Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 1

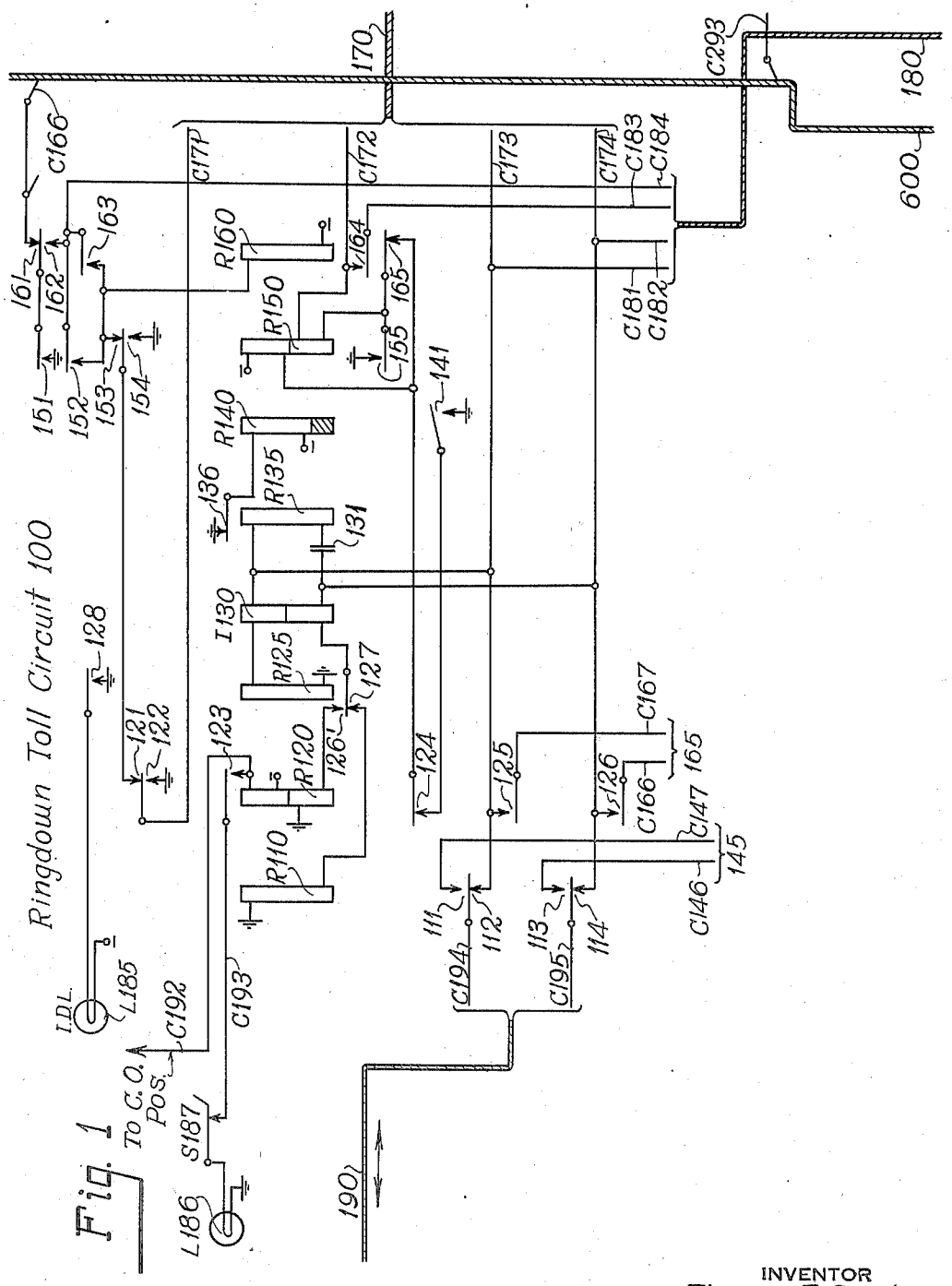


Fig. 1

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shontz
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 2

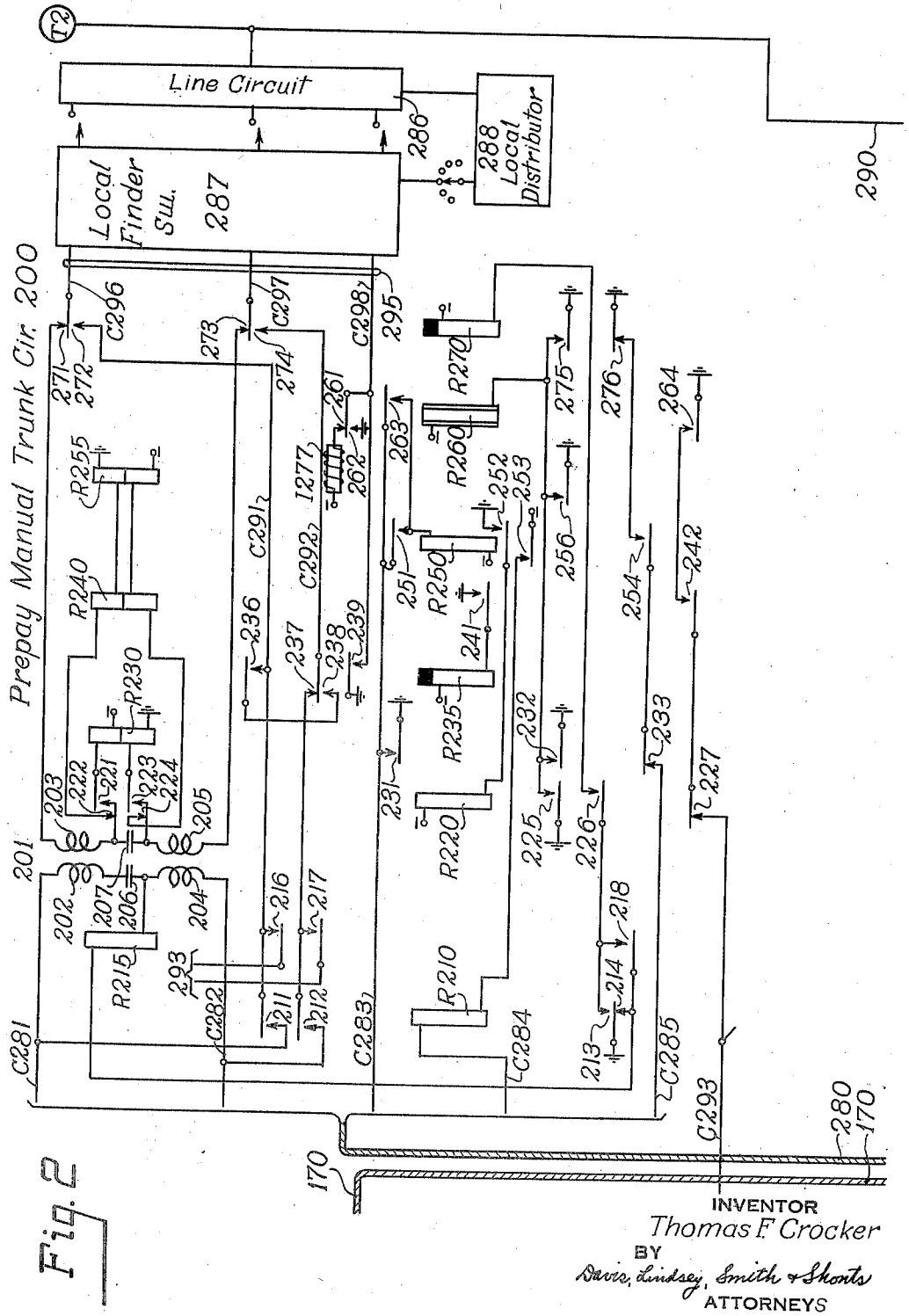


Fig. 2

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shonts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 3

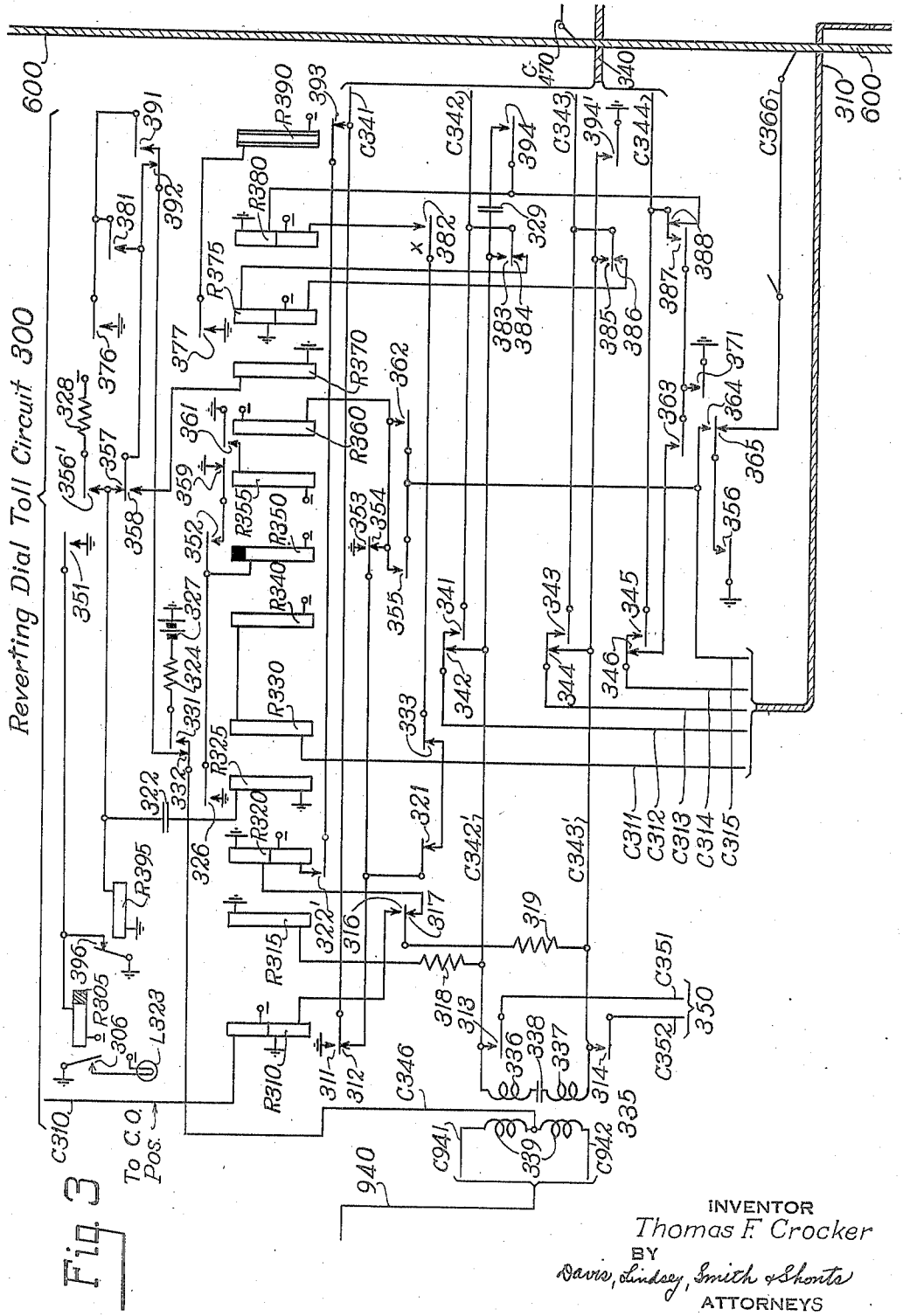


Fig. 3

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shorts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 4

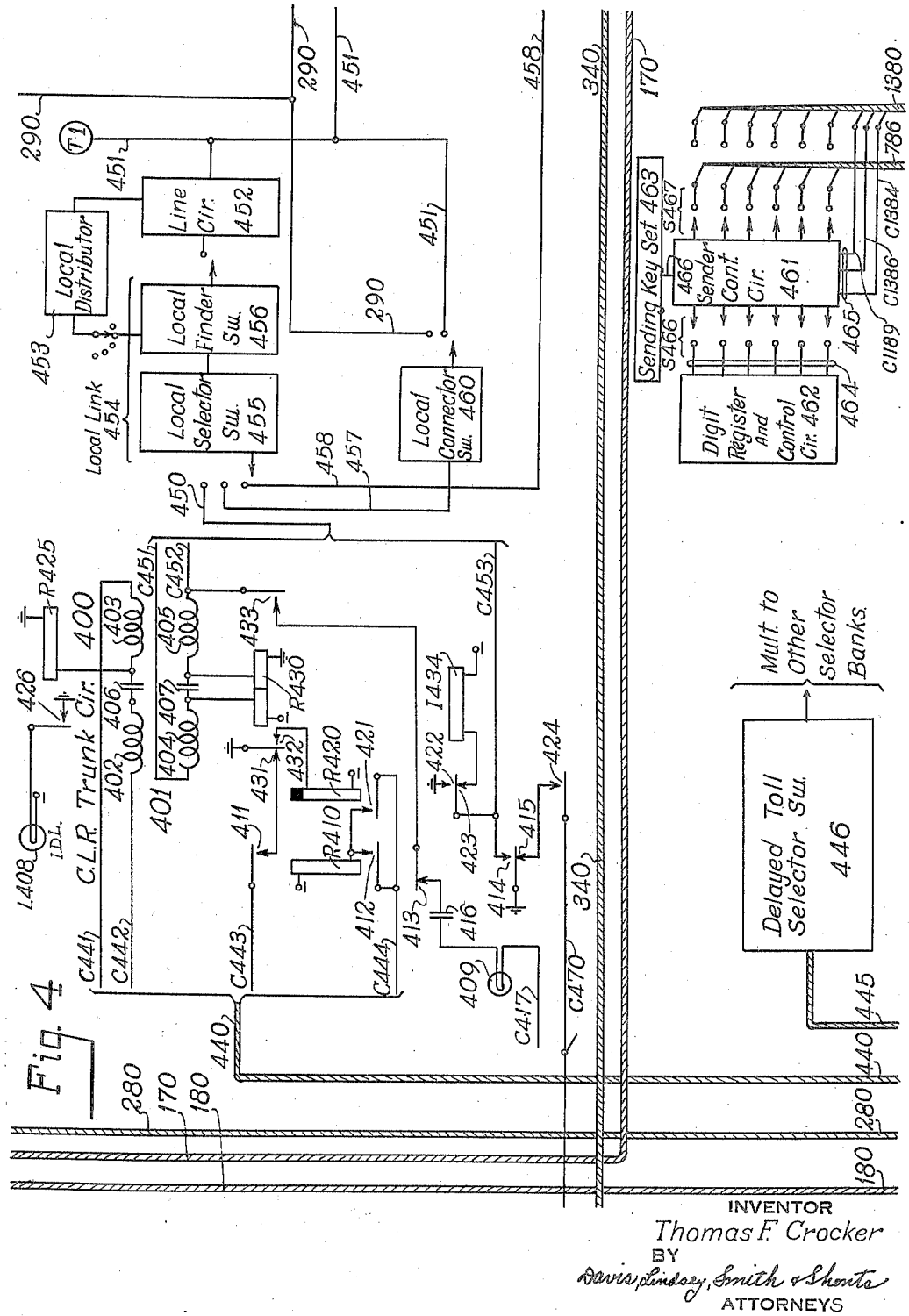


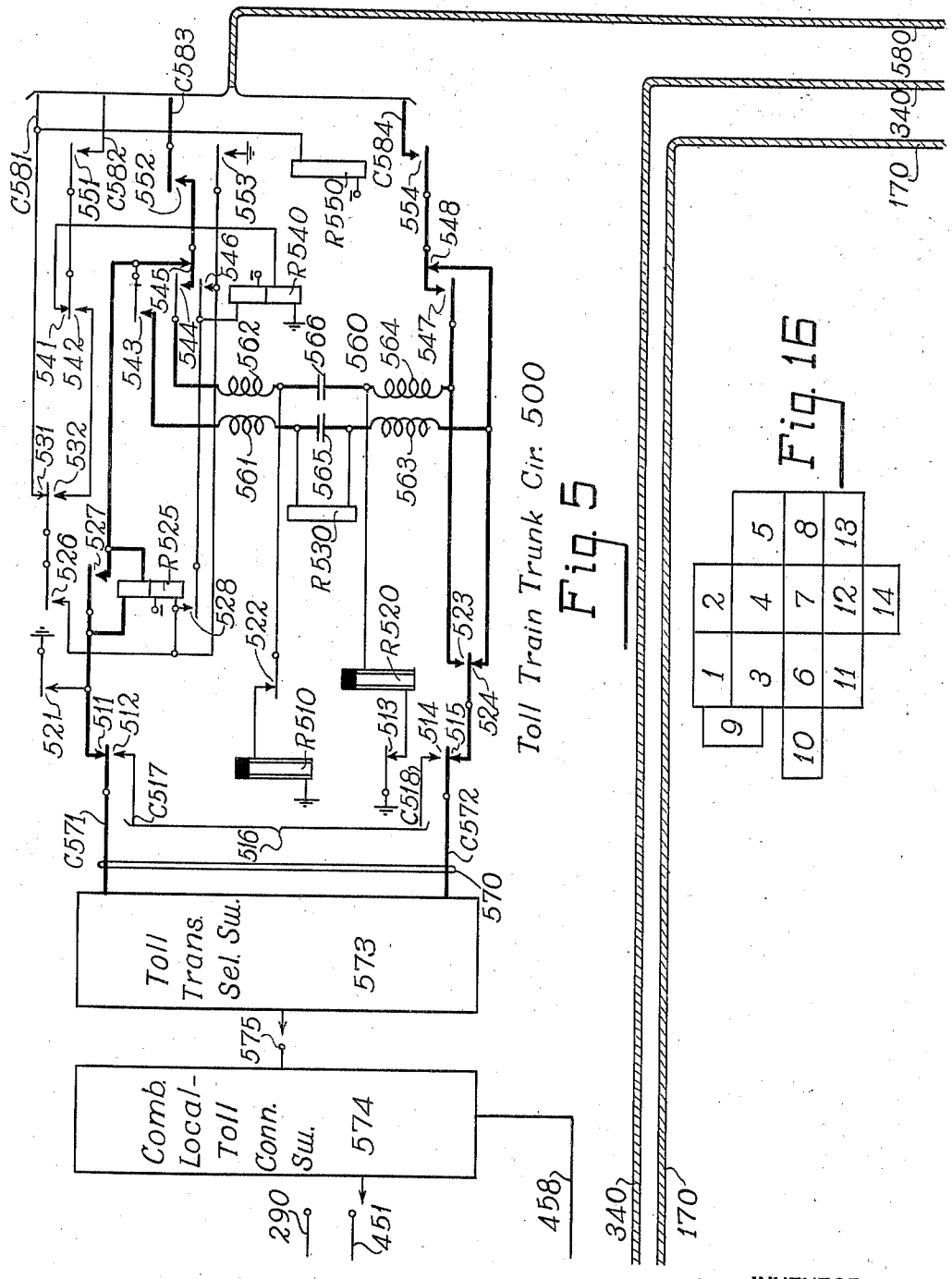
Fig. 4

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shouts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 5



INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shontz
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 6

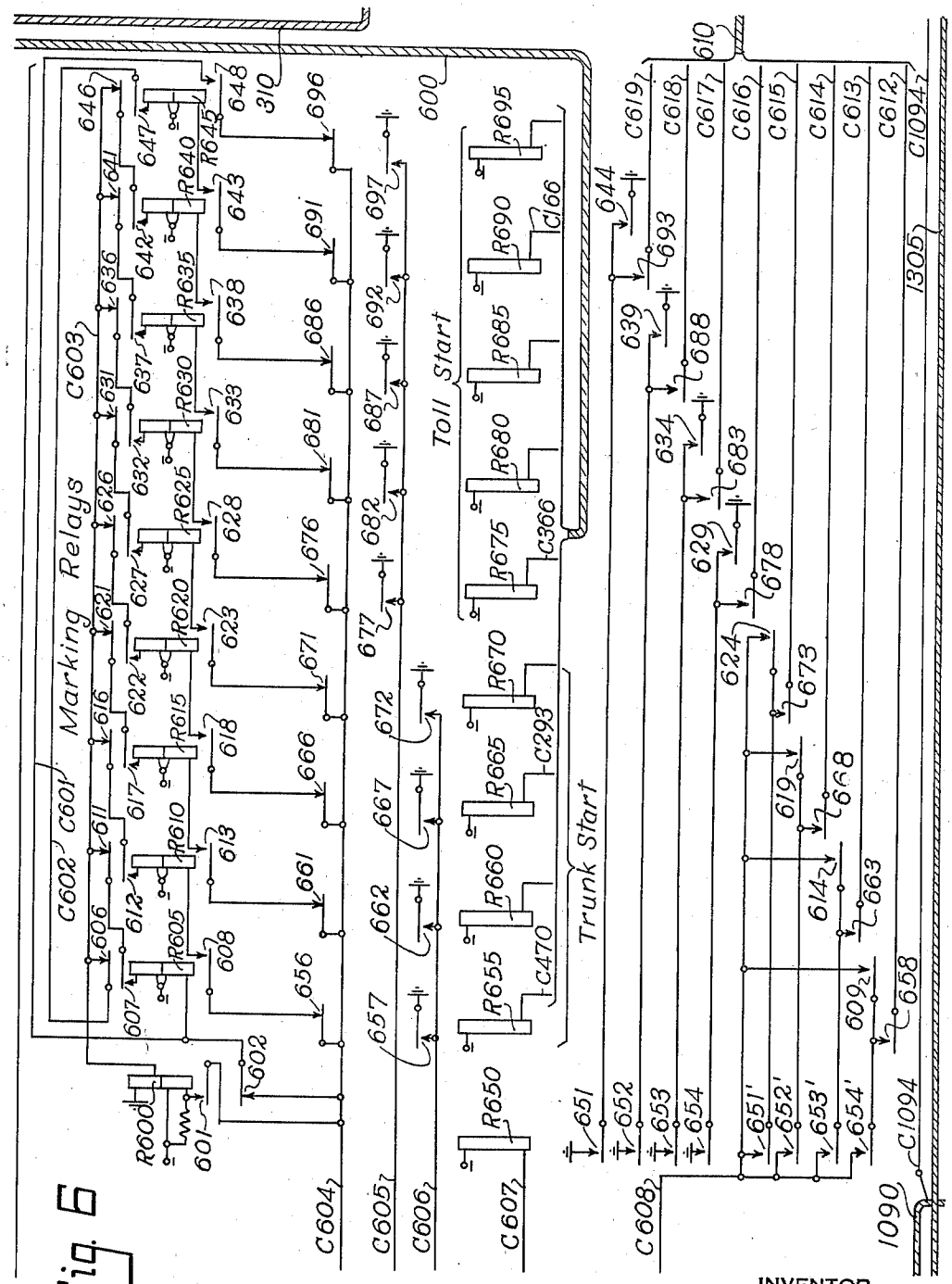


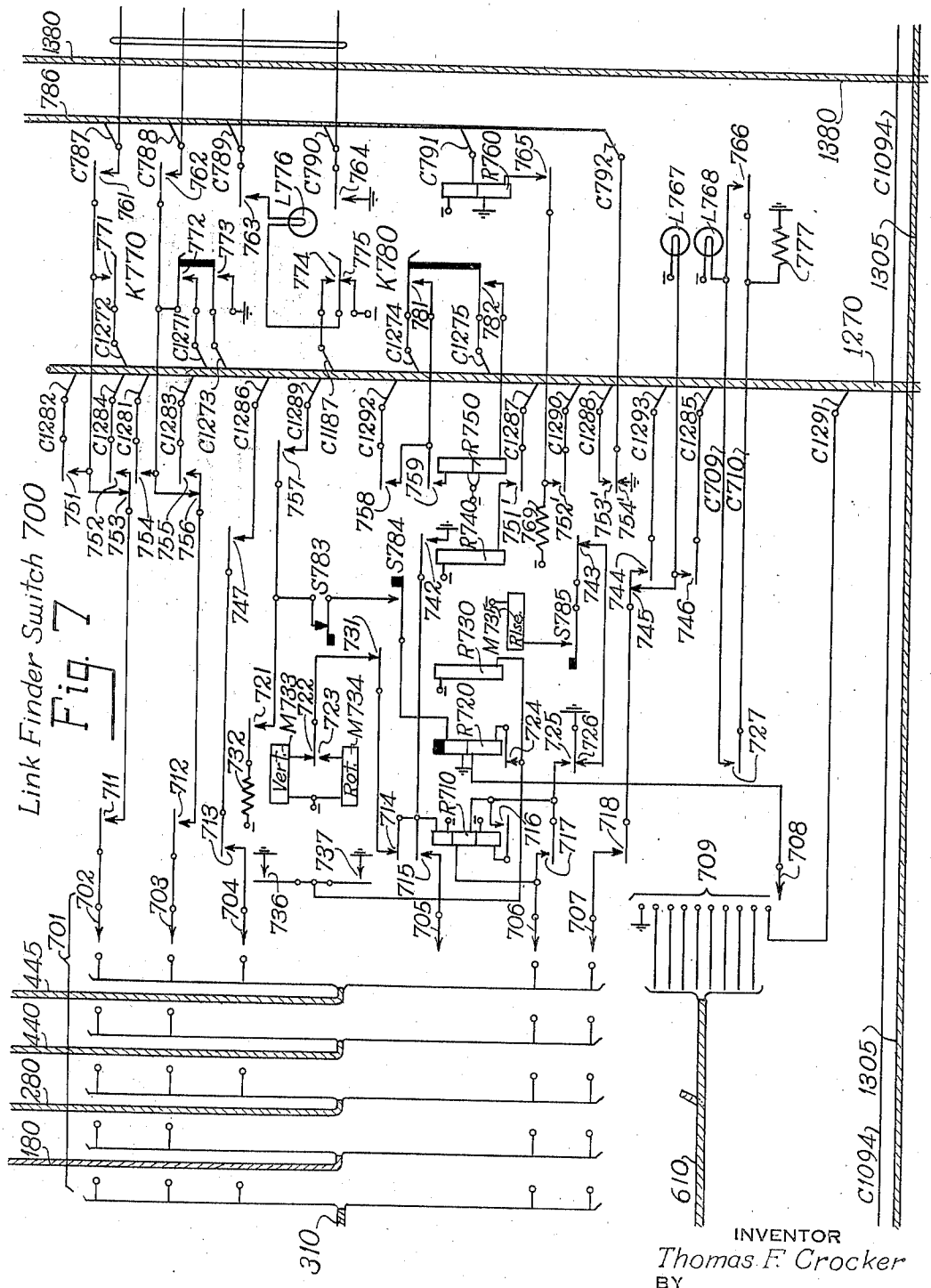
Fig. 6

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shontz
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 7



Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 8

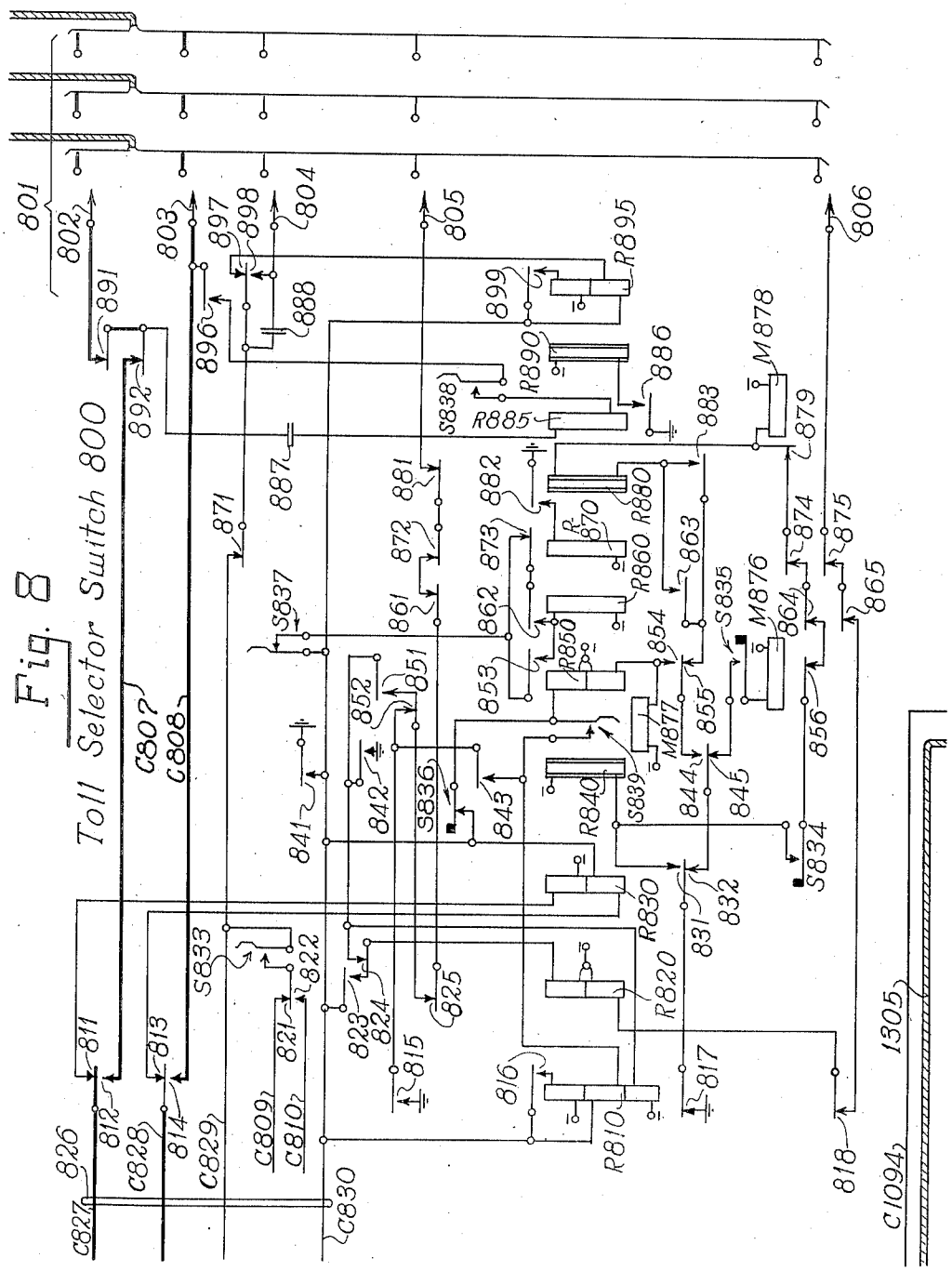


Fig. 8 Toll Selector Switch 800

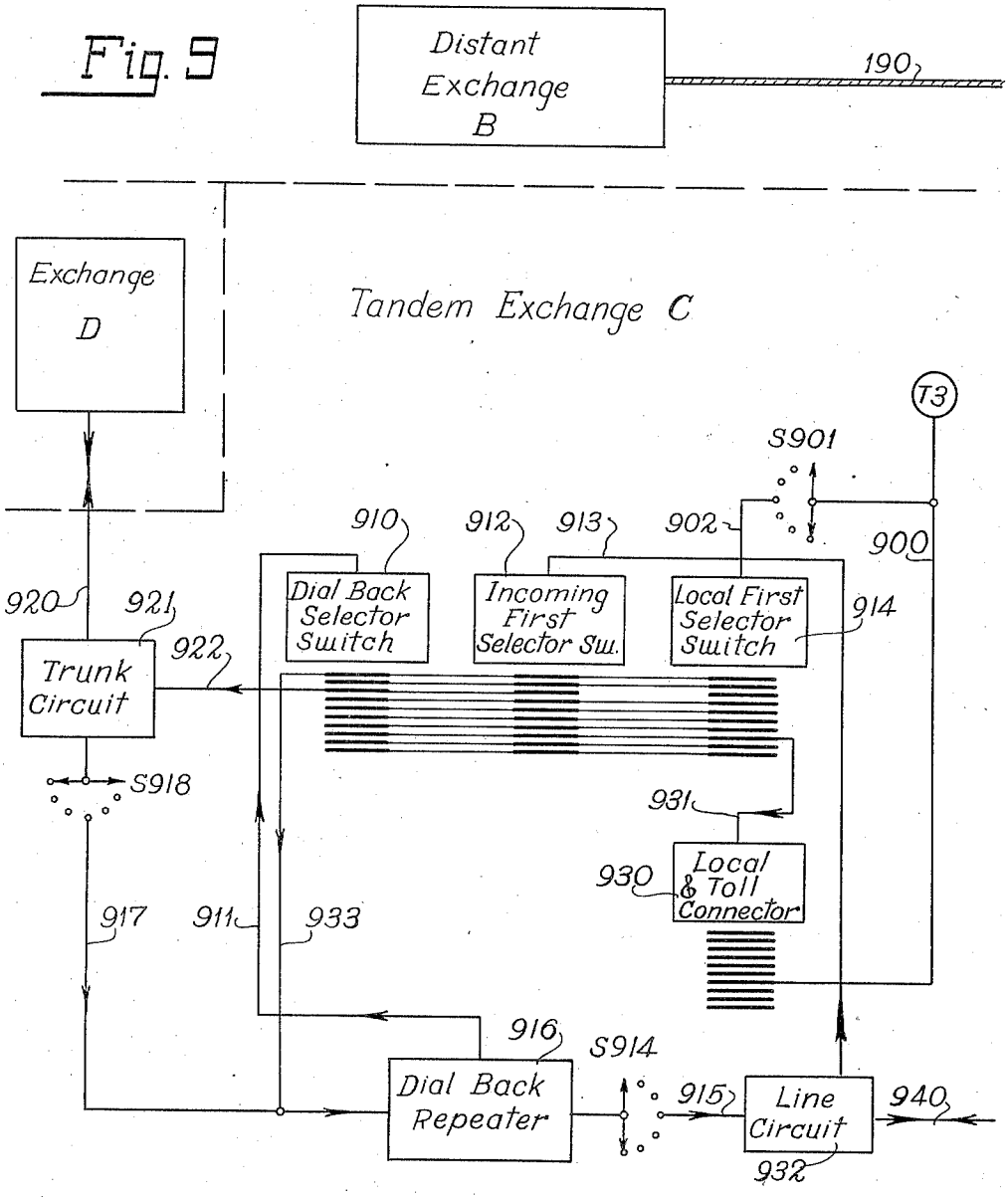
INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shontz
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 9

Fig. 9



INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shorts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 10

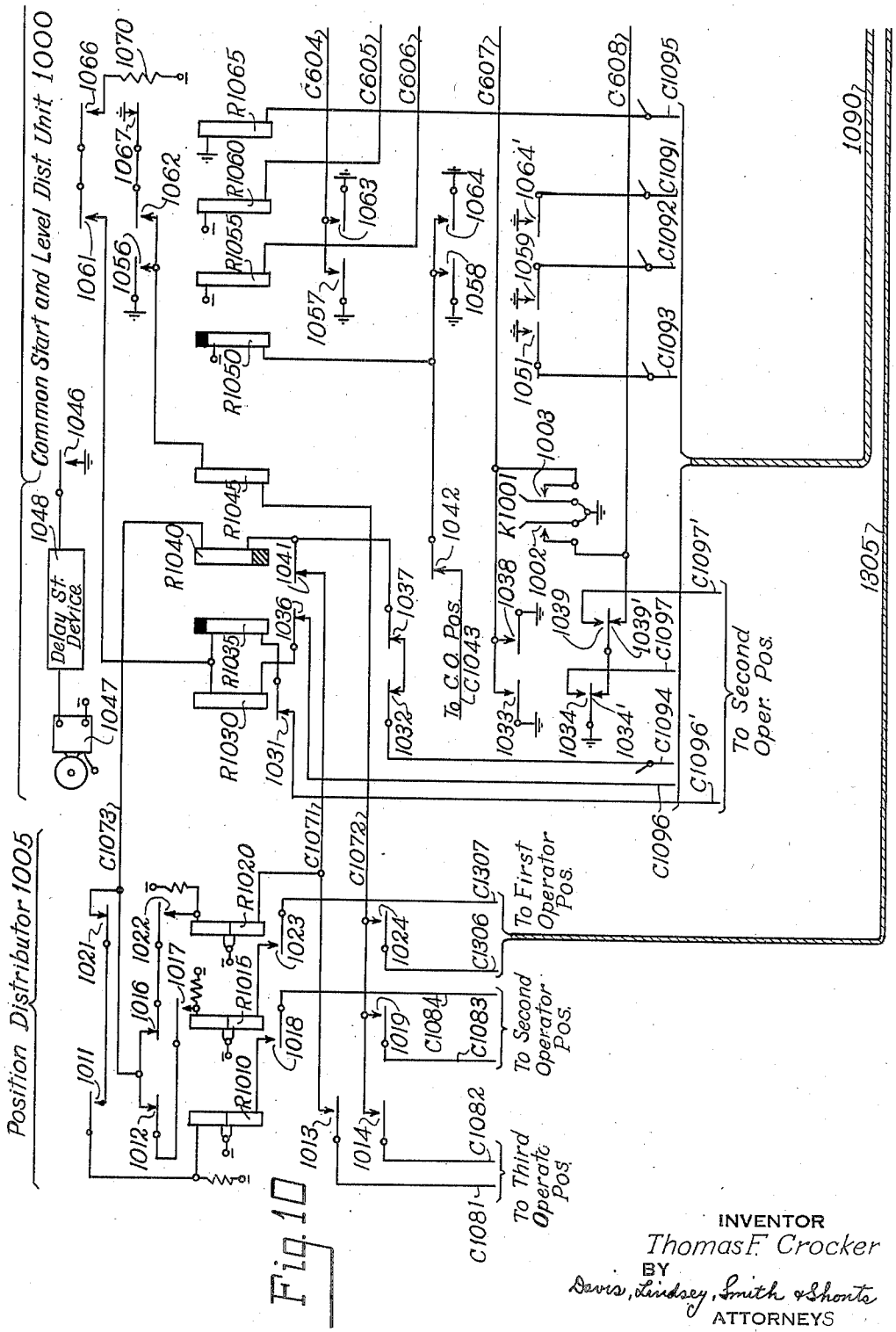


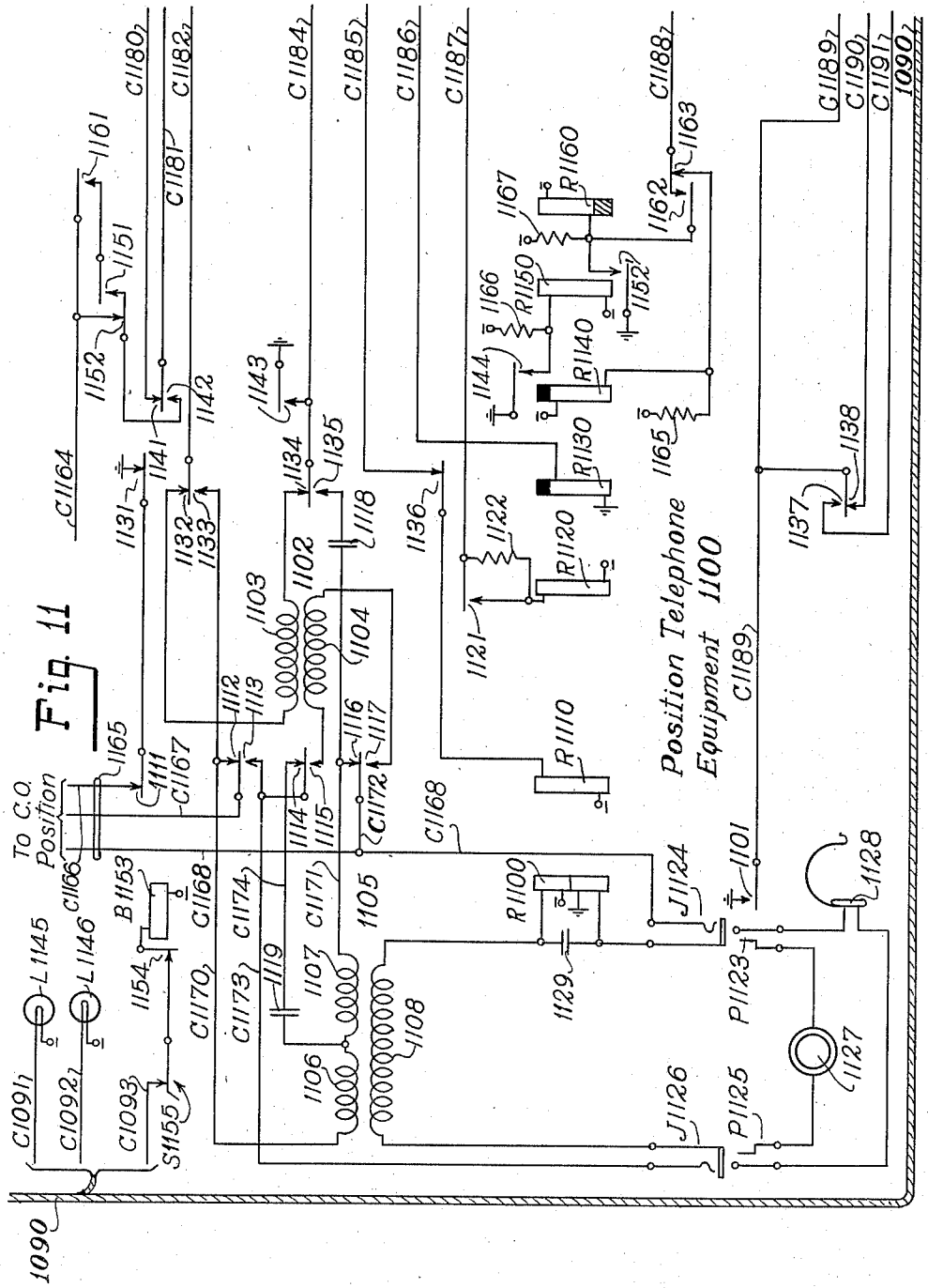
Fig. 10

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shonts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 11



INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shonts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 12

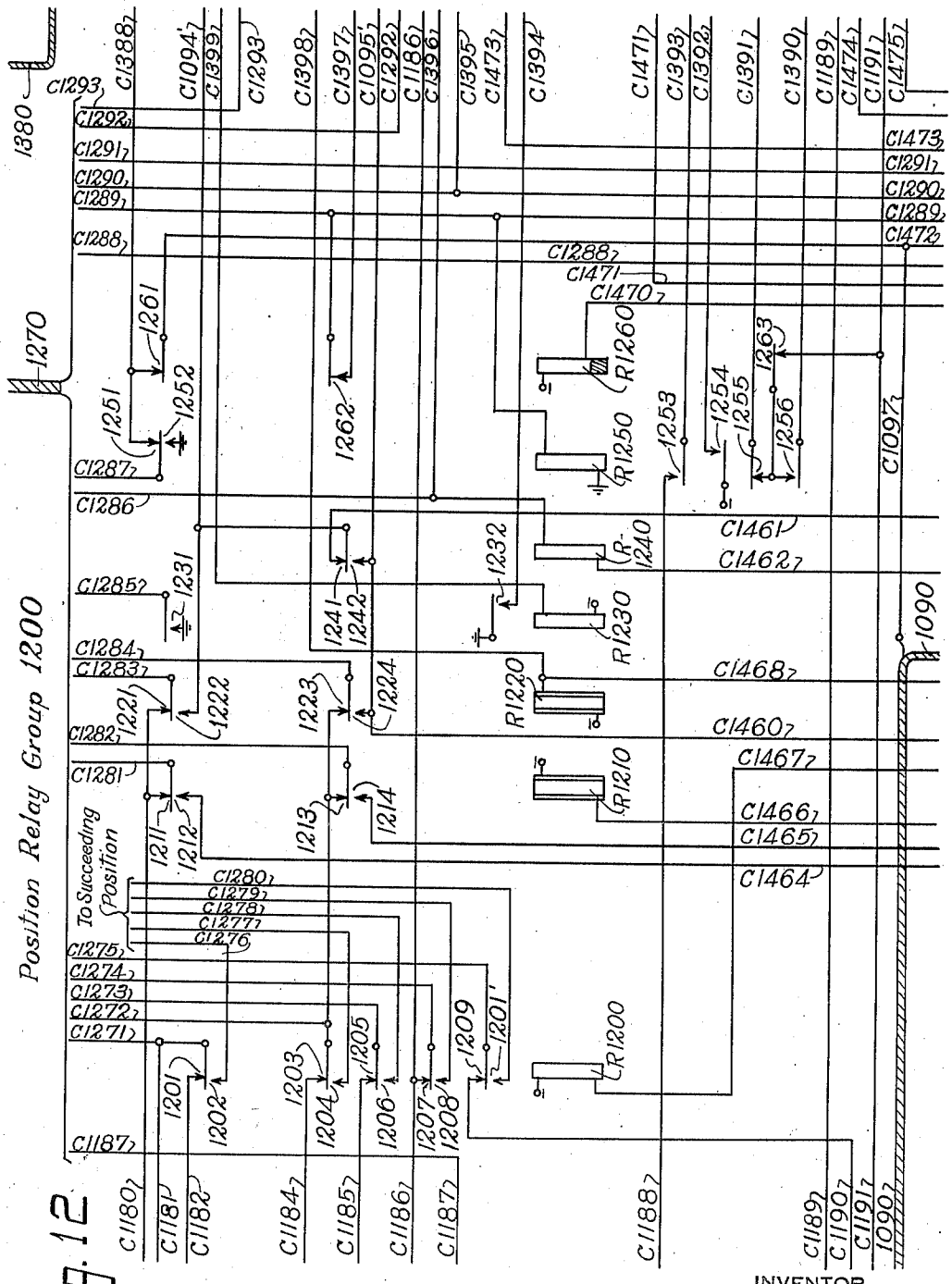


Fig. 12

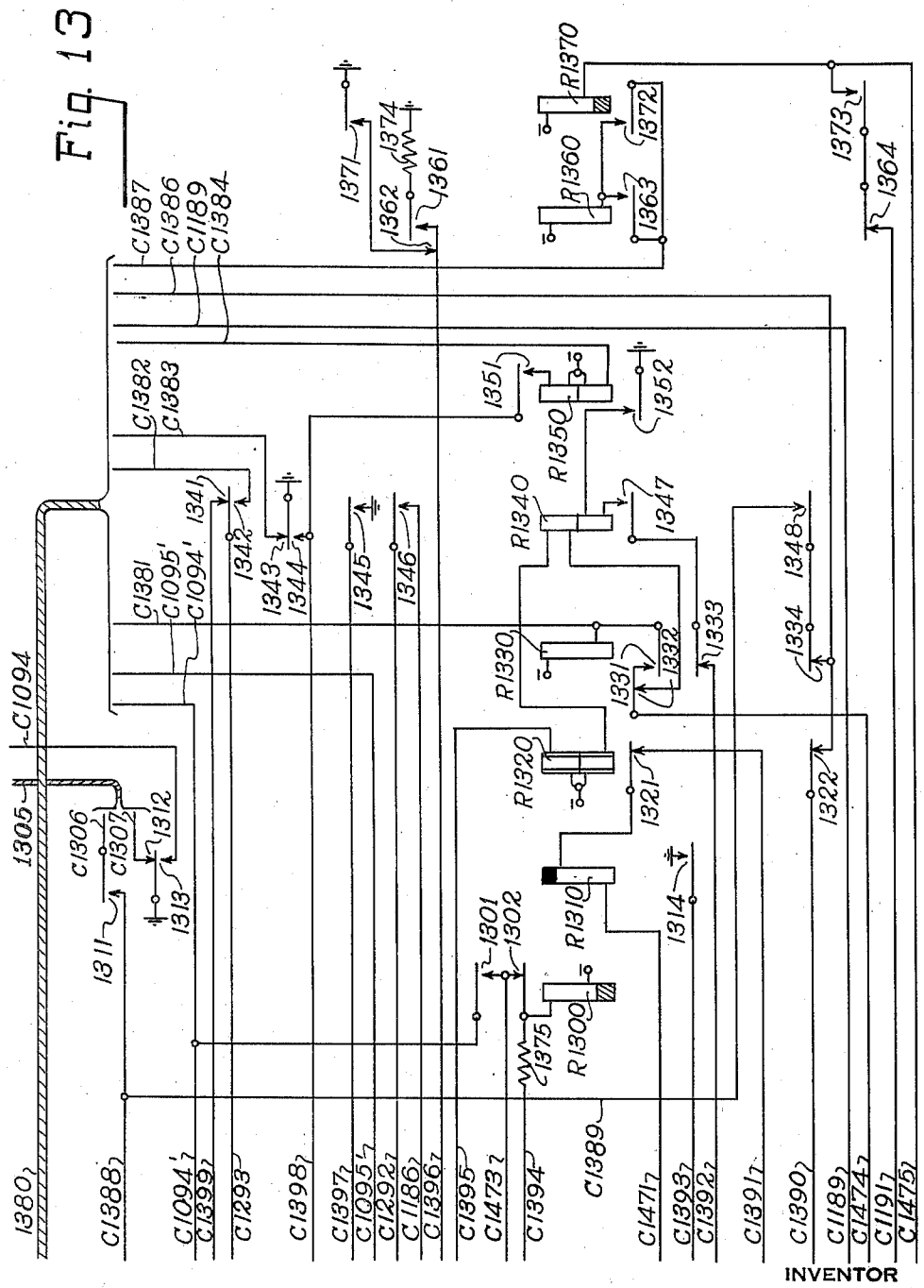
INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shorts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 13

Fig. 13



INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shouts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 14

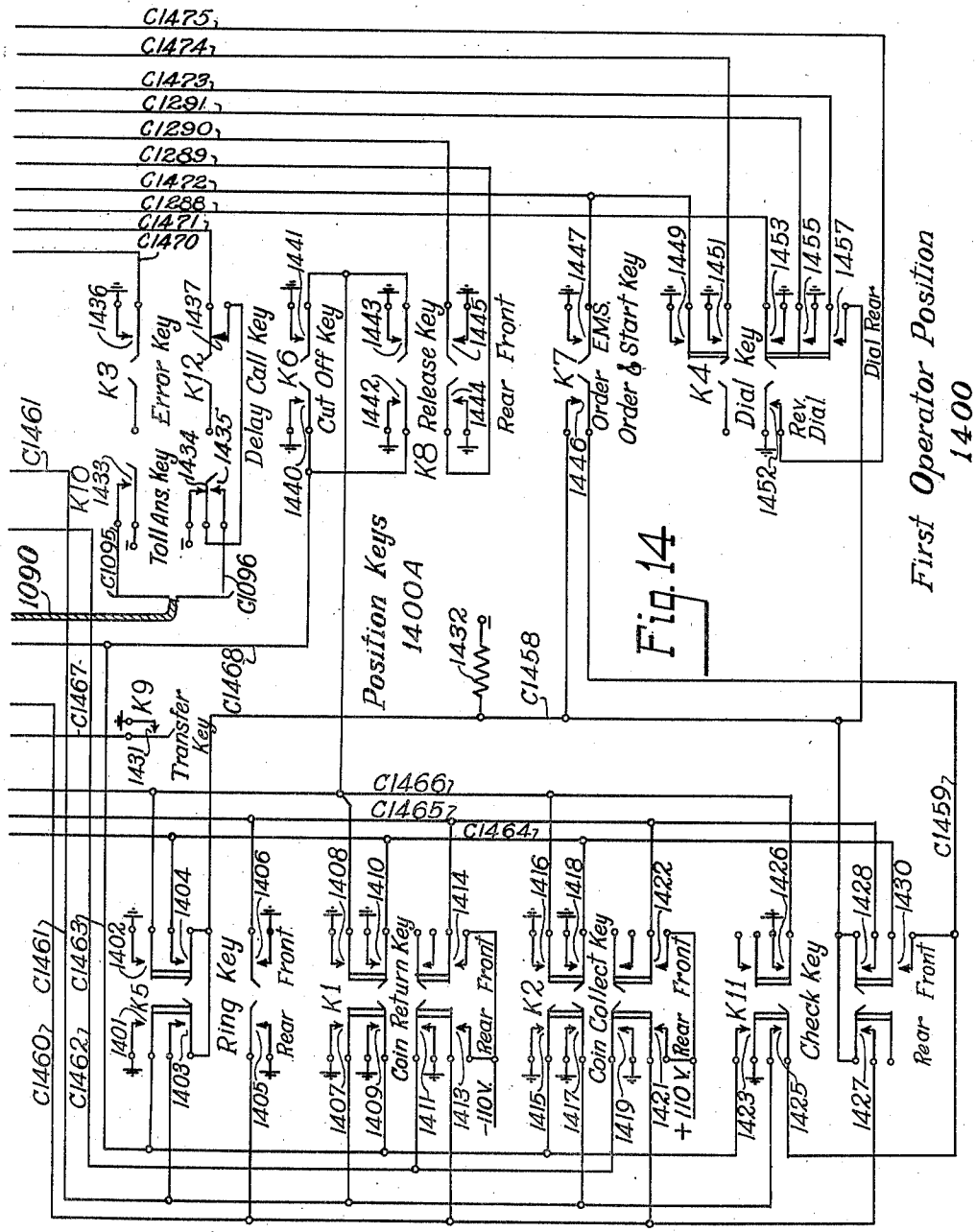


Fig. 14

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shorts
ATTORNEYS

Jan. 28, 1941. T. F. CROCKER 2,230,053

TELEPHONE SYSTEM

Filed Nov. 16, 1939 15 Sheets-Sheet 15

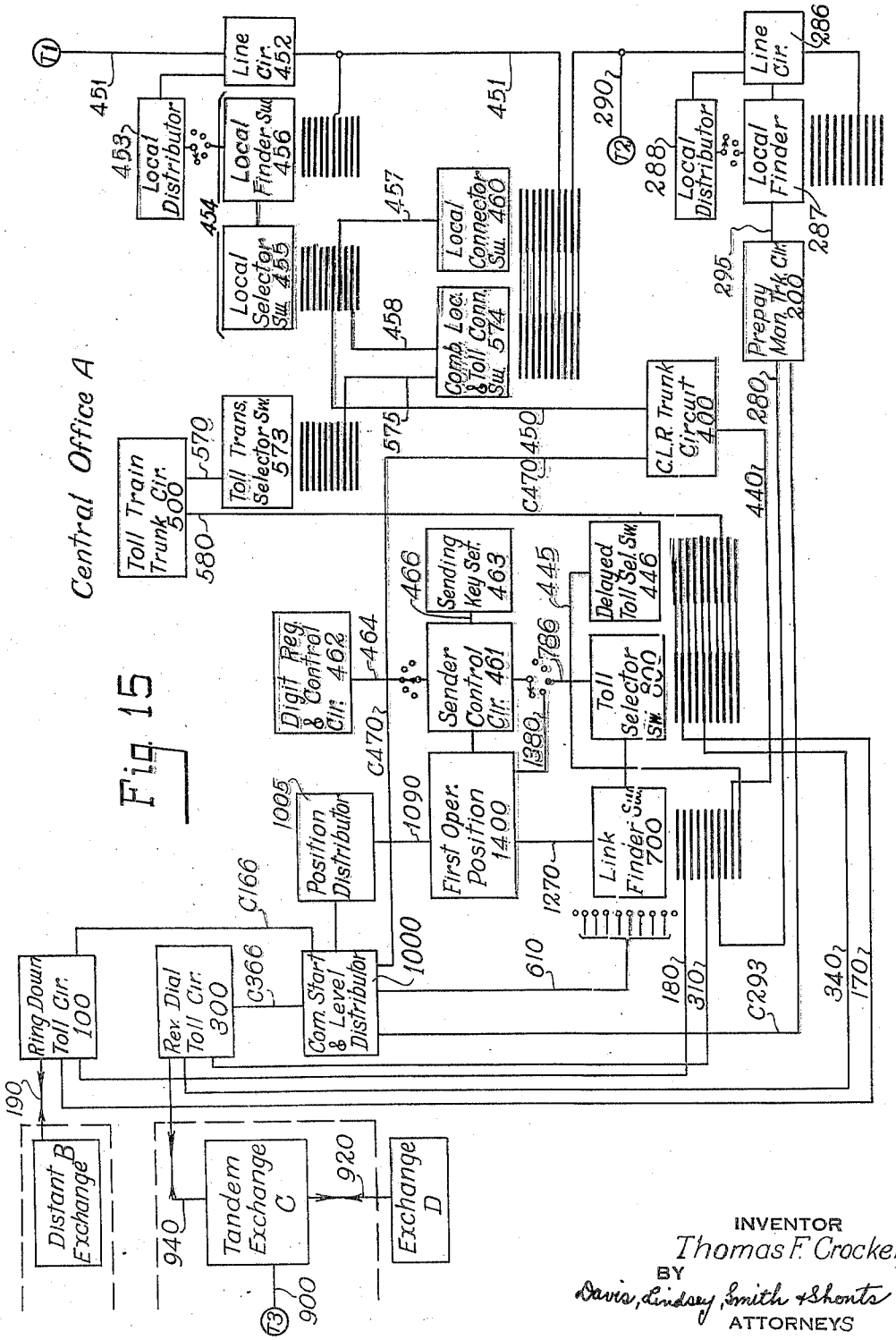


Fig. 15

INVENTOR
Thomas F. Crocker
BY
Davis, Lindsey, Smith & Shonts
ATTORNEYS

Patented Jan. 28, 1941

2,230,053

UNITED STATES PATENT OFFICE

2,230,053

TELEPHONE SYSTEM

Thomas F. Crocker, Chicago, Ill., assignor to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application November 16, 1939, Serial No. 304,778

73 Claims. (Cl. 179—27)

The present invention relates to telephone systems and more particularly to improved automatic switching apparatus of the character of that disclosed and claimed in U. S. Patent No. 2,167,710, Thomas F. Crocker, issued August 1, 1939, which apparatus is connected and arranged to handle switchboard traffic.

