Aug. 3, 1926. 1,594,877

H. D. CURRIER ET AL

TELEPHONE SYSTEM

Filed Oct. 26, 1921 7 Sheets-Sheet 1

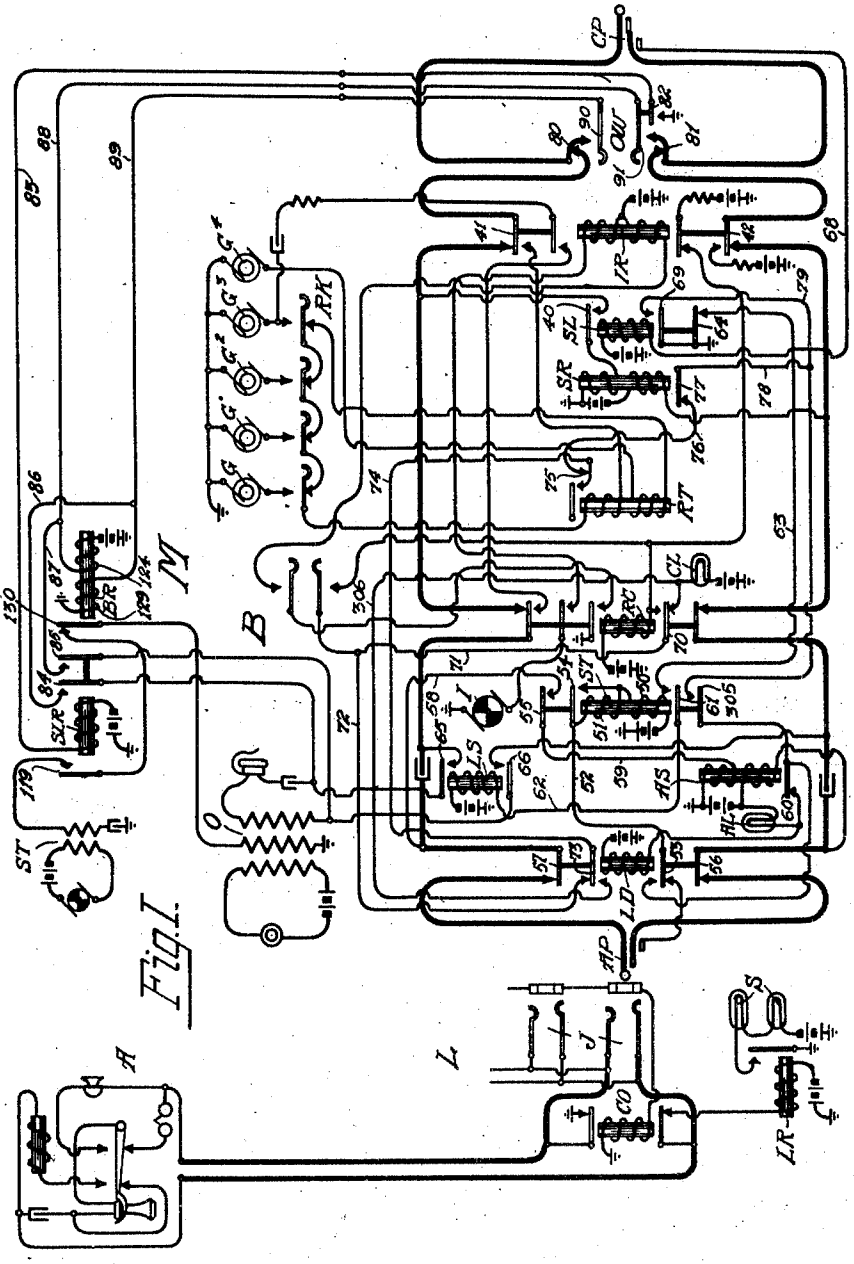

Fig. 1.

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TELEPHONE SYSTEM

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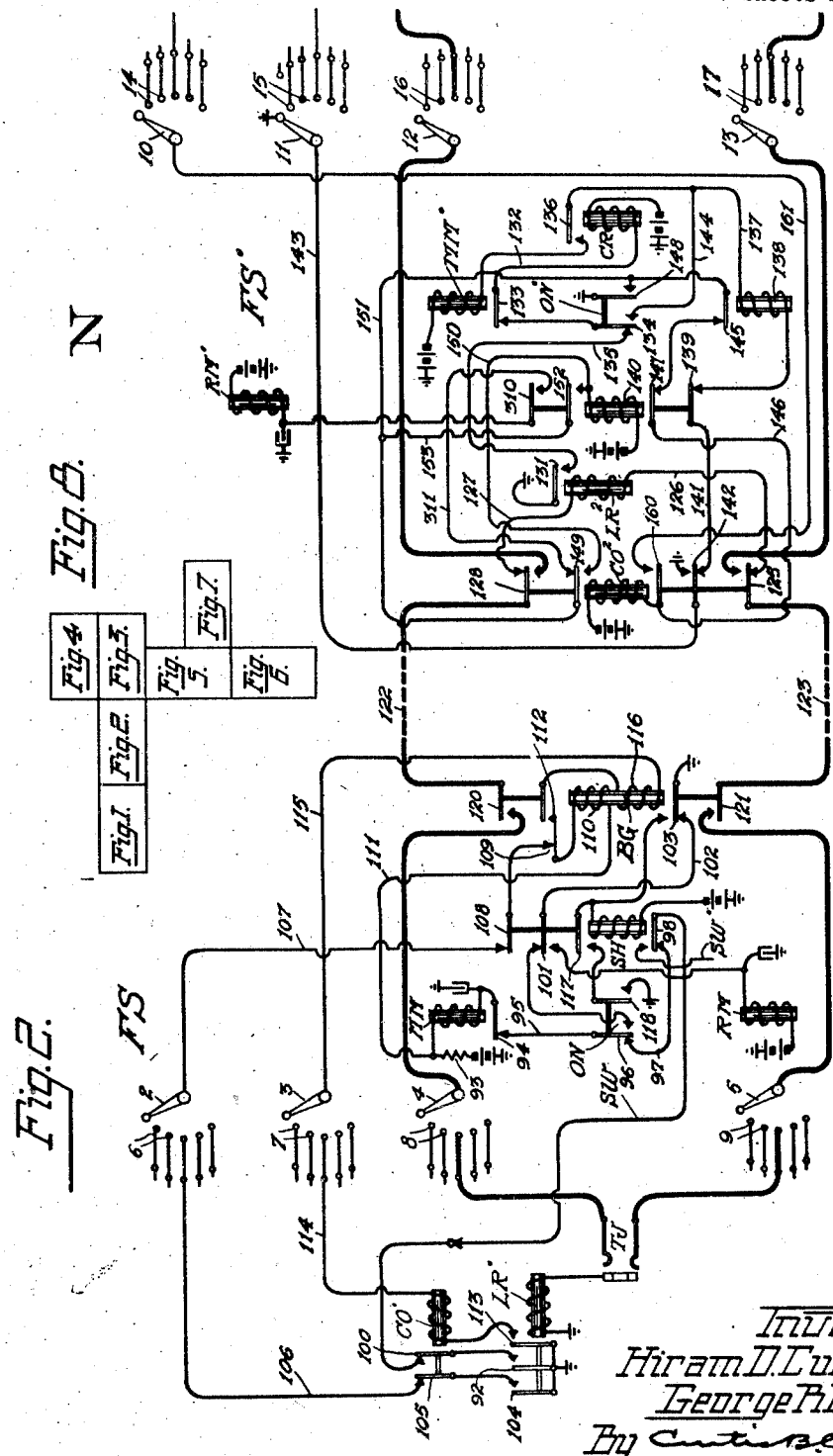


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TELEPHONE SYSTEM

Filed Oct. 26, 1921

7 Sheets-Sheet 3

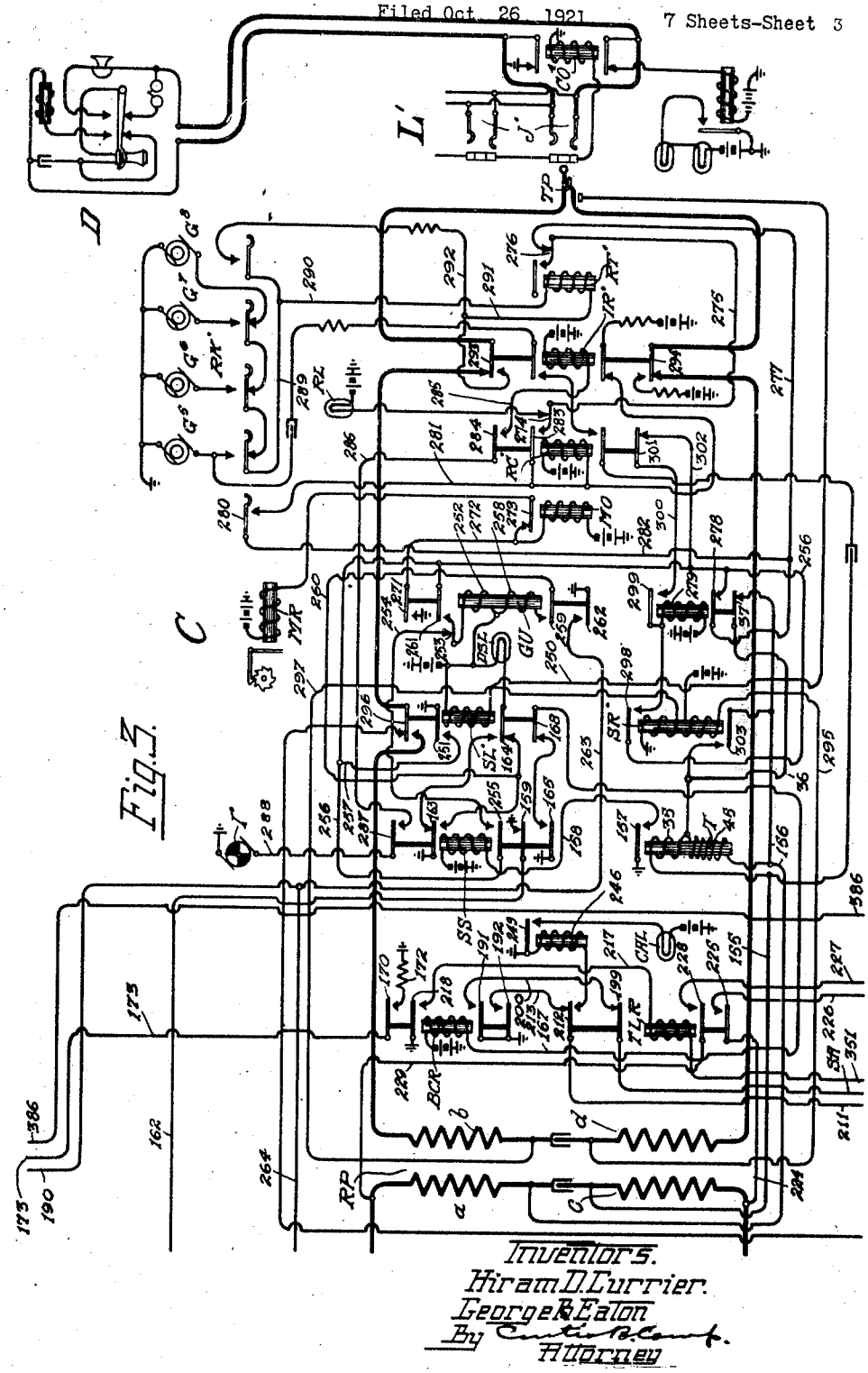

Fig. 3.

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TELEPHONE SYSTEM

Filed Oct. 26, 1921 7 Sheets-Sheet 4

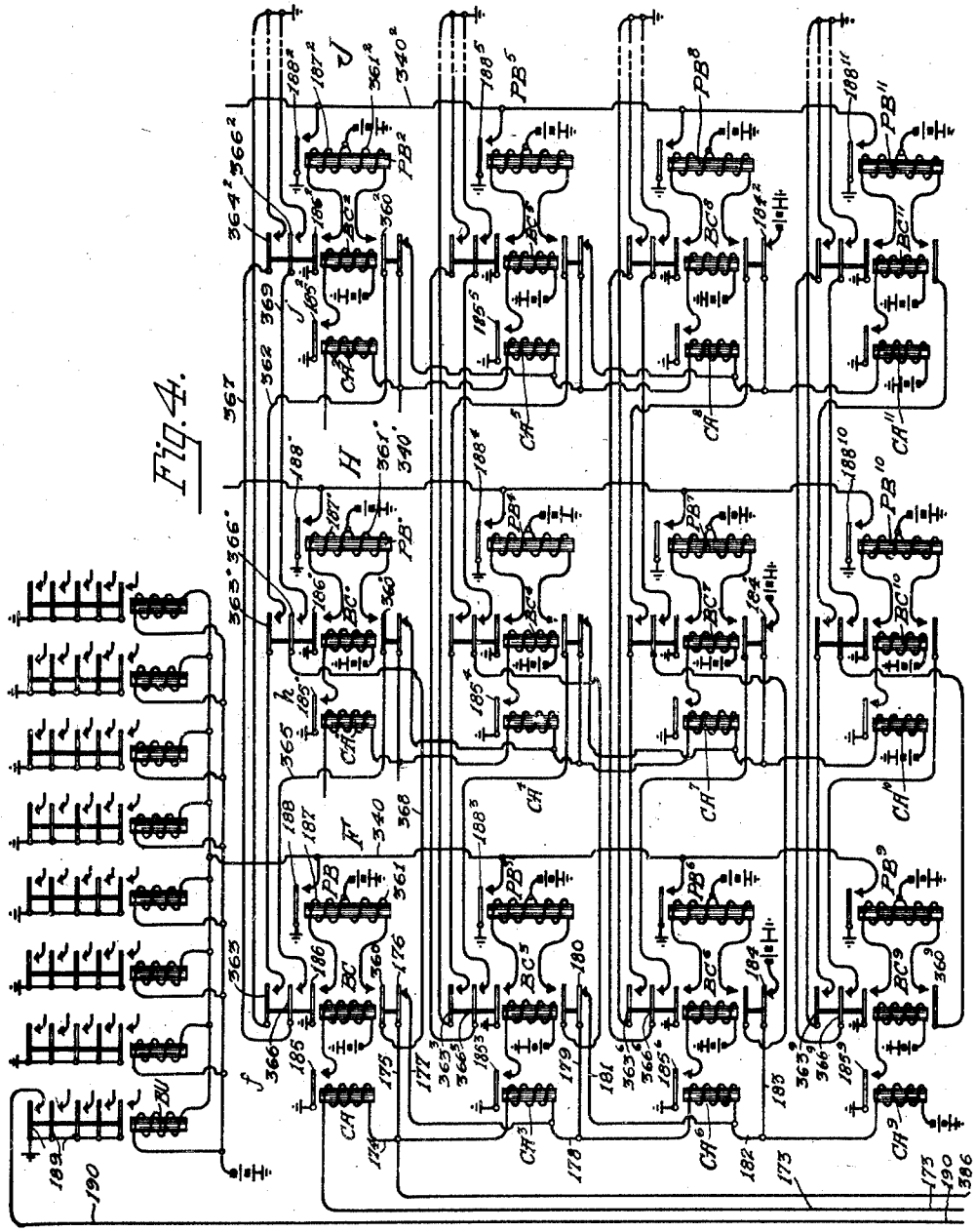

Fig. 4.

