

July 15, 1941.

J. WICKS

2,249,449

TELEPHONE SYSTEM

Filed April 22, 1940

5 Sheets-Sheet 1

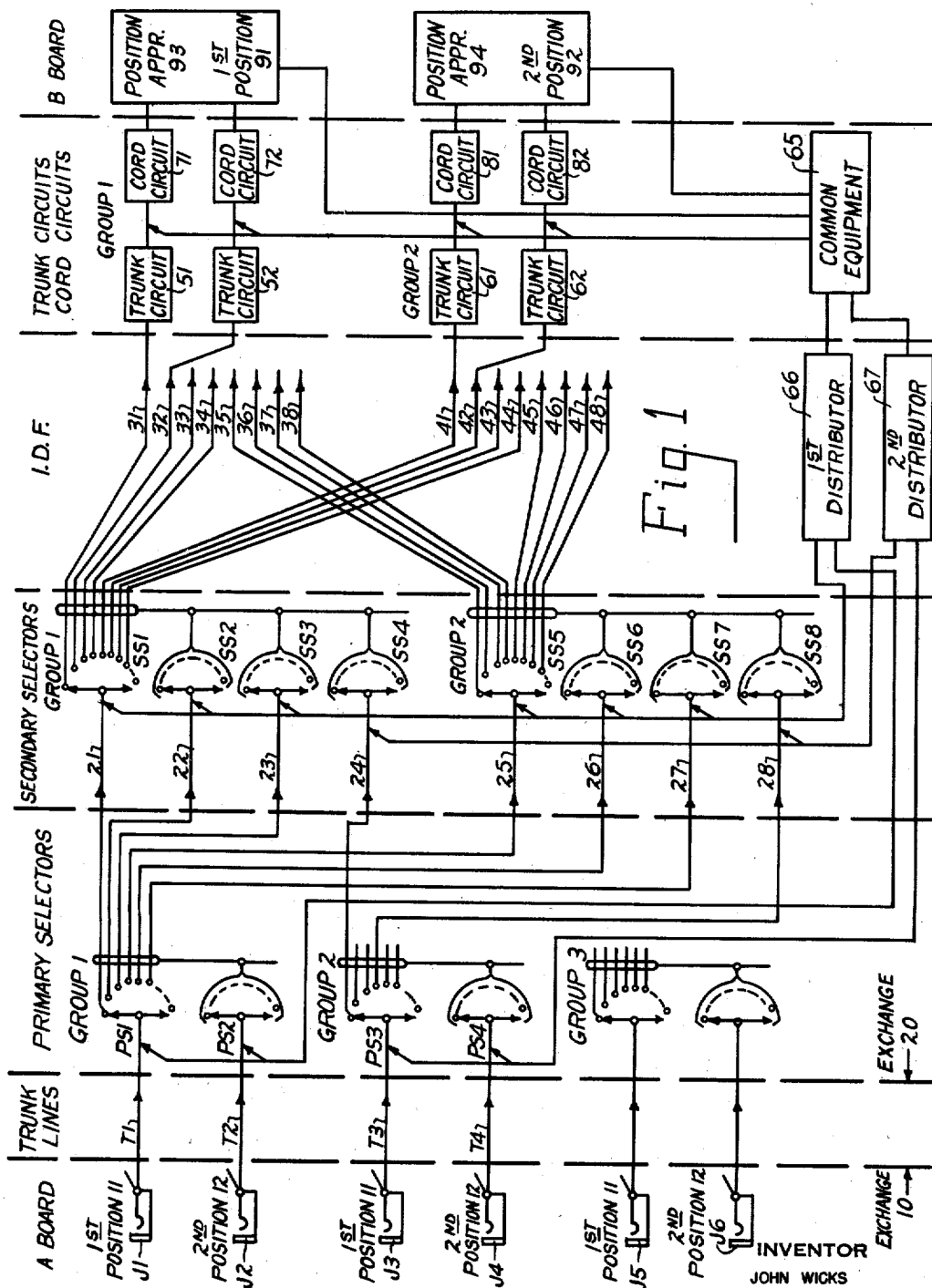


Fig. 1

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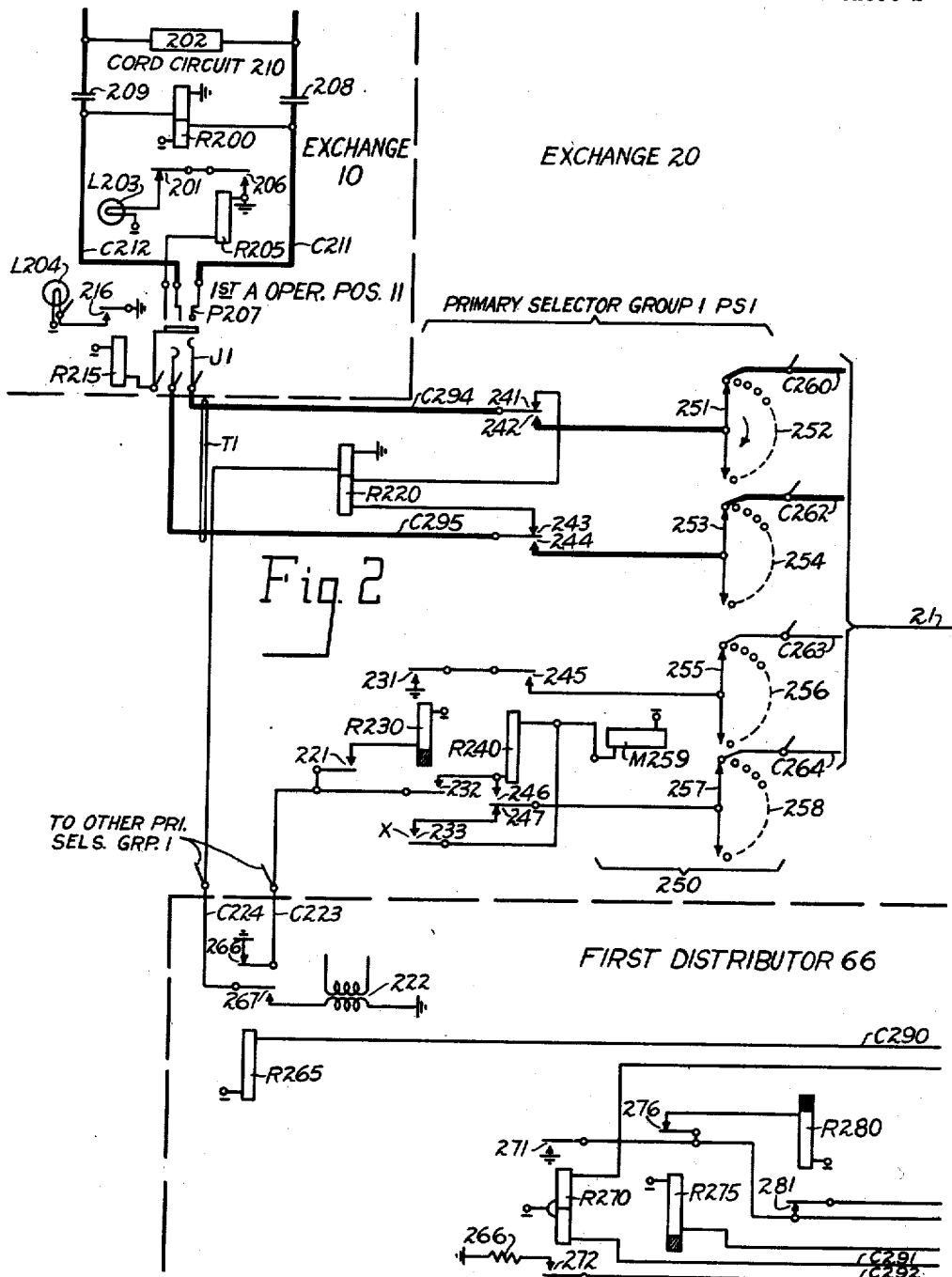
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5 Sheets-Sheet 2



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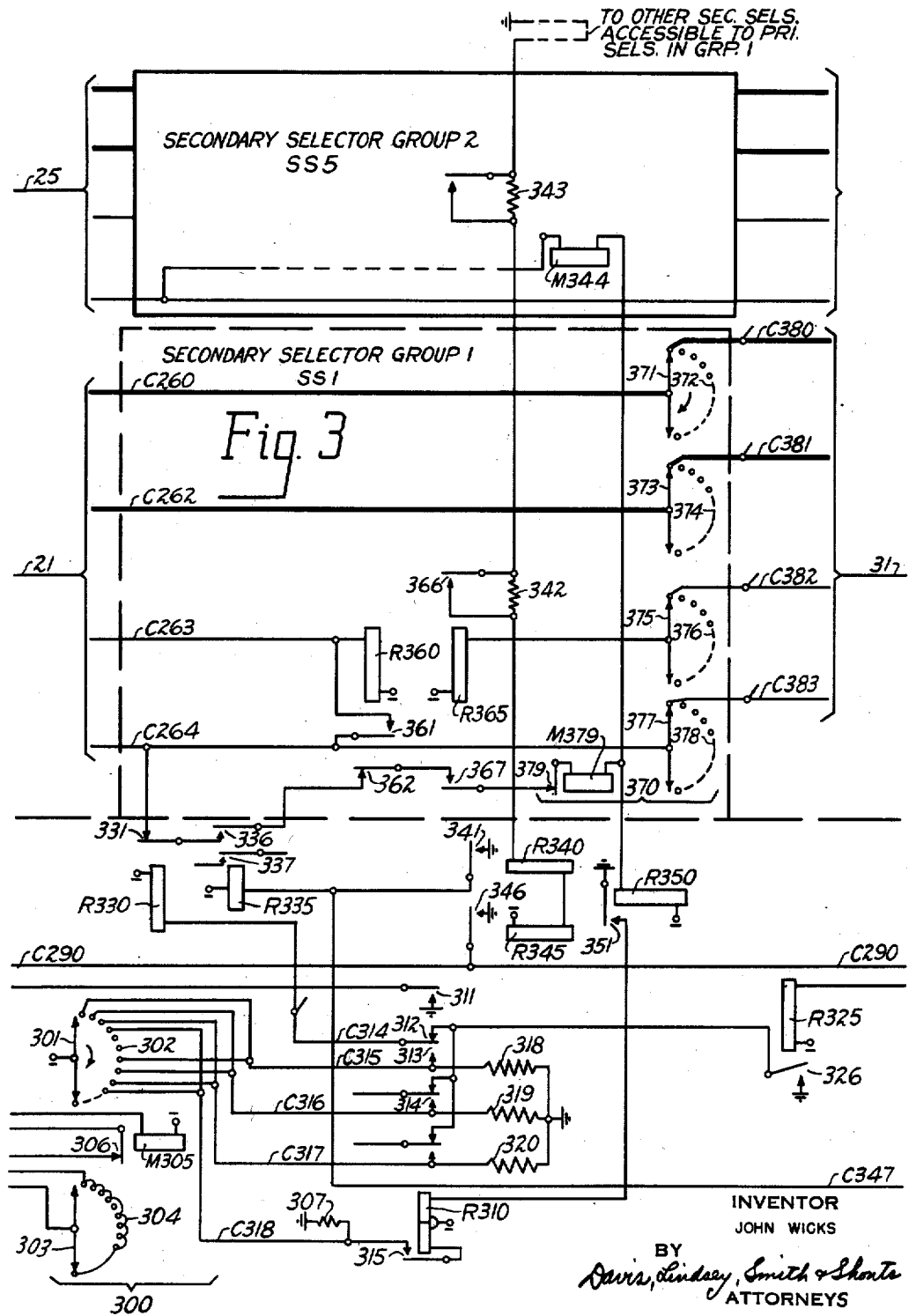
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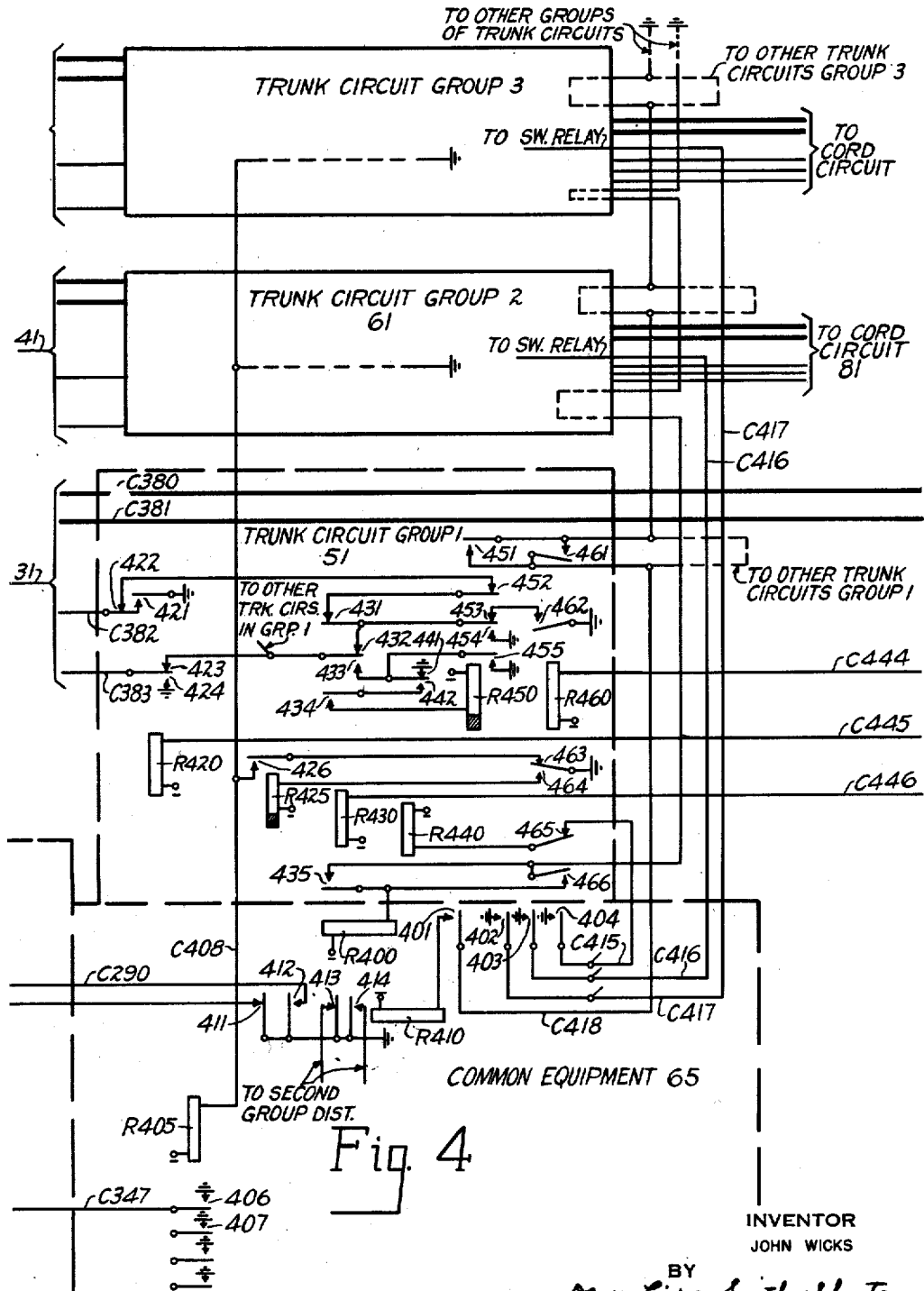
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5 Sheets-Sheet 4



