and

1722, respectively, the previously traced holding circuit for energizing the upper winding of the spacing relay R1710, thereby to cause the latter relay to restore. At this time, the first digit sender apparatus 1600 is in condition to send the second digit registered in the four marking relays R1550 to R1580, inclusive, in the first digit register apparatus 1400. Accordingly, the first digit register apparatus 1400 and the first digit sender apparatus 1600 interact repeatedly in the manner described above, thereby to cause the six digits registered in the first digit register apparatus 1400 to be transmitted to the first feeder trunk circuit 600.

When all of the digits registered in the first digit register apparatus 1400 have been transmitted by the first digit sender apparatus 1600, all of the register transfer relays R1440, R1530, etc., restore to interrupt the various multiple paths for applying ground potential to the hold conductor C683, whereupon the hold relay R1620 restores. Upon restoring, the hold relay R1620 interrupts, at the contacts 1621, the previously mentioned circuit for energizing the winding of the control relay R1630, thereby to cause the control relay R1630 to restore shortly thereafter, the latter relay being of the slow-to-release type. Also, the hold relay R1620 interrupts, at the contacts 1622, an obvious path for short-circuiting the resistor 1623, whereby the resistor 1623 is inserted in the previously traced bridge path in the line of conductors C681 and C682 extending into the first feeder trunk circuit 600. Upon restoring, the control relay R1630 completes at the contacts 1633, the previously traced circuit for energizing in multiple the upper and lower windings of the start relay R1640, thereby appreciably to reduce the series resistance of the application of battery potential to the register start conductor C687, whereupon the release relay R645 in the first feeder trunk circuit 600 operates in order to effect the release of the first trunk finder 500 and the first feeder trunk circuit 600, in the manner previously explained.

When the first feeder trunk circuit 600 is released, ground potential is removed from the register start conductor C687, thereby to interrupt the previously traced multiple circuit for energizing in series the upper and lower windings of the start relay R1640 in the first digit sender apparatus 1600, thereby to cause the latter relay to restore. Upon restoring, the start relay R1640 interrupts, at the contacts 1644, the previously traced holding circuit for energizing the winding of the control relay R1650, thereby to cause the latter relay to restore; and interrupts, at the contacts 1642, the previously traced circuits for energizing the various windings of the ten counting relays R1310 to R1800, inclusive, the pulse start relay R1750, the pulse stop relay R1740 and the three spacing relays R1710, R1720 and R1730, thereby to cause the latter relays to restore. Also, the start relay R1640 interrupts, at the contacts 1643, the previously traced circuit for energizing the winding of the cycle relay R1680, thereby to cause the latter relay to restore, whereupon the circuits for energizing the windings of the pulse relay R1670 and the cycle relay R1690 are interrupted, thereby to cause the latter relays to restore. At this time, the first digit register apparatus 1400 and the first digit sender apparatus 1600 are completely released.

At this point, it is noted that the operation or the error relay R640 in the first feeder trunk circuit 600 is effective to interrupt, at the contacts

643, the previously traced paths for applying ground potential to the register start conductor C687, thereby to interrupt the circuit for energizing the lower winding of the start relay R1640 in the first digit sender apparatus 1600 in order to effect the release of this apparatus, in the manner described above, incident to the operation of the error key K12 of the key set 1305 at the first operator position 810 at the automatic B switchboard 800. Hence, the operation of the error key K12 of the key set 1305 at the first operator position 810 is effective to clear out the first digit register apparatus 1400 and to arrest operation of the first digit sender apparatus 1600. More particularly, it is noted that, upon restoring, the start relay R1640 interrupts, at the contacts 1641, the previously traced path for applying ground potential to the release conductor C1601, thereby to interrupt the previously traced holding circuits for energizing the upper windings of the various register transfer relays R1440, R1530, etc., in series with the respective marking relays in the two groups of marking relays R1450 to R1480, inclusive, and R1550 to R1580, inclusive, etc., thereby to effect the clearing out of any digits registered in the first digit register apparatus 1400.

At this point, it is noted that the first digit register apparatus 1400 is so connected and arranged that the various digit registers therein may be utilized in rotation, whereby more than six digits may be transmitted in the event this is necessary. More particularly, the first and second digits are respectively registered in the two groups of marking relays R1450 to R1480, inclusive, and R1550 to R1580, inclusive, as previously explained; also, the seventh and eighth digits will be registered respectively in the two groups of marking relays mentioned. Reconsidering the first register 1401, it is noted that when the first digit is registered in the first group of marking relays R1450 to R1480, inclusive, the first register transfer relay R1440 operates and completes, at the contacts 1442, an alternative holding circuit for energizing the lower winding thereof, this circuit extending from the grounded release conductor C1601 by way of the contacts 1442, C1606, the contacts 1611, C1605 and the lower winding of R1440 to battery. Subsequently, the first impulse transfer relay R1430 interrupts, at the contacts 1431, the previously traced holding circuit for energizing the upper winding of the first register transfer relay R1440; however, the above-traced holding circuit for energizing the lower winding of the first register transfer relay R1440 is not interrupted until the sixth digit is registered in the last register 1502. When this occurs a circuit is completed for energizing the winding of the seizure relay R1610, thereby to cause this relay to operate. Upon operating, the seizure relay R1610 interrupts, at the contacts 1611, the previously traced holding circuit for energizing the lower winding of the first register transfer relay R1440, thereby to cause the latter relay to restore. Further, the seizure relay R1610 completes, at the contacts 1612, an obvious circuit, including the conductor C1607, for energizing the winding of the first select relay R1490, thereby to cause the latter relay to operate. Upon operating, the first select relay R1490 reprepares, at the contacts 1491, etc., the previously traced circuits for energizing the windings of the marking relays R1450 to R1480, inclusive, whereby these relays are in readiness to register the seventh digit transmit-

ted by the key set 1305 at the first operator position 810.

Operation of the call waiting apparatus 900

When all of the feeder trunk finders are busy and operation of the first feeder trunk finder distributor 1300 is initiated, the reset relay R1370 therein operates, as previously explained, thereby to complete, at the contacts 1371, an obvious path for applying ground potential to the busy conductor C1339. Similarly, when operation of the second feeder trunk finder distributor 1350 is initiated, when all of the feeder trunk finders are busy, the reset relay, not shown, in the second feeder trunk finder distributor 1350 operates in order to complete a similar path for applying ground potential to the busy conductor C1338. The application of ground potential to the busy conductor C1339 completes an obvious circuit for energizing the lower winding of the start relay R980 in the call waiting apparatus 900; similarly, the application of ground potential to the busy conductor C1338 completes an obvious circuit for energizing the upper winding of the start relay R980 in the call waiting apparatus 900. When thus energized the start relay R980 operates to complete, at the contacts 981, an obvious circuit for illuminating the call waiting lamp L973, thereby to indicate the presence of either one or two waiting calls to the operators at the various operator positions at the automatic B switchboard 800, while all of the feeder trunk finders and, consequently, all of the operator positions at the automatic B switchboard 800 are busy.