A telehpone system of this character conventionally comprises an automatic central office, a number of distant exchanges of any desired type, and interconnecting toll lines, the central office and each of the distant exchanges serving local subscriber substations having subscriber lines extending thereto. Local calls in the central office and in the distant exchanges of the automatic type are completed under the control of the subscriber at the subscriber substations; local calls in other of the distant exchanges are completed in any suitable manner; and calls between the central office and the distant exchanges are completed by operators at a switchboard provided in the central office. More particularly, the switchboard which is provided in the central office comprises a number of operator positions including groups of inward or toll operator positions, groups of combined line and recording or C. L. R. operator positions, and groups of delayed or point-to-point operator positions.

In handling traffic at the switchboard, incoming calls from the distant exchanges are first routed by way of the toll lines to the toll operator positions at the switchboard and then completed therefrom directly to the local subscriber substations in the central office, or transferred therefrom to the point-to-point operator positions to be completed later. Also, through calls between the distant exchanges and including the central office are first routed by way of the toll lines to the toll operator positions at the switchboard and then extended therefrom by way of the toll lines to others of the distant exchanges. Outgoing calls originating at the subscriber substations in the central office which are to be extended to distant exchanges are first routed by way of C. L. R. trunks to the C. L. R. operator positions at the switchboard and then completed therefrom directly by way of the toll lines to the distant exchanges, or transferred therefrom to the point-to-point operator positions to be completed later. In completing a call from a point-to-point operator position, the operator thereat first completes a connection to the called toll line or subscriber substation and then completes a connection to the calling toll line or subscriber substation.

The various toll and trunk calls are routed to and extended from the different operator positions by automatic switching apparatus including both local and toll switch trains, which apparatus is distributed for use and governed by suitable control means. Also, apparatus is provided at each operator position for answering calls routed thereto, for supervising calls completed by way of the operator position, and for controlling the switching apparatus, thereby to extend and to initiate calls from the operator position. Furthermore, apparatus at each operator position is provided for performing the various functions over the different toll, trunk and subscriber lines.

It is an object of the present invention to provide in a telephone system of the character described and including an automatic switch train associated with an operator position and a trunk accessible to the switch train, an improved trunk circuit associated with the trunk which is so connected and arranged that a connection to the operator position including the trunk may be readily controlled and supervised.

Another object of the invention is to provide in a telephone system of the character described including a paystation, an operator position, a trunk, and switching apparatus for extending a connection from the paystation by way of the trunk to the operator position, an improved trunk circuit associated with the trunk which is so connected and arranged that a connection routed from the paystation by way of the switching apparatus and the trunk to the operator position and the coin control apparatus at the paystation may be readily governed and supervised.

Another object of the invention is to provide in a telephone system of the character described and comprising a central office including a switchboard provided with a number of operator positions and a community automatic exchange or C. A. X. network including a number of exchanges and a number of toll lines extending therebetween, an improved arrangement for completing reverting calls between the exchanges in the C. A. X. network by way of the toll lines from the operator positions.

Another object of the invention is to provide in a signaling system including automatic switching mechanism having access to a plurality of groups of lines, an improved call distributor for causing the calling lines in the groups to be seized by the switching mechanism in a predetermined order.

Another object of the invention is to provide in a signaling system including automatic switching mechanism having access to a plurality of groups

of lines, an improved call distributor which is operative through a cycle in order to cause the switching mechanism to seize the calling lines in the groups in a predetermined order, whereby all of the calling lines in a given group are seized one by one by the switching mechanism before any of the calling lines in the succeeding group are seized one by one by the switching mechanism.

Another object of the invention is to provide in a signaling system including automatic switching mechanism having access to a plurality of groups of lines, an improved call distributor which is selectively operative in a plurality of different manners in order to cause calling lines in the groups to be seized by the switching mechanism in a corresponding plurality of different predetermined orders.

A further object of the invention is to provide in a telephone system of the character described including a number of operator positions, an improved call distributor which is so connected and arranged that calls on the lines in the groups are routed group by group in a predetermined order to the operator positions to be answered.

A further object of the invention is to provide in a telephone system of the character described and including a number of universal operator positions and a call distributor for routing incoming toll and trunk calls to the operator positions to be answered, operator controlled means at each of the operator positions for restricting the operation of the call distributor to that of incoming toll calls to the associated operator position to be answered.

A further object of the invention is to provide in a telephone system of the character described and including a number of universal operator positions and a call distributor for routing incoming toll and trunk calls to the operator positions to be answered, operator controlled means at each of the operator positions for selectively converting the associated operator position from a universal operator position to a toll operator position and to a point-to-point operator position.

The invention is illustrated as being embodied in a telephone system comprising a central office of the automatic type, a community automatic exchange or C. A. X. network including a number of exchanges of the automatic type, and a distant exchange of any suitable type. The central office serves a number of local subscriber substations and a number of local paystations of the prepay manual type; while the distant exchange and each of the exchanges in the C. A. X. network serve a number of local subscriber substations. Local switch trains are provided in the central office and in each of the exchanges in the C. A. X. network, thereby to permit the local subscribers in the respective exchanges to complete local calls; while local calls in the distant exchange are completed in any desired manner.

The C. A. X. network includes a tandem exchange and another exchange. Trunk lines are arranged between the other exchange and the tandem exchange in the C. A. X. network; C. A. X. toll lines are arranged between the tandem exchange in the C. A. X. network and the central office; while other toll lines are arranged between the distant exchange and the central office. Also, C. L. R. trunks are arranged in the central office which are accessible to the local switch train therein.

A switchboard is arranged in the central office which comprises a number of operator positions. Furthermore, a toll switch train is arranged in the central office which comprises a number of delayed toll selector switches and a number of groups of finder-selector links individually associated with the operator positions at the switchboard, each of the finder-selector links including a link finder switch and a toll selector switch. Each of the link finder switches has access to each of the delayed toll selector switches, to each of the C. L. R. trunks, to each of the paystation lines, and to each of the toll lines; while each of the toll selector switches and each of the delayed toll selector switches has access to each of the toll lines, and to a number of toll transmission selector switches. The local switch train comprises a number of finder-selector links, each including a finder switch and a selector switch, a number of connector switches accessible to the selector switches, and a number of combination local and toll connector switches accessible to the selector switches and to the toll transmission selector switches. Finally, the combination local and toll connector switches and the connector switches have access to the local subscriber lines and to the local paystation lines.

Also, apparatus is arranged at each of the operator positions for governing the operation of the finder-selector links associated therewith, thereby to answer, to extend, to initiate and to supervise calls routed by way of the associated finder-selector links.

In accordance with one feature of the invention, each toll line extending between the central office and the distant exchange comprises first and second branches, each branch including two line conductors, and is provided with an associated toll circuit including a ring relay, an order relay and an identity relay. A first operating circuit is provided for the ring relay which includes one of the line conductors of the second branch of the toll line; a second operating circuit is provided for the order relay which includes the one line conductor of the second branch of the toll line; and a third operating circuit is provided for the identity relay which includes the other line conductor of the second branch of the toll line. Further, the toll circuit comprises a source of ringing voltage, a source of out-of-order voltage, and an identity signal individual to the toll line. The ring relay, the order relay and the identity relay are so connected and arranged that the ring relay is operative to disconnect the first and second branches of the toll line and to connect the source of ringing voltage to the line conductors of the first branch of the toll line, that the order relay is operative to connect the source of out-of-order voltage to both branches of the toll line, and that the identity relay is operative to cause operation of the identity signal and to interrupt the first operating circuit and to complete the second operating circuit in the event it is prepared. The finder switch of any one of the finder-selector links associated with any one of the operator positions is operative to seize the second branch of the toll line, thereby to complete a connection between the one operator position and the toll line. Finally, a device is provided at the one operator position which is selectively operative to complete by way of the finder switch of the one finder-selector link the first operating circuit, or to prepare by way of the finder switch of the one finder-selector link the second operating circuit and to complete by way of the finder switch of the one finder-selector link the third operating circuit, or to complete

by way of the finder switch of the one finder-selector link the third operating circuit.

In accordance with another feature of the invention, there is provided a trunk having a trunk circuit associated therewith which includes a finder switch having access to each of the paystation lines. Also, an arrangement is provided which is responsive to the presence of a call on any one of the paystation lines for causing the finder switch to seize the paystation line, thereby to complete a connection between the paystation associated with the one paystation line and the trunk circuit. Further, the trunk circuit comprises means operative to create a call on the trunk which is governed by the deposit of a coin at the paystation. Each of the operator positions comprises apparatus which is operative to answer a call on the trunk and a device which is selectively operative to cause the coin deposited at the paystation to be collected or refunded. Furthermore, means is provided at the paystation for performing a release operation; and means is provided at the operator position for performing a release operation. Finally, the trunk circuit comprises means controlled by the performance of the release operations for causing the release of the finder switch when there is no deposited coin at the paystation and for causing the finder switch to remain operated and another call to be created on the trunk when there is a deposited coin at the paystation.

In accordance with another feature of the invention, the C. A. X. network comprises two automatic exchanges connected by trunk lines and is so connected and arranged that the subscribers in the two automatic exchanges may complete local automatic connections in the respective exchanges but are restricted from completing inter-exchange calls. Also, the C. A. X. network comprises a repeater and means operative to seize the repeater in response to the initiation of an inter-exchange call on a subscriber line in either one of the exchanges, thereby to cause the repeater to seize an idle one of the toll lines extending between the C. A. X. network and the central office. Means is provided which is controlled when the one toll line is seized by the repeater for rendering busy the one toll line and for creating a call on the one toll line. The automatic switching apparatus associated with any one of the operator positions at the switchboard in the central office is operative to seize the one toll line having a call thereon, thereby to complete a connection between the one operator position and the one toll line. Finally, means is provided which is under the control of the operator at the one operator position for revertively extending the connection over the switching apparatus and the one toll line to a subscriber line in either one of the exchanges in the C. A. X. network.

In accordance with a further feature of the invention, the telephone system comprises a plurality of groups of lines, switching mechanism having access to the lines in the groups, means for causing the switching mechanism to seize a calling line in a marked one of the groups, and a call distributor operative to mark in a predetermined order each one of the groups including a calling line. The call distributor is so connected and arranged that it is operative to mark only one of the groups at a time and to mark a second of the groups only when all of the calling lines in a marked first of the groups have been seized by the switching mechanism. Also, there is provided means controlled by the presence of a calling line in any one of the groups for initiating operation of the call distributor and means controlled when all of the calling lines in the groups have been seized by the switching mechanism for arresting operation of the call distributor.

In accordance with a further feature of the invention, the call distributor is operative to mark group by group in accordance with an established order of preference among the groups each one of the groups including a calling line; and control means is provided which is selectively operative to establish a fixed order of preference among the groups and to establish a variable order of preference among the groups.

In accordance with a further feature of the invention, the telephone system comprises an exchange provided with a switchboard including a plurality of operator positions, a number of groups of lines associated with the switchboard, apparatus at each of the operator positions for answering incoming calls on the lines in the groups, a position distributor operative to select in a predetermined order the operator positions, means for controlling the operation of the position distributor, a call distributor operative to route group by group in a predetermined order incoming calls on the lines in the groups to select ones of the operator positions, and means for controlling the operation of the call distributor. The call distributor is so connected and arranged that all incoming calls on the lines in a given group are routed one by one to select ones of the operator positions before any incoming calls on lines in a succeeding group are routed one by one to select ones of the operator positions.

In accordance with a further feature of the invention, the call distributor is normally operative to cause a prepared one of the finder-selector links in a selected one of the groups associated with one of the operator positions to operate and route both toll calls and trunk calls to the one operator position to be answered. Operator controlled means is provided at the one operator position for restricting the operation of the call distributor, whereby only toll calls are routed thereby to the one operator position to be answered. Additional operator controlled means is provided at the one operator position for preventing the position distributor from selecting any one of the finder-selector links in the associated group when a delayed call is initiated at the one operator position.

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

The 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 15 illustrates the general arrangement of a telephone system embodying the present invention; Figs. 1 to 14, inclusive, taken together, illustrate the details of a system having incorporated therein the features of the invention as briefly outlined above; and Fig. 16 illustrates the mode of combining Figs. 1 to 14, inclusive, to form a unified system.

Description of the apparatus incorporated in the telephone system

Referring now more particularly to Fig. 15 of the drawings, the telephone system there illustrated comprises a central office A, a distant exchange B, a distant community automatic exchange or C. A. X. network including a tandem exchange C and an exchange D associated therewith. The central office A and each of the exchanges B, C and D serve a number of local stations, the local stations served by the central office A including both subscriber stations and paystations. More particularly, the central office A serves a number of local subscriber substations, including the subscriber substation indicated at T1 and associated with the subscriber line 451 extending to the central office, and a number of paystations, including the paystation indicated at T2 and associated with the paystation line 290 extending to the central office, each of the paystations being of the prepay manual type; while the tandem exchange C serves a number of subscriber substations, including the subscriber substation indicated at T3 and associated with the subscriber line 900 extending to the tandem exchange. The central office A and the distant exchange B are interconnected by a group of two-way toll lines of the ring-down type, including the toll line indicated at 190. The central office A and the tandem exchange C are interconnected by a group of two-way toll lines, including the toll line indicated at 940. The tandem exchange C is interconnected with the exchange D by a group of two-way trunks, including the trunk indicated at 920. Each of the toll lines extending between the central office A and the distant exchange B terminates in a ring-down toll circuit individual thereto, the ring-down toll circuit 180 being individual to the toll line 190. Each of the toll lines extending between the central office A and the tandem exchange C terminates in a reverting dial toll circuit individual thereto, the reverting dial toll circuit 300 being individual to the toll line 940. Each of the subscriber and paystation lines extending to the central office A is provided with a line circuit individual thereto, the subscriber line 451 being provided with a line circuit 452 individual thereto, and the paystation line 290 being provided with a line circuit 285 individual thereto.

The central office A and each of the exchanges C and D are of the automatic type, while the distant exchange B may be of any desired type. Accordingly, the central office A and each of the exchanges C and D are provided with local switch trains which preferably comprise a plurality of groups of finder, selector and connector switches of the Strowger type arranged in the usual manner in order to set up the various connections between the local subscriber substations in the central office A and in the exchanges C and D. More particularly, the central office A is provided with a local switch train comprising a number of local links, including the local link 454, and a number of connector switches, including the connector switch 460. Each of the local links comprises a finder switch and a selector switch, the local link 454 comprising a finder switch 456 and a selector switch 455. Preferably, the finder switches, the selector switches and the connector switches in the local switch train are of the Strowger type and are connected and arranged in a well known manner.

Also, a group of combined line and recording or C. L. R. trunks, including the C. L. R. trunk 450, is provided in the central office A, which trunks are accessible to the selector switches of the local switch train. More particularly, the C. L. R. trunk 450 is accessible to the selector switch 455 of the local link 454. Furthermore, a C. L. R. trunk circuit is individually associated with each C. L. R. trunk, the C. L. R. trunk circuit 400 being individually associated with the C. L. R. trunk 450.

Further, the central office A is provided with a toll switch train comprising a plurality of groups of finder-selector links, one of the groups including the link illustrated which comprises the finder switch 700 and the toll selector switch 800; a group of delayed toll selector switches, including the delayed toll selector switch 446; a group of toll transmission selector switches, including the toll transmission selector switch 573; and a group of combination local and toll connector switches, including the combination local and toll connector switch 574. Preferably, these switches are of the Strowger type and are connected and arranged in a manner more fully described subsequently.

An automatic dial switchboard is arranged in the central office A and comprises a number of operator positions, each operator position having a group of finder-selector links individually associated therewith. For example, the finder-selector link illustrated is included in a group of links individually associated with the first operator position 1400 at the switchboard.

Each of the finder switches of the finder-selector links has access to each of the C. L. R. trunks in the central office A, to each of the C. A. X. toll lines extending between the central office A and the tandem exchange C, to each of the toll lines extending between the central office A and the distant exchange B, to each delayed toll selector switch and to each of the paystation lines in the central office A. More specifically, the finder switch 700 of the finder-selector link illustrated has access to the C. L. R. trunk 450 by way of the trunk line 440, to the C. A. X. toll line 940 by way of the trunk line 310, to the toll line 190 by way of the trunk line 180, to the delayed toll selector switch 446 by way of the trunk line 445, and to the paystation line 290 by way of the trunk line 280. Furthermore, the finder switch 700 is accessible to the trunk circuit at the first operator position 1400 by way of the cable 1270. Also, each of the toll selector switches and each of the delayed toll selector switches has access to each of the toll lines extending between the central office A and the distant exchange B, to each of the C. A. X. toll lines, and to a group of toll transmission selector switches. More specifically, the delayed toll selector switch 446 and the toll selector switch 800 each has access to the toll line 190 by way of the trunk line 170, to the C. A. X. toll line 940 by way of the trunk line 340, and to the toll transmission selector switch 573 by way of the trunk line 580.

Also, it is noted that a toll train trunk circuit is provided with each individual toll transmission selector switch and is interposed between the toll transmission selector switch and the delayed toll selector switches and the toll selector switches. More particularly, the toll train trunk circuit 500 is individually provided with the toll transmission selector switch 573 and is directly connected to the trunk line 580.

Each of the combination local and toll con-

nector switches is accessible to the selector switches in the local switch train and to the toll transmission selector switches and has access to each subscriber line and each paystation line terminating at the central office A. More particularly, the combination local and toll connector switch 574 is accessible to the selector switches in the local switch train by way of the line 458 and is accessible to the toll transmission selector switches by way of the line 575. Also, the selector switches in the local switch train have access to the group of C. L. R. trunks at the central office A and to the group of connector switches in the local switch train; while the connector switches in the local switch train have access to each subscriber line and each paystation line terminating at the central office A. Also, it is noted that a group of prepay manual trunk circuits is provided in the central office A and interposed between the individual trunk lines extending to the finder switches of the finder-selector links associated with the operator positions at the switchboard and the various paystation lines, this group of prepay manual trunk circuits including the prepay manual trunk circuit 200 individually associated with the trunk line 280.

Preferably, each of the operator positions, including the first operator position 1400 at the switchboard in the central office A, is of the universal type, thereby making it possible to render toll, C. L. R. and point-to-point service at each operator position. Also, at least the first and second operator positions are so connected and arranged that the service rendered thereby may be restricted to toll service. Also, the central office A comprises a common start and level distributor unit 1000, which is arranged to distribute calls to the finder switches of the links associated with the operator positions in a manner more fully described hereinafter, and a position distributor 1005, which is so connected and arranged that incoming calls to the switchboard are routed in a predetermined order to the operator positions to be answered.

More particularly, the common start and level distributor unit 1000 is so connected and arranged that the different types of trunk calls and the different types of toll calls are routed to the various operator positions to be answered in a predetermined order. The common start and level distributor unit 1000 operates to route all calls of a particular type, either trunk or toll, to the various operator positions to be answered before any calls of another type, either trunk or toll, are routed to the various operator positions to be answered; the type of calls answered first being determined by the type of call first incoming to the switchboard. This arrangement insures that all of the calls of a given type are answered before any of the calls of another type are answered.

Also individually associated with each operator position are one or more sender control circuits, the sender control circuit 461 being individually associated with the first operator position 1400. Furthermore, at each operator position there is provided a sending key set individual thereto which is associated with each of the sender control circuits associated with the operator position, the sending key set 463 being individually associated with the first operator position 1400 and with the sender control circuit 461. Finally, a group of digit register and control circuits is commonly associated with the switchboard, each of the sender control circuits being provided with switching apparatus having access to each of the digit register and control circuits and being operative to select an idle digit register and control circuit when the sender control circuit is taken for use. Also, each of the sender control circuits is provided with switching apparatus having access to the trunk circuit at the operator position individual thereto and to each of the finder-selector links individually associated with the associated operator position. More specifically, the sender control circuit 461 is individually associated with the first operator position 1400 by way of the line 465 and is operatively associated with the sending key set 463 by way of the line 466. Also, the sender control circuit 461 has access to the digit register and control circuit 462 by way of the line 464 to the trunk circuit at the first operator position by way of the cable 1380 and to the toll selector switch 800 of the finder-selector link illustrated by way of the cable 786.

Preferably, the elements of the C. A. X. network, as best shown in Fig. 9, are connected and arranged in the manner described and claimed in U. S. Patent No. 2,133,682, Pier Bakker, issued October 18, 1938. Briefly, the C. A. X. network comprises a tandem exchange C and an exchange D interconnected by a group of trunk lines including the trunk line 920. Individually associated with each of the trunk lines extending between the tandem exchange C and the exchange D are a line circuit and a line switch, the line circuit 921 and the line switch S918 being individually associated with the trunk line 920. Also arranged in the exchange D is a local switch train which is utilized in completing local calls therein. Each of the C. A. X. toll lines extending between the central office A and the tandem exchange C is provided with a line circuit individual thereto, the line circuit 932 being individual to the C. A. X. toll line 940.

A number of subscriber lines, including the subscriber line 900, are served by the tandem exchange C. Each subscriber line has a subscriber substation and a line switch individually associated therewith, the subscriber substation T3 and the line switch S901 being individually associated with the subscriber line 900. A switch train is provided in the tandem exchange C which comprises a group of local first selector switches, including the local first selector switch 914, a group of incoming first selector switches, including the incoming first selector switch 912, a group of dial back selector switches, including the dial back selector switch 910, a group of local and toll connector switches, including the local and toll connector switch 930, and a group of dial back repeaters, including the dial back repeater 916. Each of the dial back repeaters is provided with a line switch individual thereto, the line switch S914 being individual to the dial back repeater 916.

Further, it is noted that the incoming first selector switches are individually associated with the line circuits of the C. A. X. toll lines extending between the central office A and the tandem exchange C, the incoming first selector switch 912 being individually associated by way of the line 913 with the line circuit 932 of the C. A. X. toll line 940; while the dial back selector switches are individually associated with the dial back repeaters, the dial back selector switch 910 being individually associated by way of the line 911 with the dial back repeater 916.

The switch train provided in the tandem exchange C is so connected and arranged that the

local first selector switches are accessible to the line switches individually associated with the subscriber lines terminating at the tandem exchange C; the dial back repeaters are accessible to the line switches individually associated with the trunks extending between the tandem exchange C and the exchange D; and the line circuits of the C. A. X. toll lines extending between the central office A and the tandem exchange C are accessible to the line switches individually associated with the dial back repeaters. Further, it is noted that the dial back repeaters are also accessible to the incoming first selector switches and to the local first selector switches; while the local and toll connector switches are accessible to the dial back selector switches, to the incoming first selector switches, and to the local first selector switches. Finally, it is noted that the trunk circuits individually associated with the trunk lines extending between the tandem exchange C and the exchange D are accessible to the dial back selector switches and to the incoming first selector switches but are not accessible to the local first selector switches.

Preferably, each of the line switches is of the well known rotary type; while each of the dial back selector switches, the incoming first selector switches, the local first selector switches, and the local and toll connector switches is of the well known Strowger type.

The switch train in the tandem exchange C is so connected and arranged that local calls between subscriber lines terminating at the tandem exchange C may be completed directly just as local calls between subscriber lines terminating at the exchange D may be completed directly as previously noted; however, the switch train in the tandem exchange C is so connected and arranged that inter-exchange calls between the exchange D and the tandem exchange C cannot be completed directly but must be completed with the aid of an operator at one of the operator positions at the switchboard in the central office A. More particularly, the call is first extended from the exchange D to the tandem exchange C and therefrom by way of one of the C. A. X. toll lines extending between the central office A and the tandem exchange C to one of the operator positions at the switchboard in the central office A. The operator at the operator position at the switchboard in the central office A then extends the connection revertively over the C. A. X. toll line extending between the central office A and the tandem exchange C to the particular subscriber substation in the tandem exchange C. Also, inter-exchange calls between the tandem exchange C and the exchange D must be completed with the aid of an operator at one of the operator positions at the switchboard in the central office A in a similar manner. Further, the switch train in the tandem exchange C is so connected and arranged that an operator at one of the operator positions at the switchboard in the central office A may set up a connection directly in the tandem exchange C or in the exchange D.

Preferably, each of the reverting dial toll circuits terminating the C. A. X. toll lines in the central office A is identical to the reverting dial toll circuit **300** terminating the C. A. X. toll line **940**. As best shown in Fig. 3, the reverting dial toll circuit **300** comprises a repeater **335**, a group of relays including two trouble relays R**310** and R**315**, a ring relay R**320**, a ring-up relay R**325**, a dial out relay R**330**, a switching relay R**340**, a start relay R**350**, a marking relay R**360**, a supervisory relay R**370**, an impulse relay R**375**, a cut-through relay R**380**, a hold relay R**390**, an alarm relay R**395** and two control relays R**355** and R**305**, and a control network including a booster battery **327**. Also associated with the reverting dial toll circuit **300** is a source of trouble tone voltage **350**, a supervisory lamp L**323**, and a chief operator position, not shown.

Preferably, each of the C. L. R. trunk circuits terminating the C. L. R. trunks in the central office A is identical to the C. L. R. trunk circuit **400** terminating the C. L. R. trunk **450**. As best shown in Fig. 4, the C. L. R. trunk circuit **400** comprises a repeater **401** operatively associated with the C. L. R. trunk **450** and with the trunk line **440** extending to the finder switches of the finder-selector links at the switchboard. Also, the C. L. R. trunk circuit **400** comprises a group of relays including a marking relay R**410**, a start relay R**420**, a line relay R**430** and an identity relay R**425**, and a control network. Also individually associated with the C. L. R. trunk circuit **400** and commonly associated with the operator positions at the switchboard is an identity lamp L**408**.

Preferably, each of the toll train trunk circuits individually associated with the toll transmission selector switches is identical to the toll train trunk circuit **500** individually associated with the toll transmission selector switch **573** which comprises, as best shown in Fig. 5, a repeater **560** operatively associated with the line **570** extending to the toll transmission selector switch **573** and with the trunk line **580** extending to the toll selector switches of the finder-selector links at the switchboard and to the delayed toll selector switches. Also, the toll train trunk circuit **500** comprises a group of relays including a ring relay R**510**, a coin control relay R**520**, two supervisory relays R**525** and R**530**, a switching relay R**540** and a marking relay R**550**, and a control network.

Preferably, each of the ring-down toll circuits terminating the ring-down toll lines in the central office A is identical to the ring-down toll circuit **100** terminating the ring-down toll line **190**. As best shown in Fig. 1, the ring-down toll circuit **100** comprises a group of relays including a ring relay R**110**, an order relay R**120**, an identity relay R**125**, a ring-up relay R**135**, a start relay R**150**, a marking relay R**160** and a control relay R**140**, and a control network. Also associated with the ring-down toll circuit **100** is a source of trouble tone voltage **165**, a supervisory lamp L**166** and a chief operator position, not shown. Furthermore, an identity lamp L**185** is individually associated with the ring-down toll circuit **100** and commonly associated with the operator positions at the switchboard.

Preferably, each of the prepay manual trunk circuits is identical to the prepay manual trunk circuit **200** which comprises, as best shown in Fig. 2, a local finder switch **287** having access to the line circuits of the paystation lines terminating at the central office A and a group of relays including two coin control relays R**210** and R**255**, a ring relay R**215**, a supervisory relay R**230**, a line relay R**240**, a marking relay R**250**, a hold relay R**260** and a number of control relays R**220**, R**235** and R**270**, and a control network. Further, the prepay manual trunk circuit **200** comprises a repeater **201** operatively associated with the trunk line **280** extending to the finder switches of the finder-selector links associated with the operator

positions at the switchboard and a line 295 extending to the local finder switch 287. Also, a local distributor 288 is provided at the central office A which is operative to assign the local finder switch of an idle one of the pre-pay manual trunk circuits to the use of a paystation line having a call thereon.

Preferably, each of the line circuits terminating the subscriber lines extending to the central office A from local subscriber substations is identical to the line circuit 452 which, as indicated in Fig. 4, is a substation line circuit of any suitable connection and arrangement; while each of the line circuits terminating the paystation lines extending to the central office A from local paystations is identical to the line circuit 286 which, as indicated in Fig. 2, is a paystation line circuit of any suitable connection and arrangement. The specific connection and arrangement of the subscriber line circuit and of the paystation line circuit is not disclosed as the details thereof form no part of the present invention.

The position distributor 1005 comprises, as best shown in Fig. 10, a number of position relays and a control network. Three position relays R1020, R1015 and R1010 are illustrated, these position relays respectively corresponding to the first, second and third operator positions at the switchboard. Also, a number of trunk lines are provided which extend between the position distributor 1005 and the individual operator positions at the switchboard, the trunk line 1305 extending between the position distributor 1005 and the first operator position 1400 at the switchboard.

The common start and level distributor unit 1000 comprises, as best shown in Figs. 10 and 6, two toll position relays R1030 and R1035 respectively corresponding to the first and second operator positions at the switchboard, a position busy relay R1040, a timer start relay R1045, a signal relay R1050, a trunk relay R1055, a toll relay R1060, a toll answer relay R1065, two control relays R600 and R650, nine marking relays R605, R610, R615, R620, R625, R630, R635, R640 and R645, four trunk start relays R655, R660, R665 and R670, five toll start relays R675, R680, R685, R690 and R695, and a control network. Also, the common start and level distributor unit 1000 comprises an audible signal 1047, a timer or delay starting device 1048 and a control key K1001. A number of trunk lines are provided which extend between the common start and level distributor unit 1000 and the individual operator positions at the switchboard, the trunk line 1000 extending between the common start and level distributor unit 1000 and the first operator position 1400 at the switchboard.

The trunk start relay R655 corresponds to a group of ten C. L. R. trunks, including the C. L. R. trunk 450, terminating in the second level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard; the trunk start relay R660 corresponds to a group of ten C. L. R. trunks, not shown, terminating in the third level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard; the trunk start relay R665 corresponds to a group of ten paystation lines, including the paystation line 290, terminating in the fourth level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard; and the trunk start relay R670 corresponds to a group of ten reserve trunks, not shown, terminating in the fifth level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard. Finally, the toll start relay R675 corresponds to a group of ten C. A. X. toll lines, including the C. A. X. toll line 940, terminating in the sixth level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard; the toll start relay R680 corresponds to a group of ten C. A. X. toll lines, not shown, terminating in the seventh level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard; the toll start relay R685 corresponds to a group of ten reserve toll lines, not shown, terminating in the eighth level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard; the toll start relay R690 corresponds to a group of ten ring-down toll lines, including the ring-down toll line 199, terminating in the ninth level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard; and the toll start relay R695 corresponds to a group of ten ring-down toll lines, not shown, terminating in the tenth level of the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard.

Each of the start relays is so connected and arranged that it is operative when a call is initiated on any one of the ten trunk or toll lines in the associated group and remains operated until all of the calls on the trunk or toll lines in the associated group have been answered by the operators at the operator positions at the switchboard. The marking relays R605 to R645, inclusive, are so connected and arranged that the calls on the lines in the various ten-line groups of trunk and toll lines are answered by the operators at the operator positions at the switchboard in a predetermined order. More particularly, the calls in the various levels between two and ten, inclusive, in the contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard are cleared of calls successively in a manner more fully described hereinafter.

Preferably, the finder switches, selector switches and connector switches included in the local switch train in the central office A are identical to the finder switch, selector switch and connector switch indicated at 456, 455 and 460, respectively, in Fig. 4. Also, the combined local and toll connector switches are identical to the combined local and toll connector switch indicated at 574 in Fig. 5. Further, the local finder switch included in each prepay manual trunk circuit is identical to the local finder switch indicated at 287 in Fig. 2; while each of the toll transmission selector switches is identical to the toll transmission selector switch indicated at 573 in Fig. 5. Moreover, each of these switches is of the well known Strowger type and is connected and arranged in the usual manner. The specific connection and arrangement of these switches are not described as the details thereof form no part of the present invention.

The specific connections and arrangements of the local distributor indicated at 453 in Fig. 4 and associated with the links of the local switch train, and the local distributor indicated at 288

in Fig. 2 and associated with the local finder switches included in the prepay manual trunk circuits are not described as the details thereof form no part of the present invention.

Preferably, each of the operator positions at the automatic dial switchboard is identical to the first operator position 1400 which comprises a set of position keys 1400A, position telephone equipment 1100 and a relay group 1200. As best shown in Fig. 14, the set of position keys 1400A arranged at the first operator position 1400 comprises a coin return key K1, a coin collect key K2, an error key K3, a dial key K4, a ring key K5, a cut-off key K6, an order and start key K7, a release key K8, a transfer key K9, a toll answer key K10, a check key K11 and a delay call key K12. Also associated with the first operator position are an audible signal B1153, a toll lamp L1145 and a trunk lamp L1146. The connections and arrangements of the keys, the audible signal and the lamps mentioned are described in detail hereinafter.

The position telephone equipment 1100 at the first operator position 1400 comprises, as best shown in Fig. 11, a receiver 1128, a transmitter 1127, a talking repeater 1105, and a monitoring repeater 1102, the last-mentioned repeaters being operatively associated with the telephone instrument at the first operator position and with the trunk circuit thereat in a manner more fully described hereinafter.

The relay group 1200 arranged at the first operator position 1400 comprises, as best shown in Figs. 11, 12 and 13, a group of relays including a transmitter supply relay R1100, a monitor relay R1110, a talk relay R1130, a transfer relay R1200, a front split relay R1210, a rear split relay R1220, a supervisory relay R1230, a rear coin control relay R1240, an answer pilot relay R1250, an error relay R1260, a dial rear relay R1300, a distributor start relay R1310, a call pilot relay R1320, a cut-in relay R1330, a call relay R1340, a reverting call relay R1370 and a number of control relays R1120, R1140, R1150, R1160, R1350 and R1360, and a control network. Certain of the relays mentioned are connected and arranged for the purpose of controlling the association of the telephone instrument at the first operator position with the trunk circuit thereat; while other of the relays mentioned are so connected and arranged that they control the transmission of tone to the receiver of the telephone instrument at the first operator position when an incoming call is routed to the first operator position. Finally, the remainder of the relays mentioned are so connected and arranged that various types of toll and trunk calls may be initiated, answered, released and supervised from the first operator position in a manner more fully described subsequently.

As previously noted, a group of finder-selector links is individually associated with each operator position, the finder-selector link illustrated comprising the finder switch 700, shown in Fig. 7, and the toll selector switch 800, shown in Fig. 8, being included in the group of finder-selector links individually associated with the first operator position 1400. Preferably, each of the finder-selector links is identical to the finder-selector link illustrated, the finder switch of each of the finder-selector links being operatively associated with the cable 1270 extending to the trunk circuit at the first operator position 1400.

The finder switch 700 comprises a switching mechanism 701 of the Strowger type including a wiper set provided with a number of wipers 702 to 708, inclusive, and capable of both vertical and rotary movements. Further, the mechanism 701 comprises a circumferentially disposed main contact bank including ten vertical levels of contact sets arranged in circumferentially spaced-apart relationship. Also, the mechanism 701 includes a vertical control contact bank 709 associated with a vertical control wiper 708. The mechanism 701 is provided with a vertical magnet M733 for moving the wiper set thereof in the vertical direction, a rotary magnet M734 for moving the wiper set thereof in the rotary direction, and a release magnet M735 for releasing the wiper set thereof and for causing the wiper set thereof to be returned to its normal position. Finally, the switching mechanism 701 has a number of sets of switch springs S733, S734 and S735 operatively associated therewith which are controlled in accordance with the movements of the wiper set thereof in a manner more fully described subsequently.

Also, the finder switch 700 comprises a group of relays including an electropolarized relay R710, a transfer relay R720, a step relay R730, a start relay R740, a connect relay R750 and a cut-in relay R760, and a control network. Moreover, the finder switch 700 has individually associated therewith a link listening or talk key K780 and a monitor key K770 which are operative to associate the finder switch 700 with the cable 1270 extending to the trunk circuit at the first operator position 1400. Finally, a number of supervisory lamps L776, L767 and L768 are associated with the finder switch 700 for supervisory purposes.

The toll selector switch 800 comprises a switching mechanism 801 of the Strowger type including a wiper set provided with a number of wipers 802 to 806, inclusive, and capable of both vertical and rotary movements. Further, the mechanism 801 comprises a circumferentially disposed main contact bank including ten vertical levels of contact sets arranged in circumferentially spaced-apart relationship. Moreover, the mechanism 801 is provided with a vertical magnet M877 for driving the wiper set thereof in the vertical direction, a rotary magnet M878 for moving the wiper set thereof in the rotary direction, and a release magnet M876 for releasing the wiper set thereof and for causing the wiper set to be returned to its normal position. Finally, the switching mechanism 801 has a number of sets of switch springs S833, S834, S835, S836, S837, S838 and S839 operatively associated therewith which are controlled in accordance with the movements of the wiper set in a manner more fully described subsequently. Also, the toll selector switch 800 comprises a group of relays including an electropolarized relay R810, a busy relay R820, a line relay R830, a hold relay R840, a transfer relay R850, a ringdown relay R885 and a number of control relays R860, R870, R880, R890 and R895, and a circuit network.

Preferably, each of the delayed toll selector switches, including the delayed toll selector switch 446, illustrated in Fig. 4, is identical to each of the toll selector switches included in the finder-selector links. For example, the delayed toll selector switch 446 is identical to the toll selector switch 800 forming a part of the finder-selector link illustrated.

As previously noted, one or more sender control circuits are individually associated with each operator position, the sender control circuit 491, illustrated in Fig. 4, being individually associated with the first operator position 1400. Pref-

cuit, traced hereinafter, for energizing the lower winding of the transfer relay R720.

When the wiper set of the mechanism 701 is moved away from its normal position one step in the vertical direction the sets of switch springs S784 and S785 are actuated into engagement, When the set of switch springs S784 is actuated into engagement a holding circuit, traced hereinafter, is prepared for energizing the upper winding of the transfer relay R720; and when the set of switch springs S785 is actuated into engagement a circuit, traced hereinafter, is prepared for energizing the release magnet M735 of the mechanism 701.

Upon operating, the step relay R730 interrupts, at the contacts 731, a point in the previously traced circuit for energizing the vertical magnet M733, thereby to cause the latter magnet to restore. Upon restoring, the vertical magnet M733 interrupts, at the contacts 736, the previously mentioned circuit for energizing the winding of the step relay R730, thereby to cause the latter relay to restore. Upon restoring, the step relay R730 recompletes, at the contacts 731 the previously traced circuit for energizing the vertical magnet M733, thereby to cause the vertical magnet M733 to reoperate. The vertical magnet M733 and the step relay R730 interact, in the previously described manner, thereby to cause the vertical magnet M733 to drive the wiper set of the mechanism 701 step by step in the vertical direction until the wiper set of the mechanism 701 is driven to the second vertical level wherein the trunk line 440 extending to the C. L. R. trunk circuit 400 and the C. L. R. trunk 450 is terminated in the main contact bank of the mechanism 701, at which time the vertical control wiper 708 engages in the associated vertical control contact bank 709 the second contact terminating the conductor C612 in the trunk line 610 having ground potential thereon.

When the vertical wiper 708 engages the second contact in the vertical control contact bank 709 having ground potential thereon, a circuit is completed for energizing in series the lower winding of the transfer relay R720 and the winding of the step relay R730, this circuit extending from ground potential appearing upon the wiper 708 by way of the lower winding of R720, the contacts 724 and the winding of R730 to battery. Shortly after the transfer relay R720 is energized over the above-traced circuit, this relay being of the slow-to-operate type, it operates to complete, at the contacts 721, the previously mentioned holding circuit for energizing the upper winding of the transfer relay R720, this circuit extending from ground by way of the upper winding of R720, the sets of switch springs S784 and S783, the contacts 721 and the resistor 732 to battery. Also, the transfer relay R720 interrupts, at the contacts 724, a point in the previously traced circuit for energizing the lower winding thereof in series with the winding of the step relay R730 and interrupts, at the contacts 722, the previously traced circuit for energizing the winding of the vertical magnet M733, thereby to arrest further movement of the wiper set of the mechanism 701 in the vertical direction. Furthermore, the transfer relay R720 completes, at the contacts 723, a circuit for energizing the rotary magnet M734 of the mechanism 701, this circuit extending from ground by way of the contacts 742, 714, 731 and 723 and the winding of M734 to battery. Also, the transfer relay R720 interrupts at the contacts 726, a further point in the previously mentioned circuit for energizing the release magnet M735, prepares, at the contacts 725, a point in a circuit, traced hereinafter, for energizing the intermediate winding of the electropolarized relay R710 and completes, at the contacts 727, a circuit for illuminating the supervisory lamp L768. The circuit for illuminating the supervisory lamp L768 extends from ground by way of the resistor 777, C710, the contacts 727, C709 and the lamp L768 to battery. The illumination of the supervisory lamp L768 indicates to the operator at the first operator position 1400 that the finder-selector link illustrated is busy.

When the rotary magnet M734 is energized over the previously traced circuit it operates to drive the wiper set of the mechanism 701 one step in the rotary direction and to complete, at the contacts 737, an obvious circuit for energizing the winding of the step relay R730, thereby to cause the latter relay to operate. Upon operating, the step relay R730 interrupts, at the contacts 731, the previously traced circuit for energizing the rotary magnet M734, thereby to cause the rotary magnet M734 to restore and interrupt, at the contacts 737, the circuit for energizing the winding of the step relay R730, whereupon the step relay R730 restores to recomplete, at the contacts 731, the previously traced circuit for energizing the rotary magnet M734. The rotary magnet M734 and the step relay R730 continue to interact, in the above described manner, until the wiper set of the mechanism 701 is rotated to the rotary position of the contact set in the main contact bank of the mechanism 701 wherein the trunk line 440 extending to the C. L. R. trunk circuit 400 is terminated, at which time the wiper 706 of the wiper set engages a contact in the contact set terminating the control conductor C444 of the trunk line 440, the control conductor C444 having battery potential thereon. When the wiper 706 engages the contact terminating the control conductor C444 of the trunk line 440 having battery potential thereon, a circuit is completed for energizing the intermediate winding of the electropolarized relay R710, this circuit extending from ground at the contacts 725 by way of the intermediate winding of R710, the wiper 706, the control conductor C444 of the trunk line 440, the contacts 421 and the winding of R410 to battery. When energized over the above-traced circuit the electropolarized relay R710 operates exceedingly fast to complete, at the contacts 716, a holding circuit for energizing the lower winding thereof, this circuit extending from ground by way of the contacts 725 and 716 and the lower winding of R710 to battery. Also, the electropolarized relay R710 prepares, at the contacts 718, a circuit, traced hereinafter, for energizing the supervisory relay R1230 in the relay group 1200 and completes, at the contacts 717, an obvious path for short-circuiting the intermediate winding thereof in order to reduce the series resistance of the circuit for energizing the winding of the marking relay R410 in the C. L. R. trunk circuit 400, thereby to cause the latter relay to operate. Also, upon operating, the electropolarized relay R710 completes, at the contacts 711 and 712, a connection between the line conductors C441 and C442 of the trunk line 440 and the line conductors C1284 and C1283 in the cable 1270 extending to the first operator position 1400. At this time the line conductor C1182 of the trunk circuit at the first operator position

is connected by way of the contacts 1201, C1271, C1161, the contacts 1141, C1180, the contacts 1221, the line conductor C1283 in the cable 1270, the contacts 755 and 712 and the wiper 703 to the line conductor C442 of the trunk line 440; and the line conductor C1184 of the trunk circuit at the first operator position is connected by way of the contacts 1203 and 1223, the line conductor C1284 in the cable 1270, the contacts 752 and 711 and the wiper 702 to the line conductor C441 of the trunk line 440. Further, it is noted that the line conductors C441 and C442 of the trunk line 440 are interconnected in the C. L. R. trunk circuit 400 by way of the windings 402 and 403 of the repeater 401 and the condenser 406. Moreover, the line conductors C1182 and C1184 of the trunk circuit at the first operator position are operatively connected to the windings 1106 and 1107 of the talking repeater 1105 as previously explained. Accordingly, the telephone instrument at the first operator position 1400 is operatively associated with the repeater 401 in the C. L. R. trunk circuit 400.

Upon operating, the marking relay R410 in the C. L. R. trunk circuit 400 completes, at the contacts 412, an obvious holding circuit for energizing the winding thereof, prepares, at the contacts 411, a further point in the previously mentioned circuit for energizing the winding of the supervisory relay R1230 in the relay group 1200, and interrupts, at the contacts 413, the previously traced path for conducting interrupted generator current over the conductor C417 to the line conductor C452 of the C. L. R. trunk 450, thereby to interrupt the projection of tone current over the C. L. R. trunk 450 to the telephone instrument at the subscriber substation T1. Also, the marking relay R410 completes, at the contacts 414, an obvious alternative path for applying direct ground potential to the control conductor C453 of the C. L. R. trunk 450, thereby to mark the C. L. R. trunk 450 as busy to the local selector switches having access thereto. Finally, the marking relay R410 interrupts, at the contacts 415, the previously mentioned path for applying ground potential to the start conductor C470 in the trunk line 600 extending to the common start and level distributor unit 1000.

At this time ground potential in the C. L. R. trunk circuit 400 has been removed from the start conductor C470 in the trunk line 600; however, a multiple path for applying ground potential to the start conductor C470 in the trunk line 600 may be completed in one or more of the other C. L. R. trunk circuits individually associated with the group of ten C. L. R. trunks, including the C. L. R. trunk 450. More particularly, ground potential is completely removed from the start conductor C470 in the trunk line 600 only when all of the C. L. R. trunks in the group of ten C. L. R. trunks, including the C. L. R. trunk 450, are idle or when all of the C. L. R trunks in this group of C. L. R. trunks having calls thereon have been seized by the finder switches of the links associated with the operator positions at the switchboard. In other words, when there are no calls waiting to be answered on the C. L. R. trunks in this group of ten C. L. R. trunks ground potential is removed from the start conductor C470 in the trunk line 600, thereby to interrupt the previously mentioned circuit for energizing the winding of the trunk start relay R655 in order to cause the latter relay to restore.

Upon restoring, the trunk start relay R655 interrupts, at the contacts 657, the previously mentioned path for applying ground potential to the conductor C606, thereby to cause the trunk relay R1055 to restore in the event none of the other trunk start relays R660, R665 and R670 is operated at this time. Assuming that none of the trunk start relays R655, R660, R665 and R670 is operated at this time, the trunk relay R1055 then restores. Also, upon restoring, the trunk start relay R655 prepares, at the contacts 656, the previously mentioned circuit for energizing the lower winding of the marking relay R610 in the event the toll relay R1060 is operated at this time, the toll relay R1060 being operated at this time in the event any one of the toll start relays R675, R680, R685, R690 or R695 is operated. In other words, there are no calls to be answered on the C. L. R. trunks in the group of C. L. R. trunks terminating in the second level of the contact banks of the finder switches of the links associated with the operator positions at the switchboard at this time; and further operation of the common start and level distributor unit 1000 is initiated at this time in the event there are toll lines in the groups of toll lines terminting in other levels of the contact banks of the finder switches of the links associated with the operator positions at the switchboard having calls thereon to be answered.

Upon restoring, the trunk relay R1055 interrupts, at the contacts 1057, the previously mentioned path for applying ground potential to the conductor C604, the application of ground potential to the conductor C604 being under the control of the toll relay R1060 at this time, as previously noted. Also, the trunk relay R1055 interrupts, at the contacts 1056, the previously traced path for applying ground potential by way of the winding of the timer start relay R1045 to the start conductor C1305 in the trunk line 1305, thereby to cause the timer start relay R1045 to restore in the event the toll relay R1060 is not operated at this time. Also, upon restoring, the trunk relay R1055 interrupts, at the contacts 1058, a further point in the previously mentioned path for applying ground potential to the conductor C1043 extending to the chief operator position and interrupts, at the contacts 1059, the multiple circuits for illuminating the trunk lamps at the various operator positions at the switchboard. More particularly, the trunk relay R1055 interrupts, at the contacts 1059, the previously traced circuit for illuminating the trunk lamp L1146 at the first operator position. When the trunk lamp L1146 at the first operator position 1400 is thus extinguished the operator thereat is advised that there are no trunk calls waiting to be answered. Also upon restoring the trunk relay R1055 interrupts at the contacts 1058 the previously mentioned circuit for energizing the winding of the signal relay R1050, thereby to cause the latter relay to restore. Upon restoring the signal relay R1050 interrupts, at the contacts 1051, the previously mentioned multiple circuits for energizing the windings of the audible signals at the operator positions at the switchboard. Upon restoring, the timer start relay R1045 interrupts, at the contacts 1046 the previously mentioned path for applying ground potential to the relay starting device 1048, thereby to arrest the timing operation thereof and positively to prevent operation of the audible signal 1047.

When the finder switch 700 operated to move the wiper set of the mechanism 701 to the second level in the associated contact bank wherein the trunk line 440 extending to the C. L. R. trunk circuit 400 is terminated, the transfer relay R720

ond operator position at the switchboard, which circuit will be completed after a call extended to the switchboard has been answered by the operator at the first operator position 1400 in a manner more fully described hereinafter. Also, upon operating, the position relay R1020 prepares, at the contacts 1024, a path, traced hereinafter, for applying ground potential to the start conductor C1305 in the trunk line 1305, thereby to prepare a further point in the previously mentioned circuit for energizing the winding of the start relay R740 in the finder switch 700.

Also, upon operating, the connect relay R750 in the finder switch 700 prepares, at the contacts 757, a circuit, traced hereinafter, for energizing the winding of the answer pilot relay R1250 and prepares, at the contacts 752 and 755, a circuit, traced hereinafter, for connecting the trunk circuit at the first operator position 1400 to the wipers 702 and 703 of the wiper set included in the mechanism 701 of the finder switch 700. Further, the connect relay R750 interrupts, at the contacts 754', an obvious path for applying ground potential to the conductor C792 in the cable 786, thereby to mark the cable 786 as having a calling condition thereon. At this time the apparatus at the first operator position 1400 and the apparatus in the finder switch 700 of the finder-selector link illustrated are in condition to receive the next incoming call to the switchboard, and the next incoming call to the switchboard will be routed to the first operator position 1400 in a manner more fully described subsequently.

Extension of a call from a local subscriber substation in the central office A to the switchboard

In order to establish a connection between a local subscriber substation in the central office A to the switchboard, the subscriber at the local subscriber substation first removes the receiver of the telephone instrument thereat, thereby to obtain a connection to the local switch train in the central office. Assuming that the subscriber at the subscriber station T1 desires a connection to the switchboard at the central office A he removes the receiver of the telephone instrument thereat from its switch-hook, thereby to cause the line circuit 452 associated with the subscriber line 451 extending to the subscriber substation T1 to operate and mark the subscriber line 451 as a calling line, whereupon the local distributor 453 operates and assigns an idle one of the local links, such, for example, as the local link 454, to the use of the calling subscriber line 451. The local finder switch 456 of the local link 454 then operates to seize the calling subscriber line 451, thereby to cause the local selector switch 455 associated therewith to be conditioned to be responsive to impulses and to return dial tone current over the calling subscriber line 451 in order to indicate to the subscriber at the calling subscriber substation T1 that he may operate the dial mechanism thereat in order to extend the connection further. Also when the local finder switch 456 seizes the subscriber line 451 the line circuit 452 operates to mark the subscriber line 451 as busy to the switches having access thereto. The subscriber at the calling subscriber substation T1 then dials a single digit, preferably the digit 0, thereby to cause the local selector switch 455 to operate automatically and search for an idle C. L. R. trunk. Assuming that the C. L. R. trunk 450 is the first available C. L. R. trunk extending to the switchboard the local selector switch 455 operates and seizes this C. L. R. trunk.