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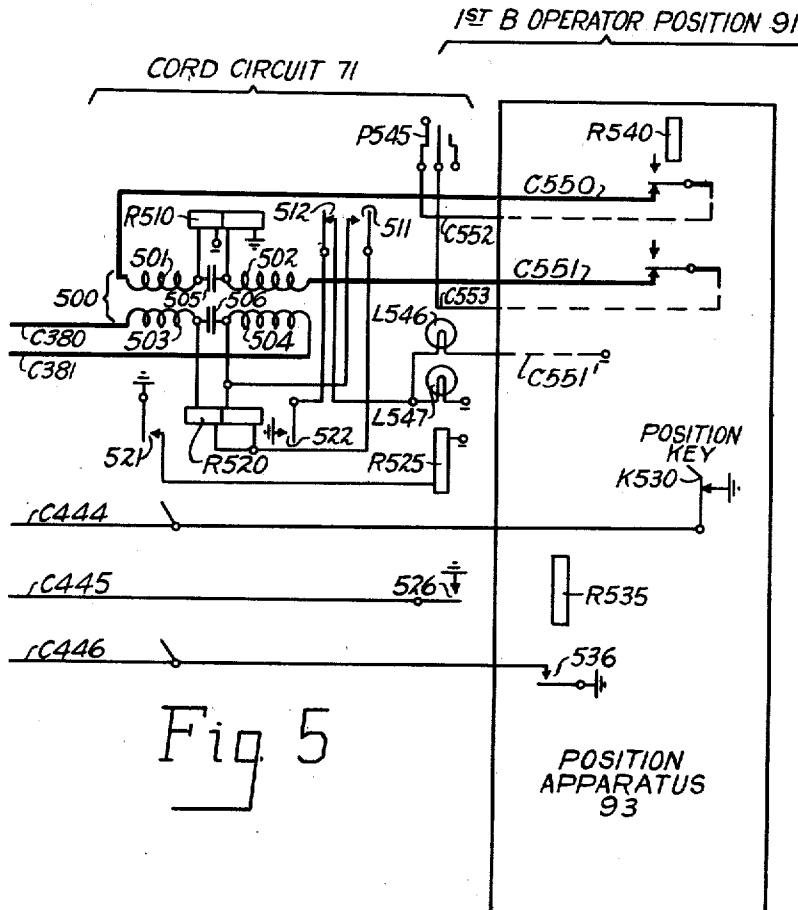
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2,249,449

TELEPHONE SYSTEM

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Application April 22, 1940, Serial No. 330,974

18 Claims. (Cl. 179—27)

The present invention relates to telephone systems and more particularly to improved semi-automatic telephone systems of the character of that disclosed and claimed in John Wicks Patent No. 2,167,733, issued August 1, 1939.

It is an object of the present invention to provide an improved arrangement for distributing calls to available cord circuits at a number of operator positions at a B switchboard.

Another object of the invention is to provide a call distributing arrangement between a number of operator positions at an A switchboard and a number of operator positions at a B switchboard which comprises an improved switching arrangement including a plurality of primary selectors and a plurality of secondary selectors.

A further object of the invention is to provide in a call distributing arrangement of the character noted, an improved arrangement for controlling the assignment of both the primary and secondary selectors and the cord circuits at the various operator positions at the B switchboard.

The features of the present invention are illustrated as being incorporated in a telephone system comprising a first exchange including an A switchboard provided with a number of operator positions, a second exchange including a B switchboard provided with a number of operator positions, a plurality of trunk lines extending between the first exchange and the second exchange, and automatic switching apparatus in the second exchange for routing calls straightforward from the various operator positions at the A switchboard to the various operator positions at the B switchboard.

In accordance with one feature of the invention the telephone system comprises a B switchboard including a plurality of operator positions, a plurality of groups of cord circuits individually associated with the operator positions, a plurality of secondary selectors having access to the cord circuits, means for causing idle ones of the secondary selectors to preselect idle ones of the cord circuits in the various groups of cord circuits, a plurality of primary selectors having access to the secondary selectors, an A switchboard, a plurality of jacks at the A switchboard, a plurality of trunk lines individually associated with the primary selectors and individually terminating in the jacks, and means at the A switchboard for routing a call over any one of the trunk lines by way of the corresponding one of the jacks. Also the system comprises means controlled when a call is routed over one of the trunk lines for causing the associated one

of the primary selectors to operate and select an idle one of the secondary selectors which has preselected an idle one of the cord circuits in one of the groups of cord circuits, thereby to route the call on the one trunk line straightforward to the associated operator position at the B switchboard to be answered, means controlled when a call is routed over the one trunk line for rendering busy the one trunk line, means controlled when the one secondary selector is selected by the one primary selector for rendering busy the one secondary selector and the one cord circuit in the one group of cord circuits, a source of tone voltage, and means controlled when all of the secondary selectors are rendered busy for preventing operation of all of the primary selectors and for connecting the source of tone voltage to each idle one of the trunk lines.

In accordance with another feature of the invention the system comprises means at each of the operator positions at the B switchboard for answering and for extending a call routed thereto, a plurality of normally ineffective blocking means individually associated with the operator positions, each of the blocking means being effective to prevent calls from being routed to the associated operator position, means controlled while a call is being extended from one of the operator positions for rendering effective the associated one of the blocking means, additional means controlled while a call is being extended from each of the operator positions for rendering again ineffective each of the blocking means. More particularly, each of the cord circuits in each of the groups of cord circuits includes means for storing a call routed thereover; and the system comprises further means controlled when a call is stored in one of the cord circuits in one of the groups of cord circuits for rendering again effective the associated one of the blocking means, and additional means controlled when a call is stored in one of the cord circuits in each of the groups of cord circuits for preventing operation of the primary selectors and for connecting the source of tone voltage to each idle one of the trunk lines.

In accordance with a further feature of the invention the system comprises means controlled when one of the secondary selectors is selected by one of the primary selectors for rendering busy the secondary selector and the one of the cord circuits in one of the groups of cord circuits preselected by the one secondary selector and for marking against selection each idle one

of the secondary selectors which has preselected the one cord circuit, and means including a distributor controlled when only a predetermined number of the secondary selectors are marked for selection for causing operation of the group of idle secondary selectors marked against selection, thereby to cause the last-mentioned group of secondary selectors to preselect idle ones of the cord circuits in the various groups of cord circuits. More particularly, the distributor is so connected and arranged that the last-mentioned group of secondary selectors is operated sequentially by subgroups in the event the group exceeds a predetermined number and that the last-mentioned group of secondary selectors is operated substantially simultaneously in the event the group does not exceed the predetermined number.

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

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings in which Figure 1 illustrates the general arrangement of a telephone system including two exchanges and embodying the present invention; and Figs. 2 to 5, inclusive, taken together, illustrate the details of the system having incorporated therein the features of the invention, as briefly outlined above.

Description of the apparatus incorporated in the telephone system

Referring now more particularly to Fig. 1 of the drawings, the telephone system there illustrated comprises two exchanges 10 and 20 and a number of one-way trunk lines, including the trunk lines T1, T2, T3, T4, etc., extending therebetween. The exchanges 10 and 20 are of the manual type, each serving a number of subscriber substations, not shown. The exchange 10 comprises an A board provided with a number of A operator positions, including the positions 11 and 12, and a B board, not shown; while the exchange 20 comprises an A board, not shown, and a B board provided with a number of B operator positions, including the positions 91 and 92. Also the exchange 20 comprises automatic switching apparatus, including a number of groups of primary selectors, and a number of groups of secondary selectors. For example, the first and second groups of primary selectors respectively include the individual primary selectors PS1, PS2 and PS3, PS4; while the first and second groups of secondary selectors respectively include the individual secondary selectors SS1, SS2, SS3, SS4 and SS5, SS6, SS7, SS8. Further the exchange 20 comprises a number of groups of paired trunk circuits and cord circuits. For example, the first group of paired trunk circuits and cord circuits includes the paired trunk circuits and cord circuits 51, 71 and 52, 72, etc., individually associated with the first position 91 at the B board; while the second group of paired trunk circuits and cord circuits includes the paired trunk circuits and cord circuits 61, 81 and 62, 82, etc., individually associated with the second position 92 at the B board. Finally, the exchange 20 comprises common equipment 65 as-

sociated with each operator position at the B board and with each trunk circuit and a number of distributors including the distributors 66 and 67.

The trunk lines T1, T2, etc., extending between the exchanges 10 and 20 terminate in jacks at the A board in the exchange 10 and in the primary selectors in the exchange 20. For example, the trunk line T1 terminates in a jack J1 at the first position 11 at the A board in the exchange 10, the jack J1 being multipled to other of the positions at the A board, and terminates in the primary selector PS1 in the first group of primary selectors in the exchange 20; while the trunk line T2 terminates in a jack J2 at the second position 12 at the A board in the exchange 10, the jack J2 being multipled to other of the positions at the A board, and terminates in the primary selector PS2 in the first group of primary selectors in the exchange 20. Thus it will be understood that each primary selector in each group of primary selectors in the exchange 20 is accessible by way of an associated trunk line to several of the positions at the A board in the exchange 10; and that each position at the A board in the exchange 10 has access by way of the associated trunk lines to several primary selectors in each group of primary selectors in the exchange 20.

Each secondary selector in each group of secondary selectors in the exchange 20 terminates a trunk line accessible to the primary selectors in a corresponding group of primary selectors. For example, the secondary selectors SS1, SS2 and SS3 in the first group of secondary selectors respectively terminate the trunks 21, 22 and 23 accessible to the primary selectors in the first group of primary selectors; while the secondary selectors SS4, etc., in the first group of secondary selectors respectively terminate the trunks 24, etc., accessible to the primary selectors in the second group of primary selectors. Similarly, the secondary selectors SS5, SS6 and SS7 in the second group of secondary selectors respectively terminate the trunks 25, 26 and 27 accessible to the primary selectors in the first group of primary selectors; while the secondary selectors SS8, etc., in the second group of secondary selectors respectively terminate the trunks 28, etc., accessible to the primary selectors in the second group of primary selectors. Thus it will be understood that the primary selectors in each group of primary selectors have access to several secondary selectors in each group of secondary selectors.

Each trunk circuit in each group of trunk circuits in the exchange 20 terminates a trunk accessible to the secondary selectors in a corresponding group of secondary selectors. For example, the trunk circuits 51 and 52 in the first group of trunk circuits respectively terminate the trunks 31 and 32 accessible to the secondary selectors in the first group of secondary selectors; while other trunk circuits in the first group of trunk circuits respectively terminate the trunks 35, 36, etc., accessible to the secondary selectors in the second group of secondary selectors. Similarly, the trunk circuits 61 and 62 in the second group of trunk circuits respectively terminate the trunks 41 and 42 accessible to the secondary selectors in the first group of secondary selectors; while other trunk circuits in the second group of trunk circuits respectively terminate the trunks 45, 46, etc., accessible to the secondary selectors

in the second group of secondary selectors. Thus it will be understood that the secondary selectors in each group of secondary selectors have access to a number of trunk circuits in each group of trunk circuits.