As previously explained, while a call is waiting to be answered on any one of the trunks, the trunk circuit associated therewith operates to cause resistance ground potential therein to be applied to the call waiting conductor C974. The waiting relays R950 and R930 are of the marginal type and are so connected and arranged that, when resistance ground potential is connected in either one or two of the associated trunk circuits to the call waiting conductor C974, neither of these relays operates. On the other hand, when resistance ground potential in either three or four of the associated trunk circuits is connected to the call waiting conductor C974, the waiting relay R950 operates; however, the waiting relay R930 does not operate. Finally, when resistance ground potential in five or more of the associated trunk circuits is connected to the call waiting conductor C974, the waiting relay R930 operates while the waiting relay R950 occupies its operated position.

When the start relay R980 is operated and neither of the waiting relays R930 or R950 is operated, the previously mentioned circuit for illuminating the call waiting lamp L973 is completed, as previously noted, in order to indicate that one or two calls are waiting to be answered. When the start relay R980 is operated and the waiting relay R950 operates, the waiting relay R950 completes, at the contacts 952, an obvious circuit for illuminating the call waiting lamp L972 in order to indicate that three or four calls are waiting to be answered. Also, the waiting relay R950 completes, at the contacts 951, an obvious circuit for energizing the winding of the control relay R960, thereby to cause the latter relay to operate and interrupt, at the contacts 961, the previously mentioned circuit for illuminating the call waiting lamp L973, whereupon this call waiting lamp is extinguished. When the

waiting relay R930 operates it completes, at the contacts 931, an obvious circuit for energizing the winding of the control relay R940, thereby to cause the latter relay to operate. Upon operating, the control relay R940 completes, at the contacts 941, an obvious circuit for illuminating the call waiting lamp L971, in order to indicate that five or more calls are waiting to be answered. Also, the control relay R940 interrupts, at the contacts 942, the previously mentioned circuit for illuminating the call waiting lamp L972, whereupon this call waiting lamp is extinguished.

Periodically, ground potential is applied to the timing conductor C982, thereby to cause periodic operation and subsequent restoration of the reset relay R910. Each time the reset relay R910 operates it interrupts, at the contacts 911, the previously traced series circuit for energizing the windings of the waiting relays R930 and R950, thereby to cause these relays to restore. Also, the reset relay R910 completes, at the contacts 912, an obvious circuit for energizing the winding of the timing relay R920, thereby to cause the latter relay to operate. Upon operating, the timing relay R920 interrupts, at the contacts 921, a common point in the previously mentioned circuits for illuminating the call waiting lamps L973 and L972, thereby to cause either one of these call waiting lamps illuminated to be extinguished. Upon restoring, the waiting relay R930 interrupts, at the contacts 931, the previously mentioned circuit for energizing the winding of the control relay R940, thereby to cause the latter relay to restore, and interrupt, at the contacts 941, the previously mentioned circuit for illuminating the call waiting lamp L971, whereby this waiting lamp, if illuminated, is extinguished. Upon restoring, the waiting relay R950 interrupts, at the contacts 951, the previously mentioned circuit for energizing the winding of the control relay R960, thereby to cause the control relay R960 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the control relay R960 reprepares, at the contacts 961, the previously mentioned circuit for illuminating the call waiting lamp L973.

Upon restoring, the reset relay R910 reprepares, at the contacts 911, the previously traced series circuit for energizing the windings of the waiting relays R930 and R950, whereby the call waiting condition of the system is tested in order to cause the waiting relay R950 to operate in the event there are three or more waiting calls, and to cause the waiting relay R930 to operate in the event there are five or more waiting calls, as previously explained. Also, the reset relay R910 interrupts, at the contacts 912, the previously mentioned circuit for energizing the winding of the timing relay R920, thereby to cause the timing relay R920 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the timing relay R920 reprepares, at the contacts 921, the common point in the previously mentioned circuits for illuminating the call waiting lamps L973 and L972. This recycling of the call waiting apparatus 900 by the reset relay R910 is provided in view of the fact that the waiting relays R930 and R950 are of the marginal type. Accordingly, it will be understood that the call waiting apparatus 900 provides an indication to the operators at the various operator positions at the automatic B switchboard 800 of the number of calls waiting to be answered when all of the operator positions are busy. When operation of the first feeder trunk

finder distributor 1300 and operation of the second feeder trunk finder distributor 1350 are resumed, the previously traced circuits for energizing the upper and lower windings of the start relay R980 are interrupted, thereby to cause this relay to restore. Upon restoring, the start relay R980 interrupts, at the contacts 981, a common point in the previously mentioned circuits for illuminating the call waiting lamps L973 and L972.

Night service

The operator at each operator position at the automatic B switchboard 800 may busy her position by busying the associated feeder trunk finder to the first feeder trunk finder distributor 1300 and the second feeder trunk finder distributor 1350. In order to accomplish this end at the first operator position 810 at the automatic B switchboard, it is only necessary for the operator thereat to withdraw the plugs associated with the transmitter 876 and the receiver 877 thereat from the associated jacks J874 and J875, whereupon the previously traced circuit for energizing the winding of the position relay R860 is interrupted in order to cause the latter relay to restore. Upon restoring, the position relay R860 interrupts, at the contacts 862, the previously traced paths for applying ground potential to the first guard conductor C1382 extending into the first feeder trunk finder distributor 1300, and to the second guard conductor C1355 extending into the second feeder trunk finder distributor 1350; whereupon the first feeder trunk finder 700 individually associated with the first operator position 810 at the automatic B switchboard 800 is rendered busy to both the feeder trunk finder distributors. Also, the position relay R860 interrupts, at the contacts 862, the previously traced multiple circuit, including the resistor 824, for energizing the winding of the hold relay R820; however, the hold relay R820 does not restore at this time, assuming that the other three operator positions at the automatic B switchboard 800 are staffed at this time. Finally, the position relay R860 completes, at the contacts 861, a circuit for energizing the winding 871 of the repeater 870 with tone current, this circuit extending from ground by way of the winding 871 of the repeater 870, the condenser 866 and the contacts 861 to the tone conductor C864 having tone potential connected thereto. The tone current traversing the winding 871 of the repeater 870 induces a corresponding tone voltage in the associated windings 872 and 873 of the repeater 870, whereby tone current is projected over the associated first feeder trunk finder 700 and a feeder trunk seized thereby in the event the first feeder trunk finder 700 seizes a calling feeder trunk the instant the operator at the first operator position 810 vacates her position.

When the operator reassumes the first operator position 810 at the automatic B switchboard 800 she first inserts the plugs associated with the transmitter 876 and the receiver 877 thereat into the associated jacks J874 and J875, thereby to recomplete the previously traced circuit for energizing the winding of the position relay R860. The position relay R860 reoperates to interrupt, at the contacts 861, the previously traced circuit for energizing the winding 871 of the repeater 870 with tone current, and completes, at the contacts 862, the previously traced paths for applying ground potential to the first and sec-

ond guard conductors C1382 and C1355 respectively extending into the first and second feeder trunk finder distributors 1300 and 1350, respectively. Also, the position relay R860 completes, at the contacts 862, the previously traced multiple circuit, including the resistor 824, for energizing the winding of the hold relay R820, as previously noted.