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TELEPHONE SYSTEM

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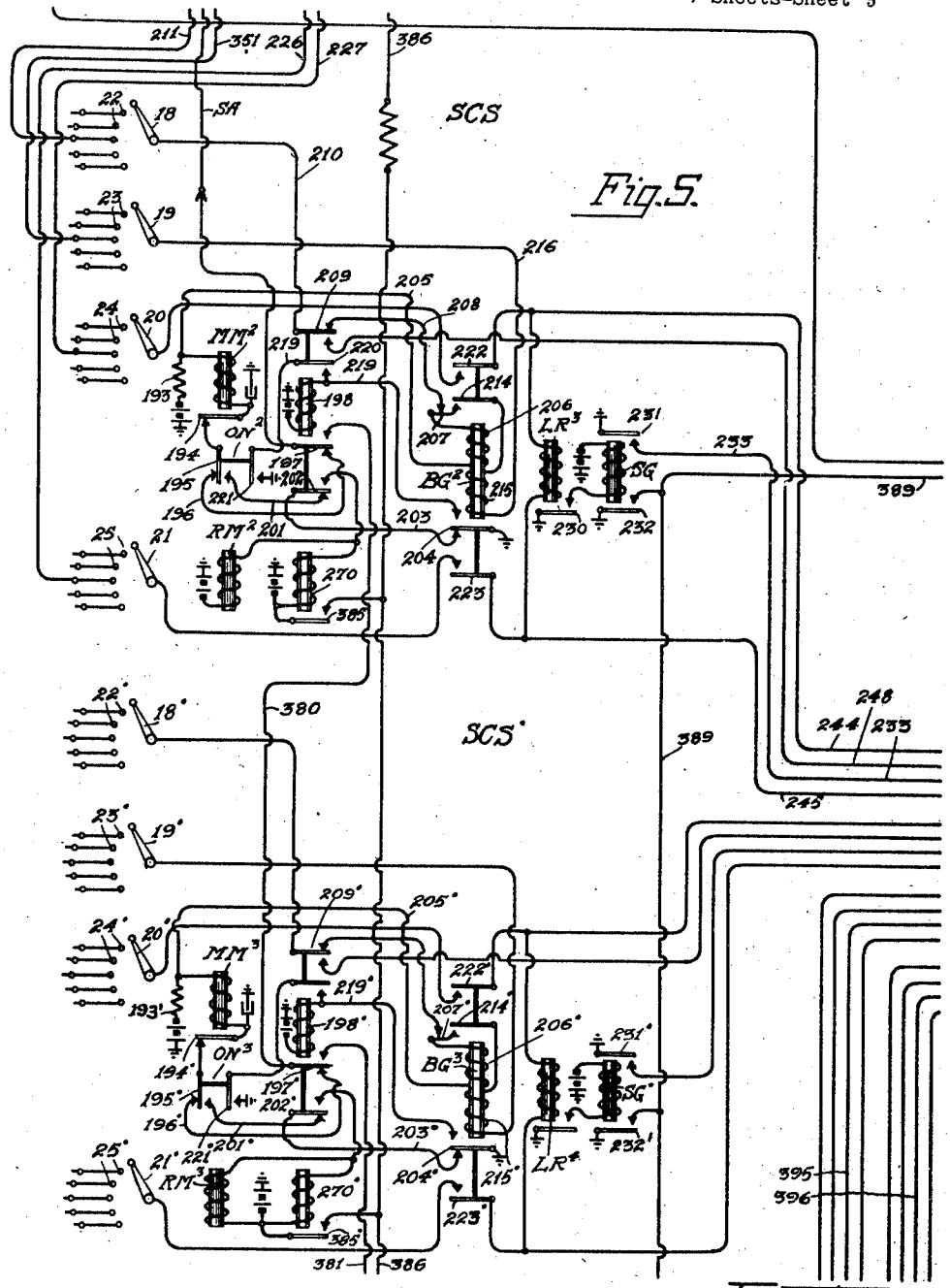


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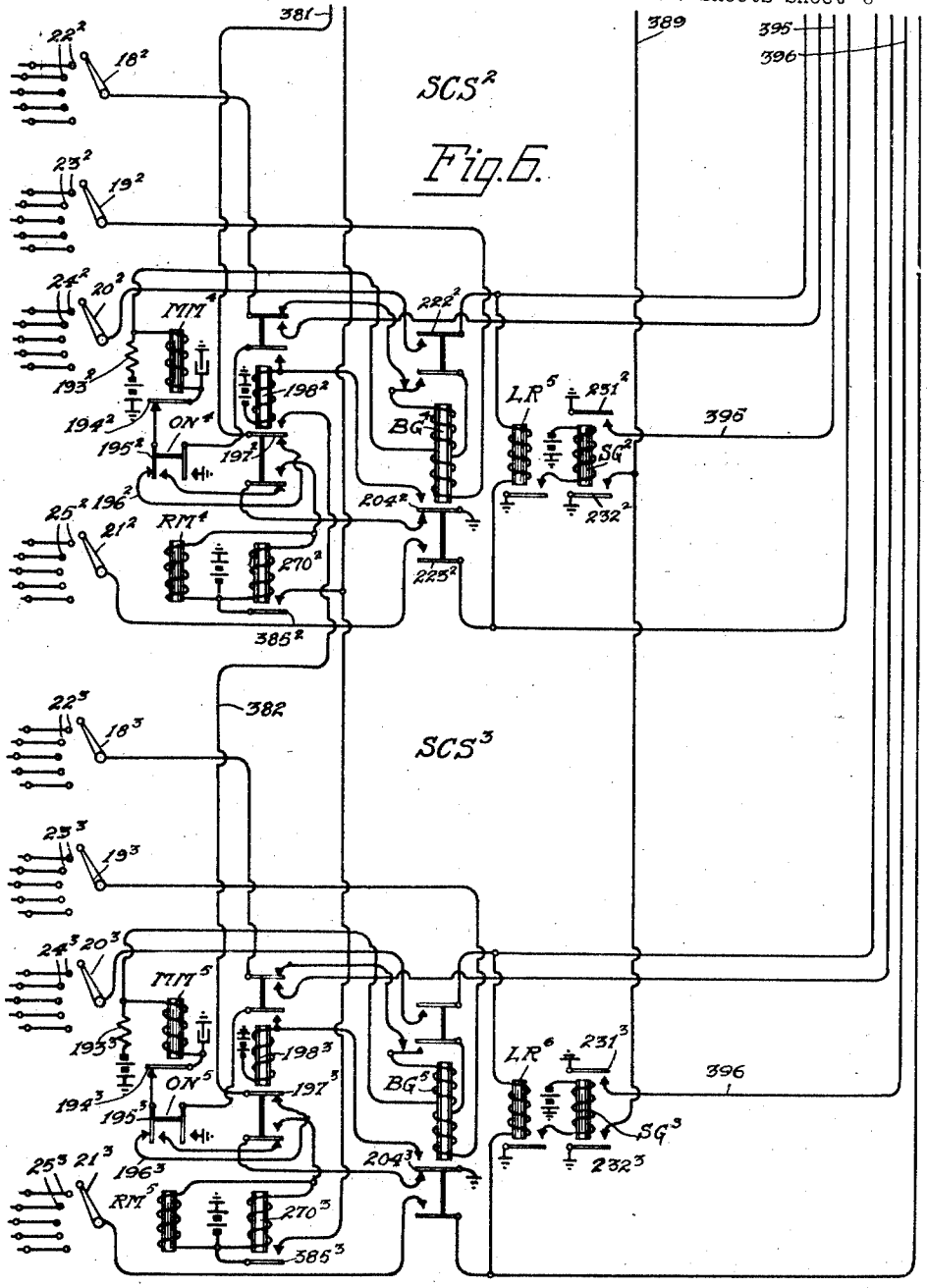
TELEPHONE SYSTEM

Filed Oct. 26, 1921 7 Sheets-Sheet 6

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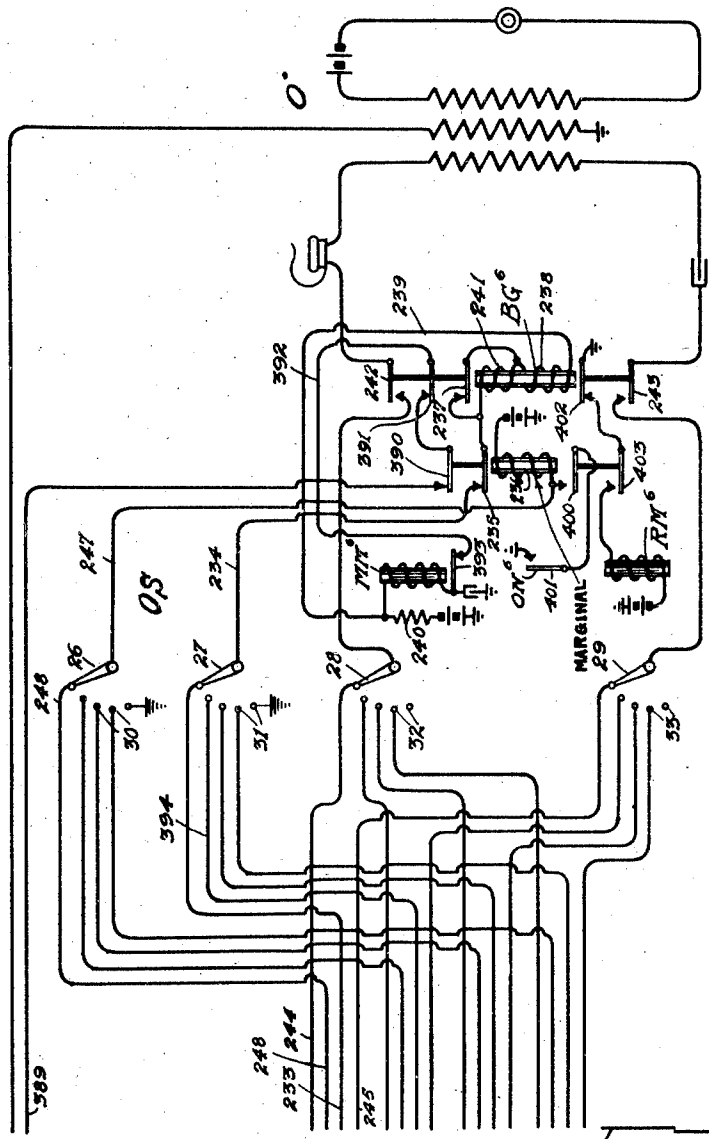
TELEPHONE SYSTEM

Filed Oct. 26, 1921 7 Sheets-Sheet 7

Fig. 7.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

Application filed October 26, 1921. Serial No. 510,445.

Our invention relates to telephone systems and has to do more particularly with multi-office exchange systems in which the subscribers' stations of the same exchange or different exchanges are connected by means of manual switchboard apparatus and automatic apparatus, and one of the main objects of our invention is to provide improved circuit arrangements for a system of the above character.

In multi-office exchange systems of the above type, wherein operators are provided for manipulating the cord and trunk circuits, the operators use cord circuits for interconnecting the lines of their own exchange, but when they desire to connect with a line in a distant exchange, they connect to a trunk circuit terminating before a B operator in the distant exchange, who, after having communicated with the A operator at the originating exchange over a special order wire circuit independent of the trunk circuits, and after having designated the trunk to be used by the A operator at the originating exchange, connects the trunk circuit to the wanted line.

Systems of this type have been found faulty, due to the fact that special order wire circuits are required to handle these trunking connections, and due to the liability of mistakes being made in passing the number to the B operator and in the assignment of the trunk to the A operator at the originating exchange. In overcoming these objects, we provide circuits in which the A operator is provided with trunk jacks which are accessible from her position and which are connected to apparatus that extends to different exchanges and terminates in plugs before B operators at such exchanges.

One of the features of our invention is the termination of the outgoing trunk jacks in the banks of finder switches, and the incoming ends of the trunk circuits at the distant exchange in individual non-numerical trunk selecting switches, so that when a connection is established with an outgoing trunk jack for extending a connection to a distant exchange, one of the finder switches is caused to operate to seize the trunk jack. When the trunk jack is seized the non-numerical trunking switch at the distant exchange is set in motion to extend the connection to an idle trunk leading to an idle trunk operator at the distant exchanges, thus giving the A operator an individual outgoing trunk to any B operator at a distant exchange.

Another feature of our invention is the provision of an order wire key associated with the A operator's cord circuits at the originating exchange which when actuated places her in direct communication with the B operator at the distant exchange over the seized trunk, and thus permits the direct passing of the call from the A operator at the originating exchange to a B operator at the distant exchange without the aid of an order wire circuit. The order wire circuit is thus eliminated, and we do away with the assignment of the trunk by the B operator to the A operator.

Another feature of our invention is the means for controlling the busy indication at the B operator's position. Each position remains busy as long as its particular operator has a greater number of calls before her than any other adjacent operators. Means are also provided for removing the busy indication whenever an operator has a smaller load, or a load equal to the smallest load on any operator's position.

A feature of this busy controlling means is the distribution of the calls to the operators according to their respective abilities to handle calls.

Still another feature of our invention is a provision whereby as many as four calls may be stored at a trunk operator's position in such a way that a distributing means is provided for incoming trunk calls in such a manner as to give each operator the same number of stored calls, in case the operators are not keeping up with the load. This storing feature provides a definite means for checking up the speed at which the incoming trunk calls are being handled at the trunk or B position.

For a more complete understanding of our invention, reference may be had to the accompanying drawings, in which we illustrate apparatus for interconnecting two subscribers at different exchanges, and which comprises Figs. 1, 2, 3, 4, 5, 6 and 7, which, when joined as shown in Fig. 8, illustrate a complete connection. All of the parts have been shown at normal, and the apparatus shown in Fig. 1, and the left-half of Fig.

2 is located at the exchange M, and the right half of Fig. 2 and all of Figs. 3, 4, 5, 6 and 7 is located at the exchange N. In Fig. 4 we illustrate trunk operator's busy control and storing circuits *f*, *h* and *j*, which are associated with the operators' positions F. H and J, and in Figs. 5, 6 and 7 we illustrate the trunk operator's sequence selecting switch circuit for selecting in sequence the calls stored at a trunk operator's position.

Referring now more in general to our invention, it comprises the exchanges M and N. At the exchange M a plurality of substations A are provided, connecting to line circuits L, comprising the usual cut-off relay CO, line relay LR, multiple line lamps S and multiple answering jacks J. The multiple jacks J terminate before a number of different operators' positions, each of which is provided with a line signal S so that when a call is initiated a plurality of signals S are lighted, and thus a number of operators are apprised of the call. For interconnecting the substations a plurality of cord circuits B are provided at each of the operators' positions, each cord including answering and calling plugs AP and CP connected by the heavily marked talking conductors. The answering end of the cord circuit B is provided with a sleeve relay ST, which is energized when an answering plug AP is inserted into the jack J of a calling line. The relay ST is provided with a high and a low resistance winding, and upon the actuation of relay ST the high resistance winding is shunted and thus prevents a relay ST of another cord circuit, as B, from being energized, should the operator associated with the second cord attempt to answer the call. An operator of another cord attempting to seize the call after the first operator has connected to the calling line is prevented from communicating with the subscriber as the low winding of relay ST of the first cord prevents the relay ST of the second cord from operating. As the second operator is not connected to the calling line, due to the relay ST of the second cord remaining normal, she does not receive an answer from the calling subscriber and withdraws the answering plug of her cord circuit from the connected jack.

An answering supervisory relay AS is also provided and is actuated upon the energization of relay ST, and the said relay AS upon actuation prevents the premature lighting of the answering supervisory lamp AL. A listening relay LS is also provided and is actuated in response to the energization of relay ST to connect the operator's set O to the cord conductors. A link disconnect relay LD is provided which is energized when the calling subscriber replaces his receiver after finishing conversation, to open the link conductors to allow the line circuit L of the calling subscriber to restore to normal to permit the subscriber to recall. The relay LD also operates when the calling subscriber replaces his receiver and before the called subscriber answers, and then serves to disconnect the ringing current from the called line when the cord circuit B is used for establishing a local connection.

The calling end of the cord circuit B is provided with a sleeve relay SL actuated when the calling plug CP is inserted into a jack of a called local line or into an outgoing trunk jack which extends to a distant exchange. The relay SL, upon energization, opens the circuit of the listening relay LS, which relay de-energizes to disconnect the operator's set O from the cord conductors. A party-line ringing key RK is provided for connecting one of a plurality of ringing generators G, G', $G^2$ or $G^3$ to signal the called-for subscriber when the cord circuit is used to establish a local connection. A ringing control relay RC is provided which is actuated upon the actuation of the ringing key RK, and the said relay RC upon actuation brings about the energization of the interrupter relay IR, which relay IR is intermittently energized and de-energized through the agency of an interrupter I to connect ringing current to the called local line. A ringing trip relay RT is provided which is actuated upon the response of the subscriber at the local called-for substation. A supervisory relay SR is also provided which is actuated upon the response of the called-for subscriber, either by the response of a locally connected subscriber or a subscriber at a distant exchange. A calling supervisory lamp CL is provided and is used for the usual supervisory purposes.

In order to handle trunking connections, in addition to the equipment just described, we provide a trunk order wire key OW for each cord circuit, which key when actuated operates a secondary listening relay SLR which connects the operator's set O, and also opens the cord conductors. The operator's set O is connected to the calling end of the cord circuit B, whereby the operator at the cord circuit B may converse with the operator to whom the trunk connection is to be extended.

The secondary listening relay SLR, the battery feed and tone disconnect relay BR and tone device ST are common to an operator's position and are brought into association with a trunking connection when the order wire key OW is actuated, as will be more fully hereinafter described.

Referring now to Fig. 2, we illustrate a trunk jack TJ, of which there are a number, before each operator's position, and which are multiply connected to a plurality of finder switches FS whereby any one of a plurality of the said switches FS may seize

the connected trunk jack TJ, as will be more fully hereinafter described. Associated with each trunk jack TJ, we show a line relay LR′ and a cut-off relay CO′, for purposes as will be more fully hereinafter described. The finder switch FS may be of any desired or suitable construction and is provided with a spring restored shaft having wipers 2, 3, 4 and 5 and with four sets of fifty contacts 6, 7, 8 and 9, to which contacts the trunk jacks TJ are multipled.

A rotary step-by-step motor magnet MM is provided for rotating the switch shaft and wipers 2, 3, 4 and 5 by means of a ratchet and pawl mechanism. A retaining pawl is also provided and adapted to be operated by a release relay RM for permitting the shaft wipers 2, 3, 4 and 5 to be restored to normal by spring tension. A common starting wire SW is provided and is common to a group of trunk jacks TJ which lead to a group of switches FS. A bridging relay BG is provided which energizes when the trunk jack TJ is seized by the switch FS to shunt the motor magnet MM to prevent further advancement of the wipers 2, 3, 4 and 5. The switching relay SH energizes upon the actuation of the relay BG to extend the starting conductor SW through to the next finder switch FS of the group (not shown). The switch FS is also provided with a set of off-normal contacts ON which assume their alternate position upon the first step of the switch off normal, and remain so until the switch FS is again restored to normal.