Each distributor in the exchange 20 governs the distribution of the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the corresponding group of primary selectors and controls the cutoff of the primary selectors in the corresponding group of primary selectors. For example, the first distributor 66 governs the distribution of the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors, and controls the cutoff of the primary selectors in the first group of primary selectors.

The A board in the exchange 10 is of conventional connection and arrangement comprising a number of substantially identical operator positions each including position apparatus. As best shown in Fig. 2, the position apparatus at the first A operator position 11 comprises position equipment including a number of cord circuits connected and arranged in a manner similar to the cord circuit 210. More particularly, the cord circuit 210 comprises a line relay R200, a busy relay R205, a call plug P207 and an answer lamp L203, and it is adapted to be connected to the telephone instrument 202 at the first A operator position 11. Also, the jack J1 at the first A operator position 11 terminating the trunk line T1 has a control relay R215 and a busy lamp L204 individually associated therewith.

The B board in the exchange 20 is of conventional connection and arrangement comprising a number of substantially identical operator positions each including position apparatus. As best shown in Fig. 5, the position apparatus at the first B operator position 91 comprises position apparatus 93 including a telephone instrument, not shown, a position key K530, an answer relay R535, apparatus for connecting the telephone instrument to any one of the associated cord circuits, not shown, and a number of split relays individually associated with the various cord circuits, the split relay R540 being individually associated with the cord circuit 71.

Preferably, each of the primary selectors is identical to the primary selector PS1 in the first group of primary selectors which comprises, as best shown in Fig. 2, a rotary switch 250 and a number of relays including a line relay R220, a hold relay R230 and a stop relay R240 connected and arranged in a manner more fully described subsequently. The rotary switch 250 comprises four rotary wipers 251, 253, 255 and 257 provided with individually associated rotary contact banks 252, 254, 256 and 258 and a rotary magnet M259 for moving the wipers noted in the rotary direction.

Preferably, each of the secondary selectors is identical to the secondary selector SS1 in the first group of secondary selectors which comprises, as best shown in Fig. 3, a rotary switch 370, a busy relay R360 and a test relay R365 connected and arranged in a manner more fully described subsequently. The rotary switch 370 comprises four rotary wipers 371, 373, 375 and 377 provided with individually associated rotary contact banks 372, 374, 376 and 378 and a rotary magnet M379 for moving the wipers noted in the rotary direction.

Preferably, each of the trunk circuits is identical to the trunk circuit 51 in the first group of

trunk circuits, which comprises, as best shown in Fig. 4, a number of relays including a busy relay R420, a control relay R425, an answer relay R430, a switching relay R440, a storage relay R450 and a start relay R460 connected and arranged in a manner more fully described subsequently.

Preferably, each of the cord circuits is identical to the cord circuit 71 in the first group of cord circuits, which comprises, as best shown in Fig. 5, a repeater 500, and a number of relays including a line relay R520, a battery supply relay R510 and a busy relay R525 connected and arranged in a manner more fully described subsequently. Further the cord circuit 71 includes a plug P545 and has individually associated therewith an answer lamp L546 and a line lamp L547.

The common equipment 65 comprises, as best shown in Fig. 4, a number of relays including an operator start relay R405, an operator busy relay R400 and a storage busy relay R410, connected and arranged in a manner more fully described subsequently.

Preferably, each of the distributors is identical to the first distributor 66 which comprises, as best shown in Figs. 2 and 3, a rotary switch 300 and a number of relays, including a common primary selector cutoff relay R265, a hold relay R270, two step relays R275 and R280, a plurality of individual secondary selector cutoff relays, including the individual secondary selector cutoff relay R330 individually associated with the secondary selector SS1 in the first group of secondary selectors, a secondary selector start relay R335, a switching relay R310, a test start relay R340, a test stop relay R345, a distributor start relay R350 and a common secondary selector cutoff relay R325 connected and arranged in a manner more fully described subsequently. The rotary switch 300 includes two rotary wipers 301 and 303 provided with individually associated rotary contact banks 302 and 304 and a rotary magnet M305 for moving the wipers noted in the rotary direction.

A better understanding of the connection and arrangement of the apparatus incorporated in the telephone system will be facilitated from a consideration of the general operation of the various pieces of apparatus incorporated therein incident to the extension of a call from the A board in the exchange 10 to the B board in the exchange 20, as will appear hereinafter.

General operation of the system

Considering now the general operation of the system with reference to Fig. 1 of the drawings it is noted that, after a call on a telephone line in the exchange 10 which is to be completed to a telephone line in the exchange 20 is answered by the operator at one of the operator positions at the A board in the exchange 10, such, for example, as the first A operator position 11, the call is trunked by way of one of the trunk lines extending between the exchange 10 and the exchange 20, such, for example, as the trunk line T1, to the automatic switching apparatus in the exchange 20. The call is then automatically routed or trunked straightforward by the switching apparatus in the exchange 20 over an idle one of the cord circuits associated with an idle one of the operator positions at the B board, such, for example, as the first B operator position 91. More particularly, when the operator at the first A operator position 11 inserts the call plug of a

cord circuit at her position into the jack J1 terminating the trunk line T1, operation of the primary selector PS1 in the first group of selectors is initiated, whereupon the first selector PS1 seizes an idle trunk in the group of trunks accessible thereto, such, for example, as the trunk 21. At this point it is noted that the trunk 21 is idle only when the associated secondary selector SS1 in the first group of secondary selectors is idle and has previously selected an idle one of the trunks accessible thereto, such, for example, as the trunk 31, the trunk 31 being marked as idle only when the associated paired trunk circuit 51 and cord circuit 71 are idle and the operator at the first B operator position 91 is idle and in readiness to receive a call. Accordingly, the primary selector PS1 operates immediately to seize the trunk 21 extending by way of the secondary selector SS1, the trunk 31, the trunk circuit 51 and the cord circuit 71 to the first B operator position 91, whereupon apparatus at the first B operator position 91 operates to connect the telephone instrument thereat to the cord circuit 71 and to cause a zip-zip tone to be transmitted to the telephone instrument at the first B operator position 91 and over the previously traced connection to the telephone instrument at the first A operator position 11. Accordingly, almost immediately the operator at the first A operator position 11 in the exchange 10 inserts the call plug of the cord circuit 71 at her position into the jack J1, the connection is completed to the first B operator position 91 in the exchange 20 and tone is heard in the receiver of the telephone instrument at the first A operator position 11 indicating to her that the number may be passed to the operator at the first B operator position 91. The operator at the first A operator position 11 then passes the number to the operator at the first B operator position 91, whereupon the operator at the first B operator position 91 promptly completes the connection to the called telephone line in the exchange 20, at which time the position apparatus 93 at the first B operator position 91 is again rendered idle for further use.

Idle ones of the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in a corresponding group of primary selectors are assigned intermittently by the associated distributor. For example, when a predetermined number of the secondary selectors in the various groups of secondary selectors are rendered busy to the primary selectors in the first group of primary selectors, operation of the associated first distributor 66 is initiated. At this point it is noted that the secondary selectors in the various groups of secondary selectors may be rendered busy either by the direct seizure and extension of connections by way of the secondary selectors or by the seizure and extension of connections by way of the trunk circuits previously selected by the secondary selectors. Accordingly, when operation of the first distributor 66 is initiated, operations of the idle secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors which are selecting busy trunk circuits are initiated. These secondary selectors in the various groups of secondary selectors then operate to preselect idle ones of the trunk circuits in the various groups of trunk circuits. Further, it is noted that the particular mode of operation of the first distributor 66 depends upon the number of secondary selectors in the various groups of secondary selectors, the operations of which

are initiated when operation of the first distributor 66 is initiated. More particularly, in the event the operations of a large number of secondary selectors are initiated, the first distributor 66 operates further in order to cause these secondary selectors to be operated in sequential groups; on the other hand, in the event the operations of a small number of secondary selectors are initiated, the first distributor 66 is not further controlled, thereby to allow all of these secondary selectors to operate simultaneously.

Furthermore, the first distributor 66 is so connected and arranged that when all of the secondary selectors in the various groups of secondary selectors, accessible to the primary selectors in the first group of primary selectors, are busy, the first distributor 66 operates, thereby to prevent further operation of the primary selectors in the first group of primary selectors and to mark as busy the associated trunk lines terminating in the jacks at the various positions at the A board in the exchange 10.

Also the trunk circuits in each group of trunk circuits are so connected and arranged that when the associated B operator position is busy answering a call on a cord circuit in the associated group of cord circuits, each of the other trunk circuits in the associated group of trunk circuits is rendered busy, thereby to prevent additional calls to be extended to the associated B operator position at this time.

Furthermore, the trunk circuits in the various groups of trunk circuits are so connected and arranged that, when all of the B operator positions are busy, one additional call may be stored in a trunk circuit in each group of trunk circuits. Finally, the common equipment 65 is so connected and arranged that, when one call is stored in a trunk circuit in each group of trunk circuits, the various distributors are controlled, thereby to prevent operation of the primary selectors in the various groups of primary selectors and to mark as busy each of the trunk lines extending to the various positions at the A board in the exchange 10.

Detailed operation of the system

Considering now the detailed operation of the system with reference to Figs. 2 to 5, inclusive, it is assumed that the operator at the first A operator position 11 in the exchange 10 has answered a call on the cord circuit 210 which is to be completed in the exchange 20. After answering the call the operator at the first A operator position 11 inserts the call plug P207 of the cord circuit 210 into one of the jacks terminating an idle one of the trunk lines, such, for example, as the jack J1, the trunk line T1 being marked as idle by the extinguished condition of the busy lamp L204 associated with the jack J1 terminating the trunk line T1. When the call plug P207 is inserted into the jack J1 there is completed an obvious circuit for energizing in series the winding of the busy relay R205 in the cord circuit 210 and the winding of the control relay R215, thereby to cause operation of these relays. Upon operating, the busy relay R205 completes, at the contacts 206, an obvious circuit for illuminating the answer lamp L203; and upon operating, the control relay R215 completes, at the contacts 216, an obvious circuit for illuminating the busy lamp L204 at the first A operator position 11 and the corresponding busy lamps at the other A operator positions. The illumination of the answer lamp L203 indicates to the

operator at the first A operator position 11 that the call has not yet been answered on a called telephone line in the exchange 20; while the illumination of the busy lamps at the various A operator positions indicates to the operators thereat that the trunk line T1 is busy.

Also when the call plug P207 of the cord circuit 210 is inserted into the jack J1 there is completed a circuit for energizing the lower winding of the line relay R220 in the primary selector PS1 terminating the trunk line T1, this circuit extending from ground by way of the upper winding of the line relay R200 in the cord circuit 210, C212, the call plug P207, the jack J1, the line conductor C295 of the trunk line T1, the contacts 243, the lower winding of the line relay R220 in the primary selector PS1, the contacts 241, the line conductor C294 of the trunk line T1, the jack J1, the call plug P207, C211 and the lower winding of the line relay R200 in the cord circuit 210 to battery. When this circuit is completed the line relay R220 in the primary selector PS1 operates; however, the line relay R200 in the cord circuit 210 does not operate due to the high series resistance of this circuit. Upon operating, the line relay R220 completes, at the contacts 221, an obvious circuit for energizing the winding of the hold relay R230, thereby to cause the latter relay to operate. Upon operating, the hold relay R230 prepares, at the contacts 231, a path for applying ground potential to the wiper 255 of the rotary switch 250 and completes, at the contacts 233, a test circuit for the stop relay R240.

The subsequent operation of the primary selector PS1 depends upon the idle or busy condition of the trunk 21 engaged by the wipers noted of the rotary switch 250 and extending to the secondary selector SS1. More particularly, it is noted that, in the event the trunk 21 is marked as busy, ground potential appears upon the control conductor C264 thereof, thereby to complete in multiple a path for short-circuiting the winding of the stop relay R240 and a circuit for energizing the rotary magnet M259. The path for short-circuiting the winding of the stop relay R240 extends from the grounded control conductor C264 of the trunk 21 by way of the wiper 257 and engaged contact in the associated contact bank 258 of the rotary switch 250, the contacts 247 and 233, the winding of R240, the contacts 232, C223 and the contacts 266 to ground. The short-circuiting of the winding of the stop relay R240 positively prevents operation thereof at this time. The circuit for energizing the rotary magnet M259 extends from the grounded control conductor C264 of the trunk 21 by way of the previously traced path to the contacts 233, and therefrom by way of the contacts 259 and the rotary magnet M259 to battery. When thus energized the rotary magnet M259 operates, thereby to condition the wipers noted of the rotary switch 250 to be driven one step in the clockwise direction and to interrupt, at the contacts 259, the previously traced circuit for energizing the rotary magnet M259, thereby to cause the rotary magnet M259 to restore. Upon restoring, the rotary magnet M259 drives the wipers noted of the rotary switch 250 one step in the clockwise direction, thereby to cause the wiper 257 of the rotary switch 250 to engage the second contact in the associated contact bank 258 terminating the control conductor of the next trunk. Accordingly, the primary selector PS1 operates as previously explained, thereby to test the idle or

busy condition of the next trunk. More particularly, the rotary magnet M259 of the rotary switch 250 is energized intermittently, thereby to cause the rotary switch 250 to be driven step by step in the clockwise direction until the wipers noted thereof select an idle trunk.