When the operator at each operator position at the automatic B switchboard 800 vacates her position, night service is automatically instituted in view of the fact that all of the multiple circuits for energizing the winding of the hold relay R820 are interrupted, whereupon the latter relay restores. Upon restoring, the hold relay R820 completes, at the contacts 821, obvious multiple circuits for energizing the windings of the switching relays R810 and R840, thereby to cause the latter relays to operate. Upon operating, the switching relay R840 interrupts, at the contacts 841 and 843, the connection between the first feeder trunk finder 700 and the first operator position 810 at the automatic B switchboard 800, and completes, at the contacts 842 and 844, an obvious connection between the first feeder trunk finder 700 and the answer key K855 at the automatic night operator position 850. Also, the switching relay R840 interrupts, at the contacts 847, a point in the previously traced circuit for energizing the winding of the tone relay R790, and prepares, at the contacts 846, an alternative circuit for energizing the winding of the tone relay R790. The alternative circuit for energizing the winding of the tone relay R790 is completed when the answer key K855 at the automatic night operator position 850 occupies its operated position; and extends, when completed, from ground by way of the contacts of the answer key K855, C851, the contacts 846, C817, the contacts 757, 774 and 739 and R790 to battery. Further, the switching relay R840 completes, at the contacts 845, a multiple holding circuit for energizing the windings of the switching relays R810 and R840 when the answer key K855 occupies its operated position, in an obvious manner. Finally, the switching relay R840 completes, at the contacts 848, etc., a multiple connection between the key set 1305 at the first operator position 810 at the automatic B switchboard 800 and the key set, not shown, at the automatic night operator position 850, whereby the various digit register apparatus individually associated with corresponding ones of the feeder trunk circuits may be selectively controlled by the key set at the automatic night operator position 850.

Upon operating, the switching relay R810 interrupts, at the contacts 812, a point in the previously traced circuit for illuminating the supervisory lamp L815 at the first operator position 810, and prepares, at the contacts 811, a point in an obvious circuit for energizing the winding of the buzzer 853 and for illuminating the supervisory lamp L854 at the automatic night operator position 850. Finally, the switching relay R810 interrupts, at the contacts 814, a further point in the previously traced path for applying ground potential at the first operator position 810 to the first and second guard conductors C1382 and C1355, respectively, and completes, at the contacts 813, a point in an obvious alternative path for applying ground potential to the first and second guard conductors C1382 and C1355, respectively.

Accordingly, at this time, the first feeder trunk

finder 700 which is normally individually associated with the first operator position 810 at the automatic B switchboard 800 is operatively associated with the automatic night operator position 850; and the other three feeder trunk finders are marked as busy to the first and second feeder trunk finder distributors 1300 and 1350, respectively. Hence, at this time, all incoming calls are answered at the automatic night operator position 850 by way of the first feeder trunk finder 700. When the first feeder trunk finder 700 operates to find a calling feeder trunk at this time, the previously mentioned circuit for illuminating the supervisory lamp L854 and for operating the buzzer 853 at the automatic night operator position 850 is rendered effective. Also, when the operator at the automatic night operator position 850 operates the answer key K855, in the event the answer key K855 is not operated at this time, the previously traced circuit for energizing the winding of the tone relay R790 is completed, whereby the first feeder trunk finder 700 operates to cause tone current to be transmitted both to the automatic night operator position 850 and over the feeder trunk seized by the first feeder trunk finder 700 to the calling operator position, thereby to indicate to the operator at the calling operator position that the call may be passed to the operator at the automatic night operator position 850 and to indicate to the operator at the automatic night operator position 850 that a call is to be passed to her position.

The operation of the apparatus at the automatic night operator position 850, in order to control the operation of the various digit register and sender apparatus and the first feeder trunk finder 700, is identical to that at the first operator position 810 at the automatic B switchboard 800; and in the interest of brevity it is not described in detail. Accordingly, it will be understood that, when night service is instituted, all incoming traffic to the automatic B switchboard 800 is cut over to the automatic night operator position 850 to be handled in the manner previously explained.

Conclusions

From the foregoing, it is apparent that a telephone system is provided which comprises a central office including an automatic B switchboard and a manual A switchboard, a distant exchange including a manual A switchboard, a distant exchange including automatic switching apparatus, and an improved arrangement for controlling the distribution of calls from the various A switchboard to the various operator positions at the automatic B switchboard to be answered and for subsequently extending the calls to the automatic switching apparatus.

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

What is claimed is:

1. In a telephone system, an A switchboard, a B switchboard including a plurality of operator positions, a plurality of trunks accessible to said A switchboard, a plurality of primary switches of the fully directive type having access to said trunks, each of said primary switches including a plurality of connect relays operative in differ-

ent combinations to seize said trunks, a plurality of feeder trunks individually associated with said primary switches, a plurality of secondary switches of the fully directive type having access to said feeder trunks and individually associated with said operator positions, each of said secondary switches including a plurality of connect relays operative in different combinations to seize said feeder trunks, means at said A switchboard for initiating a call on any one of said trunks, a primary marking network including a plurality of primary marking paths individually corresponding to said trunks and responsive to the presence of a call on any one of said trunks for completing the corresponding one of said primary marking paths, means responsive to the completion of said one primary marking path for operating in an idle one of said primary switches the connect relays corresponding to said one trunk, thereby to cause said one primary switch to seize said one trunk in order to extend the call to the associated one of said feeder trunks, a secondary marking network including a plurality of secondary marking paths individually corresponding to said feeder trunks and responsive to the presence of a call on any one of said feeder trunks for completing the corresponding one of said secondary marking paths, and means responsive to the completion of said one secondary marking path for operating in an idle one of said secondary switches the connect relays corresponding to said one feeder trunk, thereby to cause said one secondary switch to seize said one feeder trunk in order to extend the call to the associated one of said operator positions to be answered.

2. In a telephone system, an A switchboard, a B switchboard including a plurality of operator positions, automatic switching apparatus, a plurality of trunks, each of said trunks including an incoming branch accessible to said A switchboard and an answering branch and an outgoing branch associated with said switching apparatus, a plurality of primary switches of the fully directive type having access to the answering branches of said trunks, a plurality of feeder trunks individually associated with said primary switches, a plurality of secondary switches of the fully directive type having access to said feeder trunks and individually associated with said operator positions, means at said A switchboard for initiating a call on the incoming branch of any one of said trunks, first apparatus responsive to the presence of a call on the incoming branch of any one of said trunks for operating an idle one of said primary switches directly to seize the answering branch of said one trunk, thereby to extend the call on said one trunk to the associated one of said feeder trunks, second apparatus responsive to the presence of a call on any one of said feeder trunks for operating an idle one of said secondary switches directly to seize said one feeder trunk, thereby to extend the call on said one feeder trunk to the associated one of said operator positions to be answered, and means controllable from any one of said operator positions having a call on one of said trunks extended thereto for governing over the answering branch and the outgoing branch of said one trunk said automatic switching apparatus.

3. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, a digit register-sender device, an operator position, a digit register-sender controller associated with said operator

position, means responsive to the presence of a call on said incoming branch for connecting said incoming branch and said answering branch and for connecting said answering branch and said operator position, thereby to extend the call on said trunk to said operator position to be answered, means responsive to the extension of the call on said trunk to said operator position for connecting said digit register-sender device to said answering branch and for connecting said digit register-sender controller to said digit register-sender device, means responsive to an initial operation of said digit register-sender controller to register a digit in said digit register-sender device for disconnecting said incoming branch and said answering branch and for disconnecting said answering branch and said operator position and for connecting said outgoing branch and said answering branch, means for causing said digit register-sender device to send a digit or digits registered therein, means responsive to a final operation of said digit register-sender controller for disconnecting said digit register-sender controller from said digit register-sender device and for conditioning said digit register-sender device for automatic release when the digit or digits registered therein have been sent thereby, and means controlled when said digit register-sender device is released for disconnecting said digit register-sender device from said answering branch and for disconnecting said outgoing branch and said answering branch and for connecting said incoming branch and said outgoing branch.

4. In a telephone system, a trunk including an incoming branch and an answering branch, a primary switch having access to said answering branch, a digit register-sender device associated with said primary switch, a secondary switch having access to said primary switch, an operator position associated with said secondary switch, a digit register-sender controller associated with said operator position, means responsive to the presence of a call on said incoming branch for causing said primary switch to seize said answering branch, means responsive to the seizure of said answering branch by said primary switch for connecting said incoming branch and said answering branch and for causing said secondary switch to seize said primary switch, and means responsive to the seizure of said primary switch by said secondary switch for connecting said digit register-sender controller to said digit register-sender device.

5. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, a primary switch having access to said answering branch, a digit register-sender device associated with said primary switch, a secondary switch having access to said primary switch, an operator position associated with said secondary switch, a digit register-sender controller associated with said operator position, means responsive to the presence of a call on said incoming branch for causing said primary switch to seize said answering branch, means responsive to the seizure of said answering branch by said primary switch for connecting said incoming branch and said answering branch and for causing said secondary switch to seize said primary switch, means responsive to the seizure of said primary switch by said secondary switch for connecting said digit register-sender controller to said digit register-sender device, means responsive to an initial operation of said

digit register-sender controller to register a digit in said register-sender device for disconnecting said incoming branch and said answering branch and for connecting said outgoing branch and said answering branch, and means for causing said digit register-sender device to send over said primary switch and said answering and outgoing branches a digit or digits registered therein.

6. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, a primary switch having access to said answering branch, a digit register-sender device associated with said primary switch, a secondary switch having access to said primary switch, an operator position associated with said secondary switch, a digit register-sender controller associated with said operator position, means responsive to the presence of a call on said incoming branch for causing said primary switch to seize said answering branch, means responsive to the seizure of said answering branch by said primary switch for connecting said incoming branch and said answering branch and for causing said secondary switch to seize said primary switch, means responsive to the seizure of said primary switch by said secondary switch for connecting said digit register-sender controller to said digit register-sender device, means responsive to an initial operation of said digit register-sender controller to register a digit in said register-sender device for disconnecting said incoming branch and said answering branch and for connecting said outgoing branch and said answering branch, means for causing said digit register-sender device to send over said primary switch and said answering and outgoing branches a digit or digits registered therein, and means responsive to a final operation of said digit register-sender controller for disconnecting said digit register-sender controller from said digit register-sender device and for releasing said secondary switch and for conditioning said digit register-sender device for automatic release when the digit or digits registered therein have been sent thereby.

7. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, a primary switch having access to said answering branch, a digit register-sender device associated with said primary switch, a secondary switch having access to said primary switch, an operator position associated with said secondary switch, a digit register-sender controller associated with said operator position, means responsive to the presence of a call on said incoming branch for causing said primary switch to seize said answering branch, means responsive to the seizure of said answering branch by said primary switch for connecting said incoming branch and said answering branch and for causing said secondary switch to seize said primary switch, means responsive to the seizure of said primary switch by said secondary switch for connecting said digit register-sender controller to said digit register-sender device, means responsive to an initial operation of said digit register-sender controller to register a digit in said register-sender device for disconnecting said incoming branch and said answering branch and for connecting said outgoing branch and said answering branch, means for causing said digit register-sender device to send over said primary switch and said answering and outgoing branches a digit or digits registered therein, means responsive to a final operation of said digit register-sender controller for disconnecting said digit reg-

ister-sender controller from said digit register-sender device and for releasing said secondary switch and for conditioning said digit register-sender device for automatic release when the digit or digits registered therein have been sent thereby, means responsive to the release of said digit register-sender device for releasing said primary switch, and means responsive to the release of said primary switch for disconnecting said outgoing branch and said answering branch and for connecting said incoming branch and said outgoing branch.

8. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, said branches being normally mutually disconnected, a trunk circuit associated with said trunk and including three relays, a control network for said relays, means responsive to the operation of a first of said relays while a second and a third of said relays are restored for connecting said incoming and said answering branches, means responsive to the operation of said second and said third relays while said first relay is operated for disconnecting said incoming and said answering branches and for connecting said answering and said outgoing branches, means responsive to the restoration of said third relay while said first and said second relays are operated for disconnecting said answering and said outgoing branches and for connecting said incoming and said outgoing branches, and means responsive to the restoration of said first and said second relays while said third relay is restored for disconnecting said incoming and said outgoing branches.

9. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, said branches being normally mutually disconnected, a trunk circuit associated with said trunk and including three relays, said relays being operative in different combinations to connect each two of said branches, and a control network for said relays including a series operating circuit for two of said relays.

10. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, said branches being normally mutually disconnected, a trunk circuit associated with said trunk and including three relays, said relays being operative in different combinations to connect each two of said branches, and a control network for said relays including a series operating circuit for two of said relays, one of said last-mentioned relays being of the marginal type.

11. In a telephone system, a trunk including an incoming branch and an answering branch and an outgoing branch, said branches being normally mutually disconnected, each of said branches including two talking conductors, said answering branch including a control conductor, a trunk circuit associated with said trunk and including a number of relays, said relays being operative in different combinations to connect the talking conductors of each two of said branches, an automatic switch having access to said answering branch, and means controllable over said switch by way of the control conductor of said answering branch for selectively governing the operation of said relays.

12. In a telephone system, a trunk, a digit register-sender device individually associated with said trunk, said digit register-sender device being adapted to register and to send over said trunk one or more digits, an operator position,

a digit register-sender controller individually associated with said operator position, means for connecting said trunk to said operator position, and means controlled when said trunk is connected to said operator position for connecting said digit register-sender controller to said digit register-sender device.

13. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, an operator position, a digit register-sender controller individually associated with said operator position, means for connecting any one of said trunks to said operator position, and means controlled when said one trunk is connected to said operator position for connecting said digit register-sender controller to the associated one of said digit register-sender devices.

14. In a telephone system, a trunk, a digit register-sender device individually associated with said trunk, said digit register-sender device being adapted to register and to send over said trunk one or more digits, a plurality of operator positions, a plurality of digit register-sender controllers individually associated with said operator positions, means for connecting said trunk to any one of said operator positions, and means controlled when said trunk is connected to said one operator position for connecting the associated one of said digit register-sender controllers to said digit register-sender device.

15. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, a plurality of operator positions, a plurality of digit register-sender controllers individually associated with said operator positions, means for connecting any one of said trunks to any one of said operator positions, and means controlled when said one trunk is connected to said one operator position for connecting the associated one of said digit register-sender controllers to the associated one of said digit register-sender devices.

16. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, an operator position, a digit register-sender controller individually associated with said operator position, automatic switching apparatus associated with said operator position and having access to said trunks, means responsive to the presence of a call on any one of said trunks for causing said switching apparatus to seize said one trunk and to extend the call on said one trunk to said operator position to be answered, and means controlled when the call on said one trunk is extended to said operator position for connecting said digit register-sender controller to the associated one of said digit register-sender devices.

17. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, an

operator position, a digit register-sender controller individually associated with said operator position, an automatic switch individually associated with said operator position and having access to said trunks, means responsive to the presence of a call on any one of said trunks for operating said automatic switch to seize said one trunk thereby to extend the call on said one trunk to said operator position to be answered, and means controlled by the operation of said automatic switch to seize said one trunk for connecting said digit register-sender controller to the associated one of said digit register-sender devices.

18. In a telephone system, a trunk, a digit register-sender device individually associated with said trunk, said digit register-sender device being adapted to register and to send over said trunk one or more digits, a plurality of operator positions, a plurality of digit register-sender controllers individually associated with said operator positions, automatic switching apparatus associated with said operator positions and having access to said trunk, means responsive to the presence of a call on said trunk for causing said switching apparatus to seize said trunk and to connect said trunk to an idle one of said operator positions, thereby to extend the call on said trunk to said one operator position to be answered, and means controlled when the call on said trunk is extended to said one operator position for connecting the associated one of said digit register-sender controllers to said digit register-sender device.

19. In a telephone system, a trunk, a digit register-sender device individually associated with said trunk, said digit register-sender device being adapted to register and to send over said trunk one or more digits, a plurality of operator positions, a plurality of digit register-sender controllers individually associated with said operator positions, a plurality of automatic switches individually associated with said operator positions and having access to said trunk, means responsive to the presence of a call on said trunk for operating one of said automatic switches associated with an idle one of said operator positions to seize said trunk, thereby to extend the call on said trunk to said one operator position to be answered, and means controlled by the operation of said one automatic switch to seize said trunk for connecting the one of said digit register-sender controllers associated with said one operator position to said digit register-sender device.

20. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, an operator position, a digit register-sender controller individually associated with said operator position, automatic switching apparatus associated with said operator position and having access to said trunks, means responsive to the presence of a call on any one of said trunks for operating said switching apparatus to seize said one trunk and to connect said one trunk to said operator position in the event said operator position is idle, means responsive to the operation of said switching apparatus for rendering busy said operator position and for connecting said digit register-sender controller to the associated one of said digit register-sender devices, means responsive to an initial operation of said digit register-sender controller for registering a digit or digits in said one digit register-sender device, means for causing said one digit register-sender device to send over said one trunk

a digit or digits registered therein, means responsive to a final operation of said digit register-sender controller for releasing said switching apparatus and for disconnecting said digit register-sender controller from said one digit register-sender device, and means responsive to the release of said switching apparatus for rendering idle said operator position.

21. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually and directly connected to said trunks, each of said digit register-sender devices being adapted to register and to send over the directly connected one of said trunks one or more digits, an operator position, means for connecting any one of said trunks to said operator position, and means selectively controllable from said operator position when said one trunk is connected thereto for registering one or more digits in the directly connected one of said digit register-sender devices.

22. In a telephone system including a plurality of links, an allotter operative through a given cycle to allot to idle ones of said links calls accumulated during a prior cycle of operation thereof, means for accumulating calls initiated during said given cycle of operation of said allotter to be allotted during a subsequent cycle of operation of said allotter, and means controlled by the presence of accumulated calls to be allotted for operating said allotter.

23. In a telephone system including a plurality of links, an allotter operative through a given cycle to allot to idle ones of said links calls accumulated during a prior cycle of operation thereof, means for accumulating calls initiated during said given cycle of operation of said allotter to be allotted during a subsequent cycle of operation of said allotter, means controlled by the presence of accumulated calls to be allotted for initiating operation of said allotter, and means controlled when all accumulated calls have been allotted for arresting operation of said allotter.

24. In a telephone system including a plurality of links, an allotter operative through a given cycle to allot to idle ones of said links only calls accumulated during prior cycles of operation thereof, means for accumulating all calls initiated during said given cycle of operation of said allotter to be allotted during subsequent cycles of operation of said allotter, and means controlled by the presence of accumulated calls to be allotted for operating said allotter.

25. In a telephone system including a plurality of links, an allotter operative through a given cycle to allot to idle ones of said links all of the calls accumulated during the second preceding cycle of operation thereof and at least some of the calls accumulated during the first preceding cycle of operation thereof, means for accumulating calls initiated during said given cycle of operation of said allotter to be allotted during the first and the second succeeding cycles of operation of said allotter, and means controlled by the presence of accumulated calls to be allotted for operating said allotter.

26. In a telephone system including a plurality of links, an allotter operative through a given cycle to allot to idle ones of said links calls of a first class accumulated during the first preceding cycle of operation thereof and calls of a second class accumulated during the second preceding cycle of operation thereof, means for accumulating calls of the first and the second classes initiated during said given

cycle of operation of said allotter to be allotted respectively during the first and the second succeeding cycles of operation of said allotter, and means controlled by the presence of accumulated calls to be allotted for operating said allotter.

27. In a telephone system, a plurality of lines, a plurality of links, an allotter operative through a given cycle to allot to idle ones of said links the lines in a batch of said lines accumulated during a prior cycle of operation thereof, whereby idle ones of said links are connected to the lines in said last-mentioned batch, means for accumulating into a batch the ones of said lines having calls appearing thereon during said given cycle of operation of said allotter to be allotted during a subsequent cycle of operation of said allotter, and means controlled by the presence of an accumulated batch of said lines to be allotted for operating said allotter.

28. In a telephone system, a plurality of groups of lines, a plurality of links, an allotter operative through a given cycle to allot to idle ones of said links the lines in a batch of said lines accumulated during a prior cycle of operation thereof, the lines in said last-mentioned batch being allotted group by group, whereby idle ones of said links are connected to the lines in a given group in said last-mentioned batch before idle ones of said links are connected to the lines in another group in said last-mentioned batch, means for accumulating into a batch the ones of said lines having calls appearing thereon during said given cycle of operation of said allotter to be allotted during a subsequent cycle of operation of said allotter, and means controlled by the presence of an accumulated batch of said lines to be allotted for operating said allotter.

29. In a telephone system, a plurality of lines, a plurality of links having access to said lines, a distributor associated with said links, a plurality of marking paths corresponding to said lines and associated with said distributor, means controlled when said marking paths are completed for causing said distributor to operate idle ones of said links to seize corresponding ones of said lines, means responsive to the presence of calls on said lines for preparing corresponding ones of said marking paths, and means for controlling the order in which prepared ones of said marking paths are completed.

30. In a telephone system, a plurality of lines, a plurality of links having access to said lines, a distributor associated with said links, a plurality of marking paths corresponding to said lines and associated with said distributor, means controlled when said marking paths are completed for causing said distributor to operate idle ones of said links to seize corresponding ones of said lines, means responsive to the presence of calls on said lines for preparing corresponding ones of said marking paths, and means for completing prepared ones of said marking paths batch by batch in a predetermined order.