The trunking circuit extends to the distant exchange over the conductors 122 and 123, which conductors terminate in a trunking switch FS′ located at the distant exchange N. The switch FS′ is similar to the switch FS of the exchange M and is provided with a spring restored shaft which carries wipers 10, 11, 12 and 13, and contact sets 14, 15, 16 and 17, of which there are fifty sets, which may be engaged by the said wipers 10, 11, 12 and 13, and to which contacts the trunk circuit of the exchange N are multipled. The switch FS′ is provided with a line relay $LR^2$, which is actuated when a switch FS of the exchange M seizes an outgoing trunk jack TJ. A motor magnet MM′ is provided, which steps the wipers 10, 11, 12 and 13 from one set of contacts 14, 15, 16 and 17 to the next to seek an idle trunk circuit in a trunk or B operator's position at the distant exchange N. A cut-off relay $CO^2$ is also provided which is energized when an idle set of contacts is seized and a release magnet RM′ is provided which, when energized, permits the release of the switch FS′ to permit the wiper to restore to normal. A set of off-normal contacts ON′ is provided, which assume their alternate position upon the first step of the switch wipers off normal and again restored to their normal position when the wipers assume their normal position when the switch is released.

The trunk circuit C as illustrated in Fig. 3 is adapted to be seized by a switch FS′ and terminates at its incoming end in a repeating coil RP, which comprises windings *a*, *b*, *c* and *d*. A test relay T is provided, which is actuated when the trunk is seized and a relay SS is provided which is actuated upon the energization of relay T. An energizing circuit is also established for the busy control relay BCR to prepare circuits in the operators' busy control and storing circuits and in the operators' sequence selecting switch circuit, as will be more fully hereinafter described. A trunk operator's listening relay TLR is provided to control the connection of the trunk operator's set to the trunk conductors, and a calling lamp CAL is also provided which, when lighted, signals the trunk operator that a call is awaiting her attention. A sleeve relay SL′ is provided which is energized when the trunk plug TP of the trunk circuit C is inserted into the jack of a called line, and a busy guard relay is also provided, which relay GU is energized upon the energization of the relay SL′. A meter relay MR is also provided, which is energized upon the actuation of the relay SL′ to register a connection, and a meter cut-off relay MO is provided which is energized after the meter relay MR causes registration to prevent further registrations of the meter. A party-line ringing key RK′ is provided, and associated therewith are a plurality of ringing generators $G^5$, $G^6$, $G^7$ and $G^8$ for the usual signaling purposes. A ringing control relay RC′, a ringing interrupter relay IR′ and a ringing trip relay RT′ are provided for controlling the application of ringing current to the called line, as will be more fully hereinafter described. A calling supervisory relay SR′ is also provided which is energized when the called subscriber answers. A combined disconnect and storing lamp DSL is provided, as is also a ringing lamp RL.

Referring now to Fig. 4, illustrating three trunk operators' busy control and storing circuits *f*, *h* and *j*, assumed to be associated with three operators' positions F, H and J: Each circuit is similar to the others and a description of the circuit *f* is sufficient. The operator's busy control and storing circuit *f* associated with the trunk operator's position F is provided with four call storing relays CA, $CA^5$, $CA^6$ and $CA^9$, which are of the marginal type, in that the relay CA will operate through a 3000 ohm resistance to ground which is placed in circuit with the relay CA upon the energization of the relay BCR of a trunk cord C which is seized to

extend a connection to the trunk operator's position F. The relay $CA^3$ will operate through a 1500-ohm resistance to ground, but not through 3000 ohms, relay $CA^6$ through a 1000-ohm resistance to ground, but not through 1500 ohms, and relay $CA^9$ through a 750-ohm resistance to ground, but not through 1000 ohms, for the purpose of storing calls before this trunk operator's position F, as will be more fully hereinafter described. "Busy clearing" relays BC, $BC^3$ $BC^6$ and $BC^9$ are also provided, which relays, upon energization, establish energizing circuits for the position busying relays PB, $PB^3$, $PB^6$ and $PB^9$, respectively, to establish energizing circuits for the group busy relays BU, which relays upon energization busy all the trunks of the trunk operator's position F when a cord has been seized in this operator's position.

Referring now to Figs. 5 and 6: We illustrate the operators' sequence call selecting switches SCS, SCS′, $SCS^2$ and $SCS^3$, which are provided four per operator. These switches, when calls are extended to a trunk operator's position F, are operated to select the selected trunk circuit to operatively connect therewith. When calls are stored at a trunk operator's position as F, the switches SCS, etc., are operated and restored in a regular rotation. The switch SCS, which is typical of all four switches with which each operator's position is equipped, will be described. It is provided with wipers 18, 19, 20 and 21, which, through the agency of a motor magnet $MM^2$, are stepped into engagement with the contact sets 22, 23, 24 and 25 to select the contacts to which the seized trunk circuit is multipled. A bridging relay $BG^2$ is provided, which when energized connects the operator's talking wires to the trunk conductors. A release magnet $RM^2$ is also provided, which when energized withdraws its retaining pawl to permit the wipers to restore to normal under spring tension. Off-normal contacts $ON^2$ are also provided, which assume their alternate position upon the first step of the wipers off normal and are restored to their normal position upon the restoration of the wipers to normal.

In Fig. 7 we illustrate an operator's selecting switch, which comprises wipers 26, 27, 28 and 29, which are stepped from one contact set 30, 31, 32 and 33 to the next through the agency of a motor magnet $MM^6$ to pick up the calls extended to an operator's position in the order in which they are received or stored at an operator's position. A bridging relay $BG^6$ is provided which, when energized, connects the operator's set O′ through to the trunk cord conductors. The switch is a five-point switch, and when the wipers engage the fifth set of contacts, a release magnet $RM^6$ is energized to release the wipers so that they may again be stepped from one contact set to the next to connect the operator's set O′ to the trunk conductor. A set of off-normal contacts $ON^6$ are provided, which are moved to their alternate position upon the first step of the wipers off normal and moved back to their normal position when the wipers are restored to normal.

The system outlined comprises an exchange M, which comprises A and B switchboards in which the A operators are each provided with a plurality of cord circuits B for interconnecting subscribers' lines A. The A operator is also provided with a plurality of trunk jacks TJ which extend to a distant exchange. The B operators at the distant exchange N are each provided with a plurality of trunk circuits C, of which there are forty for each trunk position and means are provided so that any of the A operators at the exchange M may select an idle B operator and an idle incoming trunk at this B operator's position. The operator's busy control and storing circuits *f*. *h* and *j* provide means for controlling the "busy" when the trunk operator's set and trunk are automatically selected in one of these positions. A position remains busy as long as a particular operator has a greater load than any adjacent operator (one in the same group), and the "busy" is removed whenever the operator has a smaller load, or one equal to the smallest load on any operator's position in the same group.

A storing feature is also provided whereby as many as four calls may be stored in front of each trunking operator. In the trunk circuit C as described in connection with Fig. 3, a disconnect and storing lamp DSL is lighted when a call is extended to the operator's position, and indicates to the trunk operator at all times the number of calls stored at her position. The switches SCS, SCS′, etc., of which there are four for each operator's position, also operate when calls are connected to an operator's position, and when calls are stored the switches SCS, SCS′, etc., also operate to store the calls on the four switches SCS, SCS′, etc., in their regular rotation. The operator's switch OS, of which there is one for each position, picks up these calls in the sequence in which they are received and stored.

Assuming now that the subscriber at the substation A of the exchange M initiates a call, the removal of the receiver thereat closes an energizing circuit for the line relay LR of the line circuit L, over the line conductors, and the closing of the alternate contact of line relay LR upon energization lights line lamps S at a plurality of operator's positions. Assuming that it is the operator associated with the cord circuit B that answers the call, the insertion of the

answering plug AP into the jack J of the calling line establishes a series energizing circuit for the cut-off relay CO of the line circuit L and the sleeve relay ST of the cord circuit B, over circuit traced from battery through the windings 50 and 51 of the relay ST, conductor 52, normal contact 53 of the link disconnect relay LD, the sleeve contacts of the connected plug AP and jack J, through the winding of the cut-off relay CO to ground. The closure of alternate contact 54 of the relay ST closes a circuit through the low resistance winding 50 of the relay ST, the circuit being traced from battery through the winding 50 of the relay ST, its alternate contact 54, over the previously traced path to ground through the winding of the cut-off relay CO. The high resistance winding 51 of the relay ST is shunted, this arrangement providing for secret service, as relay ST of a second cord will not operate in series with the cut-off relay CO for the reason that the low winding of the relay ST of the cord circuit B renders the relay ST of the second cord inoperative.

The closing of alternate contact 55 establishes an energizing circuit for the answering supervisory relay AS, traced from battery through the lower winding of the relay AS, normal contact 56 of the relay LD, ring contacts of the connected plug AP and jack J, through the now closed contacts of the substation switchhook and back through the tip contacts of the jack J and plug AP, normal contact 57 of the relay LD, conductor 58, alternate contact 55 of relay ST, conductor 59, through the upper winding of the relay AS to ground. The opening of normal contact 60 of the relay AS upon its energization prevents the premature lighting of the answering supervisory lamp AL. The energization of the relay CO of the line circuit L opens the energizing circuit of the line relay LR, which relay restores to efface the line signals S. The closing of alternate contact 61 of the relay ST establishes an energizing circuit for the listening relay LS, traced from battery through the winding of the relay LS, conductor 62, alternate contact 61 of the relay ST, conductor 63, to ground at normal contact 64 of the sleeve relay SL. The relay LS energizing closes its alternate contacts 65 and 66 to connect the operator's set O to the cord conductors.

Should another operator attempt to seize the call after the operator associated with the cord circuit B is connected thereto, the low resistance path through winding 50 of the relay ST prevents the relay ST of the second cord from operating, and the listening relay LS of the second cord failing to operate does not connect its associated operator's set O across the cord conductors. The second operator failing to receive a response when she answers, knows that the call has been answered by another operator and withdraws the plug of her cord circuit from the multiple jack of the calling line. The operator's set O having been connected to the cord conductors as just described, the operator now inquires the wants of the calling subscriber at the substation A. The cord circuit B may be used for establishing local connections between the subscribers terminating at the exchange M and also may be used for trunk connections between it and distant exchanges.

Assuming that the subscriber at the substation A in the exchange M wishes to converse with the subscriber at the substation D terminating at the exchange N, the operator now inserts the calling plug CP into a trunk jack TJ which leads to the exchange N, and after the insertion of the plug CP into the trunk jack TJ the operator actuates the trunk order wire key OW, which order wire key OW is individual to the cord circuit. The insertion of the plug CP into trunk jack TJ establishes a series energizing circuit for the sleeve relay SL of the cord circuit B and the line relay LR′ associated with the trunk jack TJ, the circuit being traced from battery through the winding of the sleeve relay SL, conductor 68, sleeve contacts of the connected plug CP and trunk jack TJ, to ground through the winding of the line relay LR′. Relay SL now energizes and opens its normal contact 64, thus opening the energizing circuit of the listening relay LS, which relay LS restores to normal, and the opening of alternate contacts 65 and 66 disconnects the operator's set O from the cord conductors. The closing of alternate contact 69 of the relay SL closes a circuit for the calling supervisory lamp CL, traced from battery through the lamp CL, normal contact 70 of the ringing control relay RC, conductors 71 and 72, normal contact 73 of the link disconnect relay LD, conductor 74, normal contact 75 of the ringing trip relay RT, conductor 76, normal contact 77 of the supervisory relay SR, conductors 78 and 79, to ground at alternate contact 69 of the relay SL, the said lamp CL now lighting over the circuit just traced. The actuation of the trunk order wire key OW opens the cord conductors of the calling end of the cord circuit B at its contacts 80 and 81, and the closing of alternate contact 82 of the order wire key OW establishes an energizing circuit for the secondary listening relay SLR, over a circuit traced from battery through the winding of relay SLR, conductor 83, to ground at alternate contact 82 of the key OW. The relay SLR, it is to be understood, is common to an operator's position, and the closure of its alternate contacts 84 and 85 connects the operator's set O to the calling

end of the cord B over conductors 86 and 87, 88 and 89, and through the make-before-break contacts 90 and 91 of the key OW, through the tip and sleeve conductors of the cord circuit B. The closure of alternate contact 92 of the line relay LR' associated with the trunk jack TJ establishes an energizing circuit for the motor magnet MM of the finder switch FS associated with the trunk jack TJ into which the calling plug CP has been inserted. The circuit of the motor magnet MM may be traced from battery, through the resistance 93, through the winding of the motor magnet MM, its normal contact 94, conductor 95, normal contact 96 of the off-normal contacts ON, conductor 97, normal contact 98 of the switching relay SH, conductor SW, normal contact 100 of the cut-off relay CO', to ground at alternate contact 92 of the line relay LR'. Motor magnet MM energizing steps the wipers of the finder switch FS into engagement with the first set of contacts 6, 7, 8 and 9. Upon the first step of the wipers 2, 3, 4 and 5 from their normal position, the off-normal contacts ON assume their alternate position, and the opening of normal contact 96 opens the initial energizing circuit of the motor magnet MM, but a substitute energizing circuit is again established for the motor magnet MM upon the closure of its normal contact 94, circuit being traced from battery through the resistance 93, through the winding of the motor magnet MM, its normal contact 94, alternate contact 96 of off-normal contacts ON, normal contact 101, conductor 102, to ground at normal contact 103 of the bridging relay BG.

The magnet MM energizing steps the wipers 2, 3, 4 and 5 into engagement with the next set of contacts 6, 7, 8 and 9, and the opening of its contact 94 again allows the relay MM to restore. Upon the closure of contact 94 magnet MM is again energized, and the interruption of its contact 94 causes the said magnet MM to energize and de-energize, thus stepping the wipers 2, 3, 4 and 5 over the contact sets 6, 7, 8 and 9 in search of a selected trunk jack TJ, and when the wiper 2 of the switch FS engages the grounded contact 6 associated with the trunk jack TJ of the selected trunk, a circuit is established for the bridging relay BG traced from ground at alternate contact 104 of the line relay LR', normal contact 105 of the cut-off relay CO', conductor 106, contact 6, wiper 2, conductor 107, normal contact 108 of the switching relay SH, normal contact 109 of the relay BG, through the winding 110 of the relay BG, conductor 111, through the resistance 93 to battery and ground. The low resistance path through the winding 110 of the relay BG shunts the magnet MM, preventing further actuation of the said magnet, and the closing of the make-before-break contact 112 of the relay BG closes a locking circuit for the relay BG, traced from ground at alternate contact 113 of the line relay LR', through the winding of the cut-off relay CO', conductor 114, contact 7, wiper 3, conductor 115, through the lower winding 116 of the relay BG, the alternate contact 112 of the relay BG, through the upper winding 110 of relay BG, conductor 111, through the resistance 93 to battery and ground. The closing of alternate contact 103 of the relay BG establishes an energizing circuit for the switching relay SH, traced from battery through the winding of the relay SH, to ground at alternate contact 103 of the relay BG. The closing of alternate contact 117 of the relay SH establishes a locking circuit for the said relay SH, traced from battery through the winding of the relay SH, its alternate contact 117, to ground at alternate contact 118 of the off-normal contacts ON. The closing of alternate contact 98 of the relay SH now extends the common starting wire SW through the said alternate contact 98 to the starting wire SW', which wire SW' leads to the next switch of the group so that in the event that an operator inserts another plug CP into a trunk jack TJ associated with her position, the next switch of the group will be used to select the trunk jack. The closing of alternate contact 119 of the secondary listening relay SLR connects the special tone ST to the tertiary winding of the operator's induction coil of the set O, thus giving the operator of the cord circuit B who is extending the trunk connection a tone notifying her that the switch FS is operating to select the elected trunk. The switch FS having selected trunk jack TJ to be used in extending the connection to the distant exchange N, wipers 2, 3, 4 and 5 are engaging the contacts 6, 7, 8 and 9 associated with the trunk jack TJ, and the energization of the relay BG closes its alternate contacts 120 and 121 to close the continuity of the trunk conductors 122 and 123, which now extends the connection to the incoming end at the distant exchange N. The trunk terminates at the distant exchange N in a switch FS', and upon the closure of the alternate contacts 120 and 121 of the relay BG of the switch FS, an energizing circuit is established for the combined battery feed and tone disconnect relay BR, traced from battery through the winding 124 of the relay BR, conductor 88, alternate contact 91 of the key OW, ring contacts of the connected plug CP and trunk jack TJ, the contact 9, wiper 5, alternate contact 121 of the relay BG, normal contact 125 of the cut-off relay $CO^2$ of the switch FS', conductor 126, through the winding of the line relay $LR^2$ of the switch FS', conductor 127, normal contact 128 of the relay $CO^2$, trunk conductor 122, alternate contact 120 of the relay BG, wiper 4, contact 8, the tip

contacts of the connected jack TJ and plug CP, through alternate contact 90 of the key OW, conductor 89, through the winding 129 of the relay BR to ground. Relay BR upon energization opens its normal contact 130, disconnecting the tone ST from the operator's set O of the cord circuit B, notifying her that the trunk jack TJ has been selected and that the call has been extended to the distant exchange M. The line relay $LR^2$ of the switch FS' also energized over the circuit just traced and closed its alternate contact 131, establishing an energizing circuit for the control relay CR, traced from battery through the winding of the relay CR, conductor 132, normal contact 133 of the motor magnet MM', normal contact 134 of the off-normal contacts ON', conductor 135, to ground at alternate contact 131 of the line relay $LR^2$. The relay CR upon energization closes its alternate contact 136, establishing an energizing circuit for the motor magnet MM', traced from battery through the winding of the magnet MM', alternate contact 136 of the relay CR, conductor 137, through the winding of the slow-acting relay 138, normal contact 139 of the relay 140, conductor 141, normal contact 142 of the cut-off relay $CO^2$, conductor 143 to ground at wiper 11. The motor magnet MM' upon energization steps the wipers 10, 11, 12 and 13 into engagement with the first set of contacts 14, 15, 16 and 17 which lead to a trunk circuit in the exchange N.