When the local selector switch 455 seizes the C. L. R. trunk 450 a loop circuit is completed in the local selector switch 455 including the windings of the line relay R430 in the C. L. R. trunk circuit 400, this loop circuit extending from ground by way of the right-hand winding of R430 and the winding 405 of the repeater 401 to the line conductor C452 of the C. L. R. trunk 450 and from battery by way of the left-hand winding of R430 and the winding 404 of the repeater 401 to the line conductor C451 of the C. L. R. trunk 450, the line conductors C451 and C452 of the C. L. R. trunk 450 being connected together by way of a loop circuit including the local selector switch 455, the local finder switch 456, the line circuit 452, the subscriber line 451 and the telephone instrument at the subscriber substation T1. When the windings of the line relay R430 are thus energized this relay operates to complete, at the contacts 433, a circuit for returning tone current over the C. L. R. trunk 450 to the telephone instrument at the subscriber substation T1, this circuit extending from the interrupted generator conductor C417 by way of the resistor 409, the condenser 416 and the contacts 413 and 433 to the line conductor C452 of the C. L. R. trunk 450. This application of tone current to the line conductor C452 of the C. L. R. trunk 450 causes the receiver of the telephone instrument at the subscriber substation T1 to produce a tone in order to indicate to the subscriber thereat that his call is receiving attention. Also, upon operating, the line relay R430 completes, at the contacts 432, an obvious circuit for energizing the winding of the start relay R420, thereby to cause this relay to operate. Upon operating, the start relay R420 completes, at the contacts 421, an obvious path for applying battery potential by way of the winding of the marking relay R410 to the control conductor C444 of the trunk line 440 extending to the contact bank of the finder switch 700 and interrupts, at the contacts 423, a point in a normally completed circuit for applying battery potential to the control conductor C453 of the C. L. R. trunk 450, the last-mentioned circuit being normally completed to mark the C. L. R. trunk 450 as idle. The circuit for applying battery potential to the control conductor C453 of the C. L. R. trunk 450 extends, when completed, from battery by way of the impedance I434 and the contacts 423 to the control conductor C453 of the C. L. R. trunk 450. Further, the start relay R420 completes, at the contacts 422, an obvious path for applying ground potential to the control conductor C453 of the C. L. R. trunk 450, thereby to mark the C. L. R. trunk 450 as busy to the local selector switches having access thereto. Finally, the start relay R420 completes, at the contacts 424, an obvious path for applying ground potential to the start conductor C470 in the trunk line 600 extending to the common start and level distributor unit 1000.

This application of ground potential to the start conductor C470 in the trunk line 600 completes an obvious circuit for energizing the winding of the trunk start relay R655 corresponding to the group of ten C. L. R. trunks, including the C. L. R. trunk 450. When the winding of the trunk start relay R655 is thus energized this relay operates to interrupt, at the contacts 656, a point in a circuit, traced hereinafter, for energizing the lower winding of the marking relay

R610, to complete, at the contacts 657, an obvious path for applying ground potential to the conductor C606, thereby to complete an obvious circuit for energizing the winding of the trunk relay R1055, and to prepare, at the contacts 658, a path, traced hereinafter, for applying ground potential to the conductor C612 in the trunk line 610 extending to the vertical control contact bank 709 of the mechanism 701 of the finder switch 700, the conductor C612 being terminated by the second contact in the vertical control contact bank 709, thereby to mark the second level in the main contact bank of the mechanism 701 as terminating the trunk line 440 extending to the C. L. R. trunk circuit 400 associated with the C. L. R. trunk 450.

When the trunk relay R1055 is thus energized it operates to complete, at the contacts 1057, an obvious path for applying ground potential to the conductor C604, thereby to complete a circuit for energizing the lower winding of the marking relay R605, this circuit extending from the grounded conductor C604 by way of the contacts 602 and the lower winding of R605 to battery. The marking relay R605 then operates to complete, at the contacts 607, a holding circuit for energizing the upper winding thereof in series with the upper winding of the control relay R600, this circuit extending from ground by way of the upper winding of R600, C603, the contacts 611 and 607 and the upper winding of R605 to battery. Also, the marking relay R605 interrupts, at the contacts 606, a point in a holding circuit, traced hereinafter, for energizing the upper winding of the marking relay R645 in series with the upper winding of the control relay R600, prepares, at the contacts 608, a point in the previously mentioned circuit for energizing the lower winding of the marking relay R610, and completes, at the contacts 609, the previously mentioned path for applying ground potential to the conductor C612 in the trunk line 610. The last-mentioned path extends from ground by way of the contacts 1034', 1039', C608 and the contacts 609 and 658 to the conductor C612 in the trunk line 610. At this time further operation of the marking relays R605 to R645, inclusive, is arrested due to the operated condition of the trunk start relay R655, which latter relay retains interrupted, at the contacts 656, the previously mentioned circuit for energizing the lower winding of the marking relay R610.

Also, upon operating, the trunk relay R1055 prepares, at the contacts 1058, a point in the previously mentioned path for applying ground potential to the conductor C1043 extending to the chief operator position, this path being interrupted at this time due to the operated condition of the position busy relay R1040. Further, the trunk relay R1055 completes, at the contacts 1059, an obvious path for applying ground potential to the conductor C1092 in the trunk line 1090, thereby to complete an obvious circuit for illuminating the trunk lamp L1146 at the first operator position 1400 at the switchboard and multiple circuits, not shown, for illuminating the trunk lamps at the other operator positions at the switchboard. The illumination of the trunk lamps at the various operator positions at the switchboard indicates to the operators thereat that a trunk call has been extended to the switchboard to be answered. Further the trunk relay R1055 completes at the contacts 1058 an obvious circuit for energizing the winding of the signal relay R1050 thereby to cause the latter relay to operate. Upon operating the signal relay R1050 completes at the contacts 1051 an obvious circuit for energizing the winding of the audible signal B1153 at the first operator position 1400 at the switchboard and multiple circuits not shown, for energizing the windings of the audible signals at the other operator positions at the switchboard. The operation of the audible signal B1153 indicates to the operator at the first operator position that an incoming call has been extended to the switchboard.

Also, the trunk relay R1055 completes, at the contacts 1056, a path for applying ground potential by way of the winding of the timer start relay R1045 to the start conductor C1305 in the trunk line 1305, thereby to complete a circuit for energizing the winding of the timer start relay R1045 in series with the start relay R740 in the finder switch 700, this circuit extending from ground by way of the contacts 1056, the winding of R1045, C1072, the contacts 1024, the start conductor C1306 in the trunk line 1305, the contacts 1311, C1388, the contacts 1251, the conductor C1287 in the cable 1270, the contacts 751' and the winding of R740 to battery. When thus energized the timer start relay R1045 and the start relay R740 operate.

Upon operating, the timer start relay R1045 completes, at the contacts 1046, an obvious path for applying ground potential to the delay starting device 1048, which device operates a predetermined time interval thereafter to complete an obvious circuit for operating the audible signal 1047. The operation of the delay starting device 1048 a predetermined time interval after the operation of the timer start relay R1045 to initiate operation of the audible signal 1047 is effective to indicate to the exchange attendant that the finder switch 700 associated with the first operator position 1400 at the switchboard has failed to find a trunk line terminating in the contact bank thereof having a calling condition thereon.

Continuing now with the operation of the finder switch 700 incident to the operation of the start relay R740, the latter relay completes, at the contacts 742, an obvious circuit for energizing the upper winding of the electropolarized relay R710, thereby to render the latter relay exceedingly fast to operate when the intermediate winding thereof is energized, as will be explained hereinafter. Also, the start relay R740 completes, at the contacts 742, a circuit for energizing the vertical magnet M733 of the mechanism 701, this circuit extending from ground by way of the contacts 742, 714, 731 and 722 and the winding of M733 to battery. When the vertical magnet M733 is energized over the above-traced circuit it operates to drive the wiper set of the mechanism 701 away from its normal position one step in the vertical direction. Also, upon operating, the start relay R740 interrupts, at the contacts 743, a point in a circuit, traced hereinafter, for energizing the release magnet M735 of the mechanism 701, prepares, at the contacts 744, a circuit, traced hereinafter, for energizing the supervisory relay R1230 in the relay group 1200 and prepares, at the contacts 7436, a circuit, traced hereinafter, for illuminating the supervisory lamp L767.

Also, upon operating, the vertical magnet M733 completes, at the contacts 736, an obvious circuit for energizing the winding of the step relay R730, thereby to cause the latter relay to operate and prepares, at the contacts 736, a cir-

operated as previously explained. Also, upon operating, the transfer relay R720 completes, at the contacts 721, a path for applying battery potential to the conductor C1289 in the cable 1270 extending to the first operator position 1400, this path extending from battery by way of the resistor 732 and the contacts 721 and 757 to the conductor C1289. This application of battery potential to the conductor C1289 in the cable 1270 completes an obvious path for energizing the winding of the answer pilot relay R1250 in the relay group 1200, thereby to cause the latter relay to operate. Upon operating, the answer pilot relay R1250 interrupts, at the contacts 1251, the previously traced circuit for energizing the winding of the start relay R740 in the finder switch 700 and completes, at the contacts 1252, an obvious holding circuit for energizing the winding of the last-mentioned relay, thereby to retain the start relay R740 in its operated position. Also, the answer pilot relay R1250 completes, at the contacts 1253, the previously mentioned circuit for energizing the winding of the control relay R1140, this circuit extending from ground by way of the contacts 1314, C1393, the contacts 1253, C1188, the contacts 1163 and the winding of R1140 to battery. Shortly after the winding of the control relay R1140 is energized over the above-traced circuit, this relay being of the slow-to-operate type, it operates to complete, at the contacts 1114, an obvious circuit for energizing the winding of the control relay R1150, thereby to cause the latter relay to operate. Upon operating, the control relay R1150 completes, at the contacts 1152, an obvious circuit for energizing the winding of the control relay R1160, thereby to cause the latter relay to operate. Upon operating, the control relay R1160 completes, at the contacts 1162, a holding circuit for energizing the winding thereof, this circuit extending from the grounded conductor C1188 by way of the contacts 1162 and the winding of R1160 to battery. Also, the control relay R1160 interrupts, at the contacts 1163, the previously traced crcuit for energizing the winding of the control relay R1140, thereby to cause the latter relay to restore. Upon restoring, the control relay R1140 interrupts, at the contacts 1144, the previously mentioned circuit for energizing the winding of the control relay R1150, thereby to cause the latter relay to restore. Upon restoring, the control relay R1150 interrupts, at the contacts 1152, the previously mentioned original circuit for energizing the winding of the control relay R1160. Shortly after the control relay R1160 operates, ground potential is removed from the control conductor C1188 due to the restoration of the distributor start relay R1310 in a manner more fully described hereinafter, thereby to interrupt the previously traced holding circuit for energizing the winding of the control relay R1160. Shortly thereafter, the control relay R1160 restores, this relay being of the slow-to-release type.

Upon operating, the control relay R1140 completes, at the contacts 1142 and 1143, a circuit for impressing high frequency tone current upon the windings 1106 and 1107 of the talking repeater 1105, this circuit extending from the tone conductor C1164 by way of the contacts 1152 and 1142, C1181, the contacts 1261, C1182, the contacts 1133, C1170, the windings 1106 and 1107, C1171, the condenser 1118, the contacts 1135, C1184 and the contacts 1143 to ground. Upon operating, the control relay R1150 interrupts, at the contacts 1152, the above-traced circuit for impressing high frequency tone current upon the windings 1106 and 1107 of the talking repeater 1105 and prepares, at the contacts 1151, an additional circuit for impressing high frequency tone current upon the windings mentioned of the talking repeater 1105. Upon operating, the control relay R1160 completes, at the contacts 1161, the previously mentioned additional circuit for impressing high frequency tone current upon the windings mentioned of the talking repeater 1105, this additional circuit extending from the tone conductor C1164 by way of the contacts 1161, 1151 and 1142 to C1181 and therefrom by way of the previously traced path including the windings 1106 and 1107 of the talking repeater 1105 to ground at the contacts 1143. When the control relay R1140 restores it interrupts, at the contacts 1142, the previously traced additional circuit for impressing high frequency tone current upon the windings mentioned of the talking repeater 1105. Accordingly, high frequency tone current is twice connected to and disconnected from the windings mentioned of the talking repeater 1105. As previously explained, the receiver 1128 at the first operator position 1400 is operatively connected to the winding 1107 of the talking repeater 1105. Accordingly, the receiver 1128 operates to produce a zip-zip tone at the first operator position, thus indicating to the operator thereat that the finder switch 700 is operating to route a call to this position.

Also, upon operating, the answer pilot relay R1250 interrupts, at the contacts 1255, the previously traced circuit for energizing the winding of the distributor start relay R1310, thereby to cause the latter relay to restore. Upon restoring, the distributor start relay R1310 interrupts, at the contacts 1314, the previously traced path for applying ground potential to the control conductor C1188 as previously explained, in order to cause the control relay R1160 to restore. Also, upon operating, the answer pilot relay R1250 completes, at the contacts 1256, a path for applying ground potential to the start conductor C1386 included in the cable 1380 extending to the sender control circuit 461, this path extending from ground by way of the contacts 1101, C1189, the contacts 1137, C1191, the contacts 1263 and 1256, C1390 and the contacts 1322 to the start conductor C1386 included in the cable 1380.

This application of ground potential to the start conductor C1386 in the cable 1380 extending to the sender control circuit 461 causes the apparatus included in the sender control circuit 461 to operate in a well known manner. More particularly, the operation of the rotary switch S467 is controlled, thereby to cause the last-mentioned switch to find the cable 786 having a calling condition thereon and extending to the finder-selector link illustrated. When the rotary switch S467 finds the cable 786 a circuit is prepared for energizing the cut-in relay R760 in the finder switch 700. Also, the operation of the sender control circuit 461 causes the rotary switch S466 to find an idle digit register and control circuit. Assuming that the rotary switch S466 selects the line 464 extending to the digit register and control circuit 462, the sending key set 463 at the first operator position 1400 is then in condition to be operated, thereby to cause the connection to be extended by way of the toll selector switch 800 associated with the finder switch 700 after the call has been answered at the first operator position.

Also, upon restoring, the distributor start re-

lay R1310 interrupts, at the contacts 1311, a further point in the previously traced circuit for energizing the winding of the start relay R740 in the finder switch 700, a holding circuit being completed at this time for energizing the winding of the last-mentioned relay due to the operated condition of the answer pilot relay R1250. Further, the distributor start relay R1310 completes, at the contacts 1312, the previously mentioned path for applying ground potential to the guard conductor C1307 in the trunk line 1305, thereby to complete a circuit for energizing the lower winding of the position relay R1015, this circuit extending from the grounded guard conductor C1307 in the trunk line 1305 by way of the contacts 1023 and the lower winding of R1015 to battery. The position relay R1015 then operates in the event the distributor start relay in the relay group associated with either the second or the third operator positions at the switchboard is operated, multiple ground potential appearing upon the distributor start conductor C1094, thereby to cause the position relay R1015 to complete, at the contacts 1017, a holding circuit for energizing the upper winding thereof in series with the winding of the position busy relay R1040. This circuit extends from ground potential appearing upon the distributor start conductor C1094 by way of the contacts 1032 and 1037, the winding of R1040, C1073, the contacts 1012 and 1017 and the upper winding of R1015 to battery. In the event the distributor start relay in the relay group associated with the second operator position at the switchboard is not operated, ground potential appears upon the guard conductor C1084, thereby to cause the position relay R1015 to complete, at the contacts 1018, a circuit for energizing the lower winding of the position relay R1010 incident to the operation of the position relay R1015. Upon operating, the position relay R1010 completes, at the contacts 1011, a holding circuit for energizing the upper winding thereof in series with the winding of the position busy relay R1040, this circuit extending from the ground distributor start conductor C1094 by way of the contacts 1032 and 1037, the winding of R1040, C1073, the contacts 1021 and 1011 and the upper winding of R1010 to battery.

In the event the distributor start relays in the relay groups associated with both the second and third operator positions at the switchboard occupy their restored positions ground potential appears upon both of the guard conductors C1083 and C1081. Also, ground potential appears upon the guard conductor C1307 due to the restored position of the distributor start relay R1310. Furthermore, ground potential is completely removed from the distributor start conductor C1094, thereby to interrupt the previously traced holding circuits for energizing the winding of the position busy relay R1040 in series with the upper windings of the different position relays R1010, R1015 and R1020. Accordingly, operation of the position distributor 1005 is arrested in this event.

In view of the above description of the operation of the position distributor 1005 it will be understood that further operation of the position distributor 1005 is initiated at this time incident to the restoration of the distributor start relay R1310 in the relay group associated with the first operator position 1400 only in the event the distributor start relay in the relay group associated with one of the other operator positions is operated. When the distributor start relay in the relay group associated with one of the operator positions is operated ground potential is again applied to the distributor start conductor C1094, thereby to initiate further operation of the position distributor 1005 in order to cause the position distributor 1005 to select the idle operator position at the switchboard to have the next incoming call extended to the switchboard routed thereto to be answered.

At this time, when the distributor start relay in each relay group associated with each operator position at the switchboard is restored, not one of the three previously traced holding circuits for energizing the winding of the position busy relay R1040 in series with the upper winding of one of the position relays R1010, R1015 or R1020 is completed. Accordingly, the position busy relay R1040 restores to prepare, at the contacts 1042, a point in the previously mentioned path for applying ground potential to the conductor C1043 extending to the chief operator position. At this time the previously mentioned path for applying ground potential to the conductor C1043 extending to the chief operator position will be completed due to the operation of either the trunk relay R1055 or the toll relay R1060, thereby to indicate to the chief operator that either a trunk call or a toll call has been extended to the switchboard and that the apparatus at no operator position at the switchboard is conditioned to answer the call.

Assuming that the distributor start relay in the relay group associated with the second operator position is operated, when the distributor start relay R1310 in the relay group 1200 associated with the first operator position 1400 restores, the position relay R1015 remains in its operated position, the previously traced holding circuit for energizing the winding thereof in series with the upper winding of the position busy relay R1040 being completed. The operated position relay R1015 interrupts, at the contacts 1016, a point in the previously traced holding circuit for energizing the upper winding of the position relay R1020 in series with the winding of the position busy relay R1040, prepares, at the contacts 1018, the previously traced circuit for energizing the lower winding of the position relay R1010, and prepares, at the contacts 1019, a point in a circuit for applying ground potential by way of the winding of the timer start relay R1045 to the start conductor C1083. Also, when the distributor start relay R1310 restores it interrupts, at the contacts 1313, the previously traced path for applying ground potential to the distributor start conductor C1094 in the trunk line 1090, ground potential being applied to the distributor start conductor C1094 in the relay group associated with the second operator position at this time.

The position relay R1020 then restores to interrupt, at the contacts 1022, a further point in the previously traced holding circuit for energizing the upper winding thereof in series with the winding of the position busy relay R1040, to prepare, at the contacts 1021, a point in the previously traced holding circuit for energizing the upper winding of the position relay R1010 in series with the winding of the position busy relay R1040, to interrupt, at the contacts 1023, the previously traced circuit for energizing the lower winding of the position relay R1015, and to interrupt, at the contacts 1024, the previously traced path for applying ground potential by way of the timer start relay R1045 to the start conductor C1306 in the trunk line 1305. Accordingly, at this time, the position busy relay R1040 and the position

relay R1015 occupy their operated positions, thereby to condition the apparatus at the second operator position at the switchboard to be operative to answer the next call incoming to the switchboard.

Continuing now with the operation of the finder-selector link illustrated associated with the first operator position at the switchboard incident to the seizure of the trunk line 440 extending to the C. L. R. trunk circuit 400 associated with the C. L. R. trunk 450 by the finder switch 700, when the finder switch 700 seizes the trunk line 440, a connection is established between the telephone instrument at the subscriber substation T1 and the telephone instrument at the first operator position 1400. Also, when the rotary switch S467 of the sender control circuit 461 finds the cable 786 a loop circuit for energizing the upper and lower windings of the line relay R830 in the toll selector switch 800 is completed, this circuit extending from ground in the sender control circuit 461 by way of the conductor C790 in the cable 786, the control conductor C830 of the line 826, the lower winding of R830, the contacts 813 and the line conductor C828 of the line 826 to the line conductor C788 in the cable 786 and from battery by way of the upper winding of R830, the contacts 811 and the line conductor C827 of the line 826 to the line conductor C787 in the cable 786, the line conductors C787 and C788 in the cable 786 being connected together by way of the loop circuit in the sender control circuit 461. When the above-traced loop circuit for energizing the upper and lower windings of the line relay R830 is completed the latter relay operates to condition the toll selector switch 800 to be responsive to impulses transmitted from the digit register and control circuit 462 in a manner more fully described subsequently. At this time the telephone instrument at the calling subscriber substation T1 is operatively connected with the telephone instrument at the first operator position 1400. More particularly, the telephone instrument at the subscriber substation T1 is connected by way of the subscriber line 451, the line circuit 452, the local finder switch 456, the local selector switch 455 and the C. L. R. trunk 450 to the repeater 401 in the C. L. R. trunk circuit 400; the repeater 401 in the C. L. R. trunk circuit 400 is connected by way of the trunk line 440, the finder switch 700, the cable 1270 and the trunk circuit at the first operator position to the talking repeater 1105; while the transmitter 1127 and the receiver 1128 at the first operator position are operatively associated with the talking repeater 1105. Accordingly, at this time, the subscriber at the subscriber substation T1 and the operator at the first operator position 1400 may converse in either direction over the established connection and the subscriber at the calling subscriber substation T1 advises the operator at the first operator position 1400 concerning the destination of the call, whereupon the operator at the first operator position actuates the sending key set 463 thereat. When the operator at the first operator position actuates the sending key set 463 the digit register and control circuit 462 registers a number of digits corresponding to the switch train route to the called subscriber substation or to a terminating exchange having access to the subscriber line extending to the called subscriber substation, which digits, when transmitted over the outgoing switch train including the toll selector switch 800, are effective to cause the call to be extended as above indicated. The exact manner of extending a call from the operator position to various destinations will be described more fully hereinafter.

It is noted that the subscriber at the calling subscriber substation T1 has switchhook supervision after the finder switch 700 operates to find the trunk line 440 extending to the C. L. R. trunk circuit 400 and may attract the attention of the operator at the first operator position 1400 before the call is extended from the first operator position to its destination. This may be accomplished by the subscriber at the calling subscriber substation T1 merely by operating the switchhook thereat a number of times. Each time the switchhook at the subscriber substation T1 is operated the previously traced loop circuit including the local switch train for energizing the windings of the line relay R430 in the C. L. R. trunk circuit is interrupted to cause the latter relay to restore. Upon restoring, the line relay R430 completes, at the contacts 431, a circuit for energizing the supervisory relay R1230 in the relay group 1200, this circuit extending from ground by way of the contacts 431 and 411, the control conductor C443 of the trunk line 440, the wiper 707, the contacts 718 and 744, the conductor C1293 in the cable 1270, the contacts 1341, C1399 and the winding of R1230 to battery. When energized over the above-traced circuit the supervisory relay R1230 operates to complete, at the contacts 1231, an obvious path for applying ground potential to the conductor C1285 in the cable 1270. This application of ground potential to the conductor C1285 in the cable 1270 completes a circuit for illuminating the supervisory lamp L1767, this circuit extending from the grounded conductor C1285 by way of the contacts 746 and the lamp L1767 to battery. Accordingly, each time the switchhook at the calling subscriber substation T1 is operated the supervisory relay R1230 in the relay group 1200 at the first operator position 1400 operates to complete, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L1767; likewise, each time the switchhook at the calling subscriber substation T1 is released the supervisory relay R1230 restores to interrupt, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L1767. This flashing of the supervisory lamp L1767 attracts the attention of the operator at the first operator position 1400, whereupon the operator at the first operator position communicates with the subscriber at the calling subscriber substation T1.

After the operator at the first operator position 1400 has answered the call from the calling subscriber substation T1 she may desire to learn the particular one of the C. L. R. trunks which is utilized in the connection between the calling subscriber substation T1 and the first operator position. This may be accomplished by the operator at the first operator position by operating the check key K11 to its left-hand or rear position. When the check key K11 is thus operated the contacts 1423 thereof are actuated into engagement, thereby to complete a circuit for energizing the winding of the rear split relay R1220, this circuit extending from ground by way of the contacts 1423 of the check key K11, C1463, C1468 and the winding of R1220 to battery. When energized over the above-traced circuit the rear split relay R1220 operates to interrupt, at the contacts 1221 and 1233, the connection between the line

conductors C1283 and C1284 in the cable 1270 and the line conductors C1182 and C1184 of the trunk circuit at the first operator position and to complete, at the contacts 1222 and 1224, obvious connections between the line conductors C1283 and C1284 in the cable 1270 and the line conductors C1094' and C1095' in the trunk circuit at the first operator position. Also, when the check key K11 is operated to its rear position the contacts 1427 thereof are actuated into engagement, thereby to complete a path for applying battery potential to the line conductor C441 of the trunk line 440, this path extending from battery by way of the resistor 1432, C1458, the contacts 1427 of the check key K11, C1460, the contacts 1224, the line conductor C1284 in the cable 1270, the contacts 752 and 711 and the wiper 702 to the line conductor C441 of the trunk line 440. This application of ground potental to the line conductor C441 of the trunk line 440 completes an obvious circuit for energizing the winding of the identity relay R425, thereby to cause the latter relay to operate. Upon operating, the identity relay R425 completes, at the contacts 426, an obvious circuit for illuminating the identity lamp L408 individually associated with the C. L. R. trunk circuit 400 and the C. L. R. trunk 450 and commonly associated with the operator positions at the switchboard. The illumination of the identity lamp L408 indicates to the operator at the first operator position that the established connection between the first operator position and the calling subscriber substation T1 includes the C. L. R. trunk 450.

After the particular C. L. R. trunk included in the established connection between the first operator position 1400 in the central office A and the calling subscriber substation T1 has been identified by the operator at the first operator position she operates the check key K11 back to its normal position. When the check key K11 is operated back to its normal position the contacts 1423 thereof are actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the winding of the rear split relay R1220 and the contacts 1427 thereof are actuated into disengagement, thereby to interrupt the previously traced path for applying battery potential to the line conductor C441 of the trunk line 440. The identity relay R425 then restores and shortly thereafter the rear split relay R1220 restores, the latter relay being of the slow-to-release type. Upon restoring, the rear split relay R1220 recompletes, at the contacts 1221 and 1223, the previously traced connections between the line conductors C1283 and C1284 in the cable 1270 and the line conductors C1182 and C1184 of the trunk circuit at the first operator position. Upon restoring, the identity relay R425 interrupts, at the contacts 426, the previously mentioned circuit for illuminating the identity lamp L408, thereby to cause the last-mentioned lamp to be extinguished.

Extension of a call from the switchboard to the distant exchange B

Assuming that the incoming call from the calling substation T1 is to be extended to the distant exchange B the operator at the first operator position 1400 initiates the extension of the call by actuating the sending key set 463 as previously noted. More particularly, the operator at the first operator position operates the keys of the sending key set 463, thereby to cause the digit register and control circuit 462 to register a predetermined number of digits corresponding to the switch train route to the distant exchange B. Immediately the keys of the sending key set 463 are operated the digit register and control circuit 462 begins to operate, first to register the digits and then to control the operation of the sender control circuit 461, thereby to cause the impulses comprising the digits to be transmitted into the toll selector switch 800 in a well known manner.

Should the operator at the first operator position make an error in registering the digits she operates the error key K3 thereat, thereby to complete, at the contacts 1436 thereof, an obvious circuit for energizing the winding of the error relay R1260, thereby to cause the last-mentioned relay to operate. Upon operating, the error relay R1260 interrupts, at the contacts 1263, the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380 extending to the sender control circuit 461. The operator at the first operator position then operates the send disconnect key of the sending key set 463. When the send disconnect key of the sending key set 463 is thus operated and ground potential is removed from the start conductor C1386 the sender control circuit 461 is released, whereupon the previously traced loop circuit for energizing the line relay R830 in the toll selector switch 800 is interrupted, thereby to cause the toll selector switch 800 to be released in a manner more fully described subsequently. Shortly after operating the error key K3 the operator at the first operator position releases this key, thereby to interrupt, at the contacts 1436 thereof, the previously mentioned circuit for energizing the winding of the error relay R1260. Shortly thereafter the error relay R1260 restores, this relay being of the slow-to-release type, to recomplete, at the contacts 1263, the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380 extending to the sender control circuit 461. When ground potential is reapplied to the start conductor C1386 in the cable 1380, the sender control circuit 461 reoperates, in the previously described manner, thereby to cause the rotary switch S466 to again seize by way of the line 464 the digit register and control circuit 462 and condition the digit register and control circuit 462 to be responsive to digits set up by the operator on the sending key set 463. Also, the rotary switch S467 reoperates to seize the cable 786 associated with the toll selector switch 800, thereby to condition the toll selector switch 800 to be responsive to impulses to be transmitted thereto. The operator at the first operator position 1400 then sets up the digits on the sending key set as previously described, whereupon the digit register and control circuit 462 registers the digits and operates to cause the sender control circuit 461 to transmit the digits over the loop circuit including the line relay R830 and the toll selector switch 800 as previously noted.

Disregarding for the present the details of the operation of the toll selector switch 800 in response to the impulses transmitted thereto from the sender control circuit 461, it is noted that, when all of the digits registered in the digit register and control circuit 462 have been transmitted the sender control circuit 461 operates to cause ground potential to be applied to the conductor C791 in the cable 786. The operator at the first operator position then operates the send disconnect key of the sending key set 463, thereby to cause the sender control circuit 461 to be released, ground potential being re-

moved from the start conductor C1386 in the cable 1380 in a manner more fully described hereinafter. This application of ground potential to the conductor C791 in the cable 786 completes an obvious circuit for energizing the upper winding of the cut-in relay R760. When thus energized the cut-in relay R760 operates to complete, at the contacts 765, a holding circuit for energizing the lower winding thereof in series with the upper winding of the call pilot relay R1320. The last-mentioned circuit extends from ground by way of the lower winding of R760, the contacts 765 and 752', the conductor C1290 in the cable 1270, C1395 and the upper winding of R1320 to battery. When energized over the above-traced circuit the call pilot relay R1320 operates to interrupt, at the contacts 1322, the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380, as previously noted, and to interrupt, at the contacts 1321, a further point in the previously traced circuit for energizing the winding of the distributor start relay R1310. Also, upon operating, the cut-in relay R760 completes, at the contacts 764, an alternative path for applying ground potential to the control conductor C830 of the line 826, thereby to retain the toll selector switch 800 operated independently of the sender control circuit 461. Also, the cut-in relay R760 completes, at the contacts 763, a circuit, traced hereinafter, for illuminating the supervisory lamp L776 and for operating the control relay R1120 for a purpose more fully described subsequently and completes, at the contacts 766, an obvious alternative circuit for illuminating the supervisory lamp L768. Moreover, the cut-in relay R760 completes, at the contacts 761 and 762, a connection between the line 826 extending to the toll selector switch 800 and the line conductors C1184 and C1182 of the trunk circuit at the first operator position 1400.

Continuing now with the operation of the toll selector switch 800, when the previously traced loop circuit including the upper and lower windings of the line relay R830 is completed, due to the seizure of the cable 786 by the sender control circuit 461, the line relay R830 operates as previously explained. Upon operating, the line relay R830 interrupts, at the contacts 832, a point in a circuit, traced hereinafter, for energizing the release magnet M876 of the mechanism 801 included in the toll selector switch 800 and completes, at the contacts 831, a circuit for energizing the winding of the hold relay R840. The last-mentioned circuit extends from ground by way of the contacts 817 and 831 and the winding of R840 to battery. When energized over the above-traced circuit the hold relay R840 operates to interrupt, at the contacts 845, a further point in the previously mentioned circuit for energizing the release magnet M876, to prepare, at the contacts 844, a circuit, traced hereinafter, for energizing the vertical magnet M877 of the mechanism 801 in multiple with the lower winding of the transfer relay R850, and to complete, at the contacts 841, an obvious path for applying ground potential to the control conductor C830 of the line 826 independently of the sender control circuit 461.

This application of ground potential to the control conductor C830 of the line 826 completes a circuit for energizing the upper winding of the transfer relay R850, this circuit extending from the grounded control conductor C830 of the line 826 by way of the set of switch springs S836 and the upper winding of R850 to battery. When the upper winding of the transfer relay R850 is energized over the above-traced circuit it operates. Also, the hold relay R840 completes, at the contacts 842, a multiple circuit for energizing the upper winding of the busy relay R820 and the lower winding of the electropolarized relay R810. This circuit extends from ground by way of the contacts 842 and 824 and the upper winding of R820 to battery and from ground by way of the contacts 842 and the lower winding of R810 to battery. When the upper winding of the busy relay R820 is thus energized this relay is rendered exceedingly fast to operate when the lower winding thereof is energized. Similarly, when the lower winding of the electropolarized relay R810 is thus energized this relay is rendered exceedingly fast to operate when the intermediate winding thereof is energized. Upon operating, the transfer relay R850 prepares, at the contacts 854, a further point in the previously mentioned circuit for energizing in multiple the vertical magnet M877 and the lower winding of the transfer relay R850 and completes, at the contacts 853, a circuit for energizing the winding of the control relay R860. The circuit for energizing the winding of the control relay R860 extends from the grounded control conductor C830 of the line 826 by way of the set of switch springs S837, the contacts 853 and the winding of R860 to battery. When energized over the above-traced circuit the control relay R860 operates to prepare, at the contacts 863, a circuit, traced hereinafter, for energizing the winding of the control relay R880 in series with the rotary magnet M878 of the mechanism 801. The toll selector switch 800 is conditioned at this time to be responsive to the series of impulses transmitted thereto from the sender control circuit 461.

The subsequent operation of the toll selector switch 800 depends upon the character of the first series of impulses transmitted thereto which, in turn, depends upon the position of the trunk line in the main contact bank of the mechanism 801 extending to the desired toll or trunk line. Assuming that the trunk line 170 extending between the main contact bank of the mechanism 801 and the ring-down toll circuit 190 individually associated with the toll line 190 extending between the central office A and the distant exchange B is terminated in one of the one-digit levels in the main contact bank of the mechanism 801, the toll selector switch 800 operates as an automatic trunk hunting selector switch, only one digit being utilized to effect the operation thereof.

Each time the previously traced loop circuit extending between the sender control circuit 461 and the line relay R830 in the toll selector switch 800 is interrupted the line relay R830 restores and each time this loop circuit is completed the latter relay reoperates. Each time the line relay R830 restores it interrupts, at the contacts 831, the previously traced circuit for energizing the winding of the hold relay R840 and completes, at the contacts 832, the previously mentioned circuit for energizing in multiple the vertical magnet M877 and the lower winding of the transfer relay R850. Conversely, each time the line relay R830 operates it interrupts, at the contacts 832, the previously traced circuit for energizing in multiple the vertical magnet M877 and the lower winding of the transfer relay R850 and completes, at the contacts 831, the previously mentioned circuit

for energizing the winding of the hold relay R840. The hold relay R840, being of the slow-to-release type, does not restore during impulsing and the vertical magnet M877 operates each time it is energized to cause the wiper set of the mechanism 801 to be driven step by step in the vertical direction. Similarly, the transfer relay R850 does not restore during impulsing, this relay being of the slow-to-release type. The previously mentioned circuit for energizing the vertical magnet M877 in multiple with the winding of the transfer relay R850 extends from ground by way of the contacts 817, 832 and 844 to the contacts 854, from the contacts 854 by way of the winding of M877 to battery, and from the contacts 854 by way of the lower winding of R850 to battery.

When the wiper set of the mechanism 801 is driven away from its normal position one step in the vertical direction the set of switch springs S836 is actuated into disengagement, while the sets of switch springs S834 and S835 are actuated into engagement. When the set of switch springs S836 is actuated into engagement the previously traced circuit for energizing the upper winding of the transfer relay R850 is interrupted; when the set of switch springs S834 is actuated into engagement a point in an alternative circuit, traced hereinafter, for energizing the rotary magnet M878 is prepared; and when the set of switch springs S835 is actuated into engagement a further point in the previously mentioned circuit for energizing the release magnet M876 is prepared. At the conclusion of the first digit the wiper set of the mechanism 801 occupies a vertical position opposite the level in the main contact bank of the mechanism 801 wherein the trunk line 170 is terminated and the sets of switch springs S837 and S838 are respectively actuated into disengagement and engagement. When the set of switch springs S837 is actuated into disengagement the previously traced circuit for energizing the winding of the control relay R860 is interrupted, thereby to cause the latter relay to restore and prepare, at the contacts 861, a further point in the previously mentioned circuit for energizing the intermediate winding of the electropolarized relay R810 and prepare, at the contacts 864, a further point in the previously mentioned alternative circuit for energizing the rotary magnet M878. When the set of switch springs S838 is actuated into engagement a circuit, traced hereinafter, is prepared for energizing the winding of the ring-down relay R885.

At the conclusion of the first digit mentioned the line relay R830 reoperates over the previously traced loop circuit extending into the sender control circuit 401, whereupon the previously traced circuit for energizing in multiple the vertical magnet M877 and the lower winding of the transfer relay R850 is interrupted at the contacts 832. Also, the line relay R830 prepares, at the contacts 831, a further point in the previously mentioned alternative circuit for energizing the rotary magnet M878. Shortly thereafter the transfer relay R850 restores to complete, at the contacts 856, the previously mentioned alternative circuit for energizing the rotary magnet M878 and to prepare, at the contacts 852, a further point in the previously mentioned circuit for energizing the intermediate winding of the electropolarized relay R810. The previously mentioned alternative circuit for energizing the rotary magnet M878 extends from ground by way of the contacts 817 and 831, the set of switch springs S834, the contacts 856, 864, 874 and 879 and the winding of M878 to battery. When energized over the above-traced circuit the rotary magnet M878 operates to interrupt, at the contacts 879, the previously traced alternative circuit for energizing the winding thereof, whereupon the rotary magnet M878 restores to recomplete, at the contacts 879, the previously traced alternative circuit for energizing the winding thereof. Accordingly, the rotary magnet M878 operates intermittently, thereby to drive the wipers of the mechanism 801 step by step in the rotary direction. The rotary magnet M878 continues to operate, thereby to cause the wiper set of the mechanism 801 to be rotated step by step in the rotary direction until an idle trunk line in the group of trunk lines extending to the ring-down toll circuits associated with the toll lines extending between the central office A and the distant exchange B is found.

Each time the wiper set of the mechanism 801 is rotated one step in the rotary direction a trunk line is tested by the electropolarized relay R810. In the event the trunk line is busy ground potential appears upon the control conductor thereof, thereby to complete a path for short-circuiting the intermediate winding of the electropolarized relay R810, this path extending from the grounded control conductor C830 of the line 826 by way of the intermediate winding of R810, the contacts 843, 852, 825, 861, 872 and 881 and the wiper 805 of the wiper set of the mechanism 801 to the grounded control conductor of the busy trunk line. When an idle trunk line is tested by the electropolarized relay R810 in the above described manner battery potential appearing upon the control conductor thereof completes a circuit substantially identical to the above-traced circuit for energizing the intermediate winding of the electropolarized relay R810. When the intermediate winding of the electropolarized relay R810 is thus energized the electropolarized relay R810 operates exceedingly fast to complete, at the contacts 816, a holding circuit for energizing the upper winding thereof, this circuit extending from the grounded control conductor C830 of the line 826 by way of the contacts 816 and the upper winding of R810 to battery. Also, upon operating, the electropolarized relay R810 interrupts, at the contacts 817, the previously traced alternative circuit for energizing the rotary magnet M878, thereby to prevent further movement of the wiper set of the mechanism 801 in the rotary direction. Also, the electropolarized relay R810 interrupts, at the contacts 817, the previously traced circuit for energizing the winding of the hold relay R840, thereby to cause the latter relay to restore shortly thereafter. Moreover, the electropolarized relay R810 interrupts, at the contacts 811 and 813, the previously traced loop circuit for energizing the upper and lower windings of the line relay R830, thereby to cause the latter relay to restore. Also, the electropolarized relay R810 prepares, at the contacts 812 and 814, points in a circuit, traced hereinafter, for connecting the line conductors C827 and C828 of the line 826 to the line conductors of the seized trunk line. Finally, the electropolarized relay R810 completes, at the contacts 815, a path for applying ground potential to the wiper 805 of the wiper set of the mechanism 801, this path extending from ground by way of the contacts 815, 852, 825, 861, 872 and 881 to the wiper 805.

This application of ground potential to the wiper 805 of the wiper set of the mechanism 801

causes the ring-down toll circuit associated with the seized trunk line to operate and mark the associated trunk line as busy to the switches having access thereto. Assuming that the trunk line 170 extending to the ring-down toll circuit 100 individually associated with the toll line 190 extending between the central office A and the distant exchange B is seized by the toll selector switch 800 the ring-down toll circuit 100 operates at this time, thereby to mark the toll line 190 as busy to the switches having access thereto.

In the event the distant exchange B is of the automatic type series of impulses are transmitted thereto from the sender control circuit 461 by way of the toll selector switch 800, the ring-down toll circuit 100 and the toll line 190, thereby to cause the switch train therein to operate and extend the connection to a toll operator position in the distant exchange B. When the toll selector switch 800 operates to seize the trunk line 170 extending to the ring-down toll circuit 100 the wiper 804 of the wiper set of the mechanism 801 engages a contact in the main contact bank of the mechanism 801 terminating the control conductor C172 of the trunk line 170 which is adapted to have ground potential in the ring-down toll circuit 100 applied thereto, thereby to complete a circuit, traced hereinafter, for illuminating the supervisory lamp L776.

At this time the trunk circuit at the first operator position 1400 is connected to the toll line 190 extending between the central office A and the distant exchange B, the line conductor C1182 of the trunk circuit at the first operator position being connected by way of the contacts 1201, C1181, the contacts 1141, C1180, the contacts 1211, the line conductor C1281 in the cable 1270, the contacts 754 and 762, the line conductor C826 of the line 826, the contacts 814 and C808 to the wiper 803; and the line conductor C1184 of the trunk circuit at the first operator position being connected by way of the contacts 1203 and 1213, the line conductor C1282 in the cable 1270, the contacts 751 and 761, the line conductor C827 of the line 826, the contacts 812, C807 and the contacts 892 and 891 to the wiper 802. Also, the line conductors C1182 and C1184 of the trunk circuit at the first operator position are operatively connected to the talking repeater 1105 as previously explained; and the wipers 803 and 802 of the wiper set of the mechanism 801 engage the line conductors C174 and C173, respectively, of the trunk line 170 extending to the ring-down toll circuit 100. Finally, the line conductor C173 of the trunk line 170 is connected by way of the contacts 112 to the line conductor C194 of the toll line 190; and the line conductor C174 of the trunk line 170 is connected by way of the contacts 114 to the line conductor C195 of the toll line 190.

As previously explained, the toll selector switch 800 operated to seize the trunk line 170 extending to the ring-down toll circuit 100 due to the presence of battery potential upon the control conductor C171 of the trunk line 170 engaged by the wiper 805 of the wiper set of the mechanism 801. The battery potential on the control conductor C171 of the trunk line 170 is derived in the ring-down toll circuit 100 and extends from battery by way of the winding of the marking relay R160, the contacts 153 and 121 to the control conductor C171 of the trunk line 170. Furthermore, when the electropolarized relay R810 operates to cause ground potential to be applied to the wiper 805 of the wiper set of the mechanism 801 and consequently to the control conductor C171 of the trunk line 170 a circuit, substantially identical to that previously traced, is completed for energizing the winding of the marking relay R160. When the winding of the marking relay R160 is thus energized this relay operates to complete, at the contacts 163, a path for applying ground potential to the control conductor C184 of the trunk line 180 extending to the main contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard, thereby positively to mark as busy the ring-down toll circuit 100 by way of the trunk line 180. The last-mentioned path extends from the grounded control conductor C171 of the trunk line 170 by way of the contacts 121, 153 and 163 to the control conductor C184 of the trunk line 180.

Also, when the sender control circuit 461 operates to transmit all of the digits registered in the digit register and control circuit 462 it operates to cause battery potential to be momentarily applied to the conductor C789 in the cable 786, thereby to complete a circuit for energizing the lower winding of the control relay R895 in the toll selector switch 800, this circuit extending from the grounded control conductor C830 of the line 826 by way of the lower winding of R895, the contacts 897 and 871 and the control conductor C829 of the line 826 to the conductor C789 in the cable 786 having battery potential thereon. When the lower winding of the control relay R895 is thus energized this relay operates to complete, at the contacts 899, an obvious holding circuit for energizing the upper winding thereof, to prepare, at the contacts 896, a further point in the previously mentioned circuit for energizing the winding of the ring-down relay R885, and to prepare, at the contacts 898, a further point in the previously mentioned circuit for illuminating the supervisory lamp L776.

The operator at the first operator position 1400 then causes ringing current to be projected over the toll line 190 extending between the central office A and the distant exchange B, this being accomplished by operating the ring key K5 at her position to its right-hand or front position. When the ring key K5 is thus operated an obvious circuit is completed, at the contacts 1402 thereof, for energizing the winding of the front split relay R1210, thereby to cause the latter relay to operate. Also, at the contacts 1406 and 1404 of the ring key K5, obvious paths are completed for respectively connecting ground and battery potentials to the conductors C1465 and C1464. Upon operating, the front split relay R1210 interrupts, at the contacts 1211 and 1213, the previously traced connection between the trunk circuit at the first operator position and the line conductors C1281 and C1282 in the cable 1270 and completes, at the contacts 1212 and 1214, connections between the conductors C1464 and C1465 and the line conductors C1281 and C1282, respectively, in the cable 1270. Accordingly, a path is completed for connecting ground potential to the line conductor C173 of the trunk line 170 and a path is completed for connecting battery potential to the line conductor C174 of the trunk line 170, the first-mentioned path extending from the grounded conductor C1465 by way of the contacts 1214, the line conductor C1282 in the cable 1270 and by way of the previously traced path to the line conductor C173 of the trunk line 170, and the second-mentioned path extending from battery potential on the con-

ductor C1464 by way of the contacts 1212 and the line conductor C1281 in the cable 1270 and by way of the previously traced path to the line conductor C174 of the trunk line 170.

This application of ground potential to the line conductor C173 of the trunk line 170 completes a path for short-circuiting the winding of the identity relay R125, this path extending from the grounded line conductor C173 of the trunk line 170 by way of the upper winding of the impedance I130 and the winding of R125 to ground. The short-circuiting of the winding of the identity relay R125 positively prevents this relay from operating at this time. The application of battery potential to the line conductor C174 of the trunk line 170 completes a circuit for energizing the winding of the ring relay R110, this circuit extending from battery potential appearing upon the line conductor C174 by way of the lower winding of the impedance I130, the contacts 127 and the winding of R110 to ground. When thus energized the ring relay R110 operates to interrupt, at the contacts 112 and 114, the previously traced connections between the line conductors C194 and C195 of the toll line 190 and the line conductors C173 and C174 of the trunk line 170 and to complete, at the contacts 111 and 113, obvious connections between the line conductors C194 and C195 of the toll line 190 and the line conductors C147 and C146 of the line 145 extending to the ringing generator. Accordingly, alternating ringing current is projected from the ringing generator by way of the line 145 over the toll line 190 to the distant exchange B.

After the operator at the first operator position 1400 operates the ring key K5 to its front position, thereby to cause alternating ringing current to be projected over the toll line 190 to the distant exchange B, she restores the ring key K5 to its normal position. When the ring key K5 is restored to its normal position the previously traced paths for applying ground and battery potentials to the conductors C1465 and C1464, respectively, are interrupted, at the contacts 1406 and 1404 thereof, and the previously mentioned circuit for energizing the winding of the front split relay R1210 is interrupted at the contacts 1402 thereof. Accordingly, the front split relay R1210 restores shortly thereafter, this relay being of the slow-to-release type, and the previously traced path for short-circuiting the winding of the identity relay R125 and the previously traced circuit for energizing the winding of the ring relay R110 are interrupted. The ring relay R110 then restores to interrupt, at the contacts 111 and 113, the previously traced connection for projecting ringing current from the ringing generator over the toll line 190 and to complete, at the contacts 112 and 114, the previously traced connection between the toll line 190 and the trunk line 170. At this time the operator at the first operator position 1400 in the central office A may communicate with the toll operator in the distant exchange B, the toll operator position in the distant exchange B being connected to the toll line 190. Further, the operator at the first operator position 1400 in the central office A instructs the operator at the toll operator position in the distant exchange B concerning the forwarding of the call, after which the toll operator at the toll operator position in the distant exchange B extends the call to its destination in a well known manner.

After the connection has been established between the first operator position 1400 in the central office A and the toll operator position in the distant exchange B the toll operator at the toll operator position in the distant exchange B may desire to attract the attention of the operator at the first operator position 1400. This may readily be accomplished by the operator at the distant exchange B by operating a key at her position, thereby to cause alternating ringing current to be projected over the toll line 190 to the ring-down toll circuit 100. When alternating ringing current is projected over the toll line 190 a circuit is completed for energizing the winding of the ring-up relay R135, this circuit extending from the line conductor C194 of the toll line 190 by way of the contacts 112, C173, the winding of R135, the condenser 131, C174 and the contacts 114 to the line conductor C195 of the toll line 190, the line conductors C194 and C195 of the toll line 190 having alternating voltage impressed therebetween at the toll operator position in the distant exchange B. When the ring-up relay R135 is thus energized it operates to interrupt, at the contacts 136, an obvious normally completed circuit for energizing the winding of the control relay R140, thereby to cause the control relay R140 to restore shortly thereafter, the latter relay being of the slow-to-release type. Upon restoring, the control relay R140 completes, at the contacts 141, a circuit for energizing the upper winding of the start relay R150, this circuit extending from ground by way of the contacts 141 and 124 and the upper winding of R150 to battery. When energized over the above-traced circuit the start relay R150 operates to complete, at the contacts 155, a path for applying ground potential to the control conductor C172 of the trunk line 170, this path extending from ground by way of the contacts 155 and the lower winding of R150 to the control conductor C172 of the trunk line 170. This application of ground potential to the control conductor C172 of the trunk line 170 completes a circuit for energizing the winding of the control relay R1120 in the relay group 1200 at the first operator position 1400, this circuit extending from the grounded control conductor C172 of the trunk line 170 by way of the wiper 804 of the wiper set of the mechanism 801, the contacts 898 and 871, the control conductor C829 of the line 826, the contacts 763, the supervisory lamp L776, the contacts 774 of the talk key K780, the conductor C1187 in the cable 1270, the resistor 1122 and the winding of R1120 to battery. When energized over the above-traced circuit the control relay R1120 operates to complete, at the contacts 1121, an obvious path for short-circuiting the resistor 1122, thereby to reduce the series resistance of the above-traced circuit in order to cause the supervisory lamp L776 to be illuminated. However, the series resistance of the above-traced circuit is sufficiently high to prevent adequate energization of the lower winding of the start relay R150 in order to retain this relay in its operated position. Accordingly, the start relay R150 restores in the event the previously traced circuit for energizing the upper winding thereof has been interrupted at this time.

The operator at the toll operator position in the distant exchange B operates the key at her position back and forth between its normal and ring position, thereby to cause the ring-up relay R135 to operate and restore intermittently. Each time the ring-up relay R135 restores it completes, at the contacts 136, the previously mentioned

circuit for energizing the winding of the control relay R140. The control relay R140 then operates to interrupt, at the contacts 141, the previously traced circuit for energizing the upper winding of the start relay R150, thereby to cause the latter relay to restore. Accordingly, the start relay R150 is intermittently operated, thereby to complete intermittently, at the contacts 155, the previously traced path for applying ground potential to the control conductor C172 of the trunk line 170, whereupon the supervisory lamp L776 flashes. The flashing of the supervisory lamp L776 attracts the attention of the operator at the first operator position 1400.

Also, the ringing current projected from the toll operator position in the distant exchange B over the toll line 190 is conducted over the trunk line 170, thereby to complete a circuit for energizing the winding of the ring-down relay R885, this circuit extending from the line conductor C173 of the trunk line 170 by way of the wiper 802 of the wiper set of the mechanism 801, the contacts 891, the condenser 807, the winding of R885, the set of switch springs S838, the contacts 896 and the wiper 803 to the line conductor C174 of the trunk line 170, alternating ringing voltage being impressed across the line conductors C173 and C174 of the trunk line 170 as previously explained. When energized over the above-traced circuit the ring-down relay R885 operates to complete, at the contacts 886, an obvious circuit for energizing the winding of the control relay R890, thereby to cause the latter relay to operate. Upon operating, the control relay R890 interrupts, at the contacts 891 and 892, the connection between the line conductor C173 of the trunk line 170 and the line conductor C1184 of the trunk circuit at the first operator position, thereby to prevent the alternating ringing current projected over the trunk line 170 from being conducted to the talking repeater 1105 and the consequent production of tone by the receiver 1128 at the first operator position associated with the talking repeater 1105. Also, upon operating, the control relay R890 interrupts, at the contacts 891, the previously traced circuit for energizing the winding of the ring-down relay R885, thereby to cause the latter relay to restore and interrupt, at the contacts 886, the previously mentioned circuit for energizing the winding of the control relay R890. However, the control relay R890, being of the slow-to-release type, does not immediately restore. Shortly thereafter the control relay R890 restores to recomplete, at the contacts 891 and 892, the previously traced connection between the line conductor C173 of the trunk line 170 and the line conductor C1184 of the trunk circuit at the first operator position and to again prepare, at the contacts 891, the previously traced circuit for energizing the winding of the ring-down relay R885.

After the operator at the first operator position 1400 has extended the call from the switchboard in the central office A to the toll operator position in the distant exchange B she may desire to learn the particular one of the toll lines which is utilized in the connection between the switchboard in the central office A and the toll operator position in the distant exchange B. This may be accomplished by the operator at the first operator position by operating the check key K11 to its right-hand or front position. When the check key K11 is thus operated the contacts 1426 thereof are actuated into engagement, thereby to complete a circuit for energizing the winding of the front split relay R1210, this circuit extending from ground by way of the contacts 1426 of the check key K11, C1466 and the winding of R1210 to battery. When energized over the above-traced circuit the front split relay R1210 operates. Also, when the check key K11 is operated to its front position a path is completed for applying battery potential to the conductor C1465, this path extending from battery by way of the resistor 1432, C1458 and the contacts 1428 of the check key K11 to the conductor C1465. Upon operating, the front split relay R1210 completes, at the contacts 1214, a circuit for energizing the winding of the identity relay R125, this circuit extending from battery potential on the conductor C1465 by way of the contacts 1214, the line conductor C1282 in the cable 1270, the contacts 751 and 761, the line conductor C827 of the line 826, the contacts 812, C807, the contacts 892 and 891, the wiper 802, the line conductor C173 of the trunk line 170, the upper winding of the impedance I130 and the winding of R125 to ground. When energized over the above-traced circuit the identity relay R125 operates to complete, at the contacts 128, an obvious circuit for illuminating the identity lamp L185 individually associated with the ring-down toll circuit 190 and the toll line 190 and commonly associated with the operator positions at the switchboard.