Assuming that the trunk 21 selected by the wipers noted of the rotary switch 250 is idle at this time, battery potential appears upon the control conductor C264 thereof and there is completed in multiple a circuit identical to that previously traced for energizing the winding of the stop relay R240 and a path identical to that previously traced for short-circuiting the rotary magnet M259 incident to the operation of the hold relay R230. Accordingly, in this event, operation of the rotary magnet M259 is not initiated and the stop relay R240 operates immediately. Upon operating, the stop relay R240 interrupts, at the contacts 247, the previously mentioned path for short-circuiting the rotary magnet M259 and prepares, at the contacts 246, a circuit for energizing in series the winding of the stop relay R240 and the rotary magnet M259, which circuit is completed incident to the switching-through of the secondary selector SS1 terminating the trunk 21, in a manner more fully explained subsequently. Also, upon operating, the stop relay R240 completes, at the contacts 245, a circuit for energizing the winding of the busy relay R360 in the secondary selector SS1, this circuit extending from ground by way of the contacts 231 and 245, the wiper 255 and engaged contact in the associated contact bank 256 of the rotary switch 250, the control conductor C263 of the trunk 21 and the winding of R360 to battery. When thus energized the busy relay R360 operates to complete, at the contacts 361, a holding circuit for energizing in series the winding of the stop relay R240 and the rotary magnet M259, this circuit extending from ground at the contacts 231 by way of the previously traced path to the control conductor C263 of the trunk 21 and therefrom by way of the contacts 361, the control conductor C264 of the trunk 21, the wiper 257 and engaged contact in the associated contact bank 258 of the rotary switch 250, the contacts 246, the winding of the stop relay R240, the contacts 259 and the rotary magnet M259 to battery. When this holding circuit is completed the stop relay R240 remains in its operated position; however, the rotary magnet M259 does not operate due to the high series resistance of this circuit. Also the busy relay R360 prepares, at the contacts 361, a holding circuit traced herein-after for energizing the winding thereof, additional ground potential being applied to the control conductor C264 of the trunk 21 subsequently, in a manner more fully explained hereinafter.

As previously noted, when operation of the primary selector PS1 is initiated, ground potential appears upon the control conductor C264 in the event the trunk 21 is busy; while battery potential appears upon the control conductor C264 in the event the trunk 21 is idle. Assuming that the secondary selector SS1 has previously selected the trunk 31 extending to the trunk circuit 51 at this time, the path for applying ground potential to the control conductor C264 of the trunk 21 extends from the control conductor C383 of the trunk 31 by way of the wiper 377 and engaged contact in the associated contact bank 378 of the rotary switch 370 to the control conductor C264 of the trunk 21, the path

for applying ground potential to the control conductor C383 of the trunk 31 which is completed depending upon a number of conditions, in a manner more fully explained hereinafter. For example, a path may be completed for applying ground potential to the control conductor C383 of the trunk 31 which extends from ground by way of the contacts 424 to the control conductor C383 of the trunk 31; a path may be completed for applying ground potential to the control conductor C383 of the trunk 31 which extends from ground by way of the contacts 441, 433, and 423 to the control conductor C383 of the trunk 31; a path may be completed for applying ground potential to the control conductor C383 of the trunk 31 which extends from ground by way of the contacts 454, 432 and 423 to the control conductor C383 of the trunk 31; and a path may be completed for applying ground potential to the control conductor C383 of the trunk 31 which extends from ground by way of the contacts 462, 453, 432 and 423 to the control conductor C383 of the trunk 31. The particular one of these paths for applying ground potential to the control conductor C383 of the trunk 31 depends upon certain operating conditions of the cord circuit 71, the associated cord circuit 71 and the apparatus at the associated first B operator position 91, in a manner more fully explained hereinafter. Assuming that the secondary selector SSI has previously selected the trunk 31 extending to the trunk circuit 51 at this time, the path for applying battery potential to the control conductor C264 of the trunk 21 extends from battery by way of the winding of the test relay R365, the wiper 375 and engaged contact in the associated contact bank 376 of the rotary switch 370, the control conductor C382 of the trunk 31, the contacts 422, 452, 431, 432 and 423, the control conductor C383 of the trunk 31 and the wiper 377 and engaged contact in the associated contact bank 378 of the rotary switch 370 to the control conductor C264 of the trunk 21.

Also upon operating, the stop relay R240 interrupts, at the contacts 241 and 243, the previously traced circuit for energizing the lower winding of the line relay R220, thereby to cause the line relay to restore. Also the stop relay R240 completes, at the contacts 242 and 244, a loop circuit extending between the line relay R200 in the cord circuit 210 and the line relay R520 in the cord circuit 71. This loop circuit extends from ground by way of the upper winding of the line relay R220, C212, the call plug P207, the jack J1, the line conductor C295 of the trunk line T1, the contacts 244, the wiper 253 and engaged contact in the associated contact bank 254 of the rotary switch 250, the line conductor C262 of the trunk 21, the wiper 373 and engaged contact in the associated contact bank 374 of the rotary switch 370, the line conductor C381 of the trunk 31, the winding 504 of the repeater 500, the right-hand and left-hand windings of the line relay R520, the winding 503 of the repeater 500, the line conductor C380 of the trunk 31, the wiper 371 and engaged contact in the associated contact bank 372 of the rotary switch 370, the line conductor C260 of the trunk 21, the wiper 251 and engaged contact in the associated contact bank 252 of the rotary switch 250, the contacts 242, the line conductor C294 of the trunk line T1, the jack J1, the call plug P207, C211 and the lower winding of the line relay R200 in the cord circuit 210 to battery.

When this loop circuit is completed the line relay R520 in the cord circuit 71 operates. However, the line relay R200 in the cord circuit 210 does not operate due to the high series resistance of this circuit.

Upon restoring, the line relay R220 interrupts, at the contacts 221, the previously mentioned circuit for energizing the winding of the hold relay R230, thereby to cause the latter relay to restore shortly thereafter, the hold relay being of the slow-to-release type. At this point it is noted that, prior to the restoration of the hold relay R230 to interrupt, at the contacts 231, the previously traced path for applying ground potential to the control conductor C264 of the trunk 21, an alternative path is completed for applying ground potential to the control conductor C264 of the trunk 21. Accordingly, the previously mentioned holding circuit for energizing the winding of the busy relay R360 and the previously traced circuit for energizing in series the winding of the stop relay R240 and the rotary magnet M259 are not interrupted incident to the restoration of the hold relay R230.

Upon operating, the line relay R520 in the cord circuit 71 completes, at the contacts 522, an obvious circuit for illuminating the line lamp L547 and an obvious path for applying ground potential by way of the answer lamp L546 to the control conductor C551' in the position apparatus 93 at the first B operator position 91. This application of ground potential to the control conductor C551' causes the position apparatus 93 to operate, thereby to associate the telephone instrument at the first B operator position 91 with the cord circuit 71, whereupon a circuit is completed for illuminating intermittently the answer lamp L546. The illumination of the line lamp L547 indicates to the operator at the first B operator position 91 that there is a call waiting to be answered on the cord circuit 71; while the flashing of the answer lamp L546 indicates to the operator at the first B operator position 91 that the position apparatus 93 is operatively connected to the cord circuit 71. Also when the position apparatus 93 is operatively connected to the cord circuit 71, tone current is transmitted therefrom to the telephone instrument at the first B operator position 91 and over the line conductors C550 and C551 to the repeater 500. More particularly, tone current is transmitted over the windings 501 and 502 of the repeater 500, thereby to cause a similar tone current to be transmitted over the previously traced connection, including the trunk line T1, to the cord circuit 210 at the first A operator position 11. The transmission of tone current to the receiver of the telephone instrument at the first B operator position 91 indicates to the operator thereof that the position apparatus 93 is operatively connected to one of the cord circuits; while the transmission of tone current to the cord circuit 210, and consequently to the telephone instrument 202 operatively associated therewith at the first A operator position 11, indicates to the operator thereof that the call has been answered at the B board in the exchange 20. Accordingly, the operator at the first A operator position 11 in the exchange 10 passes the number to the operator at the first B operator position 91 in the exchange 20; and thereafter the operator at the first B operator position 91 completes the connection to the called telephone line in the exchange 20.

Also when the position apparatus 93 is con-

nected to the cord circuit 71 the answer relay R535 operates, thereby to complete, at the contacts 536, an obvious multiple circuit for energizing the windings of the answer relays in the trunk circuits in the first group of trunk circuits. For example, the answer relay R430 in the trunk circuit 51 is operated, thereby to complete, at the contacts 433, the previously traced path for applying ground potential to the control conductor C383 of the trunk 31. Similarly, the answer relays in the other trunk circuits in the first group of trunk circuits operate, thereby to mark the trunks respectively extending thereto as busy in order to prevent the secondary selectors in the various groups of secondary selectors which have previously selected the trunks mentioned from being selected by the primary selectors in the various groups of primary selectors at this time, in order to mark the other cord circuits in the first group of cord circuits individually associated with the first B operator position 91 as busy to the primary selectors in the various groups of primary selectors.

Also upon operating, the line relay R520 in the cord circuit 71 completes, at the contacts 521, an obvious circuit for energizing the winding of the busy relay R525, thereby to cause the latter relay to operate. Upon operating, the busy relay R525 completes, at the contacts 526, an obvious circuit for energizing the winding of the busy relay R420 in the trunk circuit 51, thereby to cause the latter relay to operate. Upon operating, the busy relay R420 interrupts, at the contacts 422 and 423, a further point in the previously traced connection between the control conductors C382 and C383 of the trunk 31 and completes, at the contacts 424, the previously mentioned path for applying ground potential to the control conductor C383 of the trunk 31. This application of ground potential to the control conductor C383 of the trunk 31 completes the previously traced multiple holding circuits for energizing the winding of the busy relay R360 in the secondary selector SS1 and the winding of the stop relay R240 in series with the rotary magnet M259 in the primary selector PS1. Also the busy relay R420 completes, at the contacts 421, a circuit for energizing the winding of the test relay R365 in the secondary selector SS1, this circuit extending from ground by way of the contacts 421, the control conductor C382 of the trunk 31, the wiper 375 and engaged contact in the associated contact bank 376 of the rotary switch 370 and the winding of R365 to battery. When thus energized the test relay R365 operates, thereby to prepare, at the contacts 367, a circuit traced hereinafter for energizing the rotary magnet M379 of the rotary switch 370 and to complete, at the contacts 366, an obvious path for short-circuiting the resistor 342. At this point it is noted that a normally completed series circuit for energizing the winding of the test stop relay R345 and the test start relay R340 in the first distributor 66 is provided which includes a number of resistors arranged in series relationship and provided in the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors. The series resistance of the above-traced circuit is sufficiently high to prevent adequate energization of the test start relay R340 and the test stop relay R345 under normal conditions; and the resistance of this series circuit is not reduced sufficiently in order to cause adequate energization of the windings of the test

start relay R340 and the test stop relay R345 until several of the resistors provided in the secondary selectors are short-circuited, in a manner more fully explained hereinafter, the test start relay R340 and the test stop relay R345 being operated when the windings thereof are adequately energized.

Also upon operating, the answer relay R430 prepares, at the contacts 434, a circuit traced hereinafter for energizing the winding of the storage relay R450 and prepares, at the contacts 435, a point in a chain circuit traced hereinafter for energizing the winding of the operator busy relay R400 in the common equipment 65 for purposes more fully explained hereinafter.

The operator at the first B operator position 91 initiates the extension of the call to the called line in the exchange 20 by inserting the plug P545 of the cord circuit 71 into the jack terminating the desired called line. Thereafter, the position apparatus 93 associated with the first B operator position 91 causes ringing current to be projected over the called line and then operates further, thereby to disconnect the cord circuit 71 from the position apparatus 93 in order to free the position apparatus 93 associated with the first B operator position 91 to receive additional calls routed thereto over idle ones of the cord circuits in the first group of cord circuits from the A board in the exchange 10. When the position apparatus 93 is disconnected from the cord circuit 71 the answer relay R535 restores, thereby to interrupt the previously mentioned circuits for energizing the answer relays in the trunk circuits in the first group of trunk circuits in order to cause the answer relays to restore. More particularly, the answer relay R430 in the trunk circuit 51 restores to interrupt, at the contacts 434, a further point in the previously mentioned circuit for energizing the winding of the storage relay R450 and to interrupt, at the contacts 435, a further point in the previously mentioned circuit for energizing the winding of the operator busy relay R400.