The motor magnet MM' upon energization opens its normal contact 133 to open the energizing circuit of the control relay CR, and the relay CR now de-energizes, and the opening of its alternate contact 136 opens the circuit of the motor magnet MM'. Should the first set of contacts engaged by the wipers 10, 11, 12 and 13 lead to a trunk that is already in use, the private contact 15 now engaged by the wiper 11 will be grounded and another energizing circuit is established for the control of relay CR, traced from battery through the winding of the raly CR, normal contact 133 of magnet MM', alternate contact 134 of the off-normal contacts ON' (the said off-normal contacts ON' having moved to their alternate position upon the first step of the wipers 10, 11, 12 and 13 from their normal position), conductor 144, conductor 137, through the winding of relay 138, normal contact 139 of relay 140, conductor 141, normal contact 142 of relay $CO^2$, conductor 143 of the wiper 11, to the grounded busy contact 15. The relay CR energizing closes its alternate contact 136, establishing an energizing circuit for the motor magnet MM', to ground at the busy grounded contact 15 over the previously described path, and the motor magnet MM' again energizes to step the wipers 10, 11, 12 and 13 into engagement with the next set of contacts 14, 15, 16 and 17. The motor magnet MM' upon energization opens its normal contact 133, allowing the relay CR to restore, and the relay CR restoring in turn opens the circuit of the motor magnet MM' at its alternate contact 136. It will thus be seen that due to the see-saw action of the relay CR and the motor magnet MM', the wipers 10, 11, 12 and 13 are stepped from one contact set to the next until an idle set is encountered. When the wiper 11 engages an ungrounded contact 15, no energizing circuit is established for the relay CR, and the relay CR remains at normal and thus prevents further actuation of the motor magnet MM', and the wipers now remain in engagement with this idle contact set 14, 15, 16 and 17. The relay 138 remains energized during the rapid energizations and de-energizations of the relay CR, and its normal contact 145 is opened to prevent the energization of the cut-off relay $CO^2$, and when an idle contact set is encountered the relay 138 restores, and the closing of its normal contact 145 establishes an energizing circuit for the cut-off relay $CO^2$ of the switch FS', traced from battery through the winding of the relay $CO^2$, conductor 146, normal contact 147 of the relay 140, normal contact 145 of the relay 138, to ground at alternate contact 148 of the off-normal contacts ON'.

The closing of alternate contact 149 of relay $CO^2$ establishes an energizing circuit for the relay 140, traced from battery through the winding of the relay 140, conductor 150, through the alternate contact 149 of the relay $CO^2$, conductor 151, to ground at alternate contact 148 of off-normal contacts ON'. The closing of alternate contact 152 of relay 140 establishes a locking circuit for itself traced from battery through the winding of relay 140, its alternate contact 152, conductors 153 and 151, to ground at alternate contact 148 of the off-normal contacts ON'. The initial energizing circuit of the cut-off relay $CO^2$ is opened at normal contact 147 of the relay 140, but a substitute energizing circuit is established for the cut-off relay $CO^2$ before it has time to de-energize, as will be presently described. The closing of alternate contact 142 of the relay $CO^2$ places ground upon the private wiper 11, which busies the engaged private contact 15 to prevent any other switch FS' from engaging the selected contact set.

The cut-off relay $CO^2$ energizing closes its alternate contacts 128 and 125, opening the energizing circuit of the line relay $LR^2$, and the closure of the said contacts now extends the trunk conductors 122 and 123 to the selected idle trunk circuit C at an idle B or trunk operator's position at the exchange N. An energizing circuit for the test relay T of the trunk circuit C is now established,

traced from battery through the winding 124 of the relay BR associated with the cord B of the exchange M, conductor 88, alternate contact 91 of the key OW, ring contacts of the connected plug CP and trunk jack TJ, contact 9, wiper 5, alternate contact 121 of the relay BG, trunk conductor 123, alternate contact 125 of the relay $CO^2$, wiper 13, contact 17, the winding *c* of the repeating coil RP, conductor 155, through the low resistance winding 35 of relay T, conductor 36, normal contact 37 of relay 279, conductor 156, through the winding *a* of the repeating coil RP, contact 16, wiper 12, alternate contact 128 of the relay $CO^2$, trunk conductor 122, alternate contact 120 of the relay BG, wiper 4, contact 8, tip contacts of the connected jack TJ and plug CP, alternate contact 90 of the key OW, conductor 89, to ground through the winding 129 of the relay BR. This circuit just traced shunts out the high resistance winding 45 of relay T of trunk cord C, for purposes as will be presently described.

The closing of alternate contact 157 of the relay T establishes an energizing circuit for the secondary relay SS, traced from battery through the winding of the said relay SS, conductor 158, to ground at alternate contact 157 of the relay T. The closing of alternate contact 159 of the relay SS establishes a substitute energizing circuit for the cut-off relay $CO^2$ of the finder switch FS', which may be traced from battery through the winding of the relay $CO^2$, its alternate contact 160, conductor 161, wiper 10, contact 14, conductor 162, to ground through alternate contact 159 of the relay SS, the said relay $CO^2$, remaining energized until the termination of conversation. The closing of alternate contact 163 of relay SS establishes a circuit for the combined disconnect and storing lamp DSL, traced from battery through the said lamp DSL, normal contact 164 of the sleeve relay SL', to ground at alternate contact 163 of the relay SS. The closing of alternate contact 165 of the relay SS establishes an energizing circuit for the busy control relay BCR of the seized trunk cord C, traced from battery through the winding of the relay BCR, conductor 167, normal contact 168 of the relay SL', to ground at alternate contact 165 of the relay SS.

The relay BCR energizing closes its alternate contact 170, establishing an energizing circuit for the call storing relay CA of the trunk operator's busy control and storing circuit *f*, which circuit *f* is common to this operator's position F, with which the trunk circuit C as seized by the switch FS' is associated. The energizing circuit of the relay CA may be traced from ground through the 3000-ohm resistance 172, alternate contact 170 of the relay BCR, conductor 173, which is common to all relays BCR of trunk circuits at position F, through the winding of the relay CA, conductors 174, 175, normal contact 176 of the busy clearing relay BC, conductors 177, 178, 179, normal contact 180 of the busy clearing relay $BC^3$, conductors 181, 182 and 183 to battery through normal contact 184 of the busy clearing relay $BC^6$. The relay CA, upon energization, closes its alternate contact 185, establishing an energizing circuit for the busy clearing relay BC, traced from battery, through the winding of the relay BC, to ground at alternate contact 185 of the relay CA.

The relay BC energizing, closes its alternate contact 186 to establish an energizing circuit for the position busying relay PB, traced from battery through the upper winding 187 of the relay PB to ground at alternate contact 186 of the relay BC. The relay PB energizes over this circuit and closes its alternate contact 188 connecting ground to the conductor 340, which ground operates the group of busying relays BU associated with the position F, and the busying relays BU upon energization close their alternate contacts 189, temporarily busying the balance of the trunks in this position by grounding their contacts 15 at the selecting switches, each trunk having a wire, as 190, leading to a relay BU. The busy potential thus placed on all the private contacts 15 and their multiples of trunks at this operator's position remains until the call which has been extended over this particular trunk to her position is extended to the called line, as will be more fully hereinafter described. The relay BCR upon energization also closes its alternate contacts 191, 192. The closing of alternate contact 191 connects ground to the starting conductor SA common to all relays BCR of the position, to close an energizing circuit for the motor magnet $MM^2$ of the operator's sequence call selecting switch SCS, of which there are four for each operator's position, for purposes as will be hereinafter more fully described.

The circuit of the motor magnet $MM^2$ of the switch SCS may be traced from battery through the resistance 193, the winding of magnet $MM^2$, its normal contact 194, normal contacts 195 of the off-normal contacts $ON^2$, conductor 196, normal contact 197 of the relay 198, starting conductor SA, normal contact 199 of the trunk listening relay TLR, conductor 200, to ground at alternate contact 191 of the relay BCR. The magnet $MM^2$ upon energization steps the wipers 18, 19, 20 and 21 into engagement with the first set of contacts 22, 23, 24 and 25, and upon the first step of the wipers off-normal, the off-normal contacts $ON^2$ assume their alternate position, and the motor magnet $MM^2$ upon energization

opens its normal contact 194 to interrupt its circuit, and the magnet $MM^2$ now restores. The off-normal contacts $ON^2$ having moved to their alternate position, the initial energizing circuit of magnet $MM^2$ is opened at normal contact 195 of off-normal contacts $ON^2$, but the closing of alternate contact 195 of off-normal contacts $ON^2$ establishes a substitute energizing circuit for the motor magnet $MM^2$, traced from battery through resistance 193, through the winding of the motor magnet $MM^2$, its normal contact 194, alternate contact 195 of off-normal contact $ON^2$, conductor 201, normal contact 202 of relay 198, conductor 203 to ground at normal contact 204 of the bridging relay $BG^2$. The motor magnet $MM^2$ is again energized over this circuit, and, due to the opening and closing of its contact 194, it is thus alternately energized and de-energized to step the wipers 18, 19, 20 and 21 from one set of contacts 22, 23, 24 and 25 to the next, and when the wiper 18 engages the contact 22, which was grounded upon the energization of the ralay BCR of the trunk circuit C, an energizing circuit is established for the bridging relay $BG^2$ of the switch SCS, which may be traced from battery through the resistance 193, conductor 205, through the upper winding 206 of the relay $BG^2$, normal contact 207 of relay $BG^2$, conductor 208, normal contact 209 of the relay 198, conductor 210, wiper 18, contact 22, conductor 211, normal contact 212 of the relay TLR, conductor 213, to ground at alternate contact 192 of the relay BCR. The relay $BG^2$ upon energization closes its alternate contact 214, closing a locking circuit for itself traced from battery through the resistance 193, conductor 205, through the upper winding 206 of the relay $BG^2$, its alternate contact 214, lower winding 215 of the relay $BG^2$, conductor 216, wiper 19, contact 23, conductor 351, through the winding of the relay TLR, conductor 217, to ground at alternate contact 218 of the relay BCR, and relay TLR is also energized for the purposes as will presently be described.

The circuit just described, which causes the energization of relay $BG^2$, shunts the motor magnet $MM^2$ and prevents further actuations of the said magnet, and the wipers 18, 19, 20 and 21 remain in engagement with the selected set of contacts 22, 23, 24 and 25. The relay $BG^2$ upon energization closes its alternate contact 204, establishing an energizing circuit for the relay 198, traced from battery through the winding of the relay 198, conductor 219 to ground at alternate contact 204 of the relay $BG^2$, and the relay 198 energizing closes its alternate contact 220, establishing a locking circuit for itself from battery through its winding, its alternate contact 220 to ground at alternate contact 221 of the off-normal contacts $ON^2$. The closing of alternate contacts 222 and 223 of the relay $BG^2$ established an energizing circuit for the line relay $LR^3$, traced from battery through the winding 124 of the relay BR, associated with the cord circuit B, at the exchange M, conductor 88, alternate contact 91 of the key OW, ring contacts of the connected plug CP and jack TJ, contact 9, wiper 5, alternate contact 121 of the relay BG, trunk conductor 123, alternate contact 125 of the cut-off relay $CO^2$, wiper 13, contact 17, conductor 224, alternate contact 225 of the relay TLR, conductor 226, contact 25, wiper 21, alternate contact 223 of the relay $BG^2$, through the winding of the line relay $LR^3$, alternate contact 222 of the relay $BG^2$, wiper 20, contact 24, conductor 227, alternate contact 228 of the relay TLR, conductor 229, contact 16, wiper 12, alternate contact 128 of relay $CO^2$, trunk conductor 122, alternate contact 120 of the relay BG, wiper 4, contact 8, tip contacts of the connected trunk jack TJ and plug CP, alternate contact 90 of the key OW, conductor 89 to ground through the winding 129 of the relay BR. The relay $LR^3$ energizing closes its alternate contact 230, establishing an energizing circuit for the starting relay SG, traced from battery through the winding of the relay SG, through ground at alternate contact 230 of the relay $LR^3$. The relay SG upon energization closes its alternate contacts 231 and 232, and the closing of alternate contact 231 establishes an energizing circuit for the switching relay $BG^6$ of the operator's selecting switch OS, traced from ground at alternate contact 231 of the relay SG, conductor 233, contact 31, wiper 27, conductor 234, normal contact 235 of relay 236, normal contact 237 of the relay $BG^6$, through the low resistance winding 238 of the relay $BG^6$, conductor 239, through the resistance 240 to battery.

The circuit just traced through the relay $BG^6$ shunts the magnet $MM^6$ of the switch OS, due to the low resistance path through winding 238 of relay $BG^6$, and prevents the magnet $MM^6$ from stepping the wipers 26, 27, 28 and 29 of the switch. The relay $BG^6$ upon energization opens its normal contact 237 and a substitute circuit is established for the said relay $BG^6$, traced from battery through the resistance 240, conductor 239, through the winding 238 and 241 of the relay $BG^6$, normal contact 235 of the relay 236 to ground at alternate contact 231 of the relay SG over the previously described path.

The closing of alternate contacts 242 and 243 of the relay $BG^6$ connects the operator's set O′ to the trunk conductors of the trunk circuit C, from alternate contact 242 of the relay $BG^6$, the wiper 28, contact 32, conductor 244, alternate contact 222 of relay $BG^2$,

wiper 20, contact 24, conductor 227, contact 228 of the relay TLR, conductor 229 to the tip strand of the trunk cord C, and the other lead from the operator's set O' extends through alternate contact 243 of the relay $BG^6$, the wiper 29, contact 33, conductor 245, through alternate contact 223 of the relay $BG^2$, wiper 21, contact 25, conductor 226, alternate contact 225 of the relay TLR, conductor 224, to the ring strand of the trunk cord.

Referring again to the switch SCS, the energization of relay 198 causes its alternate contact 209 to close, to establish an energizing circuit for the relay 246 of the cord C, traced from battery through the winding of the relay 236 of the switch OS, conductor 247, wiper 26, contact 30, conductor 248, alternate contact 209 of the relay 198, conductor 210, wiper 18, contact 22, conductor 211, alternate contact 212 of the relay TLR to ground through the winding of the relay 246, which relay energizes over this circuit, but relay 236 of the switch OS does not, due to its construction and adjustment. The closing of alternate contact 249 of the relay 246 closes a circuit for the call lamp CAL from battery through the lamp CAL to ground at alternate contact 249 of the relay 246, and the lighting of the lamp CAL notifies the trunk operator of the position F that the call has been extended to her position and is awaiting her attention. The trunk operator's set O' having been connected to the trunk cord conductors, as just described, through alternate contacts 225 and 228 of relay TLR of the seized trunk cord C, the operator, noting the lighted signal CAL, inquires the number of the substation that is wanted by the calling subscriber at the exchange M from the operator at the exchange M, and assuming that the operator at the exchange M now passes the number to the trunk or B operator at the exchange N, and that it is the subscriber at the substation D that is wanted, the trunk operator at the exchange N will now test the multiple jack J' of the wanted substation in the usual manner as to its idle or busy condition.

After the A operator at the exchange M has passed the number of the wanted substation to the B or trunk operator at the exchange N, the A operator restores the key OW. The restoration opens the alternate contact 82 of the said key, thus allowing the secondary listening relay SLR at the exchange M to restore, and the opening of its alternate contacts 84 and 85 disconnects the operator's set O at the exchange M from the cord conductors. The closing of the make-before-break contacts 90 and 91 of the key OW now establishes a substitute energizing circuit for the test relay T of the trunk cord C at the exchange N, traced from ground through the upper winding of the relay SR of the cord circuit B at the exchange M, alternate contact 40 of the sleeve relay SL, normal contact 41 of the interrupter relay IR, normal contact 80 of the key OW, and over the previously described path through the low resistance winding 35 of the relay T, back through normal contact 81 of the key OW, normal contact 42 of the relay IR, to battery, through the lower winding of the relay SR. The relay SR also energizes over this circuit due to the low resistance path through the winding 35 of the relay T of the trunk C at the exchange N, and the opening of normal contact 77 of the relay SR of cord B at the exchange M prevents the supervisory signal CL from lighting, thus giving the A operator at the exchange M a dark keyshelf.