After the particular toll line included in the established connection between the first operator position 1400 in the central office A and the toll operator position in the distant exchange B has been identified by the operator at the first operator position she operates the check key K11 back to its normal position. When the check key K11 is operated back to its normal position the contacts 1426 thereof are actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the winding of the front split relay R1210, whereupon the latter relay restores shortly thereafter. Also, when the check key K11 is operated back to its normal position the contacts 1428 thereof are actuated into disengagement, thereby to interrupt the previously traced path for applying battery potential to the conductor C1465, whereupon the previously traced circuit for energizing the winding of the identity relay R125 is interrupted. The identity relay R125 then restores to interrupt, at the contacts 128, the previously mentioned circuit for illuminating the identity lamp L185, thereby to cause the last-mentioned lamp to be extinguished.

Before proceeding with the explanation of the operation of the apparatus at the first operator position 1400 in order to interconnect the calling subscriber substation T1 and the toll operator position in the distant exchange B, it is noted that the operator at the first operator position may render any one of the ring-down toll circuits and the associated toll line extending between the central office A and the distant exchange B busy after establishing a connection from the first operator position to the particular ring-down toll circuit. Assuming that the operator at the first operator position 1400 desires to render the ring-down toll circuit 190 busy after establishing a connection thereto by way of the toll selector switch 800, as previously explained, she operates the order and start key K7 to its left-hand or order position and operates the check key K11 to its front position. When the check key K11 is operated to its front position the previously traced circuit for energizing the winding of the front split relay R1210 is completed at the contacts 1426 thereof and the

previously traced path for applying battery potential to the conductor C1465 is completed at the contacts 1428 thereof. Also, when the check key K11 is operated to its front position, while the order and start key K7 is operated to its order position, a path is completed for connecting battery potential to the conductor C1464, this path extending from battery by way of the resistor 1432, C1458, the contacts 1446 of the order and start key K7, C1459 and the contacts 1430 of the check key K11 to the conductor C1464. The front split relay R1210 then operates to complete, at the contacts 1214, the previously traced circuit for energizing the winding of the identity relay R125, thereby to cause operation of the latter relay. Also, the front split relay R1210 completes, at the contacts 1212, a circuit for energizing the lower winding of the order relay R120, this circuit extending from battery potential appearing upon the conductor C1464 by way of the contacts 1212, the line conductor C1281 in the cable 1270, the contacts 754 and 762, the line conductor C828 of the line 826, the contacts 814, C808, the wiper 803, the line conductor C174 of the trunk line 170, the lower winding of the impedance I130, the contacts 126' and the lower winding of R120 to ground. When energized over the above-traced circuit the order relay R120 operates to complete, at the contacts 123, a holding circuit for energizing the upper winding thereof in series with the supervisory lamp L186, this circuit extending from ground by way of the lamp L186, the switch S187, C193, the contacts 123 and the upper winding of R120 to battery. Also, it is noted that the upper winding of the order relay R120 may be energized by way of a circuit including the conductor C192 extending to the chief operator position. Accordingly, the order relay R120 may be operated and retained in its operated position under the control of the chief operator or under the control of an operator at one of the operator positions at the switchboard. The illumination of the lamp L186 indicates to the attendant at the central office A that the ring-down toll circuit 100 and the toll line 190 individually associated therewith are out of order. After the ring-down toll circuit 100 or the toll line 190 has been repaired, the attendant at the central office A may again place the ring-down toll circuit 100 and the toll line 190 in service by momentarily operating the switch S187, thereby to interrupt the previously traced holding circuit for energizing in series the lamp L186 and the upper winding of the order relay R120.

Also, upon operating, the order relay R120 completes, at the contacts 122, an obvious path for applying ground potential to the control conductor C171 of the trunk line 170, thereby to prevent seizure of the trunk line 170 and the ring-down toll circuit 100 associated therewith by the switches having access thereto. Further, the order relay R120 interrupts, at the contacts 124, a point in the previously traced circuit for energizing the upper winding of the start relay R150, thereby to prevent operation of the latter relay and the consequent seizure of the trunk line 180 and the ring-down toll circuit 100 by the finder switches of the finder-selector links associated with the operator positions at the switchboard. Finally, the order relay R120 completes, at the contacts 125 and 126, obvious connections between the line conductors C194 and C195 of the toll line 190 and the line conductors C167 and C166 of the line 165 extending to a source of trouble tone voltage. The application of trouble tone voltage between the line conductors of the toll line 190 marks the toll line 190 as out of order, which tone will be received in the event the toll line 190 is seized by the operator at the toll operator position in the distant exchange B.

Continuing now with the operation of the apparatus at the first operator position 1400 in order to establish a connection between the calling subscriber substation T1 and the toll operator position in the distant exchange B, after the call has been forwarded by the operator at the operator position 1400 in the central office A to the toll operator position in the distant exchange B and the operator at the operator position 1400 in the central office A has verified the forwarding of the call, the operator at the first operator position informs the subscriber at the calling subscriber substation T1 that he may begin the conversation. The operator at the first operator position then returns the talk key K780 of the finder switch 700 to its normal position. When the talk key K780 is returned to its normal position a further point in the previously traced circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120 in series is interrupted at the contacts 774 thereof; however, an alternative circuit, traced hereinafter, is prepared, at the contacts 775 of the talk key K780, for illuminating the supervisory lamp L776. Also, when the talk key K780 is restored to its normal position a further point in the previously traced circuit for energizing the lower winding of the connect relay R750 is interrupted at the contacts 782 thereof; and a point is interrupted, at the contacts 781 of the talk key K780, in the previously traced holding circuit for energizing the upper winding of the connect relay R750 in series with the winding of the talk relay R1130, thereby to cause the latter relays to restore.

Upon restoring, the connect relay R750 interrupts, at the contacts 752 and 755, points in the previously traced circuit for connecting the C. L. R. trunk 450 to the trunk circuit at the first operator position and interrupts, at the contacts 751 and 754, points in the previously traced circuit for connecting the called toll line 190 to the trunk circuit at the first operator position. Also, the connect relay R750 completes, at the contacts 753 and 756, a direct connection between the finder switch 700 and the line 826 extending to the toll selector switch 800, thereby to complete a direct connection between the C. L. R. trunk 450 and the toll line 190. Also, at this time, the calling subscriber line 451 extending to the calling subscriber substation T1 is operatively connected to the C. L. R. trunk 450 by way of the local link 454 and the called subscriber substation is operatively connected with the toll line 190 by way of the toll operator position in the distant exchange B. Hence, at this time, the subscriber at the calling subscriber substation T1 and the subscriber at the called subscriber substation in the distant exchange B may communicate with each other.

Also, upon restoring, the connect relay R750 interrupts, at the contacts 757, the previously traced circuit for energizing the winding of the answer pilot relay R1250, interrupts, at the contacts 752', the previously traced circuit for energizing the upper winding of the call pilot relay R1320, and interrupts, at the contacts 751', the previously traced circuit for energizing the winding of the start relay R740, thereby to cause these

relays to restore. Upon restoring, the start relay R740 interrupts, at the contacts 742, the previously traced circuit for energizing the upper winding of the electropolarized relay R710; however, the electropolarized relay R710 remains in its operated position at this time due to the completed holding circuit for energizing the lower winding thereof. Also, the transfer relay R720 remains in its operated position due to the completed holding circuit for energizing the upper winding thereof. Further, the start relay R740 interrupts, at the contacts 744, a further point in the previously traced circuit for energizing the winding of the supervisory relay R1230 and prepares, at the contacts 745, an alternative circuit, traced hereinafter, for illuminating the supervisory lamp L767. Finally, the start relay R740 prepares, at the contacts 743, a further point in the previously mentioned circuit for energizing the release magnet M735. Further, the cut-in relay R760 remains in its operated position due to the completed holding circuit for energizing the lower winding thereof, this circuit extending from ground by way of the lower winding of R760, the contacts 765 and the resistor 769 to battery.

At this time the subscriber at the calling subscriber substation T1 has switchhook supervision and may attract the attention of the operator at the first operator position 1400 by operating the switchhook at the subscriber substation T1 a number of times, thereby to cause the line relay R430 in the C. L. R. trunk circuit 400 to operate and restore intermittently as previously explained. Each time the line relay R430 restores it completes, at the contacts 431, the previously mentioned alternative circuit for illuminating the supervisory lamp L767, this circuit extending from ground by way of the contacts 431 and 411, the control conductor C443 of the trunk line 440, the wiper 707 of the wiper set of the mechanism 701, the contacts 718 and 745 and the lamp L767 to battery. Conversely, each time the line relay R430 operates it interrupts, at the contacts 431, the previously traced alternative circuit for illuminating the supervisory lamp L767. Accordingly, the subscriber at the calling subscriber substation T1 may cause the supervisory lamp L767 to flash, thereby to attract the attention of the operator at the first operator position 1400.

Upon restoring, the talk relay R1130 in the relay group 1200 at the first operator position 1400 interrupts, at the contacts 1133 and 1135, points in the previously traced circuit for connecting the trunk circuit at the first operator position to the windings 1106 and 1107 of the talking repeater 1105 and completes, at the contacts 1132 and 1134, points in the previously traced circuit for connecting the trunk circuit at the first operator position 1400 to the winding 1103 of the monitoring repeater 1102. Also, upon restoring, the talk relay R1130 completes, at the contacts 1131, the previously mentioned path for applying ground potential to the control conductor C1166 of the trunk line 1165 extending to the chief operator position, thereby to indicate to the chief operator that the operator at the first operator position is not now engaged in setting up a connection. Finally, upon restoring, the talk relay R1130 interrupts, at the contacts 1137, a further point in the previously traced circuit for applying ground potential to the start conductor C1386 in the cable 1380 extending to the sender control circuit 461, completes, at the contacts 1138, the previously traced path for applying ground potential to the conductor C1275 in the cable 1270, and prepares, at the contacts 1136, a circuit, traced hereinafter, for energizing the winding of the monitor relay R1110. Upon restoring, the answer pilot relay R1250 interrupts, at the contacts 1252, the path for applying ground potential to the conductor C1287 in the cable 1270, interrupts, at the contacts 1256, a further point in the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380 and prepares, at the contacts 1255, the previously traced circuit for energizing the winding of the distributor start relay R1310. Upon restoring, the call pilot relay R1320 prepares, at the contacts 1321, a further point in the previously traced circuit for energizing the winding of the distributor start relay R1310 and prepares, at the contacts 1322, a point in the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380 extending to the sender control circuit 461. At this time the relay group 1200 at the first operator position 1400 is completely released for further use and the operator at this position may receive other calls by operating the talk key of an idle one of the finder-selector links associated with her position away from its normal position in the manner previously explained.

At this time the operator at the toll operator position in the distant exchange B may attract the attention of the operator at the first operator position 1400 in the central office A by operating a key at her position, thereby to cause alternating ringing current to be projected over the toll line 190 to the ring-down toll circuit 100. When alternating ringing current is projected over the toll line 190 to the ring-down toll circuit 100 the ring-up relay R135 operates in order to cause the control relay R140 to restore as previously explained. Upon restoring, the control relay R140 completes, at the contacts 141, the previously traced circuit for energizing the upper winding of the start relay R150, thereby to cause the latter relay to operate and complete, at the contacts 155, a holding circuit for energizing the lower winding thereof in series with the supervisory lamp L776, this circuit extending from ground by way of the contacts 155, the lower winding of R150, the control conductor C172 of the trunk line 170, the wiper 804 of the wiper set of the mechanism 801, the contacts 898 and 871, the control conductor C829 of the line 826, the contacts 763, the supervisory lamp L776 and the contacts 775 of the talk key K780 to battery. After the operator at the toll operator position in the distant exchange B has transmitted one splash of ringing current over the toll line 190 to the ring-down toll circuit 100 she returns the key at her position to its normal position, thereby to cause the ring-up relay R135 to restore and the control relay R140 to reoperate. However, the start relay R150 remains in its operated position and the supervisory lamp L776 remains illuminated. The operator at the first operator position 1400 may again associate the telephone instrument and the trunk circuit at her position with the finder-selector link illustrated by operating the talk key K780 away from its normal position, whereupon the previously traced circuit for energizing in series the lower winding of the start relay R150, the winding of the control relay R1120 and the supervisory lamp L776 is completed. As previously noted the resistance of the winding of the supervisory relay R1120 is sufficiently high to prevent adequate energization of the lower winding of the start relay R150,

thereby to cause the latter relay to restore and interrupt, at the contacts 155, the previously traced circuit for energizing in series the lower winding of the start relay R150, the winding of the supervisory relay R1120 and the supervisory lamp L776.

In the above description of the operation of the toll selector switch 800 to find an idle trunk line in the group of trunk lines, including the trunk line 170, extending to the ring-down toll circuits associated with the group of toll lines extending between the central office A and the distant exchange B it was assumed that the trunk line 170 in this group was idle at this time and that the toll selector switch 800 operated to seize the trunk line 170. However, it may occur that all of the trunk lines in the group of trunk lines are busy at this time, due to the fact that all of the toll lines extending between the central office A and the distant exchange B are busy. Accordingly, in this event, the toll selector switch 800 continues to operate until the wiper set of the mechanism 801 thereof is driven in the rotary direction to the position of the contact set in the main contact bank of the mechanism wherein the last busy trunk line in the group of trunk lines, including the trunk line 170, is terminated. At this time ground potential appears upon the contact of the contact set in the main contact bank of the mechanism 801 engaged by the wiper 806 of the wiper set of the mechanism 801. This application of ground potential to the wiper 806 completes a circuit for energizing the lower winding of the busy relay R820, this circuit extending from the grounded wiper 806 by way of the contacts 875, 865 and 818 and the lower winding of R820 to battery. When energized over the above-traced circuit the busy relay R820 operates exceedingly fast to complete, at the contacts 823, a holding circuit for energizing the upper winding thereof, this circuit extending from the grounded control conductor C830 of the line 826 by way of the contacts 823 and the upper winding of R820 to battery. Also, upon operating, the busy relay R820 prepares, at the contacts 822, a path, traced hereinafter, for applying current to the control conductor C829 of the line 826. Further, the busy relay R820 interrupts, at the contacts 825, the previously traced circuit for energizing the intermediate winding of the electropolarized relay R810, thereby to prevent operation of the latter relay at this time. The rotary magnet M878 continues to operate intermittently, thereby to drive the wiper set of the mechanism 801 step by step away from its normal position until it is driven eleven steps away from its normal position, whereupon the sets of switch springs S833 and S839 are actuated into engagement. When the set of switch springs S839 is actuated into engagement an alternative circuit is completed for energizing the intermediate winding of the electropolarized relay R810 in series with the upper winding of the transfer relay R850, this circuit extending from the grounded control conductor C830 of the line 826 by way of the intermediate winding of R810, the set of switch springs S839 and the upper winding of R850 to battery. When the above-traced circuit is completed the electropolarized relay R810 operates exceedingly fast and the transfer relay R850 reoperates. Upon operating, the electropolarized relay R810 interrupts, at the contacts 817, the previously traced circuit for energizing the rotary magnet M878, thereby to arrest further operation of the toll selector switch 800 and interrupts, at the contacts 811 and 813, the previously traced loop circuit for energizing the windings of the line relay R830, thereby to cause the latter relay to restore. Also, upon operating, the electropolarized relay R810 completes, at the contacts 816, the previously traced holding circuit for energizing the upper winding thereof, interrupts, at the contacts 817, the previously traced circuit for energizing the winding of the hold relay R840, thereby to cause the latter relay to restore shortly thereafter, and interrupts, at the contacts 818, a further point in the previously traced circuit for energizing the lower winding of the busy relay R820. At this time the electropolarized relay R810, the busy relay R820 and the transfer relay R850 remain in their operated positions.

After the sender control circuit 461 operates to transmit all of the digits registered in the digit register and control circuit 462 the cut-in relay R760 operates as previously explained, thereby to complete, at the contacts 763, a circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120, this circuit extending from the interrupted current conductor C810 by way of the contacts 822, the set of switch springs S833, the control conductor C829 of the line 826, the contacts 763, the lamp L776, the contacts 774 of the talk key K780, the conductor C1187 in the cable 1270, the resistor 1122 and the winding of R1120 to battery. When energized over the above-traced circuit the control relay R1120 operates to complete, at the contacts 1121, the previously traced path for short-circuiting the resistor 1122. Accordingly, the supervisory lamp L776 flashes intermittently, thereby to indicate to the operator at the first operator position 1400 that all of the trunk lines in the group of trunk lines extending to the ring-down toll circuits associated with the toll lines extending between the central office A and the distant exchange B are busy. Further, it is noted that, although the sender control circuit 461 operates to transmit all of the digits registered in the digit register and control circuit 462 subsequent to the operation of the toll selector switch 800 as previously explained, these digits are not transmitted beyond the toll selector switch 800 as the wiper set of the mechanism 801 engages no trunk line when it occupies a position disposed eleven steps away from its normal position. The operator at the first operator position 1400 then advises the subscriber at the calling subscriber substation T1 that the connection cannot immediately be had due to the fact that all of the toll lines extending between the central office A and the distant exchange B are busy at this time. The operator at the first operator position then releases the toll selector switch 800 in a manner more fully described hereinafter.

An established connection routed by way of one of the finder-selector links individually associated with the first operator position 1400 may be monitored by the operator thereat. For example, in order to monitor the established connection routed by way of the finder-selector link illustrated associated with the first operator position the operator thereat operates the monitor key K770 of the finder switch 700 away from its normal position. When the monitor key K770 is operated away from its normal position a circuit is completed, at the contacts 773 thereof, for energizing the monitor relay R1110 in the relay group 1200, this circuit extending from ground by way of the contacts 773 of the monitor key K770, the conductor C1273 in the cable 1270, the

contacts 1205, C1185, the contacts 1136 and the winding of R1110 to battery. When energized over the above-traced circuit the monitor relay R1110 operates to complete, at the contacts 1115 and 1117, a circuit for operatively associating the receiver 1128 of the telephone instrument at the first operator position with the monitoring repeater 1102. The last-mentioned circuit extends from the receiver 1128 by way of the tip of the plug P1123, the tip of the jack J1124, C1168, C1172, the contacts 1117, the winding 1104 of the monitoring repeater 1102, the contacts 1115, C1173, the tip of the jack J1126 and the tip of the plug P1125 to the receiver 1128. Also, the monitor relay R1110 completes, at the contacts 1113, 1115 and 1117, a connection between the line conductors C1167 and C1168 of the trunk line 1165 extending to the chief operator position and the winding 1104 of the monitoring repeater 1102, thereby to establish a monitoring connection between the monitoring repeater 1102 in the position telephone equipment 1100 associated with the first operator position and the chief operator position. Further, the monitor relay R1110 interrupts, at the contacts 1111, the previously traced path for applying ground potential to the control conductor C1166 of the trunk line 1165. When ground potential is removed from the control conductor C1166 of the trunk line 1165 the signal device at the chief operator position is operated, thereby to indicate to the chief operator that the first operator position 1400 is busy. Finally, the monitor relay R1110 interrupts, at the contacts 1112 and 1116, the previously traced connection between the line conductors C1167 and C1168 of the trunk line 1165 and the windings 1106 and 1107 of the talking repeater 1105.

Also, when the monitor key K770 is operated the line conductors C1272 and C1271 in the cable 1270 are respectively connected, at the contacts 771 and 772 of the monitor key K770, to the line conductors C827 and C828 of the line 826 extending between the finder switch 700 and the toll selector switch 800. Further, it is noted that the line conductors C1272 and C1271 in the cable 1270 are respectively connected by way of the contacts 1203 and 1201 to the line conductors C1184 and C1182 of the trunk circuit at the first operator position 1400, the line conductors C1182 and C1184 being connected by way of the contacts 1132 and 1134, respectively, to the winding 1103 of the monitoring repeater 1102 as previously explained. Accordingly, at this time, the operator at the first operator position may monitor the established connection routed between the calling subscriber substation T1 and the called subscriber substation in the distant exchange B by way of the finder-selector link illustrated. Moreover, as previously noted, the operator at the chief operator position may monitor this established connection by way of the trunk line 1165.

In order to interrupt the monitoring connection between the first operator position 1400 and the established connection routed by way of the finder-selector link illustrated the operator at the first operator position restores the monitor key K770 of the finder switch 700 to its normal position. When the monitor key K770 is restored to its normal position the previously traced circuit for energizing the winding of the monitor relay R1110 is interrupted at the contacts 773 thereof, thereby to cause the monitor relay R1110 to restore. Also, at the contacts 771 and 772 of the monitor key K770, the previously traced connection between the line conductors C827 and C828 of the line 826 extending between the finder switch 700 and the toll selector switch 800 and the line conductors C1272 and C1271 in the cable 1270 is interrupted. Upon restoring, the monitor relay R1110 interrupts, at the contacts 1115 and 1117, the previously traced connection betwen the receiver 1128 and the winding 1104 of the monitoring repeater 1102, interrupts, at the contacts 1113, 1115 and 1117, the previously traced connection between the line conductors of the trunk line 1165 and the winding 1104 of the monitoring repeater 1102, recompletes, at the contacts 1111, the previously traced path for applying ground potential to the control conductor C1166 of the trunk line 1165, and recompletes, at the contacts 1112 and 1116, the previously traced connection between the line conductors of the trunk line 1165 and the windings 1106 and 1107 of the talking repeater 1105. When ground potential is reapplied to the control conductor C1166 of the trunk line 1165 the signal at the chief operator position is operated in order to indicate to the chief operator that the operator at the first operator position 1400 is not engaged at this time.

Also, it is noted that an established connection routed by way of one of the finder-selector links individually associated with the first operator position 1400 may be split in either direction. For example, the operator at the first operator position may wish to split the connection routed by way of the finder-selector link illustrated and talk to the calling party to the exclusion of the called party. This is accomplished by operating the talk key K780 of the finder switch 700 away from its normal position, thereby to complete, at the contacts 782 thereof, the previously traced connection for energizing the lower winding of the connect relay R750. The connect relay R750 then operates to complete, at the contacts 759, the previously traced circuit for energizing the upper winding thereof in series with the winding of the talk relay R1130, thereby to cause the latter relay to operate. The connect relay R750 completes, at the contacts 757 and 752', the previously traced circuits for energizing the winding of the answer pilot relay R1250 and the upper winding of the call pilot relay R1320, thereby to cause the latter relays to operate. Upon operating, the answer pilot relay R1250 completes, at the contacts 1252, the previously traced circuit for energizing the winding of the start relay R740, thereby to cause the latter relay to operate. Also, when the talk key K780 is operated away from the normal position there is prepared, at the contacts 774 thereof, the previously traced circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120 in series. Upon operating, the talk relay R1130 recompletes, at the contacts 1133 and 1135, the previously traced circuit for operatively connecting the windings 1106 and 1107 of the talking repeater 1105 to the line conductors C1182 and C1184 of the trunk circuit at the first operator position. Finally, the connect relay R750 completes, at the contacts 751 and 754, the previously traced connection between the trunk circuit at the first operator position and the called subscriber substation in the distant exchange B and completes, at the contacts 752 and 755, the previously traced connection between the calling subscriber substation T1 and the trunk circuit at the first operator position. Accordingly, at this time, the calling subscriber substation T1 and the called sub-

scriber substation in the distant exchange B are operatively interconnected by way of the trunk circuit at the first operator position, and the telephone instrument at the first operator position is operatively connected to the trunk circuit thereat. Hence, at this time, a three-way communication connection is established.

The operator at the first operator position 1400 then operates the cut-off key K6 to its right-hand or front position, thereby to complete, at the contacts 1441 thereof, an obvious circuit for energizing the winding of the front split relay R1210. The front split relay R1210 operates as previously explained, thereby to disconnect, at the contacts 1211 and 1213, the line conductors C1281 and C1282 in the cable 1270 from the trunk circuit at the first operator position. At this time the line conductors C1284 and C1283 in the cable 1270 are connected to the subscriber line 451 extending to the calling subscriber substation T1 and to the trunk circuit at the first operator position; while the line conductors C1282 and C1281 in the cable 1270 are connected to the subscriber line extending to the called subscriber substation in the distant exchange B and disconnected from the trunk circuit at the first operator position. Accordingly, at this time, the operator at the first operator position may talk to the party at the calling subscriber substation T1 to the exclusion of the party at the called subscriber substation in the distant exchange B. After the operator at the first operator position has finished her conversation with the party at the calling subscriber substation T1 the cut-off key K6 is returned to its normal position, thereby to interrupt, at the contacts 1441, the previously mentioned circuit for energizing the winding of the front split relay R1210. The front split relay R1210 then restores shortly thereafter to recomplete, at the contacts 1211 and 1213, the previously traced connection between the line conductors C1281 and C1282 in the cable 1270 and the trunk circuit at the first operator position, thereby to recomplete the three-way communication connection including the calling subscriber substation T1, the called subscriber substation in the distant exchange B and the telephone instrument at the first operator position 1400.

Also, the operator at the first operator position 1400 may wish to split the connection routed by way of the finder-selector link illustrated and talk to the called party to the exclusion of the calling party. This is accomplished by operating the talk key K780 of the finder switch 700 away from its normal position as previously explained and then by operating the cut-off key K6 to its left-hand or rear position. When the cut-off key K6 is operated to its rear position the contacts 1440 thereof are actuated into engagement, thereby to complete an obvious circuit for energizing the winding of the rear split relay R1220. The rear split relay R1220 then operates to interrupt, at the contacts 1221 and 1223, the previously traced connection between the line conductors C1283 and C1284 in the cable 1270 and the trunk circuit at the first operator position. At this time the line conductors C1281 and C1282 in the cable 1270 are connected to the subscriber line extending to the called subscriber substation in the distant exchange B and to the trunk circuit at the first operator position; while the line conductors C1283 and C1284 in the cable 1270 are connected to the subscriber line extending to the calling subscriber substation T1 and are disconnected from the trunk circuit at the first operator position. Accordingly, the operator at the first operator position 1400 may converse with the subscriber at the called subscriber substation in the distant exchange B to the exclusion of the subscriber at the calling subscriber substation T1. After the operator at the first operator position 1400 has finished her conversation with the called subscriber at the subscriber substation in the distant exchange B the cut-off key K6 is returned to its normal position, thereby to interrupt, at the contacts 1440 thereof, the previously traced circuit for energizing the winding of the rear split relay R1220. Shortly thereafter the rear split relay R1220 restores to recomplete, at the contacts 1221 and 1223, the previously traced connection between the line conductors C1283 and C1284 in the cable 1270 and the trunk circuit at the first operator position, thereby to recomplete the three-way communication connection including the calling subscriber substation T1, the called subscriber substation in the distant exchange B and the telephone instrument at the first operator position. Thereafter the talk key K780 may be restored to its normal position, thereby to complete the direct connection between the calling subscriber substation T1 and the called subscriber substation in the distant exchange B as previously explained.

It is noted that in the event an operator at any one of the operator positions at the switchboard finds it necessary to vacate her position at a time when a call is routed by way of one of the finder-selector links associated with her position she may transfer the call to the succeeding operator position for supervision. For example, in the event the operator at the first operator position 1400 desires to vacate her position during the time when the established connection is routed by way of the finder-selector link illustrated she may transfer the call to the succeeding operator position for supervision by operating the transfer key K9 at her position. When the transfer key K9 is operated an obvious circuit is completed, at the contacts 1431 thereof, for energizing the winding of the transfer relay R1200, thereby to cause the latter relay to operate. Upon operating, the transfer relay R1200 completes, at the contacts 1202, an obvious connection between the line conductors C1271, C1281 and C1283 in the cable 1270 and the line conductor C1276 extending to the succeeding operator position, completes, at the contacts 1204, an obvious connection between the line conductors C1272, C1282 and C1284 in the cable 1270 and the line conductor C1277 extending to the succeeding operator position, and completes, at the contacts 1206, 1208 and 1201', obvious connections between the conductors C1273, C1274 and C1275 in the cable 1270 and the respective conductors C1278, C1279 and C1280 extending to the succeeding operator position. Further, the transfer relay R1200 interrupts, at the contacts 1201 and 1203, the previously traced connections between the line conductors C1271, C1272, C1281, C1282, C1283 and C1284 in the cable 1270 and the trunk circuit at the first operator position and interrupts, at the contacts 1205, 1207 and 1209, the connections between the respective conductors C1273, C1274 and C1275 in the cable 1270 and the conductors C1285, C1286 and C1190 of the trunk circuit at the first operator position.

At this time, in the event the monitor key K770 of the finder switch 700 is operated away

from its normal position, the connection between the conductors C1272 and C1271 in the cable 1270 and the conductors C1276 and C1277 extending to the succeeding operator position renders the succeeding operator position operative to monitor the established connection routed by way of the finder-selector link illustrated. On the other hand, in the event the talk key K780 of the finder switch 700 is operated away from its normal position the connection between the conductors C1281, C1282, C1283 and C1284 in the cable 1270 and the conductors C1276 and C1277 extending to the succeeding operator position renders the succeeding operator position operative to communicate over the established connection routed by way of the finder-selector link illustrated with either or both of the parties at the subscriber substations included in the established connection.

When the operator returns to the first operator position 1400 she operates the transfer key K9 back to its normal position, thereby to interrupt at the contacts 1431 thereof, the previously mentioned circuit for energizing the winding of the transfer relay R1200 in order to cause the latter relay to restore. Upon restoring, the transfer relay R1200 interrupts the previously traced connections between the conductors mentioned in the cable 1270 and the conductors mentioned extending to the succeeding operator position, thereby to render the supervision of the established connection rounted by way of the finder-selector link illustrated under the control of the operator at the first operator position 1400.

Release of an established connection at the switchboard

The release of an established connection routed by way of one of the finder-selector links associated with one of the operator positions is primarily under the control of the operator thereat. For example, the release of the established connection routed by way of the finder-selector link illustrated is primarily under the control of the operator at the first operator position 1400. However, disconnect supervision is provided at the first operator position 1400 in order to indicate to the operator thereat that the subscriber at the calling subscriber substation T1 has replaced the receiver of the telephone instrument at his substation upon its switchhook as previously noted. Also, ring-off supervision is provided at the first operator position 1400 in order to indicate to the operator thereat when the toll operator in the distant exchange B rings off the connection after the subscriber at the called subscriber substation in the distant exchange B replaces the receiver of the telephone instrument at his substation upon its switchhook as previously noted. When the subscriber at the calling subscriber substation T1 replaces the receiver of the telephone instrument thereat upon its switchhook the line relay R430 in the C. L. R. trunk circuit 400 restores, thereby to complete, at the contacts 431, one or the other of the previously traced circuits for illuminating the supervisory lamp L767. The supervisory lamp L767 is illuminated directly from ground by way of the contacts 431 of the line relay R430 in the C. L. R. trunk circuit 400 over the previously traced circuit in the event the talk key K780 is restored to its normal position when the subscriber at the calling subscriber substation T1 replaces the receiver of the telephone instrument thereat upon its switchhook as previously explained. Also, the previously traced circuit for illuminating the supervisory lamp L767 is completed by way of ground at the contacts 1231 of the supervisory relay R1230 in the relay group 1200 over the previously traced circuit in the event the talk key K780 is operated away from its normal position when the subscriber at the calling subscriber substation T1 replaces the receiver of the telephone instrument thereat upon its switchhook as previously explained.

When the subscriber at the called subscriber substation in the distant exchange B replaces the receiver of the telephone instrument thereat upon its switchhook the operator at the toll operator position in the distant exchange B is given a disconnect signal, whereupon this operator transmits ringing current or a ring-off signal over the toll line 190 to the ring-down toll circuit 109. The start relay R150 then operates to cause ground potential to be applied to the control conductor C172 of the trunk line 170, whereupon the previously traced circuit for illuminating the supervisory lamp L767 is completed directly from battery by way of the contacts 775 of the talk key K780, in the event the talk key K780 occupies its normal position at this time. On the other hand, in the event the talk key K780 is operated away from its normal position at this time the previously traced circuit for operating the control relay R1120 in the relay group 1200 is completed, thereby to cause the latter relay to operate and complete the previously traced low resistance series circuit for illuminating the supervisory lamp L776.

The illumination of the supervisory lamp L767 indicates to the operator at the first operator position 1400 that the party at the calling subscriber substation T1 desires attention or has placed the receiver of the telephone instrument thereat upon its switchhook. Likewise, the illumination of the supervisory lamp L776 indicates to the operator at the first operator position that the operator at the toll operator position in the distant exchange B desires attention or has transmitted the ring-off signal. The operator at the first operator position 1400 then operates the talk key K780 away from its normal position, in the event it occupies its restored position at this time, and listens in upon the established connection, thereby to ascertain whether the calling or called party desires attention or whether the conversation has terminated.

The operator at the first operator position may selectively release the front end or the rear end of the established connection or she may release both ends of the established connection. The manner in which the release of the established connection is effected depends upon whether the operator at the first operator position 1400 desires to communicate with either the calling or called party subsequently. Moreover, the operator at the first operator position may release the front end of the established connection, while the calling party on the rear end of the established connection retains his connection to the first operator position, and then subsequently extend the front end of the connection to another destination in the event the calling party so desires.

In order to release the rear end of the established connection without releasing the front end thereof the operator at the first operator position 1400 operates the release key K8 to its left-hand or rear position, the talk key K780 of the finder switch 700 being operated away from its

normal position at this time. When the release key K8 is operated to its rear position an obvious circuit is completed, at the contacts 1442 thereof, for energizing the winding of the rear split relay R1220. When thus energized the rear split relay R1220 operates to disconnect the line conductors C1283 and C1284 in the cable 1270 from the trunk circuit at the first operator position as previously explained. The conductors mentioned in the cable 1270 are disconnected from the trunk circuit at the first operator position in order to prevent disagreeable clicks from being transmitted to the trunk circuit at the first operator position incident to the release of the local switch train as described hereinafter.

Also, when the release key K8 is operated to its rear position an obvious path is completed, at the contacts 1444 thereof, for applying ground potential to the release conductor C1289 in the cable 1270. This application of ground potential to the release conductor C1289 in the cable 1270 completes a path for short-circuiting the upper winding of the transfer relay R720 in the finder switch 700, this path extending from the grounded release conductor C1289 by way of the contacts 757, the sets of switch springs S783 and S784 and the upper winding of R720 to ground. When the upper winding of the transfer relay R720 is thus short-circuited it restores to interrupt, at the contacts 721, the previously traced holding circuit for energizing the upper winding thereof and the previously traced path for applying battery potential to the release conductor C1289. Also, this application of ground potential to the release conductor C1289 completes an obvious path for short-circuiting the winding of the answer pilot relay R1250, thereby to cause the latter relay to restore. Upon restoring, the answer pilot relay R1250 interrupts, at the contacts 1252, the previously traced circuit for energizing the winding of the start relay R740, thereby to cause the latter relay to restore. Upon restoring, the start relay R740 interrupts, at the contacts 742, the previously traced circuit for energizing the upper winding of the electropolarized relay R710; and, upon restoring, the transfer relay R720 interrupts, at the contacts 725, the previously traced holding circuit for energizing the lower winding of the electropolarized relay R710. Accordingly, the electropolarized relay R710 restores at this time. Also, upon restoring, the transfer relay R720 completes, at the contacts 726, the previously mentioned circuit for energizing the release magnet M735, this circuit extending from ground by way of the contacts 726 and 743, the set of switch springs S785 and the winding of M735 to battery. When energized over the above-traced circuit the release magnet M735 operates to release the wiper set of the mechanism 701 and to cause the wiper set thereof to be returned to its normal position. When the wiper set of the mechanism 701 is returned to its normal position the sets of switch springs S784 and S785 are actuated into disengagement. When the set of switch springs S784 is actuated into disengagement a further point in the previously traced holding circuit for energizing the upper winding of the transfer relay R720 is interrupted; and when the set of switch springs S785 is actuated into disengagement the previously traced circuit for energizing the release magnet M735 is interrupted. When the wiper set of the mechanism 701 is returned to its normal position the previously traced circuit for applying ground potential to the control conductor C444 of the trunk line 440 is interrupted.

Assuming, at this time, that the subscriber at the calling subscriber substation T1 has replaced the receiver of the telephone instrument thereat upon its switchook the line relay R430 occupies its restored position, thereby to cause the start relay R420 to restore. When ground potential is removed from the control conductor C444 of the trunk line 440 the previously traced holding circuit for energizing the winding of the marking relay R410 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the start relay R420 interrupts, at the contacts 422, the previously mentioned path for applying ground potential to the control conductor C453 of the C. L. R. trunk 450 and completes, at the contacts 423, the previously traced path for applying battery potential to the control conductor C453 after the marking relay R410 restores to interrupt, at the contacts 414, the multiple path for applying ground potential to the control conductor C453. When ground potential is removed from the control conductor C453 of the C. L. R. trunk 450 the local link 454, including the local selector switch 455 and the finder switch 456, restores to its normal position. Also, when the local link 454 is released the line circuit 452 individually associated with the subscriber line 451 operates, thereby to mark the subscriber line 451 as idle to the switches having access thereto. At this time the local link 454 and the C. L. R. trunk 450 are available for further use; however, the front end of the connection has not been released. Accordingly, the toll selector switch 800 remains in its operated position.

It is noted that at this time the call pilot relay R1320 in the relay group 1200 remains in its operated position, thereby to interrupt, at the contacts 1321, a point in the previously traced circuit for energizing the distributor start relay R1310 in order to prevent an incoming call from being routed to the first operator position 1400 at this time. Also, the operated call pilot relay R1320 retains interrupted, at the contacts 1322, a further point in the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380 extending to the sender control circuit 461, thereby to prevent operation of the sender control circuit 461 at this time.

In order to release the front end of the established connection without releasing the rear end thereof the operator at the first operator position 1400 operates the release key K8 to its right-hand or front position. When the relase key K8 is operated to its front position an obvious circuit is completed, at the contacts 1443 thereof, for energizing the winding of the front split relay R1210. The front split relay R1210 then operates to disconnect the line conductors C1281 and C1282 in the cable 1270 from the trunk circuit at the first operator position, thereby to eliminate disagreeable clicks from being transmitted to the trunk circuit at the first operator position incident to the release of the toll switch train.

Also, at the contacts 1445 of the release key K8, an obvious circuit is completed for applying ground potential to the release conductor C1290 in the cable 1270. This application of ground potential to the release conductor C1290 in the cable 1270 completes a path for short-circuiting the lower winding of the cut-in relay R760, this path extending from the grounded release conductor C1290 by way of the contacts 752' and 765 and the lower winding of R760 to ground. When the

lower winding of the cut-in relay R760 is thus short-circuited this relay restores to interrupt, at the contacts 765, a further point in the holding circuit for energizing the lower winding thereof and to interrupt, at the contacts 764, a point in the previously mentioned path for applying ground potential to the control conductor C830 of the line 826 extending to the toll selector switch 800. Also, upon restoring, the cut-in relay R760 interrupts, at the contacts 761 and 762, the connection between the finder switch 700 and the trunk line 826 extending to the toll selector switch 800.

When ground potential is removed from the control conductor C830 of the line 826 the previously traced holding circuit for energizing the upper winding of the electropolarized relay R810 is interrupted, thereby to cause the latter relay to restore and interrupt, at the contacts 816, a further point in the previously traced holding circuit for energizing the upper winding thereof. Also, upon restoring, the electropolarized relay R810 completes, at the contacts 817, the previously mentioned circuit for energizing the release magnet M876, this circuit extending from ground by way of the contacts 817, 832 and 845, the set of switch springs S835 and the winding of M876 to battery. When energized over the above-traced circuit the release magnet M876 operates to release the wiper set of the mechanism 801 and to cause this wiper set to be returned to its normal position. Also, upon restoring, the electropolarized relay R810 interrupts, at the contacts 812 and 814, further points in the previously traced connection between the line 826 and the trunk line 170. When the wiper set of the mechanism 801 is returned to its normal position the previously traced path for applying ground potential to the control conductor C171 of the trunk line 170 is interrupted. Also, when the wiper set of the mechanism 801 is returned to its normal position the sets of switch springs S834 and S835 are actuated into disengagement, while the set of switch springs S836 is actuated into engagement. When the set of switch springs S835 is actuated into disengagement the previously traced circuit for energizing the release magnet M876 is interrupted. At this time the toll selector switch 800 is completely released and is available for further use.

When ground potential is removed from the control conductor C171 of the trunk line 170 the previously traced circuit for energizing the winding of the marking relay R160 is interrupted, thereby to cause the latter relay to restore. At this time battery potential is applied by way of the winding of the marking relay R160 to the control conductor C171 of the trunk line 170, thereby to mark the trunk line 170 as idle to the switches having access thereto. The apparatus at the distant exchange B is then released by the operator at the toll operator position, thereby to render the toll line 190 available for further use.

After the operator at the first operator position 1400 operates the release key K8 to its front position, as previously explained, in order to cause the front end of the connection to be released she returns this key to its normal position, thereby to interrupt, at the contacts 1443 thereof, the previously mentioned circuit for energizing the winding of the front split relay R1210, so that thereafter the front split relay R1210 restores to reconnect the line conductors C1281 and C1282 in the cable 1270 to the trunk circuit at the first operator position. Also, when the release key K8 is returned to its normal position the previously mentioned path for applying ground potential to the release conductor C1290 in the cable 1270 is interrupted, at the contacts 1445 thereof, thereby to interrupt an obvious circuit for energizing the upper winding of the call pilot relay R1320. The call pilot relay R1320 then restores shortly thereafter, this relay being of the slow-to-release type, to complete, at the contacts 1322, the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380 extending to the sender control circuit 461. This application of ground potential to the start conductor C1386 causes the sender control circuit 461 to operate, in the previously described manner, thereby to associate an idle digit register and control circuit therewith and to find the cable 786 extending to the finder-selector link illustrated. At this time the finder switch 700 is operatively connected with the calling subscriber substation T1. When the sender control circuit 461 operates to find the cable 786 extending to the finder-selector link illustrated the line relay R830 in the toll selector switch 800 operates, in the previously described manner, thereby to condition the toll selector switch 800 to be responsive to impulses transmitted thereto from the sender control circuit 461. At this time the operator at the first operator position 1400 may extend the connection to any desired destination in the previously described manner by again operating the sending key set 463 at her position.

As previously noted the operator at the first operator position 1400 may release both the front end and the rear end of an established connection routed by way of one of the finder-selector links individually associated with her position. For example, in order to release both ends of the established connection routed by way of the finder-selector link illustrated the operator at the first operator position operates the talk key K780 away from its normal position and then operates the release key K8 from its normal position to its rear position and then to its front position and then back to its normal position. When the release key K8 is thus operated first the finder switch 700 and then the toll selector switch 800 are released in the previously described manner. When both the answer pilot relay R1250 and the call pilot relay R1320 are restored to their normal positions the previously traced circuit for energizing the winding of the distributor start relay R1310 is completed, in the event the talk relay R1130 remains in its operated position due to the operated condition of the talk key K780 of the finder switch 700. When thus energized the distributor start relay R1310 operates, as previously explained, thereby to cause ground potential to be applied to the start conductor C1094 in the trunk line 1090 extending to the common start and level distributor unit 1000 and ground potential to be removed from the guard conductor C1307 in the trunk line 1305 extending to the position distributor 1005. Accordingly, at this time, the first operator position 1400 is marked as idle and is in readiness to receive an incoming call to the switchboard routed thereto by the operation of the position distributor 1005 as previously explained.

Extension of a call from a paystation in the central office A to the switchboard

Calls initiated at the paystations in the central office A are answered at the switchboard and routed therefrom to their destinations. For example, in order to initiate a call at the paystation

T2 the party at the paystation T2 removes the receiver of the telephone instrument thereat from its switchhook and places a coin in the coin slot of the instrument. When the receiver of the telephone instrument at the paystation T2 is removed from its switchhook the line circuit 286 associated with the paystation line 290 operates, thereby to cause the local distributor 288 to operate and assign an idle one of the prepay manual trunk circuits to the use of the calling paystation line 290. Assuming that the prepay manual trunk circuit 200 is assigned by the local distributor 288 to the use of the calling paystation line 290, the local finder switch 287 thereof operates to find the paystation line 290, whereby battery potential present upon the control conductor C298 of the line 295 extending to the local finder switch 287 causes the local finder switch 287 to switch through when the calling paystation line 290 is found. The line circuit 286 then operates, thereby to mark the paystation line 290 as busy to the connector switches of the local switch train and to the combined local and toll connector switches having access thereto. The path for applying battery potential to the control conductor C298 of the line 295 extends from battery by way of the impedance I277 and the contacts 261 to the control conductors C298 of the line 295.

When the local finder switch 287 finds the calling paystation line 290 a loop circuit is completed for energizing the windings of the line relay R240 and the coin control relay R255, this loop circuit extending from ground by way of the upper winding of R255, the upper winding of R240, the contacts 222, the winding 203 of the repeater 201 and the contacts 271 to the line conductor C296 of the line 295; and from battery by way of the lower winding of R255, the lower winding of R240, the contacts 224, the winding 205 of the repeater 201 and the contacts 273 to the line conductor C297 of the line 295. The line conductors C296 and C297 are connected together by way of a loop circuit including the local finder switch 287, the line circuit 286, the line conductors of the paystation line 290 and the telephone instrument at the paystation T2. When the above-traced loop circuit is completed the line relay R240 operates; however, the coin control relay R255 operates only in the event a coin has been deposited in the coin slot of the instrument at the paystation T2. In the present example it is assumed that the party at the paystation T2 has deposited a coin in the coin slot of the instrument thereat, thereby to cause the coin control relay R255 to operate. Upon operating, the line relay R240 completes, at the contacts 241, an obvious circuit for energizing the winding of the control relay R235, thereby to cause the latter relay to operate shortly thereafter, this relay being of the slow-to-operate type. Also, the line relay R240 prepares, at the contacts 242, a point in a path, traced hereinafter, for applying ground potential to the distributor start conductor C293 in the trunk line 600 extending to the common start and level distributor unit 1000. Upon operating, the control relay R235 completes, at the contacts 239, an obvious path for applying ground potential to the control conductor C298 of the line 295, thereby to retain the local finder switch 287 in its operated position. It is noted that the coin control relay R255 is of the differential type and that the upper winding thereof is short-circuited when the coin is placed in the coin slot of the instrument at the paystation T2, thereby to cause this relay to operate.

Upon operating, the coin control relay R255 completes, at the contacts 256, an obvious circuit for energizing the winding of the hold relay R260, thereby to cause the latter relay to operate. Upon operating, the hold relay R260 completes, at the contacts 262, an obvious multiple path for applying ground potential to the control conductor C298 of the line 295, completes, at the contacts 263, an obvious path for applying battery potential by way of the winding of the marking relay R250 to the control conductor C283 of the trunk line 280, and completes, at the contacts 264, the previously mentioned path for applying ground potential to the distributor start conductor C293 in the trunk line 600. The path for applying ground potential to the distributor start conductor C293 in the trunk line 600 extends from ground by way of the contacts 264, 242 and 227 to the distributor start conductor C293.

This application of ground potential to the distributor start conductor C293 in the trunk line 600 completes an obvious circuit for energizing the winding of the trunk start relay R665, thereby to cause the latter relay to operate. Upon operating, the trunk start relay R665 interrupts, at the contacts 666, a point in a circuit, traced hereinafter, for energizing the lower winding of the marking relay R620, completes, at the contacts 667, an obvious path for applying ground potential to the conductor C606, thereby to complete an obvious circuit for energizing the winding of the trunk relay R1055 in the event this relay is not operated at this time, and prepares, at the contacts 668, a point in a path, traced hereinafter, for applying ground potential to the conductor C614 in the trunk line 610 extending to the vertical control contact banks of the mechanisms of the finder switches of the finder-selector links associated with the operator positions at the switchboard. It is noted that the conductor C614 terminates in the fourth level of the vertical control contact bank 709 of the mechanism 701 of the finder switch 700 in view of the fact that the group of trunk lines, including the trunk line 280, extending to the prepay manual trunk circuit 200 terminates in the fourth level in the main contact bank of the mechanism 701 of the finder switch 700 of the finder-selector link illustrated associated with the first operator position 1400 at the switchboard.

Assuming that the trunk relay R1055 is operated at this time, due to the operated condition of the trunk start relay R655 corresponding to the condition which prevails when there are C. L. R. calls to the switchboard which are waiting to be answered when the trunk start relay R665 operates due to the initiation of the call at the paystation T2, the position distributor 1005 is operating in the manner previously described in order to route the C. L. R. calls to the operator positions at the switchboard to be answered. Also, at this time, the previously traced holding circuit for energizing the upper winding of the control relay R600 in series with the upper winding of the marking relay R605 is completed.

After all of the C. L. R. calls waiting to be answered have been routed by the position distributor 1005 to the operator positions at the switchboard and have been answered the trunk start relay R655 restores to complete, at the contacts 656, the previously mentioned circuit for energizing the lower winding of the marking relay R610, this circuit extending from ground by way of the contacts 1057, C604, the contacts 656 and 608 and the lower winding of R610 to bat-

tery. When energized over the above-traced circuit the marking relay R610 operates to complete, at the contacts 612, a holding circuit for energizing the upper winding thereof in series with the upper winding of the control relay R600, this circuit extending from ground by way of the upper winding of R600, C603, the contacts 616 and 612 and the upper winding of R610 to battery. Also, upon operating, the marking relay R610 interrupts, at the contacts 611, the previously traced holding circuit for energizing the upper winding of the control relay R600 in series with the upper winding of the marking relay R605, thereby to cause the latter relay to restore. Further, the marking relay R610 completes, at the contacts 613, a circuit, similar to those previously traced, for energizing the lower winding of the marking relay R615, thereby to cause the latter relay to operate. Upon operating, the marking relay R615 completes, at the contacts 617, a holding circuit, similar to those previously traced, for energizing the upper winding of the control relay R600 in series with the upper winding of the marking relay R615 and interrupts, at the contacts 616, the previously traced holding circuit for energizing the upper winding of the control relay R600 in series with the upper winding of the marking relay R610, thereby to cause the marking relay R610 to restore. Further, the marking relay R615 prepares, at the contacts 618, a circuit, similar to those previously traced, for energizing the lower winding of the marking relay R620; however, this circuit is not completed at this time due to the operated condition of the trunk start relay R665. More particularly, the trunk start relay R665 interrupts, at the contacts 666, a point in the previously mentioned circuit for energizing the lower winding of the marking relay R620. Finally, the marking relay R615 completes, at the contacts 619, the previously mentioned path for applying ground potential to the conductor C614 in the trunk line 610, this path extending from ground by way of the contacts 1034', 1039', C608 and the contacts 619 and 668 to the conductor C614.

Assuming that the operator at the first operator position 1400 has operated away from its normal position the talk key K780 of the finder switch 700 of the finder-selector link illustrated associated with this operator position and that the position relay R1020 in the position distributor 1005 is operated, the position relay R1020 completes, at the contacts 1024, the previously traced circuit for connecting ground potential by way of the contacts 1056, the winding of the timer start relay R1045, C1072, and the contacts 1024 to the start conductor C1306 in the trunk line 1305 extending to the first operator position 1400. Also, at this time, the signal relay R1050, the timer start relay R1045 and the position busy relay R1040 occupy their operated positions as previously explained.

This application of ground potential to the start conductor C1306 in the trunk line 1305 extending to the first operator position 1400 completes the previously traced circuit for energizing the start relay R740 in the finder switch 700. When the start relay R740 is thus energized the finder switch 700 operates to find the trunk line in the group of trunk lines, including the trunk line 280, extending to the group of prepay manual trunk circuits. More particularly, the finder switch 700 searches in the fourth level of the main contact bank of the mechanism 701 and seizes the trunk line 280 extending to the prepay manual trunk circuit 200. When the trunk line 280 is found by the finder switch 700 the distributor start relay R1310 in the relay group 1200 restores in order to interrupt, at the contacts 1313, the previously mentioned path for applying ground potential to the distributor start conductor C1094 in the trunk line 1090 and to complete, at the contacts 1312, the previously mentioned path for applying ground potential to the guard conductor C1307 in the trunk line 1305 extending to the position distributor 1005. This application of ground potential to the guard conductor C1307 in the trunk line 1305 completes the previously traced circuit for energizing the lower winding of the position relay R1015, thereby to cause operation thereof. The subsequent operation of the position distributor 1005 is the same as that previously explained.

The vertical position of the contact set in the main contact bank of the mechanism 701 in the fourth level thereof terminating the trunk line 280 is marked by the presence of ground potential upon the conductor C614 in the trunk line 610 extending to the vertical control contact bank 709 of the mechanism 701. Also, the rotary position wherein the contact set terminating the trunk line 280 in the main contact bank of the mechanism 701 is located is marked by the presence of battery potential upon the control conductor C283 of the trunk line 280.

As previously noted, when the finder switch 700 operates to seize the trunk line 280 the electropolarized relay R710 operates to complete, at the contacts 717, an obvious path for applying direct ground potential to the wiper 706, thereby to complete a circuit for energizing the winding of the marking relay R250, this circuit extending from ground by way of the contacts 725 and 717, the wiper 706, the control conductor C283 of the trunk line 280, the contacts 263 and the winding of R250 to battery. When energized over the above-traced circuit the marking relay R250 operates, to complete, at the contacts 251, an obvious holding circuit for energizing the winding thereof by way of the control conductor C283 of the trunk line 280. Also, the marking relay R250 completes, at the contacts 252, an obvious circuit for energizing the winding of the control relay R220, thereby to cause the latter relay to operate. Further, the marking relay R250 prepares, at the contacts 254, a path, traced hereinafter, for applying ground potential to the control conductor C285 of the trunk line 280 and prepares, at the contacts 253, a point in a circuit, traced hereinafter for energizing the winding of the coin control relay R210. Upon operating, the control relay R220 interrupts, at the contacts 227, the previously traced path for applying ground potential to the distributor start conductor C293 in the trunk line 600, prepares, at the contacts 226, a point in a circuit, traced hereinafter, for energizing the winding of the control relay R270, completes, at the contacts 225, an alternative holding circuit for energizing the winding of the hold relay R260, interrupts, at the contacts 222 and 224, the previously traced circuit for energizing in series the windings of the line relay R240 and the coin control relay R255, and completes, at the contacts 221 and 223, a circuit for energizing the winding of the supervisory relay R230 by way of the loop circuit extending to the calling paystation T2. The circuit for energizing the winding of the supervisory relay R230 extends from ground by way of the lower winding of R230, the contacts 223,

the winding 295 of the repeater 201 and the contacts 273 to the line conductor C297 of the line 295; and from battery by way of the upper winding of R230, the contacts 221, the winding 203 of the repeater 201 and the contacts 271 to the line conductor C296 of the line 295; the line conductors C297 and C296 of the line 295 being connected together by way of the loop circuit extending to the telephone instrument at the paystation T2. The line relay R240 and the coin relay R255 then restore. Upon restoring, the line relay R240 interrupts, at the contacts 241, the previously mentioned circuit for energizing the winding of the control relay R235, thereby to cause the latter relay to restore.