31. In a telephone system, a plurality of lines, a plurality of links having access to said lines, a distributor associated with said links, a plurality of marking paths corresponding to said lines and associated with said distributor, means responsive to the completion of a batch of said marking paths for operating said distributor through a given cycle, whereby idle ones of said links are operated to seize corresponding ones of said lines, means responsive to

the initiation of calls on said lines for preparing corresponding ones of said marking paths, and means controlled upon the termination of said given cycle of operation of said distributor for completing a batch of prepared ones of said marking paths.

32. In a telephone system, a plurality of lines, a plurality of links having access to said lines, a distributor associated with said links, a plurality of marking paths corresponding to said lines and associated with said distributor, means responsive to the completion of a batch of said marking paths for operating said distributor through a given cycle, whereby idle ones of said links are operated to seize corresponding ones of said lines, means responsive to the initiation of calls on said lines for preparing corresponding ones of said marking paths, and means controlled during said given cycle of operations of said distributor for preventing the completion of prepared ones of said marking paths and controlled upon the termination of said given cycle of operation of said distributor for completing prepared ones of said marking paths.

33. In a telephone system, a plurality of groups of lines, a plurality of links having access to said lines, a distributor associated with said links, a plurality of marking paths corresponding to said lines and associated with said distributor, means responsive to the completion of a batch of said marking paths for operating said distributor through a given cycle, whereby idle ones of said links are operated to seize corresponding ones of said lines group by group, such that the last-mentioned lines in a given group are seized prior to the seizure of the last-mentioned lines in another group, means responsive to the initiation of calls on said lines for preparing corresponding ones of said marking paths, and means controlled upon the termination of said given cycle of operation of said distributor for completing a batch of prepared ones of said marking paths.

34. In a telephone system, a plurality of lines, a plurality of links having access to said lines, a distributor associated with said links, a plurality of marking paths corresponding to said lines and associated with said distributor, means responsive to the completion of a batch of said marking paths prepared during a prior cycle of operation of said distributor for operating said distributor through a given cycle of operation, whereby idle ones of said links are operated to seize corresponding ones of said lines, means responsive to the initiation of calls on said lines during said given cycle of operation of said distributor for preparing corresponding ones of said marking paths, and means controlled upon the termination of said given cycle of operation of said distributor for completing a batch of prepared ones of said marking paths.

35. In a telephone system, a plurality of lines, a plurality of marking relays individually associated with said lines, a plurality of links having access to said lines, a distributor associated with said links, means responsive to the control of the marking relay associated with any one of said lines for causing said distributor to operate an idle one of said links to seize said one line, means responsive to the initiation of a call on any one of said lines for preparing the associated one of said marking relays to be controlled, and means operative intermittently to control each prepared one of said marking relays.

36. In a telephone system, a plurality of lines, a plurality of marking relays individually asso-

ciated with said lines, a plurality of links having access to said lines, a distributor associated with said links, means responsive to the operation of the marking relay associated with any one of said lines for causing said distributor to operate an idle one of said links to seize said one line, means responsive to the initiation of a call on any one of said lines for preparing a point in the operating circuit of the associated one of said marking relays, and means operative intermittently to prepare a common point in the operating circuits of said marking relays, whereby each marking relay having a previously prepared operating circuit is operated.

37. In a telephone system, a plurality of lines, a plurality of marking relays individually associated with said lines, a plurality of links having access to said lines, a distributor associated with said links, a plurality of marking paths corresponding to said lines and associated with said distributor, means responsive to the operation of the marking relay associated with any one of said lines for completing the corresponding marking path, means responsive to the completion of any one of said marking paths for causing said distributor to operate an idle one of said links to seize the corresponding line, means responsive to the seizure of any one of said lines for interrupting the corresponding marking path, means responsive to the initiation of a call on any one of said lines for preparing a point in the operating circuit of the associated marking relay, and means operative intermittently to prepare a common point in the operating circuit of said marking relays, whereby each marking relay having a previously prepared operating circuit is operated.

38. In a telephone system, a plurality of groups of lines, a plurality of links having access to said lines, a link distributor associated with said links, means for causing said link distributor to allot group by group marked calling one of said lines to idle ones of said links in a predetermined order, whereby said last-mentioned links are operated to seize each marked calling line in a given group by group marked calling ones of said lines in another group, and means including a line distributor associated with said lines for controlling the order in which calling lines in said groups are marked.

39. In a telephone system, a plurality of groups of lines, a plurality of links having access to said lines, a link distributor associated with said links, means for causing said link distributor to allot group by group marked calling ones of said lines to idle ones of said links in a predetermined order, whereby said last-mentioned links are operated to seize each marked calling line in a given group prior to seizure of the marked calling lines in another group, a line distributor associated with said lines, and means controlled when said link distributor allots the last group of marked calling ones of said lines for causing said line distributor to mark calling ones of said lines.

40. In a telephone system, a plurality of groups of lines, a plurality of links having access to said lines, a link distributor associated with said links, means for causing said link distributor to allot group by group marked calling ones of said lines to idle ones of said links in a predetermined order, whereby said last-mentioned links are operated to seize each marked calling line in a given group prior to seizure of the marked calling lines in another group, a line distributor associated with said lines, and means controlled when said

link distributor allots the last group of marked calling ones of said lines for causing said line distributor to mark each calling one of said lines except the calling lines included in said last group.

41. In a telephone system, a plurality of groups of lines, a plurality of links having access to said lines, a link distributor associated with said links, means for causing said link distributor to allot group by group marked calling ones of said lines to idle one of said links in a predetermined order, whereby said last-mentioned links are operated to seize each marked calling lines in a given group prior to seizure of the marked calling lines in another group, a line distributor associated with said lines and including a control relay, means controlled by the marking of calling ones of the lines in a number of said groups for completing a corresponding number of multiple operating circuits for said control relay, thereby to cause operation thereof, means controlled as said link distributor allots group by group marked calling ones of said lines for interrupting one by one the multiple operating circuits for said control relay, thereby to cause restoration thereof when said link distributor allots the last group of marked calling ones of said lines, and means controlled by the restoration of said control relay for marking calling ones of said lines.

42. In a telephone system, a plurality of groups of lines, a link having access to said lines, means for allotting said link successively in rotation to the ones of said groups including a calling line as said link becomes idle intermittently, and means for causing said link to seize a calling line in the one of said groups to which it is allotted.

43. In a telephone system, two groups of lines, a link having access to said lines, means for allotting said link alternately as it becomes idle intermittently to said two groups in the event each of said groups includes a calling line, and means for causing said link to seize a calling line in either of said groups to which it is allotted.

44. In a telephone system, two groups of lines, a link having access to said lines, means for allotting said link repeatedly as it becomes idle intermittently to one of said groups in the event the other of said groups includes no calling line and for allotting said link alternately as it becomes idle intermittently to said two groups in the event each of said groups includes a calling line, and means for causing said link to seize a calling line in either of said groups to which it is allotted.