Assuming that the line is idle, the trunk operator associated with the trunk C inserts the trunk plug TP into the multiple jack J' of the wanted substation D, thus establishing a series energizing circuit for the sleeve relay SL' of the trunk circuit C and the cut-off relay $CO^4$ of the line circuit L' associated with the called line, traced from battery through the winding of the relay SL', conductor 250, sleeve contacts of the connected plug TP and jack J' to ground through the winding of the cut-off relay $CO^4$. The relay SL' upon energization opens its normal contact 164, interrupting the energizing circuit of the combined disconnect and storing lamp DSL, which lamp is now effaced. The sleeve relay SL' energizing closes its alternate contact 251, establishing an energizing circuit for the busy guard relay GU, traced from battery through the winding 252 of relay GU, normal contact 253 of relay GU, conductor 254, alternate contact 255 of relay SS, conductors 256 and 257 to ground at alternate contact 251 of the relay SL'. A locking circuit is closed through the lower winding 258 of the relay GU, traced from battery through its lower winding 258, its alternate contact 259, conductor 260, to ground at alternate contact 163 of relay SS. A locking circuit is also established through the upper winding 252 of the relay GU, from battery through the winding 252 of the relay GU, its alternate contact 261, conductors 256 and 257 to ground at alternate contact 251 of the relay SL'. These two locking circuits for the relay GU are for purposes as will be presently described.

The sleeve relay SL' upon energization opens its normal contact 168 to open the energizing circuit through the relay BCR and the relay BCR upon de-energization opens its alternate contact 170. The opening of alternate contact 170 of relay BCR opens the energizing circuit of the relay CA of the trunk operator's control and storing circuit associated with this operator's position F, of which the trunk circuit C is one. The

relay CA now restores and the opening of its alternate contact 185 opens the energizing circuit of the relay BC. The relay BC upon restoration opens its alternate contact 186, opening the energizing circuit of the relay PB and the relay PB upon de-energization opens its alternate contact 188, removing the ground from the group of busying relays BU, which relays now restore and the opening of their alternate contacts 189 removes the busying grounds from the multiple contacts 15 of the switches FS′ in which the trunk cords C of this trunk operator's position F terminate, making them again selectable so that other calls may be extended to this B operator's position F.

The closing of alternate contact 262 of the relay GU, however, places a busy potential upon the private contact 15 of the selected trunk circuit C which may be traced from ground at alternate contact 262 of the relay GU, conductors 263 and 264, to the contact 15, thus preventing any other switch, as FS′, from selecting this particular trunk that is now in use. The relay BCR upon restoration opens its alternate contact 218 to open the energizing circuit of the relay TLR of the trunk C, and the relay $BG^2$ of the switch SCS. The relay TLR upon restoration opens its alternate contact 212, allowing relay 246 to de-energize. The relay 246 restoring opens its alternate contact 249, to efface the called signal lamp CAL, and the relay TLR upon restoration also opens its alternate contacts 225 and 228 to disconnect the trunk operator's set O′ from the trunk cord conductors. The relay $BG^2$ upon restoration closes its normal contact 204, closing an energizing circuit for the release magnet $RM^2$ traced from battery through the winding of release magnet $RM^2$, alternate contact 202 of relay 198, conductor 203 to ground at normal contact 204 of the now de-energized relay $BG^2$, and the release magnet $RM^2$ now withdraws the retaining pawl from the ratchet and allows the wipers 18, 19, 20 and 21 to restore to their normal position.

The relay 270 is also energized upon the restoration of the relay $BG^2$, due to the closing of its normal contact 204, but the energization of this relay has no effect on the circuit at this time. When the wipers reach their normal position, the off-normal contacts $ON^2$ assume their normal position, and the opening of alternate contact 221 of the said off-normal contacts $ON^2$ opens the locking circuit of relay 198, and the opening of alternate contact 221 allows relay 198 to restore, and the opening of alternate contact 202 of relay 198 opens the circuit of the release magnet $RM^2$, and the relay 270, which relay and magnet now restore to normal. When relay $BG^2$ de-energizes, its alternate contacts 222 and 223 are opened allowing relay $LR^3$ to restore and the relay $LR^3$ in turn opens the energizing circuit of the relay SG, at its contact 230. The relay SG upon de-energization opens its alternate contact 231 opening the energizing circuit of relay $BG^6$ of the switch OS, and the relay now restores. The sequence selecting switch SCS and the operator's selecting switches are now at normal and are again ready to select another call that may be extended to the operator's position F.

Returning now to the extension of a call to the called subscriber at the substation B, and the energization of the relay GU, the closing of alternate contact 271 of the relay GU closes an energizing circuit for the meter relay MR traced from battery through the winding of the meter relay MR, normal contact 273 of the meter cut-off relay MO and conductor 272 to ground at alternate contact 271 of the relay GU, the said meter relay MR now actuating to register a connection. The closure of alternate contact 271 of the relay GU also energizes the meter cut-off relay MO, the circuit being traced from battery through the winding of the relay MO to ground at alternate contact 271 of the relay GU. The meter cut off relay MO upon energization opens its normal contact 273, preventing further actuations of the meter relay MR, which meter relay MR now restores to normal. A circuit for the ringing lamp RL is also established traced from battery through the lamp RL, normal contact 274 of relay RC′, conductor 275, normal contact 276, of the ringing trip relay RT, conductor 277, normal contact 278, of the relay 279, conductors 256 and 257 to ground at alternate contact 251 of the relay SL′. The ringing lamp RL is lighted over this circuit, giving the trunk operator associated with this trunk cord C visual indication notifying her that the called subscriber at the substation D has as yet not been signaled. To signal the called for subscriber at the substation D, the opertor associated with the trunk circuit C now depresses the proper ringing key plunger of the ringing key RK′ to connect the proper ringing generator frequency of the generators $G^5$, $G^6$, $G^7$ or $G^8$, as the case may be, to operate the call signal at the called substation D.

Assuming that the ringing generator $G^6$ is the proper frequency for signaling the substation D, the operator depresses the ringing key plunger associated with this frequency, and the depression of the said key plunger actuates the end spring contact 280 causing it to momentarily assume its alternate position, and the closure of said alternate contact 280 establishes an energizing circuit for the ringing control relay RC′, traced from battery through the winding of the said relay RC′, conductor 281 alternate contact 280 of the end spring contacts of the ringing key

RK′, conductor 282, normal contact 278, of the relay 279, conductors 256 and 257 to ground at alternate contact 251, of the sleeve relay SL′. The closing of alternate contacts 283 of the relay RC′ establishes a locking circuit for itself traced through the winding of the said relay RC′, its alternate contact 283, conductor 275, normal contact 276, of the ringing trip relay RT, conductor 277, normal contact 278 of relay 279, conductors 256 and 257 to ground at alternate contact 251 of the sleeve relay SL′. The opening of normal contact 274 of the relay RC′ opens the circuit of the ringing lamp RL and the closure of alternate contact 284 of the relay RC′ closes an energizing circuit for the interrupter relay IR′ traced from battery through the winding of the relay IR′, conductor 285, alternate contact 284 of relay RC′, conductor 286, alternate contact 287 of the relay SS, conductor 288, and through the constantly rotating interrupter I′ to ground. The relay IR′ is thus intermittently energized and de-energized by the interrupter I′ and the ringing current from the generator $G^6$ is thus connected and disconnected to intermittently operate the called signal at the called for substation D. The ringing current may be traced from the ungrounded pole of the generator $G^6$ through the closed key plunger contact of the ringing key RK′, conductors 289 and 290, through the winding of the ringing trip relay RT′, conductors 291 and 292, alternate contact 293 of the interrupter relay IR′, tip contacts of the connected plug TP and jack J′, through the condenser and call signal to the called substation D back through the ring contacts of the connected jack J′ and plug TP to battery and ground through alternate contact 294 of the ringing interrupter relay IR′. The call signal at the substation D is thus intermittently energized due to the energization and de-energization of interrupter relay IR′, and the subscriber at the substation D in response to his call signal removes his receiver from the switchhook.

Should the subscriber at the substation D remove his receiver during a ringing period, the combined generator and battery flowing through the winding of the ringing trip relay RT′ causes the same to actuate, and the opening of its normal contact 276 opens the locking circuit for the ringing control relay RC′, which relay RC′ restores, and the opening of the alternate contact 284 disconnects interrupter I′ from the interrupter relay IR′, said relay IR′ now restores to normal and prevents further application of ringing current after the called subscriber at the substation D answers in response to his call signal.

Should the subscriber at the substation D remove his receiver during a silent period, that is, when the ringing interrupter relay IR′ is in de-energized position, an energizing circuit for the supervisory relay SR′ is established, the circuit being traced from battery through the lower winding of the relay SR′, conductor 295, winding *d* of the repeater coil RP, normal contact 294 of the relay IR′, ring contacts of the connected plug TP and jack J′, through the now closed contacts of the substation switch hook at the substation D, back through the tip contacts of the connected jack J′ and plug TP, normal contact 293 of the relay IR′, alternate contact 296 of the sleeve relay SL′, winding *b* of the repeater coil RP, conductor 297, through the upper winding of the relay SR′ to ground. The closure of alternate contact 298 of the relay SR′, upon its energization, establishes an energizing circuit for the relay 279 traced from battery through the winding of the delay 279, alternate contact 298 of the relay SR′, conductors 256 and 257 to ground at alternate contact 251 of the sleeve relay SL′. Relay 279 upon energization opens its normal contact 278 to open the locking circuit of the ringing control relay RC′. In this way, in the event the subscriber at the substation D answers during a silent period, the said relay RC′, upon restoration, opens its alternate contact 284, disconnecting interrupter I′ from the ringing interrupter relay IR′ and the said relay IR′ restoring prevents further application of ringing current. A locking circuit for relay 279 is established upon the closure of its alternate contact 299, traced from battery through the winding of the said relay 279, its alternate contact 299, conductor 300, normal contact 301 of relay RC′, conductor 302, conductors 256 and 257, to ground at alternate contact 251 of the relay SL′. The opening of normal contact 37 of the relay 279 opens the shunt about the high resistance winding 45 of the relay T, but the closing of alternate contact 303 of the supervisory relay SR′ places another shunt about the high resistance winding of the test relay T, and the relay SR of the cord circuit B at the exchange M remains energized.

The subscriber at the substation A at the exchange M and the subscriber at the substation D at the exchange N are now in conversational circuit, the talking circuit being traced over the heavily marked conductors.

Assuming now that the subscribers at the substations A and D have finished conversation, they replace their receivers upon their respective switchhooks. The replacing of the receiver by the subscriber at the substation A at the exchange M opens the circuit of the answering sleeve supervisory relay AS of the cord circuit B, and the closing of its normal contact 60 establishes an energizing circuit for the link disconnect relay LD, traced from battery through the winding of the

relay LD, normal contact 60 of the relay AS, alternate contact 305 of the relay ST, conductor 79, to ground at alternate contact 69 of the sleeve relay SL. The link disconnect relay LD energizing disassociates the calling line from the strands of the cord circuit at its normal contacts 56 and 57 and closes a locking circuit for the relay ST extending from battery through the said relay, its alternate contact 54, conductor 52, alternate contact 53 of the relay LD, alternate contact 305 of the relay ST, conductor 79 to ground at alternate contact 69 of the sleeve relay SL. The relays LD and ST remain energized until the connection is taken down.

The opening of normal contact 53 of the relay LD allows the cut-off relay CO of the line circuit L to restore which places the line circuit L at normal. The closing of normal contact 60 of the relay AS closes a circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, normal contact 60 of the relay AS, alternate contact 305 of the relay ST, conductor 79 to ground at alternate contact 69 of the relay SL. The answering supervisory lamp AL is lighted notifying the operator at the exchange M that the subscriber at the calling substation A has replaced his receiver upon the switchhook. The subscriber at the substation A may immediately initiate a recall before the answering and calling plugs AP and CP are removed by again removing his receiver which again brings about the energization of the line relay LR, which relay, upon energization, closes the circuit for the multiple line lamps S, and the same operator or another may seize the recall.

The subscriber at the substation D of the exchange N now replaces his receiver upon the switchhook opening the energizing circuit of the supervisory relay SR′ of the trunk circuit C. Upon the restoration of the relay SR′, its alternate contacts 303 is again opened and as the relay 279 is locked up, its normal contact 37 is open, and the opening of the contact 303 of relay SR′ removes the shunt from about the high resistance winding 45 of the relay T, and the circuit of the supervisory relay SR of the cord circuit B at the exchange M restores due to the insertion of the high resistance winding 45 of the test relay T into the circuit of the relay SR of the cord circuit B at the exchange M. The relay SR upon restoration, closes its normal contact 77 to close a circuit through the supervisory lamp CL from battery through the lamp conductor 306, alternate contact 73 of the relay LD, conductor 74, normal contact 75 of the relay RT, conductor 76, normal contact 77 of the relay SR, conductors 78 and 79 to ground at alternate contact 69 of the relay SL.

The calling supervisory lamp CL is lighted to notify the operator at the exchange M that the called subscriber at the substation D at the exchange N has replaced his receiver. The operator at the exchange M noting the two lighted supervisory signals AL and CL removes the answering plug AP from the jack J of the calling line A, and the calling plug CP from the trunk jack TJ. The removal of the plug CP from the trunk jack TJ opens the energizing circuit of the line relay LR′ associated with the trunk jack TJ, and the sleeve relay SL of the cord circuit B at the exchange M. The line relay LR′ now restores and opens its alternate contact 113, opening the series energizing circuit of the cut-off relay CO′, and the relay BG of the finder switch F. The relay BG de-energizing, closes its normal contact 103, closing an energizing circuit for the release magnet RM of the said switch FS, the circuit of the release magnet RM being traced from battery through the winding of the magnet RM, alternate contact 101 of the relay SH, conductor 102 to ground at normal contact 103 of the relay BG. The release magnet RM, upon energization, removes the retaining pawl from the ratchet, allowing wipers 2, 3, 4 and 5 to restore to their normal position under spring tension. When the wipers have restored to normal, the off-normal contacts ON are moved to again assume their normal position, and the opening of alternate contact 118 of the off-normal contacts ON opens the locking circuit of the switch relay SH, which relay SH restores to normal, and the opening of alternate contact 101 of the relay SH opens the circuit of the release magnet RM, which magnet RM also restores. The finder switch FS is now at normal and is available for extending other trunk connections.

The removal of the plug CP from the trunk jack TJ at the outgoing end of the exchange M opens the circuit of the high resistance test relay T of the trunk circuit C, at the exchange N, and the relay T de-energizing opens its alternate contact 157 which brings about the restoration of the relay SS. The relay SS upon de-energization opens its alternate contact 163 and opens the locking circuit through the lower winding 258 of the relay GU, but the relay GU does not restore at this time due to the locking circuit through the upper winding 252 of the relay GU, to ground at alternate contact 251 of the sleeve relay SL′. The closure of normal contact 163 of the relay SS establishes a circuit for the combined disconnect and storing lamp signal DSL traced from battery through the lamp DSL, alternate contact 164 of relay SL′ to ground at normal contact 163 of the relay SS. The lamp DSL is lighted over this circuit and notifies the operator at the exchange N that disconnection has taken place at the exchange M where the call originated. The

opening of alternate contact 159 of the relay SS permits the de-energization of the cut-off relay $CO^2$ of the trunk circuit FS'. The cut-off relay $CO^2$ of the switch FS' upon de-energization closes its normal contact 149, establishing an energizing circuit for the release magnet RM', traced from battery through the magnet RM', alternate contact 310 of relay 140, conductor 311, normal contact 149 of the relay $CO^2$, conductor 151 to ground at alternate contact 148 of off normal contacts $ON^2$, and release magnet RM' withdraws the retaining pawl from the ratchet, allowing the wipers 10, 11, 12 and 13 to restore to their normal position under spring tension, and when the wipers have restored to their normal position, off-normal contacts ON' again assume their normal position, and the opening of alternate contact 148 of the off normal contacts ON' opens the circuit of the relay 140 and the release magnet RM'. The switch FS' is now at normal and again available for use in extending other connections.