When the call is answered on the called telephone line in the exchange 20 a loop circuit is completed for energizing the winding of the battery supply relay R510 in the cord circuit 71. This circuit extends from ground by way of the right-hand winding of the battery supply relay R510, the winding 502 of the repeater 500 and the line conductors C551 and C553 to the plug P545; and from battery by way of the left-hand winding of the battery supply relay R510, the winding 501 of the repeater 500 and the line conductors C550 and C552 to the plug P545, the plug P545 being connected by way of the jack terminating the called line to a bridge path present between the line conductors of the called line. When this circuit is completed a connection is established between the calling line in the exchange 10 and the called line in the exchange 20, this connection including the calling line and the cord circuit 210 at the first A operator position 11 in the exchange 10, the trunk line T1 and the primary selector PS1, the secondary selector SS1, the trunk circuit 51, the cord circuit 71 and the called line in the exchange 20. Further it is noted that the line conductors C380 and C381 of the cord circuit 71 are connected to the windings 503 and 504 of the repeater 500; while the line conductors C550 and C551 of the cord circuit 71 are connected to the windings 501 and 502 of the repeater 500, the windings 501 and 502 of the repeater 500 being inductively coupled to the

windings 503 and 504 thereof. Further it is noted that a signal current path is provided between the line conductors C380 and C381 of the cord circuit 71, including the condenser 506 and excluding the windings of the line relay R520; while a signal current path is provided between the line conductors C550 and C551 of the cord circuit 71, including the condenser 505 and excluding the windings of the battery supply relay R510.

Upon operating, the battery supply relay R510 interrupts, at the contacts 512, the previously mentioned circuit for illuminating the line lamp L547, thereby to indicate to the operator at the first B operator position 91 that the call routed by way of the cord circuit 71 has been answered. Also the battery supply relay R510 interrupts, at the contacts 512, a further point in the previously mentioned circuit for illuminating intermittently the answer lamp L546, the last-mentioned circuit being interrupted incident to the operation of the position apparatus 93 to disconnect the cord circuit 71 therefrom. Finally, the battery supply relay R510 completes, at the contacts 511, an obvious path for short-circuiting the right-hand winding of the line relay R520, thereby to reduce the resistance of the previously traced connection including the line relay R200 in the cord circuit 210 at the first A operator position 11 in the exchange 10, thereby to cause the line relay R200 to operate. Upon operating, the line relay R200 interrupts, at the contacts 201, the previously mentioned circuit for illuminating the answer lamp L203, thereby to indicate to the operator at the first A operator position 11 that the call has been answered on the called line in the exchange 20.

Reviewing now the operation of the trunk circuit 51, it is noted that the busy relay R420 occupies its operated position, thereby to cause ground potential to be applied, at the contacts 424, to the control conductor C383 of the trunk 31 and to cause ground potential to be applied by way of the secondary selector SS1 to the control conductor C264 of the trunk 21. Also the operated busy relay R420 causes ground potential to be applied by way of the contacts 421 to the control conductor C382 of the trunk 31. The application of ground potential to the control conductor C264 of the trunk 21 marks the trunk 21 and consequently the secondary selector SS1 as busy to each primary selector in the first group of primary selectors, thereby to prevent other of the primary selectors in the first group of primary selectors from seizing the trunk 21. The application of ground potential to the control conductor C383 of the trunk 31 marks the trunk 31, and consequently the trunk circuit 51 and the cord circuit 71 individually associated with the first B operator position 91, as busy to the secondary selectors in the first group of secondary selectors, thereby to prevent any of the secondary selectors in the first group of secondary selectors from seizing the trunk 31 when another preselecting operation of the secondary selectors in the first group of secondary selectors is initiated, in a manner more fully explained hereinafter. Furthermore, the application of ground potential to the control conductor C383 of the trunk 31 marks as busy any one of the secondary selectors in the first group of secondary selectors which has previously selected the trunk 31 prior to the operation of the secondary selector SS1 in the first group of secondary selectors. Accordingly, at this time, each second-

ary selector in the first group of secondary selectors which has previously selected the trunk 31 prior to the operation of the secondary selector SS1 in the first group of secondary selectors is marked as busy to the primary selectors in the corresponding groups of primary selectors.

The application of ground potential to the control conductor C382 of the trunk 31 completes the previously traced circuit for energizing the winding of the test relay R365 in the secondary selector SS1 in the first group of secondary selectors and the operating circuits of the test relays in the other secondary selectors in the first group of secondary selectors which have previously selected the trunk 31 prior to the operation of the secondary selector SS1 in the first group of secondary selectors. Accordingly, at this time, the test relays in several of the secondary selectors in the first group of secondary selectors may occupy their operated positions, thereby to short-circuit the associated resistors in the corresponding secondary selectors in the first group of secondary selectors. More particularly, the test relays in a predetermined number of the secondary selectors in the first group of secondary selectors may be operated, thereby to cause the resistance of the previously traced series circuit for energizing the windings of the test start relay R340 and the test stop relay R345 to be appreciably reduced. More particularly, the test start relay R340 is of the marginal type and is so connected and arranged that it is operated when there are only two idle secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors which are available to be seized by the primary selectors in the first group of primary selectors and that it is restored when there are four or more idle secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors which are available to be seized by the primary selectors in the first group of primary selectors. Furthermore, the test stop relay R345 is of the marginal type and is so connected and arranged that it is operated only when there are no idle secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors which are available to be seized by the primary selectors in the first group of primary selectors.

The release of the established connection between the calling line in the exchange 10 and the called line in the exchange 20 is under the control of the respective lines. More particularly, when the connection to the called line in the exchange 20 is released the previously traced circuit for energizing the winding of the battery supply relay R510 is interrupted, thereby to cause the latter relay to restore. Upon restoring, the battery supply relay R510 recompletes, at the contacts 512, the previously mentioned circuit for illuminating the line lamp L547. The illumination of the line lamp L547 indicates to the operator at the first B operator position 91 that the connection to the called line in the exchange 20 has been released, whereupon the operator at the first B operator position 91 takes down the connection by withdrawing the plug P545 of the cord circuit 71 from the jack terminating the called line. Also, upon restoring, the battery supply relay R510 interrupts, at the contacts 511, the previously mentioned path for

short-circuiting the right-hand winding of the line relay R520, thereby to increase the resistance of the loop circuit including the winding of the line relay R200 in the cord circuit 210 at the first A operator position 11 in the exchange 10, thereby to cause the line relay R200 to restore. Upon restoring, the line relay R210 completes, at the contacts 201, the previously mentioned circuit for illuminating the answer lamp L203. The illumination of the answer lamp L203 indicates to the operator at the first A operator position 11 that the connection to the called line in the exchange 20 has been released. The operator at the first A operator position 11 then takes down the connection to the trunk line T1 by withdrawing the call plug P207 of the cord circuit 210 from the associated jack J1 terminating the trunk line T1 and by withdrawing the answer plug of the cord circuit 210 from the associated jack terminating the calling line in the exchange 10.

When the call plug P207 is withdrawn from the jack J1, the previously traced loop circuit, including the windings of the line relay R520 in the cord circuit 71, is interrupted, thereby to cause the line relay R520 to restore. Upon restoring, the line relay R520 interrupts, at the contacts 522, the previously mentioned circuit for illuminating the line lamp L547, thereby to indicate to the operator at the first B operator position 91 that the connection from the A board in the exchange 10 has been taken down. Further the line relay R520 interrupts, at the contacts 521, the previously mentioned circuit for energizing the winding of the busy relay R525, thereby to cause the latter relay to restore and interrupt, at the contacts 526, the previously mentioned circuit for energizing the winding of the busy relay R420 in the trunk circuit 51. The busy relay R420 then restores to interrupt, at the contacts 424, the previously traced path for applying ground potential to the control conductor C383 of the trunk 31, thereby to mark the trunk 31 as idle to the secondary selectors in the first group of secondary selectors, and to interrupt the previously traced holding circuit for energizing the winding of the busy relay R360 and the previously traced holding circuit for energizing the winding of the stop relay R240 in series with the rotary magnet M259. The busy relay R360 in the secondary selector SS1 and the stop relay R240 in the primary selector PS1 then restore. Upon restoring, the busy relay R360 prepares, at the contacts 362, a point in a circuit traced hereinafter for energizing the rotary magnet M379. Upon restoring, the stop relay R240 interrupts, at the contacts 246, a further point in the previously traced holding circuit for energizing the winding thereof in series with the rotary magnet M259. Also upon restoring, the busy relay R420 re-completes, at the contacts 422 and 423, the previously traced connection between the control conductors C382 and C383 of the trunk 31, thereby to cause battery potential to be applied to the control conductor C383 of the trunk 31 and to the control conductor C264 of the trunk 21. The application of battery potential to the control conductor C383 of the trunk 31 marks the trunk 31 as idle to the secondary selectors in the first group of secondary selectors; and the application of battery potential to the control conductor C264 of the trunk 21 marks the trunk 21 as idle to the primary selectors in the first group of primary selectors. Also upon restoring, the busy relay R420 interrupts, at the contacts 421, the

previously traced path for applying ground potential to the control conductor C382 of the trunk 31, thereby to interrupt the circuits for energizing the windings of the test relays in the various secondary selectors in the first group of secondary selectors which have previously selected the trunk 31. Upon restoring, the test relay R365 interrupts, at the contacts 366, the previously mentioned path for short-circuiting the resistor 342, thereby to increase the series resistance of the previously traced circuit for energizing in series the windings of the test start relay R340 and the test stop relay R345 of the first distributor 66. Further, the test relay R365 interrupts, at the contacts 367, a point in a circuit traced hereinafter for energizing the rotary magnet M379. At this time the apparatus in the exchanges 10 and 20 utilized in completing the previously traced connection are completely released and available for further use.

Considering now the operation of the first distributor 66, when there are only two idle secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors, the resistance of the previously traced series circuit for energizing the winding of the test start relay R340 and the winding of the test stop relay R345 is reduced sufficiently, thereby to cause operation of the test start relay R340. Upon operating, the test start relay R340 completes, at the contacts 341, an obvious circuit for energizing the windings of the secondary selector start relay R335, thereby to cause the latter relay to operate. Upon operating, the secondary selector start relay R335 prepares, at the contacts 336, 337, etc., circuits for energizing the rotary magnets in the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors. For example, at this time, the previously mentioned circuit for energizing the rotary magnet M379 of the rotary switch 370 included in the secondary selector SS1 is completed only in the event the secondary selector SS1 is idle and has previously selected a trunk extending to a trunk circuit which is now busy. More particularly, in the event the secondary selector SS1 is busy due to the seizure thereof by a primary selector in the first group of primary selectors, the busy relay R360 occupies its operated position, thereby to interrupt at the contacts 362, a point in the previously mentioned circuit for energizing the rotary magnet M379. On the other hand, in the event the secondary selector SS1 is idle and has previously selected a trunk extending to an idle trunk circuit, the test relay R365 occupies its restored position, thereby to retain interrupted at the contacts 367, a point in the previously mentioned circuit for energizing the rotary magnet M379. Accordingly, it will be understood that the secondary selector SS1 is operated incident to the operation of the secondary selector start relay R335 only in the event the busy relay R360 occupies its restored position and the test relay R365 occupies its operated position, which conditions prevail only in the event that the secondary selector SS1 has not been seized by one of the primary selectors in the first group of primary selectors and has previously selected a trunk extending to a trunk circuit which is now busy.

Assuming that the busy relay R360 occupies its

restored position and the test relay R365 occupies its operated position, the previously mentioned circuit for energizing the rotary magnet M379 is completed, this circuit extending from ground potential appearing upon the control conductor of the trunk previously selected by the rotary switch 370 and extending to a busy trunk circuit by way of the wiper 377 and engaged contact in the associated contact bank 378 of the rotary switch 370, the control conductor C264 of the trunk 21, the contacts 331, 336, 362, 367 and 379, the rotary magnet M379 and the winding of the distributor start relay R350 to battery. When thus energized the rotary magnet M379 operates, thereby to condition the wipers noted in the rotary switch 370 to be driven one step in the clockwise direction and to interrupt, at the contacts 379, the previously traced circuit for energizing the rotary magnet M379, thereby to cause the rotary magnet M379 to restore and drive the wipers noted of the rotary switch 370 one step in the clockwise direction. When this series circuit for energizing the rotary magnet M379 and the winding of the distributor start relay R350 is completed the distributor start relay R350 does not necessarily operate, this relay being of the marginal type, and is operated only in the event it is energized in multiple with a number of other rotary magnets in addition to the rotary magnet M379, as explained more fully hereinafter.

When the wipers noted of the rotary switch 370 are driven one step in the rotary direction the next trunk extending to a trunk circuit is tested, in the manner previously explained. In the event this trunk is busy, further operation of the rotary magnet M379 is initiated; on the other hand, in the event this trunk is idle, further operation of the rotary magnet M379 is arrested. More particularly, in the event the trunk selected by the rotary switch 370 is idle, no potential appears upon the control conductor thereof engaged by the wiper 375 in the associated contact bank 376, thereby to interrupt the previously traced circuit for energizing the winding of the test relay R365 in order to cause the latter relay to restore and interrupt, at the contacts 367, a point in the previously traced circuit for energizing the rotary magnet M379. Accordingly, at this time, the rotary magnet M379 is energized intermittently until the rotary switch 370 is operated to select an idle trunk extending to an idle trunk circuit, at which time further operation of the rotary magnet M379 is arrested. Also it is noted that the other secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors are operated in a manner similar to the secondary selector SS1 described above, thereby to cause each of the secondary selectors in the various groups of secondary selectors which are not seized by the primary selectors in the first group of primary selectors and which have previously selected trunk circuits which are now busy to be operated in order to preselect idle trunk lines extending to idle trunk circuits.