When ground potential is removed from the distributor start conductor C293 in the trunk line 600 the previously traced circuit for energizing the winding of the trunk start relay R660 is interrupted in the event there are no calls in the group of prepay manual trunk circuits, including the prepay manual trunk circuit 200, waiting to be answered, thereby to cause the trunk start relay R665 to restore. Upon restoring, the trunk start relay R665 interrupts, at the contacts 668, the previously traced path for applying ground potential to the conductor C614 in the trunk line 610 and interrupts, at the contacts 667, the previously traced path for applying ground potential to the conductor C606, thereby to cause the trunk relay R1055 to restore in the event the other trunk start relays R655, R660 and R670 occupy their restored positions. Further, the trunk start relay R665 completes, at the contacts 666, the previously mentioned circuit for energizing the lower winding of the marking relay R620 in the event ground potential appears upon the conductor C604, ground potential appearing upon the conductor C604 in the event either the trunk relay R1055 or the toll relay R1060 occupies its operated position as previously explained. The operation of the remainder of the apparatus in the common start and level distributor unit 1000 incident to the restoration of the trunk start relay R665 is the same as that previously explained. More particularly, the marking relays R605 to R645, inclusive, are rendered operative to test for a group of trunk lines or a group of toll lines, including a line having a calling condition thereon, as previously explained.

At this time talking battery is supplied from the supervisory relay R230 to the telephone instrument at the paystation T2 and the trunk circuit at the first operator position 1400 is operatively connected by way of the finder switch 700 to the line conductors C281 and C282 of the trunk line 280, the line conductors C281 and C282 being connected together by way of the windings 202 and 204 of the repeater 201 and the condenser 206. Accordingly, at this time, a connection is established between the paystation T2 and the first operator position 1400 at the switchboard.

The operator at the first operator position 1400 then answers the call and communicates with the party at the paystation T2 in order to ascertain the destination to which the call is to be extended. The operator at the first operator position, after learning the destination of the call, operates the sending key set 463 at her position in the previously described manner, thereby to cause the toll selector switch 800 to operate and extend the call to its destination as previously explained.

After a connection has been established from the first operator position 1400 by way of the toll selector switch 800 to the called subscriber substation in the previously described manner the operator operates the coin collect key K2 to its left-hand or rear position, thereby to cause the apparatus at the paystation T2 to operate and collect the coin which has been inserted in the coin slot of the instrument thereat. When the coin collect key K2 is operated to its rear position the contacts 1415 thereof are actuated into engagement, thereby to complete an obvious circuit for energizing the winding of the rear split relay R1220 in order to cause the latter relay to operate. Also, at the contacts 1419 of the coin collect key K2, a circuit is completed for energizing the winding of the rear coin control relay R1240 in series with the winding of the coin control relay R210, this circuit extending from ground by way of the contacts 1419 of the coin collect key K2, C1462, the winding of R1240, the conductor C1286 in the cable 1270, the contacts 747 and 713, the wiper 704, the control conductor C284 of the trunk line 280, the winding of R210 and the contacts 253 to battery. When energized over the above-traced circuit the rear coin control relay R1240 and the coin control relay R210 operate. Upon operating, the rear coin control relay R1240 completes, at the contacts 1242, an obvious connection between the line conductors C1094' and C1095' of the trunk circuit at the first operator position, the line conductors C1094' and C1095' of the trunk circuit at the first operator position being connected to the line conductors C1283 and C1284 in the cable 1270 due to the operation of the rear split relay R1220. Finally, at the contacts 1421 of the coin collect key K2, a path is completed for projecting positive 110 volt current over the line conductors C281 and C282 of the trunk line 280, this path extending from the positive terminal of a grounded source of 110 volt current by way of the contacts 1421 of the coin collect key K2 and C1460 to the line conductor C1095', from the line conductor C1095' by way of the contacts 1242 to the line conductor C1094', and from the line conductors C1094' and C1095' to the line conductors C1283 and C1284 in the cable 1270. This path extends further from the line conductor C1283 by way of the contacts 755 and 712 and the wiper 703 to the line conductor C282 of the trunk line 280 and from the line conductor C1284 by way of the contacts 752 and 711 and the wiper 702 to the line conductor C281 of the trunk line 280.

Upon operating, the coin control relay R210 interrupts, at the contacts 214, a point in a circuit, traced hereinafter, for energizing the winding of the ring relay R215 and completes, at the contacts 213, a circuit for energizing the winding of the control relay R270, this circuit extending from ground by way of the contacts 213 and 226 and the winding of R270 to battery. Shortly after the above-traced circuit is completed the control relay R270 operates, this relay being of the slow-to-operate type. Also, upon operating, the coin control relay R210 completes, at the contacts 211 and 212, obvious connections between the line conductors C281 and C282 of the trunk line 280 and the by-pass conductors C291 and C292.

Upon operating, the control relay R270 completes, at the contacts 275, an obvious alternative holding circuit for energizing the winding of the hold relay R260, interrupts, at the contacts 276, a further point in the previously mentioned path for applying ground potential to the control con-

ductor C285 of the trunk line 280, and completes, at the contacts 272 and 274, obvious connections between the by-pass conductors C291 and C292 and the line conductors C296 and C297 of the line 295. Accordingly, at this time, the line conductors C281 and C282 of the trunk line 280 are connected to the line conductors C296 and C297 of the line 295, thereby to cause positive 110 volt current to be projected over the local finder switch 287, the line circuit 286 and the line conductors of the paystation line 290. When positive 110 volt current is projected over both of the line conductors of the paystation line 290 to the paystation T2 the apparatus at the paystation T2 operates to collect the coin deposited in the coin slot of the instrument thereat.

After operating the coin collect key K2 to its rear position, thereby to collect the coin at the paystation T2, the operator at the first operator position returns this key to its normal position. When the coin collect key K2 is returned to its normal position the previously mentioned circuit for energizing the winding of the rear split relay R1220 is interrupted, at the contacts 1415 thereof, and the previously traced circuit for energizing the winding of the rear coin control relay R1240 in series with the winding of the coin control relay R210 is interrupted, at the contacts 1419 thereof, thereby to cause the rear split relay R1220, the rear coin control relay R1240 and the coin control relay R210 to restore. Also, at the contacts 1421 of the coin collect key K2, the previously traced path for projecting positive 110 volt current over the line conductors of the paystation line 290 extending to the paystation T2 is interrupted. Upon restoring, the rear coin control relay R1240 interrupts, at the contacts 1242, the connection between the line conductors C1094' and C1095' of the trunk circuit at the first operator position; and, upon restoring, the rear split relay R1220 recompletes, at the contacts 1221 and 1223, the previously traced connection between the line conductors C1283 and C1284 in the cable 1270 and the line conductors C1182 and C1184 of the trunk circuit at the first operator position.

Upon restoring, the coin control relay R210 interrupts, at the contacts 213, the previously traced circuit for energizing the winding of the control relay R270, thereby to cause the latter relay to restore, and interrupts, at the contacts 211 and 212, the previously mentioned connection between the line conductors C281 and C282 of the trunk line 280 and the conductors C291 and C292. Upon restoring, the control relay R270 interrupts, at the contacts 272 and 274, the previously mentioned connection between the conductors C291 and C292 and the line conductors C296 and C297 of the line 295 and recompletes, at the contacts 271 and 273, the previously traced connection between the line conductors C296 and C297 of the line 295 and the windings 203 and 205 of the repeater 201. Accordingly, at this time, the connection between the paystation T2 and the first operator position 1400 is reestablished by way of the repeater 201 in the prepay manual trunk circuit 200.

It is noted that the party at the calling paystation T2 has switchhook supervision and may signal the operator at the first operator position 1400 by repeatedly operating the switchhook at the paystation T2. Each time the switchhook is operated the previously traced loop circuit for energizing the windings of the supervisory relay R230 is interrupted, thereby to cause the latter relay to restore. Conversely, each time the switchhook at the paystation T2 is released the previously traced circuit for energizing the windings of the supervisory relay R230 is recompleted, thereby to cause the latter relay to reoperate. Each time the supervisory relay R230 restores it completes, at the contacts 233, the previously mentioned path for applying ground potential to the control conductor C285 of the trunk line 280, this path extending from ground by way of the contacts 276, 254 and 233 to the control conductor C285. Also, each time the supervisory relay R230 operates it interrupts, at the contacts 233, the previously traced path for applying ground potential to the control conductor C285 of the trunk line 280. This application of ground potential to the control conductor C285 of the trunk line 280 causes the supervisory lamp L767 to be illuminated regardless of the position of the talk key K780 of the finder switch 700. In the event the talk key K780 of the finder switch 700 occupies its normal position this application of ground potential to the control conductor C285 of the trunk line 280 completes the previously traced direct circuit for illuminating the supervisory lamp L767. On the other hand, in the event the talk key K780 of the finder switch 700 is operated away from its normal position at this time, this application of ground potential to the control conductor C285 of the trunk line 280 completes the previously traced circuit for energizing the winding of the supervisory relay R1230, thereby to cause the latter relay to operate and complete, at the contacts 1231, the previously traced alternative circuit for illuminating the supervisory lamp L767. Accordingly, the intermittent operation of the switchhook at the calling paystation T2 by the party thereat causes the supervisory lamp L767 to flash, thereby to indicate to the operator at the first operator position 1400 that the party at the calling paystation T2 desires her attention.

The remainder of the supervision of the established connection including the calling paystation T2 is under the control of the operator at the first operator position 1400 and is accomplished in the manner previously described.

In the event the operator at the first operator position 1400 is unable to extend the call to her position from the calling paystation T2 to the desired destination the party at the calling paystation T2 is so informed and the coin which he has inserted in the coin slot of the instrument thereat is refunded to him. This is accomplished by the operator at the first operator position 1400 by operating the coin return key K1 to its left-hand or rear position. When the coin return key K1 is operated to its rear position an obvious circuit is completed, at the contacts 1409 thereof, for energizing the winding of the rear split relay R1220 and a circuit, substantially identical to that previously traced, is completed, at the contacts 1411 thereof, for energizing the winding of the rear coin control relay R1240 in series with the winding of the coin control relay R210. Finally, at the contacts 1413 of the coin return key K1, there is completed a path for applying negative 110 volt current to the conductor C1460, this path extending from the negative terminal of a grounded source of 110 volt current by way of the contacts 1413 of the coin return key K1 to the conductor C1460. The rear split relay R1220, the rear coin control relay R1240 and the coin control relay R210 again operate as previously explained. Also, upon operating, the coin control relay R210 completes,

at the contacts 213, the previously traced circuit for energizing the winding of the control relay R270, thereby to cause the latter relay to operate. The operated rear split relay R1220, rear coin control relay R1240, coin control relay R210 and control relay R270 complete a circuit, substantially identical to that previously traced, for projecting negative 110 volt current over the line conductors of the paystation line 200 to the paystation T2. When current is thus projected to the paystation T2 over both of the line conductors of the paystation line 290 apparatus thereat operates in order to cause the coin which the party at the paystation T2 has deposited in the coin slot of the instrument thereat to be refunded to him.

After operating the coin return key K1 to its rear position the operator at the first operator position 1400 returns this key to its normal position, thereby to interrupt, at the contacts 1409 thereof, the previously mentioned circuit for energizing the winding of the rear split relay R1220 and to interrupt, at the contacts 1411 thereof, the previously traced circuit for energizing the winding of the rear coin control relay R1240 in series with the winding of the coin control relay R210. Finally, at the contacts 1413 of the coin return key K1, the previously traced path for projecting negative 110 volt current over the line conductors of the paystation line 290 is interrupted. The rear split relay R1220, the rear coin control relay R1240, the coin control relay R210 and the control relay R270 then restore as previously explained, thereby to reestablish the connection between the paystation T2 and the first operator position 1400.

In the event the operator at the first operator position 1400 should desire to ring the party at the calling paystation T2 the ring key K5 is operated to its left-hand or rear position. When the ring key K5 is operated to its rear position the contacts 1401 thereof are actuated into engagement, thereby to complete an obvious circuit for energizing the winding of the rear split relay R1220, and the contacts 1403 thereof are actuated into engagement, thereby to complete a path for applying battery potential to the conductor C1461, this path extending from battery by way of the resistor 1432 and the contacts 1403 of the ring key K5 to the conductor C1461. The rear split relay R1220 then operates to complete, at the contacts 1222, a circuit for energizing the winding of the ring relay R215, this circuit extending from battery potential appearing upon the conductor C1461 by way of the contacts 1241, the line conductor C1094' of the trunk circuit at the first operator position, the contacts 1222, the line conductor C1283 in the cable 1270, the contacts 755 and 712, the wiper 703, the line conductor C282 of the trunk line 280, the winding 204 of the repeater 201, the winding of R215 and the contacts 214 to ground. When energized over the above-traced circuit the ring relay R215 operates to complete, at the contacts 218, an alternative circuit for energizing the winding of the control relay R270, this circuit extending from ground by way of the contacts 214, 218 and 226 and the winding of R270 to battery. When energized over the above-traced circuit the control relay R270 operates to interrupt, at the contacts 271 and 273, the previously traced connection between the line conductors C296 and C297 of the line 295 and the repeater 201 and to complete, at the contacts 272 and 274, the previously traced connection between the line conductors C296 and C297 of the line 295 and the by-pass conductors C291 and C292. Also, upon operating, the ring relay R215 completes, at the contacts 216 and 217, a connection between the line conductors of the line 293 and the by-pass conductors C291 and C292, the line 293 being connected to a source of ringing current. Accordingly, ringing current is projected from the line 293 by way of the previously traced connection including the local finder switch 287 over the paystation line 290 to the paystation T2.

After the paystation T2 has been rung the operator at the first operator position 1400 returns the ring key K5 to its normal position, thereby to interrupt, at the contacts 1401 and 1403 thereof, the previously traced circuits for energizing the winding of the rear split relay R1220 and the winding of the ring relay R215. The rear split relay R1220 and the ring relay R215 then restore. Upon restoring, the ring relay R215 interrupts, at the contacts 218, the previously traced circuit for energizing the winding of the control relay R270, thereby to cause the latter relay to restore. At this time the trunk circuit at the first operator position 1400 is again operatively connected by way of the repeater 201 and the local finder switch 287 to the paystation T2. The party at the paystation T2 may then answer the call and again converse with the operator at the first operator position 1400.

The release of the connection between the paystation T2 and the first operator position 1400 at the switchboard and the release of an established connection including the paystation T2 and routed by way of the finder-selector link illustrated are under the control of the operator at the first operator position and are accomplished in the previously described manner.

When the finder switch 700 is released ground potential therein is removed from the control conductor C283 of the trunk line 280. However, ground potential is not completely removed from the control conductor C283 of the trunk line 280 until the party at the calling paystation T2 replaces the receiver of the telephone instrument thereat upon its switchhook. When the party at the calling paystation T2 replaces the receiver of the telephone instrument thereat upon its switchhook the previously traced loop circuit for energizing the windings of the supervisory relay R230 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the supervisory relay R230 interrupts, at the contacts 231, the previously mentioned path for applying ground potential in the prepay manual trunk circuit 200 to the control conductor C283 of the trunk line 280. When ground potential is completely removed from the control conductor C283 of the trunk line 280 the marking relay R250 then restores to interrupt, at the contacts 252, the previously mentioned circuit for energizing the winding of the control relay R220. The control relay R220 then restores to interrupt, at the contacts 225, the previously traced circuit for energizing the winding of the hold relay R260. Shortly thereafter the hold relay R260 restores, this relay being of the slow-to-release type. Upon restoring, the hold relay R260 interrupts, at the contacts 262, the previously mentioned path for applying ground potential to the control conductor C298 of the line 295, thereby to cause the local finder switch 287 to be released. When the local finder switch 287 is released the line circuit 286 is operated, thereby to mark the paystation line 290 as idle to

the switches having access thereto. At this time the prepay manual trunk circuit 200 is completely released and is available for further use.

When the established connection between the paystation T2 and the first operator position 1400 at the switchboard is released, due to the release of the finder switch 700 of the finder-selector link illustrated, the prepay manual trunk circuit 200 is not completely released in the event a coin remains in the coin slot of the instrument at the paystation T2. In this event, when the finder switch 700 is released, the marking relay R250, the control relay R220 and the supervisory relay R230 restore as previously explained. At this time, upon restoring, the control relay R220 completes, at the contacts 222 and 224, the previously traced circuit for energizing the windings of the line relay R240 and the coin control relay R255, due to the presence of the coin in the coin slot of the instrument at the paystation T2. Accordingly, the line relay R240 and the coin control relay R255 immediately operate. More particularly, the coin control relay R255 operates to complete, at the contacts 256, an alternative holding circuit for energizing the winding of the hold relay R260 prior to restoration thereof incident to the release of the control relay R220 and the supervisory relay R230. When the control relay R220 restores and the line relay R240 reoperates the previously traced path for applying ground potential to the distributor start conductor C293 in the trunk line 600 extending to the common start and level distributor unit 1000 is recompleted. Hence, the common start and level distributor unit 1000 and the position distributor 1005 reoperate in order to cause the call on the prepay manual trunk circuit 200 to be routed to one of the operator positions at the switchboard to be answered. The apparatus at the selected operator position at the switchboard operates in the previously described manner; and when the operator thereat answers the call on the prepay manual trunk circuit 200 and finds no one at the paystation T2 she operates the coin collect key at her position, thereby to cause the coin deposited in the coin slot of the instrument at the paystation T2 to be collected in the manner previously described. The operator at the selected operator position at the switchboard then restores the coin collect key to its normal position and operates the release key, thereby to cause the prepay manual trunk circuit 200, the local finder switch 287, and the line circuit 286 to be released in the manner previously described. At this time the apparatus mentioned is completely released and available for further use as previously explained.

Extension of a call from the distant exchange B to the switchboard

A call which is to be extended from the distant exchange B to the central office A is routed by the operator at the toll operator position in the distant exchange B over one of the toll lines to the central office A and is answered at the switchboard. For example, in order to route a call from the distant exchange B to the central office A over the toll line 190, the operator at the toll operator position in the distant exchange B first seizes the toll line 190 and causes alternating ringing current to be projected thereover to the ring-down toll circuit 100 individually associated therewith. When the alternating ringing current is projected over the toll line 190 to the ring-down toll circuit 100 individually associated therewith the previously traced circuit for energizing the winding of the ring-up relay R135 is completed, thereby to cause the latter relay to operate. Upon operating, the ring-up relay R135 interrupts, at the contacts 136, the previously mentioned normally completed circuit for energizing the winding of the control relay R140. Shortly thereafter the control relay R140 restores to complete, at the contacts 141, the previously traced circuit for energizing the upper winding of the start relay R150, thereby to cause the latter relay to operate. Upon operating, the start relay R150 prepares, at the contacts 155, a point in a circuit, traced hereinafter, for applying ground potential by way of the lower winding of the start relay R150 to the control conductor C183 of the trunk line 180 extending to the main contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard. Further, the start relay R150 completes, at the contacts 154, a path for applying ground potential to the control conductor C171 of the trunk line 170 accessible to the toll switch train, this path extending from ground by way of the contacts 154 and 121 to the control conductor C171 of the trunk line 170. Also, the start relay R150 completes, at the contacts 152, a path for applying battery potential by way of the winding of the marking relay R160 to the control conductor C184 of the trunk line 180, this path extending from battery by way of the winding of R160 and the contacts 152 to the control conductor C184 of the trunk line 180. Further, the start relay R150 completes, at the contacts 151, a path for applying ground potential to the distributor start conductor C166 in the trunk line 600 extending to the common start and level distributor unit 1000, this path extending from ground by way of the contacts 151 and 161 to the distributor start conductor C166. Finally, the start relay R150 completes, at the contacts 155, a holding circuit for energizing the upper winding thereof, this circuit extending from ground by way of the contacts 155 and 165 and the upper winding of R150 to battery.

After the operator at the toll operator position in the distant exchange B causes alternating ringing current to be projected over the toll line 190 she causes the projection of ringing current thereover to be interrupted, thereby to cause the previously traced circuit for energizing the winding of the ring-up relay R135 to be interrupted. The ring-up relay R135 then restores to recomplete, at the contacts 136, the previously mentioned circuit for energizing the winding of the control relay R140. The control relay R140 then operates to interrupt, at the contacts 141, the previously traced original circuit for energizing the upper winding of the start relay R150.

The application of ground potential to the distributor start conductor C166 in the trunk line 600 completes an obvious circuit for energizing the winding of the toll start relay R690. The toll start relay R690 then operates to complete, at the contacts 692, an obvious path for applying ground potential to the conductor C605, thereby to complete an obvious circuit for energizing the winding of the toll relay R1060, whereupon the latter relay operates. Further, the toll start relay R690 interrupts, at the contacts 691, a point in a circuit, traced hereinafter, for energizing the lower winding of the marking relay R545 and prepares, at the contacts 693, a point in a path, traced hereinafter, for applying ground potential to the

conductor C619 in the cable 610 extending to the vertical control contact banks of the mechanisms of the finder switches of the finder-selector links associated with the operator positions at the switchboard. It is noted that the conductor C619 is terminated in the ninth level of the vertical control contact bank 709 of the mechanism 701 of the finder switch 700 due to the fact that the trunk line 180 extending to the ring-down toll circuit 100 is terminated in the ninth level of the main contact bank of the mechanism 701 of the finder switch 700.

Upon operating, the toll relay R1060 completes, at the contacts 1063, an obvious path for applying ground potential to the conductor C604, thereby to initiate operation of the marking relays R605 to R645, inclusive. Further, the toll relay R1060 prepares, at the contacts 1064, an obvious path for applying ground potential to the control conductor C1043 extending to the chief operator position and completes, at the contacts 1064, an obvious circuit for energizing the winding of the signal relay R1050. Shortly thereafter, the signal relay R1050 operates. Further, the toll relay R1060 completes, at the contacts 1064', an obvious path for applying ground potential to the conductor C1091 in the trunk line 1090, thereby to complete a multiple circuit for illuminating the toll lamps associated with the operator positions at the switchboard. For example, the application of ground potential to the conductor C1091 in the trunk line 1090 completes an obvious circuit for illuminating the toll lamp L1145 associated with the first operator position 1400 at the switchboard. The illumination of the toll lamp L1145 indicates to the operator at the first operator position 1400 that a toll call has been extended to the switchboard to be answered. Upon operating, the signal relay R1050 completes, at the contacts 1051, an obvious path for applying ground potential to the conductor C1093 in the trunk line 1090, thereby to complete a multiple circuit for energizing the audible signals associated with the operator positions at the switchboard. For example, the application of ground potential to the conductor C1093 in the trunk line 1090 completes the previously traced circuit for energizing the winding of the signal B1153 associated with the first operator position 1400, thereby to cause the signal B1153 to operate and produce an audible signal at the first operator position 1400. The operator at the first operator position 1400 may interrupt the previously traced circuit for energizing the winding of the signal B1153 by operating the manual switch S1155 as previously noted, thereby to arrest the operation of the signal B1153.

Also, upon operating, the toll relay R1060 completes, at the contacts 1062, an alternative circuit for applying ground potential by way of the timer start relay R1045 to the start conductor extending to the relay group at one of the operator positions at the switchboard. Assuming that the position relay R1020 in the position distributor 1005 is operated at this time a path is completed for applying ground potential by way of the winding of the timer start relay R1045 to the start conductor C1306 in the trunk line 1305 extending to the first operator position 1400 at the switchboard, this path extending from ground by way of the contacts 1067 and 1062, the winding of R1045, C1072 and the contacts 1024 to the start conductor C1306 in the trunk line 1305. As previously noted, the control relay R600 and one of the marking relays R605 to R645, inclusive, remain operated at this time. For example, the previously traced circuit for energizing the upper winding of the control relay R600 in series with the upper winding of the marking relay R605 may be completed at this time. Accordingly, the application of ground potential to the conductor C604 completes the previously traced circuit for energizing the lower winding of the marking relay R610, thereby to cause the latter relay to operate. Upon operating, the marking relay R610 causes the marking relay R615 to operate and the marking relay R605 to restore in the manner previously explained. Hence, at this time, the marking relays R610, R615, R620, R625, R630, R635 and R640 operate successively and the marking relays R605, R610, R615, R620, R625, R630 and R635 restore successively. At the conclusion of the operation of the marking relays mentioned the marking relay R640 remains in its operated position due to the fact that the previously mentioned circuit for energizing the lower winding of the marking relay R645 is interrupted due to the operated condition of the toll start relay R690. Upon operating, the marking relay R640 completes, at the contacts 642, a holding circuit for energizing the upper winding thereof in series with the upper winding of the control relay R600, this circuit extending from ground by way of the upper winding of R600, C603, the contacts 646 and 642 and the upper winding of R640 to battery. Also, the marking relay R640 prepares, at the contacts 643, a point in the previously mentioned circuit for energizing the lower winding of the marking relay R645 and completes, at the contacts 644, the previously mentioned path for applying ground potential to the conductor C619 in the trunk line 610, this path extending from ground by way of the contacts 644 and 693 to the conductor C619 in the trunk line 610.

Assuming that the operator at the first operator position 1400 is awaiting a call and has operated the talk key K730 of the finder switch 700 of the finder-selector link illustrated away from its normal position, thereby to condition the finder switch 700 to be operative to find a trunk line having a calling condition thereon, the application of ground potential to the start conductor C1306 in the trunk line 1305 extending to the first operator position 1400 completes the previously traced circuit for energizing the winding of the start relay R740 in the finder switch 700. When the start relay R740 is thus energized the finder switch 700 operates to find the trunk line 180 having a calling condition thereon as previously explained. As previously noted, the common start and level distributor unit 1000 has operated to mark by way of the conductor C619 in the trunk line 610 in the vertical control contact bank 709 of the mechanism 701 the ninth level wherein the trunk line 180 is terminated in the main contact bank of the mechanism 701. Also, the rotary position wherein the trunk line 180 is terminated in the main contact bank of the mechanism 701 is marked by the presence of battery potential appearing upon the control conductor C184 of the trunk line 180 as previously noted.

As previously noted, when the finder switch 700 operates to seize the trunk line 180 the electropolarized relay R710 therein operates to complete, at the contacts 717, a path for applying direct ground potential to the control conductor C184 of the trunk line 180, thereby to complete a circuit, substantially identical to that previously traced, for energizing the winding of the marking

relay R160 in order to cause the latter relay to operate.

Upon operating, the marking relay R160, interrupts, at the contacts 165, the previously traced holding circuit for energizing the upper winding of the start relay R150, thereby to cause the latter relay to restore. Further, the marking relay R160 completes, at the contacts 163, an obvious holding circuit for energizing the winding thereof by way of the control conductor C184 of the trunk line 180 and prepares, at the contacts 164, a point in the previously mentioned path for applying ground potential by way of the lower winding of the start relay R150 to the control conductor C183 of the trunk line 180. Also, the marking relay R160 completes, at the contacts 163, a path for applying ground potential to the control conductor C171 of the trunk line 170, this path extending from the grounded control conductor C184 of the trunk line 180 by way of the contacts 163, 153 and 121 to the control conductor C171 of the trunk line 170. This application of ground potential to the control conductor C171 of the trunk line 170 marks the trunk line 170 as busy to the switches having access thereto. Finally, the marking relay R160 interrupts, at the contacts 161, the previously traced path for applying ground potential to the distributor start conductor C166 in the trunk line 600 extending to the common start and level distributor unit 1000.

At this time, when ground potential is removed from the distributor start conductor C166 in the ring-down toll circuit 100, the toll start relay R690 restores unless multiple ground potential appears upon the distributor start conductor C166 due to the presence of calls on other of the ring-down toll circuits in the group of ring-down toll circuits, including the ring-down toll circuit 100, which have not been answered at the switchboard at this time. The subsequent operation of the common start and level distributor unit 1000 and the position distributor 1005 is the same as that previously explained.

The operator at the first operator position 1400 then answers the call and communicates with the operator at the toll operator position in the distant exchange B in order to ascertain the destination to which the call is to be extended. The operator at the first operator position, after learning the destination of the call, operates the sending key set 403 at her position in the previously described manner, thereby to cause the toll selector switch 800 to operate and extend the call to its destination in the manner previously explained.

Also, it is noted that the operator at the toll operator position in the distant exchange B may signal the operator at the first operator position 1400 when the talk key K780 of the finder switch 700 occupies either its normal position or its operated position. In order to signal the operator at the first operator position 1400 the operator at the toll operator position in the distant exchange B causes alternating ringing current to be projected over the toll line 190, thereby to cause the ring-down toll circuit 100 to operate and cause ground potential to be applied by way of the lower winding of the start relay R150 to the control conductor C183 of the trunk line 180 in the manner previously explained. This application of ground potential to the control conductor C183 of the trunk line 180 completes the previously traced direct circuit for illuminating the supervisory lamp L767 in the event the talk key K780 of the finder switch 700 occupies its normal position; while this application of ground potential to the control conductor C183 of the trunk line 180 completes the previously traced circuit for energizing the winding of the supervisory relay R1230 in the event the talk key K780 of the finder switch 700 occupies its operated position as previously explained. When the supervisory relay R1230 is thus energized it operates to complete, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L767. It is noted that when the previously traced direct circuit for illuminating the supervisory lamp L767 is completed a holding circuit is completed for energizing the lower winding of the start relay R150, which holding circuit is interrupted at the contacts 745 of the start relay R740 incident to the operation of the talk key K780 of the finder switch 700 away from its normal position. On the other hand, this holding circuit for energizing the lower winding of the start relay R150 is not completed in series with the winding of the supervisory relay R1230 due to the high series resistance of the winding of the supervisory relay R1230 when the start relay R740 occupies its restored position while the talk key K780 occupies its normal position.

The illumination of the supervisory lamp L767 indicates to the operator at the first operator position 1400 that the operator at the toll operator position in the distant exchange B wishes to communicate with her, whereupon the operator at the first operator position operates the talk key K780 of the finder switch 700 away from its normal position in the event that it is not already operated away from its normal position and communicates with the operator at the toll operator position in the distant exchange B.

The remainder of the supervision of the established connection including the ring-down toll circuit 100, the operation of the ring-down toll circuit 100 in order to cause the identity lamp L195 to be illuminated, and the operation of the ring-down toll circuit 100 in order to cause trouble tone voltage to be applied to the toll line 190 are accomplished in the previously described manner under the control of the operator at the first operator position 1400.

The release of the connection between the toll operator position in the distant exchange B and the first operator position 1400 at the switchboard and the release of an established connection including the toll operator position in the distant exchange B and routed by way of the finder-selector link illustrated are under the control of the operator at the first operator position 1400 and are accomplished in the previously described manner.

When the established connection is released incident to the release of the finder switch 700 ground potential is removed from the control conductor C184 of the trunk line 180, thereby to interrupt the previously traced holding circuit for energizing the winding of the marking relay R160. The marking relay R160 then restores to interrupt, at the contacts 163, a further point in the previously traced holding circuit for energizing the winding thereof, to interrupt, at the contacts 164, a further point in the previously traced path for applying ground potential by way of the lower winding of the start relay R150 to the control conductor C183 of the trunk line 180, and to prepare, at the contacts 165, a further point in the previously traced holding circuit for energizing the upper winding of the start relay R150. Further, the marking relay R160 interrupts, at

the contacts 163, a further point in the previously traced path for applying ground potential to the control conductor C171 of the trunk line 170, the previously traced path for applying battery potential by way of the winding of the marking relay R160 to the control conductor C171 of the trunk line 170 being completed at this time. At this time the ring-down toll circuit 100 is completely released and the trunk line 170 extending thereto is marked as idle to the switches having access thereto. The operator at the toll operator position in the distant exchange B then releases the connection between her position and the toll line 190 in a well known manner, thereby to render the toll line 190 available for further use.

Extension of a call from the C. A. X. network to the switchboard

A call which is to be extended from one of the subscriber substations in the exchanges C and D to the central office A is first extended to one of the dial back repeaters in the tandem exchange C and routed therefrom by way of one of the C. A. X. toll lines to the switchboard in the central office A to be answered. For example, when a call is initiated at the subscriber substation T3 in the tandem exchange C the line switch S901 individually associated with the subscriber line 900 extending to the calling subscriber substation T3 operates to find an idle one of the local first selector switches, such, for example, as the local first selector switch 914. When the line switch S901 seizes the line 902 extending to the local first selector switch 914 the local first selector switch 914 is rendered responsive to a first digit transmitted from the calling subscriber substation T3. The subscriber at the calling subscriber substation T3 then dials the digit 0, thereby to cause the local first selector switch 914 to operate and hunt for an idle one of the dial back repeaters, such, for example, as the dial back repeater 916. When the local first selector switch 914 seizes the line 933 extending to the dial back repeater 916 the line switch S914 individually associated with the dial back repeater 916 operates automatically to hunt for an idle one of the C. A. X. toll lines, such, for example, as the C. A. X. toll line 940. More particularly, the line switch S914 individually associated with the dial back repeater 916 seizes the line 915 extending to the line circuit 932 individually associated with the C. A. X. toll line 940, whereupon the dial back repeater 916 operates automatically to cause alternating ringing current to be projected by way of the line switch S914, the line 915 and the line circuit 932 over the line conductors C941 and C942 of the C. A. X. toll line 940 in parallel. The alternating ringing current projected over the line conductors C941 and C942 of the C. A. X. toll line 940 traverses the winding 339 of the repeater 335 to the simplex conductor C346 connected to the simplex of the winding 339. This alternating ringing current is conducted from the simplex conductor C346 by way of the contacts 332, 392 and 357, the condenser 322 and the winding of the ring-up relay R325 to ground. When the winding of the ring-up relay R325 is thus energized this relay operates to complete, at the contacts 326, an obvious circuit for energizing the winding of the start relay R350. Shortly thereafter, the start relay R350 operates, this relay being of the slow-to-operate type, in order to complete, at the contacts 352, a holding circuit for energizing the winding thereof. The holding circuit for energizing the winding of the start relay R350 extends from ground by way of the contacts 359 and 352 and the winding of R350 to battery. Also, the start relay R350 completes, at the contacts 353, a path for applying ground potential to the control conductor C341 of the trunk line 340, thereby to mark the trunk line 340 as busy to the switches having access thereto, this path extending from ground by way of the contacts 353 and 312 to the control conductor C341 of the trunk line 340. Further, the start relay R350 completes, at the contacts 355, a path for applying battery potential by way of the winding of the marking relay R360 to the control conductor C315 of the trunk line 310, this circuit extending from battery by way of the winding of R360 and the contacts 355 to the control conductor C315 of the trunk line 310. Also, the start relay R350 completes, at the contacts 351, an obvious alternative holding circuit for energizing the winding of the control relay R305 and completes, at the contacts 356, a path for applying ground potential to the distributor start conductor C366 in the trunk line 600 extending to the common start and level distributor unit 1000. The last-mentioned path extends from ground by way of the contacts 356 and 365 to the distributor start conductor C366.

At this point it is noted that battery potential in the line circuit 932 in the tandem exchange C is normally applied to the line conductors C941 and C942 of the C. A. X. toll line 940, thereby normally to complete a holding circuit for energizing the winding of the alarm relay R395, this circuit extending from ground by way of the winding of R395, the contacts 357, 392 and 332, the simplex conductor C346 and the winding 339 of the repeater 335 to the line conductors C941 and C942 of the C. A. X. toll line 940 having battery potential appearing thereon. The normally operated alarm relay R395 completes, at the contacts 396, an obvious circuit for energizing the winding of the control relay R305, thereby to retain the latter relay in its operated position. The operated control relay R305 retains interrupted, at the contacts 306, an obvious circuit for illuminating the supervisory lamp L323. In view of the foregoing, it will be understood that in the event the C. A. X. toll line 940 extending between the tandem exchange C and the central office A is interrupted or has a ground fault thereon the previously traced circuit for energizing the winding of the alarm relay R395 will be interrupted, whereupon the latter relay will restore. Upon restoring, the alarm relay R395 interrupts, at the contacts 396, the previously mentioned circuit for energizing the winding of the control relay R305. Shortly thereafter the control relay R305 restores, this relay being of the slow-to-release type, to complete, at the contacts 306, the previously mentioned circuit for illuminating the supervisory lamp L323. The illumination of the supervisory lamp L323 indicates to the attendant in the central office A that the C. A. X. toll line 940 extending between the central office A and the tandem exchange C is defective.

Continuing now with the operation of the reverting dial toll circuit 300 incident to the seizure of the C. A. X. toll line 940 by the dial back repeater 916, the application of ground potential to the distributor start conductor C366 in the trunk line 600 completes an obvious circuit for energizing the winding of the toll start relay R675, thereby to cause the latter relay to operate.

Upon operating, the toll start relay R675 completes, at the contacts 677, an obvious path for applying ground potential to the conductor C605, thereby to complete the previously traced circuit for energizing the winding of the toll relay R1060 in order to cause the latter relay to operate. Also, the toll start relay R675 interrupts, at the contacts 676, the previously traced circuit for energizing the lower winding of the marking relay R630 and prepares, at the contacts 678, a point in a path, traced hereinafter, for applying ground potential to the conductor C616 in the trunk line 610 extending to the vertical control contact banks of the mechanisms of the finder switches of the finder-selector links associated with the operator positions at the switchboard. More particularly, it is noted that the conductor C616 terminates in the sixth level of the vertical control contact bank 709 of the mechanism 701 of the finder switch 700, thereby to mark the sixth level wherein the trunk line 310 extending to the reverting dial toll circuit 300 is terminated in the main contact bank of the mechanism 701 of the finder switch 700.

The toll relay R1060 then operates to cause the marking relays R605 to R645, inclusive, to operate in the previously described manner. At the conclusion of the operation of the marking relays the marking relay R625 occupies its operated position, thereby to complete, at the contacts 629, the previously mentioned path for applying ground potential to the conductor C616 in the trunk line 610, this path extending from ground by way of the contacts 629 and 678 to the conductor C616 in the trunk line 610. Also, upon operating, the toll relay R1060 causes operation of the signal relay R1050 as previously explained. Assuming that the position relay R1020 is operated at this time, the toll relay R1060 completes, at the contacts 1062, the previously traced circuit for applying ground potential by way of the winding of the timer start relay R1045 to the start conductor C1306 in the trunk line 1305 extending to the first operator position 1400 at the switchboard. The operations of the signal relay R1050 and the timer start relay R1045 are effective to perform the functions previously noted. When ground potential is applied to the start conductor C1306 of the trunk line 1305 extending to the first operator position 1400 the previously traced circuit for energizing the winding of the start relay R740 in the finder switch 700 is completed, assuming that the talk key K780 of the finder switch 700 is operated away from its normal position. The finder switch 700 then operates to find the trunk line 310 extending to the reverting dial toll circuit 300 as previously explained.

As previously noted, the common start and level distributor unit 1000 marks, by way of the conductor C616 in the trunk line 610 and the vertical contral contact bank 709 of the mechanism 701 of the finder switch 700, the sixth level in the main contact bank of the mechanism 701 wherein the trunk line 310 is terminated. Also, the rotary position wherein the trunk line 310 is terminated in the main contact bank of the mechanism 701 is marked by the presence of battery potential appearing upon the control conductor C315 of the trunk line 310.

As previously noted, when the finder switch 700 operates to seize the trunk line 310, the electropolarized relay R710 therein operates to complete, at the contacts 717, an obvious path for applying direct ground potential to the control conductor C315 of the trunk line 310, thereby to complete a circuit, substantially identical to that previously traced, for energizing the winding of the marking relay R360. The marking relay R360 then operates to complete, at the contacts 362, an obvious holding circuit for energizing the winding thereof from the control conductor C315 of the trunk line 310 and prepares, at the contacts 363, a path, traced hereinafter, for applying ground potential to the control conductor C314 of the trunk line 310. Further, the marking relay R360 completes, at the contacts 361, an obvious circuit for energizing the winding of the control relay R355, thereby to cause the latter relay to operate. Finally, the marking relay R360 interrupts, at the contacts 365, the previously traced path for applying ground potential in the reverting dial toll circuit 300 to the distributor start conductor C366 in the trunk line 600. Upon operating, the control relay R355 interrupts, at the contacts 359, the previously traced holding circuit for energizing the winding of the start relay R350, thereby to cause the latter relay to restore, the ring-up relay R325 being restored at this time to interrupt, at the contacts 326, the previously traced original circuit for energizing the winding of the start relay R350. It is noted that the ringing current which is projected from the dial back repeater 916 over the C. A. X. toll line 940 to cause operation of the ring-up relay R325 is projected thereover only during a relatively short time interval. Upon restoring, the start relay R350 completes, at the contacts 354, a path for applying ground potential to the control conductor C341 of the trunk line 340, thereby to mark the trunk line 340 as busy to the switches having access thereto, this path extending from the grounded control conductor C315 of the trunk line 310 by way of the contacts 362, 354 and 312 to the control conductor C341 of the trunk line 340. Also, upon operating, the control relay R355 completes, at the contacts 356', an alternative circuit for energizing the winding of the alarm relay R395, this circuit extending from ground by way of the winding of R395, the contacts 356' and the resistor 328 to battery. Further, the control relay R355 interrupts, at the contacts 357, a point in the original circuit for energizing the winding of the alarm relay R395 by way of the simplex conductor C346 and completes, at the contacts 358, a circuit for energizing the winding of the supervisory relay R370. The circuit for energizing the winding of the supervisory relay R370 extends from ground by way of the winding of R370, the contacts 358, 392 and 332, the simplex conductor C346, the winding 339 of the repeater 335, the line conductors C941 and C942 of the C. A. X. toll line 940, the line circuit 932, the line 915 and the line switch S914 to battery in the dial back repeater 916. It is noted that a series resistance is included in the above-traced circuit in the dial back repeater 916 which prevents the winding of the supervisory relay R370 from being adequately energized by way of the above-traced circuit. Accordingly, the supervisory relay R370 does not operate at this time.

At this time a connection is established between the calling subscriber substation T3 in the tandem exchange C and the first operator position 1400 at the switchboard in the central office A; and the operator at the first operator position answers the call and communicates with the subscriber at the calling subscriber substation T3 in order to ascertain the destination to which

the call is to be extended. The operator at the first operator position, after learning the destination of the call, operates the sending key set 463 at her position in the previously described manner, thereby to cause the toll selector switch 800 to operate and extend the call to its destination as previously explained.

When ground potential in the reverting dial toll circuit 300 is removed from the distributor start conductor C366 in the trunk line 600 the toll start relay R675 restores in the event there are no other reverting dial toll circuits in the group of reverting dial toll circuits, including the reverting dial toll circuit 300, having calls thereon from the C. A. X. network which have not been answered at the switchboard. The subsequent operations of the common start and level distributor unit 1000 and the position distributor 1005 are the same as previously described.

In connection with the supervision of the established connection between the subscriber substation T3 in the tandem exchange C and the central office A it is noted that the subscriber at the calling subscriber substation T3 has switchhook supervision and, when he replaces the receiver of the telephone instrument at the calling subscriber substation T3 upon its switchhook, the supervisory lamp L767 is illuminated regardless of the position of the talk key K780 of the finder switch 700. More particularly, when the subscriber at the calling subscriber substation T3 replaces the receiver of the telephone instrument thereat upon its switchhook, the dial back repeater 916 is controlled by way of the previously traced circuit between the subscriber substation T3 and the dial back repeater 916 to cause the series resistance of the previously traced circuit for energizing the winding of the supervisory relay R370 to be reduced, whereby the winding of the supervisory relay R370 is effectively energized. The supervisory relay R370 then operates to complete, at the contacts 371, the previously mentioned path for applying ground potential to the control conductor C314 of the trunk line 310, this path extending from ground by way of the contacts 371, 363 and 346 to the control conductor C314 of the trunk line 310. This application of ground potential to the control conductor C314 of the trunk line 310 completes the previously traced direct circuit for illuminating the supervisory lamp L767 in the event the talk key K780 of the finder switch 700 occupies its normal position. On the other hand, this application of ground potential to the control conductor C314 of the trunk line 300 completes the previously traced circuit for energizing the winding of the supervisory relay R1230 in the relay group 1200 in the event the start relay R740 is restored incident to the operation of the talk key K780 of the finder switch 700 away from its normal position. The supervisory relay R1230 then operates to complete, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L767.

When the subscriber at the calling subscriber substation T3 in the tandem exchange C removes the receiver of the telephone instrument thereat from its switchhook the dial back repeater 916 is controlled over the previously traced circuit to increase the series resistance of the circuit for energizing the winding of the supervisory relay R370, thereby to cause the latter relay to restore. Upon restoring, the supervisory relay R370 interrupts, at the contacts 371, the previously traced path for applying ground potential to the control conductor C314 of the trunk line 310, thereby to cause the supervisory lamp L767 to be extinguished. Accordingly, the subscriber at the calling subscriber substation T3 in the tandem exchange C may cause the supervisory lamp L767 to flash by repeatedly operating the switchhook at the subscriber substation T3.

In the event the C. A. X. toll line 940 or the reverting dial toll circuit 300 associated therewith is found to be defective the operator at the first operator position 1400 may render the C. A. X. toll line 940 and the reverting dial toll circuit 300 busy by operating the order and start key K7 to its order position and by operating the check key K11 to its rear position. When the check key K11 is operated to its rear position the previously traced circuit for energizing the winding of the rear split relay R1220 is completed at the contacts 1423 thereof; the previously traced path for applying battery potential to the conductor C1460 is completed at the contacts 1427 thereof; and the previously traced path for applying battery potential to the conductor C1461 is completed at the contacts 1425 thereof. The rear split relay R1220 then operates to complete, at the contacts 1222 and 1224, paths for applying battery potential to the line conductors C313 and C312 of the trunk line 310, assuming that the talk key K780 of the finder switch 700 is operated away from its normal position. The path for applying battery potential to the line conductor C313 of the trunk line 310 extends from battery potential on the conductor C1461 by way of the contacts 1241, C1094', the contacts 1222, the line conductor C1283 in the cable 1270, the contacts 755 and 712 and the wiper 703 to the line conductor C313; and the path for applying battery potential to the line conductor C312 of the trunk line 310 extends from battery potential on the conductor C1460 by way of the contacts 1224, the line conductor C1284 in the cable 1270, the contacts 752 and 711 and the wiper 702 to the line conductor C312. The application of battery potential to the line conductor C312 completes a circuit for energizing the winding of the trouble relay R315, this circuit extending from battery potential appearing upon the line conductor C312 of the trunk line 310 by way of the contacts 342, C342', the resistor 318 and the winding of R315 to ground. The trouble relay R315 then operates to complete, at the contacts 316, a circuit for energizing the lower winding of the trouble relay R310, this circuit extending from battery potential appearing upon the line conductor C313 of the trunk line 310 by way of the contacts 344, C343', the resistor 319, the contacts 316 and the lower winding of R310 to ground. When energized over the above-traced circuit the trouble relay R310 operates to complete, at the contacts 311, an obvious path for applying ground potential to the control conductor C341 of the trunk line 340, thereby to mark the trunk line 340 as busy to the switches having access thereto. Also, the trouble relay R310 completes, at the contacts 313 and 314, a circuit for energizing the windings 336 and 337 of the repeater 335 by way of the trouble tone line 350, this circuit extending from a source of trouble tone by way of the line conductor C351 of the line 350, contacts 313, the winding 336, the condenser 338, the winding 337, the contacts 314 and the line conductor C352 of the line 350 to the source of trouble tone. The trouble tone current traversing the windings 336 and 337 of the repeater 335 induces trouble tone voltage in the winding 339 of the repeater 335, thereby to cause a trouble tone voltage to be

impressed between the line conductors C941 and C942 of the C. A. X. toll line 940. Also, it is noted that the trouble relay R310 may be operated by way of the conductor C310 extending to the chief operator position, thereby rendering it possible for the operator at the chief operator position to render busy the reverting dial toll circuit 300 and the C. A. X. toll line 940. At this time, in the event the C. A. X. toll line 940 is seized by one of the dial back repeaters in the tandem exchange C, the receiver of the telephone instrument at the calling subscriber substation will produce trouble tone, thereby to indicate to the subscriber at the calling subscriber substation that the C. A. X. toll line which has been seized is out of order and that he should release the connection and initiate another call.

The remainder of the supervision of the established connection including the C. A. X. toll line 940 is under the control of the operator at the first operator position 1400 and is accomplished in the manner previously explained. Also, the release of the connection between the calling subscriber substation T3 in the tandem exchange C and the switchboard is under the control of the operator at the first operator position 1400 and is accomplished in the previously described manner.

When the established connection between the calling subscriber substation T3 in the tandem exchange C and the switchboard is released, due to the release of the finder switch 700, the previously traced path for applying ground potential to the control conductor C315 of the trunk line 310 is interrupted, thereby to interrupt the previously traced holding circuit for energizing the winding of the marking relay R360. The marking relay R360 then restores to interrupt, at the contacts 361, the previously mentioned circuit for energizing the winding of the control relay R355, thereby to cause the latter relay to restore. Upon restoring, the marking relay R360 interrupts, at the contacts 362, a further point in the previously traced path for applying ground potential to the control conductor C341 of the trunk line 340, thereby to cause the previously traced path for applying battery potential by way of the winding of the marking relay R360 to the control conductor C341 of the trunk line 340 to be completed in order to mark the trunk line 340 as idle to the switches having access thereto. At this time the reverting dial toll circuit 300 and the C. A. X. toll line 940 are completely released and available for further use, assuming that the subscriber at the calling subscriber substation T3 in the tandem exchange C has replaced the receiver of the telephone instrument thereat upon its switchboard. When the subscriber at the calling subscriber substation T3 replaces the receiver of the telephone instrument thereat upon its switchhook the local first selector switch 914 is released and rendered available for further use. When the local first selector switch 914 is released the dial back repeater 916 is released and is rendered available for further use. At this time all of the apparatus in the tandem exchange C utilized in the established connection between the subscriber substation T3 in the tandem exchange C and the first operator position 1400 at the switchboard in the central office A is released.

In order to extend a call from one of the subscriber substations in the exchange D to the central office A the call is first initiated at the calling subscriber substation in the exchange D and then routed by the switch train therein over one of the trunk lines, such, for example, as the trunk line 920, to the tandem exchange C. When a call is routed to the trunk line 920 the trunk circuit 921 individually associated therewith operates to cause the individually associated line switch S918 to operate and seize an idle one of the dial back repeaters, such, for example, as the dial back repeater 916 in the tandem exchange C. More particularly, the line switch S918 seizes the line 917 extending to the dial back repeater 916, whereupon the line switch S914 individually associated with the dial back repeater 916 operates to seize an idle one of the C. A. X. toll lines extending between the tandem exchange C and the central office A in the manner previously described. The operation of the reverting dial toll circuit individually associated with the C. A. X. toll line seized and the operation of the apparatus in the central office A in order to cause the call to be routed to one of the operator positions at the switchboard are the same as previously explained. Furthermore, the supervision and the release of the established connection between the exchange D in the C. A. X. network and the central office A are the same as previously described.

Common start and distributor unit-line group preference control

From the foregoing description of the operation of the common start and level distributor unit 1000 incident to the extension of the various types of trunk and toll calls to the switchboard in the central office A, it will be readily understood that the common start and level distributor unit 1000 normally operates to mark, one at a time and in a predetermined order, the conductors C612 to C619, inclusive, included in the trunk line 610 extending to the vertical control contact banks of the mechanisms of the finder switches of the finder-selector links associated with the operator positions at the switchboard. More particularly, the conductors C612 to C619, inclusive, in the trunk line 610 are normally marked sequentially under the joint control of the trunk start relays R665 to R670, inclusive, the toll start relays R675 to R695, inclusive, and the marking relays R605 to R645, inclusive, whereby all of the calls on lines in a predetermined group are seized by the finder switches of the finder-selector links before any of the calls on the lines in the succeeding group are seized by the finder switches of the finder-selector links. This normal operation of the common start and level distributor unit 1000 is effected due to the fact that a given one of the marking relays is prevented from operating while the preceding marking relay and the corresponding start relay are operated, the given marking relay being operated incident to the restoration of the previously mentioned start relay in the event another of the start relays is operated at this time, as previously explained. Accordingly, the calls on the lines in the various groups of toll lines are routed by the common start and level distributor unit 1000 to the operator positions at the switchboard to be answered in a predetermined sequence, thereby to prevent the calls on the lines in the groups terminated by the contact sets in the lower levels of the main contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard from being answered at the operator positions at the switchboard in

preference to the calls on the lines in the groups terminated by the contact sets in the upper levels of the main contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard.

However, the operation of the common start and level distributor unit 1000 may be controlled in order to cause the calls on the lines in the groups terminated by the contact sets in the lower levels of the main contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard to be answered at the operator positions at the switchboard in preference to the calls on the lines in the groups terminated by the contact sets in the upper levels of the main contact banks of the finder switches of the finder-selector links associated with the operator positions at the switchboard. This may be accomplished by operating the control key K1001 away from its normal position, thereby to complete, at the contacts 1002 thereof, an obvious path for applying ground potential to the conductor C608, and to complete, at the contacts 1003 thereof, an obvious circuit for energizing the winding of the control relay R650. The control relay R650 then operates to prepare, at the contacts 651 to 654, inclusive, and at the contacts 651' to 654', inclusive, obvious paths for applying ground potential to the conductors C616 to C619, inclusive, and the conductors C612 to C615, inclusive. At this time, when the control key K1001 is operated away from its normal position, operation of any one of the trunk start relays R655 to R670, inclusive, or operation of any one of the toll start relays R675 to R695, inclusive, is effective to complete the previously mentioned paths for applying ground potential to the respective and corresponding conductors C612 to C619, inclusive, in the trunk line 610. Accordingly, by way of example, it is noted that the operation of the trunk start relay R655 is effective to mark the conductor C612 in the trunk line 610 in spite of the fact that the conductor C619 in the trunk line 610 might have been previously marked due to the previous operation of the toll start relay R695. Hence, the operating finder switch of one of the finder-selector links associated with one of the operator positions will seize the calling C. L. R. line in the group of C. L. R. lines in preference to the calling toll line in the group of toll lines, in spite of the fact that the call on the tool line was initiated prior to the initiation of the call on the C. L. R. line. In other words, when the control key K1001 is operated away from its normal position the finder switches of the finder-selector links associated with the operator positions at the switchboard operate to seize calling lines in the various groups of lines in accordance with the levels of the contact sets in the main contact banks of the finder switches terminating the groups of lines, and without regard to the order in which the calls on the lines in the groups of lines were initiated.