The operator at the trunk circuit C has as yet not withdrawn the plug TP from the jack J', and the locking circuit through the upper winding 252 of the relay GU is still maintained and continues to connect ground to the test conductor 264 which leads to the test contacts 15 of the switch FS', to which the trunk circuit C is multipled, the ground extending from ground at alternate contact 262 of the relay GU, over conductors 263 and 264 to the test contact 15. Thus any other finder switch FS' is prevented from selecting the trunk circuit C that is still connected to the called line D. The operator noting the lighted disconnect lamp DSL knows that the operator at the exchange M has withdrawn the plugs of the cord circuit B from the respective jacks, and she now withdraws the trunk plug TP from the jack J' of the called line. The removal of the plug TP opens the series energizing circuit for the sleeve relay SL' and the cut-off relay $CO^4$, and the opening of alternate contact 251 opens the locking circuit through the winding 252 of the relay GU, and the opening of the said alternate contact 251 of the sleeve relay SL' opens the locking circuit of the relay 279. The opening of alternate contact 164 of the sleeve relay SL' brings about the effacement of the lamp DSL. The relay GU upon de-energization opens its alternate contact 262, removing ground from the test conductor 264 which extends to the test contacts 15, thus removing the busy potential at the said contacts 15, now rendering the trunk circuit at the exchange N selectable by other trunk switches FS'. The opening of alternate contact 271 opens the circuit of the meter cut-off relay MO, the said relay MO restoring to normal. The apparatus that was used in establishing the connection from the calling subscriber at the substation A at the exchange M to the called subscriber D at the exchange N is now at normal and available for establishing other connections.

In the foregoing description we have assumed that all the apparatus was in its normal unactuated position, but for a clearer understanding of the trunk operator's busy control and storing circuit of Fig. 4 and the operator's sequence selecting circuit of Figs. 5, 6, and 7, we will now describe more in detail the operation of the circuits when calls are being stored before the different operators' positions, and the method of selecting the calls in sequence by means of the operator's sequence selecting circuits, illustrated in Figs. 5, 6, 7 and 8.

Assuming now that the trunk operators at positions F, H and J are idle and that the first call coming in has selected the trunk cord C associated with the operator's position F, as in the previous description, relays T, SS and BCR are energized, and the closure of the alternate contact 170 of relay BCR of the selected trunk cord C connects the 3000-ohm resistance 172 from ground to battery through the relay CA of the operator's position F over a path previously described. The relays BC and PB are also operated as previously described and the relay PB closes its alternate contact 188 to cause the operation of the group busying relays BU which relays BU operate to place a ground or busy potential upon the balance of the trunks in this operator's position F, as previously described in detail.

Assuming that the operator at position F does not answer this call, the second call extended to the exchange N will select a trunk cord as C in the operator's position H. Relays T, SS and BCR of the trunk cord C seized in the operator's position H will operate in a like manner, and the closing of alternate contact 170 of the relay BCR will connect ground through the 3000-ohm resistance through the winding of relay CA' of the operator's position H to battery at normal contact 184' of the relay BC' associated with the operator's position H. Relay CA' operates to close an energizing circuit for the relay BC', due to the closure of alternate contact 185' of the relay CA'. The relay BC' energizing in turn establishes an energizing circuit for the relay PB' from ground through alternate contact 186' of the relay BC', and through the winding 187' of the relay PB' to battery. Relay PB' energizing its alternate contact 188' is closed to establish an energizing circuit for the group busying relays BU associated with the operator's position H, which relays BU operating close their alternate contacts, plac-

ing a ground or busy potential upon the rest of the trunks in this position H.

Assuming that the operators at positions F and H do not answer either call and that a third call is extended to the exchange N, this call will come in on position J, the only position having trunks not busy. The relay $CA^2$ associated with the position J will operate from ground through the 3000-ohm resistance of the selected trunk cord C of the operator's position J, through the winding of the relay $CA^2$ to battery at normal contact $184^2$ of relay $BC^8$ of the position J. The closing of alternate contact $185^2$ of relay $CA^2$ closes a circuit through relay $BC^2$, which will be energized to in turn close a circuit for the relay $PB^2$ from battery through its upper winding $187^2$ to ground at alternate contact $186^2$ of relay $BC^2$. The closure of alternate contact $360^2$ closes a circuit through the lower winding $361^2$ of relay $PB^2$ from battery through the winding $361^2$, alternate contact $360^2$, conductor 362, alternate contact 363′ of the relay BC′ of the position H, alternate contact 363 of the relay BC of the position F to ground. The closing of alternate contact $364^2$ of the relay $BC^2$ at the position J now closes a circuit through the lower winding 361′ of the relay PB′ of the position H, the circuit being traced from battery through the lower winding 361′, alternate contact 360′ of the relay BC′, conductor 365, the alternate contact 366 of the relay BC of the position F, conductor 367, alternate contact $364^2$ of relay $BC^2$ of position J to ground.

The closing of alternate contact $366^2$ of the relay $BC^2$ of the position J closes a circuit through the lower winding 361 of the relay PB of the position F, traced from battery through the winding 361, alternate contact 360 of the relay BC of the position F, conductor 368, alternate contact 366′ of the relay BC′ of the position H, conductor 369, alternate contact $366^2$ of the relay $BC^2$ of the position H to ground. The circuits through the lower windings 361, 361′, $361^2$ of the relays PB, PB′ and $PB^2$ at the positions F, H and J bring about the de-energization of the said relays at the respective positions F, H and J, due to their differential construction, and the opening of their alternate contacts 188, 188′ and $188^2$ removes the ground from conductors 340, 340′ and $340^2$ to open the circuits of each of the groups of busy relays BU associated with the positions F, H and J, thus removing the busying ground from all the trunks not in use. Assuming that the operators at positions F, H and J have not answered any one of the three calls and a fourth call comes in, and assuming that position F is selected, the relay BCR of the seized trunk circuit C associated with the position F that is extending the call to the operator's position F closes its alternate contact 170, places an additional 3000-ohm resistance 172 in multiple of the common conductor 173, and the two 3000-ohm resistances 172 placed in multiple of the conductor 173 reduce the resistance to 1500 ohms, and as the relay $CA^3$ will operate through 1500 ohms the relay $CA^3$ of the position F operates over a circuit traced from battery at normal contact 184 of the relay $BC^6$, conductors 183, 182 and 181, normal contact 180 of the relay $BC^3$, conductors 179 and 178 through the winding of the relay $CA^3$, conductor 174, through the winding of the relay CA and over conductor 173 to ground at the alternate contacts 170 of the two relays BCR of the trunk circuits C that are selected, now that another call has been extended to the operator's position F. The relay $CA^3$ upon energization closes its alternate contact $185^3$ to bring about the energization of relay $BC^6$, and the relay $BC^6$ in turn closes a circuit for the relay $PB^3$, and relay $PB^3$ upon energization closes its alternate contact $188^3$ to again establish an energizing circuit for the busy group relays BU associated with the position F, which relays upon energization again close their alternate contacts to busy the remaining trunks at the operator's position F.

The fifth incoming call extended to the exchange N will be extended to position H and cause the energization of the relay $CA^4$ associated with the position H, the said relay $CA^4$ energizing in a similar manner to that described in connection with relay $CA^3$ of position F, whereby two resistances 172 placed in multiple with the conductor 173 permit the relay $CA^4$ to energize for the same reason as described in connection with relay $CA^3$ of position F. The relay $CA^4$ upon energization closes its alternate contact $185^4$ and brings about the energization of the relay $BC^4$, which in turn closes a circuit for relay $PB^4$, and the relay $PB^4$ upon energization closes its alternate contact $188^4$ to operate the busy group relays BU associated with the position H to cause the remaining trunks at the position H to be busied against selection.

The sixth incoming call extended to N will be extended to the position J to cause the relay $CA^5$ to be energized in a manner obvious from the preceding, and relay $CA^5$ in turn brings about the energization of the relay $BC^5$ through its alternate contact $185^5$. Relay $BC^5$ upon energization closes its alternate contact to close a circuit through the upper winding of the relay $PB^5$, but the relay $PB^5$, due to the differential construction, restores to normal, as a circuit is also closed through its lower winding which brings about the de-energization of this relay $PB^5$. The differential relays $PB^3$ and $PB^4$ of the positions F and H also restore to normal due to circuits being closed

through their lower windings over circuits corresponding to those described in connection with the first three calls that were stored at the operators' positions F, H and J. The relays $PB^3$, $PB^4$ and $PB^5$ open their alternate contacts to permit the de-energization of the busy group relays BU associated with the three positions F, H and J, and each group of relays BU associated with said position will cause the remaining trunks in the positions F, H and J to again test idle.

Assuming that none of the six calls thus far extended to the positions F, H and J have been answered, a seventh call coming in will again be extended to the position F, and as relays BC and $BC^3$ of the position F are energized, the normal contacts 176 and 180 of the relays BC and $BC^3$ are opened and such seventh call will be extended to a trunk circuit C at the position F and bring about the energization of the relay BCR at that cord, and the closing of its alternate contact 170 will place another 3000-ohm resistance 172 in multiple with the other two resistances 172 of the two other trunk cords C that have been connected. The resistance between the wire 173 and ground being 1000 ohms, relay $CA^6$ energizes, in turn bringing about the energization of the relays $BC^6$ and $PB^6$. The relay $PB^6$ energizing, its alternate contact is closed to energize the group busying relays BU, which relays BU in turn busy the remaining trunks at the operator's position F.

An eighth call coming in will operate the relay $CA^7$ in a like manner as described in connection with relay $CA^6$, and the relay $CA^7$ upon energization brings about the energization of the relays $PC^7$ and $PB^7$, and the closing of the alternate contact of the relay $PB^7$ operates the busy relays BU associated with the position H, busying all the remaining trunks of this operator's position.

A ninth call coming in will be extended to the operator's position J and cause the energization of the relay $CA^8$ of position J in the same manner as described in connection with relay $CA^6$, and the relay $CA^8$ in turn closes the circuits for the relay $BC^8$ and the relay $PB^8$. The relay $PB^8$ will not energize, due to a circuit now being closed through its upper and lower windings, which circuit is closed upon the energization of relay $BC^8$, and due to the differential construction of the relay $PB^8$, the relay remains at normal. Circuits are also established through the lower windings of the relays $PB^6$ and $PB^7$ of the positions F and H upon the energization of relay $BC^8$ of position J, and due to their differential construction they restore, and due to the opening of the alternate contacts of the relays $PB^6$, $PB^7$ and $PB^8$ at the positions F, H and J, the circuits of each group of group busying relays BU will be opened and permit the de-energization of their associated group busying relays BU to remove the busy from the remaining trunks at the positions F, H and J.

A tenth call coming in will be extended to the operator's position F, and a trunk circuit C having been seized in the operator's position F, a fourth 3000-ohm resistance 172 is connected in multiple with the other three resistances 172 of the other trunk cords at the operator's position F, to further reduce the resistance connected to the common conductor 173, thus causing the relay $CA^9$ to energize and the relay $CA^9$ energizing brings about the energization of the relays $BC^9$ and $PB^9$, and the relay $PB^9$ upon energization closes its alternate contact to energize the group busying relays BU associated with the position F to busy the remaining trunks at the operator's position F.

An eleventh call coming in will be extended to the operator's position H, and the relay $CA^{10}$ is energized in the same manner as relay $CA^9$, and the relay $CA^{10}$ in turn will bring about the energization of the relays $BC^{10}$ and $PB^{10}$, and the relay $PB^{10}$ in turn will bring about the energization of the group busying relays BU associated with the position H to busy the remaining trunks in this position.

A twelfth call coming in will be extended to the operator's position J and cause the energization of the relay $CA^{11}$ in the same manner as described in connection with relays $CA^9$ and $CA^{10}$, and the relay $CA^{11}$ upon energization will bring about the energization of the relay $BC^{11}$. No energizing circuit is effected for the relay $PB^{11}$ of the position J, as a circuit is also closed through its lower winding, and due to its differential construction, relay $PB^{11}$ de-energizes. Relays $PB^9$ and $PB^{10}$ at the positions F and H are also de-energized, due to the circuits being established through the lower windings upon the energization of relay $BC^{11}$ of position J, and due to their differential construction they restore to normal, and the opening of their alternate contacts will permit the de-energization of the group of group busying relays BU of the respective positions F, H and J, removing the busy from the remaining trunks at the operators' positions.

For a simple understanding and description of the circuit operation, we have in the foregoing assumed that the calls came in to the various positions in regular sequence, that is, 1, 2, 3 order, top level, then 1, 2, 3, order, second level, and so on down to the bottom level. It is, however, obvious that in actual practice such regular sequence would rarely, if ever, occur. Now that the regular order operation is disclosed, it is

apparent that the organization of the system as a whole assures merely the desired method of operation, which is that each operator of the group F, H, J, has one stored call (it making absolutely no difference in the circuit organization which of F or H or J got the first call or the last call) before a second call can be stored before any operator of the group. Furthermore, it is indifferent to the circuit organization whether the second call stored at one position happens to strike F, H or J. The organization of circuits, however, does guarantee to each operator that she will not have a third call stored against her until the operators each have two awaiting attention. In other words, the calls will in actual practice be stacked up at hazard, as one might say, except that no operator can ever have more than one call more than any other operator.

In the description thus far we have assumed that twelve calls have come in and none of them were answered, so that each of the positions F, H and J have four calls stored in each position.

Four trunk cords C have been seized in each operator's position F, H and J, as just described, and from the previous description it is remembered that relays TSS and BCR are energized as soon as switch FS′ seizes the trunks C in the positions F, H and J. The energization of each of the relays SS of the trunk circuits C will bring about the lighting of the disconnect and storing lamps DSL and the glowing of the four lamps DSL at each operator's position F, H and J shows that four calls are stored at each of the operators' positions. When the first call was stored in the operator's position F, the relay BCR was energized, and the closure of the alternate contact 191 of the relay BCR closes an energizing circuit for the motor magnet $MM^2$ of the sequence call-selecting switch SCS, of which there are four for each operator's position, and the motor magnet $MM^2$ steps the wipers 18, 19, 20 and 21 into engagement with the set of contacts 22, 23, 24 and 25 which lead to the seized trunk C. The second call stored at the position F causes the relay BCR of the second seized trunk C to close its alternate contact 191 to establish an energizing circuit for the motor magnet $MM^3$ of the switch SCS′ associated with the operator's position F, the circuit being traced from battery through the resistance 193′ through the winding of the magnet $MM^3$, its normal contact 194′, normal contact 195′ of the off-normal contacts $ON^3$, conductor 196′, normal contact 197′ of the relay 198′, over conductor 380, through alternate contact 197 of relay 198 of switch SCS, common starting conductor SA, normal contact 199 of relay TLR, conductor 200 to ground at alternate contact 191 of the relay BCR of the trunk cord C that was seized in extending the second call to the operator's position F.

The motor magnet $MM^3$ of the switch SCS′ is energized over this circuit and steps the wipers 18′, 19′, 20′ and 21′ into engagement with the first set of contacts 22′, 23′, 24′ and 25′. Upon the first step of the switch wipers off normal, normal contact 195′ of the off-normal contacts $ON^3$ is moved to its alternate position and a substitute energizing circuit is established for the motor magnet $MM^3$, traced from battery through the motor magnet $MM^3$, its normal contact 194′, alternate contact 195′ of the off-normal contacts $ON^3$, conductor 201′, normal contact 202′, conductor 203′ to ground at normal contact 204′ of the relay $BG^3$. The motor magnet $MM^3$ steps the wipers 18′, 19′, 20′ and 21′ from one contact set 22′, 23′, 24′ and 25′ to the next, and when the wiper 18′ engages the grounded contact 22′ which is grounded through alternate contact 192 of the relay BCR of the cord C, an energizing circuit is established for the relay $BG^3$ from the said ground at alternate contact 192 of the relay BCR of the cord C that was seized in extending the second connection to the operator at position F, through contact 22′, wiper 18′, normal contact 209′ of the relay 198′, normal contact 207′ of the relay $BG^3$ through the winding 206′ of the relay $BG^3$, conductor 205′ through the resistance 193′ to battery. The circuit through the relay $BG^3$ shunts out the motor magnet $MM^3$ of the switch SCS′ and prevents further stepping of the wipers of the switch.

The closing of alternate contacts 222′ and 223′ of relay $BG^3$ brings about the energization of the line relay $LR^4$, and the line relay $LR^4$ in turn closes an energizing circuit for the relay SG′. The closing of alternate contact 204′ of relay $BG^3$ closes a circuit for the relay 198′ from battery through its winding 198′, conductor 219′, to ground at alternate contact 204′ of the relay $BG^3$; the relay 198′ then closes a locking circuit for itself through its alternate contact 219′ to ground at alternate contact 221′ of off-normal contacts $ON^3$. The closure of alternate contact 214′ of relay $BG^3$ closes a locking circuit for itself from battery through its upper winding 206′, its alternate contact 214′, through its lower winding 215′, wiper 19′, contact 23′, through the winding of the relay TLR of the cord C that is seized in extending the second connection to ground at alternate contact 218 of the relay BCR of the second cord seized to extend the connection.