In view of the above explanation of the mode of operation of the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors, it will be understood that when four or more of the secondary selectors mentioned preselect idle trunks extending to idle trunk circuits the test relays in the secondary selectors restore, thereby to cause the resistance of the

series circuit for energizing the winding of the test start relay R340 and the test stop relay R345 to be increased sufficiently in order to cause the test start relay R340 to restore. Upon restoring, the test start relay R340 interrupts, at the contacts 341, the previously mentioned circuit for energizing the windings of the secondary selector start relay R335, thereby to cause the latter relay to restore in order to interrupt, at the contacts 336, 337, etc., further points in the previously mentioned circuits for energizing the rotary magnets in the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors. In view of the above explanation of the mode of operation of the first distributor 66 in order to cause the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors to preselect idle trunk lines extending to idle trunk circuits, it will be understood that the other distributors operate in a similar manner in order to cause the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the corresponding groups of primary selectors to select idle trunks extending to idle trunk circuits.

Continuing now with the operation of the first distributor 66, it is noted that the operation of the secondary selector start relay R335 may be effective to cause the circuits for energizing a large number of rotary magnets to be completed in multiple series, including the winding of the distributor start relay R350. In this event, the winding of the distributor start relay R350 is sufficiently energized, thereby to cause this relay to operate. Upon operating, the distributor start relay R350 completes, at the contacts 351, an obvious circuit for energizing the upper winding of the switching relay R310, thereby to cause the latter relay to operate and complete, at the contacts 315, an obvious holding circuit for energizing the lower winding thereof. Also the switching relay R310 completes, at the contacts 313, 314, etc., a number of multiple circuits for energizing in multiple a number of groups of individual secondary selector cutoff relays. For example, the switching relay R310 completes, at the contacts 313, a circuit for energizing the winding of the individual secondary selector cutoff relay R330 associated with the secondary selector SS1, this circuit extending from ground by way of the resistor 318, the contacts 313, C314 and the winding of R330 to battery. When thus energized the individual secondary selector cutoff relay R330 operates. Similarly, the other individual secondary selector cutoff relays in the group, including the individual secondary selector cutoff relay R330, and in the other groups operate, thereby to prevent operation of the corresponding secondary selectors. For example, upon operating, the individual secondary selector cutoff relay R330 interrupts, at the contacts 331, the previously traced circuit for energizing the rotary magnet M379.

Also upon operating, the switching relay R310 completes, at the contacts 311, an obvious circuit for energizing the upper winding of the hold relay R270, thereby to cause the latter relay to operate. Upon operating, the hold relay R270 completes, at the contacts 272, a holding circuit for energizing the lower winding thereof, this circuit extending from ground by way of the resistor 266, the contacts 272, C292, the wiper 303 and engaged contact in the associated contact

bank 304 of the rotary switch 300, C291 and the lower winding of R270 to battery. Also the hold relay R270 completes, at the contacts 271, a circuit for energizing the rotary magnet M305, this circuit extending from ground by way of the contacts 271 and 281 and the rotary magnet M305 to battery. When thus energized the rotary magnet M305 operates to interrupt, at the contacts 306, a circuit traced hereinafter for energizing the winding of the step relay R275. Also, at the contacts 271, the hold relay R270 completes a circuit for energizing the winding of the step relay R280, this circuit extending from ground by way of the contacts 271 and 276 and the winding of R280 to battery. When thus energized the step relay R280 operates shortly thereafter, the latter relay being of the slow-to-operate type. Upon operating, the step relay R280 interrupts, at the contacts 281, the previously traced circuit for energizing the rotary magnet M305, thereby to cause the rotary magnet M305 to restore. Upon restoring, the rotary magnet M305 completes, at the contacts 306, the previously mentioned circuit for energizing the winding of the step relay R275, this circuit extending from ground by way of the contacts 271 and 306 and the winding of R275 to battery. When thus energized the step relay R275 operates to interrupt, at the contacts 276, the previously traced circuit for energizing the winding of the step relay R280, thereby to cause the latter relay to restore. Upon restoring, the step relay R280 re completes, at the contacts 281, the previously traced circuit for energizing the rotary magnet M305, thereby to cause the rotary magnet M305 to operate and interrupt, at the contacts 306, the previously traced circuit for energizing the winding of the step relay R275. Shortly thereafter the step relay R275 restores, this relay being of the slow-to-release type, to re complete, at the contacts 276, the previously traced circuit for energizing the winding of the step relay R280. Accordingly, the step relays R275 and R280 and the rotary magnet M305 interact in the manner described above, thereby to cause the rotary magnet M305 to operate and restore periodically, whereupon the wipers noted of the rotary switch 300 are driven step by step in the clockwise direction until the wiper 303 engages the contact in the associated contact bank 304 which is not connected to the conductor C291. When the wiper 303 engages the contact in the associated contact bank 304 mentioned, the previously traced holding circuit for energizing the lower winding of the hold relay R270 is interrupted, thereby to cause the latter relay to restore in order to arrest further operation of the step relays R275 and R280 and the rotary magnet M305.

Also it is noted that, upon operating, the individual secondary selector cutoff relays R330, etc., interrupt the previously traced multiple circuits for energizing the winding of the distributor start relay R350, thereby to cause the latter relay to restore. Upon restoring, the distributor start relay R350 interrupts, at the contacts 351, the previously mentioned circuit for energizing the upper winding of the switching relay R310, the latter relay being retained in its operated position due to the completed holding circuit for energizing the lower winding thereof at this time. When the wiper 301 engages the fourth contact in the associated contact bank 302, an obvious path is completed for short-circuiting the lower winding of the switching relay R310, thereby to

cause the latter relay to restore and interrupt, at the contacts 315, the previously traced holding circuit for energizing the winding thereof. Also the switching relay R310 interrupts, at the contacts 313, 314, etc., the previously traced circuits for energizing the individual secondary selector cutoff relays R330, etc., thereby to cause the latter relays to restore.

Considering now more particularly the operation of the rotary switch 300 in the first distributor 66, when the wiper 301 engages the first contact in the associated contact bank 302 a path is completed for short-circuiting the windings of the individual secondary selector cutoff relays in the group of relays including the relay R330, the switching relay R310 occupying its operated position at this time. This path extends from battery by way of the wiper 301 and engaged first contact in the associated contact bank 302 of the rotary switch 300, C315, the contacts 313, C314 and the windings of the individual secondary selector cutoff relays in the associated group to battery. Accordingly, at this time, only the individual secondary selector cutoff relays R330, etc., in the group mentioned restore, thereby to prepare, at the contacts 331, etc., the previously traced circuits for energizing the windings of the rotary magnets M379, etc., in series with the distributor start relay R350. It is noted that the distributor start relay R350 is so connected and arranged that it will not reoperate when only the group of rotary magnets M379, etc., are operating. When the wiper 301 disengages the first contact and engages the second contact in the associated contact bank 302 of the rotary switch 300, the individual secondary selector cutoff relays in the previously mentioned group are reoperated and the individual secondary selector cutoff relays in the second group are restored, in a manner similar to that previously explained, thereby to cause operation of the rotary magnets in the corresponding group.

In view of the above explanation of the mode of operation of the first distributor 66, it will be understood that, in the event operation of the rotary switch 300 is initiated, the various groups of rotary magnets are operated sequentially. This arrangement prevents the operation of the corresponding groups of secondary selectors from interfering with each other by preselecting the same idle trunk line extending to an idle trunk circuit. In other words, by causing the secondary selectors to operate in relatively small groups, the secondary selectors in the different groups preselect different idle trunks extending to corresponding different idle trunk circuits. This arrangement prevents excessive operation of the secondary selectors incident to operation of the first distributor 66 and causes intermittent operation of the first distributor 66 to be less frequent than it would be in the event all of the groups of secondary selectors were allowed to operate simultaneously.

At this point it is noted that, ordinarily, operation of the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors will be arrested prior to completion of the operating cycle of the first distributor 66 due to the fact that the test start relay R340 restores when four or more secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors are rendered available to be seized

by the primary selectors in the first group of primary selectors, as previously explained. Upon restoring, the test start relay R340 interrupts, at the contacts 341, the previously mentioned circuit for energizing the winding of the secondary selector start relay R335, thereby to cause the latter relay to restore in order to arrest further operation of the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors, as previously explained.

Also, in connection with the operation of the first distributor 66, it is noted that when all of the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors are rendered busy, due to actual seizure of the secondary selectors mentioned by the primary selectors mentioned, it is impossible for the first distributor 66 to assign idle secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors as all of the secondary selectors are busy at this time. Accordingly, in this event, the test stop relay R345 is operated in order to complete, at the contacts 346, an obvious circuit for energizing the winding of the common primary selector cutoff relay R265. When thus energized the common primary selector cutoff relay R265 operates to interrupt, at the contacts 266, the previously mentioned path for applying ground potential to the control conductor C223, thereby positively to prevent operation of the primary selectors in the first group of primary selectors. Further the common primary selector cutoff relay R265 completes, at the contacts 267, an obvious connection between the secondary winding of the tone transformer 222 and the control conductor C224, the primary winding of the tone transformer 222 being connected to a suitable source of tone current, not shown. The application of tone current to the control conductor C224 completes an obvious circuit for energizing the upper winding of the line relay R220 in the primary selector PS1 and the line relays in the other primary selectors, thereby to cause the line relays mentioned to induce a corresponding tone voltage in the lower windings thereof which are connected to the trunk lines individually extending to the primary selectors in the first group of primary selectors. Accordingly, at this time, in the event one of the trunk lines extending between the exchange 10 and the exchange 20 and terminating in the primary selectors in the first group of primary selectors is seized at the A board in the exchange 10, busy tone will be produced in the receiver of the telephone instrument at the particular operator position at the A board, thereby to indicate to the operator at the particular operator position at the A board that all of the trunk lines in the first group extending between the exchange 10 and the exchange 20 are busy at this time.

When one of the secondary selectors in one of the groups of secondary selectors accessible to the primary selectors in the first group of primary selectors becomes idle, the test relay therein restores, thereby to cause restoration of the test stop relay R345 in the first distributor 66, in the manner previously explained. Upon restoring, the test stop relay R345 interrupts, at the contacts 346, the previously traced circuit for energizing the winding of the common primary selector cutoff relay R265, thereby to cause the latter relay to restore. Upon restoring, the com-

mon primary selector cutoff relay R265 completes, at the contacts 266, the previously mentioned path for applying ground potential to the control conductor C233 and interrupts, at the contacts 267, the previously mentioned circuit for energizing the upper windings of the line relays in the primary selectors in the first group of primary selectors with tone current. When ground potential is reapplied to the control conductor C223 the primary selectors in the first group of primary selectors are again rendered operative, in the manner previously explained.

Considering now the operation of the common equipment 65, when the operator at any B operator position, such, for example, as the first B operator position 91, is answering a call on one of the cord circuits in the associated group of cord circuits, such, for example, as the cord circuit 71 in the first group of cord circuits, the answer relay R535 in the position apparatus 93 occupies its operated position, thereby to cause the answer relays R430, etc., in the trunk circuits in the first group of trunk circuits to occupy their operated positions. The operated answer relays in the trunk circuits in the first group of trunk circuits mark these trunk circuits as busy, thereby to prevent the primary selectors in the various groups of primary selectors from selecting secondary selectors in the various groups of secondary selectors which have previously selected the trunk circuits in the first group of trunk circuits at this time, as previously explained. At this time, when the operator at the first B operator position 91 is busy, calls are routed to the operators at the other B operator positions to be answered.

When each B operator position at the B board in the exchange 20 is busy the previously mentioned chain circuit for energizing the winding of the operator busy relay R400 in the common equipment 65 is completed, this circuit extending from ground by way of the contacts in at least one of the trunk circuits in each group of trunk circuits and the winding of R400 to battery. More particularly, the circuit for energizing the winding of the operator busy relay R400 includes the contacts 435 of the answer relay R430 in the trunk circuit 51 in the first group of trunk circuits individually associated with the first B operator position 91. When thus energized the operator busy relay R400 operates to complete, at the contacts 404, a circuit for energizing the winding of the switching relay R440 in the trunk circuit 51 in the first group of trunk circuits and to complete, at the contacts 403, 402, etc., similar circuits for energizing the windings of the switching relays in the other trunk circuits in the other groups of trunk circuits. When thus energized the switching relays in the trunk circuits in the various groups of trunk circuits operate in order to condition the trunk circuits in the various groups of trunk circuits to store a call, in a manner more fully explained hereinafter. The circuit for energizing the winding of the switching relay R440 in the trunk circuit 51 extends from ground by way of the contacts 404, C415, the contacts 465 and the winding of R440 to battery. When thus energized the switching relay R440 operates to interrupt, at the contacts 441, the previously traced path for applying ground potential to the control conductor C383 of the trunk 31 and to complete, at the contacts 442, a path for applying battery potential by way of the winding of the storage relay R450 to the control conductor C383 of the trunk 31, this path

extending from battery by way of the winding of R450, the contacts 434, 442, 433 and 423 to the control conductor C383 of the trunk 31. This operation of the switching relay R440 conditions the trunk circuit 51 to be seized by a primary selector in one of the groups of primary selectors over one of the secondary selectors in the first group of secondary selectors, in the manner previously explained. Accordingly, at this time, each trunk circuit in each group of trunk circuits is conditioned to store one call.