In order to reestablish normal operation of the common start and level distributor unit 1000, it is only necessary to return the control key K1001 to its normal position, thereby to interrupt, at the contacts 1002 thereof, the previously mentioned path for applying ground potential to the conductor C608, and to interrupt, at the contacts 1003 thereof, the previously mentioned circuit for energizing the winding of the control relay R650. The control relay R650 then restores to interrupt, at the contacts 651 to 654, inclusive, and at the contacts 651' to 654', inclusive, further points in the previously mentioned paths for applying ground potential to the conductors C612 to C619, inclusive, in the trunk line 610.

Conversion of an operator position at the switchboard from a universal position to a toll position

It is noted that while both the first and the second operator positions at the switchboard in the central office A are normally universal positions, in that both trunk calls and toll calls are normally answered thereat, each of these positions may be converted to a toll position, thereby restricting the position to the answering of toll calls incoming to the central office A from the distant exchange B and from the C. A. X. network. For example, the first operator position 1400 at the switchboard in the central office A may be converted from a universal position to a toll position by operating the toll answer key K10 away from its normal position. When the toll answer key K10 is operated away from its normal position, a point in the previously traced circuit for energizing the winding of the distributor start relay R1310 is interrupted at the contacts 1434 thereof; and a circuit, traced hereinafter, is prepared, at the contacts 1435 thereof, for energizing the winding of the distributor start relay R1310 in the relay group 1200 in series with the winding of the toll position relay R1030 in the common start and level distributor unit 1000. Also, at the contacts 1433 of the toll answer key K10, an obvious path is completed for applying battery potential to the conductor C1095 in the trunk line 1090, thereby to complete an obvious circuit for energizing the winding of the toll answer relay R1065. The toll answer relay R1065 then operates to interrupt, at the contacts 1067, a point in the previously traced circuit, which is normally completed at the contacts 1062 incident to the operation of the toll relay R1060, for energizing the winding of the timer start relay R1045 in series with the winding of the start relay in the finder switch of one of the finder-selector links associated with one of the operator positions at the switchboard. Accordingly, at this time, the operation of the toll relay R1060 is not effective to complete, at the contacts 1062, the previously traced circuit for energizing the winding of the timer start relay R1045 in series with the winding of the start relay in the finder switch of a selected one of the finder-selector links associated with one of the operator positions at the switchboard. However, the operation of the trunk relay R1055 is effective to complete, at the contacts 1056, the previously traced circuit for energizing the winding of the timer start relay R1045 in series with the winding of the start relay in the finder switch of a selected one of the finder-selector links at one of the operator positions as previously explained.

Also, upon operating, the toll answer relay R1065 prepares, at the contacts 1066, a further point in the previously mentioned circuit for energizing the winding of the toll position relay R1030 in series with the winding of the distributor start relay R1310 in the relay group 1200 associated with the first operator position 1400 at the switchboard. Accordingly, at this time, the distributor start relay R1310 in the relay group 1200 associated with the first operator position 1400 at the switchboard remains in its restored position, thereby to retain completed, at the contacts 1312, the previously traced path for applying ground

potential to the guard conductor C1307 in the trunk line 1305 extending between the first operator position 1400 and the position distributor 1005. Accordingly, the position relay R1020 in the position distributor 1005 will not remain in its operated position at this time, thereby to select the first operator position 1400 to have a call routed thereto, due to the presence of ground potential upon the guard conductor C1307 in the trunk line 1305. Accordingly, trunk calls incoming to the switchboard at this time must be routed by the position distributor 1005 to the second and third operator positions at the switchboard.

However, when a call is extended from the distant exchange B or from the C. A. X. network to the switchboard in the central office A, one of the toll start relays R675 to R695, inclusive, operates, thereby to cause the toll relay R1060 to operate in the previously described manner. Upon operating, the toll relay R1060 completes, at the contacts 1063, the previously traced path for applying ground potential to the conductor C604, thereby to initiate operation of the marking relays R605 to R645, inclusive, in the manner previously described, and completes, at the contacts 1064, the previously traced circuit for energizing the winding of the signal relay R1050 in order to cause operation of this relay. Further, the toll relay R1060 and the signal relay R1050 complete, at the contacts 1064' and 1051, respectively, the previously traced circuits for illuminating the toll lamp L1145 and for operating the audible signal B1153 at the first operator position 1400 as previously explained. Finally, the toll relay R1060 completes, at the contacts 1061, the previously mentioned circuit for energizing the winding of the toll position relay in the common start and level distributor unit 1000 in series with the winding of the distributor start relay R1310 in the relay group 1200 associated with the first operator position. This circuit extends from ground by way of the contacts 1101, C1189, the contacts 1137, C1191, the contacts 1263 and 1255, C1391, the contacts 1321, the winding of R1310, C1471, the contacts 1437 of the delay call key K12, the contacts 1435 of the toll answer key K10, the conductor C1096 in the trunk line 1090, the contacts 1036, the winding of R1030, the contacts 1061 and 1066 and the resistor 1070 to battery. When energized over the above-traced circuit the toll position relay R1030 and the distributor start relay R1310 operate. Upon operating, the toll position relay R1030 interrupts, at the contacts 1031, a point in a circuit, substantially identical to that previously traced, for energizing the winding of the toll position relay R1035 in the event the toll answer key at the second operator position at the switchboard is operated away from its normal position at this time. It is noted that the toll position relay R1030 is relatively fast to operate with respect to the toll position relay R1035, the latter relay being of the slow-to-operate type. Also, upon operating, the toll position relay R1030 interrupts, at the contacts 1032, a point in the previously traced circuit for energizing the winding of the position busy relay R1040 in series with the winding of either the position relay R1010 or R1015 in the position distributor 1005, thereby to cause the position busy relay R1040 to restore shortly thereafter and the operated one of the position relays R1010 or R1015 to restore immediately. Upon restoring, the position busy relay R1040 completes, at the contacts 1042, the previously traced path for applying ground potential to the conductor C1043 extending to the chief operator position, thereby to cause the signal at the chief operator position to operate. The operation of the signal at the chief operator position indicates to the operator thereat that all of the operator positions at the switchboard in the central office A are busy at this time.

Further, the toll position relay R1030 completes, at the contacts 1033, an obvious circuit for energizing the winding of the control relay R650, thereby to cause the latter relay to operate and prepare, at the contacts 651, 652, 653 and 654, paths for applying ground potential to the respective conductors C619, C618, C617 and C616 in the trunk line 610, one or more of these paths being completed at the contacts 678, 683, 688 or 693, depending upon the operated condition of the corresponding toll start relay R675, R680, R685 or R690, respectively. In the event a number of the toll start relays are operated, a number of the previously mentioned paths are completed, thereby to cause ground potential to be applied by way of the conductors mentioned in the trunk line 610 to the various contacts in the vertical control contact banks of the mechanisms of the finder switches of the finder-selector links associated with the first operator position 1400 at the switchboard wherein trunk lines are terminated in the main contact banks of the mechanisms of the finder switches of the finder-selector links associated with the first operator position 1400 at the switchboard having calls thereon, the trunk lines mentioned having either toll calls thereon, initiated at the distant exchange B, or C. A. X. toll calls thereon, initiated in the C. A. X. network.

Also, upon operating, the toll position relay R1030 completes, at the contacts 1034, an obvious path for applying ground potential to the emergency start conductor C1097 in the trunk line 1090, thereby to complete an alternative circuit for energizing the winding of the start relay in the finder switch of one of the finder-selector links associated with the first operator position 1400. Assuming that the talk key K780 of the finder switch 700 is operated away from its normal position at this time, the application of ground potential to the emergency start conductor C1097 in the trunk line 1090 completes an alternative circuit for energizing the winding of the start relay R740 in the finder switch 700, this circuit extending from the grounded emergency start conductor C1097 in the trunk line 1090 by way of C1472, the contacts 1261 and 1251, the start conductor C1287 in the cable 1270, the contacts 751' and the winding of R740 to battery. When energized over the above-traced circuit the start relay R740 in the finder switch 700 operates, thereby to cause the finder switch 700 to operate and seize the first trunk line having a call from the distant exchange B or from the C. A. X. network thereon terminating in the level of the main contact bank of the mechanism 701 of the finder switch 700 corresponding to the first marked level in the vertical control contact bank 709 of the mechanism 701, the first marked level in the vertical control contact bank 709 of the mechanism 701 depending upon which one of the conductors C616, C617, C618 or C619 in the trunk line 610 has ground potential thereon as previously explained. At this point it is noted that the tenth contact in the vertical control contact bank 709 of the mechanism 701 of the finder switch 700 has direct ground potential connected thereto, corresponding to the tenth level in the main contact bank

of the mechanism 701. Accordingly, in the event the wiper set of the mechanism 701 of the finder switch 700 is operated ten steps in the vertical direction away from its normal position a circuit is directly completed for energizing the lower winding of the transfer relay R720 in the manner previously explained.

Upon operating, the distributor start relay R1310 interrupts, at the contacts 1312, the previously traced path for applying ground potential to the guard conductor C1307 in the trunk line 1305 and completes, at the contacts 1313, the previously traced path for applying ground potential to the distributor start conductor C1094 in the trunk line 1090. However, this application of ground potential to the distributor start conductor C1094 in the trunk line 1090 and the removal of ground potential from the guard conductor C1307 in the trunk line 1305 are without effect at this time due to the operated position of the toll position relay R1030.

When the finder switch 700 operates to extend the toll call to the first operator position 1400 the answer pilot relay R1250 operates in the manner previously explained, thereby to interrupt, at the contacts 1255, the previously traced circuit for energizing the winding of the distributor start relay R1310 in the relay group 1200 in series with the winding of the toll position relay R1030 in the common start and level distributor unit 1000 in order to cause these relays to restore. Upon restoring, the distributor start relay R1310 interrupts, at the contacts 1313, the previously traced path for applying ground potential to the distributor start conductor C1094 in the trunk line 1090 and completes, at the contacts 1312, the previously traced path for applying ground potential to the guard conductor C1307 in the trunk line 1305. Upon restoring, the toll position relay R1030 prepares, at the contacts 1031, the previously mentioned circuit for energizing the winding of the toll position relay R1035 in the common start and level distributor unit 1000 in series with the winding of the distributor start relay in the relay group associated with the second operator position, the last-mentioned circuit being completed in the event the toll answer key at the second operator position is operated away from its normal position and the toll relay R1060 remains in its operated position due to the presence of other toll calls to be answered at the switchboard. Accordingly, in the last-mentioned event, the toll position relay R1035 operates to interrupt, at the contacts 1036, a further point in the previously traced circuit for energizing the winding of the toll position relay R1030, to interrupt, at the contacts 1037, a further point in the previously traced circuit for energizing the winding of the position busy relay R1040 in series with the winding of one of the position relays in the position distributor 1005, to complete, at the contacts 1038, an alternative path for applying ground potential to the conductor C607 in order to complete an alternative circuit for energizing the winding of the control relay R650, and to complete, at the contacts 1039, an obvious path for applying ground potential to the emergency start conductor C1097' extending to the second operator position at the switchboard.

Assuming that the toll answer key at the second operator position at the switchboard is not operated away from its normal position, when the toll position relay R1030 restores the previously mentioned circuit for energizing the winding of the toll position relay R1035 is not completed at the contacts 1031 incident to the restoration of the toll position relay R1030. Also, upon restoring, the toll position relay R1030 interrupts, at the contacts 1033, the previously traced path for applying ground potential to the conductor C607, thereby to interrupt the previously traced circuit for energizing the winding of the control relay R650 in order to cause the latter relay to restore. Finally, the position relay R1030 recompletes, at the contacts 1034', the previously traced path for applying ground potential to the conductor C608 and completes, at the contacts 1032, the previously traced circuit for energizing the lower winding of the position relay R1020, in the event that ground potential appears upon the distributor start conductor C1094, ground potential being present upon the distributor start conductor C1094 in the event the distributor start relay in the relay group associated with either the second or third operator positions at the switchboard is operated at this time. The position relay R1020 then operates to complete, at the contacts 1023, the previously traced circuit for energizing the lower winding of the position relay R1015, ground potential being present upon the guard conductor C1307 in the trunk line 1305 at this time. The position relays R1020, R1015 and R1010 continue to operate in the manner previously described until either the position relay R1015 or the position relay R1010 is operated, corresponding to the second or the third operator position which is in readiness to receive an incoming call to be answered, as previously explained. Accordingly, at this time, incoming trunk calls to the switchboard may be answered at the second and third operator positions at the switchboard in spite of the fact that incoming toll calls to the switchboard may be waiting to be answered. However, after the operator at the first operator position 1400 extends the toll call answered thereat and the relay group 1200 associated therewith is released, the distributor start relay R1310 in the relay group 1200 and the toll position relay R1030 in the common start and level distributor unit 1000 reoperate in series circuit relationship, in the manner previously explained, in the event the toll relay R1060 is operated at this time due to the operated condition of one of the toll start relays R675 to R695, inclusive, depending upon the presence of an incoming toll call to the switchboard waiting to be answered. Upon operating, the toll position relay R1030 prevents further operation of the position distributor 1005 in the manner previously explained.

Assuming that there are no incoming toll calls to the switchboard to be answered at this time, the toll start relays R675 to R695, inclusive, restore, thereby to cause the toll relay R1060 to restore. The position distributor 1005 then operates, in the previously described manner, thereby to cause the position relays R1015 and R1010 to operate successively in order to cause trunk calls to be routed to the second and third operator positions to be answered. In other words, the operation of the toll answer key K10 at the first operator position 1400 is effective to cause incoming toll calls to the switchboard to be routed to this position to be answered in preference to the other operator positions at the switchboard; while the position distributor 1005 remains effective to route incoming trunk calls to the switchboard to the second and third operator positions to be answered in the event there

are no incoming toll calls to the switchboard waiting to be answered at the time.

In order to reconvert the first operator position 1400 to a universal position so that both incoming toll and trunk calls to the switchboard may be answered thereat in the order established by the common start and level distributor unit 1000, it is only necessary to restore the toll answer key K10 to its normal position. When the toll answer key K10 is restored to its normal position the previously traced circuit for energizing the winding of the toll answer relay R1065 is interrupted at the contacts 1433 thereof, thereby to cause the toll answer relay R1065 to restore in the event the toll answer key at the second operator position at the switchboard is not operated away from its normal position at this time. Also, when the toll answer key K10 is operated back to its normal position, a further point in the previously traced circuit for energizing the winding of the toll position relay R1030 in series with the winding of the distributor start relay R1310 is interrupted at the contacts 1435 thereof. Finally, at the contacts 1434 of the toll answer key K10, the previously traced original circuit for energizing the winding of the distributor start relay R1310 is prepared. Upon restoring, the toll answer relay R1065 interrupts, at the contacts 1066, a further point in the previously traced circuit for energizing the winding of the toll position relay R1030 in series with the winding of the distributor start relay R1310 and prepares, at the contacts 1067, the previously traced circuit for energizing the winding of the timer start relay R1045, which circuit may then be completed incident to the operation of the toll relay R1060.

Also, it is noted that the operator at any one of the operator positions at the switchboard may initiate operation of the finder switch of one of the finder-selector links associated with her position without regard to the operation of the position distributor 1005, thereby to cause the finder switch to operate and hunt for a trunk line having either a trunk call or a toll call thereon waiting to be answered. For example, the operator at the first operator position 1400 may complete a circuit for energizing the winding of the start relay R740 in the finder switch 700 without regard to the operation of the position distributor 1005, and even though the toll answer key K10 thereat is operated away from its normal position, merely by operating the order and start key K7 to its right-hand or emergency start position, assuming that the talk key K780 of the finder switch 700 is operated away from its normal position. The circuit for energizing the winding of the start relay R740 in the finder switch 700 extends from ground by way of the contacts 1447 of the order and start key K7, C1472, the contacts 1261 and 1251, the start conductor C1287 in the cable 1270, the contacts 751' and the winding of R740 to battery. When energized over the above-traced circuit the start relay R740 operates, thereby to cause the finder switch 700 to operate in the previously described manner. Upon operating, the finder switch 700 seizes the first trunk line in the main contact bank of the mechanism 701 corresponding to the first marked level in the vertical control contact bank 709 of the mechanism 701 as determined by the particular operated one of the marking relays R605 to R645, inclusive, and the operated one of the trunk start relays R655 to R670, inclusive, or the operated one of the toll start relays R675 to R695, inclusive. In other words, at this time the finder switch 700 operates to find a trunk line having either an incoming trunk call or an incoming toll call thereon waiting to be answered, depending upon the first marked level in the vertical control contact bank 709 of the mechanism 701.

When the finder switch 700 finds a trunk line having a calling condition thereon, the answer pilot relay R1250 in the relay group 1200 operates as previously explained, thereby to complete, at the contacts 1252, the previously traced holding circuit for energizing the winding of the start relay R740 in the finder switch 700. Accordingly, it is only necessary for the operator at the first operator position 1400 to operate momentarily the order and start key K7 to its emergency start position in order to cause the finder switch 700 to operate in the manner described above. After the order and start key K7 has operated to its emergency start position it may be returned to its normal position without causing the finder switch 700 to be released. The release of the established connection including the finder-selector link illustrated is the same as that previously explained.

Furthermore, it is noted that in the event the position relay R1020 occupies its operated position, when the order and start key K7 at the first operator position 1400 is operated to its emergency start position in order to cause the finder switch 700 to operate in the manner previously explained, the previously traced circuit for energizing the lower winding of the position relay R1015 is completed incident to the restoration of the distributor start relay R1310, the distributor start relay R1310 being restored when the answer pilot relay R1250 is operated incident to the operation of the finder switch 700 to find the trunk line having the calling condition thereon. Accordingly, the position relay R1015 operates to cause the position relay R1020 to restore in the manner previously explained. This arrangement prevents the position distributor 1005 from operating to route an incoming call to the switchboard to the first operator position to be answered after the operator at the first operator position has operated the order and start key K7 to its emergency start position.

Extension of a call from the switchboard to a local subscriber substation in the central office A

Assuming that an incoming call answered at one of the operator positions at the switchboard, such, for example, as the first operator position 1400, is to be extended to a local subscriber substation in the central office A, such, for example, as the local subscriber substation T1, the operator at the first operator position initiates the extension of the call by actuating the sending key set 463 as previously noted. Assuming that the incoming call has been answered at the first operator position and routed thereto by way of the finder switch 700 of the finder-selector link illustrated and that the sender control circuit 461 is operatively associated with the cable 786 individually extending to the toll selector switch 800 and with the digit register and control circuit 462, the operator at the first operator position actuates the keys of the sending key set 463, thereby to cause the digit register and control circuit 462 to register a series of digits corresponding to the switch train route to the local subscriber substation T1. The digit register and control circuit 462 then operates to control the

operation of the sender control circuit 461, thereby to cause the sender control circuit 461 to transmit the impulses comprising the digits to the toll selector switch 800 in a well-known manner. At this time the normally completed circuit for energizing the windings of the line relay R830 in the toll selector switch 800 is interrupted in the sender control circuit 461 a number of times corresponding to the first digit registered, thereby to cause the line relay R830 to restore repeatedly a number of times corresponding to the number of interruptions of the circuit for energizing the windings thereof. The repeated restoration of the line relay R830 is effective to complete repeatedly, at the contacts 832, the previously traced circuit for energizing in multiple the vertical magnet M877 and the lower winding of the transfer relay R850, thereby to cause the vertical magnet M877 to operate repeatedly and drive the wiper set of the mechanism 801 step by step in the vertical direction to a corresponding level in the associated main contact bank.

More particularly, at the conclusion of the first digit the wiper set of the mechanism 801 occupies a vertical position corresponding to the level in the associated main contact bank wherein the group of trunk lines, including the trunk line 580, is terminated, the trunk line 580 extending to the toll train trunk circuit 500 as previously noted. At this time the set of switch springs S837 is actuated into disengagement in order to cause the toll selector switch 800 to operate as a trunk hunting selector switch in the previously described manner; while the set of switch springs S838 is not actuated into engagement as the group of trunk lines, including the trunk line 580, is not associated with the group of ring-down toll circuits. The rotary magnet M878 of the mechanism 801 then operates automatically to drive the wiper set of the mechanism in the rotary direction until the wiper set engages a contact set in the main contact bank of the mechanism 801 terminating a trunk line extending to an idle one of the toll train trunk circuits. Assuming that the toll train trunk circuit 500 is the first idle toll train trunk circuit in the group, the toll selector switch 800 operates automatically, in the previously described manner, thereby to seize the trunk line 580 extending thereto.

The trunk line 580 is marked as idle by the presence of battery potential upon the control conductor C581 thereof, thereby to cause the intermediate winding of the electropolarized relay R810 in the toll selector switch 800 to be energized, when the wiper set of the mechanism 801 engages the contact set in the main contact bank thereof terminating the trunk line 580 as previously explained. The battery potential appearing upon the control conductor C581 of the trunk line 580 is derived in the toll train trunk circuit 500 and extends from battery by way of the winding of the marking relay R550 to the control conductor C581 of the trunk line 580. When the intermediate winding of the electropolarized relay R810 is thus energized it operates, thereby to complete, at the contacts 815, the previously traced path for applying ground potential to the wiper 805 of the wiper set of the mechanism 801 in the manner previously explained. Also, upon operating, the electropolarized relay R810 completes, at the contacts 812 and 814, the previously traced paths for connecting the line conductors C827 and C828 of the line 826 to the wipers 802 and 803, respectively, of the wiper set of the mechanism 801. The application of ground potential to the wiper 805 of the wiper set of the mechanism 801 completes an obvious path for applying ground potential to the control conductor C581 of the trunk line 580, thereby to complete an obvious circuit for energizing the winding of the marking relay R550. The marking relay R550 then operates to complete, at the contacts 552 and 554, a loop circuit between the sender control circuit 461 and the toll transmission selector switch 573, this loop circuit extending from the line conductor C571 of the line 570 by way of the contacts 511, the upper winding of the supervisory relay R525, the contacts 545 and 552, the line conductor C583 of the trunk line 580, the wiper 803, C803, the contacts 814 and the line conductor C828 of the line 826 to the line conductor C788 in the cable 786; and from the line conductor C572 of the line 570 by way of the contacts 515, 524, 548 and 554, the line conductor C584 of the trunk line 580, the wiper 802, the contacts 891 and 892, C807, the contacts 812 and the line conductor C827 of the line 826 to the line conductor C787 in the cable 786; the line conductors C571 and C572 of the line 570 being connected together in the toll transmission selector switch 573 and the line conductors C787 and C788 in the cable 786 being connected together in the sender control circuit 461.

Also, upon operating, the marking relay R550 completes, at the contacts 551, a path for applying ground potential to the control conductor C582 of the trunk line 580, this path extending from ground by way of the lower winding of the switching relay R540, the contacts 541 and 551 to the control conductor C582 of the trunk line 580. Finally, the marking relay R550 completes, at the contacts 553, an obvious circuit for energizing the lower winding of the supervisory relay R525; however, the supervisory relay R525 does not operate when the lower windings thereof is thus energized, this relay being of the polarized type. When the loop circuit is thus completed between the sender control circuit 461 and the toll transmission selector switch 573, the toll transmission selector switch 573 is rendered responsive to impulses transmitted thereto.

The sender control circuit 461 then operates to transmit the second digit to the toll transmission selector switch 573 by way of the previously traced loop circuit, whereupon the toll transmission selector switch 573 operates automatically to hunt for an idle line, such, for example, as the line 575, in the group of lines extending to the combination local and toll connector switches. When the line 575 is seized by the toll transmission selector switch 573 the combination local and toll connector switch 574 associated therewith is rendered operative to be responsive to subsequent impulses transmitted thereto. Subsequently the sender control circuit 461 operates to transmit two additional digits to the combination local and toll connector switch 574, thereby to cause the combination local and toll connector switch 574 to seize the subscriber line 451 extending to the called subscriber substation T1. The subsequent operation of the combination local and toll connector switch 574 depends upon the idle or busy condition of the subscriber line 451, as will be explained hereinafter. After all of the digits have been transmitted by the sender control circuit 461 it operates to cause ground potential to be applied to the conductor C791 in the cable 786, thereby to complete the

previously traced circuit for energizing the upper winding of the cut-in relay R760 in the finder switch 700 as previously explained. Further, the sender control circuit 461 operates to cause battery potential to be applied to the conductor C789 in the cable 786, thereby to complete the previously traced circuit for energizing the lower winding of the control relay R895 in the toll selector switch 800. The control relay R895 then operates to complete, at the contacts 899, the previously traced holding circuit for energizing the upper winding thereof and to prepare, at the contacts 896, the previously traced circuit for energizing the winding of the ring-down relay R885. However, the winding of the ring-down relay R885 may not be energized at this time due to the fact that the set of switch springs S838 is actuated into disengagement. Further, the control relay R895 completes, at the contacts 898, a path for applying battery potential to the control conductor C582 of the trunk line 580, this path extending from battery potential appearing upon the conductor C789 in the cable 786 by way of the control conductor C829 of the line 826, the contacts 871 and 898 and the wiper 894 to the control conductor C582 of the trunk line 580. This application of battery potential to the control conductor C582 of the trunk line 580 completes the previously traced circuit for energizing the lower winding of the switching relay R540, thereby to cause the latter relay to operate and complete, at the contacts 546, a holding circuit for energizing the upper winding thereof, this circuit extending from ground by way of the contacts 553 and 546 and the upper winding of R540 to battery. After the sender control circuit 461 transmits all of the digits registered in the digit register and control circuit 462 the sender control circuit 461 is released as previously explained.

Also, upon operating, the switching relay R540 interrupts, at the contacts 545 and 548, the previously traced connection between the line conductors C583 and C584 of the trunk line 580 and the line conductors C571 and C572 of the line 570 extending to the toll transmission selector switch 573 and completes, at the contacts 544 and 547, an operative connection between the repeater 560 and the line conductors C583 and C584 of the trunk line 580, this connection extending from the line conductor C583 by way of the contacts 552 and 544, the winding 562 of the repeater 560, the condenser 566, the winding 564 of the repeater 560 and the contacts 547 and 554 to the line conductor C584. Further, the switching relay R540 completes, at the contacts 543, an operative connection between the line conductors C571 and C572 of the line 570 and the repeater 560, this connection extending from the line conductor C571 by way of the contacts 511, the upper winding of the supervisory relay R525, the contacts 543, the winding 561 of the repeater 560, the winding of the supervisory relay R530, the winding 563 of the repeater 560 and the contacts 524 and 515 to the line conductor C572. Also, upon operating, the switching relay R540 prepares, at the contacts 542, a path, traced hereinafter, for applying ground potential to the control conductor C582 of the trunk line 580.

When the combination local and toll connector switch 574 operates to seize the subscriber line 451 extending to the calling subscriber substation T1 battery potential therein is reversed over the previously traced connection including the line 575 and the toll transmission selector switch 573 to the line 570 and the repeater 560, thereby to cause the supervisory relay R525 to operate. Upon operating, the supervisory relay R525 completes, at the contacts 528, a holding circuit for energizing the lower winding thereof, this circuit extending from ground by way of the contacts 553, 546 and 528 and the lower winding of R525 to battery. Further, the supervisory relay R525 completes, at the contacts 527, an obvious path for short-circuiting the upper winding thereof, thereby to minimize the resistance of the previously traced connection between the repeater 560 and the toll transmission selector switch 573. Finally, the supervisory relay R525 completes, at the contacts 526, the previously mentioned path for applying ground potential to the control conductor C582 of the trunk line 580, the supervisory relay R530 being operated at this time due to the completion of the previously traced circuit for energizing the winding thereof. The path for applying ground potential to the control conductor C582 of the trunk line 580 extends from ground by way of the contacts 553, 526, 532, 542 and 551 to the control conductor C582 of the trunk line 580.

When the previously traced circuit for energizing the upper winding of the cut-in relay R760 in the finder switch 700 is completed the latter relay operates to complete, at the contacts 765, the previously traced holding circuit for energizing the lower winding thereof and the previously traced circuit for energizing the upper winding of the call pilot relay R1320 in the relay group 1200. The call pilot relay R1320 then operates to interrupt, at the contacts 1322, the previously traced path for applying ground potential to the start conductor C1386 in the trunk line 1380 extending to the sender control circuit 461. Further, the cut-in relay R760 completes, at the contacts 764, the previously mentioned path for applying ground potential to the control conductor C830 of the line 826, thereby to retain the toll selector switch 800, the toll train trunk circuit 500, the toll transmission selector switch 573 and the combination local and toll connector switch 574 in their operated positions. Also, the cut-in relay R760 completes, at the contacts 761 and 762, the previously traced operative connection between the trunk circuit at the first operator position 1400 and the line conductors C827 and C828 of the line 826, the line conductors C827 and C828 of the line 826 being operatively connected to the line conductors C584 and C583 of the trunk line 580 at this time and consequently to the repeater 560. Accordingly, at this time, the trunk circuit at the first operator position 1400 is operatively connected by way of the toll selector switch 800 and the toll line 580 to the repeater 560; and the repeater 560 in the toll train trunk circuit 500 is operatively connected by way of the line 570, the toll transmission selector switch 573 and the line 575 to the combination local and toll connector switch 574.

The application of ground potential to the control conductor C582 of the trunk line 580 completes a series circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120, this circuit extending from the grounded control conductor C582 of the trunk line 580 by way of the wiper 894, the contacts 898 and 871, the control conductor C829 of the line 826, the contacts 763, the lamp L776, the contacts 774 of the talk key K780 of the finder switch 700, the conductor C1187 in the cable 1270, the resistor 1122 and the winding of R1120 to battery. When energized over the

above-traced circuit the control relay R1120 operates to complete, at the contacts 1121, the previously mentioned path for short-circuiting the resistor 1122, thereby to cause the supervisory lamp L776 to be illuminated. The illumination of the supervisory lamp L776 indicates to the operator at the first operator position 1400 that the combination local and toll connector switch 574 has seized the subscriber line 451 extending to the called subscriber substation T1. In the event the called subscriber substation T1 is busy at this time the combination local and toll connector switch 574 operates to cause busy tone current to be transmitted over the previously traced connection to the repeater 560 in the toll train trunk circuit 500, whereupon the repeater 560 operates to cause busy tone current to be repeated over the previously traced connection between the repeater 560 and the trunk circuit at the first operator position 1400. The busy tone current conducted to the trunk circuit at the first operator position 1400 causes the receiver of the telephone instrument thereat to produce a corresponding busy tone, indicating to the operator that the called subscriber line 451 is busy at this time. In the event the called subscriber substation T1 is busy at this time the operator at the first operator position advises the subscriber at the calling subscriber substation that the desired connection may not immediately be had due to the busy condition of the called subscriber substation T1. The operator at the first operator position then releases the front end of the connection including the toll selector switch 800, the toll train trunk circuit 500, the toll transmission selector switch 573 and the combination local and toll connector switch 574 in a manner more fully described hereinafter. Subsequently the operator at the first operator position may again set up the connection to the combination local and toll connector switch 574, thereby again to test the idle or busy condition of the called subscriber substation T1. Finally, the called subscriber substation T1 is found to be idle or the subscriber at the calling subscriber substation is advised to abandon the call.

In the event the called subscriber substation T1 is idle at this time the combination local and toll connector switch 574 operates to establish a connection between the called subscriber substation T1 and the repeater 560 in the toll train trunk circuit 500 and busy tone current is not conducted therefrom by way of the previously traced circuit to the repeater 560 in the toll train trunk circuit 500. Accordingly, when the supervisory lamp L776 is illuminated and the operator at the first operator position does not receive busy tone, she operates the ring key K5 to its front position, thereby to cause ringing current to be projected over the subscriber line 451 to the called subscriber substation T1.

More particularly, when the ring key K5 is operated to its front position, the contacts 1402 thereof are actuated into engagement, thereby to complete the previously mentioned circuit for energizing the winding of the front split relay R1210 in order to cause the latter relay to operate. Also, the contacts 1406 of the ring key K5 are actuated into engagement, thereby to complete an obvious path for applying ground potential to the conductor C1465; while the contacts 1404 of the ring key K5 are actuated into engagement, thereby to complete the previously traced path for applying battery potential to the conductor C1464. Upon operating, the front split relay R1210 completes, at the contacts 1212 and 1214, the previously traced paths for connecting battery and ground potentials to the line conductors C1281 and C1282, respectively, in the cable 1270. This application of ground potential to the line conductor C1282 in the cable 1270 completes a path for short-circuiting the winding of the coin control relay R520, this path extending from the grounded line conductor C1282 by way of the contacts 751, 761, the line conductor C827 of the line 826, the contacts 812, C807, the contacts 892 and 891, the wiper 892, the line conductor C584 of the trunk line 570, the contacts 554 and 547, the winding 564 of the repeater 560, the winding of R520 and the contacts 513 to ground. This application of battery potential to the line conductor C1281 in the cable 1270 completes a circuit for energizing the winding of the ring relay R510, this circuit extending from battery potential on the line conductor C1281 by way of the contacts 754 and 762, the line conductor C828 of the line 826, the contacts 814, C808, the wiper 893, the line conductor C583 of the trunk line 580, the contacts 552 and 544, the winding 562 of the repeater 560, the contacts 522 and the winding of R510 to ground. Shortly after the ring relay R510 is energized over the above-traced circuit, this relay being of the combination slow-to-operate and slow-to-release type, it operates to interrupt, at the contacts 511 and 515, the previously traced connection between the repeater 560 and the called subscriber substation T1. Also, upon operating, the ring relay R510 interrupts, at the contacts 513, the previously traced path for short-circuiting the winding of the coin control relay R520 and completes, at the contacts 512 and 514, a circuit for projecting ringing current over the subscriber line 451 extending to the called subscriber substation T1, this circuit extending from one terminal of a source of ringing current by way of the line conductor C517 of the line 516 and the contacts 512 to the line conductor C571 of the line 570, and from the other terminal of the source of ringing current by way of the line conductor C518 of the line 516 and the contacts 514 to the line conductor C572 of the line 570; the line conductors C571 and C572 of the line 570; being connected by way of the toll transmission selector switch 573, the line 575 and the combination local and toll connector switch 574 to the line conductors of the subscriber line 451; and the ringer at the called subscriber substation T1 being bridged across the line conductors of the subscriber line 451.

After the operator at the first operator position 1400 operates the ring key K5 to its front position, in order to cause ringing current to be projected over the subscriber line 451 to the called subscriber substation T1, she operates the ring key K5 back to its normal position. When the ring key K5 is thus operated, the contacts 1402 thereof are actuated into disengagement, thereby to interrupt the previously mentioned circuit for energizing the winding of the front split relay R1210; the contacts 1404 thereof are actuated into disengagement, thereby to interrupt the previously traced circuit for energizing the winding of the ring relay R510; and the contacts 1406 thereof are actuated into disengagement, thereby to interrupt a further point in the previously traced path for short-circuiting the winding of the coin control relay R520. Shortly thereafter, the front split relay R1210 restores to recomplete, at the contacts 1211 and 1213, the previ-

ously traced connection between the trunk circuit at the first operator position and the repeater 560. Shortly thereafter, the ring relay R510 restores to interrupt, at the contacts 512 and 514, the previously traced circuit for projecting ringing current over the subscriber line 451 to the called subscriber substation T1 and to recomplete, at the contacts 511 and 515, the previously traced connection between the called subscriber substation T1 and the repeater 560. When the call is answered at the called subscriber substation T1 the toll transmission selector switch 573 operates, thereby to cause the potential to be removed from between the line conductors C571 and C572 of the line 570, whereupon the supervisory relay R530 restores. Upon restoring, the supervisory relay R530 interrupts, at the contacts 532, the previously traced series circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120, thereby to cause the supervisory lamp L776 to be extinguished and the control relay R1120 to restore. When the supervisory lamp L776 is thus extinguished it indicates to the operator at the first operator position 1400 that the subscriber at the called subscriber substation T1 has answered the call. At this time the previously traced connection between the trunk circuit at the first operator position and the repeater 560 is completed, and the previously traced connection between the repeater 560 and the called subscriber substation T1 is completed. Accordingly, the operator at the first operator position then converses with the subscriber at the called subscriber substation T1, advising him that there is an incoming call at the switchboard for him. The operator at the first operator position may then disconnect the relay group 1200 from the finder-selector link illustrated by operating the talk key K780 of the finder switch 700 away from its normal position as previously explained.

It is noted that the subscriber at the called subscriber substation T1 has switchhook supervision and may signal the operator at the first operator position 1400 by intermittently operating the switchhook at his substation, thereby to cause the toll transmission selector switch 573 to operate intermittently and cause battery potential to be applied intermittently between the line conductors C571 and C572 of the line 570, in order to cause the supervisory relay 530 to operate intermittently. Each time the supervisory relay R530 operates it completes, at the contacts 532, a circuit for illuminating the supervisory lamp L776 regardless of the position of the talk key K780 of the finder switch 700. In the event the talk key K780 of the finder switch 700 occupies its normal position the previously traced direct circuit for illuminating the supervisory lamp L776 is completed from battery by way of the contacts 775 of the talk key K780. On the other hand, in the event the talk key K780 of the finder switch 700 is operated away from its normal position the previously traced series circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120 is completed. Accordingly, the supervisory lamp L776 flashes, thereby to indicate to the operator at the first operator position 1400 that the subscriber at the called subscriber substation T1 desires her attention, whereupon the operator at the first operator position completes an operative connection between the trunk circuit at her position and the called subscriber substation T1 in the manner previously explained.

The remainder of the supervision of the established connection routed by way of the finder-selector link illustrated and the release of this established connection are accomplished in the manner previously explained. It is noted that when the established connection is released the toll selector switch 300 is returned to its normal position, whereupon the previously traced path for applying ground potential to the control conductor C581 of the trunk line 580 is interrupted, thereby to cause the marking relay R550 to restore in the event the supervisory relay R530 has reoperated due to replacement of the receiver of the telephone instrument at the called subscriber substation T1 upon its switchhook. It is noted that, upon operating, the supervisory relay R530 interrupts, at the contacts 531, an alternative holding circuit for energizing the winding of the marking relay R550, this alternative holding circuit extending, when completed, from ground by way of the contacts 553, 526 and 531, the control conductor C581 of the trunk line 580 and the winding of R550 to battery. Upon restoring, the marking relay R550 interrupts, at the contacts 553, the previously traced holding circuit for energizing the upper winding of the switching relay R540 and the lower winding of the supervisory relay R525, thereby to cause the latter relays to restore. Further, the marking relay R550 interrupts, at the contacts 552 and 554, the previously traced connection between the trunk circuit at the first operator position 1400 and the repeater 560. Upon restoring, the switching relay R540 interrupts, at the contacts 543, the previously traced connection between the toll transmission selector switch 573 and the repeater 560, whereupon the toll transmission selector switch 573 is released. When the toll transmission selector switch 573 is released it causes the combination local and toll connector switch 574 to be released. When the combination local and toll connector switch 574 is released the line circuit 452 operates to mark the subscriber line 451 extending to the called subscriber substation T1 as idle, assuming that the subscriber at the called subscriber substation T1 has replaced the receiver of the telephone instrument thereat upon its switchhook. When ground potential is removed from the control conductor C581 of the trunk line 580 battery potential by way of the winding of the marking relay R550 is applied to the control conductor C581 of the trunk line 580, thereby to mark the toll train trunk circuit 500 as idle. At this time the toll train trunk circuit 500, the toll transmission selector switch 573 and the combination local and toll connector switch 574 are available for further use.

Extension of a call from the switchboard to a paystation in the central office A

Assuming that an incoming call answered at one of the operator positions at the switchboard, such, for example, as the first operator position 1400, is to be extended to a local paystation in the central office A, such, for example, as the local paystation T2, the operator at the first operator position initiates the extension of the call by actuating the sending key set 403 as previously explained. Assuming that the incoming call has been answered at the first operator position and routed thereto by way of the finder switch 700 of the finder-selector link illustrated and that the sender control circuit 401 is operatively associated with the cable 706 individually extending to the toll selector switch 300 and with the digit

register and control circuit 462, the operator at the first operator position actuates the keys of the sending key set 463, thereby to cause the digit register and control circuit 462 to register a series of digits corresponding to the switch train route to the paystation T2. The digit register and control circuit 462 then operates to control the operation of the sender control circuit 461, thereby to cause the sender control circuit 461 to transmit the impulses comprising the digits registered to the toll selector switch 800 in a well known manner.

The impulses comprising the first digit registered are transmitted from the sender control circuit 461 to the toll selector switch 800 in the previously described manner, thereby to cause the wiper set of the mechanism 801 of the toll selector switch 800 to be driven in the vertical direction to a corresponding level as previously explained. More particularly, the wiper set of the mechanism 801 is driven to the level corresponding to the level in the main contact bank of the mechanism 801 wherein the group of trunk lines, including the trunk line 580, is terminated. The wiper set of the mechanism 801 is then driven in the rotary direction until it engages a contact set in the main contact bank of the mechanism terminating a trunk line extending to an idle one of the toll train trunk circuits in the manner previously explained. Assuming that the toll train trunk circuit 500 is the first idle toll train trunk circuit in this group the toll train trunk circuit 500 operates, in the previously described manner, thereby to seize the trunk line 580 extending thereto.

When the trunk line 580 is seized by the toll selector switch 800 the electropolarized relay R810 in the toll selector switch 800 operates, in the previously described manner, thereby to cause the marking relay R550 to operate and complete the previously traced connection between the sender control circuit 461 and the toll transmission selector switch 573. The sender control circuit 461 then operates to transmit a second digit, thereby to cause the toll transmission selector switch 573 to hunt for an idle combination local and toll connector switch in the group of combination local and toll connector switches as previously explained. Assuming that the toll transmission selector switch 573 seizes the line 575 extending to the combination local and toll connector switch 574, when the line 575 is thus seized the combination local and toll connector switch 574 is rendered responsive to two digits transmitted thereto. The sender control circuit 461 then operates to transmit two additional digits to the combination local and toll connector switch 574, thereby to cause the combination local and toll connector switch 574 to operate and seize the paystation line 290 extending to the paystation T2.

After all of the digits registered have been transmitted by the sender control circuit 461, the sender control circuit 461 operates, in the previously described manner, thereby to cause the cut-in relay R760, the control relay R395 and the switching relay R540 to operate as previously explained. Upon operating, the cut-in relay R760 and the switching relay R540 complete the previously traced connection between the trunk circuit at the first operator position 1400 and the repeater 560 and the previously traced connection between the repeater 560 and the combination local and toll connector switch 574. When the combination local and toll connector switch 574 operates to seize the paystation line 290 extending to the called paystation T2 the supervisory relays R525 and R530 operate as previously explained. Upon operating, the supervisory relay R530 completes, at the contacts 532, the previously traced series circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120.

At this time the illumination of the supervisory lamp L776 indicates to the operator at the first operator position 1400 that the combination local and toll connector switch 574 has seized the paystation line 290 extending to the called paystation T2 and the combination local and toll connector switch 574 operates to cause busy tone current to be transmitted therefrom over the previously traced connection to the trunk circuit at the first operator position in the event the called paystation T2 is busy at this time.

In the event the called paystation T2 is idle at this time the operator at the first operator position 1400 then operates the ring key K5 to its front position, thereby to cause the front split relay R1210 and the ring relay R510 to operate in the manner previously described. Upon operating, the ring relay R510 causes ringing current to be projected over the paystation line 290 to the called paystation T2 in the manner previously described in order to cause the ringer at the paystation T2 to be operated. After operating the ring key K5 to its front position the operator at the first operator position returns the ring key K5 to its normal position, thereby to cause the front split relay R1210 and the ring relay R510 to restore as previously explained. When the party at the called paystation T2 answers the call the toll transmission selector switch 573 operates, thereby to cause the battery potential to be removed from between the line conductors C571 and C572 of the trunk line 570 as previously explained, whereupon the supervisory relay R530 restores to interrupt, at the contacts 532, the previously traced series circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120. The supervisory lamp L776 is then extinguished and the control relay R1120 then restores.

At this time the previously traced connection between the trunk circuit at the first operator position 1400 and the repeater 560 is completed, and a connection is completed between the repeater 560 and the called paystation T2. The connection between the repeater 560 and the called paystation T2 extends from the line conductor C571 of the line 570 by way of the contacts 511, 527 and 543, the winding 561 of the repeater 560, the condenser 565, the winding 563 of the repeater 560, the contacts 524 and 515 to the line conductor C572 of the line 570, the line conductors C571 and C572 of the line 570 being connected by way of the toll transmission selector switch 573, the line 575 and the combination local and toll connector switch 574 to the line conductors of the paystation line 290, the telephone instrument at the called paystation T2 being bridged across the line conductors of the paystation line 290. The operator at the first operator position 1400 then converses with the party at the called paystation T2 and advises him that there is an incoming call at the switchboard for him.

The present call routed to the called paystation T2 may be paid for by the party thereat. In this

event the operator at the first operator position advises the party at the called paystation T2 to insert a coin in the coin slot of the instrument thereat in the usual manner. In order to collect the coin inserted in the coin slot of the instrument at the called paystation T2 the operator at the first operator position operates the coin collect key K2 to its right-hand or front position. When the coin collect key K2 is thus operated the contacts 1416 thereof are actuated into engagement, thereby to complete an obvious circuit for energizing the winding of the front split relay R1210; the contacts 1418 thereof are actuated into engagement, thereby to complete an obvious path for applying ground potential to the conductor C1464; and the contacts 1422 thereof are actuated into engagement, thereby to complete an obvious path for applying positive 110 volt potential to the conductor C1465. The front split relay R1210 then operates to complete, at the contacts 1212 and 1214, the previously traced connections between the conductors C1464 and C1465 and the line conductors C1281 and C1282 in the cable 1270. The application of ground potential to the conductor C1464 completes a path for short-circuiting the winding of the ring relay R510, this path extending from ground potential on the conductor C1464 by way of the contacts 1212, the line conductor C1281 in the cable 1270, the contacts 754 and 762, the line conductor C828 of the line 826, the contacts 814, C808, the wiper 803, the line conductor C583 of the trunk line 580, the contacts 552 and 544, the winding 562 of the repeater 560, the contacts 522 and the winding of R510 to ground. The application of positive 110 volt potential to the conductor C1465 completes a circuit for energizing the winding of the coin control relay R520, this circuit extending from positive 110 volt potential on the conductor C1465 by way of the contacts 1214, the line conductor C1282 in the cable 1270, the contacts 751 and 761, the line conductor C827 of the line 826, the contacts 812, C807, the contacts 892 and 891, the wiper 802, the line conductor C584 of the trunk line 580, the contacts 554 and 547, the winding 564 of the repeater 560, the winding of R520 and the contacts 513 to ground. Shortly after the winding of the coin control relay R520 is energized over the above-traced circuit this relay operates, it being of the combination slow-to-operate and slow-to-release type. Upon operating, the coin control relay R520 completes, at the contacts 521, an obvious path for applying ground potential to the line conductor C571 of the line 570 and completes, at the contacts 523, a path for applying positive 110 volt potential to the line conductor C572 of the line 570, the last-mentioned path extending from positive 110 volt potential on the line conductor C584 of the trunk line 580 by way of the contacts 554, 547, 523 and 515 to the line conductor C572 of the line 570. The application of ground potential and positive 110 volt potential to the line conductors C571 and C572, respectively, of the line 570 completes a circuit, substantially identical to that previously traced, for projecting positive 110 volt current over the paystation line 290 to the called paystation T2, thereby to cause the apparatus at the paystation T2 to operate and collect the coin deposited in the coin slot of the telephone instrument thereat.

After operating the coin collect key K2 to its front position the operator at the first operator position 1400 returns the coin collect key K2 to its normal position, thereby to interrupt, at the contacts 1416 thereof, the previously mentioned circuit for energizing the winding of the front split relay R1210 and to interrupt, at the contacts 1418 and 1422 thereof, the previously traced paths for applying ground potential and 110 volt potential respectively to the conductors C1464 and C1465. The front split relay R1210 then restores to recomplete, at the contacts 1211 and 1213, the previously traced connection between the trunk circuit at the first operator position 1400 and the repeater 560. Shortly after the front split relay R1210 restores the coin control relay R520 restores to interrupt, at the contacts 521, the previously mentioned path for applying ground potential to the line conductor C571 of the line 570 and to recomplete, at the contacts 524, the previously traced connection between the repeater 560 and the telephone instrument at the called paystation T2.

Instead of collecting the coin at the called paystation T2, as explained above, the operator at the first operator position 1400 may wish to refund the coin deposited in the coin slot of the instrument at the paystation T2 to the party thereat. This is accomplished by operating the coin return key K1 to its right-hand or front position, thereby to complete, at the contacts 1408 thereof, an obvious circuit for energizing the winding of the front split relay R1210 and to complete, at the contacts 1410 and 1414 thereof, obvious paths for applying ground potential and negative 110 volt potential respectively to the conductors C1464 and C1465. The front split relay R1210 then operates, as previously explained, thereby to complete, at the contacts 1214, the previously traced circuit for energizing the winding of the coin control relay R520. The coin control relay R520 then operates to complete, at the contacts 521, the previously mentioned path for applying ground potential to the line conductor C571 of the line 570 and to complete, at the contacts 523, the previously traced path for applying negative 110 volt potential to the line conductor C572 of the line 570. Accordingly, negative 110 volt current is projected over the paystation line 290 to the called paystation T2, thereby to cause the apparatus thereat to operate and refund the coin deposited in the coin slot of the telephone instrument thereat to the party at the paystation T2.

After operating the coin return key K1 to its front position the operator at the first operator position 1400 returns the coin return key K1 to its normal position, thereby to interrupt, at the contacts 1408 thereof, the previously mentioned circuit for energizing the winding of the front split relay R1210 and to interrupt, at the contacts 1410 and 1414 thereof, the previously mentioned paths for applying ground potential and negative 110 volt potential respectively to the conductors C1464 and C1465. The front split relay R1210 then restores, thereby to cause the coin control relay R520 to restore as previously explained. At this time a connection is completed between the trunk circuit at the first operator position 1400 and the called paystation T2.

It is noted that the party at the called paystation T2 has switchhook supervision and may signal the operator at the first operator position by repeatedly operating the switchhook at the paystation T2, thereby to cause the supervisory relay R530 to operate intermittently in order to cause the supervisory lamp L776 to flash regardless of the position of the talk key K780 of the finder switch 700 as previously explained.

The remainder of the supervision and the release of the established connection routed by way of the finder-selector link illustrated are accomplished in the manner previously explained. It is noted that when the established connection is released the toll selector switch 800 is returned to its normal position, whereupon the previously traced path for applying ground potential to the control conductor C581 of the trunk line 580 is interrupted in the event the supervisory relay R530 has reoperated due to the replacement of the receiver of the telephone instrument at the called paystation T2 upon its switchhook as previously explained. When ground potential is removed from the control conductor C581 of the trunk line 580 the marking relay R550, the switching relay R540 and the supervisory relay R525 restore as previously explained, whereupon battery potential is applied by way of the winding of the marking relay R550 to the control conductor C581 of the trunk line 580. This application of battery potential to the control conductor C581 of the trunk line 580 marks the trunk line 580 as idle to the switches having access thereto as previously noted. Upon restoring, the switching relay R540 interrupts, at the contacts 543, the previously traced connection between the repeater 560 and the toll transmission selector switch 573, thereby to cause the toll transmission selector switch 573 to be released. When toll transmission selector switch 573 is released the combination local and toll connector switch 574 is released, whereupon the line circuit 296 operates, thereby to mark the paystation line 290 as idle to the switches having access thereto. At this time the established connection between the trunk circuit at the first operator position 1400 and the called paystation T2 is completely released.

Extension of a call from the switchboard to the C. A. X. network

Assuming that an incoming call at one of the operator positions at the switchboard, such, for example, as the first operator position 1400, is to be extended to a subscriber substation included in the C. A. X. network, such, for example, as the subscriber substation T3 in the tandem exchange C, the operator at the first operator position initiates the extension of the call by actuating the sending key set 463 as previously noted. Assuming that the incoming call has been answered at the first operator position and routed thereto by way of the finder switch 700 of the finder-selector link illustrated and that the sender control circuit 461 is operatively associated with the cable 786 individually extending to the toll selector switch 800 and with the digit register and control circuit 462, the operator at the first operator position actuates the keys of the sending key set 463, thereby to cause the digit register and control circuit 462 to register a series of digits corresponding to the switch train route to the called subscriber substation T3 in the tandem exchange C. The digit register and control circuit 462 then operates to control the operation of the sender control circuit 461, thereby to cause the sender control circuit 461 to transmit the impulses comprising the digits registered to the toll selector switch 800 in a well known manner. The impulses comprising the first digit registered are transmitted from the sender control circuit 461 to the toll selector switch 800 in the previously described manner, thereby to cause the wiper set of the mechanism 801 of the toll selector switch 800 to be driven in the vertical direction to a corresponding level as previously explained. More particularly, the wiper set of the mechanism 801 is driven in the vertical direction to the level corresponding to the level in the main contact bank of the mechanism 801 wherein the group of trunk lines, including the trunk line 340, is terminated.

The wiper set of the mechanism 801 is then driven in the rotary direction until it engages a contact set in the main contact bank of the mechanism terminating a trunk line extending to an idle one of the reverting dial toll circuits as previously explained. Assuming that the reverting dial toll circuit 300 is the first idle trunk circuit in this group, the toll selector switch 800 operates, in the previously described manner, thereby to seize the trunk line 340, the trunk line 340 being marked as idle by the presence of battery potential upon the control conductor C341 thereof. The path for applying battery potential to the control conductor C341 of the trunk line 340 extends from battery by way of the winding of the marking relay R360 and the contacts 354 and 312 to the control conductor C341 of the trunk line 340. The electropolarized relay R810 in the toll selector switch 800 then operates, thereby to cause ground potential to be applied to the wiper 805 of the wiper set of the mechanism 801 as previously explained. This application of ground potential to the wiper 805 completes a circuit, substantially identical to that previously traced, for energizing the winding of the marking relay R360, thereby to cause the latter relay to operate. Also, upon operating, the electropolarized relay R810 in the toll selector switch 800 completes, at the contacts 812 and 814, a loop circuit for energizing the windings of the impulse relay R375, this circuit extending from ground by way of the upper winding of R375 and the contacts 384 to the line conductor C342 of the trunk line 340, and from battery by way of the lower winding of R375 and the contacts 386 to the line conductor C343 of the trunk line 380, the line conductors C342 and C343 of the trunk line 340 being connected together by way of the toll selector switch 800 as previously explained.