45. In a telephone system, two groups of lines, a link having access to said lines, a plurality of allotters individually associated with said groups of lines and commonly associated with said link, means responsive to the presence of a calling line in one of said groups for operating the associated one of said allotters, means for causing operating ones of said allotters to allot said link successively in rotation to the associated ones of said groups of lines as said link becomes idle intermittently, and means for causing said link to seize a calling line in the one of said groups to which it is allotted.

46. In a telephone system, two groups of lines, a link having access to said lines, two allotters individually associated with said two groups of lines and commonly associated with said link, means responsive to the presence of a calling line in one of said groups for operating the associated one of said allotters, means controlled

when both of said allotters are operating for causing said allotters to allot said link alternately to said two associated groups of lines as said link becomes idle intermittently, and means for causing said link to seize a calling line in either of said groups to which it is allotted.

47. In a telephone system, two groups of lines, a plurality of links having access to said lines, two allotters individually associated with said two groups of lines and having access to said links, means for causing said allotters to select the ones of said links marked as idle thereto in a predetermined order, means responsive to the presence of a calling line in one of said groups for causing the associated one of said allotters to operate the one of said links selected thereby to seize the calling line in said one group, means responsive to the operation of one of said links for marking it as busy to both of said allotters, means for releasing an operated one of said links, and means responsive to the release of one of said links for marking it as idle successively to said two allotters.

48. In a telephone system, two groups of lines, a plurality of links having access to said lines, two allotters individually associated with said two groups of lines and having access to said links, means for causing said allotters to select the ones of said links marked as idle thereto in a predetermined order, means responsive to the presence of a calling line in one of said groups for causing the associated one of said allotters to operate the one of said links selected thereby to seize the calling line in said one group, means responsive to the operation of one of said links for marking it as busy to both of said allotters, means for releasing an operated one of said links, and means responsive to the release of one of said links for immediately marking said one link as idle to the one of said allotters which was not the last to operate said one link and for subsequently marking said one link as idle to the other of said allotters which was the last to operate said one link.

49. In a telephone system, two groups of lines, a plurality of links having access to said lines, two allotters individually associated with said two groups of lines and having access to said links, means for causing said allotters to select the ones of said links marked as idle thereto in a predetermined order, means responsive to the presence of a calling line in one of said groups for causing the associated one of said allotters to operate the one of said links selected thereby to seize the calling line in said one group, means responsive to the operation of one of said links for marking it as busy to both of said allotters, means for releasing an operated one of said links, and means comprising a relay network included in one of said links and responsive to the release thereof for marking said one link as idle to said allotters in a predetermined order in accordance with which one of said allotters was last to operate said one link.

50. In a telephone system, a plurality of control devices adapted to be employed in setting up connections, two allotters having access to said control devices, means for causing said allotters to select the ones of said control devices marked as idle thereto in a predetermined order, means for causing one of said allotters to operate one of said control devices selected thereby, means responsive to the operation of one of said control devices for marking it as busy to both of said allotters, means for releasing an

operated one of said control devices, and means responsive to the release of one of said control devices for retaining the marking of said one control device as busy to the one of said allotters which was the last to operate said one control device and for marking said one control device as idle to the other of said allotters which was not the last to operate said one control device.

51. In a telephone system, a plurality of control devices adapted to be employed in setting up connections, two allotters having access to said control devices, means for causing said allotters to select the ones of said control devices marked as idle thereto in a predetermined order, means for causing one of said allotters to operate one of said control devices selected thereby, means responsive to the operation of one of said control devices for marking it as busy to both of said allotters, means for releasing an operated one of said control devices, means responsive to the release of one of said control devices for retaining the marking of said one control device as busy to the one of said allotters which was the last to operate said one control device and for marking said one control device as idle to the other of said allotters which was not the last to operate said one control device, and means governed a predetermined time interval after one of said control devices is released for marking said one control device as idle to the one of said allotters which was the last to operate said one control device.

52. In a telephone system, a plurality of groups of lines, an operator position, means for allotting said operator position successively in rotation to the ones of said groups including a calling line as said operator position becomes idle intermittently, and means for connecting said operator position to a calling line in the one of said groups to which it is allotted, thereby to extend the call on said last-mentioned line to said operator position to be answered.

53. In a telephone system, two groups of lines, an operator position, means for allotting said operator position alternately as it becomes idle intermittently to said two groups in the event each of said groups includes a calling line, and means for connecting said operator position to a calling line in either of said groups to which it is allotted, thereby to extend the call on said last-mentioned line to said operator position to be answered.

54. In a telephone system, a plurality of groups of lines, an operator position, a plurality of allotters individually associated with said groups of lines and commonly associated with said operator positions, means responsive to the presence of a calling line in one of said groups for operating the associated one of said allotters, means for causing operating ones of said allotters to allot said operator position successively in rotation to the associated ones of said groups of lines as said operator position becomes idle intermittently, and means for connecting said operator position to a calling line in the one of said groups to which it is allotted, thereby to extend the call on said last-mentioned line to said operator position to be answered.

55. In a telephone system, two groups of lines, an operator position, two allotters individually associated with said two groups of lines and commonly associated with said operator position, means responsive to the presence of a calling line in one of said groups for operating the associated one of said allotters, means controlled when

both of said allotters are operating for causing said allotters to allot said operator position alternately to said two associated groups of lines as said operator position becomes idle intermittently, and means for connecting said operator position to a calling line in either of said groups to which it is allotted, thereby to extend the call on said last-mentioned line to said operator position to be answered.

56. In a telephone system, two groups of lines, a plurality of operator positions, two allotters individually associated with said two groups of lines and having access to said operator positions, means for causing said allotters to select the ones of said operator positions marked as idle thereto in a predetermined order, means responsive to the presence of a calling line in one of said groups for causing the associated one of said allotters to connect the one of said operator positions selected thereby to the calling line in said one group, thereby to extend the call on said last-mentioned line to said last-mentioned operator position to be answered, means controlled when one of said operator positions is connected to a calling line for marking said one operator position as busy to both of said allotters, means for disconnecting one of said operator positions from a calling line, and means responsive to the disconnection of one of said operator positions from a calling line for marking it as idle successively to said two allotters.

57. In a telephone system, two groups of lines, a plurality of operator positions, two allotters individually associated with said two groups of lines and having access to said operator positions, means for causing said allotters to select the ones of said operator positions marked as idle thereto in a predetermined order, means responsive to the presence of a calling line in one of said groups for causing the associated one of said allotters to connect the one of said operator positions selected thereby to the calling line in said one group, thereby to extend the call on said last-mentioned line to said last-mentioned operator position to be answered, means controlled when one of said operator positions is connected to a calling line for marking said one operator position as busy to both of said allotters, means for disconnecting one of said operator positions from a calling line, and means responsive to the disconnection of one of said operator positions from a calling line for immediately marking said one operator position as idle to the one of said allotters which was not the last to connect said one operator position to a calling line and for subsequently marking said one operator position as idle to the other of said allotters which was the last to connect said one operator position to a calling line.