At this time, in the event the trunk 31 is seized over one of the secondary selectors in the first group of secondary selectors, such, for example, as the secondary selector SS1, ground potential is applied to the control conductor C383 of the trunk 31 incident to switching-through of the busy relay R360 in the secondary selector SS1, as previously explained, thereby to complete a circuit identical to that previously traced for energizing the winding of the storage relay R450. When thus energized the storage relay R450 operates to complete, at the contacts 455, a holding circuit for energizing the winding thereof, this circuit extending from ground by way of the contacts 455, 442 and 434 and the winding of R450 to battery. Also the storage relay R450 completes, at the contacts 455, a path for applying ground potential to the control conductor C383, this path extending from ground by way of the contacts 455, 433 and 423 to the control conductor C383 of the trunk 31. This application of ground potential to the control conductor C383 of the trunk 31 marks the trunk 31 as busy to the secondary selectors in the first group of secondary selectors having access thereto. Further the storage relay R450 completes, at the contacts 455, a circuit for energizing the storage relay in each other trunk circuit in the first group of trunk circuits, this circuit extending from ground by way of the contacts 455 and 433, the multiple illustrated to each other trunk circuit in the first group of trunk circuits and therefrom by way of the contacts corresponding to the contacts 433, 442 and 434 and the windings of the storage relays in the other trunk circuits in the first group to battery. Accordingly, the storage relays in the other trunk circuits in the first group are operated at this time, thereby to mark the other trunk circuits in the first group as busy to the secondary selectors in the various groups of secondary selectors having access thereto. Accordingly, it will be understood that the storage arrangement provided in the trunk circuits in the first group of trunk circuits and in the trunk circuits in the other groups of trunk circuits is so connected and arranged that only one call may be stored at this time in any trunk circuit in a given group of trunk circuits. Further the storage relay R450 prepares, at the contacts 451, a point in a circuit traced hereinafter for energizing the winding of the storage busy relay R410 in the common equipment 65.

The previously mentioned circuit for energizing the winding of the storage busy relay R410 in the common equipment 65 is completed when one call is stored in a trunk circuit in each group of trunk circuits and extends from ground by way of at least one of the trunk circuits in each group of trunk circuits, the control conductor C418, the contacts 401 and the winding of R410 to battery. More particularly, the above-traced circuit for energizing the winding of the storage busy relay R410 includes the contacts 451 of the operated storage relay R450 in the trunk circuit

51 in the first group of trunk circuits. When thus energized the storage busy relay R410 operates to complete, at the contacts 412, 414, etc., obvious circuits for energizing the windings of the common primary selector cutoff relays R265, etc., thereby to cause the latter relays to operate. Upon operating, the common primary selector cutoff relay R265 prevents operation of each primary selector in the first group of primary selectors, in the manner previously explained; while the other common primary selector cutoff relays prevent operation of the primary selectors in the other groups of primary selectors. Accordingly, at this time, each trunk line between the exchange 10 and the exchange 20 is marked as busy by the presence of busy tone voltage thereon and operation of the primary selectors in the various groups of primary selectors is prevented.

Also the storage busy relay R410 interrupts, at the contacts 411, 413, etc., obvious circuits for energizing the windings of the common secondary selector cutoff relays R325, etc., individually associated with the first distributor 66, etc. Upon restoring, the common secondary selector cutoff relay R325 completes, at the contacts 326, obvious multiple circuits for energizing the windings of the individual secondary selector cutoff relays R330, etc., thereby to cause the latter relays to operate in order to prevent operation of the secondary selectors in the group of secondary selectors accessible to the primary selectors in the first group of primary selectors. Similarly, the common secondary selector cutoff relays in the other distributors prevent operation of the other secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the other groups of primary selectors. Accordingly, at this time, operation of all of the primary selectors in the various groups of primary selectors and operation of all of the secondary selectors in the various groups of secondary selectors are positively prevented.

After the operator at one of the B operator positions at the B board in the exchange 20, such, for example, as the first B operator position 91, answers a call stored in a trunk circuit in the associated group of trunk circuits, such, for example, as the trunk circuit 51 in the first group of trunk circuits, the position apparatus 93 at the first B operator position 91 is disconnected from the cord circuit 71 in the first group of cord circuits individual to the trunk circuit 51 in the first group of trunk circuits, thereby to render idle the position apparatus 93 at the first B operator position 91 and to cause the answer relay R535 to restore. Upon restoring, the answer relay R535 interrupts, at the contacts 536, the previously traced circuits for energizing the windings of the answer relays in the trunk circuits in the first group of trunk circuits, thereby to cause the latter relays to restore. Upon restoring, the answer relays in the trunk circuits in the first group of trunk circuits interrupt the previously traced circuits for energizing the windings of the storage relays in these trunk circuits, thereby to cause the latter relays to restore. When the answer relay R430 and the storage relay R450 in the trunk circuit 51 restore, the trunk 31 extending to the trunk circuit 51 is marked as busy to the secondary selectors in the first group of secondary selectors having access thereto; while the other idle trunk circuits in the first group of trunk circuits are marked as idle to the secondary selectors in the various groups of secondary selectors having

access thereto. Accordingly, at this time, the operator at the first B operator position 91 is in readiness to receive another call.

Also upon restoring, the storage relay R450 interrupts, at the contacts 451, the previously traced circuit for energizing the winding of the storage busy relay R410 in the common equipment 65, thereby to cause the latter relay to restore. Also upon restoring, the answer relay R430 interrupts, at the contacts 435, the previously traced circuit for energizing the winding of the operator busy relay R400 in the common equipment 65, thereby to cause the latter relay to restore. Upon restoring, the operator busy relay R400 interrupts, at the contacts 404, 403, etc., the previously traced circuits for energizing the windings of the switching relays R440, etc., in the trunk circuits in the various groups of trunk circuits, thereby to cause the latter relays to restore. Upon restoring, the storage busy relay R410 re completes, at the contacts 411, etc., the previously traced circuits for energizing the windings of the common secondary selector cutoff relays R325, etc., thereby to cause the latter relays to operate. Upon operating, the common secondary selector cutoff relay R225 interrupts, at the contacts 226, the previously traced multiple circuits for energizing the windings of the individual secondary selector cutoff relays R330, etc., thereby to cause the latter relays to restore. Upon restoring, the individual secondary selector cutoff relays R330, etc., render the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors again operative. Also upon restoring, the storage busy relay R410 interrupts, at the contacts 412, 414, etc., the previously traced circuits for energizing the windings of the common primary selector cutoff relays R265, etc., thereby to cause the latter relays to restore. Upon restoring, the common primary selector cutoff relay R265 renders the primary selectors in the first group of primary selectors again operative and removes the busy potential applied to the trunk lines in the group of trunk lines terminated by the primary selectors in the first group of primary selectors. Accordingly, at this time, the primary selectors in the various groups of primary selectors are again rendered operative to seize idle ones of the trunks extending to idle ones of the secondary selectors in the various groups of secondary selectors; and the secondary selectors in the various groups of secondary selectors are rendered operative again to seize idle ones of the trunks extending to idle ones of the trunk circuits in the various groups of trunk circuits.

Further it is noted that the operator at any operator position at the B board in the exchange 20 may render her position busy and consequently busy the trunk circuits in the group of trunk circuits and the cord circuits in the group of cord circuits, individually associated therewith, to the secondary selectors in the various groups of secondary selectors by operating the position key at her position. For example, when the operator at the first B operator position 91 desires to vacate her position she operates the position key K530 in the position apparatus 93, thereby to interrupt the obvious normally completed multiple circuits for energizing the start relays R460, etc., in the trunk circuit 51, etc., in the first group of trunk circuits. The start relays R460, etc., restore, thereby to render busy the trunk circuit 51, etc., in the first group of trunks and

the corresponding cord circuits 11, etc., in the first group of cord circuits individually associated with the first B operator position 91. For example, the start relay R460 in the trunk circuit 51 restores to complete, at the contacts 462, the previously traced path for applying ground potential to the control conductor C383 of the trunk 31, thereby to mark the trunk 31 as busy to the secondary selectors in the first group of secondary selectors. Also the start relay R460 interrupts, at the contacts 463, a point in a circuit traced hereinafter for energizing the winding of the operator start relay R405 in the common equipment 65 and completes, at the contacts 464, an obvious circuit for energizing the winding of the control relay R425, thereby to cause the latter relay to operate. Further, the start relay R460 prepares, at the contacts 461, an obvious point in the previously traced circuit for energizing the winding of the storage busy relay R410 in the common equipment 65 and prepares, at the contacts 466, an obvious point in the previously traced circuit for energizing the winding of the operator busy relay R400 in the common equipment 65. Finally the start relay R460 interrupts, at the contacts 455, a point in the previously traced circuit for energizing the winding of the switching relay R440. Accordingly, at this time, it will be understood that all of the trunk circuits in the first group of trunk circuits are marked as busy to the secondary selectors in the various groups of secondary selectors and that operation of the operator busy relay R400 in the common equipment 65 is ineffective to cause a call to be stored in a trunk circuit in the first group of trunk circuits, in the manner previously explained. Hence, all calls from the A board in the exchange 10 to the B board in the exchange 20 must be answered at the other operator positions at the B board excluding the first B operator position 91.

When the operator reoccupies the first position at the B board in the exchange 20 she operates the position key K530 in the position apparatus 93 back to its normal position, thereby to recomplete the previously traced multiple circuits for energizing the windings of the start relays R460, etc., in the trunk circuits in the first group of trunk circuits, thereby to cause the start relays mentioned to operate and condition idle ones of the trunk circuits in the first group of trunk circuits to be accessible to the secondary selectors in the various groups of secondary selectors. For example, upon operating, the start relay R460 in the trunk circuit 51 interrupts, at the contacts 461, the previously mentioned point in the previously traced circuit for energizing the winding of the storage busy relay R410 in the common equipment 65 and interrupts, at the contacts 466, the previously mentioned point in the previously traced circuit for energizing the winding of the operator busy relay R400 in the common equipment 65. Further the start relay R460 interrupts, at the contacts 462, the previously traced path for applying ground potential to the control conductor C383 of the trunk 31, thereby to mark the trunk circuit 61 as idle. Also the start relay R460 prepares, at the contacts 465, the previously traced circuit for energizing the winding of the switching relay R440 and interrupts, at the contacts 464, the previously mentioned circuit for energizing the windings of the control relay R425. When the circuit for energizing the winding of the control relay R425 is thus interrupted this relay restores shortly

thereafter, the control relay R425 being of the slow-to-release type. Finally, upon operating, the start relay R460 completes, at the contacts 463, the previously mentioned circuit for energizing the winding of the operator start relay R405 in the common equipment 65, this circuit extending from ground by way of the contacts 463 and 426, C408 and the winding of R405 to battery. When thus energized the operator start relay R405 operates; and shortly thereafter the control relay R425 restores to interrupt, at the contacts 426, the previously traced circuit for energizing the winding of the operator start relay R405, thereby to cause the latter relay to restore. Accordingly, the operator start relay R405 remains in its operated position for a short time interval. Further it is noted that the operator start relay R405 is operated for a short time interval whenever the operator at any operator position at the B board in the exchange 20 reoccupies her position after previously vacating it.

Upon operating, the operator start relay R405 in the common equipment 65 completes, at the contacts 406, 407, etc., circuits for energizing the windings of the secondary selector start relays R335, etc., in the distributors 66, etc., thereby to initiate operation of the various distributors. For example, the operator start relay R405 completes, at the contacts 406, an obvious circuit for energizing the winding of the secondary selector start relay R335 in the first distributor 66, thereby to initiate operation of the first distributor 66, in order to cause the secondary selectors in the various groups of secondary selectors accessible to the primary selectors in the first group of primary selectors which are idle and have previously selected trunks which are now busy to be reoperated in order to select idle trunks extending to idle ones of the trunk circuits in the various groups of trunk circuits, in the manner previously explained.

Conclusions

From the foregoing it is apparent that a telephone system is provided which comprises a first exchange provided with an A board and a second exchange provided with a B board and improved automatic switching apparatus for routing calls from the various operator positions at the A board in the first exchange to the various operator positions at the B board in the second exchange, which automatic switching apparatus is connected and arranged in order to trunk the calls straightforward exceedingly fast and in a simple and efficient manner.

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

What is claimed is:

1. In a telephone system, a B switchboard, a plurality of cord circuits associated with said B switchboard, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, an A switchboard, a plurality of jacks at said A switchboard, a plurality of trunk lines individually associated with said primary selectors and individually terminating in

said jacks, means at said A switchboard for routing a call over any one of said trunk lines by way of the corresponding one of said jacks, means controlled when a call is routed over said one trunk line for causing the associated one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to route the call on said one trunk line straightforward to said B switchboard to be answered, means controlled when a call is routed over said one trunk line for rendering busy said one trunk line, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit, and means controlled when all of said secondary selectors are rendered busy for preventing operation of all of said primary selectors and for rendering busy all of said trunk lines.