When this loop circuit is completed the impulse relay R375 operates to complete, at the contacts 377, an obvious circuit for energizing the winding of the hold relay R390, thereby to cause the latter relay to operate. Also, upon operating, the marking relay R360 completes, at the contacts 361, the previously mentioned circuit for energizing the winding of the control relay R355, thereby to cause the latter relay to operate. Further, the marking relay R360 interrupts, at the contacts 365, a point in the previously traced path for applying ground potential to the distributor start conductor C366 in the trunk line 600 extending to the common start and level distributor unit 1000, thereby to prevent operation of this unit at this time. Upon operating, the control relay R355 completes, at the contacts 356', the previously mentioned alternative holding circuit for energizing the winding of the alarm relay R395, thereby to retain the latter relay in its operated position at this time. Further, the control relay R355 prepares, at the contacts 358, a point in a circuit, traced hereinafter, for energizing the winding of the supervisory relay R370. Upon operating, the hold relay R390 completes, at the contacts 391, a point in a path for applying ground potential to the simplex conductor C346, this path extending

from ground by way of the contacts 376, 391 and 332 to the simplex conductor C346. Further, the hold relay R390 prepares, at the contacts 394, a circuit, traced hereinafter, for energizing the upper winding of the cut-through relay R380 and completes, at the contacts 394', a path for short-circuiting the upper winding of the ring relay R320, this path extending from ground by way of the contacts 394', C343', the resistor 319, the contacts 317 and the upper winding of R320 to ground.

As previously noted, ground potential by way of the winding of the alarm relay R395 is normally connected by way of the previously traced path to the simplex conductor C346; and at this time, when the impulse relay R375 and the hold relay R390 operate to complete, at the contacts 376 and 391, the above-traced path for applying direct ground potential to the simplex conductor C346, the line circuit 932 individually associated with the C. A. X. toll line 940 operates in order to mark the line 915 as busy to the line switches having access thereto and to render the incoming first selector switch 912 individually associated with the line circuit 932 operative by way of the line 913.

The sender control circuit 461 then operates in order to transmit three additional digits by way of the toll selector switch 800 and the trunk line 340 to the reverting dial toll circuit 300. The impulse relay R375 follows the impulses of the digits mentioned. More particularly, each time the impulse relay R375 operates it completes, at the contacts 376, the previously traced path for applying direct ground potential to the simplex conductor C346; and each time the impulse relay R375 restores it interrupts, at the contacts 376, the previously traced path for applying direct ground potential to the simplex conductor C346. Accordingly, impulses corresponding to the three digits are transmitted by way of the simplex conductor C346, the winding 339 of the repeater 335 and the line conductors C941 and C942 of the C. A. X. toll line 940 to the line circuit 932, thereby to cause the line circuit 932 to operate and repeat the impulses by way of the line 913 to the incoming first selector switch 912. In response to the first digit repeated to the incoming first selector switch 912, this selector switch operates to hunt for an idle one of the local and toll connector switches, such, for example, as the local and toll connector switch 930. More particularly, when the incoming first selector switch 912 seizes the line 931 extending to the local and toll connector switch 930, the local and toll connector switch 930 is rendered responsive to two digits transmitted thereto from the incoming first selector switch 912. The local and toll connector switch 930 then responds to the two digits transmitted thereto in order to seize the subscriber line 900 extending to the called subscriber substation T3.

After all of the digits have been transmitted by the sender control circuit 461 it operates to cause ground potential to be applied to the conductor C791 in the cable 786 and battery potential to be applied to the conductor C789 in the cable 786. The application of ground potential to the conductor C791 in the cable 786 completes the previously traced circuit for energizing the upper winding of the cut-in relay R760, thereby to cause the latter relay to operate as previously explained. The application of battery potential to the conductor C789 in the cable 786 completes a circuit for energizing the upper winding of the cut-through relay R380, this circuit extending from battery potential on the conductor C789 in the cable 786 by way of the control conductor C829 of the line 826, the contacts 871 and 898, the wiper 804, the control conductor C344 of the trunk line 340, the contacts 388 and the upper winding of R380 to battery. When energized over the above-traced circuit the cut-through relay R380 operates to complete, at the contacts 382, a holding circuit for energizing the lower winding thereof, this circuit extending from ground potential appearing upon the control conductor C341 of the trunk line 340 by way of the contacts 312, 321, 333 and 382 and the lower winding of R380 to battery. Also, upon operating, the cut-through relay R380 interrupts, at the contacts 384 and 386, a further point in the previously traced loop circuit between the windings of the impulse relay R375 and the sender control circuit 461, completes, at the contacts 383 and 385, an operative connection between the trunk circuit at the first operator position 1400 and the C. A. X. toll line 940, the cut-in relay R760 in the finder switch 700 being operated at this time, this circuit extending from the line conductor C342 of the trunk line 340 by way of the contacts 383, C342', the winding 336 of the repeater 335, the condenser 338, the winding 337 of the repeater 335, C343' and the contacts 385 to the line conductor C343 of the trunk line 340, the line conductors C342 and C343 of the trunk line 340 being connected by way of the toll selector switch 800 and the cable 1270 to the trunk circuit at the first operator position as previously explained. Furthermore, the winding 339 of the repeater 335 is operatively connected by way of the C. A. X. toll line 940, the line circuit 932, the line 913, the incoming first selector switch 912 and the line 931 to the local and toll connector switch 930.

The local and toll connector switch 930 then operates to cause ringing current to be projected over the subscriber line 900 to the subscriber substation T3 in the event the subscriber substation T3 is idle at this time. On the other hand, in the event the subscriber substation T3 is busy at this time, the local and toll connector switch 930 operates to return busy tone current over the previously traced connection to the trunk circuit at the first operator position 1400.

Also upon restoring the impulse relay R375 interrupts, at the contacts 377, the previously mentioned circuit for energizing the winding of the hold relay R390, thereby to cause the latter relay to restore shortly thereafter. Upon restoring, the hold relay R390 completes, at the contacts 392, a circuit for energizing the winding of the supervisory relay R370, this circuit extending from ground by way of the winding of R370, the contacts 358, 392 and 332 to the simplex conductor C346, battery potential being applied to the simplex conductor C346 by way of the line conductors C941 and C942 of the C. A. X. toll line 940 in the line circuit 932 as previously explained. When thus energized, the supervisory relay R370 operates. Also, upon restoring, the hold relay R390 interrupts, at the contacts 394', the previously traced path for short-circuiting the upper winding of the ring relay R320. Upon operating, the supervisory relay R370 completes, at the contacts 371, a path for applying ground potential to the control conductor C344 of the trunk line 340, this path extending from ground by way of the contacts 371 and 387 to the control conductor C344 of the trunk line 340. This application of ground potential to the control conductor C344

of the trunk line 340 completes the previously traced series circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120 in the manner previously explained.

The illumination of the supervisory lamp L776 indicates to the operator at the first operator position 1400 that the local and toll connector switch 930 has operated to select the subscriber line 900 extending to the called subscriber substation T3. As previously noted, in the event the called subscriber substation T3 is idle, ringing current is projected from the local and toll connector switch 930 over the subscriber line 900 to the called subscribed substation T3; and in the event the called subscriber substation T3 is busy, busy tone current is returned from the local and toll connector switch 930 over the previously traced circuit to the trunk circuit at the first operator position. Assuming that the called subscriber substation T3 is idle at this time, when the call is answered thereat due to the removal of the receiver of the telephone instrument thereat from its switchhook, the line circuit 932 is controlled to increase the series resistance of the previously traced circuit, including the simplex conductor C346, for energizing the winding of the supervisory relay R370, thereby to cause the latter relay to restore. Upon restoring, the supervisory relay R370 interrupts, at the contacts 371, the previously traced series circuit for illuminating the supervisory lamp L776 and for energizing the winding of the control relay R1120, thereby to cause the supervisory lamp L776 to be extinguished and the control relay R1120 to restore. When the supervisory lamp L776 is extinguished it indicates to the operator at the first operator position 1400 that the call has been answered at the called subscriber substation T3.

The subscriber at the called subscriber substation T3 has switchhook supervision and may signal the operator at the first operator position by repeatedly operating the switchhook at the subscriber substation T3. Each time the switchhook at the called subscriber substation T3 is depressed the line circuit 932 is operated to decrease the resistance of the previously traced circuit including the simplex conductor C346, thereby to cause the supervisory relay R370 to operate. Each time the supervisory relay R370 operates it completes, at the contacts 371, the previously traced path for applying ground potential to the control conductor C344 of the trunk line 340. Each time ground potential is applied to the control conductor C344 of the trunk line 340, the supervisory lamp L776 is illuminated regardless of the position of the talk key K780 of the finder switch 700 as previously explained. Accordingly, the subscriber at the called subscriber substation T3 may cause the supervisory lamp L776 to flash by repeatedly operating the switchhook at the subscriber substation T3.

Also, the operator at the first operator position 1400 may mark the reverting dial toll circuit 300 as busy at this time, in the event the C. A. X. toll line 940 is defective, by operating the order and start key K7 to its order position and by operating the check key K11 to its right-hand or front position. When the check key K11 is operated to its front position the contacts 1426 thereof are actuated into engagement, thereby to complete an obvious circuit for energizing the winding of the front split relay R1210; and the contacts 1428 and 1430 thereof are actuated into engagement, thereby to complete obvious paths for applying battery potential to the conductors C1464 and C1465. The front split relay R1210 then operates to complete, at the contacts 1212 and 1214, the previously traced connections between the conductors C1464 and C1465 and the line conductors C1281 and C1282 in the cable 1270, thereby to cause battery potential to be connected by way of the toll selector switch 830 and the trunk line 340 to the conductors C342′ and C343′. The application of battery potential to the conductors C342′ and C343′ complete the previously traced circuits for energizing the windings of the trouble relays R315 and R310, thereby to cause these relays to operate as previously explained, the operation of the trouble relay R310 being effective to cause trouble tone voltage to be applied to the C. A. X. toll line 940 in the manner previously explained.

The remainder of the supervision and the release of the established connection routed by way of the finder-selector link illustrated are accomplished in the manner previously explained. It is noted that when the established connection is released the toll selector switch 800 is returned to its normal position, whereupon the previously traced path for applying ground potential to the control conductor C341 of the trunk line 340 is interrupted. When ground potential is removed from the control conductor C341 the previously traced circuit for energizing the winding of the marking relay R360 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the marking relay R360 interrupts, at the contacts 361, the previously mentioned circuit for energizing the winding of the control relay R355, thereby to cause the latter relay to restore. Also, when ground potential is removed from the control conductor C341, the previously traced holding circuit for energizing the lower winding of the cut-through relay R380 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the cut-through relay R380 interrupts, at the contacts 382, a further point in the previously traced holding circuit for energizing the winding thereof and interrupts, at the contacts 383 and 385, the previously traced connection between the trunk circuit at the first operator position 1400 and the repeater 335.

When the control relay R355 restores it interrupts, at the contacts 358, the previously traced circuit for energizing the winding of the supervisory relay R370 by way of the simplex conductor C346 and completes, at the contacts 357, the previously traced circuit for energizing the winding of the alarm relay R395 by way of the simplex conductor C346, thereby to cause the line circuit 932 to restore and release the incoming first selector switch 912 and to mark the line 931 as idle to the selector switches having access thereto. When the incoming first selector switch 912 is released, the local and toll connector switch 930 is released, whereupon the subscriber line 900 extending to the called subscriber substation T3 is marked as idle, in the event the subscriber thereat has replaced the receiver of the telephone instrument thereat upon its switchhook.

It will be understood that a call from the switchboard may be extended by the operator at the first operator position 1400 to a called subscriber substation in the exchange C in the C. A. X. network in a similar manner. More particularly, the operator at the first operator position 1400 operates the sending key set 463,

thereby to cause the digit register and control circuit 462 to register a series of digits corresponding to the switch train route to the called subscriber substation in the exchange D, whereupon the sender control circuit 461 operates to cause the toll selector switch 800 to seize the trunk line 340 in the manner previously explained. The reverting dial toll circuit 300 and the line circuit 932 then operate in order to cause the incoming first selector switch 912 to seize an idle trunk, such, for example, as the trunk 920 extending between the tandem exchange C and the exchange D. More particularly, the incoming first selector switch 912 seizes the line 922, thereby to cause the trunk circuit 921 to repeat digits over the trunk 920. The digits repeated over the trunk 920 extending between the tandem exchange C and the exchange D cause the switch train in the exchange D to seize the subscriber line extending to the called subscriber substation in the exchange D.

The supervision and release of the established connection between the first operator position 1400 and the called subscriber substation in the exchange D is the same as that previously explained. When the release operation is performed at the first operator position 1400 the toll selector switch 800, the reverting dial toll circuit 300, the line circuit 932, the incoming first selector switch 912, the trunk circuit 921 and the switch train in the exchange D are released, and the C. A. X. toll line 940 and the trunk 920 are marked as idle and are available for further use.

Extension of a reverting call from the switchboard to the C. A. X. network

As previously noted, the local subscribers in the exchange D and in the tandem exchange C have direct access to the local switch trains in the respective exchanges which have access only to other local subscriber lines in the respective exchanges and to trunk circuits in the tandem exchange C. Accordingly, a subscriber at a calling subscriber substation in either one of the exchanges mentioned cannot complete a connection to a subscriber substation in the other one of the exchanges mentioned unassisted, as this type of a connection must be completed with the assistance of an operator at one of the operator positions at the switchboard in the central office A. For example, in order to extend a connection from the subscriber substation T3 in the tandem exchange C to a subscriber substation in the exchange D the subscriber at the subscriber substation T3 first initiates a call to the switchboard in the central office A in the manner previously explained. Assuming that the call is routed from the calling subscriber substation T3 by way of the subscriber line 900, the line switch S901, the line 902, the local first selector switch 914, the line 933, the dial back repeater 916, the line switch S914, the line 915, the line circuit 932, the C. A. X. toll line 940, the reverting dial toll circuit 300, the trunk line 310 and the finder switch 700 of the finder-selector link illustrated to the first operator position 1400. The operator at the first operator position answers the call in the previously described manner and is advised by the subscriber at the calling subscriber substation T3 that the call is to be extended to a subscriber substation in the exchange D.

Ordinary calls routed from the C. A. X. network to the first operator position 1400 by way of the finder switch 700 are extended after they have been answered at the first operator position by way of the toll selector switch 800 to their destinations in the previously described manner. However, when the call is to be extended back into the C. A. X. network the operator at the first operator position does not set up the call by way of the toll selector switch 800, but sets up the call as a reverting call back over the C. A. X. toll line 940 by way of the finder switch 700 in a manner more fully described subsequently. This arrangement provides for the completion of the call directly in the tandem exchange C, the C. A. X. toll line 940 extending between the tandem exchange C and the central office A being utilized only for supervisory purposes. Accordingly, a substantial saving in the number of trunks extending between the tandem exchange C and the central office A is effected.

When the finder switch 700 of the finder-selector link illustrated operates to seize the trunk line 310 extending to the reverting dial toll circuit 300 the marking relay R360 operates in order to cause the control relay R355 to operate, whereupon the start relay R350 restores, as previously explained. Also, at this time, the talk relay R1130 and the answer pilot relay R1250 in the relay group 1200 associated with the first operator position 1400 occupy their operated positions.

After the operator at the first operator position 1400 is advised that the call is to be extended to the exchange D in the C. A. X. network she initiates the reverting call by momentarily operating the dial key K4 to its left-hand or reverting dial position, thereby to actuate the contacts 1452 thereof into engagement, in order to complete an obvious circuit for energizing the winding of the reverting call relay R1370. The reverting call relay R1370 then operates to prepare, at the contacts 1372, a circuit traced hereinafter for energizing the winding of the control relay R1360 and to complete, at the contacts 1373, a holding circuit for energizing the winding thereof. The holding circuit for energizing the winding of the reverting call relay R1370 extends from ground by way of the contacts 1101, C1189, the contacts 1137, C1191, the contacts 1364 and 1373 and the winding of R1370 to battery. Also, upon operating, the reverting call relay R1370 completes, at the contacts 1371, a path for applying direct ground potential to the control conductor C311 of the trunk line 310, this path extending from ground by way of the contacts 1371 and 1362, C1396, the conductor C1286 in the cable 1270, the contacts 747 and 713 and the wiper 704 to the control conductor C311 of the trunk line 310. This application of direct ground potential to the control conductor C311 of the trunk line 310 completes an obvious circuit for energizing the winding of the dial out relay R330 in series with the winding of the switching relay R340, thereby to cause these relays to operate. Upon operating, the dial out relay R330 interrupts, at the contacts 332, the previously traced path for applying ground potential by way of the winding of the supervisory relay R370 to the simplex conductor C346 and completes, at the contacts 331, a path for applying booster battery potential to the simplex conductor C346, this path extending from the ungrounded terminal of the grounded booster battery 327 by way of the resistor 324 and the contacts 331 to the simplex conductor C346. When booster battery potential is connected to the simplex conductor C346 the line circuit 932 is controlled by way of the line conductors C941 and C942 of the C. A. X. toll line 940 in order to cause

the dial back repeater 916 to operate and render the dial back selector switch 910 individually associated therewith operative by way of the associated line 911. Upon operating, the switching relay R340 prepares, at the contacts 341 and 343, a circuit, traced hereinafter, for energizing the windings of the impulse relay R375 and prepares, at the contacts 345, a circuit, traced hereinafter, for energizing the upper winding of the cut-through relay R380.

After operating the dial key K4 to its reverting dial position the operator at the first operator position 1400 operates this key to its right-hand or dial rear position. When the dial key K4 is thus operated the contacts 1451 thereof are actuated into engagement, thereby to complete a circuit for energizing the upper winding of the call relay R1340 in series with the lower winding of the call pilot relay R1320, this circuit extending from ground by way of the contacts 1451 of the dial key K4, C1474, the contacts 1332, the upper winding of R1340 and the lower winding of R1320 to battery. When energized over the above-traced circuit the call relay R1340 and the call pilot relay R1320 operate. Upon operating, the call pilot relay R1320 interrupts, at the contacts 1321, a further point in the previously traced circuit for energizing the winding of the distributor start relays R1310 and interrupts, at the contacts 1322, the previously traced path for applying ground potential to the start conductor C1386 in the trunk line 1380 extending to the sender control circuit 461, thereby to cause the sender control circuit 461 to be released at this time. Upon operating, the call relay R1340 prepares, at the contacts 1347, a holding circuit for energizing the lower winding thereof. Further, the call relay R1340 completes, at the contacts 1348, an alternative path for applying ground potential to the start conductor C1386 in the trunk line 1380, this path extending from ground by way of the contacts 1469 of the dial key K4, C1472, the contacts 1261, C1388, C1389 and the contacts 1348 and 1334 to the start conductor C1386 in the trunk line 1380. This application of ground potential to the start conductor C1386 in the trunk line 1380 again initiates operation of the sender control circuit 461 for a purpose more fully described hereinafter.

Also, when the dial key K4 is operated to its dial rear position the contacts 1453 thereof are actuated into engagement, thereby to complete an obvious path for applying ground potential to the conductor C1288 in the cable 1270. This application of ground potential to the conductor C1288 in the cable 1270 completes a path including the contacts 753' for applying ground potential to the conductor C792 in the cable 786. This application of ground potential to the conductor C792 in the cable 786 prevents the rotary switch S467 of the sender control circuit 461 from selecting the cable 786 at this time. Also, upon operating, the call relay R1340 interrupts, at the contacts 1343, the normally completed path for applying ground potential to the conductor C1383 in the cable 1380. When ground potential is removed from the conductor C1383 in the cable 1380 extending to the sender control circuit 461 the cable 1380 is marked for selection by the rotary switch S467 of the sender control circuit 461. Accordingly, the sender control circuit 461 operates at this time to cause the rotary switch S466 to select an idle one of the digit register and control circuits, such, for example, as the digit register and control circuit 462, and to cause the rotary switch S467 to select the cable 1380.

Further, the call relay R1340 completes, at the contacts 1346, a multiple circuit for energizing the upper winding of the connect relay R750 in the finder switch 700 in series with the winding of the talk relay R1130, thereby to retain the connect relay R750 in its operated position subsequent to the restoration of the talk key K780 of the finder switch 700 to its normal position, this circuit extending from ground by way of the winding of R1130, C1186, the contacts 1346, the conductor 1292 in the cable 1270, the contacts 758 and 759 and the upper winding of R750 to battery. Further, the call relay R1340 completes, at the contacts 1344, an obvious circuit for energizing the winding of the rear split relay R1220, thereby to cause the latter relay to operate. Upon operating, the rear split relay R1220 completes, at the contacts 1222 and 1224, a connection between the line conductors C1094' and C1095' in the cable 1380 and the line conductors C1283 and C1284 in the cable 1270. At this time a circuit is completed for energizing the winding of the impulse relay R375, this circuit extending from ground by way of the upper winding of R375, the contacts 384, C342 and the contacts 341 to the line conductor C312 of the trunk line 310; and from battery by way of the lower winding of R375, the contacts 386, C343 and the contacts 343 to the line conductor C313 of the trunk line 310; the line conductors C312 and C313 of the trunk line 310 being connected by way of the finder switch 700 to the line conductors C1284 and C1283 in the cable 1270; the line conductors C1283 and C1284 in the cable 1270 being connected to the line conductors C1094' and C1095' in the cable 1380; and the line conductors C1094' and C1095' in the cable 1380 being connected together by way of a loop circuit in the sender control circuit 461. Accordingly, the impulse relay R375 is energized at this time and operates. Upon operating, the impulse relay R375 completes, at the contacts 377, the previously mentioned circuit for energizing the winding of the hold relay R390, thereby to cause the latter relay to operate as previously explained. Finally, at the contacts 1457 of the dial key K4, a path is completed for short-circuiting the winding of the dial rear relay R1300, this path extending from battery by way of the resistor 1432, C1458, the contacts 1457 of the dial key K4, C1473, the contacts 1302 and the winding of R1300 to battery. The completion of this path for short-circuiting the winding of the dial rear relay R1300 positively prevents operation of the latter relay at this time.

When the rotary switch S467 of the sender control circuit 461 seizes the cable 1380 ground potential is applied to the conductors C1384 and C1387 in the cable 1380, thereby to complete an obvious circuit for energizing the lower winding of the control relay R1350 and to complete a circuit for energizing the winding of the control relay R1360. The circuit for energizing the winding of the control relay R1360 extends from ground potential on the conductor C1387 in the cable 1380 by way of the contacts 1372 and the winding of R1360 to battery. When energized over the above-traced circuit the control relay R1360 operates to complete, at the contacts 1363, an obvious holding circuit for energizing the winding thereof, including the grounded conductor C1387 in the cable 1380. Also, upon operating, the control relay R1360 interrupts, at the contacts 1362, the previously traced path for

applying direct ground potential to the control conductor C311 of the trunk line 310 and completes, at the contacts 1361, an alternative path, substantially identical to that previously traced, for applying resistance ground potential by way of the resistor 1374 to the control conductor C311 of the trunk line 310. When resistance ground potential is substituted on the control conductor C311 of the trunk line 310 for direct ground potential thereon a high resistance circuit is completed for energizing the winding of the dial out relay R330 in series with the winding of the switching relay R340. The dial out relay R330 is not adequately energized by way of this circuit; however, the switching relay R340 is adequately energized thereby. Accordingly, the dial out relay R330 restores, while the switching relay R340 remains operated. Upon restoring, the dial out relay R330 prepares, at the contacts 333, a point in the previously traced circuit for energizing the lower winding of the cut-through relay R380 and completes, at the contacts 332, the previously traced path for applying direct ground potential at the contacts 376 of the impulse relay R375 to the simplex conductor C346.

Also, upon operating, the control relay R1360 interrupts, at the contacts 1364, the previously traced holding circuit for energizing the winding of the reverting call relay R1370, thereby to cause the latter relay to restore shortly thereafter, this relay being of the slow-to-release type. Upon operating, the control relay R1350 completes, at the contacts 1351, a holding circuit for energizing the upper winding thereof, this circuit extending from ground by way of the contacts 1344 and 1351 and the upper winding of R1350 to battery. Further, the control relay R1350 completes, at the contacts 1352, a holding circuit for energizing the lower winding of the call relay R1340, this circuit extending from ground by way of the contacts 1352, the lower winding of R1340, the contacts 1347 and 1333, C1382 and the contacts 1254 to battery.

The operator at the first operator position 1400 then actuates the keys of the sending key set 463 in order to register in the digit register and control circuit 462 a predetermined series of digits corresponding to the switch train route to the called subscriber substation in the exchange D, whereupon the sender control circuit 461 operates, thereby to transmit the impulses comprising the digits over the previously traced loop circuit including the windings of the impulse relay R375. Accordingly, the impulse relay R375 follows the impulses transmitted by the sender control circuit 461 and causes the impulses to be repeated over the simplex conductor C346 due to the intermittent operation of the contacts 376 of the impulse relay R375. More particularly, these impulses are transmitted over the simplex conductor C346 and the line conductors C941 and C942 of the C. A. X. toll line 940 to the line circuit 932 and therefrom by way of the line 915 and the line switch S914 to the dial back repeater 916. The dial back repeater 916 repeats the first digit by way of the line 911 to the dial back selector switch 910, thereby to cause the dial back selector switch 910 to operate and seize an idle one of the trunk lines extending between the tandem exchange C and the exchange D, such, for example, as the trunk line 920. More particularly, the dial back selector switch 910 seizes the line 922 extending to the trunk circuit 921, thereby to complete a connection between the C. A. X. toll line 940 and the switch train in the exchange D. The subsequent digits are repeated from the dial back repeater 916 by way of the line 911, the dial back selector switch 910, the line 922, the trunk circuit 921 and the trunk line 920 to the switch train in the exchange D, thereby to cause the switch train in the exchange D to seize the subscriber line extending to the called subscriber substation in the exchange D.

When the sender control circuit 461 has operated to transmit all of the digits registered therein it operates to cause battery potential to be applied to the conductor C1382 in the cable 1380, thereby to complete a circuit for energizing the upper winding of the cut-through relay R380, this circuit extending from battery potential on the conductor C1382 in the cable 1380 by way of the contacts 1342, the conductor C1293 in the cable 1270, the contacts 744 and 718, the wiper 707, the control conductor C314 of the trunk line 310, the contacts 345 and 388 and the upper winding of R380 to ground. When energized over the above-traced circuit the cut-through relay R380 operates to complete, at the contacts 382, the previously traced holding circuit for energizing the lower winding thereof and to prepare, at the contacts 383 and 385, an operative connection between the repeater 335 and the trunk circuit at the first operator position. Further, the cut-through relay R380 interrupts, at the contacts 384 and 386, a further point in the previously traced circuit for energizing the windings of the impulse relay R375, thereby to cause the latter relay to restore and interrupt, at the contacts 377, the previously mentioned circuit for energizing the winding of the hold relay R390, whereupon the latter relay restores. Upon restoring, the hold relay R390 completes, at the contacts 392, the previously traced circuit for energizing the winding of the supervisory relay R370 by way of the simplex conductor C346.

After the sender control circuit 461 operates to transmit the entire series of digits it operates to cause ground potential to be applied to the conductor C1381 in the cable 1380 and is then released as previously explained. The application of ground potential to the conductor C1381 in the cable 1380 completes an obvious circuit for energizing the winding of the cut-in relay R1330, thereby to cause the latter relay to operate and complete, at the contacts 1331, a holding circuit for energizing the winding thereof, this circuit extending from ground by way of the contacts 1451 of the dial key K4, C1474, the contacts 1331 and the winding of R1330 to battery. Also, upon operating, the cut-in relay R1330 interrupts, at the contacts 1334, the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380, interrupts, at the contacts 1332, the circuit for energizing the upper winding of the call relay R1340 in series with the lower winding of the call pilot relay R1320, and interrupts, at the contacts 1333, the previously traced holding circuit for energizing the lower winding of the call relay R1340. Accordingly, the call pilot relay R1320 and the call relay R1340 restore. Upon restoring, the call relay R1340 interrupts, at the contacts 1344, the previously traced holding circuit for energizing the upper winding of the control relay R1350. When the sender control circuit 461 is released the previously mentioned circuit for energizing the lower winding of the control relay R1350 and the previously traced holding circuit for energizing the winding of the control relay R1360 are inter-

rupted, thereby to cause these relays to restore. Upon restoring, the control relay R1360 interrupts, at the contacts 1361, the previously traced resistance circuit for energizing the winding of the dial out relay R330 in series with the winding of the switching relay R340, thereby to cause the switching relay R340 to restore, the dial out relay R330 being restored at this time.

Also, upon restoring, the call relay R1340 interrupts, at the contacts 1344, the previously traced circuit for energizing the winding of the rear split relay R1220, thereby to cause the latter relay to restore. Further, the call relay R1340 completes, at the contacts 1343, the previously mentioned path for applying ground potential to the conductor C1383 in the cable 1380, thereby to mark the cable 1380 as busy to the rotary switch S467 of the sender control circuit 461. Upon restoring, the rear split relay R1220 recompletes, at the contacts 1221 and 1223, the previously traced connection between the line conductors C1283 and C1284 in the cable 1270 and the trunk circuit at the first operator position 1400, thereby to complete the previously traced operative connection between the trunk circuit at the first operator position and the repeater 335.

The operator at the first operator position 1400 then returns the dial key K4 to its normal position, thereby to interrupt, at the contacts 1449 thereof, a further point in the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380 and to interrupt, at the contacts 1451, the previously traced holding circuit for energizing the winding of the cut-in relay R1330, thereby to cause the latter relay to restore shortly thereafter, this relay being of the slow-to-release type. Also, when the dial key K4 is restored to its normal position it interrupts, at the contacts 1453, the previously traced path for applying ground potential by way of the conductor C1288 in the cable 1270 to the conductor C792 in the cable 786 and interrupts, at the contacts 1457 thereof, the previously traced path for short-circuiting the winding of the dial rear relay R1300.

As previously noted, when the hold relay R390 restores it completes, at the contacts 392, the previously traced circuit for energizing the winding of the supervisory relay R370, thereby to cause the latter relay to operate and complete, at the contacts 371, a path for applying ground potential to the control conductor C314 of the trunk line 310, this path extending from ground by way of the contacts 371, 363 and 346 to the control conductor C314 of the trunk line 310. This application of ground potential to the control conductor C314 of the trunk line 310 completes the previously traced circuit for energizing the winding of the supervisory relay R1230, thereby to cause the latter relay to operate. Upon operating, the supervisory relay R1230 completes, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L767. The illumination of the supervisory lamp L767 indicates to the operator at the first operator position 1400 that the sender control circuit 461 has operated to transmit all of the digits registered in the digit register and control circuit 462 and that the switch train in the exchange D has operated to seize the subscriber line extending to the called subscriber substation therein. At this time, in the event the called subscriber line in the exchange D is busy, busy tone current is returned over the previously traced connection between the repeater 335 and the switch train in the exchange D and repeated by the repeater 335 to the trunk circuit at the first operator position 1400. The operator at the first operator position 1400 then advises the subscriber at the calling subscriber substation T3 that the called subscriber substation in the exchange D is busy at this time and that the connection may not immediately be had.

On the other hand, in the event the called subscriber substation in the exchange D is idle at this time, the switch train in the exchange D operates to cause ringing current to be projected thereover to the called subscriber substation. When the call is answered at the called subscriber substation in the exchange D the dial back repeater 916 is controlled over the previously traced circuit between the switch train in the exchange D and the dial back repeater 916 in order to cause the line circuit 932 to operate, thereby to increase the resistance of the previously traced circuit including the simplex conductor C346 for energizing the winding of the supervisory relay R370. The supervisory relay R370 then restores to interrupt, at the contacts 371, the previously traced circuit for energizing the winding of the supervisory relay R1230, thereby to cause the latter relay to restore and interrupt, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L767. When the supervisory lamp L767 is extinguished it indicates to the operator at the first operator position 1400 that the call has been answered at the called subscriber substation in the exchange D.

At this time a connection is established between the calling subscriber substation T3 in the tandem exchange C and the called subscriber substation in the exchange D, this connection extending from the calling subscriber substation T3 by way of the subscriber line 900, the line switch S901, the line 902, the local first selector switch 914, the line 933, the dial back repeater 916, the line 911, the dial back selector switch 910, the line 922, the trunk circuit 921, the trunk line 920 extending between the tandem exchange C and the exchange D, and the switch train in the exchange D to the subscriber line extending to the called subscriber substation in the exchange D. Also, an operative connection is completed between the dial back repeater 916 and the trunk circuit at the first operator position 1400, this connection extending from the dial back repeater 916 by way of the line switch S914, the line 915, the line circuit 932, the C. A. X. toll line 940, the repeater 335, the reverting dial toll circuit 300, the trunk line 310 in the finder switch 700 to the trunk circuit at the first operator position. Accordingly, a three-way communication connection between the first operator position 1400, the calling subscriber substation T3 in the tandem exchange C and the called subscriber substation in the exchange D is completed at this time.

It is noted that the subscriber at the calling subscriber substation T3 in the tandem exchange C and the subscriber at the called subscriber substation in the exchange D both have switchhook supervision and may signal the operator at the first operator position 1400 by repeatedly operating the switchhook of the telephone instruments at their respective substations, thereby to cause the dial back repeater 916 to control the operation of the line circuit 932, whereupon the supervisory relay R370 is repeatedly operated in

order to cause ground potential to be intermittently connected to the control conductor C314 of the trunk line 310. The intermittent application of ground potential to the control conductor C314 causes flashing of the supervisory lamp L767, regardless of the position of the talk key K780 of the finder switch 700 as previously explained.

It is noted that the established connection between the calling subscriber substation T3 in the tandem exchange C and the called subscriber substation in the exchange D is primarily under the control of the subscriber at the calling subscriber substation T3; however, the operator at the first operator position 1400 may release the leg of the connection between the first operator position 1400 and the dial back repeater 916 by operating the release key K8 to its rear position, thereby to cause the finder switch 700 to be released in the manner previously described. When the finder switch 700 is released ground potential is removed from the control conductor C315 of the trunk line 300, thereby to cause the marking relay R360, the cut-through relay R380 and the control relay R355 in the reverting dial toll circuit 300 to restore as previously explained. Upon restoring, the control relay R355 completes, at the contacts 357, the previously traced path for applying ground potential by way of the winding of the alarm relay R395 to the simplex conductor C346, thereby to cause the line circuit 932 to operate and control the operation of the dial back repeater 916. More particularly, the dial back repeater 916 interrupts the connection between the repeater 916 and the line circuit 932, whereupon the C. A. X. toll line 940 is marked as idle and is available for further use.

The established connection between the calling subscriber substation T3 in the tandem exchange C and the called subscriber substation in the exchange D may be released under the control of the subscriber at the calling subscriber substation T3 and is effected when the receiver of the telephone instrument thereat is replaced upon its switchhook, thereby to cause the local first selector switch 914 to be released. When the local first selector switch 914 is released the dial back repeater 916 is released in order to cause the release of the dial back selector switch 910, whereupon the trunk circuit 921 is released. When the trunk circuit 921 is released the switch train in the exchange D is released, thereby to cause the trunk line 920 extending between the tandem exchange C and the exchange D to be marked as idle to the switches having access thereto and to cause the subscriber line extending to the called subscriber substation in the exchange D to be marked as idle to the switches having access thereto, assuming that the subscriber at the called subscriber substation in the exchange D has replaced the receiver of the telephone instrument thereat upon its switchhook at this time.

The extension of a connection from a calling subscriber substation in the exchange D to a called subscriber substation in the tandem exchange C must be completed under the control of an operator at the switchboard in the central office A in a similar manner. For example, in order to extend a connection from the calling subscriber substation in the exchange D to the called subscriber substation T3 in the tandem exchange C the subscriber at the calling subscriber substation in the exchange D first initiates the call and controls the switch train in the exchange D in order to cause it to seize a trunk line extending between the exchange D and the tandem exchange C, such, for example, as the trunk line 920. When the trunk line 920 is seized the trunk circuit 921 individually associated therewith operates, thereby to cause the line switch S918 individually associated therewith to operate and seize an idle one of the dial back repeaters, such, for example, as the dial back repeater 916. More particularly, the line switch S918 seizes the line 917, thereby to cause the dial back repeater 916 to operate and cause the line switch S914 to operate and hunt for an idle C. A. X. toll line extending between the tandem exchange C and the central office A, such, for example, as the C. A. X. toll line 940. More particularly, the line switch S914 seizes the line 915, thereby to cause the line circuit 932 to control by way of the C. A. X. toll line 940 the reverting dial toll circuit 300. The reverting dial toll circuit 300 causes the finder switch of one of the finder-selector links associated with one of the operator positions at the switchboard to seize the trunk line 310 extending to the reverting dial toll circuit 300. Assuming that the finder switch 700 of the finder-selector link illustrated associated with the first operator position 1400 finds the trunk line 310 extending to the reverting dial toll circuit 300 the operator at the first operator position answers the call and is advised that the connection is to be extended to the called subscriber substation T3 in the tandem exchange C in the manner previously described. The operator at the first operator position 1400 then controls, by way of the finder switch 700, the reverting dial toll circuit 300, the C. A. X. toll line 940, the line 915 and the line switch S914, the operation of the dial back repeater 916, thereby to cause the dial back repeater 916 to render the dial back selector switch 910 operative by way of the line 911. The operator at the first operator position 1400 then actuates the keys of the sending key set 463, thereby to cause the sender control circuit 461 to transmit digits over the C. A. X. toll line 940 to the dial back repeater 916, whereupon the dial back selector switch 910 operates to seize an idle one of the local and toll connector switches, such, for example, as the local and toll connector switch 930. More particularly, the dial back selector switch 910 seizes the line 931 extending to the local and toll connector switch 930, whereupon the local and toll connector switch 930 is rendered responsive to two additional digits transmitted thereto. When the two additional digits are transmitted to the local and toll connector switch 930 it operates to seize the subscriber line 900 extending to the called subscriber substation T3. The subsequent operation of the local and toll connector switch 930 is dependent upon the idle or busy condition of the called subscriber substation T3 as previously explained.

Assuming that the subscriber substation T3 is idle at this time a three-way communication connection is established between the calling subscriber substation in the exchange D, the called subscriber substation T3 in the tandem exchange C and the first operator position 1400. The supervision of the established connection between the calling subscriber substation in the exchange D and the called subscriber substation T3 in the tandem exchange C and the release of the leg of the connection between the dial back repeater 916 and the first operator position 1400 are performed

by the operator at the first operator position in the manner previously explained. Finally, the release of the established connection between the calling subscriber substation in the exchange D and the called subscriber substation T3 in the tandem exchange C is under the control of the subscriber at the calling subscriber substation in the exchange D and is effected in the manner previously explained.

Extension of a delayed call from the switchboard

After a call is answered at one of the operator positions at the switchboard the operator thereat extends the call to the desired destination in the manner previously explained. In the event the subscriber substation at the destination is busy or all of the trunk lines extending to an intermediate switching point in the outgoing switch train are busy the calling party is so advised and subsequently the operator again endeavors to extend the connection to the destination as previously explained. However, in the event the called subscriber substation remains busy or all of the trunk lines extending to an intermediate switching point in the outgoing switch train remain busy the calling party is advised that the call may not immediately be extended and that when the connection has been extended to the desired destination he will be recalled. The operator at the first operator position then prepares a ticket for the call indicating the calling and called substations and passes this ticket to a point-to-point operator position. The operator at the point-to-point operator position then endeavors to establish a connection from her position to the called subscriber substation and after this connection is established she establishes a connection from her position to the calling subscriber substation. This type of call is termed a delayed, point-to-point or tail-to-tail call and will hereinafter be referred to as a delayed call.

Assuming that the operator at the first operator position 1400 wishes to make a delayed call from her position she first operates the delay call key K12 away from its normal position, thereby to interrupt, at the contacts 1437 thereof, a point in the previously traced circuit for energizing the winding of the distributor start relay R1310 in order positively to prevent operation of the latter relay at this time. The restored distributor start relay R1310 retains completed, at the contacts 1312, the previously traced path for applying ground potential to the guard conductor C1307 in the trunk line 1305 extending between the first operator position 1400 and the position distributor 1005, thereby positively to prevent operation of the position distributor 1005 to route an incoming call to the first operator position 1400 to be answered at this time. The talk key of the finder switch of an idle one of the finder-selector links associated with the first operator position is then operated away from its normal position. Assuming that the talk key K789 of the finder switch 700 is operated away from its normal position the finder switch 700 is conditioned to be operated.

The operator at the first operator position 1400 then operates the dial key K4 to its dial rear position, thereby to complete, at the contacts 1455 thereof, an obvious path for applying ground potential to the marking conductor C1291 in the cable 1270. This application of ground potential to the marking conductor C1291 in the cable 1270 marks the first level in the vertical control contact bank 709 of the mechanism 701 of the finder switch 700 corresponding to the first level of contact sets in the main contact bank of the mechanism 701, wherein the group of trunk lines extending to the group of delayed toll selector switches is terminated. Also, at the contacts 1449 of the dial rear key K4, there is completed an obvious path for applying ground potential to the conductor C1472, thereby to complete a path extending by way of the contacts 1261 and 1251 to the start conductor C1287 in the cable 1270. This application of ground potential to the start conductor C1287 in the cable 1270 completes the previously traced circuit for energizing the winding of the start relay R740 in the finder switch 700, thereby to initiate operation of the finder switch 700. More particularly, the vertical magnet M733 drives the wiper set of the mechanism 701 one step in the vertical direction, whereupon the vertical control wiper 708 engages the first contact in the associated vertical control contact bank 709 having ground potential thereon and the previously traced circuit for energizing the lower winding of the transfer relay R720 is completed. The transfer relay R720 then operates in order to complete, at the contacts 723, the previously traced circuit for energizing the rotary magnet M734. The rotary magnet M734 then drives the wiper set of the mechanism 701 in the rotary direction until it engages a contact set in the main contact bank of the mechanism terminating a trunk line extending to an idle delayed toll selector switch. Assuming that the delayed toll selector switch 446 is the first idle delayed toll selector switch in this group the finder switch 700 continues to operate until the trunk line 445 extending thereto is engaged by the wiper set of the mechanism 701. The finder switch 700 then operates to seize the trunk line 445, thereby to render the delayed toll selector switch 446 operative in response to a digit transmitted thereto in the manner previously explained. Also, upon operating, the transfer relay R720 in the finder switch 700 completes, at the contacts 721, the previously traced circuit for energizing the winding of the answer pilot relay R1250, thereby to cause the latter relay to operate as previously explained.

Also, when the dial key K4 is operated to its dial rear position the contacts 1451 thereof are actuated into engagement, thereby to complete the previously traced circuit for energizing the upper winding of the call relay R1340 in series with the lower winding of the call pilot relay R1320, whereupon the latter relays operate. Also, the contacts 1453 of the dial key K4 are actuated into engagement, thereby to complete the previously traced path for applying ground potential to the conductor C792 in the cable 786 in order to mark the cable 786 as busy in the previously described manner. Finally, at the contacts 1457 of the dial key K4, the previously traced path for short-circuiting the winding of the dial rear relay R1300 is completed at this time. Upon operating, the call pilot relay R1320 interrupts, at the contacts 1321, a further point in the previously traced circuit for energizing the winding of the distributor start relay R1310 and interrupts, at the contacts 1322, a point in the previously traced original path for applying ground potential to the start conductor C1386 in the trunk line 1380. Upon operating, the call relay R1340 interrupts, at the contacts 1343, the previously mentioned path for applying ground potential to the conductor C1383 in the cable 1380, thereby to mark the cable 1380 to be selected by the rotary switch S467 of the sender

control circuit 461. Also, the call relay R1340 completes, at the contacts 1344, the previously traced circuit for energizing the winding of the rear split relay R1220, thereby to cause the latter relay to operate and complete, at the contacts 1222 and 1224, the previously traced connection betwen the line conductors C1094' and C1095' in the cable 1380 and the line conductors C1283 and C1284 in the cable 1270. Further, the call relay R1340 completes, at the contacts 1346, the previously traced alternative circuit for energizing the winding of the talk relay R1130 in series with the upper winding of the connect relay R750, prepares, at the contacts 1347, the previously traced holding circuit for energizing the lower winding thereof, and completes, at the contacts 1348, the previoulsy traced alternative path for applying ground potential to the start conductor C1386 in the cable 1380. This application of ground potential to the start conductor C1386 in the cable 1380 initiates operation of the sender control circuit 461. The rotary switch 466 of the sender control circuit 461 then selects an idle one of the digit register and control circuits, such, for example, as the digit register and control circuit 462, and the rotary switch S467 of the sender control circuit 461 selects the cable 1380.

When the sender control circuit 461 selects the cable 1380 ground potential is applied to the conductor C1384 in the cable 1380, thereby to complete the previously mentioned circuit for energizing the lower winding of the control relay R1350. The control relay R1350 then operates to complete, at the contacts 1351, the previously traced holding circuit for energizing the upper winding thereof. When the answer pilot relay R1250 operates it completes, at the contacts 1252, the previously traced alternative path for applying ground potential to the start conductor C1287 in the cable 1270, thereby to complete a holding circuit for energizing the winding of the start relay R740. Further, the answer pilot relay R1250 completes, at the contacts 1254, the previously traced holding circuit for energizing the lower winding of the call relay R1340.

At this time a loop circuit is completed between the sender control circuit 461 and the delayed toll selector switch 446, this circuit extending from the line conductor C1094' in the cable 1380 by way of the contacts 1222, the line conductor C1283 in the cable 1270, the contacts 755 and 712, and the wiper 703 to one of the line conductors of the trunk line 445, and from the line conductor C1095' in the cable 1380 by way of the contacts 1224, the line conductor C1284 in the cable 1270, the contacts 752 and 711 and the wiper 702 to the other line conductor of the trunk line 445, the line conductors C1094' and C1095' in the cable 1380 being connected together by way of a loop circuit in the sender control circuit 461, and the line conductors of the trunk line 445 being connected to impulse responsive apparatus in the delayed toll selector switch 446.

The operator at the first operator position then operates the sending key set 463, thereby to register in the digit register and control circuit 462 the switch train route to the called subscriber substation, whereupon the digit register and control circuit 462 immediately operates to cause the sender control circuit 461 to operate and transmit the impulses comprising the digits registered over the previously traced loop circuit to the delayed toll selector switch 446. The delayed toll selector switch 446 operates in response to the first digit transmitted thereto in a manner similar to the operation of the toll selector switch 809, thereby to cause the connection to be extended to the called subscriber substation.

In the event the operator at the first operator position 1400 makes an error in actuating the sending key set 463 she operates the error key K3 away from its normal position, thereby to complete, at the contacts 1436 thereof, the previously mentioned circuit for energizing the winding of the error relay R1260, thereby to cause the latter relay to operate. Upon operating, the error relay R1260 completes, at the contacts 1262, a path for applying ground potential to the release conductor C1289 in the cable 1270, this path extending from ground by way of the contacts 1345, C1397 and the contacts 1262 to the release conductor C1289. This application of ground potential to the release conductor C1289 in the cable 1270 causes the finder switch 700 to restore to its normal position in the previously described manner. Also, this application of ground potential to the release conductor C1289 in the cable 1270 completes an obvious path for short-circuiting the winding of the answer pilot relay R1250, thereby to cause the latter relay to restore. Upon restoring, the answer pilot relay R1250 interrupts, at the contacts 1254, the previously traced holding circuit for energizing the lower winding of the call relay R1340.

When all of the digits registered in the digit register and control circuit 462 have been transmitted, the digit register and control circuit 462 operates in order to cause ground potential to be applied to the conductor C1381 in the cable 1380, thereby to cause the cut-in relay R1330 to operate as previously explained. Upon operating, the cut-in relay R1330 completes, at the contacts 1331, the previously traced holding circuit for energizing the winding thereof and interrupts, at the contacts 1332, the previously traced circuit for energizing the upper winding of the call relay R1340 in series with the lower winding of the call pilot relay R1320, thereby to cause the latter relays to restore. Further, the cut-in relay R1330 interrupts, at the contacts 1334, the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380. Upon restoring, the call relay R1340 interrupts, at the contacts 1344, the previously traced holding circuit for energizing the upper winding of the control relay R1350 and the previously mentioned circuit for energizing the winding of the rear split relay R1220, thereby to cause the latter relays to restore. Upon restoring, the rear split relay R1220 recompletes, at the contacts 1221 and 1223, the previously traced connections between the line conductors C1283 and C1284 in the cable 1270 and the trunk circuit at the first operator position 1400. The operator at the first operator position 1400 then restores the dial key K4 to its normal position, thereby to interrupt, at the contacts 1451 thereof, the previously traced holding circuit for energizing the winding of the cut-in relay R1330 in order to cause the latter relay to restore. The operator at the first operator position then operates the error key K3 back to its normal position, thereby to interrupt the previously traced circuit for energizing the winding of the error relay R1260, thereby to cause the latter relay to restore shortly thereafter, the error relay R1260 being of the slow-to-release type.

The operator at the first operator position 1400 then operates the dial key K4 back to its dial rear position, whereupon the finder switch 700 oper-

ates, in the previously described manner, thereby to select the trunk line 445 extending to the delayed toll selector switch 446 and to cause the answer pilot relay R1250 to reoperate, the call pilot relay R1320 and the call relay R1340 being operated at this time. Upon operating, the call relay R1340 recompletes, at the contacts 1348, the previously traced path for applying ground potential to the start conductor C1386 in the cable 1380, thereby to cause the rotary switch S467 in the sender control circuit 461 to again select the cable 1380, whereupon the control relay R1350 is operated as previously explained. Again the operator at the first operator position actuates the sending key set 463, thereby to cause digits to be transmitted to the delayed toll selector switch 446 as previously explained. After all of the digits registered in the digit register and control circuit 462 have been transmitted, the sender control circuit 461 operates to cause the cut-in relay R1330 to operate as previously explained, whereupon the call pilot relay R1320, the call relay R1340 and the control relay R1350 restore as previously explained. The operator at the first operator position then operates the dial key K4 back to its normal position, thereby to cause the cut-in relay R1330 to restore as previously explained.

The subsequent operation of the delayed toll selector switch to seize the trunk circuit extending to the switch train having access to the called subscriber substation is the same as that previously explained. When a connection is extended by the switch train to the called subscriber substation ground potential is applied by way of the switch train to the control conductor of the trunk line 445, thereby to complete the previously traced circuit for energizing the winding of the supervisory relay R1230. The supervisory relay R1230 then operates to complete, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L767. The illumination of the supervisory lamp L767 indicates to the operator at the first operator position that the switch train has operated to extend the connection to the called subscriber substation. At this time a connection is completed between the trunk circuit at the first operator position and the switch train. The subsequent operation of the switch train depends upon the idle or busy condition of the called subscriber substation. In the event the called subscriber substation is busy, busy tone current is returned over the connection to the trunk circuit at the first operator position; and in the event the called subscriber substation is idle, ringing current is projected over the subscriber line extending to the called subscriber substation. When the call is answered at the called subscriber substation the switch train operates to cause ground potential to be removed from the control conductor of the trunk line 445, thereby to interrupt the previously traced circuit for energizing the winding of the supervisory relay R1230 in order to cause the latter relay to restore and interrupt, at the contacts 1231, the previously traced circuit for illuminating the supervisory lamp L767. When the supervisory lamp L767 is extinguished it indicates to the operator at the first operator position that the call has been answered at the called subscriber substation. The operator at the first operator position 1400 then advises the subscriber at the called subscriber substation that there is a call for him and then proceeds to extend the call over the front end of the finder-selector link illustrated by causing the toll selector switch 800 to operate in the previously described manner. More particularly, the sending key set 463 is operated, thereby to register in the digit register and control circuit the switch train route to the calling subscriber substation. The digit register and control circuit 462 then operates to cause the sender control circuit 461 to transmit the digits registered to the toll selector switch 800. The operations of the toll selector switch 800 and the outgoing switch train in response to the digits transmitted thereto are the same as previously explained.

The supervision and release of the delayed call are the same as previously explained. Particularly, it is noted that the operator at the first operator position 1400 may release the rear end of the connection, including the finder switch 700, the delayed toll selector switch 446 and the local switch train seizing the called subscriber line, by operating the release key K8 to its rear position as previously explained; while the front end of the connection, including the toll selector switch 800 and the outgoing switch train, may be released by operating the release key K8 to its front position as previously explained.

Extension of local calls in the central office and in the exchanges

As previously noted, subscribers at the subscriber substations in the central office A may complete calls to other subscriber substations in the central office A unassisted. For example, the subscriber at the subscriber substation T1 in the central office A may extend a call to another subscriber substation in the central office A unassisted. First the subscriber at the subscriber substation T1 removes the receiver of the telephone instrument thereat from its switchhook, thereby to cause the line circuit 452 individually associated with the subscriber line 451 to operate and cause the local distributor 453 to assign an idle one of the local links, such, for example, as the local link 454, to the use of the calling subscriber substation T1. The local finder switch 456 of the local link 454 then operates to seize, by way of the line circuit 452, the subscriber line 451. The subscriber at the calling subscriber substation T1 then actuates the dialing mechanism at his substation, thereby to transmit a predetermined series of digits over the subscriber line 451, whereupon the local selector switch 455 operates to seize a line extending to an idle local connector switch, such, for example, as the local connector switch 460. More particularly, the local selector switch 455 seizes the line 457 extending to the local connector switch 460, thereby to render the local connector switch 460 responsive to digits dialed thereinto. The subscriber at the calling subscriber substation T1 then actuates the dialing mechanism thereat, thereby to cause the local connector switch 460 to seize the subscriber line extending to the called subscriber substation. Subsequently, the local connector switch 460 operates in the usual manner, depending upon the idle or busy condition of the called subscriber substation. Furthermore, the release of the established connection between the subscriber substations in the central office A is directly under the control of the subscribers at the substations.

As previously noted, the subscribers at the subscriber substations in the tandem exchange C and in the exchange D may complete calls to other subscriber substations in the respective ex-

changes without assistance. For example, the subscriber at the subscriber substation T3 in the tandem exchange C may complete a call to another subscriber substation in the tandem exchange C unassisted. In order to initiate a call of this type the subscriber at the calling subscriber substation T3 removes the receiver of the telephone instrument thereat from its switchhook, thereby to cause the line switch S901 to select an idle local first selector switch, such, for example, as the local first selector switch 914. More particularly, the line switch S901 seizes the line 902 extending to the local first selector switch 914, thereby to render the local first selector switch 914 operative in response to a digit dialed thereinto. The subscriber at the calling subscriber substation T3 then operates the dialing mechanism thereat, thereby to cause the local first selector switch 914 to operate and seize a line extending to an idle local and toll connector switch, such, for example, as the local and toll connector switch 930. More particularly, the local first selector switch 914 seizes the line 931 extending to the local and toll connector switch 930, thereby to render the local and toll connector switch 930 operative in response to two digits dialed thereinto. The subscriber at the calling subscriber substation T3 then actuates the dialing mechanism thereat, thereby to cause the local and toll connector switch 930 to seize the subscriber line extending to the called subscriber substation. The subsequent operation of the local and toll connector switch 930 depends upon the idle or busy condition of the called subscriber substation in the usual manner. Furthermore, the release of this connection is under the control of the subscribers at the subscriber substations in the usual manner.