58. In a telephone system, a plurality of trunks, a plurality of trunk circuits individually associated with said trunks, a plurality of operator positions, switching apparatus having access to said trunks and associated with said operator positions, a control conductor, means responsive to the presence of a call on any one of said trunks for causing the associated one of said trunk circuits to connect resistance potential therein to said control conductor, means for causing said switching apparatus to seize calling ones of said trunks in a predetermined order and to route the calls on seized ones of said trunks to idle ones of said operator positions to be answered in a predetermined order, means responsive to the seizure of any one of said trunks by said switch-

ing apparatus for causing the associated one of said trunk circuits to disconnect resistance potential therein from said control conductor, and apparatus commonly associated with said operator positions and operative in accordance with the number of connections of resistance potential in said trunk circuits to said control conductor selectively to indicate the number of said trunks having calls thereon waiting to be answered at said operator positions.

59. In a telephone system, a plurality of trunks, a plurality of trunk circuits individually associated with said trunks, a plurality of operator positions, switching apparatus having access to said trunks and associated with said operator positions, a control conductor, means responsive to the presence of a call on any one of said trunks for causing the associated one of said trunk circuits to connect resistance potential therein to said control conductor, means for causing said switching apparatus to seize calling ones of said trunks in a predetermined order and to route the calls on seized ones of said trunks to idle ones of said operator positions to be answered in a predetermined order, means responsive to the seizure of any one of said trunks by said switching apparatus for causing the associated one of said trunk circuits to disconnect resistance potential therein from said control conductor, a plurality of relays of the marginal type, a series operating circuit including said control conductor for said relays, whereby said relays are operated in accordance with different numbers of connections of resistance potential in said trunk circuits to said control conductor, and a call waiting indicator commonly associated with said operator positions and selectively operated by said relays.

60. In a telephone system, a plurality of trunks, a plurality of trunk circuits individually associated with said trunks, a plurality of operator positions, switching apparatus having access to said trunks and associated with said operator positions, a control conductor, means responsive to the presence of a call on any one of said trunks for causing the associated one of said trunk circuits to connect resistance potential therein to said control conductor, means for causing said switching apparatus to seize calling ones of said trunks in a predetermined order and to route the calls on seized ones of said trunks to idle ones of said operator positions to be answered in a predetermined order, means responsive to the seizure of any one of said trunks by said switching apparatus for causing the associated one of said trunk circuits to disconnect resistance potential therein from said control conductor, a plurality of relays of the marginal type, a series operating circuit including said control conductor for said relays, whereby said relays are operated in accordance with different numbers of connections of resistance potential in said trunk circuits to said control conductor, timing means for periodically interrupting and recompleting said series operating circuit, thereby to reset said relays, and a call waiting indicator commonly associated with said operator positions and selectively operated by said relays.

61. In a telephone system, a plurality of trunks, a plurality of trunk circuits individually associated with said trunks, a plurality of operator positions, switching apparatus having access to said trunks and associated with said operator positions, a control conductor, means responsive to the presence of a call on any one of said trunks

for causing the associated one of said trunk circuits to connect resistance potential therein to said control conductor, means for causing said switching apparatus to seize calling ones of said trunks in a predetermined order and to route the calls on seized ones of said trunks to idle ones of said operator positions to be answered in a predetermined order, means responsive to the seizure of any one of said trunks by said switching apparatus for causing the associated one of said trunk circuits to disconnect resistance potential therein from said control conductor, a plurality of relays of the marginal type, a series operating circuit including said control conductor for said relays, whereby said relays are operated in accordance with different numbers of connections of resistance potential in said trunk circuits to said control conductor, a call waiting indicator commonly associated with said operator positions, means controlled when all of said operator positions are busy for initiating operation of said call waiting indicator, additional means controlled in accordance with a predetermined operation of said relays for initiating operation of said call waiting indicator, and means governed by said relays for controlling the operation of said call waiting indicator.

62. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, a plurality of first operator positions, a second operator position, a digit register-sender controller at each of said operator positions, switching apparatus normally operative to route calling ones of said trunks to idle ones of said first operator positions in a predetermined order, means controlled when a calling one of said trunks is routed to one of said first operator positions for rendering busy said one first operator position and for connecting the digit register-sender controller at said one first operator position to the one of said digit register-sender devices individually associated with said one trunk, means at each of said first operator positions for rendering busy and for vacating the associated first operator position, means controlled when each of said first operator position is vacated for rendering said switching apparatus operative to route calling ones of said trunks to said second operator position as said second operator position becomes idle intermittently, and means controlled when a calling one of said trunks is routed to said second operator position for rendering busy said second operator position and for connecting the digit register-sender controller at said second operator position to the one of said digit register-sender devices individually associated with said one trunk.

63. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, a first operator position, a first digit register-sender controller at said first operator position, a second operator position, a second digit register-sender controller at said second operator position, switching apparatus normally operative to route calling ones of said trunks to said first operator position as said first operator position becomes idle intermittently, means controlled when a calling one of said trunks is routed to said first operator position for

rendering busy said first operator position and for connecting said first digit register-sender controller to the one of said digit register-sender devices individually associated with said one trunk, means controllable from said first operator position for rendering busy and for vacating said first operator position, means controlled when said first operator position is vacated for rendering said switching apparatus operative to route calling ones of said trunks to said second operator position as said second operator position becomes idle intermittently, and means controlled when a calling one of said trunks is routed to said second operator position for rendering busy said second operator position and for connecting said second digit register-sender controller to the one of said digit register-sender devices individually associated with said one trunk.

64. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, a plurality of operator positions, a plurality of digit register-sender controllers individually associated with said operator positions, an automatic switch having access to said trunks, means for selectively connecting said automatic switch to said operator positions, means controlled when the one of said operator positions to which said automatic switch is connected is idle for operating said automatic switch to seize a calling one of said trunks, and means responsive to the operation of said automatic switch to seize a calling one of said trunks for rendering busy the one of said operator positions to which said automatic switch is connected and for connecting the one of said digit register-sender controllers individually associated with said one operator position to the one of

said digit register-sender devices individually associated with said one trunk.

65. In a telephone system, a plurality of trunks, a plurality of digit register-sender devices individually associated with said trunks, each of said digit register-sender devices being adapted to register and to send over the associated one of said trunks one or more digits, a plurality of operator positions, a plurality of digit register-sender controllers individually associated with said operator positions, an automatic switch having access to said trunks, means for selectively connecting said automatic switch to said operator positions, means controlled when the one of said operator positions to which said automatic switch is connected is idle for operating said automatic switch to seize a calling one of said trunks, means responsive to the operator of said automatic switch to seize a calling one of said trunks for rendering busy the one of said operator positions to which said automatic switch is connected and for connecting the one of said digit register-sender controllers individually associated with said one operator position to the one of said digit register-sender devices individually associated with said one trunk, means responsive to an initial operation of said one digit register-sender controller for registering a digit in said one digit register-sender device, means responsive to a final operation of said one digit register-sender controller for conditioning said one digit register-sender device for automatic release when the digit or digits registered therein have been sent thereby and for releasing said automatic switch, and means responsive to the release of said automatic switch for rendering idle said one operator position and for disconnecting said one digit register-sender controller from said one digit register-sender device.

HARRY N. NEWSTEDT.

CERTIFICATE OF CORRECTION.

Patent No. 2,315,008.

March 30, 1943.

HARRY N. NEWSTEDT.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 38, second column, line 45, claim 38, for "by group marked calling ones of said" read --prior to seizure of the marked calling--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of May, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.