2. In a telephone system, a B switchboard including a plurality of operator positions, a plurality of groups of cord circuits individually associated with said operator positions, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, an A switchboard, a plurality of jacks at said A switchboard, a plurality of trunk lines individually associated with said primary selectors and individually terminating in said jacks, means at said A switchboard for routing a call over any one of said trunk lines by way of the corresponding one of said jacks, means controlled when a call is routed over said one trunk line for causing the associated one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle cord circuit in one of said groups of cord circuits, thereby to route the call on said one trunk line straightforward to the associated one of said operator positions to be extended, means at each of said operator positions for extending a call routed thereto, a plurality of normally ineffective blocking means individually associated with said operator positions, each of said blocking means being effective to prevent calls from being routed to the associated operator position, means controlled while a call is being extended from one of said operator positions for rendering effective the associated one of said blocking means, and additional means controlled while a call is being extended from each of said operator positions for rendering again ineffective each of said blocking means.

3. In a telephone system, a B switchboard, a plurality of cord circuits associated with said B switchboard, a plurality of secondary selectors having access to said cord circuits, a plurality of primary selectors having access to said secondary selectors, an A switchboard, a plurality of jacks at said A switchboard, a plurality of trunk lines individually associated with said primary selectors and individually terminating in said jacks, means at said A switchboard for routing a call over any one of said trunk lines by way of the corresponding one of said jacks, means controlled when a call is routed over said one trunk line for causing the associated one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to route the call on said one trunk line straightforward to

said B switchboard to be answered, means controlled when a call is routed over said one trunk line for rendering busy said one trunk line, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit and for marking against selection each idle one of said secondary selectors which has preselected said one cord circuit, means controlled when only a predetermined number of said secondary selectors are marked for selection for causing operation of the idle ones of said secondary selectors marked against selection, thereby to cause the last-mentioned secondary selectors to preselect idle ones of said cord circuits, and means controlled when all of said secondary selectors are rendered busy for preventing operation of all of said primary selectors and for rendering busy all of said trunk lines.

4. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, a plurality of trunk lines individually associated with said primary selectors, means for routing a call over any idle one of said trunk lines, means controlled when a call is routed over said one trunk line for causing the associated one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call on said one trunk line to said operator position to be answered, means controlled when a call is routed over said one trunk line for rendering busy said one trunk line, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit, and means controlled when all of said secondary selectors are rendered busy for preventing operation of all of said primary selectors and for rendering busy all of said trunk lines.

5. In a telephone system, a first operator position, a plurality of cord circuits associated with said first operator position, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, a second operator position, a plurality of jacks at said second operator position, a plurality of trunk lines individually associated with said primary selectors and individually terminating in said jacks, means at said second operator position for routing a call over any one of said trunk lines by way of the corresponding one of said jacks, means controlled when a call is routed over said one trunk line for causing the associated one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call on said one trunk line to said first operator position to be answered, means controlled when a call is routed over said one trunk line for rendering busy said one trunk line, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit, a source of tone voltage, and means controlled when all of said secondary selectors are rendered

busy for preventing operation of all of said primary selectors and for connecting said source of tone voltage to each idle one of said trunk lines.

6. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of groups of primary selectors, the primary selectors in said groups of primary selectors having access to different ones of said secondary selectors, means for routing a call to any idle one of the primary selectors in any one of said groups of primary selectors, means controlled when a call is routed to one of the primary selectors in one of said groups of primary selectors for causing the last-mentioned primary selector to operate and seize an idle one of the secondary selectors accessible thereto which has preselected an idle one of said cord circuits, thereby to extend the call to said operator position to be answered, means controlled when a call is routed to the one primary selector in said one group of primary selectors for rendering busy the last-mentioned primary selector, means controlled when said one secondary selector is seized by the one primary selector in said one group of primary selectors for rendering busy said one secondary selector and said one cord circuit, and means controlled when each of said secondary selectors accessible to the primary selectors in said first group of primary selectors is rendered busy for rendering busy and for preventing operation of each of the primary selectors in said first group of primary selectors.

7. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, a plurality of trunk lines individually associated with said primary selectors, means for routing a call over any idle one of said trunk lines, means controlled when a call is routed over said one trunk line for causing the associated one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call on said one trunk line to said operator position to be answered, means controlled when a call is routed over said one trunk line for rendering busy said one trunk line, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit, means at said operator position for extending the call on said one cord circuit, means controlled while the call on said one cord circuit is being extended for marking idle ones of said cord circuits against selection by said secondary selectors and for marking idle ones of said secondary selectors which have preselected idle ones of said cord circuits against selection by said primary selectors, and means controlled when all of said secondary selectors are rendered busy for preventing operation of all of said primary selectors and for rendering busy all of said trunk lines.

8. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, a plu-

ality of primary selectors having access to said secondary selectors, a plurality of trunk lines individually associated with said primary selectors, means for causing idle ones of said secondary selectors which are marked against selection to preselect idle ones of said cord circuits, means for routing a call over any idle one of said trunk lines, means controlled when a call is routed over said one trunk line for causing the associated one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call on said one trunk line to said operator position to be answered, means controlled when a call is routed over said one trunk line for rendering busy said one trunk line, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit, means controlled when said one cord circuit is rendered busy for marking against selection each idle one of said secondary selectors which has preselected said one cord circuit, and means controlled when all of said secondary selectors are rendered busy for preventing operation of all of said primary selectors and for rendering busy all of said trunk lines.

9. In a telephone system, a plurality of operator positions, a plurality of groups of cord circuits individually associated with said operator positions, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call over an idle one of said primary selectors to an idle one of said secondary selectors and therefrom by way of the preselected cord circuit in one of said groups of cord circuits to the associated one of said operator positions to be extended, means at each of said operator positions for extending a call routed thereto, a plurality of normally ineffective blocking means individually associated with said operator positions, each of said blocking means being effective to prevent calls from being routed to the associated operator position, means controlled while a call is being extended from one of said operator positions for rendering effective the associated one of said blocking means, and additional means controlled while a call is being extended from each of said operator positions for rendering again ineffective each of said blocking means.

10. In a telephone system, a plurality of operator positions, a plurality of groups of cord circuits individually associated with said operator positions, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call over an idle one of said primary selectors to an idle one of said secondary selectors and therefrom by way of the preselected cord circuit in one of said groups of cord circuits to the associated one of said operator positions to be extended, means at each of said operator positions for extending a call routed thereto, a plurality of normally ineffective blocking means individually associated with said operator positions, each of said blocking means being effective to prevent calls from being routed to the associated operator position, means controlled while a call is being extended from one

of said operator positions for rendering effective the associated one of said blocking means, each of the cord circuits in each of said groups of cord circuits including means for storing a call routed thereover, additional means controlled while a call is being extended from each of said operator positions for rendering again ineffective each of said blocking means, and further means controlled when a call is stored in one of the cord circuits in one of said groups of cord circuits for rendering again effective the associated one of said blocking means.

11. In a telephone system, a plurality of operator positions, a plurality of groups of cord circuits individually associated with said operator positions, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call over an idle one of said primary selectors to an idle one of said secondary selectors and therefrom by way of the preselected cord circuit in one of said groups of cord circuits to the associated one of said operator positions to be extended, means at each of said operator positions for extending a call routed thereto, a plurality of normally ineffective blocking means individually associated with said operator positions, each of said blocking means being effective to prevent calls from being routed to the associated operator position, means controlled while a call is being extended from one of said operator positions for rendering effective the associated one of said blocking means, additional means controlled while a call is being extended from each of said operator positions for rendering again ineffective each of said blocking means, and further means controllable by the operator at any one of said operator positions for rendering effective the associated one of said blocking means.

12. In a telephone system, a plurality of operator positions, a plurality of groups of cord circuits individually associated with said operator positions, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call to an idle one of said primary selectors and for causing said one primary selector to operate and select an idle one of said secondary selectors which has preselected an idle cord circuit in one of said groups of cord circuits, thereby to route the call to the associated one of said operator positions to be extended, means at each of said operator positions for extending a call routed thereto, a plurality of normally ineffective blocking means individually associated with said operator positions, each of said blocking means being effective to prevent calls from being routed to the associated operator position, means controlled while a call is being extended from one of said operator positions for rendering effective the associated one of said blocking means, each of the cord circuits in each of said groups of cord circuits including means for storing a call routed thereover, additional means controlled while a call is being extended from each of said operator positions for rendering again ineffective each of said blocking means, further means controlled when a call is stored in one of the cord circuits in one of said groups of cord circuits for rendering

again effective the associated one of said blocking means, and additional means controlled when a call is stored in one of the cord circuits in each of said groups of cord circuits for preventing operation of said primary selectors.

13. In a telephone system, a plurality of operator positions, a plurality of groups of cord circuits individually associated with said operator positions, a plurality of secondary selectors having access to said cord circuits, means for causing idle ones of said secondary selectors to preselect idle ones of said cord circuits, a plurality of primary selectors having access to said secondary selectors, a plurality of trunk lines individually associated with said primary selectors, means for routing a call over an idle one of said trunk lines and the associated one of said primary selectors to an idle one of said secondary selectors and therefrom by way of the preselected cord circuit in one of said groups of cord circuits to the associated one of said operator positions to be extended, means controlled when a call is routed over said one trunk for rendering busy said one trunk, means at each of said operator positions for extending a call routed thereto, a plurality of normally ineffective blocking means individually associated with said operator positions, each of said blocking means being effective to prevent calls from being routed to the associated operator position, means controlled while a call is being extended from one of said operator positions for rendering effective the associated one of said blocking means, each of the cord circuits in each of said groups of cord circuits including means for storing a call routed thereover, additional means controlled while a call is being extended from each of said operator positions for rendering again ineffective each of said blocking means, further means controlled when a call is stored in one of the cord circuits in one of said groups of cord circuits for rendering again effective the associated one of said blocking means, a source of tone voltage, and additional means controlled when a call is stored in one of the cord circuits in each of said groups of cord circuits for connecting said source of tone voltage to each idle one of said trunk lines.

14. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call to any idle one of said primary selectors and for causing said one primary selector to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call to said operator position to be answered, means controlled when a call is routed to said one primary selector for rendering busy said one primary selector, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit and for marking against selection each idle one of said secondary selectors which has preselected said one cord circuit, means controlled when only a predetermined number of said secondary selectors are marked for selection for causing operation of the idle ones of said secondary selectors marked against selection, thereby to cause the last-mentioned secondary selectors to preselect idle ones of said cord circuits, and means controlled when all of said secondary selectors are rendered busy for

preventing operation of all of said primary selectors.

15. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, a plurality of primary selectors having access to said secondary selectors, a plurality of trunk lines individually terminated by said primary selectors, means for routing a call over any idle one of said trunk lines, means controlled when a call is routed over said one trunk line for causing the corresponding one of said primary selectors to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call on said one trunk line to said operator position to be answered, means controlled when a call is routed over said one trunk line for rendering busy said one trunk line, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit and for marking against selection each idle one of said secondary selectors which has preselected said one cord circuit, means controlled when only a predetermined number of said secondary selectors are marked for selection for causing operation of the idle ones of said secondary selectors marked against selection, thereby to cause the last-mentioned secondary selectors to preselect idle ones of said cord circuits, a source of tone voltage, and means controlled when all of said secondary selectors are rendered busy for connecting said source of tone voltage to each idle one of said trunk lines.

16. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call to any idle one of said primary selectors and for causing said one primary selector to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call to said operator position to be answered, means controlled when a call is routed to said one primary selector for rendering busy said one primary selector, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit and for marking against selection each idle one of said secondary selectors which has preselected said one cord circuit, and means including a distributor controlled when only a predetermined number of said secondary selectors are marked for selection for causing operation of the group of idle secondary selectors marked against selection, thereby to cause the last-mentioned group of secondary selectors to preselect idle ones of said cord circuits, said distributor being so connected and arranged that the order of operation of said last-mentioned group of secondary selectors is determined by the number in the group.

17. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call to any idle one of said primary selectors and for causing said one primary selector to operate

and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call to said operator position to be answered, means controlled when a call is routed to said one primary selector for rendering busy said one primary selector, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit and for marking against selection each idle one of said secondary selectors which has preselected said one cord circuit, and means including a distributor controlled when only a predetermined number of said secondary selectors are marked for selection for causing operation of the group of idle secondary selectors marked against selection, thereby to cause the last-mentioned group of secondary selectors to preselect idle ones of said cord circuits, said distributor being so connected and arranged that said last-mentioned group of secondary selectors are operated sequentially by subgroups.

18. In a telephone system, an operator position, a plurality of cord circuits associated with said operator position, a plurality of secondary selectors having access to said cord circuits, a plurality of primary selectors having access to said secondary selectors, means for routing a call to any idle one of said primary selectors

and for causing said one primary selector to operate and select an idle one of said secondary selectors which has preselected an idle one of said cord circuits, thereby to extend the call to said operator position to be answered, means controlled when a call is routed to said one primary selector for rendering busy said one primary selector, means controlled when said one secondary selector is selected by said one primary selector for rendering busy said one secondary selector and said one cord circuit and for marking against selection each idle one of said secondary selectors which has preselected said one cord circuit, and means including a distributor controlled when only a predetermined number of said secondary selectors are marked for selection for causing operation of the group of idle secondary selectors marked against selection, thereby to cause the last-mentioned group of secondary selectors to preselect idle ones of said cord circuits, said distributor being so connected and arranged that said last-mentioned group of secondary selectors are operated sequentially by subgroups in the event the group exceeds a predetermined number and that said last-mentioned group of secondary selectors are operated substantially simultaneously in the event the group does not exceed said predetermined number.

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