Also, the subscribers at the subscriber substations in the exchange D may complete calls to other subscriber substations in the exchange D without assistance in a manner similar to that previously explained in connection with the completion of calls between subscriber substations in the tandem exchange C.

As previously noted, the distant exchange B may be of any desired type, in which event local calls between the subscriber substations therein may be completed in any well known manner.

Conclusions

From the foregoing it is apparent that a telephone system is provided which comprises an automatic switchboard including a number of operator positions and improved switching apparatus controllable from the operator positions for performing the various toll and trunk services in an efficient manner, thereby to insure that toll and trunk calls may be easily set up and supervised at the operator positions at the switchboard.

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

What is claimed is:

1. In a telephone system, a trunk including first and second branches normally connected together, each branch of said trunk including two line conductors, a trunk circuit associated with both branches of said trunk and including a ring relay and an identity relay, a first operating circuit for said ring relay including one of the line conductors of the second branch of said trunk, a second operating circuit for said identity relay including the other line conductor of the second branch of said trunk, a source of ringing voltage, said ring relay being operative to disconnect the first and second branches of said trunk and to connect said source of ringing voltage to the line conductors of the first branch of said trunk, an identity signal individual to said trunk, said identity relay being operative to cause operation of said identity signal, an operator position, automatic switching apparatus associated with said operator position and having access to the second branch of said trunk, means for causing said switching apparatus to seize the second branch of said trunk, thereby to complete a connection between said operator position and said trunk, and a device at said operator position selectively operative to complete by way of said switching apparatus said first operating circuit or said second operating circuit.

2. In a telephone system, a trunk including first and second branches normally connected together, each branch of said trunk including two line conductors, a trunk circuit associated with both branches of said trunk and including an order relay and an identity relay, a first operating circuit for said order relay including one of the line conductors of the second branch of said trunk, a second operating circuit for said identity relay including the other line conductor of the second branch of said trunk, a source of out-of-order voltage, said order relay being operative to connect said source of out-of-order voltage to both branches of said trunk, an identity signal individual to said trunk, said identity relay being operative to cause operation of said identity signal and to complete said first operating circuit in the event it is prepared, an operator position, automatic switching apparatus associated with said operator position and having access to the second branch of said trunk, means for causing said switching apparatus to seize the second branch of said trunk, thereby to complete a connection between said operator position and said trunk, and a device at said operator position selectively operative to prepare by way of said switching apparatus said first operating circuit and to complete by way of said switching apparatus said second operating circuit or to complete by way of said switching apparatus said second operating circuit.

3. In a telephone system, a trunk including first and second branches normally connected together, each branch of said trunk including two line conductors, a trunk circuit associated with both branches of said trunk and including a ring relay and an order relay and a control relay, a first operating circuit for said ring relay including one of the line conductors of the second branch of said trunk, a second operating circuit for said order relay including the one line conductor of the second branch of said trunk, a third operating circuit for said control relay including the other line conductor of the second branch of said trunk, a source of ringing voltage, said ring relay being operative to disconnect the first and second branches of said trunks and to connect said source of ringing voltage to the line conductors of the first branch of said trunk, a source of out-of-order voltage, said order relay being operative to connect said source of out-of-order voltage to both branches of said trunk, said control relay being operative to interrupt

said first operating circuit and to complete said second operating circuit in the event it is prepared, an operator position, automatic switching apparatus associated with said operator position and having access to the second branch of said trunk, means for causing said switching apparatus to seize the second branch of said trunk, thereby to complete a connection between said operator position and said trunk, and a device at said operator position selectively operative to complete by way of said switching apparatus said first operating circuit or to prepare by way of said switching apparatus said second operating circuit and to complete by way of said switching apparatus said third operating circuit.

4. In a telephone system, a trunk including first and second branches normally connected together, each branch of said trunk including two line conductors, a trunk circuit associated with both branches of said trunk and including a ring relay and an order relay and an identity relay, a first operating circuit for said ring relay including one of the line conductors of the second branch of said trunk, a second operating circuit for said order relay including the one line conductor of the second branch of said trunk, a third operating circuit for said identity relay including the other line conductor of the second branch of said trunk, a source of ringing voltage, said ring relay being operative to disconnect the first and second branches of said trunk and to connect said source of ringing voltage to the line conductors of the first branch of said trunk, a source of out-of-order voltage, said order relay being operative to connect said source of out-of-order voltage to both branches of said trunk, an identity signal individual to said trunk, said identity relay being operative to cause operation of said identity signal and to interrupt said first operating circuit and to complete said second operating circuit in the event it is prepared, an operator position, automatic switching apparatus associated with said operator position and having access to the second branch of said trunk, means for causing said switching apparatus to seize the second branch of said trunk, thereby to complete a connection between said operator position and said trunk, and a device at said operator position selectively operative to complete by way of said switching apparatus said first operating circuit or to prepare by way of said switching apparatus said second operating circuit and to complete by way of said switching apparatus said third operating circuit or to complete by way of said switching apparatus said third operating circuit.

5. In a telephone system, a trunk, first and second stations, an operator position, switching apparatus associated with said operator position, means under the control of a party at said first station for extending a connection from said first station by way of said trunk and said switching apparatus to said operator position, means under the control of an operator at said operator position for extending said connection from said operator position by way of said switching apparatus to said second station, a device at said operator position operative to a first position to exclude said operator position from said connection and operative to a second position to include said operator position in said connection, a signal at said operator position, a trunk circuit associated with said trunk and including a signal relay, an operating circuit for said signal relay, a series holding circuit for said signal relay and operating circuit for said signal including said switching apparatus, said signal relay being operative to complete said series circuit when said device is operated to its first position, said series circuit being interrupted when said device is operated to its second position, and means under the control of a party at said first station for completing said operating circuit.

6. In a telephone system, a trunk, first and second stations, an operator position, switching apparatus associated with said operator position, means under the control of a party at said first station for extending a connection from said first station by way of said switching apparatus to said operator position, means under the control of an operator at said operator position for extending said connection from said operator position by way of said switching apparatus and said trunk to said second station, a device at said operator position operative to a first position to exclude said operator position from said connection and operative to a second position to include said operator position in said connection, a signal at said operator position, a trunk circuit associated with said trunk and including a signal relay, an operating circuit for said signal relay, a series holding circuit for said signal relay and operating circuit for said signal including said switching apparatus, said signal relay being operative to complete said series circuit when said device is operated to its first position, said series circuit being interrupted when said device is operated to its second position, and means under the control of a party at said second station for completing said operating circuit.

7. In a telephone system, a station, a plurality of trunks, a plurality of trunk circuits individually associated with said trunks, an operator position, an answer switch associated with said operator position and having access to said trunks, means for extending a connection from said station to an idle one of said trunks, means controlled when said connection is extending to said one trunk for rendering busy said one trunk and for creating a call on said one trunk, means controlled by the presence of a call on said one trunk for causing said answer switch to seize said one trunk, thereby to complete a connection from said station by way of said one trunk and said answer switch to said operator position, a device at said operator position operative to cause signal current to be projected over said answer switch and said one trunk seized thereby to the trunk circuit individually associated with said one trunk, a plurality of identity signals individually corresponding to said trunks and associated with said operator position, and means included in the trunk circuit individually associated with said one trunk and responsive to the projection of signal current thereto for operating the identity signal individually corresponding to said one trunk, thereby to indicate to the operator at said operator position the particular one of said trunks which is included in the completed connection between said station and said operator position.

8. In a telephone system, a station, a plurality of trunks, a plurality of trunk circuits individually associated with said trunks, an operator position, a call switch associated with said operator position and having access to said trunks, operator controlled means at said operator position for causing said call switch to seize an idle one of said trunks, means controlled when said one trunk is seized by said call switch for rendering busy said one trunk, switching means operative to extend a connection from said one trunk to said station,

operator controlled means at said operator position for controlling the operation of said switching means, thereby to complete a connection from said operator position by way of said call switch and said one trunk and said switching means to said station, a device at said operator position operative to cause signal current to be projected over said call switch and said one trunk seized thereby to the trunk circuit individually associated with said one trunk, a plurality of identity signals individually corresponding to said trunks and associated with said operator position, and means included in the trunk circuit individually associated with said one trunk and responsive to the projection of signal current thereto for operating the identity signal individually corresponding to said one trunk, thereby to indicate to the operator at said operator position the particular one of said trunks which is included in the completed connection between said operator position and said station.

9. In a telephone system, a paystation, a line extending to said paystation, a trunk, a trunk circuit associated with said trunk and including a finder switch having access to said line, means at said paystation operative to initiate a call on said line, means controlled by the presence of a call on said line for causing said finder switch to seize said line, means included in said trunk circuit operative to create a call on said trunk, means at said paystation governed by the deposit of a coin thereat for controlling the operation of said last-mentioned means, an operator position, apparatus at said operator position operative to answer a call on said trunk, a device at said operator position selectively operative to cause the coin deposited at said paystation to be collected or refunded, means at said paystation for performing a release operation, means at said operator position for performing a release operation, and means included in said trunk circuit and controlled by the performance of said release operations for causing the release of said finder switch when there is no deposited coin at said paystation and for causing said finger switch to remain operated and another call to be created on said trunk when there is a deposited coin at said paystation.

10. In a telephone system, a paystation, a line extending to said paystation, a plurality of trunks, a plurality of trunk circuits individually associated with said trunk, each of said trunk circuits including a finder switch having access to said line, a distributor, means at said paystation operative to initiate a call on said line, means controlled by the presence of a call on said line for causing said distributor to assign the finder switch included in one of said trunk circuits and for causing the assigned finder switch included in said one trunk circuit to seize said line, means included in said one trunk circuit operative to create a call on the associated trunk, means at said paystation governed by the deposit of a coin thereat for controlling the operation of said last-mentioned means, an operator position, apparatus at said operator position operative to answer a call on any one of said trunks, a device at said operator position selectively operative to cause the coin deposited at said paystation to be collected or refunded, means at said paystation for performing a release operation, means at said operator position for performing a release operation, and means included in said one trunk circuit and controlled by the performance of said release operations for causing the release of the finder switch included in said one trunk circuit when there is no deposited coin at said paystation and for causing the finder switch included in said one trunk circuit to remain operated and another call to be created on the associated trunk when there is a deposited coin at said paystation.

11. In a telephone system, a paystation, a line extending to said paystation, a trunk, a trunk circuit associated with said trunk and including a finder switch having access to said line, means at said paystation operative to initiate a call on said line, means controlled by the presence of a call on said line for causing said finder switch to seize said line, means included in said trunk circuit operative to create a call on said trunk, means at said paystation governed by the deposit of a coin thereat for controlling the operation of said last-mentioned means, an operator position, an answer switch associated with said operator position, means controlled by the presence of a call on said trunk for causing said answer switch to seize said trunk, thereby to complete a connection from said paystation to said operator position, a device at said operator position selectively operative to cause the coin deposited at said paystation to be collected or refunded, means at said paystation for performing a release operation, means at said operator position for performing a release operation, means controlled when said release operation is performed at said operator position for causing said answer switch to release, and means included in said trunk circuit and controlled jointly by the performance of said release operation at said paystation and the release of said answer switch for causing the release of said finder switch in the event there is no deposited coin at said paystation and for causing said finder switch to remain operated and another call to be created on said trunk in the event there is a deposited coin at said paystation.

12. In a telephone system, a paystation, a line extending to said paystation, a trunk, a trunk circuit associated with said trunk and including a finder switch having access to said line, means at said paystation operative to initiate a call on said line, means controlled by the presence of a call on said line for causing said finder switch to seize said line, means included in said trunk circuit operative to create a call on said trunk, means at said paystation governed by the deposit of a coin thereat for controlling the operation of said last-mentioned means, an operator position, a plurality of answer switches associated with said operator position, operator controlled means at said operator position operative to prepare any one of said answer switches, means controlled by the presence of a call on said trunk for causing a prepared one of said answer switches to seize said trunk, thereby to complete a connection from said paystation by way of said one answer switch to said operator position, a device at said operator position selectively operative to cause the coin deposited at said paystation to be collected or refunded, means at said paystation for performing a release operation, means at said operator position for performing a release operation, means controlled when said release operation is performed at said operator position for causing said one answer switch to release, and means included in said trunk circuit and controlled jointly by the performance of said release operation at said paystation and the release of said one answer switch for causing the release of said finder switch in the event there is no deposited coin at said paystation and for

causing said finder switch to remain operated and another call to be created on said trunk in the event there is a deposited coin at said paystation.

13. In a telephone system, a paystation, a line extending to said paystation, a trunk including first and second branches, a trunk circuit including a repeater and a ring relay and a coin relay and a control relay, the first branch of said trunk being normally connected to said repeater and the second branch of said trunk being connected to said repeater, a first operating circuit for said ring relay including the second branch of said trunk, a second operating circuit for said coin relay including the second branch of said trunk, a third operating circuit for said control relay, a by-pass circuit, a source of ringing voltage, said ring relay being operative to connect said source of ringing voltage to said by-pass circuit and to complete said third operating circuit, said coin relay being operative to connect the second branch of said trunk to said by-pass circuit and to complete said third operating circuit, said control relay being operative to disconnect the second branch of said trunk from said repeater and to connect the second branch of said trunk to said by-pass circuit, an operator position, means for extending a connection from said paystation by way of said line to the first branch of said trunk and from the second branch of said trunk to said operator position, first and second sources of coin control voltage, and operator controlled means at said operator position for selectively completing said first and said second operating circuits and for selectively connecting said first and said second sources of coin control voltage to the second branch of said trunk.

14. In a telephone system, a trunk including first and second branches, a trunk circuit associated with both branches of said trunk, an operator position, an impulse transmitter, operator controlled means at said operator position operative to cause a predetermined potential to be connected to the first branch of said trunk and then to cause said transmitter to be connected to the second branch of said trunk, means controlled when said transmitter is connected to the second branch of said trunk for causing said predetermined potential to be disconnected from the first branch of said trunk, an impulse responsive device, means controlled when said predetermined potential is connected to and then disconnected from the first branch of said trunk for connecting said device to the first branch of said trunk, means for causing said transmitter to transmit impulses over the second branch of said trunk to said trunk circuit, and means included in said trunk circuit for repeating over the first branch of said trunk impulses received over the second branch of said trunk.

15. In a telephone system, a trunk including first and second branches, a trunk circuit including an impulse relay and a repeater, both branches of said trunk being normally connected to said repeater, first control means operative to disconnect the second branch of said trunk from said repeater and to connect the second branch of said trunk to said impulse relay, second control means operative to connect a predetermined potential to the first branch of said trunk, an operator position, an impulse transmitter, operator controlled means at said operator position operative to cause operation of said first and second control means and then to cause said transmitter to be connected to the second branch of said trunk, means controlled when said transmitter is connected to the second branch of said trunk for causing said second control means to restore, an impulse responsive device, means controlled when said predetermined potential is connected to and then disconnected from the first branch of said trunk for connecting said device to the first branch of said trunk, means for causing said transmitter to transmit impulses over the second branch of said trunk to said impulse relay, means controlled by the operation of said impulse relay for repeating impulses over the first branch of said trunk, and means controlled when said transmitter has transmitted all of the impulses to be transmitted for causing said first control means to restore.

16. In a telephone system, a trunk including first and second branches, a trunk circuit including an impulse relay and a repeater, both branches of said trunk being normally connected to said repeater, first and second control relays, a first operating circuit for said first and second control relays, a second operating circuit for said first control relay, said first control relay being operative to disconnect the second branch of said trunk from said repeater and to connect the second branch of said trunk to said impulse relay, said second control relay being operative to connect a predetermined potential to the first branch of said trunk, an operator position, an impulse transmitter, operator controlled means at said operator position operative to cause said first operating circuit to be completed and then to cause said transmitter to be connected to the second branch of said trunk, means controlled when said transmitter is connected to the second branch of said trunk for causing said first operating circuit to be interrupted and said second operating circuit to be completed, an impulse responsive device, means controlled when said predetermined potential is connected to and then disconnected from the first branch of said trunk for connecting said device to the first branch of said trunk, means for causing said transmitter to transmit impulses over the second branch of said trunk to said impulse relay, means controlled by the operation of said impulse relay for repeating impulses over the first branch of said trunk, and means controlled when said transmitter has transmitted all of the impulses to be transmitted for causing said second operating circuit to be interrupted.

17. In a telephone system, a trunk including first and second branches, a trunk circuit associated with both branches of said trunk, automatic switching means having access to the first branch of said trunk, means for causing said switching means to seize the first branch of said trunk, automatic switching apparatus having access to the second branch of said trunk, means included in said trunk circuit and controlled when the first branch of said trunk is seized by said switching means for causing said switching apparatus to seize the second branch of said trunk, an operator position, an impulse transmitter, operator controlled means at said operator position operative to cause a predetermined potential to be connected to the first branch of said trunk and then to cause said transmitter to be connected to said switching apparatus, means controlled when said transmitter is connected to said switching apparatus for causing said predetermined potential to be disconnected from the first branch of said trunk, a switching device, means controlled when said predetermined po-

tential is connected to and then disconnected from the first branch of said trunk for connecting said switching device to the first branch of said trunk, means for causing said transmitter to transmit impulses over said switching apparatus and the second branch of said trunk to said trunk circuit, and means included in said trunk circuit for repeating over the first branch of said trunk impulses received over the second branch of said trunk.

18. In a telephone system, a trunk including first and second branches, a trunk circuit including an impulse relay normally connected to the second branch of said trunk and a switching relay and a repeater connected to the first branch of said trunk, said switching relay being operative to disconnect said impulse relay from the second branch of said trunk and to connect the second branch of said trunk to said repeater, the first branch of said trunk including two line conductors connected by way of said repeater to a simplex conductor, said impulse relay being operative to transmit impulses by way of said simplex conductor and said repeater over the line conductors of the first branch of said trunk, an impulse responsive device connected to the line conductors of the first branch of said trunk, an operator position, an impulse transmitter, means operative to connect said operator position and said transmitter to the second branch of said trunk, operator controlled means at said operator position for controlling the operation of said last-mentioned means, means for causing said transmitter to transmit impulses over the second branch of said trunk to said impulse relay, and means controlled when said transmitter has transmitted all of the impulses to be transmitted for causing operation of said switching relay.

19. In a telephone system, a trunk including first and second branches, a trunk circuit including an impulse relay normally connected to the second branch of said trunk and a switching relay and a repeater connected to the first branch of said trunk, said switching relay being operative to disconnect said impulse relay from the second branch of said trunk and to connect the second branch of said trunk to said repeater, the first branch of said trunk including two line conductors connected by way of said repeater to a simplex conductor, said impulse relay being opertive to transmit impulses by way of said simplex conductor and said repeater over the line conductors of the first branch of said trunk, an impulse responsive device connected to the line conductors of the first branch of said trunk, an operator position, an impulse transmitter, automatic switching apparatus having access to the second branch of said trunk, operator controlled means at said operator position operative to cause said switching apparatus to seize the second branch of said trunk, means for connecting said transmitter to said switching apparatus, means for causing said transmitter to transmit impulses over said switching apparatus and the second branch of said trunk to said impulse relay, and means controlled when said transmitter has transmitted all of the impulses to be transmitted for causing operation of said switching relay.

20. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor, said call distributor being operative in a first manner to mark each one of said groups including a calling line, whereby a plurality of said groups may be marked at a given time, and being operative in a second manner to mark group by group in a predetermined order each one of said groups including a calling line, whereby only one of said groups may be marked at a given time, and means for selectively controlling the manner of operation of said call distributor.

21. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor, said call distributor being operative in a first manner to mark in a first predetermined order each one of said groups including a calling line and operative in a second manner to mark in a second predetermined order each one of said groups including a calling line, and means for selectively controlling the manner of operation of said call distributor.

22. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor, said call distributor being operative in a first manner to mark in a first predetermined order each one of said groups including a calling line and operative in a second manner to mark in a second predetermined order each one of said groups including a calling line, means for selectively preparing said call distributor to operate in either one of said manners, means controlled by the presence of a calling line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the calling lines in said groups have been seized by said switching mechanism for arresting operation of said call distributor.

23. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor operative to mark in a predetermined order each one of said groups including a calling line, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time, means controlled by the presence of a calling line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the calling lines in said groups have been seized by said switching mechanism for arresting operation of said call distributor.

24. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor operative to mark successively each one of said groups including a calling line, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time, means controlled by the presence of a calling line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the calling ilnes in said groups have been seized by said switching mechanism for arresting operation of said call distributor.

25. In a signaling system, a plurality of groups of lines, switching mechanism having access to

the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor operative to mark in a predetermined order each one of said groups including a calling line, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time and to mark a second of said groups only when all of the calling lines in a marked first of said groups have been seized by said switching mechanism, means controlled by the presence of a calling line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the calling lines in said groups have been seized by said switching mechanism for arresting operation of said call distributor.

26. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor operative to mark in a predetermined order each one of said groups including a calling line, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time and to mark a second of said groups only when all of the calling lines in a marked first of said groups have been seized by said switching mechanism, and means for causing operation of said call distributor.

27. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor operative through a continuous cycle to mark group by group in a predetermined order each one of said groups including a calling line, means for initiating operating said call distributor, normally ineffective stop means for arresting operation of said call distributor while any one of said groups is marked, means controlled when any one of said groups is marked for rendering effective said stop means, means controlled when all of the calling lines in said one group have been seized by said switching mechanism for rendering ineffective said stop means, and means for terminating the operation of said call distributor.

28. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a call distributor operative through a continuous cycle to mark group by group in a predetermined order each one of said groups including a calling line, means controlled by the presence of a calling line in any one of said groups for initiating operation of said distributor, normally ineffective stop means for arresting operation of said call distributor while any one of said groups is marked, means controlled when any one of said groups is marked for rendering effective said stop means, means controlled when all of the calling lines in said one group have been seized by said switching mechanism for rendering ineffective said stop means, and means controlled when all of the calling lines in said groups have been seized by said switching mechanism for terminating the operation of said call distributor.

29. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a plurality of markers individually corresponding to said groups, each of said markers being operative to mark the corresponding group, control means operative to cause said markers to operate and to restore in a predetermined order, means governed by the presence of a calling line in any one of said groups for initiating operation of said control means, normally ineffective stop means for arresting the operation and the restoration of said markers, means controlled when a marker corresponding to one of said groups including a calling line operates for rendering effective said stop means, means controlled when all of the calling lines in said one group have been seized by said switching mechanism for rendering ineffective said stop means, and means governed when all of the calling lines in said groups have been seized by said switching mechanism for arresting operation of said control means.

30. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a plurality of markers individually corresponding to said groups, each of said markers being operative to mark the corresponding group, control means operative to cause said markers to operate and to restore successively throughout a continuous cycle, means governed by the presence of a calling line in any one of said groups for initiating operation of said control means, normally ineffective stop means for arresting the cycle of operation and restoration of said markers, means controlled when a marker corresponding to one of said groups including a calling line operates for rendering effective said stop means, means controlled when all of the calling lines in said one group have been seized by said switching mechanism for rendering ineffective said stop means, and means governed when all of the calling lines in said groups have been seized by said switching mechanism for arresting operation of said control means.

31. In a signaling system, a plurality of groups of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line in a marked one of said groups, a plurality of start relays individually corresponding to said groups, means controlled by the presence of a calling line in any one of said groups for causing operation of the corresponding start relay, means controlled when all of the calling lines in any one of said groups are seized by said switching mechanism for causing restoration of the corresponding start relay, a plurality of marking relays individually corresponding to said start relays, control means operative to cause said marking relays to operate and to restore in a predetermined order, means controlled when any one of said start relays is operated for operating said control means, said marking relays being so connected and arranged that when one of said marking relays corresponding to an operated one of said start relays operates further operation and restoration of said marking relays are arrested until said one start relay restores, and means controlled jointly by an operated one of said marking relays and the corresponding operated start relay for marking the corresponding group.

32. In a signaling system, a plurality of groups

of lines, switching mechanism having access to the lines in said groups, means for causing said switching mechanism to seize a calling line included in a marked one of said groups, a plurality of start relays individually corresponding to said groups, operating circuits for said start relays, means controlled by the presence of a calling line in any one of said groups for completing the operating circuit of the corresponding start relay, means controlled when all of the calling lines in any one of said groups are seized by said switching mechanism for interrupting the operating circuit of the corresponding start relay, a plurality of marking relays individually corresponding to said start relays, a circuit network for operating said marking relays, said circuit network being so connected and arranged that said marking relays operate and restore automatically in a predetermined order when said circuit network is completed, means controlled when any one of said start relays is operated for completing said circuit network, additional means controlled when one of said marking relays corresponding to an operated one of said start relays operates for interrupting said circuit network until said one start relay restores, and means controlled jointly by an operated one of said marking relays and the corresponding operated start relay for marking the corresponding group.

33. A distributor comprising a plurality of start relays, operating circuits for said start relays, means for selectively controlling the operating circuits of said start relays, a plurality of marking relays individually corresponding to said start relays, operating circuits for said marking relays, holding circuits for said marking relays, a circuit network governed jointly by said start relays and said marking relays for controlling the operating circuits of said marking relays, said circuit network being so connected and arranged that the operating circuits of said marking relays are prepared by the operation of any one of said start relays and that the operating circuit of one of said marking relays is normally completed by the operation of the preceding marking relay and interrupted by the restoration of the preceding marking relay, means controlled by the operation of one of said marking relays for completing the holding circuit thereof and for interrupting the holding circuit of the preceding marking relay, means controlled by the operation of one of said start relays for interrupting the operating circuit of the marking relay succeeding the corresponding marking relay, and means controlled jointly by the operation of any one of said start relays and the operation of the corresponding marking relay for completing a marking circuit individual thereto.

34. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, apparatus at said operator position for answering incoming calls on the lines in said groups, a call distributor operative in a first manner to route in a first predetermined order incoming calls on the lines in said groups to said operator position and operative in a second manner to route in a second predetermined order incoming calls on the lines in said groups to said operator position, means for selectively preparing said call distributor to operate in either one of said manners, means controlled by the presence of a call on a line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the calls on the lines in said groups have been answered at said operator position for arresting operation of said call distributor.

35. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, apparatus at said operator position for answering incoming calls on the lines in said groups, a call distributor operative to route group by group in accordance with an established order of preference among said groups incoming calls on the lines in said groups to said operator position, means for operating said distributor, control means selectively operative to establish a first order of preference among said groups and to establish a second order of preference among said groups, and means for governing the operation of said control means.

36. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, apparatus at said operator position for answering incoming calls on the lines in said groups, a call distributor operative to route group by group in accordance with an established order of preference among said groups incoming calls on the lines in said groups to said operator position, means controlled by the presence of a call on a line in any one of said groups for initiating operation of said call distributor, means controlled when all of the calls on the lines in said groups have been answered at said operator position for arresting operation of said call distributor, control means selectively operative to establish a fixed order of preference among said groups and to establish a variable order of preference among said groups, and means for governing the operation of said control means.

37. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, apparatus at said operator position for answering incoming calls on the lines in said groups, a call distributor operative to route group by group in a predetermined order incoming calls on the lines in said groups to said operator position, whereby all incoming calls on lines in a given group are routed to said operator position before any incoming calls on lines in a succeeding group are routed to said operator position, and means for controlling the operation of said call distributor.

38. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, apparatus at said operator position for answering incoming calls on the lines in said groups, a call distributor operative through a continuous cycle to route group by group in a predetermined order incoming calls on the lines in said groups to said operator position, whereby all incoming calls on lines in a given group are routed to said operator position before any incoming calls on lines in a succeeding group are routed to said operator position, and means for controlling the operation of said call distributor.

39. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a number of groups of lines associated with said switchboard, apparatus at each of said operator positions for answering incoming calls on the lines in said groups, a position distributor operative to select in a predetermined order said operator positions, means for

controlling the operation of said position distributor, a call distributor operative to route group by group in a predetermined order incoming calls on the lines in said groups to selected ones of said operator positions, whereby all incoming calls on lines in a given group are routed one by one to selected ones of said operator positions before any incoming calls on lines in a succeeding group are routed one by one to selected ones of said operator positions, and means for controlling the operation of said call distributor.

40. In a telephone system, an operator position, a number of groups of lines associated with said operator position, apparatus at said operator position for answering a call on any line in an assigned one of said groups, a call distributor operative to assign in a predetermined order each one of said groups including a line having a call thereon, said call distributor being so connected and arranged that it is operative to assign only one of said groups at a time, means controlled by the presence of a call on a line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the calls on the lines in said groups have been answered by the apparatus at said operator position for arresting operation of said call distributor.

41. In a telephone system, a number of operator positions, a number of groups of lines commonly associated with said operator positions, apparatus at each of said operator positions for answering a call on any line in an assigned one of said groups, a position distributor for selecting in a predetermined order said operator positions, means for controlling the operations of said position distributor, a call distributor operative to assign to selected ones of said operator positions in a predetermined order each one of said groups including a line having a call thereon, said call distributor being so connected and arranged that it is operative to assign only one of said groups at a time, means controlled by the presence of a call on a line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the calls on the lines in said groups have been answered by the apparatus at said operator positions for arresting operation of said call distributor.

42. In a telephone system, an operator position, a number of groups of lines, switching mechanism associated with said operator position and having access to the lines in said groups, means for causing said switching mechanism to seize a line having a call thereon in a marked one of said groups, means operative to take for use a line in any one of said groups, thereby to create a call on the line, means for controlling the operation of said last-mentioned means, a call distributor operative to mark in a predetermined order each one of said groups including a line having a call thereon, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time, means controlled by the presence of a call on a line in any one of said groups for initiating operation of said call distributor, and means controlled when all of the lines having calls thereon in said groups have been seized by said switching mechanism for arresting operation of said call distributor.

43. In a telephone system, an operator position, a number of groups of lines, switching mechanism associated with said operator position and having access to the lines in said groups, said switching mechanism being operative to seize a line having a call thereon in a marked one of said groups, means operative to take for use a line in any one of said groups, thereby to create a call on the line, means for controlling the operation of said last-mentioned means, a call distributor operative to mark in a predetermined order each one of said groups including a line having a call thereon, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time, means controlled by the presence of a call on a line in any one of said groups for initiating operation of said call distributor and for causing operation of said switching mechanism, and means controlled when all of the lines having calls thereon in said groups have been seized by said switching mechanism for arresting operation of said call distributor.

44. In a telephone system, an operator position, a number of groups of lines, a number of finder switches associated with said operator position, each of said finder switches having access to the lines in said groups and being operative to seize a line having a call thereon in a marked one of said groups, operator controlled means at said operator position for preparing any one of said finder switches to be operated, means operative to take for use a line in any one of said groups, thereby to create a call on the line, means for controlling the operation of said last-mentioned means, a call distributor operative to mark in a predetermined order each one of said groups including a line having a call thereon, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time, means controlled by the presence of a call on a line in any one of said groups for initiating operation of said call distributor and for causing operation of a prepared one of said finder switches, and means controlled when all of the lines having calls thereon in said groups have been seized by said finder switches for arresting operation of said call distributor.

45. In a telephone system, an operator position, a number of groups of lines, a number of finder switches associated with said operator position, each of said finder switches having access to the lines in said groups and being operative to seize a line having a call thereon in a marked one of said groups, operator controlled means at said operator position for preparing any one of said finder switches to be operated, means operative to take for use a line in any one of said groups, thereby to create a call on the line, means for controlling the operation of said last-mentioned means, a call distributor operative to mark in a predetermined order each one of said groups including a line having a call thereon, said call distributor being so connected and arranged that it is operative to mark only one of said groups at a time, control means governed by the presence of a call on a line in any one of said groups for initiating operation of said call distributor and for causing operation of a prepared one of said finder switches, means governed when all of the lines having calls thereon in said groups have been seized by said finder switches for arresting operation of said call distributor, and additional operator controlled means at said operator position for causing operation of a prepared one of said finder switches independently of said control means.

46. In a telephone system, a number of operator positions, a number of divisions of lines,

a group of finder switches individually associated with each of said operator positions, each of said finder switches having access to the lines in said divisions and being operative to seize a line having a call thereon in a marked one of said divisions, operator controlled means at each of said operator positions for preparing any one of the finder switches in the associated group to be operated, a position distributor for selecting in a predetermined order the groups of finder switches in which a finder switch is prepared, means operative to take any for use a line in any one of said divisions, thereby to create a call on the line, means for controlling the operation of said last-mentioned means, a call distributor operative to mark in a predetmined order each one of said divisions including a line having a call thereon, said call distributor being so connected and arranged that it is operative to mark only one of said divisions at a time, means controlled by the presence of a call on a line in any one of said divisions for initiating operation of said call distributor and for causing operation of a prepared one of said finder switches in a selected one of said groups, and means controlled when all of the lines having calls thereon in said divisions have been seized by said fiinder switches for arresting operation of said call distributor.

47. In a telephone system, an operator position, a number of divisions of lines associated with said operator position, apparatus at said operator position for answering a call on a line in an assigned one of said divisions, a call distributor operative to assign in a predetermined order each one of said divisions including a line having a call thereon, said call distributor being so connected and arranged that it is operative to assign only one of said divisions at a time and to assign a second of said divisions only when all of the calls on lines in an assigned first of said divisions have been answered by the apparatus at said operator position, means controlled by the presence of a call on a line in any one of said divisions for initiating operation of said call distributor, and means controlled when all of the calls on the lines in said divisions have been answered by the apparatus at said operator position for arresting operation of said call distributor.

48. In a telephone system, a number of operator positions, a number of divisions of lines associated with said operator positions, apparatus at each of said operator positions operative to answer a call on a line in an assigned one of said divisions, operator controlled means at each of said operator positions for preparing the apparatus at the associated operator position to be operated, a position distributor for selecting in a predetermined order prepared ones of said apparatus, means operative to take for use a line in any one of said divisions, thereby to create a call on the line, means for controlling the operation of said last-mentioned means, a call distributor operative to assign in a predetermined order each one of said groups including a line having a call thereon, said call distributor being so connected and arranged that it is operative to assign only one of said divisions at a time and to assign a second of said divisions only when all of the calls on lines in an assigned first of said divisions have been answered by the apparatus at said operator positions, means controlled by the presence of a call on a line in any one of said divisions for initiating operation of said call distributor and for causing operation of a selected one of said apparatus, and means controlled when all of the calls on the lines in said divisions have been answered by the apparatus at said operator positions for arresting operation of said call distributor.

49. In a telephone system, an exchange provided with a switchboard including an operator position, a plurality of toll lines and a plurality of trunk lines associated with said switchboard, said toll lines being accessible to a distant exchange and said trunk lines being accessible to local subscriber substations, apparatus at said operator position for receiving incoming calls on said lines and for extending outgoing calls on said lines, a call distributor normally operative to route incoming calls on both said toll lines and said trunk lines to said operator position, means for controlling the operation of said call distributor, and operator controlled means at said operator position operative to restrict the operation of said call distributor entirely to that of routing incoming calls on said toll lines to said operator position.

50. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, said number of groups including at least one group of toll lines and at least one group of trunk lines, said toll lines being accessible to a distant exchange and said trunk lines being accessible to local subscriber substations, apparatus at said operator position for receiving incoming calls on the lines in said groups, a call distributor normally operative to route by group in a predetermined order incoming calls on the lines in said groups to said operator position, whereby all incoming calls on lines in a given group are routed to said operator position before any incoming calls on lines in a succeeding group are routed to said operator position, means for controlling the operation of said call distributor, and operator controlled means at said operator position operative to restrict the operation of said call distributor entirely to that of routing incoming calls on the lines in said group of toll lines to said operator position.

51. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a plurality of toll lines and a plurality of trunk lines associated with said switchboard, said toll lines being accessible to a distant exchange and said trunk lines being accessible to local subscriber substations, apparatus at each of said operator positions for receiving incoming calls on said lines and for extending outgoing calls on said lines, a position distributor for selecting in a predetermined order said operator positions, a call distributor normally operative to route incoming calls on both said toll lines and said trunk lines to selected ones of said operator positions, means for controlling the operation of said call distributor, and operator controlled means at each operator position operative to restrict the operation of said last-mentioned means entirely to that of routing incoming calls on said toll lines to the associated operator position.

52. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a number of groups of lines associated with said switchboard, said number of groups including at least one group of toll lines and at least one group of trunk lines, said toll lines being accessible to a distant exchange and

said trunk lines being accessible to local subscriber substations, apparatus at each of said operator positions for receiving incoming calls on the lines in said groups, a position distributor for selecting in a predetermined order said operator positions, a call distributor normally operative to route group by group in a predetermined order incoming calls on the lines in said groups to selected ones of said operator positions, whereby all incoming calls on lines in a given group are routed one by one to selected ones of said operator positions before any incoming calls on lines in a succeeding group are routed one by one to selected ones of said operator positions, means for controlling the operation of said call distributor, and operator controlled means at each operator position operative to restrict the operation of said call distributor entirely to that of routing incoming calls on the lines in said group of toll lines to the associated operator position.

53. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a plurality of first lines and a plurality of second lines associated with said switchboard, apparatus at each of said operator positions for receiving incoming calls on said lines, a position distributor normally operative to select in a predetermined order said operator positions, means for controlling the operation of said position distributor, a call distributor normally operative to route in a first predetermined order incoming calls on both said first lines and said second lines to selected ones of said operator positions, means for controlling the operation of said call distributor, and operator controlled means at one of said operator positions operative to prevent said position distributor from selecting said one operator position and to cause said call distributor to route in a second predetermined order only incoming calls on said first lines to said one operator position.

54. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a plurality of first lines and a plurality of second lines associated with said switchboard, apparatus at each of said operator positions for answering incoming calls on said lines routed thereto, a position distributor normally operative to select in a predetermined order idle ones of said operator positions, means for controlling the operation of said position distributor, a call distributor normally operative to route incoming calls on both said first lines and said second lines to selected ones of said operator positions, means for controlling the operation of said call distributor, means for rendering busy each of said operator positions while an unanswered call on a line is routed thereto, means for rendering idle each of said operator positions after a call on a line routed thereto has been answered, operator controlled means at one of said operator positions operative to prevent said position distributor from selecting said one operator position, and means controlled by the presence of an incoming call on one of said first lines when said operator controlled means is operated and when said one operator position is idle for causing said position distributor to restore and for causing said call distributor to route the incoming call on said one first line to said one operator position.

55. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a plurality of first lines and a plurality of second lines associated with said switchboard, apparatus at each of said operator positions for receiving incoming calls on said lines, a position distributor normally operative to select in a predetermined order said operator positions, means for controlling the operation of said position distributor, a call distributor normally operative to route incoming calls on both said first lines and said second lines to selected ones of said operator positions, means for controlling the operation of said call distributor, operator controlled means at a first and at a second of said operator positions, the operator controlled means at said first and said second operator positions being operative to prevent said position distributor from selecting the associated operator position, and means controlled when the operator controlled means at both said first and said second operator positions are operated for causing said call distributor to route in a predetermined order only incoming calls on said first lines to said first and said second operator positions.

56. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a plurality of first lines and a plurality of second lines associated with said switchboard, apparatus at each of said operator positions for answering incoming calls on said lines routed thereto, a position distributor normally operative to select in a predetermined order idle ones of said operator positions, means for controlling the operation of said position distributor, a call distributor normally operative to route incoming calls on both said first lines and said second lines to selected ones of said operator positions, means for controlling the operation of said call distributor, means for rendering busy each of said operator positions while an unanswered call on a line is routed thereto, means for rendering idle each of said operator positions after a call on a line routed thereto has been answered, operator controlled means at one of said operator positions operative to prevent said position distributor from selecting said one operator position, means controlled by the presence of an incoming call on one of said first lines when said operator controlled means is operated and when said one operator position is idle for causing said position distributor to restore and for causing said call distributor to route the incoming call on said one first line to said one operator position, and means controlled when the incoming call on said one first line is routed to said one operator position for causing said position distributor to reoperate.

57. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a plurality of lines associated with said switchboard, apparatus at each of said operator positions for answering incoming calls on said lines routed thereto, a position distributor for selecting idle ones of said operator positions, a call distributor for routing incoming calls on said lines to selected ones of said operator positions, means controlled when said call distributor routes an incoming call on one of said lines to a selected one of said operator positions for rendering busy said one operator position and for causing said position distributor to select another idle one of said operator positions, means controlled after the apparatus at said one operator position has answered the incoming call on said one line routed thereto for rendering idle said one operator position, a timer, and means controlled by said timer for producing a signal in the event the apparatus at said one

operator position does not answer the incoming call on said one line routed thereto within a predetermined time interval.

58. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a plurality of lines associated with said switchboard, apparatus at each of said operator positions for answering incoming calls on said lines routed thereto, a position distributor for selecting idle ones of said operator positions, a call distributor for routing incoming calls on said lines to selected ones of said operator positions, means controlled when said call distributor routes an incoming call on one of said lines to a selected one of said operator positions for rendering busy said one operator position and for causing said position distributor to select another idle one of said operator positions, means controlled after the apparatus at said one operator position has answered the incoming call on said one line routed thereto for rendering idle said one operator position, a supervisory operator desk, and means controlled by the presence of an incoming call on one of said lines when there is no operator position selected by said position distributor for transmitting a signal to said supervisory operator desk.

59. In a telephone system, first and second exchanges, a toll line extending between said exchanges, automatic switching means in said first exchange having access to said toll line, subscriber lines, subscriber substations associated with said subscriber lines, subscriber controlled means at each of said substations for causing said switching means to seize said toll line, two automatic switching devices in said first exchange, each of said switching devices having access to said subscriber lines, an operator position in said second exchange, automatic switching apparatus in said second exchange having access to said toll line, means controlled by the seizure of said toll line by said switching means for causing said switching apparatus to seize said toll line, operator controlled means at said operator position operative subsequent to seizure of said toll line by said switching means to cause a first of said switching devices to be selected, additional operator controlled means at said operator position operative to cause said switching apparatus to seize said toll line, means controlled by the seizure of said toll line by said switching apparatus incident to the operation of said additional operator controlled means for causing a second of said switching devices to be selected, and further operator controlled means at said operator position for controlling the operation of a selected one of said switching devices over said switching apparatus and said toll line.

60. In a telephone system, first and second exchanges, a toll line extending between said exchanges, automatic switching means in said first exchange having access to said toll line, subscriber lines, subscriber substations associated with said subscriber lines, subscriber controlled means at each of said substations for causing said switching means to seize said toll line, two automatic switching devices in said first exchange, each of said switching devices having access to said subscriber lines, an operator position in said second exchange, a link in said second exchange including an answer switch and a call switch each having access to said toll line, means controlled by the seizure of said toll line by said switching means for causing said answer switch to seize said toll line, operator controlled means at said operator position operative to select over said answer switch and said toll line a first of said switching devices, additional operator controlled means at said operator position operative to cause said call switch to seize said toll line, means controlled by the seizure of said toll line by said call switch for selecting a second of said switching devices, and further operator controlled means at said operator position for controlling the operation of a selected one of said switching devices over one of said switches and said toll line.

61. In a telephone system, a trunk, first and second lines, automatic switching means having access to said trunk, means controlled over said first line for causing said switching means to seize said trunk, an automatic switching device having access to said second line, an operator position, automatic switching apparatus having access to said trunk, means controlled by the seizure of said trunk by said switching means for causing said switching apparatus to seize said trunk, operator controlled means at said operator position operative to cause said switching device to be associated with said trunk, and additional operator controlled means at said operator position for controlling the operation of said switching device over said switching apparatus and said trunk, thereby to cause said switching device to seize said second line in order operatively to interconnect said first line and said second line.

62. In a telephone system, a trunk, a plurality of lines, automatic switching means associated with said lines and having access to said trunk, an automatic switching device having access to said lines, means controlled over a first of said lines for causing said switching means to seize said trunk, thereby to extend a call from said first line to said trunk, an operator position, automatic switching apparatus associated with said operator position and having access to said trunk, means controlled by the seizure of said trunk by said switching means for causing said switching apparatus to seize said trunk, thereby to answer the call on said trunk, operator controlled means at said operator position operative to cause said switching device to be associated with said trunk, and additional operator controlled means at said operator position for controlling the operation of said switching device over said switching apparatus and said trunk, thereby to cause said switching device to seize a second of said lines in order revertively to extend the call over said trunk from said first line to said second line.

63. In a telephone system, a trunk, a plurality of lines, automatic switching means associated with said lines and having access to said trunk, an automatic switching device having access to said lines, means controlled over a first of said lines for causing said switching means to seize said trunk, thereby to extend a call from said first line to said trunk, an operator position, automatic switching apparatus associated with said operator position and having access to said trunk, means controlled by the seizure of said trunk by said switching means for causing said switching apparatus to seize said trunk, thereby to answer the call on said trunk, operator controlled means at said operator position operative to cause said switching device to be associated with said trunk, additional operator controlled means at said operator position for controlling the operation of said switching device over said switching appa-

ratus and said trunk, thereby to cause said switching device to seize a second of said lines in order revertively to extend the call over said trunk from said first line to said second line and to complete a three-way communication connection including said operator position and said first line and said second line, and further operator controlled means at said operator position for releasing said switching apparatus and the connection to said operator position without releasing the connection between said first line and said second line.

64. In a telephone system, a plurality of trunks, first and second lines, automatic switching means having access to said trunks, an automatic switching device having access to said second line, means controlled over said first line for causing said switching means to seize an idle one of said trunks, means controlled when said one trunk is seized by said switching means for rendering busy said one trunk, an operator position, a group of finder switches associated with said operator position, each of said finder switches having access to said trunks and being operative to seize any one of said trunks having a calling condition thereon, operator controlled means at said operator position for preparing any one of said finder switches to be operated, means controlled when any one of said trunks is seized by said switching means for creating a calling condition thereon and for causing a prepared one of said finder switches to be operated, additional operator controlled means at said operator position operative to cause said switching device to be associated with said switching means, and further operator controlled means at said operator position for controlling the operation of said switching device over said one finder switch and said one trunk, thereby to cause said switching device to seize said second line in order operatively to interconnect said first line and said second line.

65. In a telephone system, a plurality of trunks, first and second lines, automatic switching means having access to said trunks, an automatic switching device having access to said second line, means controlled over said first line for causing said switching means to seize an idle one of said trunks, means controlled when said one trunk is seized by said switching means for rendering busy said one trunk, a number of operator positions, a group of finder switches individually associated with each of said operator positions, each of said finder switches having access to said trunks and being operative to seize any one of said trunks having a calling condition thereon, operator controlled means at each of said operator positions for preparing any one of the finder switches in the associated group to be operated, a position distributor for selecting in a predetermined order the groups of finder switches in which a finder switch is prepared, means controlled when one of said trunks is seized by said switching means for creating a calling condition thereon and for causing a prepared one of said finder switches in a selected one of said groups to be operated, additional operator controlled means at each of said operator positions operative to cause said switching device to be associated with said switching means, and further operator controlled means at each of said operator positions for controlling the operation of said switching device over an operated one of the finder switches in the group associated therewith and the one of said trunks seized by said one finder switch, thereby to cause said switching device to seize said second line in order operatively to interconnect said first line and said second line.

66. In a telephone system, a first station, a second station, a dial-back repeater, a control trunk, means for completing a connection between said first station and said repeater, means included in said repeater and responsive to the completion of said last-mentioned connection for completing a connection between said repeater and said control trunk, an operator position, automatic switching apparatus operative to complete a connection between said operator position and said control trunk, means controlled when said connection is completed between said repeater and said control trunk for operating said switching apparatus, switching means having access to said second station, means included in said repeater and operative to complete a connection between said repeater and said switching means, operator controlled means at said operator position for operating over said control trunk said last-mentioned means, and additional operator controlled means at said operator position for controlling over said switching apparatus and said control trunk the operation of said switching means, thereby to cause said switching means to complete a connection to said second station.

67. In a telephone system, a first station, a second station, a dial-back repeater, a control trunk, means for completing a connection between said first station and said repeater, means included in said repeater and responsive to the completion of said last-mentioned connection for completing a connection between said repeater and said control trunk, an operator position, automatic switching apparatus operative to complete a connection between said operator position and said control trunk, means controlled when said connection is completed between said repeater and said control trunk for operating said switching apparatus, switching means having access to said second station, means included in said repeater and responsive to the momentary application of booster battery potential to said control trunk for completing a connection between said repeater and said switching means, operator controlled means at said operator position for causing booster battery potential to be applied momentarily to said control trunk, and additional operator controlled means at said operator position for controlling over said switching apparatus and said control trunk the operation of said switching means, thereby to cause said switching means to complete a connection to said second station.

68. In a telephone system, a first station, a second station, a repeater, a control trunk, means operative to interconnect said first station and said repeater and said control trunk, an operator position, automatic switching apparatus operative to interconnect said control trunk and said operator position, means controlled by the operation of said last-mentioned means for operating said switching apparatus, means operative to interconnect said repeater and said second station, operator controlled means at said operator position for controlling over said switching apparatus and said control trunk the operation of said last-mentioned means, thereby to establish a three-way communication connection including said first station and said second station and said operator position, means operative to

release said switching apparatus and the connection between said repeater and said operator position without releasing the connection between said first station and said second station, and additional operator controlled means for operating said last-mentioned means.

69. In a telephone system, a first station, a second station, a repeater, a number of control trunks, means operative to complete a connection between said first station and said repeater, means included in said repeater and responsive to the completion of said last-mentioned connection for completing a connection between said repeater and an idle one of said control trunks, means controlled when said connection is completed between said repeater and said one control trunk for rendering busy said one control trunk and for creating a call on said one control trunk, an operator position, automatic switching apparatus having access to said control trunks and operative to complete a connection between said operator position and any one of said control trunks having a call thereon, means controlled by the presence of a call on any one of said control trunks for operating said switching apparatus, means operative to interconnect said repeater and said second station, and operator controlled means at said operator position for controlling over said switching apparatus and said one control trunk the operation of said last-mentioned means, thereby to establish a three-way communication connection including said first station and said second station and said operator position.

70. In a telephone system wherein subscriber lines in two automatic exchanges connected by trunk lines complete local automatic connections in the respective exchanges but are restricted from completing inter-exchange calls, an office, a plurality of control trunks extending to said office, a repeater, means operative to seize said repeater in response to the initiation of an inter-exchange call on a subscriber line in either one of said exchanges, means included in said repeater and responsive to the seizure thereof for seizing an idle one of said control trunks, means controlled when said one control trunk is seized by said repeater for rendering busy said one control trunk and for creating a call on said one control trunk, said office including an operator position and automatic switching apparatus having access to said control trunks, said automatic switching apparatus being operative to complete a connection between said operator position and any one of said control trunks having a call thereon, means controlled by the presence of a call on any one of said control trunks for operating said switching apparatus, thereby to extend a connection to said operator position, and means controlled by the operator at said operator position for revertively extending the connection over said switching apparatus and said one control trunk to a subscriber line in either one of said exchanges.

71. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, said number of groups including at least one group of toll lines and at least one group of trunk lines, apparatus at said operator position for receiving incoming calls on the lines in said groups, a call distributor normally operative to route group by group in a predetermined order incoming calls on the lines in said groups to said operator position, whereby all incoming calls on lines in a given group are routed to said operator position before any incoming calls on lines in a succeeding group are routed to said operator position, means for controlling the operation of said call distributor, and means for restricting the operation of said call distributor entirely to that of routing incoming calls on the lines in said group of toll lines to said operator position.

72. In a telephone system, an exchange provided with a switchboard including an operator position, a number of groups of lines associated with said switchboard, said number of groups including at least one group of toll lines and at least one group of trunk lines, apparatus at said operator position for receiving incoming calls on the lines in said groups and for extending and initiating outgoing calls on the lines in said groups, a call distributor normally operative to route group by group in a predetermined order incoming calls on the lines in said groups to said operator position, whereby all incoming calls on lines in a given group are routed to said operator position before any incoming calls on lines in a succeeding group are routed to said operator position, means for controlling the operation of said call distributor, means for restricting the operation of said call distributor entirely to that of routing incoming calls on the lines in said group of toll lines to said operator position, and means controlled when an outgoing call is initiated at said operator position on a line in any one of said groups for preventing the operation of said call distributor.

73. In a telephone system, an exchange provided with a switchboard including a plurality of operator positions, a number of groups of lines associated with said switchboard, said number of groups including at least one group of toll lines and at least one group of trunk lines, apparatus at each of said operator positions for receiving incoming calls on the lines in said groups and for extending and initiating outgoing calls on the lines in said groups, a position distributor for selecting in a predetermined order said operator positions, a call distributor normally operative to route group by group in a predetermined order incoming calls on the lines in said groups to selected ones of said operator positions, whereby all incoming calls on the lines in a given group are rounted one by one to selected ones of said operator positions before any incoming calls on lines in a succeeding group are routed one by one to selected ones of said operator positions, means for controlling the operation of said call distributor, means for restricting the operation of said call distributor entirely to that of routing incoming calls on the lines in said group of toll lines to said operator positions, and means controlled when an outgoing call is initiated at any one of said operator positions on a line in any one of said groups for preventing said position distributor from selecting said one operator position.

THOMAS F. CROCKER.

CERTIFICATE OF CORRECTION.

Patent No. 2,230,053. January 28, 1941.

THOMAS F. CROCKER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 67, first column, line 45, claim 9, for the word "finger" read --finder--; page 69, second column, line 9, claim 20, for "dlstributor" read --distributor--; page 73, first column, line 16, for "predetmined" read --predetermined--; line 27, for "flinder" read --finder--; and second column, line 35, claim 50, after "route" insert --group--; page 77, second column, line 56, claim 73, for "rounted" read --routed--; 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 25th day of February, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)

CERTIFICATE OF CORRECTION.

Patent No. 2,230,053. January 28, 1941.

THOMAS F. CROCKER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 67, first column, line 45, claim 9, for the word "finger" read --finder--; page 69, second column, line 9, claim 20, for "dlstributor" read --distributor--; page 73, first column, line 16, for "predetmined" read --predetermined--; line 27, for "flinder" read --finder--; and second column, line 35, claim 50, after "route" insert --group--; page 77, second column, line 56, claim 73, for "rounted" read --routed--; 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 25th day of February, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)