The third call having been extended to the trunk operator's position F causes the relays T, SS, BCR of the said cord C to energize, and the closing of alternate contact 191 of relay BCR of this third cord C establishes a circuit for the motor magnet $MM^4$ from the ground that was placed on the starting con-

ductor SA, due to the closing of alternate contact 191 of the relay BCR of the third cord, through alternate contact 197 of the switch SCS, over conductor 380, through alternate contact 197′ of the relay 198′ of the switch SCS′ over conductor 381, through normal contact $197^2$ of the relay $198^2$ of the switch $SCS^2$, conductor $196^2$, normal contact $195^2$ of the off-normal contacts $ON^4$, normal contact $194^2$ of the magnet $MM^4$, through the winding of the motor magnet $MM^4$, through the resistance $193^2$ to battery. The motor magnet $MM^4$ steps the wipers $18^2$, $19^2$, $20^2$ and $21^2$ into engagement with the first set of contacts $22^2$, $23^2$, $24^2$ and $25^2$, and the operation of the switch $SCS^2$ is the same as described in connection with the switch SCS′. When the wiper $18^2$ engages the grounded wiper $22^2$ due to the closing of alternate contact 192 of the relay BCR of the third cord seized in extending a connection to this operator's position F, it closes an energizing circuit for the relay $BG^4$, and the relay $BG^4$ upon energization shunts out the motor magnet $MM^4$ and prevents further stepping of the wipers of the switch $SCS^2$. Relay $198^2$, relay $LR^5$ and relay $SG^2$ are also energized.

The fourth call that is extended to the position F selects the fourth trunk circuit C associated with the trunk operator's position F, and brings about the energization of the relays T, SS, BCR of the seized trunk cord C, and the closure of alternate contact 191 of the relay BCR of this fourth trunk circuit C that is extending a connection to the operator's position F places a ground upon the common starting conductor SA and brings about the energization of the motor magnet $MM^5$ of the switch $SCS^3$, circuit being traced from ground on the starting conductor SA, through alternate contact 197 of the relay 198 of the switch SCS, conductor 380, through alternate contact 197′ of the relay 198′ of the switch SCS′, conductor 381, through alternate contact $197^2$ of the relay $198^2$ of the switch $SCS^2$, over conductor 382, through normal contact $197^3$ of relay $198^3$, conductor $196^3$, normal contact $195^3$, of the off-normal contacts $ON^5$, normal contact $194^3$ of the motor magnet $MM^5$, through the winding of the said motor magnet $MM^5$, through the resistance $193^3$ to battery. The motor magnet $MM^5$ steps the wipers $18^3$, $19^3$, $20^3$ and $21^3$ into engagement with the first set of contacts $22^3$, $23^3$, $24^3$ and $25^3$. Upon the first step of the wipers off normal, their normal contacts $ON^5$ assume their alternate position, and the closure of alternate contact $195^3$ closes a substitute energizing circuit for the motor magnet $MM^5$ to ground at normal contact $204^3$ of the relay $BG^5$. The motor magnet $MM^5$ now steps the wipers from one contact set to the next, and when the wiper $18^3$ engages the grounded contact $22^3$, which contact is grounded upon the closure of alternate contact 192 of relay BCR of the fourth cord seized, it brings about the energization of the relay $BG^5$, and the relay $BG^5$ shunts out the motor magnet $MM^5$ and prevents further stepping of the wipers of the switch $SCS^3$. The relay $BG^5$, line relay $LR^6$, relay $SG^3$ and relay $198^3$ are energized over circuits as previously described.

The first call answered by the operator of the position F has already been described in the previous description, which connection was described in tracing a call from the calling subscriber at the substation A at the exchange M to the called subscriber at the substation D at the exchange N. As soon as the operator's set is connected to the trunk cord C that has extended the first call to the trunk operator's position F, and after the trunk operator has inserted the trunk plug into the multiple jack J′ of the called line, the relay BCR is de-energized due to the opening of normal contact 168 of the sleeve relay SL′, and the opening of alternate contact 218 of the relay BCR opens the energizing circuit of the relay $BG^2$ of the switch SCS, and the closing of normal contact 204 of relay $BG^2$ closes an energizing circuit for the release magnet $RM^2$, also for relay 270. The release magnet $RM^2$ withdraws its retaining pawl and allows the switch wipers 18, 19, 20 and 21 to restore to normal. The relay BCR of the trunk cord C when de-energized allows its alternate contact 170 to open and disconnect the resistance 172. The disconnection of this resistance again increases the resistance connected to the common conductor 173 from 750 to 1000 ohms, as there are still three resistances connected in multiple with the conductor 173. This increased resistance permits the relay $CA^9$ of the position to restore as it operates through 750 ohms resistance but releases through a 1000-ohm resistance. The closing of alternate contact 385 of the relay 270 places a releasing battery shunt on the common conductor 386 from battery through the alternate contact 385 of the relay 270 over conductor 386, about the windings of relays $CA^3$, $CA^6$ and $CA^9$ to battery. This shunt does not affect the relay CA, but does restore to normal relay $CA^9$, but relays $CA^3$ and $CA^6$ are so adjusted that they hold up when the 20-ohm battery shunt is applied. The said shunt exists only momentarily or until the switch SCS restores, at which time relay 270 de-energizes, its circuit being opened at contacts $ON^2$, and the shunt is removed. By the de-energization of BCR one of the resistances 170 has been removed from circuit, so that when the shunting effect terminates relay $CA^9$ does not re-energize because the resistance on wire 173 is now 1000 ohms. The relay $CA^9$ restoring to normal,

the opening of its alternate contact $185^9$ permits the de-energization of the relay $BC^9$, and the relay $BC^9$ upon restoration opens its alternate contacts $363^9$, $366^9$ to open the circuit through the lower windings of the relays $PB^{10}$ and $PB^{11}$ of the positions H and J, and the relays $PB^{10}$ and $PB^{11}$ are again energized through their upper windings, and the closing of alternate contacts $188^{10}$ and $188^{11}$ of the relays $PB^{10}$ and $PB^{11}$ again closes circuits of relays BU associated with positions H and J.

The relay $BG^2$ at SCS de-energizes, and the opening of alternate contact 222 and 223 permits the de-energization of the line relay $LR^3$, and the line relay $LR^3$ deenergizing its alternate contact 230 is opened to permit the de-energization of the relay SG, and the opening of alternate contact 231 of the relay SG opens the energizing circuit of the relay $BG^6$ of the switch OS and the said relay restores. The first call having been answered, the second call stored at the position F will now be answered by the operator at the position F. The relay SG′ of the switch SCS′ being energized, as before described, ground from alternate contact 232′ of said relay SG′ extends over conductor 389, through normal contact 390 of relay 236 of switch OS, normal contact 391 of the relay $BG^6$ of switch OS, conductor 392, normal contact 393 of the motor magnet $MM^6$ of switch OS, through the winding of the said motor magnet $MM^6$, through the resistance 240 to battery. The motor magnet $MM^6$ now steps the wipers 26, 27, 28 and 29 into engagement with the second set of contacts 30, 31, 32 and 33, and when the wiper 27 engages the contact 31 of the second set, an energizing circuit is again established for the relay $BG^6$, traced from battery through the resistance 240, conductor 239 through the winding 238 of the relay $BG^6$, normal contact 237 of the said relay $BG^6$, normal contact 235 of relay 236, conductor 234, conductor 394 to ground at alternate contact 231′ of the relay SG′. The circuit through the relay $BG^6$ just described shunts out the motor magnet $MM^6$, and the wipers 26, 27, 28 and 29 now remain in engagement with the second set of contacts 30, 31, 32 and 33, and the closure of alternate contacts 242 and 243 of the relay $BG^6$ now connects the operator's set O′ to the trunk cord C that was seized in extending the second call to the trunk operator's position F. When the trunk operator of position F inserts the trunk plug of this second cord into the jack of the called line, relay BCR of this cord is de-energized, opening the energizing circuit of the relay $BG^3$ of the switch SCS′, and the relay $BG^3$ restoring its normal contact 204′ is again closed, closing an energizing circuit for the release magnet $RM^3$, the release magnet $RM^3$ withdrawing its pawl to permit the wipers 18′, 19′, 20′ and 21′ to assume their normal position. The relay BCR of the second cord de-energizing, its alternate contact 170 is opened, disconnecting the resistance 172 from the common conductor 173, and as there are still two trunk cords connected to the position F, two resistances 172 are still connected in multiple with the conductor 173, thus increasing the resistance from 1000 to 1500 ohms. The relay 270′ is also energized and the closing of its alternate contact 385′ places battery upon the common shunting conductor 386, and the effect of the release shunt placed across the relays $CA^3$, $CA^6$ causes the relay $CA^6$ to de-energize, and the opening of the contact $185^6$ permits the relay $BC^6$ to de-energize, and the opening of its alternate contacts $363^6$ and $366^6$ permits the relays $PB^7$ and $PB^8$ of the positions H and J to again energize, as the circuit through their lower windings is opened at the said contacts to again busy the remaining trunk at the positions H and J.

In regard to the relay 270, it energizes and de-energizes again immediately (as soon as switch SCS′ in restoring opens its $ON^3$ contacts), and the shunting battery placed on 386 is connected momentarily only. During the shunting, relay $CA^3$ remains operated due to its adjustment. However, relay $CA^6$ will not, for reasons previously explained, pull up under these circumstances. It will now be observed that although position F tests idle to incoming calls, there is a double "busy" protection to position H, because relays $PB^7$ and $PB^{10}$ are both energized. Similarly, relays $PB^8$ and $PB^{11}$ being both energized, afford a double "busy" to position J.

The operator at the trunk position F now answers a third call. The switch $SCS^2$ having selected the third trunk cord C that has been seized in the trunk operator's position F, and the relay $SG^2$ of the switch $SCS^2$ being energized, its alternate contact $232^2$ is closed, establishing an energizing circuit for the motor magnet $MM^6$ of the switch OS, from ground at alternate contact $232^2$ over conductor 389, normal contact 390 of the relay 236, normal contact 391 of the relay $BG^6$, conductor 392, normal contact 393 of the magnet $MM^6$, through the resistance 240 to battery. The magnet $MM^6$ now steps the wipers 26, 27, 28 and 29 of the switch OS to the third set of contacts 30, 31, 32 and 33 of the switch OS, and when the wiper 27 engages the contact 31 of the third set, an energizing circuit is established for the relay $BG^6$ of the switch OS, traced from ground at alternate contact $231^2$, over conductor 395, contact 31, wiper 27, conductor 234, normal contact 235 of relay 236, normal contact 237 of relay $BG^6$ winding 238

of the said relay, conductor 239, resistance 240 to battery. The circuit through the relay $BG^6$ shunts out the motor magnet $MM^6$ and prevents further stepping of the wipers 26, 27, 28 and 29. The closing of alternate contacts 242 and 243 of relay $BG^6$ connects the operator's set O' to the cord conductors of the trunk cord C that has been seized when the third call has been extended to the trunk operator's position F. When the trunk operator of position F inserts the trunk plug of the third plug into the multiple jack of the called line, the relay BCR of this trunk cord restores and opens the energizing circuit of the relay $BG^4$ of the switch $SCS^2$, and the relay $BG^4$ closes its normal contact $204^2$, closing an energizing circuit for the release magnet $RM^4$, and the release magnet $RM^4$ energizing withdraws the retaining pawl and allows the wipers $18^2$, $19^2$, $20^2$ and $21^2$ to restore to normal. The relay BCR of the third cord trunk de-energizes to open its alternate contact 170 to disconnect the resistance 172 from the common conductor 173, and as there is now only one trunk cord C connected to the position F that is waiting to be extended to a called line, the resistance is increased to 3000 ohms. The relay $270^2$ is also energized, and the closing of its alternate contact $385^2$ connects battery to the releasing shunt conductor 386 and de-energizes the relay $CA^3$. The relay $CA^3$ de-energizing, its alternate contact $185^3$ is opened to bring about the restoration of the relay $BC^3$, and the opening of alternate contacts $363^3$ and $366^3$ of the relay $BC^3$ again permits the energization of the relays $PB^4$ and $PB^5$ as the circuits through their lower windings are opened at these contacts. Relays $PB^4$ and $PB^5$ again energizing cause the trunks of their respective positions H and J to be again busied against selection. The relay $BG^4$ of switch $SCS^2$ de-energizing its alternate contacts $222^2$ and $223^2$ are opened, permitting the de-energization of the line relay $LR^5$, the line relay $LR^5$ in turn de-energizing the relay $SG^2$. The relay $SG^2$ upon de-energization opens the energizing circuit of the relay $BG^6$ of the switch OS, and the said relay restores to normal and disconnects the operator's set O' from the third cord C. From what has gone before, it will be understood that relay $270^2$ only momentarily places the release shunt; also that positions H and J are now three times "busy."

The third call having been answered, the operator is now connected to the fourth cord that was seized in extending the fourth call to the operator's position F. The closing of alternate contact $232^3$ of the relays $SG^3$ establishes an energizing circuit for the motor magnet $MM^6$ of the switch OS from ground at alternate contact $232^3$ of the relay $SG^3$ of the switch $SCS^3$, over conductor 389 to battery through the winding of the motor magnet $MM^6$ of the switch OS over the previously described path. The motor magnet $MM^6$ steps the wipers 26, 27, 28 and 29 into engagement with the fourth set of contacts 30, 31, 32 and 33, and the wiper 27 engages the fourth contact 31 of the set, and ground from alternate contact $231^3$ of relay $SG^3$ establishes a circuit for the relay $BG^6$ of the switch OS from ground at alternate contact $231^3$ of the relay $SG^3$, conductor 396, contact 31, wiper 27, to battery, through the winding 238 of the relay $BG^6$, over a previously described path. This circuit through the relay $BG^6$ shunts out the motor magnet $MM^6$ and prevents further stepping of the wipers 26, 27, 28 and 29. The relay $BG^6$ upon energization closes its alternate contacts 242 and 243 to connect the operator's set O' to the fourth cord seized, and when the operator connects the plug of this cord into the multiple jack of the called line, the sleeve relay of this cord energizes to open the energizing circuit of the relay BCR of the trunk cord. This opens the energizing circuit of the relay $BG^5$, and the relay $BG^5$ de-energizing, its normal contact $204^3$ is closed, establishing a circuit for the release magnet $RM^5$, and the release magnet $RM^5$ energizing withdraws the retaining pawl to permit the wipers $18^3$, $19^3$, $20^3$ and $21^3$ to restore. The relay BCR of the fourth cord trunk de-energizes to open its alternate contact 170 to disconnect the resistance 172 from the common conductor 173, and this permits the relay CA of the position F to de-energize, as its circuit is opened at the alternate contact 172 of the de-energized relay BCR. The relay CA upon de-energization opens its alternate contact 185 to cause the de-energization of relay BC, and the relay BC upon de-energization opens its alternate contacts 363 and 366 and permits the relays PB' and $PB^2$ at the positions H and J to be energized to hold busy these two positions H and J, so that now positions H and J are "busy" four times as compared to position F.

Now, should another call be extended to the exchange N, the call will be extended to the position F and cause the operation of the relay CA, as the calls stored at positions H and J have as yet not been answered, and upon the energization of relay CA relay BC will energize, but relay PB will not, due to its differential construction, and due to the energization of relay BC, relays PB' and $PB^2$ will also de-energize, but positions H and J will still test busy, as the other position busying relays PB at H and J will still be energized and keep these two positions busy. The position F will, of course, be idle, due to the failure of relay PB to operate,

and the next call extended will appear in position F, and this will also be true of the third and fourth calls.

The order in which stored calls were above assumed to be answered, namely, all of position F's calls answered before the operators at H and J answered any of theirs, is, of course, not an order that would be at all likely to occur in actual service conditions, and we adopted it for the purpose of giving a straight ahead explanation of the circuit and switch operation.

The connections of the "busying" apparatus of positions H and J to their trunk circuits and to their respective switches SCS, SCS', etc., and to OS being like those of position F, it will be readily seen that if the operator at position H had been the first to answer one of the twelve calls stored at the three positions F, H and J, then her position (H) would have been the idle one, while the de-energization of the relay $BC^{10}$ would unbalance differential relays $PB^9$ and $PB^{11}$, and positions F and J would become "busy."

Assume now that the operator at J next answered a call, her relay $CA^{11}$ would de-energize and her position would be "idle" as well as position H, position F continuing busy. Now observe that the circuit of the lower or neutralizing winding of relay $PB^9$ at F is open both at relay $BC^{10}$ (H) and at relay $BC^{11}$ (J). Thus, position F is twice "idle", as it might for conciseness be expressed. Now, assume that the next operator J answers the second stored call at her position. Then her relays $CA^8$ and $BC^8$ will de-energize with obvious results as to relay $PB^8$. The lower or neutralizing winding of relay $PB^7$ at H will be open at contact of relay $BC^8$ at J. Hence, $PB^7$ energizes to "busy" position H. In this status, it will be noted that position F is twice "busy" towards position J, and once "busy" towards position H, while H is once "busy" towards position J. Further detail is considered superfluous, it being now apparent that the organization governs itself on the principle of selectivity and seeks automatically and continuously, as calls come in and are disposed of, to keep an even number before each operator of the group.

The switch OS which connects the operator's set O' to the trunk conductors is a five-point switch, and from the previous description, it is remembered that the wipers 26, 27, 28 and 29 were left in engagement with the fourth set of contacts. Now, when another call is extended to the position F, ground over conductor 389 will close an energizing circuit for the motor magnet $MM^6$ over a circuit as previously described, to step the wipers 26, 27, 28 and 29 into engagement with the fifth set of contacts 30, 31, 32 and 33, and when the wipers 26 and 27 engage the contacts 30 and 31, which are permanently grounded, a circuit is established for the relay $BG^6$, traced from battery, through the resistance 240, conductor 239, winding 238 of relay $BG^6$, normal contacts 237 and 235 of relays $BG^6$ and 236 to ground at contact 31 engaged by wiper 27. The ground at contact 30 which is now engaged by wiper 26 closes an energizing circuit for relay 236 from battery through the winding of relay 236 to ground at contact 30 engaged by wiper 26. Relay 236 upon energization closes its alternate contact 400 to close a locking circuit for itself, traced from battery through relay 236, its alternate contact 400 to ground at alternate contact 401 of off-normal contacts $ON^6$, which assumed their alternate position upon the first step of the wipers of the switch OS off normal. The opening of normal contact 235 of relay 236 opens the energizing circuit of relay $BG^6$, and relay $BG^6$ upon restoration closes its normal contact 402, establishing an energizing circuit for the release magnet $RM^6$, traced from battery through the winding of magnet $RM^6$, alternate contact 403 of relay 236, to ground at normal contact 402 of relay $BG^6$. The release magnet $RM^6$ upon energization withdraws the retaining pawl and allows the wipers 26, 27, 28 and 29 to restore to their normal position to again engage the first set of contacts 30, 31, 32 and 33.

The wipers upon restoration bring about the restoration of the off-normal contacts $ON^6$, and the opening of alternate contact 401 of contacts $ON^6$ opens the energizing circuits of the relay 236 and release magnet $RM^6$ so as to again start selecting to connect the operator's set O' to the trunk cord C to which a call has been extended.

While we have described a preferred embodiment of our invention, it may obviously be adjusted and employed in various ways, and we do not intend in the appended claims to limit ourselves to the precise structures shown and described, but what we do claim is:

1. An automatic distributing system for telephone switchboards comprising operators' positions divided into groups, apparatus for storing calls at each position of a group, and means for each position automatically acting on the means of the other positions of the group tending to equalize the storing of calls among the positions.

2. An automatic distributing system for telephone switchboards including a pair of operators' positions, signals at said positions and automatic selecting and connecting mechanism to display them, and automatic means at each of said positions to prevent additional signals being displayed at it while less signals are displayed at the other position.

3. An automatic distributing switchboard

for telephone systems including groups of operators' positions, call indicating signals for said positions, and automatic devices for directing incoming calls among said positions according to the number of signals displayed at a position in proportion to the numbers displayed at the other positions of its group.

4. A telephone switchboard including a group of positions, signals for each position, more displayed at one position than at another, automatic distributing means for allotting incoming calls between said positions, and automatic apparatus to prevent the allotment of additional calls to one of said positions until the signals displayed at both are equal.

5. A telephone switchboard including a pair of operators' positions, signals for manifesting calls at said positions, automatic distributing selecting and connection apparatus for distributing calls among said positions, an apparatus whereby the direction of distribution is determined by the relative proportions of signals displayed at the positions.

6. An automatic distributing system for telephone exchanges including single plug cord circuits at an operator's position, automatic selecting switches to connect subscribers' line with idle cord circuits, means for storing calls at said operator's position, and operator sequence switches for said position to automatically connect her talking set with the selected cord circuits successively and in the same order in which the stored calls appeared at the operator's position.

7. In an automatic distributing system for telephone exchanges, an operator's position and circuits with call indicating signals thereat, means for connecting subscribers' lines to said circuits, call storing means at said operator's position, and automatic listening circuits for the operator's position adapted to connect her telephone set to different selected circuits successively and in the order in which the signals of the stored calls were displayed.

8. In an automatic distributing system, means for automatically assigning time preferences for incoming calls according to priority of their coming in, an operator's set and means for automatically connecting said operator's set to the circuits on which the calls come in according to priority.

9. In a telephone system including a group of trunk operators' positions, a group of trunk circuits for each operator's position, selector switches for automatically extending calls to said trunk operators' positions, position busying means, call storing means for each trunk operator's position, a trunk operator's set, a sequence connector switch and an operator's switch for connecting said operator's set to a selected trunk circuit, said position busying means and said storing means operating to render said operator's position non-selectable when said trunk operator is completing a connection while the other trunk operators' positions have no calls awaiting their attention or having calls less in number than said first trunk operator has awaiting her attention.

10. In a telephone system including a group of trunk operators' positions, trunk circuits for each operator's position, call storing means and group busying means for each operator's position, finder switches for selecting said trunk circuits for extending calls thereto, said call storing means and said busying means operable upon the selection of any of the trunk circuits in the position to render the other trunk circuits of that position busy in case none of the trunk circuits in the other position have been selected, or if selected, the trunk circuits selected in each of the other positions are less in number than the trunk circuits selected in said first position, and means for rendering said busying means inoperable when the selected trunk circuits in each of the other positions are greater in number than the selected trunk circuits in said first position.

11. In a telephone system including a group of trunk operators' positions and a group of trunk circuits for each position, finder switches for selecting said trunk circuits, call storing means and position busying means for each of said operator's positions, said storing means operable upon the selection of any one of said trunk circuits in that position, the operation of said storing means causing the operation of said busying means to render that position busy against selection so long as the number of trunk circuits selected in that position are greater than the smallest number of selected trunk circuits in any one of the other operators' positions.

12. In a telephone system including trunk operator positions, a group of trunk circuits for each of said positions, a group of finder switches for selecting said trunk circuits to extend calls thereto, call storing means and operator's position busying means, said storing means operating to store up the calls in the order in which the trunk circuits of one of said operator's positions are selected by said finder switches, an operator's telephone set for each position, an operator's switch associated with said telephone set, a group of sequence switches associated with said operator's switch both operable to connect said operator's set to the selected trunk circuits in the same order in which said call storing means have operated to store up the calls, said position busying means rendering said position non-selectable when the number of calls stored in that position is greater than

the number of calls stored in any one of the other positions.

13. In a telephone system including operators' positions, operator's trunk circuits for same, finder switches for extending calls to said trunk circuits, automatic call storing means for storing up the calls in the same order in which the calls are extended to the trunk circuits in an operator's position, position busying means for preventing the selection of trunk circuits in that position when the number of trunk circuits already selected is greater than the number of selected trunk circuits in any of the other positions, and means for rendering said position busying means inoperable when the number of selected trunk circuits or stored calls at the different operators' positions are the same.

14. In a telephone system including a group of operators' positions for extending calls, automatic call storing means for each position, position busying means, differential relays in each of said call storing means adapted when operated to cause the operation of said position busying means, means for rendering said differential relays inoperable when the number of operated differential relays in the different call storing means at all the positions is the same to render said position busying means inoperable to permit another call to be stored up in any of the operators' positions.

15. In a telephone system including trunk operators' positions, trunk operators' circuits at each position, finder switches for extending a call from a local operator's position to an idle one of said trunk operators' circuits, automatic call storing means at each trunk operator's position operable when a circuit at that position has been selected by said finder switches, position busying means for each of said operator's positions operable upon the operation of said call storing means to prevent another of said finder switches from selecting another circuit in the same position prior to the completed connection of the call of the called line, and providing the circuits selected in said position are greater in number than the selected circuits in any of the other of said positions.

16. In a telephone system including a local operator's position, a group of trunk operators' positions, a group of trunk circuits at each trunk operator's position, means for selecting one of said trunk circuits for extending a connection from said local operator's position to an idle trunk operator's position, call storing means at each of said trunk operator's positions for storing up the calls in the order in which the trunk circuits are selected, a group of sequence connector switches for each trunk operator's position and operable in the same order in which said call storing means are operated and also controlled by said storing means, an operator's telephone set, an operator's switch associated with said group of sequence connector switches, said operator's switch co-operatively operating with said sequence switch to connect said operator's set to the selected trunk circuits in the same order of time said trunk circuits are selected, and position busying means at each trunk operator's position for preventing the selection of said trunk circuits at that position if the calls stored at that position are greater in number than those stored at any of the other of said trunk operator's positions.

17. In a telephone system including a local operator's position, a group of trunk operators' positions, means for extending calls from said local operator's position to said trunk operator's positions automatic storing means at each trunk operator's position adapted to store up the calls in the same chronological order in which they are extended to said trunk operator's position, position busying means associated with each call storing means for preventing calls from being extended to that position when that position has more calls stored thereat than the number of calls stored at either of the other trunk operators' positions.

18. In a telephone system including a local operator's position, a group of trunk operators' positions, means for extending calls from said local position to any of said trunk positions, automatic call storing means at each of said trunk positions operable to register the calls in the same chronological order in which they are extended to said trunk positions, said storing means comprising a number of units, each unit including a chain of relays and each trunk position having the same number of units, trunk position busying means for each of said trunk positions and operable by any of said units at that position to render that position non-selectable.

19. In a telephone system including a local operator's position, a group of trunk operators' positions, means for extending calls from said local position to any of said trunk positions, automatic call storing means at each of said trunk positions operable to register the calls in the same chronological order in which they are extended to said trunk positions, said storing means comprising a number of units each unit including a chain of relays and each trunk position having the same number of units, trunk position busying means for each of said trunk positions and operable by any of said units at that position to render that position non-selectable when the units operated in that position are greater in number than the number of the operated units in either of the other of said trunk positions.

20. In a telephone system including a local operator's position, a group of trunk

operators' positions, means for extending calls from said local position to any of said trunk positions, automatic call storing means at each of said trunk positions operable to register the calls in the same chronological order in which they are extended to said trunk positions, said storing means comprising a number of units, each unit including a chain of relays and each trunk position having the same number of units, trunk position busying means for each of said trunk positions and operable by any of said units at that position to render that position non-selectable, and means for preventing the operation of said busying means to render all of said trunk positions idle when the units of said storing means operated at each trunk position are the same in number.

21. In a telephone system including a group of operators' positions, a group of operators' circuits at each position for extending calls, means for selecting said operators' circuits and extending calls thereto, call storing means comprising a number of units for storing the calls in the same chronological order in which the calls are extended to said operators' circuits sequence connector switches co-operatively associated with said operators' circuits and said call storing means and being the same in number as the number of said units an operator's telephone set, an operator's switch common to and operable by said sequence connector switches for connecting said operator's set to said operators' circuits having calls extended thereto.

22. In a telephone system including a group of operators' positions, a group of operators' circuits at each position for extending calls, means for selecting said operators' circuits and extending calls thereto, storing means comprising a number of units for storing the calls in the same chronological order in which the calls are extended to said operators' circuits, sequence connector switches co-operatively associated with said operators' circuits and said call storing means, and being the same in number as the number of said units, an operator's set, an operator's switch common to and operable by said sequence connector switches for connecting said operator's set to said operators' circuits having calls extended thereto, and means for restoring the said unit when the call stored thereat is extended by the operator at that position to a called line.

23. In a telephone system including a group of operators' positions, a group of operators' circuits at each position for extending calls, means for selecting said operators' circuits and extending calls thereto, call storing means comprising a number of units for storing the calls in the same chronological order in which the calls are extended to said operators' circuits, sequence connector switches co-operatively associated with said operators' circuits and said call storing means, and being the same in number as the number of said units, an operator's set, an operator's switch common to and operable by said sequence connector switches for connecting said operator's set to said selected operators' circuits in the same chronological order in which said operators' circuits are selected.

24. In a telephone system including a group of operators' positions, a group of operators' circuits at each position for extending calls, means for selecting said operators' circuits and extending calls thereto, call storing means comprising a number of units for storing the calls in the same chronological order in which the calls are extended to said operators' circuits, sequence connector switches co-operatively associated with said operators' circuits and said call storing means, and being the same in number as the number of said units, an operator's set, an operator's switch common to and operable by said sequence connector switches for connecting said operator's set to said operators' circuits having calls extended thereto, and means for preventing said operator's set from being connected to any of said selected operator circuits other than the chronological order in which said operators' circuits are selected.

25. In a telephone system including a group of operators' positions, a group of operators' circuits at each position for extending calls, means for selecting said operators' circuits and extending calls thereto, call storing means comprising a number of units for storing the calls in the same chronological order in which the calls are extended to said operators' circuits, sequence connector switches co-operatively associated with said operators' circuits and said call storing means, and being the same in number as the number of said units, an operator's set, an operator's switch common to and operable by said sequence connector switches for connecting said operator's set to said operators' circuits having calls extended thereto, and means for disconnecting said operator's set from said selected operator's circuit when that circuit has completed a connection to extend the calls to a called line.

26. In a telephone system including a local operator's position, cord circuits for same, a local operator's set, trunk circuits at trunk operators' positions, a trunk operator's set, a pair of trunk conductors terminating at said local position, finder switches for automatically extending a connection over said trunk conductors to one of said trunk circuits when one of said cord circuits is connected to the terminal of said trunk conductors, automatic means for con-

necting the trunk operator to the trunk circuit connected to said cord circuit, manual means and automatic means for co-operatively connecting said local operator's set in circuit with said trunk operator's set, said automatic means only operable when said trunk operator is connected to said trunk circuit, and means for restoring said automatic means at said local position when the trunk operator has extended the connection.

27. In a telephone system including trunk operators' positions, a group of trunk circuits for each of said positions, a group of finder switches for selecting said trunk circuits to extend calls thereto, call storing means, said storing means operating to store up the calls on the trunk circuits at one of said operators' positions as the trunk circuits are selected by said finder switches, an operator's telephone set for each position, an operator's switch associated with said telephone set, a group of sequence call switches associated with said operator's switch both operable to connect said operator's set to the selected trunk circuits in the same order in which said call restoring means have operated to store up the calls, and a calling supervisory signal individual to each of said trunk circuits and adapted to light when said operator's set is connected to that trunk circuit to indicate to the operator the circuit to which her set has been connected.

28. In a telephone system including trunk operators' positions, a group of trunk circuits for each of said positions, a group of finder switches for selecting said trunk circuits to extend calls thereto, call storing means, said storing means operating to store up the calls in which the trunk circuits of one of said operators' positions are selected by said finder switches, an operator's telephone set for each position, an operator's switch associated with said telephone set, a group of call sequence switches associated with said operator's switch both operable to connect said operator's set to the selected trunk circuits in the same order in which said call storing means have operated to store up the calls, a calling supervisory signal individual to each of said trunk circuits and adapted to light when said operator's set is connected to that trunk circuit to indicate to the operator the circuit to which her set has been connected, and means for effacing said calling supervisory signal when said operator connects said trunk circuit to a called line.

29. A telephone system including an operator's position, means for extending calls to said position, means for storing calls at said position, an operator's set, and automatic means to connect said operator's set for answering the calls.

30. A telephone system including an operator's position, means for extending and storing calls at said position, an operator's set, and means to connect said operator's set for answering the calls in the order in which they were extended to said position.

31. A telephone system including an operator's position, automatic means for extending calls to said position, an operator's set, and automatic means to connect said operator's set for answering the calls extended to said position in the order in which they were received.

32. A telephone system including a trunk operator's position, automatic means for extending calls to said operator's position, an operator's set, and automatic means to connect said operator's set for answering the calls extended to the operator's position.

33. A telephone system including a plurality of operators' positions, operators' sets, means for extending and storing calls at said operators' positions and for equalizing the number of calls stored at the different operators' positions, and means associated with said positions to connect said operators' sets for answering the call stored at the different operators' positions in the order in which they were received.

34. A telephone system including a plurality of trunk operators' positions, means for extending and storing calls at said operators' positions and for equalizing the number of calls stored at the different positions, operators' sets for said positions, and automatic means to connect said operators' sets for answering the calls.

35. A telephone system including a number of trunk operators' positions, operators' sets, means for extending calls to and for storing calls at said operators' positions, means to connect said operators' sets for answering the calls at said operators' positions in the order in which the said calls were received at said positions.

36. A telephone system including a plurality of trunk operators' positions, automatic means for storing calls at said operators' positions, operators' sets, and for permitting a like number of calls to be stored at the different operators' positions, and means to connect said operators' sets for answering the stored calls and in the order in which the operators receive the calls.

37. A telephone system including operators' positions, automatic means for extending calls to said operators' positions, operators' sets, and automatic means to connect said operators' sets for answering the calls at said positions in the sequence in which the operators receive the calls.

38. A telephone system including an A operator's position and a B operator's position, A operator's means for extending calls to said B operator's position, an operator's set at said B operator's position, and automatic means to connect said operator's set

for answering calls at the B operator's position in the sequence in which the A operator extended the calls to the B operator's position.

39. A telephone system including a trunk operator's position, an operator's set, and automatic means for extending calls to said position and for storing calls at said position if said operator is busy and to connect said operator's set for answering the calls in the sequence stored as the operator completes the calls.

40. A telephone system including operators' positions, means for distributing calls to said positions and for storing calls thereat, an operator's set, means to automatically connect said set to said storing means, and means for determining the rotation in which the operators will answer the calls.

41. A telephone system including a switchboard, means for extending calls to said switchboard, means permitting the storing of said calls at positions on said switchboard, an operator's set, means to automatically connect said set to said storing means, and automatic means for determining the calls which the operator at each position will answer.

42. A system of distribution and storing permitting the extending of and storing of calls at a switchboard, to be answered by the operators as they become idle.

Signed by us at Chicago, in the county of Cook and State of Illinois, this 24th day of October, 1921.

HIRAM D. CURRIER.
GEORGE R. EATON.